SYMONS'S
MONTHLY
METEOROLOGICAL MAGAZINE.

CCLXXIII.] OCTOBER, 1888. [PRICE FOURPENCE, or 5s. per ann. post free.

THE BRITISH ASSOCIATION AT BATH.

WE cannot spare space to describe as fully as we have sometimes done the work of the British Association meeting. Moreover, the discussion upon Lightning Conductors occupied more than three hours, hence even a very condensed report of it will unavoidably occupy much space, and the subject is of too great importance to be slighted. We shall therefore give a list of the reports and papers which bore upon meteorology, and, where practicable, state the leading *feature* of each in a few words.

Report of the Committee on Meteoric Dust.—Prof. Schuster, F.R.S., has all along been the chief worker in this committee; he has been seriously ill, and therefore only an interim report was presented. When a meteor comes within our atmosphere, it is rendered incandescent by friction against the air, it is rapidly oxidized, and particles of oxide, &c., fall away, forming for a few seconds the "tail" of the meteor. These particles fall very slowly to the earth, and the committee was appointed to collect dust from snow-covered mountain tops and from arctic wastes, far away from centres of population, and ascertain its constituents.

Report of the Earth Tremor Committee.—The North of England Institute of Mining Engineers began a few years since the automatic registration of some slight tremors (hardly strong enough to be called earth-quakes). which were found to be somewhat frequent on the coast of Durham. The subject was brought before the British Association in 1887 by Prof. Lebour, F.R.S., and a rather strong committee was appointed to consider the subject. The present is their first report, and it deals with the various instruments suggested and tried, and points out the difficulty of finding sites free from disturbing causes such as sea waves, strong winds, railways, carriages, &c. The committee, while very desirous that similar observations should be made in other parts of the country, point out that the first essential is agreement as to form of instrument and mode of erection. We desire to mention in connection with the above that Vol. XXXVII. of the "Proceedings" of the North of England Insti-

tute of Mining Engineers contains two most valuable papers on seismometers, amply illustrated, the first being the report of its own committee, and the second a paper by Prof. A. S. Herschel, F.R.S.

Report of the Committee on Solar Radiation.—This committee was appointed several years since in order to ascertain whether it was possible to determine precisely the amount of heat received on the surface of the earth. The committee have had a beautiful instrument constructed by Mr. Casella, from designs furnished (jointly we believe) by Prof. Stokes, F.R.S., and the late Prof. Balfour Stewart, F.R.S.; the latter had been throughout secretary to the committee, and was on the point of testing the instrument when he was taken from us. The committee has been re-appointed, with the addition of Mr. Whipple, of Kew Observatory, and it is to be hoped that the instrument will soon be on trial.

Report of the Committee on the Ben Nevis Meteorological Observatory.—The committee report that the work done at the observatory has been mostly directed towards obtaining a wider knowledge of halos, of clouds, St. Elmo's fires, and other natural phenomena. It is found that the St. Elmo's fire is observed at definite phases of the weather. The usual difference in temperature between the summit and bottom of Ben Nevis is about 16° F., but in the driest season of the year it became as small as 7° F. With reference to electrical phenomena, the report states that, when a cloud rests on the mountain, the telegraphic wire which makes communication between the base and summit has an earth current passing through it in one direction, and after the cloud blows over, the direction of the earth current changes. Some work has been done with a view to ascertaining, in conjunction with other observatories, the earliest time at which a storm can be predicted which is travelling from the Atlantic over the British Isles to the European Continent, and by observing the prevailing cyclones and anticyclones the observers think it possible to find out whether a storm reaching the British Isles will travel northward or southward. The committee strongly advocate the erection of a low level station at or near Fort William. We understand that the Meteorological Council have granted for this low level station some, or all, of the instruments formerly at their station at Armagh.

Report of the Committee on the Surface Temperature of Rivers, Lakes, and Estuaries.

This committee was appointed to investigate the seasonable variations of temperature in lakes, rivers, and estuaries in different parts of the United Kingdom, in co-operation with the local societies represented on the Association. The work of the committee has been confined to testing the methods for carrying on a series of systematic general observations. To be satisfactory, such observations must be conducted simultaneously for a period of several years, in as many parts of the country as possible. Volunteer observers will be necessary, and for this purpose it seems to the committee eminently desirable

to obtain the co-operation of local societies, the members of which might feel disposed to take up the work for a definite time. During the present year a commencement has been made in Scotland. There were 20 observers at work for the committee, supplied with thermometers of a uniform pattern. After giving details, the committee recommend that they be re-appointed, with a grant to be expended in clerical assistance, observation books and circulars, thermometers, and postage. The actual arrangements have been mainly carried out by Dr. H. R. Mill, assisted by Mr. John Gunn, of the *Challenger* office. The committee was re-appointed, with a grant of £30.

HON. R. ABERCROMBY.—*Modern Views about Hurricanes as compared with Older Theories.*

The author said that the old conception of the hurricane was that the wind blew in circles; but modern research showed that a hurricane was really an oval eddy, and that the vortex, or centre, of the wind rotation was not in the geometrical centre of the oval, but usually nearer one edge or other of the depression. A hurricane was always changing its shape, so that the oval was sometimes lying in one way and sometimes quite in a different direction; while sometimes the vortex was displaced towards one side of the oval one day and towards quite another side on the next. The vortex swayed about and sometimes even described a loop. For several reasons no rule was possible for determining absolutely the bearing of the vortex by observations on board a single ship; whereas it used to be stated positively that facing the wind the vortex bore eight points—at right angles—to the right in the Northern, and to the left in the Southern Hemisphere. Modern research has proved that a hurricane was usually embedded in some prevailing trade wind or monsoon, and that there was therefore a belt of intensified trade wind outside the true storm field. This belt was always on the side of the hurricane furthest from the equator. The old rules for finding which semicircle of a hurricane a ship might be in, and the old rules for heaving-to in either hemisphere, were all proved to be both true and valuable by modern research. The speaker said that it was much to be regretted that the examination papers of the Board of Trade for masters and mates were painfully behind the modern standards of knowledge, and in these matters the Germans and other nations were now ahead of England. The whole knowledge expected from merchant captains was contained in six questions, and the candidate was expected to say that the centre bore eight points, or perhaps a little more, from the direction of the wind, while no notice was taken either of the small incurvature in front or of the great incurvature in rear, or of the belt of intensified trade where the usual indications of being exactly in front of the vortex failed. No one should blame the master of a ship for not following the established rules without the closest investigation, for, as Piddington says, "absolute rules are all nonsense," and much depends on the capabilities of a ship and on the ever-varying conditions of a heavy cross sea.

Prof. Douglas Archibald felt that many vessels had been lost through following strictly the antiquated rules. Seamen were rather conservative, and liked to stick to their own rules; but he was of opinion the sooner the results of modern research were adopted the better it would be all round.

Dr. W. H. Russell asked whether anyone could throw any light upon the reasons why winds were so frequently rotatory.

Mr. W. H. Shaw gave an explanation upon rotatory winds, and illustrated his remarks by several diagrams. His arguments tended to show that rotatory wind was caused by rushes of hot air from one quarter meeting rushes of cold air coming in an opposite direction, which caused the rotatory motion.

CAPTAIN ABNEY, F.R.S.—*On Transparency of the Atmosphere.*

E. A. COWPER.—*An improved Seismograph.*

Mr. Cowper is a member of the Earth Tremors Committee already mentioned, and this was a description of an instrument which he had been led to design for the work of the Committee.

PROFESSOR G. H. DARWIN, F.R.S.—*On the Mechanical Conditions of a Swarm of Meteorites, and on Theories of Cosmogony.*

This and the subsequent paper by Mr. Norman Lockyer himself, bear on his remarkable hypothesis of the formation of the Solar System.

J. JOLY.—*On reading electrically Meteorological Instruments distant from the Observer.*

The method consists in lowering, by an escapement arrangement worked by an electro-magnet, a platinum wire into the tube of the barometer or thermometer whose height is to be read off. The initial height of the end of the wire is known, and every time a current is sent through the electro-magnet, the wire is lowered by the one-hundredth part of an inch. The total distance by which the wire is lowered is therefore known from the number of contacts. When the mercury and the platinum wire touch, a current passes, which gives a signal by an electric bell.

This reads like a very crude form of the Meteorograph invented many years since by Van Rysselbergh, which has long been in operation at Brussels, and which, during the Paris Electrical Exhibition, engraved in Paris the complete meteorological elements as they were occurring at Brussels.

PROF. J. NORMAN LOCKYER, F.R.S.—*The Spectra of Meteorites compared with the Solar Spectrum.*

See *ante.*

E. J. LOWE.—*On the Effects of the Weather of* 1888 *on the Animal and Vegetable Kingdoms.*

DR. H. R. MILL.—*On the Temperature of some Scottish Rivers.*

W. N. SHAW.—*On some Charts of Kew Corrections for Mercury Thermometers.*

W. N. SHAW.—*On an Apparatus for Determining the Temperature by the Variation of Electrical Resistance.*

We have no abstracts of these papers and were unable to be present when they were read. The title of the last one indicates a probable relation to the long-distance-reading-thermometer invented by Sir W. Siemens, and which the Royal Meteorological Society has at work on the tower of Lincoln Cathedral.

THE DISCUSSION ON LIGHTNING CONDUCTORS.

The discussion between the Mathematical and Physical Science and the Mechanical Sections on lightning conductors was as brilliant a passage of arms as any of the memorable encounters which have taken place in former meetings

of the Association. Some years ago a conference of eminent philosophers considered closely the whole subject, and drew up a report, with rules and regulations for their use and application, which report is widely known, and almost universally acted upon. The use of copper was preferred to iron; perfect connection with damp earth was to be secured by plates, and the point of the conductor was to be blunt, to prevent fusion if struck; whilst all round its upper part there was to be a ring of projecting points to attract the electricity from the atmosphere, and so continuously draw the potent force harmlessly away. People have trusted to their lightning conductors; and they have paid for copper, at a heavy price, to ensure their effectiveness. But a short time ago the late Dr. Mann's widow founded in his memory a small lectureship, with the result that Professor Oliver Lodge has, during the present year, delivered two lectures, in which information of such novelty and importance, based upon scientifically conceived experiments, has been produced as to cause extreme excitement.

The first experiment was very simple. It consisted in giving the imitation lightning discharge an alternative path, or, in other words, the choice between a certain conductor and a certain length of air. From a Holtz or Wimshurst electrical machine two Leyden jars were charged, the spark flying off between the two terminals of the machine. But the outer coats of the jars were led to a second discharger, the air-space in which could be varied. To the rods of this second discharger a circuit of fine iron wire was attached, and the electrical current, or flash, had before it the choice of conduct by the wire, or of bridging by spark through the air, the hiatus between the poles of the discharger. In its first condition the only discharge obtained between the first set of terminals was a feeble and intermittent, but frequent, sparking, very different from the loud report heard when the second set of knobs was brought within striking distance of each other. These second knobs may be at double the distance apart of the first knobs, and yet the discharge will be complete and noisy. The two sparks occur together; the first one precipitating the second. But the reverse will not take place. The experiments have been varied in different ways. Whenever the second spark was allowed to occur, the first spark was very loud; but as soon as the discharge was compelled to traverse the alternative conductor by putting the knobs too far apart for the current to bridge the gap, the noise of the discharge was much diminished, not merely because there was only one spark instead of two, but because, for some reason, the discharge meets with such obstruction in the wire that its duration is lengthened. In the first experiments the length of the first spark was maintained at one inch; the length of the second spark was varied until it sometimes passed and sometimes missed. The alternative path was forty feet of stout (No. 1 Birmingham wire gauge) copper rod, with a resistance to ordinary electric currents of 0·025 ohm. Nevertheless, the discharge refused to take this apparently easy path, and persisted in jumping the air, although the gap measured 1·43 inch. This is the critical distance; for if the knobs are removed further apart the discharge goes by the thick copper wire, and the noise and suddenness of the discharge are less. But if for the thick copper rod a similar length of fine iron wire is employed (No. 27 Birmingham wire gauge), the resistance of which to ordinary currents is 33·3 ohms, or 1,300 times as much as the other, the discharge distinctly prefers the iron wire; for if the knobs remain at the same distance apart as before, no sparks are given off, although the critical spark is increased to 1·03 in. The inference from these experiments is that the lightning conductors would be best constructed of barbed wire, the wire not being so thin as to be deflagrated by the lightning flash.

The case for the existing system was defended by Mr. Preece, who has under his charge 500,000 lightning conductors, and 30,000 or 40,000 lightning protectors in use by the Post Office for the protection of the telegraph offices. He credited Professor Lodge with having made experiments of great value; but he differed in the conclusion drawn from them. He felt convinced that the result of that discussion would be to establish the truth of the position taken

up by the Lightning Rod Conference, and would bring to the front what they were all anxious to see, the true theory of electricity shadowed forth by Professor Fitzgerald in his opening address, and that would make this meeting an epoch in the history of electricity.

PROFESSOR OLIVER J. LODGE said he had no lightning conductors under his supervision and all his conclusions were formed from experiments, and if they were correct very few buildings were effectively and thoroughly protected at the present time; and, further, if his views were correct, lightning rods would in the future cost very much less than now. Mr. Preece said that no properly constructed rod ever failed, but in the report to the conference there were a number of entire failures named.* He had made some very careful experiments in which he provided alternative courses for an electric current, and he found that it required less electro-motive force to send the current along a thin iron wire than along a thick copper one. According to Mr. Preece the object of the conductor was to prevent a flash of lightning, but conductors were struck and melted. The conductor had two functions to perform—to act as a point and prevent a flash if it could, and to carry off a flash when it could not help receiving one. The electricity above had some energy, and they could not hocus pocus it out of existence. It might be better to let it dribble away slowly down a bad conductor than to let it rush headlong down a good one. (Hear, hear). The length of flash was a question for the consideration of meteorologists, and the duration of flashes was a subject on which the same gentlemen might do good work. He had seen flashes which appearsd to last two or three seconds, but he thought they must have been a succession of flashes. The fact that flashes deflected the compass needle did not prove that they were not oscillatory nor did it prove anything as to their duration. A short powerful flash might produce the same effects. There was the question of a flash magnetizing a bar of steel. With regard to the areas of protection, the area which Mr. Preece admitted he protected was so small that they might give it him without discussion. There was, however, in his opinion no sure area of protection. Mr. Preece might have pressed him hard on the question of the conditions of a flash. He (the speaker) had assumed that the flash behaved as electricity did in an experiment. The cloud, however, was not like the tinfoil of a Leyden jar; it was made up of atoms with spaces between them, and a discharge might be more like that of a spangle jar, or might be dribbled away a bit at a time and not by great rushes. But they could not assume that it would always do so, and must prepare for the occurrence of a great rush. The true character of lightning must be discovered by observing lightning, and not by experiments in a laboratory.

THE HON. RALPH ABERCROMBY showed a number of photographs of lightning flashes, and said that there was no absolute evidence in photographs of flashes of lightning following each other rapidly on exactly the same path. There was, however, distinct evidence of the tendency of lightning flashes to occur parallel to each other. There seemed to be a tendency in lightning flashes to be ramified, to give off threads all round the main flash. Photography gave conclusive evidence that flashes were not so instantaneous as was generally supposed. It showed that the flash did not jump from a cloud straight to the earth, but went meandering through the air and tying itself into knots, so that it could not be so instantaneous as was imagined. He was of opinion that lightning clouds were generally more than 5,000ft. high, but there was no evidence of one of more than 7,000ft. high.

LORD RAYLEIGH said that although he had no special knowledge of lightning conductors, from his general acquaintance with electricity he should say that Professor Lodge's experiments would have a most important practical application to lightning conductors in the future. Mr. Preece spoke of the development

* Certainly, and in, we believe, every instance the cause of failure is pointed out—they were *not* "properly constructed."—ED.

of energy by the condensation of vapour into water, but the question was to find how some of that energy came to take the electrical form. They could come to one conclusion from what they heard—namely, that houses made of sheet iron would be the safest possible places in a thunderstorm. With reference to the reports as to the occurrence of globular lightning, he believed them to be much exaggerated, and expressed an opinion that the whole effect might be a physiological optical delusion. The most efficient protection for gunpowder against lightning would be, he thought, to put it in a house whose exterior was entirely of iron and to put no lightning rod on it.

PROFESSOR ROWLAND observed that the conditions of Professor Lodge's experiments were scarcely the same as those of actual lightning, and he pointed out that the length of the spark was no measure of the resistance of the conductor. Further, he showed some effects in Mr. Abercromby's photographs which were probably due to astigmatism in the lens of the camera.

M. DE FONVIELLE, who spoke in French, said he, with Mr. Preece, was a supporter of the old lightning conductor theory, and he was partly led to that state of mind by the fact that there were large numbers of conductors in Paris, and there was very seldom an accident caused by lightning. The large numbers of lightning rods in a city could not fail to protect the city generally from the effects of lightning and to help in discharging a thundercloud passing over it.

PROFESSOR GEORGE FORBES said that Professor Lodge had come to say that if iron was not better than copper, it was at least as good; but they could not be quite prepared to accept that, because the experiments might be tried in instances more nearly approaching the natural conditions, and in that case he believed copper would be found to be the best.

SIR J. DOUGLASS said that his experience of lighthouses protected by lightning rods covered a space of 40 years and was comforting to the members of the Lightning Rod Conference. He never knew a rod fulfilling the conditions they prescribed to fail in protecting the lighthouse.

PROFESSOR CRUM BROWN suggested the use of a revolving camera in taking photographs, in order to separate flashes, and thus see if each is single or not.

MR. SYDNEY WALKER said that anything which would cheapen lightning conductors would be gladly welcomed. In the cases where damage had occurred, he believed that the result was due to a defect in the conductor. He pointed out that iron would not stand the weather so well as copper, and that, besides, it would be affected by the gases at the top of a factory chimney or similar places.

MR. G. J. SYMONS said he had investigated many accidents by lightning and had so got valuable experience. The conclusion left on his mind was that if people would erect conductors precisely in accordance with the rules laid down by the conference and fulfilling all the conditions, they would be absolutely safe. Where accideuts occurred to buildings with conductors, there wa a reasonable explanation to be found. Professor Lodge's experiments were laboratory experiments, and to get the real facts they must have something on a much larger scale, perhaps by a series of interrupted conductors on poles on the tops of some of those high hills where storms frequently occurred. With regard to protected areas, there were only two cases on record, and those doubtful, of anything being struck within the protected area as defined by the conference.

DR. WALKER said he saw an obelisk on the top of a hill struck. The top was knocked off and the fluid came from the steps of the monument at 14 different points, ploughing up the ground and breaking rock at 100ft. distance.

MR. WOOD thought the black flash shown in one of the photographs was due to the reflection of one of the other flashes.

LORD RAYLEIGH said that Prof. Stokes attributed it to the combination of gases in the path of the flash, causing an opaque stratum.

PROFESSOR LODGE said he could not understand why a conductor should have such a good earth. Why did not three points do at the bottom as well

as at the top? If properly-constructed conductors never failed, how was it that the hotel at Brussels was burnt, for that was considered protected in the most orthodox way?* He would not say that conductors were of no use; they were of great use, but not absolutely certain, In his experiment he was bound to adopt the plan he did, because the experiment could not be done in any other way. It was only the outer surface of the conductor which conducted, and he did not know that there was any good in the centre of a rod. A tube would do as well, and would be all the better if opened out into a flat bar, and yet, better than that would be a strand of wires. Iron buildings to be safe, must have perfect connections, for the smallest gap might give off a spark. That was the danger in houses supplied with gas; if the fluid travelled along the pipes and came to a gap a spark and explosion might result.

Mr. PREECE said the points between Professor Lodge and himself were reduced to a very small compass indeed. He himself had always been a great advocate of iron on account of its cheapness. The use of copper caused needless expense in the erection of lightning conductors. He believed every private house could be protected in accordance with the recommendations of the conference for £1, if people would buy a coil of stranded iron wire, a quarter of an inch in diameter with the finial points, and have that put up.

The President summed up the discussion, and said the principal thing for them to pay attention to was that prevention was better than cure. (Hear, hear.) There could be very little doubt that the presence of a considerable number of conductors afforded a great deal of protection to the area in which it existed, as was shown in the instance of Paris. It was desirable, if possible, that the whole country should be covered with conductors to prevent the discharge of flashes. There was no doubt that, though there might be room for improvement in the conductors, they had on the whole been right. (Cheers.)

REVIEWS.

Instructions for Observing Clouds on Land and Sea, with photographs and engravings. By the Hon. RALPH ABERCROMBY, F.R.Met.Soc. 8vo., 22 pages, 10 photos.—London: Edward Stanford, 1888.

THIS little manual has many claims upon the attention of all meteorologists. It is written by one of the most experienced observers of clouds—one who has studied them in nearly all latitudes—and it has at any rate the indirect, if not the actual support of another of the highest authorities, for we learn from the preface that Prof. Hildebrandsson, of Upsala, as well as Capt. Toynbee, has read the proof sheets and made several valuable suggestions. The frontispiece contains ten photo reproductions reduced from photographs taken by Mr. Abercromby in various parts of the world, and are by far the best series we have seen. The marvellous sharpness of the reproduction is well shown in Fig. 8, a cumulo nimbus photographed off Rio de Janeiro, wherein a building on the sea shore, although less than one-tenth of an inch in length by about one-hundredth in height, will, under adequate power, be seen to contain a door and 25 windows,

* The Hotel de Ville at Brussels was *not* protected in accordance with the report of the Lightning Rod Conference, but with thin iron rods, just such as Prof. Lodge seems to think desirable.—Compare "Melsen L. F. H. Des paratonneres à pointes, à conducteurs, et à raccordements multiples. Brussels: 1877," and "Report of Lightning Rod Conference. London: Spon., 1882."—ED.

every one perfectly sharp, though only a few thousandths of an inch in height or breadth. Having spoken thus highly of the excellence of the reproduction, we are glad to say that the photographs are worthy of the care bestowed upon them. There are very great difficulties in obtaining an accurate and uniformly printed series of cloud pictures. These are the best we have seen, but they vary much in the printing.* Mr. Abercromby is such an authority that one is almost afraid to criticise, but it seems rather strange that the name of cumulus is correctly applied both to the grand mountain-like masses in No. 1, and to the woolly tufts in No. 7.

The pamphlet is divided into three portions—

I.—Instructions for observing clouds on land and sea.

II.—The directions in which cloud stripes lie.

III.—The direction of cloud motion.

The whole work has been carefully thought out, and must be studied attentively, diagrams being freely used in illustration of Sections II. and III. Doubtless the author had good reason for omitting all reference to cloud mirrors, but if, in his opinion, they are bad, we wish that he had pointed out their defects; if they are good, we do not understand why they are ignored.

Even those who do not contemplate making systematic observations of clouds and their motions may be advised to secure a copy of this pamphlet and its beautiful frontispiece while it is to be had.

Der Wolkenbruch am 2-3 August, 1888, im Gebiete des oberen Queis und Bober—[The torrential rains of August 2nd-3rd, 1888, in the Water-sheds of the Upper Queis and Bober]. By Dr. G. HELLMAN, Excerpt from Centralblatt der Bauverwaltung. 4to., 1888.

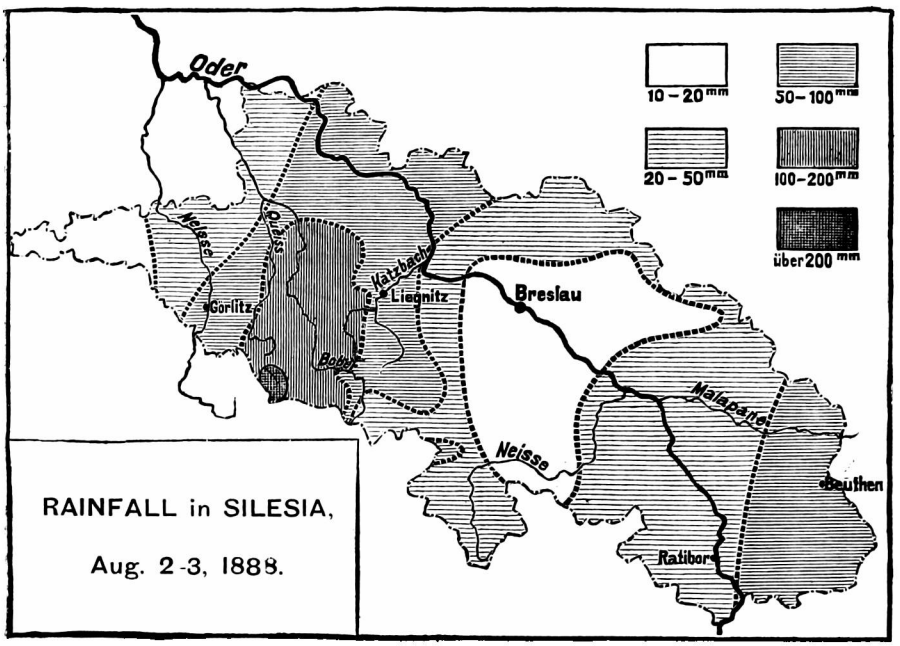
GERMANY is rapidly being provided with an efficient system of rain-fall registration. Therefore, when the great rain of August 2nd-3rd occurred, there was a satisfactory network of stations in operation, at 50 of which more than 2·00 in. was measured. Dr. Hellman having very kindly procured for us an electro from the block used to illustrate his paper, we are able to put the whole subject before our readers in a very short and clear way.

Locality.—The greatest fall (over 200 mm., *i.e.*, over 7·87 in.) indicated on the map by the darkest shading, is over an area of nearly 35 square miles on the N.E. side of the mountain range, and at the head of two affluents (the Upper Queis and the Bober) of the Oder; and over a tract of country about 30 miles by 50 miles the fall exceeded 4 in., while nearly all the rest of Silesia had from 1 to 4 in. The well known mountain station on the Schneekoppe was just to the S.E. of the heaviest fall, and had only 4·29 in.

---

* So that some of the fine weather clouds appear as the darkest of the series.

Those who are not familiar with the smaller rivers will at once recognize the locality of greatest fall, both from the above references to the Schneekoppe, and if we mention that it is just half way between Dresden and Breslau.



ENGLISH EQUIVALENTS.

10–20^{mm} = 0·4 in. to 0·8 in. ..... 50–100^{mm} = 2 in. to 4 in.

20–50^{mm} = 0·8 in. to 2 in. ..... 100–200^{mm} = 4 in. to 8 in.

über 200^{mm} = over 8 in.

Conditions of the Fall.—In the afternoon of August 2nd, there was a gentle N.W. wind and decreasing temperature, which first overclouded the sky, and then produced towards evening a thick mist, which later turned to gentle rain: but the barometer continued to fall, the wind to rise, and the rain to increase, so that about 10 and 11 p.m. it was unusually heavy. The storm and rainfall seem to have been heaviest about 2 to 3 a.m., but both continued with varying intensity until about 4 p.m. on the 3rd of August. The rain, therefore, all fell in about 18 hours, although it fell in parts of two days.

Total fall of Rain.—Dr. Hellman has received returns from 225 stations, and it is upon this splendid series that the map is based. It would, of course, be unwise for us to print any but the mos important values. We have therefore selected all that exceed *five*

inches. The initial letters preceding each name refer to the watershed in which each station is situated. **B**—Bober; **K**—Katzbach; **Q**—Queis.

	in.		in.
Q Flinsberg	8·47	**B** Schreiberhau	5·43
Q Gross Iser	8·03	**Q** Beerberg	5·39
B Agnetendorf	6·81	**B** Seifershau	5·28
B Ludwigsdorf	6·61	**K** Probsthain	5·24
K Falkenhain	5·98	**B** Neue Schlesische Baude	5·20
B Giersdorf	5·63	**K** Schönau	5·08
K Willenberg	5·63	**B** Alt-Kemnitz	5·04
Q Grenzdorf	5·55		
		B Schneekoppe (5246 ft.)	4·29

HEAVY SNOWSTORMS.

To the Editor of the Meteorological Magazine.

SIR,—I am writing a line to say we have a heavy fall of snow here this morning, after a lovely September. Everything is covered, and it must be deep on the hills. Of course it is melting fast, but we had ice and the thermometer at 30° this morning. I don't remember so much at so early a date since I kept a record.—Yours truly,

A. RAWSON.

Fallbarrow, Bowness, Windermere, October 1st, 1888.

To the Editor of the Meteorological Magazine.

SIR,—This very unusual season has now presented us with another phenomenon. Last night (1st to 2nd) we had a *heavy snow storm*, commencing at 10 p.m, without wind, falling level as near as possible, four inches deep at 7 a.m., and I have recorded ·31 inch, carefully melted and measured in the gauge. The storm has been succeeded by the most lovely bright sunshine this morning, but now (at 11 a.m.) the snow is only partially melted.

Yours very truly,

G. F. PEARSON.

Downton, Kington, Herefordshire, October 2nd, 1888.

THE DROUGHT OF 1887 IN IRELAND.

To the Editor of the Meteorological Magazine.

SIR,—As various inquiries have reached me as to where my paper "On the drought of 1887 and some of its effects on Irish agriculture" can be obtained, will you give me space to say that I have a few spare copies left, and will forward one to any applicant until all are gone.—Yours very truly,

RICHARD M. BARRINGTON.

Fassaroe, Bray, Co. Wicklow, Aug. 31, 1888.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, JAN., 1888.

STATIONS. (*Those in italics are South of the Equator.*)	Absolute. Maximum. Temp.	Maximum. Date.	Minimum. Temp.	Minimum. Date.	Average. Max.	Min.	Dew Point.	Humidity.	Absolute. Max. in Sun.	Min. on Grass.	TotalRain. Depth.	Days.	Aver. Cloud.
	°		°		°	°	°	0–100	°	°	inches		0–10
England, London	51·8	8	23·1	1	42·7	33·2	35·6	91	78·3	19·0	·90	9	7·0
Malta	64·8	31	40·7	21	57·5	48·7	44·8	76	114·2	34·3	2·39	10	5·3
Cape of Good Hope.	99·2	28	51·5	12	85·6	59·1	...	...	...	...	·27	2	3·1
Mauritius	84·3	31	72·1	14*b*	82·0	74·3	70·1	78	138·1	65·0	8·86	20	6·3
Calcutta	77·8	5	48·3	31	74·0	55·1	49·8	55	133·1	36·4	·92	5	2·9
Bombay	86·0	7	64·2	29	81·0	68·8	65·1	72	134·6	54·4	1·85	4	1·6
Ceylon, Colombo	90·5	8	66·1	19	87·9	70·0	67·9	73	146·6	58·0	·02	1	0·9
Melbourne	104·0	15	48·8	25	73·6	56·8	55·0	71	155·8	40·7	2·58	12	5·4
Adelaide	106·8	15	50·9	31	86·9	62·6	51·9	45	160·6	40·3	·37	7	4·1
Wellington	...	...	...	...	...		...	...	...	...	...	...	...
Auckland	78·0	16	54·5	9	72·2	58·4	54·6	69	153·0	40·0	1·34	12	6·0
Falkland Isles	...	...	...	...	...	...	...	...	...	...	...	...	...
Jamaica, Kingston	91·0	14	59·6	5	88·3	64·2	65·8	74	...	...	·09	...	...
Barbados	80·0	1	67·0	3, 17*c*	78·0	70·0	68·1	79	...	...	10·33	20	6·0
Toronto	41·1	13	—11·9	22	22·6	6·9	13·0	82	...	—20·5	1·93	17	6·7
New Brunswick, Fredericton	42·9	2	—22·0	28	16·3	— 4·1	4·0	76	...	...	3·40	14	4·2
Manitoba, Winnipeg	28·0	29*a*	—45·6	11	—4·8	—23·4	—7·0	96	...	...	·79	8	4·0
British Columbia, Victoria	54·0	27	8·0	13	37·0	27·5	...	...	...	...	5·02	15	

a And 31. *b* And 20. *c* And 18.

REMARKS, JANUARY, 1888.

MALTA.—Mean temp. 52°·9; mean hourly velocity of wind 11·9 miles. Sea temp. fell from 59°·0 to 57°·8 rising again to 58°·6. L on 11th, 17th, and 31st. J. SCOLES.

Mauritius.—Mean temp. of air 0°·4 below, of dew point 0°·5 above, and rainfall 2·57 in. above average. Pressure (29·951 in.) ·007 in. below average. Mean hourly velocity of wind 12·2 miles, 0·8 mile above average; extremes 41·1 miles on 5th and 0·0 mile on 9th. Prevailing direction E.S.E. T on 6 days, L on 7 days.
C. MELDRUM, F.R.S.

Melbourne.—Mean temp. of air 1°·3 below average. Mean temp. of dew point 2°·3, humidity 7, mean amount of cloud 0·3, rainfall ·80 in., and pressure slightly above average. Prevailing wind S.; strong on 5 days. Hot wind and dust storms on 15th; fog on 14th; T and L on 2nd; L on 12th; aurora on 8th. Heavy dew on 3 days. R. L. J. ELLERY, F.R.S.

Adelaide.—Mean pressure (29·931 in.) and temperature about the average. Rainfall about half the average. C. TODD.

Auckland.—A cool, dry month. Mean temp. 2° below the average. Rainfall not half the average. Pressure close to the average. T. F. CHEESEMAN.

BARBADOS.—Pressure pretty steady. Mean temp. (73°·8) the same as the 30 years' average. Wind high and gusty and 20 per. cent. above average. Rainfall 61 per cent. above average. R. ROWIE WALCOTT.

SUPPLEMENTARY TABLE OF RAINFALL, SEPTEMBER, 1888.

[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	1·16	XI.	Castle Malgwyn	·60
,,	Margate, Birchington...	·77	,,	Rhayader, Nantgwillt..	·84
,,	Littlehampton	1·17	,,	Carno, Tybrith	·57
,,	Hailsham	...	,,	Corwen, Rhug	·80
,,	Ryde, Thornbrough	·88	,,	Port Madoc	3·00
,,	Alton, Ashdell.....	1·76	,,	I. of Man, Douglas	1·04
III.	Oxford, Magdalen Col...	1·13	XII.	Stoneykirk, Ardwell Ho.	1·50
,,	Banbury, Bloxham	·91	,,	New Galloway, Glenlee	1·64
,,	Northampton	1·10	,,	Melrose, Abbey Gate ...	·94
,,	Cambridge, Beech Ho...	·88	XIII.	N. Esk Res. [Penicuick]	1·15
,,	Wisbech, Bank House..	1·23	XIV.	Ballantrae, Glendrishaig	1·88
IV.	Southend	1·25	,,	Glasgow, Queen's Park.	1·42
,,	Harlow, Sheering	·91	XV.	Islay, Gruinart School..	1·94
,,	Rendlesham Hall	2·55	XVI.	St. Andrews, Pilmour Cot	·42
,,	Diss	·96	,,	Balquhidder, Stronvar..	1·06
,,	Swaffham	1·21	,,	Dunkeld, Inver Braan..	·24
V.	Salisbury, Alderbury...	1·69	,,	Dalnaspidal H.R.S. ...	1·56
,,	Warminster	1·50	XVII.	Keith H.R.S.	1·20
,,	Bishop's Cannings	1·94	,,	Forres H.R.S.	1·28
,,	Ashburton, Holne Vic....	1·18	XVIII.	Strome Ferry H.R.S....	3·19
,,	Hatherleigh, Winsford.	·79	,,	Fearn, Lower Pitkerrie.	·76
,,	Lynmouth, Glenthorne.	1·06	,,	Loch Shiel, Glenaladale	4·16
,,	Probus, Lamellyn	1·36	,,	S. Uist. Ardkenneth ...	2·79
,,	Launceston, S. Petherwin	1·09	,,	Invergarry	1·93
,,	Wincanton, Stowell Rec.	1·38	XIX.	Lairg H.R.S.	...
,,	Taunton, Lydeard Ho...	1·02	,,	Forsinard H.R.S.	2·08
,,	Wells, Westbury.....	1·22	,,	Watten H.R.S.	1·46
VI.	Bristol, Clifton	1·28	XX.	Dunmanway, Coolkelure	1·52
,,	Ross	·79	,,	Fermoy, Gas Works ...	·70
,,	Wem, Clive Vicarage ...	·92	,,	Tipperary, Henry Street	·82
,,	Cheadle, The Heath Ho.	·90	,,	Limerick, Kilcornan ...	1·19
,,	Worcester, Diglis Lock	·91	,,	Miltown Malbay.....	1·41
,,	Coventry, Coundon	1·21	XXI.	Gorey, Courtown House	·60
VII.	Melton, Coston	1·09	,,	Navan, Balrath	·73
,,	Ketton Hall [Stamford]	1·89	,,	Mullingar, Belvedere...	·95
,,	Horncastle, Bucknall...	1·65	,,	Athlone, Twyford	·79
,,	Mansfield, St. John's St.	·71	,,	Longford, Currygrane...	1·39
VIII.	Knutsford, Heathside ...	1·26	XXII.	Galway, Queen's Coll...	1·12
,,	Walton-on-the-Hill.....	·94	,,	Clifden, Kylemore	3·14
,,	Lancaster, South Road.	2·04	,,	Crossmolina, Enniscoe..	1 45
,,	Broughton-in-Furness ..	2·50	,,	Collooney, Markree Obs.	1·85
IX.	Shipley, Esholt Vic. ..	...	XXIII.	Rockcorry.....	...
,,	Ripon, Mickley	·89	,,	Warrenpoint	1·63
,,	Scarborough, West Bank	2·35	,,	Seaforde	1·22
,,	East Layton [Darlington]	1·31	,,	Belfast, New Barnsley .	1·93
,,	Middleton, Mickleton..	1·04	,,	Cushendun	1·70
X.	Haltwhistle, Unthank..	1·16	,,	Bushmills	1·56
,,	Shap, Copy Hill	·69	,,	Stewartstown	1 24
XI.	Llanfrechfa Grange	1·21	,,	Buncrana	1·70
,,	Llandovery	1·83			

SEPTEMBER, 1888.

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.	Date	Min. Deg	Date	No. of Nights below 32°. In shade.	On grass.
			inches	inches.	in.								
I.	ENGLAND.	London (Camden Square) ...	1·43	— 1·08	·37	25	14	72·7	15	42·4	1	0	0
II.		Maidstone (Hunton Court)...	·74	— 1·57	·38	28	4	...	...	...	...	...	...
,,		Strathfield Turgiss	1·45	— ·85	·41	29	13	74·2	15	36·9	12	0	0
III.		Hitchin	1·31	— 1·17	·68	9	12	68·0	3	38·0	30	0	0
,,		Winslow (Addington)	1·24	— 1·24	·59	9	12	70·0	3, 14	37·0	1, 12	0	0
IV.		Bury St. Edmunds (Culford)	1·02	— 1·76	·22	8	11	70·0	20*a*	32·0	2	1	...
,,		Norwich (Cossey)	1·69	— 1·39	·55	24	12	71·0	16	37·0	1	0	2
V.		Weymouth(LangtonHerring)	1·16	...	·33	27	10	70·0	24	41·0	9, 12	0	0
,,		Barnstaple.....	1·26	— 3·02	·47	1	6	69·0	21	38·0	10*e*	0	0
,,		Bodmin	1·86	— 3·38	·48	27	11	68·0	15	42·0	12	0	0
VI.		Stroud (Upfield)	·76	— 2·49	·21	23	9	71·0	15	38·0	30	0	0
,,		ChurchStretton(Woolstaston)	·57	— 2·90	·15	4	11	68·5	2	38·0	30	0	0
,,		Tenbury (Orleton)	·63	— 2·72	·23	5	10	71·2	2	34·0	12	0	...
VII.		Leicester (Barkby)	1·30	— 1·40	·57	24	15	72·0	15	30·0	30	1	3
,,		Boston	1·39	— 1·22	·30	2, 4	9	78·0	25	39·0	30	0	0
,,		Hesley Hall [Tickhill].....	1·01	...	·39	24	13	72·0	14*b*	35·0	27	0	...
VIII.		Manchester (Ardwick).....	1·69	— 2·08	·46	5	9	64·0	14	39·0	26	0	0
IX.		Wetherby (Ribston Hall) ...	·69	— 2·39	·23	2	6	...	...	...	...	...	...
,,		Skipton (Arncliffe)	1·90	— 3·68	1·13	1	11	70·0	17	34·0	21	0	...
,,		Hull (People's Park)	1·59	— 1·40	·58	10	13	...	...	...	...	...	...
X.		North Shields	1·40	— 0·92	·44	1	12	68·0	5	37·0	30	0	0
,,		Borrowdale (Seathwaite).....	5·77	— 7·45	2·55	1	11	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely).....	1·12	— 3·68	·36	27	8	...	...	...	...	...	...
,,		Haverfordwest	1·45	— 3·60	·47	27	10	66·8	15	35·7	22	0	3
,,		Plinlimmon (Cwmsymlog) ...	2·90	...	·80	5	10	...	...	...	...	...	...
,,		Llandudno.....	1·01	— 2·74	·29	1	12	70·0	13	41·0	26	0	0
XII.	SCOTLAND.	Cargen [Dumfries]	1·08	— 3·33	·44	1	8	69·6	21	35·0	30	0	...
,,		Jedburgh (Sunnyside).....	1·12	— 1·47	·36	1	8	68·0	22	37·0	18*f*	0	...
XIV.		Old Cumnock	2·57	— 1·92	1·12	1	13	68·0	19	26·0	29	2	...
XV.		Lochgilphead (Kilmory).....	2·61	— 3·15	1·15	1	12	...	...	31·0	30	1	...
,,		Oban (Craigvarren)	2·77	...	·64	1	14	61·2	17	43·4	30	0	0
,,		Mull (Quinish).....	2·81	...	·35	3, 5	15	...	...	...	...	...	...
XVI.		Loch Leven Sluices	·40	— 2·83	·20	1	3	...	...	...	...	...	...
,,		Dundee (Eastern Necropolis)	·40	— 2·54	·20	15	5	71·9	18	34·1	30	0	...
XVII.		Braemar	1·04	— 2·90	·32	6	10	71·0	23	30·0	10	2	11
,,		Aberdeen	1·85	...	·42	1	13	66·0	12*c*	37·0	9	0	0
XVIII		Lochbroom	1·42	...	·21	6	15	...	...	...	...	...	...
,,		Culloden	·91	— 1·99	...	...	...	68·0	14	31·0	26	1	7
XIX.		Dunrobin	1·66	...	·34	2	9	68·0	21	33·0	26	0	...
,,		Kirkwall (Swanbister)..... ..	...	...	...	...	...	...	...	...	...	...	...
XX.	IRELAND.	Cork (Blackrock)	1·19	— 2·96	·88	27	9	73·0	20	36·0	7, 30	0	...
,,		Dromore Castle	1·75	...	·71	28	12	0·0	25	34·0	30	0	...
,,		Waterford (Brook Lodge) ...	·75	...	·60	27	5	69·0	28	36·0	17	0	...
,,		O'Briensbridge (Ross)	·94	...	·29	1	10	68·0	14	42·0	19*g*	0	0
XXI.		Carlow (Browne's Hill)	·61	— 2·65	·21	27	8	...	...	...	..	...	...
,,		Dublin (FitzWilliam Square)	·73	— 1·68	·23	6	10	65·5	5	39·2	30	0	0
XXII.		Ballinasloe	·83	— 3·13	·24	27	8	64·0	4	36·0	30	0	...
XXIII		Waringstown	1·17	— 2·18	·24	2	11	70·0	18	35·0	9	0	0
,,		Londonderry (Creggan Res.).	1·75	...	·35	6	15	...	...	...	...	...	...
,,		Omagh (Edenfel)	1·06	— 2·98	·31	1	11	65·0	14*d*	38·0	30	0	0

a And 21. *b* And 20. *c* And 22. *d* And 16. *e* And 13. *f* And 27, 30. *g* And 20 and 22.
+ Shows that the fall was above the average; —that it was below it.

METEOROLOGICAL NOTES ON SEPTEMBER, 1888.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermoneter; 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 first ten days were showery, but warm. The middle fortnight gloriously fine, quite an Indian summer, bright and hot in the middle of the day. The close of the month was showery, warm, and close. TS on 7th, T and L on 9th.

HITCHEN.—Streams lower than ever before known.

ADDINGTON.—Generally fine, with a small rainfall and a good deal of bright sunshine, which helped harvesting greatly. Dense fog on 15th and 28th. L on 8th.

LANGTON HERRING.—A beautiful month. R 1·73 in. below the average of 18 years. The weather was very fine from 9th to 23rd, with frequent heavy dews. Prevailing wind N.E.; pressure high and steady; Fog on 28th and 29th.

BODMIN.—A most genial month, remarkable for the number of days without R. Mean temp. 55°·9.

WOOLSTANSTON.—A beautiful month for harvest, which, contrary to expectation, has been secured in excellent condition. Mean temp. 53°·4.

ORLETON.—A fine, pleasant month, with a larger proportion of sunlight than usual, although there were many cloudy and gloomy days. Slight frost occurred on 12th and 13th and fogs were frequent; the barometer was generally high and steady; there were no violent gales, and the rainfall was the smallest in September during 57 years, with the exception of September, 1832 and 1865. Mean temp. 1°·8 below the average; distant T on 7th.

BARKBY.—The second, third, and last weeks were fine for harvest, the crops being above the average of late years. Remarkably heavy dews throughout. In many places the corn harvest was finished before the hay.

BOSTON.—Harvest not completed at the end of the month, the latest recorded for 50 years. The fine weather of the last three weeks enabled the farmers to get the corn in fairly good condition.

HULL.—The weather of the first ten days was showery, that of the remainder of the month fine, but with frequent fogs or mists.

WALES.

HAVERFORDWEST.—One of the driest, finest, and at the same time coldest Septembers in 40 years' records. From 5th to 27th only ·02 in. of R fell, bright sunshine prevailed, the wind blew principally from N.E. and E.S.E., and the nights were remarkably cold. Perhaps the finest month of the year. Mean temp. low (51°·9). Dense fogs in the third week.

SCOTLAND.

CARGEN.—Mean temp. (51°·8) 2°·8 below the average, mainly owing to the unusually low minima. Sunshine 28 hours above the average. Mean pressure the highest recorded in any month since July, 1885. Thick fog on 22nd, 23rd, and 24th. Sleet fell late on 30th and on October 1st the hills were covered with S.

JEDBURGH.—The weather was cold and ungenial, with prevailing N. and N.E. winds, and fogs were prevalent.

OBAN.—The first half of the month was like August, showery and cold, but the latter half was very fine, with calm though cool weather. Crops, though light, were good, potatoes and turnips being specially well saved.

LOCHBROOM.—A beautiful harvest month, but a sudden change took place on 29th, when it became cold and wintry, and the high hills were deeply covered with the S on 30th.

CULLODEN.—The weather during the greater part of the month was exceed-

ingly fine, warm, and sunny—beautiful harvest weather. Crops very heavy and promising all over the north. Severe frost in the last week did considerable damage to vegetation.

IRELAND.

CORK, BLACKROCK.—On the whole a fine genial month, very favourable for harvesting, but at times hazy with a few cold nights; only ·21 in. of R fell during the first 24 days.

WATERFORD.—The driest September since 1865 and one of the best harvest seasons for some years. A good deal of fog.

Ross.—An exceptionally fine month, the driest for 40 years; there were many successive bright days with some dull, foggy weather at the close.

DUBLIN.—A fine month with very high barometric pressure, variable light winds, a scanty rainfall, low temp. and frequent fogs. Mean temp. 54°·4; prevailing winds N., N.W., and W.; mean humidity 87; amount of cloud 6·1.

WARINGSTOWN.—A splendid harvest month.

A WHIRLWIND AT WEST HADDON, NEAR DAVENTRY, NORTHAMPTONSHIRE.

On Thursday, August 2nd, about four o'clock, in Mr. W. W. Slye's hay field, as the labourers were at work collecting and carting the hay, a whirlwind was formed near them; first of small circular dimensions, but quickly increasing in size, it eventually took up a quantity of hay to a considerable height in the air. One man, it is said, feeling the effects of the current, held tightly to the animal in his charge, and so was enabled to keep on *terra firma*. The hay thus hoisted, we learn, was floated along, first in a south-easterly direction, passing over the Crick-road, then taking a more southerly direction by the alms-houses, and along the field adjoining. It was next seen crossing the bottom end of the first Buttock's field, then taking second Buttock's in its erratic course, and was finally lost to view, veering toward the west near a spinney on Mr. Gilbert's farm (not far from the Watford road), and some three-quarters of a mile or more from the starting point. Portions of the hay, like ballast thrown from a balloon, were found in several places along the path the whirlwind took. At three o'clock the same day a smaller quantity of hay in the same field was similarly lifted and wafted along, but in a more westerly direction.