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Richard Manliffe Barrington.

1849—1915.

MR. R. M. BARRINGTON, of Fassaroe, Bray, Co. Wicklow, inherited from his father, Mr. E. Barrington, a love of nature and of observation which made him, for many years, the leading Irish naturalist, using the word with all the breadth and fulness that it carried in the days of White of Selborne. While devoted to Botany and Meteorology, it was Ornithology which absorbed most of the time and enthusiasm which Mr. Barrington lavished on the study of nature in Ireland. He had published his first paper on a point in bird life before he entered Trinity College, Dublin, in 1865, and his labours in this direction culminated in his great volume on the Migration of Birds, as observed at the Irish Lighthouses. By profession a barrister, Mr. Barrington found more congenial occupation under the Irish Land Commission and in the management of his own picturesquely situated estate. As a young man he was an ardent mountain climber and his exploits in the Alps are still remembered for the large number of difficult peaks which he ascended in rapid succession within a few days. A rainfall record had been established at Fassaroe the year before Mr. Barrington was born, and it appeared in *British Rainfall* from 1860 to 1875, under the name of his father; from that time the familiar name of R. M. Barrington has never been absent from the annual volumes. The records before 1853 have, unfortunately, been lost, but in 1905, Mr. Barrington, with the help of Mr. A. Hampton Brown, now assistant secretary of the Royal Meteorological Society, made a complete discussion of the Fassaroe rainfall for 50 years. This valuable contribution to Irish climatology remains unpublished. Mr. Barrington frequently attended the meetings of the British Association, and we retain the happiest recollection of his hospitality when the Association met in Dublin in 1908. It was natural that when Trustees were appointed for the British Rainfall Organization in 1910, the name of Mr. Barrington should be proposed as representing Ireland, and we have to acknowledge gratefully the continuous interest which he showed in the success of the rainfall work and his unvarying kindness on all occasions.

Mr. Barrington's genial helpfulness to the younger students of Natural History in Ireland did much to encourage the systematic study of several branches of science and the application of scientific observation to agriculture and the welfare of the community. Mr. Barrington died very suddenly from a heart attack, on the 15th of September, while driving his motor car home from Dublin. The rainfall observations at Fassaroe have not been interrupted, but are being carried on by Mrs. Barrington and her family, who have always been in the fullest sympathy with Mr. Barrington's scientific pursuits.

AN APPRECIATION

By SIR JOHN MOORE, M.D., D.Sc.

THROUGH very many years it was my privilege to enjoy the close personal friendship of Richard Manliffe Barrington, or "Dick Barrington," as his many intimate friends, including myself, were wont to call him.

It was in relation to weather and climatology that he and I were brought into closest contact, and whenever anything out of the common occurred in connection with the weather, a written, or in later years a telephonic, message would be sure to reach me from Fassaroe, Barrington's charming residence between Bray and Enniskerry, in the Co. Wicklow. The Fassaroe meteorological observations extend back, so far as rainfall is concerned, to the year 1853, and from 1864 to the present date full temperature records have been kept in addition. From 1837 to 1863 the date on which harvest began at Fassaroe each year was carefully noted by Barrington's grandfather and father, so that his bent towards weather observation was hereditary. The Fassaroe records must be amongst the oldest extant in Ireland, and I am glad that they are being continued by Mrs. Barrington.

But my friend did not confine his scientific pursuits to weather-lore and climatology. He was a naturalist of the first rank, and justice has been done elsewhere to his far-reaching knowledge of plants and birds. It was my good fortune in August, 1909, to travel across the Atlantic with him in the Canadian Pacific Railway Company's splendid steamer, the *Empress of Ireland*, which, years afterwards, met such an untoward fate in the St. Lawrence, off Rimouski. We were bound for the meeting of the British Association at Winnipeg. On that memorable voyage nothing escaped Barrington's keen observation. Every sea bird was observed, recognized, and named. I shall never forget his informal discourses on the habits of the shearwater and the other winged inhabitants of the air above the ocean. In Barrington's death, Ireland has lost a true and worthy son, and Irish science one of its most cultured exponents.

PROFESSOR PETTERSSON ON LUNAR PERIODS IN SOLAR AND TERRESTRIAL CLIMATE.

By L. C. W. BONACINA.

THE well-known Swedish oceanographer, Professor Otto Pettersson, has published in English the results of certain laborious and abstruse investigations which he and collaborators have conducted in the sphere of cosmical physics.* In the present notice I venture to express no opinion upon the intrinsic value of these researches, except to say that the evidence for the theory upheld does not seem conclusive, and that the "resonance" explanation of sunspots requires much more substantial justification, but merely offer a condensed statement of some of the more interesting and anomalous results together with a short discussion of a few of the questions raised. The subject, as suggested by the title, discusses an apparently remarkable commensuration of the moon's periods with sunspot periods on the one hand, and terrestrial climatic periods on the other, and so may be treated from both a geographical and astronomical standpoint. A preliminary statement may be thus given :—there are periodic changes of longer and shorter duration in the position of the moon's orbit, and these periods underlie variations of well known phenomena in the hydrosphere and atmosphere of the earth, and in the photosphere of the sun. It is shown that once in about eighteen centuries the line of the moon's apsides at the time of peri-helion (about winter solstice) falls in the ecliptic, and the apogee apex is directed towards the sun, a configuration, it is held, which raises the tide-generating force to a maximum—of the sun and moon upon the earth at the time of full moon, and of the earth and moon upon the sun at new moon. There are minor periods of 90, 18, 9, $4\frac{1}{2}$, etc., years, dependent on other configurations, giving rise to secondary, tertiary, and weaker maxima of the tidal force, but these need not be specifically detailed here. The last absolute maximum of the tide-producing force occurred about the end of the Middle Ages, and the one before that in the 3rd or 4th century B.C., the intervening minimum falling at the beginning of the Viking Age. There is evidence that at both maximum epochs violent storm floods and catastrophic inundations used to occur on the Atlantic coasts in conformity with the more powerful tides which were then raised, and that there were climatic alterations in different parts of the world connected with the increased tidal energy of the oceans. But it is not only in the surface phenomena of bigger flood waves

* On the occurrence of lunar periods in solar activity and the climate of the Earth : a study in geophysics and cosmic physics.

On climatic variations in historic and prehistoric time. (Ur Svenska Hydrografisk-Biologiska Kommissionens Skrifter, Häft V). Quarto. Maps, illustrations and curves.

and greater difference between spring and neap tides that the effects are apparent, inasmuch as an important part is alleged to be played by the locally generated submarine tidal waves, which according to their intensity are shown to give rise indirectly to marked changes in the superincumbent air as will now be explained. The submarine waves whose tidal nature has been demonstrated by Professor Pettersson and his collaborators, are engendered when the oceanic tidal wave impinges on submarine ridges such as occur in the North Atlantic, and, travelling on, persist in the boundary layer, where lighter surface water overlies salt deep-water—a stratification common in the Arctic seas and in the Baltic, Skagerak and Cattegat. It is pointed out that in the 13th, 14th and 15th centuries the Baltic in certain winters was completely frozen over, and that the *prima causa* of this was oceanographic and not meteorological—lying in the stronger influx of Atlantic water through the Belts and Sound which caused the light surface water down to the boundary layer in the Baltic to flow out and grow thinner, and so freeze more readily than in times of weaker tidal influx like the present. But the frozen sea surface would react upon the climate increasing both the cold and the atmospheric pressure, whilst in summer the same shallowness of the Baltic surface layer resulting from the swelling up of the under layer would lead to its more rapid heating, and thus tend to bring about greater warmth in the Scandinavian countries, such a conjecture as to a more continental climate being actually borne out by observations of Tycho Brahe. To the more intense tidal circulation must likewise be attributed the great Hanseatic herring fisheries of the Middle Ages, the present day migrations of these fish not extending nearly so far into the Baltic. Concerning probable climatic variations in other regions, Prof. Pettersson discusses the case of Iceland and Greenland at special length, since his views are at variance with those of Dr. Nansen on this subject, as are they also in relation to the “Wineland” controversy. Multifarious historical evidence is adduced by Pettersson testifying to the prevalence in the Viking Age of such mild conditions in Greenland that the eastern coast was quite accessible to the Norse colonists, and that the coast of Iceland was not subject to its present-day bombardments by polar ice. The comparative mildness and fertility of Greenland at that epoch is attributed to a greater intensity of the Irminger branch of the Gulf Stream, the effect of which was to cause the Arctic ice to melt in higher latitudes. But at a later period towards the end of the Middle Ages, when the tide-generating force waxed to a maximum, the circulation of the Atlantic became altered, and great submarine waves entered the Polar basin, resulting in the breaking up of large quantities of ice to be carried southward by the current which chills the coast of Greenland. It is maintained

on grounds which Nansen is stated to reject on account of the gentle disposition of the present-day Eskimo, that the deterioration of the climate of Greenland to something like modern conditions necessitated a southward migration from far northern regions of the aboriginal race to the extermination of the European colonists.

The solar aspect of the lunar influences under review is studied in relation to the phenomena of sunspots, as intimated above; but while the discovered relationship between the moon periods and the sunspot periods seems difficult to ignore, still more to deny, the explanation is very recondite, and, as attempted by Pettersson, it is couched in a form which is not easy to follow. The only planetary influence which appears to be connected with the sunspot periods is that due to the earth-moon system, and the outstanding anomaly which should engage the attention of cosmical physicists is this: that while the position of the moon's orbit relative to that of the earth is shown to undergo changes of the same periodicity as the sunspots, the latter are not, essentially at least, gravitational phenomena. Pettersson has constructed by harmonic analysis, using various lunar periods for basis, the frequency of sunspots as expressed in the tables of Wolf, revised in 1902 by Wölfer, with the apparently fortunate result that the resemblance between the original curve and the reconstruction according to moon periods is very close. There are many long and short periods contained in the sunspot curve for the last couple of centuries, including the well-known one of 11 years, itself composed of the 9 and 13-year periods, and these can be detected in the variations of rainfall, temperature, and other meteorological elements in different parts of the world. An important feature of these sunspot periods is the fact first discovered by Schuster, that no single period dominates the sunspot frequency permanently, one period prevailing for a time and being supplanted by another, becoming for the time being latent. In this connection Pettersson points out that the periodicity of many meteorological and oceanographic phenomena remains unrecognized on account of the error of assuming that such periodicity must necessarily be permanent through the ages and discoverable by harmonic analysis. But what is of paramount interest in the relationship between the moon periods and the sunspot periods is the above-mentioned anomaly that the spots, intimately related though they be to the position of the moon, do not *per se* appear to be direct gravitational phenomena, but to represent a condition of the sun with respect to a certain intensity or distribution of gravitational (or other) impulses; for not only is the tide-producing power of the earth and moon upon the sun's surface of a small order of magnitude as expressed in the ordinary units, but there is the remarkable circumstance that the configuration of the earth, moon and sun known as peri-

helion-node-apside, which occasions the maximum tidal energy on both the earth and the sun, is marked by comparative rest in the sun's activity as denoted by the frequency of spots. The absolute maximum of spots is found to precede "perihelion-node-apside" by a considerable interval, and to occur when the orbits of the earth and moon take up an oblique (asymmetric) position to one another, and in the same way the lesser maxima of spots precede corresponding maxima of the tidal force on the sun. Professor Pettersson, who does not venture to speculate upon the *nature* of the force in action, further considers the sunspots to be the effects of resonance set up by the regularly repeated changes in the positions of the earth and moon, or to quote his own words, "The sunspots are effects of resonance of the rhythmically repeated symmetric and asymmetric constellations of the earth and moon . . ." In plainer language what would appear to happen is this: the sun (in relation to the spots) lies in a certain field of effective force, due to the earth and moon, the nature of which is possibly gravitational (or probably magnetic) and the intensity of which varies regularly with the relative positions of those bodies, but is never in itself great; when, however, its small initial impulses are constantly repeated, it develops the full resonance effect of sunspots. There is, of course, the apparently opposing view among some astronomers that the spots are manifestations of volcanic energy and have an internal origin; but as is generally the case in matters of well-grounded controversy, it will probably be found that both the external and internal theories are true, or partially so. For, whereas, on the one hand, the occurrence of lunar periods in the sunspot variations is a fact whose import cannot be ignored, on the other hand, having regard to a body of such consistency as the sun, it is only reasonable to assume that the spots are merely an index of more widespread, deep-seated changes in the sun due to the same external impulses which should thus be considered the prior cause.

To the thoughtful student of these researches of which we have here given a necessarily brief and inadequate exposition, a number of important questions will at once arise. Apart from their possibilities in long-period weather forecasting, of which Professor Pettersson and his coadjutors are fully cognizant, they bring up in a new light the old unscientific belief in the influence of the moon on weather, and profoundly affect also the conceptions of the climatologist. Now what, henceforth, is to be the answer of the meteorologist when confronted with the question, Has the moon any influence on the weather? It is the man of science who alone knows the impossibility of giving simple answers to many scientific questions. In the present case it is clear that the nature of his answer should be guided by the character of the inquirer. The crude notions of those who believe, for instance, that the monthly phases of the

moon so govern the atmosphere that every new moon is a potential cause of a radical alteration in the state of the weather, any chance coincidence being at once attributed to cause and effect—*post hoc propter hoc*—will, of course, be refuted by the meteorologist as vigorously as heretofore. But he will be able to judge by the status of the enquirer when he might usefully explain that the varying position of the moon does appear to impose a certain modification, entirely subordinate to the major effects of solar heat, upon the intensity of the different weather elements. It may be noted, further, that while such lunar influence on the atmosphere as has been here discussed seems to act mainly through the medium of the oceanic tides, it cannot be definitely asserted that direct tidal effects in the atmosphere liable to affect the weather, do not also occur. Professor Strömberg has, indeed, launched the theory that tidal movements somewhat analagous to the "boundary waves" of the ocean, do occur in the different strata of the atmosphere; but it is well known that our barometers at the bottom of the sensibly uniformly deep compressible ocean of air fail to reveal those dominating gravitational impulses which are so conspicuous in the sea, and such tidal action as may occur in the atmosphere—whatever effect on the weather it may have—can only be brought to light through refined methods of mathematical analysis, adequate to extricate it from other over-riding factors.

Finally, it is evident that climatological conceptions will to a certain extent require re-adjustment in the light of these results—should they be corroborated. Although the subject of meteorological periodicities has often been investigated, it cannot be said that the result for the short time which has elapsed since the growth of instrumental observation has had far reaching consequences, and hitherto climatologists have for the most part neglected to consider their import, on the assumption that a series of, say, fifty years is long enough to include practically all the seemingly fortuitous variations and abnormalities of weather liable to occur in a given locality, and that such a run of years would furnish a set of mean values of pressure, temperature, rainfall, etc., substantially the same as that of any other period of fifty years in the same or another century.

But it has been shown above that it possibly requires a period of some eighteen centuries to furnish anything like a full climatic picture of the earth during the present geological epoch, with the result that the signification of a fifty years' average may be very much less than has been supposed. The climatologist, in other words, finds himself shipwrecked, and he must, in future, endeavour to navigate the waves of time with a knowledge that will enable him to recognize when he is sailing, say, on the crest of a tertiary maximum in the intensity of rainfall, or plunged into the trough of the corresponding minimum. I have elsewhere defined

"climate" as an expression denoting the frequency with which different states of weather, both common and rare, occur over a given area in the course of a considerable series of years. This definition must remain rigorously true when extended to embrace centuries, but its practical value in the course of a generation or the life of an individual is obviously not enhanced when examined in the light of such researches as Pettersson's.

In conclusion it should be noted that these alleged climatic changes of historic time are not to be confused with the far greater changes of geological time arising from quite other causes. The geological-time changes may themselves be to a certain extent of a periodic nature, forming a gigantic series of waves on which the historic periods are superimposed as mere ripples, but so slow is their course that the effect even after the lapse of centuries must be absolutely negligible.

Correspondence.

To the Editor of Symons's Meteorological Magazine.

APPEAL FOR RECORDS, THUNDERSTORM OF JUNE 14th, 1914.

I AM continuing investigations as to the Meteorological conditions accompanying the Thunderstorms of June 14th, 1914 (see *British Rainfall*, 1914, pp. 48-56). I should be very grateful if anyone who has any records of any kind as to the weather on that day in any part of England, especially the south, would let me have them if they have not already done so. Autographic records would be carefully treated and returned. I have already had the records available at the Meteorological Office, but *any* other observations would be most welcome, cloud, sunshine, temperature, pressure, anything. Timed observations are obviously most useful.

J. FAIRGRIEVE.

Frocester, Friern Lane, New Southgate, N.

A REMARKABLE PERIOD OF LITTLE RAIN.

DURING the three months ending November 30th, my total rainfall has been only 3.83 in., and the number of rain days only 25. At any time of the year so low a record for three months would be remarkable, but it is still more so when it includes months with the high averages of October and November. Though no absolute

drought occurred, September had a period of 12 days, and November one of 13 days, without measurable rain.

	Rain days.	Rainfall.	Average of 15 years.
September	6	·70	2·65
October	12	1·14	4·45
November	7	1·99	3·98
TOTAL ...	25	3·83	11·08

W. G. WELCH.

Hampson-in-Ellel, Lancaster, December 1st, 1915.

NOVEMBER FROSTS, 1915, AND OTHERS.

THE invigorating period of frost—of the true solstitial or winter stamp—which immediately followed the violent gale of November 12th, 1915, and lasted without a real break in the cold type till the 29th, though, perhaps, of unusually long duration for so early a period in the winter, ought not to be overrated, in view of the fact that there have been many rigorous periods, both general and local, in the Novembers since the opening of the present century, to go no farther back. Whilst the thermometric intensity of the late frost will in due course, no doubt, be compared with that of previous frosts, I venture to assert that, having regard to the general character of the cold weather experienced, the frost which prevailed during the last ten days of November, 1904, was more severe over the kingdom generally. Minima below 20° were, I think, more general in 1904 than in 1915, whilst so far as London is concerned, the snowfall of 22nd November, 1904, was much heavier than that of the 17th, 1915. Then we must not overlook the intense skating week all over Scotland of mid-November, 1909; nor the Arctic temperatures and deep snows with which November, 1912, closed in the north, when *maxima* below 20° were recorded in Ayrshire and other Scottish districts. Moreover, November, 1910, was cold and snowy very generally; and several other Novembers brought sharp, if short, touches of cold, notably 1901, 1902, 1905, and 1914. Most people have piteably short and inaccurate meteorological memories, and always will magnify the importance of the events of the passing moment, and I feel I must utter a protest against the statement of a meteorological writer in a London daily newspaper who described the recent experience as the hardest November frost for a “generation.” There is nothing very remarkable about frost and snow in the month of November, not much more, perhaps, than there is later on in the winter, inasmuch as the relatively small difference of some four to five degrees between the mean temperature of November and January (42°, November, 38°, January, approximately), is not so much a measure of a greater liability to the occurrence of a frost *spell* in January as of a some-

what lower general level of temperature operating through, as it were, any particular type of weather as it occurs. It is rare for a November to pass without a spell of severe weather in the northern portions of the kingdom, and in no month has the character of the bitter north wind with its portent of snow impressed me more vividly in the wild moors of the north of England. The great frost of December and January, 1890-91, commenced on November 25th, in the south of England, where heavy falls of snow occurred with maximum temperatures below freezing and minimum below 20° before the end of the month in London, whilst in Paris the thermometer fell to 5° , likewise before November was out.

L. C. W. BONACINA.

December 1st, 1915.

REVIEW.

Note on the Effects of Raingage Exposures. By W. G. REED (Reprinted from the *Monthly Weather Review*, U.S.A.) Washington, 1915. Size, $12 \times 9\frac{1}{2}$. Pp. 4.

So far as we are aware, comparatively little attention has been paid, outside this country, to the effect of exposure on the indications of rain gauges, and we read with pleasure of experiments, albeit not very conclusive, at the Meteorological Observatory of the University of California, at Berkeley. The area dealt with, about one square mile in extent, comprises the basin of the Strawberry Creek. On this small gathering ground, which varies in elevation from about 500 to 2,000 ft., thirteen rain gauges were erected in 1913 and 1914. The exposures varied greatly and none were good, but in some cases the gauges were more screened from wind eddies than in others. The gauges were read as a rule once or twice monthly, the average annual number of rain days at Berkeley being only 66. The method followed was to compare each reading with the mean value for the whole thirteen and to judge of the suitability of the exposure by the consistency of the results. The subject is one which bristles with difficulties and is complicated by the fact that the defects of exposure which appear at first to be the more trivial are often responsible for the most serious anomalies in the readings. We should for example, have been disposed to lay considerable stress on the variations in the heights of the rain gauges above ground, which we notice, varied from 8 inches to 22 inches, a factor of importance in wind-swept localities. It seems probable that no definite conclusions can be arrived at unless the individual measurements can be studied in their relation to the wind direction and velocity during the time when the rain is actually falling.

We hope that these observations will be continued, since a single year's results can hardly be regarded as sufficient. c.s.

ROYAL METEOROLOGICAL SOCIETY.

THE first meeting of the session was held on November 17th, at the Society's rooms, Major H. G. Lyons, F.R.S., President, in the Chair.

Mr. J. S. Dines, M.A., read a paper on "The Mounting and Illumination of Barometers and the Accuracy obtainable in the Readings." He discussed the relative accuracy of the Fortin Barometer and the Kew Barometer as exhibited by readings from two pairs of instruments and the probable magnitude of errors introduced by details in the method of reading. Mr. W. Marriott, Dr. C. Chree, Mr. F. J. W. Whipple, Mr. C. Harding, and Mr. W. W. Bryant took part in the discussion on the advantages and disadvantages of various methods of reading the standard instruments at present in use.

A paper by Mr. N. A. Comissopulos, of the Egyptian Meteorological Office, "On the Seasonal Variability of Rainfall over the British Isles," placed before the meeting by the Secretary, was based on the rainfall data provided in the recent paper on Isomeric Rainfall Maps, by Dr. H. R. Mill and Mr. Carle Salter, and suggested an alternative method of studying seasonal oscillation.

The standard deviations and coefficients of variability ($\frac{\sigma}{\sqrt{12}A} \times 100$ where σ is the standard deviation and A the average annual rainfall, *i.e.*, the standard deviation expressed as a percentage of one-twelfth of the annual rainfall) were calculated from the monthly rainfall averages and a map was constructed showing lines of equal coefficients of variability. These formed in general a series of closed curves roughly equidistant from the coast lines. In addition the variability was correlated with both altitude, giving a coefficient of -0.9 ± 0.5 , and with mean annual rainfall, giving $+0.40 \pm 0.04$, showing that the latter only had any interdependence.

Dr. H. R. Mill, in welcoming Mr. Comissopulos' work, said that the map of variability expressed quantitatively what he and Mr. Salter had previously arrived at qualitatively in their map of the standard isomer. Mr. Salter pointed out that a single coefficient would not adequately express the character of a bi-phased curve and suggested that mathematicians might provide a formula for analysing the seasonal curves into their simple component curves in order to differentiate between the spring—autumn and the winter—summer oscillations.

Mr. C. E. P. Brooks commented on the fact that the minimum coefficient resulting from an absolute chance distribution was almost reached in the minima shown on the map. Dr. C. Chree and Messrs. W. H. Dines and F. J. W. Whipple also spoke.

The following were elected fellows of the Society :—Mr. T. N. N. Chettiar, Mr. Thomas Fox, Rev. K. D. McDonald, Lieut. W. R. Patterson, Mr. J. M. Whitting, Cadet F. S. R. Wilson-Holden.

RAINFALL TABLE FOR NOVEMBER, 1915.

STATION.	COUNTY.	Lat. N.	Long. W. [*E.]	Height above Sea. ft.	RAINFALL OF MONTH.	
					Aver. 1875— 1909. in.	1915. in.
Camden Square.....	<i>London</i>	51 32	0 8	111	2'34	2'31
Tenterden.....	<i>Kent</i>	51 4	*0 41	190	3'07	3'35
Arundel (Patching).....	<i>Sussex</i>	50 51	0 27	130	3'54	3'42
Fawley (Cadland).....	<i>Hampshire</i>	50 50	1 22	52	3'39	3'28
Oxford (Magdalen College).....	<i>Oxfordshire</i>	51 45	1 15	186	2'25	2'08
Wellingborough(Swanspool).....	<i>Northampton</i>	52 18	0 41	155	2'22	2'21
Shoeburyness.....	<i>Essex</i>	51 31	*0 48	13	2'09	3'05
Bury St. Edmunds(Westley).....	<i>Suffolk</i>	52 15	*0 40	226	2'40	2'18
Geldeston [Beccles].....	<i>Norfolk</i>	52 27	*1 31	38	2'49	2'87
Polapit Tamar [Launceston].....	<i>Devon</i>	50 40	4 22	315	4'07	3'48
Rousdon [Lyme Regis].....	„.....	50 41	3 0	516	3'51	2'73
Stroud (Upfield).....	<i>Gloucestershire</i>	51 44	2 13	226	2'77	1'91
Church Stretton (Wolstaston).....	<i>Shropshire</i>	52 35	2 48	800	2'94	3'02
Boston.....	<i>Lincolnshire</i>	52 58	0 1	11	2'05	2'86
Worksop (Hodsock Priory).....	<i>Nottinghamshire</i>	53 22	1 5	56	1'98	2'23
Mickleover Manor.....	<i>Derbyshire</i>	52 54	1 32	280	2'21	2'67
Macclesfield.....	<i>Cheshire</i>	53 15	2 7	501	3'00	1'81
Southport (Hesketh Park).....	<i>Lancashire</i>	53 39	2 59	38	3'16	2'14
Arncliffe Vicarage.....	<i>Yorkshire, W.R.</i>	54 8	2 6	732	6'12	3'83
Wetherby (Ribston Hall).....	„.....	53 59	1 24	130	2'34	1'83
Hull (Pearson Park).....	<i>E.R.</i>	53 45	0 20	6	2'34	2'51
Newcastle (Town Moor).....	<i>Northumberland</i>	54 59	1 38	201	2'63	1'75
Borrowdale (Seathwaite).....	<i>Cumberland</i>	54 30	3 10	423	13'59	5'91
Cardiff (Ely).....	<i>Glamorgan</i>	51 29	3 13	53	4'08	3'04
Haverfordwest.....	<i>Pembroke</i>	51 48	4 58	90	5'16	3'49
Aberystwyth (Gogerddan).....	<i>Cardigan</i>	52 26	4 1	83	4'50	3'88
Llandudno.....	<i>Carnarvon</i>	53 20	3 50	72	3'19	2'91
Cargen [Dumfries].....	<i>Kirkcudbright</i>	55 2	3 37	80	4'35	2'86
Marchmont House.....	<i>Berwick</i>	55 44	2 24	498	3'21	2'66
Girvan (Pinmore).....	<i>Ayr</i>	55 10	4 49	207	5'24	1'88
Glasgow (Queen's Park).....	<i>Renfrew</i>	55 53	4 18	144	3'63	1'55
Inveraray (Newtown).....	<i>Argyll</i>	56 14	5 4	17	7'39	3'18
Mull (Quinish).....	„.....	56 34	6 13	35	6'24	3'00
Dundee (Eastern Necropolis).....	<i>Forfar</i>	56 28	2 57	199	2'62	1'59
Braemar.....	<i>Aberdeen</i>	57 0	3 24	1114	3'76	4'28
Aberdeen (Cranford).....	„.....	57 8	2 7	120	3'29	3'23
Gordon Castle.....	<i>Moray</i>	57 37	3 5	107	2'85	4'04
Fort Augustus (S. Benedict's).....	<i>E. Inverness</i>	57 9	4 41	68	4'51	2'69
Loch Torridon (Bendamp).....	<i>W. Ross</i>	57 32	5 32	20	8'90	6'82
Dunrobin Castle.....	<i>Sutherland</i>	57 59	3 56	14	3'25	4'32
Wick.....	<i>Cathness</i>	58 26	3 6	77	2'95	3'78
Killarney (District Asylum).....	<i>Kerry</i>	52 4	9 31	178	5'54	5'23
Waterford (Brook Lodge).....	<i>Waterford</i>	52 15	7 7	104	3'80	2'88
Nenagh (Castle Lough).....	<i>Tipperary</i>	52 54	8 24	120	3'88	5'09
Ennistymon House.....	<i>Clare</i>	52 57	9 18	37	4'62	4'99
Gorey (Courtown House).....	<i>Wexford</i>	52 40	6 13	80	3'41	5'22
Abbey Leix (Blandsfort).....	<i>Queen's County</i>	52 56	7 17	532	3'28	2'72
Dublin (Fitz William Square).....	<i>Dublin</i>	53 21	6 14	54	2'64	3'67
Mullingar (Belvedere).....	<i>Westmeath</i>	53 29	7 22	367	3'38	2'48
Crossmolina (Enniscoe).....	<i>Mayo</i>	54 4	9 16	74	5'75	4'62
Cong (The Glebe).....	„.....	53 33	9 16	112	5'00	4'66
Collooney (Markree Obsy.).....	<i>Sligo</i>	54 11	8 27	127	4'02	3'70
Seaforde.....	<i>Down</i>	54 19	5 50	180	3'86	3'02
Bushmills (Dundarave).....	<i>Antrim</i>	55 12	6 30	162	3'77	...
Omagh (Edenfel).....	<i>Tyrone</i>	54 36	7 18	280	3'66	2'77

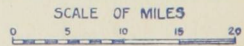
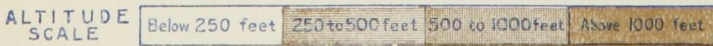
RAINFALL TABLE FOR NOVEMBER, 1915—*continued*.

RAINFALL OF MONTH (con.)					RAINFALL FROM JAN. 1.				Mean Annual 1875-1909.	STATION.
Diff. from Av. in.	% of Av.	Max. in 24 hours.	No. of Days	Date.	Aver. 1875-1909.	1915.	Diff. from Aver. in.	% of Av.		
		in.			in.	in.			in.	
— .03	99	.69	11	9	22.98	26.54	+3.56	115	25.11	Camden Square
+ .28	109	.67	12	14	24.87	27.64	+2.77	111	27.64	Tenterden
— .12	97	.97	11	10	27.57	34.02	+6.45	123	30.48	Patching
— .11	97	.90	11	13	28.64	34.46	+5.82	120	31.87	Cadland
— .17	92	.86	11	8	22.52	24.97	+2.45	111	24.58	Oxford
— .01	100	.89	12	10	23.07	20.47	—2.60	89	25.20	Swanspool
+ .96	146	.75	11	12	17.57	21.39	+3.82	122	19.28	Shoeburyness
— .22	91	.83	12	14	23.26	21.04	—2.22	90	25.40	Westley
+ .38	115	.48	12	22	21.66	26.55	+4.89	123	23.73	Geldeston
— .59	86	.75	9	15	33.81	36.84	+3.03	109	38.27	Polapit Tamar
— .78	78	1.13	11	11	29.86	31.71	+1.85	106	33.54	Rousdon
— .86	69	.80	11	11	27.10	27.73	+ .63	102	29.81	Stroud
+ .08	103	1.36	12	11	29.42	33.04	+3.62	112	32.41	Wolstaston
+ .81	139	1.03	12	18	21.47	22.02	+ .55	103	23.35	Boston
+ .25	113	1.32	12	15	22.29	20.43	—1.86	92	24.46	Hodsock Priory
+ .46	121	1.06	12	10	24.27	26.77	+2.50	110	26.65	Mickleover
—1.19	60	.49	9	8	31.38	29.10	—2.28	93	34.73	Macclesfield
—1.02	68	.45	12	11	29.60	25.61	—3.99	87	32.70	Southport
—2.29	63	1.55	12	11	54.74	42.92	—11.82	78	61.49	Arncliffe
— .51	78	.85	12	6	24.60	23.23	—1.37	94	26.87	Ribston Hall
+ .17	107	1.16	12	21	24.10	22.85	—1.25	95	26.42	Hull
— .88	67	.63	12	17	25.48	19.87	—5.61	78	27.94	Newcastle
—7.68	43	2.30	9	9	114.34	82.41	—31.93	72	120.48	Seathwaite
—1.04	75	1.33	11	16	37.58	31.92	—5.66	85	42.28	Cardiff
—1.67	68	1.29	11	13	41.63	39.79	—1.84	96	46.81	Haverfordwest
— .62	86	1.50	11	13	40.80	37.00	—3.80	91	45.46	Gogerddan
— .28	91	1.21	12	12	27.52	27.02	— .50	98	30.36	Llandudno
—1.49	66	1.07	8	9	38.63	36.88	—1.75	95	43.47	Cargen
— .55	83	.44	29	17	30.93	26.82	—4.11	87	33.76	Marchmont
—3.36	36	.65	8	12	44.29	37.62	—6.67	85	49.77	Girvan
—2.08	43	.40	8, 27	7	32.02	23.83	—8.19	74	35.97	Glasgow
—4.21	43	1.08	8	11	60.10	49.99	—10.11	83	68.67	Inveraray
—3.24	48	1.11	8	18	49.98	37.35	—12.63	75	56.57	Quinish
—1.03	61	.82	29	9	25.97	23.89	—2.08	92	28.64	Dundee
+ .52	114	2.29	9	12	31.80	36.35	+4.55	114	34.93	Braemar
— .06	98	.78	29	16	29.30	29.65	+ .35	101	32.73	Aberdeen
+1.19	142	1.86	9	20	27.62	32.25	+4.63	117	30.34	Gordon Castle
—1.82	60	1.09	9	18	38.91	28.29	—10.62	73	44.53	Fort Augustus
—2.08	77	1.21	30	18	74.07	62.80	—11.27	85	83.93	Bendamph
+1.07	123	1.00	9	17	28.81	27.47	—1.34	95	31.90	Dunrobin Castle
+ .83	128	...	...	...	26.77	21.87	—4.90	82	29.88	Wick
— .31	94	1.27	11	15	47.89	44.32	—3.57	93	54.81	Killarney
— .92	76	.99	11	9	35.25	34.53	— .72	98	39.57	Waterford
+1.21	131	2.19	11	12	35.09	35.63	+ .54	102	39.43	Castle Lough
+ .37	108	1.73	11	14	41.49	41.31	— .18	100	46.52	Ennistymon
+1.81	153	2.21	12	8	31.57	33.45	+1.88	106	34.99	Courtown Ho.
— .56	83	.95	11	13	32.51	30.88	—1.63	95	35.92	Abbey Leix
+1.03	139	1.59	12	10	25.41	28.67	+3.26	113	27.68	Dublin
— .90	73	.95	12	9	32.76	35.68	+2.92	109	36.15	Mullingar
—1.13	80	.72	26	21	46.76	44.58	—2.18	95	52.87	Enniscoie
— .34	93	1.28	11	16	43.48	42.03	—1.45	97	48.90	Cong
— .32	92	.78	9	17	38.37	39.11	+ .74	102	42.71	Markree
— .84	78	.88	12	11	35.14	32.97	—2.17	94	38.91	Seaforde
...	...	...	...	...	33.69	...	...	...	37.56	Dundarave
— .89	76	.65	29	16	35.47	33.24	—2.23	94	39.38	Omagh

SUPPLEMENTARY RAINFALL, NOVEMBER, 1915.

Div.	STATION.	Rain inches	Div.	STATION.	Rain inches.
II.	Warlingham, Redvers Road..	3.66	XI.	Lligwy	3.09
„	Ramsgate	3.30	„	Douglas	4.24
„	Hailsham	4.06	XII.	Stoneykirk, Ardwell House...	1.51
„	Totland Bay, Aston House...	2.60	„	Carsphairn Shiel	4.93
„	Stockbridge, Ashley..	2.63	„	Beattock, Kinnelhead	3.35
„	Grayshott	3.40	„	Langholm, Drove Road	2.60
III.	Harrow Weald, Hill House...	2.20	XIII.	Meggat Water, Cramilt Lodge	2.39
„	Caversham, Rectory Road ...	1.94	„	North Berwick Reservoir....	1.28
„	Pitsford, Sedgebrook....	2.60	„	Edinburgh, Royal Observaty.	1.00
„	Woburn, Milton Bryant.....	2.39	XIV.	Maybole, Knockdon Farm ...	1.42
„	Chatteris, The Priory.....	2.67	XV.	Ballachulish House	3.94
IV.	Elsenhams, Gaunts End	2.44	„	Campbeltown, Witchburn ..	3.56
„	Colchester, Hill Ho., Lexden	2.08	„	Holy Loch, Ardnadam.....	4.17
„	Ipswich, Rookwood, Copdock	1.98	„	Islay, Eallabus	3.08
„	Blakeney	3.14	„	Tiree, Cornaigmore	3.80
„	Swaffham	2.89	XVI.	Dollar Academy	2.61
V.	Bishops Cannings	2.03	„	Balquhider, Stronvar.....	..
„	Wimborne, St. John's Hill ...	3.50	„	Glenlyon, Meggernie Castle..	2.58
„	Ashburton, Druid House.....	4.09	„	Blair Atholl	3.31
„	Cullompton	2.50	„	Coupar Angus	2.07
„	Lynmouth, Rock House	3.87	„	Montrose, Sunnyside Asylum.	1.85
„	Okehampton, Oaklands.. ..	3.37	XVII.	Alford, Lynturk Manse	3.79
„	Hartland Abbey.....	2.89	„	Fyvie Castle	4.41
„	Probus, Lamellyn.....	2.47	„	Keith Station	6.19
„	North Cadbury Rectory.....	2.32	XVIII.	Rothiemurchus	3.92
VI.	Clifton, Pembroke Road....	1.98	„	Loch Quoich, Loan	5.80
„	Ross, The Graig	1.63	„	Drumnadrochit	4.40
„	Shifnal, Hatton Grange.....	2.30	„	Skye, Dunvegan	4.48
„	Droitwich.....	2.18	„	Lochmaddy, Bayhead	2.41
„	Blockley, Upton Wold.....	2.34	„	Glencarron Lodge	4.98
VII.	Market Overton.....	3.15	XIX.	Invershin	3.36
„	Market Rasen	2.43	„	Melvich	4.34
„	Bawtry, Hesley Hall	2.38	„	Loch Stack, Achfary	6.07
„	Derby, Midland Railway.....	2.66	XX.	Dunmanway, The Rectory ..	5.76
„	Buxton	2.96	„	Glanmire, Lota Lodge.....	4.15
VIII.	Nantwich, Dorfold Hall	3.05	„	Mitchelstown Castle.....	3.30
„	Chatburn, Middlewood	2.21	„	Darrynane Abbey.....	5.11
„	Lancaster, Strathspey	1.94	„	Clonmel, Bruce Villa	3.52
IX.	Langsett Moor, Up. Midhope	3.19	„	Newmarket-on-Fergus.Fenloe	3.74
„	Scarborough, Scalby	3.34	XXI.	Laragh, Glendalough .....	..
„	Ingleby Greenhow	3.18	„	Ballycumber, Moorock Lodge	2.18
„	Mickleton	2.20	„	Balbriggan, Ardgillan	2.70
X.	Bellingham, High Green Manor	1.47	XXII.	Ballynahinch Castle.....	6.73
„	Ilderton, Lilburn Cottage ...	2.41	„	Woodlawn	3.52
„	Keswick, The Bank.....	2.47	„	Westport, St. Helens	5.06
XI.	Llanfrehfa Grange	2.93	„	Dugort, Slievemore Hotel ...	3.82
„	Treherbert, Tyn-y-waun	5.74	„	Mohill Rectory	2.80
„	Carmarthen, The Friary	4.26	XXIII.	Enniskillen, Portora.....	1.96
„	Fishguard, Goodwick Station.	3.11	„	Dartrey [Cootehill]	1.98
„	Crickhowell, Tal-y-maes.....	4.60	„	Warrenpoint, Manor House ..	2.95
„	New Radnor, Ednol	2.80	„	Banbridge, Milltown	1.79
„	Birmingham WW., Tyrmynydd	5.63	„	Belfast, Cave Hill Road	2.45
„	Lake Vyrnwy .....	..	„	Ballymena Harryville	3.66
„	Llangynhafal, Plâs Draw.....	4.28	„	Londonderry, Creggan Res...	3.21
„	Dolgelly, Bryntirion.....	4.61	„	Dunfanaghy, Horn Head ...	3.46
„	Bettws-y-Coed, Tyn-y-bryn...	4.48	„	Killybegs	3.58

THAMES VALLEY RAINFALL — NOVEMBER 1915.



THE WEATHER OF NOVEMBER.

THE month of November was remarkable throughout the British Isles for a persistently low temperature and an abnormal range of pressure. In many places the month was the coldest November on record. At Chellaston, Derbyshire, the mean temperature was $34^{\circ}\cdot9$, or $7^{\circ}\cdot3$ below the average, and at Biggar the mean temperature was $31^{\circ}\cdot1$. The general deficiency was about 5° . Sunshine was almost everywhere abundant and much in excess of the average; rainfall was generally deficient. The greater part of the month's total fell in the earlier half, when gales and stormy weather were experienced.

At the close of October a well marked cyclone passed up the English Channel, and lay for the first few days of November over Northern Europe. North-easterly winds with considerable sunshine were experienced, except in the south-east, where cloud and rain prevailed. From the 5th a cyclone developed off the coast of Norway and moved south-west until the 9th, when it had its centre over Scotland. Warmer weather resulted and the majority of stations recorded their maximum temperature for the month from 6th to 9th. These were, however, generally much below the normal and in many cases barely exceeded 50° . In the south the temperature was higher; at Cadland 60° was reached on the 9th, and at North Cadbury 59° on the 8th. In the north of Scotland there was heavy rain and some snow, Drumna-drochit recording 1.20 in. and 2.14 in. on the 8th and 9th. On the 11th a deep cyclone developed off the west of Ireland and became the predominating influence. Unsettled conditions resulted, culminating in gales and heavy rain from the 11th to 13th. In the north precipitation was frequently in the form of snow. On the 11th and 12th heavy rain was general in the south and west, the greatest falls being recorded in Ireland. The rainfall for these two days at Doolin, Co. Clare, was 5.08 in. At Clonmannon, Co. Wicklow, on the 12th, the fall was 2.37 in., and the gale which accompanied it was the worst north-easter experienced there since 1861. Gusts of wind were recorded in the south and west districts reaching a velocity of over 80 miles per hour. More settled anticyclonic conditions followed with abundant sunshine, moderate winds from the north and very low temperatures. These conditions were maintained with little change until almost the end of the month. Minima below 20° were recorded in most districts; on the 17th and 18th the temperature fell to 9° at Biggar. On the 15th snow was general, except in the extreme south. Thence to the 29th slight falls of rain and snow in most parts prevented the occurrence of an absolute drought, except in the south of Ireland, where no precipitation was recorded from 14th to 28th inclusive at several stations. The last two days of the month were again generally wet and stormy with an increase in temperature and south-west winds. Thunderstorms occurred in the south with hail and squalls.

The rainfall of the month was in excess of the average over three areas: the north-east of Scotland, a central strip in Ireland from west to east, and in the north Midland counties of England, with a coastal fringe from Flamborough Head to Kent. The deficiency was most marked on the west coast of Scotland and the extreme north-west of England, where less than half the average was recorded. Broadly the wettest parts had the smallest percentage of the average, the distribution being comparatively uniform. Over the Kingdom as a whole the general rainfall expressed as a percentage of the average was: England and Wales, 82; Scotland, 74; Ireland, 97; British Isles, 83.

The following sunshine records were reported: Camden Square, 60 hours; Worthing, 120 hours; Totland Bay, 112 hours; Copdock, 77 hours; Sidmouth, 97 hours; Weymouth, 109 hours; Ashbourne, 76 hours; Southport, 84 hours; Bolton, 32 hours; Hull, 56 hours; Haverfordwest, 115 hours; Swinton, 52 hours; Paisley, 49 hours; Perth, 76 hours; Loch Stack, 36 hours.

In London (Camden Square), the mean temperature was $39^{\circ}\cdot2$, or $4^{\circ}\cdot3$ below the average, being the coldest November, with three exceptions, since 1858. Duration of rainfall, 47.4 hours. Evaporation, .25 in.

Climatological Table for the British Empire, June, 1915.

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.										
London, Camden Square	88°·9	8	41°·8	1	72°·9	51°·0	52°·4	0·100	76	133°·6	37°·5	inches ·69	8	5·2
Malta	84°·2	21	66°·0	6	77°·6	69°·1	...	90	140°·0	...	1°·36	8	1°·6	
Lagos	89°·0	4	70°·0	13	85°·0	74°·5	74°·3	84	155°·0	67°·0	24°·95	25	8°·8	
Cape Town	81°·9	12	41°·3	20	63°·8	49°·4	50°·3	78	...	...	5°·92	14	5°·5
Natal, Durban	...	...	...	...	...	...	...	...	...	...	...	...	...
Johannesburg ... ..	...	...	...	...	...	...	...	...	...	...	...	...	...
Mauritius	80°·1	4	57°·2	†27	76°·1	62°·6	61°·3	76	...	47°·9	1°·00	14	5°·4	
Bloemfontein	71°·7	5	21°·2	20	61°·8	32°·7	32°·5	70	..	...	°·02	1	2°·3
Calcutta... ..	95°·0	8	74°·3	1	91°·2	79°·4	78°·2	83	...	70°·2	10°·64	14	8°·1	
Bombay... ..	94°·2	17	76°·4	27	89°·5	81°·1	77°·2	78	135°·7	67°·2	40°·10	13	6°·1	
Madras	106°·3	1	76°·8	24	98°·3	82°·6	74°·1	67	159°·6	74°·6	1°·31	8	5°·0	
Colombo, Ceylon	91°·4	4	72°·5	16	87°·7	77°·6	74°·7	81	153°·7	69°·7	7°·96	21	7°·6	
Hongkong	91°·0	27	73°·6	13	86°·2	78°·4	76°·0	83	...	...	11°·96	19	7°·9
Sydney	67°·2	5	42°·1	27	62°·3	48°·1	44°·3	66	116°·3	40°·2	1°·33	5	4°·4	
Melbourne	65°·1	2	38°·5	26	56°·8	46°·5	43°·4	72	102°·0	28°·8	2°·08	20	7°·7	
Adelaide	72°·7	1	42°·6	8	61°·2	50°·2	48°·5	75	121°·2	33°·3	3°·40	15	6°·8	
Perth	70°·1	9	44°·6	27	64°·8	53°·5	52°·7	80	129°·3	39°·0	8°·07	23	7°·5	
Coolgardie	70°·8	4	36°·6	9	63°·0	47°·4	45°·3	69	125°·6	30°·4	3°·07	11	6°·5	
Hobart, Tasmania	63°·3	2	33°·9	26	53°·2	41°·1	38°·3	68	106°·0	26°·3	1°·57	23	5°·9	
Wellington	60°·8	13	31°·2	20	54°·9	44°·4	43°·9	80	112°·6	23°·0	2°·37	16	8°·1	
Auckland	66°·0	13	42°·0	14	59°·4	48°·2	49°·5	85	118°·0	37°·0	4°·48	21	6°·2	
Jamaica, Kingston	94°·3	27	71°·9	29	89°·5	74°·6	73°·0	76	...	...	14°·51	9	...
Grenada	89°·0	*21	72°·0	8, 14	86°·0	74°·0	...	77	135°·0	...	4°·62	23	4°·5	
Toronto	82°·0	29	42°·9	24	73°·1	51°·3	50°·3	68	137°·6	40°·8	1°·34	13	4°·7	
Fredericton	81°·8	5	31°·0	3	71°·7	47°·1	...	78	...	...	5°·44	16	5°·7
St. John, N.B.	73°·7	6	38°·5	2	62°·9	48°·3	49°·5	79	...	...	5°·97	15	6°·4
Alberta, Edmonton	75°·6	†23	33°·1	14	66°·2	45°·1	...	68	139°·0	26°·3	6°·42	19	5°·7	
Victoria, B.C.	82°·5	30	47°·9	24	65°·2	50°·5	...	74	142°·0	39°·2	°·61	4	3°·7	

* 22.

† 24.

‡ 28.

MALTA—Three or four TSS, which is exceptional.

Mauritius—Mean temp. 0°·6 above, and R 1·58 in. below, averages. Mean hourly velocity of wind 1·28 miles below average.

COLOMBO, CEYLON—Mean temp. 82°·7, or 0°·9 above, dew point 0°·2 below, and R ·25 in. below, averages. TSS on three days.

HONGKONG—Mean temp. 81°·6, mean hourly velocity of wind 8·0, and bright sunshine 175·9 hours.

Melbourne—Mean temp. 1°·2 above, and R normal.

Adelaide—Mean temp. 2°·3 above and R ·37 in. above, averages.

Perth—R generally above the average.

Coolgardie—Temp. 2°·7 above, and R about two inches above, averages.

Hobart—Temp. 1°·1 above, and R ·61 in. below, averages.

Wellington—Mean temp 0°·2 above, and R 2·71 in. below, averages. Bright sunshine 79·8 hours. T, L, and H on 18th. Fog on three mornings.

Auckland—R close to average.

ALBERTA, EDMONTON—Great flood on 29th, the river Saskatchewan rising 28 ft. in 36 hours, 45 ft. 2 in. above low water level, doing great damage. TSS on 8 days.