

# SYMONS'S METEOROLOGICAL MAGAZINE.

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## Sir Cuthbert Peek.

1855-1901.

By the death of Sir Cuthbert Peek, Bart., on July 6th, at the age of 46 years, the science of Meteorology has lost a patron and student. Sir Cuthbert will be remembered on account of his establishment, in 1886, of a completely equipped astronomical and meteorological observatory at Rousdon, in Devon, from which an annual report of considerable value has ever since been regularly issued. He was, at the time of his death, a member of the Council of the Royal Meteorological Society, and he had been an observer for the British Rainfall Organization for eighteen years. These services to meteorology are deserving of recognition, and remind us once more of the worthy tradition of British science, that men of wealth and leisure should co-operate on equal terms with the specialist and the humbler amateur in advancing knowledge.

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## ON A FALLACY AS TO THE DIURNAL BAROMETER WAVE.

By W. H. DINES, B.A.,

*President of the Royal Meteorological Society.*

THE paper of Mr. Helm Clayton recently read at the Royal Meteorological Society has suggested yet another cause for the puzzling phenomenon of the double daily oscillation of the barometer, and although there seem to be many difficulties in the way of accepting the theory put forward by Mr. Clayton, the idea is decidedly a hopeful one.

Under these circumstances it may be well to call attention to the fallacy of one of the explanations given in sundry books on Meteorology. If a barometer were placed in a sealed vessel, a steam boiler for instance, the changes in level of the mercury would exactly follow the changes in the temperature of the air inside, the percentage changes in the height being exactly equal to the percentage changes in the absolute temperature, i.e., in the temperature

measured from about  $-460^{\circ}\text{F}$ . If there were a large opening in the boiler we know that warming the air would not alter the barometric height, corrected of course for temperature. If there were a very small hole, warming would raise the mercury level, and it would continue above its proper value until some of the air had had time to escape, a time that might be considerable if the hole were very small.

The fallacy to which I refer lies in assuming that the inertia of the air can act like a containing vessel with a small hole in it. The inertia of the air does act like a containing vessel, but it is like one with a large and not with a small hole.

Supposing a sudden change of temperature to have occurred in the lower layers of air, or a sudden increase of vapour tension, the result would be not a rise of the barometer lasting for hours or even minutes, but an oscillation with an extremely small period. On the supposition that the air above the warmed strata is rigid throughout the time that would elapse before the barometer fell back to its previous level is easily calculated. It is independent of the magnitude of the supposed change of temperature, and under the most favorable circumstances could not amount to 30 seconds. The air, however, is not rigid but elastic, and this greatly reduces the time.

Anyone unwilling to accept the result of a mathematical calculation may perhaps convince himself of this by experimenting with a column of water 34 ft. long, or even with the mercury column of the barometer itself. The inertia of the superincumbent air is exactly equal to the inertia of the mercury column, the only difference being that if an increased pressure moves both the mercury column and the upper layers of air, the air has farther to go; and if it were possible for the inertia of the air to cause an increase of pressure to last for hours, the inertia of the mercury column would prevent the barometer from registering the change.

For calm air the barometer gives a perfectly exact measure of the mass of air above it, and no theory of the daily oscillation is tenable that runs counter to this fact.

Warmth reduces the height of the barometer provided there is time for the upper part of the warmed column to roll off, but could a space be enclosed by a wall reaching to the upper limit of the air, no variations of temperature in the enclosed space could effect the barometer in the slightest degree.

A mathematical statement of this question may be added for the convenience of anyone who wishes to go into the matter more fully.

Consider some air confined in a vertical tube of cross section  $A$ , and compressed by a piston of the same weight as that of the upper layers of the atmosphere. Let the pressure of the confined air be  $p$ , then the weight of the piston must be  $Ap$ .

Now suppose a sudden but small change of pressure; it is required to find the time that will elapse before the pressure regains the value  $p$ .

Let  $h$  be the height of the column of air in the case of equilibrium, i.e., when  $p$  is the pressure,  $h+x$  the height, and  $P$  the corresponding pressure at any other time.

We have (Case I. for isothermal expansion)  $\frac{P}{p} = \frac{h}{h+x} \dots (a)$

(Case II. for adiabatic expansion)  $\frac{P}{p} = \left(\frac{h}{h+x}\right)^{1.408}$

Confining our attention to Case I. we have  
force moving piston =  $AP$  - weight of piston =  $A(P-p)$ .

From (a)  $P-p = -p \frac{x}{h+x} = -p \frac{x}{h}$  if we neglect the square and higher powers of  $\frac{x}{h}$

The mass of the piston is  $\frac{Ap}{g}$

Hence  $\frac{Ap}{g} \cdot \frac{d^2x}{dt^2} = -A \frac{px}{h}$

or  $\frac{d^2x}{dt^2} + \frac{g}{h} x = 0$ .

This being the case of harmonic motion, the period is  $2\pi\sqrt{\frac{h}{g}}$  and the time we require is  $\frac{1}{4}$  of this; namely,  $\frac{\pi}{2}\sqrt{\frac{h}{g}}$

For adiabatic expansion the time is  $\frac{\pi}{2}\sqrt{\frac{h}{g \times 1.408}}$

It follows that the time is independent of the actual change of pressure, provided only that this be small compared with the original pressure, and also that it varies as the square root of the height of the atmosphere in which the pressure is changed.

Supposing the temperature of the first half mile of air were suddenly changed, we have  $h=2640$  ft. (since  $g$  is expressed in ft.  $h$  must be also in ft.).

This gives a time of  $\frac{\pi}{2}\sqrt{\frac{2640}{32}} = 14$  seconds about.

For adiabatic expansion the time is 20 % less.

The question is one that admits of a more rigorous solution. (See *Besant's Hydromechanics*, p. 253, 3rd Edition.) The actual period of the barometric oscillations must be about that required for the passage of a sound wave of a length not greater than  $2h$ , and could hardly exceed a few seconds.

## UNPRECEDENTED HEAT IN NEW YORK.

THE heat-wave which overspread a considerable part of the United States from June 28th to July 4th appears from the reports in the daily Press to have produced more serious effects in New York than had ever been experienced before. The maxima recorded do not seem to have exceeded  $100^\circ$  in the shade, but the minima were frequently over  $80^\circ$ , so that little difference of temperature was perceptible indoors between day and night. The humidity also was exceptionally high. The asphalt, with which most of the streets in New York are paved, softened with the heat, and the wheels of heavy vehicles ploughed deep ruts in the roadway. Outdoor work was practically suspended, and it is stated that even the excitement of financial operations proved an inefficient spur to exhausted human

nature, and the Stock Exchanges both in New York and Boston were closed from July 3rd to 8th. It is said that 150,000 people had abandoned New York City, and special permission had been given to open the public parks at night for people to sleep in whose dwellings are uninhabitable on account of the heat. The hospitals were filled to overflowing with cases of heat prostration, and the deaths in the street have been so numerous that many bodies have had to be buried without identification. The *Times* correspondent, telegraphing on July 4th, says that the deaths from heat in Greater New York alone for seven days are estimated variously at from 619 to 740. Another newspaper states that over a thousand horses have dropped dead.

One of the most remarkable features of the heat-wave is a forecast stated to emanate from the Weather Bureau that there was no hope of any improvement in the weather for a month, but this, if issued, was fortunately falsified by the facts.

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#### ROYAL METEOROLOGICAL SOCIETY.

THE last meeting of the session was held on Wednesday afternoon, June 19th, at the Society's rooms, 70, Victoria Street, Westminster, Mr. W. H. Dines, B.A., President, in the chair.

Mr. J. H. H. Harrison, Mr. H. D. Jassooobhoy, and Dr. R. L. Jones were elected Fellows.

The President stated that the Symons Memorial Fund (see *ante* p. 73) had been transferred to the Society, and that the Council had that day accepted the trust.

A paper by Mr. H. Helm Clayton, of the Blue Hill Observatory, Mass., U.S.A., on "The Eclipse Cyclone, the Diurnal Cyclones, and the Cyclones and Anticyclones of Temperate Latitudes," was read by the Secretary. The author has discussed the meteorological observations made along the path of the total solar eclipse in the United States on May 28th, 1900, and also those made during three previous eclipses in various parts of the world. The meteorological changes due to the eclipse were separated from other changes of greater length, such as the diurnal and the cyclonic, by interpolating a uniform change between the beginning and the end of the eclipse and subtracting this from the observations. The author finds that a cyclone follows in the wake of the eclipse—though the changes are very minute and feeble—the fall of temperature developing a cold air cyclone in an astonishingly short time with all the peculiar circulation of winds and distribution of pressure which constitute such a cyclone. In the author's opinion the results show that a fall of temperature of the air does not act primarily to cause an anticyclone but a cyclone, and the anticyclone is a secondary phenomenon or rather a part of the cyclone. He also says that "the eclipse cyclone has suggested a new theory of the diurnal barometric waves, and also suggested explanations of certain phenomena of ordinary cyclones and anticyclones."

The President said that there can be no doubt that the low pressures at the poles are due to the centrifugal force of the westerly winds that blow more or less in all temperate latitudes, and hence we must accept Ferrel's cold centre cyclone as a possible phenomenon. The whole question as put forward in the paper depended on the reality of the cyclonic circulation produced by the eclipse, and if that were accepted as a fact it had a most important bearing on theoretical meteorology. Mr. Clayton's supposition as to the cause of the double barometric daily oscillation was also very suggestive, but there was one awkward fact against it which he seemed to have overlooked. The double oscillation, opposed to the 24 hour period oscillation, was most marked near the Equator, but owing to the absence of the directive tendency due to the Earth's rotation, these regions were exactly those in which a cyclone could not be set up by the daily temperature variation.

Capt. M. W. C. Hepworth mentioned that in the region of the trade winds, the diurnal range of barometric pressure is more accentuated in strong winds, both in rise and fall, than in light winds.

Prof. G. H. Darwin, Dr. R. H. Scott, Mr. J. Hopkinson, Mr. R. H. Curtis, and Capt. A. Carpenter, R.N., also took part in the discussion.

A paper by Mr. F. Napier Denison, of Victoria, British Columbia, on "The Seismograph as a sensitive Barometer," was read by the Secretary. A Milne seismograph was installed in 1898 at the Meteorological Office, Victoria, B.C.,\* and the author has since that time compared its movements with the changes of atmospheric pressure recorded by his aerograph. He finds that when the barometric pressure is high over the Pacific slope from British Columbia south-eastward to California, and the barometer off the Pacific coast is comparatively low, the horizontal pendulum of the seismograph tends to move towards the eastward. This movement appears to be due to a distortion of the Earth's crust, caused by the heavier air over the Pacific slope depressing the underlying land surface below its normal position, while on the other hand, the comparatively light air over the adjacent ocean tends to allow the surface beneath to rise above its normal level. It has been found that when an extensive storm area is approaching from the westward, and often 18 to 24 hours before the local barometer begins to fall, the horizontal pendulum of the seismograph swings steadily to the eastward, completely masking any diurnal fluctuations that might have existed, as the storm area approaches; and in the event of it being followed by an important high area, the pendulum will begin to swing towards the westward before it is possible to ascertain the position of this area on the current Weather Charts.

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\* It seems rather late to correct a slip made so long ago as 1899 (*S. M. M.*, 34, 148); but in the interests of accuracy the opportunity may be taken to mention that the Superintendent of the Meteorological Office at Victoria, B.C., was then and is still Mr. E. Baynes Reed.

Prof. G. H. Darwin, F.R.S., said that, while he was not convinced that the author had as yet established his conclusions, he thought that there was a future for work of this kind in meteorology. He had himself estimated about 20 years ago the probable amount of the elastic yielding of the Earth's surface under varying pressures, and had concluded that there were in existence instruments of sufficient delicacy to detect the changes in question.

Dr. H. R. Mill thought that Mr. Denison's site at Victoria, B.C., was not a particularly happy one for the purpose of measuring seismic changes due to differences of atmospheric pressure. There was a rapid increase in the depth of the water off the Pacific coast, and a rapid rise of the land on the east to the plateau west of the Rocky Mountains. Hence there was a want of symmetry on the two sides that would make that portion of the crust imperfectly balanced.

The President, Mr. R. Inwards, Mr. R. H. Curtis, and Mr. J. Hopkinson also joined in the discussion.

A letter was read from Prof. J. Milne, F.R.S., in which he said :—  
 "Not only will a horizontal pendulum respond to barometric change, but it responds to variations in several other meteorological elements. Here at Shide, Isle of Wight, my pendulum swings west before bad weather."

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## Correspondence.

### SUN PILLAR.

*To the Editor of Symons's Meteorological Magazine.*

ON the evening of Tuesday, June 25th, 1901, a very vivid and beautiful sun pillar was seen from Portland, Dorset. All the atmospheric conditions were favourable. Near the horizon there was a dense dark mist, sufficient to prevent the actual setting of the sun from being seen. The sun's disc was bright red, and the column of light which rose direct from the sun was bright yellowish crimson. It rose from the horizon about 40 degrees of arc, widening a little towards its highest portion. It was seen from 8 p.m. until about 9 p.m., when it gradually faded away from the summit. It was a most impressive and beautiful vision, requiring the brush of a Turner to faithfully depict it. The barometer stood at 30·43 in., the thermometer at 70°, and the relative humidity at 74 per cent.

W. R. M. WAUGH, F.R.A.S.

*The Observatory, Portland.*

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### THE PRESENT SUMMER.

*To the Editor of Symons's Meteorological Magazine.*

A SHORT time ago I called attention to a curious "rule of thumb" about our London summers—those in the later half of a decade (5-9) show, in general, a greater average of heat than those in the earlier half (0-4).

Here is a table of mean temperature, and of the number of those very hot days with max. temperature  $80^{\circ}$  or more :—

		Mean Temp. of Summer.		Relation to average, $61^{\circ}2$ .		No. of Very Hot Days.		Relation to average, 15.
1841	...	58 $\cdot$ 0	...	—3 $\cdot$ 2	...	2	...	—13
1851	...	60 $\cdot$ 9	...	—0 $\cdot$ 3	...	9	...	— 6
1861	...	61 $\cdot$ 6	...	+0 $\cdot$ 4	...	11	...	— 4
1871	...	60 $\cdot$ 8	...	—0 $\cdot$ 4	...	15	...	aver.
1881	...	61 $\cdot$ 1	...	—0 $\cdot$ 1	...	17	...	+ 2
1891	...	59 $\cdot$ 8	...	—1 $\cdot$ 4	...	9	...	— 6

So far as these data go, we may at least say that if the summer of 1901 has a higher mean temperature than  $61^{\circ}6$ , or more than 17 very hot days ( $80^{\circ}$  or more), it will be the first time since 1840 that the summer of a year ending in 1 has been so hot. Permit me also to send you this table :—

MEAN TEMP. OF SUMMER (GREENWICH).

	aver.			aver.	diff.
1802—04	63 $\cdot$ 3	.....	1806—08	64 $\cdot$ 9	+1 $\cdot$ 6
1812—14	59 $\cdot$ 6	.....	1816—18	60 $\cdot$ 5	+ .9
1822—24	61 $\cdot$ 1	.....	1826—28	63 $\cdot$ 1	+2 $\cdot$ 0
1832—34	61 $\cdot$ 3	.....	1836—38	61 $\cdot$ 7	+ .4
1842—44	60 $\cdot$ 8	.....	1846—48	62 $\cdot$ 0	+1 $\cdot$ 2
1852—54	60 $\cdot$ 5	.....	1856—58	63 $\cdot$ 1	+2 $\cdot$ 6
1862—64	60 $\cdot$ 0	.....	1866—68	62 $\cdot$ 3	+2 $\cdot$ 3
1872—74	61 $\cdot$ 9	.....	1876—78	62 $\cdot$ 5	+ .6
1882—84	60 $\cdot$ 5	.....	1886—88	60 $\cdot$ 9	+ .4
1892—94	61 $\cdot$ 1	.....	1896—98	62 $\cdot$ 2	+1 $\cdot$ 1

The values prior to 1841 are from Buchan's table. I may be singularly constituted, but it seems to me difficult to think all this fortuitous.

ALEX. B. MACDOWALL.

## REVIEWS.

*Atlas Meteorologico de la República Argentina, Primera Parte, Provincia de Buenos Aires.* Por ENRIQUE A. S. DELACHAUX. Buenos Aires, 1901. Size  $13\frac{1}{2} \times 10\frac{1}{2}$ . Pp. 24 and 24 maps.

WE are indebted to the kindness of Dr. Francisco P. Moreno for an early opportunity of examining this interesting atlas, which for the first time represents in a graphic manner the climate of the chief province of the Argentine Republic. The maps are admirably produced in colour, by the South American Bank Note Company, and on account of the very uniform configuration of the country, the eighteen stations for general meteorological observations, supplemented by about eighty additional rainfall stations, give a fair approximation to the general climate. Still, in a province with an area of 120,000 square miles, a hundred stations cannot be expected to give a very exact delineation, although, as a first attempt, they are invaluable. The maps show the mean temperature, pressure

and winds, and relative humidity, for the year, and for each of the four seasons, the rainfall for the year, for the dry season, and for the wet season, and four extra maps showing certain abnormal conditions.

M. Delachaux has utilized the work of the provincial and of the national governments, and he lays stress in his introduction on the great importance of obtaining a full knowledge of the climatic conditions of a country, and especially of its rainfall, with the object of turning its resources to the best account.

The Argentine Republic, both as regards the federal and the provincial governments, has proved itself an enlightened nation in its appreciation of scientific work ; its great museum and observatory at La Plata, and its observatory at Cordoba, might serve as models not only to South America, but to many countries in Europe. Quite recently the federal government has voted a large sum of money for the establishment of a magnetic and meteorological observatory on Staten Island, the nearest land to the Antarctic circle in touch with civilization, so that, along with Great Britain and Germany, it stands in the front rank of scientific exploration towards the south pole. The telegraph system of the Argentine has now, we believe, been extended to include the whole span of the south temperate zone, from the tropic to the Antarctic Ocean, and considering the vast importance of an exact knowledge of weather changes to an agricultural and pastoral people, many of whom depend on the results of irrigation, and to fishermen, we shall be greatly surprised if a Central Weather Service, publishing daily synoptic charts of the whole country, and issuing storm warnings, is not soon established. Meteorology would greatly benefit by the increase in knowledge of the weather of the southern hemisphere, which would thus be secured.

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*Moore's Meteorological Almanac and Weather Guide, 1901. For the Farmer, the Horticulturist, the Shipper, the Mariner, the Merchant, the Tourist, the Healthseeker, and for those who wish to learn the Art of Weather-forecasting. By PROFESSOR WILLIS L. MOORE, LL.D., Chief United States Weather Bureau, Washington, D.C. Chicago and New York : Rand, McNally & Co. Price 50 cts.*

THIS is an interesting attempt to popularise scientific weather study, and particularly to acquaint the American public with the work of the Weather Bureau. While the author is by no means so confident of the course of future weather as "Old Moore" was in his celebrated almanac, he differs from his ancient namesake by giving reasons for every statement, which cannot fail to convince fair-minded readers. He utters a strong and much needed warning on the subject of charlatans and long-period forecasts, proving the absurdity of their pretensions. A list of the highest and lowest recorded temperatures in each month at 120 selected stations is useful to the



American reader ; but meteorologists in this country will turn with most interest to the articles on the construction and use of weather maps, the employment of kites in meteorological research, and the methods of rainfall observation officially adopted.

We have only noted one blunder, and that in a very subsidiary position, but it is so amazing that we must quote it *in extenso*.—"A severe storm so scattered and damaged the British armada on May 29, 1858, that the fleet was forced back to port for repairs. This delay enabled the English to make further preparations for the invasion."

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*The Circulation of the Surface Waters of the North Atlantic Ocean.* By H. N. DICKSON, B.Sc. [*Phil. Trans. Series A*, 196, 61-203]. London : Published for the Royal Society by Dulau & Co., 1901. Size 12 x 9. Pp. 44. Plates.

WE regret that we cannot give adequate space to a review of this important memoir, which contains the details of as solid and laborious a piece of research in physical geography as we have seen. The belief that the physics of the atmosphere cannot be considered apart from those of the hydrosphere or ocean has now become a demonstrated truth, and Mr. Dickson's monthly maps of the surface temperature and salinity of the North Atlantic for the two complete years 1896 and 1897 supply a solid basis on which to establish the real nature of the relationship between the conditions of sea and air. This Mr. Dickson proposes to deal with in a second paper which will be eagerly awaited by meteorologists.

Meanwhile we may state the general conclusions at which he has arrived. The water of the eastern shore of the Atlantic north of 30° N., consisting of a mixture from the Gulf Stream and Labrador Current, drifts across the Atlantic and is banked up off the coast of south-western Europe. This action is strongest when the Atlantic anticyclone attains its greatest development in summer, and the proportion of Gulf Stream water brought to Europe is accordingly greatest at that season. The drifts in the northern part of the ocean are under the control of the cyclones crossing it, and they are accordingly strongest in winter, when more of the Labrador Current water reaches the shores of Europe. The water banked up off the coasts of Europe escapes northward in a current, which Mr. Dickson names the European Stream, through the Faerö-Shetland Channel and between Faerö and Iceland, which is always strongest in summer. This warm water melts enormous quantities of Arctic ice, and being greatly freshened and cooled thereby, spreads over the surface of the North Atlantic in autumn and winter until it becomes gradually mixed by the currents with the underlying water. Attention is called to the results as to the influence of the ocean on the air worked out by Professors Pettersson and Meinardus, a line of research which is expected to be notably forwarded by the proposed international exploration of the eastern Atlantic.



## METEOROLOGICAL NEWS AND NOTES.

THE ANNUAL VISITATION of Greenwich Observatory took place on June 1st, when the Board of Visitors and a number of invited guests were shown over the Observatory. The Astronomer Royal's Report details the work done at the Observatory during the year ending May 10, 1901, and of course it mainly refers to astronomical observations. The magnetic observations have been to some extent affected by the electric tramways, but it is satisfactory to find that precautions may be taken which will obviate any very serious interference with the records. The meteorological observations have been supplemented by a Stevenson screen in the Magnetic Pavilion enclosure for comparison with the Glaisher stand and with the Stevenson screen in the Observatory grounds. The mean temperature of 1900 was  $50^{\circ}\cdot5$ , or  $1^{\circ}$  above the average for the fifty years 1841-90, the rainfall was  $20\cdot22$  in., or  $4\cdot32$  in. below the average of fifty years.

A NEW METEOROLOGICAL OBSERVATORY has been opened at Horta, in the Azores, by the King of Portugal. The *Times* states that the observatory "is in connection with the Agricultural Department of Washington"; but it is scarcely necessary to point out that the importance of the observations at this unique mid-Atlantic station will be greater to the meteorological services of Europe than to those of America, and our impression is that the observatory is international. The importance of founding this observatory has been strongly urged by the Prince of Monaco and supported by many British men of science.

MR. WILLIAM ELLIS, F.R.S., who was for nearly twenty years in charge of the meteorological and magnetic work at Greenwich Observatory, and is still an honoured authority on meteorological science, is the subject of a biographical note, illustrated by a portrait, in the May number of *Terrestrial Magnetism*.

DEALING WITH THE COLD-AIR CYCLONE as a form of atmospheric movement, Dr. A. Harvey, of Toronto, writing to the *Geographical Journal* for June, points out that the alternation of temperature in the long day and night of the polar year must give rise to such a phenomenon on an intense as well as an extensive scale, and formulates the thesis—"It is this polar alternation of heat and cold which sets our atmosphere in motion, and at the poles, not at the equator, we must begin our studies of meteorology."

JOURNALISM ABOUNDS IN SURPRISES, and the questions put to meteorological experts by interviewers or special commissioners sometimes convey or elicit unexpected information. Thus in an article on "Spring Rainfalls and Droughts" in the *Church Family Newspaper* describing an interview at 63, Victoria Street, on the measurement of rainfall, we observe the question, "I suppose observations reach the theological office from all parts of the country?" and the answer, "Yes, there are gauges everywhere."

## CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, JANUARY, 1901.

STATIONS.	Absolute.				Average.				Absolute.		Total Rain.		Aver.
	Maximum.		Minimum.		Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days.	
	Temp.	Date.	Temp.	Date.									
(Those in italics are South of the Equator.)	°		°		°	°	°	0.100	°	°	inches		
London, Camden Square	55.0	27	20.5	9	43.3	33.5	35.4	89	72.6	19.9	.55	12	6.7
Malta	62.9	31	39.5	6	57.9	48.4	46.0	80	114.3	35.4	5.39	16	3.9
Cape Town	83.4	14	51.0	30	75.5	58.9	56.7	70	...	...	5.09	9	4.3
Mauritius	90.7	1	70.5	8	86.4	73.4	70.2	73	150.1	65.1	18.60	14	6.1
Calcutta	80.3	27	50.1	25	73.9	55.5	54.0	70	132.4	45.3	1.31	6	2.8
Bombay	86.6	23	63.0	5	80.9	66.9	63.1	69	136.5	53.4	.74	2	1.8
Colombo, Ceylon	91.7	31	69.2	27	88.4	72.6	70.3	78	154.0	66.0	11.91	14	3.1
Melbourne	98.2	19	46.6	10	75.6	54.6	50.8	65	153.6	39.6	3.01	12	5.3
Adelaide	108.0	19	47.1	5	83.5	60.7	50.7	47	161.8	43.0	1.07	9	3.2
Sydney	92.1	4	57.7	17	77.5	62.6	54.1	60	152.8	48.9	6.47	11	4.2
Wellington	79.0	19	44.0	13b	67.4	55.0	50.4	68	140.0	37.0	4.14	11	4.8
Auckland	79.0	6	48.0	27	70.0	58.8	53.6	68	152.0	44.0	3.22	16	5.7
Jamaica, Halfway Tree	87.0	11	61.0	28	83.9	66.0	63.9	76	...	...	1.39	2	2.1
Trinidad	91.0	29	60.0	31	87.2	67.9	71.3	82	160.0	51.0	1.99	4	...
Grenada	85.0	28a	66.2	13	81.9	72.9	68.7	69	150.0	...	5.93	14	2.1
Toronto	45.4	9	-10.9	19	31.5	16.7	21.2	82	57.2	-12.5	2.47	16	7.8
Fredericton	43.9	22	-19.8	20	25.0	3.7	8.3	79	...	...	3.81	8	6.2
New Brunswick,	{	31.0	13	-36.8	2	7.6	-14.5	...	...	...	.81	9	5.2
Winnipeg, Manitoba		{	51.7	12	24.0	4	43.2	34.7	...	...	4.15	20	7.7
Victoria, British Columbia													

a—and 30. b—and 26.

## REMARKS.

MALTA.—Mean temp. of air 52°·9 or 0°·4 below the average. Mean hourly velocity of wind 12.9 miles or 1.6 above average. Mean temp. of sea 59°·3. TSS on 6 days. L on 2 days, and H on 6 days. J. F. DOBSON.

Mauritius.—Mean temp. of air 0°·5 above, of dew point 0°·1 below, and R 11.26 in. above their respective averages. Mean hourly velocity of wind 14.2 miles, or 3.0 miles above the average; extremes, 72.0 miles on 12th and 2.0 on 16th; prevailing direction N.E. and S.E. by E., with occasional light airs from N.W. to N. L and T on 25th. A cyclone, the centre of which passed between Mauritius and Bourbon on the night of January 12th—13th, caused considerable damage in the latter Island. At Mauritius the damage was principally confined to the collapse of straw huts, though several houses of more substantial construction suffered. T. F. CLAXTON.

COLOMBO, CEYLON.—Mean temp. of air 0°·4 above, of dew point 0°·5 above, and R 8.67 in. above, their respective averages. Mean hourly velocity of wind 7.3 miles; prevailing direction N.E. and N.W. TSS occurred on three days; L was seen on 2 days. W. C. S. INGLES.

Adelaide.—Mean temp. of air 2°·1 below the average. Very cool in the first half, but warm in the latter half of the month, R moderate in the S.E.; practically rainless inland. C. TODD, F.R.S.

Sydney.—Mean temp. of air 1°·5 below, humidity 10.8 below, and R 2.80 in. above, their respective averages. H. C. RUSSELL, F.R.S.

Wellington.—Mean temp. of air 1°·4 below, and R .24 in. above their respective averages. Fine in the early part of the month, but strong N.W. winds and showery from 5th to 11th, then fine to 22nd, and light wind or calm; the rest of the month was very wet. H on 4 days. Fog on 7th. Very slight earthquake on 18th, about 10 a.m. R. B. GORE.

Auckland.—Unusually cool. Mean temp. of air being nearly 4° below the average. R .75 in. above the average. T. F. CHEESEMAN.

TRINIDAD.—R .95 in. below the 30 years' average. J. H. HART.

SUPPLEMENTARY TABLE OF RAINFALL,  
 JUNE, 1901.

Div	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
I.	Uxbridge, Harefield Pk..	1.42	XI.	Castle Malgwyn .....	3.76
II.	Dorking, Abinger Hall .	2.44	„	Builth, Abergwesyn Vic.	4.15
„	Sheppey, Leysdown .....	.88	„	Rhayader, Nantgwillt...	3.20
„	Hailsham .....	.97	„	Lake Vyrnwy .....	2.63
„	Crowborough .....	1.19	„	Corwen, Rhug .....	2.07
„	Ryde, Thornbrough .....	...	„	Criccieth, Talarvor .....	2.72
„	Emsworth, Redlands ...	3.73	„	I. of Anglesey, Lligwy..	2.38
„	Alton, Ashdell .....	1.94	„	Douglas, Woodville.....	3.35
„	Newbury, Welford Park	1.83	XII.	Stoneykirk, Ardwell Ho.	3.12
III.	Oxford, Magdalen Coll..	1.39	„	New Galloway, Glenlee	3.66
„	Banbury, Bloxham .....	1.49	„	Moniaive, Maxwelton Ho.	3.78
„	Pitsford, Sedgebrook ...	2.27	„	Lilliesleaf, Riddell .....	2.32
„	Huntingdon, Bampton.	1.41	XIII.	N. Esk Res. [Penicuik]	2.10
„	Wisbech, Bank House...	.63	XIV.	Glasgow, Queen's Park..	2.81
IV.	Southend .....	.62	XV.	Inveraray, Newtown ...	5.84
„	Colchester, Lexden .....	1.72	„	Ballachulish, Ardsheal...	5.67
„	Saffron Walden, Newport	1.35	„	Islay, Eallabus .....	4.28
„	Rendlesham Hall .....	1.43	XVI.	Dollar .....	2.41
„	Swaffham .....	1.10	„	Balquhidder, Stronvar...	6.33
V.	Salisbury, Alderbury ...	.87	„	Coupar Angus Station...	1.64
„	Bishop's Cannings .....	1.95	„	Blair Atholl .....	2.69
„	Blandford, Whatcombe .	1.93	XVII.	Keith H.R.S. ....	3.79
„	Ashburton, Druid House	1.59	„	Forres H.R.S. ....	2.48
„	Okehampton, Oaklands.	2.61	XVIII.	Fearn, Lower Pitkerrie..	1.58
„	Hartland Abbey .....	3.77	„	S. Uist, Askernish .....	2.96
„	Lynton, Glenthorne ...	...	„	Invergarry .....	4.53
„	Probus, Lamellyn .....	2.14	„	Aviemore, Alvie Manse.	3.63
„	Wellington, The Avenue	2.93	„	Loch Ness, Drumnadrochit	2.65
„	North Cadbury Rectory	.96	XIX.	Invershin .....	3.55
„	Clifton, Pembroke Road	1.91	„	Durness .....	...
VI.	Ross, The Graig .....	2.15	„	Watten H.R.S. ....	2.37
„	Wem, Clive Vicarage ...	2.20	XX.	Dunmanway, Coolkelure	3.52
„	Wolverhampton, Tettenhall	3.00	„	Cork, Wellesley Terrace	1.48
„	Cheadle, The Heath Ho.	1.98	„	Killarney, District Asyl.	3.58
„	Coventry, Priory Row ..	2.67	„	Caher, Duneske .....	2.32
VII.	Market Overton .....	2.19	„	Ballingarry, Hazelport...	2.94
„	Grantham, Stainby .....	2.11	„	Limerick, Kilcornan ...	...
„	Horncastle, Bucknall ...	1.24	„	Miltown Malbay .....	3.65
„	Worksop, Hodsock Priory	1.66	XXI.	Gorey, Courtown House	2.71
VIII.	Neston, Hinderton .....	2.10	„	Moynalty, Westland ...	2.69
„	Southport, Hesketh Park	1.71	„	Athlone, Twyford .....	3.49
„	Chatburn, Middlewood.	1.49	„	Mullingar, Belvedere ...	2.74
„	Duddon Val., Seathwaite Vic.	4.75	XXII.	Woodlawn .....	3.13
IX.	Baldersby .....	1.48	„	Crossmolina, Enniscoe ..	3.64
„	Scalby, Silverdale .....	1.90	„	Collooney, Markree Obs.	3.58
„	Ingleby Greenhow Vic..	2.06	XXIII.	Enniskillen, Model Sch.	3.71
„	Middleton, Mickleton ...	1.46	„	Warrenpoint .....	1.76
X.	Haltwhistle, Unthank H.	...	„	Miltown, Banbridge.....	2.69
„	Bamburgh .....	1.34	„	Belfast, Springfield .....	3.81
„	Keswick, The Bank .....	2.65	„	Bushmills, Dundarave..	3.72
XI.	Llanfrecfa Grange .....	2.65	„	Stewartstown .....	2.63
„	Treherbert, Tyn-y-waun	3.98	„	Killybegs .....	...
„	Llandovery .....	2.71	„	Horn Head .....	2.87

JUNE, 1901.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.					TEMPERATURE.				No. of Nights below 32°.			
		Total Fall.	Difference from average 1890-9.	Greatest Fall in 24 hours.		Days on which .01 or more fell.	Max.		Min.					
				Dpth	Date		Deg.	Date	Deg.	Date.	In shade.	On grass.		
		inches.	inches.	in.										
I.	London (Camden Square) ...	1.25	— .65	.49	30	9	82.8	9	40.9	19	0	0		
II.	Tenterden .....	1.60	— .59	.64	30	9	76.0	22	39.5	15	0	...		
	Hartley Wintney .....	1.65	— .30	.68	30	10	79.0	22	37.0	19	0	...		
III.	Hitchin .....	.95	— .83	.41	30	9	77.0	9	37.0	18	0	...		
	Winslow (Addington) .....	1.20	— .65	.66	30	13	79.0	9	33.0	19	0	1		
IV.	Bury St. Edmunds (Westley) .....	1.27	— .77	.35	30	10	80.5	9	38.0	13	0	...		
	Norwich (Brundall) .....	1.55	...	.50	17	14	79.0	9	40.2	13	0	0		
V.	Winterbourne Steepleton ...	1.15	...	.59	19	10	76.8	29	38.0	9	0	2		
	Torquay (Cary Green) ...	1.01	...	.33	29	8	68.5	6	44.2	13	0	0		
	Polapit Tamar [Launceston].	2.26	— .13	.50	20	13	73.1	29	37.0	26	0	...		
VI.	Stroud (Upfield) .....	2.46	+ .46	1.05	30	13	80.0	29	44.0	14	0	...		
	Church Stretton (Woolstaston) .....	2.79	+ .65	1.10	30	15	74.0	28	39.5	13	0	...		
	Worcester (Diglis Lock) .....	2.63	+ 1.01	1.22	30	11	...	...	...	...	...	...		
VII.	Boston .....	1.00	— .68	.65	30	8	80.0	9	38.0	13	0	...		
	Hesley Hall [Tickhill] .....	1.26	— .41	.48	30	10	83.0	9	33.0	19	0	...		
	Derby (Midland Railway) .....	1.84	— .21	.90	30	10	83.0	28	39.0	18	0	...		
VIII.	Manchester (Plymouth Grove) .....	1.80	— .94	.69	20	14	82.0	8, 28	41.0	12a	0	...		
IX.	Wetherby (Ribston Hall) ...	1.08	— 1.01	.35	17	6	...	...	...	...	...	...		
	Skipton (Arneliffe) .....	2.36	— 1.37	.46	20	15	...	...	...	...	...	...		
	Hull (Pearson Park) .....	2.04	+ .07	.54	21	13	79.0	9	36.0	19	0	1		
X.	Newcastle (Town Moor) .....	1.15	— .73	.33	17	12	...	...	...	...	...	...		
	Borrowdale (Seathwaite) .....	6.63	— .47	1.40	20	14	76.0	28	42.7	13	0	...		
XI.	Cardiff (Ely) .....	2.98	+ .65	1.27	20	10	...	...	...	...	...	...		
	Haverfordwest .....	3.80	+ 1.47	.85	22	14	78.6	29	41.7	8	0	0		
	Aberystwith (Gogerddan) ...	4.05	+ 1.41	.90	20	13	84.0	28	34.0	13	0	...		
	Llandudno .....	1.90	— .07	.54	13	15	71.0	29	44.0	13	0	...		
XII.	Cargen [Dumfries] .....	3.96	+ 1.24	1.24	22	12	...	...	...	...	...	...		
XIII.	Edinburgh (Royal Observatory) .....	2.10	...	.60	23	13	73.4	8	39.2	11	0	...		
XIV.	Colmonell .....	2.62	— .05	.78	22	11	79.0	29	36.0	6	0	...		
XV.	Tighnabruach .....	4.69	...	1.05	19	13	70.0	28	40.0	7b	0	...		
	Mull (Quinish) .....	4.67	+ 1.24	.84	2	18	...	...	...	...	...	...		
XVI.	Loch Leven Sluices .....	2.34	— .04	.63	23	12	...	...	...	...	...	...		
	Dundee (Eastern Necropolis) .....	2.25	+ .42	.85	22	11	81.2	8	37.1	15	0	...		
XVII.	Braemar .....	2.89	+ .56	.45	22	14	75.6	8	34.0	18	0	7		
	Aberdeen (Cranford) ...	1.47	— .67	.30	22	20	72.0	8	38.0	8, 18	0	...		
	Cawdor (Budgate) .....	2.18	— .14	.40	17	18	...	...	...	...	...	...		
XVIII.	Strathconan [Beaully] .....	3.15	— .36	.85	11	11	...	...	...	...	...	...		
	Glencarron Lodge .....	4.89	— .85	.90	12	19	74.1	30	39.0	11	0	...		
XIX.	Dunrobin .....	2.26	+ .22	.52	10	13	64.2	27	37.0	11	0	0		
	S. Ronaldshay (Roeberry) ...	3.25	+ 1.29	.45	11	17	67.0	21	38.0	11c	0	...		
XX.	Darrynane Abbey .....	2.82	— .28	1.32	22	17	...	...	...	...	...	...		
	Waterford (Brook Lodge) ...	2.95	+ .34	1.28	22	8	74.0	29	38.0	13	0	...		
	Broadford (Hurdlestown) ...	2.50	+ .09	1.20	22	15	76.0	30	38.0	12	0	0		
XXI.	Carlow (Browne's Hill) .....	2.31	+ .04	.81	22	13	...	...	...	...	...	...		
	Dublin (Fitz William Square) .....	1.63	— .29	.71	22	13	71.6	29	42.6	18	0	0		
XXII.	Ballinasloe .....	3.61	+ .96	1.55	22	12	78.0	8	40.0	5d	0	...		
	Clifden (Kylemore) .....	4.40	+ 1.03	1.13	18	14	...	...	...	...	...	...		
XXIII.	Seaforde .....	2.77	+ .21	1.05	22	13	73.0	27	40.0	6	0	...		
	Londonderry (Creggan Res.) .....	3.95	+ .81	.69	22	19	...	...	...	...	...	...		
	Omagh (Edenfel) .....	3.34	+ .33	1.06	22	18	75.0	29	39.0	6	0	...		

+ Shows that the fall was above the average ; — that it was below it.

a—and 25. b—and 11, 16, 17. c—and 12, 16. d—and 13, 15.

## METEOROLOGICAL NOTES ON JUNE, 1901.

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.

### ENGLAND.

LONDON, CAMDEN SQUARE.—With the exception of heavy showers in the early morning of the 22nd, no R of any consequence fell before the 30th, when two sharp TSs occurred, followed by a steady downpour in the evening. An exceptionally well-defined sun pillar was seen from 7.45 to 8.15 p.m. on the 26th. Mean temp.  $60^{\circ}\cdot6$ , or  $0^{\circ}\cdot2$  above the average.

TENTERDEN.—A partial drought for 34 days ended on the 11th: showers on 12th and 21st gave little relief, but on 30th the fall was sufficient to do good, though too late to save the hay crop.

HARTLEY WINTNEY.—With the exception of slight showers in the middle of the month, the weather continued very dry, with cold S.W. and N.W. winds. On the 29th we were on the edge of a TS of short duration, with little R falling, the severest part of the storm being about 30 miles further S. TS on 30th. Ozone on 8 days, with a mean of  $4\cdot5$ .

WINSLOW, ADDINGTON.—A great deal of very fine weather, but deficiency of R. Pastures were much dried up before the end. The nights were generally cold, there being  $2^{\circ}$  of frost on the grass on 19th, doing much damage to some garden crops. T on 30th, with heavy R, more than half of the month's total falling after 5 p.m. on that day.

BURY ST. EDMUNDS, WESTLEY.—A most unfavourable month for vegetation. The crops in the mixed soils of west Suffolk were the worst grown for 50 years. Distant T on 3rd.

WINTERBOURNE STEEPLETON.—The first and last weeks were warm, especially the days in the last week, and the middle of the month was cool. TS on 30th. The R for the first half of the year was decidedly below the average, amounting only to  $12\cdot59$  in.

TORQUAY, CARY GREEN.—R  $1\cdot21$  in. below the average. Mean temp.  $1^{\circ}\cdot7$  below the average, and duration of sunshine  $28\cdot7$  hours below the average; 3 sunless days. Mean ozone  $5\cdot1$ , the greatest amount being  $9\cdot0$  on 1st, with S.S.W. wind, and the least  $2\cdot0$  on 22nd, with S.E. wind.

POLAPIT TAMAR [LAUNCESTON].—The first part was dry and warm. From the 18th to the end nice rains fell, and on 29th heavy R, with T and vivid L. The wind throughout was generally northerly or easterly, and very drying.

MANCHESTER, PLYMOUTH GROVE.—Fine summer weather from 6th to 9th, and from 27th to the end, but upon the whole it was very unsettled, with cold north-westerly wind.

HULL, PEARSON PARK.—The total R was not heavy yet there were a few heavy showers during the month, and a fair amount of sunshine. The temp. was rather variable, the days being frequently hot, and the nights cold. TS on 3rd.

### WALES.

HAVERFORDWEST.—The weather was unsettled, but warm, with very little sunshine, and no very high temp. Hay crops generally were slight, though corn is looking well, and potatoes are good, but everything is backward. Duration of sunshine  $155\cdot8$  hours. TS on 29th; T at times on 30th.

ABERYSTWITH, GOGERDDAN.—Extraordinarily wet for the time of year. There was very little growing weather, the wind being in the N. and N.E.

## SCOTLAND.

TIGHNABRUAICH, CRAIGANDARAICH.—R was normal for the month, and for the half-year the amount was 4·12 in. less than for the same period in 1900.

ABERDEEN, CRANFORD.—N.W. gales on 11th, 12th and 13th, and on 17th.

S. RONALDSHAY, ROEBERRY.—A wet, cold and blustering month. Mean temp. 51°·0, 1°·0 below the average of 11 years.

## IRELAND.

DARRYNANE ABBEY.—The first part was changeable and rather cold, and the last few days fine and hot.

BROADFORD, HURDLESTOWN.—A very favourable month. Crops of all kinds doing well. The R for the first half-year was 4·96 in. less than that of the same period last year.

DUBLIN, FITZWILLIAM SQUARE.—Although not so fine, sunny and dry as May, June was a favourable month. The mean temp., R and rainy days were all somewhat below the average, and the wind still clung to the colder points of the compass, especially N.W. and E.N.E. There was a complete absence of T and L. Mean temp. 56°·9, or 0°·9 below the average. High winds were noted on 12 days, attaining the force of a gale on 13th and 23rd. The temp. reached, or exceeded, 70° on only one day.

OMAGH, EDENFEL.—Almost until its very end June was a cold, harsh month, with strong, generally polar, winds, and a mean temp. rendered low rather by the absence of warmth in the day time, than by any approach to frost by night. R was considerably over the average, chiefly on account of a remarkable fall of 1·07 in. on 22nd. On the 26th the weather changed completely, and afterwards was warm, and almost hot and summerlike.

## WATERSPOUT ON JULY 6TH.

The *Times* of July 8th publishes the following :—"Little Buckingham Farm, lying just north-west of Shoreham, was devastated on Saturday afternoon by a waterspout in the hills above. A large column of water rushed along the valley in which the farm lies, tearing up mangels and oats. Two cottages, in which some farm labourers lived, stood right in the track of the flood, and their occupants had to be rescued from the upper windows. The rush of water rendered the ladder unsteady and made the work of succour difficult. Some crops on another farm higher up the valley were also damaged. Mr. Burfoot's nursery of cut flowers on the Old Shoreham-road and a lower road leading to Shoreham Cemetery were under water and traffic was interrupted for some four hours."

Mr. T. P. Newman remarks that no rain fell at Haslemere, though heavy black clouds were visible to the south. Miss Cook, writing from Nutley, Uckfield, reports a fall of 1·88 in. of rain in half-an-hour, between 1·45 and 2·15 p.m., during a thunderstorm on the same day.