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M E T E O R O L O G I C A L M A G A Z I N E .

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THE NEWBOTTLE WHIRLWIND OF NOV. 30TH, 1872.

BY T. BEESLEY, F.C.S.

[WE are sure that no words of ours are needed to explain the reason for the large space we devote to this subject. We are aware of no instance in which a similar phenomenon has been observed by so many persons, or their evidence so carefully and judiciously collected as it has been by Mr. Beesley in the present case. With the second portion of the narrative in our next, we shall present a lithograph from the plan which has been drawn with scrupulous accuracy, and perhaps (should there be a general wish to obtain them) we may be able to inform our readers of arrangements for supplying copies of the photographs. We postpone any further remarks until the conclusion of the narrative.—Ed.]

Saturday, November 30th, 1872, was a day remarkable for atmospheric disturbance. Thunder-storms occurred in many parts of England, with sudden gales of wind. The barometer fell rapidly; its reading at Banbury (5, High Street), 345 feet above sea level, was at

9 a.m. 28·607 at 32°
3 p.m. 28·479 at 32°
10·30 p.m. 28·359 at 32°

About 11 a.m. it became very dark, so that it was difficult to read a newspaper when sitting near a window. In a few minutes, hail, followed by rain, fell sharply, and in the midst of it came a single flash of lightning, instantly followed by crashing thunder. Distant thunder was heard in the afternoon, and at Adderbury, three or four miles on the south, a person who was engaged in repairing the church clock, felt a powerful electric shock when he took hold of the iron connecting rods, although no storm was then in progress there. At night, a rumour spread that there had been a "fire-ball" at Newbottle Spinney, which had knocked down a number of trees, as well as a park wall, but I did not hear of it until the Monday following. On Tuesday morning the

Times had the following letter from T. L. M. Cartwright, Esq., of Newbottle Manor, which led me at once to visit the spot, where I was so fortunate as to meet with that gentleman, and with Mr. Francis Dagley, of Newbottle, to both of whom I am indebted for much courteous assistance, both in the way of information, and in procuring for me interviews with those who were actual witnesses of the occurrence. This visit was repeated on the two following days in company with Mr. G. J. Symons, when many measurements were taken; and again on Saturday for photographs. Several subsequent visits have enabled me to perfect the plan, and acquire much additional information, in which I have been greatly helped by Mr. Cartwright.

MR. CARTWRIGHT'S LETTER.

Mr. T. L. M. Cartwright writes to us from Banbury under date Saturday:—

“May I ask you to insert the following account of a curious atmospheric phenomenon which occurred here to-day? About 12 o'clock we had a heavy storm of rain and hail, in the middle of which there was a very vivid flash of lightning, with almost instantaneous thunder of a very peculiar rattling sound. About five minutes afterwards, as I was leaving the house, my gardener called me to come quickly and see the ball of fire. I was unfortunately half a minute too late, but I have seen four persons who saw it from different points, and who all agree they heard a whizzing, roaring sound like a passing train, which attracted their attention, and then saw a huge revolving ball of fire travelling from six to ten feet off the ground. The smoke was whizzing round and rising high into the air, and a blast of wind accompanied it, carrying a cloud of branches along and destroying everything in its way. The havoc done is very considerable—large trees bodily uprooted, others broken off about ten feet from the ground, others have all their branches snapped off; in one place about 100 yards of a wall laid flat, and the remainder thrown over at intervals, as if the ball had rebounded, and some of the stones carried ten yards off. I rode this afternoon along the whole line of its journey, about two miles in length; the direction was first from S.W. to N.E., and near the end it turned N.W. Where it first began the breadth of ground travelled over was very narrow, but increased as it proceeded, till in the last field the *débris* covered a space quite 150 yards wide, and here it seems to have exhausted itself, as all the witnesses agree that the ball of fire seemed to vanish at this spot without any explosion. Here the ground had been cut in places as if by a cannon ball, but I could find no cause for this, and I saw no signs of fire on its route. One man, however, says there was a strong sulphurous smell after it had passed. About the time of this occurrence, my farm men at work about a mile in quite another direction, saw the water of a pond carried up into the air by whirlwind. The wind all day has been light from S.S.E. My pocket aneroid (made by Bryson, of Edinburgh) stood this morning at 28·45. At this moment it stands at 28·27, showing that the atmospheric disturbance has not yet begun to subside.”

Newbottle Spinney, in the county of Northampton, is rather more than four miles from Banbury, on the south-east, and is a mile and a half east of the Great Western Railway Station at King's Sutton—a village famous for its elegant church-spire of the 15th century, which is very conspicuous from the railway. A road runs from King's Sutton through the once famous Astrop Spa to Newbottle Spinney, reaching there an elevation of 180 ft. above the railway and the Cherwell valley, and of 480 ft. above sea level; thence it proceeds to Newbottle village,

half a mile further. Three quarters of a mile beyond this is a spot marked "Bunting House" on the Ordnance map, and near it is a brook which runs through Charlton, and by Walton Grounds, two farm-houses, two miles south-west, to the Cherwell. South of Walton Ground the surface rises sharply towards Aynho; north of the Spinney the ground falls again to a ford on the bridle-road to "Rosamond's Bower;" another elevation still further north, we come to the Farthinghoe Station on the Buckingham branch of the North-Western Railway, and to the villages of Thenford and Marston St. Lawrence; the latter five miles distant from Walton Grounds, at the south extremity of the line.

The storm at Newbottle occurred somewhat later than at Banbury, but its features were similar. At 12.30 p.m., there was a sharp hail-storm, lasting for a few minutes, and in the midst of it a single flash of "pale" lightning, and then almost simultaneously, rattling thunder.

Barometer readings at King's Sutton.

DEAR SIR,—I give below the readings of the barometer, corrected and reduced to sea level, for four days, which will show the atmospheric disturbance at the time of the whirlwind :—

	8 a.m.	8 p.m.
Nov. 29.	29.55	29.15
„ 30.	29.05	28.80
Dec. 1.	29.00	29.13
„ 2.	29.54	29.64

These readings show the *greatest depression*, as well as the time of sinking and recovery.—I am, dear Sir, yours very truly,
Mr. Beesley.

EDWIN GOOD.

Three men, Thomas Rawbone, Samuel Mitchell, and Thomas King, were with a threshing engine at the farm-buildings shown in the Ordnance map, three quarters of a mile east of "Bunting House," on the road to Hinton; they had taken shelter under a rick, and were looking towards Walton Grounds, when they noticed a strange agitation in a cloud hanging over that place. It was distinguished from the general mass of dark clouds by a look as of "smoke," or, as the engineman, Rawbone, said, of "steam." Suddenly, as Mitchell described it to me, "an arm was put forth" from this cloud, and then "something like a great cart-rope" shot down to the earth, and whirled round as fast as the fly-wheel of the engine, and rapidly mounted the hill towards Newbottle Spinney in a succession of leaps, the "rope" or pipe sometimes reaching the ground, at other times being drawn up towards the clouds. Rawbone speaks of the pipe as more like the tall trunk of a tree. As they were a mile and a half distant, they did not hear any noise, and did not notice any injury done to the trees, only the tops of which were visible from their station.

"Hoc fit ubi interdum non quit vis incita venti
Rumpere quam cœpit nubem, sed deprimit, ut sit
In mare de cœli tamquam demissa columna,
Paulatim, quasi quid pugno braccique superne
Coniectu tradatur et extendatur in undas."

Lucretii de rerum natura, lib. VI. l. 431-5.

Wyatt, a milkman at Mr. Roger's farm, Walton Grounds, was during the storm at the cow-house, shown in the Ordnance map just above the "d" in "grounds" (and marked (A) in the accompanying plan). After the thunder, he left to go to the farm-house. There was but little wind then, and the hail had nearly ceased; but on reaching (B) about 200 yards west, he felt so violent a gust, apparently coming down the hill from the south, that he had to support himself by a cart which was standing there. He saw no cloud at that time, but heard a rushing noise. A "dead fence" runs north from the cow-shed to the wash-pool on the brook. As the wind passed this fence it broke a gap in it, and then first became visible as a "cloud of smoke," having probably taken up water as spray from the wash-pool and become a veritable waterspout. A pollard willow was broken down close to the east end of the cow-shed. Thomas Markham and John Seeney were working on that part of Walton Grounds near Rainsborough Camp, when they saw a cloud of smoke near the farm-house, and going up the hill, and were so alarmed that they ran off. Above this wash-pool it was first seen by the men threshing; and some men getting ironstone at a quarry on the high ground south of King's Sutton, also saw it here. Going north, the next trace of its passage is found at the north corner of a grass-field near "Ryefield-buildings" on Mr. Roger's farm, half a mile N.N.E. of the wash-pool. Here a large elm-tree was blown down, and lay with its head to north. An ash, eleven yards east of it was badly injured; but three smaller trees in the same hedgerow, respectively three, eight, and twenty-three yards west of it were untouched. A woman living in the cottage at Ryefield-buildings says, "it began in the trees behind our house. We heard a great rush of wind, but did not go out. The noise was like the clanging of doors." From the elm-tree a stream of branches stretched N.N.E. across the arable-field to the next hedge—340 yards. Here an elm was uprooted, and lay 13° W. of N., and two others, five and ten yards east, were touched. Other trees, three, eight, and twenty-three yards west of it, were untouched. Onward, for about 500 yards, the course was bare of trees, and no marks of destruction were visible; then two trees, standing in the second grass-one field south of Newbottle Spinney, were considerably damaged; on the northern corner of this field was overthrown, and one or two others in the next field, and by the side of the road leading from the Spinney to Newbottle Farm, had many branches broken. Some minor damage to fences happened near here.

Samuel Adkins, of Charlton, says that from that village he saw the whirlwind pass over some of the fields last-mentioned, and particularly noticed that the column of "smoke" revolved in a direction contrary to the sun's motion. When asked how he came to notice this, he replied that portions of the "smoke as big as a wheelbarrow," were occasionally thrown off from the main column, and after circling around it for a time, were drawn into it again.

At an angle of Newbottle Spinney, the property of Sir William

Brown, Bart, of Astrop House, just where the road from Astrop runs into the green lane leading to Charlton, a large elm was uprooted, and lay 40° W. of N. Behind, within the Spinney, two more of some size and several smaller were blown to N. The part of the Spinney over which the whirlwind next passed is planted with young ash trees, to which no damage was done; but larger trees border the road, and on the south side of it, near to the eastern entrance, two elm trees were overturned, one lying across the other, the mean direction being north.

On the north side of the road, 90 yards from the eastern entrance, a huge beech—the finest of many fine trees there—95 feet high, and 15 feet in circumference, was prostrated, the roots bringing up a ball of earth measuring 23 by 17 feet and weighing many tons. Its head lay 14° E. of N. Two large beech trees on the west lost great arms, and others behind near the gate were much injured. The thatch of a hovel was partly taken off, and straw lying in the adjoining yard was blown up into the trees.

William Adams and a boy were breaking stones on the road through the Spinney, and when the storm came on took shelter under a tree not far from the large beech. The boy, alarmed at the lightning, begged to go home. They left to do so, but had not gone far when they heard a rushing noise, and, looking back, saw a “cloud of smoke” come through the trees just where the road branches off to Rosamond’s Bower, knocking down and breaking the tress just mentioned. The “smoke” was as much as if five or six railway engines had gone by.

William Marshall, gardener at Newbottle Manor, was returning from the stables to the house. He heard a noise like a long railway train crossing a bridge, and saw leaves and branches whirled into the air above the Spinney, and immediately afterwards “a dark ball, as big as a carriage,” and sending up “a cloud of smoke,” come out of the trees with a shower of branches, and roll “over and over,” down the hill in the direction of the bridle road; the cloud of smoke at the same time whirling “round and round” with a “buzzing noise.” He distinctly saw sparks of a red colour emitted from the ball about six feet from the ground, and this is confirmed by another man, William Jilson, of Astrop, who, from a field on the west, saw fire and ran away affrighted. Notwithstanding the natural tendency in uneducated observers to assume that “where there is smoke there is fire,” I am disposed to credit these observations, although not supported by the other spectators, who, however, had not so good a view as these men had. It has been suggested that these sparks were produced by the friction of branches and twigs whirled round by the rotatory current; but I think it more likely that they were connected with electrical discharges consequent upon the friction of currents of air. Mr. Cartwright and Marshall went over the ground a few minutes after the occurrence; but they saw no trace of charred wood, nor anything to indicate combustion, and no smell of burning or of “sulphur” was perceptible. No other witness noticed the “rolling ball,” but none other saw the cloud as it came out from amongst the trees loaded with leaves and branches.

From Newbottle Spinney the whirlwind took the direction of the wall of Newbottle Park, and its course was seen by several persons working in the fields between this and Astrop on the west. A very intelligent foreman labourer, named Adams, his son and grandson, were amongst the number. They thought it looked "like hail driven up by the wind;" but the hail had ceased for some minutes, and it was hardly raining; the wind was light. They describe the branches of the trees as whirled up into the air and falling at a distance in all directions. A man running his fastest could not keep up with the cloud. William Preedy, of King's Sutton, Jessie Twinam, and three boys also saw it. Preedy thought a man running very fast might overtake it. D. Fullerton, Esq., of Aynho Park, saw it as he was walking along the elevated road from Charlton to Farthinghoe Lodge, and, like the rest, compared it to a revolving cloud of smoke.

Ten trees grew along the eastern side of Newbottle Park wall; only two of these were uninjured. The first lost a large limb; the third was touched; the fourth stripped of its smaller branches; the fifth, one foot six inches in diameter, broken short off; the seventh lost a branch; the top of the eighth was strangely twisted and broken; the ninth, a large elm, was prostrated to the W., carrying down with it a portion of the wall; the tenth was trimmed. Of the park wall, which is five and a half feet high and two feet thick, a length of ninety feet was broken down towards the bottom of the field, and some of the stones were carried thirty-eight feet to the west. A few yards above this, a small portion was thrown down to the east, the only instance of this direction. Great arms, branches, and tops of trees were scattered along the line of ruin on both sides of the wall, especially on the east or Newbottle side. At the bottom of the field, on this side, is another Spinney coming up to the wall of this and the next field. Some mischief was done here. On the farther or north side, 430 feet from the wall, two large branches were blown from an ash.

(To be continued.)

THE BRITISH ASSOCIATION AT BRADFORD.

(Continued from page 140.)

ON NEGRETTI'S TEST GAUGE SOLAR RADIATION THERMOMETER.

Mr. Symons stated that meteorologists had long been endeavouring to obtain an instrument whereby comparable observations of the amount of solar radiation could be made. Various experiments and observations by the Rev. F. W. Stow, the late Mr. F. Nunes, M.A., and the author, had shown that this object is attained by the use of a mercurial maximum thermometer, of which the bulb and one inch of the stem are coated with dull black, the thermometer being enclosed in a glass jacket, the bulb in the centre of a sphere of not less than two inches diameter, and from which nearly all the air had been extracted. To all thermometers thus mounted the title of vacuum thermometers had been applied. It had, however, been found that the amount of exhaustion varied considerably, and that the indications of the thermometer were thereby greatly affected. The instruments hitherto made, however, had been indiscriminately sold and used, and no ready means had been available for determining the amount of air left in. The speciality of the instrument which he exhibited was that a small vacuum gauge was inserted in the jacket, so that the precise extent to which the exhaustion had been carried could be seen at any time, and strict comparability in this respect ensured.

PROF. ZENGER, ON THE ACTION OF SYMMETRICAL CONDUCTORS AND LIGHTNING CONDUCTORS.

Professor Zenger read a paper on this subject, illustrating it with the well-known experiment in physics of placing two insulated hemispheres of brass plate in contact with another insulated sphere of brass. If the former were charged with electricity and removed from the inner brass sphere, there was found no trace of electricity on its surface. The electricity was shown to be accumulated on the surface of the outer spherical conductor, with equal tension in every point of the surface. Professor Zenger showed that if the outer hemispheres were replaced by two circular wires, no action whatever in the inner conductor was found. He said it was easy to see that this simple experiment might prove useful in regard to the construction of electric apparatus and of lightning conductors to protect buildings, and even whole cities, from the destructive action of atmospheric lightning. He had, therefore, endeavoured to ascertain the effects if any other form of a symmetrically-arranged conductor were used, instead of a circular form. In the first instance, he had tried the parabolic wires joined to the electroscope; next, a rectangular wire with five different openings. If placed exactly in the middle of the rectangular wire, no action was observed; if placed eccentrically, however, there was small but increasing action; and if he placed a needle or another sharp-pointed instrument between the protecting wire and the electroscope, he still better observed the different action produced by placing the electroscope in an eccentric position. He therefore thought that it was possible by symmetrical wires placed on buildings or over whole cities, so to procure an entire protection from atmospherical electricity. If the electric clouds should even enter between the objects protected and the protecting wires, their activity would be greatly diminished, for the wires would become immediately charged, and nearly all the electricity accumulated on their surface without any danger to the protected buildings.

Mr. Glaisher, who had taken the chair in the temporary absence of the president, said their thanks were due to Professor Zenger for his communication upon a subject so important. What they wanted to know was the distance at which buildings were protected by a lightning conductor, and Professor Zenger's assertion that the sections of a globe were as effective as the whole globe itself, would be an important addition to scientific knowledge if proved to be so.

Professor Clerk-Maxwell, who said he had paid some attention to the subject of shielding bodies from electrical action by means of the wire, feared the form that Professor Zenger had given them would be rather difficult to work out mathematically.

Professor Zenger said that the correspondent of the *Engineer* newspaper had just informed him that the instrument hut of the Atlantic Telegraph Company at Valencia, was protected by wires on the principle he had just mentioned, and the plan of protecting the hut had been devised by Mr. Cromwell Varley.

F. H. WENHAM, ON THE INFLUENCE OF TEMPERATURE ON THE ELASTIC FORCE OF SPRINGS.

Mr. F. H. Wenham said that at the last meeting of the British Association, at Brighton, Professor Phillips brought forward some remarkable facts relating to the aneroid barometer, showing that in new instruments a permanent set or difference of indication was caused by high temperature, and that a number of alternations of heat, extending over some period of time, were required before the elastic plate became so completely seasoned (so to term it) as to ensure regularity in the indications. It has long been known to meteorologists that thermometers, though accurately graduated at first, acquired after a few months an index error of sometimes 2 or 3°, arising from a tendency of unannealed glass forming the material of new bulbs, partly by under tension, to return to a state of equilibrium with a consequent alteration in capacity, thus showing the propriety of seasoning the instruments by repeatedly subjecting them to the extremes of temperature they were capable of bearing before finally setting them to scale. Mr. Wenham gave the results of a series of experiments he had made in connection with instruments for measuring and regulating time, force, and temperature. He said that a comparison of numerous data might develop a definite law very useful to the practi-

tioner in the various instruments to which it related. The most singular result was that indicating that a metal whose elasticity was obtained by condensation of the material, should lose it equally with equal degrees of heat, while steel, in which elasticity resulted from fire in the process of hardening and tempering, obeyed a different rule. Possibly this might give some reason for the fact that a gold alloy had been used by some chronometer makers in lieu of steel balance-springs, probably rendering a secondary compensation less necessary. He had seen such springs in use, but had never heard it stated why they had been applied. It was a long established fact that if a chronometer was adjusted for extreme temperatures, it would be incorrect for mean ones or the converse. To meet the irregular way in which the elasticity of steel was affected by heat, this law of elasticity in relation to temperature once ascertained, might determine the path in which the compensating weight should traverse, so that a due proportionate decrease of central force might counteract the elastic loss of the spring by increase of temperature. The indications with glass were far less definite, but to demonstrate how great and sudden changes of temperature might affect a thermometer, the following experiment had been tried:—The bulb of a thermometer was suddenly plunged into melted lead. The mercury instantly darted down far below zero. The action was so quick that the point could not be ascertained. This was caused by the sudden expansion of the bulb by heat before it reached the mercury, by conduction this then began to rise very rapidly, and before it had arrived at the top of the tube the bulb was withdrawn. This requires adroitness, for as we all know, the instant that the mercury touches the top, the bulb will burst. This must be greased before immersion in the fused lead, otherwise a film of the metal will adhere and retain sufficient heat to carry the mercury to the top, with a consequent fracture. A thermometer treated in this rough manner afterwards showed an index error of six degrees, the mercury having risen to this extent; but after a few days the equilibrium was partly restored, and the error remained permanently at three degrees. As a comment on the above experiments it might be urged that a source of inaccuracy would arise from a vertical force acting on a lever, varying in length, but after the deflecting weights were suspended the arm was brought so far above the horizontal line as to divide the remaining small arc due to the heat deflection. The sine of the chord for this in a radius of 12 inches was too minute to make any difference in the force of leverage worth noting. Further experiments were required, but the present ones showed directly in all instruments for indicating and registering weight, pressure, temperature, and perhaps time, by means of the law of elasticity, that the material, whether of steel, glass, and particularly any metal in which this property was obtained by condensation or hammering, the importance of subjecting them to an excess of temperature before the graduations and adjustments were made.

G. M. WHIPPLE, ON A NEW FORM OF RUTHERFORD'S MINIMUM THERMOMETER.

Mr. G. M. Whipple, B.Sc., said that the common instrument has a bulb either spherical or cylindrical, and it is found that, owing to the slow rate at which the expansion of alcohol takes place, rapid changes of temperature of the air frequently pass unrecorded by it. The new instrument devised and constructed by Mr. Hicks, has its "bulb" formed as a double cylinder, open at either end, the spirit being a thin film between the two glass coats. By this means the surface exposed to the air is immensely increased, and consequently the thermometer is enabled to follow sudden changes with a rapidity almost equalling that of mercurial instruments. Experiments made at the Kew Observatory were briefly described, which showed that the instrument acts up to the expectations of its constructor.

Mr. Symons thought that the instrument would be well adapted for terrestrial radiation purposes.

Professor Carey Foster suggested that the variations in the sensibility of thermometers might be slightly attributable to the use of diluted alcohol.

Mr. Glaisher said attention should be directed rather to getting a mercurial minimum thermometer than to improving the alcohol one.

PROF. HERSCHEL, ON THE CONDUCTIVITY OF ROCKS.

Professor Herschel stated the results of some experiments on the conductivity of rocks. The means by which he had endeavoured to get some certain results on this point were the enclosure of a box of heated water in non-conducting material, and in contact with the rock whose conductivity was to be tested. A delicate thermo-electric pile then measures the amount of heat conducted by the stone. Professor Herschel said that results of very great value had not yet been attained with certainty. Amongst other things, however, it had been ascertained that shale had a very low conducting power.

C. MELDRUM, ON A PERIODICITY OF CYCLONES AND RAINFALL IN CONNECTION WITH THE SUNSPOT PERIODICITY.

Professor Balfour Stewart, in the absence of Mr. C. Meldrum, read a paper by that gentleman on a periodicity of cyclones and rainfall in connection with the sunspot periodicity. The author attempted to establish that there is periodicity in those districts visited by cyclones. An important catalogue of cyclones, including the dates, localities, maximum force of wind, and other information of a valuable character, supplemented the paper, which appeared to show that there was a maximum of rainfall connected with each maximum of cyclones in the Indian Ocean, and gave evidence that the periodicity of cyclones was connected with the periodicity of sunspots.

ARTHUR SCHUSTER, ON A CURIOUS PHENOMENON OBSERVED ON THE TOP OF SNOWDON.

Mr. Arthur Schuster gave a short description of a curious phenomenon observed on the top of Snowdon. He stated that about two years ago as he and his brother were coming down from the top of Snowdon about half an hour after sunrise, their attention was directed to a light spot which seemed to walk with them. On the spot was a coloured bow. Then a second bow appeared, and then another and another till five consecutive bows were seen at once. In one of the bows he saw his own shadow. The fog approached the spot where he stood, and as it approached the outer bows disappeared while the inner bow took brilliant colours and contracted so as to form an entire circle round his shadow. At last, when the fog was about two feet away, he could see the shadow of his own head surrounded by a brilliantly coloured circle. Two seconds afterwards he was surrounded by a dense fog. One single fog bow had often been observed, but he did not know whether more than one had ever been seen.

Professor Forbes said that such phenomenon had frequently been witnessed, but he had never heard of so many as five bows being seen at once; and he confessed that he had sought in vain for an explanation such as that which Mr. Schuster was in search of. Had that gentleman been able to give the size of the bows, and the distance between them when the cloud was a certain distance from him—say fifteen or twenty yards—they might have had some data on which to work.

Mr. T. J. Pearsall said it would also be of importance to determine the amount of darkness between the lines of the bows.

Mr. Glaisher had heard of, and seen, similar phenomena, but not more than three rings.

G. M. WHIPPLE, ON THE PASSAGE OF SQUALLS ACROSS THE BRITISH ISLES.

Mr. G. M. Whipple, Kew Observatory, read a paper on "The Passage of Squalls across the British Isles." After exhibiting the uncertainty attendant upon the investigation of meteorological laws by the aid of observations made over a small part of the earth's surface like the British Isles, owing to the want of well-marked characteristics serving to identify and track out masses of air moving over the country, Mr. Whipple called attention to squalls occurring abruptly, and presenting certain definite features recorded in a conspicuous manner by self-recording meteorological instruments, when they passed over them. The appearance of the instrumental curves at the time of a squall was described and illustrated by means of tracings from the quarterly weather reports

of the Meteorological Committee, and a table was exhibited showing a brief history of twenty-three squalls registered in th reports from 1869 to 1873. From this it appeared that their motion was almost invariably in a direction from west to east, with a velocity diminishing as they progressed. The velocity of the easterly motion was sometimes as high as 100 miles per hour, and fell as low as ten miles ; the rate given by the whole series being thirty-eight miles per hour. Referring to other papers which had appeared on these phenomena, Mr. Whipple suggested that use might with advantage be made of a better knowledge of squalls in issuing storm warnings.

J. PARK HARRISON, ON LUNAR INFLUENCE ON CLOUDS AND RAIN.

Mr. J. Park Harrison said he first brought before the British Association as a tyro fifteen years ago the fact that the temperature of the air seemed to be affected by the time of the moon's age. He followed Sir John Herschel in believing that the moon had a certain influence in either raising clouds to higher elevations or dispelling them. This was consistent with his idea that a certain amount of cloud increased the temperature. It appeared to him clear that it was to the influence of the moon that the alteration in cloud quantities was to be attributed. He said that a tabulation of the amounts of cloud according to the age of the moon, by Professor Schiaperelli, in Italy, showed that the moon affected cloud ; and these results were confirmed by tables of rain arranged in the same way by Mr. Chase in America, and by Mr. Hennessey in India.

The Chairman said it was an important question whether the clouds of day as well as of night were included, as there was a great difference between the two. To determine the problem they wanted the amount of cloud when the moon was above the horizon, and not otherwise, at which time clouds were more continuous, covering more sky than during the day.

Mr. G. M. Whipple suggested that telegraphic communication might be established between Greenwich and Kew, and simultaneous observations taken, so as to determine the absolute altitude of well defined clouds.

BALLOONS AND UPPER CURRENTS.

To the Editor of the Meteorological Magazine.

SIR,—The great American balloon project, though it has collapsed, may not have been altogether in vain.

I am rejoiced that the balloon came to grief—1st, because I apprehended danger to the aeronauts—it appeared to me a fearful risk of human life ; and 2ndly, because it is derogatory to the dignity of science to mix up its advancement with newspaper advertising.

This remark applies with equal force to scientific serials, which ought to be devoted to purely scientific purposes ; for, unless the advertising sheet be kept very select, the periodicals are in danger of degenerating into mere trade circulars.

But though the balloon voyage from America to Europe be neither desirable nor probable, the scheme suggests anew the advisability of employing balloons for the purpose of determining the direction of the upper aerial currents. It might be very useful to ascertain whether there really is an upper westerly current over the Atlantic, and equally so to know the direction of the superposed currents in the regions of the Trades, Cyclones, and elsewhere.

Yet all this might be accomplished without jeopardising human life. On the present occasion, I can only suggest a scheme for accomplishing this—not to state it in its entirety—and ask for the opinion of others.

I propose, then, that trial balloons be used; they may be of two classes. (a). Floating, or as they would be used as bottles upon the ocean, they might be called "Bottle Balloons." It would be for those practised in aeronautics to decide the particular size and formation of these balloons, but I think they need not be very large. The details of their construction must be carefully considered. I would have them weighted, so as to prevent their rising above the desired height, or fitted with valves, which should be self-acting, that is, to be opened by the distention of the balloon in rarefied air. This would ensure their descent at a time which might be calculated. The starting-point, the time occupied in the voyage, and the place of descent, would enable us to calculate the most probable direction of their course. They must be made to float in water, in case of their falling into the ocean.

(b). Captive balloons could be used at some of the great meteorological stations, and constant observations made with them, as with the vane for the lower currents. It would be possible to go still further with this plan, and actually carry out the American idea (avoiding the fearful risk), and making the balloon captive to a steam vessel, the vessel following the lead of the balloon or balloons, which would not be beyond telescopic range.

SAML. H. MILLER.

Wisbech, November, 1873.

THE FROST IN OCTOBER 1873.

Low temperatures are to be expected occasionally in October, but it is not every year that it has so cold a period as the past has been. We have selected for the table those days on which the lowest temperatures most generally occurred, but, as is shown by the following note from Mr. Stow, in some localities the lowest temperature fell on other days.—Ed.

To the Editor of the Meteorological Magazine.

SIR,—Perhaps the following notes of temperature, &c., in Wensleydale, may be of interest for the purpose of comparison. September 27th, max. 71°·8, min. 43°·1 (at Arncliffe I see it is reported to have been 26°); September 29th, min. 28°·6; 30th, 27°·9. October 3rd, max. 66°, min. 54°; 9th, min. 25°·6, 8 a.m., 30°·8, 9 a.m., 37°·5, 9 p.m., 52°; min. on 13th, 29°·6; 15th, 27°; 16th, 28°·8; 19th, 31°·6; 24th, 27° (?); 25th, 24°·8; 26th, 28°; 27th, 24°; 28th, 29°·3; 29th, 29°·5; 30th, 34°·2. It was below 32° in air on 11 days in October, and on grass on 14 days, the lowest being 20°. The 24th was the coldest day, mean about 31°, and on the 27th the mean was 33°. On the 27th it was as low as 29°·7 at 9 a.m. The atmosphere became hazy on the 28th, and the frost less severe.

Rainfall—total in October 3·26 in., of which ·83 in. fell on 1st, and ·43 in. on 31st. On the 1st heavy rain began at noon, and at 5.30 the flood came down the Yore like a low wave. I observed the water rise about 2½ feet in the first two minutes; the phenomenon, I am told,

is not uncommon. Its rate of progression at the point I saw it was about five miles an hour. Snow fell heavily on the hills on the 23rd, and heavy gales occurred on 10th and night of 31st.

I am Sir, your obedient servant,
Aysgarth, Bedale, November 1st, 1873.

F. W. STOW.

Minimum temperature in shade, in October, 1873.

Div.	STATIONS.	28th.	29th.	30th.	31st.
I.	Camden Square	27·4	27·1	26·2	27·4
„	Pinner Hill	—	—	29·0	—
„	Winchmore Hill.....	—	23·0	—	—
„	Harrow	18·0	—	—	—
II.	Addiscombe	26·5	24·5	25·5	28·5
„	Greenwich	27·7	26·7	27·0	28·9
„	Bromley Common	—	23·0	—	—
„	Strathfield Turgiss	24·8	23·2	23·3	26·4
III.	Addington Manor	—	21·0	21·0	—
„	Magdalen College, Oxford...	20·0	—	—	—
IV.	Wereham	—	19·2	—	—
V.	Dartmoor Prison	30·0	33·5	32·0	37·0
„	Druid House, Ashburton ...	32·0	—	32·0	—
„	The Castle, Taunton	—	25·0	25·0	—
VI.	Sansaw Hall, Wem	—	—	27·0	—
„	Brereton, Leamington	—	25·0	—	—
VII.	Leicester	26·2	23·0	27·2	—
„	Coston, Melton Mowbray ...	—	22·0	—	—
„	Calcethorpe Manor, Brigg...	—	27·9	—	—
IX.	Stanley Vicarage, Wakefield	21·0	—	—	—
„	Moorside, Halifax	—	29·5	—	—
XI.	Castle Malgwyn, Llechryd...	19·0	19·0	—	—
XXI.	Twyford, Athlone	24·0	—	—	—

For low shade temperatures at other stations see table, page 161.

Min. temp. on grass during same period.

I.	Camden Square	21·4	21·6	20·9	22·4
II.	Addiscombe	20·5	19·0	18·8	25·0
„	Greenwich	22·1	20·0	22·0	22·9
„	Strathfield Turgiss.....	19·7	17·4	21·3	25·4
V.	Dartmoor... ..	28·0	30·5	29·7	32·5
„	Bodmin	—	—	26·0	—
XI.	Haverfordwest	22·0	—	—	—

ERRATUM.

To the Editor of the Meteorological Magazine.

SIR,—Will you kindly in your next number correct one mistake in my letter of the 16th September, as published in your magazine for the present month? The word “north” in the tenth line should be “south-west.”

The error is so evident from the context, that a correction is almost superfluous; still it is better to be accurate.

I am, Sir, yours &c.,

ALFRED NORTH.

28, Lansdowne Crescent, Notting Hill, W., Oct. 22nd, 1873.

OCTOBER, 1873.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.					TEMPERATURE.				No. of Nights below 32°	
		Total Fall.	Difference from average 1860-5	Greatest Fall in 24 hours.		Days on which ≥ 1 or more fell.	Max.		Min.			
				inches.	in.		Dpth	Date.	Deg.	Date.	Deg.	Date.	In shade	On grass
I.	Camden Town	2.97	+ .38	1.04	12	15	73.4	2	26.2	30	5	13
II.	Maidstone (Linton Park)	3.31	+ .21	.68	23	18	78.0	2	27.0	31	...	...
	Selborne (The Wakes)	3.72	+ .49	1.05	12	15	68.0	3	21.5	29*	10	11
III.	Hitchin	2.48	- .72	1.2	15	15	65.0	2, 3	23.0	29	9	...
	Banbury	1.84	- .59	.41	22	15	70.4	3	22.0	29	...	7
IV.	Bury St. Edmunds (Culford)	3.57	+ .86	.89	12	13	69.0	1, 3	22.0	29	10	14
V.	Bridport	2.49	- 1.54	.34	7	15	70.0	2, 3	24.0	29*	7	...
	Barnstaple	4.46	+ .34	.89	22	19	72.0	2	30.5	29*	...	...
	Bodmin	4.51	- .81	.68	7	24	78.0	19	33.0	28	0	5
VI.	Cirencester	2.36	- 1.13	.41	21	17	...	...	...	...	...	...
	Shiffnal (Houghton Hall)	2.38	+ .14	.46	21	20	67.0	1	23.0	28†	7	...
	Tenbury (Orleton)	2.05	- 1.18	.50	21	17	69.8	1	22.8	28†	9	14
VII.	Leicester (Wigston)	2.01	- .69	.43	22	15	72.0	3	25.0	28	9	...
	Boston	1.37	- .75	.23	12	16	71.0	3	25.0	30	7	...
	Grimsby (Killingholme)	2.31	...	.53	11	16	66.5	2, 3	31.0	28†	2	...
	Derby	2.40	- .44	.72	11	13	67.0	1, 2, 3	26.0	29	7	...
VIII.	Manchester	4.44	+ .63	.79	21	20	68.0	3	26.0	27†	8	9
IX.	York	1.67	- .85	.41	2	16	62.5	10	28.0	25	11	...
	Skipton (Arncliffe)	9.10	+ 2.44	1.64	9	22	63.0	3	21.0	9	...	...
X.	North Shields	2.24	- 1.04	1.08	2	16	62.2	1	30.0	27	3	8
	Borrowdale (Seathwaite)	21.23	+ 4.91	4.20	9	21	...	...	...	...	...	...
XI.	Cardiff (Ely)	5.32	- .43	1.17	22	19	...	...	...	...	...	...
	Haverfordwest	4.43	- .76	.65	6	23	67.0	3	24.9	27	5	10
	Rhayader (Cefnfaes)	3.34	- 2.26	.50	9, 31	20	65.0	...	24.0	...	...	...
	Llandudno	3.98	+ .02	.56	21	21	67.4	1	33.0	26	0	...
XII.	Dumfries	4.83	- .09	1.20	2	23	60.5	10	23.5	27	11	13
	Hawick (Silverbut Hall)	3.91	...	1.10	2	18	...	...	...	...	...	...
	Kilmarnock (Annanhill)	6.08	...	.90	1	24	56.6	5	27.2	27	3	8
XIV.	Castle Toward	8.19	+ 2.44	1.40	7	22	59.0	3	26.0	27	5	...
XV.	Leven (Nookton)	3.73	- .02	.84	2	16	60.0	4, 18	25.0	27	6	18
XVI.	Stirling (Deanston)	6.26	+ 1.35	.76	11	28	56.3	1	21.0	27	10	23
	Logierait	4.20	...	.59	2	19	57.0	17	25.0	24	8	...
XVII.	Braemar	3.89	+ 1.14	.67	31	20	59.2	13	23.0	27	7	24
	Aberdeen	2.56	...	.71	31	20	58.5	12	29.5	9	5	16
XVIII.	Inverness (Culloden)	2.30	- .36	.23	2	21	54.1	9	34.7	27	0	14
	Portree	11.67	+ .89	1.39	19	29	...	...	...	...	...	...
	Loch Broom	9.80	...	1.08	31	29	...	...	...	...	...	...
XIX.	Helmsdale	5.65	...	1.82	31	24	...	...	...	...	...	...
	Sandwick	6.56	+ 1.64	.82	10	28	53.6	18	35.7	21	0	8
XX.	Caherciveen Darrynane Abbey	6.95	...	1.40	8	25	...	...	...	...	...	...
	Cork	2.17	...	.33	6, 29	10	...	...	...	...	...	...
	Waterford	4.19	- .21	.81	30	23	64.0	3	31.0	28	3	...
	Killaloe	6.57	+ 1.55	1.02	1	22	70.0	1	26.0	28	4	11
XXI.	Portarlington	3.58	- 1.55	.86	1	29	66.0	1	27.0	25	4	...
	Monkstown	2.76	- 1.16	1.26	24	18	68.0	3	24.0	15†	11	...
XXII.	Galway	5.50	...	.87	2	23	65.0	3	28.0	27	4	...
	Bunninadden (Doo Castle)	4.81	...	...	...	...	...	...	...	...	...	...
XXIII.	Waringstown	2.49	...	.38	21	17	67.0	3	26.0	24	6	14
	Edenfell (Omagh)	4.00	...	.68	2	24	65.0	1	23.0	25	7	...

* And 30. † And 29. ‡ And 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.

LINTON.—Great atmospheric disturbance on 23rd, when there was T and L, and the bar. fell to 28·48 in. ; it, however, quickly rose again, and on 28th was 30·21 in., a rise of 1·73 in. in five days. Several fine bright sunny days, with a full average of frosty mornings, but only severe on 31st. Winds various, and about the average of fogs.

SELBORNE.—Prevailing winds first three weeks S. W., last week N. E. Sudden change from N. E. to S. W. on 31st; the last week's temp. very low, the average min. being only 27°·3—the coldest week I have ever recorded in October. Fog on 1st, 2nd, 19th (all day), 24th, 25th and 31st; 1st and 25th very dense. frequent white frosts.

HITCHEN.—The lowest temp. (23°·0) ever registered in October.

BANBURY.—High winds on 8th, 10th, 21st and 22nd. Fog on 24th, 28th, 29th and 30th.

CULFORD.—The last week exceedingly cold, the min. on 29th being 22°·0, or one degree lower than was experienced during the year 1872. Mean temp. of the month 46·4 in. Polar winds on four days; equatorial winds on 27 days. T with heavy R on the 8th.

BRIDPORT.—On the 22nd it was blowing a heavy gale till 6 p.m., when it ceased, and fine starlight continued till 12 p.m., then it blew harder and harder, till 4.45 a.m. it blew with hurricane force, quite shaking the house.

SHIFFNAL.—Up to the 13th the weather was mild, the max. averaging 58·7 in., with R almost daily, and on the 21st it rained the whole day, with great fall of bar., followed on 23rd by R mixed with S, and on 24th by TS with heavy R at 5 p.m. from N.; the prevailing winds were from W. and S. W. From 22nd inclusive, frosts nightly to the 31st. Dense fog on 19th and 24th. Vast quantities of acorns and of hips; one red admiral butterfly seen on the 12th, and fieldfares on the 27th.

ORLETON.—Although the first 11 days were generally warm and pleasant, the mean temp. of the month was about 4° lower than the average. Severe frosts occurred frequently, and on the mornings of the 28th and 29th the ther. (protected) fell to 22°·8 each morning, which is lower than any reading in October since 1859. In the latter part of the month the fluctuations in the bar. were very great. On the 23rd the mercury fell to 28·70 in. and on the 28th it stood at 30·30 in. On the 22nd there was a great wind; L was seen frequently on the nights of the 23rd and 24th, and distant T was heard on the 23rd, 24th, and 25th. On the 24th it was tolerably loud and frequent in S. E. On the 23rd a storm of H covered the ground, but there has not been any S.

WIGSTON.—Exceptionally cold during the last ten days of the month. The month proved favourable for agricultural operations, and good progress was made in wheat sowing and lifting potatoes.

BOSTON.—Temp. on 3rd 71°, the highest of the seven years on record, the next highest was in 1869, when 68° was registered. Sharp frosts on 8th, 9th and 25th, on the 30th the temp. fell to 25°, the water in the canal having a thin coat of ice. On 6th and 8th very high tides although the wind along the N. coast was light, varying from W. to N. W. and S. W. The rise of the water above low water in the estuary was 24 ft. 10 in. ; an average spring-tide rising 22 ft. It is most unusual for the tide to rise to such a height except under the influence of a strong N. W. wind.

GRIMSBY.—TS with heavy rain following on the 3rd; stormy night on 10th; H and R on 26th; fieldfares arrived on 28th; latter part of the month cold but fine; altogether a pleasant month; a fine seed time; many rime frosts; great fluctuation of the bar, but no storms here.

MANCHESTER.—H on 7th, 13th, 14th, and 20th.

ARNcliffe.—S on 22nd.

NORTH SHIELDS.—TS on 12th, L on 22nd.

SEATHWAITE.—T on 8th, 20th, and 25th; L on 17th and 20th. Ten days on

which 1 in. or more of rain was registered, five on which 2 in. or more fell, and one (the 9th), when the fall was 4·20 in., the total fall for the month being 21·23 in.

W A L E S .

Haverfordwest.—A very wet stormy month, taken altogether a cold one; very sharp frosts set in on the 24th, and continued till the 29th, during which time the sky was clear and the air calm; the bar. attained a great elevation; the end wet and stormy; L and H on 8th; heavy gales on 21st from N.N.W., and on 23rd from S.S.W.; bar on 23rd 28·88, on 26th 30·10, and on 27th 30·51.

Cefnfaes.—This month has been cold, and severe frost for so early in the season. S on the hills; prevailing winds N.E. and N.W.

Llandudno.—Sea fog passed over at 5 p.m. on 4th; stormy, with a warm wind, on 10th, T during the night; H showers on 13th and morning of 14th; constant H showers on the 20th; stormy with H showers in the afternoon of 23rd, L in the evening, and S on the hills on the 24th.

S C O T L A N D .

Dumfries.—Up to the 23rd, excessively wet; heavy R on 2nd; occasional frost at night; frequent storms with S on 14th and 23rd, after which severe frosts at night with fine days. The close of the month wet and stormy. The mean temp. 2°·7 below that of corresponding month. The frost greatly injured the potatoes, a considerable breadth of which are still to be dug.

Silverbut Hall.—Very stormy on 1st, 2nd and 10th, but the month on the whole has been a mild one.

Kilmarnock.—Heavy gales on the 6th, 20th and 21st; ozone was scarce; considerable frost on 8th, 9th and 13th, and from 23rd to 27th; H and S fell on 20th and 23rd. On 23rd Arran and surrounding hills covered with S; L on 12th; much grain was standing and in stook at the middle of the month, and it was not till its close that the fields could be said to be cleared. Death rate 38 per 1000, principally consumption and fever.

Braemar.—A very favourable month for harvest operations. Auroræ on 15th and 22nd. Lunar rainbow on 5th; L on 7th.

Aberdeen.—Bar., temp., and R all rather below the average, wind pressure slightly above it; TS on 7th, with H; L on seven other days; auroræ on seven days; a cold and rather dry month, with high winds. On the 20th the fields in the interior were in many cases covered with one or two inches of S.

Culloden.—Large lunar halo on 4th, 6th, and 9th, solar halo on morning of 16th, faint aurora on 17th; T on 5th at 4.50 p.m.; L on 6th and 14th; bar. down to 28·52 at 2 p.m. on 22nd.

Portree.—Very wet and stormy; strong gale from S. on 6th. R, sleet or S showers nearly every day, with frost at night; high ground covered with S the whole month, and October has failed this year to be the highlanders' harvest month, for about one half of the corn is still in stook, in very bad condition, and very few of the potatoes are lifted; the ground is quite soaked with wet; upwards of 1 in. of R fell on four days in this month.

Lochroom.—With nearly 10 inches of R, and only two dry days, this month may almost be considered as a continued downpour. Some of the grain and many of the potatoes are still in the fields, and the S nearly down to the bottoms of the valleys. With the exception of December, 1866, and November, 1869, this has been the greatest fall of R recorded here since I began in 1865. On Monday, the 20th, there was a terrific storm from the N.W., and on Monday, the 6th, we had one of the highest tides for many years. Falling stars have been very frequent during the month.

Sandwick.—October has been wetter and colder than the mean. There were gales on four days, and that on the 20th were the strongest we have had for years, being 70 miles an hour. Auroræ on four nights. October is generally our wettest month, but this year the R and wind have been excessive, and injured the grain crops and the potatoes. Flocks of swans arrived on 9th and 15th, very early.

I R E L A N D .

Darrynane.—The rainfall this month is less than in any October since I began to take observations in 1870. Prevalent wind N.W.; H showers on 7th,

13th, 22nd, and 23rd; hoar frost on 5th, 26th, and 27th. The comparative dryness of the month has saved the farmers from a threatened hay famine, a serious matter in this country, which depends entirely upon butter and stock. T on 22nd.

MONKSTOWN.—There was an unusual number of frosty nights (11) without being followed by R, as is usually the case at this time of the year; the min. too is very low, $24^{\circ}0$; T S with 1.26 in. of R on the 24th.

DOO CASTLE.—Wet month. Potatoe digging progressing slowly in consequence. A few nights of severe frost towards the close of the month.

OMAGH.—Weather till the 20th unusually mild and wet for the season; fourth week fine with occasional very hard frosts.

REVIEW.

Negretti and Zambra's Encyclopædic Illustrated and Descriptive Catalogue. 500 pages, large 8vo. Negretti: Holborn Viaduct.

A CATALOGUE, with 3,180 separate items, ranging from watch glasses (1865) to smith's forges (2,014), from 6-horse power steam engines (2,740) to chloroform (3,074), from spectacles at two shillings per pair (1044) to equatorials * at £342 and upwards (1234), may well be described as "Encyclopædic," and is a tolerably distracting subject for a reviewer.

For instance, there are between one and two hundred varieties of thermometers, at prices varying from 1s. to £5 5s., and yet singularly enough, omitting one variety (we pronounce no opinion on its merits), viz., that of the pencil case withdrawing clinical thermometer.

The special features of the catalogue, in addition to its comprehensiveness, are,—(1), the details of several instruments not in any other catalogue; (2), a series of generally well written and correct notes on a variety of subjects. We may enumerate a few of the former: Long Range Barometers by McNeill and Howson, Saussure's and Jones's Hygrometer, Leslie's Thermometric Hygrometer, Prestel's Anemometer; and, to leave Meteorology for a moment, the Sciopticon, which strikes us as a capital modification of the magic lantern. It is, we believe, an American idea, and seems well worth examination by those who wish to avoid the trouble and danger inseparable from the use of the oxyhydrogen light. Of course, in so large a catalogue there are sure to be some errors, but there are very few. A curious one occurs on page 31, in describing Negretti and Zambra's second patent mercurial minimum thermometer, it is stated that "This thermometer, like Negretti and Zambra's patent maximum, has a small plug of platinum wire inserted in the supplementary tube." Considering that their patent maximum has neither "supplementary tube" nor "platinum plug," the appropriateness of the description is not obvious; and, moreover, its price is omitted. With such a multitude of items a good index is indispensable, and we are glad to say that the index, which occupies 34 pages, is worthy of the handsome and instructive volume which it appropriately closes.

* We should be glad to see the orthography of this word settled. Negretti's give equatorial, and it is so given in Arago's *Astronomy* (Smyth and Grant's translation), in Chambers's *Hand Book of Astronomy*, the *Astronomical Register*, and Drew's *Manual of Astronomy*. On the other hand, the Astronomer Royal, in all the Greenwich publications, spells it Equatoreal, so does Hind in his capital *Astronomical Vocabulary*.