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THE MOON AND RAINFALL.

By W. ELLIS, F.R.S.

IN the number of this magazine for November, 1901, there is a communication from Mr. MacDowall, in which he draws attention to the circumstance that in the years 1889 to 1900 the rainfall at Greenwich was in each year "greater about new moon than about the middle of the time between full moon and last quarter." He takes the sum of rainfall on the day before, the day of, and the day following new moon, and the sum also for the third, fourth and fifth days, following full moon, in each month of every year. Forming annual means of these sums he finds as stated that the value at new moon is greater in every year, by amounts varying from 0·02 in. to 0·25 in., with a mean excess of 0·10 in.

Mr. MacDowall remarks that he hoped "at some future time to extend this branch of the inquiry further back." But why, it may be asked, should he publish a partial result at all, since the labour of carrying back the investigation to earlier years was not great, and the Greenwich records, on which the results are based, are easily available. I am led to offer this remark from having noticed in other of Mr. MacDowall's papers their fragmentary character. Considering his capacity for work, one hardly understands how he can be content to put forward results that can carry little or no weight, when the material is to hand on which to base something more worthy of attention, more especially considering that he attacks subjects that call for somewhat exhaustive treatment. No good purpose is served by publishing immature work, indeed harm, and too often such is done. Better to labour more in secret, than produce that which cannot reasonably carry some degree of conviction. Even a negative result, if arrived at after a laborious investigation, is well worth making known, as it may prevent others doing unprofitable work.

In the present case any person meeting with Mr. MacDowall's figures would be inclined at once to ask what happened before the year 1889. I have had the curiosity to inquire, having re-calculated what Mr. MacDowall has done, and carried back the investigation to include the forty years 1862 to 1901, sufficient for my present

purpose (see annexed table). My numbers for the years 1889 to 1900 confirm entirely those of Mr. McDowall, but it will be seen that whilst in each year from 1889 to 1900 the new moon value is the greater; in 1888, the year next preceding that first employed by him, it is less by 0·19 in. It is also less in seven out of the twelve years that precede the twelve used by him. There are also six years, 1872 to 1877, having consecutively a lesser new moon value.

It will be further seen by the table that there is a tendency to — values in the earlier years, and a yet more decided tendency to + values in the later years. Dividing the whole period into four groups of ten years each, we deduce from the table as follows :—

Mean three days' Rainfall.

Period.	At New Moon. in.	Following Full Moon. in.	Excess at New Moon. in.
1862—1871	0·204	0·213	— 0·009
1872—1881	0·208	0·237	— 0·029
1882—1891	0·197	0·177	+ 0·020
1892—1901	0·234	0·140	+ 0·094

Considering that the average three days' rainfall is about 0·20 in. the differences in the first three decades, regarding the variable character of rainfall, are perhaps not surprising: that in the fourth decade is considerable, but it happens here that the rainfall at new moon is much above the average, and that following full moon very much below. It forms no part of my object to suggest any direct cause of these variations, but it has yet to be shown that the moon has anything to do therewith.

Meteorological investigations of the kind cannot be, as it were, rushed or settled by a few figures hastily thrown together. Nature does not so readily yield up many of her secrets. In the apparent charm and fascination that impels people to endeavour to trace lunar influence in meteorology it seems not to be sufficiently understood that the sun is the real disturber of the atmosphere, variations otherwise produced appearing to be, in comparison, insignificant, and correspondingly difficult to determine. It is to be remembered that no sensible heat is received from the moon, and the endeavour to trace lunar influence on rainfall is not encouraged thereby. Besides which in any attempt to discover lunar influence in meteorology a first condition is that the inquiry should be thorough, based on a long series of observations, and also on the records of different places, in order that any proposition made may, as far as possible, be either distinctly affirmed or negatived thereby. For otherwise, one inquiry may reveal some apparent connection that another inquiry would apparently overturn, rendering it doubtful whether the resulting numbers could, in either case, be taken as anything more than accidental residuals, that is effects of which the precise cause is unknown.

Mean Three Days' Rainfall at the Royal Observatory, Greenwich.

Year.	At New Moon.	Following Full Moon.	Excess at New Moon.	Year.	At New Moon.	Following Full Moon.	Excess at New Moon.
	in.	in.	in.		in.	in.	in.
1862.....	·07	·40	—·33	1882.....	·10	·20	—·10
1863.....	·08	·20	—·12	1883.....	·14	·15	—·01
1864.....	·21	·11	+·10	1884.....	·08	·14	—·06
1865.....	·45	·17	+·28	1885.....	·36	·16	+·20
1866.....	·28	·32	—·04	1886.....	·30	·17	+·13
1867.....	·18	·23	—·05	1887.....	·19	·21	—·02
1868.....	·28	·14	+·14	1888.....	·12	·31	—·19
1869.....	·17	·30	—·13	1889.....	·19	·10	+·09
1870.....	·14	·13	+·01	1890.....	·30	·20	+·10
1871.....	·18	·13	+·05	1891.....	·19	·13	+·06
1872.....	·29	·32	—·03	1892.....	·27	·15	+·12
1873.....	·15	·24	—·09	1893.....	·28	·08	+·20
1874.....	·16	·20	—·04	1894.....	·17	·15	+·02
1875.....	·08	·19	—·11	1895.....	·31	·27	+·04
1876.....	·21	·23	—·02	1896.....	·36	·17	+·19
1877.....	·19	·24	—·05	1897.....	·22	·14	+·08
1878.....	·25	·19	+·06	1898.....	·13	·10	+·03
1879.....	·26	·24	+·02	1899.....	·30	·05	+·25
1880.....	·16	·21	—·05	1900.....	·14	·11	+·03
1881.....	·33	·31	+·02	1901.....	·16	·18	—·02

The three days included at New Moon are the day before, the day of, and the day following New Moon. Those following Full Moon are the 3rd, 4th and 5th days after that of Full Moon.

The excess in the last column is to be understood algebraically, the sign — indicating defect.

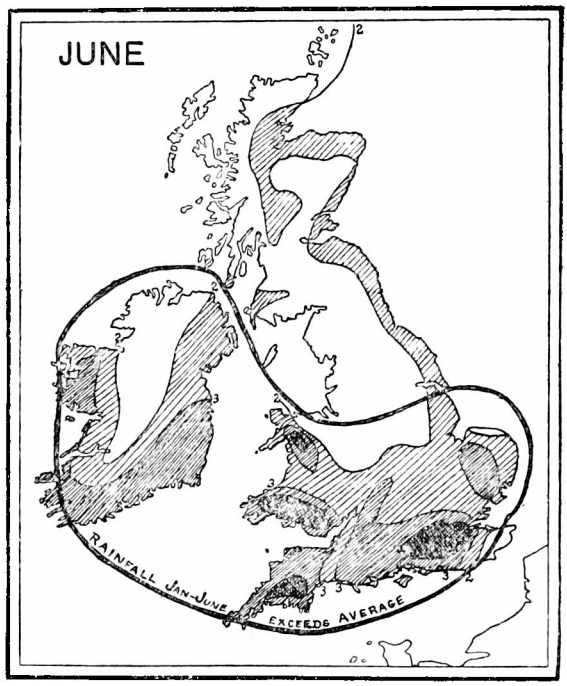
Each yearly value depends on 12 monthly values, excepting, for New Moon, in the years 1864, 1867, 1870, 1872, 1875, 1878, 1880, 1883, 1886, 1889, 1891, 1894, 1897, 1900; and for Full Moon in the years 1863, 1866, 1868, 1871, 1874, 1876, 1879, 1882, 1885, 1887, 1890, 1893, 1895, 1898, 1901, when they depend on 13 monthly values.

THE WEATHER OF JUNE AND THE RAINFALL OF THE FIRST HALF OF 1902.

WITH reference to our article in the previous number on the probable weather of the last week in June, in London, it is interesting to notice that the week, except its last day, was absolutely rainless, and for several days absolutely cloudless. As an illustration of the dryness of the air we may mention that at Camden Square, on the 28th, at 0·20 p.m., the dry bulb thermometer read 82°·3, and the wet bulb only 62°·3. Mr. J. McEwan sends us the following record of the week's sunshine at Enfield, which we think must be nearly unique.

Sunday,	22nd June, 1902	10 hrs.	45 min.
Monday,	23rd ,, ,,	5 ,,	50 ,,
Tuesday,	24th ,, ,,	15 ,,	0 ,,
Wednesday,	25th ,, ,,	15 ,,	20 ,,
Thursday,	26th ,, ,,	15 ,,	0 ,,
Friday,	27th ,, ,,	15 ,,	20 ,,
Saturday	28th ,, ,,	15 ,,	20 ,,
	Total for week	92 hrs.	35 min.

No finer weather for great functions in the open air could be imagined, and the dramatic stoppage of the ceremonies, in honour of which the whole British Empire was a-flutter with flags, suggested a curious thought—that fine weather is no palliation for anxiety and disappointment, although bad weather is an effective check to rejoicing.



With the exception of the brilliant week, which began on June 24th, the month proved inclement, following closely in the wake of one of the worst of Mays. The mean temperature over the whole country was low, especially in the second week. At Camden Square the mean temperature of each of the ten days, 7th to 16th, was below 55°, and averaged only 52°·3, about 8° below the average of 40 years; while for the eleven days, 6th to 16th, the maximum temperature never rose above 65°, and averaged a trifle under 59°, more than 12° below the average of 40 years, and this was typical of the whole country.

The distribution of rainfall in June was particularly interesting, and the accompanying map exhibits its general features. The unshaded part of the land indicates a rainfall under two inches, which prevailed over the centre and north of Ireland, the north-west and centre of England, and the greater part of Scotland. This is an inversion of the usual distribution, and, speaking generally, the shortage of rain has been accentuated at the stations where rainfall is usually high; and obliterated at those where it is usually low;

indeed, twice as much rain fell at the stations in Surrey as at those in the Lake District, or in the west of Scotland.

The map shows a darker shading for each additional inch of rain, and it will be observed that falls exceeding three inches were confined to the south of Ireland, North Wales, South Wales, the south, and some parts of the east, of England. To the south and west of London a large area had more than four inches of rain, and this was in fact the wettest part of the British Isles. In consequence, the average, estimated on the basis of the ten years 1890–99, was made up at most stations in the south, as the table of the six months' fall on p. 99 shows in detail. The heavy line on the map encircles all those parts of the country where the six months' rainfall of 1902 is known to have exceeded the average, with the single exception of the north-east of Scotland, where two stations showed an excess of 1 and 2 per cent. respectively. Since May the whole of Scotland, and the greater part of the north of England, beyond the Trent, has suffered an increase of deficiency by nearly five per cent., but the remainder of England and Wales has, speaking generally, improved its rainfall position by a similar amount. The heavy line on the map is merely diagrammatic; within it there is a fairly large area in South Wales, the lower Severn and upper Thames valleys, where several stations were still 10 per cent., and one as much as 20 per cent., short of the average fall for the half-year.

Correspondence.

THE IPSWICH STORM OF JULY 1ST.

To the Editor of Symons's Meteorological Magazine.

I have seen no reports in the London newspapers of the terrific storm which occurred here on Tuesday, July 1st, an account of which, from the *East Anglian Daily Times*, I enclose. The rainfall registered by my gauge between 0.45 and 2.45 p.m. was 2·62 in., and that from 9 a.m. on the 1st to 9 a.m. yesterday 2·85 in. Sir Cecil Domville, whose residence is about a mile from the centre of the town in a westerly direction, writes in this morning's paper that he registered 3·36 in. between 0.30 and 2.30 p.m., and 3·90 in. for the twenty-four hours ending at 9 a.m. on the 2nd.

E. R. TURNER.

Clare Lodge, Ipswich, 3rd July, 1902.

[The very full report of the storm is too long to quote even in abstract. It was a thunderstorm of unusual intensity accompanied by torrential rain, which in a few minutes converted the steeper streets into rushing cataracts. The ornamental ponds in the Park overflowed, and fish washed out of them were caught in gardens and houses a long distance away. Cellars were flooded in the lower-

lying streets; the flood swept through some houses carrying furniture into the street, where for a time the depth of water exceeded 3 feet. The tide happened to be low at the time of the storm, which consequently appears to have been less destructive than that of July 21st, 1897, when a high tide prevented the flood-water from flowing off rapidly. Although the roads were seriously damaged by the force of the rush of water, and several buildings were struck by lightning, no loss of life is reported.]

A JULY FROST.

To the Editor of Symons's Meteorological Magazine.

ON Wednesday morning, the 2nd instant, the following remarkably low minima of temperature were registered here:—

		°
In Stevenson Screen		39·9
On short grass	Spherical bulb thermometer	31·3
	Link bulb sensitive thermometer	30·2

The instruments were in perfect order, and the readings were carefully checked before the indices were disturbed.

I believe that July frosts prevailed extensively in 1863, but they must be extremely rare so near to the coast as at Southport. The minimum on the present occasion occurred under an easterly "calm."

JOSEPH BAXENDELL.

The Fernley Observatory, Southport,
3rd July, 1902.

DEW IN RAIN GAUGES.

To the Editor of Symons's Meteorological Magazine.

WITH reference to the recent correspondence on the effect upon the number of "days with rain" of the practice of including small amounts of dew and hoar frost, may I venture to point out that in properly-constructed Snowdon and Meteorological Office pattern rain gauges *extremely* little dew or hoar frost is ever deposited. The reason, of course, is that the rims and funnels of those instruments are in such sufficiently good thermal contact with the lower metal cylinder sunk for some distance into the ground, that conduction from the warmer earth generally prevents the upper part of the gauge from cooling sensibly below the dew-point. The contrast—after a calm, clear night—between the nearly clean and dry appearance of a Snowdon rim and funnel and the thickly rime-coated condition of the thermally-insulated funnel of a "Howard's bottle" rain gauge has frequently much impressed me. For this reason the latest (Float pattern) form of Halliwell's standard self-recording rain gauge, which is now rapidly coming into both English and Colonial use, has been designed to be a substantially dewless gauge.

JOSEPH BAXENDELL.

The Fernley Observatory, Southport,
3rd July, 1902.

REVIEWS.

The Climates and Baths of Great Britain, being the Report of a Committee of the Royal Medical and Chirurgical Society of London. C. THEODORE WILLIAMS, M.D., *Chairman*; P. HORTON SMITH, M.D., *Hon. Secretary.* Volume II. *The Climates of London and of the Central and Northern portions of England, together with those of Wales and of Ireland.* London: Macmillan and Co., 1902. Size 9 × 6. Pp. xvi. + 628. *Maps.*

THE first feeling aroused by this substantial volume is regret that it was found impossible to secure local co-operation to enable the climates of Scotland also to be treated. We trust that the valuable collection of information compiled regarding the other parts of the British Isles will yet lead to the production of a similar volume in the Northern kingdom.

The present volume contains nine principal articles, viz. The climate of—

London and Middlesex, by Dr. W. Ewart.
The East Coast, by Dr. W. Murrell.
The Midland Counties, by Dr. P. Horton-Smith.
Lancashire, by Dr. R. Maguire.
The Lake District, by Dr. H. L. Brooksbank.
Northumberland, Durham and Yorkshire, by Dr. W. S. Lazarus-Barlow.
North Wales, by Dr. D. J. Leech.
South Wales, by Dr. C. Theodore Williams.
Ireland, by Sir John W. Moore.

Each article might be profitably noticed in detail did space permit, for each is a storehouse of interesting facts which are brought together nowhere else. Being the work of medical men, the treatment of climate is mainly in its relation to health, and necessarily in conjunction with the other conditions which affect hygiene. The general impression left on our mind by the perusal of the volume is that the winds, humidity, sunshine and temperature of the British Isles are so uniform and free from extremes that variations due to difference of latitude are quite unimportant compared with those produced by local conditions of soil, elevation and exposure. The determining causes of local climate are in fact geographical rather than meteorological, and the book is really an essay in medical geography. This is recognised, though perhaps not fully, by the inclusion of orographical maps on a serviceable scale, their colouring indicating the height of the land in tints of brown and green, but the maps would be more expressive if the two shades of green employed had been transposed. It is recognised also by many of the authors in their appeal to the maps of Bartholomew's magnificent "Atlas of Meteorology," itself perhaps the greatest contribution to meteorological science ever published in this country. But an atlas can only be serviceable for general distributions; minor varieties of climate

must be discussed from observations in the localities themselves, and it is here that the chief drawback to the scientific completeness of the work occurs.

The question has sometimes been raised as to whether there is any use in meteorological societies collecting and publishing observations from numerous stations, and here it has a conclusive answer. Were it not for the "Meteorological Record" and Mr. Bayard's discussion of its contents for the ten years 1880-89, the volume now under notice would have been a thing of shreds and patches distressing to contemplate. As it is, many places rising into note as health resorts have either no meteorological records or observations for so short a time as to be practically valueless, a fact which is not always clearly pointed out by the authors. In the case of temperature the mean for a few years often comes within a few degrees of the true mean; but with rainfall this happens much more rarely. Thanks to the labours of the observers associated with the British Rainfall Organization, there is less lack of data with regard to the distribution of rain; but the uncritical handling of the recorded figures may lead to erroneous results. As a model of how rainfall should be treated for such a purpose, we have pleasure in referring to Dr. Theodore Williams' chapter on the Climate of South Wales, in which he introduces a short but masterly discussion of the rainfall by the late Mr. Symons. There the fall for each station is calculated to the true mean and given to the nearest inch. Some of the authors have omitted to call attention to the totally different values of rainfall in different periods of years, and an unwary reader might go far astray in accepting the average say of 1895-99 at a wet western station as comparable with an average of say 1870-99 at a dry eastern one. We feel it to be our duty to state this plainly in the hope that a second edition may rectify any confusion that may have arisen.

Several authors very properly dwell on the necessity of looking at the intensity as well as the total amount of rainfall. It is well known that some places with a very high annual fall have a smaller number of hours of rain than other places with perhaps only half the fall. The soil also is of supreme importance as regards the humidity of the air, which may be greater over clay in a comparatively dry district than over sand or gravel in a wet one. Much stress is justly laid by all writers on the primary importance of drainage and water supply. An interesting case in point is London, where the water-tight paving of the streets has led to a remarkable dessication of the soil immediately underlying it with excellent results to health. We are happy to see the firm and honest handling of the drainage and water supply of some rising health resorts, the authorities of which have not yet realized the duties they owe to the public.

An interesting remark is made in treating of the climate of the coast of North Wales as to the power of a cliff facing north to neutralize the effect of the cold north wind beating against it, which would be felt severely if the background were a valley or plain. We

published in our last volume, p. 43, a photograph taken in Sweden which illustrates this point well.

We cannot attempt to go critically into the numerical data which are cited, but we cannot pass the remarkable statement on p. 245 that the rainfall of "Northumberland, Durham and Yorkshire" is 30·975 in., as compared with 39·76 in. for the British Isles generally. Our first conjecture was that the figures had been transposed; but even so it would not put the matter right. There is evidently a blunder somewhere.

Sir John Moore's account of Ireland occupies nearly half the volume, and all readers must regret to see in the preface that this section had to be curtailed. The general ignorance of Ireland which prevails in England is ample justification for the author's enveloping the dry bones of his subject in the living tissues of literary and historical associations, and this he has done in an admirable way. We should much like to see his work in its entirety, provided with numerous maps and photographs, published as a separate book which would form a most attractive guide to Ireland for the serious visitor anxious to know something of the country.

Temperature Tables for the British Islands. Daily Means for the Thirty years 1871 *to* 1900, *with Diagrams and Additional Tables.* Published by the Authority of the METEOROLOGICAL COUNCIL. London, 1902. Size 12 × 10. Pp. xvi. + 120. Price 10*s.* 6*d.*

THIS is a report of exceptional value. It is, in the first place, a compendium of exact and authoritative detail. The mean daily temperature with maximum and minimum for the 30 years, the highest and lowest daily temperature, with maxima and minima and the year in which each occurred, are given for every day of each month for the four observatories of Valencia, Aberdeen, Falmouth and Kew. All the elements are deduced from the sheets of the photographic recording instruments, and the mean for the day is the mean of 24 hourly points taken from the curve. The enormous thermometers used for photographic recording respond more slowly to changes of temperature than do the ordinary thermometers placed in a Stevenson screen, and an elaborate comparison of the two made at Aberdeen is given in the introduction.

Curves representing each of the elements dealt with are given for Valencia and Aberdeen, and the ingenious device is adopted of printing two sets of the curves, one in red and one in green, on transparent paper so mounted that either may be superimposed for comparison on the other, or on the third set which is printed in black. A normal curve of the yearly temperature, deduced theoretically from a formula based on the harmonic analysis of the actual data, serves as a standard of reference for all the other curves of annual change.

Diagrams also give the mean daily curves in terms of differences

from the monthly average for each hour of the day for every month at the four observatories, and the same data are expressed in tables.

Finally, the Report gives a set of Tables embodying the means and extremes of temperature for each month and for the year at 117 other places distributed over the whole surface of the British Isles. Many of these do not cover the whole period of 30 years, but a supplement is promised to supply the means of adjustment for the difference in length of observations. The mean monthly temperature is given in these supplementary tables in two forms: first, the actual mean of the maximum and minimum readings; and, second, the corrected mean obtained from the former by Sir Richard Strachey's method, which differs from the actual mean by about half a degree in the most extreme cases.

These Temperature Tables are of great value in forming a basis for the study of daily and monthly variations of temperature; though it must be confessed that so far as a smooth curve is a proof of the length of time being sufficient to furnish true means it is shown clearly enough that 30 years is not enough to found averages upon. But this is where theoretical treatment shows its strength, and it is impossible to doubt that the smooth curve deduced by the formula suggested by the observations does really represent the true mean which observations for an infinite number of years would yield if there is no secular change in progress.

We congratulate Mr. Shaw and the staff of the Meteorological Office on producing a piece of work of lasting value and an excellent example of the scientific method of handling a mass of figures.

METEOROLOGICAL NEWS AND NOTES.

BEN NEVIS OBSERVATORY is to cease to exist in October. We reserve any comment on this statement except that there seems unfortunately to be little room to hope for the decision of the Directors being altered.

THE QUEENSLAND WEATHER BUREAU has, according to the *Brisbane Chronicle*, been "completely wiped out" by the refusal of the Federal Government of Australia to take it over along with the Post Office Department, to which it was attached. We sympathise with Mr. Wragge on this abrupt conclusion of his enthusiastic labours in Queensland; but as we have received no indication of the intentions of either the Federal or the State Government with regard to the meteorological service in the future, we cannot at present express any opinion on the matter. It is incredible that so progressive a community as the Australian, and one so dependent on an efficient system of weather warnings, can have allowed observations to lapse over a large part of the Commonwealth.

"THE GOVERNMENT OF INDIA have decided," says *The Times* of June 27th, "not to make public the forecasts which the [Meteorological] Department submit to them from time to time, on account

of the imperfect data on which such forecasts are necessarily based. The weekly reports which are sent home by the Government of India and published in this country give the most trustworthy indications that can be obtained, both of the actual facts and of the prospects for the future." The suggestion seems to be that the Government of India have sources of information which enable them to supplement the imperfect data of the Meteorological Department; but additional information on the subject would be welcome.

BRILLIANT SUNSETS probably due to volcanic dust in the atmosphere, have been reported from all parts of the country, and several of our correspondents have been kind enough to send in specimens of dust found in rain gauges, suggesting that they may be of volcanic origin. In a few cases the large quantity and coarse grain of the dust proves at once that it had its origin within the immediate neighbourhood of the gauge, in other cases the small quantity received makes it almost impossible to determine the nature of the material; but we have submitted all the samples to a geological authority for his opinion.

MR. W. H. DINES has been carrying on experiments with his rhomboidal kites at Crinan, in the west of Scotland, during the month of June, and has, we believe, succeeded in obtaining satisfactory meteorological records from heights up to 4,800 feet or more. Mr. John Anderson has been making similar experiments with a bamboo box-kite at Millport.

METEOROLOGICAL KITE-FLYING is absorbing increased attention in several countries, and Herr R. Assmann gives an account in the current number of *Das Wetter* of the desiderata for an ideal kite-station. He enumerates the risks that have to be guarded against and suggests methods, sometimes very elaborate, for overcoming the various difficulties. The ideal site is a flat-topped hill or plateau, bare of vegetation over a considerable area, but surrounded at a proper distance by woods, so that an escaped kite may be recovered by the wire entangling in the trees. There must be no towns, railways, electric tramways or telegraph wires, and, above all, no military camps or exercising grounds in the neighbourhood; and all points where danger might arise should be guarded by the erection of safety wires on posts from 15 to 30 feet high.

THE ANNUAL VISITATION OF GREENWICH OBSERVATORY took place on Saturday, June 7th, when the guests were welcomed during a thunderstorm, which gave point to the remark in the Astronomer-Royal's Report that the rainfall since the beginning of May was showing signs of redressing the drought of the seven previous years which had only had the rainfall of six average years.

MAGNETISM AND SEISMOLOGY form the subject of a new department of the Royal Meteorological Institute of the Netherlands which has been placed under the direction of Mr. Maurits Snellen, while Mr. C. H. Wind has been appointed Director-in-Chief of the Institute.

JUNE, 1902.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1890-9.	Greatest Fall in 24 hours. Dpth	Date	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Date	Min. Deg.	Date.	No. of Nights below 32°. In shade.	On grass.
			inches.	inches.	in.								
I.	ENGLAND.	London (Camden Square) ...	3·13	+ 1·23	·80	13	19	84·5	28	39·2	10	0	0
II.		Tenterden	1·57	— ·62	·26	3	16	81·0	28	40·0	10	0	0
,,		Hartley Wintney	3·36	+ 1·41	·68	13	18	85·0	28	40·0	10*c*	0	0
III.		Hitchin	...	...	...	...	..	...	...	...	...	...	...
,,		Winslow (Addington)	2·03	+ ·18	·45	12	18	83·0	28*a*	35·0	10	0	1
IV.		Bury St. Edmunds (Westley)	3·56	+ 1·52	·88	16	15	84·5	29	35·0	10	0	...
,,		Norwich (Brundall)	2·34	+ ·32	·76	13	16	80·2	30	36·3	11	0	0
V.		Winterborne Steepleton	3·40	...	·71	13	15	77·5	28	38·3	18	0	0
,,		Torquay	3·22	...	·81	13	17	70·3	27	45·3	15*c*	0	0
,,		Polapit Tamar [Launceston]..	3·52	+ 1·13	·52	15	17	78·5	28	39·2	10	0	0
VI.		Stroud (Upfield)	3·70	+ 1·70	·69	7	17	82·0	28	45·0	6, 17	0	...
,,		Church Stretton (Woolstaston)	2.94	+ ·80	·83	16	17	76·5	28	39·0	9	0	0
,,		Worcester (Diglis Lock)	2·52	+ ·90	·47	15	18	...	...	...	...	...	...
VII.		Boston	2·53	+ ·85	·60	14	18	85·0	27*b*	34·0	10	0	...
,,		Hesley Hall [Tickhill].....	1·22	— ·45	·50	12	13	86·0	28	37·0	10	0	...
,,		Derby (Midland Railway).....	2·53	+ ·48	·68	29	16	87·0	28	37·0	10	0	...
VIII.		Manchester (Plymouth Grove)	1·04	— 1·70	·17	6	14	...	...	...	...	...	...
IX.		Wetherby (Ribston Hall) ...	1·21	— ·88	·29	12	13	...	...	...	...	...	...
,,		Skipton (Arncliffe)	1·65	— 2·08	·29	12	13	...	...	...	...	...	...
,,		Hull (Pearson Park).	2·13	+ ·16	·37	12	15	80·0	28	36·0	10	0	1
X.		Newcastle (Town Moor)	2·03	+ ·15	·33	16	14	...	...	...	...	...	...
,,		Borrowdale (Seathwaite).....	2·01	— 5·09	·50	22	13	83·5	28	37·1	9	0	...
XI.	WALES.	Cardiff (Ely).....	2·71	+ ·38	·39	13	18	...	...	...	...	...	...
,,		Haverfordwest	3·18	+ ·85	·82	12	17	80·9	28	44·6	10	0	0
,,		Aberystwith (Gogerddan) ...	3·14	+ ·50	·68	1, 6	14	...	...	40·0	8*d*	0	...
,,		Llandudno.....	1·75	— ·22	·33	29	19	82·0	25	44·5	10	0	...
XII.	SCOTLAND.	Cargen [Dumfries]	1·82	— ·90	·27	20	12	84·5	28	37·0	10	0	...
XIII.		Edinburgh (Royal Observatory)	2·33	...	·60	6	16	78·3	25	37·5	10	0	1
XIV.		Colmonell	1·65	— 1·02	·32	15	13	87·0	28	40·0	6	0	...
XV.		Tighnabruaich	1·54	...	·34	22	10	74·0	25*b*	40·0	9	0	...
,,		Mull (Quinish).....	1·36	— 2·07	·35	6	12	...	...	...	...	...	...
XVI.		Loch Leven Sluices	1·79	— ·59	·49	7	13	...	...	...	...	...	...
,,		Dundee (Eastern Necropolis)	1·60	— ·23	·25	14	15	75·8	30	38·0	18	0	...
XVII.		Braemar	1·69	— ·64	·37	6	13	77·7	27	32·4	18	0	5
,,		Aberdeen (Cranford)	1·73	— ·41	·39	4	18	73·0	30	37·0	8, 10	0	...
,,		Cawdor (Budgate)	3·55	+ 1·23	1·19	14	17	...	...	...	...	...	...
XVIII		Strathconan [Beauly]	1·96	— 1·55	·50	14	8	...	...	...	...	...	...
,,		Glencarron Lodge.....	2·01	— 3·73	·30	22	16	80·1	26	36·0	10	0	...
XIX.		Dunrobin	2·15	+ ·11	·52	5	13	73·8	25	37·0	1	0	...
,,		S. Ronaldshay (Roeberry) ...	1·57	— ·39	·32	13	13	73·0	27	37·0	8, 10	0	...
XX.	IRELAND.	Darrynane Abbey.....	3·72	+ ·62	1·16	18	24	...	...	...	...	...	...
,,		Waterford (Brook Lodge) ...	3·73	+ 1·12	1·14	1	17	78·0	28	41·0	10*e*	0	...
,,		Broadford (Hurdlestown) ...	1·40	— 1·01	·33	1	17	...	...	...	...	...	...
XXI.		Carlow (Browne's Hill)	3·20	+ ·93	·54	1	19	...	...	...	...	...	...
,,		Dublin (Fitz William Square)	2·37	+ ·45	·74	19	17	74·7	25	42·1	10	0	0
XXII.		Ballinasloe	1·75	— ·90	·75	1	14	80·0	28	37·0	9	0	...
,,		Clifden (Kylemore)	4·76	— ·67	·93	1	16	...	...	...	...	...	...
XXIII		Seaforde.....	3·34	+ ·78	1·18	19	17	80·0	25	39·0	10	0	0
,,		Londonderry (Creggan Res.).	1·42	— 1·72	·31	13	15	...	...	...	...	...	...
,,		Omagh (Edenfel)	2·12	— ·89	·40	1	14	80·0	28	37·0	12	0	0

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

a—and 29. *b*—and 28. *c*—and 18. *d*—and 10, 16. *e*—and 13.

SUPPLEMENTARY TABLE OF RAINFALL, JUNE, 1902.

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
I.	Uxbridge, Harefield Pk..	3·93	XI.	Castle Malgwyn	4·84
II.	Dorking, Abinger Hall .	3·68	,,	Builth, Abergwesyn Vic.	...
,,	Sheppey, Leysdown	2·69	,,	Rhayader, Nantgwillt ...	2·95
,,	Hailsham	2·60	,,	Lake Vyrnwy	2·72
,,	Crowborough.....	4·13	,,	Ruthin, Plâs Draw	1·96
,,	Ryde, Beldornie Tower..	2·23	,,	Criccieth, Talarvor	3·46
,,	Emsworth, Redlands ...	3·51	,,	I. of Anglesey, Lligwy..	2·33
,,	Alton, Ashdell	4·26	,,	Douglas, Woodville.....	1·51
,,	Newbury, Welford Park	3·35	XII.	Stoneykirk, Ardwell Ho.	2·37
III.	Oxford, Magdalen Coll..	1·80	,,	Dalry, Old Garroch	1·84
,,	Banbury, Bloxham	2·36	,,	Montaive, Maxwelton Ho.	2·16
,,	Pitsford, Sedgebrook ...	2·53	,,	Lilliesleaf, Riddell	1·96
,,	Huntingdon, Brampton.	2·50	XIII.	N. Esk Res. [Penicuick]	2·15
,,	Wisbech, Bank House...	3·40	XIV.	Glasgow, Queen's Park..	1·99
IV.	Southend	2·66	XV.	Inveraray, Newtown ...	1·89
,,	Colchester, Lexden	3·25	,,	Ballachulish, Ardsheal...	1·87
,,	Saffron Waldon, Newport	2·36	,,	Islay, Eallabus..... ...	1·99
,,	Rendlesham Hall	2 50	XVI.	Dollar.....	1·90
,,	Swaffham	2·89	,,	Balquhidder, Stronvar...	2·43
V.	Salisbury, Alderbury ...	3·19	,,	Coupar Angus Station...	2·06
,,	Bishop's Cannings	3·07	,,	Blair Atholl	1·30
,,	Blandford, Whatcombe .	...	,,	Montrose, Sunnyside ...	2·25
,,	Ashburton, Druid House	3·00	XVII.	Keith H.R.S.....	2·66
,,	Okehampton, Oaklands.	4·36	XVIII.	Fearn, Lower Pitkerrie..	1·74
,,	Hartland Abbey	3·71	,,	S. Uist, Askernish	1·00
,,	Lynmouth, Rock House	3·70	,,	Invergarry.....	·98
,,	Probus, Lamellyn	3·66	,,	Aviemore, Alvie Manse.	1·95
,,	Wellington, The Avenue	2·32	,,	Loch Ness, Drumnadrochit	2·26
,,	North Cadbury Rectory	3·59	XIX.	Invershin	2·71
VI.	Clifton, Pembroke Road	3·17	,,	Bettyhill	...
,,	Ross, The Graig	2·55	,,	Watten H.R.S.....	1·41
,,	Shifnal, Hatton Grange	1·92	XX.	Dunmanway, Coolkelure	5·55
,,	Wem, Clive Vicarage ...	1·65	,,	Cork, Wellesley Terrace	3.27
,,	Cheadle, The Heath Ho.	1·69	,,	Killarney, District Asyl.	3·09
,,	Coventry, Priory Row ..	2·94	,,	Caher, Duneske	...
VII.	Market Overton	2·11	,,	Ballingarry, Hazelfort...	1·60
,,	Grantham, Stainby	1·87	,,	Miltown Malbay	2·28
,,	Horncastle, Bucknall ...	2·59	XXI.	Gorey, Courtown House	3·30
,,	Worksop, Hodsck Priory	1·13	,,	Moynalty, Westland ...	2·55
VIII.	Neston, Hinderton	1·81	,,	Athlone, Twyford	1·83
,,	Southport, Hesketh Park	1·56	,,	Mullingar, Belvedere ...	1·93
,,	Chatburn, Middlewood.	1·08	XXII.	Woodlawn	2·20
,,	Duddon Val., Seathwaite Vic.	1·46	,,	Westport, Murrisk Abbey	2·44
IX.	Baldersby	1·96	,,	Crossmolina, Enniscoe ..	3·12
,,	Scalby, Silverdale	2·75	,,	Collooney, Markree Obs.	1·85
,,	Ingleby Greenhow Vic..	1·88	XXIII.	Enniskillen, Model Sch.	...
,,	Middleton, Mickleton ...	·90	,,	Warrenpoint.....	·85
X.	Beltingham	1·75	,,	Banbridge, Milltown ...	2·25
,,	Bamburgh	2·63	,,	Belfast, Springfield	...
,,	Keswick, The Bank	1·23	,,	Bushmills, Dundarave..	1·05
XI.	Llanfrechfa Grange	3·70	,,	Stewartstown	2·26
,,	Treherbert, Tyn-y-waun	4·97	,,	Killybegs	2·61
,,	Llandovery	2·58	,,	Horn Head	1·05

METEOROLOGICAL NOTES ON JUNE, 1902.

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.—Although the first few days were fair, real summer weather did not occur until after the 21st. Constant R and low temp. for the first three weeks. A week of hot sunny weather ended the month. TSS on 4th and 30th. Mean temp. 59°·5 or 0°·9 below the average.

TENTERDEN.—The first half was showery and cold, but with no heavy R. Ten days with max temp. below 60°. The last week was hot with the first full day's sunshine for two months. Total duration of sunshine 218 hours. TSS on 3rd, 4th and 30th.

CROWBOROUGH.—The first three days were warm, but afterwards it became unusually cold with keen winds. The last week was very warm. The month was very wet, only in 1871, 1872 and 1888, has June had a heavier fall. The 6 months' total is still 1·65 in. below the average of 27 years. TSS on 4th, 7th, 17th and 30th, the last being very severe.

HARTLEY WINTNEY.—The wettest June since 1888. The last week was hot and dry. Distant T on 7th and 14th; L on 3rd. Ozone on 23 days, mean 2·7.

BURY ST. EDMUNDS, WESTLEY.—Wet and cold until 17th. From 20th to the end fine and hot with with much sunshine. T on four days.

TORQUAY, CARY GREEN.—R 1·04 in. above the average. Mean temp. 2·3 in. below the average. Duration of sunshine 173·5 hours, or 62·6 hours below the average. Mean amount of ozone 5·0.

POLAPIT TAMAR [LAUNCESTON].—Very rough and wet to 22nd. Then fine and dry to the end and very hot. Wind chiefly easterly.

WELLINGTON, THE AVENUE.—Probably one of the coldest Junes on record up to 23rd, when a warm period set in with brilliant sunshine. R frequent but only exceeded the average by about ·30 in. Strong winds at times.

CLIFTON, PEMBROKE ROAD.—Rainy and cold with very little sun till 22nd. Very hot with brilliant sunshine from 24th to 28th. Dull and sultry on 29th and 30th. R ·75 in. above the average and that for the six months 3·33 in. below the average. TS on 7th.

ROSS, THE GRAIG.—Except on 2nd and 3rd the daily max. temp. of the first three weeks was almost unprecedentedly low. The last eight days however brought a spell of brilliant and very hot and dry weather, which, to some extent, restored the balance. Vegetation is vigorous and flourishing.

HULL, PEARSON PARK.—Very unpleasant until about the 20th being generally cold and cloudy. Very little sunshine until 19th, when a warm period set in. T and L on 1st and 4th, and L on 29th.

WALES AND THE ISLANDS.

LLANFRECHFA GRANGE,—Ungenial with cold winds until 23rd. Crops backward and fruit falling off in many places. Violent TS on 1st.

DOUGLAS, WOODVILLE.—Cold and sunless until the 24th, when a sudden change occured to sunshine. The winds were harsh, while the comparative drought was a drawback to vegetation.

SCOTLAND.

LILLIESLEAF, RIDDELL.—The first half was a continuance of R and cold experienced throughout the winter and spring. No TSS. Foliage and crops never looked better.

INVERARAY, NEWTOWN.—The early part was cold though fine. Warm weather set in on 22nd and it was very hot till the end.

MULL, QUINISH.—Very cold from 1st to 23rd, with persistent N.E. and N.W. wind. Very hot and dry from 23rd to the end. R is now much needed and this must rank as the worst spring and early summer for the last 30 years.

COUPAR ANGUS.—The temp. was reduced owing to the cold winds and the absence of sunshine. The heat wave on 22nd just came in time to redeem the character of the month. But for the TS on 30th it would have been the sixth month in succession with a short R.

WATTEN, H.R.S.—First half cloudy and cold. Little sun and thick haze. The latter half was mild and fine with more sunshine. TS on 23rd.

IRELAND.

MILTOWN MALBAY.—The coldest and most ungenial June remembered, till 23rd, when the temp. changed. The 27th, 28th and 29th were excessively hot. The R of the first six months is 12·12 in., the lowest on record.

DUBLIN, FITZWILLIAM SQUARE.—The mean temp. of the first three weeks was 53°·2, and that of the fourth week was 63°·0. Winds from polar quarters prevailed, but their force was light in the fourth week with unclouded sunshine. Up to the 22nd the R was frequent. The duration of sunshine was 193 hours. Mean temp. 56°·7 or 1°·1 below the average. High winds on 5 days, never reaching the force of a gale. L on 19th and TS on 29th.

OMAGH, EDENFEL.—The weather of the first fortnight was a continuance of the low temp., sunless skies and excessive R of the spring months. A complete reversal of atmospheric conditions, unprecedented in the 36 year's record, commenced on 20th, and brought a brilliant spell of summer weather. Vegetation is now abundant and promising.

THE FIVE MONTHS' RAINFALL OF 1902.

Aggregate Rainfall for January—June, 1902.

Stations.	Diff. from aver.	Per cent. of aver.	Stations.	Diff from aver.	Per cent. of aver.	Stations.	Diff. from aver.	Per cent. of aver.
	in.			in.			in.	
London	+ ·36	104	Arncliffe	-10·38	61	Aberdeen	+ ·30	102
Tenterden	—3·50	69	Hull	— ·77	93	Cawdor	— ·66	95
Hartley Wintney	·00	100	Newcastle	—1·63	84	Strathconan	+ ·25	101
Hitchin	...	...	Seathwaite	-19·00	67	Glencarron	—1·84	95
Winslow	—1·92	80	Cardiff	—1·52	90	Dunrobin	— ·66	95
Westley	+1·38	113	Haverfordwest	—1·81	90	Darrynane	—4·70	78
Brundall	+ ·92	109	Gogerddan	—1·51	92	Waterford	— .02	100
Blandford	...	...	Llandudno	+ ·89	107	Broadford	+ ·29	102
Polapit Tamar	— ·17	99	Dumfries	—4·06	79	Carlow	+ ·14	101
Stroud	— ·20	98	Lilliesleaf	— ·96	92	Dublin	+ ·64	105
Woolstaston	+ ·46	104	Colmonell	—1·53	92	Mullingar	—1·73	89
Worcester	+1·44	115	Glasgow	—2·91	81	Ballinasloe	— ·16	99
Boston	+1·35	116	Islay	—1·48	92	Clifden	—4·53	87
Hesley Hall	+ ·17	102	Mull	—2·83	88	Crossmolina	+ ·95	104
Derby	+1·37	114	Loch Leven	—5·02	67	Seaforde	+2·87	118
Manchester	...	...	Dundee	—3·12	73	Londonderry	—2·22	87
Wetherby	—1·75	83	Braemar	— ·71	95	Omagh	+2·46	115

For comments on this table see p. 87.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, JANUARY, 1902.

STATIONS. (*Those in italics are South of the Equator.*)	Absolute. Maximum. Temp.	Absolute. Maximum. Date.	Absolute. Minimum. Temp.	Absolute. Minimum. Date.	Average. Max.	Average. Min.	Average. Dew Point.	Average. Humidity.	Absolute. Max. in Sun.	Absolute. Min. on Grass.	TotalRain. Depth.	TotalRain. Days.	Aver. Cloud.
	°		°		°	°	°	0-100	°	°	inches		
London, CamdenSquare	52·9	10	23·8	15	46·0	36·6	36·4	86	70·9	25·2	·76	11	6·6
Malta	64·3	31	45·3	30	60·2	48·8	46·6	79	119·5	38·9	·84	6	3·9
Lagos, W. Africa	...	...	...	...	...	...	...	...	...	...	...	...	...
Cape Town	88·3	20	49·6	17	75·3	58·2	54·2	65	...	...	·58	6	4·1
Durban, Natal	92·1	16	56·4	5	82·7	66·5	...	...	150·5	...	6·35	23	6·5
Mauritius	87·8	3	65·1	20	85·9	72·2	68·4	72	154·9	58·5	2·20	21	5·6
Calcutta	86·2	31	49·5	2	79·7	56·1	53·8	63	133·5	43·1	·00	0	0·6
Bombay	89·6		65·3	5	84·9	69·8	65·9	69	136·3	54·9	·00	0	0·3
Madras	85·3	*a*	63·0	31	83·9	67·8	67·1	78	140·3	58·9	1·28	3	2·8
Kodaikanal	68·5	28	39·4	26	66·3	45·6	...	63	128·4	27·2	8·61	8	1·6
Colombo, Ceylon	91·8	25	65·2	24	87·9	70·6	68·4	75	157·7	61·3	1·95	5	3·7
Hongkong	78·0	13	48·5	1	68·4	59·2	52·2	67	125·4	...	·28	1	3·5
Melbourne	103·0	31	46·2	28	77·8	55·5	51·4	59	161·7	36·3	1·53	9	5·7
Adelaide	109·8	31	48·6	15	84·7	60·8	51·0	50	162·2	43·4	·28	9	5·4
Coolgardie	108·3	11	48·8	21	88·5	61·4	62·4	56	...	...	1·25	7	3·4
Sydney	92·2	17	58·1	29	78·1	64·2	58·2	65	151·2	49·8	1·77	15	4·7
Wellington	8·10	13	48·0	30	69·0	56·0	50·8	67	133·0	41·0	2·27	13	5·3
Auckland	78·0	14	52·0	8	70·6	58·5	53·2	67	144·0	54·0	1·58	11	5·4
Jamaica, Negril Point	88·0	19	66·0	23*b*	82·9	71·2	70·1	81	...	...	1·32	5	...
Trinidad	91·0	3	61·0	5	84·7	67·8	71·4	80	166·0	63·0	2·56	8	...
Grenada	84·4	14	69·6	31	81·5	72·7	69·2	72	150·0	...	4·22	17	2·0
Toronto	41·0	2	1·3	28	30·5	16·2	20·2	80	74·2	—3·2	2·60	12	7·3
Fredericton, N.B.	45·9	23	—12·7	15	27·5	6·9	6·0	60	...	...	3·44	10	5·4
Winnipeg	40·0	8	—36·1	27	19·3	—4·4	..	...	...	...	·12	4	4·7
Victoria, B.C.	52·4	3	12·3	25	43·9	35·2	...	...	...	...	3·13	15	7·1
Dawson, Yukon	16·0	22	—50·0	1	—7·4	—23·6	...	...	...	..	1·73	6	4·7

a—and 27. *b*—and other days.

REMARKS.

MALTA.—Mean temp. of air 54°·1, or 0°·8 above the average. Mean hourly velocity of wind 10·1 miles, or 1·3 below average. Mean temp. of sea 61°·0. J. F. DOBSON.

Mauritius.—Mean temp. of air 0°·7 , dew point 1°·8, and rainfall 4·96 in. below their respective averages. Mean hourly velocity of wind 11·0 miles, or 0·2 miles below the average ; prevailing direction E. by N. to E.S.E. T. F. CLAXTON.

MADRAS.—R ·39 in. above the average. 238 hours of bright sunshine. A. MOFFAT.

KODAIKANAL.—Mean temp. 51°·6. Sunshine 231 hours. Wet bulb minimum 30°·2 on 26th ; lowest humidity 7 per cent. on 17th. C. MICHIE SMITH.

COLOMBO.—Mean temp. of air 78°·5 or 0°·6 below, of dew point 1°·4 below, and R 1·29 in. below, their respective averages. Mean hourly velocity of wind 8·5 miles ; prevailing direction N.W. and N.E. TSS on 2nd. W. C. S. INGLES.

HONGKONG.—Mean temp. of air 63°·1, or 3°·4 above the average, bright sunshine 239 hours, or 33 per cent. above the average. R ·70 in. below the average of 39 years. Mean hourly velocity of wind 13·5 miles, or 0·9 miles below the average. F. G. FIGG.

Adelaide.—Mean temp. of air 1°·3 below the average C. TODD, F.R.S.

Sydney.—Mean temp. of air 0°·4, R 1·86 in., humidity 6·4, below their respective averages. H. C. RUSSELL, F.R.S.

Auckland.—Mean temp. of air 2°·0, and R 1 inch below average. T. F. CHEESEMAN.

TRINIDAD.—R ·38 in. below the 30 years average. J. H. HART.