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SUNLIGHT.

ALTHOUGH the last few years have witnessed a rapid succession of improvements in the means of measuring the heating power of the sun's rays, and the measurement of their chemical action has not been neglected, we are inclined to believe that the work now before us* will eventually be regarded as one of the most important contributions towards the solution of many problems respecting agriculture and sanitation which at present are beyond the limits even of conjecture.

We cannot in this review do more than bring the subject and the book to the notice of our readers; it is written in M. Marchand's usual lucid style, and though it extends to more than 200 pages, we think that few who begin it will leave it unfinished.

Instead of introducing the subject ourselves we will let M. Marchand do so; although perhaps the language may lose by translation, we shall rigidly preserve the sequence of ideas.

INTRODUCTION.

"Every one knows that the light which the sun scatters through the realms of space is not by any means a homogeneous principle, the prism decomposes it into coloured rays, of which we have a faithful picture in the rainbow, and into invisible rays which are only appreciable through the physical or chemical properties which they possess. The first series reunited constitute again the powerful illuminating white light. The second series are subdivisible into two very distinct groups—one subseries possesses heating properties which, while scarcely sensible in the violet portion of the spectrum, acquires an intensity more and more easily measureable as one advances towards the red end of the spectrum, and attains its maximum effect in the unilluminated space beyond the red extremity of the spectrum. The other subseries, on the contrary, are endowed with a very energetic power of setting in motion the atoms of matter, and giving rise to those phenomena of

* Étude sur la force chimique contenue dans la lumière du Soleil, la mesure de sa puissance et la détermination des climats qu'elle caractérise, par E. Marchand, Pharmacien, etc. Paris: Gauthier-Villars. 8vo., 1874. [The preface bears date March, 1875.]

combination and separation which are the study of the chemist; and they have for this reason been called the CHEMICAL RAYS."

"It is usual to call this chemical action of light ACTINISM! This is not a suitable term; derived form ακτινος it only expresses the radiating force of the sun considered with regard to its illuminating power. I propose its retention for that purpose only, and to designate the chemical power of the solar rays by the word 'ANTITUPIE,' French synonym of αντιτυπια it signifies *reactionary power*, and in order to define more rigorously the force whence it is derived I designate it throughout this memoir by the term '*Photantitupie*,' as I shall call the action of measuring its power '*Photantitupimétrie*.'"*

"This Antitupic power varies in each part of the spectrum, with the nature of the elements submitted to it, but on the whole its distribution may be regarded as the reverse of that of the heating rays. It is sometimes perceptible even in the red rays, and presents there quite a remarkable power when acting upon certain substances, but usually it is in the blue or violet rays that it attains its greatest force. It often extends even beyond the violet into the grey-lavender rays, first recognised by Sir J. Herschel and afterwards by many other observers, and into the entirely unilluminated space beyond them."

"In order to complete this brief and rapid exposition, it is desirable to mention also that lately M. Edmond Becquerel has pointed out the existence in solar light of two other species of rays which he has designated *continuators* and *phosphorogenic*. The latter, which extend from the indigo to beyond the violet possess the property of rendering various bodies, among others sulphide of Barium, luminous in the dark. The former, which are coloured, especially yellow, orange, and red, do not exercise by themselves, according to M. Becquerel, any direct chemical action, but he says they possess under certain conditions the remarkable property of continuing the development of this action when it has been commenced. We shall have occasion subsequently to refer to the mode of action of these two species of rays, and the value of the distinction thus drawn between them."

"To epitomize: the sunlight on reaching the earth's surface consists of an assembly of variously refrangible rays, of which some possess lighting, some heating, and some chemical properties. Let us add finally, for it is worthy of notice, that if the heating rays are deprived of chemical properties, the red part of the spectrum still possesses the power of annihilating the reactions produced in the violet portion, *it even sometimes reverses them*. Thus, for example, white gum Guiacum becomes oxydized when exposed to the air, and of a blue colour when exposed to the violet rays, but if when so tinted it is placed in the red rays it becomes blanched, as Wollaston first showed at the beginning of this century. Thus also a sensitized Daguerreotype plate, of which the

* Although we share M. Marchand's views respecting the desirability of removing the anomaly of designating the chemical rays Actinic, and the word Actinometry is not short, we fear there is little chance for Photantitupimetry—seven syllable words do not thrive on English soil.

surface is submitted to the action of weak solar light, undergoes different changes, according to the portion of the spectrum allowed to fall upon it, and in part of the blue, as well as in the indigo and violet rays, it takes that deep olive tint, which is always produced by prolonged exposure to strong white light, whether direct or diffused. On the contrary, the same surface exposed to the other portion (the red end) of the spectrum remains unaffected, or if previously tinted by exposure to the violet rays, it is speedily restored to its primitive state, that is to say the action previously exerted is destroyed. M. J. Draper, to whom we are indebted for this curious observation, has found moreover that the less refrangible rays, preserve from the action of the more refrangible rays impressionable substances exposed to them."

"By the threefold action above mentioned the solar rays have an important influence on climatology, they illuminate our earth and its atmosphere, and spread over its surface this heating and antitupical power, without which, matter would remain inert, and the world would be lifeless. The illuminating power of light is an important natural agent, but it is not the quality which exercises the most potent influence on all those marvellous phenomena which science studies, and whereof, little by little, and with great labour, it discovers the immutable laws. In fact, as an illuminating agent, light is not absolutely necessary to the support of life—at least of animal life—and it only plays a secondary part in meteorology. It is especially through the heating and chemical rays by which it is accompanied that it exerts so marvellous a power. When unassisted by these rays it is powerless to affect even the most delicate thermometer, or to effect the slightest change in the molecular arrangement even of substances the most sensitive to the action of the chemical rays; it is then even powerless to assist the growth of plants, which only results from the fixation of the carbon which they borrow from the carbonic acid diffused in the atmosphere wherein they live.

The sun, centre of the great planetary system, sheds in every direction, as the result of the violent conflagrations of which it is the scene, sheaves of threefold rays, but these rays may reach the earth deprived of both heating and chemical power, if they come to us reflected from an opaque body. Of this a striking illustration is afforded by the light reflected to us by the moon, which, though readily decomposed into coloured rays by the prism, possesses neither heating nor chemical power,* and is also without appreciable influence upon vegetation."

"As an illuminating power the light emanating from the sun undoubtedly deserves to be treated from a meteorological point of view,

* M. Marchand gives here a long note which we must abridge into a few lines. He begins by saying that this statement is not rigorously exact; of the existence in moonlight of chemical rays we have proof in the possibility of taking excellent photographs of the moon, and M. Marié-Davy has obtained indications of heat-rays by a thermo-pile, placed in the focus of a 9-in. equatorial. As, however, the heat thus indicated was only 0°·000022 F. or $\frac{1}{50000}$th of a degree F., we hardly need concern ourselves with its effects.

but its absorption by the media which it traverses, and its interception by the clouds and vapour of the atmosphere is such as to render it difficult even in the course of a single day to make observations with sufficient frequency to obtain trustworthy mean values. In this respect we shall state further on the results obtained by Bouguer, but under ordinary circumstances all that can be done as regards meteorology is to estimate approximately the amount of cloud."

M. Marchand then states his mode of estimating the amount of cloud, the hours at which he observed it, the mean amount for each month of twenty years 1853-72, and remarks upon the conclusions to be drawn from them.

The author then proceeds to explain the different modes adopted for measuring the total chemical energy of the rays reaching the earth's surface, by Draper, Niepce de St. Victor, Roussin, Bunsen and Roscoe, and Edmond Becquerel. He then describes fully his own method, and the very important conclusions to which his elaborate and long continued observations lead. For all these details, however, we refer our readers to the work itself, and we promise them a varied intellectual treat in its perusal. As a proof of the variety, we may conclude by mentioning two or three points which arise from the investigation, *e.g.*, the question of the height to which the earth's atmosphere extends, that of an open polar sea, and of the total solar energy.

OBSERVATIONS OF CIRRUS.

To the Editor of the Meteorological Magazine.

SIR,—I believe that synoptic observations of the upper currents throw much light on the general laws by which the surface currents of our atmosphere are regulated. Foreign observers are prosecuting this research with vigour. In our islands, I believe I am correct in saying, there are not 15 observers who record separately the motions of the Cirrus. May I, through your columns, implore assistance in this work? If any observers who have not hitherto contributed observations of Cirrus, are ready to undertake the task, they may possibly welcome a few suggestions from one who has worked at it steadily for very many years.

1st, As to locality. Observations are wanted *everywhere*. The accidents of a cloudy sky, fog, &c., often prevent an observation at one station, when it can be made at a neighbouring one. But observers are especially required in the extreme S.W. and N.W. of the British Isles, and in the N.W. of France.

2nd, As to time. Many observers are so wedded to regular hours, that they will not, except at such hours, make observations of upper currents. I have found that a diligent observer, favourably situated, who observes the motions of Cirrus whenever possible, makes them on an average upon 230 days annually. Another observer, who observes for me twice a day, at 8 a.m. and 2 p.m., can make them on 85 days only. It must be remembered, too, that absolute synchronism is of

far less importance in observations of the upper currents than in those of the surface winds, because the changes in the direction of the former are far fewer, and take place on a grander scale than those of the latter.

3rd, As to the mode of observation. It seems hardly necessary to say, that in watching the motions of Cirrus, the observer must be perfectly stationary, and should have some stationary object, such as the corner of a roof, a church spire, or the like, nearly in the line of vision; but I have seen numerous mistakes made from the neglect of this latter precaution, when several layers of clouds are crossing each other.

4th, As to the clouds observed. Let Cirro-cumulus be entered separately from Cirrus. And if there be a particle of doubt as to the type of the cloud observed, let the observation be recorded with a note of interrogation.

I shall be glad to supply printed forms of entry to any persons who may be ready to give their assistance by taking observations, and I ought perhaps to mention, that copies of all Cirrus observations obtained by me are forwarded to Upsala, but if any observers who wish to use my forms already transmit observations on the Upsala forms, I trust that they will continue to do so, as I wish to supplement, and not to interfere with, Hildebrandsson's important enterprise.

Yours truly,

W. CLEMENT LEY.

Ashby Parva, Lutterworth, January 13th, 1876.

P.S.—I imagined (vainly, as now appears from Mr. Birt's letter) that in speaking of the "directions of the movements" of Cirri, I could only be understood to mean "the directions from which they move," and I intentionally omitted all allusion to the position of their streaks or bands on the sky. I am glad, however, that Mr. Birt has directed attention to this latter element, as it is undoubtedly of some, though of inferior, importance. In the forms for entry above mentioned, a column is devoted to it. I have nearly prepared for publication a table of the positions of "Polarization," in the observations of the last decade, and of the relations which these bear to the direction of movement.

For my own part, I have never been able to trace any more connection between the positions of the lines of Cirrus and magnetic or auroral manifestations, than between the latter and the positions of the isobars on an ordinary weather chart. I have before me some synoptic maps of the positions or arrangement of the lines of Cirrus, and also of the directions of the currents in which the Cirri travelled. The latter exhibit every kind of variation of the anti-cyclonic, and of the cyclonic type. I take one of the last-mentioned, that for July 12th, 1875. From Valencia to our east coast there existed a uniform upper current from N.W., and the lines or belts of Cirrus stretched from N.N.W. to S.S.E. In France the upper current was from W.

and W.N.W.; the position of the belts I do not know. In Austria from W.S.W.; belts stretching from W.S.W. to E.N.E. At the entrance of the Baltic the Cirri moved from W.S.W., and in Scandinavia from S.W., the belts stretching from S.W. and S.S.W. to N.E. and N.N.E. A relation of dependence is here traceable between the form of the belts and the directions of movement. A relation may also be noticed between the directions of movement and the distribution of pressures and winds at the earth's surface. But can anyone find, not an association of ideas, but a real relation, between the "polarization" of the Cirri on that day, and the magnetic and electric elements? If he can, he will have discovered a skeleton-key to half the problems of meteorology—a "*sesame*" for its most hidden treasures.

W. C. L.

January 19th.

SNOW MEASUREMENT.

To the Editor of the Meteorological Magazine.

SIR,—I am glad to see by your last issue that this question is likely to be futher discussed. At present the results are, I fear, not trustworthy.

As a small contribution, I send you the following figures, shewing the results of my efforts to measure the snowfall in December last.

The four gauges, A, B, C, D, stand at the four corners of a square of 5ft. 6in., each is 5in. in diameter, 1ft. above the ground, and 433 ft. above sea level. A is a gauge of ordinary pattern; B is likewise of ordinary pattern so far as the funnel is concerned, but the receiving bottle is placed underground; C is a Snowdon pattern; D is a Snowdon pattern with the bottle underground.

DATE.	A	B	C	D	Miles of Wind.
November 30	·015	·010	·010	·010	170
December 1	·005	·005	·015	·010	160
,, 2	·400	·390	·455	·456	67
,, 3	·005	·005	·005	·005	58
,, 4	·025	·020	·020	·020	80
,, 5	·110	·115	·140	·100	145
,, 6	·015	·015	·010	·020	158

On the 2nd December the snow was about 8in. deep on the ground. It had filled the funnels, and then was piled up in a bunch to windward, being supported by a buttress of snow resting againt the outside of the gauge. How much ought to have gone into the gauges I could not tell, but in order to measure I cut down through the bunch straight with the edge of the gauge and melted what was in and over the funnel; the result was that the deepest funnels had most snow. This, however, was not the case on the 5th, but why D had less than any of the others I can't tell.

Since then I have made an attempt at a snow gauge in the form of a

cylinder, 18in. deep, 5in. diameter, set 6in. in the ground in the middle of the square with, so far, the following results.

Date.	A	B	C	D	Snow gauge.	Wind.
January 8 ...	·040	·040	·050	·040	·050	283
,, 13 ...	·110	·075	·130	·115	·150	93

I don't much believe in measuring the depth of the snow on the ground ; generally a great deal melts before the snow begins to lie.

The question seems worth discussion. I hope some of your readers in more snowy districts will be able and willing to help.

I am, &c.,

EDWARD E. DYMOND, F.M.S.

REMARKABLE PHENOMENON.

To the Editor of the Meteorological Magazine.

SIR,—I think the extraordinary circumstance I am about to relate will excuse me for intruding on you.

On Sunday morning, January 23rd, the sea in Rye Bay was frozen over. The ice was a quarter of an inch thick for three or four miles out. The temperature inland was by no means cold.

The local paper states : — "A Phenomenon.—Early on Sunday morning last Rye Bay presented an unusual and singular appearance, being covered with an unbroken sheet of ice, almost an eighth of an inch in thickness, for more than three miles out at sea.

Several boats which, were out, experienced a difficulty in making their way through it, and the cold was intense. Within the memory of some of the oldest sea-faring men such a circumstance has not been witnessed before."

I see the paragraph says only an eighth of an inch ; the sailors told me a quarter.—I am, &c.

E. B. CURTEIS.

Leasan, near Rye, February 3rd.

OZONE.

To the Editor of the Meteorological Magazine.

SIR,—A letter in your magazine of January, 1876, from the pen of Dr. Palmer, of Tipperary, Ireland, on "Ozone at 6,000 feet above sea level," has attracted my notice, on account of the most complete unacquaintance therein displayed with all the results of the years of toil of those who have made the study of atmospheric ozone *the* pursuit of their lives. Dr. Palmer exposes starch tests in the old fashioned cages, and speaks of his observations made in this way as "trustworthy," and then adds, "For the striking inequality of the results, I attempt no explanation." I should not have noticed this letter, but that greater men than Dr. Palmer have recently similarly distinguished (?) themselves. I observed an abstract of a paper by Professor Pettenkoffer, of Munich, in the "Central Blatt für Agrikultur Chemie," of April, 1875, in which this eminent man seems to have *only now* discovered

that the depth of colour of the so-called ozone tests has much to do with the force of the wind! There is some excuse for the Professor, because he is a foreigner, but there can be no reason why an Irishman should write as if in perfect ignorance of everything that has been written on the subject of ozone for many years past.

I hope that Dr. Palmer will not consider that the foregoing is written in an unkind spirit. It is not intended to be so. It is really, however, most disheartening to me, that a professional brother should write in so verdant a manner.

I am, Sir, yours respectfully,

CORNELIUS B. FOX, M.D., F.M.S.

Chelmsford, Essex, January, 1876.

PREVALENT WINDS.

To the Editor of the Meteorological Magazine.

SIR,—Amongst the many and varied observations of your widely-spread correspondents, there are but few that take up the subject of the direction in which the wind blows, leaving that matter, I presume, in the hands of the sea-going class alone. But there is assuredly no reason for this; for although it may not exercise so important an influence on land as it does at sea, it is unquestionably a very powerful agent for good or evil, in the one as well as the other, and in the rural districts, at least, it forms the principal guide the residents have to the coming weather, and a long period of observation has enabled them in a general way to judge tolerably accurately, for a few hours at least, what meteorological changes, if any, are likely to happen. But it is not my purpose to advert to this matter, but to point out in which way the winds of the past year have differed from the averages of the preceding 26 seasons in which the direction the wind was blowing at noon each day was recorded. At the same time, it is only fair to say, that only the eight cardinal points are taken, and in the observations, the nearest approach to any one of them was read as being such :—

	Total No. days in all.		Yearly average.	Record of 1875.
East wind	431	being an average	16·6	16
S.E. ,,	825	,,	31·7	32
S. ,,	1399	,,	53·9	87
S.W. ,,	2151	,,	82·7	51
W. ,,	1108	,,	42·6	38
N.W. ,,	870	,,	33·5	18
N. ,,	1082	,,	41·6	63
N.E. ,,	1560	,,	60·0	57
Not ascertained or changeable	70	,,	2·7	3

From the above it will be seen that the N. and S. winds have been more prevalent the past year than usual, and the S.W. and N.W. fewer, the others not remarkable. But on looking, during the past year, over the table giving the figures for each year, it was easy to discern that the prevalence of N.E. winds indicates a dry season. For instance, I find as many as 115 days are noted as having N.E. winds in 1855, when the rainfall of the year was under 21 in. In like manner, 87, 71, and 79 days are recorded for 1858, 1864, and 1870, respectively, all being dry years; but it is also remarkable that some

of the heaviest rains we have had have been with the wind in that direction, thus verifying the saying of the district, that when it does rain with a N.E., "it does not half do it." But in a general way, the S.E., S., and S.W. winds, bring most rain, the last named being also generally the highest, while, on the other hand, we certainly have fewer due E. winds than are met with elsewhere. On this head, however, I would like to have the records from other places, as the subject is certainly as well deserving of study as some of the abstract ones into which meteorology seems to be divided.

JOHN ROBSON.

Linton Park, Maidstone.

UNDERGROUND THERMOMETERS.

To the Editor of the Meteorological Magazine.

SIR,—I was pleased to see the subject of underground temperature brought forward in your last Magazine, for, as you say, there are very few instruments in this country for determining the temperature of the soil, and what there are, will undoubtedly bear improvement.

The form of instrument you propose has many advantages over the old pattern, which has practically a limit to its length, both in making and planting, while the tube you describe, might I suppose easily be driven to any depth by an application of the apparatus used for sinking tube-wells without any fear of damage; but on reading your paper it occurred to me, that if the instrument were used for depths of more than five feet, the long wooden rod would be rather awkward, and that reading might be facilitated by having the thermometer mounted in about a foot or eighteen inches of rod, and suspended from the cap by a chain.

I do not quite understand the nature of the cotton plug above the thermometer, but if air-tight (and it would be useless unless it were so) the pressure of the air would make it rather difficult to raise the thermometer. Would it not be practicable to have a plug that would only act when the thermometer was at rest? for instance, on the top of the thermometer fix a plate of wood or metal, nearly fitting the pipe, on which fasten a pear-shaped wash-leather bag, partly filled with mercury; when the thermometer was at the bottom and the chain slack, the bag would swell out and fill the tube, but when the chain attached to the top of the bag was pulled, the bag would elongate and rise without any difficulty. These suggestions of course apply only to deep underground thermometers, but for any length less than five feet the thermometer as you describe it, is vastly superior to the old form; it can be read with any degree of accuracy of which the instrument is capable, without the very unpleasant task of putting your face on the ground, and from its great simplicity should, I think, be much cheaper than the instrument now in use, besides being decidedly more durable.—Yours faithfully,

H. S. WALLIS.

1, *Springfield-road, N.W., Feb. 3rd*, 1876.

KEW VERIFICATION.

NOTICE.

The Kew Committee of the Royal Society give notice that in order to afford to the public greater facilities for the verification of instruments at Kew than have hitherto existed, they are prepared to under take the transport of instruments, &c., from London to Kew and back, free of charge.

With this object they have made arrangements for Mr. R. Strachan, of the Meteorological Office, 116, Victoria Street, to receive at that office any instruments intended for verification.

As soon as the instruments have been verified and are returned to London, notice will be sent from Kew to the parties concerned.

By order of the Committee,

ROBERT H. SCOTT, *Hon. Sec.*

Kew Observatory, Jan. 29th, 1876.

[The above circular has been sent to some of our contemporaries as an advertisement, but not to us; as, however, our interest in the progress of meteorology is far greater than our desire to accumulate £ s. d., and we believe that the new arrangement is a good one, we present the Kew Committee, not with a gratuitous advertisement, but with prominent insertion. Moreover, we desire to impress upon our readers the opinion which we entertain, that it is very unwise for those who devote their time to meteorological observations to risk wasting all their labour, and leading to the dissemination of error, by using unverified instruments. Hitherto the danger, and the time occupied, in sending instruments to and from Kew, has been a somewhat unfair tax upon the opticians. This difficulty is swept away by the new arrangement, and we trust that henceforth the influence of the manufacturers will be exerted in support of the purchase of verified instruments; in fact, probably the maker who announced that all his instruments were verified, would secure a priority with many observers. No one would think of buying gold or silver without the Hall Mark; we hope to see the day when no one who claims to be considered a meteorological observer will use an unverified thermometer. We therefore hope that not only will the arrangement now announced succeed, but that it will soon be found desirable to organize a branch establishment in London and thereby avoid sending to Kew at all, except in rare instances.]—ED.

FINE DAYLIGHT METEOR.

Bombay, December 17th.—On the 11th of December, Her Majesty's ship "Crocodile" was in latitude, 13° 30′ N.; longitude 52° 30′ E., about 2 days from Aden, and about 5.45 p.m., a most extraordinary phenomenon made its appearance in the sky. The sun was setting at the time, and the smoke of a Peninsular and Oriental steamer, we had lately passed, was disappearing in the west, when almost instantaneously a band or streak of light appeared in the heavens, about 15° above the horizon, and 30° north of W., it extended upwards some 25°, in a zig-zag form, like a quaint signature written on the sky, in magnesium light, and looking at it sideways, it seemed to form roughly the letters "ANHIRTY." The streak at its lower extremity was 1½ft. broad, getting thinner as it approached the zenith. It did not seem to keep quite still, but to creep out sideways as do the

beams of an aurora borealis. The sunset was most beautiful at the time, or rather the sun had just disappeared below the horizon in orange and greenish-gold tints, but this trail, though, like burnished steel or the sheen of tar spilt on water, with its purplish tints, was too uncommon and uncanny to strike one as beautiful. It shone till darkness enveloped it—viz., for some ten or fifteen minutes. No one on board the "Crocodile" had ever seen anything like it before, and many were the conjectures as to its cause. Some attributed it to electricity; some said it was a sort of dust carried up from the desert, suspended at such an angle that the sun's rays suddenly impinging on it gave it the appearance I have described. The wags said it was the mirage of the trail of the great sea serpent. Any way it was a most remarkable sight, and one that will never be forgotten by those who had the good luck to see it.

December 20th.—The Peninsular and Oriental steamer "Gwalior," Commander Babot, arrived here on the 18th, having experienced bad weather in the Bay of Biscay, which caused her to be two days late. When two days from Aden her people also were astonished by the sight of a huge meteor, which they describe as coming through the sky like a ball of fire, the size of the sun, throwing out sparks that it appeared to hit and to throw up the water, whence they consider it was within seven miles of them when it fell. It left a luminous trail behind, which at first was straight but gradually took a zig-zag form, and no doubt it was this we saw in the "Crocodile." They all talk of its wondrous appearance.—*Morning Post, January 10th*, 1876.

SUPPLEMENTARY TABLE OF RAINFALL IN JAN., 1876.

[For the Counties, Divisions, Latitudes, and Longitudes of these Stations, see Met. Mag., Vol. XI., p. 28.]

Station.	Total Rain.	Station.	Total Rain.
	in.		in.
Acol	·89	Llanfrechfa	2·77
Hailsham	·61	Castle Malgwyn	2·32
Andover	1·70	Heyope	1·89
Strathfield Turgiss	·89	Rhug, Corwen	1·21
Addington Manor	2·02	Port Madoc	2·47
Oxford	1·68	Melrose	·86
Cambridge	2·03	Cessnock, Glasgow	3·39
Sheering	1·06	Gruinart	...
Ipswich	1·11	Keith	1·02
Diss	2·44	Strathconan	4·49
Swaffham	1·85	Springfield, Tain	·96
Compton Bassett	2·43	Skibbereen	2·61
Hessary Tor, Dartmoor	3·70	Glenville, Fermoy	3·44
Teignmouth	1·07	Tralee	3·03
Torrington	1·88	Newcastle, W. Limerick	1·13
Trevarrick, St. Austell	1·42	Kilrush	...
Taunton	·90	Kilkenny	·93
Bristol	...	Twyford, Athlone	1·68
Sansaw	1·93	Kilsallaghan	·60
Cheadle	1·69	Ballinasloe	1·77
Ashby-de-la-Zouch	1·87	Kylemore	9·66
Coston, Melton Mowbray	1·54	Bangor	5·37
Bucknall	1·66	Carrick on Shannon	2·19
Walton, Liverpool	·89	Rockcorry	1·65
Broughton-in-Furness	3·87	Warrenpoint	2·26
Stanley, Wakefield	·84	Bushmills	1·67
Gainford	·31	Buncrana	2·19
Shap	4·15		

REVIEW.

The Theory of the Causes by which Storms Progress in an Easterly Direction over the British Isles, and why the Barometer does not always indicate real vertical pressure. By ROBERT TENNENT, ESQ.—From the *Proceedings of the Royal Society of Edinburgh*, July 5th, 1875.

THE laws of storms find in Mr. Tennent a radical reformer, without mistake. While the majority of meteorologists who have dealt with the subject regard surface friction as an element of retardation to the progress of storms, the theory is advanced in this paper, that the progress itself is the result of surface friction. This theory may be summarised as follows :—

When a barometric depression is formed, it will tend to move forward in the direction in which the supply of air is most scarce, and by doing so will be able to procure the necessary amount of supply. The equatorial currents which in our latitudes occupy the front segment of the depression, have a horizontal source of supply, and having been drawn from a long distance over the earth's surface, are subject to great retardation from the inequalities of that surface. The polar currents in the rear derive their supply from a vertical source, and are fed by upper currents, whose motion is impeded only by the comparatively unimportant friction of the subjacent portions of the atmosphere. The depression is in consequence filled up or supplied with difficulty by the equatorial currents in the eastern, and with comparative facility by the polar currents in the western segment. "There are thus two different modes of inflow towards the low central barometer; one is an advantageous, the other a disadvantageous form. It is by this latter mode that the gradient is lowered. It takes place with inclined columns, resulting from rapid upper and retarded surface currents. Much of the work of inflow is thus thrown upon the uppers. To enable them to maintain their superior velocity, they themselves must be adequately supplied by the uppers in advance. This is accomplished by outward extension; they advance forward to procure the requisite supply from the still atmosphere ahead, which now begins to inflow spirally. It is to this advancing line of removal that the term, 'curve of outward propagation' is applied. It may be illustrated thus :—If a river, flowing down an incline, does so uniformly and at an equal rate of speed, removal will equal restoration; but if in the lower part of its course a more rapid removal is inaugurated, while supply above remains as before, the curve representing the point at which the increased removal begins to travel upwards will represent the forward movement of this curve of outward propagation or extension."

On Mr. Tennent's theory, a change of hydrostatic pressure produced at any given point in a fluid previously at rest, will propagate itself most readily in the direction in which the currents established have the greatest surface friction to overcome, a statement which we regard as paradoxical.

From an observational point of view, we think that the author's conclusions are open to some serious objections. In the first place, there is involved the supposition that in the front segment of a depression the *upper* as well as the under currents flow *inwards*, spirally towards the centre, whereas the contrary appears in a large number of cases to have been almost demonstrated by observation. In the second place, since on an oceanic surface the amount of friction is exceedingly small, as compared with that on a land surface, we should expect that, on Mr. Tennent's theory, depressions would be, *cæteris paribus*, much the greatest in the interior of large continents, and comparatively unimportant in mid-ocean; yet we find the reverse to be commonly observed. And lastly, for the same reason, it is difficult to conceive why a depression situated on the east coast of an extensive continent. such, *e.g.*, as that of North America, should ever be found to travel eastwards, if eastward propagation is the result of an excess of surface friction.

The adoption of this theory would necessitate the most sweeping changes in the construction of weather charts. The isobarics are regarded by Mr. Tennent as often absolutely uninterpretable with reference to the real inflow of air. In order to represent the conditions of real pressure, they must be greatly widened out in the front of every depression, so as to be drawn through figures of very unequal observed pressure. Thus the isobar 30·00 in the rear of a depression, where real and observed pressures are supposed nearly to coincide, will have to be widened out in the front of the depression, through localities where a pressure of about 30·20 is observed. The attempt to execute this process will, we believe, indicate to the reader, more effectively than our criticisms, the inaccuracy of the theory; for it will exhibit the reality of the general relation between the gradients of observed pressures, and the directions and velocities of observed winds.

It is indispensable to the author's hypothesis that barometric pressure should be found to be actually less with equatorial, than it is with polar currents. In support of this, Strachan's Paper in the *Proceedings of the Meteorological Society* (misquoted, by the way, as the "English Meteorological Magazine") for June, 1869, is referred to. "Not proven," is all that we can say of this assumption. The common assertion that "the barometer falls lowest in S.W. gales," is true only in a modified sense, and as an accident of geographical position. An actual barometric minimum is invariably accompanied by a calm; but as the track of depression centres is ordinarily to the N.W. of our islands, and generally on the polar side of districts in the temperate zones, our barometric oscillations are commonly greatest with equatorial winds. At Stykkisholm, where the track is ordinarily on the S. and E., the lowest barometer is commonly observed with polar winds.

While dissenting, however, from Mr. Tennent's conclusions, we welcome every attempt to grapple fairly with questions which are confessedly among the most important, as well as the most intricate, in general meteorology. Z.

JANUARY, 1876.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1860–5	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Date.	Min. Deg.	Date.	No. of Nights below 32°. In shade	On grass
			inches	inches.	in.								
I.	ENGLAND.	Camden Town	·94	— 1·01	·32	21	11	54·8	31	18·9	12	17	21
II.		Maidstone (Linton Park)	1·24	— ·82	·27	22	15	57·0	31	17·0	9	...	...
,,		Selborne (The Wakes)	1·43	— 1·84	·26	21	12	51·0	3	21·0	19	14	18
III.		Hitchen	1·86	— ·28	·92	21	11	49·0	3	15·0	11	23	...
,,		Banbury	1·73	— ·36	·65	21	11	51·5	3	20·0	16	20	..
IV.		Bury St. Edmunds (Culford)	1·80	— ·07	·83	21	12	53·0	31	21·0	8	20	25
V.		Sprowston	2·04	...	1·09	21	12	...	...	...	...	...	...
,,		Bridport	1·38	— 1·71	·32	13	10	...	...	...	...	...	...
,,		Barnstaple	2·13	— 1·39	·67	20	11	55·5	4	29·0	8	...	...
VI.		Bodmin	1·62	— 3·57	·46	20	15	55·0	3	25·0	10†	9	13
,,		Cirencester	2·46	— ·54	1·18	21	6	...	...	...	...	...	...
,,		Shifnal (Haughton Hall)	1·60	— ·30	·79	20	6	51·0	31	17·0	12	19	24
VII.		Tenbury (Orleton)	2·34	— ·19	·92	20	12	53·7	3	19·5	12	18	20
,,		Leicester (Belmont Villas)	1·87	...	·73	21	12	53·0	31	16·5	12	17	...
,,		Boston	1·82	+ ·11	·80	21	9	53·0	3	20·0	16	16	...
VIII.		Grimsby (Killingholme)	1·39	...	·40	20	13	52·0	31	26·0	9‡	10	...
IX.		Mansfield	1·33	...	·46	21	8	53·5	31	15·8	8	16	..
,,		Manchester	1·74	— ·78	·70	20	9	52·5	31	23·0	12	15	20
X.		York	1·02	— ·56	·31	12	8	...	...	...	...	...	...
,,		Skipton (Arncliffe)	2·83	— 2·81	·81	19	17	52·0	31	16·0	8	20	...
XI.		North Shields	·70	— 1·41	·20	12	10	52·2	31	25·0	9	11	21
,,		Borrowdale (Seathwaite)	10·91	— 5·45	2·87	22	16	...	...	...	...	...	...
,,	WALES.	Cardiff (Ely)	...	...	...	...	...	...	...	...	...	...	...
,,		Haverfordwest	3·12	— 1·93	1·00	20	10	52·0	31	22·5	8	12	16
XII.		Machynlleth	3·26	...	·85	20	13	...	...	...	...	...	...
,,		Llandudno	1·19	— 1·35	·55	20	6	55·0	28	22·2	9	...	...
XIV.	SCOTLAND.	Dumfries (Crichton Asylum)	1·86	— 2·33	·30	22	17	50·4	24	15·7	11	15	17
XV.		Hawick (Silverbut Hall)	1·20	...	·44	19	13	...	...	...	...	...	..
XVI.		Kilmarnock (Annanhill)	1·70	...	·34	19	21	54·0	4	23·0	9,10	11	16
,,		Castle Toward	3·49	— 2·80	·45	22	20	52·0	19	20·0	10	12	...
,,		Quinish	...	...	...	...	...	...	...	...	...	...	...
XVII.		Balfour	...	...	...	...	...	..	...	..	..	...	...
,,		Grandtully	2·09	...	70·	19	12	...	...	...	...	...	...
XVIII		Braemar	1·61	— 1·52	·57	19	15	50·0	31	13·8	14	12	24
,,		Aberdeen	1·14	...	·27	3	12	51·5	31	22·5	9	11	16
,,		Loch Broom	4·46	...	·72	22	22	...	...	...	...	.	...
XIX.		Portree	11·87	— 1·22	1·83	27	27	..	...	...	...	...	...
,,		Inverness (Culloden)	·88	— 1·40	·36	24	19	53·0	31	21·1	10	8	19
XX.		Helmsdale	1·39	...	·30	18	18	...	...	...	...	...	...
,,		Sandwick	2·92	— ·37	·38	19	22	51·2	24	26·4	10	3	8
,,	IRELAND.	Caherciveen Darrynane Abbey	3·33	..	·83	29	17	...	...	...	...	...	...
,,		Cork	2·61	...	·65	29	19	...	...	...	...	...	...
XXI.		Waterford	2·24	— 2·62	·61	29	17	52·0	2	26	10	..	...
,,		Killaloe	...	...	...	...	...	...	...	...	...	...	...
XXII.		Portarlington	1·13	— 2·88	·25	30	21	55·0	4	23·5	8	15	...
,,		Monkstown, Dublin	·36	— 3·03	·10	29*	9	...	...	...	...	...	...
XXIII		Galway	2·95	...	·47	27	21	56·0	28	24·0	11	11	...
,,		Ballyshannon	1·85	...	·54	19	16	...	...	...	...	...	...
		Waringstown	1·25	...	·23	29	17	55·0	3	20·0	13	12	15
		Edenfel (Omagh)	1·44	...	·33	29	14	53·0	3,4	22·0	21	14	0

* And 16. † 11. ‡ 12 & 16.

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

METEOROLOGICAL NOTES ON JANUARY.

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

ENGLAND.

LINTON.—Wintry from 6th to 17th, the ground being covered with S during that time, which drifted considerably on the 14th, with sharp frosts on 6th, 8th, 9th, 12th, and 16th, yet not remarkably severe, and the remainder of the month mild, the beginning and the end particularly so. Fogs frequent, and but little sunshine. Winds never high, mostly S. and S.E.; on the whole a mild month for January.

SELBORNE.—A very cheerless and foggy month. Fog on 19 days, at times very dense. Prevailing wind first half of the month, N.E., afterwards variable. Blackbird first heard singing on the 4th.

CULFORD.—The weather during the month may be considered as sseaonable with perhaps an unusual prevalence of polar or easterly wind. Mean temp. 35·9.

BODMIN.—Mean Bar. 30·28, the highest mean I have ever registered. Mean temp. 42·1. This month and the preceding one have been remarkable for the very small rainfall, much less than I have ever registered during the past 26 years.

SHIFNAL.—After an unusually mild Christmas, the new year opened with slight frost, and although the number of frosty nights is large (19), the intensity was small. Notwithstanding the sudden and vast R fall of the 20th and 21st, amounting to 1·27, this has been the driest January since 1864. The month was remarkable for the amount of fog and mist, accompanied, as usual, by a high bar. and easterly wind. The R on 20th commenced from the S., with drizzle, at 10 a.m., and so on till night, when it changed to N.W. and fell heavily, followed next day by S mixed with it till night, and hard frost on the following day. The fog which came on the 28th was sudden and intense, and lasted all night. Snowdrops peeping on the 24th, and both they and aconites in blossom on 29th. Throstle first heard on the 29th.

ORLETON.—The mean temp. was nearly 1° below the average, and the ther. was at or below 32° on 20 nights; the sky was cloudy; the bar. on the morning of the 15th inst. stood at 30·42 (uncorrected). The deposit in the gauge was chiefly snow and was small except on the 20th and 21st, when small R set in about 8 p.m., on 20th increasing to heavy rain at midnight and continuing till about 6 a.m., on 21st, when it suddenly changed to S in dense flakes, which covered the ground and continued falling thickly till 4 p.m., clearing at 8 p.m.; in the 24 hours 1·82 in. fell. On the hills the S was deep and lodged upon the trees so as to break and uproot many of them. The wind was generally moderate. 13th great darkness and haze from 7 to 9.30 a.m.

LEICESTER.—Great changes of temperature during the month. With the exception of the severe frost on the 11th there were only four nights on which the temp. fell below 28°. Heavy S on the 21st. Very foggy on 27th and 28th.

GRIMSBY.—Aconites in flower on 7th. Thrush first heard on 20th. A month of seasonable weather; never severe; high bar.; and much fog. Vegetation backwarder than last year. Several pleasant days.

MANSFIELD.—Dull and damp; though little rain has fallen the earth has appeared charged with moisture.

ARNCLIFFE.—With the exception of the 19th, when there was a fall of ·81, I never registered so little in the month of January.

WALES.

HAVERFORDWEST.—S in small quantities on the Precelly range on the 1st, and again on the 21st; no S in the lowlands; one of the finest and driest Januarie, for many years; seasonable frosts with clear skies; the last four days overcasts misty, and damp, with high bar.

LLANDUDNO.—Primroses in the hedges on the 2nd. A crocus gathered on 17th. Mazereon in flower on 18th. S on the distant hills on 22nd, and patches of it up to the 31st. A fine dry month, the last ten days unusually mild for the time of year, No S fell during the month, and rain on six days only. The min. registered 22·2 on the 9th, so far the lowest temp. of the winter.

SCOTLAND.

DUMFRIES.—Rainfall greatly below the average, a fourth only of the fall in last January. Mean temp. the same as last year (40·02). Heavy fall of S on 9th, followed by several days of hard frost; latter part of the month mild but windy.

HAWICK.—A terrible hurricane blew from the W. on the 23rd and 24th, which blew down the gable end of a house in Hawick, and made locomotion very difficult for gentlemen and almost impossible for ladies; the noise made by the wind among the timber in the joiner's yard was tremendous.

CASTLE TOWARD.—Much wind and rain; only very little snow, a sprinkle on the 8th, but frequent falls of sleet. Altogether a stormy month, and not favourable for out-door operations.

ANNANHILL.—Frequent frosts; registered temp. going down on the grass to 32° or under on 16 days; S fell in the middle of the month; L seen on the evening of the 2nd, and aurora on the 11th. Day sky usually cloudy, but some of the evenings cloudless, though in the low grounds fogs appeared frequently with the frosts.

BRAEMAR.—An unusually fine and mild month.

ABERDEEN.—Bar. and mean temp. above the average (19 years), and rainfall greatly below it. A month of mild weather, with frequent high winds and little S.

LOCHBROOM.—Exceedingly like its predecessor, fine and open, the latter part mild and genial, like spring; indeed, the bushes are beginning to bud, and the primroses are in a flourishing state.

PORTREE.—A wet and squally month; a strong gale all day on 23rd; TS at 11.45 p.m. on 19th; lunar halo on 30th; heavy H showers on the 20th, and S on 21st.

CULLODEN.—Slight aurora on the last night of the old year; thick fog on morning of the 6th; lunar halo on 11th; stormy from S.S.W. in evening of 23rd and during the night of 24th; pressure from 16 to 25 lbs. on square foot.

SANDWICK.—January has been drier and warmer than the mean. The ground white with S only on two days. There were five gales of wind, 50 miles an hour or more; that on the 18th was the strongest, being 70 miles an hour for three hours; aurora on 14th, 20th, and 22nd.

IRELAND.

DARRYNANE.—First fortnight dry and easterly winds, the rest of the month foggy and gloomy, but mild, with W. and S.W. winds; frost from 9th to 15th inclusive, and on 21st and 22nd.

MONKSTOWN.—With the exception of May, 1871, when only ·35 fell, this month (·36) is the smallest amount measured here in any month. The month was in general fine and mild, with southerly winds, and the atmosphere moist, yet without R; slight frost occurred on six mornings.

BALLYSHANNON.—The month as a whole has been unusually mild and spring-like, and very favourable for the preparation of the ground for cropping, which will soon begin. The rainfall has been light (1·85), 2·62 in. less than the corresponding month last year.

WARINGSTOWN.—A singularly fine month, with a week or ten days of bright frosty weather, succeeded by a mild dry thaw. Rainfall very much less than I have ever measured before; the average of the last 14 years is 3·32, this month 1·25, being—2·07. The driest January in that period (previously) 1864, 1·55.

OMAGH.—The finest and driest January on record here, and with the exception of occasional intervals of dry frost, may also be called the mildest.