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ON THE AMOUNT OF HEAT REQUIRED FOR THE GROWTH AND RIPENING OF WHEAT.

By R. H. Curtis.

The relation of Meteorology to Agriculture is a large subject which may be studied from several points of view. In some of its aspects the relation is sufficiently obvious, but in others it requires to be sought for, and, as has happened in other fields of enquiry, it may perhaps be found in unlooked-for directions and as the result of indirect research. The connection between the rainfall of autumn and the yield of wheat in the ensuing harvest, to which Dr. Shaw has recently called attention, would appear to be an example of such an unexpected discovery, and doubtless there are others equally interesting awaiting the patient investigator in this promising branch of enquiry.

Many facts have been observed in connection with the growth of plants which lead to the probable conclusion that the amount of heat required to enable them to perform the several functions involved must be the same for the same plant when grown under fairly similar conditions; and if these thermal constants could be determined they would probably be of considerable value. As to the precise part which heat plays in connection with growth, very little is known with certainty. Whether it is used, and if so to what extent, in the transformation of the materials of which a plant is built up; or in keeping alive and in action certain of its organs; or whether the plant itself develops heat, some of which it may possibly use again, are questions upon which we have little definite knowledge, and they lie perhaps beyond the province of meteorology. But it is within its province to ascertain information relating to the meteorological conditions which influence plant life, and these certainly embrace the amounts of heat required to bring about the accomplishment of certain stages of growth, such as the ripening of cereal crops, a knowledge of which would be of no small theoretical and practical value.

This is a subject which has already received a considerable amount of attention, and, amongst others, Boussingault, Hervé-Mangon, and De Candolle on the Continent, and Dr. Gilbert, F.R.S., in this

country, have endeavoured to determine the thermal constants for various plants, but especially for the ripening of wheat.

The method usually followed on the Continent was to find the mean temperature of the air for the entire period covered by the growth of the plant, and then to multiply the excess of that figure above zero centigrade by the number of days in the period, and to regard the product as the accumulated amount of temperature required. Gilbert somewhat modified this by starting his period from arbitrarily chosen dates, as the 1st of January, the 1st of February, &c., and also from the time at which the temperature had so far advanced in its annual march that it continuously showed some excess over the point selected as his zero. This point was 42° Fahr., which was regarded as the critical temperature at which the processes involved in the growth of the plant became active, whilst they remained dormant when the thermometer fell below it. Of course it is quite possible that each species may have, to a certain extent, its own zero at which growth begins, but probably the value chosen by Dr. Gilbert is very nearly correct for most, or at any rate for the cereals generally grown in this country.

The temperature observations employed by Gilbert were the monthly means for Greenwich for the years 1852-78, and the daily means for the six years 1871-76. He also used the mean values for accumulated temperature published by the Meteorological Office for the Eastern and Midland Counties of England for the years 1878-85; the termination of his period was in every case the time at which the harvest was reaped at the experimental agricultural station at Rothamsted.

It may be well to explain here that the values of accumulated temperature which have been published by the Meteorological Office since the year 1878, and which are the values referred to above as having been to some extent used by Dr. Gilbert, are calculated by a method devised by Gen. Strachey, F.R.S., for finding from ordinary temperature observations the amounts of the daily temperature above and below a fixed base such as Dr. Gilbert used. The results are expressed in what are termed *day-degrees*, following the analogy of the *foot-pound*, the term signifying a degree of temperature continued throughout the whole day. Thus, if the temperature throughout the day was continuously 44°, the base temperature being 42°, the accumulated temperature for the day would be 2 day-degrees. If, again, the thermometer should read 40° from midnight to noon, and then suddenly rising should remain at 44° till the following midnight, it would be equivalent to 1 day-degree *below* the base and 1 day-degree *above*, the two degrees for the half-day being obviously the equivalent of one degree for the whole day. General Strachey has given a formula for calculating these values from the readings of the maximum and minimum thermometers, and also for obtaining the mean temperature more accurately than by simply taking the mean of the readings of the two instruments as is usually done.

To turn now to Dr. Gilbert's results. As might have been expected, he got a somewhat smaller sum of accumulated temperature according as he moved the starting point of his calculations further into the year, and the results were also different, as they were derived from the Greenwich monthly means, the Greenwich daily means, or from the accumulated mean temperature values for the Eastern and Midland Counties published by the Meteorological Office. Starting in each case from the 1st of January, the average amount of accumulated temperature to the time of wheat harvest from the three sets of data was 2023° F., 2189° F., and 1904° F., respectively. Boussingault's values are much larger than these, even when reduced to the same base temperature, but this may have been due to his having used an average term for the growth of the wheat, instead of the more precise Rothamsted data employed by Gilbert. Hervé-Mangon found the value for wheat to be 1854° F. when corrected to 42° as the base value, and this amount approximates very closely to that Gilbert obtained from the Meteorological Office data.

The result of some calculations of the amount of accumulated temperature required for the blossoming of a plum tree, which I made some time ago, led me to the conclusion that it was not right to select an arbitrary date for commencing such calculations, but that they ought to cover the whole interval between sowing and reaping. Nor, for that matter, is it absolutely certain that the base temperature selected is the most suitable, or that it should be maintained throughout the whole of the year, for it is quite possible that growth may go on with lower temperatures than 42° F., or that, at any rate, with such lower temperatures certain changes and modifications proceed in the plant which prepare it for more active development later on.

It was with a view to testing some of these conclusions that I obtained, through the kindness of Mr. A. D. Hall, M.A., the Director of the Lawes Agricultural Trust, the dates of sowing and reaping wheat and barley crops at Rothamsted over a long series of years, the whole of which I have, unfortunately, not been able to use owing to the absence of the corresponding temperature observations.

For the purpose of my calculations, I employed the temperature observations actually made at Rothamsted, instead of using a mean value for a large district which might possibly embrace at once very dissimilar conditions of weather; and I also got out the number of day-degrees below, as well as above, 42° F. from the time of sowing till harvest.

The mean amount of accumulated temperature, above 42°, required for the growth and ripening of autumn sown wheat is shown by my calculations to be 1961 degrees Fahrenheit; the maximum amount is 7 per cent. in excess of this figure, and the minimum, which comes from the data for last year, 1903-4, is 8 per cent. below it. But whilst the time interval between sowing and ripening varies in different years by as much as seven weeks, which is 17 per cent. of the average period, the differences in the amounts of accumulated tempera-

ture are within 2 per cent. of the average in 16 out of the 28 years dealt with. In eight of the remaining years it amounts to or exceeds 5 per cent.; so that, speaking broadly, one may say that the divergencies from the average, when not trifling, are rather large. This, I believe to be due to the modifying effect of other important elements, such as rainfall or sunshine, which have to be considered in conjunction with temperature, and whose incidence separately or combined was more or less abnormal in those years. The year, 1903-4, in which the largest difference from the mean temperature occurs, the 8 per cent. just mentioned, affords an illustration of this. That year was abnormal in respect of the short interval which elapsed between sowing and harvest, and also in the *distribution* of rainfall over the period. I find that for the 38 weeks it covers (strictly, 262 days), the total rainfall was nearly normal in amount, but that during no fewer than 28 weeks of the period it was less than normal, to an aggregate amount of nearly 8½ inches. This deficit was made up to the extent of 8 inches in 10 weeks of excess, six of which fell within the winter limits when the temperature was low and growth almost stationary. Mr. Hall, the Director at Rothamsted, referring to the effect of moisture on growth in a letter to me, says: "Great dryness shuts up the growth of the plant and leads to premature ripening, the farmer is well acquainted with the character of such grain," and he gave me details of experiments he has made on the subject, in one of which three pots of wheat were grown under similar conditions of heat, whilst the supply of water was throughout maintained in one pot below, in another at, and in the third above the optimum, with the result that the low water ripened a week or ten days before either of the other two. A similar deficiency of water must, I think, have been the cause to which the abnormally short period between sowing and harvest and the consequently small amount of accumulated temperature in this year was due, and probably, also, the other fact that the yield of wheat for the year was exceptionally small.

The space at my disposal in this Magazine will not allow me to go at greater length into the influence of rainfall, or even to touch upon that of sunshine, both of which elements are, of course, intimately connected with the effect of temperature upon growth; nor can I refer at this time to the temperature results I have similarly obtained for the growth of barley.

"BRITISH RAINFALL, 1904."

THE volume of *British Rainfall* for 1904* was published on August 11th. It is exactly the same size as last year; the reduction in the number of pages in Part II., due to the less remarkable rainfall

* On the Distribution of Rain over the British Isles during the year 1904, as observed at about 4000 stations in Great Britain and Ireland. With articles upon various branches of Rainfall Work. Compiled by Hugh Robert Mill. London: Edward Stanford, 1905.

of 1904, being equalised by the increase in Part I. on account of the greater space devoted to original articles on rainfall work, and to the introduction of a new feature, the publication of complete daily records for ten selected stations.

The increase in the number of stations is less than in 1903, but amounts to the very substantial number of 153, the total number of records dealt with being 3982. All the new features introduced last year have been continued, and special attention has been devoted to the mapping of heavy rains. Nine of the wettest days have been selected for complete cartographical treatment, the distribution of rainfall being brought out by lines drawn for ·25 in., ·50 in. and for each whole inch of fall. The tracks of the atmospheric depressions associated with the day's rain are added.

The special articles in Part I. include a brief analysis of the rainfall records at Ben Nevis and Fort William, illustrated by a striking photograph of the high-level Observatory. There is also a discussion of Dry Octobers in which the four driest Octobers since *British Rainfall* was instituted are compared, and October, 1904, shown to have been the driest with one exception in that period. The most important article is devoted to the Mean Monthly Duration and Rate of Rainfall at Camden Square, based on the measurement of the traces of an automatic recording rain gauge for twenty-four years. Although this paper is only preliminary to a complete discussion, it yields some interesting results of a definite nature. One of these is that although the curve of mean monthly rainfall and the curve of mean monthly duration show double maxima and minima in the year, the curve of mean monthly intensity of rainfall which results from them shows a single maximum in July and a single minimum in January with a remarkably uniform rise and fall. It is shown that the rate of fall of rain per hour is twice as great in July as in January, and the annual curve of intensity bears a considerable resemblance to the annual curve of mean temperature of the air.

The Editor points out that the distinctive feature of *British Rainfall* is the joint responsibility of the Observer and the Editor for the accuracy of every entry, and he mentions that one return in every eight has been the object of special editorial enquiry before its value was accepted as correct.

SCOTTISH METEOROLOGICAL SOCIETY.

At the half-yearly meeting of this Society held in Edinburgh on July 18th, the following Report was presented by the Council:—

There has been no change in the Society's stations since the meeting in March.

The Registrar-General for Scotland has been regularly supplied with the monthly and quarterly reports from this office; and also direct from the observers in the eight large towns of Scotland, with

the daily observations of temperature and rainfall required for his weekly reports.

The Meteorological Council at London has been supplied direct from the observers at Glencarron, Fort Augustus, Braemar, Clathick, Marchmont, and Cally, with daily observations of temperature and rainfall, and in some cases sunshine, for their weekly weather reports.

As stated in the Report to the meeting in March last, the Ben Nevis and Fort William Observatories were closed in October, 1904. The buildings on Ben Nevis, and the bridle-path which extends from the foot of the hill to the summit, have now been handed over to the proprietor of the ground, in accordance with the stipulation in the Feu-charter, by which, when the building ceased to be used as an Observatory, the ground and all buildings on it revert to the Superior. The Observatory in Fort William has been advertised for sale, but has not yet found a purchaser. As soon as the Fort William Observatory is sold, the Observatories' Fund will be wound up and the board of directors dissolved.

The closing of the Ben Nevis Observatories and the dissolution of the board of directors can only be regarded as a great blow to meteorological investigation in Scotland. The important work of discussing and utilising the Ben Nevis records will now devolve on this Society. The Society has no funds available for this purpose, but certain charges in connection with the examination and discussion of the Ben Nevis observations, which were formerly paid by the Ben Nevis Observatories' Fund, have, since 31st December last, been borne by the Society. During these six months the Society has received special donations from gentlemen interested in the continuance of the discussion of the Ben Nevis records, which have enabled it to meet this additional outlay. Intimation has also been received that for the ensuing academic year 1905-6 a sum of £100 will be granted for this object to Dr. Buchan by the Carnegie Trust for the Endowment of Post-graduate Research. But more will be needed if the Ben Nevis record is to be fully utilised.

The third volume of the Ben Nevis observations, containing the records for the years 1893 to 1897 inclusive, is approaching completion.

Correspondence.

To the Editor of Symons's Meteorological Magazine.

THE STUDY OF THUNDERSTORMS.

THUNDERSTORMS in England derive a special interest both on account of their comparative rarity and their uncertainty as to time and place of occurrence. It has often occurred to me, therefore, that this much neglected branch of British climatology might be cultivated more assiduously than it is with the object of ascertaining

the periods and areas of maximum and minimum frequency of storms, and then, with the aid of the known laws of physics, of theorizing upon and establishing, as far as possible, a science of British thunderstorms.

If readers of this Magazine in all parts of the British Islands would care to co-operate with us for the purpose, and send us in notices of all thunderstorms that occur in their respective localities, we would record and tabulate these notices, and after the accumulation of a sufficient number of facts, discuss them, with the hope of of investigating into the real nature and causes of thunderstorms. In the notices received information would be useful as to (1) the type of thunderstorm experienced; (2) the intensity and duration of the storm, amount of rainfall, occurrence of hail, &c.; (3) the conditions of temperature and humidity before, during and after the storm; (4) damage caused by the storm; (5) the geographical features of the locality reporting the storm, while the distribution of atmospheric pressure over Great Britain during the stormy periods would also be studied. Obviously the reports would have to be received from fixed stations and not from observers away from home; also, since no two observers would agree as to what constitutes a thunderstorm, let us fix an arbitrary standard and define a thundery day as one upon which thunder is heard at the place of observation, just as a "rainy day" is one with ·01 in. of rain.

I have a very strong suspicion that one of the areas of maximum frequency and intensity of summer thunderstorms in England will be found to lie among the Pennine moorlands, for my own experience of thunderstorms in East Lancashire and the West Riding of Yorkshire has led me to believe that they are more persistent and severe in those districts than in the neighbourhood of London even, where storms are undoubtedly relatively frequent; and I believe it is a fact that the Stonyhurst Observatory on the border of north-east Lancashire records on an average more thunderstorms a year than the Greenwich Observatory. It would be interesting to compare the observations of storms in the Pennine district and in the Lake country with those of storms in upland tracts in the south of England like Dartmoor, Exmoor, or Hindhead.

Most people have an instinctive idea that thunderstorms are less frequent at the seaside than inland, but the reason for the fact that they are is not altogether so obvious as it is sometimes imagined. So far as I know, little exact knowledge exists relating to the distribution of British thunderstorms, and on that account I have considered it not inappropriate to make the above proposal to readers of the Magazine.

Perhaps when we know more about our own displays of thunder and lightning, we shall feel more disposed to compare them with the grander and more terrible electrical phenomena of central Europe, notably those of France and northern Italy.

L. C. W. BONACINA.

4, York Terrace, Sidmouth, Devon, July 26th, 1905.

[We should be pleased to assist in any well-devised scheme for the study of thunderstorms. Perhaps Mr. Bonacina might be disposed before launching a new scheme to prepare a summary of the results obtained through Mr. Symons's investigations commenced in 1858, and those of the Thunderstorm Committee of the Royal Meteorological Society which reported in 1888 and 1889. This would greatly facilitate fresh efforts.—ED. *S.M.M.*]

THE PARALLEL BETWEEN 1896 AND 1905.

I CORDIALLY endorse your criticisms in the June number (page 85) upon the comparison which I have been attempting. It is entirely true that one heavy rain, whether at the beginning or end of a month, may entirely change its character, and make that which truly was a parallel appear from the tables to be no parallel. But the converse does not hold; the month cannot appear to have been dry throughout without having been so in reality.

To compare the Junes of 1896 and 1905 by the light of the tables already published, it is clear that the parallel can be claimed for no more than the southern half of England and Wales, though in some parts of that area it was very close.

It remains to be seen how far the July now ended will have been, as in 1896, very warm and dry over England south of the Humber and in South Wales, and, on the contrary, wet and cool in Scotland and excessively wet in Ireland.

The tables for 1896 show that August had its first three weeks dry, but conspicuously deficient in warmth, and turned wet at the close; and that September was excessively wet over all our islands, every station but one having a +, and these excesses in almost every case very large ones indeed.

Few of your readers can have stronger reasons than myself for hoping that the period August 20th to September 30th may depart as *widely as possible* from the 1896 pattern. I do not at all desire to be "a true prophet once more." H. A. BOYS, F.R.Met.Soc.

North Cadbury Rectory, Somerset, August 1st, 1905.

RAINFALL AT SUNDERLAND.

MY record is so extraordinary for the seven months that I enclose my monthly values up to date:—

1905.	Total. in.	Max. Fall. in.	Date.	Days.
January	·27	·10	17	7
February	·56	·19	13	12
March	1·60	·45	26	14
April	2·53	·37	23	21
May	·78	·31	3	9
June	·79	·32	18	6
July	·98	·33	23	8
	7·51			77

Perhaps the most striking thing is the fact that the total for the three months, May, June and July, only gives 2·55 in. The month of July has been very hot, causing the summer drought to be most trying.

Reviewing the twelve months from the date of this letter, I may remark that only 16·61 in. has fallen, during which period there have been seven months giving each less than one inch.

W. F. VINT.

The Cedars, Sunderland, August 1st, 1905.

LIGHTNING CONDUCTORS.

A FEW years ago a theory was brought forward that there is no necessity to place a lightning conductor on an *old* church; because if the church has never been struck by lightning, the probability is that it never will be struck.*

This proposition seems at first sight very plausible. For if a church tower or spire, erected in the fourteenth or fifteenth century, has remained until the twentieth century without a lightning conductor, and without having attracted the lightning, it is probable that there is some especial reason for its immunity. The causes which conduce to this freedom from injury are not always easy to trace. It may be that there is some conformation of the land which draws the thunderstorms away from the church; or there may be some hills or high trees in the immediate neighbourhood; or possibly a bed of ironstone, which absorbs the lightning. In any case, by the laws of chance, if a high building has existed for five hundred years without damage by lightning, it is probable that it will stand for all time without being struck.

This protection, whatever it may be, is however liable at any time to fail, and a violent and erratic flash may in an instant destroy a beautiful piece of architecture which has stood for centuries.

A remarkable example of this occurred in Egypt on the 31st March last, when, during a very violent thunderstorm, "the minor pyramid of Ghizeh was struck by lightning slightly below the apex of the monument. Several of the immense stone boulders of which the pyramid is built were dislodged, and rolled down with a terrific crash on to the sands below. The place that received the shock looks like a gaping wound. No such accident has occurred within living memory."†

This pyramid was erected by King Menkaoora about the year 3633 B.C.; and, as far as we know, it has stood since that time without being struck by lightning. We cannot, therefore, avoid the conclusion that a building without a lightning conductor is never safe from the lightning flash; no, not after a period of five thousand years.

CHRISTOPHER A. MARKHAM.

The Garth, Dallington Avenue, Northampton, 8th July, 1905.

* *Symons's Monthly Meteorological Magazine*, June, 1898, p. 65.

† *The Times*, 10th April, 1905.

REVIEWS.

Transvaal Meteorological Department. Observations for the period 1st July, 1903—30th June, 1904. With Appendix. First Report. Pretoria, 1905. Size 13 × 8½. Pp. 68.

We welcome Mr. Innes's first Report of the Transvaal Meteorological Service, though at first sight it seems a trifle confusing to include parts of two calendar years. It is explained, however, that it is in harmony with usage in the northern hemisphere to break the year in winter. This strikes us as a bad reason, because it is not on account of the seasons but of the calendar that it was ever adopted. Further, it is pointed out that the summer is the rainy season, and therefore it is an advantage to keep the summer unbroken. This seems to us a good and sufficient reason for the method adopted. We note with pleasure that the time-reckoning is from 0 to 24, thus obviating the stupid and bewildering use of *a.m.* and *p.m.* to which we have grown accustomed.

So far as a hasty glance at the list of stations allows us to estimate, the number at work in the colony is 210. Most of these are rainfall stations, now using a 5 in. Snowdon gauge with the rim set at a height of 4 feet above the ground, though many are still equipped with a shallower funnel, which leads to much loss by out-splashing in hail or heavy rain. In the tables of rainfall we note that cyphers are inserted for falls less than an inch. Experience will, we believe, show that the practice always followed in this Magazine and in *British Rainfall* of omitting the cypher before the decimal point saves much trouble and many errors.

We write this note hurriedly, not because the Report is of small interest, but because it is our last bit of editorial work before we start to see for ourselves something of the equipment of the South African meteorological services.

London Fogs. Report of the Meteorological Council upon an Inquiry during the Winters of 1901-2 and 1902-3. London, 1904. Size 12 × 10. Pp. 48. *Plates.* Price 2s. 6d.

It can hardly be denied that all that could be done with the time and materials at disposal, was done in the investigation of London fogs, recently undertaken by the Meteorological Council. Unfortunately, however, the means available were of so scanty a nature that the chief aim of the inquiry, the satisfactory forecasting of fogs and of their probable density and duration, must still be largely a problem of the future.

When the winter of 1901-2 was already so far advanced as to render a study of the season as a whole impossible, a grant of £250 by the London County Council, enabled the Meteorological Council to appoint Captain A. Carpenter to conduct the inquiry. With the co-operation of the Metropolitan Fire Brigade, the Metropolitan

Police, the Superintendents of the London Parks and various official and private observers, Captain Carpenter collected all the available information, and his ultimate conclusions may be briefly stated as follows :—

(*a*). There is no evidence of special connection between fog and geological conditions.

(*b*). Elevated stations are freer from fog than others.

(*c*). Fogs are produced in London by local conditions, and are not identified with any particular locality in London. The local atmospheric conditions need further investigation.

(*d*). The meteorological conditions for the formation of fog are carefully set forth and illustrated. They include barometric pressure, air temperature and river temperature. In 22 cases out of 25 during the night preceding fog the temperature of radiation fell much below the river temperature.

(*e*). There is a marked tendency for fogs to commence in the early morning after a clear night.

The question of the possibility of foretelling fogs, apart from the more definite conclusions arrived at as to favourable conditions, was not materially advanced, but a more extensive observational investigation was urged, and notes upon the outstanding part of the inquiry were set forth. To this end, in spite of the inability to obtain further support from the London County Council, the Meteorological Council carried on the collection and discussion of the observations during the winter of 1902-3, and Mr. R. G. K. Lempfert made a report upon the work. The comparative absence of fog in that season somewhat hampered the inquiry, but the observations were commenced on September 1st, and all cases of autumnal fogs were included. An improved classification of fogs with regard to density, based on their relative interference with traffic, was introduced with very fair success, and Dr. Shaw's distinction between "steaming-water fogs," "cold-surface fogs" and "cloud fogs" rendered the discussion more complete.

It is considered possible that a special organization, capable of putting the requisite meteorological observations in the hands of an expert at 5 a.m., would make it possible to forecast local fogs with some degree of success, but it is again urged that a further examination of the meteorological conditions is previously required.

Included in the report are many plates and maps showing the distribution of typical fogs, and the observations of temperature, etc., taken at the time.

SEVEN MONTHS' RAINFALL OF 1905.

Aggregate of Rainfall for January—July, 1905.

Stations.	Total Rain.	Per cent. of Aver.	Stations.	Total Rain.	Per cent. of Aver.	Stations.	Total Rain.	Per cent. of Aver.
	in.			in.			in.	
London	13·41	102	Bolton	19·34	93	Braemar	16·70	94
Tenterden	14·95	108	Wetherby	10·53	74	Aberdeen	13·61	81
Hartley Wintney	13·36	96	Arncliffe	25·11	80	Cawdor	16·22	106
Hitchin	13·32	104	Hull	10·66	78	Invergarry	32·18	113
Winslow	11·45	81	Newcastle	8·94	63	Bendamph	44·44	105
Westley	13·29	100	Seathwaite	61·96	93	Dunrobin	17·00	104
Brundall	11·43	89	Cardiff, Ely	17·46	84	Killarney	24·63	82
Alderbury	15·33	103	Haverfordwest	20·83	89	Waterford	19·12	94
Winterbourne	14·03	73	Gogerddan	22·52	103	Broadford	17·29	101
Torquay	14·16	80	Llandudno	13·58	92	Carlow	14·78	82
Polapit Tamar	15·91	87	Cargen	19·41	88	Dublin	11·03	76
Bath	11·69	74	Lilliesleaf	12·99	76	Mullingar	16·08	85
Stroud, Upfield	14·26	91	Colmonell	18·16	82	Ballinasloe	14·20	74
Woolstaston	14·70	87	Glasgow	14·60	80	Clifden	33·08	82
Bromsgrove	10·20	79	Inveraray	36·00	116	Crossmolina	23·10	91
Boston	11·38	93	Islay, Eallabus	25·23	111	Seaforde	15·31	75
Hodsock Priory	9·11	68	Mull	28·78	102	Londonderry	19·16	93
Derby	8·97	64	Dundee	10·10	67	Omagh	19·44	101

The column of the rainfall table for July devoted to difference from the average exhibits an unbroken succession of minus signs, denoting that the fall for this month fell short of the average over the whole of the British Isles. It is probable, however, that in localities where the thunderstorm of the 9th reached its greatest intensity, instances of excesses occurred. The result of the general deficiency was to reduce the average of the percentages in the aggregate table from 97 for January to June to 89 for January to July. Only a comparatively small portion of the British Isles has an aggregate fall still in excess of the average; this portion comprises the whole of that part of Scotland lying to the N.W. of a line drawn from Kintyre, through the Trossach district and roughly along the course of the river Spey. Inveraray was comparatively the wettest spot, with 116 per cent. An area in the S.E. of England, just including London and extending N. to Bury St. Edmunds and W. to Salisbury, also had a fall exceeding the average to a slight extent, and almost negligible isolated excesses occurred at Aberystwyth and Broadford. A considerable area over which less than three-quarters of the average fall has taken place lies in the S.E. of Scotland and N.E. of England, extending from Forfarshire along the E. coast and into the English Midlands. We print elsewhere a letter calling attention to the abnormally deficient rainfall at Sunderland, to which the nearest station included in the table is Newcastle, with only 63 per cent. of the average. In the extreme N. and S. of this area Dundee had only 67 per cent. and Derby 63 per cent. There was also a small area in Dorset with a deficiency exceeding a quarter of the average. Ireland showed a fairly uniform deficiency, reaching 26 per cent. at Ballinasloe.

METEOROLOGICAL NEWS AND NOTES.

THE BRITISH ASSOCIATION meets this year in South Africa, and our report of the proceedings as regards meteorology must consequently appear a little later than usual. The scientific meetings of the Association were planned to commence at Cape Town on August 15th, and after a few days they will be adjourned to Johannesburg, where the official party arrives on the 28th. On the conclusion of the scientific meetings a long excursion will be made by special train, extending as far as the Victoria Falls on the Zambesi, and a large party will return to England from Beira in Portuguese East Africa, calling at various points on the east coast on the way homeward through the Red Sea and Suez Canal. We understand that although the papers dealing with meteorology are, this year, to be scattered through several sections, the usual opportunity of a reunion of meteorologists and rainfall observers will be afforded by a Meteorological Breakfast in Cape Town.

THERE ARE DEGREES OF MANY KINDS adapted for measuring different phenomena, but while some degrees are convertible into distances, others are not. The observer, from whose report of a double rainbow in a provincial paper (the editor's blushes we sympathetically spare by suppressing name and date) we quote the following trifle, came near to finding the pot of gold that tradition says lies buried under the rainbow's foot :—"To give an idea of the width of the band from the inner violet to the outer violet is exceedingly difficult; but where the horizon was near to the observer, the band of the double bow would be about eighty yards wide." We wonder how wide the moon appears on the same scale.

THE TRUE DIRECTION AND VELOCITY OF THE WIND AT SEA may be determined by means of an instrument devised by Mr. A. Lawrence Rotch and manufactured by Mr. Casella of Holborn. This instrument, which consists of two brass discs marked with the points of the compass, and pivotted with three graduated rules, performs the operation of combining the direction taken by the smoke, or pennant, of a ship with the course and speed of the vessel, in such a manner that the resultant direction and velocity of the wind can be read off without further calculation. Mr. Rotch has found the instrument specially useful for determining wind when flying kites from vessels, and it has been satisfactorily tested during four transatlantic voyages.

AN EXTREMELY HEAVY FALL OF RAIN in one day is reported in the *Cincinnati Price Current* (Ohio) of June 29th, 1905 :—"Two weeks before, at Birmingham, in S.E. Iowa, $10\frac{3}{4}$ in. of rain fell in twelve hours according to 'Government measurement'; and at Milton, a little further south, a correspondent reported 12 in. of rain as having fallen in eight hours."

RAINFALL IN THE TALLA VALLEY.*

AT the beginning of 1896 the Edinburgh Water Trust undertook to ascertain the mean rainfall of the Talla Drainage Area, in the south-east of Peeblesshire, with a view to adjusting the compensation due on impounding the stream for the water-supply of Edinburgh City. For this purpose seven rain gauges were erected at spots within the area in question, varying in altitude from 966 feet to 2627 feet, and so placed that their readings should give a proper representation of the rainfall. The observations were subsequently tabulated and discussed by Mr. Hall Blyth and Mr. W. A. Tait, and the results laid before the Royal Society of Edinburgh.

It was found necessary to augment the arithmetical averages of the total falls for the seven years over which observations extended by 4 per cent, in order to arrive at an approximately correct value for a long period. This process showed means varying from 47·66 in. at Quarter Hill in the extreme north of the area, 1196 feet above sea level, to 73·92 in. at Gameshope Farm at 1538 feet. The mean of the seven gauges was 62·51 in., or for a long period 65 inches. The increase of rainfall with altitude was somewhat irregular, since three stations gave values exceeding that of the most elevated station, and two had considerably less rainfall than the least elevated.

From a table giving the average results for the seven gauges for each month it appears that December was by far the wettest month, having a mean fall of 8·76 in., whilst November, the next wettest, had only 6·44 in. May was the driest with 3·37 in. It is obvious that the period is far too short for the monthly means to have much significance, but it is noticeable that the total for the six months July to December exceeded that for January to June by 11·63 in. The wettest month recorded was December, 1900, with 17·11 in. at Gameshope Farm, and the driest, March, 1900, with ·30 in. at Gameshope Loch.

Daily records were maintained at three duplicate gauges, and these showed that the longest period of practically continuous rainfall was from September 11th to October 11th, 1896, during which period 13·89 in. of rain fell at Gameshope Farm; and the heaviest continuous fall was from December 26th to 30th, 1897, when 9·99 in. fell at the same station. Three falls exceeding 3·00 in. in 24 hours took place at Gameshope Farm, none at any other station.

It is gratifying to know that, upon the recommendation of the Arbiters, the Edinburgh Water Trust have agreed to continue the gaugings, recognising that the ultimate value of so unique a series of observations cannot fail to be very great.

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* Note on the Rainfall on the Drainage Area of the Talla Reservoir, by B. Hall Blyth and W. A. Tait. *Proc. Roy. Soc. Edin.*, XXV. (1905), 616-629.

OPTICAL CONVENTION, 1905.

THE Optical Convention was held at the Northampton Institute, Clerkenwell, E.C., from May 31st to June 3rd. The object of the convention was to bring into close sympathy and co-operation men who are interested in optical matters from all sides of the question, technical and scientific.

Dr. R. T. Glazebrook, F.R.S., Director of the National Physical Laboratory, was the President, and he delivered the opening address at a Conversazione on Tuesday evening, May 30th. The mornings of the subsequent days of the week were devoted to papers and discussions on optical subjects. On Thursday evening, Prof. Silvanus P. Thompson, F.R.S., delivered a lecture on "The Polarization of Light by Nicol Prisms and their modern equivalents;" and on Saturday afternoon the members of the convention went on an excursion to Teddington to inspect the National Physical Laboratory.

In connection with the Convention an exhibition of Optical and Scientific Instruments was held in the great hall of the Northampton Institute, the stands being arranged on the ground floor and in the gallery. Optical glass was shown in its crude state, and the various processes could be traced through which it has to pass until it becomes a lens for the spectacle or an object glass for the most powerful telescope.

The catalogue, which was a special feature of the exhibition, was compiled in order to be a work of permanent value. It contained a classified description not only of the objects exhibited, but of the other work of many representative firms, arranged in such a way that anyone consulting it can easily find by whom the goods he is in search of are made, and where he is to go to see specimens or to obtain information.

Class VII. was devoted to "Meteorological Instruments and Temperature Measurers." The instruments were grouped in the catalogue under the following sections, although the various instruments were placed on the individual makers' stands—viz: 1. Barometers; 2. Self-Recording Barometers; 3. Thermometers; 4. Self-Recording Thermometers; 5. Hygrometers; 6. Anemometers; 7. Sunshine Recorders; 8. Rain Gauges; 9. Evaporimeters; 10. Miscellaneous; and 11. Atmospheric Electricity.

The exhibitors in this class were: Anglo-American Opitical Co., Messrs. R. and J. Beck, Cambridge Scientific Instrument Co., Messrs. J. Casartelli and Son, Messrs. F. Darton and Co., Messrs. J. Davis and Son, Messrs. Dring and Fage, Mr. F. L. Halliwell, Mr. J. J. Hicks, Mr. G. Kent, Messrs. Lander and Smith, Messrs. Negretti and Zambra, and Messrs. Short and Mason.

As the exhibits were confined to the work of English makers, the well-known instruments of MM. Richard Frères and other foreign firms were not included in the exhibition.

RAINFALL AND TEMPERATURE, JULY, 1905.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables in *British Rainfall* to which each station belongs.]	RAINFALL. Total Fall.	Diff. from average, 1870-99.	Greatest in 24 hours. Depth	Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Max. Date.	Min. Deg.	Min. Date.	No. of Nights below 32°. Shade	Grass
		inches	inches.	in.								
I.	London (Camden Square) ...	·96	— 1·53	·31	9	8	85·3	26	49·8	7	0	0
II.	Tenterden ...	·59	— 1·67	·36	4	6	83·0	14	49·0	20	0	0
,,	Hartley Wintney ...	·94	— 1·44	·48	5	5	83·0	9, 26	48·0	19	0	0
III.	Hitchin	1·25	— 1·30	·66	9	8	80·0	8, 9*a*	46·0	6, 18	0	...
,,	Winslow (Addington) ...	1·22	— 1·55	·54	1, 9	6	82·0	14, 26	44·0	7, 19	0	0
IV	Bury St. Edmunds (Westley)	1·15	— 1·76	·49	27	8	85·3	14	46·0	7	0	...
,,	Brundall	·65	— 2·05	·19	15	6	82·6	14	48·8	7	0	0
V.	Alderbury ...	·30	— 2·16	·10	22	7	88·0	21	32·0	6	1	...
,,	Winterbourne Steepleton ...	·50	— 2·28	·38	10	4	78·9	25	39·8	7	0	0
,,	Torquay (Cary Green) ...	·59	— 2·14	·20	27	5	78·7	26	50·7	7	0	0
,,	Polapit Tamar [Launceston]	·63	— 2·30	·14	9	15	77·6	9	38·7	7	0	0
,,	Bath	·56	— 2·27	·21	22	6	79·8	8	43·5	7	0	0
VI.	Stroud (Upfield) ...	·83	— 2·07	·38	9	10	81·0	26	50·0	6	0	...
,,	Church Stretton (Woolstaston)	1·36	— 1·30	·61	26	11	77·0	21	45·5	4, 28	0	...
,,	Bromsgrove (StokeReformatory)	·92	— 1·46	·44	1	6	80·0	21	38·0	6	0	..
VII.	Boston ...	1·25	— 1·19	·50	26	8	85·0	25	47·0	7	0	..
,,	Worksop (Hodsock Priory).	1·31	— 1·20	·37	26	9	83·5	14	42·5	4	0	2
,,	Derby (Midland Railway)...	·84	— 1·79	·46	26	8	85·0	8, 21	44·0	31	0	...
VIII.	Bolton (The Park) ...	2·46	— 1·66	·77	26	16	80·4	9	45·6	4	0	0
IX.	Wetherby (Ribston Hall) ...	1·66	— ·95	·65	22	8	...	...	...	...	...	...
,,	Arncliffe Vicarage ...	1·66	— 3·31	·45	22	16	...	...	...	...	...	...
,,	Hull (Pearson Park) ...	1·60	— ·90	·82	22	9	85·0	14	47·0	4, 19	0	0
X.	Newcastle (Town Moor) ...	1·66	— 1·25	·56	2	11	...	...	...	...	...	...
,,	Borrowdale (Seathwaite) ...	5·02	— 4·35	1·75	17	18	80·3	9	44·6	29	0	...
XI.	Cardiff (Ely)	1·69	— 1·83	1·12	1	11	...	...	...	...	...	...
,,	Haverfordwest (High St.)..	2·29	— 1·41	·84	1	15	77·6	9	45·1	7	0	0
,,	Aberystwyth (Gogerddan)..	3·12	— 1·15	·65	1	11	84·0	8	39·0	3, 27	0	...
,,	Llandudno ...	2·21	— ·40	·77	26	14	76·0	9	47·8	28	0	...
XII.	Cargen [Dumfries] ...	1·38	— 1·92	·38	29	8	83·0	9	41·0	28, 29	0	...
,,	Lilliesleaf (Riddell) ...	2·03	— 1·23	·47	2	12	81·0	9	40·0	28	0	0
XIII.	Edinburgh (Royal Observy.)	1·45	...	·25	2	15	75·9	21	41·4	30	0	0
XIV.	Colmonell ...	1·79	— 1·51	·37	21	15	82·6	9	40·0	26	0	...
XV.	Tighnabruaich ...	4·03	— ·30	·64	29	21	70·0	1	42·0	5	0	0
,,	Mull (Quinish) ...	3·75	— ·63	·58	28	25	...	...	...	...	...	...
XVI.	Dundee (Eastern Necropolis)	1·35	— 1·68	·25	29	15	82·9	21	44·0	28	0	...
XVII.	Braemar ...	2·19	— ·70	·60	12	18	75·1	11	38·0	...	0	...
,,	Aberdeen (Cranford) ...	1·87	— 1·15	·40	2	15	78·0	14, 21	42·0	6	0	...
,,	Cawdor (Budgate)	1·92	— 1·42	·41	22	18	...	...	...	...	...	...
XVIII.	Invergarry ...	2·46	— 1·32	·41	9	10	...	...	...	...	...	...
,,	Bendamph ...	5·07	— 1·39	·50	16	24	...	...	...	...	...	..
XIX.	Dunrobin Castle ...	1·75	— 1·07	·44	9	16	72·0	7, 21	44·0	19	0	...
,,	Castletown	2·75	...	·70	27	26	71·0	14	41·0	23, 24	0	...
XX.	Killarney ...	1·48	— 2·51	·46	26	15	78·0	2, 9, 10	44·0	27	0	...
,,	Waterford (Brook Lodge)...	2·19	— ·91	·58	26	13	76·0	9	42·0	4	0	...
,,	Broadford (Hurdlestown) ...	1·97	— ·97	·37	28	18	77·0	9	44·0	27	0	...
XXI.	Carlow (Browne's Hill) ...	1·37	— 1·65	·37	9	10	...	...	...	...	...	...
,,	Dublin (FitzWilliam Square)	·82	— 1·81	·11	9	17	81·8	14	49·3	6	0	0
XXII.	Ballinasloe	1·04	— 2·27	·25	28	15	80 6	1	41·0	27	0	...
,,	Clifden (Kylemore House)..	2·77	— 3·38	·50	16, 22	13	...	...	...	...	...	...
XXIII.	Seaforde	1·17	— 2·23	·32	28	13	84·0	12	45·0	27	0	0
,,	Londonderry (Creggan Res.)	2·36	— 1·11	·26	28	21	...	...	...	...	...	...
,,	Omagh (Edenfel) ...	2·27	— 1·12	·45	22	18	81·0	1	39·0	27	0	0
June.—	Lilliesleaf (Riddell) ...	1·99	— ·45	·90	28	7	79·0	24	39·0	4	0	3

\+ Shows that the fall was above the average; — that it was below it. *a* and 25, 26.

SUPPLEMENTARY RAINFALL, JULY, 1905.

Div.	STATION.	Rain. inches	Div.	STATION.	Rain. inches
II.	Dorking, Abinger Hall	·68	XI.	New Radnor, Ednol	2·17
,,	Ramsgate, West Cliff.....	·98	,,	Rhayader, Nantgwillt ...	1·93
,,	Hailsham	·90	,,	Lake Vyrnwy	1·65
,,	Crowborough	·50	,,	Ruthin, Plâs Drâw.....	2·35
,,	Osborne.....	·24	,,	Criccieth, Talarvor.....	2·51
,,	Emsworth, Redlands..... ...	·41	,,	Anglesey, Lligwy	1·54
,,	Alton, Ashdell	·24	,,	Douglas, Woodville	1·41
,,	Newbury, Welford Park ...	·97	XII.	Stoneykirk, Ardwell House	1·46
III.	Harrow Weald	2·61	,,	Dalry, Old Garroch	2·46
,,	Oxford, Magdalen College..	·14	,,	Langholm, Drove Road.....	4·05
,,	Banbury, Bloxham Grove...	1·58	,,	Moniaive, Maxwelton House	1·45
,,	Pitsford, Sedgebrook.....	·47	XIII.	N. Esk Reservoir[Penicuick]	2·70
,,	Huntingdon, Brampton.....	·68	XIV.	Maybole, Knockdon Farm..	2·68
,,	Wisbech, Bank House	·91	,,	Glasgow, Queen's Park	2·87
IV.	Southend	·29	,,	Campbeltown, Redknowe...	2·56
,,	Colchester, Lexden.....	·32	XV.	Inveraray, Newtown.....	4·46
,,	Saffron Waldon, Newport...	1·64	,,	Ballachulish House.....	6·77
,,	Rendlesham Hall	·26	,,	Islay, Eallabus	3·54
,,	Swaffham	·66	XVI.	Dollar	3·00
,,	Blakeney	1·61	,,	Loch Leven Sluices	2·09
V.	Bishops Cannings	1·45	,,	Balquhidder, Stronvar	...
,,	Ashburton, Druid House ...	·50	,,	Coupar Angus Station	1·48
,,	Okehampton, Oaklands.....	·50	,,	Blair Atholl.....	1·48
,,	Hartland Abbey	2·07	,,	Montrose, Sunnyside.....	1·30
,,	Lynmouth, Rock House ...	1·24	XVII.	Alford, Lynturk Manse ...	3·91
,,	Probus, Lamellyn	·50	,,	Keith..... ..	1·74
,,	Wellington, The Avenue ...	·27	XVIII.	N. Uist, Lochmaddy	3·09
,,	North Cadbury Rectory ..	·72	,,	Aviemore, Alvey Manse ...	1·35
VI.	Clifton, Pembroke Road ...	·91	,,	Loch Ness, Drumnadrochit.	2·45
,,	Moreton-in-Marsh, Longboro'	·38	,,	Glencarron Lodge	5·96
,,	Ross, The Graig	·67	,,	Fearn, Lower Pitkerrie.....	1·65
,,	Shifnal, Hatton Grange.....	1·82	XIX.	Invershin	1·6
,,	Wem Rectory	1·48	,,	Altnaharra	1·74
,,	Cheadle, The Heath House.	2·13	,,	Bettyhill	1·20
,,	Coventry, Kingswood	1·30	,,	Watten	2·11
VII.	Market Overton	3·13	XX.	Cork, Wellesley Terrace ...	1·70
,,	Market Rasen	1·32	,,	Darrynane Abbey	3·06
,,	Bawtry, Hesley Hall.....	1·18	,,	Glenam [Clonmel]	1·27
VIII.	Neston, Hinderton.....	3·07	,,	Ballingarry, Gurteen	1·54
,,	Southport, Hesketh Park...	1·75	,,	Miltown Malbay.....	2·64
,,	Chatburn, Middlewood	2·38	XXI.	Gorey, Courtown House ...	2·02
,,	Cartmel, Flookburgh	2·01	,,	Moynalty, Westland	1·39
IX.	Langsett Moor, Up. Midhope	1·47	,,	Athlone, Twyford	1·12
,,	Scalby, Silverdale	1·30	,,	Mullingar, Belvedere.....	1·69
,,	Ingleby Greenhow	1·01	XXII.	Woodlawn	2·17
,,	Middleton, Mickleton	·53	,,	Westport, Murrisk Abbey..	2·90
X.	Beltingham	1·19	,,	Crossmolina, Enniscoe	2·10
,,	Font Reservoir, Fallowlees.	1·12	,,	Collooney, Markree Obsy...	1·59
,,	Ilderton, Lilburn Cottage..	·65	XXIII.	Enniskillen, Portora	...
,,	Keswick, The Bank	1·57	,,	Warrenpoint	1·79
XI.	Llanfrechfa Grange.....	·69	,,	Banbridge, Milltown	1·93
,,	Treherbert, Tyn-y-waun ...	3·12	,,	Belfast, Springfield	1·93
,,	Carmarthen, Friary	2·23	,,	Bushmills, Dundarave	2·51
,,	Castle Malgwyn	1·81	,,	Stewartstown	2·22
,,	Plynlimon.....	6·80	,,	Killybegs	2·63
,,	Tallyllyn	·30	,,	Horn Head	2·52

METEOROLOGICAL NOTES ON JULY, 1905.

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 AND WALES.

LONDON, CAMDEN SQUARE.—Although the temp. at no time reached an abnormally high point, the most characteristic feature of the month was the persistent heat. On every day the mean temp. was well above the average, and the mean for the month was as high as 67°·4, exceeding the average by 4°·1. This has only been exceeded in four previous Julys and in no other month; the mean min., 57°·7, was only once exceeded, reaching 58°·4 in July, 1859. Owing to the comparative absence of TSS the R was considerably in defect. TSS of moderate intensity occurred on 9th and 27th, T continuing almost all day on 9th. Duration of sunshine 214·8* hours, and of R only 10·2 hours.

TENTERDEN.—Very similar to July, 1904, as regards temp. and weather, but less sunshine and much less R. Duration of sunshine 258† hours. TS on 5th.

CROWBOROUGH.—A brilliant month without any extreme or oppressive heat. R very deficient, amounting to less than one-sixth of the average. Mean temp. 63°·8. T on 5th, 6th and 14th.

OSBORNE.—Dry and warm. R only 12 per cent. of the average of 48 years.

HARTLEY WINTNEY.—Glorious summer weather prevailed throughout. Very dry, without excessive heat. The nights were as beautiful as the days. Ozone on 6 days with a mean of 2·2. Absence of TSS.

ADDINGTON MANOR.—A fine month, nearly all the R falling on two days. Very heavy TS on 9th, causing many accidents in the neighbourhood.

COLCHESTER.—The driest July since observations began in 1889, and continuously hot except for a few nights about 17th, but no exceptionally high max. All vegetation seriously dried up.

BRUNDALL.—Mean temp. 65°·5, being 4°·1 above the average and 0°·4 higher than in July, 1900, which previously held the record back to 1876. T and L on 1st, 12th, 26th and 27th; T on 9th.

TORQUAY.—Duration of sunshine 238·9* hours or 3·0 hours above the average, Mean temp. 64°·1, being 2°·7 above the average. Mean amount of ozone 3·4.

WELLINGTON.—A brilliant summer month with many warm days and nights, but no excessively high shade temp. R only about one-eighth of the average.

NORTH CADBURY.—A glorious July, with high mean temp. especially at night, but small range and no extremes. A large hay crop was got in well. Entire absence of T and L.

CLIFTON.—Fine and warm, with occasional slight R caused by disturbances from the Atlantic. Weather of the westerly type continued nearly throughout. The last week was very sultry. R less than one-third of the average.

ROSS.—The month began with heavy R, but it was fine and frequently hot afterwards. Much T on 9th.

MARKET OVERTON.—On 9th 2·07 in. of R fell in little more than an hour during a TS.

BOLTON.—The temp., although at no time reaching the highest records, was decidedly above the average, the mean exceeding 60° on 13 days. Mean temp. 59°·8. Duration of sunshine 166·0* hours, or 15·2 hours above the average. TS on 9th.

SOUTHPORT.—Unusually warm and sunny and decidedly dry, with an almost continuous prevalence of sea winds of normal strength. Mean temp. 2°·3 above the average; rather hot from 8th to 14th. Duration of sunshine 28 hours above the average. R 1·37 in. below the average. Evaporation exceptionally large. TS on 9th and T on 2nd.

LILBURN.—Again remarkable for small R, only 1·79 in. having fallen in three months. Corn and pastures were burnt up and water supplies running short everywhere.

LLANFRECHFA GRANGE.—Hot and close with shortage of R. Very calm, the wind force never exceeding 2. Wheat was in good order and ripening fast, but oats and barley straw short. R was much wanted and water supply deficient.

HAVERFORDWEST.—Moderately fine with temp. generally high. No TSS; a good deal of fog Crops were good, though some hay was spoilt. Duration of sunshine 193·1* hours.

ABERYSTWYTH.—Good R was rendered useless by the hot dry winds which followed, and crops suffered much.

DOUGLAS.—Fine and dry with temp. slightly above, and R considerably below, the average.

SCOTLAND.

LANGHOLM.—R ·29 in. below the average of 29 years.

TIGHNABRUAICH.—A summer temp. was maintained throughout, the mean max. being 63°·9 and the mean min. 50°·0. The R fell chiefly after sundown.

MULL.—Showery and unsettled, with wind between S. and W. throughout. Very warm. T and L on 9th and 21st.

COUPAR ANGUS.—Mean temp. 58°·7; the effect of the sunny warm days being reduced by several cold nights. The R was again short, as in every month of the year except March.

LYNTURK MANSE.—Heavy local storms, and weather of a thundery nature. A TS began at 4.45 p.m. on 2nd, was very heavy for an hour and lasted with intervals till 10 p.m. T and L on 9th, T on 10th and 11th. The temp. was high, not falling after T.

DRUMNADROCHIT.—R ·43 in. less than, and rainy days equal to, the average of 19 years.

DUNROBIN.—The drought of June lasted till the middle of July, when the weather changed and showers fell on most days.

BETTYHILL.—Beautifully fine, with a few slight showers. Crops were light in consequence of want of R.

IRELAND.

CORK.—Drought, particularly up to the 25th, caused a deficiency of water supply in the city. Although no day was remarkably warm, the high min. temp. caused the mean to be high.

DARRYNANE ABBEY.—R 81 per cent. of the average of 25 years. The first 10 days were very fine and hot; afterwards close and misty till the last week, which was sunny and moderately warm.

BROADFORD.—Favourable on the whole. Root crops were good, but oats poor and hay light. Water was very low.

MILTOWN MALBAY.—Very sultry, with sea-fogs and mist. R slight until 31st, and upland pastures burnt up. Hay crop short. Potatoes promising, but blight commencing to show.

DUBLIN.—Very warm; the mean temp. being 63°·8, or 0°·1 higher than in 1887, the previous warmest. Entire absence of electrical disturbances.

ATHLONE.—The smallest R in any July during 30 years.

BALLINASLOE.—The driest July in 34 years.

BANBRIDGE.—During a TS on 9th the L struck a tent in which a Gospel service was being held. Two lives were lost and several persons injured.

BELFAST.—The finest July for several years, and most beneficial for the farmer, especially for hay.

OMAGH.—A magnificent summer month, insuring the safety of a good average hay crop in perfect order, and with sufficient R, especially during the latter half, to supply the moisture necessary for green crops of unusual luxuriance.

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* Campbell-Stokes. † Jordan.

Climatological Table for the British Empire, February, 1905.

STATIONS. (*Those in italics are South of the Equator.*)	Absolute. Maximum. Temp.	Date.	Absolute. Minimum. Temp.	Date.	Average. Max.	Min.	Dew Point.	Humidity.	Absolute. Max. in Sun.	Min. on Grass.	Total Rain. Depth.	Days.	Aver Cloud.
	°		°		°	°	°	0-100	°	°	inches		
London, Camden Square	54·4	5	30·6	20	47·5	37·9	38·2	87	89·6	26·9	·79	12	6·0
Malta	63·1	22	38·2	15	56·8	46·1	41·3	74	116·9	33·8	1·53	9	3·4
Lagos	...	...	...	...	...	...	...	...	...	...	...	...	...
Cape Town	85·8	1	55·5	3	76·8	61·4	58·1	69	...	...	·59	3	3·5
Durban, Natal	88·5	4	61·4	27	82·0	67·8	...	...	152·1	...	5·48	16	6·1
Johannesburg	80·7	2	46·8	27	73·1	55·7	56·0	82	154·0	48·5	3·30	19	5·5
Mauritius	87·5	12	69·5	26	85·3	73·7	72·1	80	152·4	64·6	3·36	17	5·9
Calcutta	86·9	25	45·9	10	75·8	54·6	51·0	60	148·4	39·9	1·62	3	3·4
Bombay	87·9	20	56·7	1	80·0	63·5	56·7	61	137·2	47·3	·08	1	1·2
Madras	91·3	27	62·0	1	87·2	70·0	68·2	73	149·7	58·4	·31	2	2·8
Kodaikanal	69·4	17	43·8	4	66·2	48·0	46·2	67	134·6	28·6	1·66	5	4·0
Colombo, Ceylon	92·4	13	68·5	12	87·4	73·0	71·0	78	156·2	64·0	2·74	6	4·5
Hongkong	73·5	24	42·8	10	58·9	51·6	51·1	84	109·9	...	1·10	11	9·2
Melbourne	101·6	10	46·6	14	76·6	55·6	51·1	62	156·4	35·0	1·83	5	4·9
Adelaide	105·4	10	46·4	13	81·0	57·2	49·3	50	168·4	41·8	·25	3	3·7
Coolgardie	105·0	17	46·4	11	85·8	59·3	49·1	45	178·8	43·2	·60	3	3·6
Sydney	95·6	23	59·8	13	77·4	64·9	59·8	68	130·8	53·1	1·86	15	5·9
Wellington	77·0	5	45·0	27	68·9	54·7	52·1	70	129·5	40·0	1·45	6	5·5
Auckland	78·0	12*a*	55·0	2, 28	73·0	58·7	55·5	70	143·0	42·0	·56	5	3·5
Jamaica, Negril Point	87·9	10	64·7	25	84·5	67·7	69·1	78	...	...	1·67	4	...
Grenada	83·4	25	68·0	1	81·2	70·2	66·4	69	147·0	...	2·11	18	2·9
Toronto	37·8	20	-8·2	4	25·3	7·7	9·6	85	59·0	-14·0	1·40	13	5·6
Fredericton	42·4	26	-21·0	20	25·8	-0·9	-3·0	58	...	...	2·75	10	4·9
Winnipeg	39·8	23	-39·0	2	13·3	-10·1	...	...	...	...	·27	3	3·4
Victoria, B.C.	56·4	26	22·7	12	46·2	37·3	...	...	...	...	2·27	10	5·2
Dawson	24·6	27	-42·4	4	1·1	-12·1	...	...	...	...	1·30	5	4·4

a—and 17.

MALTA.—Adopted mean temp. of air 51°·0 or 3°·2 below, and mean hourly velocity of wind 11·6 or 0·2 below, averages. Mean temp. of sea 56°·3. TS on 12th.

Mauritius.—Mean temp. of air 0°·4, of dew point 1°·2 above, and R 3·96 in. below, averages. Mean hourly velocity of wind 7·9 miles, or 3·1 below average. L on 12 days and T on 9 days.

MADRAS.—Bright sunshine 238·4 hours.

KODAIKANAL.—Bright sunshine 216 hours.

COLOMBO.—Mean temp. of air 80°·1, or 0°·1 below, of dew point 0°·5 above, and R ·64 in. above, averages. Mean hourly velocity of wind 6·7 miles; prevailing direction N.W. TS on 6 days.

HONGKONG.—Mean temp. of air 55°·3. Mean hourly velocity of wind 11·3 miles; mean direction E. by N.

Adelaide.—Mean temp. of air 69°·1 or 4°·9 below the average and the lowest on record, being equalled in 1886. R ·36 in. below average.

Sydney.—Mean temp. of air 0°·1 above, R 2·95 in. below, and humidity 5·3 per cent. below, averages.

Wellington.—Mean temp. of air 0°·6 below, and R 1·77 in. below, averages.