

SYMONS'S

MONTHLY

METEOROLOGICAL MAGAZINE.

CLXV.]

OCTOBER, 1879.

[PRICE FOURPENCE.
or 5s. per ann. post free.]

THE RAINFALL OF THE CHANNEL ISLANDS.

THANKS to the liberality and kindness of Prof. Raulin, of Bordeaux, we have the pleasure of issuing with the present number of this Magazine copies of that part of Prof. Raulin's great work which contains the details of the rainfall in the Channel Islands.

We have on several occasions drawn attention to the task which Prof. Raulin has undertaken, and which we rejoice to see approaching completion. Our readers have now, in the appendix issued herewith, the opportunity of judging how great has been the labour of compiling similar details for the whole of France, and what a mass of information is contained in the volumes already published. No human work is perfect, and we are not going to assert that Prof. Raulin has collected every rainfall observation ever made in France, but he has tried hard to do so, and with such success that we could hardly imagine a more hopeless task than to be instructed to compile a table of French rain records not quoted by Prof. Raulin.

We believe that a similar publication ought to be prepared in every country, so as to concentrate all existing data, and to avoid for the future the terribly wide search which is necessary in the past. At the present time, and we trust for all time to come, there has been established in most countries some central office, which charges itself with the annual collection and publication of all the rainfall observations made during the previous year. But until lately this was not the case; and those who undertake a task analogous to that which Prof. Raulin has nearly completed, must search, not only standard works, like Cotte's *Mémoires* or Martin's *Patria*, but long series of medical and engineering journals, and even of ordinary newspapers—the difficulty, indeed, is not so much where to search as where not to search, so strange and unexpected are many of the publications in which the observers of the last and of the first half of the present century published their records.

Besides the difficulty of collecting the data there is another, that of paying for the printing. This is no difficulty where the charge can be thrown on the nation, but it is almost prohibitory in other cases.

Regarding the accompanying extract, we need say little. Its utility is such as to need no praise from us.

Perhaps it may be well to tabulate the mean values for the various stations :—

			Mm.		Inches.
Alderney, Harbour Works ...	1851-71 ...	725.2	...	28.55	
Guernsey, Fort George	1854-70 ...	729.9	...	28.74	
„ York Place	1843-70 ...	904.8	...	35.63	
„ Grange Road.....	1866-70 ...	931.1	...	36.65	
Sark, Parsonage	1865-70 ...	747.7	...	29.44	
Jersey	1848-56 ...	804.9	...	31.69	
„ Millbrook	1858-70 ...	745.3	...	29.33	
„ Fort Regent	1866-70 ...	711.0	...	27.99	

For the convenience of those not familiar with the metric scale we give the following little table, which will enable anyone to convert any of the quantities into English inches. We have throughout ignored the decimals of a millimetre, as even 0.9 is less than 0.04 of an inch.

In one respect the table which we have given is in an unusual form. The usual way of reading the table would be to consider that it showed that 11 millimetres = .39, 12 = .78, and so on; but that is not the case: the numbers along the top are the multiples of those in front, and therefore we see that 10 millimetres = .39, 20 = .78, and so on. With this explanation and the series of examples from page 619, we cannot deem further remarks necessary.

	1	2	3	4	5	6	7	8	9	10
1	.04	.08	.12	.16	.20	.24	.28	.31	.35	.39
10	.39	.79	1.18	1.57	1.97	2.36	2.76	3.15	3.54	3.94
100	3.94	7.87	11.81	15.75	19.69	23.62	27.56	31.50	35.43	39.37
Year.	Winter.		Spring.		Summer.		Autumn.			
1860...1000	= 39.37		300 = 11.81		200 = 7.87		200 = 7.87		200 = 7.87	
					60 = 2.36		60 = 2.36		60 = 2.36	
	40 = 1.57		3 = .12		6 = .24		9 = .35		2 = .08	
	1040 = 40.94		303 = 11.93		206 = 8.11		269 = 10.58		262 = 10.31	

PARHELIA.

To the Editor of the Meteorological Magazine.

SIR,—An exceeding perfect instance of the phenomenon known as “Parhelia” occurred here this morning, a description of which may prove interesting to some of your readers.

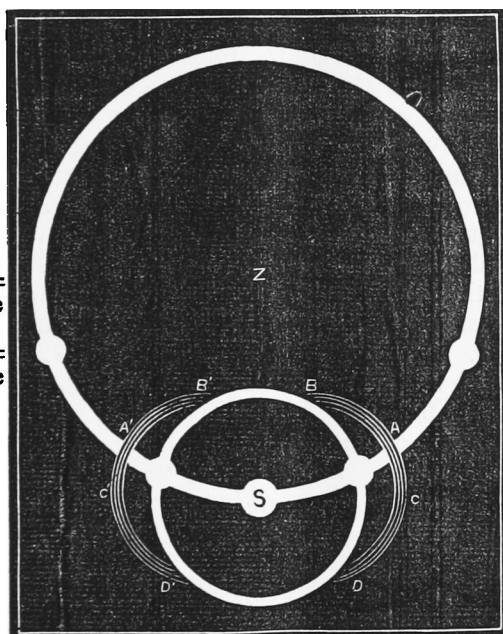
About 9.45 I noticed from the train on my way to business, a small piece of rainbow near the southern horizon, what sailors call a “weather-gall.” A second glance showed me that this formed a portion of the halo of a pair of parhelia, in connection with which there appeared to be three intersecting circles, the exact relations of which I was unable to ascertain till I reached town and entered the grounds of Trinity College, where I had a tolerably clear view.

Round the sun was a complete and well-defined circle of light, some 30° in diameter, the sun being in the centre. Intersecting this was a second much larger circle, also complete, having the zenith for its centre, and the sun's zenith distance for radius, thus of course passing through the sun. At the two points of intersection of these

circles were brilliant parhelia, while on the large circle, and at some distance from the smaller one, on each side were two smaller parhelia, much less brilliant than the principal pair. Over each of these latter was a bow of light, as though an ellipse had intersected the smaller circle, the transverse diameter of which was about that of the circle. These bows were strongly tinged with prismatic colours, especially where they approached the circle, one of them being the "weather-gall" already alluded to. The upper end of each bow was much more brilliantly coloured than the lower.

Towards 10.15 these appearances gradually faded, but did not wholly disappear for a couple of hours. The sky was covered with what seemed a thin grey haze, with a few woolly-looking cumulus clouds near the horizon. The barometer was high—over 30 inches—and the wind was light and westerly; the temperature was considerably colder than yesterday, some 6° or 7°, say about 50°.

Z = Zenith;
A B and A' B' =
strong prismatic
arcs;
C D and C' D' =
fainter prismatic
arcs.



The enclosed sketch will explain the above description.—Faithfully yours,

GREENWOOD PIM, M.A., F.L.S.

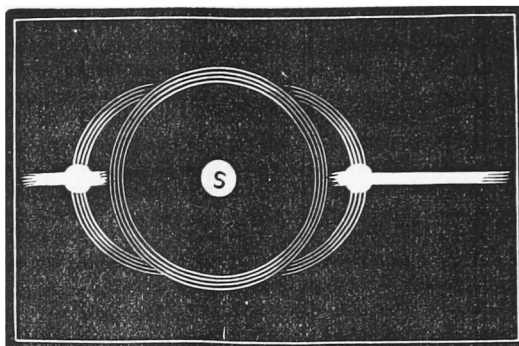
Monkstown, Co. Dublin, 22nd Sept., 1879.

To the Editor of the Meteorological Magazine.

SIR,—Yesterday I saw a remarkable halo and parhelia, of which I can find no example in any of the meteorological magazines, or in Herschell's or Buchan's meteorological works.

It was formed in cirrus clouds coming from the W., the surface

wind being also from the same direction. The following sketch will give some idea of its appearance from 0.45 to 1 p.m. :—



[The white bands in this engraving are parts of the circle described round the zenith in the other sketches.—ED.]

The remarkable part of the phenomenon was the supplementary arc on either side of the main halo, describing the section of a circle of which the sun could not have been the centre. The supplementary arcs were prismatically coloured like the halo, and having the red on the inside. An ordinary halo was visible all the morning, and a parhelson on its W. side from 9.50 to 11.30 a.m., and also on the E. side at 10.40 a.m., both being situated on the circle of the halo, as usually happens. The parhelia from 0.45 to 1 p.m. were situated on the supplementary arcs, as shown in sketch. The halos, &c., were occasionally obscured by passing cumuli.

At 2 p.m. the barometer (corrected to 32° sea level), read 29.975 in.; the dry bulb thermo. 59°·8, wet bulb 52°·6; and the wind was W., force 3. Last night it blew freshly from S.W., with rain, and this afternoon it is again raining.—Yours sincerely,

EDWIN E. GLYDE.

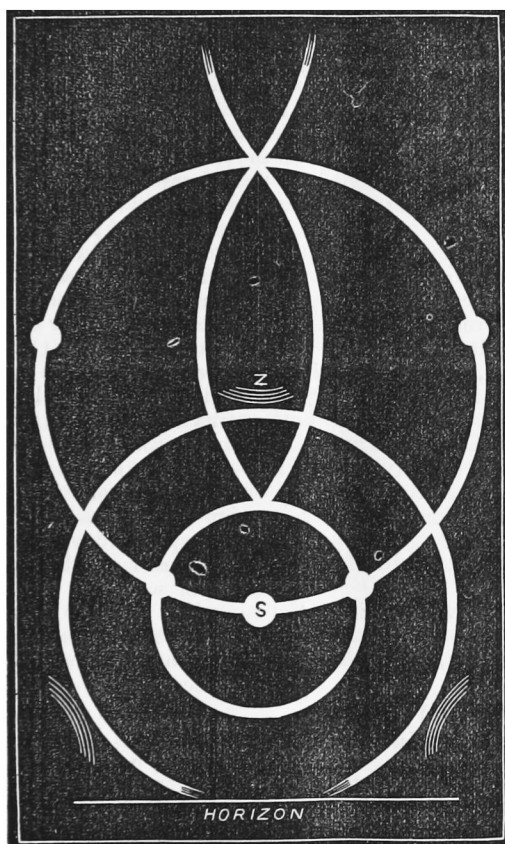
Kirkham, Babbacombe, Torquay, Sept. 23rd, 1879.

To the Editor of the Meteorological Magazine.

SIR,—I send you a copy of an article I wrote for the *Dublin Daily Express* and *Freeman's Journal*, on the wonderful display of halos and parhelia last Monday morning, and also a sketch of the phenomenon :—

“Between 9 and 10 a.m. of Monday, September 22nd, 1879, an unusually striking and beautiful display of solar halos and parhelia, or ‘mock suns,’ was seen from Dublin and its vicinity. The morning was bright and cold—‘a morning without clouds’—but shortly before 9 a.m. a thin veil of cirrus cloud, floating at a great height, began to overspread the sky from W.N.W. When this cloud approached the sun a series of beautiful circles—some coloured like the rainbow, others of pure white light—became developed, and at certain points the brilliancy caused by the intersection of some of these circles gave rise to the phenomenon of parhelia, or ‘mock suns.’ At 9.40, when the display was seen in its greatest magnificence, two almost perfect circles were observed surrounding the sun—one at a distance of 22°, the other at a distance of 46° from the sun, as the common centre. To right and left, at a distance of 22° from, and at the same height above, the horizon as the sun, were well-marked parhelia, or ‘mock suns.’ But this was only half of

the display. The central circles were tipped at the points where the mock suns were situated by other and much wider circles which, with the zenith as their common centre, ran parallel to the horizon. One only of these was perfect, and it resembled a band or girdle of beautiful white light, running round the sky at the same height as the sun. Far beneath the sun to right and left portions of rainbow-tinted arcs of halos lay across the sky, and so distinct were these that a careless or thoughtless observer might easily have mistaken them for the 'wind-galls,' or portions of rainbows seen near the horizon on a wild showery evening. Close to the zenith a third spectrum was observed. After 10 a.m. the beauty of the halos faded, but the zenith circle was visible until mid-day. An attempt to explain briefly this beautiful display, to which the foregoing description does but scant justice, may not be without interest.



"The phenomena of halos, whether connected with the sun or moon, depend upon the presence in the air of innumerable crystals of ice, generally forming a light cirrus cloud. As is well known, cirrus cloud floats at a great height above the earth, far within the zone of perpetual frost. Experiment has proved that water crystallises in the form of regular hexagonal or six-sided prisms, sometimes with plane ends perpendicular to the sides, sometimes with hexagonal pyramids as terminals. The combination of any two non-parallel faces of such crystals must act as a prism, decomposing white light as it passes through them into its constituent colours. Every such crystal placed somewhere near the line joining the eye and sun must in general send to the former some definitely coloured ray from each effective pair of surfaces. The refractive index of ice, however, is such that no ray can pass through a prism of

it whose angle is greater than about 99.5° , and we are therefore limited to pairs of faces whose inclination is not superior to this. The most important pairs are two *alternate* faces of the prism, where the inclination is 60° , and a face with a terminal plane, the angle being 90° . If, then, there are in a cloud innumerable prisms of ice, with refracting angles of 60° , those prisms which are nearly in a line between the sun and the spectator will refract light in different directions. But there is a position of the vertical prism called that of 'minimal deviation,' for which a slight alteration of the prism produces no alteration in the direction of the refracted ray. Those prisms, then, which are near the position of 'minimal deviation' will conspire to refract light in the same direction and their effects will be added. The appearance, will, therefore, be a circle of reddish light surrounding the sun as centre, its angular radius being the angle of minimal deviation, which for a prism of ice of 60° angle is about $21^\circ 50'$. The light reflected from the surfaces of the prisms will be white and uniformly diffused about the sun. To right and left of the sun and on the halo, bright coloured images of the sun, called parhelia (from the Greek words, *para*, near, and *helios*, the sun), are formed by an excess of the prismatic crystals having their axes vertical or horizontal. The halo of 46° depends upon the right-angled prisms, formed by combining a terminal plane with one of the faces of the hexagonal prism. The refracting angle is different, and so this halo is of greater dimensions than that of 22° radius.

"The beautiful white zone around the zenith is produced by the reflection of light from the surfaces of the vertical prisms, which are so many vertical mirrors, in accordance with optical laws appearing to have the same altitude as the sun itself. From the foregoing, then, it would appear that the coloured circles are the result of refraction from prisms having angles of either 60° (halos of 22° radius), or 90° (halos of 46° radius), whereas the white circles are caused by reflection from countless tiny ice mirrors suspended high in mid air. It only remains to mention that the halo-producing sheet, 'formed'—to use the words of the Rev. Clement Ley—"by the interlacing fibres of more or less cirriform cloud," is frequently the harbinger of storm and rain; for in front of an advancing barometrical depression, or cyclonic system, there commonly exists in the higher regions of the atmosphere a great bank of frozen moisture with its millions of ice prisms and mirrors. Yesterday's magnificent halos only too truly forshadowed the night of wind and rain which has just passed over this country.*

"In conclusion, we would direct the attention of those who are interested in the subject of halos and parhelia, to an admirable article in Vol. V. of *Chambers' Encyclopædia*, on which, indeed, the foregoing brief explanation has been based."

Yours very truly,

J. W. MOORE, M.D.

40, Fitzwilliam-square West, Dublin, Sept. 26th, 1879.

* The barometer at Stornoway fell 1.25 inches, to 28.37 inches, in the twenty-fours ending 8 a.m. of Tuesday, Sept. 23rd.

A SOLAR HALO.—Mr. Carey Coombs, M.D., writes to us from Castle Carey, Somerset:—"At noon on the 22nd instant, while driving near Ditchet (a village twenty miles south of Bath), I saw, in the zenith, a large white circle (the halo of 46°). This circle cut a smaller coloured circle which surrounded the sun (the halo of 22°), forming at the points of intersection mock suns or parhelia, which were coloured. An arc of another circle, beautifully coloured, touched the highest point of the halo of 22° , and the whole effect was beautiful. It is supposed that solar halos are produced by the refraction of the sun's rays from the surfaces of hexagonal prisms of congealed watery vapour—high up in the atmosphere—rainbows being formed by similar refraction from spherical rain drops. The sun at noonday is not a pleasant object to look at, and it is possible that solar halos are often overlooked, but their supposed rarity in our latitudes has induced me to record what I saw on Monday."—*Daily Telegraph*.

A CORRESPONDENT of the *Bristol Times and Mirror*, writing from Weston-super-Mare, says :—"A singular phenomenon was observed on Monday. Mr. Courtney, the School Board officer, while on the Esplanade, was watching what he took at first to be a 'sun dog' (a sailor's term for broken segments of rainbows), when he noticed a well-defined and perfect circle of light, the centre of which was opposite to and about 45° from the sun, and the periphery of which passed through the sun's centre. The diameter of the circle, measured from the sun's centre northwards, was about 90° , the northern boundary being about as far above the northern horizon as the sun is south of the zenith. He hastened home and got the correct time (it was just apparent noon), the sun's azimuth, and some rough measurements of the circle by sextant, applying at the same time a telescope of low power to the examination of the composition of the circle boundary line. From this observation he was satisfied that the circle was formed, not as is usual in solar halos, by a dark shadow filling up the circumscribed space, but by a boundary line of light, fleecy cloud, or mist, arranged in a thick and somewhat broken band of a degree or two in width. At one o'clock this band began to break up, and at 1.15 it had dispersed and disappeared, except that here and there within the space of the circle, the same fleecy cloud or mist was arranging itself, appearing and disappearing in streamers and tresses like waving masses of hair. There was bright sunshine, though the sky was leaden-hued, and the atmosphere warm and moist and sultry. The barometer was falling rapidly, and the occurrence was followed by strong gales through the night."

METEOROLOGY IN JAVA.*

WE are very glad to find that Dr. Bergsma is steadily continuing the system which he commenced in 1864, and that the quality of the work issued under his superintendence is, taken as a whole, highly creditable. The first volume of the *Batavia Observations* was the subject of a long notice in this Magazine for September, 1872; the second and third volumes have just appeared, and we, therefore, proceed to give a short notice of the steps taken by the Dutch Government towards ascertaining the climatic conditions of Java, Borneo, and other parts of the Malay Archipelago. And first as to head quarters—Batavia Observatory. When Dr. Bergsma, after making himself familiar with the routine of the best European observatories, arrived at Batavia and prepared the plans for a permanent observatory, he found that it would be very costly, and while sending in the estimate for a permanent building, he decided on renting a house one story high and surrounded, like most of those in Batavia, by a garden nearly four acres in extent, and using part of this house as a temporary observatory. It is fortunate that he adopted this course, for it was several years before the Government felt justified in voting the funds requisite for the purchase of the temporary house and grounds, and for the erection thereon of the permanent observatory. As it is, there will be nearly fifteen years' records of hourly readings at the temporary observatory, which can easily be connected with the results of the self-recording instruments in the permanent observatory, and will add enormously to the utility of its records.

* Observations made at the Magnetical and Meteorological Observatory at Batavia, by Dr. P. A. BERGSMAN. Large 4to, Vols. II. & III., 1878. Government Printing Office, Batavia.

As regards the Archipelago in general, we reprint the paragraph in which Dr. Bergsma explains the state of matters ; it is evidently so satisfactory as to need no comment from us.

"The organization of meteorological stations at other places in the Archipelago will not meet with such great difficulties as the erection of the central observatory ; the expenses will be relatively small, and the observatory will afford ample opportunity for obtaining well trained native observers, able to make the observations at the stations under the superintendence of surgeons of the army, or other government officers. A first step has already been made by the organization of a great number of stations spread all over the Archipelago, at which observations of the rain will be made, principally by surgeons of the army and other government medical officers. On January 1st, 1879, these observations, to be published regularly by the Batavia Observatory, will begin at 95 stations, of which 55 are situated on the island of Java, 22 on Sumatra, 2 on Bangka, 1 on Bileton, 8 on Borneo, 4 on Celebes, 1 on Amboina, 1 on Banda, and 1 on Ternate ; to which stations I hope 20 or 30 more will be added in the course of next year."

Although these splendid volumes contain a mass of tables, and the results are most fully and carefully worked up, we have not noticed any compact synoptical table ; we have, therefore, compiled the following, which gives most of the principal elements, all expressed in English measures.

TABLE I.

BATAVIA (TEMPORARY OBSERVATORY).

Lat. 6° 11' 0" S. Lon. 106° 49' 45" E. Altitude 22 ft.

PERIOD.	1866-1875.				1864-75.	
ELEMENT.	Mean Temperature.	Mean Pressure at 32° at 25ft. above Sea.	Mean Elastic Force of Vapour.	Mean Humidity.	Mean Rainfall.	'Mean No. of days with Rain.
MONTH.	°	in.	in.	0-100.	in.	
January	77·2	29·869	·819	88	16·97	24
February	77·3	29·861	·826	88	14·53	21
March	78·4	29·866	·831	86	7·36	15
April	79·2	29·852	·846	85	4·17	12
May	79·3	29·851	·839	84	3·58	9
June	78·8	29·869	·819	84	3·94	8
July	78·1	29·878	·783	82	2·52	7
August	78·7	29·879	·767	79	2·40	6
September	79·2	29·886	·783	79	3·15	8
October	79·2	29·871	·804	81	5·67	11
November	79·0	29·869	·815	83	5·04	12
December	77·6	29·860	·811	86	12·01	19
Year	78·5	29·868	·812	84	81·34	152
Absolute Max.	92·7	30·056	1·078	100	—	—
„ Min.	66·9	29·646	·472	32	—	—
Mean Daily Range ...	10·6	0·107	·055	24	—	—

In our previous notice we complained of the position of the rain gauge on the roof of the house ; we adhere to that complaint, but we know full well how scarce are trustworthy records from the Malay Archipelago, and we have therefore converted and prepared the following abstract :—

RAINFALL AT BATAVIA.

YEAR.	1864	1865	1866	1867	1868	1869	1870	1871	1872	1873	1874	1875	1864-75
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
Jan....	20·16	24·65	8·47	20·67	10·16	11·85	9·37	23·43	35·55	12·01	14·25	13·23	16·97
Feb....	7·68	4·53	24·57	24·49	9·17	16·85	11·65	14·33	16·81	13·39	12·01	18·98	14·53
March	5·63	8·66	4·68	2·24	7·09	5·12	2·40	7·60	13·78	14·69	7·32	9·21	7·36
April..	3·58	6·89	3·42	1·85	3·86	4·41	4·03	5·71	·94	4·53	2·13	8·62	4·17
May...	1·81	·75	14·45	·67	·55	5·55	3·23	5·59	4·61	1·22	3·98	·43	3·58
June..	2·79	10·04	·24	1·38	1·14	7·48	6·22	2·91	2·68	1·61	10·59	·04	3·94
July...	2·60	1·57	·39	2·91	3·15	2·60	1·89	2·20	7·05	·59	5·20	·04	2·52
Aug...	3·03	4·88	·16	1·34	6·69	·28	3·35	·08	1·89	2·28	3·90	1·06	2·40
Sept...	2·28	1·69	5·63	3·35	·24	3·70	6·53	4·10	1·65	·55	6·97	1·18	3·15
Oct....	7·32	·20	6·81	10·31	3·58	7·28	5·12	6·85	5·55	1·42	3·74	9·73	5·67
Nov...	3·23	10·20	2·83	5·83	4·02	1·38	6·61	2·76	6·57	1·65	8·74	6·57	5·04
Dec....	4·73	9·45	17·72	21·42	7·48	13·74	24·61	18·62	6·61	5·91	3·03	10·75	12·01
Total..	64·84	83·51	89·37	96·46	57·13	80·24	85·01	94·18	103·69	59·85	81·86	79·84	81·34

	Maximum.		Mean.	Minimum.	
	Amount.	Date.		Amount.	Date.
Fall in a year ...	103·69	1872	81·34	57·13	1868.
„ „ month.	35·55	January, 1872	6·78	·04	June & July, 1875.
„ „ day ...	7·29	May 15, 1866	·54	·00	
„ in an hour...	3·83	Jan. 10, 1867	·15	·00	

We trust that Dr. Bergsma has ere this started a new and properly placed rain gauge, and that he has seen and will loyally follow Rule II. of the British Rainfall system, which says—

“ II.—OLD GAUGES.—Old established gauges should not be moved, nor their registration discontinued until, at least, two years after a new one has been in operation, otherwise the continuity of the register will be irreparably destroyed. Both the old and the new ones must be registered at the same time and the results recorded for comparison.”

Dr. Bergsma and his staff appear to be so careful, and the Director seems so desirous of rendering his work as nearly perfect as possible, that we have no doubt as to this little matter being properly attended to.

We cannot spare space for further extracts, but we desire to call attention to the author's remarks on cases in which Bessel's formula gives results evidently erroneous.

THE BRITISH ASSOCIATION AT SHEFFIELD.

(Continued from page 125.)

ON THE QUANTITATIVE ELEMENTS OF HYDROGEOLOGY.
—PERCOLATION.

By JOSEPH LUCAS, F.G.S., Hydrogeologist, late of H.M. Geological Survey.

Divisions of the Rainfall Year.—Among observers of percolation, Mr. Evans divides the year into the winter half, October 1 to March 31, and the summer half, April 1 to September 30. Messrs. Lawes and Gilbert take the harvest year from September 1 to August 31. Mr. Greaves gives the amount for each quarter, and for the year ending at each quarter—March, June, September, and October. Ebermayer divides the year into four quarters—

Spring.....	March	April	May
Summer.....	June	July	August
Autumn.....	September	October	November
Winter.....	December	January	February

Giving his annual totals in respect of the twelve months, March—February.

In a paper* read at the Meteorological Society, Mr. James Glaisher, F.R.S., supplies materials for comparing these various methods. He shows that the rainfall year divides itself into two halves, commencing March 1 and September 1, thereby proving the sagacity of Ebermayer.

Divisions of the Percolation Year.—The month of March contains the driest ten-day, fifteen-day, and thirty-day periods in the year, and the months of March and April the driest sixty-day period. The effect of this is manifested in the complete cessation of percolation in April. There is no such uniformity in the wettest periods of equal duration, and in consequence percolation does not recommence till the close of the longer wettest periods of thirty, sixty, and ninety days. Mr. Evans's soil gauge frequently leaves off recording percolation a month earlier, and begins to record it again a month later, than Mr. Greaves's. Mr. Evans's gauge is filled with a mixture of *gravel, loam, and mould*, and Mr. Greaves's of *gravel, loam, and sand*, which probably accounts for the difference in this respect.

Characters of the Soil.—The calibre of the constituent grains of the soil, and the per-centage of grains of various calibres in the natural admixture, should be known for every soil on which percolation experiments are or have been carried out. In a collection of grains of given calibre spheres will occupy more space than any other shape, or the absorbent capacity is least when the grains are spherical. The space occupied by any number of spheres, from one upwards, which exactly lie in a cubic foot, is '5236 cubic feet as long as the arrangement is cubical, the retentive power increasing with the fineness of the grains. The natural arrangement is, however, pyramidal, in which one sphere rests in the hollow between four. As more spheres will thus go into a cubic foot the space occupied is somewhat greater than '5236, and the absorbent capacity somewhat less than '4764. The absorbent capacity (pyramidal) decreases with the diminishing calibre of the grains. The *absorbent capacity* is the space available for holding water between the grains of the soil. The *retentive power*, the quantity which the soil can hold by capillarity, increases with the fineness of the soil. The *percolative capacity* presents three cases :—1. Natural percolation from rainfall. 2. The percolative capacity at retentive point. 3. The percolative capacity under pressure.

Natural percolation depends upon the amount of, and difference between, the absorbent and retentive power, and so upon the calibre of the soil and the shape of the grains; the quantity of rain falling; the humidity of the soil at the time of the fall; the temperature of the soil, the percolating rain, and the air; and the humidity of the air; probably also on the elevation of the ground, for which see Dines "On the Temperature of Hill and Valley."†

* "On the Fall of Rain on Every Day of the Year, from Observations extending from 1818 to 1869."—*Proc. Met. Soc.*, vol. v., p. 87.

† *Quar. Journ. Met. Soc.*, Ap. 17th, 1872.

Percolation commences when the degree of humidity of the soil just exceeds the retentive point. The absorbent capacity of a cubic foot of sand of less than .035 in calibre was 730.8 cubic inches, or .422 cubic foot, which equals a depth of 5 inches of rain on the square foot; its retentive power 461 cubic inches, which equals a depth of 3.208 inches of rain on the square foot. Such falls of rain in 24 hours are excessively rare, so that the soil is rarely or never saturated. It generally exists in a degree of humidity far below retentive point, so that only the excess over this deposit can percolate. The percolative capacity at saturation point requires to be determined experimentally; also the degree of humidity corresponding to the observed annual average natural percolation. Mr. Evans gives this as 8.227 inches for the 25 years, 1835-1860, which equals a daily transit of 3.24 cubic inches through each square foot. We do not know the average humidity represented by this percolation. Even when the humidity exceeds retentive point, percolation sets in, and a waterline is formed. The zero of percolation represents the minimum waterline, and saturation point the maximum waterline. Therefore the *degree of humidity*, the *quantity percolating*, and the *height of the waterline* can be expressed in terms of each other.

Temperature of Percolation.—The temperature of percolation has not been observed. Changes of temperature in the soil must act upon the contained moisture in the same way as they do in the air above, thereby tending to cause evaporation or to produce percolation. In an abstract of more than 100,000 observations upon the temperature of the soil made in the Gardens of the Royal Botanic Society, London, 1871-1876. Mr. G. J. Symons, F.R.S., shows that the heat wave commences in March, and spreads downward till the whole 4 feet of observation is warmer than the air in September and October; the effect of the preceding cold wave disappearing at 4 feet by the end of August. In November the cold wave commences and moves down till the whole 4 feet is colder than the air by the end of February, when the heat wave begins again. This corresponds with the division of Ebermayer on March 1 as regards the commencement of the heat wave at the surface and the disappearance of the preceding heat wave at 4 feet; and on September 1 as regards the disappearance of the preceding cold wave at 4 feet, *but not as regards the surface*, the heat wave lasting till the end of October. These heat divisions correspond with the "least rain" periods of Glaisher which occur in February and March, the last two months of the cold wave, and with the "heaviest rain" periods which end with the heat wave at 3 inches in October; with the cessation of percolation in March (when the heat wave begins) and its recommencement in November (when the cold wave begins).

In reference to future observations on percolation, therefore, it is suggested that:—

1. Artificial admixtures should be avoided.
2. The calibre of the constituent grains, and the percentage of grains of each gauge in the natural admixture, should be experimentally ascertained.
3. The absorbent capacity should be measured.
4. The retentive power should be proved.
5. The percolative capacity at saturation point, and as far as possible at less degrees of humidity, should be measured.
6. The percolative capacities under pressure greater than that of saturation should be proved.
7. Percolators should contain thermometers.

There should be a set of three cylinders—A, the saturated cylinder, filled with saturated soil, closed top and bottom, and provided with thermometers.

B a common Dalton gauge, provided with thermometers.

C the dry cylinder, filled with dry soil, closed top and bottom, and provided with thermometers.

SUPPLEMENTARY TABLE OF RAINFALL IN SEPT., 1879.

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

Div.	STATION.	Total Rain. in.	Div.	STATION.	Total Rain. in.
II.	Margate, Acol	2·79	XI.	Port Madoc	3·47
„	Littlehampton	3·86	„	Douglas	4·87
„	Dorking, Abinger	3·84	XII.	Carsphairn	7·25
„	Hastings, Manor House	2·97	„	Melrose, Abbey Gate	1·37
„	Hailsham	3·13	XIV.	Douglas Cas., Newmains	3·56
„	I. of W., St. Lawrence.	3·52	XV.	Islay, Gruinart School	6·13
„	Strathfield Turgiss	2·39	XVI.	St. Andrew's, Cambo .....	...
III.	Great Missenden	3·50	„	Aberfeldy H.R.S.	3·39
„	Winslow, Addington	2·94	XVII.	Tomintoul	1·38
„	Oxford, Magdalen Col.	2·87	„	Keith H.R.S.	1·14
„	Northampton	2·80	„	Forres H.R.S.	·76
„	Cambridge, Merton Vil.	2·59	XVIII.	Strome Ferry H.R.S.	8·40
IV.	Harlow, Sheering	3·42	„	Lochbroom	5·32
„	Diss	4·12	„	Auchnasheen H.R.S. ....	...
„	Swaffham	3·34	„	Tain, Springfield	·94
„	Hindringham	2·82	„	Loch Shiel, Glenfinnan.	16·39
V.	Salisbury, Alderbury	3·63	„	Dalwhinnie H.R.S. ....	...
„	Calne, Compton Bassett	3·46	XIX.	Lairg H.R.S. ....	...
„	Beaminster Vicarage	4·86	„	Altnabreac H.R.S.	1·80
„	Dartmoor Prison .....	...	„	Watten H.R.S.	1·96
„	Langtree Wick	4·33	XX.	Fermoy, Glenville	3·72
„	Lynmouth, Glenthorne.	5·59	„	Tralee, Godfrey Place .....	...
„	St. Austell, Cosgarne	3·76	„	Cahir, Tubrid	2·47
„	Taunton	2·25	„	Tipperary, Henry St.	2·93
VI.	Bristol, Ashleydown	3·89	„	Newcastle West	3·32
„	Wem, Sansaw Hall	3·21	„	Kilrush	4·82
„	Cheadle, The Heath Ho.	2·71	„	Corofin	4·70
„	Bickenhill Vicarage	3·39	XXI.	Kilkenny, Butler House	3·86
VII.	Melton Mowbray	3·29	„	Carlow, Browne's Hill	4·71
„	Horncastle, Bucknall	3·43	„	Kilsallaghan	3·45
VIII.	Walton-on-the-Hill	3·00	„	Navan, Balrath	3·96
„	Broughton-in-Furness	5·77	„	Athlone, Twyford	5·50
IX.	Wakefield, Stanley Vic.	1·31	„	Mullingar, Belvedere	4·40
„	Ripon, Mickley	1·80	XXII.	Ballinasloe	4·50
X.	Gainford	1·43	„	Clifden, Kylemore	11·29
„	Haltwhistle, Unthank	1·53	„	Crossmolina, Enniscoe	4·59
„	Shap, Copy Hill	4·95	„	Carrick-on-Shannon	6·31
XI.	Llanfrehfa Grange	5·44	„	Dowra	5·43
„	Llandovery	5·57	XXIII.	Rockcorry	5·01
„	Solva	3·95	„	Warrenpoint	5·98
„	Castle Malgwyn	4·78	„	Newtownards	3·86
„	Rhayader, Nantgwillt	5·27	„	Larne, Carnlough	4·54
„	Carno, Tybrite	4·81	„	Bushmills	3·92
„	Corwen, Rhug	2·79	„	Buncrana, Rockfort	5·11

SEPTEMBER, 1879.

Div.	STATIONS.	RAINFALL.						TEMPERATURE.				No. of Nights below 32°	
		Total Fall.	Difference from average 1860-5	Greatest Fall in 24 hours.		Days on which -01 or more fell.		Max.		Min.		In shade.	On grass.
				Dpth.	Date.			Deg.	Date.	Deg.	Date.		
		inches	inches.	in.									
I.	Camden Square	3·67	+ 1·41	1·49	23	12		72·6	4	39·6	1	0	0
II.	Maidstone (Hunton Court)...	2·50	+ ·38	·96	23	13		...	...	...	...	...	...
III.	Selborne (The Wakes).....	3·76	+ 1·32	1·02	23	16		68·0	6	34·0	1	0	0
	Hitchen	2·71	+ ·85	·53	23	16		64·0	3,6	38·0	24	0	0
IV.	Banbury	2·99	+ ·62	·65	28	16		68·0	3	35·0	1	0	...
	Bury St. Edmunds (Culford).	3·71	+ 2·10	1·41	23	14		71·0	7,8	38·0	15†	0	2
V.	Norwich (Cossey).....	3·43	+ 1·64	1·23	23	14		72·5	3	34·0	28	0	1
	Bridport	3·33	+ 1·01	·87	23	13		...	...	...	...	...	...
"	Barnstable	3·66	— ·10	·52	6, 12	18		75·0	7	40·0	1	0	...
"	Bodmin	4·30	+ ·63	·84	6	17		67·0	15	43·0	25	0	0
VI.	Cirencester	3·65	+ ·79	·66	23	14		...	...	...	...	...	...
"	Shifnal (Haughton Hall) ...	2·69	+ ·74	·60	24	17		67·0	6	33·0	30	0	1
"	Tenbury (Orleton)	3·25	+ ·57	·51	30	18		77·3	6	33·0	30	0	2
VII.	Leicester (Town Museum) ...	3·33	...	·68	13	15		69·1	3	35·2	30	0	3
"	Boston	3·45	+ 1·88	·64	28	17		73·0	3	37·0	30	0	...
"	Grimsby (Killingholme)	2·77	...	·88	13	13		70·0	7	37·0	30	0	...
"	Mansfield	2·62	...	·53	24	13		70·3	3	31·9	31	1	0
VIII.	Manchester (Ardwick).....	3·13	— 0·5	·72	12	16		70·0	6	42·0	28,29	0	0
IX.	York	2·07	— ·26	·30	8	14		72·0	7	32·0	30	1	2
X.	Skipton (Arncliffe)	3·90	— 1·06	·94	25	20		...	...	...	...	...	...
"	North Shields	·73	— ·97	·19	21	14		65·0	3	37·0	30	0	0
XI.	Borrowdale (Seathwaite).....	16·67	+ 3·46	3·06	11	24		...	...	...	...	...	...
"	Cardiff	4·85	...	·69	7	17		67·0	6	39·5	1	0	...
"	Haverfordwest	5·26	+ 1·55	1·06	11	18		67·0	6	34·0	29	0	1
"	Lampeter (St. David's Coll.).	...	...	...	...	...		...	...	...	...	...	...
XII.	Llandudno	3·00	+ ·66	·72	26	17		67·0	6	42·0	30	0	...
"	Cargen	5·63	+ 2·17	·89	30	17		68·4	6	32·4	27	0	3
XIII.	Hawick (Silverbut Hall).....	2·15	...	·50	30	16		...	...	...	...	...	...
XIV.	Annanhill	5·54	...	1·03	27	20		64·0	7	36·0	27	0	...
XV.	Kilmory	8·61	...	1·05	27	23		...	...	34·0	3	0	...
"	Mull (Quinish)	11·57	...	2·02	1	26		...	...	...	...	...	...
"	Loch Leven	2·90	— ·13	·50	23	13		...	...	...	...	...	...
XVII.	Loch Long (Arddaroch)	10·92	+ 4·24	1·41	28	21		...	...	...	...	...	...
"	Arbroath	1·91	— ·61	·39	11	11		63·0	3*	35·0	27	0	...
XVIII.	Braemar	1·81	— ·83	·35	30	15		66·2	7	26·7	27	3	12
"	Aberdeen	3·20	...	1·09	30	19		64·5	4	36·0	27	0	5
"	Portree	11·76	+ 1·00	2·45	2	26		...	...	...	...	...	...
"	Inverness (Culloden)	1·40	— 1·29	·56	12	...		66·3	7	37·1	27	0	4
XIX.	Dunrobin	1·56	— 1·21	·50	27	14		68·0	2	34·0	25	0	...
"	Sandwick	3·29	— ·37	·72	27	23		61·0	8	41·6	27	0	0
XX.	Cork .....	...	...	...	...	...		...	...	...	...	...	...
"	Caherciveen Darrynane Abbey	4·53	...	·50	8	22		...	...	...	...	...	...
"	Waterford	5·34	+ 2·21	1·27	8	21		64·0	18	34·0	30	0	0
XXI.	Killaloe	5·54	+ 1·38	·80	25	19		76·0	2	34·0	30	0	...
"	Portarlinton	5·23	+ 1·95	2·92	7	22		67·0	2	38·5	23	0	...
XXII.	Monkstown, Dublin	1·79	— ·20	·55	7	14		...	...	...	...	...	...
XXIII.	Galway	5·03	...	·78	27	22		63·0	6	40·0	24	0	...
"	Waringstown	4·48	...	·90	7	19		68·0	6	33·0	23	0	1
"	Edenfel (Omagh)	6·55	...	1·52	7	26		66·0	15	30·0	23	1	...
"	Ballinful	4·83	...	1·38	7	19		...	...	...	...	...	...

* And 14, 19.

† And 25, 27.

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

METEOROLOGICAL NOTES ON SEPTEMBER.

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

ENGLAND.

SELBORNE.—Prevailing wind, west.

BANBURY.—Some corn is yet uncut, and much remains to carry. Harvest deficient both in quantity and quality.

CULFORD.—Mean temp. of month $55^{\circ}4$, and polar winds prevailed on eight days. The rainfall of the present year already amounts to 28.15 in., which exceeds the total fall of 14 out of the 20 preceding years. Severe TS on the night of the 16th.

COSSEY.—Most of the corn in this district harvested by the 27th. Two distinct currents of air, the upper from S.W., the lower from N.E., during the heavy rainfall on the morning of the 24th.

BODMIN.—Average temp. of month, $57^{\circ}8$.

CIRENCESTER.—Rainfall still above the average, but less than either of the preceding summer months. Not a good month for the harvest, which is unusually late.

SHIFNAL.—The first week brought a prospect of a change from the persistent E of August, but on the 7th it set in again and fell daily for a week. Harvest sadly prolonged, much wheat still uncut. Very few wasps, not one mushroom.

ORLETON.—The first six days were fine, pleasant, warm, and dry, but on the 7th R set in again, and the remainder of the month was cloudy and gloomy, with frequent heavy falls of R and very little sunlight. Mean temp. a little more than 1° below the average, making the eleventh month in succession with a mean temp. below the average. Much of the white straw crops is now cut, but very little is carried, and in damp situations the grain is beginning to sprout. It is the latest harvest ever remembered.

BOSTON.—The weather has been most unfavourable for harvest. Scarcely any white corn is yet carried, and beans are not yet cut; the sheaves stand soaking in the fields, and dry but little when the days are fine, owing to the absence of wind and sunshine. The harvest is the latest known since 1860. Wheat was not in ear till the end of the first week in July; in 1860 it was a few days later. The average time for this district is the 16th of June, the earliest being May 27th, 1868, in which year the mean temp. of May, June, and July were 8° , 3° , and 2° above the average respectively; this year the temps. of those months were 5° , 2° , and 5° below the average.

GRIMSBY.—The unsettled weather of the previous months still continued, and harvest work was a gloomy and depressing task; the close of the month gave no signs of any improvement, but even if the corn should be got in in fair condition, the quality and yield must be very inferior. Rime on ground on 27th.

NORTH SHIELDS.—Solar halo and parhelia on 22nd, solar halo on 27th, and lunar halos on 1st and 27th, TS on 8th.

SEATHWAITE.—Fearful storm on the 11th, 3.06 in. of R; TS on 7th; frequent frosts at night towards the close of the month, eight days with a rainfall exceeding 1 in.

WALES.

HAVERFORDWEST.—First five days fine and warm. A period of very wet weather then set in, lasting to the 12th, with high wind; from that time to the 19th, fine, clear, warm weather prevailed, of inestimable value to the harvest. The weather during the remainder of the month was most precarious—stormy, wet, and sometimes very cold. The oats, although a light crop, are heavy grain and excellent quality; barley is generally very poor.

LLANDUDNO.—A week of fine, dry weather from the 13th to the 19th in-

clusive ; rest of the month very variable, resembling a good deal the proverbial weather of April. Mean temp. about $2^{\circ}5$ below the average, and the rainfall about $\cdot 25$ in. above.

SCOTLAND.

HAWICK.—With the exception of the 2nd, 3rd, 22nd, and 23rd, which were very squally, the month was a mild one. Farmers are now in the midst of harvest, and in order to secure their crops are scarcely waiting for the golden tinge of autumn, many fields being cut which are hardly ripe. The potato crop has not failed so completely in this district since 1847. All tender flowers blackened by the frosts of the nights of 20th and 25th.

QUINISH.—A very wet and stormy month. Wind from S.W. to N.W. the entire month. No corn in stack as yet, though the greater part has been cut for some time.

BRAEMAR.—The best month of the year. Crops still green, and now injured by frost.

ABERDEEN.—A month of fairly average weather. The crops were mostly still green on the 24th, when the frosts on the grass set in.

PORTREE.—A very wet and stormy month. Cutting is far advanced, but the crops are in a very bad state from the continuance of wet weather. A hurricane on 23rd from S. to W., 1 a.m. to 11 a.m., a great number of fruit trees and bushes broken.

CULLODEN.—Weather more favourable, little R and a considerable portion of the grain crops carried in fair condition, potato crop much diseased, turnip crop not rooting well. The heavy S.S.W. gale on 23rd did much damage in gardens and where grain crops were uncut.

DUNROBIN.—Weather generally during the month much improved ; wind mostly west.

SANDWICK.—Mean temp. low, in fact that of all the months this year has been below the average of the last 52 years. Such a continuance of cold weather makes the harvest uncommonly late ; half of the oat crop is not yet cut, and some of it cannot be expected to ripen now. H on 12th, sleet on 29th, a gale of 45 miles an hour from 9 till 11 p.m. on 3rd, and another of 50 miles an hour from 5 a.m. till noon on the 23rd.

IRELAND.

DARRYNANE ABBEY.—Except the five days, 14th to 18th, which were very fine, this was another wet and cold month. The rainfall to the end of the month is almost identical with that of the same period in 1872. The figures are :—1872 : 43·68 in., 209 days ; 1879 : 43·65 in., 209 days.

KILLALOE.—A very unfavourable month for harvest work, crops ripening slowly and unevenly from wet and absence of sunshine. Very serious damage to outstanding hay and potato crop.

MONKSTOWN.—After the first week a very fine seasonable month, with comparatively little R, enabling farm operations to be prosecuted vigorously. A very fine solar halo and parhelia on 22nd. No visible frost as yet.

OMAGH.—The weather of September has been no improvement on that of the months preceding, extremely heavy rainfalls, frequently accompanied by gales, having been its chief feature ; but notwithstanding this summerless year a heavy hay crop has been well saved, and an equally heavy oat harvest is now in operation. On the whole the prospect is not disheartening.

THE WEATHER IN SEPTEMBER.

At the beginning of the month a large anticyclone (with readings above $30^{\circ}4$) lay over the southern parts of England and Ireland ; and fine weather prevailed in most parts of the country. On the 2nd, however, the high pressure

gave way, and depressions began to appear, passing along our western and northern coasts and causing rain in those localities, and cloudy weather even in the South and East. Another anticyclone established itself over this kingdom on the 4th, but on the 5th disturbances again began to appear in the West, and continued to pass in a northerly direction along our western coasts till the end of the week. The winds were strong to a gale in the North-west and North at the beginning and end of the week, but generally moderate in the East and South.

A large, but somewhat shallow, depression lay over our western coasts at the early part of the second week. The disturbance, after moving slightly to the North-west, and becoming deeper, suddenly changed its course and passed in an almost easterly direction across our Islands, causing in its passage strong winds generally, and a W. gale on the west coasts. The winds subsequently veered to N.W. and fell moderate; but on the 11th they returned to S.W., and breezes from that quarter or from W. continued through the remainder of the week, by which time light E. airs were beginning to show themselves on our South coast. The weather during this week was generally unsettled, and heavy rain fell in the west on the 11th, and in the south on the 13th.

The weather during the third week was comparatively quiet. At first pressure was highest on our south-west coast, and an arm of high readings spread eastward over these Islands. During the 17th and 18th, readings were highest over Sweden, with a band stretching westward over the North of England and Ireland, so that N.E. to E. breezes had spread northwards over the greater part of England, while the W. breezes still continued in the north. On the 19th pressure rose quickly, and an area of high bar. readings was formed over these Islands, with light N. breezes, but very cloudy, dull, or misty weather. On the evening of the same day, a fall of the barometer began in the north-west, which became brisk during the night and spread to all our coasts, so that on the following morning the charts shewed an area of high pressure lying over France and the South of England. with a rather important depression to the northward of Scotland. Brisk W. breezes prevailed generally, but the weather, though cloudy and unsettled in the W., was fine and bright in the E. after noon of the 20th.

During the former half of the last week the weather over these Islands and their neighbourhood was in a very unsettled state. On the 21st the wind was W., and the weather generally cloudy and cool; but by the following morning, when the wind had veered to N.W. or W.N.W., the weather had cleared considerably and was generally fine though cool. During the 22nd, however, a rapid fall of the bar. occurred, and on the next day a depression (which caused a fall of 1.25 in. at Stornoway, and a more or less rapid fall over West Europe) was shown off the N.W. coast of Scotland, bringing fresh to hard S. to S.W. gales on our coasts. A rapid recovery succeeded this depression in the north; but in the south a shallow subsidiary appeared, and passed across the South of England, occasioning very heavy rain and a considerable increase of wind. During the 24th the bar. rose everywhere, and on the 25th an area of high pressure was shewn over France, with a depression off the West coast of Norway, a distribution which caused moderate to fresh W. winds, and very fine weather. From then till the close of the week the bar. continued to rise, and very fine weather with W. winds was experienced; but on the 27th, a fresh fall of the bar. occurred in the west, accompanied by a strong S. wind and overcast skies, and this change gradually spread eastward to all parts of these Islands. The weather continued unsettled during the remaining three days of the month.

Temperature during the first half of the month was below the average, particularly so the first week, but the third week showed a material improvement. Temperature of course decreased as the month drew to a close.

HORACE E. MILLER.

Lowestoft.