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THE BRITISH ASSOCIATION AT YORK.

(Continued from page 138.)

THE papers bearing on Meteorology were so numerous that we have decided on deferring the report of Mr. Symons's paper "On the Rainfall Observations on York Minster," and inserting it in the next volume of *British Rainfall*. The rest of the reports and papers were as follows :—

REPORT OF THE COMMITTEE ON LUMINOUS METEORS.

Special mention was made of an aerolite, about 5 inches in diameter, which fell near Middlesborough, and embedded itself in a considerable depth of earth. It was estimated that it struck the earth with a velocity of 412ft. per second—a velocity which might have been acquired by falling half-a-mile; but the meteor had undoubtedly fallen at least fifty miles. As the information the committee received was of a very miscellaneous character, the committee suggested that they should not make any further report for a few years.

The President observed that meteoric stones, instead of descending in a solid mass, as in this case, were generally shattered to pieces by the intense heat.

Professor Herschel observed that the stone in question had never been exposed to much heat, as it had only been falling some six or ten seconds.

The President remarked that the stone had had considerable vitrification over its whole surface, where evidence of fusion was seen. It was certainly not melted throughout when it struck the earth. The interior part of the stone had been cooled, and it was so cold as not to melt when it struck the earth. The stone was not actually observed to be luminous, but there was no doubt that it was luminous in the air. There was something marvellous in a body like this moving through space, and they could not help asking whether it was created as it now was. They could scarcely imagine the stone having been like that in all time. This was a lesson with regard to objections to the supposition that living matter might have come to the earth from meteorites. It seemed to him to be an exceedingly improbable supposition that there were not living plants on this earth at this moment whose ancestry was meteoric.

The Rev. Mr. Howlett asked the President whether there was any particular difficulty in the idea of germs of life being introduced by aerolites, considering the extremes of temperature, first of cold and then of heat, through which the seed would have to pass?

Sir W. Thomson said the subject was one for enquiry ; but it was considered that extreme cold would not destroy life in dry seed or spores. In reply to another question, he said that there was a general concensus of sentimental belief that there was something like life in many other bodies of the universe besides the earth, but there was no scientific belief, because there was no certainty. No trace of organic life had been found in any meteorite.

REPORT ON THE CIRCULATION OF UNDERGROUND WATERS.

The results of the committee's investigation showed that the Permian, Triassic, and Jurassic formations of England and Wales are capable of absorbing from five to ten inches of annual rainfall, giving an average yield of from 200,000 to 400,000 gallons per square mile per day. The area occupied by the formations was in round numbers—Permian and Triassic, 8,600 square miles, Oolite, 6,600 square miles, capable of yielding 1,720 millions and 1,320 millions respectively, at the lowest rate of absorption; or united, affording a supply for 100,000,000 people, at 30 gallons per head.

The Secretary, Mr. De Rance, then described the water-bearing conditions of the Yorkshire area.

Professor Prestwich, of Oxford, remarked that the report was an excellent one.

Dr. Wright said that this report redeemed geologists from the charge which had been made against them that their researches were not of value to the public. There was no subject of greater importance than our water supply.

Mr. Baldwin Latham said that the underground waters were dangerous to health.

Professer Hull, from a considerable experience, disagreed with the last speaker. When the waters percolated, say two or three hundred feet in the red sandstone, they came out almost completely separated from organic impurities, and might be used with perfect safety.

The Chairman, in putting the thanks of the section to the reader of the report, said that it contained some valuable information.

REPORT OF THE COMMITTEE ON UNDERGROUND TEMPERATURE.

By Professor Everett.

Professor Everett remarked that if they went into the earth they found it gradually hotter, varying from one degree in 30 or 40 feet in some parts, to one in 100 feet in others. During the year observations had been taken at the East Manchester Coal Field, the Talavgoch Lead Mine, Flintshire, and at the Radstock Collieries, Bath. With respect to the observations in the East Manchester Coal Field, these were taken respectively at Ashton Moss, Bredbury, and Nook Pit. At Ashton Moss, at a depth of 2,790 feet, the temperature was 85·3 degs.; at Bredbury Colliery, at a depth of 1,020 feet, the temperature was 62 degs.; and at Nook Pit, at a depth of 1,050 feet, 63½ degs. These observations agreed exceedingly well. The mean natural temperature might be assumed to be 49 degs. The increments of temperature at that depth would then stand as follows:—Ashton Moss, 36·3 degs. in 2,790 feet; Bredbury, 13 deg. in 1,020 feet; Nook Pit, 13½ deg. in 1,050 feet. This gave for each deg. of increase—Ashton Moss, 76·9 feet; Bredbury, 78·5 feet; Nook Pit, 79 feet. In Flintshire the observations showed great irregularity last year, and the new observations taken this year increased the irregularity. The observations were taken at a place in the lead mine 660 feet deep, the temperature was 62 degs. Fahr., while 48 degs., being assumed to be the surface temperature, gave an increase of 14 degs. in 660 feet, or of 1 deg. for 47 feet. At the Radstock Colliery, observations were made at three pits—the Wells May Pit, 560 feet deep; the Ludlow Pit, 1,000 feet; and the third in the same pit, at a depth of 810 feet. He assumed 50 degs. in that locality as surface heat; and thus for 560 feet the increase was 11·7 degs.; for 810 feet, 13 degs.; and the same for 1,000 feet; giving respectively 1 deg. in 48 feet, 1 deg. in 62 feet, and 1 deg. in 77 feet.

Dr. Haughton suggested that the increase in temperature was due to chemical agency.

Father Perry remarked that time should be taken into consideration, because if chemical action were going on, it might vary according to the exhaustion of material.

ON A NEW THERMOGRAPH.

By Dr. W. D. Bowkett.

This instrument was for recording changes of temperature by the action of heat upon a hollow circular metallic ring connected with a circular vessel, the whole being filled with fluid and hermetically sealed. One end of the ring was fixed, the other free to move, and the amount of motion was magnified and measured by a series of levers, one end of which carried the recording pen. Increments of heat caused increments of pressure in the ring, which, as in Bourdon's pressure gauge, then moved at its free end. The instrument had been largely used by Dr. Bowkett in the Leeds Fever Hospital for clinical purposes; but it was also adapted for many branches of chemical and physical research.

THE SUN SPOT PERIOD AND PLANETARY TIDES IN THE SOLAR ATMOSPHERE.

Mr. F. B. Edmonds read a paper on the above subject, and at the outset said circumstances having led the author to what promised to be an important development of the planetary hypothesis of solar disturbance, he would direct their attention to some of the results already obtained. As a consequence of the fundamental assumption that the planets were the disturbing agents and universal gravitation the disturbing force, it followed that planetary influence would vary with the conditions under which it was exercised. The influence of the planet may be localised on a surface or stratum of small thickness, so that the disturbing force would vary inversely as the square of the distance of the planet. The predominance of Jupiter under this supposition seemed to preclude the idea that sun spot maxima and minima could depend simply on the opposition and conjunction of the planets. The consequence of such a supposition was not to be lost sight of, but may be taken together with the more general supposition that the attractive force is exercised on a gaseous or lunar body, of which the altitude is not insignificant. Again, the mass of the sun is acted on as a whole by the planets, and such parts as are fluid, whether in the liquid or gaseous form, were subject to a disturbance of a tidal character as a matter of course. The apparent insignificance of the cause seemed to have hitherto deterred investigation from following up this particular view, just as it has hindered the prosecution of the tidal hypothesis generally. According to the Newtonian or equilibrium theory of the tides, in its elementary form, tidal disturbing force varies directly as the diameter of the body disturbed, to the mass of the disturbing body, and inversely as the cube of the distance of this disturbing body. A disturbing force would, therefore, raise a tide on the sun more than one hundred times greater than the same force would raise if acting on a globe of the size of the earth, other things being the same. Looking at the sun spot numbers as a record of spring tides, and for the first approximation only recognising such tides as would be due to the conjunction and opposition of Venus and the earth, it remained that a relation should be established between these tides and the Javian tide in the form of special tides varying in magnitude with the sun spot numbers. The connection between the sun spots and magnetic disturbance discovered by Sabine and others is now established. The zodiacal light was now generally considered to be a solar appendage, and if so, might it not be one of those great waves to which he had referred—perhaps the Javian tide? It might be that we were at times, if not always, in actual material communication with the sun—touching the sun, in fact, although the touch might be light.

The Chairman remarked that the paper was a most valuable one, and would, he hoped materially help to the solution of a question which had excited the greatest interest amongst scientific men, and he hoped it would tend to promote the discovery of the truth.

ON THE PRESSURE OF WIND UPON A FIXED PLANE SURFACE.

By T. HAWKSLEY, P.P. INST. C.E.; F.R.S., &c.

The recent failure of the Tay Bridge and other important structures during heavy gales of wind, have attracted much attention to the subject of this paper. The general solution of the problem may be thus briefly stated :—

Let v = the velocity of the current in feet per second.

h = the height through which a heavy body must fall to produce the velocity v.

w = the weight in pounds of a cubic foot of the impinging fluid [for atmospheric air average about 0·0765 lbs.]

g = 32, the coefficient of gravity.

Then $h = \frac{v^2}{2g}$; and since p the pressure of a fluid striking a plane perpendicularly and then escaping at right angles to its original path, is that due to twice the height h [Daubuisson's *Hydraulics*; Rouse's *Experiments*] we have simply :—

$$p = \frac{wv^2}{g} =$$

(for atmospheric air) $$\frac{0{\cdot}0765v^2}{32} = \left(\frac{v^2}{20}\right)$$

very nearly.

From this easily remembered formula the following Table of Pressure is constructed :—

VELOCITIES IN		PRESSURES IN LBS. PER SQUARE FOOT.
FEET PER SECOND.	MILES PER HOUR.	
10	6·8	0·25
20	13·6	1·00
30	20·4	2·25
40	27·2	4·00
50	34·0	6·25
60	40·8	9·00
70	47·6	12·25
80	54·4	16·00
90	61·2	20·25
100	68·0	25·00
110	74·8	30·25
120	81·6	36·00
130	88·4	42·25
140	95·2	49·00
150	102·0	56·25

In general, only these, the maximum pressures, are required; but sometimes, as in the case of the enclosed sail of a windmill or ship, or the roof of a building, the diminished pressure of a surface placed obliquely to the *effective* current is needed; we have then

$$p = \left(\frac{v \sin. \theta^2}{20}\right)$$

in which v, = the absolute velocity with which the air strikes the receding plane; and θ = the internal angle between the obliquely placed surface and the direction of the impinging wind.

With regard to the phenomenon called "a gust of wind," nothing is known, either as to its cause, or as to its exceptional but almost momentary velocity, or as to the extent of the area over which it temporarily operates; but it is, notwithstanding, certain that a wind pressure of even 40 lbs. on the square foot is unknown in these islands, because, as may be readily shewn, the intensity of pressure would suffice to have overthrown most of the long-existing factory chimnies, to have overset post windmills, and to have scattered the greater number of the slighter built domestic and other structures which have nevertheless "weathered many a storm," and still remain intact.

It remains to make a passing allusion to whirlwinds, tornadoes, and water-spouts, all the results of spiral motions apparently produced in some obscure manner by electrical action. These phenomena are very rarely observed to occur on an important scale in these kingdoms. The powerful forces concerned in, or generated by, these erratic movements have never been measured, and, consequently, cannot be formulated; but it may be observed that were they known they could not be introduced with propriety into calculations of the strength of structures intended to have commercial value, because of the extreme improbability of any particular structure falling within the range of their destructive effects. They fall, in fact, within the legal category of "Actus Dei."

The conclusion of the author of this paper, therefore, is that for structural calculations a maximum wind pressure of 40 lbs. per square foot may be very safely adopted, notwithstanding some common anemometrical observations to the contrary.

With regard to these observations, the author remarks that the instruments in use are little better than philosophical toys, and that, in general, they afford no direct, comparable, or reliable indications of either velocities or pressures; and that they are often so injudiciously placed as in many instances to record the effects of combined, and, therefore, locally accelerated currents; whilst, in other instances, they record only the effects of obstructed, and, therefore, locally extended currents.

As the acquisition of accurate data is of great and increasing importance, the author suggests that the British Association, and other learned societies interested in physical investigations, should unite in providing the necessary funds and observers for the purpose.

Mr. G. J. Symons, F.R.S., said that the paper made no reference to the report of the Treasury Committee appointed to inquire into the Tay Bridge disaster, which Report would require careful investigation before it could be accepted. Referring to the statement in the paper that whirlwinds were rarely observed on an important scale in these kingdoms, Mr. Symons said that within the last month there had been no less than four seriously destructive whirlwinds in different parts of the country. The first in point of violence occurred at Boston, in Lincolnshire, taking a path a quarter of a mile long, and, irrespective of slight damage, seriously damaged a carpenter's shed, carried a pile of timber into an adjoining field, went across a large drain, sucking the water up a foot and a half, lifted a carpenter's shop 8 feet high and 10 feet square bodily over a hay-stack, and deposited it on the other side, and went next to a foundry, part of the roof of which it deposited in a gentleman's drawing-room. There had also been a serious whirlwind at Bramham Park, the effects of which he had not yet investigated. He understood that one of the large railway stations of Vienna had had its roof lifted off and carried away. It had long been his fear that the roofs of Charing Cross or King's Cross would be carried away and dropped down in some inconvenient position not intended for them. He could give many instances of mechanical energy by these storms, and of such a character, too, that they might think him romancing if he were to relate them. At Baldock the roofs of three maltings were lifted up and re-deposited at a short distance, but a few of the slates were found sticking in the trees like the heads of axes. That would give them an idea of the energy of the wind. The Treasury Wind Pressure Committee had ignored entirely the question of whirlwinds. If they had heard that a whirlwind of 200 or 300 feet in breadth had gone against the Tay Bridge they would have the explanation of its downfall.

If they were to make their structures so strong that even a whirlwind would not carry them away, he was afraid their cost would be vastly increased.

Mr. J. F. Bateman, F.R.S., said that when the railway bridge was made across the Menai Straits, he went through the calculations of wind pressure with the late Sir Wm. Fairbairn, and the maximum pressure was 120lb. per square foot, upon which, he believed, the bridge was constructed. The actual pressure arrived at was what it might have to bear from a West Indian hurricane.

Mr. Head noticed that Mr. Hawksley assumed that the wind was always perpendicular to the plane of the pressure plate, and that it had a free escape all round.

Sir F. Bramwell, F.R.S.—Mr. Hawksley provides for those cases where it has not.

Mr. Head only wished to say that that seemed to be very seldom the case in practice. The author also appeared to put out of question the wind coming in gusts. But he believed on the night of the Tay Bridge disaster one of the great features was the extremely violent gusts which occurred. If gusts could occur in that way, and as air had weight, might it not be that momentum was involved as well as pressure. Therefore the calculations of merely so much surface operated upon by so much pressure were not sufficient. Then, again, the great danger was in heavy gusts on surfaces which were boxed in. They ought to make experiments on the effect of wind on different shapes, such as square, convex, concave, and other kinds of surfaces. Those things would have to be taken into account before they could know something permanently useful about wind pressure.

Sir F. Bramwell, in proposing a vote of thanks to Mr. Hawksley, said that the practical question for engineers was whether it was worth while to build structures so as to resist a hurricane, or must they be content to make them of sufficient strength to resist even extraordinary storms. It seemed to him that if the matter were investigated, the excessive extra cost of structures to resist hurricanes would be prohibitory. He stated the other day, on the authority of Mr. Barlow, that in the proposed Forth Bridge there were 2,000 tons more material in consequence of its being made to resist the pressure produced by known or anticipated winds; and if they added to that material for resisting hurricanes, the bridge would not only become too costly, but an impossibility.

Mr. Symons, replying to a question as to comparisons of observed pressure with observed velocity, stated that at Bidston an anemometer was erected with both plates and cups. The writer of the paper had alluded to the instruments at present in use as philosophical toys. Mr. Symons thought that that was going too far, and was rather hard upon the Government of this country, that had spent £6,000 or £7,000 in putting them up. He should like to see a better anemometer than they had now, but he did not know where he should have to look for it. All other countries were copying ours, which showed that if ours were toys, they were the best in the world.

ON THE EFFECTS OF GULF STREAMS UPON CLIMATES.

By Dr. S. Haughton, F.R.S.

He said that the Gulf Stream and its counter-current, the Labrador current, produced important effects upon climate. The northern hemisphere was warmer than the southern from lat. 0 degs. to lat. 30 degs., and it was colder than the southern from lat. 40 degs. to lat. 60 degs. The higher temperature of the southern hemisphere in the temperate latitudes was explained by the existence of three gulf streams in that hemisphere, while there was only one in the North Atlantic, and a partial one through Behring's Straits in the northern hemisphere. The general climatal effect of the Gulf Stream was therefore to make the annual range of temperature less, but it had no effect whatever upon summer heat, or upon the fruiting of plants and trees, as that required a given July temperature, for reproduction. The January temperatures in the North Atlantic at 70 degs. were raised by the Gulf Stream, whilst the July temperatures remained unaffected. The effect of the cold currents, which were indirectly caused by the warm currents to preserve the proper condition of equilibrium, was nothing at all upon the January temperatures, and they lowered the July temperatures. The effect of the cold water was to lower the July temperature and to leave January untouched, and the effect of the warm current from the south was to raise January and to leave July unaltered.

ON SUN-SPOT MAXIMA AND TERRESTRIAL MAGNETIC DISTURBANCES.

By the Rev. F. Howlett.

The object of this paper was to promote discussion as to a correlation between the amount of terrestrial magnetic disturbances and the sun-spot area observable at such times, on the solar disc, as deduced from various observations made between the years 1859 and 1881 inclusive. Occasion was taken to point out the numerous cases of such a coincidence as recorded both at Kew and Greenwich between magnetic storms of greater or less intensity and unusual solar activity, as indicated by unusually large spots or groups of spots, showing also remarkable peculiarities at times in the forms and behaviour of such spots. Out of fifteen periods of large spot disturbance submitted for comparison with the Kew record, no less than twelve were in remarkable accordance with terrestrial magnetic storms of greater or less magnitude, whilst only one case, that of the unusually violent storm of January 4th, 1863, failed to show any but a comparatively feeble, though unusually prolonged, coincidence.

ON THE INFLUENCE OF BAROMETRIC PRESSURE ON THE DISCHARGE OF WATER FROM SPRINGS.

By Mr. Baldwin Latham, M. Inst. C.E., F.G.S., F.M.S.

The Author stated that it was alleged by some of the long-established millers on the chalk streams that they were able to foretell the appearance of rainfall by a sensible increase in the volume of water flowing down the stream before the period of rainfall. He had therefore undertaken a series of observations to investigate the phenomena, and he found in setting up gauges in the Bourne flow in the Caterham valley near Croydon, in the spring of this year, (1881), and selecting periods when there was no rain to vitiate the results, that whenever there was a rapid fall in the barometer there was a corresponding increase in the volume of water flowing, and with a rise of the barometer there was a diminution in the flow. The gaugings of deep wells confirmed these observations; for where there was a large amount of water held by capillarity in the strata above the water-line, at that period of the year when the wells became sensitive and the flow from the strata was sluggish, a fall in the barometer coincided with a rise in the water line, and under conditions of high barometric pressure the water-line was lowered. Percolating gauges also gave similar evidence, for, after percolation had ceased, and the filter was apparently dry, a rapid fall of the barometer occurring, a small quantity of water passed from the percolating gauges. The conclusion arrived at was that atmospheric pressure exercised a marked influence upon the escape of water from springs.

Dr. J. Evans, F.R.S., who had given the subject much consideration, and had taken observations for some years, thought Mr. Latham had brought forward facts sufficient to establish his interesting theories. He gave an account of the results which had come under his own observation, and hoped Mr. Latham would pursue his investigations, and endeavour to ascertain the amount of percolation in the chalk, and the quantity of water available from it for drinking and various other purposes.

Mr. W. Topley stated that although they were indebted to Mr. Latham for his valuable paper, the subject was not a new one, it having been brought forward years ago by Mr. Bailey Denton, who had made interesting observations on the subject.

Professor Hughes asked whether the author had taken into consideration the hygrometric conditions, as it appeared that he had observed that different flows coincided with the S.W. and E. winds. The different pressure on surface and subterranean waters due to evaporation of the surface water under the dry E. wind or moist S.W. wind, would be so great that it should not be neglected in considering such small differences of actual pressure as are to be referred to the atmosphere.

Mr. J. Lucas, as a resident in the neighbourhood, Mr. Mylne, F.R.S., and Mr. R. H. Scott, F.R.S., continued the discussion, the latter observing that Mr. Latham had distinctly proved his case.

The Chairman (Professor Ramsay, F.R.S.) said he had listened to the paper with great interest. He had given the subject his careful consideration, and the result had been that he had been enabled to predict the state of the weather with tolerable accuracy.

Mr. Latham stated in reply, that, with regard to the remarks of Professor Hughes, he had considered the bearing of hygrometric influences, but he had found no analogy whatever between water levels and the hygrometric state of the atmosphere. He had been led into this investigation by the fact that, although Croydon took its water supply from a chalk formation, it was visited with typhoid fever every ten years or so. He found that at an interval of every decade there were marked periods of low water, and these were marked periods of fever in the country. The underground water had an immense bearing on the public health of the country. If persons would take measurements in wells it would be found to be of great value with regard to sanitary results. The flows of the Bourne had nothing to do with barometric pressure ; it was simply owing to the super saturation of the North Downs with water.

THE CALIBRATION OF MERCURIAL THERMOMETERS.

By PROFESSOR RÜCKER.

The author said that the late Mr. Welsh, of Kew Observatory, described before the British Association, in 1853, the methods which he introduced of making and correcting mercurial thermometers. Calibration is the determination of the amount of variation existing in the bore of the thermometer tube. The method of making this correction used by Mr. Welsh, and still employed at Kew, is theoretically less accurate than others, and has been unfavourably noticed by some foreign critics. Professors Thorpe and Rücker have recently calibrated a number of thermometers with great care, and by the most elaborate and perfect method hitherto proposed, viz., Bessel's. One set of three thermometers was made for them at Kew. They were calibrated according to Welsh's instructions, and afterwards the measurements necessary for the application of Bessel's were kindly made by the Kew authorities, the calculations being performed by Professors Thorpe and Rücker. They have thus subjected the Kew thermometers to the most rigorous test possible, and they were able to announce that in one instrument the errors left after the application of Welsh's method, were not greater than four-thousandths of a degree Centigrade, and in no case did they much exceed one-hundredth of a degree. As it is impossible to read on these thermometers less than a hundredth of a degree with certainty, Welsh's method as applied at Kew is almost perfect. The practical answer to the theoretical objections raised to it is, that the errors to which they point are negligible when the instrumental appliances are as perfect as they are at Kew.

ON A NEW INTEGRATING ANEMOMETER.

By MR. H. S. HELE SHAW & DR. WILSON.

This instrument is designed to give, by means of curves traced on a piece of paper, the direction and quantity of the wind passing over any given spot. It nay be briefly described thus. The ordinary cup anemometer of Robinson is ised to drive a train of wheels, and thus ultimately to turn a serrated roller, which moves a board in the direction of, and with a velocity proportional to, that of the wind. On the board, which is horizontal and about two feet square, is placed a sheet of paper, upon which the roller presses, and in turning leaves the required trace, moving at the same time the paper underneath it. The board is prevented from having a rotary motion by means of a pair of frames, the upper moving by means of wheels on the lower, each of which is only capable of a motion in one direction and perpendicular to that of the other. By an application of clock work, the element of time is introduced, which in conjunction with space gives velocity, and a method of doing this was shown, as also the proposed form of the instrument for observatories. A number of curves already taken were exhibited, and their interesting nature was pointed out by combing them so as to shew the whole motion of the wind over University College, Bristol, for nearly a week.

Mr. Whipple, of Kew Observatory, said that he had no doubt that the instrument would be most valuable in observatories when further perfected by Mr. Shaw. He pointed out the difficulty that would be experienced in light winds with reference to the manner of application of the clock work.

Mr. R. H. Scott, F.R.S., pointed out the small expense of the anemometer compared with others for effecting the same object.

Mr. Shaw, answering an objection as to work put upon the cups, showed that care had been taken to so reduce it that the extent would be inappreciable.

ON THE RESULT OF OBSERVATIONS OF ATMOSPHERIC ELECTRICITY AT THE KEW OBSERVATORY DURING 1880.

By Mr. G. M. Whipple, F.R.A.S.

Having reviewed what had been done in the past in this direction, the author said that lately he had succeeded in devising a modification of Professor Everett's method, and had constructed a glass scale, by means of which the tabulation of the curves could be effected with the greatest facility and expedition. Accordingly they had now commenced the tabulation and discussion of the accumulated records, and by the kind permission of the Meteorological Council, he was able to lay a few of the facts derived from the curves for 1880 before them. Having determined the values of the atmospheric tension for every hour during the year when measurements of the trace were possible, the diurnal, monthly, and annual variations were computed. Having plotted these, the curves were contrasted with those given by Mr. Birt and by Professor Everett, with the view of finding what, if any, difference in the phenomena observed might be attributed to instrumental causes. The mean diurnal curve for 1880 closely followed Professor Everett's. As regards the curve of annual variation of tension, they found that for 1880 the curve more closely approached that of 1845–7 than it did that of 1863. The months of mean maximum tension were January, when it was 143 volts, and March was 136 ; and of the minima, August 37 volts, and September 47 volts. As the result of the year's observations in the first cases, it was found that generally the laws differed in summer and in winter. It was found at Kew that for the year maximum tension (109 volts) occurred with north-westerly winds, and the minimum (64) with south-easterly winds ; but for the summer months the tension was greatest (109 volts) with an east wind, and lowest (50) with a north wind ; whilst in winter the conditions are almost reversed, and northerly and north-westerly winds have the strongest tensions, 133 and 128 volts respectively, and south-easterly the weakest with 48. These results may be influenced by the intensity of the wind, as it is found that, contrary to what would be imagined, the light winds had a higher potential than strong breezes, the average tension being in the latter case but about one-third of that in the former. This, however, is not very well marked in summer, when there did not seem to be a very defined relation between the two phenomena—it is almost entirely due to the winter observations. An examination was also made of the relation between cloudiness of the sky and atmospheric electricity; and, finally, its variations under changes of condition of the moisture of the air.

ON A UNIVERSAL SUNSHINE RECORDER.

By Mr. G. M. Whipple, F.R.A.S.

This is a new form of card supporter for the Campbell Sunshine Recorder, consisting of a light frame capable of holding the slip of cardboard to be burned by the sun in any desired position, being arranged so as to receive ordinary parallel strips of card at all times of the year, and to allow of the instrument being employed on any part of the earth's surface without detriment to its efficiency. The card-holders themselves were moveable, so as to permit of the cards being changed indoors, or dried, if wet, before removal, thereby avoiding tearing or mutilation of the record in the operation. The instrument is also furnished with an appliance for placing the card correctly in position to receive the sun's image.

THE ORGANIZATION OF THE METEOROLOGICAL SERVICE IN SOME OF THE PRINCIPAL COUNTRIES OF EUROPE.*

XII.—ITALY *(Continued).*

5. *The "Osservatorio dell' Università,"* at Turin. Regular meteorotogical observations were begun at this Observatory in 1865. For he first two years, observations were only made three times a day, afterwards these were made 6 times daily, and since 1869, a Barograph and a Thermograph, by Hipp, have been in operation. From 1866 the observations have been published in the "*Bullettino meteorologico......di Torino.*" The Director of the Observatory is M. A. Dorna, and there is a council of 6 members, including the Director. The expenses are borne by the Turin Academy, the University, and the town of Turin.

6. *The Meteorological Department* of the "*Reale Osservatorio di Brera,*" at Milan. Meteorological observations were begun here in 1763, and have been continued without interruption until this day. The Director of the Observatory is M. G. Schiaparelli. Of the older series of observations we may mention specially a discussion by M. Celoria, *Sulle variazioni periodiche e non periodiche della temperatura nel clima di Milano* (Milan, 1874). Of the more recent observations we may mention an elaborate discussion by MM. Schiaparelli and Celoria, *Sulle variazioni periodiche del barometro nel clima di Milano* in the *Meteorologia Italiana* for 1868. Since the year 1867 a Barograph by Hipp (Aneroid) has been working in a very satisfactory manner.

Publications. The meteorological observations of the Milan Observatory have been published as follows:—

1763-1834 in the "Effemeridi astronomiche di Milano."
1848-59 in the "Giornale dell' Istituto Lombardo."
1860-62 in the "Atti dell' Istituto Lombardo."
1863-78 in the "Rendiconti dell' Istituto Lombardo."

The observations for the later years are contained in the *Meteorologia Italiana.*

The following special discussions may also be mentioned:—

Carlini, Considerazioni sulle vicissitudine della quantità annuale delle piogge......di Milano. (Eff. di Milano, 1859.)

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* Continued from *Meteorological Magazine* for September.

Schiaparelli, Dell' influenza della luna sulle vicende atmosferiche. (Milano, 1866.)

Celoria, Sul grande commovimento atmosferico avvenuto il 1° di Agosto 1872 nella bassa Lombardia e nella Lomellina. (Milano, 1873.)

Schiaparelli, Sul modo di ricavare la vera espressione delle leggi della natura delle curve empiriche. (Eff. di Milano, 1867.)

At the instigation of M. Schiaparelli, the Milan Observatory commenced the collection of observations of thunderstorms in Upper Italy, in 1876. The stations now number about 300. A little instrument (a kind of quadrant) is used for determining the approximate height of the lightning. Details of the working of this service will be found in M. Denza's *Ordinamento del servizio dei temporali nell' alta Italia, Torino*, 1879. The expenses of the meteorological branch of the Milan Observatory (exclusive of salaries) amounts to £100 yearly.

7. The *Reale Osservatorio* at Modena and the *Italian Meteorological Society*. Observations were begun here in 1830, and were greatly extended in 1864, under the superintendence of M. D. Ragona. Since 1873, the Observatory has possessed a complete series of self-registering instruments. The first series of observations, 1830-50, was published by M. Bianchi in the *Memorie della Società Italiana delle scienze, Vol.* XXV. 2 ; and the observations 1864-6 have been published by M. Ragona in the *Bollettino meteorologico* of the Modena Observatory, and the later observations have appeared in the *Meteorologia Italiana.* In addition to an ordinary rain gauge there is in use a *Pluviometro orvarico*, which gives the rainfall for each separate hour. This instrument is described in the *Annuario della Società meteorologica Italiana, Vol. I. p.* 305.

Publications. The climate of Modena is among the best studied in all Italy. The following special works by M. Ragona may be mentioned :—

1. Andamento annuale della temperatura. (Suppl. Met. Ital., 1875, III.
2. Andamento annuale delle variazioni delle temperature massime e minime. Ann. Soc. Met. Ital., Vol. II.
3. Andamento annuale della pressione atmosferica. Suppl. Met. Ital., 1877, II.
4. Andamento annuale della umidità relativa ed assoluta. Modena, 1879.
5. Andamento diurno ed annuale della velocità del vento. Modena, 1878.

Società meteorologica Italiana. This society was founded by M. Ragona in 1876, and has published two volumes of its proceedings This society is now amalgamated with the recently established Meteorological Association.

8. *The Meteorological Division of the R. Osservatorio de Campidoglio,*

at Rome. Observations were formerly made here by Madam C. Scarpellini, *Bollettino delle Osservazioni ozonometriche-meteorologiche fatte in Roma*, 1865-74. From the year 1873 a more extensive and reliable series of observations was begun. In addition to the records of some self-registering instruments, direct observations are made every three hours from 6 a.m. till midnight. The observations are published in the *Atti della Reale Accademia dei Lincei*, and in the *Bollettino mensile* of the *Meteorologia Italiana*. The Director of the Observatory is M. L. Respighi.

9. *The Meteorological Department of the Osservatorio del Collegio, Romano*, at Rome. At the instigation of the *Societas meteorologica palatina*, meteorological observations were begun here in 1782. Secchi's meteorograph was erected in 1858. After Secchi had published three vols. and one part of the *Memorie dell' Osservatorio del Collegio Romano*, 1852-63, he began in the year 1862 the *Bollettino meteorologico*, of which 17 vols. appeared, containing meteorological and magnetical observations at Rome, and some of the neighbouring localities. Of the discussions which have appeared in this Bulletin we may specially mention the following :—

Mancini, Sulla temperatura dell' aria in Roma (40 years); Bulletin for 1868.

Quadro delle quantita totale di pioggia caduta in Roma nel periodo di 85 anni (1782-1866); Bulletin for 1869.

Secchi, Sulla pioggia osservata al Collegio Romano.....dal 1825—al 1874; Bulletin for 1878.

Secchi, Sulla velocità del vento osservata al Collegio Romano; Bulletin for 1877.

Lais, Prolegomeni allo studio delle burrasche del clima di Roma (Rome, 1873).

Also a very elaborate discussion by G. St. Ferrari :—

Meteorologia Romana (Rome, 1878).

The *Collegio Romano* is now occupied by the Central Meteorological Office.

10. *The Meteorological Department of the R. Specola di Capo-dimonte*, at Naples.—The director of this Observatory is M. F. Brioschi. Observations have been published almost *in extenso* since 1866 in the *Bullettino Meteorologico* of the Observatory.

11. *The Reale osservatorio meteorologico Vesuviano.*—This observatory, renowned for its position upon Vesuvius, was built in the years 1841-7, at a height of about 2089 feet above sea-level. The director is M. Palmieri; his attention is more devoted to electricity and seizmology than to meteorology. Meteorological observations, similar to those of a station of the second order have been published in the *Corrispondenza meteorologica Italiana alpina-appennina*. The Observatory has published Annals for 1859, 1862, 1862-4, and (new series) 1873.

12. *The local climatology of various parts* :—

(*a*) *Vicenza.*—The *Accademia Olimpica* has erected a meteorological observatory which is under the direction of Count A. da Schio. In addition to the ordinary instruments, various self-registering instruments have been in action for some years. Vicenza has become a centre for about 80 other stations of various kinds, chiefly for rainfall and thunderstorms. The observations have been partly published in the *Meteorologia Italiana*.

(*b*) *Velletri*.—This station is under the direction of Professor P. J. Galli. In 1876 it became a centre for other stations in the *Provincia Romana*, and published a monthly bulletin entitled *Meteorologia della Provincia Romana con applicazioni*, containing the Velletri observations *in extenso*, and the means of some other stations, and the daily rainfall at some 20 stations.

(*c*) *Potenza*.—Professor Fittipaldi organised a system of rainfall and earthquake stations, the results of which are given in the *Rendiconto della istituzione . . . . . di Potenza*.

(*d*) *Lecce*.—In a similar manner Professor C. De Giorgi established about 30 stations of the third order in this province, chiefly in the interest of agriculture. The observations for 1877-8 are published in *Note di climatologia agraria Salentina*."

There are various other important independent establishments, among which may be mentioned, Alessandria, Padua, Venice, Pesaro, Urbino, and Ancona, Reggio Callabria, Palermo, Siracusa, many of which have published long series of observations. Our space will not permit of giving further particulars of these stations.

We are much indebted to Dr. Hellmann for these details, which have been extracted from his very valuable reports to the Prussian Ministry of Public Instruction. The present article concludes the series which he has hitherto published, with the exception of the service in England, the meteorological organization of which is pretty well known to the readers of this magazine.

J. S. HARDING.

[In thanking Mr. Harding for the service which he has rendered to English speaking meteorologists of all countries, by his translations of Dr. Hellmann's reports, we find only one point upon which we differ. He has thought it best to omit all notice of English work; we think that it is most necessary that we should

"See ourselves as others see us,"

and we therefore hope, ere very long, to add England as a separate paper.—Ed. *M. M.*]

METEOROLOGICAL NOTES ON SEPTEMBER.

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.—The weather of the month was favourable for tillage operations, and especially favourable for root crops. Wasps very scarce.

Banbury.—Harvest nearly completed at the end of the month. L on 18th; distant T and L on 9th; fog on ten days.

Culford.—Weather generally wet till towards the end of the month; distant T and L on 18th.

BODMIN.—A very dry and genial month ; mean. temp. 56°·6.

CIRENCESTER.—Rainfall moderate, but not a very good harvest month in consequence of the heavy dews, and the dry periods not being long enough.

WOOLSTASTON.—Mean temp. of the month 54°·3 ; swallows left about the 19th.

ORLETON.—A cloudy, cold, and damp month. with frequent falls of fine R, and a few clear days at intervals. Although the R was never heavy, it was long continued and greatly retarded the harvest. Thick fogs occurred on eight days. Bar. generally high and steady ; mean temp. about 1°·5 below the average ; no L or T.

BOSTON.—Harvest, which was commenced in the first week of August, was finished on the last day of September ; during this time R fell on 31 days, and the longest period of fine weather was four days. The sunshine and high temp. of May, June, and July produced grain of splendid quality and fair abundance, but the wet weather of August and September detracted much from its value, and added to the expense of harvesting.

KILLINGHOLME.—An excellent corn crop, both as to quantity and quality, such as has not been known since 1868, but greatly damaged by continuous wet. T and L on 18th.

MANSFIELD.—On the whole, dull and wet ; no great amount of R, but many damp and close days when nothing would dry. The last week was very fine and bright with heavy dews at night. Bar. very slightly below the average, wind very variable ; TS at 10.30 p.m. on 18th.

WALES.

HAVERFORDWEST.—On the whole a grand month of fine weather; crops saved in splendid condition. A heavy storm of R and wind on 24th and 25th ; several very cold nights.

LLANDUDNO.—A fine dry and calm month : Mean. temp. about 1°·5 below the average. Rainfall less than one-third of the average.

SCOTLAND.

CARGEN.—A dull, cheerless month ; great want of sunshine, and an unusual amount of humidity, most unfavourable for getting the crops into the stack-yard ; mean temp. about the average. Corn nearly all in at the end of the month, but generally in indifferent condition. A well-developed solar halo on the 6th.

SILVERBUT HALL.—A cold, wet and sunless month, retarding harvest work.

BRAEMAR.—A month of changeable weather, yet favourable for maturing the crops, a great part of them being still green.

ABERDEEN.—Although the rainfall was considerably below the average ; the weather was damp and misty, with an absence of sunshine ; prevailing wind northerly.

PORTREE.—A fine harvest month, crops fully an average ; disease appearing in potatoes ; hill sheep strong and healthy.

CULLODEN.—Harvest late ; oats thin ; turnips in many places much improved.

SANDWICK.—The driest September since 1846, the rainfall being 3·14 in. less than the mean of 40 years ; the first half of the month was cold, from the prevalence of northerly and easterly winds ; from the 21st to 24th, inclusive, there was a gale of S.E. wind, but after that the weather was generally fine. Aurora on three nights.

IRELAND.

CORK, BLACKROCK.—Mean temp. 57·°1.

DROMORE.—A very fine harvest month ; much sunshine and high temp. throughout. Hay and oat crops heavy, potatoes a good crop in inland districts but failed in many places on the coast, turnips promising.

WATERFORD.—The early part of the month was very favourable for harvest work ; frequent heavy dews ; distant T on 9th. Very few wasps.

KILLALOE.—Splendid harvest weather up to the 17th, latter part of the month variable. Mean temp. 56°·2.

MONKSTOWN.—A fine bright month, with warm sunny days, and but little R; in every way favorable for harvest operations.

WARINGSTOWN.—Pretty fair on the whole, though the third week was wet. Excellent crops of all sorts, no serious damage to grain.

LONDONDERRY.—Month on the whole favourable for farming operations, grain and potatoe crops yielding well. Wind variable.

SUPPLEMENTARY TABLE OF RAINFALL IN SEPT., 1881.

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

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
II.	Dorking, Abinger	2·49	XI.	Carno, Tybritle	1·71
,,	Margate, Acol	2·74	,,	Corwen, Rhug	1·82
,,	Littlehampton	3·46	,,	Port Madoc	2·20
,,	St. Leonards	2·84	,,	Douglas	3·49
,,	Hailsham	2·20	XII.	Carsphairn	2·47
,,	I. of W., St. Lawrence.	1·77	,,	Melrose, Abbey Gate	3·94
,,	Alton, Ashdell	2·77	XIV.	Glasgow, Queen's Park.	1·91
III.	Great Missenden	2·84	XV.	Islay, Gruinart School.	3·38
,,	Winslow, Addington	1·70	XVI.	Cupar, Kembach	3·66
,,	Oxford, Magdalen Col.	1·39	,,	Aberfeldy H.R.S.	1·86
,,	Northampton	1·42	,,	Dalnaspidal	4·21
,,	Cambridge, Merton Vil.	...	XVII.	Tomintoul	2·42
IV.	Harlow, Sheering	2·16	,,	Keith H.R.S.	2·81
,,	Diss	3·12	XVIII.	Forres H.R.S.	1·75
,,	Swaffham	3·26	,,	Strome Ferry H.R.S.	...
,,	Hindringham	3·28	,,	Lochbroom	1·41
V.	Salisbury, Alderbury	1·59	,,	Tain, Springfield	1·91
,,	Calne, Compton Bassett	1·97	,,	Loch Shiel, Glenfinnan.	4·05
,,	Beaminster Vicarage	...	XIX.	Lairg H.R.S.	..
,,	Ashburton, Holne Vic.	3·08	,,	Altnabreac H.R.S.	1·21
,,	Langtree Wick	2·90	,,	Watten H.R.S.	1·31
,,	Lynmouth, Glenthorne.	1·72	XX.	Fermoy, Glenville	2·73
,,	St. Austell, Cosgarne	...	,,	Tralee, Castlemorris	2·46
,,	Taunton, Fullands	2·90	,,	Cahir, Tubrid	2·06
VI.	Bristol, Clifton	2·10	,,	Tipperary, Henry St.	3·15
,,	Ross	1·41	,,	Newcastle West	2·01
,,	Wem, Sansaw Hall	1·42	,,	Kilrush	1·54
,,	Cheadle, The Heath Ho.	1·81	,,	Corofin	1·76
,,	Coundon	2·13	XXI.	Kilkenny, Butler House	...
VII.	Melton, Coston	2·43	,,	Carlow, Browne's Hill.	2·93
,,	Horncastle, Bucknall	2·44	,,	Navan, Balrath	1·48
VIII.	Macclesfield Park	1·98	,,	Athlone, Twyford	4·05
,,	Walton-on-the-Hill	2·00	,,	Mullingar, Belvedere	2·16
,,	Broughton-in-Furness	4·39	XXII.	Ballinasloe	3·72
IX.	Wakefield, Stanley Vic.	2·57	,,	Clifden, Kylemore	6·01
,,	Ripon, Mickley	3·28	,,	Crossmolina, Enniscoe.	3·44
,,	Scarborough	4·95	,,	Carrick-on-Shannon	2·66
,,	Mickleton	4·44	XXIII.	Dowra	2·77
X.	Haltwhistle, Unthank.	4·33	,,	Rockcorry	2·43
,,	Shap, Copy Hill	2·69	,,	Warrenpoint	2·65
XI.	Llanfrechfa Grange	1·86	,,	Newtownards	2·31
,,	Llandovery	2·61	,,	Carnlough	...
,,	Solva	2·07	,,	Bushmills	2·20
,,	Castle Malgwyn	1·61	,,	Buncrana	...
,,	Rhayader, Nantgwillt.	3·24			

SEPTEMBER, 1881.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1870–9	Greatest Fall in 24 hours. Dpth	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.	Camden Square	2·03	— ·47	·85	24	11	73·7	18	41·7	16	0	0
II.		Maidstone (Hunton Court)	3·06	+ ·75	·78	5	17	...	...	...	...	...	...
,,		Strathfield Turgiss	1·64	— ·66	·53	24	12	74·0	18	38·5	16	0	0
III.		Hitchin	1·91	— ·57	·47	24	17	65·0	18	38·0	15¶	0	...
,,		Banbury	1·23	— 1·58	·47	24	16	71·0	18	36·0	29	0	...
IV.		Bury St. Edmunds (Culford)	3·18	+ ·40	·48	24	20	69·0	18	35·0	30	0	...
,,		Norwich (Cossey)	2·56	— ·52	·44	22	19	73·0	18	38·5	28	0	...
V.		Bridport	2·30	...	·78	5	11	65·0	7, 18	35·0	29	0	...
,,		Barnstaple	2·31	— 1·97	·69	5	14	69·0	17	39·0	16	0	...
,,		Bodmin	1·98	— 3·26	·50	5	12	68·0	18	40·0	16	0	0
VI.		Cirencester	2·24	— ·90	·78	24	10	...	...	...	...	...	...
,,		Church Stretton (Woolstaston	1·74	— 1·73	·57	20	18	66·5	18	41·0	2	0	...
,,		Tenbury (Orleton)	1·95	— 1·40	·56	24	17	70·7	18	36·0	17**	0	0
VII.		Leicester (Town Museum)	2·37	...	·66	24	18	73·6	18	37·5	17**	0	...
,,		Boston	2·53	— ·08	·49	5	16	74·0	18	42·0	28	0	...
,,		Grimsby (Killingholme)	2·82	— ·25	·50	22	20	69·0	18	41·5	17	0	...
,,		Mansfield	1·81	— 1·13	·39	22	19	70·8	18	37·0	17	0	0
VIII.		Manchester (Ardwick)	...	...	...	...	...	...	...	...	...	...	...
IX.		Wetherby (Ribstone)	2·84	— ·24	·91	23	12	...	...	...	...	...	...
,,		Skipton (Arncliffe)	2·81	— 2·77	·52	17	20	68·0	8	37·0	15††	0	...
X.		North Shields	4·64	+ 2·32	1·50	21	20	68·2	18	40·0	28	0	0
,,		Borrowdale (Seathwaite)	5·05	— 8·17	1·65	17	14	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely)	2·45	— 2·35	·46	5	9	...	...	...	...	...	...
,,		Haverfordwest	2·24	— 2·81	·80	24	10	64·5	20*	34·0	16	0	1
,,		Aberystwith (Goginan)	...	...	...	...	...	...	...	...	...	...	...
,,		Llandudno	·98	— 2·77	·23	17	13	64·4	29	42·2	16	0	...
XII.	SCOTLAND.	Cargen	2·38	— 2·03	·58	17	15	65·4	8	40·0	1	0	...
,,		Hawick (Silverbut Hall)	2·32	— ·32	·73	21	18	...	...	...	...	...	...
XIV.		Douglas Castle (Newmains)	3·15	— 1·25	·61	17	16	...	...	...	...	...	...
XV.		Kilmory	2·80	— 2·96	·58	24	19	...	...	35·0	1, 15	0	...
,,		Appin Airds	3·24	...	...	...	...	...	...	...	...	...	...
,,		Mull (Quinish)	3·32	...	1·15	29	16	...	...	...	.	...	...
XVI.		Loch Leven	3·50	+ ·27	1·00	22	10	...	...	...	...	...	...
,,		Arbroath	3·06	— ·01	1·54	22	12	66·0	16	40·0	28	0	...
XVII.		Braemar	2·54	— 1·40	1·50	21	14	62·0	11	31·2	28	1	10
,,		Aberdeen	2·11	...	1·01	21	15	64·0	26	37·0	27	0	0
XVIII		Portree	3·42	— 3·98	1·25	29	15	...	...	...	...	...	...
,,		Inverness (Culloden)	1·51	— 1·39	...	...	...	62·8	28	41·0	20	0	1
XIX.		Dunrobin	3·90	...	1·23	6	9	62·5	26	41·0	27	0	...
,,		Sandwick	·77	— 2·72	·22	29	12	59·5	3	44·0	19	0	0
XX.	IRELAND.	Cork (Blackrock)	2·57	— 1·58	·96	20	13	78·0	1	35·0	21	0	...
,,		Dromore Castle	3·06	...	·90	19	11	...	...	...	...	...	...
,,		Waterford (Brook Lodge)	2·96	...	·72	20	12	68·0	7†	35·0	13‡‡	0	...
,,		Killaloe	2·99	...	·66	17	10	72·0	1‡	36·0	16	0	...
XXI.		Portarlington	2·53	— ·65	·68	20	15	64·0	24	38·0	1	0	...
,,		Monkstown	1·31	...	·54	20	10	70·0	9, 22	37·0	1	0	0
XXII.		Galway	2·70	— 1·15	·81	20	17	65·0	§	39·0	16	0	...
XXIII.		Waringstown	2·33	— 1·02	·57	17	13	69·0	8, 10	37·0	18	0	0
,,		Londonderry	2·07	...	·45	23	16	64·0	20‖	42·0	12§§	0	0
.		Edenfel (Omagh)	2·48	— 1·56	·74	20	18	68·0	1	33·0	18	0	...

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

* And 23. † 21, 23. ‡ 8, 13. § Various. ‖ And 22. ¶ And 28.
** And 29. †† 28, 30. ‡‡ 14, 21. §§ And 19.