Symons's
Meteorological Magazine.

No. 609. OCTOBER, 1916. Vol. LI.

THE CLIMATE OF SAMOA.

Mr. D. C. Bates, Director of the Meteorological Office, Wellington, New Zealand, sends us the following summary of the mean meteorological conditions of Apia, in Samoa, extracted from the first annual report of the medical officer of the Military Forces in possession of Samoa and based upon "several years'" observations, presumably official figures, recorded for the German Government. Samoa it will be remembered was the first of the German colonies captured immediately after the outbreak of the war, and was taken by troops sent from New Zealand. Features of the climate are the almost uniform temperature throughout the year, the mean of February, the warmest month, being only 2°·1 F. higher that than of June, the coldest month, and the sharp division of the year into six "dry" months with less than 8 inches of rain each, and six wet months with more than 11½ inches. The total rainfall for the year comes out at 124·4 in.

In the annual report, 1916, the medical officer states, "The meteorological returns for the year show a long period of dry weather followed by a heavy rainfall," and gives the monthly means for previous years as follows :—

	Temperature F.	Rainfall inches	Humidity per cent.	Sunshine hours per month
January ...	79·0	19·20	85	156
February ...	79·3	18·80	85	188
March	79·1	14·90	82	145
April	79·0	11·80	86	156
May	78·4	5·90	83	197
June	77·2	5·70	82	173
July	77·3	3·10	82	140
August... ...	77·5	3·90	80	144
September ...	77·7	6·30	81	176
October ...	78·8	7·70	82	230
November ...	78·8	11·80	83	170
December ...	79·3	15·30	83	157
Total ...		124·4		

Professor Henrik Mohn.

Bergen, 15th May, 1835—Kristiania, 15th September, 1916.

THE rugged, kindly face of Professor Mohn was always one of the most welcome and unfailing land-marks of the international gatherings of meteorologists, oceanographers, and geographers, and many friends outside Norway, as well as in his native land, will mourn his loss. A good linguist, like most Scandinavians, he never felt or caused the awkwardness of a foreigner, and his British, French and German friends were thus enabled to appreciate the goodness of his great and simple character as readily as his own northern kinsfolk.

When the Norwegian Meteorological Institute was founded in 1866 Mohn was appointed the first Director, and he filled this post for forty-eight years, retiring in 1913. He was indefatigable in his efforts to improve the Norwegian meteorological service, and succeeded not only in bringing it into a high state of efficiency, but also in establishing a record amongst the government meteorological services of the world by full and prompt publication. His annual volumes on the Rainfall of Norway were, we believe, the only publications of the kind that were ready by the June or July of the year following that with which they dealt, and, so far as we are aware, the only annual records of the rainfall of a country to appear regularly at an earlier date than *British Rainfall*.

Mohn wrote many memoirs on the climate of Norway, and, in conjunction with Professor Hildebrandsson, he published, in 1891, an important paper on Storms in the Scandinavian peninsula. As was natural in a maritime country like Norway his attention was early directed to oceanography and the conditions of the polar regions. He took a large share in working up the results of the fine Norwegian Sea Expedition of 1876-78, the earliest results of the stimulus given by H.M.S. *Challenger*, and discussed the meteorological observations made by Dr. Nansen on his first crossing of Greenland in 1888, and those of the great trans-polar drift of the *Fram* in 1893-96. His last work was a discussion of the meteorology of the Antarctic regions as shown in the results of Captain Amundsen's expedition to the South Pole in 1912.

Of a more general character was his well-known "Principles of Meteorology" (1887), which was translated into French, Russian, Polish, Spanish and Italian, but, characteristically enough, not into English. Dr. Mohn was Professor of Meteorology in the University of Kristiania. He received an honorary degree from the Swedish University of Upsula in 1877, and, amongst many other foreign honours, he was elected an honorary member of the Royal Meteorological Society in 1874.

Edward Mawley.

1842—Berkhamsted, 15th September, 1916.

THE death, after a very short illness, of Mr. Edward Mawley, terminates a life of quiet usefulness in horticulture and meteorology, and removes a man who was the friend of all who knew him. For nearly half a century he was an enthusiast in gardening, and retiring early from his profession as an architect he practically devoted his whole life to the absorbing interests of the growth and improvement of flowers. Roses and dahlias were his chief delight, and he took a leading part in the development of the National Rose Society, of which he was an original member. He became Secretary of that Society when its membership was only a few hundred, and when, after 37 years, he became President, the members numbered more than 6,000. Mr. Mawley was no narrow-minded devotee of the sport of rose-growing. He treated the subject in a scientific manner and pursued many investigations, which, starting from the flower-garden, led him far into several branches of science where his work had enduring value. Of these one was the study of phenology—the dates of the various annual life stages of plants, and the migrations of animals—and Fellows of the Royal Meteorological Society will long remember the annual reports he read on this subject from 1889 to 1910.

Mr. Mawley was elected a Fellow of the Royal Meteorological Society in 1876, and served continuously on the Council from 1881 to 1908. He was President in 1896-98, when he gave two addresses of great value. The first was on Shade Temperature, giving the results of a lengthy series of experiments with different patterns of thermometer screen, which resulted in the adoption of the Royal Meteorological Society's modification of the Stevenson screen. The second was on Weather Influence on Farm and Garden Crops, and may be said to have intertwined the two main branches of his life-work. After retiring from the presidency he acted as Secretary at the meetings of the Society from 1898 to 1901, and throughout the whole time his influence was always exercised in extending the usefulness of the Society and increasing its dignity.

Mr. Mawley commenced his meteorological observations at Richmond, Surrey, in 1870, and in 1873 he went to Addiscombe, near Croydon, where his meteorological observations were greatly extended. In 1883, he moved to Berkhamsted, where he soon created one of the finest private meteorological stations in the country. Besides the ordinary instruments of a second order station he had a series of self-recording instruments for wind, rain, sunshine, pressure and temperature, and, in addition to these, he had a pair of percolation gauges. He supplied full monthly abstracts of his observations to the press and to various scientific societies and publications. For more than forty years he was a friend and supporter of the British Rainfall Organization, and lost no opportunity of promoting rainfall observing amongst his innumerable horticultural friends.

DIRECTIONS FOR SNOWFALL STUDY TO BEGIN IN NOVEMBER 1916.

By L. C. W. Bonacina.

In pursuance of the suggestions embodied in my articles in this Magazine for April, 1916, and February, 1915, I draw up a few rules for such Rainfall Observers as are willing in their periodical returns to the British Rainfall Organization to furnish data respecting the occurrence and depth of snow in the irrespective localities. Those who are willing to contribute thus to the study of British snowfall should be ready to commence recording on November 1st, which, as previously pointed out, is the best date—in as much as few Novembers pass without heavy local snowfalls, especially in the uplands. It is clear that January 1st does not commence a new meteorological year, whilst to begin the study on December 1st would also be illogical, since the latter part of November is, from the general climatic point of view one with December. I may conveniently give the directions under the headings of occurrence and depth of snow.

Occurrence of Snow.—The occurrence of snow, whether heavy or slight, should be entered to the date in every case, and, in the ordinary way, careful Observers of the weather are not likely to fail to notice a real snowfall, however light. But difficulty may sometimes arise in connection with the question of all that is to be included under the term snow, since this form of precipitation may approximate to rain on the one hand or to hail on the other. Wet flaky sleet, being a mixture of rain and snow, should, of course, be counted as an occurrence of snow, but it is not so easy to decide whether soft winter hail, commonly called graupel, should be regarded as snow. In the majority of instances graupel is suggestive of snowy types of weather, and I suggest that graupel should be entered as snow in every case when the maximum temperature of the day is below 40° F.

A further reason for including soft hail with snow is this : that frozen pellets are very variable in appearance, hardness, and texture, and sometimes appear to be nothing else than flakes of snow stuck together. Under this heading I wish to caution Observers against mistaking very fine snow for very fine rain. In cold weather it occasionally happens that precipitation has to be very carefully inspected in order to see whether it is composed of fine drops of water or of fine crystals.

Depth of Snow.—When Observers read their rain gauge, say at 9 a.m., they should record the depth of undrifted snow which has fallen during the preceding 24 hours. A little judgment and exercise of common sense should enable the Observer to choose some spot

for measuring the snow that will give a fair approximation to the general depth of undrifted snow in the locality. In order not to tax the Observer unduly at odd times of the day, the depth of snow, even if heavy, which has melted soon after falling, or which has not lasted till the regular observing hour, need not be entered. In such cases the snow need only be entered under the occurrence column.

Correspondence.

To the Editor of Symons's Meteorological Magazine.

THUNDERSTORM AT IPPLEPEN, S. DEVON.

The Rev. R. D. Cook, B.A., Vicar of Ipplepen, has sent me a description of the recent thunderstorm, some notes on which may interest your readers. He says :—

"We had a very heavy thunderstorm here on the night of September 28th-29th. It lasted practically twelve hours, but there was little thunder until almost the end ; then it was intense. At 5.50 a.m. (G.M.T.) on the 29th, the brick work of the chimney-stack of two cottages—just across the road from the post office —was struck and demolished, the lightning going down the chimney into the kitchen and scattering its contents. The next door house (the cottages being in a terrace) was treated in the same way, the kitchen cupboard door being wrenched off, and the china, etc., smashed. The ridge of the roof between the two houses was torn off and the ridge tiles driven right and left—one piece being found at least 400 feet away, and another about 200 feet in the opposite direction, having been carried right over intervening houses. About half a mile distant three ancient fir trees were struck and scored from top to bottom. Denbury Manor ($1\frac{1}{2}$ miles to the northward) was very badly damaged, a large hole being made in the roof of the nursery, and the room practically wrecked. A little nearer Newton Abbot, *i.e.*, at Ogwell, a sheep was killed, and a large hole made in the ground. The rainfall at 9 a.m. (G.M.T.) on the 29th was ·62 in.'

D. W. HORNER.

October 1st, 1916.

IRISH AND GREENWICH TIME.

In your magazine for September, page 123, there is a slip under the heading, "End of Summer Time." From October 1st Greenwich Mean Time will apply to Ireland as well as to Great Britain, in accordance with the "Irish Time Act, 1916."

JOHN W. MOORE, M.D.

40, Fitzwilliam Square West, Dublin, Sept. 20th, 1916.

NOTES ON "BRITISH RAINFALL, 1915."

Summer Time. I see in the 1915 yearly volume, p. 9, that you fear Summer Time may cause inaccuracies in some reports. I think it has made mine a little *more accurate*, as I was rarely able to visit my rain gauge exactly at 9 o'clock Greenwich Time.

Definition of a Rain Day. I cordially agree with the proposal [p. 18] to make 1 mm. or ·04 in., limit value. The difficulty of measuring very small rainfalls is shown by the wild discrepancies in the number of rain-days at neighbouring stations. Moreover, the rainfalls below 1 mm. have no practical importance, at least not in a district of mines, moors, and wet, like this; perhaps Essex strawberry-growers may regard them differently. This is a goitre district and I drink rain-water to avoid goitre, so the condition of my rain-barrel is of practical interest to me, and I know that showers of less than 1 mm. bring nothing into the barrel, the moss-patched flag roof absorbs them.

Millimeters. As an ardent matricalist I am, of course, extremely pleased to see that I am no longer the only unofficial person sending you records in mm. I see at least one other in my own county, and three or four elsewhere. I lately received a Japanese paper in which the rain was given in millimeters. As there seems no chance that the world's records can ever become mutually intelligible in any other way, I hope the other British Observers will gradually come round.

Ore-veins and Rainfalls. Your remarks, on p. 75, to the effect that the Dalcross downpour, the Norwich downpour, etc., occurred where the track of a cyclone made a sharp angle, suggest a curious analogy with mining. Metallic veins are always richest where crossed by another vein. Perhaps light on the origin of rain may throw light on the origin of ore, or *vice versa*, though I cannot yet form any distinct theory. C. HARPUR.

Nenthead, Alston, Cumberland, 6th October, 1916.

HEAVY RAINS IN SCOTLAND.

A rainstorm which is described in *The Times* of October 13th as being locally of unprecedented severity swept over the Lochaber district during the night of October 11th-12th. At Fort William 4·5 in. of rain fell in the 12 hours ending 9 a.m. on the 12th. Fort William was entirely isolated so far as railway communication was concerned owing to the numerous "wash-outs" that had taken place on the West Highland, the Mallarg and other railways. Glen Nevis was converted into a lake, and some houses were inundated.

REMARKABLE COLD IN THE ARGENTINE.

By R. C. MOSSMAN, F.R.S.E.

IT will be remembered that the month of June in the British Isles was of an exceptionally bleak character (see this magazine June and July, 1916, pp. 67 and 83). From records given in a new monthly bulletin issued by Mr. Rector, Director of the Cordoba branch of the Argentine Meteorological Office, it is seen that the cold of the past winter months was unprecedented in the middle latitudes of the Argentine Republic. We have been able to supplement the information given in the above bulletin from manuscript data in our possession dealing with the monthly temperature in Cordoba since 1873 when the record began. The mean temperature of June, 1916, in Cordoba was 42°·6 F., being 7°·4 below the normal and 1°·2 below that of June, 1875, which was previously the coldest month on record. The cold was unequally partitioned between day and night, the mean maxima being only 3°·1 below the normal, while the mean minima were as much as 11°·0 below the normal. Mr. Rector remarks : " On the average there are 8 days in June in which the temperature falls to 32°·0 F. or lower. The greatest number hitherto recorded in June was 17, in 1915, but this year there were 26. The frosts have been general in all the province being most pronounced in the vicinity of this capital and to the north-east." The lowest shade temperature in June, 1916, was 16°·7, the previous record being 17°·2. The remarkable cold continued throughout July, the mean temperature of which was 45°·9, or 5°·2 below the average, and 0°·2 below the previous coldest (1885). A high barometer, clear skies, and light winds were associated with the great cold. On August 30th ·12 in. of rain fell, " the first precipitation registered since May 29th, or ninety-two consecutive days without rain. Only on three occasions since 1873 has there been a longer absolute drought." The combined cold and drought played great havoc with plants which endure uninjured any ordinary winters. Similar exceptional conditions were experienced in Buenos Aires, where there were " sixty-five consecutive nights in which the thermometer* fell from 2° to 9° C. below the freezing point."

As was to be expected the remarkably cold winter and high pressure in the Argentine has been preceded, associated and followed by equally remarkable phenomena in other parts of the world. Thus early in May there were unusual floods in Cape Colony associated with much loss of life and live stock. At the close of that month an unprecedented cold snap occurred in Melbourne (see this Magazine, p. 101). June was remarkable for great cold in Britain and for heat in the eastern Mediterranean and Egypt. In

* I have reason to believe that this refers to an exposed thermometer. R.C.M.

New Zealand the month was most unusual, the mean June temperature, taking Auckland, Wellington, Dunedin and Hokitika as representative of the country, being 3°·5 in excess of the normal. At Wellington and Dunedin all records for previous June months were broken back to the commencement of the series in 1867, and at Auckland, which has a longer record, June, 1916, was the mildest since 1861, and the wettest since 1889, while the small rainfall at Wellington was a record for the month. In Australia and Tasmania temperature conditions were not abnormal, except at Perth, W.A., where June was 2°·7 above the normal, and at Melbourne, where pressure was ·20 in. under the average. In South Africa the Cape Town temperature was under the June normal by 2°·0, but at Johannesburg 2°·7 above the normal. To deal with other phenomena it may be noted that the July rainfall at Hobart, Tasmania, was the greatest since 1878, the last occasion in which the recent very high Nile Flood was exceeded. Finally we may note the practical failure of the north-east Trade Winds, for some months past, and the remarkable flood rains that set in over Victoria on the evening of September 21st, lasting several days, which, Mr. Hunt describes, " as the most widespread, heavy and continuous downfall that has ever occurred in Victoria."

REPORT ON ATMOSPHERIC POLLUTION.

THE first report of the committee of investigation on atmospheric pollution appointed at the International Exhibition and Conference, London, 1912, appears in full in the *Lancet* of February 26th, 1916, the period dealt with embracing the results obtained for the year ending March, 1915. The report extends to forty pages. The committee appointed by the conference of delegates with Sir Napier Shaw as Chairman has held several meetings, in the course of which it has drawn up specifications of a standard collector or " pollution gauge " and of an appropriate method of analysing the products.

The Committee met for the first time on June 21st, 1912, and since that time has held twelve meetings.

On the recommendation of a Sub-Committee, consisting of the Hon. Secretary, Mr. J. G. Clark, and Mr. Bailie Smith, it has approved the specification of a standard gauge for collecting the atmospheric impurity which falls on an exposed surface together with that which comes down with the rainfall. It has arranged for the manufacture of the gauge and has been successful in securing the co-operation of the authorities of nineteen cities and towns by whom gauges have been installed and provision made for the analysis of the collected products.

The Committee's interpretation of the term " pollution " relates to such matter solid, liquid, or gaseous, as reaches the surface of

the earth or falls upon the buildings, etc., either by its own gravity or with the assistance of falling rain.

The atmosphere, as we know it from everyday experience, contains suspended solid matter which cannot be regarded as a normal part of its constitution. Its significance from the physiological point of view is realised when we remember that an adult human being inhales about 400 cubic feet of air per day. No doubt a large proportion of this suspended matter is arrested in the filtering mechanism of the respiratory organs, but investigation has shown that suspended matter of a gritty nature will sometimes bring about bronchial inflammation.

Much of the solid pollution consists of combustible sooty matter, and those who have had occasion to handle shrubs, trees, and other plants in or near towns, are familiar with the sooty stains that are left on the hands. This constituent is the source of much trouble in towns, where it gives a distasteful murky appearance to works of art, delicate fabrics, buildings, etc. Mural paintings are frequently found seriously obscured by a deposit which has its origin in the pollution suspended in the air.

The large proportion of free carbon in the suspended matter clearly explains the dirtying effects that are too obvious in our towns and cities; but, in addition, there are sulphates present, the effect of which on building stones is notorious. The sulphur takes the form of calcium sulphate, ammonium sulphate, and a very minute quantity of free sulphur, the latter probably having its origin in the oxidation of sulphuretted hydrogen evolved from the imperfect combustion of raw coal.

Although the sulphur oxides and the ammonia are described here as forming *gaseous* pollution, they are usually found in the combined state as ammonium sulphate, which is normally a soluble solid. The sulphur, however, seems to lose none of its destructive effect on buildings by this union; in fact, experiments which have been made for the Committee indicate that the sulphur oxides in union with the ammonia are even more destructive than when they are free. This seems to arise partly from the fact that the basic substances of certain building stones have a natural tendency to displace ammonia from its salts and unite themselves with the acid component; and partly from the fact that the soluble solid ammonium sulphate, in the presence of moisture, has a much greater penetrating and continuous effect upon building stones than would be the case with the gaseous sulphur oxides.

Stones which are largely composed of carbonates of lime and magnesia suffer seriously in this way. A reaction takes place between the ammonium sulphate and the carbonates of lime and magnesia, the latter being converted into sulphates, with the formation of ammonium carbonate. The formation of those substances causes the stone to disintegrate, the process of destruction being hastened

by the action of rain. The vapours to which the attention of the Committee has been given were the tarry hydrocarbons. This tarry matter attaches itself to the carbon particles and gives them very great adhesive power, so that when they have deposited on and attached themselves to building stones, plants, etc., they cannot be readily washed away by rain, as would be the case if the tar were not there.

The gaseous pollutions kept in mind by the Committee were the sulphur oxides and ammonia. Coal contains on the average about 1 per cent. of its weight of sulphur (say, 20 to 30 lb. for each ton of coal). Under conditions of perfect combustion this sulphur would be evolved as either di-oxide or tri-oxide of sulphur, or both, but, as has been shown, if the combustion is not perfect, sulphuretted hydrogen appears—in fact, it is probably always safe to assume that when visible smoke is evolved from coal sulphuretted hydrogen accompanies it.

The Committee recognises that during recent years many thousands of smoke-producing coal fires have been supplanted by gas cooking and heating stoves, and, still more recently, the electric stove has been introduced. The products of combustion from a gas fire consist mainly of carbonic acid and water vapour, together with a minute quantity of sulphur oxides. As regards heating capacity, a coal fire consuming 21 lb. of coal per day would be about equal to a gas fire consuming 200 cubic feet of gas per day, but whereas the coal would evolve about 1,500 grains of sulphur in various forms, as well as the tar, carbon, etc., already alluded to, the gas would contribute only 50 to 60 grains of sulphur in the form of sulphur oxides.

The first duty of the Committee was to consider the method of investigation to be adopted.

The various methods available for the measurement of atmospheric pollution are referred to in detail, but, in the present instance, it will be sufficient to merely mention them.

1. A measured volume of air may be filtered through cotton or asbestos wool and the weight of the deposit ascertained.

2. All rain and deposit matter falling on a gauge vessel of known catchment area may be collected, the water evaporated or filtered, and the residue weighed and analysed.

3. *Aitken's Dust Counter.*—This is an ingenious instrument devised by Dr. John Aitken, F.R.S., and is intended for counting the number of dust particles in the air, but no attempt is made to ascertain their composition.

4. Glass plates may be exposed to the air for a known length of time, then washed in water and their opacity measured.

5. A jet of air of standard size and velocity may be caused to strike a glass plate or a white paper placed at a fixed distance from the nozzle, and the opacity of the plate or discolouration of the paper measured after a definite time.

6. A measured volume of air may be drawn through filter paper and the degree of discolouration produced on the paper compared with a calibrated scale. Or the air may be drawn through the paper until a predetermined degree of discolouration has been produced the volume required being measured.

7. An optical method might be used by which the opacity of a column of air of a given length to a standard light is measured. This might be arranged to give quantitative results by preparing a scale of opacity from measurements taken with air containing known amounts of suspended matter, but the results would probably not be of great accuracy.

8. The rain might be caught and its opacity, after a thorough shaking, compared with a standard scale made by adding definite proportions of soot to distilled water.

9. Boxes having a collecting surface of known area may be exposed for a definite time, their contents collected and analysed.

The results which are considered in the Report now under notice, are all obtained by the use of Method No. 2 above described. This may therefore be now considered in greater detail. The standard form of deposit gauge was the subject of very careful consideration by the Committee; provision had to be made to prevent contamination by bird-droppings and by matter from the gauge itself, also to prevent the access of dead leaves and other large wind-blown particles. It was necessary at the same time to obtain a fair and representative sample of the matter deposited in the neighbourhood. Great care had to be exercised that the gauges were not set up in such positions as to give fallacious results.

The question of the treatment of the water and solid impurities caught by the gauge was gone into most carefully. A Sub-Committee of skilled chemists was appointed to draft a standard method of analysis; this was printed and sent to each co-operating authority, and the analyses were carried out in most cases by the public analyst. The results were sent to the Committee monthly on a special form of report.

The choice of "metric tons per square kilometre" as the unit for final comparison of figures was made by the Committee after careful consideration; it was influenced partly by the hope that the results would be of international as well as local interest.

The standard gauge, consists of a galvanised iron stand, supporting a circular enamelled iron gauge vessel of 4 square feet superficial area. Projecting above the gauge vessel is a wire screen open at the top, intended to prevent birds from settling on the edge of the vessel. The gauge vessel is conical at the bottom and communicates, by means of a glass tube and rubber connection, with a group of three or more bottles connected together; designed to hold one month's rainfall. The rain and deposited matter falling on the gauge are collected in the bottles, and removed once a month for analysis.

(To be continued.)

RAINFALL TABLE FOR SEPTEMBER, 1916.

STATION.	COUNTY.	Lat. N.	Long. W. [*E.]	Height above Sea.	RAINFALL OF MONTH.	
					Aver. 1875—1909.	1916.
		° ′	° ′	ft.	in.	in.
Camden Square	*London*	51 32	0 8	111	2·00	1·48
Tenterden	*Kent*	51 4	*0 41	190	2·25	·89
Arundel (Patching)	*Sussex*	50 51	0 27	130	2·58	2·12
Fordingbridge (Oaklands)	*Hampshire*	50 56	1 38	135	2·39	2·81
Oxford (Magdalen College)	*Oxfordshire*	51 45	1 15	186	1·98	·73
Wellingborough (Swanspool)	*Northampton*	52 18	0 41	155	2·13	·53
Bury St. Edmunds (Westley)	*Suffolk*	52 15	*0 40	226	2·18	2·11
Geldeston [Beccles]	*Norfolk*	52 27	*1 31	38	2·13	1·50
Polapit Tamar [Launceston]	*Devon*	50 40	4 22	315	3·11	2·55
Rousdon [Lyme Regis]	,,	50 41	3 0	516	2·69	2·23
Stroud (Field Place)	*Gloucestershire*	51 44	2 13	226	2·39	1·06
Church Stretton (Wolstaston)	*Shropshire*	52 35	2 48	800	2·40	1·18
Boston	*Lincolnshire*	52 58	0 1	11	2·07	1·29
Worksop (Hodsock Priory)	*Nottinghamshire*	53 22	1 5	56	1·84	1·33
Mickleover Manor	*Derbyshire*	52 54	1 32	280	2·11	·94
Macclesfield	*Cheshire*	53 15	2 7	501	2·92	...
Southport (Hesketh Park)	*Lancashire*	53 39	2 59	38	3·09	2·56
Arncliffe Vicarage	*Yorkshire, W.R.*	54 8	2 6	732	4·55	4·16
Goldsborough Hall	,, ,,	54 0	1 25	119	2·17	1·99
Hull (Pearson Park)	,, *E.R.*	53 45	0 20	6	2·05	1·23
Newcastle (Town Moor)	*Northumberland*	54 59	1 38	201	2·00	1·43
Borrowdale (Seathwaite)	*Cumberland*	54 30	3 10	423	11·28	7·86
Cardiff (Ely)	*Glamorgan*	51 29	3 13	53	3·61	3·16
Haverfordwest	*Pembroke*	51 48	4 58	90	3·91	2·80
Aberystwyth (Gogerddan)	*Cardigan*	52 26	4 1	83	3·89	3·98
Llandudno	*Carnarvon*	53 20	3 50	72	2·50	2·78
Cargen [Dumfries]	*Kirkcudbright*	55 2	3 37	80	3·34	3·83
Marchmont House	*Berwick*	55 44	2 24	498	2·67	2·70
Girvan (Pinmore)	*Ayr*	55 10	4 49	207	4·30	1·92
Glasgow (Queen's Park)	*Renfrew*	55 53	4 18	144	2·99	·79
Islay (Eallabus)	*Argyll*	55 47	6 15	68	4·49	3·02
Mull (Quinish)	,,	56 34	6 13	35	5·20	3·25
Balquhidder (Stronvar)	*Perth*	56 21	4 23	422	5·81	1·31
Dundee (Eastern Necropolis)	*Forfar*	56 28	2 57	199	2·34	1·70
Braemar	*Aberdeen*	57 0	3 24	1114	2·73	1·76
Aberdeen (Cranford)	,,	57 8	2 7	120	2·69	1·79
Gordon Castle	*Moray*	57 37	3 5	107	2·58	1·10
Drumnadrochit	*E. Inverness*	57 20	4 29	138	2·94	1·33
Fort William	,, ,,	56 49	5 6	171	6·66	2·53
Loch Torridon (Bendamph)	*W. Ross*	57 32	5 32	20	7·28	5·17
Dunrobin Castle	*Sutherland*	57 59	3 56	14	2·51	1·51
Killarney (District Asylum)	*Kerry*	52 4	9 31	178	3·79	2·41
Waterford (Brook Lodge)	*Waterford*	52 15	7 7	104	3·19	1·68
Nenagh (Castle Lough)	*Tipperary*	52 54	8 24	120	3·16	1·63
Ennistymon House	*Clare*	52 57	9 18	37	4·22	3·69
Gorey (Courtown House)	*Wexford*	52 40	6 13	80	2·78	2·67
Abbey Leix (Blandsfort)	*Queen's County*	52 56	7 17	532	2·93	1·80
Dublin (Fitz William Square)	*Dublin*	53 21	6 14	54	2·06	2·14
Mullingar (Belvedere)	*Westmeath*	53 29	7 22	367	3·02	1·90
Crossmolina (Enniscoe)	*Mayo*	54 4	9 16	74	4·42	2·83
Cong (The Glebe)	,,	53 33	9 16	112	4·05	2·79
Collooney (Markree Obsy.)	*Sligo*	54 11	8 27	127	3·65	2·55
Seaforde	*Down*	54 19	5 50	180	3·25	1·13
Ballymena (Harryville)	*Antrim*	54 52	6 13	150	3·43	1·62
Omagh (Edenfel)	*Tyrone*	54 36	7 18	280	3·39	1·24

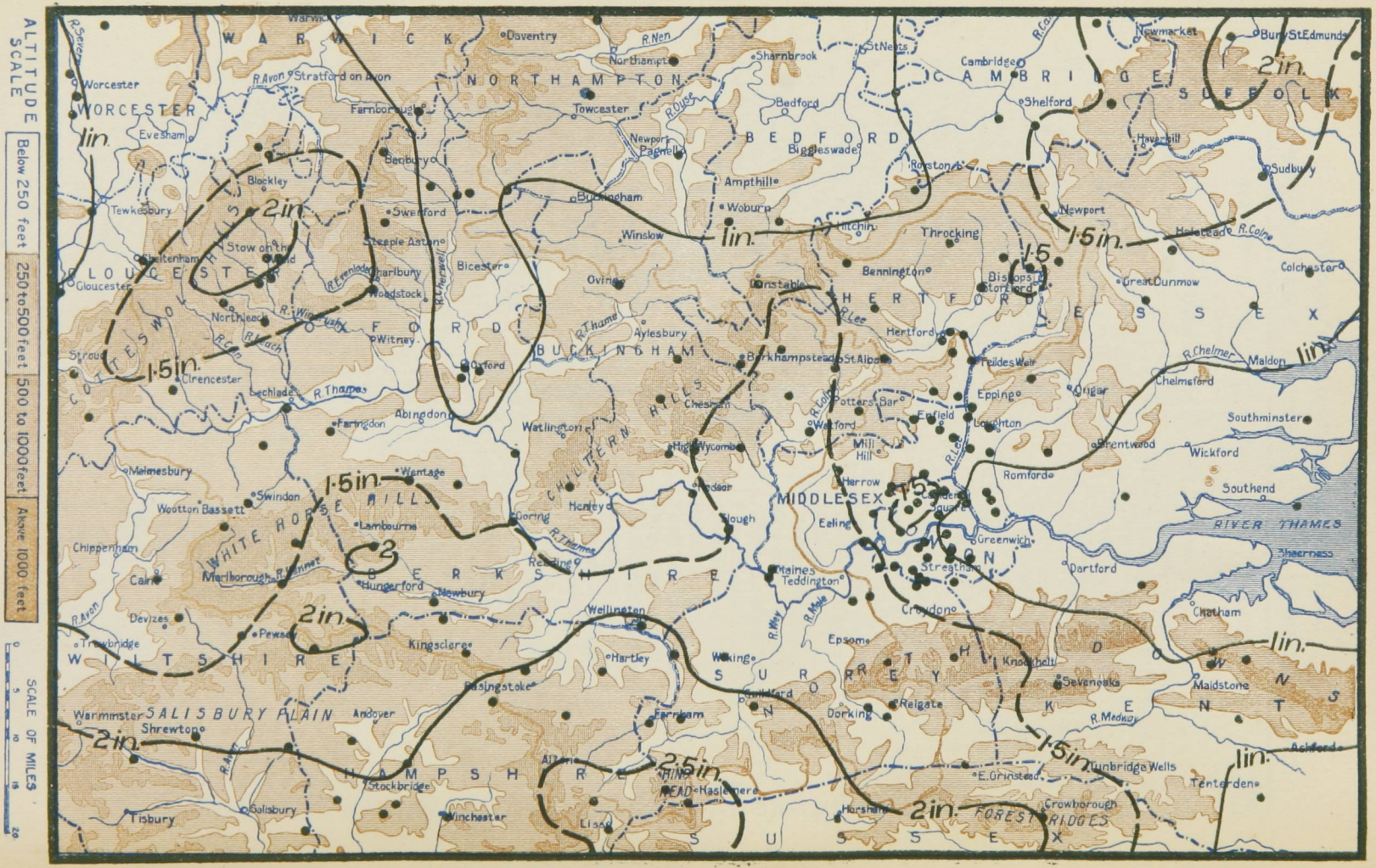
RAINFALL TABLE FOR SEPTEMBER, 1916—*continued.*

RAINFALL OF MONTH (*con.*)					RAINFALL FROM JAN. 1.					
Diff. from Av. in.	% of Av.	Max. in 24 hours. in.	Max. in 24 hours. Date.	No. of Days	Aver. 1875–1909. in.	1916. in.	Diff. from Aver. in.	% of Av.	Mean Annual 1875–1909. in.	STATION
— ·52	74	·28	17	13	17·92	23·54	+5·62	131	25·11	Camden Square
—1·36	40	·34	17	10	18·32	19·71	+1·39	107	27·64	Tenterden
— ·46	82	·36	26	13	20·02	21·84	+1·82	109	30·48	Patching
+ ·42	109	·83	1	10	20·33	24·94	+4·61	122	31·06	Fordingbridge
—1·25	37	·32	17	13	17·45	20·50	+3·05	117	24·58	Oxford
—1.60	25	·19	17	7	18·25	18·65	+ ·40	102	25·20	Swanspool
— ·07	97	·54	4	14	18·14	23·96	+5·82	132	25·40	Westley
— ·63	70	·44	19	16	16·33	...	...	...	23·73	Geldeston
— ·56	82	·55	28	15	24·90	24·25	— ·65	97	38·27	Polapit Tamar
— ·46	83	·56	26	11	22·54	22·19	— ·35	98	33·54	Rousdon
—1·33	44	·24	28	10	21·12	22·82	+1·70	108	29·81	Stroud
—1·22	49	·35	17	8	22·71	21·81	— ·90	96	32·41	Wolstaston
— ·78	62	·56	3	14	16·67	20·85	+4·18	125	23·35	Boston
— ·51	72	·35	3	11	17·54	17·42	— ·12	99	24·46	Hodsock Priory
—1·17	45	·42	3	11	19·25	21·78	+2·53	113	26·65	Mickleover
...	...	...	...	...	24·85	...	...	...	34·73	Macclesfield
— ·53	83	·77	17	12	22·70	20·46	—2·24	90	32·70	Southport
— ·39	91	2·32	3	8	42·14	43·82	+1·68	104	61·49	Arncliffe
— ·18	92	1·15	3	11	19·51	19·80	+ ·29	101	27·29	Goldsborough Hall
— ·82	61	·50	3	11	18·57	20·24	+1·67	109	26·42	Hull
— ·57	72	1·01	3	8	19·65	21·16	+1·51	108	27·94	Newcastle
—3·42	69	3·97	17	9	88·04	87·64	— ·40	96	129·48	Seathwaite
— ·45	88	1·28	26	12	28·63	32·08	+3·45	112	42·28	Cardiff
—1·11	71	·76	17	12	30·96	25·11	—5·85	81	46·81	Haverfordwest
+ ·09	102	1·71	17	11	30·92	30·89	— ·03	100	45·46	Gogerddan
+ ·28	111	·82	2	12	20·55	21·68	+1·13	115	30·36	Llandudno
+ ·49	114	1·01	3	12	29·83	35·52	+5·69	119	43·47	Cargen
+ ·03	101	1·14	3	15	23·89	31·49	+7·60	132	33·76	Marchmont
—2·38	45	·59	18	17	33·67	34·52	+ ·85	103	49·77	Girvan
—2·20	26	·26	17	14	25·03	29·80	+4·77	119	35·97	Glasgow
—1·47	67	·81	17	20	32·78	35·39	+2·61	108	48·79	Eallabus
—1·95	63	·81	16	15	37·87	32·41	—5·46	84	56·57	Quinish
—4·50	23	1·00	17	3	49·78	49·69	— ·09	100	73·77	Stronvar
— ·64	76	·87	3	10	20·54	28·52	+7·98	139	28·64	Dundee
— ·97	64	1·14	18	9	24·16	31·37	+7·21	130	34·93	Braemar
— ·90	66	·56	3	11	22·78	24·28	+1·50	107	32·73	Aberdeen
—1·48	43	·32	18	13	21·39	27·12	+5·73	127	30·34	Gordon Castle
—1·61	45	·46	18	11	25·47	35·66	+10·19	140	36·13	Drumnadrochit
—4·13	38	·88	17	15	51·52	49·02	—2·50	95	75·80	Fort William
—2·11	71	1·53	18	15	56·79	58·44	+1·65	103	83·93	Bendamph
—1·00	60	·80	18	11	22·41	25·80	+3·39	115	31·90	Dunrobin Castle
—1·38	63	·47	25	20	36·76	39·87	+3·11	109	54·81	Killarney
—1·51	52	·39	26	10	27·45	22·63	—4·82	82	39·57	Waterford
—1·53	51	·45	17	10	27·73	26·93	— ·80	97	39·43	Castle Lough
— ·53	87	·85	17	18	32·47	31·81	— ·66	98	46·52	Enniskymon
— ·11	98	1·14	27	8	24·41	23·48	— ·93	96	34·99	Courtown Ho.
—1·13	63	·94	27	12	25·70	24·69	+ ·99	104	35·92	Abbey Leix
+ ·08	104	·58	2	14	19·89	24·16	+4·27	121	27·68	Dublin
—1·12	63	·75	17	6	26·19	30·58	+4·39	117	36·15	Mullingar
—1·59	54	·79	27	20	35·74	38·27	+2·53	107	52·87	Enniscoe
—1·26	69	1·59	27	15	33·88	32·56	—1·32	96	48·90	Cong
—1·10	70	·54	17	20	30·14	34·45	+4·31	114	42·71	Markree
—2·12	35	·46	17	11	27·63	26·65	— ·98	98	38·91	Seaforde
—1·81	47	·42	16	10	29·14	30·22	+1·08	103	40·84	Ballymena
—2·15	36	·60	17	14	28·05	28·17	+ ·12	100	39·38	Omagh

SUPPLEMENTARY RAINFALL, SEPTEMBER, 1916.

Div.	STATION.	Rain inches.	Div.	STATION.	Rain inches.
II.	Warlingham, Redvers Road .	1·61	XI.	Lligwy	2·56
,,	Ramsgate	1·29	,,	Douglas, Isle of Man	2·47
,,	Hailsham	1·57	XII.	Stoneykirk, Ardwell House...	1·76
,,	Totland Bay, Aston House...	1·94	,,	Carsphairn, Shiel	3·08
,,	Stockbridge, Ashley..	2·09	,,	Beattock, Kinnelhead	3·52
,,	Grayshott	2·74	,,	Langholm, Drove Road	2·55
III.	Harrow Weald, Hill House...	1·49	XIII.	Selkirk, The Hangingshaw..	2·19
,,	Pitsford, Sedgebrook...	·86	,,	North Berwick Reservoir.....	1·02
,,	Woburn, Milton Bryant.....	·85	,,	Edinburgh, Royal Observaty.	1·47
,,	Chatteris, The Priory..... ...	1·72	XIV.	Maybole, Knockdon Farm ...	1·40
IV.	Elsenham, Gaunts End	1·42	XV.	Buchlyvie, The Manse.....	1·10
,,	Shoeburyness	·82	,,	Ballachulish House	2·27
,,	Colchester, Hill Ho., Lexden	1 05	,,	Oban.....	2·30
,,	Ipswich, Rookwood,Copdock	1·16	,,	Campbeltown, Witchburn ..	2·25
,,	Aylsham, Rippon Hall.....	1·64	,,	Holy Loch, Ardnadam.....	3·01
,,	Swaffham	1·21	,,	Tiree, Cornaigmore	...
V.	Bishops Cannings	1·41	XVI.	Dollar Academy	1·83
,,	Wimborne, St. John's Hill...	2·81	,,	Glenlyon, Meggernie Castle..	1·35
,,	Ashburton, Druid House.....	3·27	,,	Blair Atholl	1·23
,,	Cullompton	2·97	,,	Coupar Angus	1·37
,,	Lynmouth, Rock House	2·35	,,	Montrose, Sunnyside Asylum.	1·08
,,	Okehampton, Oaklands... ...	2·83	XVII.	Alford, Lynturk Manse	1·30
,,	Hartland Abbey.....	2·64	,,	Fyvie Castle	1·52
,,	St. Austell, Trevarna	2·38	,,	Keith Station	1·81
VI.	North Cadbury Rectory.....	3·66	XVIII.	Rothiemurchus	1·24
,,	Clifton, Stoke Bishop	1·61	,,	Loch Quoich, Loan	10·10
,,	Ledbury, Underdown..... ..	·97	,,	Skye, Dunvegan	3·59
,,	Shifnal, Hatton Grange.....	1·22	,,	Lochmaddy, Bayhead	2·30
,,	Droitwich.....	1·14	,,	Fortrose.....	·99
VII.	Blockley, Upton Wold.....	1·98	,,	Glencarron Lodge	3·94
,,	Grantham, Saltersford.....	1·35	XIX.	Altnaharra	2·37
,,	Market Rasen	1·37	,,	Melvich	1·79
,,	Bawtry, Hesley Hall	2·07	,,	Loch More, Achfary	5·05
,,	Derby, Midland Railway.....	·92	XX.	Dunmanway, The Rectory ..	1·35
VIII.	Buxton	2·92	,,	Glanmire, Lota Lodge.....	1·07
,,	Nantwich, Dorfold Hall	2·25	,,	Mitchelstown Castle.....	2·36
,,	Chatburn, Middlewood	2·83	,,	Darrynane Abbey.....	1·88
IX.	Lancaster, Strathspey	2·88	,,	Clonmel, Bruce Villa	2·47
,,	Langsett Moor, Up. Midhope	1·64	,,	Broadford, Hurdlestown.....	2·39
,,	Scarborough, Scalby	1·51	XXI.	Enniscorthy, Ballyhyland...	2·58
,,	Ingleby Greenhow	1·88	,,	Rothnen, Clonmannon	2·30
X.	Mickleton	2·30	,,	Ballycumber, Moorock Lodge	1·79
,,	Bellingham, High Green Manor	2·16	,,	Balbriggan, Ardgillan	1·83
,,	Ilderton, Lilburn Cottage ...	1·52	,,	Castle Forbes Gardens.....	2·01
XI.	Thirlmere, The Bank	2·65	XXII.	Ballynahinch Castle.....	4·00
,,	Llanfrechfa Grange	1·53	,,	Woodlawn	2·92
,,	Treherbert, Tyn-y-waun	4·94	,,	Westport, St. Helens	3·49
,,	Carmarthen, The Friary	3·04	,,	Dugort, Slievemore Hotel ...	4·11
,,	Fishguard, Goodwick Station.	2·33	XXIII.	Enniskillen, Portora.....	1·26
,,	Crickhowell, Tal-y-maes.....	3·50	,,	Dartrey [Cootehill]	1·65
,,	New Radnor, Ednol	1·45	,,	Warrenpoint, Manor House ..	1·05
,,	Birmingham WW., Tyrmynydd	3·46	,,	Belfast, Cave Hill Road	1·35
,,	Lake Vyrnwy	4.21	,,	Glenarm Castle	1·49
,,	Llangynhafal, Plâs Drâw.....	4·04	,,	Londonderry, Creggan Res...	2·26
,,	Dolgelly, Bryntirion.....	7·16	,,	Dunfanaghy, Horn Head ...	2·20
,,	Bettws-y-Coed, Tyn-y-bryn...	3·83	,,	Killybegs	4·10

THAMES VALLEY RAINFALL——SEPTEMBER, 1916.



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

Rainfall Stations reporting

Isohyetals.

Symons's Meteorological Magazine

WEATHER OF SEPTEMBER.

THE characteristic features of the weather of September were a deficiency of sunshine and of rainfall with a relatively small number of rainy days.

The mean temperature of the month, taking the country as a whole, was in close agreement with the normal. In the north and east temperature was slightly below the average, but in the south and west the average was exceeded, the excess being most pronounced in Ireland, where it was less than 2°.

The month opened with a low pressure system to the north-west accompanied by strong southerly winds and rain in the west. On the 3rd a well mark cyclonic area lay over the Irish Sea, which, moving eastward, caused heavy rain to the north of its centre as much as 2·32 in. at Arncliffe on the 3rd. On the morning of the 7th temperature fell to 35° at Balmoral, the winds in Scotland being light from the east or calm. The approach of an anti-cyclone from the west on the 6th was accompanied by warmer weather, and on the 7th temperature rose to 77° at Killarney, and 75° at Bettws-y-Coed on the 8th. From the 14th to the 16th rather fresh northerly and north-westerly winds, associated with the advance of a high-pressure area from the Atlantic, caused cold weather throughout the whole country. Temperature in shade fell to 32° at West Linton on the 16th, and minima below 40° were widely recorded. From the 14th to the 25th maxima of 70° or above were uncommon, and on the 21st frost in shade was experienced as far south as Marlborough, with readings as low as 28° at West Linton and 29° at Balmoral. The rainfall of the month was in general under the average, although the areas with less than half the average were in no district of wide extent. In Northampton the precipitation fell to about a quarter of the average at some places. More than the average fell in one or two widely separated regions, but even in Wales and the south of Scotland, where an excess was fairly common, the departure from the average was unimportant. The actual amount in Great Britain varied from more than ten inches in the normally rainy areas in South Wales, the Lake District, and at Inverness, to less than an inch over the Thames Estuary, South Kent, the south Midlands and the estuary of the Forth. A narrow fringe on the eastern coastal areas extending from Wick to Dover, had in general, less than 1·5 in. In Ireland the only region with more than 4 in. was a small area in Connemara, where the maximum was 7·5 ins. The least rainfall under 1 inch was to the south of Lough Neagh and to the east and south-east of Belfast.

In the Thames Valley the maximum fall—slightly more than 2·5 ins.—occurred on the Hampshire heights. More than 2 ins, fell on the Cotswolds, and less than an inch in the Thames Estuary. Over the country as a whole the general rainfall expressed as a percentage of the average was :—England and Wales, 77 per cent.; Scotland, 58 per cent.; Ireland, 64 per cent. British Isles, 66 per cent, the driest month of the present year.

Sunshine was deficient everywhere and in no part of the month was there any prolonged spell of fine sunny weather. The actual amounts recorded varied from five hours a day in the Channel Islands and four hours in the north-east, and south-east England to about two and a half hours in the north of Scotland. The general deficiency over the country as a whole was about one hour a day, the amount varying from a third of an hour in the east of Scotland to an hour and a half in the south of Ireland. The amounts at individual stations were as follows :—Worthing, 156 hours, Weymouth, 141 hours, Swinton, (Berwick) 121 hours, Southport, 118 hours, Haverfordwest, 114 hours, Paisley, 113 hours, Copdock, 108 hours, Camden Square, 95 hours, Bolton, 86 hours, Hull, 83 hours, Loch More, 67 hours. In London (Camden Square) the mean temperature was 56°·7 or 1°·0 below the average. Duration of rain 28·0 hours, Evaporation 1·24 in.

Climatological Table for the British Empire, April, 1916.

STATIONS. (*Those in italics are South of the Equator.*)	Absolute. Maximum. Temp.	Date.	Minimum. Temp.	Date.	Average. Max.	Min.	Dew Point.	Humidity.	Absolute. Max. in Sun.	Min. on Grass.	Total Rain Depth.	Days.	Aver. Cloud.
	°		°		°	°	°	0-100	°	°	inches		
London, Camden Square	77·3	27	32·8	1	59·8	39·8	40·5	49	123·2	28·5	1·31	15	4·3
Malta	77·0	21	48·0	17	67·1	55·8	...	80	130·0	...	1·37	6	2·0
Lagos	91·2	5	72·2	11	88·8	76·5	74·4	73	156·2	69·5	5·46	11	7·4
Cape Town	94·1	3	47·9	28	74·2	56·1	54·5	72	...	...	·99	5	4·2
Johannesburg	77·3	26	42·0	23	71·2	50·6	44·1	66	...	37·8	·43	4	3·2
Mauritius	85·7	6	62·6	22	82·3	69·1	69·3	82	...	56·1	5·57	17	5·3
Bloemfontein	81·9	20	34·2	25	74·7	48·7	46·1	62	..	...	2·09	6	3·3
Calcutta...	105·4	30	70·3	13	97·4	77·0	72·6	67	...	66·6	1·80	3	2·5
Bombay...	92·6	6	75·6	1	89·9	77·9	73·7	72	133·6	57·7	·04	1	2·0
Madras	101·2	24	74·7	3	94·1	78·1	74·6	75	161·6	72·0	·02	1	2·2
Colombo, Ceylon ...	91·0	10	69·8	16	89·0	75·9	74·8	82	158·8	68·0	11·17	22	6·5
Hongkong	85·8	30	56·8	5	75·3	67·1	66·0	83	...	...	4·30	8	7·4
Sydney	...	...	...	...	...	...	...	...	...	...	...	...	...
Melbourne	80·0	19	40·3	30	66·0	50·9	46·6	63	131·4	31·4	2·06	18	5·8
Adelaide	82·5	10	42·5	26	68·4	52·7	49·1	65	136·0	34·9	1·51	15	5·7
Perth	94·0	8	49·0	23	76·0	56·0	49·5	54	157·0	37·0	·43	4	3·9
Coolgardie	88·4	8	39·6	26	75·3	50·0	42·0	42	144·0	33·0	·03	1	2·6
Hobart, Tasmania .	77·8	1	39·2	28	61·6	46·6	43·2	65	127·3	31·9	4·37	21	5·5
Wellington ...	70·2	7	40·2	9	64·9	53·5	55·0	77	101·6	30·0	3·69	12	6·5
Auckland	...	...	...	...	...	...	...	...	...	...	...	...	...
Jamaica, Kingston ..	90·3	10	68·1	9	86·7	71·2	69·2	74	...	...	2·99	12	...
Grenada	88·0	3	70·0	12	86·0	74·0	...	71	136·0	...	1·83	13	2·5
Toronto	68·6	30	25·3	7	51·9	36·9	35·5	76	123·0	26·0	3·24	18	5·6
Fredericton	66·0	17	18·0	4	52·0	31·0	31·1	66	...	...	1·76	6	4·7
St. John, N.B. ...	59·2	20	24·0	4	48·6	33·0	31·0	68	136·3	18·7	2·48	9	6·2
Victoria, B.C.	62·7	2	37·2	22	54·4	37·2	41·0	77	129·2	29·0	1·12	15	6·1

Johannesburg.—Bright sunshine, 269·5 hours.

Mauritius.—Mean temp. 1°·1 dew point 0°·9, and R 1·11 in. above averages.

COLOMBO, CEYLON.—Mean temp. 82°·5, or 0°·2 below, dew point same as average and R 3·43 in., above averages. Mean hourly velocity of wind 4·5 miles. T and L on twelve days.

HONGKONG.—Mean temp. 70°·6, mean hourly velocity of wind 11·1 miles. Bright sunshine 145·0 hours.

Melbourne.—Mean temp 1°·2 below, and R ·24 in. below, averages.

Adelaide.—Mean temp. 3°·4 below, and R ·35 in. below, averages. a cool month mean max. lowest on record.

Perth.—Rainfall 1·20 in. below, average

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

Hobart.—Temp. 1°·0 below, and R slightly below, averages.

Wellington.—Mean temp. 2°·4 above, and R ·33 in. below, averages. Bright sunshine 160·2 hours. T L and H on 8th. Frost on 4 days and fog on 1 day.