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RAINFALL IN PERSIA.

WE have just been favoured by Mr. A. Hontum Schwindler with the results of his rainfall measurements since he began them at Teheran, in November, 1891. The gauge is about $4\frac{1}{2}$ inches in diameter, and having been supplied by Dr. Hann, is no doubt perfectly accurate; the receiving surface is 13 inches above ground and 3,850 feet above sea-level. It is in a large garden, and unsheltered except slightly from the S., from which quarter rain rarely falls.

Mr. Schwindler makes the following remark:—

“The rainfall here was formerly very much less, say up to 10 or 11 years ago; it then did not, I think, exceed five inches per annum, but it is now about ten. The great increase is no doubt due to the many gardens which have sprung up within the last 10 years in, and outside, the city, and perhaps also to the formation, 10 years ago, of a lake 50 miles south of Teheran. The lake has a length of 22 miles, and is from 3 to 6 miles broad.”

The following are the returns converted into English inches:—

YEAR.	Jan. in.	Feb. in.	Mar. in.	April. in.	May. in.	June. in.	July. in.	Aug. in.	Sept. in.	Oct. in.	Nov. in.	Dec. in.	YEAR. in.
1891 ...	—	—	—	—	—	—	—	—	—	—	1·34	2·76	—
1892 ...	1·29	·75	1·43	1·03	·14	·00	·00	·00	·00	·71	3·23	·87	9·45
1893 ...	2·16	·25	·63	2·67	·39	·00	·06	·53					

We were under the impression that these were the first observations made in Teheran, but that appears not to be the case.

We append all the Persian rainfall returns of which we are aware. If any of our readers can tell us of any more, we shall be glad to add them in a subsequent number. We can trace in the vast territory of the Shah only the following localities where any records have been kept:—

Ooromia in the N.W. Latitude $37^{\circ} 28' N.$, Longitude $45^{\circ} 8' E.$, and 7,334 feet above the sea.

According to Loomis, a record for one year (he does not say which) was kept here, and the total was 21·51 inches.

Bushire, on the Eastern shore of the Persian Gulf. Latitude $28^{\circ} 59' N.$, Longitude $50^{\circ} 49' E.$, and 25 ft. above sea.

Observations have been made here regularly from 1878 onwards, and published in the annual volumes on the Meteorology of India.

We have extracted them all, and append them with the mean for the whole period :—

YEAR.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sep.	Oct.	Nov.	Dec.	YEAR.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
1878...	2.12	2.13	.26	.35	.00	.00	.00	.00	.00	.00	.00	.00	4.86
1879...	1.71	1.67	1.42	.36	.00	.00	.00	.00	.00	.00	.00	1.21	6.37
1880...	.39	4.01	.14	.15	.00	.00	.00	.00	.00	.00	1.35	12.67	18.71
1881...	.13	4.54	.97	.22	.00	.00	.00	.00	.00	.00	2.57	1.36	9.79
1882...	2.26	.66	.98	1.52	.00	.00	.00	.00	.00	.00	.00	1.61	7.03
1883...	4.01	5.55	.47	1.06	.00	.00	.00	.00	.00	.00	2.02	8.97	22.08
1884...	2.20	3.99	.77	1.95	.00	.00	.00	.00	.00	.00	1.59	4.05	14.55
1885...	12.90	4.73	1.92	1.70	.00	.00	.00	.00	.00	.00	.16	2.24	23.65
1886...	3.74	6.66	.62	.50	.00	.00	.00	.00	.00	.00	.00	.76	12.28
1887...	3.44	.99	.17	.00	.00	.00	.00	.00	.00	.00	1.12	7.16	12.88
1888...	4.99	2.13	.23	.42	.00	.00	.00	.00	.00	.00	2.37	1.13	11.27
1889...	4.86	.87	.72	.00	.12	.00	.00	.00	.00	.00	.00	.02	6.59
1890...	2.07	1.87	3.61	2.12	.00	.00	.00	.00	.00	.00	1.95	6.74	18.36
Mean	3.45	3.06	.94	.80	.01	.00	.00	.00	.00	.00	1.01	3.69	12.96

Lastly, we have in the "Annalen" issued by the Russian Government a series of observations made at Teheran between 1883 and 1890. Strictly speaking, they were not all made in Teheran, but for all practical purposes they may be so regarded. It is generally known that the Persian Gulf is almost, if not quite, the hottest place in the world. Teheran is far from the Gulf, and nearly 4,000 feet above it, but Teheran itself is so hot and dry in the summer that it is deserted by all who are able; and the observer, Dr. Tscherepnin, who was probably attached to the Russian Embassy, always left Teheran in the last week of May, and did not return until some time in September or October, and he took his instruments with him. He did not go far, only to Sergende, about 8 miles N., and about a thousand feet higher. In all ordinary cases such a removal would have been fatal to the value of the record, but while Dr. Tscherepnin was at Sergende the rainfall was usually infinitesimal. We therefore treat the observations as if all made in Teheran. At Teheran the gauge was 5 ft. above the ground, and at Sergende in a raised garden, which was 10 ft. above the general level. Dr. Tscherepnin died rather suddenly on July 18th, 1888, and after a few fragmentary observations the record seems to have terminated.

Monthly Rainfall at Teheran, Lat. 35° 41' N., Lon. 51° 25' E., Alt. 3,714 ft?

YEAR.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sep.	Oct.	Nov.	Dec.	YEAR.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
1883...	—	—	—	—	—	—	—	—	—	—	—	.47	—
1884...	3.22	2.43	1.38	1.26	.63	.35	.00	.00	.00	.62	.52	.79	11.20
1885...	3.82	.49	1.81	2.51	2.29	1.02	.00	.00	.16	.43	.94	.42	13.89
1886...	.74	3.15	1.85	2.22	.19	.00	.00	.00	.00	.20	.85	1.29	10.49
1887...	1.79	4.81	.78	.71	.15	.00	.00	.00	.00	.65	.04	2.05	10.98
1888...	.71	2.72	1.88	.94	1.04	.04	.04	.31	.00	—	1.42	—	—
1889...	—	—	—	—	—	—	—	—	—	—	—	—	—
1890...	—	—	—	—	.43	.13	.29	.08	.04	—	.52	2.96	—
Mean	2.39	2.72	1.46	1.68	.81	.34	.00	.00	.04	.47	.59	1.14	11.64

Of stations outside Persia, but useful from their proximity, there are two :—

Lenkoran, on the Russian shore of the Caspian, in Lat. $38^{\circ} 46' N.$, and in Lon. $48^{\circ} 51' E.$, where observations made for the nine years. 1848–56, gave a mean of 47·40 inches, and for the six years, 1874–78 and 1880, gave 45·00. The average monthly values are about as under* :—

Jan. in.	Feb. in.	March. in.	April. in.	May. in.	June. in.	July. in.	Aug. in.	Sept. in.	Oct. in.	Nov. in.	Dec. in.
4·37	2·83	3·66	2·67	1·53	·87	1·16	1·91	8·15	8·70	6·65	4·37

Mascot (or *Muscat*) on the Western shore of the Persian Gulf, in Lat. $23^{\circ} 29' N.$, and Lon. $58^{\circ} 33' E.$, where the fall in the season 1883–84 was 7·24 inches, and in 1884–5, 4·98 inches, scarcely any rain falling except between November and March, both inclusive.

The foregoing returns are insufficient to establish definite conclusions, but to us they seem to show :—

- (1.) That as the new observations at Teheran indicate a mean fall of about 10 inches, and the old Russian observations at Teheran indicate a mean fall of about 11 inches, the fall there is probably between 10 and 12 inches.
- (2.) That nearly all of it falls in the winter half of the year.
- (3.) That N. of the great mountain range between Teheran and the Caspian the fall is nearly four times as great, and although the fall in summer is small, it is there much greater than in Persia.
- (4.) That at Bushire, on the Eastern shore of the Persian Gulf, the fall, both as to amount and distribution, much resembles that at Teheran.
- (5.) That at the S.W. extremity of the Persian Gulf, at Muscat, the fall is very small, and analogous to that at Kurrachee (Karachi).

In conclusion, we must express our regret that, from Ispahan (the Oxford and the Cambridge of Persia) there are no records to be found. From the position which our correspondent, Mr. Hontum Schwindler, holds, we think it not improbable that he may be able to induce some one at Ispahan to take up the subject. It would be to the credit of Persia, and to the benefit of all students of physical geography and climatology, if he should do this.

THEOPHRASTUS.

It will be remembered that last year we mentioned that the translation of the two treatises by Theophrastus, "Concerning Winds" and "Of the Signs of Rain, &c.," had been undertaken by Mr. J. G. Wood. The translation is completed, and a form is enclosed with this Magazine which those who desire a copy are requested to fill up and return.

* Die Regen-verhältnisse des Russischen Reiches von H. Wild, 1887.

THE BRITISH ASSOCIATION AT NOTTINGHAM.

THE above meeting, in spite of the great zeal of, and the very excellent arrangements made by, the local secretaries, was not nearly equal to that held in the same town in 1866, as is sufficiently indicated by the fact that in 1866 there was £1,751 voted as grants for scientific purposes, and in 1893 there was only £705 available for similar objects—a decrease of 60 per cent.

This is not the place to discuss the causes of this decline ; we have to deal merely with the papers, and to report those which fell most nearly within the province of this Magazine.

SOLAR RADIATION.

The ninth report of the Committee on the Best Means of Recording the Direct Intensity of Solar Radiation, was read by its author, Professor McLeod. The work does not advance very much. Mr. Casella has constructed a thermometer with a lenticular bulb, colourless, and not green glass. On May 22nd, the green and white bulbs were tested, and it was found that the white bulb indicated an excess—above the temperature of the case—of only two thirds of that marked by the green thermometer. This is no disadvantage ; it rather facilitates the reduction of the results. As the simultaneous observation of the three thermometers is not an easy operation, an attempt has been made to replace them by two thermo-electric junctions. If such an instrument, in connection with a galvanometer, could be made photographically self-recording, we should have a real intensity meter. Ordinary galvanometers would not be suitable, being influenced by earth magnetism and other magnetic disturbances. Experiments with a D'Arsonval galvanometer have so far not given satisfactory results.

PHOTOGRAPHY OF METEOROLOGICAL PHENOMENA.

The third report of the Committee on the Application of Photography to the Elucidation of Meteorological Phenomena, drawn up by Mr. A. W. Clayden, the secretary, was read in his absence by the chairman, Mr. G. J. Symons, F.R.S. Owing to the new duties of the secretary, who had been appointed principal of the Technical and University Extension College at Exeter, the work had progressed slowly. A good deal of work has been done, however, and wider interest is being taken in the matter. The double film plates do not appear to offer special advantages for cloud photography, so that the black mirror and the slow plate are recommended. Mr. Greenwood Pim has sent excellent photographs of clouds on the High Alps. The collection of cloud photographs is so extensive that only pictures of high-level clouds are solicited. As to the classification of clouds, no general understanding has been arrived at, so that the report recommends the division of clouds simply into three groups—cumulus, stratus, cirrus—and the grouping of the varieties by numbers. The lightning photographs confirm the author's views about the narrow ribbon structure, which seems to represent the true form of the flash. This question is discussed at some length. Mr. Clayden distinguishes between the flash, lasting a mere fraction of a second, though longer than generally assumed, and not resolvable into components, and the discharge, consisting of series of flashes, following about the same or related paths with considerable rapidity, and lasting, altogether, two and three, up to seven seconds. This Mr. Clayden

determined, with the aid of Mrs. Clayden, by observing the second hand of his watch. The hands moved steadily, not in a series of jerks, as would have been the case if the continuity of illumination had been an illusion due to persistence of vision. Swaying tree tops and other objects can also be watched. An argument commonly advanced to prove that all duplicated flashes are due to movement of the camera, is that the track to be followed by successive flashes is marked out by the first, which creates a path of minimum resistance in the form of a partial vacuum. But such a tube of rarefied air would be moved by the wind. Velocities of 3, 18, and 34 miles an hour would in one second cause a displacement of 4 ft., 26 ft., and 50 ft., and in three seconds, of 13 ft., 79 ft., and 150 ft. Mr. Clayden thinks that the bends and breaks in flashes, especially near the ground, are caused by these air currents, and that the major thickness of the ribbon in one particular direction need not be ascribed to marginal deformation and focal errors. The flashes of one discharge vary in brilliancy; the persistent luminosity may be the flame of burning nitrogen. For the completion of an atlas of typical clouds, the Committee asked for a grant of £35, last year's grant of £15 not having been drawn. [But they did not get it.—ED.]

The full report of the Committee on

EARTH TREMORS,

an abstract of which was communicated by Mr. Symons, will be a valuable contribution to this literature. Brief accounts are given of Wolf's nadirane, Bertelli's tromometer, Milne's tremor recorder, and detailed descriptions of the new bifilar pendulum of Mr. Horace Darwin, and of the horizontal pendulum of Dr. E. von Rebeur-Paschwitz. Mr. H. Darwin's instrument was shown by the inventor. It is a simplified form of the one used by himself and Professor G. H. Darwin twelve years ago at Cambridge. The mirror forms the bob of a pendulum, and is suspended by two hooks on fine silver wire, the ends of which are attached to supports which are about 12 in. apart in a vertical and 1-200th of an inch in a horizontal direction. Any tilt of the ground will cause the upper support to move through a greater distance than the lower, and will produce a deflection of the mirror unless the movement be along a line parallel to its plane. The mirror and its frame are inclosed in a brass tube, little wider than the mirror, filled with paraffin oil. This arrangement makes the mirror dead-beat and insensible to vibrations of a short period, such as produced by passing carts or trains and by neighbouring earthquakes, whilst the instrument would indicate the dying-out pulsations of an earthquake, slow secular changes of level, and tilts arising from atmospheric pressure. Such an instrument has, since April, been put up by the secretary, Mr. Davison, who was not present, in the cellar of his house at Birmingham. The observations are made with a telescope and a gas jet 10 ft. away. A movement of less than 1-300th of a second can be detected, that is, the vertical angle of an isosceles triangle of 1 in. base and 1,000 miles length of side. The heat effects are very troublesome; the gas jet expands the brass tubes, causing an apparent tilt in one direction, and generates convection currents in the paraffin, giving rise to a far greater deflection in the other sense. For photographic reproduction an induction spark will therefore have to be used. Dr. Copeland will fit up such an instrument in the new observatory being built near Edinburgh. Mr. Horace Darwin described a newer and smaller instrument, about 1 ft. high, devised by Mr. Davison, in which extraordinary precautions are taken to avoid all heat effects and other

disturbances. To bring the points of supports into as nearly a vertical position as desirable, levers of 10 ft. ending in left and right-handed screws are turned ; the frame of the mirror is adjusted by means of a screw under the control of a pneumatic bell arrangement of Mr. Horace Darwin's. Professor Oliver Lodge recommended water vapour for the chamber, and the rotating screen of Mr. Boys for equalising radiation from right and left, giving a uniform though not constant temperature. Diurnal tremors, he thought, might be charged to the tides ; he suspected that something of the kind happened at Birkenhead and Liverpool. Mr. Ranyard objected that there should be two tremors instead of one daily in that case ; Professor Everett believed in expansion of the earth's crust.

The next report, read by Professor Milne, F.R.S.,

EARTHQUAKE AND VOLCANIC PHENOMENA OF JAPAN,

dealt with the same problems, and contained little about what people generally understand by earthquakes and volcanoes. The report records hundreds of observations for each different group, made by means of the Gray-Milne seismograph, and by the horizontal pendulum, for continuous photographic record, which Professor Milne last year described as new, but which he soon afterwards learned had been used for some time by Dr. von Rebeur-Paschwitz, at Potsdam and elsewhere. Throughout the report, parallels are drawn between the observations of Dr. von Paschwitz and Professor Milne. The former's pendula are heavy and adjusted for periods of 12 and 18 seconds, Professor Milne's exceedingly light. The report discusses daily tiltings, temperature and barometric effects, possible relationship with magnetic movements, and geologic structure. The direction of the earthquakes is generally at right angles to the mountain side, as if the sides moved like the sides of a roof hinged to its ridge. Earthquakes are so frequent in Japan that chemical balances by Oertling and Bunge could be used as indicators ; at times, any accurate quantitative work, as well as astronomical observations, become impossible. The list of earthquakes for February, 1893, numbers 101. These earthquakes have the nasty habit by their horizontal reciprocating motion of snapping, walls and piers at the base. Now Professor Tatsumo has calculated the proper section for such structures, and built walls, and Mr. C. A. W. Pownall, M.I.C.E., has constructed brick arches for the bridges of the Usui Pass, about 110 ft. high, which as yet have answered very well ; these piers taper in curves from the base upwards.

BEN NEVIS.

An abstract of the report of the Ben Nevis Committee was given by Dr. Peddie. The pressure curves for clear and for foggy weather are quite distinct. Between 7 p.m. and 4 a.m., fog pressure is higher than with clear sky, and attains its maximum at midnight ; between 5 a.m. and 6 p.m. fog pressure is lower, the minimum being about noon. During anti-cyclonic periods, the temperature difference between the observatory at the top and at the foot becomes less ; occasionally a higher temperature is registered at Ben Nevis. When the anti-cyclone gives way, the temperatures assume their normal difference. These alterations can be brought about by a fall of temperature at the top, or a rise at Fort William, the temperature of the other observatory remaining stationary.

SUNSPOTS AND AIR TEMPERATURE.

To the Editor of the Meteorological Magazine.

SIR,—I willingly comply with “W. E.’s” request. The years taken as maximum sunspot years are these:—1769, 1778, 1788, 1804, 1816, 1830, 1837, 1848, 1860, 1870, 1883. Those taken as minimum:—1766, 1775, 1784, 1798, 1810, 1823, 1833, 1843, 1856, 1867, 1878, 1889.

It is generally understood, I believe, that whatever correspondence may have been noticed, in these regions, between variations of air temperature and those of sunspots, there has been, in recent years, a plain departure from it. The point I wanted to consider was whether, taking as long a series of years as possible, one would find a clear balance of temperature on one side or the other.

It occurred to me lately to look through the *Annual Summary*, and note in how many weeks of each year the mean temperature for the week rose above some given limit. I do not know whether you will consider the following results of this somewhat rough mode of measurement worth giving. The figures relate to 65° as limit; and I have smoothed them by means of three-year averages:—

	Mean temp. of week over 65°.		Smoothed.		Mean temp. of week over 65°.		Smoothed.
1860	0	.....	...	1877	0	.....	3·0
1861	1	.....	·3	1878	4	.....	1·3
1862	0	.....	·7	1879	0	.....	1·7
1863	1	.....	·7	1880	1	.....	1·3
1864	1	.....	2·0	1881	3	.....	1·3
1865	4	.....	2·3	1882	0	.....	1·0
1866	2	.....	2·3	1883	0	.....	1·7
1867	1	.....	3·3	1884	5	.....	2·0
1868	7	.....	3·7	1885	1	.....	2·7
1869	3	.....	4·3	1886	2	.....	2·7
1870	3	.....	3·0	1887	5	.....	2·3
1871	3	.....	2·7	1888	0	.....	1·7
1872	2	.....	2·3	1889	0	.....	·0
1873	2	.....	2·0	1890	0	.....	·0
1874	2	.....	2·0	1891	0	.....	·0
1875	2	.....	3·0	1892	0	.....	1·3
1876	5	.....	2·3	1893	4	.....	—

These figures cannot be thought favourable on the whole to the view in question. The recent group of cool summers is well remembered; but from the present point of view we seem to have had a sort of cooling process since the end of the sixties. The smoothed curve has three waves, culminating in 1869, 1875 (or 1877), and 1885 (or 1886), with the decreasing values 4·3, 3·0, 2·7; while minima occur at 1873 (or 1874), 1882, and (say) 1889, with values 2·0, 1·0, 0. This is, of course, only one way of looking at the matter.—Yours faithfully,

A. B. M.

THE RECENT EARTHQUAKE.

To the Editor of the Meteorological Magazine.

SIR,—Will you allow me to ask the help of your readers in obtaining materials for a memoir on the recent earthquake felt in Wales and the West of England on November 2nd?

My object in this memoir is to trace as accurately as possible the boundary of the area over which the shock was felt, or the accompanying sound heard, and to draw lines through all places at which the shock was of approximately the same intensity. It would be of great service to know simply the names of as many places as possible where the shock was felt, or the accompanying sound heard. Still more useful would it be to have answers to any of the questions printed below, especially to those numbered 2, 3, 5 and 6. I shall be most glad and thankful to receive accounts from any places whatever; and I may add that no exact account, however scanty the information given, can fail to possess some value, or to help in throwing light on the nature and origin of the shock.

1.—Name of the place where the earthquake was observed.

2.—Time at which it was felt, if possible to the nearest minute.

3.—Nature of the shock: (a) Were two distinct shocks felt, separated by an interval of a few seconds? (b) If so, which was the stronger? (c) What was the duration of each, and of the interval between them? (d) Was the sound heard during this interval?

4.—How many seconds did the shock last, not including the accompanying sound?

5.—Was the shock strong enough (a) to make doors, windows, fire-irons, crockery, &c., rattle; (b) to cause the chair, &c., on which the observer was resting to be perceptibly raised or moved; (c) to make chandeliers, pictures, &c., swing, or to stop clocks?

6.—(a) Was the shock accompanied by any unusual rumbling sound; and, if so, what did it resemble? (b) Did the beginning of the sound precede, coincide with, or follow, the beginning of the shock, and by how many seconds? (c) Did the end of the sound precede, coincide with, or follow, the end of the shock, and by how many seconds? (d) Were the strongest vibrations felt before, at, or after the instant when the sound was loudest, and by how many seconds?

Yours obediently,

CHARLES DAVISON.

373, Gillott Road, Birmingham.

P.S.—At the Editor's request, I add a few lines as to the extent of the area disturbed by this earthquake. As far as I can judge from a hasty glance at the records already received, the disturbed area seems to have been nearly, but not quite, the same as that of the earthquake of August 18th, 1892. If anything, it is somewhat greater; but this may be due to the occurrence of the shock at a more favourable hour for observation. It was certainly noticed

further both to the east, north and west, having been felt at Bournemouth, Marlborough and Birmingham, at several places in the south of Lancashire, and in Ireland, in the counties of Kilkenny and Waterford. On the other hand, it was, I believe, less perceptible in the south of Cornwall than the shock of last year, and this seems to point to a more northerly position for the centre of disturbance.

THE DROUGHT AND HEAT OF 1893.

To the Editor of the Meteorological Magazine.

SIR,—The drought which ended for a time on 21st June, being followed by nearly the average rainfall during July, reasserted itself early in August—the 22 days from 5th to 26th of August inclusive only yielding 0·20 in. of rain, and the first 15 days of September only 0·12 in.

The following figures show how remarkably dry each of the first three quarters of the year has been ; while the total of 9·39 in. for the 9 months is probably the smallest on record :—

	in.		in.
January	1·46	}	4·85
February	2·99		
March	·40		
April	·08	}	1·42
May	·36		
June	·98		
Half Year =			6·27
July	1·73	}	3·12
August	·42		
September	·97		
Nine Months =			<u>9·39</u>

The exceptional heat of 6th to 22nd August also deserves recording—the maxima of the 17 consecutive days ranging from 75°·7 to 93°·7, a mean max. of 83°·9 for that period ; of just 85° for the 15 days from 7th to 21st ; and of 87°·1 for the 11 days from 8th to 18th, the mean temperature of the same 11 days being 72°·1, and the hottest day of all the 18th, with a max. of 93°·7, the very remarkable min. of 68°·5, and a mean of 81°·1.

All my thermometers are on a Glaisher stand.

The effects of such a season on vegetation have been in many cases phenomenal. For instance, there is a good second crop of ripe strawberries early in *October* at Eastbourne, Hampstead, Cambridge, and elsewhere.—Yours truly,

PERCY BICKNELL.

Foxgrove, Beckenham, October, 1893.

P.S.—In the middle of the month strawberries were abundant in the Cambridge market, one grower (at Histon) alone gathering over a ton ; while gooseberries were said to be not long over, and apple trees to be bearing a second crop of fruit then “as large as walnuts.” Strawberries continued plentiful almost to the end of the month, and fine raspberries were gathered in Cambridge and Lancashire, and as late as the 29th near Ongar, Essex.

October 31st.

OCTOBER RASPBERRIES AND STRAWBERRIES.

To the Editor of the Meteorological Magazine.

SIR,—You will be interested to hear that a small dish of ripe raspberries was gathered in the garden here on October 27th.—Yours faithfully,

R. C. CANN LIPPINCOTT.

Over Court, near Bristol, October 31st, 1893.

[We add the following confirmatory notes from the *Journal of Horticulture*.—ED.]

Whitcroft, Pershore, Worcestershire.—I have picked several small dishes of raspberries this month, finer and quite as good flavoured as they were in the summer, and very highly coloured. I also gathered some on October 27th.—JAS. WICKETTS.

Hollingbourne House, Maidstone, Kent.—On September 18th I gathered a good dish of ripe raspberries, left others, some just colouring, but whether they will ripen is a question. The fruit is from the summer fruiting varieties, but the crop was a very light one, the hot dry season having a great effect upon this particular fruit.—G. R. HEMMINGS.

Cambridge, October 24th.—As an illustration of the very exceptional character of the season we forward some fresh gathered strawberries, being now busy picking and preserving our second crop this year. We have already, during October, gathered 1 ton 5 cwt., and as the plants have still a large quantity of blossom and green fruit, we expect to be able to pick double the weight if this mild weather continues.—S. CHIVERS & SONS.

The Gardens, Brockley Hall, Kent.—During the last week in September and up to the present time I have gathered about four and half dozen of ripe strawberries from plants grown out of doors. I have noticed only two sorts fruiting—viz., 'Black Prince' and 'Vicomtesse Héricart de Thury,' although one plant of 'Latest of All' bore two or three fruit. Some of the fruit were quite equal in flavour and size to those of the summer. To-day (October 25th) I find that there are about one and half dozen of good sized fruits, but many have decayed during the wet weather.—G. WALLIS.

REVIEWS.

Pubblicazioni della Specola Vaticana. Fascicolo II. and III., 4to: Tipografia Vaticana, Roma, 1891 and 1893, xxii.-306 pages and 20 plates; and xxx.-442 pages and 39 plates.

WE cannot trace having received or noticed Fascicolo I. of this excellent series, but we can speak most highly of the two which we have. Everyone who has ever had the pleasure of meeting Padre Denza, knows what energy he throws into all that he undertakes. When, therefore, the present Pontiff, Leo XIII., had decided that the observatory at the Vatican—originally founded in 1582 by Pope

Gregory XIII.*—should be rebuilt and equipped with good instruments, and that Padre Denza should be the Director, there was no doubt as to the quality or quantity of the work which would be issued from it.

The present volumes amply confirm our anticipations. In materials, in printing, and especially in the abundance and beauty of their illustrations, they have few rivals. As regards the plates of clouds by Signor Manucci in Fascicolo III., we have seen nothing approaching them for beauty and for fidelity.

The work of the observatory is divided into sections—Astronomy and Meteorology, to which Terrestrial Magnetism has been added. The observatory is housed in two separate buildings—one in the Vatican, in the old observatory of Pope Gregory, and the other in the Leonine Tower on the top of the hill. As far as we can gather, it appears that the whole cost of fitting up the buildings, and providing splendid instruments, and of the endowment, has been defrayed personally by the present Pope, either out of his own resources, or from the offerings forwarded at his Jubilee. Be that as it may, it is beyond all question that it is to Leo XIII. that science is indebted for the establishment of a first-class observatory, and for very handsome annual volumes of results.

Report on the present state of our knowledge respecting the General Circulation of the Atmosphere. Presented to the Meteorological Congress at Chicago, August, 1893, by L. TEISSERENC DE BORT. London : Edward Stanford, 1893. 4to, 20 pages, and 15 maps and diagrams.

M. TEISSERENC DE BORT, who is well known as one of the staff of the French Meteorological Office and as General Secretary of the Meteorological Society of France, seems to us to have rendered considerable service to meteorologists by the preparation of this paper. The views expressed in it are in many respects similar to those of Ferrel, but the present paper, although dealing with many abstruse points, has the singular merit of extreme lucidity. One could rarely find a page, even in what Ferrel regarded as a popular work, in which one or more mathematical equations did not occur. In the present paper we do not see one from beginning to end, and yet the author gives a clear account of Ferrel's work, attacks weak portions of it, and carries on the investigation considerably further than Ferrel had done.

The way in which M. Teisserenc de Bort works in his previous researches on the distribution of cloud over the globe, and the pretty little plates in which he gives views of the Eastern and Atlantic hemispheres of the earth, as seen from (say) Mars, and compares them with Jupiter, as photographed at Paris in 1886, can only be done justice to by those who have this nicely printed memoir before them.

* The author of the Gregorian Calendar, now used almost everywhere except in Russia.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, MAY, 1893.

STATIONS. (Those in italics are South of the Equator.)	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.									
°		°		°	°	°	0-100	°	°	inches			
England, London	78·6	12	38·2	31	70·2	47·4	46·3	67	127·9	34·0	·80	8	4·4
Malta.....	81·9	30	52·5	8	74·4	59·6	57·8	77	137·3	47·0	·15	2	4·3
Cape of Good Hope ...	84·1	31	37·1	20	67·1	50·8	52·3	82	...	...	2·49	10	5·1
Mauritius	80·3	1	61·1	23	71·7	67·6	65·7	81	132·2	53·4	4·13	23	5·5
Calcutta.....	96·9	20	66·4	7	89·2	75·3	75·5	80	159·0	66·8	17·11	11	5·7
Bombay.....	91·8	27	75·3	29	89·8	79·9	75·5	75	149·0	73·2	6·30	6	3·3
Ceylon, Colombo	88·7	3	71·3	15	85·4	76·9	72·9	78	150·5	70·0	10·32	26	7·6
Melbourne.....	72·5	4	35·9	15	62·3	49·9	49·2	78	121·8	28·5	4·00	18	7·3
Adelaide	77·1	24	43·8	19	65·9	52·3	48·5	68	134·2	37·5	3·56	15	5·8
Sydney	70·2	30	43·7	17	64·5	52·0	50·7	84	121·0	32·0	1·35	15	4·1
Wellington	65·7	5	41·0	28	61·1	50·5	48·0	76	120·0	30·0	3·16	16	4·5
Auckland	70·0	16	48·5	20	64·2	54·6	54·9	86	122·0	44·0	3·73	23	6·7
Jamaica, Kingston.....	87·9	21	69·2	13	86·0	71·7	70·4	80	...	...	2·67	10	5·6
Trinidad	93·0	15 ^a	66·0	30	88·1	70·2	71·3	78	141·0	64·0	11·35	23	...
Toronto	73·2	21	37·6	24	61·0	42·9	42·6	70	...	31·2	3·86	13	6·0
New Brunswick, Fredericton	83·7	12	27·4	8	63·7	39·7	40·2	64	...	...	3·26	15	6·0
Manitoba, Winnipeg ...	81·6	31	18·0	1	64·0	38·0	...	...	...	...	2·23	5	5·0
British Columbia, Esquimalt	66·2	15	40·1	24	58·4	45·1	46·4	85	...	...	2·40	22	7·0

^a And 17th.

REMARKS.

MALTA.—Mean temp. 65°·4; mean hourly velocity of wind 8·7 miles. J. SCOLES.

Mauritius.—Mean temp. of air 0°·6 below, dew point 1°·5 above, and rainfall ·10 in. above, their respective averages. Mean hourly velocity of wind 9·7 miles, or 0·3 below average; extremes, 27·1 on 26th, and 0·0 on 21st; prevailing direction, E.S.E. Lightning on 14th and 15th; thunder and lightning on 16th, 17th, 18th and 19th.

CEYLON, COLOMBO.—Thunderstorms occurred on the 5th, 6th, 7th, 8th, 11th and 12th.

F. C. H. CLARKE, Lt.-Col. R.E.

Melbourne.—Frost on the 15th; lunar halo on 24th; lightning in S.E. on the 8th, and S.W. on the 22nd.

R. L. J. ELLERY, F.R.S.

Adelaide.—Mean pressure 0·141 in. below the average, and the lowest with one exception in 36 years. Mean temp. 1°·4 above the average; rainfall, ·60 in. above the average at Adelaide, and very heavy over the country to the North—some stations recording 9 to 10 inches for the month.

C. TODD, F.R.S.

Sydney.—Temp. 0°·2 below, rainfall 3·96 in. below, and humidity 9°·1 above their respective averages.

H. C. RUSSELL.

Wellington.—From the 4th to the 25th generally showery, with intervals of fine, bright days; fine and bright in the early and latter parts of the month. Prevailing N.W. and S.E. winds, generally moderate in force. Fog on 20th; earthquakes on 12th, 13th, 18th and 27th. Mean temp. 3°·8 above the average.

R. B. GORE.

Auckland.—A warm, moist and disagreeable month; but with no heavy falls of rain, save one of 1·23 in. on the 21st. Mean temp. more than 2° above the average; rainfall about ·25 in. below the average.

T. F. CHEESEMAN.

JAMAICA, KINGSTON.—Fair. Rain only one-half of the average, although the rains generally were above the average. Mean hourly velocity of wind 3·9 miles.

ROBT. JOHNSTONE.

SUPPLEMENTARY TABLE OF RAINFALL,
OCTOBER, 1893.

[For the Counties, Latitudes, and Longitudes of most of these Stations,
see *Met. Mag.*, Vol. XIV., pp. 10 & 11.]

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			
II.	Dorking, Abinger Hall.	4.30	XI.	Builth, Abergwessin Vic.	6.95
„	Birchington, Thor	2.46	„	Rhayader, Nantgwillt..	6.69
„	Brighton Prestonville Rd	...	„	Corwen, Rhug	3.01
„	Hailsham	4.75	„	Carnarvon, Cocksida ...	4.32
„	Ryde, Thornbrough	5.01	„	I. of Man, Douglas	4.63
„	Alton, Ashdell	4.59	XII.	Stoneykirk, Ardwell Ho.	2.60
III.	Oxford, Magdalen Col...	2.56	„	New Galloway, Glenlee	5.88
„	Banbury, Bloxham	2.60	„	Melrose, Abbey Gate ...	1.73
„	Northampton, Sedgebrook	2.88	XIII.	N. Esk Res. [Penicuick]	3.65
„	Alconbury	3.90	„	Edinburgh, Blacket Pl..	2.51
„	Wisbech, Bank House..	2.89	XIV.	Glasgow, Queen's Park.	5.02
IV.	Southend	2.76	XV.	Islay, Gruinart School..	6.96
„	Harlow, Sheering	1.75	XVI.	Dollar	3.53
„	Colchester, Lexden	1.92	„	Balquhider, Stronvar..	7.23
„	Rendlesham Hall	2.00	„	Coupar Angus Station..	2.30
„	Diss	2.17	„	Dunkeld, Inver Braan..	3.15
„	Swaffham	2.17	„	Dalnaspidal H.R.S. ...	6.86
V.	Salisbury, Alderbury...	4.19	XVII.	Keith H.R.S.	3.03
„	Bishop's Cannings	4.36	„	Forres H.R.S.	3.65
„	Blandford, Whatcombe.	4.88	XVIII.	Fearn, Lower Pitkerrie.	3.65
„	Ashburton, Holne Vic....	4.31	„	Loch Shiel, Glenaladale	16.55
„	Okehampton, Oaklands.	4.72	„	N. Uist, Loch Maddy ...	6.83
„	Hartland Abbey	5.54	„	Invergarry	10.30
„	Lynmouth, Glenthorne.	5.36	„	Aviemore H.R.S.	3.48
„	Probus, Lamellyn	4.53	„	Loch Ness, Drumnadrochit	4.31
„	Wincanton, Stowell Rec.	3.40	XIX.	Invershin	4.32
„	Weston-super-Mare .....	...	„	Scourie	8.64
VI.	Clifton, Pembroke Road	5.49	„	Watten H.R.S.	5.36
„	Ross, The Graig	2.09	XX.	Dunmanway, Coolkelure	4.19
„	Wem, Clive Vicarage ...	2.09	„	Fermoy, Gas Works ...	2.39
„	Cheadle, The Heath Ho.	1.73	„	Killarney, Woodlawn ...	3.92
„	Worcester, Diglis Lock	1.53	„	Tipperary, Henry Street	4.27
„	Coventry, Coundon	3.61	„	Limerick, Kilcornan ...	...
VII.	Ketton Hall [Stamford]	2.48	„	Ennis	3.77
„	Grantham, Stainby	2.26	„	Miltown Malbay	4.81
„	Horncastle, Bucknall ...	1.10	XXI.	Gorey, Courtown House	2.50
„	Worksop, Hodsck Priory	1.69	„	Mullingar, Belvedere ...	2.11
VIII.	Neston, Hinderton	2.03	„	Athlone, Twyford	2.65
„	Knutsford, Heathside...	2.63	„	Longford, Currygrane...	3.71
„	Lancaster, Rose Bank...	6.10	XXII.	Galway, Queen's Coll...	4.89
„	Broughton-in-Furness..	8.06	„	Crossmolina, Enniscoe..	3.79
IX.	Ripon, Mickley	1.34	„	Collooney, Markree Obs.	4.01
„	Scarborough, South Cliff	...	„	Ballinamore, Lawderdale	3.37
„	East Layton [Darlington]	1.15	XXIII.	Lough Sheelin, Arley ..	3.31
„	Middleton, Mickleton...	2.37	„	Warrenpoint	2.14
X.	Haltwhistle, Unthank...	2.74	„	Seaforde	1.75
„	Bamburgh	2.01	„	Belfast, Springfield	3.12
„	Newton Reigny	3.81	„	Bushmills, Dundarave...	5.19
XI.	Llanfrechfa Grange	3.36	„	Stewartstown	3.02
„	Llandovery	6.01	„	Buncrana	5.23
„	Castle Malgwyn .....	...	„	Lough Swilly, Carrablagh	6.26

OCTOBER, 1893.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.					Days on which '01 or more fell.	TEMPERATURE.				No of Nights below 32°	
		Total Fall.	Differ- ence from average 1880-9.	Greatest Fall in 24 hours		Max.		Min.		In shade.	On grass.		
				Dpth	Date			Deg.	Date			Deg.	Date
		inches.	inches.	in.				Deg.	Date	Deg.	Date		
I.	London (Camden Square) ...	3·87	+ ·98	1·16	9	16	66·3	16	27·8	31	2	2	
II.	Maidstone (Hunton Court)...	3·37	— ·09	1·15	11	16	...	...	...	...	...	...
III.	Strathfield Turgiss	3·17	+ ·33	·59	9	24	64·1	16	25·6	31	2	6	
IV.	Hitchin	3·62	+ ·55	1·19	9	16	65·0	16 ^a	27·0	31	3	...	
V.	Winslow (Addington)	2·31	— ·78	·73	7	14	67·0	16	24·0	31	2	6	
VI.	Bury St. Edmunds (Westley)	2·80	— ·47	·73	9	13	64·0	16	28·0	31	...	...
VII.	Norwich (Cossey)	2·01	— 1·83	·37	21	15	...	...	...	...	...	...
VIII.	Weymouth (Langton Herring)	4·05	+ ·51	1·03	17	19	64·0	16	31·0	31	1	...	
IX.	Torquay (Cary Green) ...	2·84	...	·52	17	18	64·7	21	33·6	31	0	1	
X.	Bodmin (Fore Street)	5·60	— ·40	1·02	10	25	...	...	...	...	...	...
XI.	Stroud (Upfield)	2·38	— ·65	·44	21	14	68·0	16	26·0	31	2	...	
XII.	Church Stretton (Woolstaston)	3·10	— ·67	·70	10	16	66·5	21	29·0	31	1	6	
XIII.	Tenbury (Orleton)	2·44	— ·77	·45	13	16	67·2	21	24·8	31	4	8	
XIV.	Leicester (Barkby)	2·23	— ·92	·50	7	13	69·0	15	19·0	30	4	11	
XV.	Boston	2·27	— ·84	·87	9	14	66·0	1	26·0	31	2	...	
XVI.	Hesley Hall [Tickhill].....	1·42	— 1·68	·67	7	11	69·0	21	27·0	31	2	...	
XVII.	Manchester (Plymouth Grove)	2·98	— ·39	·45	10	17	66·0	16	24·0	30	3	3	
XVIII.	Wetherby (Ribston Hall) ...	1·95	— 1·18	·55	8	11	...	...	...	...	...	...
XIX.	Skipton (Arncliffe)	6·13	+ ·10	1·24	15	21	...	...	...	...	...	...
XX.	Hull (Pearson Park)	1·62	— 2·03	·37	10	13	66·0	15 ^a	29·0	30 ^c	2	6	
XXI.	Newcastle (Town Moor)	·81	— 2·31	·17	7	13	...	...	...	...	...	...
XXII.	Borrowdale (Seathwaite).....	18·63	+ 8·04	3·71	15	23	...	...	...	...	...	...
XXIII.	Cardiff (Ely)	6·94	+ 2·40	1·54	4	20	...	...	...	...	...	...
XXIV.	Haverfordwest	4·49	— ·66	·69	11	22	61·9	16	27·3	31	3	...	
XXV.	Aberystwith, Gogerddan	5·67	+ ·32	·86	13	19	66·0	21	22·0	30 ^c	...	...
XXVI.	Llandudno	3·40	+ ·01	·34	14	21	...	...	...	...	...	...
XXVII.	Cargen [Dumfries]	4·30	+ 1·04	·66	25	23	61·8	16	25·4	31	3	...	
XXVIII.	Jedburgh (Sunnyside).....	1·75	— ·90	·49	24	10	63·0	16	25·0	31	4	...	
XXIX.	Old Cumnock	5·87	+ 2·47	·70	24	27	...	...	...	...	...	...
XXX.	Lochgilphead (Kilmory).....	9·27	+ 4·48	1·84	24	29	...	...	24·0	30	7	...	
XXXI.	Morvern (Grimnin)	11·37	— 1·68	·24	30	...	...	...	...	...	...	...
XXXII.	Mull (Quinish)	9·31	+ 4·02	1·20	24	28	...	...	...	...	...	...
XXXIII.	Loch Leven Sluices	2·70	— ·26	·80	25	8	...	...	...	...	...	...
XXXIV.	Dundee (Eastern Necropolis)	2·60	+ ·36	·65	13	12	62·5	15	28·0	31	2	...	
XXXV.	Braemar	2·99	— ·62	1·26	8	18	59·9	15	29·0	31	2	17	
XXXVI.	Aberdeen (Cranford) ...	2·39	...	·42	8	16	64·0	16	31·0	31	3	...	
XXXVII.	Strome Ferry .....	...	...	...	...	...	...	...	...	...	...	...
XXXVIII.	Cawdor [Nairn]	3·55	+ ·82	·76	8	21	...	...	...	...	...	...
XXXIX.	Dunrobin	4·49	+ 1·18	·63	8	21	...	...	30·0	31	2	...	
XL.	S. Ronaldsay (Roeberry).....	6·75	+ 3·02	·85	4	31	57·0	2	33·0	29	0	...	
XLI.	Darrynane Abbey	3·12	...	·56	16	23	...	...	...	...	...	...
XLII.	Waterford (Brook Lodge) ...	2·32	— 1·50	·45	17	18	64·5	16	28·0	30	5	...	
XLIII.	O'Briensbridge (Ross)	3·30	...	·51	13	19	62·0	17	31·0	31	3	...	
XLIV.	Carlow (Browne's Hill)	2·32	— ·97	·78	17	19	...	...	...	...	...	...
XLV.	Dublin (Fitz William Square)	1·03	— 2·35	·32	14	16	67·7	21	31·7	31	1	8	
XLVI.	Ballinasloe	3·17	+ ·18	·64	14	20	59·0	20	28·0	31	2	...	
XLVII.	Clifden (Kylemore)	8·27	...	1·55	14	27	...	...	...	...	...	...
XLVIII.	Waringstown .....	...	...	...	...	...	...	...	...	...	...	...
XLIX.	Londonderry (Creggan Res.)...	5·15	+ 1·48	·49	5	28	...	...	...	...	...	...
L.	Omagh (Edenfel)	4·37	+ 1·27	·47	25	27	61·0	14 ^b	28·0	30	6	11	

a And 21. b And 15 & 20. c And 31.

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

METEOROLOGICAL NOTES ON OCTOBER, 1893.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; 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.

STRATHFIELD TURGISS.—A genial month, with copious showers during the first fortnight, but the country was still very dry, and the rivers low at the close. A sharp snap of frost occurred on the 30th and 31st. Swallows seen for last time on the 2nd. Red Admiral butterfly flying on the 21st. Min. on grass on 31st, 18°·9.

ADDINGTON.—A fine open month, with a moderate rainfall, which kept vegetables of all kinds growing in a very marked manner, and a good many strawberries were gathered. No frost in shade until the 30th, but very sharp on the morning of the 31st, killing all tender plants, the min. on grass falling to 21°. T on 5th, 6th, and 7th, and very heavy R from 5 p.m. to 7 p.m. on the latter day.

BURY ST. EDMUNDS.—A lovely autumnal month, very mild till the 30th. Great complaints of want of water in many parishes in West Suffolk, and much illness. TS on the 5th.

LANGTON HERRING.—The weather from the 1st to the 11th was wet and mild, with very little variation of temp. from day to day. T and L on 7th, 8th, and 17th. The 14th, 15th, and 16th were very close and damp. The 30th and 31st were bright, dry, and cold. The mean temp. at 9 a.m. (51°·6) is 1°·6 above the average.

BODMIN, FORE STREET.—A rather wet month, and heavy falls of R on the 2nd and 10th. Some days rather warm, but cold in the last week. Frost on the mornings of 13th and 31st.

STROUD, UPFIELD.—L and T on 2nd, 3rd and 5th; L on 4th and 6th. Large flakes of S at night on 31st.

WOOLSTASTON.—A splendid autumn month. Mean temp. 49°·7.

TENBURY, ORLETON.—A fine month; mean temp. about 1° above the average. Some days very warm, particularly from the 14th to 17th inclusive. Very severe frost on 30th and 31st. Fog on 5 days. T from 3.30 to 4 p.m. on 1st.

LEICESTER, BARKBY.—A wonderfully fine month; more grass than in summer. Mean temp. 49°·0. T during the first week, and hard frost during the last week. R a good average, but falling mostly at night. L and T on 3rd.

MANCHESTER.—T on the 1st. Thick fog up to 10 a.m., then bright and sunny, on 30th and 31st. Fine autumn weather prevailed during most of the month, but there were periods of both summer and winter weather. Mean temp. 49°·3.

SEATHWAITE.—Falls of R exceeding an inch occurred on 7 days; exceeding two inches on 2 days; and exceeding three inches on one day. In the three days, 13th to 15th, 6·35 in. fell.

WALES.

HAVERFORDWEST.—A changeable month, and the wettest since February; still, there were many fine days, as much of the R fell at night. General appearance of the country very much improved. Frost occurred about the 11th and 19th, and again on the 30th and 31st. The Precelly range was white with S on the morning of the 31st. The wind was boisterous at times, but never reached the force of a gale; prevailing directions, S.W., S.E., and N.W. L on 5th.

GOGERDDAN.—Stormy throughout the month, with very growing weather.

SCOTLAND.

CARGEN.—The meteorological conditions of the month approached very nearly the average. The mean temp. was half a degree below the average. Pretty hard frosts were experienced on the last two nights of the month, which

quite destroyed the blooms of the very unusual number of flowering plants we have had this autumn. A TS occurred on the 5th, and a solar halo was seen on the 15th.

JEDBURGH.—The weather continued remarkably fine during the month, and allowed all out-door work to go on unchecked. The potato crop was lifted in good order. Grass as fresh looking as in midsummer. Turnips a fair crop.

ROEBERRY.—A very wet month, not one rainless day; the wettest recorded for 26 years. Mean temp. $47^{\circ}9$.

IRELAND.

DARRYNANE ABBEY.—A rather dry month so far as total goes, but few really fine days. Mild on the whole. Slight frost on 5th.

WATERFORD, BROOK LODGE.—Mean temp. $48^{\circ}4$. Springs very low. Strawberries ripe in the garden on 22nd. T on the 2nd.

O'BRIENSBRIDGE, ROSS.—The min. temp. on the night of the 16th was 55° , the max. on the succeeding day 62° , an unusually small range in mid October. The month closed with one of the brightest days of a fine season, after a slight frost.

DUBLIN.—A favourable month, of average mean temp and atmospheric pressure. There was an overwhelming prevalence of westerly and south-westerly winds, which kept the rainfall far below the average on the leeward side of the Dublin and Wicklow mountains. On the 20th and 21st there was a remarkable wave of heat. On the 30th and 31st the cold was equally decided. Mean temp. $50^{\circ}0$, slightly above the average ($49^{\circ}7$). A lunar corona was seen on the 24th. Aurora borealis on the 29th. High winds were noted on 9 days, and attained the force of a gale on the 25th and 28th. The atmosphere was more or less foggy on the 7th, 18th, and 20th. L was seen on the evenings of the 3rd, 4th, 5th, and 30th. H fell on the 26th.

OMAGH, EDENFEL.—The raw rainy weather of the first fortnight gave way to an extremely mild spell on the 14th, the mean temp. of the following day reaching 59° —an unprecedented record here in October. The remainder of the month continued wet and unsettled, but the almost total absence of frost till the last week, enabled the gradually maturing foliage to exhibit an unusual splendour of autumn tints.
