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RAINFALL AND HIGHLAND WATER POWER.

We have received a copy of a very instructive lecture delivered by Mr. Alex. Newlands, C.E., Assistant Engineer of the Highland Railway, to the Inverness Field Club, and reprinted from the *Transactions* of that society. It deals, as its title states, with "Our Sources of Power, with special reference to Highland Water Power," and we believe that the author takes a very moderate view of the available resources. He frankly acknowledges that the most important source of power in the British Isles is coal, and that this will remain the most important source for a very long time, though on the authority of Sir William Ramsay he only gives 175 years as the future duration of our coal supplies. Unquestionably the gravity of the coal question for a century before complete exhaustion is possible will lead to the introduction of economies in the use of fuel which will postpone exhaustion for a very long time, for, as Mr. Newlands points out, coal is now used in a very extravagant way, and he foresees the time when power and not coal will be transported from the mine to the factory, and in our present state of knowledge it appears that this transport of power must be effected by means of high voltage electricity. The fact that electricity can be produced by water power as readily as by the combustion of fuel affords a direct means of comparison between water-power and coal. The result of such a comparison leads Mr. Newlands to say of water powers—

"It cannot be said that as compared with coal they are of paramount importance, although Professor Forbes, F.R.S., has stated they are probably sufficient to work the whole of the Scotch railways with a substantial surplus for other purposes. . . As regards the quantity of power from water in Great Britain, a comparatively recent estimate showed that this amounted to about 1,000,000 horse-power, a national asset surely worthy of development."

It is shown that the efficiency of a source of energy depends largely on the scale on which it can be worked, small installations being more costly per unit of power than large, hence "to utilise the water power possibilities of the Highlands to the best advantage it is necessary that each entire drainage area should be developed up to its maximum output as one complete unit, or as a number of units linked into one complete system, and all generating current of the same character."

The works of the British Aluminium Company at Foyers, on Loch Ness, and at Kinlochleven, on the west coast, show the practical utility of water power in a region of high and uniform rainfall combined with a mild winter climate which makes stoppage by frost practically unknown. In such regions far from the coal-fields there seems to be no doubt that water power can be profitably used for certain manufactures, even in competition with coal, and it seems reasonable to believe that in many other places subsidiary water power would be an extremely important stand-by in permitting such essential services as the lighting of public buildings or of the streets, the running of tramways, and the maintenance of cold storage, to be carried on in the temporary stoppage of coal supplies. The recent coal strike gives a sharp point to this argument.

When Mr. Newlands tries to pass from isolated cases and general principles to the consideration of the available waterpower in the Highlands he enters upon a quaking bog of uncertainty, through which his only way is by means of assumptions which are little more than guesses, and only bear him up because they are made so very far within the mark. His difficulty is the uncertainty that exists as to the rainfall of the Highlands, but we believe that the data which have been published in the fifty annual volumes of *British Rainfall*, incomplete though they are, admit of a much closer and more favourable estimate being made than Mr. Newlands attempts. There is a very large area in the western Highlands, not on the coast but inland, in which the average annual rainfall exceeds 80 inches, and within that an imperfectly defined, but certainly large, area with an annual rainfall exceeding 100 inches. We venture to think, however, that there are few drainage areas in the Highlands the rainfall of which can be determined from existing data with a degree of accuracy to ensure equitable agreements as to water-rights between proprietors of the land and promoters of companies. It is the height of folly for a land-owner to sell all the water on his land when he does not know how much he has to sell. It is less unwise for a manufacturer to buy all the water because he may know that there is enough for his immediate requirements, and he may be able to make good use of any additional amount. We have for years been trying to induce Highland land-owners to set up rain gauges on their property and to see that they are correctly read, which is a very different thing, but with the most miserable modicum of success. Many are afraid that the rainfall observer will scare the grouse or the deer; but water power is the one resource of the country that can be worked with profit and the minimum disturbance of game. We have offered, and still offer, free instruction as to rainfall observing and free criticism and discussion of the records, not because we wish to increase the wealth of Highland lairds (though that may perhaps be a by-product of our efforts) but because we are anxious to ascertain the distribution of rainfall over the country and its relation to the configuration of the land and the direction of the prevailing winds. Our predecessor,

Mr. G. J. Symons, with the same object in view, induced the Highland Railway Company to start the observation of rainfall at each of their stations in 1872, and extremely valuable results were obtained for several years; but after a time the work at the stations increased, the high official, who was far-seeing enough to promote the enterprise, died, and one by one the records dropped out of the pages of *British Rainfall* where about 30 once appeared until now there is only one remaining.

We have upheld the efficacy of voluntary enterprise in this work, not only with words but with work and with the savings of a lifetime, so we may be excused for marvelling at the stupidity of people to whom a trifling outlay in carrying on observations might bring a large pecuniary return, and much as we dislike all compulsory legislation we are beginning to think that there is, after all, something in Mr. Newlands's suggestion that Government action is necessary to compel proprietors to take stock of resources which, in truth, are not only their property but assets of the nation :—

"These power possibilities ought to be looked upon as a national asset, and as such should be developed by Government assistance, and probably this could best be done by the appointment of a Royal Commission to examine and report on them. In Switzerland and Bavaria, Commissions appointed by these States, who own their own railway systems, are at present considering the expediency of utilising their water powers for the working of these railways; and in Norway the Government are acquiring a large interest in all the water powers available, and are developing them along the lines we are advocating."

We do not think, however, that a Royal Commission is necessary. Recent Royal Commissions on Coal Supply, Sewage Disposal, and Canals have elicited a sufficient knowledge of the ignorance which exists regarding the rainfall of remote regions of the British Isles to enable Government to deal with the matter of the Conservation of Rivers, which necessarily requires a survey of the resources available. Thanks to the enlightened action of individuals and institutions there already exist numerous records of rainfall in the Highlands which are reasonably accurate and sufficiently long to serve as standards by which the average rainfall of the country could be deduced were a close network of stations established for even a few years. We have still faith in the efficacy of voluntary individual action provided the individual adopts standard instruments and uniform methods and does not purchase "at the stores" or "from the seedsman" a rain gauge of a pattern which has been obsolete for thirty years or longer. Full instructions as to the choice and use of a rain gauge will be sent post free on application to the Director of the British Rainfall Organization, 62, Camden Square, London, N.W.

We trust that Mr. Newlands's lecture will move the leading men in the North to action, and we are sure that the Scottish Meteorological Society will support any effort that is made locally, and those practically interested in the subject will find Mr. A. Watt's recent paper on the Rainfall of Scotland and the map it contains very useful.

Abbott Lawrence Rotch.

6TH JANUARY, 1861—7TH APRIL, 1912.

THE death of Professor Rotch removes the most widely travelled and best-known of meteorologists. It would be hard to name a meteorological observatory or institution in any country which he had not visited, or a meteorologist with whom he was not on terms of personal friendship. Mr. Rotch was a familiar figure at the meetings of the British Association, and he was present at almost every international gathering connected with meteorology. Mr. Rotch lived a great deal in southern Europe in his boyhood, but his later education was in Boston, and he was a graduate of Harvard University, which later created for him a Professorship of Meteorology. Although possessed of ample means, he devoted himself to the study and advancement of his favourite science with an earnestness and constancy that no professional necessities could have increased, and in 1885 he built the celebrated meteorological observatory at Blue Hill, near Boston, where he commenced the series of researches which have made him the pioneer and one of the chief founders of the science of the upper air.

When we first met Mr. Rotch he was in Scotland to examine the equipment of the Ben Nevis Observatory, in the course of an exhaustive round of visits which took him to every high-level observatory in the world. The study of mountain observations convinced him that results of far greater interest would be secured by observations made in the free atmosphere at a great height above the ground. He made several experimental balloon trips in 1891 in Germany, where Professor Assmann was then in charge of the scientific aeronautical work, and for him Mr. Rotch carried out a series of comparisons between the sling-thermometer and Assmann's aspiration-thermometer in obtaining air temperature without the use of a thermometer screen. When the International Commission for Scientific Aeronautics was founded in 1896, it was natural that Mr. Rotch should be one of the first members, for from 1894 he had been carrying on observations by means of thermographs and barographs raised by kites at Blue Hill. Kites had been used for ascertaining temperature before by Mr. Douglas Archibald and others, and the form of kite adopted at Blue Hill was a modification of the box-kite invented by Mr. Hargraves in Australia; but it was Mr. Rotch who carried the method through the experimental stages, introduced steel wire and steam winding gear, and made it serviceable in the routine of observatories. He also adapted his kites for use at sea, and after some experiments on an Atlantic liner, he organized a series of special voyages in conjunction with M. Teisserenc de Bort, in the course of which results of the utmost importance were obtained in the Trade Wind region of the Atlantic. In 1904, on the occasion of the St. Louis Exhibition, Rotch introduced the unmanned balloon, carrying a meteorograph into the United States. He followed the development of the investigations in Europe with

the utmost attention, and his books, "Sounding the Ocean of Air," published in 1900, and "The Conquest of the Air," in 1909, did much to popularise the subject on both sides of the Atlantic. His latest published work appeared only a few months before his death, and consisted of a series of Charts of the Atmosphere for Aeronauts and Aviators.

In addition to the researches which he made personally or encouraged his assistants at Blue Hill to work out, and to the very numerous publications in the scientific journals of many countries, Mr. Rotch was closely associated with the *American Journal of Meteorology* during the greater part of its short career of twelve years, and we understand that a large share of the financial loss which it seems a meteorological monthly in the English language must entail fell upon him.

Professor Rotch leaves as his memorial a fine record of work done by his own energy and at his own cost, and his sudden death casts a wider gloom because he was not only a name but a friend to all his colleagues in the meteorological world.

METEOROLOGICAL INSTRUCTION FOR AVIATORS.

In the Government scheme of naval and military aviation outlined in a Parliamentary Paper issued on April 12th, 1912, special attention is devoted to instruction in meteorology in the courses set out for the qualification of airmen. The reference to the subject is as follows :—

METEOROLOGY.

Steps should be taken forthwith for the investigation of the atmosphere above this country. It is important if the art of aviation is to progress and accidents are to be avoided that the prevailing air currents and the meteorological conditions of the atmosphere should be studied. Such investigation must be based on the results of continuous observations from a number of stations, carefully co-ordinated, and extended over a long period. Evidence of Dr. W. N Shaw, Director of the Meteorological Office, has been taken on this question. Dr. Shaw laid stress on the importance of co-ordinating the theoretical and scientific experiments with the practical experience of flying men. It is plain that little investigation has hitherto been undertaken in respect to those meteorological problems which more particularly concern flying men. Dr. Shaw indicated that he was prepared to conduct such experiments if the necessary funds were placed at his disposal. A Meteorological Section should be established at the Central Flying School. Ultimately it may be found possible to include in this section officers who have been compelled to give up actual flying. For the immediate present, however, it will be sufficient to attach a meteorological expert to the Central Flying School for instructional purposes. All officers at the Central Flying

School should be instructed in meteorology. All members of the Royal Flying Corps should be directed to report any unusual meteorological phenomena to the Meteorological Office. Each Wing or Squadron of the Royal Flying Corps, as well as the Flying School, should keep a meteorological log, and forward a monthly report to the Meteorological Office. Such investigation of the air currents near the ground and in the upper atmosphere as will be useful to flying men should be undertaken by the Meteorological Office, and the results of their investigations and any phenomena of special interest should be communicated without delay to all branches of the Royal Flying Corps.

INTERNATIONAL BALLOON ASCENTS.

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

December 6th, 1909.

Starting Point	Country.	A miles.	B ° F.	C miles.	D ° F.	E miles	F
Crinan	Scotland	5·2	—75	6·2	—70	23	N. by E.
Pyrton Hill....	England	4·7	—62	8·1	—56	36	N.E. by E.
Paris.....	France	6·2	—57	11·0	—69	146	E.N.E.
Strassburg	Germany	6·6	—69	10·1	—67	98	N.E. by E.
Vienna.....	Austria	7·2	—71	13·2	—72	75	E.N.E.
Pavia	Italy.....	7·1	—79	9·2	—74	44	E.N.E.

December 7th, 1909.

Manchester....	England	5·6	—60	10·6	—61	25	E.S.E.
Pyrton Hill....	„	5·2	—60	9·6	—60	53	E.
„	„	4·7	—65	6·9	—62	29	S.E.
Petersfield	„	5·0	—62	10·7	—58	80	E. by N.
Hamburg.....	Germany	6·0	—68	8·0	—62	31	N.E.
Lindenberg....	„	5·6	—76	6·7	—68	98	N. by E.
Paris	France.....	4·8	—63	8·8	—63	85	E. by N.
Strassburg	Germany	*4·8	—65	7·2	—60	43	E.N.E.
Vienna.....	Austria.....	6·4	—80	9·5	—70	73	N.E.
Pavia.....	Italy.....	7·0	—65	8·2	—63	94	E. by N.

December 8th, 1909.

Crinan	Scotland	*6·9	—63	12·5	—74	67	S.E.
Manchester....	England	6·3	—60	12·0	—64	91	S.S.E.
„	„	5·9	—60	6·9	—61	109	S.S.E.
Brussels	Belgium	5·2	—75	7·5	—62	40	S.E.
Hamburg.....	Germany	5·6	—66	10·7	—63	22	N.E. by E.
Lindenberg....	„	5·4	—67	10·3	—69	26	N.E.
Paris.....	France.....	5·6	—69	10·2	—69	94	S.E.
„	„	4·9	—67	8·3	—65	233	S.E.
Munich	Germany	5·4	—74	9·4	?	94	N.E.
Vienna.....	Austria.....	5·8	—72	7·8	—67	45	N.E.
Pavia	Italy.....	4·9	—63	8·0	—61	26	N.E.
Omsk	Russia	6·9	—81	9·6	—72	?	?

December 9th, 1909.

Starting Point.	Country.	A miles.	B ° F.	C miles.	D ° F.	E miles.	F
Crinan	Scotland	7·8	—89	12·5	—80	70	E.S.E.
Manchester	England	7·5	—85	8·8	—82	109	S.S.E.
Pyrton Hill....	,, ...	7·8	—81	8·9	—76	62	S.S.E.
Brussels	Belgium	6·4	—83	9·8	—83	196	S. by E.
Hamburg.....	Germany....	6·6	—72	9·0	—66	23	S. by E.
Paris	France.....	7·1	—87	9·0	?	202	S.
Strassburg	Germany....	*5·0	—61	9·5	—71	53	S.
,, ...	,, ...	*..	..	7·7	—69	66	S.S.W.
Vienna	Austria	5·4	—66	6·7	—67	8	N.W.byW.
Pavia	Italy.....	5·3	—69	10·1	—69	54	S.
Omsk	Russia	6·5	—81	10·5	—70	?	?

December 10th, 1909.

Pyrton Hill....	England	7·3	—89	9·7	—81	32	E. by S.
Brussels	Belgium	..	..	6·8	—74	78	S.
Hamburg.....	Germany....	7·9	—92	9·8	—80	45	S.S.W.
Lindenberg	,, ...	6·9	—58	8·9	?	29	S.W.byW.
Paris	France.....	6·9	—89	7·4	—85	46	S.
Strassburg	Germany....	6·1	—72	8·4	—74	75	S.S.W.
Munich.....	,, ...	*7·6	—72	9·8	—74	88	S.W.
Vienna	Austria	5·9	—74	6·9	—68	31	W.
Pavlovsk	Russia	6·3	—72	10·4	—78	31	E.S.E.
Nizhni Olchadaeff	,, ...	6·1	—74	7·5	—71	17	N.

December 11th, 1909.

Petersfield	England	6·9	—73	10·3	—78	10	W.
Brussels	Belgium	..	..	6·9	—78	34	S.W.
Lindenberg	Germany....	6·9	—69	8·8	—70	33	W.N.W.
Paris	France.....	7·4	—81	10·9	—84	41	S.
Strassburg	Germany....	6·0	—67	..	..	53	S.W.
Zurich	Switzerland..	*6·5	—60	9·0	—71	24	W.
Munich.....	Germany....	*..	..	8·1	—69	47	W.N.W.
Vienna	Austria	5·7	—68	9·2	—63	66	N.W.byW.
Pavlovsk	Russia	7·5	—89	8·3	—83	17	S.E.
Omsk	,, ...	..	..	6·7	—86	?	?

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.

An * denotes that the beginning of the isothermal column was badly defined, and in some instances it was so badly defined that no precise height could be given.

On December 6th the barometer was low over the whole region, and exceptionally low (29·00 in.) over England. Similar conditions held on the 7th, but the barometer had risen somewhat. By the 8th a complete change had occurred in the west; a normal pressure prevailed over England, with a gradient for north-west winds. The rise continued till the 9th, which found the south-west of Europe under the influence of an anticyclone; but a steep gradient for S.W. winds had appeared over England, and a deep depression lay to the N.W. These conditions were maintained on the 10th. On the 11th the gradient over England had slackened, the barometer stood at about 29·60 in. in the west of Ireland and 30·20 in. over mid-Europe.

There are many interesting points about the set of figures for this week. Some of them are discordant, the —58° on the 10th at Lindenberg, for example; but similar discrepancies do occur, and it does not follow that the observation is in error. The low temperature in the north (Crinan and Pavlovsk) is not in accordance with the usual rule; but the usual change of temperature and change of the height of the isothermal column accompanying the rise and fall of the barometer is very plainly shown, especially over the west of Europe. Thus England and France show —60° at the beginning of the week, and about —85° after the rise of the barometer on the 9th. The general drift became reversed during the week, beginning at W.S.W. and passing through N.W. to N.E. Much importance cannot be attached to the distance a balloon travels, since accidental circumstances, such as the non-bursting of the balloon, may largely alter this; but the two long runs to the south from Paris and Brussels on the 9th are noticeable.

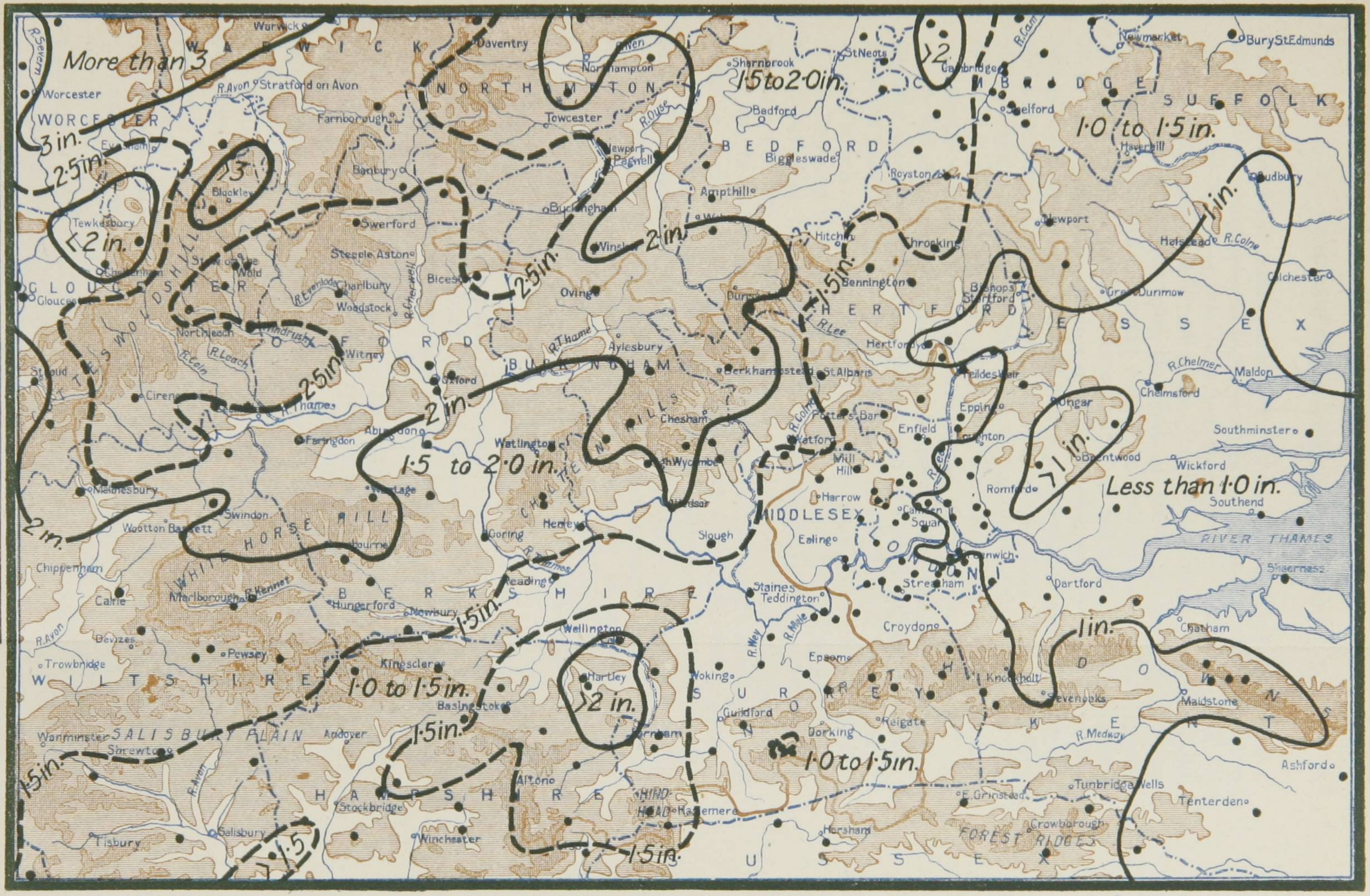
THE WEATHER OF MAY.

By Fred. J. Brodie.

Owing to frequent changes in the type of pressure distribution the weather of May was usually in a more or less unsettled state. In the south and east of England, however, there was a decided preponderance of anticyclonic conditions, and in many places a partial drought continued to prevail until very nearly the end of the month.

During the first three days the weather over a large portion of the country was affected by a cyclonic disturbance of increasing intensity, which moved eastwards along the north of Scotland and subsequently passed on to the Baltic and Northern Russia. During its presence in our own neighbourhood southerly to westerly winds prevailed, with a temperature differing but little from the normal, the highest readings being recorded on the 2nd, when the thermometer reached 65° in many parts of England and touched 71° at Greenwich. As the depression passed away an anticyclone spread over the United

THAMES VALLEY RAINFALL —— MAY, 1912.



ALTITUDE SCALE: Below 250 feet | 250 to 500 feet | 500 to 1000 feet | Above 1000 feet

SCALE OF MILES: 0 5 10 15 20

Symons's Meteorological Magazine.

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

Rainfall Stations reporting

Isohyetals.

Kingdom from the north-westward, and on the nights of the 4th and 5th a rather sharp ground frost occurred in some parts of the northern and central districts, the exposed thermometer falling to 25° at Crathes and to 27° at Birmingham. After the 5th a mild breeze set in from the south-westward, the drift of warm air over the cold sea surface resulting in much fog round our western and southern coasts. Thunderstorms occurred in many parts of Scotland on the 7th and 8th; and on the 11th, when a small depression moved north-eastwards across the country, the weather was in a generally unsettled condition, the barometric oscillations in the south of England being unusually sudden and violent. On the same day a peculiar rising and falling of the tide was reported at Watchet (Somerset). Over our eastern and south-eastern counties the weather at the time was warmer than in any other part of the month, the thermometer on the 11th rising slightly above 80° in several places, and reaching 83° at Greenwich. Between the 14th and 16th the weather was influenced by a cyclonic system which advanced northwards from Spain and moved directly across England to the upper part of the North Sea. The progress of the disturbance was marked by thunderstorms in many parts of the country and by heavy rains over northern and central Scotland. Prior to the advance of the disturbance the wind was light and variable, and on the nights of the 12th and 13th sharp ground frosts were experienced in many western and northern districts, the exposed thermometer falling to 23° at Balmoral and Newton Rigg, 24° at Crathes, and 25° at West Linton and Armagh. In the rear of the depression a cool north-westerly breeze set in over the entire kingdom, but this soon gave way under the influence of a new area of low pressure which spread in from the Atlantic, the wind becoming variable in the south but north-easterly in the north. Between the 21st and 24th the weather was in a very unsettled state generally, with thunderstorms in many parts of England; and on the nights of the 23rd and 24th further sharp ground frosts were experienced in the north, the thermometer on the grass falling to 22° at West Linton, 24° at Crathes and Newton Rigg, and 25° at Balmoral. With the formation of an anticyclone on the 25th night frosts became more general, and caused locally a considerable amount of damage to vegetation. On the night of the 25th the exposed thermometer fell to 24° as far south even as Greenwich. Towards the close of the month numerous small barometrical depressions were developed over the United Kingdom and its immediate neighbourhood, and the weather again became very unsettled, with thunderstorms on the 30th and 31st in many parts of England.

The mean temperature of the month was nearly everywhere above the average; in London May was the thirteenth consecutive month with an excess of warmth, such a sequence being altogether without precedent. Bright sunshine was below the normal, the presence of much cloud resulting in most places in an unusually high mean minimum temperature.

METEOROLOGICAL ORGANIZATION IN SOUTH AFRICA.

We have received an intimation from Mr. R. T. A. Innes, Union Astronomer, dated from the Union Observatory, Johannesburg, on 8th May, 1911, in the following words:—

This Institution is now re-named "The Union Observatory," and its activities will be mainly of an astronomical nature, but the 1st order meteorological observations will be continued, and the Observatory will also collect seismological data for the Union.

The Natal Observatory at Durban has been closed and the Cape Meteorological Commission dissolved.

On the 1st April last a new Department of Meteorology was formed in Pretoria which will embrace the meteorology of the four provinces of the Union (Cape Colony, Transvaal, Orange Free State, and Natal).

In future will you kindly address as follows:—

Meteorological affairs—To the Chief Meteorologist, Department of Irrigation, P.O. Box 399, Pretoria, Union of South Africa;

Astronomical affairs—To the Astronomer, Union Observatory, Johannesburg, Union of South Africa;

And delete from your address book the Transvaal Observatory, the Natal Observatory, the Cape Meteorological Commission.

We have not yet been informed who the Chief Meteorologist is, but we welcome the news of the unification of the meteorological service over the southern portion of South Africa, and trust that the constitution of the new Department has been so designed as to give to it the weight due to its importance. The placing of the Chief Meteorologist in the Department of Irrigation suggests that special attention will be devoted to rainfall, while the separation of astronomical and meteorological affairs will, we believe, be to the ultimate advantage of both sciences. We heartily wish prosperity to the new arrangements.

Correspondence.

To the Editor of Symons's Meteorological Magazine.

A RAINLESS APRIL.

Last month my rain gauge registered no rain. My record commences on the 1st April 1869, and the last was the first month in the record in which no rain was registered. CHAS. ALFRED CASE.

18, Lansdown Road, Sundridge Park, Bromley, 3rd May, 1911.

THE MEASUREMENT OF DEW.

My attention has been called to Mr. Bryant's letter in your May number. I am not sure that I understand his questions, but it may help if I state that, besides the meteorological interest, two important problems, one of engineering and the other of terrestrial physics, lie behind the drosometer measurements. For the civil engineer the question of what amount of water might be collected by radiation is an important one, and the measurements go far to answering this for the south of England. We learn that we cannot expect more than 1 or 2 inches of water per annum when the most advantageous conditions are adopted, and so the dew supply is not comparable with rain, which amounts, on the average, to 30 inches.

The other problem, what is the loss of heat by the Earth by radiation, has been prominently in my mind. We have many measurements of the heat received from the sun, but the great problem of the Earth's heat losses is still almost unattacked. The average surface temperature of the Earth remains approximately constant from year to year. It should be possible, therefore, to make a kind of profit and loss account of the heat, and in it the loss by radiation will be a notable item. If we could work at the upper surface of the atmosphere the problem would appear to be easier, but working as we do, at the bottom of the atmosphere, there come in the same difficulties which affect the measurement of the sun's heat supply. It has been suggested that the isothermal layer represents in effect the outside of the Earth. About this we want to know more.

In reference to my note on "The Simple Rain Gauge as a Dew Collector," it had been pointed out to me that rain gauge observers often report that they obtain dew in their gauges. A paper on this subject appeared in your Magazine, March, 1910, page 33, where a list of Dew days for 1905 to 1909 is given. I wanted to show that the simple rain gauge is certainly an inadequate dew collector, and I have given an explanation of the reason in the failure of the simple Howard pattern to collect dew. I think it likely that the more complex instruments are not much more suitable.

Mr. Bryant refers to the fact that a comparison is made between the drosometer and the rain gauge. May I say that the rain gauge was used not so much for the purpose of comparison as for the purpose of indicating whether any rain had fallen? It was not possible to watch during the whole time of exposure of the drosometer, and the rain gauge was employed to keep this watch. It has done this effectively for it has failed to collect dew. If a comparison is required it can easily be made, for at St. Leonards there is an official rain station not far off; and at Roche Court, Fareham, the drosometer was exposed by the side of the official rain gauge kept by Mrs. Rawstorne. In fact the figures for the Roche Court rain gauge are given in Table III.

The publication of my paper attracted the attention of Professor W. H. Pickering, of Harvard College Astronomical Observatory, Mass., U.S.A., who is now staying at Mandeville, Jamaica. He tells me that in Jamaica he has been making measurements of the dew by an instrument of his own design. He estimates the annual dew deposit in Jamaica at 2 centimetres per annum. I have not his permission to give more details of his method, but it seems to me to be a fact of special interest that in Jamaica the dew per annum reaches a quantity 0·8 in. of the same order as the dew in England about 1 inch. It would be interesting to have the results of observations at other parts of the Earth. SIDNEY SKINNER.

South-Western Polytechnic Institution, Chelsea, 4th June, 1912.

THE LATEST SNOW SPOT IN WALES.

In company with Rev. R. P. Dansey I visited the "latest snow spot" on Carnedd Llewelyn on May 8th.* Mr. Dansey had written to me in April expressing the opinion that, owing to the exceptional mildness of the winter, no snow would be found, to which I replied that, to me, would be nothing less than a miracle. On approaching the place we could see a small speck of snow, some 100 yards distant from the gully, leading me to expect that there would be snow to a considerable depth in the latter. The small speck was visited first, and measured only 18 in., by 12 in. and an inch in depth ; it would be all melted by the following day. On entering the gully we found, to my great disappointment and Mr. Dansey's great glee, that it was quite bare of snow. His prophecy and my miracle were both fulfilled. On examining the gully we found that it had not been filled at all during the winter, but had only held some drifted snow at the sides. It would seem that this gully provides a good climatic index, not only by acting as a reservoir for the winter's snow, but by showing whether the past months have been cold or warm. The excess of 3°·0 in mean temperature during the winter of 1911-12 would represent a raising of the snow-line of about 1,000 ft., and the conditions at the gully, which is 3,000 ft. in altitude, would probably coincide approximately with those at 2,000 ft. in an average year.

I was much interested in the rainfall map for April in the last number of the Magazine, especially in regard to the high reading of 25·40 in. at Loan, and the great difference between the east and west of Scotland. I see that you doubt the high figure, but from my own experience I quite believe it. The weather was, for at least a fortnight, probably comparatively warm, moist and misty, with *moderate* wind from the west, these being the precise conditions to produce a high rainfall. With moderate winds the greatest precipitation would be concentrated on the first lee slope, and the fall would decrease greatly towards the east. In Snowdonia the same effect is noticed from similar weather conditions. J. R. GETHIN JONES.

Capel-y-ffin, Llanthony, 28th May, 1912.

* See this Magazine, Vol. **46** (1911), 139, and *British Rainfall*, 1909, p. 46.

IS OUR WINTER BECOMING LESS SEVERE.

TREATING the evidence to hand as reliable, it seems to me the opinion of Mr. W. H. Dines, as expressed in the last number of this Magazine, is sound. For some years past I have called attention through the *English Mechanic* to old records of meteorological phenomena; the great difficulty having been to satisfy oneself that the old chroniclers were free from the vice of exaggeration. I was frequently in the neighbourhood of the Thames off Westminster during the winters of 1890-91 and 1895, and it occurred to me that if the river had never been nearer freezing over than at those times, old reports were unreliable. However, the freezing over below bridges is to me the most amazing part of the old annalists' tales. Just now I am quite unable to follow the suggestion of Mr. W. Vaux Graham in your issue for March, that embanking the river above bridges would neutralise the tendency to freeze below the same. The scour of the stream would doubtless be increased thereby; but would also the *vertical* range of the water as measured from the estuary?

So that *if* old reports are dependable, I think we ought to consent to it our climate *has* assumed a milder character in recent centuries. But it does not speak well for the effect of "education" if misrepresentation and exaggeration are excrescences only of the modern social system. We are regaled from time to time with stories of storm-water four feet (not inches) deep in the London streets. The other day we were privileged to witness a fine partial eclipse of the sun. One usually well-conducted journal informs its readers subsequently there will be no other before June, 1927! As a matter of fact in the interval there will be seven partial solar eclipses, large or small, visible here.

WILLIAM GODDEN.

84, High Road, Willesden, N.W., 22nd April, 1912.

THE WEATHER IN THE SEVENTEENTH CENTURY.

I HAVE read with much interest Mr. Dines's letter on this subject. I did not say that the winter climate of England is as severe as it used to be, but merely that the records of the freezing of the Thames in London, by Evelyn and Pepys, afforded, in my opinion, no evidence of it. There may be other evidence, upon the strength of which I should not venture to oppose my opinion to that of so well-known a meteorological authority as Mr. Dines.

Notwithstanding what Mr. Dines says, I do not think there can be any doubt that Old London Bridge constituted a much greater obstruction to the water-way than does Teddington Weir at the present time. The Bridge consisted of nineteen arches, in one of which in 1582, in another in 1590, in a third in 1701, and in a fourth in 1761, water wheels were fixed, actuating pumps to supply the City with water. Two other arches were closed to throw more water upon the wheels. In addition to this, the waterway was still further

contracted by "starlings" built round the piers for their protection. The wharfingers and lightermen of the time complained of this state of things, and the rather curious defence was made "that the Bridge was originally constructed as to restrain the ebbing of the tide, and preserve the navigation of the river above it; and that if the arches were widened the tide would ebb away so fast that there would be scarcely any navigation above the bridge a little after high water." The effect of the obstruction caused by the bridge would be to create comparatively still water below as well as above. But I need not tell Mr. Dines this. I may, however, point out, for the benefit of those of your readers who may be unfamiliar with questions of this nature, that the name "The Pool," by which the reach of the river between London Bridge and Shadwell has so long been known, sufficiently indicates that this was the case.

That the river between Surbiton and Hampton Court was not frozen in 1891 or 1895 is not remarkable, because the stream there is always, even in summer time, very strong. On January 18th, 1891, I skated from Hampton Court to Halliford, and I have a photograph, taken on that occasion, showing the river completely frozen over between Hampton and Sunbury. Walton Reach was also frozen from bank to bank. Of the conditions in 1895 I have no personal knowledge.

W. VAUX GRAHAM.

5, Queen Anne's Gate, Westminster, May 6th, 1912.

On page 56 of this month's Magazine Mr. W. H. Dines states that the River Thames "could not be crossed without the aid of a thick plank" at Kingston during the great frost of 1895. This is incorrect. On Sunday, February 10th, 1895, my sister and I walked across the frozen river without any support whatever. We started from the iron foundry at the beginning of the High Street. I may also mention that in November, 1894, we punted up the High Street during the great flood.

C. PRICE.

The Avenue, Elmers, Surbiton, April 22nd, 1912.

COLOURED RAIN.

I have been looking through the papers to see if there was any notice of "coloured" rain on the night of Sunday, May 12th. On Monday morning my gardener called my attention to a deposit on the glass in the greenhouses, very much like that we noticed in January, 1902, and February, 1903, and I should be glad to know if it has been noticed in other places.

We had some thunder and lightning about 7 p.m. on Sunday, and on Monday morning I recorded ·09 in. of rain; with no rain on the three previous days and none on the following day.

LEWIS C. FOSTER.

Trevillis, Liskeard, 16th May, 1912.

ROYAL METEOROLOGICAL SOCIETY.

THE second meeting of this Society out of London was held on the invitation of the Mayor and Corporation at Southport, on Monday, May 13th. The Fellows who attended the meeting greatly appreciated the arrangements which had been made by the Corporation for their comfort and entertainment.

On the previous Saturday evening Mr. W. Marriott gave a popular lantern lecture, entitled "A Chat about the Weather," at the Temperance Institute. The Mayor, who presided, extended a very warm welcome to the Fellows of the Society in connection with their visit to Southport. He said that it was felt that the visit from such a Society, which had so seldom held its meetings anywhere but in London, was a compliment to the town, and the people of Southport highly appreciated it.

On Monday morning the Fellows assembled at the Town Hall at 11 o'clock, and were received by the Deputy Mayor. They then proceeded in wagonettes along the promenade, the marine drive and some of the principal streets to the Anemograph Station at Marshside. Here they had an opportunity of seeing the Dines pressure-tube anemometers and the Baxendell Anemoscope at work. The head of the latter is 62 feet above the ground and 80 feet above sea level. The exposure is very open, as the district is an extensive reclaimed marsh adjoining the beach.

On their return to the Town Hall the Fellows and some members of the Corporation were entertained at lunch by the Mayor, who was unfortunately not able to be present, but his place was taken by the Deputy Mayor. At the conclusion of the repast the President asked the Deputy Mayor to convey the cordial thanks of the Fellows to the Mayor for his hospitable entertainment.

A visit was then paid to the Fernley Observatory in Hesketh Park. Here a demonstration was given by Mr. J. S. Dines of the method of filling and sending up a *ballon-sonde* with meteorograph attached for ascertaining the temperature in the upper atmosphere. The balloon could be followed by the naked eye until it had reached an altitude of about two miles in fifteen minutes. Observations of the track of the balloon were made by means of a theodolite. The visitors fully appreciated the great care bestowed upon the various instruments and the remarkably clear and valuable records obtained from them.

A meeting of the Society was subsequently held in the Science and Art School, Dr. H. N. Dickson, President, in the chair. Mr. W. Marriott read a paper on the "Results of Hourly Wind and Rainfall Records at Southport, 1902-1911," which was based upon data supplied by Mr. J. Baxendell, the Borough Meteorologist. When the hourly results were grouped according to summer and winter seasons a great contrast in the figures is at once apparent. A most marked diurnal variation in the direction of the wind is shown in the

summer—which is due to an extreme local development of those coastal phenomena, popularly called "land and sea breezes," that is, winds blowing off the land to the sea during the night and early morning, and off the sea to the land during the late morning and afternoon. The maximum frequency of easterly winds occurs about 4 a.m., and of south-easterly winds about 5 a.m. Westerly breezes are most frequent from noon to 1 p.m., and north-westerly ones from 3 to 4 p.m. Each of the two groups of winds is nearly twice as frequent at its hour of maximum as at its time of minimum. In winter there is comparatively little diurnal variation in the duration of the wind. The wind attains its greatest diurnal velocity from 1 to 3 p.m., and its least velocity from 11 p.m. to 3 a.m. The hourly values of the amount of rainfall for the year show a diurnal variation, the maximum occurring from 4 to 5 a.m., and the minimum from 10 a.m. to noon. There is also a secondary maximum at 3 p.m., and a secondary minimum at 9 p.m. The values of the average duration of rainfall in hours also show a well-marked diurnal variation. There is an early morning maximum from 4 to 7 a.m., and a midday minimum from 10 a.m. to 1 p.m.

Mr. J. S. Dines read a paper on "Some long period fluctuations in the Trade Winds of the Atlantic." He had discussed the hourly wind observations at St. Helena from 1892 to 1910, and finds that they tend to confirm the hypothesis of a long period oscillation. He has further discussed data dealing with the Trade Winds at San Juan, Porto Rico, and finds that there is a certain similarity in the changes at the two stations, a backing of one wind being accompanied by a veering of the other, while the St. Helena curve seems to be about one year in advance of the San Juan. There thus appears to be a distinct suggestion that the two variations are connected.

An interesting discussion followed the reading of these papers, in which Colonel H. E. Rawson, Mr. R. G. K. Lempfert, Mr. J. A. Curtis, Mr. R. Inwards, and others took part.

In the evening the Fellows and their friends dined together at the Prince of Wales Hotel.

The ordinary meeting of the Society was held at the Society's Rooms, 70, Victoria Street, Westminster, on Wednesday afternoon, May 22nd, Dr. H. N. Dickson, President, in the chair.

Mr. C. J. P. Cave read a paper on "The Thunderstorm of March 11th, 1912, in Hampshire and Sussex." The storm was not of the line-squall type, but was of the type of summer thunderstorms with very little movement, and besides being severe it appeared to be very local. As the result of information supplied by 132 observers, Mr. Cave has been able to investigate the storm thoroughly. Thunderstorms appear to have occurred in five patches, viz.: (1) a small patch near Alresford; (2) an area stretching from Privett in Hampshire nearly to Fernhurst in Sussex, with its centre near Liss; (3) an

area north-east of Haslemere; (4) a small patch north of Chilgrove; and (5) a patch near West Grinstead. The thunder of the Alresford storm was heard at a distance of over 18 miles. Heavy rain occurred, especially in the Liss storm; nearly an inch and a half fell at Durford Farm, between Rogate and Petersfield, and at Bordon Wood, north of Chithurst. Hail also occurred at several places. One of the peculiarities of the storm was the intense darkness that occurred near the centre, which was accompanied by black rain. This is believed to have been due to soot from London. Mr. Cave concluded by saying: "In a way the storm of March 11th resembled a line-squall; there was a long narrow band of rain, which, however, was split up into separate showers; there seems to have been a considerable difference of temperature between the two sides of the line, and in one case, at Bordon Wood, there was a fall of temperature at the beginning of the storm; it seems probable that the cause of this storm was the flowing of a cold current under a warmer one, as is the case with line-squalls. This storm differed from line-squalls in that it moved very slowly, but I believe there was a slow motion from north to south, at any rate in the neighbourhood of Petersfield. It also differed from the line squall in the important particular of being accompanied by no squall, nor did I see, or have any account of, the peculiar cloud which gives the name to the line-squall.

Mr. E. S. Bruce read a paper on "The Automatic Release of Self-recording Instruments from *Ballons-Sondes*." He pointed out that when a balloon is sent up with a meteorograph attached, it is doubtful whether these will be recovered, for they may not be seen at all, or they may fall into the sea. In order to diminish the chance of the recording instruments being lost, Mr. Bruce has devised a simple apparatus called the "Meteoparachute," which brings down the meteorograph from the balloon at any moment the observer chooses to fix before he sends the balloon up. A demonstration of the working of the arrangement was shown to the meeting.

A discussion followed the reading of these two papers, in which Dr. W. N. Shaw, Mr. W. W. Bryant, the Hon. R. Russell, Mr. E. Gold, Mr. C. Salter, Mr. W. Marriott, Colonel H. E. Rawson, Mr. R. Strachan, Mr. W. B. Tripp, Mr. R. Inwards, Mr. W. Greatheed, and the President took part.

The Hon. Rollo Russell exhibited a large number of very beautiful lantern slides of photomicrographs of snow crystals. These were made by Mr. W. A. Bentley, of Jericho, Vermont, U.S.A., who had been observing snow crystals for many years.

Mr. W. G. FitzGibbon and Mr. P. K. P. Pillay were elected Fellows of the Society.

It has been pointed out by the correspondent who favours us with these reports, that the intimation of the postponement of the discussion on Mr. Skinner's paper on the Drosometer was not made by him.

REVIEWS.

Studies in Terrestrial Magnetism. By C. CHREE, M.A., F.R.S., Sc.D. (Camb.), LL.D. (Aberdeen), Superintendent of Kew Observatory. London, 1912, Macmillan & Co., Ltd. Size 9 × 6. Pp. xii. + 206. Price 5s. net.

THIS is one of the series of Macmillan's Science Monographs, and the author explains in the preface that it does not aim at being a text-book of Terrestrial Magnetism, or as summarizing existing knowledge in those branches of the subject with which it deals, but is intended to give a connected account of his own original work. The book deals with "facts or supposed facts," the author explaining that "the absence of a definite theory as to the origin of the several magnetic changes is due to no lack of curiosity as to the causes of things, but to a belief that at the present stage theorising is less likely to be of substantial advantage than the extension of positive knowledge." This is a position with which we, in common with every student of nature through observation, have much sympathy, though it must be confessed that it does not tend to present known facts in the most attractive guise. Dr. Chree's work is laborious and profound, but it makes no appeal to the general reader or to the skimmer of the cream of science. It is eminently for the student, and even the student must read with his brain as well as his eyes. The concluding chapter on "General Conclusions" may, however, be read profitably even by the scientific amateur. Here, in a few pages, there is much information, and a clearness and moderation of statement that cannot be too highly commended. The summary of our knowledge of the relation of magnetic changes to sunspot frequency is particularly good, and we quote two sentences which might be written in letters of gold for the edification of all who deal in cycles as prophetic adjuncts :—

"The existence of a relation between sunspots and Terrestrial Magnetism is widely known, but its character is usually misunderstood. The only parallelism that may be regarded as fully established is that between the mean sunspot frequency of the year or season—not of the individual day—and the range of the corresponding diurnal inequality of the magnetic elements."

Are there Equinoctial Storms? Development of the Marine Barometer in American Waters. By JOHN H. MORRISON. New York [not dated], W. F. Sametz & Co. Size 7 × 5. Pp. 30.

THE writer has charted the precipitation at New York for 21 days centred on the equinox for 40 years, *i.e.*, on 80 consecutive occasions from 1871 to 1910, and as he found that in the 21 days in March there were 50 per cent. of the days with no rain, and in the 21 days in September 60 per cent. of days having no rain, he answers the question on his title-page with "there **are not.**"

Meteorology. A text-book of the weather, the causes of its changes and weather forecasting for the student and general reader. By WILLIAM ISBISTER MILHAM, Ph.D., Field Memorial Professor of Astronomy in Williams College. New York, 1912, The Macmillan Company. Size 9 × 6. Pp. xviii. + 550, and 40 charts. Price $4.50 net.

WE have had occasion in these pages recently to review, or rather to give hasty and inadequate notices of a good many new works on meteorology. When we opened Professor Milham's volume with a sigh for the size of it, we expected to find it another of one or other of the familiar types. However, it turns out to be quite different. The author is not a literary man, an amateur observer, a professional forecaster, or a distinguished meteorologist. He is an astronomer and a teacher. As the teaching of meteorology was part of his duties, he proceeded in a methodical and scientific manner to read up the subject, and to select and classify in orderly form the resulting material in a series of lectures for his students. These lectures he has now reduced to book form, and we find the result admirable. The chief characteristics are the systematic arrangement, the able marshalling of facts, and the concise expression of theories. The book is frankly American, that is to say, the examples dealt with are examples of American climate and weather; the only meteorological organization described is the U.S. Weather Bureau, the references to the meteorological services of other countries being little more than the statement that such exist.

We commend the courage of Professor Milham in distinguishing, after the manner of Baedeker's Guides, the titles of certain works in his bibliographies by one or two stars; these are not, however, quite so invidious as might appear, for the one star is given to the hundred best books, and the two stars to the twenty-five best books. Mr. Inwards in the department of "Weather Prediction, including Weather Proverbs and Prognostics," is decorated with two stars for his "Weather Lore," certainly the best depository of proverbs and prognostics, and Dr. W. N. Shaw gets one star for his "Forecasting Weather, 1911;" but, in another list, "William H. Shaw" gets none for the "Life History of Surface Air Currents." Of course, the author had not had time to study the more recent works in his bibliography, especially those like Dr. Shaw's "Forecasting Weather," which were still unpublished when the preface of Dr. Milham's work was signed in July, 1911, and of the originality and value of which he could have had no idea. We adopt no lofty station in commenting on the matter of assigning merit to books which have not been fully mastered, for what reviewer can read all on which he professes to pass judgment? And we ourselves are willing to decorate Professor Milham's work with a small constellation, from the examination of his plan, and the perusal of a few pages here and there which treat of matters coming within our own competence. We consider that his book should be in the library of every student of meteorology who desires to understand what he reads.

RAINFALL TABLE FOR MAY, 1912.

STATION.	COUNTY.	Lat. N.	Long. W. [*E.]	Height above Sea.	RAINFALL OF MONTH.	
					Aver. 1875—1909.	1912.
		° ′	° ′	ft.	in.	in.
Camden Square	*London*	51 32	0 8	111	1·75	1·08
Tenterden	*Kent*	51 4	*0 41	190	1·65	·47
Arundel (Patching)	*Sussex*	50 51	0 27	130	1·80	1·51
Fawley (Cadland)	*Hampshire*	50 50	1 22	52	1·96	1·27
Oxford (Magdalen College)	*Oxfordshire*	51 45	1 15	186	1·81	2·07
Wellingborough (Croyland Abbey)	*Northampton*	52 18	0 41	174	1·99	1·57
Shoeburyness	*Essex*	51 31	*0 48	13	1·27	·55
Bury St. Edmunds (Westley)	*Suffolk*	52 15	*0 40	226	1·93	1·22
Geldeston [Beccles]	*Norfolk*	52 27	*1 31	38	1·78	·58
Polapit Tamar [Launceston]	*Devon*	50 40	4 22	315	2·08	1·65
Rousdon [Lyme Regis]	,,	50 41	3 0	516	2·02	2·10
Stroud (Upfield)	*Gloucestershire*	51 44	2 13	226	2·10	1·66
Church Stretton (Wolstaston)	*Shropshire*	52 35	2 48	800	2·64	2·79
Coventry (Kingswood)	*Warwickshire*	52 24	1 30	340	2·15	3·69
Boston	*Lincolnshire*	52 58	0 1	25	1·80	2·42
Worksop (Hodsock Priory)	*Nottinghamshire*	53 22	1 5	56	2·08	3·28
Macclesfield	*Cheshire*	53 15	2 7	501	2·43	2·41
Southport (Hesketh Park)	*Lancashire*	53 38	2 59	38	2·13	2·22
Arncliffe Vicarage	*Yorkshire, W.R.*	54 8	2 6	732	3·55	3·81
Wetherby (Ribston Hall)	,, ,,	53 59	1 24	130	2·09	3·40
Hull (Pearson Park)	,, *E.R.*	53 45	0 20	6	1·98	2·99
Newcastle (Town Moor)	*Northumberland*	54 59	1 38	201	2·04	2·72
Borrowdale (Seathwaite)	*Cumberland*	54 30	3 10	423	7·50	5·02
Cardiff (Ely)	*Glamorgan*	51 29	3 13	53	2·56	1·86
Haverfordwest	*Pembroke*	51 48	4 58	95	2·62	1·32
Aberystwyth (Gogerddan)	*Cardigan*	52 26	4 1	83	2·63	1·32
Llandudno	*Carnarvon*	53 20	3 50	72	1·86	1·58
Cargen [Dumfries]	*Kirkcudbright*	55 2	3 37	80	2·87	2·10
Marchmont House	*Berwick*	55 44	2 24	498	2·53	1·64
Girvan (Pinmore)	*Ayr*	55 10	4 49	207	2·98	1·60
Glasgow (Queen's Park)	*Renfrew*	55 53	4 18	144	2·40	1·10
Inveraray (Newtown)	*Argyll*	56 14	5 4	17	3·53	3·47
Mull (Quinish)	,,	56 34	6 13	35	2·99	2·81
Dundee (Eastern Necropolis)	*Forfar*	56 28	2 57	199	2·05	1·52
Braemar	*Aberdeen*	57 0	3 24	1114	2·33	1·23
Aberdeen (Cranford)	,,	57 8	2 7	120	2·40	1·98
Cawdor	*Nairn*	57 31	3 57	250	2·07	2·16
Fort Augustus (S. Benedict's)	*E. Inverness*	57 9	4 41	68	2·36	1·78
Loch Torridon (Bendamph)	*W. Ross*	57 32	5 32	20	4·54	3·33
Dunrobin Castle	*Sutherland*	57 59	3 56	14	2·19	1·99
Wick	*Caithness*	58 26	3 6	77	2·04	3·51
Killarney (District Asylum)	*Kerry*	52 4	9 31	178	3·05	1·55
Waterford (Brook Lodge)	*Waterford*	52 15	7 7	104	2·33	1·25
Nenagh (Castle Lough)	*Tipperary*	52 54	8 24	120	2·51	1·65
Miltown Malbay	*Clare*	52 52	9 26	400	2·57	1·85
Gorey (Courtown House)	*Wexford*	52 40	6 13	80	2·24	1·21
Abbey Leix (Blandsfort)	*Queen's County*	52 56	7 17	532	2·43	1·35
Dublin (Fitz William Square)	*Dublin*	53 21	6 14	54	2·07	1·04
Mullingar (Belvedere)	*Westmeath*	53 29	7 22	367	2·51	1·22
Cong (The Glebe)	*Mayo*	53 33	9 16	112	2·94	2·22
Crossmolina (Enniscoe)	*Mayo*	54 4	9 16	74	3·17	3·13
Collooney (Markree Obsy.)	*Sligo*	54 11	8 27	127	2·80	2·11
Seaforde	*Down*	54 19	5 50	180	2·72	1·68
Bushmills (Dundarave)	*Antrim*	55 12	6 30	162	2·37	1·18
Omagh (Edenfel)	*Tyrone*	54 36	7 18	280	2·66	1·59

RAINFALL TABLE FOR MAY, 1912—*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.	1912. in.	Diff. from Aver. in.	% of Av.	Mean Annual 1875-1909. in.	STATION.
— ·67	62	·28	30	9	8·68	9·75	+1·07	112	25·11	Camden Square
—1·18	28	·12	7	10	9·41	9·66	+ ·25	103	27·64	Tenterden
— ·29	84	·33	7	13	10·33	12·75	+2·42	123	30·48	Patching
— ·69	65	·40	21	10	11·14	12·50	+1·36	112	31·87	Cadland
+ ·26	114	·76	21	13	8·33	11·25	+2·92	135	24·58	Oxford
— ·42	79	·56	21	10	9·04	8·84	— ·20	98	25·17	Croyland Abbey
— ·72	43	·16	15	10	6·23	6·43	+ ·20	103	19·28	Shoeburyness
— ·71	63	·26	22	14	8·55	8·44	— ·11	99	25·40	Westley
—1·20	33	·17	15	12	7·84	6·72	—1·14	86	23·73	Geldeston
— ·43	79	·57	21	17	13·70	16·38	+2·68	119	38·27	Polapit Tamar
+ ·08	104	·74	21	10	12·15	15·55	+3·40	128	33·54	Rousdon
— ·44	79	·27	31	13	10·65	13·54	+2·89	127	29·81	Stroud
+ ·15	106	·81	22	14	11·71	13·80	+2·09	118	32·41	Wolstaston
+1·54	171	1·07	23	13	10·23	14·24	+4·01	139	28·98	Coventry
+ ·62	134	·91	22	17	7·91	8·30	+ ·39	105	23·35	Boston
+1·20	157	·73	22	14	8·74	10·83	+2·09	124	24·46	Hodsock Priory
— ·02	99	·92	15	16	11·91	11·08	— ·83	93	34·73	Macclesfield
+ ·09	104	·41	20	14	10·70	12·56	+1·86	117	32·70	Southport
+ ·26	107	·88	20	17	23·59	26·44	+2·85	112	61·49	Arncliffe
+1·31	162	1·30	22	11	9·46	13·42	+3·96	142	26·87	Ribston Hall
+1·01	151	·77	22	14	8·99	10·11	+1·12	112	26·42	Hull
+ ·68	133	·79	20	16	9·51	10·35	+ ·84	109	27·94	Newcastle
—2·48	67	1·17	2	17	49·44	49·16	— ·28	99	129·48	Seathwaite
— ·70	73	·60	21	14	14·67	17·92	+3·25	122	42·28	Cardiff
—1·30	50	·29	7	14	16·71	20·19	+3·48	121	46·81	Haverfordwest
—1·31	50	·22	21, 31	14	15·15	16·59	+1·44	109	45·46	Gogerddan
— ·28	85	·46	31	14	10·40	9·38	—1·02	90	30·36	Llandudno
— ·77	73	·60	20	22	16·22	17·07	+ ·85	105	43·47	Cargen
— ·89	65	·63	15	8	12·00	9·68	—2·32	81	33·76	Marchmont
—1·38	54	·31	1	17	18·06	20·34	+2·28	113	49·77	Girvan
—1·30	46	·50	8	11	13·10	11·46	—1·64	88	35·97	Glasgow
— ·06	98	·76	8	18	25·68	27·27	+1·59	106	68·67	Inveraray
— ·18	94	·46	8	16	20·25	18·39	—1·86	91	56·57	Quinish
— ·53	74	·75	15	10	9·96	8·64	—1·32	87	28·64	Dundee
—1·10	53	...	...	...	12·97	13·38	+ ·41	103	34·93	Braemar
— ·42	82	·90	15	15	12·00	11·65	— ·35	97	32·73	Aberdeen
+ ·09	104	·71	15	13	10·38	7·48	—2·90	72	29·33	Cawdor
— ·58	76	·44	8	20	18·15	15·17	—2·98	84	44·53	Fort Augustus
—1·21	73	·63	10	16	33·48	30·53	—2·95	91	83·93	Bendamph
— ·20	91	·61	15	11	12·18	10·95	—1·23	90	31·90	Dunrobin Castle
+1·47	172	1·63	15	20	10·88	12·72	+1·84	117	29·88	Wick
—1·50	51	·59	19	20	21·95	21·79	— ·16	99	54·81	Killarney
—1·08	54	·37	19	9	14·61	16·97	+2·36	116	39·57	Waterford
— ·86	66	·60	19	10	14·81	14·24	— ·57	96	39·43	Castle Lough
— ·72	72	·34	19	18	15·59	16·79	+1·20	108	45·11	Miltown Malbay
—1·03	54	·35	1	9	12·83	17·88	+5·05	139	34·99	Courtown Ho.
—1·08	54	·40	19	15	13·26	13·35	+ ·09	101	35·92	Abbey Leix
—1·03	50	·30	19	19	10·15	11·16	+1·01	110	27·68	Dublin
—1·29	49	·21	5	16	13·29	15·00	+1·71	113	36·15	Mullingar
— ·72	75	·44	6	17	18·23	16·65	—1·58	91	48·90	Cong
— ·04	99	1·07	30	16	20·21	18·91	—1·30	94	52·87	Enniscoe
— ·69	75	·32	16	16	15·72	16·55	+ ·83	105	42·71	Markree
—1·04	62	·51	20	14	14·54	18·39	+3·85	126	38·91	Seaforde
—1·19	50	·24	1	15	12·93	12·98	+ ·05	100	37·56	Dundarave
—1·07	60	·40	1	15	14·28	15·09	+ ·81	106	39·38	Omagh

SUPPLEMENTARY RAINFALL, MAY, 1912.

Div.	STATION.	Rain inches	Div.	STATION.	Rain inches.
II.	Warlingham, Redvers Road..	1·19	XI.	Lligwy	1·02
,,	Ramsgate	1·01	,,	Douglas	...
,,	Hailsham	1·30	XII.	Stoneykirk, Ardwell House...	1·51
,,	Totland Bay, Aston House...	1·23	,,	Dalry, The Old Garroch	2·07
,,	Stockbridge, Ashley..	1·41	,,	Langholm, Drove Road	2.06
,,	Grayshott	1·54	,,	Beattock, Kinnelhead	2·27
,,	Caversham, Rectory Road ...	1·22	XIII.	St. Mary's Loch, Cramilt Ldge	1·32
III.	Harrow Weald, Hill House...	1·23	,,	North Berwick Reservoir	1·44
,,	Pitsford, Sedgebrook	1·56	,,	Edinburgh, Royal Observaty.	1·42
,,	Woburn, Milton Bryant	2·04	XIV.	Maybole, Knockdon Farm ...	·70
,,	Chatteris, The Priory	1·46	XV.	Campbeltown, Witchburn ..	1·82
IV.	Colchester, Lexden	1·23	,,	Holy Loch, Ardnadam	3·07
,,	Newport	1·18	,,	Ballachulish House	3·51
,,	Ipswich, Copdock	·65	,,	Islay, Eallabus	1·65
,,	Blakeney	1·66	,,	Tirie, Cornaigmore	2.31
,,	Swaffham	1·98	XVI.	Dollar Academy	1·90
V.	Bishops Cannings	1·60	,,	Balquhidder, Stronvar	2·58
,,	Winterbourne Steepleton	2·06	,,	Coupar Angus	1·58
,,	Ashburton, Druid House	2·16	,,	Glenlyon, Meggernie Castle..	1·96
,,	Cullompton	2·20	,,	Blair Athol	1·71
,,	Lynmouth, Rock House	1·18	,,	Montrose, Sunnyside Asylum.	·64
,,	Okehampton, Oaklands... ...	2·13	XVII.	Alford, Lynturk Manse	2·54
,,	Hartland Abbey	·81	,,	Fyvie Castle	3·46
,,	Probus, Lamellyn	1·94	,,	Keith Station ..	4·44
,,	North Cadbury Rectory	1·66	XVIII.	Skye, Dunvegan	4·36
VI.	Clifton, Pembroke Road	2·51	,,	N. Uist, Lochmaddy	2·62
,,	Ross, The Graig	3·20	,,	Glenquoich, Loan	6·10
,,	Shifnal, Hatton Grange	2·71	,,	Alvey Manse	2·26
,,	Droitwich	3·07	,,	Loch Ness, Drumnadrochit...	1·35
,,	Blockley, Upton Wold	3·23	,,	Glencarron Lodge	4·19
VII.	Market Overton	2·81	XIX.	Invershin	2·87
,,	Market Rasen	2·32	,,	Loch Stack, Ardchullin	2·83
,,	Bawtry, Hesley Hall	3·01	,,	Melvich	2·82
,,	Derby, Midland Railway	2·56	XX.	Skibbereen Rectory	2·67
,,	Buxton	3·16	,,	Dunmanway, The Rectory ..	1·94
VIII.	Nantwich, Dorfold Hall	2·44	,,	Glanmire, Lota Lodge	1·69
,,	Chatburn, Middlewood	2·37	,,	Mitchelstown Castle	1·60
,,	Cartmel, Flookburgh	2·33	,,	Darrynane Abbey	2·54
IX.	Langsett Moor, Up. Midhope	3·56	,,	Clonmel, Bruce Villa	1·60
,,	Scarborough, Scalby	3·60	,,	Newmarket-on-Fergus, Fenloe	1·85
,,	Ingleby Greenhow	2·07	XXI.	Laragh, Glendalough	1·61
,,	Mickleton	2·38	,,	Ballycumber, Moorock Lodge	1·26
X.	Bellingham, High Green Manor	2·36	,,	Balbriggan, Ardgillan	1·01
,,	Ilderton, Lilburn Cottage ...	1·83	XXII.	Woodlawn	1·30
,,	Keswick, The Bank	1·89	,,	Westport, St. Helens	3·05
XI.	Llanfrechfa Grange	2.71	,,	Achill Island, Dugort	...
,,	Treherbert, Tyn-y-waun	2·65	,,	Mohill, The Rectory	1·43
,,	Carmarthen, The Friary	1·16	XXIII.	Enniskillen, Portora	2·10
,,	Castle Malgwyn [Llechryd]...	·84	,,	Dartrey [Cootehill]	2·00
,,	Crickhowell, Tal-y-maes	3·10	,,	Warrenpoint, Manor House ..	1·39
,,	New Radnor, Ednol	2·76	,,	Banbridge, Milltown	1·28
,,	Rhayader, Tyrmynydd	1·74	,,	Belfast, Cave Hill Road	1·58
,,	Lake Vyrnwy	2·11	,,	Glenarm Castle	1·76
,,	Llangyhanfal, Plâs Draw	2·10	,,	Londonderry, Creggan Res...	1·53
,,	Dolgelly, Bryntirion	1·95	,,	Killybegs	2·08
,,	Bettws-y-Coed, Tyn-y-bryn...	1·64	,,	Horn Head	1·36

METEOROLOGICAL NOTES ON MAY, 1912.

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.—Though less sunny than April, May was nevertheless a fine month generally, with a deficient R. A partial drought of 41 days with ·41 in. of R ended on 11th. The long succession of warm months was further added to, this being the thirteenth month with mean temp. above the average. Duration of sunshine 163·3* hours, and of R 25·8 hours. Mean temp. 57°·8, or 3°·8 above the average. Evaporation 2·44 in. Shade max. 81°·2 on 11th; min. 38°·5 on 25th. F 0, f 0.

TENTERDEN.—Another dry month, though R fell in small quantities nearly every other day in first half. A partial drought of 69 days with ·63 in. of R extended from March 24th to May 31st. Duration of sunshine 218·0† hours. Shade max. 72°·0 on 11th; min. 36°·0 on 25th and 26th. F 0, f 3.

TOTLAND BAY.—Duration of sunshine 198·0* hours. Shade max. 68°·8 on 29th, min. 39°·0 on 1st. F 0, f 1.

MILTON BRYANT.—Very beneficial R but rapid evaporation owing to hot sun. Shade max. 76°·0 on 29th; min. 30°·0 on 1st. F 1.

IPSWICH, COPDOCK.—A dull month with deficient sunshine and deficient R. Duration of sunshine 178·9† hours. Mean temp. 55°·5. Shade max. 81°·4 on 11th; min. 38°·0 on 24th. F 0, f 5.

POLAPIT TAMAR.—Rather dry on the whole but otherwise seasonable. Shade max. 72°·2 on 10th; min. 32°·8 on 26th. F 0, f 3.

NORTH CADBURY.—Warm days, there being only two maxima below 60° and 14 reaching 70° or above. Shade max 77°·0 on 10th; min. 36°·0 on 1st. F 0, f 2.

ROSS.—Fine month except for heavy TSS on 21st and 22nd, when the town was flooded. Shade max. 71°·6 on 10th; min. 32°·0 on 1st. F 1, f 1.

HODSOCK PRIORY.—Shade max. 74°·8 on 11th; min. 28°·5 on 1st. F 1, f 6.

SOUTHPORT.—Duration of sunshine 178·3* hours or 40 hours below the average. Duration of R 62·4 hours. Evaporation 2·59 in. Mean temp. 52°·0. Shade max. 66°·0 on 11th; min. 37°·0 on 14th F 0, f 6.

HULL.—Duration of sunshine, 118·0* hours. Shade max. 75°·0 on 11th; min. 29°·0 on 1st. F 1, f 4.

HAVERFORDWEST.—Dry and cold generally. Vegetation backward. Duration of sunshine 178·4* hours. Shade max. 67°·6 on 10th; min. 38°·0 on 26th.

BETTWS-Y-COED.—Shade max. 68°·0 on 31st; min. 30°·0 on 1st. F 1.

CARGEN.—Though R fell on 22 days the amounts were below ·10 in. on 15 days. Garden and farm work well forward, but shortage of R in April and May very appreciable. Shade max. 68°·0 on 30th; min. 34°·5 on 14th. F 0.

EDINBURGH.—Shade max. 64°·8 on 8th; min. 37°·8 on 5th. F 0, f 1.

MEGGERNIE CASTLE.—A dry month and colder than usual, with N. and E. winds from the 9th to the end. Frost did damage to potatoes, and growth of everything is very slow.

FORT AUGUSTUS.—Shade max. 65°·0 on 8th; min. 31°·0 on 13th. F 1.

LOCH STACK.—Duration of sunshine, 158·7* hours.

WATERFORD.—The driest May since 1897. Shade max. 69°·5 on 28th; min. 35°·0 on 24th. F 0.

DUBLIN.—Mean temp. 53°·9, or 1°·7 above the average. Vapour fog on morning of 10th. Shade max. 68°·9 on 11th.; min. 38°·9 on 13th. F 0, f 0.

MARKREE.—Fair generally with rather low temp. Frost recorded towards end of month. Some H showers. Shade max. 65°·0 on 9th and 27th; min. 29°·0 on 25th. F 2, f 8.

WARRENPOINT.—A dry, warm and calm month, with E. winds prevailing. Shade max. 64°·0 on 11th and 30th; min. 39°·0 on 23rd. F 0, f 0.

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* Campbell-Stokes † Jordan.

Climatological Table for the British Empire, December, 1911.

STATIONS (*Those in italics are South of the Equator.*)	Absolute. Maximum. Temp.	Date.	Absolute. Minimum. Temp.	Date.	Average. Max.	Min.	Dew Point.	Humidity.	Absolute. Max. in Sun.	Min. on Grass.	Total Rain Depth.	Days.	Aver. Cloud.
	°		°		°	°	°	0-100	°	°	inches		
London, Camden Square	55·2	19	27·6	8	49·3	39·5	42·2	90	67·7	26·0	4·22	23	8·4
Lagos	88·0	sev.	69·0	24	87·0	72·7	71·8	77	149·0	67·0	3·69	3	...
Cape Town	85·2	6	50·7	22	75·5	58·1	58·4	75	...	...	1·39	9	4·0
Durban, Natal ...	94·2	21	59·8	3	81·5	68·3	...	...	152·5	...	3·54	20	7·2
Johannesburg	89·7	22	49·0	9	80·8	58·2	55·1	65	153·7	50·1	2·34	14	3·6
Bloemfontein	98·2	20	53·8	22	91·4	60·2	49·7	40	...	...	·31	2	2·3
Calcutta...	80·0	18	48·5	23	76·7	53·8	51·6	64	...	41·7	·00	0	2·4
Bombay...	91·0	14	70·1	20	87·7	73·6	67·9	67	134·2	62·4	·00	0	2·6
Madras	86·4	1	64·4	31	82·7	71·8	70·5	83	137·6	61·3	6·37	11	5·7
Kodaikanal	65·3	18*	45·2	28	60·5	50·0	48·4	81	127·0	35·2	6·49	20	7·0
Colombo, Ceylon ...	87·9	4	71·9	22	85·3	74·3	72·2	79	156·8	65·3	6·96	18	6·4
Hongkong	75·1	19	53·0	29	68·5	60·5	57·4	77	127·2	...	·10	5	6·6
Sydney	100·9	11	57·1	18	81·8	64·4	53·1	52	158·6	45·7	2·94	12	4·8
Melbourne	86·6	7	42·8	6	72·7	54·4	48·5	58	145·6	39·0	3·67	14	6·8
Adelaide	101·3	24	46·0	17	79·0	57·5	51·7	56	156·6	35·5	1·46	9	4·0
Perth	95·7	22	50·6	14	77·2	58·5	55·4	65	148·3	44·1	·42	7	3·0
Coolgardie	105·2	22	50·5	5	91·6	59·0	50·3	42	174·0	...	·05	3	1·6
Hobart, Tasmania ...	75·0	25	39·2	15	64·9	49·5	44·2	62	142·1	33·1	3·04	21	7·4
Wellington	73·0	24	45·8	16	63·3	51·5	46·7	67	124·0	34·0	4·50	21	6·7
Auckland	74·0	12	48·5	20	66·1	53·5	53·5	82	142·0	45·0	5·06	23	6·6
Jamaica, Kingston ..	91·8	18	65·5	12	87·6	70·0	69·3	78	...	...	1·11	3	4·2
Grenada	86·0	1, 26	71·0	29	82·0	74·0	...	78	141·0	...	5·64	20	4·0
Toronto	54·6	10	9·2	4	39·4	28·5	...	...	62·8	1·8	2·85	19	...
Fredericton	56·0	12	—2·0	31	31·5	16·9	...	87	...	...	2·03	7	6·5
St. John, N.B. ...	52·0	11	3·0	31	35·0	23·4	...	...	...	...	2·95	10	6·0
Edmonton, Alta. ...	50·7	2	—30·0	31	26·3	8·8	...	78	90·1	—35·8	·27	8	6·6
Victoria, B.C.	50·2	22	30·0	26	44·9	37·8	...	88	...	...	2·80	21	8·0

* and 29.

Johannesburg.—Bright sunshine, 296·4 hours. Absolute max. temp. the highest ever recorded here.

Bloemfontein.—Hot and dry, the whole country suffering from drought.

KODAIKANAL.—Bright sunshine, 139 hours.

COLOMBO.—Mean temp. of air 79°·8 or 0°·8 above, of dew point 1°·3 above, and R 1·69 in. above, averages. Mean hourly velocity of wind 6·7 miles. TS on 7 days.

HONGKONG.—Mean temp. of air 64°·3, or 1°·6 above, R 1·08 in. below, averages. Bright sunshine 133·9 hours or 45 hours below average.

Sydney.—Mean temp. of air 3°·0 above, and R ·34 in. above, averages.

Melbourne.—Mean temp. of air 0°·9 below, and R 1·41 in. above, averages.

Adelaide.—Mean temp. of air 2°·8, below, and R ·62 in. above, averages.

Hobart, Tasmania.—Temp. 2°·7 below, and R about 1°·00 above, averages.

Wellington.—Mean temp. 3°·0 below, R 1·20 in. above averages. Bright sunshine 233·6 hours.

Auckland.—Mean temp. below average, R nearly twice the average, and heavy gales on 4 days.

EDMONTON, ALTA.—Dry and cold, S on 12 days, fog on 4 days, aurora on 2 nights.