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THE LAW OF STORMS.

By W. R. BIRT, F.R.A.S., F.M.S.

Author of the Handbook of the Law of Storms, the Hurricane Guide, &c., &c.

THE number of the Meteorological Magazine for February, 1874, opens with a short article "On the Direction of the Wind in Violent Storms," in which the following sentence occurs:—"All at once we are told that these rules are incorrect, that by obeying them a captain may actually steer into destruction, and, in fact, that our supposed gem is but an imitation." A knowledge of the "Law of Storms" cannot be complete unless it assists a captain to distinguish an ordinary from an abnormal cyclone, such as are shown in Figs. I. and II., Vol. IX., p. 1. Incurving storms have hitherto been suspected to exist only in the southern hemisphere, unless Mr. Meldrum's researches should prove them to be the rule and not the exception in the Indian Ocean; in that case suspicion would be converted into certainty. We are aware that Captain Toynbee suggested, at the meeting of the Meteorological Society in December, that the Atlantic hurricane of August 20 to 24, 1873, was of this character, and recommended that synoptic charts should be constructed in order to test so important a modification of the generally-received theory of the circular cyclone.

The object of the following remarks is to show that we need not *wait* for the result of an elaborate investigation before we can put into the hands of seamen a code of laws for avoiding the dangerous parts of incurving storms similar to that which he now possesses of the ordinary cyclone. The laws of the one follow as corollaries from those of the other. Fig. 1 shows the direction of the wind in a circular storm. Fig. 2 shows the direction of the wind in an incurving storm moving towards the north-east, supposing such incurving storms to exist in the northern hemisphere. On inspecting these figures it will readily be seen that the westerly winds are differently situated in each. They are consequently the *crucial* winds distinguishing the incurving from the circular storm. In an ordinary cyclone, westerly winds characterize its southern margin and its southern radius. In an incurving storm moving towards the north-east, westerly winds characterise the western radius. Not only are westerly winds found on

Fig. 1.

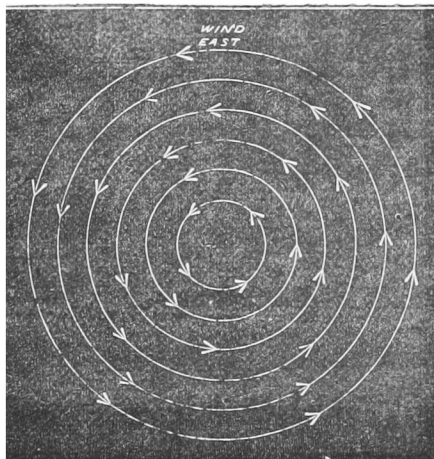
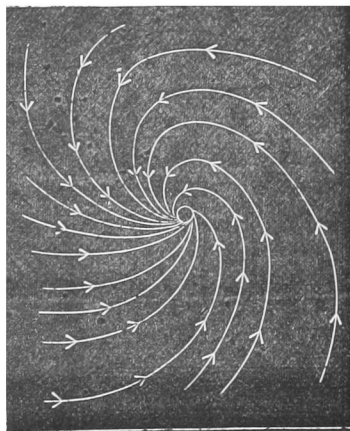
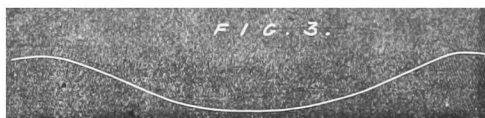


Fig. 2.



different radii of the two kinds of storms, but the barometer behaves differently with westerly winds in each. To a homeward bound vessel the westerly is a fair wind, and if the wind backs to south-west with a falling barometer the ship is gaining on a circular cyclone moving towards the north-east. If, on the other hand, the wind veers to north with a rising barometer, the cyclone is leaving the ship. Nothing during the last forty years has, we believe, affected the general principle that the barometer curve across the section or chord of a cyclone is of the form of Fig. 3, varying in depth according to distance from the centre.



Now, on the southern radius of a circular storm moving towards the north-east the ship is in the receding quadrant with a rising barometer, and if a captain sails or steams with a westerly wind at a safe distance from the centre, he will in all cases of circular storms experience a *rising* barometer, especially should his course be more eastwardly than that of the cyclone. *The case is, however, different in an incurving storm; he falls in with a westerly wind, and instead of finding any tendency in the barometer to rise, he observes that it falls very rapidly.* From this he ought at once to know, not that the generally-received theory is at fault, but that he is in a storm that does not conform to that theory, and also that, from what we know of incurving storms, he is actually sailing or steaming on the western radius of one, and no wonder that if by keeping on his course he should find himself in the dangerous vortex, much more dangerous than the vortex of a circular storm, because of the rapid changes of wind near it. Who knows that the fate of many a fine steamer has not been sealed by the captain

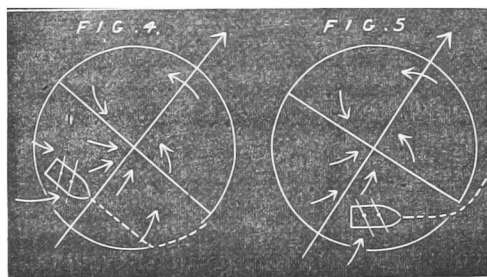
having mistaken the westerly radius of an incurving storm for the southerly radius of a circular one ; and if during the last twenty years a "Storm Service" had been instituted by our Government for the special purpose of at once discussing the data furnished by "logs" with the energy and ability of a Redfield, a Reid, a Piddington, a Thom and a Meldrum, would not England have discovered, not that the gem by which innumerable lives and untold millions of property had been saved was but an imitation, but that another gem had been added to it by which a captain on watching the wind in conjunction with his barometer would at once know in which kind of cyclone he was.

A question here arises, How is a captain to act when, having a fair wind from the westward for his voyage, he finds that every knot he advances its force increases and his barometer falls ? The reply is simple ; the circumstances in which he finds himself are such as to assure him that he is not in an ordinary cyclone (the circular motion of such a storm having been proved over and over again), but in a cyclone that does not conform to well-established rules, and just as if he were sailing or steaming on the axis line of a cyclone going south and finding his westerly wind increasing in force with a falling barometer, he would edge away to the south-east to avoid the centre, so in just the same way in an incurving storm with a westerly wind blowing directly to the centre he would, as in Fig. 4, break off his course, stand to the south-east, fall into the south-west wind, bring his barometer well up, and cross the receding semicircle on a chord parallel with a diameter at right angles to the course of the storm ; in fact, so far as a westerly wind in an incurving storm moving towards the north-east is concerned, the manœuvre is precisely the same as that for avoiding the centre when on the axis line of a circular storm moving south in the northern hemisphere.

It is necessary to bear in mind that the above deduction depends entirely upon the hypothesis that incurving storms in the northern hemisphere are of the reverse form of those given by Mr. Meldrum for the southern, the wind blowing directly to the centre being west in a storm advancing to the north-east in the northern, instead of east in a storm advancing to the south-west in the southern hemisphere. In both instances the westerly and easterly winds blowing *to the centre* occupy the left-hand segment of the receding semi-circle of the storm.

A most important matter of inquiry is the following :—According to fig. 4 the stream of air blowing directly to the centre *crosses* the left-hand segment of the receding semi-circle. Is it always so situated, or is the incurvature of such a character as truly to follow the advancing semi-circle *as a wake* ? If so, the most dangerous wind would be from south-west were the storm moving towards the north-east, and just as a commander would, to avoid the centre, edge away to the eastward in a circular storm on a south-east course ; so, in an incurving storm on a north-east course, he would, if sailing or steaming directly towards the

centre with a south-west wind, force increasing and barometer falling, avoid it by standing to the east, as in fig. 5.



It is not at all unlikely that between the circular storm on the one hand, and the incurving on the other, every possible phase may occur, but this by no means prevents rules for the guidance of captains being devised, taking the circular theory as the basis of such rules. To do so, however, would take up by far much more space than could be afforded in these pages; nevertheless, we have one or two remarks to offer. Such a code of laws relating to incurving storms should be framed without delay. Delay, as has been well said, means, in this case, "destruction," and nothing can excuse those who are in authority if they do not at once select the fittest meteorologist, or rather cyclonologist, for drawing up such a code. But few, if any materials are required, and the work may be accomplished very speedily. A further remark bears upon the examination of masters and mates by the Local Marine Boards in the "Law of Storms." The mode of distinguishing between circular and incurving storms should hold a prominent place in all such examinations. The examples given above do not amount to a tithe of those necessary for meeting the cases which may occur in the Northern Atlantic alone, but as an example of the rules that in our opinion ought to be framed we give the following:—

"If in the Northern Atlantic a homeward bound vessel experiences a westerly wind which *increases* in force, the barometer at the same time *falling* rapidly, the commander may conclude that instead of being on the southern radius of a circular storm advancing towards the north-east, he is really on the western radius of an incurving storm travelling in the same direction, and for avoiding the centre to which in this case the westerly wind is hurrying him, he must steer to the south-east, keep his barometer well up, and resume his course when he has reason to believe that the storm is well to the north of him."

To the Editor of the Meteorological Magazine.

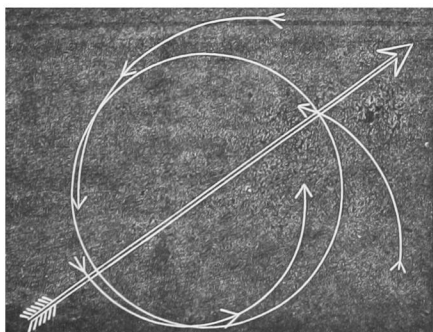
SIR,—One who has devoted fifteen years of pretty close study to a particular problem, and to questions connected with it, is entitled to a hearing thereon, even though his conclusions are opposed to those of men who are confessedly the highest authorities on the subject. But this is especially the case at a time when these authorities are at variance among themselves.

In our own latitudes, the wind commonly incurves only to a slight, but yet to an appreciable extent, towards centres of depression. I have found that at the aggregate of all European stations, the mean inclination of the surface wind towards the lower isobars, amounts to a little above 20° . At the place from which I write it is $28^{\circ} 22'$. At fifteen of the stations from which daily telegraphic returns are received at the English office, the collective mean deduced from daily observations carried on for several years is $20^{\circ} 51'$. The incurvation is commonly, however, considerably higher at inland than at maritime situations. It is also much greater in the front segment of an advancing cyclone than in any other position; and the mean inclination of south-easterly winds in the British Isles, is nearly four times as great as that of north-westerly winds. The amount of inclination is independent of, or at least bears no definable relation to, the intensity of the cyclone.

For a description of the method by which these results have been obtained, and by which any person who is at the pains to do so may verify them, as well as for a full discussion of them, which would be too lengthy for the pages of your magazine, I may be permitted to refer to the last July number of the *Journal of the Scottish Meteorological Society*.

Passing from what I claim to be ascertained fact, to what is almost purely theoretical, I may state my *belief*, that while in every part of the globe the winds incurve generally towards the districts of depression, this inclination will be found to be considerable only in the front segment of an advancing cyclone. If this view be correct, the rules hitherto accepted by naval men for the determination of the position of storm-centres will need only slight qualification. The question of indraft will then be divested of the immense practical importance which you attribute to it. It will, however, continue to be one of the highest moment in a scientific point of view, and too much labour cannot be concentrated upon it.

The accompanying figure represents, I think, the direction of wind in a cyclone progressing to N.E. more correctly than either of the diagrams which appear on page 1 of your last number. The circle is



intended to represent the isobaric, the smaller arrows the direction in which the winds are blowing, and the large arrow that in which the whole circulation is advancing. *Mutatis mutandis*, the representation will apply to cyclones advancing in any direction, or in either hemisphere.

Yours truly,

W. CLEMENT LEY.

Breinton, Hereford, Feb. 23rd, 1874.

THE AURORA BOREALIS OF FEBRUARY 4, 1874.

To the Editor of the Meteorological Magazine.

SIR,—In reply to an inquiry of Mr. Hughes in his remarks upon the Aurora of February 4, I particularly noticed the flashes so like distant sheet lightning; I did not observe these, however, for a longer time than 10 minutes (from 8.5 to 8.15); they appeared in W.N.W., where some clouds lay near the horizon: the coruscations extended to an altitude of 45° : I have often seen them as *rapid*, but never before so *bright* as to resemble lightning. I also noticed two features during this display to which allusion has not been made in your columns (1) the *dome* shape of the Aurora at 8 p.m. which was well defined for about 5 minutes, the corona being situate near the zenith, close to β Aurigæ: there was a considerable pink glow at this time. (2) I observed that a patch of brilliant white streaks of Aurora in the N. at an elevation of 45° , had a slow, steady motion among the stars from E. to W. (the streaks pointing from N. to S); this was at 8.30.

I am, Sir, yours truly,

G. WARREN.

Merton Villa, Cambridge, February 21st.

To the Editor of the Meteorological Magazine.

SIR,—Your suggestion that the main part of the aurora of the 4th inst. was between the North and the South of England, is undoubtedly correct, at least as regards the early part of the evening, for it appeared in the south here. If the same features were visible both here and at Crowborough, or at Guildford (whence J. R. Capron has sent me an account of the aurora), the lower part was probably about 50 miles above the earth, or at most 70; but if the same features were not seen from these places, of course their height must have been far less. The tops of the streamers may have reached a height of several hundred miles.

The chief features seen here were a broad arch, whose south edge was in Orion from 6.40 to 7.40 p.m.; a large bright protuberance from that edge, which moved westwards, and an arch of rays, which at 7.42 suddenly became extremely brilliant, and whose south edge was at the corona. After that, much of the aurora was in the north. I did not see the "lightning-like flashes" mentioned by W. C. Hughes (p. 10), unless they were of the same nature as the wave-like bands he mentions; flashes of that kind were very bright here.—Yours truly,

T. W. BACKHOUSE.

Sunderland, February 28th, 1874.

To the Editor of the Meteorological Magazine.

SIR,—Having seen the several communications respecting the aurora of the 4th February, and your notice of my previous remarks sent you, in the last number of your Magazine, I have much pleasure in sending you herewith a copy of my notes of the Aurora, taken at the time.

“At about 6.15 on Wednesday, the 4th February, an aurora commenced in the northern part of the sky, which gradually went down towards the south.

7.15.—An arch from W. to E., streamers shooting up from it.

7.25.—Light more diffused, a few streamers at N.W.

7.30.—An arch of light from W.S.W. to E. ; no streamers.

7.35.—Bright line of light from W.S.W. to E. ; no streamers.

7.40.—A faint irregular line of light, from W.S.W. to E.

7.45.—Diffused light.

7.50.—Same as 7.45.

7.55.—Streamers shooting down from zenith all round.

8.—Bright light at N.N.E., streamers N.N.E. and N. A sharp S.E. breeze.

8.10.—Streamers N.E.

8.15.—Streamers S.S.E. At 9 o'clock there was no perceptible aurora. Braystones and London, will, I think, be nearly 300 miles apart.

I am, Sir, faithfully yours,

WILLIAM HENRY WATSON.

Braystones, near Whitehaven, March 2, 1874.

[We see from a notice in our excellent contemporary, the Austrian *Zeitschrift*, that aurora was observed generally throughout West Russia and Sweden, also at Vienna as a faint yellow illumination of the northern horizon about 8 p.m., and at Prague between 7.30 and 9 p.m., although the sky was partially overcast, a white glimmer was noticed in N. and N.W., especially near the horizon. Magnetic disturbances were reported from the above localities, and also Tiflis and Barnaul in Asiatic Russia.—Ed.]

THE WINTER.

To the Editor of the Meteorological Magazine.

SIR,—A considerably deficient Greenwich rainfall in April and May, 1873, and scarcely any rain in the last thirteen or fourteen days of September, constituted my chief “grounds” for predicting that the winter of 1873-4, was “nearly certain to be rather severe.” Since 1834, a rainfall below 2.4 in. in the Spring period (April and May), has almost invariably been succeeded by a winter temperature (including March) in defect of the average. Such was the case in 1870-1, 1863-4, 1855-6, 1844-5, 1840-1, 1838-9, and 1837-8. The only exception was 1857-8, and even in that winter February and part of March were rather severe. The only years in which an extremely small rainfall (or no rain at all) appears to have been registered in the last thirteen or fourteen days of

September, near London, were as follow:—At Stratford, in 1810, when no rain fell in the last fourteen days; in 1837, when only $\cdot 03$ in. fell at Greenwich; in 1844, when only $\cdot 01$ in. fell; in 1870, when nothing fell, and in 1873, when no rain was registered in the last thirteen days of September, at Greenwich. A cold winter followed in each case. September, 1865, was a very dry month, but $\cdot 16$ in. fell on the 21st. It thus appears that 1873, furnishes the first instance of very dry weather in the latter half of September not being followed by a colder winter than usual. I do not, however, regret this, because it has led me to inquire into the cause of it, and in prosecuting that inquiry I have been led to take a wider survey and adopt a more comprehensive law. I have thus found that one source of error lies in limiting the rainfall data to Greenwich. I ought to have taken the mean of a number of stations extending over a large area. I also found that the rainfall of the summer months (as well as uniformity of mean temperature) modified the apparent influence of the spring rainfall on the coming winter. A law of great simplicity and accuracy, just such an one as I have long been searching for, came out in this way. The rule applies to every year without any exception. Your readers will find in the table plus against plus and minus against minus in uninterrupted succession for a quarter of a century back, which certainly exceeds anything of the kind I ever saw. I think I may fairly say that it is the best table I ever gave or have ever seen. This is very satisfactory. Some of your readers will probably like to see the law and table referred to. Under these circumstances I trust it will be no great encroachment on your space to publish them in your next number for their perusal.

GEORGE D. BRUMHAM.

Barnsbury, March 3rd, 1874.

P.S. With reference to Mr. Vernon's statements, allow me to say that I predicted a lower *minimum* temperature for February, 1874, as compared with February, 1873, not a lower mean. I distinctly said, "the mean of February, 1874, may not be so low as in last winter." Those forecasts were fulfilled. The minimum temperature of last month at Greenwich was considerably lower, and the mean not so low as in 1873. I think it would be advisable for Mr. Vernon to read what he attempts to discuss. In that case, with ordinary intelligence he would not have so grossly misrepresented what Mr. Glaisher says at page 65, of No. 97, of the Quarterly Returns of the Registrar-General. In point of fact he could not then have said, as he does on p. 7, of your last number, "that since 1771, there is no case of two successive Februaries greatly below the mean."

SIR,—I beg to be allowed to make one remark about the temperature of the month of February, which has been specially referred to by your correspondent, Mr. Vernon.

By the annexed table, taken from the Greenwich returns, it will

be seen that the month in question has, for ten out of the last fifteen years (1859-1873), been *above* the average, and for only five *below* it; and, moreover, that the excess in each of the ten years has, in nearly every case except 1873, been *greater* than the defect in each of the five years. Therefore, unless a secular change has come over the month of February in favour of a much higher temperature than the average of the last 102 years, is it not reasonable to expect that not only the temperature of the present month will be below the seasonal mean, (which, down to the present date, 23rd, bids fair to be the case), but also that it will follow suit for several years to come, or at any rate that the deficiency will greatly predominate over the excess?

I do not know on what grounds Mr. Brumham makes his predictions, nor do I believe in predictions of coming weather for any particular month, to the extent to which he goes; but surely he, as well as any other theorist, is entitled to fair play, and should not be so discouraged by being told that "predictions, if continued long enough, will *invariably* fail."

Mean Temperature of February.

1859	43°·1	+ 4°·9	departure from average of 88 years
1860	35·7	— 2·6	" " " 89 "
1861	42·1	+ 3·9	" " " 90 "
1862	41·1	+ 2·8	" " " 91 "
1863	42·1	+ 3·9	" " " 92 "
1864	36·0	— 2·3	" " " 93 "
1865	36·6	— 1·7	" " " 94 "
1866	40·5	+ 2·2	" " " 95 "
1867	44·7	+ 6·4	" " " 96 "
1868	43·0	+ 4·6	" " " 97 "
1869	45·3	+ 6·9	" " " 98 "
1870	36·2	— 2·3	" " " 99 "
1871	42·4	+ 3·9	" " " 100 "
1872	44·8	+ 6·3	" " " 101 "
1873	34·3	— 4·3	" " " 102 "

Yours truly,

C. O. F. CATOR.

Parkside, Beckenham, 23rd Feb., 1874.

To the Editor of the Meteorological Magazine.

SIR,—I am certainly surprised to read Mr. Vernon's letter attacking Mr. Brumham's predictions, both from the terms which he employs and also from his facts and arguments.

Mr. V. quotes Mr. Brumham's prediction, that the *minimum* temperatures of January and February will be below those of 1873, and then alleges as against it that the *mean* temp. of January is not less, and this he calls a refutation! However, I will help Mr. Vernon's argument to this extent, that the *minimum*, as well as the *mean*

temp. of January was *not* less than last year, and so far Mr. B.'s prediction was not fulfilled. But the minimum of *December* was *very much* less than that of 1872, and as the prediction had reference to the whole winter, more or less, I think this must be taken into account. But with regard to *February* Mr. B.'s ideas have been fully verified. He predicted a lower *minimum* and a higher *mean* temp. than that of 1873. The Greenwich minimum for February, 1873 was 25°; for 1874, 21° to this day. Unless the remainder of the month should prove *very* cold, he will also be right respecting the *mean* temperature.

I will next take Mr. Vernon's unaccountable assertion, that no two consecutive Februarys greatly below the average temp. have occurred since 1771. This is a simple mis-statement of fact, as the following instances will show, taken from Mr. Glaisher's tables :—

Feb., 1771	33·4	Feb., 1799	36·4
„ 1772	34·2	„ 1800	34·1
„ 1773	34·9		
„ 1777	35·8	„ 1843	36·0
„ 1778	35·6	„ 1844	35·2
		„ 1845	32·7
„ 1784	31·9	„ 1864	36·0
„ 1785	30·4	„ 1865	36·6

I do not, of course, know the exact value in degrees which Mr. V. attaches to the word “greatly,” but the above are some of the coldest Februarys on record, and just about equivalent on the average to the temp. of the month in question, viz., 34·4. We must also bear in mind that in consequence of the higher average of late years, the two Februarys, 1864 and 1865, were relatively very cold, although they would not have been so much so 70 years ago. Besides, even if this alleged fact were so, does Mr. Vernon mean to say it is anything more than a coincidence? Does he mean to say it is a law of nature that you do not get two cold Februarys in succession? Mr. V. rails against predictions, but here is a prediction with a vengeance! If he does not attach any importance to it, why does he adduce the fact (as he considers)? But Mr. V. does, in point of fact, put it forward as a prediction, because he gives as a reason against believing in Mr. Brumham's predictions of a cold February, the alleged circumstance (erroneous, as I have shown) that we have not had two cold Februarys in succession for the last 100 years. So much for the man who deprecates predictions!

Mr. Vernon may say prediction is “mere moonshine,” that there is “no ground for predictions,” &c., but I beg to observe that this is merely his opinion, and not by any means to be laid down in this lofty style as a dogmatic truth. I am, myself, after considerable study, of a directly opposite opinion. I have not, indeed, the slightest faith in almanack predictions, giving the exact weather for any particular day or week, but I am satisfied the *general character* of a coming

season may often be determined with a fair amount of accuracy by certain antecedent circumstances of rainfall and temperature. Will Mr. Vernon, for instance, venture to deny that a warm and dry April foreshadows a fine summer? or that a very dry and cold November foretells a mild winter? Let him go carefully into the figures of past years and see if it is not so.

It is quite a new idea to me that Englishmen are to wait for "leading European meteorologists" to show the way in any branch of science. Rather let us be more worthy of the old historic fame of England, whose sons have hitherto rather *led* than *followed* wherever the laws of nature were to be investigated. Mr. Vernon may depend on it, he will not be able "to put an end" to discussion in this way.

I will only add, that I have now been in the habit of seeing and hearing Mr. Brumham's predictions for some years, and, with very few and partial exceptions, I have found them remarkably correct; for instance, in the magazine for December, 1872, he predicted for that winter a mild December and January, and a cold February, which, I need not say, proved exactly the fact.

I am, Sir, faithfully yours,

F. TAYLOR.

19, Canonbury Park Square, London, 24th Feb., 1874.

THE ORTHOGRAPHY OF THE WORD EQUATORIAL.

To the Editor of the Meteorological Magazine.

SIR,—Your correspondent, Mr. Bushell, is correct in his surmise that his former letter was not sufficiently explicit; a circumstance which I much regret, as it led me into the impropriety of occupying valuable space in your excellent magazine with a letter which was irrelevant to the subject intended to be brought under discussion.

It now appears that the question was not respecting adjectives ending in *ial* simply, but in *orial*. This was not apparent in Mr. Bushell's former letter. Indeed, such an interpretation of his language seemed to me to be excluded by the fact of his having said, "We have *armorial*, *editorial*, *manorial*, and a hundred others after the same model;" for, as regards adjectives ending in "*orial*," we have not, I believe, half that number. I know of only twenty-seven. Of course, such adjectives could be created by the score; but I speak of those which have been accepted and are in use; and I doubt not that Mr. Bushell intended to do the same, though, perhaps, he used the expression "a hundred" for an indefinite number. It is so used sometimes. A little girl once told me that she had seen the Lord Mayor's show "a hundred" times.

I agree with him that there is not in the English language an instance of a noun that ends in *or* making *oreal* in the termination of the adjective formed from it. Unquestionably the proper spelling of the word under discussion is *equatorial*.

G. WASHINGTON MOON.

TEMPERATURE IN NORTH YORKSHIRE.

To the Editor of the Meteorological Magazine.

SIR,—Some of your readers may care to know that a minimum thermometer placed in a small louvre board screen, attached to a wall on the top of Pen Hill (1,800 ft.) registered 15° between the 6th and 23rd of February, the maximum during the same period being 42° . Here (470 ft.) the minimum was $17^{\circ}8$ (on two nights), and the maximum $50^{\circ}2$. I mean to put a rain gauge on the top. On the 6th, when I placed the thermometers there it was 3° warmer in the shade, and 5° in the sun on the hill than in the valley, but on the 23rd it was 9° colder in shade and 7° in sun, the weather on both occasions being cloudless, calm, and clear. The frost from the 9th to the 12th was very sharp, the river being full of ice, and the waterfalls and rapids presenting a singular appearance. The temperature of the water fell to 32° .

I am, Sir, your obedient servant,
F. W. STOW.

Aysgarth, February 25th.

THE METEOROLOGICAL SOCIETY.

THERE was an unusually large number of Fellows present at the meeting of this Society on the 18th ult., and the papers and discussions amply repaid their attendance. The papers were "General Remarks on West Indian Cyclones," by Mr. F. H. Jahneke, which led to a long discussion, in which the president (Dr. Mann), Messrs. Eaton, Laughton, Scott, Strachan, Symons, Capt. Toynbee, and others took part. Two papers by Mr. Hicks upon special forms of thermometers were then read, of which we postpone our notice until our next, in which we hope to refer to a number of new instruments. Lastly, there was a paper by Mr. R. H. Scott, F.R.S., upon a water-spout in Argyleshire, which led to a very lively series of remarks on waterspouts in general. Several new Fellows were balloted for, and the meeting adjourned.

SCOTTISH METEOROLOGICAL SOCIETY.

THE half-yearly meeting of this Society was held at Edinburgh on January 29th, Mr. Milne Home, of Wedderburn, in the chair. The report of the Council was submitted, and also one from the Committee charged with the investigation of the relations between Meteorology and the herring fishery. Mr. T. Stevenson brought before the meeting a proposal for establishing chains of storm stations at short distances apart, and provided with good barometers, so as to determine more accurately the velocity of the wind due to any given gradient. For observations of this class special schedules have been prepared.

FEBRUARY, 1874.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.						Days on which 0·1 or more fell.	TEMPERATURE.						No. of Nights below 32°	
		Total Fall.	Difference from average 1860-5	Greatest Fall in 24 hours.		In shade	Max.		Min.		On grass					
				Dpth	Date.		Deg.		Date.	Deg.		Date.				
													inches	inches.	in.	
I.	Camden Town	·91	—	·31	·58	26	16	54·5	28	22·4	11	15	18			
II.	Maidstone (Linton Park).....	1·31	—	·20	·41	26	11	59·0	28	18·0	6	15	...			
III.	Selborne (The Wakes).....	3·43	+	1·72	1·39	26	13	50·0	27*	21·0	9	16	16			
IV.	Hitchen	1·41	+	·15	·74	26	12	49·0	14†	17·0	5	17	...			
V.	Banbury	1·95	+	·52	·85	26	15	52·0	14‡	20·5	6	15	...			
VI.	Bury St. Edmunds (Culford).....	·75	—	·67	·39	26	8	52·0	14‡	18·0	10	14	16			
VII.	Bridport	2·45	+	·39	·50	26	14	54·0	15	22·5	9	12	...			
VIII.	Barnstaple	2·81	+	·73	·36	25	17	54·5	15	30·5	20	...	...	
IX.	Bodmin	5·40	+	2·61	1·48	25	16	52·0	23	33·0	10	0	7			
X.	Cirencester	2·39	+	·78	·60	26	13	...	...	...	...	...	...
XI.	Shiffnal (Haughton Hall) ...	2·41	+	1·52	·60	26	16	50·0	14	21·0	11	14	16			
XII.	Tenbury (Orleton)	3·06	+	1·49	·84	26	14	54·2	14	21·0	9	14	14			
XIII.	Leicester (Wigston)	1·84	+	·50	·47	26	10	54·0	27*	21·0	5, 10	...	...	
XIV.	Boston	1·57	+	·36	·56	26	11	56·0	26	20·0	6, 7	14	...			
XV.	Grimsby (Killingholme)	1·02	...	...	·60	26	13	52·0	14	22·0	11	12	...	
XVI.	Derby	1·45	—	·03	·27	26	15	54·0	14	21·0	11	16	...			
XVII.	Manchester	1·59	—	·36	·50	26	11	54·0	28	20·0	11	14	18			
XVIII.	York	1·35	—	·03	·44	26	13	50·0	27	20·0	11	13	...			
XIX.	Skipton (Arncliffe)	3·12	—	·55	·75	26	16	...	...	...	...	...	...
XX.	North Shields	·96	—	·57	·45	26	13	50·0	26	22·7	11	14	16			
XXI.	Borrowdale (Seathwaite).....	10·50	—	·88	2·22	14	17	...	...	...	...	...	...
XXII.	Cardiff (Ely)	3·03	+	·96	·49	14	15	...	...	...	...	...	...
XXIII.	Haverfordwest	4·73	+	1·87	·93	28	12	51·6	26	26·0	9	8	15			
XXIV.	Rhayader (Cefnfaes).....	4·09	+	1·11	·90	26	10	51·0	...	19·0	...	...	...
XXV.	Llandudno	1·46	+	·11	·44	26	13	57·4	21	26·2	11	6	...			
XXVI.	Dumfries	1·35	—	1·20	·28	26	16	50·5	28	21·0	11	12	17			
XXVII.	Hawick (Silverbut Hall).....	2·16	...	...	·65	15	12	...	...	...	...	...	...
XXVIII.	Kilmarnock (Annanhill).....	1·06	...	...	·33	16	13	51·6	15	23·5	9	6	14	
XXIX.	Castle Toward	1·54	—	2·20	·40	17	14	50·0	13§	...	...	7	...	
XXX.	Leven (Nookton)	1·05	—	·65	·20	26	12	53·0	21	19·0	11	18	25			
XXXI.	Stirling (Deanston)	·99	—	2·01	·23	14	17	50·0	14	17·3	11	17	20			
XXXII.	Logierait	1·66	...	...	·84	26	11	52·0	21	18·0	11	14	...	
XXXIII.	Braemar	2·54	+	·56	1·80	26	8	48·0	21	19·5	11	15	24			
XXXIV.	Aberdeen	1·37	...	...	·56	26	21	52·6	5	24·8	11	10	19	
XXXV.	Portree	4·84	—	5·39	·97	27	21	...	...	...	...	...	...
XXXVI.	Loch Broom	1·76	...	...	·56	26	16	...	...	...	...	...	...
XXXVII.	Inverness (Culloden)	·52	—	1·36	·19	27	10	53·7	21	24·0	10	4	21			
XXXVIII.	Helmsdale	·77	...	...	·26	19	14	...	...	...	...	...	...
XXXIX.	Sandwick	1·39	—	1·09	·36	20	17	50·0	20||	27·3	11	3	12			
XL.	Caherciveen Darrynane Abbey	5·54	...	...	1·19	10	27	...	...	...	...	...	...
XLI.	Cork	5·41	...	...	1·17	11	21	...	...	...	...	...	...
XLII.	Waterford	2·98	+	·95	·46	25	17	52·0	14	33·0	28	...	...	
XLIII.	Killaloe	2·43	—	·47	·58	25	17	55·0	18	28·0	28	7	10			
XLIV.	Portarlington	1·54	—	·49	·29	26	23	52·0	20	25·0	8	6	...			
XLV.	Monkstown, Dublin	3·22	+	1·19	1·75	25	14	56·0	14¶	25·0	6	12	...			
XLVI.	Galway	2·68	...	...	·37	17	18	55·0	8	28·0	10	3	...	
XLVII.	Ballyshannon	1·63	...	...	·28	2	18	43·0	14	29·0	9	2	...	
XLVIII.	Waringstown	2·20	...	...	·81	25	15	55·0	14	22·0	9	11	16	
XLIX.	Edenfell (Omagh).....	1·32	...	...	·20	25	18	50·0	20**	22·0	8	14	...	

* And 28. † 15. ‡ 27. § 16. || 21. ¶ 22. ** 24.
 +Shows that the fall was above the average; —that it was below it.

METEOROLOGICAL NOTES ON FEBRUARY.

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

ENGLAND.

LINTON.—A dry fine month up to the 26th and 27th. Frosts from 3rd to 13th, the sharpest being on 6th and 11th, with only a slight shower of S on 10th. Winds mostly north during the first half of the month, afterwards variable, but high on 17th and 26th; bar. high till 13th, then less steady. Excepting that the frosts rendered the roads very dirty, the month may be considered a fine and dry one, with never sufficient S to cover the ground.

SELBORNE.—A very damp, cloudy, and cold month; 18th, a few flakes of S at 8 a.m.; 26th, driving R from S.E. all day (1.39); 27th, T at 4 p.m., with H and R at Hartley, 1 mile distant. Fogs and white frosts frequent during the month.

BANBURY.—High wind and heavy R on 26th; fogs on 6th, 20th, 24th and 28th.

CULFORD.—The mean temp. of this month, as well as the max. and min. are all considerably below that of January, as is also the rainfall (.75); S only fell on one day (the 9th); easterly and westerly winds have been equally divided, each prevailing on 14 days. From the great mildness of January vegetation is in an unusually forward condition, which the diminished temp. of February has somewhat checked, although not to an injurious extent.

BRIDPORT.—Tremendous S.S.E. gale commenced at 6 p.m., on 25th, continuing the whole of the 26th and night; 27th, sun shone beautifully, but there was a HS; gales also on 11th and 14th.

BODMIN.—This month, like January, has been remarkable for its mildness.

SHIFNAL.—A true "February fill dyke," the wettest since 1848 (except 1872, when 2.89 in. fell); from 12th to 28th, inclusive, R daily with two exceptions (23rd and 24th); the fall of .60 (with S.E. wind) on 26th, greater than any since June 3rd last; but although rain fell on 15 days there was frost on 14 nights; ice on the 11th $1\frac{1}{2}$ in. thick. Aurora on the night of the 4th. Winds most variable throughout, coming from all points except N.E.; very strong from S.E. on 25th, 26th, and 27th. Crocuses open on the 19th; blackbird first heard on the 20th.

ORLETON.—The first eleven days were dry, and generally cloudy, with frequent frost, occasional fog, and high bar., on the morning of the 4th it stood at 30.41; The remainder of the month was rainy, with a variable temperature, the average was nearly 2°·5 less than the mean of the month. A fine display of aurora after sunset, till 8 p.m. on the 4th. No T heard or L seen.

WIGSTON.—Slight S showers on the 8th and 9th.

BOSTON.—The weather generally mild and open, except from the 4th to the 12th, when we had frost sufficient to allow of skating on the river for 2 days; on the 11th the min. temp. was only 20°, while on the 15th it never fell below 45°, a difference of 25° in four days; 4th, brilliant display of aurora in N.

GRIMSBY.—The fall of rain in December, January, and February to 26th only amounted to 1.64. The winter has been so unusually dry that the country will be ill-prepared for meeting the heat of summer. Crocuses began to flower on 1st, hepatics and snowdrops in full flower on 18th; apricot began to blossom on 24th, peach on 28th; rooks began to build on 26th.

MANCHESTER.—S on the 18th; high wind on 25th; stormy on 26th; lunar halo on 26th and 27th; aurora on 28th.

N. SHIELDS.—Blue hepatica in flower on 18th, yellow crocus on 19th, white crocus on 22nd, and purple crocus on 25th.

SEATHWAITE.—S on the tops of the hills on 15th and 25th.

WALES.

HAVERFORDWEST.—One of the wettest Februarys on my record during 25 years. Severe gale from the E. on the 10th and 11th, with extreme cold, the ther. not

ranging higher than 36° in the 48 hours, the mean being 33° . Some days very cold, but on the whole a fine month, many spring-like days; primroses in bloom, and other indications of an early spring. Great storm of R on the last day, the R falling in torrents from 11 to 12 p.m., the sudden flood doing much damage on the low lands, and in the lower parts of the town.

CEFNFAES.—The month has been temperate; stormy at the close; violent gale from S.E. on 26th. Lark heard on the 19th.

LLANDUDNO.—Thrush heard on 8th; primroses in the hedges on the 17th; T at 11 a.m. on 26th. A dry fine month.

SCOTLAND.

DUMFRIES.—The first three days mild and fine, then ten days with frost at night, but the days generally pleasant; the rest of the month showery, but the rainfall generally light, with frosts occasionally at night. Temp. $3^{\circ}7$ above average of month. Vegetation has been checked by frost, but is still unusually forward for the season.

HAWICK.—Very strong gales on the 13th and 14th, and a hurricane from the S.E. on 25th and 26th.

ANNANHILL.—Temp. rather below that of last month. R slight; land generally in good condition for spring work. Winds principally S.E. to S.W. A good deal of frost about the middle of the month; wind generally bleak and cold; evenings generally fine. Splendid aurora on 5th, at 9.15 p.m., a complete arch from E. to W., like a white rainbow or vapour. Small-pox still very bad, but not so fatal.

CASTLE TOWARD.—A dull, cloudy month throughout, with but few sunshiny days. Frosts about the 9th gave us an opportunity of filling our ice-house; a few stormy and very cold days at end of month, doing great damage to evergreen shrubs as well as forest trees, of which a great number were uprooted; bar. 30.65 on the 4th, being very steady till the latter part, when it fell to 28.95 . Pastures do not look well, but gooseberries and fruit trees are pushing forward fast.

DEANSTON.—A fine fair month, a good many frosty nights and some cold days, but for the most part it has been mild, and growth not much interrupted.

BRAEMAR.—Bright aurora on the 4th; aurora also on 5th and 6th; falling stars on 18th; lunar halo on 19th, and violent gale with S and sleet on 26th.

ABERDEEN.—Mean bar. pressure, temp., and S.W. winds above the average (17 years). The estimated pressure of wind, and the fall of rain have been below the average. Hoar frosts very frequent. Aurora on 4th, 5th, 10th, 12th, and 17th. A month of mild dry weather, with much sunshine and very little S. Terrible S.S.E. gale 1 a.m. to 6 p.m. on 26th.

CULLODEN.—Bright aurora on 5th; H on 8th and 17th; very slight S on 9th. Heavy gale on 26th; wind S.E., with frequent and rapid variations to S.S.E. and E.S.E. Horizontal movement between 9 a.m. and 3 p.m., 179 miles, and average 29.9 miles an hour, some of the gusts equal to a pressure of from 20 to 25 lbs. on the square foot. Bar. (corrected) fell to 28.68 in.; many trees blown down, and much destruction done to thatched houses.

PORTREE.—A cold stormy month; a continuous gale from 8 p.m. on 25th to 4 a.m. on 27th from S. to S.E. Less frost and S than usual this month. Cowslips and garden shrubs in full bloom. Sheep and cattle thriving well on the pastures.

LOCHBROOM.—This has been a particularly fine month; field operations are in a forward state, everything looks flourishing, and there are prospects of a good spring. On the 26th it blew a hurricane all day.

SANDWICK.—February has been milder and drier than the mean, but the 25th, 26th, and 27th, were exceedingly stormy, and I do not recollect marking so much wind in three days before; at 10.15 a.m. on each of these days the anemograph traced respectively 1037, 1368 and 1188 miles; this was the strongest S.E. wind that I have ever known; it is often very persistent as a strong breeze, but this

time it amounted to a storm of 71 miles an hour from noon till 7 p.m., on 26th. Aurora till 10 p.m. on 4th; ground white with S on 8th, and sprinkled with it again on 18th.

I R E L A N D.

DARRYNANE.—1st to 9th, fine and very mild, with light easterly winds. Very heavy gale from S.E. on 10th; 12th to 23rd, variable, and much colder, wind chiefly N. and N.W. Last five days wild and stormy; very heavy gale from S.S.W. on 26th, with H and T, and a tremendous sea running.

MONKSTOWN.—A mild, rather dry month, except the last week. Vegetation progressing rapidly. Great fluctuations in atmospheric pressure, from 30·6 on 5th, to 28·7 on the 26th; on the 25th heaviest fall of R (1·75) in 24 hours since January, 1864, except on the 22nd of July, 1873, when 1·95 fell. Prevailing winds S.E. to S.W.

BALLYSHANNON.—The month has been unusually fine, and so favorable for out-door work that farming operations are in a more than usually advanced state; a slight fall of S on the 11th, which soon disappeared.

WARINGSTOWN.—A remarkably fine and bright month.

OMAGH.—A continuance of the fine and mild weather which has marked the entire winter. Gale on 25th.

METEOROLOGICAL OBSERVATIONS AT MENTONE, FRANCE.

[We have been favoured with the following interesting abstract for the end of 1873, and hope in our next to give a similar one for the early months of 1874, together with an analogous communication from Col. Ward, who has been observing throughout the winter at Rossinière, Canton Vaud.—Ed.]

	OCT. 14-31 incl.		NOVEMBER.		DECEMBER.	
	Readings.	Date.	Readings.	Date.	Readings.	Date.
Barometer, highest reading ...	30·085, E.	27	30·282, M.	26	30·437, E.	8
Barometer, lowest ...	29·463, E.	30	29·564, M.	23	29·714, M.	28
Hygrometer, mean of degrees of dryness ...	...	...	2°·4	..	4°·0	...
Thermometer, mean max. (4ft. above ground).	...	...	67°·5	...	64°·9	...
„ absolute max. ...	78°·5	16	75°	7	71°·5	5
„ mean min. ...	...	...	44°·6	..	37°·3	...
„ absolute min. ...	46°	27	37°·5	13	28°·5	30
„ (6in.ab.gd). mean min. ...	...	...	43°·2	...	35°·9	...
„ absolute min. ...	44°·2	27	35°·7	13	26°·6	30
Solar Radiation, mean max. ...	...	...	..	..	100°·8	...
„ highest reading... ..	...	...	...	...	116°·7	28
Rainfall, total amount ...	7·986	...	8·022	...	120	...
„ greatest fall in 24 hours.	1·980	14	2·273	2	120	27
„ No. of days on which more than ·001 fell ...	11 days	...	11 days	...	1 day	...
Cloud, mean amount ...	5·3	...	4·7	..	2·7	...
„ No. of cloudless days ...	2	...	7	...	16	...
Wind, prevailing ...	...	...	N.-N.W.	..	N.-N.W.	...

Barometer, compensated aneroid—Negretti and Zambra. Hygrometer, verified at Kew. Rain Gauge (Howard's), one foot above ground.

Instrument Stand, four feet above ground; northerly exposure; observations taken at 9.0 a.m., and of Barometer also at 9.0 p.m., marked respectively M. and E.

Height above sea-level, 80 feet, calculated by Pocket Aneroid.

PHILIP WRIGHT, F.C.S.