

SYMONS'S MONTHLY METEOROLOGICAL MAGAZINE.

CXCI.]

DECEMBER, 1881.

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

A PLEA FOR THE RAINBAND.

WHAT is the Rainband? This may appear a strange question to see put in a meteorological journal, and yet I venture to surmise that not very many of your readers have ever put the question to themselves, and that comparatively few of them have investigated it as a meteorological one. I do this the more boldly because as a matter of fact I rarely take up a weather record in which it is even named; the popular and wide-spread journal which owns the giant barometer reading feet in lieu of inches, never quotes from its readings; and so far as I can glean the gallant "daft" explorer who daily mounts Ben Nevis does not carry a spectroscope in his pocket, though the high altitude he attains would make its record most interesting. Probably, I should myself have hardly heard of and never enquired about it, but that some years since I had the pleasure and profit to make the acquaintance of the talented and kindly Astronomer Royal for Scotland; who, if Mr. Lockyer is said in university rhymes to have made himself owner of half the corona, has no less, undoubtedly, appropriated to himself three-fourths at least of the rainband.

Thanks to the information and advice then given me, and to subsequent publications sent me from the same source, I became a "rainband" observer, soon began to use it as a meteorological aid, and after some desultory observations at first, daily records of it from the 1st July, 1880, to the present time now lay before me.

My aim now is, if I can, to answer the question above put, in such a way as to make the subject as attractive to your readers (or some of them) as it has been to myself. I will, therefore, at once start by describing the rainband as a dark band or shading (or rather, under sufficient amplifying power, set of fine lines) seen on the less refrangible (red) side of the double line D in the atmospheric spectrum; and the presence or absence of which is indicative of the presence, or otherwise, of moisture (more strictly speaking, excess of moisture) in the atmosphere. Its history may be said to date from the time when Angström's maps of the solar lines were found to present different aspects according to the condition of moisture of the atmosphere at

the time of observation, and when that pioneer of spectroscopy proved the presence and absence of certain lines forming bands in the spectrum, more especially a set near D, to depend on that condition. No practical meteorological result followed, however, until, as Prof. Piazzzi Smyth tell us, the subject was first presented to him as a marked feature in sky spectrum at Palermo before and after a sirocco in 1872. Next, when in July, 1875, destructive floods in both France and England (*not predicted by the barometer*) were noticed by him in connection with a peculiar band in the spectrum under dates July 19th and 26th, 1875. Prof. Smyth vividly describes in *Nature* (vol. xii, pp. 231, 252) the phenomena then observed, how the dark band near D was found the forecast of a drenching afternoon following the fine opening of a Scotch holiday in Edinburgh; and how, on another occasion, it became the "spectroscopic *prévision* of rain with a high barometer." Then followed observations in May, 1876, to the same effect in France, especially at Marseilles, where the rainband was seen in the spectrum and followed by rain to the surprise of the natives, who consulted only the public barometer and thermometers, and found none predicted. In February, 1878, appeared the fourteenth volume of the Edinburgh Astronomical Observations, 1870-1877, and here, under the head of "Meteorological Spectroscopy in the small and rough," we have the subject treated in a most complete and elaborate manner, and illustrated by a set of engravings of spectra. The Scottish Meteorological Society's Journal, N.S., Nos. li, lii, also contain contributions by Prof. Smyth on the subject. Again, in *Nature* of July 1st, 1880, vol. xxii., pp. 194, 5, the subject of "rainband spectroscopy" is dealt with in a condensed and epitomized form very acceptable to the reader, who, doubtless will recognise the identity of the "Edinburgh experimenter" in this useful contribution on the subject.

Having thus far, though imperfectly, given honour where it is due (for as far as I am aware no other rainband research of anything like such extent has been contributed from other quarters), I will again pass to the phenomenon itself. For its observation a spectroscope is of course necessary.

A large one with several prisms is desirable if the ultimate composition of the band or bands is to be examined; but for ordinary meteorological purposes and to observe the general character of the band near D, a pocket or miniature instrument is quite sufficient, indeed best adapted. This may be obtained from any scientific optician, and will cost, according to construction, from one to three guineas. The more expensive ones have an adjustable slit and achromatic lenses; but these are not necessities, and the cheaper form is nearly as useful.

I employ for my own observing a McClean's star spectroscope with a slit arrangement adapted, which makes also an efficient instrument with rather a larger spectrum than the pocket spectroscope.

Having obtained the instrument, close the slit and adjust the focus

till the lines in the spectrum are sharp and clear. This should be done on a bright part of the sky. Then point the instrument to the quarter of the heavens which it is desired to examine, and note results as to, especially, lines D and their neighbourhood.

I generally observe thus at 9 a.m. daily from my laboratory window (looking towards the south), but if time and opportunity allow three observations, at 9 a.m., 1 p.m. and 5 p.m. would be better, varying the parts of the sky tested; and I examine with the spectroscope elevated about 13 degrees. Prof. Smyth recommends to point as low as you can to the horizon provided you get transmitted light, and to observe when the sun is neither high nor low. I find in practice 9 a.m. (the same hour when my other instruments are observed) a good time to make the observation when only a single one is taken daily, and also that if I get *too* low on the horizon I am apt to have always a "rainband," or rather a false band due to earth moisture. In observing you will soon remark changes in the characters of some of the spectrum lines as compared with these when seen on a blue sky with an elevated spectroscope, and, moreover, bands of varying intensity are found added to the low spectrum not seen in the higher one. The lines and bands that change their character, or are variable in their appearing, are telluric; either rainbands or lines, called by Prof. Smyth "a function of moisture and temperature," or low sun bands and lines distinguished by him as "a function of dry air and low sun." The true solar lines remain unchanged. Prof. Smyth, in the Edinburgh volume before referred to, fully describes both in type and by illustrative drawings all these bands and lines and their changes, and points out that there are several smaller rainbands besides that near D. In practice it will, however, be found sufficient for meteorological observations generally, to examine the principal one on the red, or, if you have the spectrum as I do (with the red end of the spectrum to my left hand), left side of D. An examination of the other lines, though desirable for special purposes, will only tend to confuse the general observer. Prof. Smyth recommends, and has used, a dry air band on the right hand side of D as a standard of comparison with the rainband; but I have not often myself made use of it, judging independently by the rainband itself.

In enumeration of the darkness of the band, for the purpose of record, I use from No. 1 to 5 as under:—

- 1 means faint.
- 2 „ faint to moderate.
- 3 „ moderate.
- 4 „ moderate to strong.
- 5 „ strong.

1 to 10 is the enumeration recommended and employed by Prof. Smyth. I found, however, the dividing into so many degrees was difficult, especially when the intensity is slightly changing by passing clouds. Simultaneous observations should of course be made and

recorded of barometer, wet and dry bulbs, and wind (force and direction); and the circumstances of sun, sky, and cloud at the time should be shortly noted.

Ozone test papers may also be usefully referred to, as cold winds alike affect them and rainband readings. The D lines are generally more or less involved in the rainband shading.

To enable the observer to judge of the general appearance and intensity of the larger rainband near D, I have given (see *frontispiece*) some drawings of spectra as seen in a spectroscope of small dispersion, of which the following is a description:—

(1) Spectrum as seen upon a pure high sky, showing principal solar and telluric lines in their proper positions, and with their designations, but not showing the finer lines between, nor any bands.

(2) Spectrum observed January 17th, 1881, 8 a.m. Morning dull; red sunrise; low sunbands and lines (note especially band to right of D) strong. *No rainband.*

(3) Spectrum observed 24th August, 1881, 8 a.m., showing moderate low sunbands and lines, and a *faint* rainband, with rain lines showing through.

(4) Spectrum seen November 16th, 1880, 1 p.m. Rain and wind, but clearing in some parts of the sky. Low sunbands and lines weak. *Rainband moderate.*

(5) Spectrum seen December 9th, 1880, 8 a.m. Sun shining through watery clouds; low sun lines strong. *Rainband strong.*

(6) Spectrum seen July 6th, 1881. *Rainband everywhere, and exceptionally strong, stretching nearly half way between C and D. Whole spectrum darkened and obscured.*

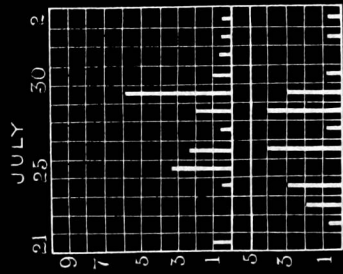
The above-described drawings do not give, except in a rough way, the details of the lines and bands other than the rainband, which is situate to the left of the double line D, and has its place marked by a R.

Spectra 2, 3, 4, and 5 are meant for observing by, as representing:—2, none; 3, faint; 4, moderate; and 5, strong. Rainband faint to moderate, and moderate to strong (the intermediate intensities) can be estimated, and in practice the eye and judgment will soon be found to accommodate themselves to the graduations 1 to 5.

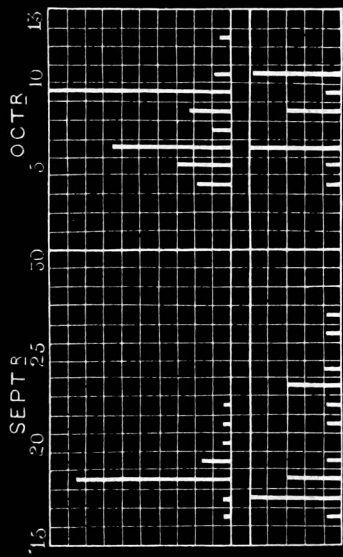
Before proceeding to the questions affecting the rainband's value to forecast rain, it may be desirable at once to say that it does not claim absolute infallibility as to time and quantity of rain to follow, though Prof. Piazzi Smyth believes "it is never really absent when rain is imminent."

How its appearance and indications may be modified will be referred to later.

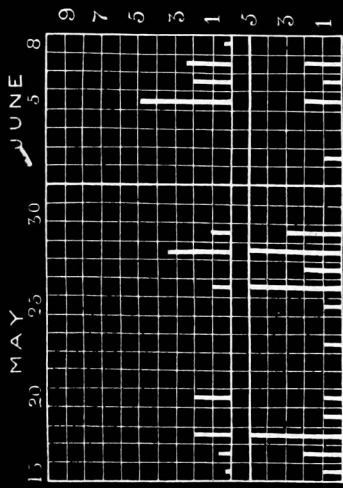
Its action is hygrometric, and involves the general principle that according to the amount of suspended moisture in the air so its appearance and strength. A faint, or faint to moderate, rainband may in some cases only show an amount of moisture which will remain suspended for some time. A moderately strong, or strong, rainband represents an excess of suspended moisture, which before long is sure to descend. Prof. Smyth mentions instances, and I



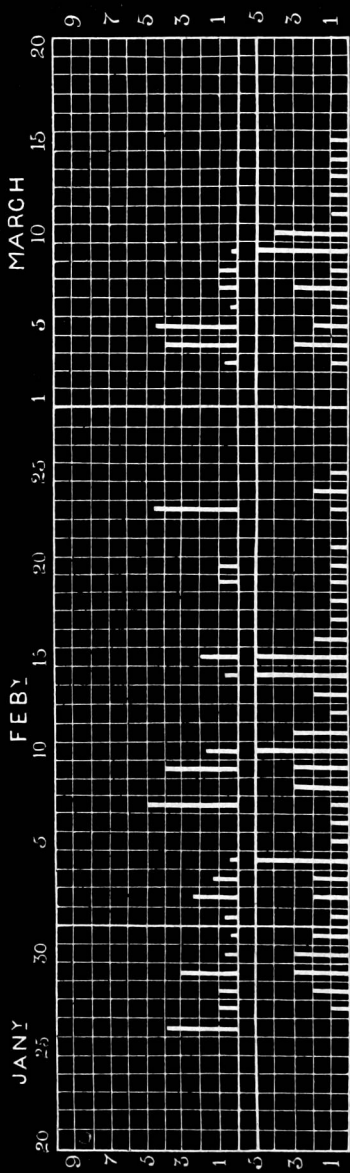
(1)



(2)



(3)



(4)

have met with some myself, where an apparently perfectly transparent sky showing rainband has, on a change of temperature, condensed, as it were, into clouds which have poured.

A little while since (August) I observed only a faint, or at most, a faint to moderate, rainband in the morning at 9 a.m., on a beautiful blue sky, studded with white cauliflower innocent looking cumuli. I predicted wet, and at mid-day meal was twitted with the sunshine and brightness, but sure enough in the afternoon down came the rain. On the other hand it will sometimes be raining, and yet only a slight, perhaps even no rainband shows, an effect generally connected with a cold wind N. or E. No rainband is also sometimes observed when the wet and dry bulb readings only slightly differ, but the explanation of this may be that low earth moisture affects the bulbs, which is not recognised in the sky-directed instrument looking through a thin stratum of it.

In order to illustrate the practical working of the rainband I have prepared the accompanying diagrams, which show graphically by comparative line lengths the rainband and rainfall during two periods of 1880 and two of 1881. The rainfall is represented by vertical lines, in which each one-tenth inch is one-tenth inch rainfall; the rainband by similar lines, in which each one-tenth inch is one of the scale 1 to 5. The rainband was observed at 8 a.m. in 1880, and 9 a.m. in 1881 on each day. The rain represents the fall during the 24 hours following the rainband observations, so that where the lines correspond the rain follows the rainband within that period.

The general result of these diagrams is that the rainband predicts and also accompanies the rain, and to a certain extent corresponds in strength with the predicted rainfall. There are discrepancies and irregularities in most of the diagrams, it is true, some of which are to be explained and accounted for by incidental circumstances, the particulars of which I take from notes made at the time, and others (such as cases of rain at night after faint rainbands in the morning) by the interval of time elapsing between the spectroscopic observations and the rainfall, it sometimes happening that the rainband will much change its intensity during three daily observations. On the other hand, occasionally the rainband will precede the rain by a day or two.

Diagram 1—July 21st to August 2nd, 1880. This diagram represents a set of rainbands, of which moderate to strong is the highest figure, leading up to a moderate rainfall. July 25th appears as exceptional in the absence of the band. The day was fine and hot, and the rain fell during the night with a change of wind from W. to S. This fall (.35) was, however, shown to be in prospect by the bands on the 22nd, 23rd, and 24th, gradually increasing in intensity from faint to moderate.

Diagram 2—September 16th to October 13th, 1880. The first and last sets of lines agree fairly. The heavy rainfall of the 18th (nearly an inch) was forecasted by a strong rain-

band the day before, which was reduced to moderate during the fall itself, and as the rain passed away so did the rainband diminish in intensity, dropping to faint on the 19th, for '20 of rain. On the 10th of October a strong rainband was only followed by a small rainfall, but the wet and dry bulbs were but 2° apart, so that much suspended moisture must have been in the lower atmosphere, and in fact on the 13th some more rain fell. In the centre of the diagram we have six rainbands (five faint and one moderate) with only a slight rainfall. The following figures, however, show for the five days on which these rainbands appeared the differences in the wet and dry bulbs.

| | | | |
|-------|-------|-------------------|-------------|
| 1880. | Sept. | 21.— 2° | } At 8 a.m. |
| | " | 22.— 4° | |
| | " | 23.— 4° | |
| | " | 24.— 1° | |
| | " | 26.— $2^{\circ}5$ | |
| | " | 27.— 3° | |

The following passages also appear in my journal at this time :—
 "The main feature of the week has been the persistent heavy morning and evening mists," and again (after quoting the above figures) "so that the air has been kept in a chronic state of saturation," a condition quite sufficient to account for a faint rainband." While on the subject of this diagram it may be mentioned that space would not well allow, otherwise I should have given in a graphic form the rainband and rain lines from 8th to 15th September, 1880, as they well illustrate how a strong rainband (on the 9th) came before very heavy rain on the 11th, while pending the actual rainfall the band was moderate and at last even faint. I insert instead the following tabular particulars :—

| Date. | | Rain. | | Rainband. |
|-------|-----------|--------|------|-----------------|
| 1880. | Sept. 8th | | '00 | None. |
| | " 9th | | '04 | Strong. |
| | " 10th | | '00 | Faint. |
| | " 11th | | 1'58 | Moderate |
| | " 12th | | '54 | Moderate. |
| | " 13th | | 1'19 | Faint. |
| | " 14th | | 1'48 | Faint. |
| | " 15th | | 1'13 | Faint. |

We thus see that the rainband indicated the finely-divided transparent moisture ready to collect and fall as rain, and showed itself upon the saturated air and warm morning mists (wind mostly S. and S.W.) above referred to, while it only moderately or faintly appeared during the heavy rain itself.

A partial explanation of this peculiar phenomenon of a low number rain-band on falling rain may be that, pending heavy rainfall, the whole spectrum is more or less obscured, and thus the rainband shading near D for want of contrast is less observed. We shall, moreover, see later that it does appear strong on a light misty rain.

In connection with this diagram it may be further pointed out how a distinction lies between warm mists and cold fogs in the rainband's behaviour. The mists before spoken of were warm ones, and

a rainband, though faint, almost without exception, appeared upon them, but at a later period (in October) partly shown in the same diagram, there were cold foggy mornings with N. wind, during which the band was absolutely and persistently nil.

It results from this and similar observations that the rainband is less reliable in winter than in summer for indicating a rapid following of rain, and we can understand this in the fact that watery particles may remain without precipitation in a cold and comparatively even temperature in winter, while they will quickly descend from a warm air in summer, as the result of a few degrees fall of temperature.

We now pass to Diagram 3, representing rain and rainband from May 16th to June 8th, 1881, and to Diagram 4, which gives a two months' comparison of rainband and rain—viz., from 20th January to 20th March, 1881. The relative periods of rainfall and rainband agree fairly well in these two diagrams, and in some instances (June 5th, 6th, and 7th, and January 27th, 28th, and 29th) the intensities agree, but the peculiar feature about the diagrams is a certain number of strong, or moderate to strong rainbands, coinciding with a very disproportionate amount of rainfall (see especially dates February 4th and 14th and March 9th, when rainfall was only .02, .05, and .02).

To be also noted is March 10th, when rainband 4 had no rain to follow, and where the observation is marked, "Sunshine through Clouds," and January 26th, rain .40 with no rainband. On this last occasion there must have been more snow and sleet than rain (with wind N., and temperature 29° for maximum) which melted in the gauge. By the 27th the wind had changed to S. and a faint rainband appeared with rain .11.

The strong rainbands before mentioned as accompanied by so little rain, being exceptional to the general rainband rules, I have tabulated, for comparison, all the cases (7) of No. 5 (strong) rainband between 1st January and 1st July, 1881, as under:—

Table shewing circumstances of all strong Rainbands (No. 5), between January 1st and July 1st, 1881.

| No. | Date. | Bar. | Ther. | W.&D Bulbs. Diff. | Wind | Rain. | Rain- band. | Ozone | Notes, 9 a.m. |
|-----|----------|-------|-------|-------------------------|------|-------|----------------|-------|---------------------------------|
| 1 | Feb. 4th | 29.33 | 46°·0 | ·0 | S. | ·02 | 5 | 4 | Clouds 10. Rain. |
| 2 | " 10th | 29.00 | 49°·5 | ·5 | S.W. | ·16 | 5 | 8 | Clouds 10. Rain. |
| 3 | " 14th | 29.60 | 38°·5 | 2°·5 | S. | ·05 | 5 | 6 | Clouds 10. Dull. |
| 4 | " 15th | 29.64 | 38°·0 | ·5 | S.W. | ·25 | 5 | 5 | Clouds 10. Rain. |
| 5 | Mar. 9th | 29.83 | 48°·0 | ·0 | W. | ·02 | 5 | 7 | Dull heavy rain. |
| 6 | May 11th | 29.56 | 53°·3 | ·3 | W. | ·08 | 5 | 8 | Raining. |
| 7 | " 26th | 29.76 | 61°·0 | 3°·0 | W. | ·12 | 5 | 4 | Overcast, slight mist, no rain. |

These records present as peculiar features, barometer generally low, difference in wet and dry bulbs slight, wind S. and W., rain minute in quantity (except the 15th with $\frac{1}{4}$ of an inch), and ozone mostly strong, while in five cases out of the seven rain was falling at the time of observation. One can understand moderate rainbands accompanying the really moderate rainfalls of the half-year in question, but the above seem anomalous. A possible explanation is afforded by the strong air saturation at low level, indicated by the slight differences in the wet and dry bulbs, and the probability that the rain so small in quantity, was in quality of the misty drizzling character containing minutely divided particles, which is favorable to the strong enforcement of the moisture bands in the spectrum. I should be very glad to hear of spectroscopic observations by others on the occasions quoted, which, while abnormal, are strangely uniform over so long a period.

The foregoing diagrams and examples doubtless are failing in information which would have been furnished, and contain inconsistencies which would have been absent had the observations upon which they are founded been taken more frequently (say three times a day in lieu of once), and had the observer applied to them more of the patience and skill bestowed on the rainband and the story it tells, by its principal investigator. They may perhaps, however, effect the desired object of inciting enquiries on an interesting and comparatively unworked subject, and that thus a spectroscope may become a common companion of other meteorological instruments, if only for the purpose of testing its efficacy. Its little cost, the readiness with which observations can be made, and the practical results which a series of such would doubtless afford, cannot, I think, but recommend a trial of it. I propose to add a few general instructions and hints which may be useful to observers.

(1). Occasionally look to your instrument and see that the prisms and lens are clean, and remove any dust from the slit. This last should be done with a camel's hair pencil.

(2). Distrust observations and reports made by assistants or friends who are not practised in spectroscopic work. I have known dust accumulated on the face of the prism give a false obscurity to the spectrum ;* persons (scientific or otherwise) who never could see a rainband at all ; others who insisted on the horizontal dust lines as rainbands, and even well-practised observers, who have differed very widely in strength estimates (a matter which may possibly affect my own diagrams).

(3). Observe generally at the altitude which you may have selected as a standard, but do not altogether confine yourself to this, and note :—

(a) If the rainband is strong on the horizon and weakens to

* To guard against this I cement a plate of microscopic glass over the eye-hole of the spectroscope.

disappearance (or nearly this) at 15 or 20 degrees above, distrust it as a prognostic of rain.

- (b) If strong on the horizon, and still strong at the height above mentioned, trust it as a prognostic.
- (c) If strong on the horizon, above, and also to the zenith, or nearly so, then, as Professor Smyth says, "Beware!" He had only known two such instances (at the time he was writing) and deluges followed.

(4). A rainband will sometimes shew at the same time, of varying intensities on sky, clouds, and breaks in clouds. The respective intensities should be considered and valued in relation to the character of the various objects examined.—*e.g.*, I observed, on an occasion this summer, at 9 a.m. a faint (No. 1) rainband on an apparently perfectly pure blue sky, and a stronger one (moderate No. 3) on some by no means dangerous looking clouds floating in it. Rain soon came, and I have no doubt both sky and clouds were nearly equally charged with moisture, though under different conditions.

(5). The solar lines in the spectrum may be brought in aid in observing. When these are bright, clear, and sharp, rainband is usually absent; when they are obscure and seen faintly, rainband is generally present. A lady, who assisted me in observing, used to judge with success by the appearance of these lines when she felt in doubt about the rainband itself.

(6). The general rules of conduct of the rainband may be summed up as follows:—

- (a) It indicates an excess of moisture in the air (often invisible) and presages according to its intensity, sometimes upon a clear, and sometimes on an opaque sky, the coming of rain and its quantity. "It is strong when the air is saturated with moisture ready to fall." (Piazzi Smyth).
- (b) When the actual rain comes, the band frequently drops in intensity, sometimes becoming even quite faint during heavy rainfall. In summer, during a warm wind, a pronounced rainband will accompany rain. If the two last are not found together, it is during the prevalence of cold winds. In winter, a moderate rainband may be observed for some time, and yet rain does not fall. This is found during the presence of a warm wind, which holds the air moisture in suspension. Upon change to a cold wind, rain follows.
- (c) A long continued faint, or faint to moderate rainband is pretty sure to be followed by rain, generally in quantity.
- (d) A faint, or perhaps faint to moderate rainband may be often seen upon fog or mist. It does not necessarily presage rain, unless it get to strong, which it seldom does. If the sky above fog or mist be clear, the spectroscop

should be elevated to examine this as the test for the rainband true.

(7). Ozone and rainband are usually in accord with one another, both weak during cold winds and cold fogs, and both strong during warm winds and warm mists. Observations on the electric condition of the atmosphere might be usefully combined.

Lastly. Observers should not be discouraged if the rainband predictions are not always immediately and exactly fulfilled. If there were but one form of rainband, and one condition of moisture in the air, we might get the formula :—Rainband = rain ; No rainband = no rain, in all cases ; but this is far from the fact. The spectroscope is a delicate instrument of research, and the intensity of the rainband admits of degrees which may be considerably modified by, (1) circumstances of observing, such as width of slit, altitude of spectroscope, time of day, and part of the sky examined ; (2) conditions of the matter examined in its graduations of transparent vapour, mist, cloud, and rain (the size and proportion of the aqueous particles varying in each) ; and (3) by other meteorological conditions and especially that of temperature, as largely affecting the quantity of moisture held in suspension.

If the character of the band is liable to be thus modified, the judgment to be formed as the result of its examination must be necessarily applied with caution, and with due regard to the probable effect of these modifications.

While the causes of some of these are apparent, others are much more obscure, and I think I may add, still imperfectly understood, It is, therefore, to the desirability of a system of regular rainband observations at varying altitudes, and by a number of observers at wide-spread stations, that I invite you and your readers' especial attention, at a time when meteorology is so much taxed, for the purpose of forecast, and requires every possible aid that scientific observation can bring to bear on so important and difficult a subject.

J. RAND CAPRON, F.R.A.S.

Guildown, Nov. 1881.

GALE OF OCTOBER 13TH-14TH, 1881.

THE opening meeting of the Meteorological Society for the present Session was held on Wednesday, Nov. 16th, at the Institution of Civil Engineers, Mr. G. J. Symons, F.R.S., President, in the chair. Twenty-seven gentlemen were balloted for, and duly elected Fellows of the Society.

The evening was devoted to an account of "The Gale which passed across the British Isles, Oct. 13th-14th, 1881," which had been prepared by Mr. G. J. Symons, F.R.S., with the assistance and co-operation of Mr. C. Harding, and other gentlemen. There is evidence of the storm being formed in the Atlantic about 150 miles S. of Nova Scotia, on Oct. 10th, and that at noon on the 13th there

was a considerable disturbance about 600 miles W. of Galway. At that time there were scarcely any instrumental indications in the British Isles of the coming storm, the barometer was falling at Valentia, but not rapidly, and at some of the western English stations it was rising. The curves of barometric fluctuation show very plainly the advance of the depression from W. to E., for, while at Valentia the minimum occurred at 2 a.m. on the 14th, on the east coast of Norfolk it is recorded that it did not occur till 4 p.m. This fact, coupled with others, seems to indicate an easterly progression of the barometric minimum, at nearly 40 miles per hour. As far as the sea is concerned, the chief force of the gale was felt in the afternoon of the 14th, in the German Ocean, and there the great loss of life and destruction to shipping seems mainly due to the exceptionally violent squalls which were peculiar to this gale, as well as to the extremely sudden manner in which the wind increased to hurricane force. The afternoon became quite darkened by the salt water blown into the air, so that it was impossible to see a ship's length ahead. The barometric chart for 9 a.m. on the 14th, showed that the pressure in the North of England was an inch lower than in the south, and nearly two inches lower than in the South of France. The area over which injury was produced was very large, and, although not without precedent, it was happily rare. The record of 56 lbs. per square foot at the Royal Observatory, Greenwich, was the highest ever registered in that locality, and close by 35 trees were blown down in the park, and 15 ft. blown off the top of a spire which had been erected about 40 years, the stone of which shows no sign of decay, and which had retained its position almost, if not wholly, by the gravity of its mass. The general opinion seems to be that the structural damage over the greater part of the country was by no means unprecedented, and in the greater part of Ireland, and the S.W. of England, was not even of an unusual character; but along the east coast, and in the east Midlands, the damage was excessive, and, on the N.E. coast, unprecedented. In Scotland the destruction of trees was enormous.

Mr. J. Wallace Peggs, C.E., F.M.S., read a paper on "The Structural Damage caused by the Gale as indicative of Wind Force," and remarked that since the Tay Bridge disaster attention had once more been directed to the subject of wind pressure. He suggested that a conference of delegates from societies specially interested in the subject should be held, who should make experiments and carefully consider the whole question of structural damage by wind.

GALE OF NOV. 26TH—28TH.

AN extreme barometric depression passed across the North of Scotland (sea level pressure below 28 inches) on the 27th, and a very heavy gale prevailed over large portions of the British Isles. Damage does not seem to have been nearly so general as on October 13th-14th, but in various localities, especially in North Staffordshire, considerable destruction of buildings took place.

KEW OBSERVATORY.

To the Editor of the Meteorological Magazine.

SIR,—In a brief notice of Kew Observatory in the last number of the *Meteorological Magazine*, you mention that it is maintained partly by the Royal Society and partly by the Meteorological Council.

The Royal Society contributes nothing from its own funds to this observatory, but acts merely as a trustee of an endowment by the late Mr. Gassiot, whose munificent devotion to science ought not to be forgotten. When the British Association withheld its grant from the Observatory, and it was likely to perish, he supported it for several years, and was so convinced of the service it rendered to science, that he determined to secure its permanence after his death, and made this endowment nearly £500 a year.

I am sure you will agree with me in thinking that an act of enlightened generosity such as this, should be generally known, that the honour it deserves may be given to his memory.—Yours truly,
T. R. ROBINSON.

Observatory, Armagh, 3rd December, 1881.

[We are delighted to insert this well-merited tribute from Dr. Robinson, and glad that, while we had bound ourselves to “reproduce as faithfully as we can the statements of Dr. Hellmann,” Dr. Robinson’s letter enables us to remind our readers of Mr. Gassiot’s splendid donation of £10,000.]—Ed.

THE PREDICTED SEVERE WINTER.

To the Editor of the Meteorological Magazine.

DEAR SIR,—I see in the last number of your Magazine a letter from a correspondent predicting another severe winter. Such forecasts seem to me very uncertain and unsatisfactory, especially when grounded on such reasons as he gives. The fall of snow in October may have some little bearing on the question, but that the weather 41 years ago can have anything to do with that of the present time, I cannot believe. Then again, what can the fact that there was more rain in August in England than in Scotland have to do with the coming winter; coincidence alone does not imply connexion.

We have had now three severe winters in succession, and these have all been preceded by an unusual amount of northerly winds. These I take to have been not merely signs, but also the cause of the severe weather that followed, by bringing down on us a polar atmosphere. This year we had some threatening weather in October, but lately we have had so much warm strong south-westerly wind, that I hope we are about to have a milder season.

Your correspondent gave it as his opinion last year, that we were about to have a winter not much below the average. Here it was 2°·5 below the mean of 10 previous years.—Yours respectfully,

S. KING.

Elswick Lodge, Nov. 27th, 1881.

SUPPLEMENTARY TABLE OF RAINFALL IN NOV., 1881.

[For the Counties, Latitudes, and Longitudes of most of these Stations,
see *Met. Mag.*, Vol. XIV., pp. 10 & 11.]

| Div. | STATION. | Total Rain. | Div. | STATION. | Total Rain. |
|-------|------------------------------|----------------|--------|------------------------------|----------------|
| | | in. | | | in. |
| II. | Dorking, Abinger | 4·71 | XI. | Carno, Tybittle | 7·45 |
| „ | Margate, Acol | 2·19 | „ | Corwen, Rhug | 5·05 |
| „ | Littlehampton | 3·65 | „ | Port Madoc | 6·29 |
| „ | St. Leonards | 2·78 | „ | Douglas | 5·22 |
| „ | Hailsham | 4·26 | XII. | Carsphairn | 12·12 |
| „ | I. of W., St. Lawrence. | 4·10 | „ | Melrose, Abbey Gate | 4·44 |
| „ | Alton, Ashdell | 5·57 | XIV. | Glasgow, Queen's Park. | 5·03 |
| III. | Great Missenden | 3·29 | XV. | Islay, Gruinart School. | 5·65 |
| „ | Winslow, Addington | 3·30 | XVI. | Cupar, Kembach | 4·07 |
| „ | Oxford, Magdalen Col. | 3·15 | „ | Aberfeldy H.R.S. | ... |
| „ | Northampton | 2·91 | „ | Dalnaspidal | 11·03 |
| „ | Cambridge, Beech Ho. | 1·52 | XVII. | Tomintoul | 2·89 |
| IV. | Harlow, Sheering | 2·59 | „ | Keith H.R.S. | 1·82 |
| „ | Diss | 1·60 | XVIII. | Forres H.R.S. | 1·94 |
| „ | Swaffham | 2·26 | „ | Strome Ferry H.R.S. | 10·34 |
| „ | Hindringham | 2·24 | „ | Lochbroom | 7·53 |
| V. | Salisbury, Alderbury | 4·20 | „ | Tain, Springfield | 2·50 |
| „ | Calne, Compton Bassett | 4·19 | „ | Loch Shiel, Glenfinnan. | 16·30 |
| „ | Beaminster Vicarage | 7·33 | XIX. | Lairg H.R.S. | 3·39 |
| „ | Ashburton, Holne Vic. | 11·75 | „ | Altnabreac H.R.S. | ... |
| „ | Langtree Wick | 5·46 | „ | Watten H.R.S. | 1·69 |
| „ | Lynmouth, Glenthorne. | 6·92 | XX. | Fermoy, Glenville | 6·87 |
| „ | St. Austell, Cosgarne | 5·37 | „ | Tralee, Castlemorris | 6·01 |
| „ | Taunton, Fullands | 2·82 | „ | Cahir, Tubrid | 5·07 |
| VI. | Bristol, Clifton | 4·32 | „ | Tipperary, Henry St. | 4·64 |
| „ | Ross | 3·74 | „ | Newcastle West* | ... |
| „ | Wem, Sansaw Hall | 2·87 | „ | Kilrush | 4·16 |
| „ | Cheadle, The Heath Ho. | 3·54 | „ | Corofin | 5·86 |
| „ | Coundon | 2·87 | XXI. | Kilkenny, Butler House | ... |
| VII. | Melton, Coston | 2·35 | „ | Carlow, Browne's Hill. | 3·92 |
| „ | Horncastle, Bucknall | 2·66 | „ | Killsallaghan | ... |
| VIII. | Macclesfield Park | 3·71 | „ | Navan, Balrath | 2·87 |
| „ | Walton-on-the-Hill | 2·85 | „ | Athlone, Twyford | 5·00 |
| „ | Broughton-in-Furness | 8·23 | XXII. | Mullingar, Belvedere | 4·04 |
| IX. | Wakefield, Stanley Vic. | 2·17 | „ | Ballinasloe | 6·17 |
| „ | Ripon, Mickley | 5·67 | „ | Clifden, Kylemore | 16·76 |
| „ | Scarborough | 1·81 | „ | Crossmolina, Enniscoe. | 8·81 |
| „ | Mickleton | 4·91 | XXIII. | Carrick-on-Shannon | 4·80 |
| X. | Haltwhistle, Unthank. | 3·87 | „ | Dowra | 3·22 |
| „ | Shap, Copy Hill | 12·31 | „ | Rockcorry | 4·27 |
| XI. | Llanfrechfa Grange | 7·70 | „ | Warrenpoint | 5·12 |
| „ | Llandovery | 6·35 | „ | Newtownards | 3·17 |
| „ | Solva | 4·05 | „ | Carnlough | ... |
| „ | Castle Malgwyn | 8·67 | „ | Bushmills | 3·44 |
| „ | Rhayader, Nantgwillt. | 9·07 | „ | Buncrana | 4·40 |

* Record destroyed, along with part of house, by gale on night of 23rd.

NOVEMBER, 1881.

| Div. | STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.] | RAINFALL. | | | | | Days on which .01 or more fell. | TEMPERATURE. | | | | No of Nights below 32° | | |
|----------|---|----------------|--|----------------------------------|-------|------|------------------------------------|--------------|-------|-------|-------|---------------------------------|-----|-----|
| | | Total Fall. | Differ- ence from average 1870-9 | Greatest Fall in 24 hours. | | Max. | | Min. | | | | | | |
| | | | | Dpth | Date. | | | Deg. | Date. | Deg. | Date. | | | |
| | | | | | | | | | | | | | | |
| I. | Camden Square..... | inches. | inches. | in. | | | | | | | | | | |
| II. | Maidstone (Hunton Court)... | 2.75 | + .31 | .55 | 24 | 16 | 62.5 | 5 | 31.9 | 1 | 1 | 6 | | |
| III. | Strathfield Turgiss | 2.62 | — .28 | .78 | 26 | 20 | ... | ... | ... | ... | ... | ... | ... | ... |
| IV. | Hitchin | 3.05 | + .30 | .66 | 26 | 20 | 63.7 | 5 | 31.2 | 30 | 3 | 13 | | |
| V. | Banbury | 2.14 | — .47 | .54 | 26 | 18 | 59.0 | 5 | 30.0 | 1 | 2 | ... | | |
| VI. | Bury St. Edmunds (Culford)... | 3.23 | + .52 | .69 | 26 | 21 | 59.0 | 12 | 28.0 | 1 | 4 | ... | | |
| VII. | Norwich (Cossey)..... | 1.98 | — .85 | .44 | 25 | 14 | 61.0 | 4.5 | 31.0 | 17† | ... | ... | | |
| VIII. | Bridport | 2.18 | — 1.13 | .39 | 26 | 15 | 64.5 | 5 | 29.5 | 1 | 2 | 5 | | |
| IX. | Barnstaple..... | 5.75 | ... | .74 | 4 | 21 | 58.0 | 7 | 25.0 | 29 | 4 | ... | | |
| X. | Bodmin | 4.26 | + .11 | .52 | 16 | 21 | 63.0 | 5 | 33.0 | 2 | ... | ... | | |
| XI. | Cirencester | 6.77 | + 1.45 | .91 | 30 | 26 | 63.0 | 9 | 35.0 | 29 | 0 | 2 | | |
| XII. | Church Stretton (Woolstaston) | 4.47 | + 1.49 | .80 | 27 | 20 | ... | ... | ... | ... | ... | ... | | |
| XIII. | Tenbury (Orleton) | 3.74 | + .30 | .80 | 30 | 22 | 59.0 | 4, 13 | 31.0 | 1 | 3 | 3 | | |
| XIV. | Leicester (Town Museum) ... | 3.33 | + .47 | .47 | 26 | 20 | 62.8 | 13 | 28.8 | 18 | 2 | 5 | | |
| XV. | Boston | 2.35 | ... | .44 | 26 | 20 | 60.2 | 13 | 31.0 | 1, 18 | 2 | 5 | | |
| XVI. | Grimsby (Killingholme) | 2.43 | + .06 | .49 | 4 | 15 | 56.0 | 10 | 33.0 | 1† | 0 | ... | | |
| XVII. | Mansfield | 2.23 | — .87 | .43 | 25 | 18 | 58.0 | 4.5 | 33.0 | 1 | 0 | ... | | |
| XVIII. | Manchester (Ardwick)..... | 2.81 | + .09 | .35 | 3 | 20 | 61.1 | 13 | 31.0 | 18 | 2 | 5 | | |
| XIX. | Wetherby (Ribstone) | 2.91 | + .15 | .81 | 27 | 14 | ... | ... | ... | ... | ... | ... | | |
| XX. | Skipton (Arncliffe) | 10.75 | + 5.00 | 2.25 | 27 | 24 | 56.0 | 14 | 28.0 | 17 | 2 | ... | | |
| XXI. | North Shields | 1.30 | — 2.15 | .32 | 26 | 14 | 61.5 | 14 | 27.5 | 18 | 2 | 2 | | |
| XXII. | Borrowdale (Seathwaite)..... | 16.73 | + 4.91 | 1.65 | 18 | 26 | ... | ... | ... | ... | ... | ... | | |
| XXIII. | Cardiff (Ely) | 5.36 | + 1.16 | .67 | 26 | 24 | ... | ... | ... | ... | ... | ... | | |
| XXIV. | Haverfordwest | 6.38 | + 1.04 | 1.00 | 27 | 19 | 58.9 | 9 | 30.0 | 28 | 1 | 1 | | |
| XXV. | Aberystwith (Goginan) | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | | |
| XXVI. | Llandudno..... | 3.06 | — .85 | .63 | 30 | 16 | 62.8 | 8 | 35.3 | 1 | ... | ... | | |
| XXVII. | Cargen | 7.38 | + 3.47 | .91 | 27 | 23 | 56.2 | 14 | 28.2 | 18 | 2 | ... | | |
| XXVIII. | Hawick (Silverbut Hall).... | 4.25 | + 1.04 | .71 | 26 | 19 | ... | ... | ... | ... | ... | ... | | |
| XXIX. | Douglas Castle (Newmains).. | 6.61 | + 3.06 | .85 | 24 | 26 | ... | ... | ... | ... | ... | ... | | |
| XXX. | Kilmory | 8.59 | + 3.23 | .71 | 30 | 26 | ... | ... | 25.0 | 18 | 2 | ... | | |
| XXXI. | Appin (Airds) | 9.08 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | | |
| XXXII. | Mull (Quinish) | 9.85 | ... | 1.19 | 22 | 28 | ... | ... | ... | ... | ... | ... | | |
| XXXIII. | Loch Leven | 4.20 | + .65 | .60 | 5* | 16 | ... | ... | ... | ... | ... | ... | | |
| XXXIV. | Arbroath | 3.28 | + .13 | .47 | 30 | 17 | 59.0 | 14 | 30.0 | 18 | 1 | ... | | |
| XXXV. | Braemar | 6.80 | + 3.03 | .84 | 26 | 26 | 57.2 | 14 | 23.3 | 18 | 6 | 23 | | |
| XXXVI. | Aberdeen | 2.70 | ... | .41 | 21 | 22 | 59.0 | 14 | 32.0 | 17§ | 2 | ... | | |
| XXXVII. | Portree | 14.55 | + 6.18 | 1.24 | 20 | 27 | ... | ... | ... | ... | ... | ... | | |
| XXXVIII. | Inverness (Culloden) | 3.73 | + 1.03 | .68 | 23 | 12 | 60.0 | 14 | 31.0 | 1 | 0 | 17 | | |
| XXXIX. | Dunrobin | 2.80 | ... | .55 | 16 | 14 | 60.7 | 14 | 30.0 | 18 | 1 | ... | | |
| XL. | Sandwick | 3.04 | — 1.40 | .35 | 21 | 26 | 58.0 | 14 | 34.2 | 18 | 0 | 1 | | |
| XLI. | Cork (Blackrock) | 7.57 | + 2.96 | 1.49 | 29 | 26 | 58.0 | 9, 10 | 29.0 | 25 | 2 | ... | | |
| XLII. | Dromore Castle | 7.18 | + 2.57 | .79 | 2 | 25 | 63.0 | 9 | 32.0 | 2 | 1 | ... | | |
| XLIII. | Waterford (Brook Lodge) ... | 5.13 | ... | .59 | 26 | 25 | 65.0 | 20 | 31.0 | 28 | 3 | ... | | |
| XLIV. | Killaloe | 4.33 | ... | .64 | 27 | 24 | 63.0 | 3 | 27.0 | 26 | 3 | ... | | |
| XLV. | Portarlington | 3.07 | + .67 | .57 | 27 | 22 | 58.5 | 11 | 31.0 | 25 | 1 | ... | | |
| XLVI. | Monkstown | 2.73 | ... | .66 | 27 | 16 | 65.0 | 14 | 33.0 | 18¶ | ... | 2 | | |
| XLVII. | Galway | 7.26 | + 3.49 | 1.04 | 27 | 27 | 60.0 | 13 | 36.0 | 29 | ... | ... | | |
| XLVIII. | Waringstown | 3.98 | + 1.27 | .75 | 30 | 23 | 62.0 | 14 | 28.0 | 25 | 1 | 8 | | |
| XLIX. | Londonderry..... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | | |
| L. | Edenfel (Omagh) | 3.33 | + .28 | .35 | 26 | 26 | 59.0 | 4 | 27.0 | 25 | 7 | ... | | |

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

* And 12, 27. † And 29. ‡ And 18, 30. § And 18. || And 28. ¶ And 28, 29.

METEOROLOGICAL NOTES ON NOVEMBER.

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; S for Snow.

ENGLAND.

HITCHEN.—A most extraordinary month, the warmest November in our record; mean temp. 6° above the average of 30 years; furious gale on the 27th and the lowest bar. reading ever recorded here.

BANBURY.—High wind on 8 days, especially on 26th and 27th, accompanied by a very low bar., L on 22nd and 27th; S on 1st.

CULFORD.—The month was exceedingly fine and mild, with frequent high winds.

COSSEY.—A genial month with a great deal of sunshine, favourable for agricultural pursuits; heavy gale on 27th and 28th.

BODMIN.—The warmest November on record here, mean temp. $52^{\circ}2$.

CIRENCESTER.—A fine mild month.

WOOLSTASTON.—A singularly warm month; mean temp. $51^{\circ}5$, a remarkable depression of the bar. occurred on the 26th and 27th.

ORLETON.—On the morning of the 1st the Highlands were all covered with S, but none fell afterwards and there were very few frosty nights. The weather was generally very warm and showery with much wind. On the evening of the 26th the bar. fell to 28.600 in. (uncorrected) and remained nearly stationary for more than 20 hours, accompanied by R and great wind. The mean temp. of the month was more than 6° above the average of 20 years, and was nearly $1^{\circ}5$ above that of October.

BOSTON.—The weather during the month was of a most unusual character, bright sunshiny days and mild temp. taking the place of fog and cold. The temp. was nearly 7° above the average, and higher than that of any November of the preceding 20; wind entirely from S.; very heavy gale on the 26th & 27th, the bar. standing at 28.80 in. for 24 hours.

GRIMSBY.—Very fine, and unusually pleasant weather for the season; scarcely any fog; frequent gales; temp. much above the average. Bar. below 29 inches for 36 consecutive hours on 26th and 27th, L at night on 27th.

MANSFIELD.—The month was remarkable for its mildness and for beautiful spring-like days; high winds occurred frequently, and a continuous gale on the 26th and 27th.

ARNcliffe.—A month of mild weather with unusually heavy rainfall; TS on 26th.

WALES.

HAVERFORDWEST.—A month of storm, heavy floods and extreme mildness; very stormy and wet from 20th to end of month. T, L, H, on the 22nd; heavy gales on 16th, 20th, 22nd, and from 25th to 28th, the last seeming to equal in violence the gale of October 14th, and lasted much longer. Bar. readings (corrected) :—25th, 9 a.m., 29.745 in.; 9 p.m., 29.675 in. 26th, 9 a.m., 29.603 in.; 9 p.m., 28.748 in. 27th, 9 a.m., 28.736 in.; 9 p.m., 28.810 in. 28th, 9 a.m., 29.418 in.; 9 p.m., 29.645 in.

LLANDUDNO.—The month was remarkable for its repeated heavy gales and the mildness of the temp., the latter being more than $5^{\circ}5$ above the average; TS on 22nd at 11.30 p.m.

SCOTLAND.

CARGEN.—The most stormy month we have had for many years; the gales on the 22nd, 26th, and 27th, were very destructive; on the 22nd, the highest tide for 15 years occurred, breaking many embankments on the Frith below Dumfries and doing much damage. Mean temp. $46^{\circ}6$, $5^{\circ}4$ above the average, L on 16th, 20th, 22nd, and 23rd.

HAWICK.—Snowstorm with high wind on 1st; gales on 15th, 16th, 21st, 25th, 26th, and 27th. The river Teviot in higher flood on the 27th than it has been since 1846, causing from £2,000 to £3,000 worth of damage to factory property. The month passed almost without frost.

QUINISH.—A very mild, wet, and stormy month ; during a fearful gale on the night of the 21st, the tide rose between 3 and 4 feet above ordinary spring tides, doing immense damage.

ABERDEEN.—The first half of the month was unusually mild, the temp. being abnormally high for the time of the year ; the latter half was very unsettled, with strong S.W. gales. Rainfall somewhat below the average ; aurora and L each seen on two nights.

PORTREE.—A wet stormy month ; a very strong gale from S.W. began at 10 p.m. on 21st, and continued with more or less violence until 10 p.m. on 22nd, accompanied by showers of S, H, and R, and loud T and vivid L ; the T and L continued at short intervals till midnight on 25th.

CULLODEN.—Very mild, strong gales frequent, heavy S on the night of the 21st, and L on several other nights.

SANDWICK.—The temp. was so high that vegetation was still proceeding till checked by the storms of 20th and some following days. There were gales of 40 to 50 miles an hour on 1st, 2nd, 3rd, 21st, and 30th, and of 60 miles or more on 20th, 22nd, and 26th ; the strongest was on 22nd, from 11 to 12 a.m., when it was 68 miles ; T and L on 22nd. Aurora on 15th, 18th, 19th and 29th.

IRELAND.

DROMORE.—The stormiest month on record ; a succession of gales with short intervals between ; fine trees blown down and houses unroofed in every direction, and the gable of an old castle, that had stood for three centuries, blown down. Mean temp. 50°·3.

WATERFORD.—Prevailing winds, S. to S.W. ; several heavy gales. L on four days.

KILLALOE.—Temp. unusually high, the mean (48°·8) being 5°·4 above the average of five years. Frequent gales and TSS.

MONKSTOWN.—From the 1st to 15th, the weather was exceedingly fine and warm, with very little R ; but the remainder of the month was wet and stormy, three distinct strong south-westerly gales occurring on 16th, 22nd and 27th ; the latter continued with unabated violence for nearly thirty hours, during which time the bar. fell to and stood steadily at about 28·420 in.

WARINGSTOWN.—Wet and very stormy, no such succession of gales remembered ; much damage done by that of the 21st.

THE AUTUMN AND WINTER OF 1881-2.

To the Editor of the Meteorological Magazine.

SIR,—The following statements in connection with the past two months may perhaps interest some of your readers :—

(1) November has been more than 3° warmer than the previous month of October was. (2) October was (45°·3) the coldest at Greenwich since 1817. (3) Last month was the warmest November there (48°·7) since 1852. (4) The Greenwich tables only show two instances in previous years of the mean temp. of November exceeding that of October, viz., in 1817 and 1852. In the former year October was 45°·0, and November 46°·9 ; and in the latter year October was 47°·9, and November 48°·9. (5) In each case the following February was decidedly cold. I do not expect that February, 1882, will prove an exception to this. Last December was very mild, and February, 1881, not much colder than usual, so that the whole winter of 1880-81, was not greatly below the average. The coming winter, on the whole, will probably be less cold than last winter was, but still, I believe, somewhat colder than the average.—Yours, &c.,

GEORGE D. BRUMHAM.

Barnsbury, Dec. 3rd, 1881.