# SYMONS'S
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## REVIEWS.

*Handbook of Meteorological Tables.* By H. A. HAZEN, M.A., Assistant Professor, Signal Office. Washington, D.C. 1888. 8vo., viii. 128 pages.

WE have often heard of this volume, and are very glad to offer it a welcome on this side of the Atlantic.

Prof. Hazen by no means intends to supersede Guyot's most valuable collection, but as a practical worker he knows which tables have been most useful to himself, and in this handbook he not merely tells us what he has found useful, but he supplies every one with a copy. Like most meteorologists, he has been obliged to calculate some fresh tables for himself, and these he very properly distinguishes as "Original."

As nearly all the tables are given in duplicate, *i.e.*, both in English and in Metric values, the volume will be nearly as useful on the Continent as in America and in England, and we are rather puzzled at no publisher's name appearing on the title page, for to print a work like this is a serious matter, and one would have supposed that the author would have arranged to partly cover his outlay by its sale. There are certainly not many meteorologists who could afford to print, and to give away the whole edition of such a volume of tabular matter. It may be that he has reserved the sale to himself instead of placing the volume in the hands of any publisher, if so, some intimation of the fact, and of the price would be useful. We are not in the habit of presenting either authors or publishers with advertisements gratis, but in this case we feel that the matter ought to be cleared up, and we shall gladly insert any brief statement with which Prof. Hazen may favour us, because we feel that he must have made a considerable sacrifice to prepare and print such a volume, and that that sacrifice merits recognition at the hands of meteorologists.

Having intimated our general approval of the volume, we need only give an idea of its arrangement and contents, and point out the respects in which we think that it falls short of perfection.

It contains seven tables (conversion, &c.), relating to temperature, nine to pressure, seven to humidity, six to wind, six to linear measures (inches into millimetres, &c.), and ten miscellaneous ones.

In the way of criticism we have little to say. There is perhaps some uncertainty or unevenness in the author's desire for precision. On p. iv., he tells us that in all the linear tables the latest value for the metre 39·3702 in., has been used, instead of the old one of 39·3709, but this is only a difference of 1 in 56209, or less than 0·001 in. in any barometric reading, and about 1 in. in a mile, a refinement far in advance of meteorology at present—and yet in Table XII., he (wisely we think), gives the barometer to hundredths of an inch only.

In the section for linear measures there is by far the best table for inches into millimetres we have ever seen; it gives the equivalent of each hundredth of an inch from 0·01 in. to 31·99 in.; but for the reverse process millimetres into inches, the table extends only from 400$^{mm.}$ (15·748 in.), to 800·9$^{mm.}$ 31·532 in.). We presume that Prof. Hazen when sending it to press was thinking solely of barometric conversions, and forgot that the table if carried down to 1$^{mm.}$ and up to 1000$^{mm.}$ (*i.e.* 1 metre), would be very valuable for rainfall work. We computed a skeleton one of this kind years ago, but have never printed it on account of the expense. We know that it seems greedy to wish for twelve pages of additional tables, but if that were too much, we would have sacrificed the 100$^{mm.}$ between 400 and 500$^{mm.}$ and given a two-page table with the equivalent of each $^{mm.}$ (*not* each 0·1$^{mm.}$) from 1 to 1000$^{mm.}$.

There is a splendid table, metres into feet, going by *each metre* from 1 metre to 4009$^{m.}$ (say 2½ miles), but we do not get feet into metres; and oddly enough the reverse occurs with miles and kilometres which we have, though kilometres into miles we have not.

One practical illustration is worth much talk. Our readers may remember that in our February number of this year, we had a remarkable record of drought from Col. Ward, to which we added some others from India and elsewhere. One of the records was so extreme (45° between the dry and wet bulb), that we could find no table to give the humidity. Prof. Hazen's tables give it at a glance.

They are unquestionably valuable helps which must be kept handy, and replaced when worn out.

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*Sur la température nocturne de l'air à différentes hauteurs.* *Par* JULIUS JUHLIN. (Présenté à la Société Royale des Sciences d'Upsal le 27 Avril, 1889). E. Berling, Upsal, 1890. 4to, 24 pages.

IT is a pity that some form of engraving is not more frequently employed on the Continent. This is an excellent little paper, but the facts would have been much more readily followed, and more permanently impressed, had the tabular values been given also as diagrams, and had there been a sketch of M. Juhlin's mast, and a rough map showing the various localities in and near Upsala, referred to in the Memoir. Section IV., "On the influence of the soil on the temperature of the air," cannot be read with advantage by any one who is not, either provided with a map of the city, or well acquainted with its topography.

The paper is divided into four sections. In the first the author gives short accounts of the experiments upon the variation of temperature with height above the soil, made by Pictet (1778), Six (1784), Wells (1814), Marcet (1837), Lottin and Bravais (1838), Plantamour (1847), Charles Martins (1858), Prestel (1858), K. Fritsch (1861), Glaisher (1868), Wild (1872), Marie Davy (1874), Hamberg (1875), and Marriott (1882). This section is rather aggravating, because, although the brief descriptions of the nature of the experiments are interesting, the author rarely states what were the results obtained. Having taken the trouble requisite to collect the descriptions, very little more would have enabled him to add greatly to the value of the paper.

The author naturally, and very properly, calls special attention to the experiments made at Upsala in the summer of 1875 by a volunteer band of twenty university students, under the direction of M. Hamberg, and says that his researches are to be regarded as supplementing those made by M. Hamberg in summer; those by M. Juhlin being in winter, and when the ground was covered with snow. He also gracefully acknowledges help received from Prof. Hildebrandsson, and his profound gratitude to Dr. N. Ekholm, and to two students (MM. Falk and Vallner), who, as he says, "have sacrificed for me their time and their nightly rest in helping me with these fatiguing observations." We supplement this by pointing out that it was not merely for M. Juhlin that these gentlemen spent night after night in the bitter frost and snow, taking the hourly readings of the various thermometers. It was, like every bit of honest, scientific work, done to increase man's knowledge of the world in which he lives—something which will last long after those who have done it have passed away.

Years ago we ourselves had a pole about the same height as that employed at Upsala (22ft.), and a complete set of thermometers at the top. In time of frost and snow, when (at 9 p.m.) we found ourselves with the readings all entered, and ourselves and our lantern safely on *terra firma*, it was always with a feeling of great thankfulness; and with six thermometers on the mast, much snow, and temperatures below zero Fahrenheit, these gentlemen must certainly have had a rough time of it. It is a great pity that there is no sketch showing how the thermometers were arranged, and how access to them was obtained for reading. One also wants to know, if all were on one mast, whether the observer read them when climbing, and again in descending, and whether his presence and that of the lamp did or did not affect the readings.

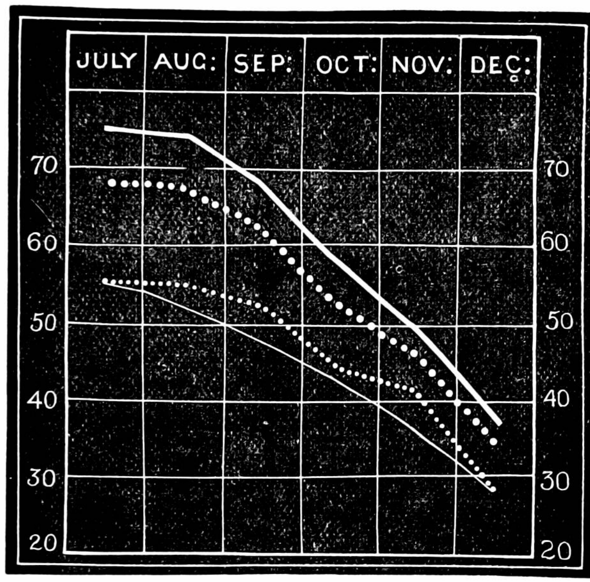
The author's summary is as follows :—

1. The decrease of temperature, due to radiation from exposed thermometers, is almost constant at all heights (above a snow surface), greater than 20 inches.
2. During clear winter nights the temperature increases with height; this begins about two hours before sunset, and lasts until about two hours after sunrise.
3. The increase of temperature with height is greater in winter than in other seasons.
4. The increase of temperature with height is a linear function of the temperature, so that the lower the temperature the more rapid is the increase.
5. During overcast and misty nights in winter there is little variation with height.
6. The variation of temperature [with height.—ED. *M. M.*] follows very closely the amount of cloud.
7. A veil of thin and high clouds diminishes but slightly the variation of temperature with height.
8. In winter the surface of snow is colder than the air around it.
9. The fact that snowy winters have usually hard and long frosts is easily explained by the physical properties of snow.
10. During winter nights the temperature on hills and lofty edifices is higher than on low ground.

We may appropriately supplement this notice with a few words respecting the temperature observations made upon the Eiffel Tower between July and December last, of which an abstract was given by M. Angot, at the Soc. Mét. de France, on the 4th of February last. He gives the following values :—

| | EIFFEL TOWER | | | | PARC ST. MAUR. | | | | DIFFERENCES. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean. | Max. | Min. | Range | Mean. | Max. | Min. | Range | Mean. | Max. | Min. | Range. |
| | deg. | deg. | deg. | deg. | deg. | deg. | deg. | deg. | deg. | deg. | deg. | deg. |
| July. | 61·2 | 67·3 | 55·2 | 12·1 | 64·1 | 75·4 | 55·2 | 20·2 | -2·9 | -8·1 | 0·0 | -8·1 |
| Aug. | 60·3 | 67·0 | 54·5 | 12·5 | 62·2 | 74·1 | 52·8 | 21·3 | -1·9 | -7·1 | +1·7 | -8·8 |
| Sept. | 56·3 | 61·9 | 51·4 | 10·5 | 56·8 | 67·8 | 47·9 | 19·9 | - ·5 | -5·9 | +3·5 | -9·4 |
| Oct. | 47·8 | 52·4 | 44·2 | 8·2 | 49·1 | 57·9 | 43·0 | 14·9 | -1·3 | -5·5 | +1·2 | -6·7 |
| Nov. | 43·2 | 45·9 | 40·3 | 5·6 | 42·6 | 49·1 | 36·6 | 12·5 | + ·6 | -3·2 | +3·7 | -6·9 |
| Dec. | 30·7 | 34·4 | 27·9 | 6·5 | 32·5 | 37·0 | 28·6 | 8·4 | -1·8 | -2·6 | - ·7 | -1·9 |
| Mean | 49·9 | 54·8 | 45·6 | 9·2 | 51·2 | 60·2 | 44·0 | 16·2 | -1·3 | -5·4 | +1·6 | -7·0 |

These values will be much more readily followed in a diagram, which we therefore give. The solid lines represent the values at the surface (Parc St. Maur), the dotted lines those at the top of the Eiffel Tower. Hence we see that the temperature at the top is much more equable than at the surface. As regards the maxima, the excess of heat at the surface (nearly 10° in summer) is doubtless due to the heat rays passing through the atmosphere without producing much effect, but heating the soil directly they reach it, and so heating the stratum of air near to it. The difference at night was less marked, but there again the soil accentuates the temperature change, because it is a better radiator than air, and, therefore, while itself cooling, it cools the air in its proximity.




## "AREAS OF RAREFACTION" OR "DEPRESSIONS."

*To the Editor of the Meteorological Magazine.*

SIR,—In reference to the intervention of Mr. Ley in this correspondence, I have only to say that if the question is one which has passed out of the stage of ventilation or discussion, and "the character of the current of scientific theory on the subject is so strong as to be unmistakable," it is a pity that Mr. Ley did not, from his point of vantage, "on the well-exposed rising ground under a strong breeze," vouchsafe some little help and guidance to the befogged and bewildered wanderers in the valley below. This would, I think, have been more in keeping with that "long-suffering kindness" which, he tells us, is a characteristic of the student of meteorology, than simply to upbraid us with our ignorance without favouring us with one ray of enlightenment. I cannot, however, accept Mr. Ley's view that this is a question on which only experts are entitled to be heard, and, therefore, though I have not had the advantage of studying Ferrel and "the Oppositionists," and at the risk of exhausting Mr. Ley's "tender-heartedness" and bringing upon myself I know not what terrible penalty in consequence, I will now, with your permission, state as briefly as I can some facts which seem to me to go far to justify the view which I maintain, viz., that the differences observable in the height of the barometric column, at the same level at different times, and in different places at the same time, correspond to real differences in the height of the aerial column above it, and not merely to differences in the density of the air.

(I.) We know that in the equatorial regions, under the influence of the solar heat, and the indraft and pressure of cooler air from higher latitudes, enormous volumes of warm air are constantly rising to a great height and flowing over on both sides of the equator towards the poles. Let us suppose some exceptionally energetic outflow of this kind to extend some distance to the north of the equator spreading out laterally at the same time, as it would naturally tend, to do, and it is obvious that we should have over the region beneath it an area of high pressure, *not because the air there was more dense* (except in so far as the addition of another stratum of air above would tend in some degree to increase the density of those upon which it was superimposed), but because there was *more air*, *i.e.*, a greater depth of air than over the adjacent regions. If, now, we suppose two such outflows of equatorial air spreading northwards or north-eastwards, with an interspace between them, it is obvious again that in this interval we shall have an area of relatively low pressure, *not because the air there is less dense or more rarefied*, but because there is a less depth of air there than in the regions around it.

Once more, if we suppose a number of such waves or streams of air, with interspaces between them, to flow over from the equatorial regions about the same time, and, setting out at points some distance to the westward of our meridian, to extend as far north as these latitudes, it is plain that (making allowance for the easterly trend of volumes of air flowing from the equator northwards), we might expect them to pass over us as bands of alternate high and low pressure—"anti-cyclonic bands or ridges" and "troughs of low pressure," or "elongated depressions"—moving in a N.E. direction, a condition of things which we know, from the evidence of our weather charts, *does*, in fact, prevail not infrequently over our islands and their neighbourhood.

It is not suggested that the "cup-like" depressions on the one hand or the anti-cyclonic "mounds" on the other extend to the extreme upper surface of the atmosphere, variously estimated at from 50 to 200 miles. It may be safely assumed that at the lowest of these limits the air would know as little of such disturbances as the bottom of the ocean knows of the storms and currents which disturb its surface. For practical purposes, in relation to pressure, wind, cloud, vapour, heat, everything, in fact, except the reflection and refraction of light, the atmosphere may be considered to terminate at a height of 20 miles at the outside, and it is within that limit that I suppose all the movements and changes which affect the height of the barometer to occur. Here, then, it seems to me that we have a *vera causa* which, taken in conjunction with the modifying influences of the rotation of the earth, the distribution of land and water, the configuration, contour, and elevation of the land, and possibly electricity and magnetism, will go a long way towards accounting for the differences of pressure indicated by the barometer.

(II.) On the other hand, that differences of atmospheric pressure cannot be accounted for by the supposition of differences of temperature is shown by some recent observations made by Dr. Hann at high altitudes, and communicated by him to the Academy of Sciences at Vienna on April 17th. During the great anti-cyclone which prevailed over Central Europe, including the Alpine District, in November last, Dr. Hann was able to employ observations up to a height of above 10,000 feet, and found that the depression of temperature which accompanied the anticyclone was limited to a few hundred feet above the earth, while on October 9th and 10th, during a barometrical minimum, he found that the temperature at the summit of the Sonnblick was lower than during the barometrical maximum above referred to; and as the result of these observations and others of the same nature, he comes to the conclusion, 1st, that "in barometrical maxima the conditions of pressure are not explained by conditions of temperature, but are a consequence of the movement of the air," and 2nd, that, whereas "until the establishment of mountain stations the temperature was assumed to be one of the chief causes of the form of motion of cyclones and anticyclones, future enquiries must take into account that at least up to 4 or 5 kilometres the temperature at the centre of an anticyclone may be, and probably always is, higher than in the centre of a cyclone."—See *Nature*, May 29th, 1890.

I have no cut-and-dried theory to offer in explanation of the origin of low pressure systems. I have simply maintained, in opposition to Dr. Muirhead, that we are not warranted in asserting that they are simply areas "where the air is more rarefied, and, therefore, lighter, *not depressed*," and that, on the contrary, there is some reason to believe that they do correspond to actual atmospheric depressions.

(III.) In reply to Dr. Muirhead's last letter, I have only to say—

1. That having carefully re-read the 3rd paragraph of his letter on page 9 of the February number of the *Meteorological Magazine*, if I have misrepresented him in ascribing to him the view that cyclones are caused by local heat, I think that the mistake was a very natural and excusable one.

2. That I have never denied the general accuracy of his account of the behaviour of the winds in a depression, but that, according to my view, *that* is the result, not the cause, of the depression, and that when a low pressure area is once formed, the effect will be precisely the same as regards the behaviour of the winds within it, whether the low pressure is due to the rarefaction of the air, or to the existence of a cup-like depression over the locality in question.

3. That Sir John Herschel, in the passage of his Essay on the Weather from which I quoted, *does* state what in his opinion originates the *wind* (the italics are his) in the cases described (see pp. 164, 165, 166 of the "Lectures on Scientific Subjects," New Edition, David Bogue, 1880), but the passage was too long to quote. And I may add that I venture to doubt whether his account of the matter, founded as it is in the main on acknowledged physical facts, has been so utterly exploded by recent advances in Meteorology as Mr. Ley would have us believe.

And now, having said my say, I gladly make way for others who may wish to be heard on the subject under discussion, thanking you, Mr. Editor, for your courtesy in allowing me to explain myself so fully, and not without hope that before the discussion is closed, some of the many readers of the Magazine who, as Mr. Ley assures us, "possess and employ sources of information such as those he has alluded to," may be induced to give us the benefit of their superior knowledge. In that case I will promise to act upon the exhortation addressed to Dr. Muirhead and myself by Mr. Ley in the closing sentence of his letter, and to "be aware, and show myself to be aware," that they do possess this advantage over us.

G. T. RYVES.

*Tean Vicarage, July 4th,* 1890.

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*To the Editor of the Meteorological Magazine.*

SIR,—I imagine that you and your readers will thank Mr. Ley for knocking together the heads of two ignorant scribblers (I am not even a F.R.G.S.) and sending them to learn their lessons. May I point out that I called attention to an unguarded use of the term "depression" in weather bulletins, as misleading the "general public." Mr. Ryves essayed to show that I was mistaken, and I defended my position. With thanks to Mr. Ley—Yours,

HENRY MUIRHEAD.

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## PRESSURE ANEMOMETERS.

*To the Editor of the Meteorological Magazine.*

SIR,—At page 55 of the *Meteorological Magazine* Dr. Black compares an anemometer pressure plate 3 feet square with one 30 feet square, and rightly states the ratio of the areas, as 1 to 100 and of the perimeters as 1 to 10; and says, "Therefore, the small plate anemometer must always indicate 2—3 times more pressure than the large one." I fail to understand this deduction.

He proceeds to give another: "From this it will follow that a more suitable form of plate anemometer would be the circular one, while the lengths of the borders would be more approximate to the areas inside them in both large and small gauges." This is neither a logical deduction nor a true statement of fact. If it "followed," no further proof would be necessary, though he proceeds to prove it. Unfortunately the demonstration is quite erroneous. A circular plate 3 feet in diameter and one 30 feet in diameter have their areas in the ratio of 1 to 100, and their perimeters in the ratio of 1 to 10; just as the fore-mentioned square plates have them—*not* "ratio of border to border and area to area of 1 to 10, so that both large and small anemometers of a circular shape would represent the pressure of the same gale equally anywhere at the same time." It is really a pity that such a beautifully simple deduction is as baseless as the fabric of a dream, and that all the subsequent pretty inferences drawn therefrom are equally unsubstantial.

Faithfully yours,

R. STRACHAN.

11, *Offord-road, N., June 9th*, 1890.

[We are always glad that errors when they escape us should be pointed out. Our attention having been concentrated on the accurate reproduction of the figures led to our missing the obvious fallacy that 7 is not a tenth of 706, which Mr. Strachan has fortunately pointed out.

The idea running in our mind, and possibly in Surgeon-Major Black's, though he certainly did not express it, was that if the rim produces any special effect (extending inwards for say 6 inches) and be supposed to have an extra pressure, the ratio of this annulus to the total area will decrease with increase of size of plate, and will be less with a circular plate than with a square one of equal area.—ED. *M.M.*]

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## ROYAL METEOROLOGICAL SOCIETY.

The usual monthly meeting of this Society was held on June 18th, at the Institution of Civil Engineers, 25, Great George-street, Westminster, Mr. Baldwin Latham, F.G.S., President, in the chair.

Mr. C. C. Farr, B.Sc., Mr. J. Hall, A.M.Inst.C.E., Mr. C. R. Rivington, and Dr. J. L. Whitehead were elected Fellows of the Society.

The following papers were read :—

1. "On the difference produced in the mean temperature derived from daily maximum and minimum readings, as depending on the time at which the thermometers are read," by Mr. W. Ellis, F.R.A.S. In the publications issued from Greenwich Observatory, the maximum and minimum temperatures are those referring to the civil day from midnight to midnight. At many stations the observers read their instruments only once a day, viz., at 9 a.m., when the reading of the maximum thermometer is entered to the preceding civil day, and the reading of the minimum thermometer to the same civil day. Such

stations are called "Climatological Stations." The author has tabulated the Greenwich maximum and minimum temperatures according to both methods for the years 1886-89, and finds that the climatological maximum and minimum means are slightly in excess of the civil day means.

2. "On the distribution of barometric pressure at the average level of the Hill Stations in India, and its probable effect on the rainfall of the cold weather," by Mr. W. L. Dallas.—The weather over India during January, 1890, was very dry, and in marked contrast to that which prevailed during January, 1889. The distribution of barometric pressure was, however, much the same in both months. The author has investigated the records at the hill stations, and has prepared charts showing the distribution of barometric pressure from both high and low level stations. From the high level charts it appears that the mean barometric gradient in 1889 was rather more than twice that in 1890, and, considering what is known of air movements, even at moderate elevations above the earth's surface, it may be assumed that these differences in pressure were accompanied by large differences of air motion, and if it is also assumed that the evaporation over the Southern Ocean is in all years fairly comparable in amount, the deficiency of rainfall over India in the winter of 1889-90 can be attributed to diminished lateral translation of vapour, owing to sluggish movements in the upper atmosphere.

3. "On the relative prevalence of different winds at the Royal Observatory, Greenwich, 1841-89," by Mr. W. Ellis, F.R.A.S. The author gives the following as the average nnmber of days of prevalence of different winds for the 49 years 1841-89, as derived from the records of the self-registering Osler anemometer :—

| N. | N.E. | E. | S.E. | S. | S.W. | W. | N.W. | Calm. |
|---|---|---|---|---|---|---|---|---|
| 40 | 45 | 27 | 22 | 35 | 106 | 46 | 22 | 22 |

4. "On some recent variations of wind at Greenwich," by Mr. A. B. MacDowall.

5. "On the action of Lightning during the Thunderstorms of June 6th and 7th, 1889, at Cranleigh, Surrey," by Capt. J. P. Maclear, R.N.—The author examined a number of trees which had been struck by lightning during these thunderstorms, and found that those which were struck before the rain fell were shattered, while those which were struck after the rain commenced were simply scored, with the bark blown off. It seems that during rain every tree is conducting electricity, and a disruptive discharge takes place where the conductor becomes insufficient. This depends on the position of the cloud, the amount of foliage on the tree, its condition of moisture, and its connection with running water.

## CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, NOV., 1889.

| STATIONS. (*Those in italics are South of the Equator.*) | Absolute. | | | | Average. | | | | Absolute. | | Total Rain. | | Aver. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Maximum. | | Minimum. | | | | | | | | | | |
| | Temp. | Date. | Temp. | Date. | Max. | Min. | Dew Point. | Humidity. | Max. in Sun. | Min. on Grass. | Depth. | Days. | Cloud. |
| | ° | | ° | | ° | ° | ° | 0–100 | ° | ° | inches | | 0–10 |
| England, London ...... | 60·3 | 8 | 27·8 | 28 | 49·5 | 40·0 | 41·2 | 88 | 97·3 | 24·4 | ·89 | 8 | 7·0 |
| Malta ...... | 79.9 | 1 | 49·3 | 25 | 69·0 | 57·2 | 51·8 | 74 | 127·2 | 42·0 | 1·10 | 8 | 4·1 |
| *Cape of Good Hope.* ... | 82·0 | 9 | 47·0 | 18 | 71·8 | 54·8 | ... | ... | ... | ... | ·50 | ... | 4·9 |
| *Mauritius* ...... | 81·4 | 24*a* | 64·0 | 5 | 79·7 | 67·6 | 63·4 | 73 | 137·8 | 55·1 | 1·78 | 9 | 5·7 |
| Calcutta ...... | 85·1 | 3 | 58·7 | 30 | 80·2 | 66·7 | 67·4 | 82 | 141·5 | 51·5 | 3·17 | 10 | 3·6 |
| Bombay ...... | 89·6 | 17 | 66·8 | 19 | 84·8 | 69·8 | 66·4 | 70 | 137·3 | 52·3 | ·00 | 0 | 0·1 |
| Ceylon, Colombo ...... | 87·7 | ... | 71·0 | ... | 85·8 | 74·5 | 70·6 | 77 | 153·0 | 62·0 | 10·29 | 18 | 5·4 |
| *Melbourne* ...... | 93·2 | 20 | 41·3 | 12 | 71·1 | 52·1 | 51·6 | 70 | 146·6 | 35·4 | 4·27 | 13 | 5·6 |
| *Adelaide* ...... | 98·0 | 19 | 44·6 | 11 | 78·2 | 57·5 | 50·6 | 54 | 149·9 | 37·5 | 2·11 | 9 | 4·2 |
| *Wellington* ...... | 72·5 | 23 | 40·0 | 30 | 64·8 | 49·1 | 47·1 | 70 | 138·0 | 33·0 | ·95 | 8 | 3·8 |
| *Auckland* ...... | 76·0 | 27 | 46·0 | 16 | 66·7 | 53·9 | 49·4 | 67 | 143·0 | 40·0 | 1·11 | 7 | 5·0 |
| Jamaica, Kingston ...... | 92·2 | 4 | 66·5 | 27 | 89·9 | 69·7 | 69·6 | 73 | ... | ... | ·19 | ... | ... |
| Trinidad ...... | 90·0 | *b* | 66·0 | 6 | 87·5 | 69·8 | 72·5 | 82 | 154·0 | 59·0 | 7·38 | 22 | ... |
| Toronto ...... | 56·8 | 2 | 16·9 | 29 | 43·9 | 33·2 | 34·1 | 81 | ... | 8·0 | 3·56 | 20 | 7·5 |
| New Brunswick, Fredericton ...... | 58·7 | 3 | 16·9 | 16 | 43·4 | 27·9 | 29·7 | 75 | ... | ... | 4·16 | 9 | 5·9 |
| Manitoba, Winnipeg ... | 52·5 | 8 | —13·5 | 28 | 33·0 | 13·9 | 19·6 | 81 | ... | ... | ·72 | 10 | 5·2 |
| British Columbia, Victoria ...... | 58·0 | 17 | 30·0 | 12,22 | 52·2 | 37·9 | ... | ... | ... | ... | 1·76 | 7 | ... |

*a* And 28. *b* Several days.

### REMARKS, NOVEMBER, 1889.

MALTA.—Mean temp., 61°·7 ; mean hourly velocity of wind, 9·2 miles ; sea temp. fell from 72°·0 to 67°·0. L on 5 days. Lunar rainbow on 10th. Waterspout on 11th at midday. J. SCOLES.

*Mauritius.*—Mean temp. of air, 1°·5, of dew point, 0°·7, and R ·14 in. below, their respective averages ; mean hourly velocity of wind, 9·0 miles, or 2·0 miles below average ; extremes, 22·8 on 30th, and 1·6 on 26th ; prevailing direction, E.S.E. C. MELDRUM, F.R.S.

*Melbourne.*—Mean temp. of air, 1°·5, of dew point, 3°·1, humidity 3, and R 1·79 in., above average. Amount of cloud 0·4 below average. Prevailing winds, S. and S.W., strong on 7 days. Heavy dew on 11 days. Fog on 13th. TSS on 4 days, and vivid and continuous L on evenings of 9th, 15th, and 26th. H on 17th. R. L. J. ELLERY, F.R.S.

*Adelaide.*—Mean pressure 0·080 in. below, and temp. 0°·8 above, the average of 32 years. R more than double the average ; total fall since Jan. 1 greater than any previous record. C. TODD, F.R.S.

*Wellington.*—Fine weather up to the 7th. with moderate northerly winds, then showery for two days, followed by fine weather up to 14th, when light rain commenced, and it continued showery until 18th ; remainder of the month very fine and dry, but strong N.W. wind from 20th to 25th. R less than a quarter of the average. R B. GORE.

*Auckland.*—A remarkably fine and dry month, the R being much less than half the average, mean temp. exactly the average. T. F. CHEESEMAN.

TRINIDAD.—R for the month ·56 in. above the average of 25 years. J. H. HART.

# JUNE, 1890.

| Div. | | STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.] | RAINFALL. Total Fall. | Difference from average. 1880-9 | Greatest Fall in 24 hours. Dpth | Greatest Fall in 24 hours. Date. | Days on which ·01 or more fell. | TEMPERATURE Max. Deg. | Max. Date | Min. Deg | Min. Date | No. of Nights below 32° In shade. | On grass. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | inches | inches. | in. | | | | | | | | |
| I. | ENGLAND. | London (Camden Square) ... | 2·82 | + ·81 | ·53 | 28 | 17 | 78·2 | 25 | 40·8 | 1 | 0 | 0 |
| II. | | Maidstone (Hunton Court)... | 1·75 | + ·13 | ·35 | 10*a* | 14 | ... | ... | ... | ... | ... | ... |
| ,, | | Strathfield Turgiss ............ | 2·76 | + ·96 | ·71 | 28 | 18 | 77·2 | 25 | 32·8 | 1 | 0 | 1 |
| III. | | Hitchin ............................ | 1·93 | + ·07 | ·52 | 30 | 18 | 73·0 | 24*b* | 47·0 | 30 | 0 | ... |
| ,, | | Winslow (Addington) ......... | 1·90 | + ·04 | ·34 | 25 | 20 | 76·0 | 24*b* | 33·0 | 1 | 0 | 1 |
| IV. | | Bury St. Edmunds (Westley) | 2·30 | + ·51 | ·50 | 10 | 13 | ... | ... | ... | ... | ... | ... |
| ,, | | Norwich (Cossey) ............... | 3·09 | + 1·54 | ·50 | 12 | 18 | ... | ... | ... | ... | ... | ... |
| V. | | Weymouth (Langton Herring) | 2·51 | + ·28 | ·39 | 29 | 18 | 72·0 | 18*c* | 43·0 | 1, 7 | 0 | ... |
| ,, | | Barnstaple ....................... | 3·24 | + 1·08 | ·50 | 25 | 17 | 69·0 | 14 | 37·0 | 1 | 0 | .. |
| ,, | | Bodmin (Fore Street) ......... | 3·98 | + 1·23 | ·59 | 25 | 21 | .. | ... | ... | ... | ... | ... |
| VI. | | Stroud (Upfield) ............... | 2·83 | + ·44 | ·65 | 25 | 17 | 78·0 | 24 | 47·0 | 7 | 0 | ... |
| ,, | | Church Stretton (Woolstaston) | 1·57 | — ·98 | ·52 | 10 | 17 | 71·0 | 23*d* | 41·5 | 7 | 0 | 0 |
| ,, | | Tenbury (Orleton) ............ | 1·93 | + ·68 | ·54 | 29 | 11 | 77·0 | 24 | 33·1 | 1 | 0 | 1 |
| VII. | | Leicester (Barkby) ........... | 1·79 | — ·56 | ·35 | 28 | 14 | 79·0 | 15 | 38·0 | 14 | 0 | 0 |
| ,, | | Boston ............................ | 1·40 | — ·49 | ·35 | 28 | 13 | 77·0 | 12 | 35·0 | 1 | 0 | ... |
| ,, | | Hesley Hall [Tickhill]......... | 1·72 | — ·20 | ·50 | 30 | 14 | 74·0 | 9, 10 | 37·0 | 8 | 0 | ... |
| VIII. | | Manchester (Plymouth Grove) | 3·47 | + ·82 | ·55 | 30 | 17 | 74·0 | 10 | 40·0 | 6, 7 | 0 | 0 |
| IX. | | Wetherby (Ribston Hall) ... | 1·82 | — ·07 | ·84 | 11 | 8 | ... | ... | ... | ... | ... | .. |
| ,, | | Skipton (Arncliffe) ............ | 6·47 | + 3·11 | 1·49 | 10 | 26 | 73·0 | 23 | 35·0 | 7 | 0 | ... |
| ,, | | Hull (People's Park) ......... | 3·53 | + 1·78 | 2·10 | 30 | 15 | ... | ... | ... | ... | .. | ... |
| X. | | North Shields ................... | 3·16 | + 1·61 | ·76 | 11 | 16 | 73·0 | 15 | 39·0 | 1, 15 | 0 | 1 |
| ,, | | Borrowdale (Seathwaite)...... | 13·59 | + 7·01 | 3·49 | 2 | 25 | ... | ... | ... | ... | ... | ... |
| XI. | WALES. | Cardiff (Ely) .................... | 2·97 | + ·54 | ·50 | 25*f* | 17 | ... | ... | ... | ... | .. | ... |
| ,, | | Haverfordwest .................. | 3·33 | + ·77 | ·71 | 8 | 21 | 68·5 | 25 | 36·2 | 6 | 0 | 4 |
| ,, | | Plinlimmon (Cwmsymlog) ... | 7·63 | ... | 1·11 | 22 | 22 | ... | ... | ... | ... | ... | ... |
| ,, | | Llandudno ........................ | 2·54 | + ·77 | ·35 | 25 | 18 | 67·0 | 23 | 42·3 | 8 | 0 | ... |
| XII. | SCOTLAND. | Cargen [Dumfries] ............ | 3·96 | + 2·01 | ·65 | 10 | 22 | 67·4 | 23 | 34·6 | 8 | 0 | ... |
| ,, | | Jedburgh (Sunnyside)......... | 3·01 | + 1·27 | ·75 | 11 | 16 | 68·0 | 23 | 36·0 | 8 | 0 | .. |
| XIV. | | Old Cumnock .................... | 3·79 | + 1·93 | ·51 | 5 | 18 | 71·0 | 10*e* | 30·0 | 6 | 2 | ... |
| XV. | | Lochgilphead (Kilmory)...... | 5·33 | + 2·23 | 1·04 | 2 | 23 | ... | ... | .. | ... | ... | ... |
| ,, | | Oban (Craigvarren) ............ | 5·82 | ... | ·99 | 3 | 23 | 64·8 | 13 | 39·6 | 8 | 0 | 0 |
| ,, | | Mull (Quinish) .................. | 6·64 | + 3·35 | 1·11 | 3 | 22 | ... | ... | ... | ... | ... | ... |
| XVI. | | Loch Leven Sluices ........... | 3·40 | + 1·65 | ·70 | 6 | 16 | ... | ... | ... | ... | ... | ... |
| ,, | | Dundee (Eastern Necropolis) | 2·90 | + 1·40 | ·55 | 5 | 15 | 71·8 | 23 | 38·9 | 7 | 0 | ... |
| XVII. | | Braemar .......................... | 2·63 | + ·64 | ·55 | 3 | 17 | 65·3 | 15 | 33·2 | 14 | 0 | 4 |
| ,, | | Aberdeen (Cranford) ......... | 1·85 | ... | ·21 | 3 | 22 | 72·0 | 23 | 36·0 | 7 | 0 | ... |
| XVIII. | | Strome Ferry..................... | 5·60 | + 2·54 | ·72 | 24 | 24 | 67·0 | 10 | ... | ... | ... | ... |
| ,, | | Culloden ......................... | 1·91 | + ·95 | ... | ... | ... | 69·0 | 10 | 38·0 | 7 | 0 | 3 |
| XIX. | | Dunrobin ......................... | 3·09 | + 1·07 | ·64 | 3 | 16 | 64·0 | 21 | 37·0 | 8 | 0 | ... |
| ,, | | S. Ronaldsay (Roeberry)...... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| XX. | IRELAND. | Cork (Blackrock) ............... | 3·22 | + ·88 | ·82 | 7 | 16 | 80·0 | 23 | 46·0 | 7, 23 | 0 | .. |
| ,, | | Dromore Castle ................ | 6·35 | + 3·19 | 1·25 | 7 | 20 | 72·0 | 12 | 35·0 | 18 | 0 | ... |
| ,, | | Waterford (Brook Lodge) ... | 3·76 | + 1·69 | ·92 | 7 | 19 | 71·0 | 23 | 39·0 | 1 | 0 | .. |
| ,, | | O'Briensbridge (Ross) ...... | 3·45 | ... | ·56 | 7 | 22 | 74·0 | 26 | 48·0 | 6 | 0 | ... |
| XXI. | | Carlow (Browne's Hill) ...... | 2·21 | + ·37 | ·34 | 7 | 20 | ... | ... | ... | .. | ... | ... |
| ,, | | Dublin (FitzWilliam Square) | 1·93 | + ·27 | ·36 | 11 | 18 | 72·0 | 5 | 43·2 | 7 | 0 | 0 |
| XXII. | | Ballinasloe ...................... | 2·51 | + ·21 | ·53 | 7 | 23 | 70·0 | 15 | 41·0 | 7 | 0 | ... |
| XXIII. | | Waringstown .................... | 3·21 | + 1·14 | ·51 | 29 | 20 | 76·0 | 15 | 41·0 | 28 | 0 | 0 |
| ,, | | Londonderry (Creggan Res.). | 3·38 | + ·96 | ·35 | 5 | 25 | .. | ... | ... | ... | .. | ... |
| ,, | | Omagh (Edenfel) ............... | 3·23 | + ·76 | ·36 | 5 | 25 | 68·0 | 15 | 44·0 | 28 | 0 | ... |

*a* And 30. *b* And 25. *c* And 23. *d* And 24. *e* And 15, 26. *f* And 29.

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

# METEOROLOGICAL NOTES ON JUNE, 1890.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hail; S for Snow.

## ENGLAND.

STRATHFIELD TURGISS.—June opened with most favorable agricultural prospects. The winter was dry and equable, the spring forward, with just enough frost to mellow the land, and with sufficient rain to make all crops luxuriant. The showers in the middle of the month were very welcome, but the last fortnight, although satisfactory for the corn crops, was somewhat unfortunate for hay-making. T on 9th, 10th and 11th. Elder in flower on 7th; pink convolvulus on 19th. Meadow brown butterfly flying on 20th.

ADDINGTON.—Potatoes and kidney beans in low situations were cut down, and the foliage in some trees was blackened by frost on 1st. Frequent showers, but not much R until nearly the end, when there was also T.

BURY ST. EDMUNDS.—The month was cool, the hottest day being the 10th, with a max. of 71° in the shade. The early wheat had a very favourable time for blossoming. Very little T.

LANGTON HERRING.—Cold and wet, but there is still a little deficit in the R for the first six months of the year. Mean temp. a little below the average of 18 years. T on 12th and 13th. Much hay spoilt or injured.

BODMIN, FORE STREET.—A very wet and cold month; very few days of regular June weather. Thick mist on 22nd and 23rd.

WOOLSTASTON.—A showery, unsettled month, very unfavourable for the hay harvest. Mean temp. 56°·9.

LEICESTER, BARKBY.—L and T on 11th, 12th and 28th; T on 10th, H on 11th. (The return of 29°·0 as the minimum on May 27th, was queried by the Editor, but there was no question of its accuracy; beans, potatoes, marrows, fruit and flower blossoms were turned quite brown, and many plants killed). [We are glad that our suspicion of Mr. Pochin's thermometer was unfounded. It is a curious example of local frost. ED.]

MANCHESTER, PLYMOUTH GROVE.—Summer weather on four days, viz., 20th, 21st, 22nd and 24th. The rest of the month very changeable and unsettled. T and L on 10th and 11th. Mean temp. 58°·0.

HULL.—The weather during the month was often cloudy, sometimes overcast and rather showery,. T heard on 27th. TS on 28th.

## WALES.

HAVERFORDWEST.—A month of constant R and low temp.; and the amount of bright sunshine very small. Unmeasurable moisture fell on five out of the nine days on which no R was recorded, so that there were 26 days out of the 30 *not dry*. Scarcely any hay was cut during the month, an almost unprecedented occurrence, very unfortunate as the crop was abundant. The temp. never reached 70°, and on many nights the temp. was very low for the time of the year. The weather never recovered after the great TS of May 25th, when, as no rain gauge was to be found in the locality, the storm can only be judged by the damage done. Fields were flooded, 100 yards of road at Abermawr washed away, a huge mass of stone estimated to weigh a ton displaced and washed away, at the adjoining village of Mathry. Roads deeply cut like mountain ravines, and the telegraph wires attached to the cable crossing to Ireland were fused by the lightning.

## SCOTLAND.

CARGEN.—Very dull weather prevailed during the month. Duration of sunshine 156 hours; 80 hours below the average. Mean temp. 54°·6, 2° below the average. There were only eight days during the month on which rain did not fall. T on the 10th, 27th and 28th.

JEDBURGH.—R was frequent during the month, and there was much sunshine, but occasional low temperature. Crops all looked well, and growth was vigorous. T and L on 27th.

OBAN.—Wettest June for 8 years ; growth of crops abundant, but heat deficient. On 24th and 25th the centre of a cyclone of unusual violence passed here.

CULLODEN.—The temp. was below the average ; grass abundant, and other crops well advanced.

## IRELAND.

CORK.—Changeable weather throughout. Very warm on the 23rd. R ·62 in. above the average of 25 years. Mean temp. 59°·1, being 1°·4 below the average of 14 years.

WATERFORD, BROOK LODGE.—T on 11th and 28th ; fog on 13th, 14th, and 15th. H on 28th.

ROSS, O'BRIENSBRIDGE.—Showers frequent, but no large amount at any time. Day temp. below, but night temp. equal to, the average. Weather adverse to hay-making, but good for green crops. No T or L.

DUBLIN.—A cloudy, showery, windy month, of average temp. and pressure and showing a marked preponderance of S.W. and W. winds. Mean temp. 58°·1, slightly above the average. High winds on 15 days, but gales on only two occasions (3rd and 24th). The temp reached or exceeded 70° in the screen on only two days, as compared with 17 days in 1887, 1 day in 1888, and 10 days in 1889. T on 11th and 28th. H on 28th and 30th.

BALLINASLOE.—A cold, wet, and windy month.

OMAGH, EDENFEL.—No other June since 1879 has been so persistently showery and unsettled. The temp. and bar. readings also bore a suspicious resemblance to that disastrous year. No damage had, however, resulted at the close, and nothing but finer weather is required to secure a year's produce of unexampled abundance.

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## THE RAINFALL OF JULY 4TH-5TH, 1890.

*To the Editor of the Meteorological Magazine.*

SIR,—The extraordinary rain of last week here deserves to be recorded in your Magazine. In the 24 hours between 5.30 p.m. of Friday, the 4th inst., and 5.30 of Saturday the 5th, there fell 3·30 in., and of this quantity 1·67 in. fell between 7.5 and 9.30 on Saturday morning. These falls are quite unprecedented during the 16 years of my observations in Ramsgate. The eight days of this month already elapsed have given more rain than any entire month of July during those years except that of 1888.—Yours faithfully,

M. JACKSON.

*The Vale, Ramsgate, July 9th,* 1890.

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[We have also received notes whence we add the following extracts —*Ed. M. M.*]

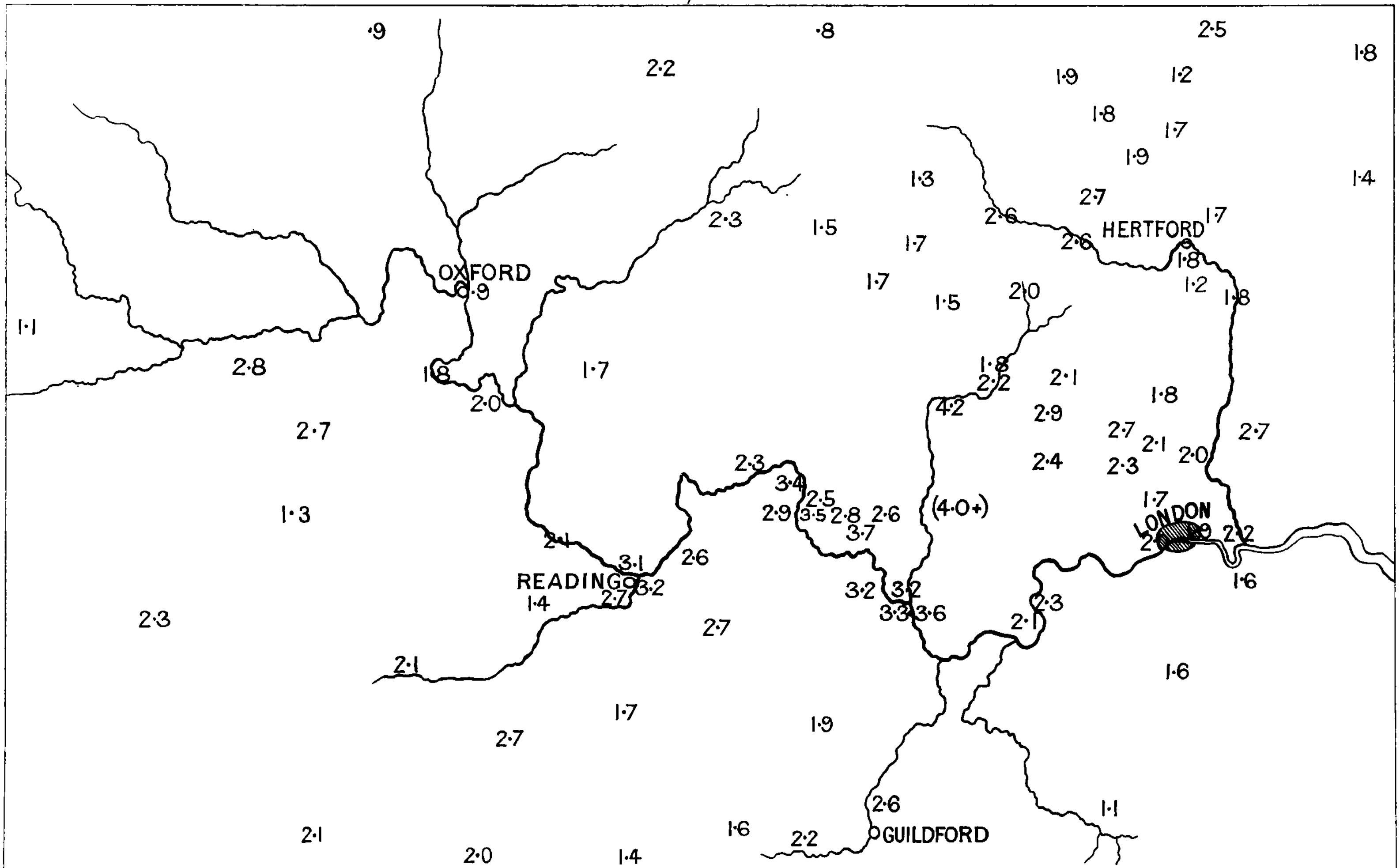
*Lower Cousley Wood, Wadhurst, Sussex.*—3 p.m. on 4th to 9 a.m. on 5th, 1·26 ; 9 am. to 4 p.m on 5th, ·44 ; total, 1·70 in.—F. WILKIN.

*Hartley, Cranbrook, Kent.*—9 a.m. 4th to 9 a.m. 5th, 1·04 ; 9 a.m. 5th to 9 a.m. 6th, ·50 ; total, 1·54 in.—G. PILE.

*Tenterden, Kent.*—3 p.m. on 4th to 9 a.m. 5th, 1·09 ; 9 a.m. 5th to 1.20 p.m., ·11; total, 1·20 in.—J. E. MACE.

*Capel Lodge, Folkestone, Kent.*—3.30 p.m. 4th to 9 a.m. 5th, 2·58 ; 9 a.m. to 9 p.m. 5th, ·32 ; total, 2·90 in.—E. NORTON, M.D.

# DEPTH OF RAIN, JULY 17TH 1890.




London Stanford's Geog[l] Estab[t]