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LUNAR HALO AND PARASELENÆ.

To the Editor of the Meteorological Magazine.

SIR,—The enclosed sketch is a representation of the remarkable halo and mock-moons seen at Hawsker, near Whitby, between 9 and 10 p.m. on Sunday, October 17th. The sketch was taken at about 9.45 p.m. The altitude of the moon was then about 33° above the visible horizon, and of the bright spots on the left of the picture about 38° . The long line appeared to be an arc of an enormous circle, and extended to the left round to the N.E. On the west side it was prolonged but little beyond the halo. The angular distance between the moon and the paraselenæ was $22\frac{1}{2}^{\circ}$; between the moon and the nearest of the bright spots on the left, 100° . An arc of a larger circle touched the halo above, but was less exactly defined. Exactly twenty-four hours after the appearance of this halo, a fearful gale began to blow, which destroyed my anemometer (Robinson's), and raised one of the heaviest seas known on this coast. In a potatoe field on the cliff edge the rows of earth were completely levelled, as if they had been drifting sand.—I am, Sir, &c.,

F. W. STOW.

Hawsker, Whitby.

To the Editor of the Meteorological Magazine.

SIR,—On Sunday evening, Oct. 17th, at about 8 o'clock, I observed a halo of about 30° diameter round the moon, and on its edge, due west from the moon, a mock moon exactly resembling the full moon when seen through a thin cloud. I have since been told that soon after a similar image of the moon formed at four points on the halo, one at each quadrant. About half-past nine, being abroad again, I saw two such, east and west of the moon; the western paraselene was then fainter than at first, but the eastern one was exceedingly bright and coloured with the prismatic colours; from it a long stream of very white cloud extended eastward as far as, and passing about 5° below, the planet Jupiter. At about half-past 9, the halo and mock moons vanished suddenly and completely; the halo had formed again at half-past 10, but without any remarkable features about it. On Monday

night, about midnight, a very violent storm broke out from the north and north-west.—Yours, &c.,

BENJAMIN STREET.

The Vicarage, Barnetby, Ulceby.

[The lunar phenomena above referred to, and so carefully observed by Mr. Stow, were seen in many parts of the country, but nowhere so well as in Lincolnshire and East Yorkshire.—Ed.]

THE STORM OF WEDNESDAY, SEPTEMBER 29TH.

[For much of the following information we are indebted to cuttings obligingly forwarded by the Rev. T. A. Preston. Such extracts are always most acceptable.—Ed.]

RAMSBURY.—Soon after 9 o'clock in the evening, suddenly, without a moment's warning, and with a peculiar roar, the fury of the storm broke over Ramsbury, against which windows were as nothing. Fragments of glass were borne to the farthest corners of the rooms, and hail-stones of extraordinary size leaped and danced about the floors as though in fiendish glee at the distress of the inhabitants, who, blinded by the lurid glare of the incessant lightning, and deafened by the loud reverberations of the thunder, the crashing of glass, the swift rush of hail on roofs and windows, and the unaccountable roar which resounded above the unearthly din, passed a night which they would fain banish as a dream on the succeeding morning, but which broken windows and flooded houses testified to be only too real. We would mention Crowood (the residence of H. R. Seymour, Esq.), where many hundreds of panes were destroyed, and windows having a southern aspect were riddled as though by swan-shot, as amply demonstrated in Ramsbury Street. It is estimated that 3,000 panes of glass were smashed in Ramsbury alone, and damage done in this way to the extent of £400. Four large elms barred the way on the Marlborough Road, and the destruction to smaller animal life was immense. Additional details will be found in the following graphic letter of A. Batson, Esq.

To the Editor of the Marlborough Times.

SIR,—The series of storms which traversed England on the 29th September from the central south to the north-west, exhibited an intensity of electrical force quite uncommon in these latitudes. The hailstorm at Ramsbury, which broke nearly every pane of glass in its direct line of advance, was preceded by an amount of lightning so frequent and so vivid that it appeared to divide equally the light and the darkness.

The first phenomenon worthy of record was a display of parhelia, seen from Baydon Hill, at a quarter-past 4 p.m. A rather small halo surrounded the sun, containing on each side a mock sun, well defined, and with prismatic colours; these were visible for about twenty minutes. A spot of light which I had previously observed in the north then assumed the same form and colours, and remained for about half-an-hour. At 6 o'clock a portentous cloud, which had rapidly gathered over the sun, began to emit flashes of forked lightning, some of which I estimated to be two miles in length, and the thunder resembled the roar of artillery. Just as the cloud appeared quite close, it receded, and another approached from the east and a third from the south; these also showed the same

remarkable rotatory movements, and all the numerous storms that evening were distinct from each other, and had a peculiar cyclonic action, which showed itself in the fantastic forms of the cloud edges.

At half-past 8 masses of horizontal stratus were predominant; the sheet lightning especially from several centres was quite incessant, and at 9 o'clock the hail broke over Ramsbury without warning and with a peculiar roar, carrying glass and hailstones all over the rooms, in some cases breaking open the shutters. As an instance, out of five consecutive windows in a south front, seven panes only out of sixty remained unbroken. Partridges and small birds were picked up in the fields. The turnips, as well as pears and apples, are much injured.

The hail tract was about a mile and a half broad, passing between Littlecote House and Ramsbury Manor, without doing harm to either, though it tore up four large elms in a space of forty-five yards in the road near the latter, leaving intact close by, a row of white poplars, which would have yielded to half the pressure. Some say the hailstones were as large as pigeon's eggs or penny pieces; the largest show indications of being jagged, and were quite an inch through.

I am your obedient servant,

ALFRED BATSON.

Ramsbury, 5th October, 1869.

LAMBORNE.—This neighbourhood was visited by a severe storm on the evening of Michaelmas Day. The lightning was of the most vivid kind; for a time the flashes were almost continuous, the sky being brilliantly illuminated. There was comparatively little thunder, but several heavy showers fell, including a hailstorm of unusual violence. The latter was remarkably severe at Ashdown Park, killing scores of partridges, a fox, and several hares, though, strange to say, nearly all the glass in Lord Craven's greenhouses escaped damage. As an instance of the extraordinary force of the storm we may mention that a heavy zinc shepherd's house on wheels, in one of Mr. Tilly's fields, was blown right over. Several windows at Park Farm, the residence of Mr. Reading, were smashed to atoms.

MARLBOROUGH.—Before daybreak on Wednesday (Sept. 29th) heavy peals of thunder and vivid lightning, accompanied by rain, passed over the town. The day throughout was sultry, and in the evening there was much lightning, flash following flash with exceeding rapidity, as many as 38 being counted in a minute. The violence of the storm, however, passed by, rather than over the town; no farther distant than Ramsbury Manor, large quantities of glass are broken by the hail, near the Manor gate on the Ramsbury side, two fine elms are thrown and stop the road. In Ramsbury nearly every pane of glass in the direction of the storm is broken, in fact there is hardly a house without broken panes, some houses having scores smashed. This extended to Marring Hill, where Mr. Waldron lost large quantities of glass. On the 29th there was a storm from 5.5 a.m. till 5.20 a.m., and a second one at 5.30 p.m. This latter was passing over the town till about 6.30 p.m., but the lightning continued almost without intermission till about 11 p.m.—T. A. PRESTON.

DEVIZES.—In Devizes the storm recurred again and again at intervals from six till ten with increasing force, and created great alarm, but no report of loss of life has reached us, though at Chippenham a horse took fright from the lightning, throwing out three children and fracturing the thigh of one of them, a boy of 13. At Calne the thunder and lightning were excessively heavy. At Savernake Station

there was a deluge, the water sweeping through like a mill stream. A dray horse was knocked down while standing in Devizes Green, and laid motionless very nearly half-an-hour. Birmingham, Liverpool, London, Portsmouth, and other places, report fearful storms. At Abingdon 65 flashes were counted in a minute.

ALDBOURNE.—No one who witnessed the terrific storm of thunder, lightning, and hail, which occurred here on Wednesday (Sept. 29th), is ever likely to forget it. The thunder, which was really awful, continued almost uninterruptedly from 6 o'clock till half-past 9; the lightning also was fearful, and the hailstorm, which came on about 9 o'clock, was truly something terrible; people could not hear each other speak for the terrific rush and the noise it made beating on roofs, walls, and windows. Many people had several windows smashed to atoms. Mr. E. Wentworth's house was so flooded that the household were kept up a portion of the night to get rid of the water. The hailstones were immense pieces of ice, rather than the small globules we are accustomed to see, and laid on the ground for hours after in large heaps of ice.

HUNGERFORD.—The tempest of Sept. 29th visited Hopgrass Marsh with great severity. The windows of the cottages, the property of F. L. Popham, Esq., were completely smashed in by the hail, and at Hopgrass Farm great damage was done. The greens were perfectly cut off eight acres of turnips, and the windows of Mr. Booth's house were wrecked on the south side. A chimney was also blown off on to the tiled roof, and a quantity of tiles broken, letting the water completely through the house.

To the Editor of the Meteorological Magazine.

SIR,—On Wednesday, Sept. 29th, our district was visited by a lightning storm of remarkable intensity and duration. I use the somewhat new-fangled term "lightning-storm" advisedly, inasmuch as the frequency and intensity of the lightning was the prominent feature in the storm, while the thunder, even when the storm was passing overhead, was not as loud as I have heard it on many previous occasions.

There was a short storm in the morning, about 8.30 a.m., which passed off in about a quarter of an hour, with a heavy shower of rain, and the day turned out remarkably warm and sultry. At 8.20 p.m. thunder was again heard, and on going out into the open air, I found that the lightning was flashing in S., with distant thunder. This continued for about half-an-hour, when a temporary lull occurred in the storm, and the rain, which had been falling more or less since 8.20, gradually ceased. Soon after 9 o'clock, however, it began to be apparent from the rapidly increasing display of distant lightning in S., that another and more considerable detachment of the storm was coming up from that direction, and the scene from this high elevation soon became one of the most magnificent conceivable. It is scarcely an exaggeration to say, that for two hours, viz., from 9.30 to 11.30 p.m., the lightning was *almost incessant*—frequently more than at the rate

of a flash a second for many consecutive seconds, and with an unusually large proportion of intensely brilliant flashes. Something of the unusual grandeur of the scene may have been due to our high elevation enabling us to take in at one view the discharges from many separate centres of disturbance; but after every allowance for our advantage in this respect, the frequency and intensity of the electric discharges was something astonishing, and reminded me of some of the great storms of 1858 and 1859.

The warmth and calmness of the air, notwithstanding the rain that had fallen in the early part of the evening, contributed much to our enjoyment of this magnificent display. It was not till nearly 11 o'clock, when the weight of the storm passed overhead here, that rain began to fall, and by 11.30 the storm may be considered to have been over, as regards this locality, though lightning was still flashing occasionally in N.E. at midnight.

As regards the direction and course of the storm, it is not very easy to speak decisively. The principal centre of discharge in this district seemed to come up in a S.E. current and to pass off in a S.W. one—thus describing a kind of curve, possibly the result of a conflict between a S.E. and a S.W. current.

There was thunder and lightning again on Thursday, Sept. 30th, about 8 p.m.; some half-a-dozen flashes, with very heavy rain; also, on Sunday, October 2nd, a thunderstorm in W., which lasted about an hour—viz., from 1.30 p.m. to 2.30, and was followed by about an hour's moderate rain. This last storm came up in a W. current, the direction of the wind on the earth being E., as indicated by the weather-cocks, but no movement of air perceptible. From the above account you will see that we have been passing through a period of unusual electrical disturbance, and I have thought you might like to have these few notes to compare with those you will doubtless receive from other quarters.—I am, Sir, yours truly,

GEORGE T. RYVES.

Hollington, Uttoxeter, Oct. 6th, 1869.

THE BRITISH ASSOCIATION AT EXETER.

(Continued from page 134.)

"On New Mean Self-registering Hygrometers," by E. Vivian, F.M.S. The author said that mean results in meteorology were ordinarily deduced from one or more daily observations, but in the rain gauge, evaporation vessel, and certain forms of anemometer, the aggregate elements, however fluctuating, were obtained by cumulative action. The latter of those methods was most certain, and admitted of being more readily reduced into a tabular form for the comparison of the general averages. At a former meeting of the British Association he exhibited a self-registering instrument on the cumulative principle, recording the mean values of the difference between the wet and dry bulb thermometers, and a self-registering maximum and minimum hygrometer. He now produced an improved form of the former instrument, and a

series of curves showing the comparative results of Leslie's hygrometer. It would be seen that the curves differed very widely as regarded each period of 24 hours, but their monthly means were sufficiently uniform to show the approximate accuracy of the old methods during long continuance of observations. That was still more evident from a second table, which extended over the greater portion of two years. The action of the mean self-registering hygrometer depended upon the condensation of the vapour of alcohol in the wet bulb. He had applied this principle to recording the aggregate difference of solar heat in sun and shade, to the duration of rain, the wet bulb being supplied by a funnel into which the rain was received. He now proposed to apply it, in conjunction with an evaporating vessel, to the recording of the actual mean temperature and also as an anemometer and eudiometer.

Mr. Symons well remembered the first exhibition of this instrument at Oxford, and rejoiced to see it in its improved form. He would like such an one to be used at every watering place, and, indeed, it was his earnest wish that the authorities of all the health resorts of this country should erect in clear open spaces similar thermometer stands, mount therein identical instruments, this being one, and record their observations on a uniform system. He was now engaged in conducting certain hygrometric experiments, and, if Mr. Vivian had no objection, he thought the new instrument should be tested. Mr. Vivian said he should be most happy to supply one for the purpose.

"On the Physical Causes which have produced the Unequal Distribution of Land and Water between the Hemispheres," by J. W. Reid. The author endeavoured to show that the cause of the ocean being so much deeper in the southern hemisphere than in the northern is the less atmospheric pressure in the former than in the latter. This was the reason why there was less land in the southern than in the northern, only the mountain tops of the former being visible above the sea as small islands. Mr. Godwin-Austen said he did not think that there was anything novel about the author's theory. Most of the facts had been gone over again and again. The supposed *cause* might really be the *effect*. The Rev. O. Fisher said that there was a similar theory advanced by Adhemar many years since.

"Experiments with the Captive Balloon," by J. Glaisher, F.R.S. The author explained the unavoidable difficulty in ordinary ascents of obtaining satisfactory observations at small altitudes—the balloon darting upwards, so that a height of one or two thousand feet was often reached almost before observations were commenced. He then pointed out that the rate of ascent of the captive balloon and its perfect equability of motion, offered special facilities for supplying the deficient data; so that by employing it he had been enabled materially to complete the investigations continued by the Association during so many years. Various and copious tables of the results of trips with M. Giffard's balloon, formed the basis of the paper, which we believe is to be printed *in extenso* in the volume of the Association. Among other points, reference was made to the strength of wind at great

heights, as compared with that at the earth's surface. Prof. Newton suggested that the curvature generally noticed in the tails of meteors some minutes after their first appearance, was a proof of violent currents at great altitudes.

Mr. Glaisher read the report on "*Luminous Meteors.*" This was the tenth annual report of the Association's Committee appointed to promote the observation of meteors and fire-balls over England and Europe, and for collecting those observations for scientific purposes. It owed its existence to the interest taken in the subject by the late Rev. Baden Powell. Great accession to the knowledge now possessed might be obtained in the course of a few years by more extensive arrangements for this purpose. The great obstacle in this country to the study of these bodies was the frequent intervention of clouds, which was not the case in many parts of the Continent and in America. Large numbers of meteors had been seen during the past year—last November. The observations at Greenwich were much interrupted by the sky being overcast; there were several seen in April and May. The report gave an account of an extraordinary meteor seen in France, in October, which exploded with a detonation louder than any artillery, at, it was considered, a height of sixty miles. Much was said of the extensive observations made in America by Professor Newton and others. The report contained catalogues of all the meteors and aerolites observed. The radiant of the November meteors was well ascertained, but of the August meteors the radiant was not certain. Mr. Glaisher expected much from the body of well-educated observers at Cambridge University, under the training of Mr. Adams. A hope was expressed also that the Association would continue the grant for promoting the observations of the meteors, and gathering facts concerning them.

Dr. A. Neumayer, of Munich, read a paper "*On the recent Fall of an Aerolite at Krähenberg, in the Palatinate.*" On the 5th of May last, at 6.32 p.m., the inhabitants of this village were startled by a terrible noise, like the discharge of heavy ordnance from some point high up in the air, which at the time was perfectly clear. It lasted about two minutes and was followed by a rolling sound like thunder, which ended with a sort of whirring, whistling sound. The people were greatly frightened, and nobody could explain the cause; they saw at length the trees moved by some unaccountable agency, though not a breath of wind was stirring. Two men working in the fields near the village, however, could not be at a loss for an explanation, for they saw a mass of stone fall to the ground, shaking it for a considerable distance. It was found the stone had penetrated the ground to a depth of two feet, which they soon unearthed. It was still warm, but not dangerous to touch. The walls of the hole were perfectly perpendicular. The sound could be heard over a district whose radius was thirty miles. The meteorolite, for such it was soon recognised to be, was carefully removed, and its weight found to be $31\frac{1}{2}$ lbs. Several pieces had been knocked off. It was of a grey colour, small specks of a metallic nature being everywhere visible, and likewise small dis-

coloured particles of a globular form. Subsequent analysis gave the specific gravity, 3.446. It was composed of chromiron, 0.94; magnetic pyrites, 5.72; silica, 43.29; alumina, 0.63; magnesia, 2.01; protoxide of iron, 21.06; soda, 1.03. It is of the class of meteors termed chondrites. This fiery rushing body, though broad daylight, was seen flying through the zenith of a place thirty-five miles south-east of the locality where it fell. The learned professor gave other trigonometrical and astronomical particulars showing the height at which it was seen. When passing through the atmosphere it showed a blueish light, leaving a bright stripe of light long after the body had disappeared. What made the fall of this aërolite specially interesting is the fact that it was possible to determine the radiant point of the shower of meteors to which it evidently belonged. The learned professor said the radiant point of this system was described in the tables of the British Association as being "well defined." He also hoped that some day "we should succeed in finding the comet whose orbit will exhibit elements identical with that of the meteors, placing us in the proud position of being able to state that we have already a particle of that comet in our possession."

Dr. Mann spoke of an aërolite which passed over the colony of Natal, quickly followed by a noise resembling the discharge of a heavy gun; the same aërolite when seen at another place 120 miles from the first, was also and as quickly heard to produce the same noise; the two reports, therefore, he thought, were not explosions, but sounds quickly produced and lost in consequence of the velocity of the mass.

Professor Newton thought the probability was that it gave two separate explosions.

Dr. R. J. Mann, in a communication "*On the Rainfall of Natal*," said that Natal is, practically speaking, a great inclined plane, with low marshes near the coast, and more and more mountainous as the inland parts are reached. The result of this is that, when the warm, steady winds of the summer months reach Natal, laden with vapour from the Indian Ocean, the inclined plane forces the moisture-laden air up into colder regions, where it is condensed, and falls again in heavy rains. Floods often occur near the coast, but not in the interior. On the hills the climate of temperate regions is experienced, and lower down the rich vegetation of sub-tropical climates is found. In consequence of its rich vegetation and its fertility, it is a good place for settlers.

Mr. G. J. Symons pointed out some resemblances between the meteorological phenomena of Britain and Natal.

"*Remarks on Meteorological Reductions, with especial reference to the Element of Vapour.*" Communicated to the Kew Committee, by Balfour Stewart, LL.D., F.R.S.

"It will be desirable to preface the method of reduction herein proposed by a few remarks on the objects contemplated in such reductions. These objects are twofold. In the first place, meteorological reductions may be pursued with the immediate object of acquiring information as to the climate of a place; or, secondly, they may be pursued with the immediate object of extending our

knowledge of meteorology, regarded as a physical science. Thus, for instance, a certain kind of reduction might be imagined to be of immediate practical benefit in determining whether a certain place might suit a certain class of persons or a certain class of plants, but yet it might not materially advance our knowledge of meteorology regarded as a physical science. But, on the other hand, all observations tending to advance our knowledge of meteorology are of undoubted practical benefit. The amount of vapour present in the air is, without doubt, a very important element of climate, inasmuch as this affects in a marked manner the skin of the human body and the leaves of plants; but I am not aware that it has yet been determined by the joint action of naturalists and meteorologists what is the precise physical function which expresses proportionally the effect of moisture upon animal and vegetable life. Is it simply relative humidity? or does not a given relative humidity at a high temperature have a different effect from that which it has when the temperature is low? There is, in fact, an absence of information as to the precise physical formula which is wished by physiologists as expressing the effect of moisture upon organic life. On the other hand, physicists may be presumed to confine themselves to meteorology regarded as a physical science. It is in this latter aspect that I proceed to discuss the question."

"Regarding meteorology, therefore, as a physical science, it is one of our objects to ascertain the distribution and laws of motion of the dry and wet components of our atmosphere; and it cannot be denied that we are at the present moment in very great ignorance of these laws. With respect to the motion of our atmosphere, it cannot be anticipated that we shall ever possess the same sort of knowledge which astronomy gives us regarding the motions of the heavenly bodies; for in the latter case the identity of the object is not lost sight of, while in the former case it is clearly impossible to ascertain the motions of individual particles of air. Our inquiries into the distribution and motion of the elements of our atmosphere must therefore be pursued by that method which enables us to ascertain the distribution and motion of any other substance or product with the individual components of which we find it impracticable to deal. Suppose, for instance, we wish to ascertain the wealth of our country in grain or in spirits, and the distribution of this commodity over the earth's surface. We should, first of all, begin by taking the stock of the commodity corresponding to a given date; we should next keep a strict account of all the imports and exports of the material, as well as of its home production and home consumption. Now, if we have taken stock properly at first, and if our account of the imports, the exports, the production, and the consumption of our material is accurate and properly kept, it will obviously be unnecessary to take stock a second time. But if these accounts are not kept with sufficient accuracy, or if we suspect that our material leaves us by some secret channel, which we wish to trace, it will clearly be necessary to take stock frequently; and thus a comparison of our various accounts may enable us to detect the place and circumstances of that secret transit which has hitherto escaped our observation. Applying these principles to the vapour of our atmosphere, what we wish to know is the amount of the material present at any one station at any moment, and also the laws of its motion. It would appear that the best way of measuring the amount present at any moment is by ascertaining the mass of vapour present in a cubic foot of air, mass and volume being fundamental physical conceptions.

"Next, with regard to the motion of the atmosphere, including its vaporous constituent, the method of co-ordinates suggested by Dr. Robinson would appear to be the natural way of arriving at this. Let us set up at a station two imaginary apertures, one facing north and south, and the other east and west, and gauge the mass of dry air and the mass of moisture that pass these openings in one hour; we shall by this means get the nearest attainable approach to the elements of motion of the atmospheric constituents from hour to hour. We shall not, however, obtain by this means a complete account of this motion, for we have at present no means of measuring its vertical component. This vertical component corresponds in fact to the secret channel in the illustration given above, which we must endeavour to detect by some indirect method. Another

thing that ought to be determined is the production or consumption of the vaporous element of our atmosphere as it passes from place to place. This might be done could we keep an accurate account of the evaporation and the precipitation, the two processes by which this element is recruited and consumed. This would, however, be a very difficult observation.

"Let us now recapitulate what information regarding moisture we can obtain from such complete meteorological observations as are at present made. We have—1.—The mass of vapour actually present at a station from hour to hour. 2.—The mass that passes a station in one hour, going east and west. 3.—The mass that passes a station in one hour, going north and south. There is wanting : 4.—The vertical component of the motion of vapour. 5.—Its production or consumption as it passes from place to place. These deficiencies may, however, be to some extent overcome by the following considerations : First, the atmosphere moves as a whole when it moves, the dry and moist air moving together, *secondly*, dry air is neither capable of production or of consumption, but always remains constant in amount. To illustrate this part of the subject, let it be supposed we wish to investigate the vertical motion of the atmosphere at a certain station. Make this station the imaginary centre of a circle, the circumference of which may be supposed to be studded with other stations at sufficiently frequent intervals, so that we can tell hour by hour, how much dry air passes in towards the centre of the circle through its circumference, and also how much passes out. Let us suppose that more is passing in than is passing out, or that the imports into the area of the circle are greater than the exports out of it. Now the dry air that passes in is incapable of production or of consumption and hence the stock of the material at the central station, and in the area generally, ought to be on the increase, since we have imagined the imports to be greater than the exports. If, however, we ascertain from actual observation that the stock of dry air is diminishing, instead of increasing, we may be sure that some is carried off by an upper current, which of course carries the moisture with the dry air. So much for the vertical component ; and in the next place, with regard to the production or consumption of aqueous vapour as it passes from place to place.

"Our consideration has hitherto been confined to *quantity* ; let us now define what is meant by the *hygrometric quality* of the air. It may be represented by the following quotient :—

$$\frac{\text{mass of vapour in a cubic foot}}{\text{mass of dry air in a cubic foot}}$$

Now this quotient can only alter by evaporation, by precipitation, or by mixture. This hygrometric quality of the air may perhaps be considered as a quality sufficiently constant to aid us in tracing the actual motion of air, just as we may make use of the element of saltiness to trace the actual path of an oceanic current. But besides this aid, we may make use of it to enable us to tell the precipitation or evaporation. For instance, a very damp air, in passing over a very dry country may be supposed to emerge less damp, having its hygrometric quality changed ; or a very dry air, in passing over a very damp country, may be supposed to emerge less dry, having its quality changed in the opposite direction. Thus, by actual observation of the quality of the air at the time of its reaching some particular tract of land or ocean, and at the time of its leaving it, we may possibly get much better observations of what goes on in the country, as far as this particular research is concerned, than if it were studded with gauges.

"I should therefore suggest that meteorological observations should, by a system of reduction, be made to show—(1) The mass of dry air and of moisture in one cubic foot actually present at each station from hour to hour. (2) The mass of dry air and of moisture that passes each station, hour by hour, in two lines of direction at right angles to each other, namely, north and south and east and west. When these hourly elements are obtained, they might for seasonal changes be reduced after the method of five-day means, or for the investigation of abrupt changes of weather, such as storms, they might be utilized in some other way. Retaining the belief that meteorology ought to be treated as much as

possible with the view, in the first place, of determining the actual motion of our atmosphere, and, in the next place, of assigning the cause of these, it is no doubt the greater movements of the atmosphere that will be indicated by five-day means. It ought, however, to be remarked that the observations at any station are subject to the influence of locality, none probably more so than those of wind. It would appear that this influence ought to be eliminated before we can make any trustworthy *quantitative* deductions regarding the greater movements of our atmosphere. I should however imagine that the *quality* of the air, as herein indicated, may be made of immediate use, in the study of storms. It has been suggested by Mr. Meldrum, who expresses his concurrence with the above remarks, that in addition to the five-day means indicated above, there might be given a brief epitome of the weather. Thus, for instance :—‘The wind blew from the N.E. at Kew from January 1st, 1 A.M., to January 4th, 3 P.M., in all 86 hours, at the average velocity of 16 miles an hour, with an average pressure of 30 inches, a temperature of 40 deg. F., and an average hygrometric quality represented by .075.’ The same remarks had previously occurred to myself, and Mr. Airy also has recently suggested the study of the meteorological phenomena of those periods during which the wind blows in the same direction.”

FINE METEOR ON OCTOBER 11TH.

To the Editor of the Meteorological Magazine.

SIR,—On the evening of the 11th inst., at 5.39 p.m., I saw, with a friend of mine, a brilliant meteor, at Lyneham, near Calne, Wilts. It was due north from us and radiated from the zenith. Its motion was slow, and it descended almost perpendicularly having a slight inclination westward, and disappeared at an altitude of about 30°. The daylight, no doubt, detracted from its brilliancy, but it left behind it a train of about 10° in length, and it appeared to burst—remaining stationary for a second—and then continued its course for about a degree (but considerably diminishing in size and leaving but a short train) when it disappeared.

My friend and I thought it could not be far distant, as it appeared to pass between us and a distant cloud, but as I see in the *Times* it was seen at Darlington and Sheffield at the same moment, I conclude we were mistaken.

The colour of the meteor was a pale yellow, and its size nearly equal to three times that of Jupiter at his greatest brilliancy. I hope others of your correspondents have witnessed it and will give us their account of it.—Faithfully yours,

M. F. W.

[This meteor was also observed at Killingholme and Llandudno—see p. 159.—ED.]

METEORIC STONE SHOWER AT WOLVERHAMPTON (?)

To the Editor of the Meteorological Magazine.

SIR,—In your last number you asked for an explanation of a reported fall of meteoric stones at Wolverhampton in May last. I remember seeing the report in the local newspapers, but my great repugnance to everything “sensational” connected with scientific observation prevented my making any particular investigation of the matter, especially as that was by no means the first phenomenon of the kind *reported* to have occurred in this locality. The fact is that the “black country” is infested with those pests of meteorological science commonly called weather prophets, and as they have not been

very successful in their predictions of late, they would appear to have turned their attention to the discovery of meteorites, large hailstones, and such like wonderful phenomena. This is the only explanation I, at least, can offer of the reported fall of meteorites referred to by you, and I am confirmed in my view of the case by the fact that I have, for a long period set "traps" of various kinds, such as a sheet and a large tin pan constantly exposed in my garden, for the express purpose of catching stray meteorites, but hitherto without success. The fact of the so-called meteorites being found *only* on paved roads, and never, so far as I am aware, in private grounds or yards at the back of houses certainly affords conclusive evidence to my mind that their origin is *not* an aerial one.

JOHN THRUSTANS, F.M.S.

Wolverhampton, Oct. 20th, 1869.

THE HEAT IN AUGUST.

To the Editor of the Meteorological Magazine.

SIR,—Your correspondent, Mr. Barter, has raised a question about the heat-wave of August 25—28. It may interest some of your readers to know the heat at 4 ft. in sun and air, kindly communicated to me by the observers at several stations, who have adopted the system of observing the solar heat which I have ventured to recommend. The close coincidence in the temperatures registered at stations very widely separated is remarkable. The extremes registered in sun varied only from 137° to 127° and in air from 77°·2 to 91°·1. The stations are arranged according to latitude, and the three hottest days at each station selected.—Yours, &c.,

F. W. STOW.

Hawsker, Whitby.

	Aug.	Sun.	Mean ditto.	Air.	Mean ditto.	Amount of Solar Radiation.	Mean ditto.
Worthing	26	123·5	...	74·5	...	49·0	49·1
	27	125·3	125·3	77·2	76·2	48·1	
	28	127·0	...	76·7	...	50·3	
Strathfield Turgiss	26	133·9	...	88·7	...	45·2	45·6
	27	132·2	133·5	87·2	87·9	45·0	
	28	134·5	...	87·8	...	46·7	
Bannerdown House, nr. Bath	26	135·0	...	87·0	...	48·0	49·0
	27	137·0	136·3	88·0	87·3	49·0	
	28	137·0	...	87·0	...	50·0	
Camden Square	26	124·0	...	87·5	...	36·5	35·3
	27	117·0	122·7	85·7	87·4	31·3	
	28	127·0	...	89·0	...	38·0	
Malvern	26	129·0	...	87·8	...	41·2	42·3
	27	133·0	131·6	90·0	89·3	43·0	
	28	132·8	...	90·0	...	42·8	
Wisbech ..	26	129·0	...	86·3	...	42·7	43·9
	27	131·2	130·6	86·2	86·7	45·0	
	28	131·6	...	87·5	..	44·1	
Huddersfield ...	25	116·0	...	82·0	...	34·0	37·7
	27	116·0	122·0	82·0	84·3	34·0	
	28	134·0	...	89·0	...	45·0	
Ripon	25	130·0	...	86·0	...	44·0	39·6
	26	131·0	128·0	91·1	88·4	39·9	
	28	123·2	...	88·2	...	35·0	

OCTOBER, 1869.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.				Days on which 1/4 or more fell.	TEMPERATURE.				No. of nights below 32° on grass.	
		Total Fall.	Difference from average 1860-5	Greatest Fall in 24 hours.			Max.		Min.			
				Dpth	Date.		Deg.	Date.	Deg.	Date.		
		inches	inches.	in.			Deg.	Date.	Deg.	Date.		
I.	Camden Town	1·87	—	·72	·71	18	14	74·6	8	26·6	28	7
II.	Staplehurst (Linton Park) ...	2·79	—	·31	·83	16	12	69·0	9	25·0	28	6
	Selborne (The Wakes).....	2·21	—	2·00	·98	22	9	70·0	8 & 9	27·0	28	8
III.	Hitchen	1·07	—	1·48	·51	18	10	66·0	9*	29·0	27	3
IV.	Banbury	1·24	—	1·19	·32	18	10	70·0	9	27·0	28	7
V.	Bury St. Edmunds (Culford) ..	2·78	+	·07	·75	2	13	69·0	9	26·0	26+	5
	Bridport	2·03	—	2·00	·44	18	13	75·5	9	26·0	20	3
	Barnstaple.....	4·76	+	·64	·82	17	20	...	...	...	...	...
	Bodmin	3·76	—	1·56	·68	17	23	75·0	22	38·0	20+	1
VI.	Cirencester	2·00	—	1·49	·77	18	11	...	...	...	...	...
	Shifnall (Haughton Hall) ...	1·59	—	·65	·39	29	14	68·0	10	25·0	20	3
	Tenbury (Orleton)	2·06	—	1·17	·46	1	15	73·2	9	29·8	20	3
VII.	Leicester (Wigston)	·75	—	1·95	·22	30	7	75·0	9, 11	25·0	27	4
	Boston	1·38	—	·74	·48	18	16	70·6	11	29·0	27	3
	Grimsbey (Killingholme)	2·09	—	...	·41	18	22	68·0	11	30·0	27§	2
	Derby	1·10	—	1·74	·27	17	12	71·0	9, 11	29·0	27§	3
VIII.	Manchester	3·12	—	·69	·47	14	19	75·0	9	29·0	20+	6
IX.	York	1·50	—	1·02	·23	28	19	70·0	9	28·0	29	4
X.	Skipton (Arncliffe)	3·31	—	3·35	·91	17	14	69·0	10	24·0	27	9
	North Shields	2·81	—	·47	·86	28	18	69·0	9	29·0	27	3
	Borrowdale (Seathwaite).....	9·95	—	6·37	2·19	13	19	...	...	...	...	...
XI.	Cardiff (Town Hall).....	3·22	...	...	·70	17	16	...	...	...	...	...
	Haverfordwest	3·73	—	1·46	·62	17	14	71·0	9	36·5	26+	...
	Rhayader (Cefnfaes).....	2·70	—	2·90	·95	17	14	74·0	...	29·0	26+	...
	Llandudno	2·75	—	1·21	·47	16	15	75·3	9	36·0	27	...
XII.	Dumfries	1·86	—	3·06	·25	3	18	65·5	10	26·0	20	4
	Hawick (Silverbut Hall) ...	1·94	...	...	·65	1	15	...	...	...	...	0
XIV.	Ayr (Auchendrane House) ...	2·95	—	2·00	·36	25	20	71·0	10	26·0	20	8
XV.	Castle Toward	2·03	—	3·72	·39	15	17	67·0	10	27·0	28	7
XVI.	Leven (Nookton)	2·26	—	1·49	·57	1	15	67·0	9	29·0	20+	7
	Stirling (Deanston)	2·72	—	2·19	1·08	1	13	65·2	9	25·7	20	8
	Logierait	3·29	...	...	1·44	1	10	...	...	...	...	...
XVII.	Ballater	5·65	...	...	1·80	16	18	74·3	10	26·5	27	7
	Aberdeen	6·16	...	...	1·77	16	23	69·6	8	29·9	27	7
XVIII.	Inverness (Culloden)	3·31	...	...	1·25	16	13	67·7	10	29·8	27	3
	Fort William .....	...	...	...	...	...	...	...	...	...	...	...
	Portree	7·52	—	3·26	1·62	15	25	...	...	...	...	...
	Loch Broom	5·65	...	...	·90	15	23	...	...	...	...	...
XIX.	Helmsdale	4·16	...	...	...	...	...	...	...	...	...	...
	Sandwick	3·33	—	1·59	·80	29	24	62·9	10	28·3	27	4
XX.	Cork	·67	...	...	·20	18	12	...	...	...	...	...
	Waterford	·84	—	3·56	·17	1	16	65·0	9, 10	36·0	20	...
	Killaloe	1·52	—	3·50	·39	15	18	72·0	9	33·0	20	0
XXI.	Portarlington	2·68	—	2·45	1·32	1	23	71·0	9	34·5	16	...
	Monkstown	1·31	—	2·61	·40	7	10	72·0	8	34·0	17	...
XXII.	Galway	1·67	...	...	·38	11	12	65·0	9	32·0	19	...
	Bunninadden (Doo Castle) ...	2·34	...	...	·51	17	23	65·0	8	33·0	18	0
XXIII.	Bawnboy (Owendoon)	1·45	...	...	·35	17	17	73·0	9	34·0	16||	0
	Waringstown	1·46	...	...	·23	17	15	74·0	10	33·0	19	0
	Strabane (Leckpatrick)	2·36	...	...	·50	17	24	71·0	9	30·0	17¶	7

* And 11 & 12. † And 27. ‡ And 29. § And 28. || And 19, 26, & 27. ¶ And 19, 27, & 28.
 + Shows that the fall was above the average; —that it was below it.

METEOROLOGICAL NOTES ON OCTOBER.

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

ENGLAND.

CAMDEN TOWN.—Ice nearly a quarter of an inch thick on 20th; S at 3.5 p.m. on 27th.

LINTON PARK, STAPLEHURST.—First half of month very mild and fine, with heavy R but no T on the 16th; the latter part changeable, with sharp frosts on the 27th and 28th, and a fall of S (not sleet) amounting to .03 in. of R on the last named day, gave a wintry appearance to the landscape; fogs frequent; no high winds, those most prevalent were W. and N.

SELBORNE.—Fogs on 4th, 6th, 9th, and 12th; ground covered with S on the 27th, a little also on the morning of 28th; sleet on 29th; bright aurora at 9 p.m. on 6th, and a faint one on 30th N. to W.; very stormy with high wind from S.W. on 16th; much wind, S.W. to N.W., on 17th, and the same on 18th. Mean max. of the month 55.4, mean min. 41.3; average min. of last five days only 30.4.

HITCHIN.—The highest and lowest temps. in October since 1859.

BANBURY.—Fog on 4th, 5th, 9th, and 10th; slight H on 17th; S on 26th.

CULFORD.—Heavy fogs on 5th and 6th; very high winds on the 18th and 19th accompanied by R and, on the latter day, by S; S to the depth of four or five ins. fell on the 27th and 28th, and on the nights of 26th and 27th the ther. fell to 26°, this depression, with a large amount of atmospheric moisture, has, as might have been expected, made sad havoc with vegetation in any degree tender, and the apple trees and even many forest trees and hedgerows present the unusual appearance of brown and withered foliage adhering firmly to the branches—the result of the foliage being destroyed by frost before the ripening process had been completed.

BRIDPORT.—Ten days early in the month very fine and unusually hot; bar. did not alter from 4th to 12th, inclusive; northerly gale on 18th, and on 27th and 28th slight S storms. Saw the last of the swallows on the 26th.

BODMIN.—The greatest heat ever registered here in October on the 9th, viz., 75°. Max. difference of wet and dry bulb 9° on 9th; average difference 2° 7.

CIRENCESTER.—A very dry month; great heat (59° at 8 a.m. on 11th and 12th) following the copious rains of September has produced much spring-like grass and some spring flowers; ground covered with S on 27th, which melted, and was again covered by S on the 28th.

HAUGHTON HALL, SHIFFNAL.—A month of extremes of temp.; fog almost every morning till the 11th with high temp.; average of day=55° 8, average of night 42° 0. The wind, up to 12th, from S.E., to 16th, S.W., and the rest of month N. and N.W.; stormy on 16th, 19th, and 27th; S on night of 26th, and bitterly cold wind from N.W. on 27th and 28th—the leaves fell without attaining their autumnal tints; dahlias, at length, cut down on the 20th by the severe frost of the previous night. Fine iridescent double *halo* round the moon on the night of the 15th; red admiral butterflies abound, 20 at a time, and a few tortoiseshell, but no white ones on 8th; flocks of fieldfares seen on 21st, and swallows (*H. rustica*) still seen at the end of month; fungi of great varieties about on 13th. Damsons an average crop, apples moderate, pears more abundant, and holly loaded with berries.

WIGSTON.—The dryness of the month has been very remarkable, being little more than a quarter of the average; the temp. of the first 12 days was greater than I have any record of for so long a period in October, the mean max. being 68°; the latter part of the month the mean max. was only 50°, this low temp. was accompanied by very high searching winds; no S in this locality.

BOSTON.—The month was ushered in by fine weather, with autumnal mists in the early mornings; a fierce gale from the N. set in on the 16th, and continued during the 17th and 18th; there was serious loss of life occasioned by shipwrecks along the Lincolnshire coast, and many fine old trees uprooted by the violence of the wind; the cold was very intense; a vessel of water on my lawn was frozen over on the mornings of the 17th and 18th with ice of an inch in thickness. A heavy fall of S on the night of the 19th, and, in the Wold district, this was

drifted in some places to the depth of two or three feet ; S also fell on the 27th and 28th ; vivid L was seen on the 26th and 27th.

KILLINGHOLME.—The weather very mild till the 13th, when a decided change took place ; many vessels on shore in the Humber and at its mouth on the 19th. A few days of fine weather occurred between the 20th and 25th ; on the last named day very severe weather set in, heralded by loud roaring of the German Ocean on the night of the 24th. More woodcocks than usual this season ; does this arise from severe weather in the north of Europe ? thrush singing on the 11th ; golden plover seen on same day ; grey crows seen on 13th, and sea gulls inland ; peewits flying inland, which I take to be a sign of fine weather, on 22nd ; fieldfares arrived on the 25th ; stormy night on 25th. Ball of fire fell in N. W. at 5.30 p.m. on 11th ; parselenæ seen in this neighbourhood on 17th ; radiant cirri like auroræ in N. E. at noon on 31st.

DERBY.—The first half of the month was unusually warm, reaching 71° on several occasions, and on one not going below 59° at night ; the wind changed about the 19th from W. to northerly direction, and was followed by a temp. lower than is at all usual at this time of the year.

MANCHESTER.—T S on 3rd.

ARNcliffe.—Last half of month unusually cold and stormy ; wind, E. and N. E.

NORTH SHIELDS.—S on 19th, 27th and 28th ; auroræ on 14th, 23rd, and 25th.

W A L E S.

HAVERFORDWEST.—Mild and damp the first 3 days ; very fine calm weather till the 14th, the weather then became stormy, squally, and wet the remainder of the month, with the exception of a few days which were cold and stormy, with H, T, and sheet L ; wind during the latter half of month from N. N. W.

CEFNFAES.—The month generally fine ; prevailing winds N. W. ; heavy S on the hills on the 26th and 27th.

LLANDUDNO.—S on the distant hills on 17th to 20th, and again 27th to 29th ; on 11th at 5.40 p.m. (being daylight) a beautiful meteor of an orange colour tinged with green was seen in N. E., its direction was from the zenith towards the horizon slanting from E. to N., and it disappeared behind a few clouds ; no explosion or noise heard.

S C O T L A N D.

DUMFRIES.—The weather has been variable, and the latter half frequently cold, with keen frost on several nights and bitter cold N. winds. In the beginning of the month the country looked very fresh and green ; to the close the woods getting divested of their foliage by frost and keen blasts ; S on hills on 14th, 18th, and 26th.

HAWICK.—With the exception of the 19th, 25th, 26th, 27th, and 28th, which were rendered bitterly cold by the strong and very keen frosty winds, the month has been a most remarkably mild one ; on the morning of the 9th the shrubs and trees were clothed all over with a very pretty network of spiders' webs, which soon disappeared when the sun rose ; on the 20th great flocks of fieldfares were seen flying in a westerly direction. The pastures which looked so very green up to the 19th have now a winter-like appearance.

AUCHENDRANE.—The bar. both as to pressure and range was high, but highest in the latter half of October ; on the other hand, the heat, rainfall, and evaporation were all greatest in the first half of the month. An atmosphere with a temp. above the mean of October and generally near saturation increased the number of rainy days by drizzling R, but left the rainfall much below the average, and although the equatorial winds equalled in frequency the polar winds and calms both together, and several severe gales passed over this district, particularly about the 16th and 23rd from N., the force of the wind per square foot did not much exceed the mean ; splendid auroral arch on evening of 25th.

CASTLE TOWARD.—On 22nd, fine meteor at 8.10 p.m. ; on 25th, a fine luminous arch from E. to W. along the galaxy or milky way, which continued from 8 to 9.15 p.m. Month mild, with comparatively high temp. up to the 12th, when we had H showers with slight frost ; S appeared on the hills on the 15th, but it was not till the 19th that bedding-out plants in the flower garden and ribbon borders were killed by the frost.

DEANSTON.—On the 1st a severe gale from the N.E. and much R; fair till the 11th; some T and L on 10th; S on hills on 16th, with gale from N; hard frosts on 17th and 25th, with fine auroral arch N.E. to S.W.; severe cold gale of wind with S on the hills on the 26th, 27th, and 28th; very mild on 29th.

LOGIERAIT.—On the whole a fine month; several strong gales, keen frosts, and a slight covering of S on 24th and 25th; brilliant aurora on night of 25th.

BALLATER.—The early part of month dry and fine, remainder stormy and wet, the total rainfall being 2 inches above the mean of 9 years; two distinct S storms, commencing on the 17th and the 26th; aurora on 6th, and luminous belt from W. to E. on 25th; temp. 1° above the mean of the month during last 6 years.

ABERDEEN.—A month of extraordinary weather; not so severe a storm in October for many years. From the 16th to the end of the month the weather was terribly severe; great floods on the 16th. Still some grain out in the upland districts. Frequent aurora; rainfall 3·17 above the mean of previous 13 years; 3 inches of S on grass at 9 p.m. on 27th; 16th was a terrible day—gale from N.E., T and L, and very heavy R, 2·83 fell between 0 a.m. and 5 p.m.

PORTREE.—From the 1st to 11th calm and mild, and very backward for gathering in the crops; from the 11th to the close of the month very stormy, squalls, frost, sleet, S, R, and very heavy gales, which have retarded the harvest. This month, contrary to expectation, has been very unfavorable for the husbandman, and the consequence is that a great portion of the corn crop is still out and in bad condition; this month has not, as usual, proved itself the Highlander's harvest friend.

LOCHBROOM.—The first week in October continued fine like the last two days of September, but on the 7th we had a change, then two nice days, but from the 10th to the end, without intermission or mitigation, it has been the most stormy, wild, wintry, and disastrous October ever remembered in this county; a large portion of the crop is yet out, and much of what is ingathered is in an unsafe state; all the potatoes remain in the ground.

SANDWICK.—As last month was the wettest September during the whole time of my observations, so this has been the most stormy and severe October; the anemometer marked 17,560 miles, or 4,718 more than the average of the last 8 years; the ground was covered with S from 16th to 19th and 26th to 28th, much injury was thus done to the grain crop, which was not cut and is not yet gathered in, while most of the potatoes are still in the ground. Frequent aurora. Although we were excepted from the violent gales that swept over England in September, we have been amply compensated by those in October, being very heavy on 13th, 14th, 17th, and 25th to 28th, about N.W. each time, and being 50 or more miles an hour during part of each day.

I R E L A N D.

KILLALOE.—Hardly any sun. Last August had the least rainfall of any August in 24 years, last September the greatest fall for September, and this October the least for October in the same period, the nearest to it being 1·89 in October, 1856.

DOO CASTLE.—A prevalence of northerly winds lowered the temp., and more or less R during their continuance has been the consequence; it rained on every day from the 9th; a gale with heavy R on the 16th. Potatoe digging has progressed but slowly and large tracts are yet unlifted; it is computed that at least one-third the produce has rotted.

OWENDOON.—Frosts on 25th and 26th, and S on mountains on 16th, 18th, & 26th.

WARINGSTOWN.—This month has been dry, and favourable to the farmer; we had a week of intensely cold weather from the 23rd, but on the whole the temp. was high as usual, and we have had no frost sufficient to kill the dahlias, though there was hoar frost on the grass on several nights.

LECKPATRICK.—Fine till 13th, when it became cold and wet. On 10th max. and min. in shade=71° and 53°, on the 14th only 50° and 34°, the means being respectively 62° and 42°, or 20° difference in 3 days.

NOTE.

Several important articles are crowded out of this number; that for next month will be twice the usual size, but will be issued at the regular price.