

# S Y M O N S ' S

## MONTHLY

# METEOROLOGICAL MAGAZINE.

CLV.]

DECEMBER, 1878.

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### INDIAN METEOROLOGY.\*

At last we have really high class meteorological work from India. By high class we mean that for which we are always pleading, namely, work involving original research; and, curiously enough, almost equally good work comes simultaneously from Calcutta and from Bombay. India, or at any rate the observatories of Bombay and Madras, have contributed largely to meteorological literature. We have 14 large quarto volumes of Bombay Observations, and yet our set is not perfect; and although the observations at Madras have not been printed in equal detail, yet the publications of that Observatory are as much as one can lift. And, after all, what have that pile of volumes taught the world? They tell us what was the pressure, temperature, and humidity of the air at Bombay at every hour of every day from 1845 to 1857; so far well, but what the public require is not only the original observations, but also the results. We have no hesitation in saying that the single volume recently published by Mr. Chambers is of far more general utility than the whole previously issued. It is so good that it can afford to be put before the meteorologists of all nations as a specimen of complete reduction; it is so good that the Astronomer Royal has had an abstract of it prepared which will be read at the next meeting of the Meteorological Society, and it is so good that we can scarcely suggest any improvements. We

\**Indian Meteorologists' Vade-Mecum.* Parts I. & II.

*Instructions to Meteorological Observers in India.* By H. F. BLANDFORD. 8vo. Calcutta, 1876-1877.

*Tables for the reduction of Meteorological Observations in India.* 1876.

*Report on the Meteorology of India in 1875.* Calcutta.

*Ditto ditto ditto* 1876-1878.

*Report on the Vizagapatam and Backergunge Cyclone of October, 1876.* By J. ELLIOTT. Folio. Calcutta, 1877.

*Report on the administration of the Meteorological Department of the Government of India.* By H. F. BLANDFORD. 1875-6.

*Ditto ditto ditto* 1876-7.

*Indian Meteorological Memoirs.* Vol. I., Part I. 1876.

*Ditto ditto* Vol. I., Part II. 1878.

*The Meteorology of the Bombay Presidency.* By C. CHAMBERS, F.R.S. 4to, and Atlas of Plates. Bombay, 1878.

recommend the work to the careful study of those responsible for meteorological progress, as the best specimen we have yet seen of thoughtful reduction of a long series of observations. It may be well to append a few of the leading elements for Colába Observatory, 1847-1872 :—

Temperature	Latitude .....	18° 53' 45" N.	Bar. at 32°	{	Absolute max. ....	30·164 in.
	Longitude.....	72° 48' 12" E.			Mean .....	29·808 in.
	Altitude .....	37 feet.			Absolute min. ....	29·183 in.
	Absolute max. ....	100°·2.	Wind	{	Total rainfall .....	70·30 in.
	Mean daily max. ...	85°·2.			Max in 24 hours ...	15·31 in.
	Mean .....	79°·8.			Rainy days, 102.	
	Mean daily min. ...	73°·5.			Mean direction N. 71° W.	
	Absolute min. ....	53°·3.			Mean force 6·5 miles per hour.	

We now come to the collection of works issued under the direction of Mr. H. F. Blandford, the chief of the Indian Service—or, as he is officially called, Meteorological Reporter to the Government of India. And here we had better insert a few words of history—or at any rate refer our readers to an article entitled “Indian Meteorology in Parliament,” which appeared in the number of this magazine for May, 1874, to which we need only add that very shortly afterwards it was announced that an Indian Meteorological Office had been organized, with Mr. Blandford as chief. Looking at the quality and quantity of the work issued from that office, we have no hesitation in saying that no better appointment could have been made. The qualifications requisite in the head of a large meteorological department are by no means confined to meteorological ability. They include fixity of purpose, faculty of command (this is totally opposed to petty tyranny, which is a great defect), conversance with the instruments, methods and objects of meteorology, with the kindred sciences of physical geography, geology and botany, with the principal modern languages, and with something more than elementary mathematics. We cannot pretend to analyse the mass of material which Mr. Blandford has put before us—some 1,500 folio pages—but we have found in it proofs of his qualifications in every one of the above points. And besides that we find evidence of that somewhat rare quality—sound common sense—in not attempting more than is thoroughly practicable, in laying a good foundation for future work by the rigorous examination of the instruments and methods now in use, by keeping up imperfect observations and comparing them with perfect ones (instead of abruptly stopping the bad ones and so creating a hiatus which would remain for all time to come), and many other equally thoughtful arrangements which we need not detail. If anyone enquires whereupon we base these strong remarks, we refer them to the three 8vo. publications, “Instructions to Meteorological Observers in India,” “Meteorology of India,” and “Tables for the reduction of Meteorological Observations in India.” Before passing to the other works on our list, we may quote Mr. Blandford’s remarks upon—

“THE RAINFALL OF CHERRA PUNJI.—The highest precipitation occurs when a saturated current of air at a high temperature is met by a hill range

running athwart its course ; and the steeper the slope, the greater is the local precipitation. Cherra Punji, in the Khasi hills, long renowned as having the greatest recorded rainfall in the world, is a remarkable illustration of the combination of these favouring conditions. The Khasi hills rise abruptly from the *jhils* of Silhet, which being but a few feet above sea level, and receiving the copious drainage of the hills that surround Cachar and Silhet, present, during the rainy season, a broad sheet of water, from which emerge a few villages built on mounds, and the low ridges locally termed *tilas*. Over this low inundated tract, sweeps the south-west monsoon from the Bay of Bengal, and, meeting the Khasi hills, is abruptly driven up to a height of 4,000 feet, before it resumes its course towards Upper Assam and the Eastern Himálaya. These circumstances alone suffice to produce an exceptionally heavy rainfall along the face of the range. But Cherra Punji is, in some respects, exceptional, even in this highly humid region. It stands on a little plateau of thickly-bedded sandstones, bounded on two sides by precipices of 2,000 feet sheer descent, which close in gorges, debouching southwards on the plains. The south-west wind blows up these, as well as on the southern face of the general scarp ; and having reached the heads of the gorges, ascends vertically. Thus Cherra Punji is surrounded, or nearly so, by vertically ascending currents of saturated air, the dynamic cooling of which is the cause of the enormous precipitation which has made this place famous. It is almost certain that the annual average varies greatly in different parts of the station ; although the whole plateau does not cover much more than a couple of square miles. Some of the earlier registers, which were kept at sites near the edges of the plateau, shew a higher precipitation than those kept in recent years at houses nearer its centre."

Two principal publications have been commenced by Mr. Blandford—one occasional, the other annual. The occasional one is entitled "Indian Meteorological Memoirs," being occasional discussions and compilations of meteorological data relating to India and the neighbouring countries. The best notion of the nature of this work will be given by quoting the titles of the papers :—

- I. The winds of Calcutta.
- II. The Meteorology and Climate of Yarkand and Kashgar.
- III. The Diurnal Variation of the Barometer at Simla.
- IV. Storms in Bengal in 1876, with increased atmospheric pressure.
- V. The rainfall of Benares in relation to the prevailing winds.
- VI. The Diurnal Variation of the Barometer at Calcutta and Hazaribagh.

All the works we have hitherto noticed have borne such evidence of originality of thought and treatment, and at the same time of uniformity, that we are forced to the conclusion that a very large proportion of the work has been done by Mr. Blandford himself. How he can have got through it we cannot tell, for we know of no one with whose it can be compared. But besides all this there are the massive Reports on the Meteorology of India for 1875 and 1876, of which the letterpress is indisputably Mr. Blandford's writing ; and even if he has a hundred assistants it is none the less an enigma how he has contrived to supervise and unify such a tremendous "output" of mental work. These last works are thoroughly worthy of the Indian Government, and may with confidence be put in comparison with those of every nation—but we think that at last we have found two points in which improvement is possible. Mr. Blandford admits the remarkable nature

of the fall of rain at Cherra Punji, he gives returns from 274 stations, why does he not re-establish one at Cherra Punji? Secondly, may we suggest that what with changes in the mode of spelling Indian names, and what with the smallness of some of the stations quoted, it is not easy to identify the locality of his minor stations. We should like to see a map of the stations in the next volume, but if not, that at least the latitude, longitude, and approximate altitude of *every* station be given.

We have one more work to mention, viz., that by the late Mr. Elliott, on the Vizagapatam and Backergunge Cyclones of 1876, a memoir which Mr. Blandford says is "entitled to rank as perhaps the most complete monograph of a cyclone that has ever been put on record," a verdict in which we thoroughly concur. The opening chapter of it gives so good a *résumé* of the progress of cyclonology that, especially as the original work is not easily obtainable, we adopt the unusual course of reprinting *in extenso* the following article:—

#### CYCLONE THEORIES.

A brief recapitulation of the various theories which have been advanced to account for the phenomena and origin of cyclones will be useful, not merely for reference in the discussion of the recent cyclones, but also as showing the present practical and theoretical knowledge on the subject of cyclones. The observations hereafter given in detail will be employed partly to test the various theories.

The earliest writer of importance on the subject of cyclones was Mr. Redfield. Colonel Capper, in his observations on the wind and monsoons published in 1801, had stated his belief that the storms of the Indian Ocean were whirlwinds or rotatory storms. He stopped short at this anticipation, stating that "it would perhaps not be a matter of great difficulty to ascertain the position of a ship in a whirlwind by observing the strength and changes of the wind. If the changes are sudden and the wind violent, in all probability the ship must be near the vortex of the whirlwind; whereas if the wind blows a great length of time from the same point; and the changes are gradual, it may be reasonably supposed the ship is far from the vortex."

Mr. Redfield contributed a series of papers, dating from the year 1822, to American scientific journals, in which he developed the theory that they were vast progressive whirlwinds or rotating storms moving along curved paths. About the same time Professor Dove in Europe had come to the conclusion that all the phenomena of such storms are fully explicable by the assumption of one or more rotary atmospheric currents or whirlwinds advancing slowly in a definite direction.

The circular theory was also adopted by the next important writer on this subject, Lieutenant-Colonel Reid, of the Royal Engineers, in his work on the Laws of Storms. He not merely confirmed the results of the investigations of Mr. Redfield, but laid down, from examination of the tracks of a number of storms, the important generalization that in the rotary storms of the tropical regions of the northern hemisphere, the direction of rotation of the winds is N. W. S. E., or opposite to the direction of motion of the hands of a watch with its face upwards; whereas in the storms of the tropical regions of the southern hemisphere, the direction of rotation is the opposite—N. E. S. W. He was thus enabled to give a series of rules for the guidance of sailors navigating tropical seas.

Mr. Piddington took up a similar line of inquiry, and analyzed carefully the path of every storm in the Bay of Bengal and Indian Ocean of which he could obtain any records. He fully adopted the circular rotatory theory, and suggested the use of the word cyclone for all such storms. He gave an elaborate

series of rules for the information and guidance of sailors navigating these seas.

But, as Mr. Buchan observes in his hand-book on meteorology, it should always be remembered that in the charts given by Reid, Piddington, and others who adopt in its simplicity the circular theory, the arrows representing the wind direction are drawn always tangential to circles described about the centre of the area of calm solely on the assumption of the truth of the circular theory. They are hypothetical directions serving in their works a definite purpose, that of enabling them to lay down practical rules for sailors navigating seas visited by cyclones, and are undoubtedly a rough approximation to the actual character of the atmospheric motion during cyclones, which is what Sir John Herschel terms vorticeous or spiral in its nature. Numerous synchronous storm charts, giving the absolute direction of the winds at the same instant, have been drawn by various meteorologists, and show that there is an indraught of air to the central region of calm as well as a rotatory motion. The combination of the two motions gives a spiral or incurving motion of the air towards the centre.

The upholders of the circular theory had thus seized only a part of the truth. The other element, the indraught or centripetal part of the motion, an important element, was left out of consideration. Mr. Espy, of Philadelphia, adopted this element to the exclusion of the other, laying down what is known as the centripetal theory. From personal observation of the direction in which the trees were lying on the ground after the tornado of the 19th of June in New Brunswick, he came to the conclusion that in this storm the winds must all have been blowing and converging to a centre. He afterwards adopted the theory of the converging motion of the air in the case of all cyclones to a centre caused by a rapid upward vertical motion at this centre, due to the vast amount of heat given out by the condensation of vapour and the subsequent fall of rain. He also laid down as a general rule that whenever a fall of rain is going on over a large area, there is necessarily produced an upward motion of the strata in and above which condensation is going on, which is followed by an indraught from all directions in the lower atmospheric strata and an out-draught in the higher.

Dr. Dove meanwhile was devoting great attention to the subject of the meteorology of winds and storms. He elaborated the idea which underlay the explanation given by Hadley to account for the easting of the trades wind, and established what he termed the law of gyration. This is that, in consequence of the diminishing velocity of rotation at places of the earth's surface as we proceed from the Equator to the Poles, "in the Northern Hemisphere, when polar and equatorial winds succeed each other, the winds veer in the direction S. W. N. E. S., and in the Southern Hemisphere, when polar and equatorial currents succeed each other, in the direction of S. E. N. to S. He also explained, on theoretical principles, the opposite directions of rotation of cyclones in the Northern and Southern Hemispheres. He also showed that the cyclonic movement of the wind was in all cases in accordance with the general principle underlying the law of gyration, and that it might be due to a mechanical obstruction, as a range of hills, or the resistance of another mass of air, or that it might result from the struggle of opposite currents which alternately displaced each other. The former is apparently his more matured explanation. The next theory of importance, that of Professor Taylor, adopted by Sir John Herschel in his work on Meteorology, is a modification of Espy's Centripetal Theory and Dove's Law of Gyration. Cyclones owe their origin, according to this theory, to the action of local heat producing an upward expansion and vertical motion of the air over a limited area. This is followed by an indraught from all the neighbouring districts, which would be strictly in accordance with the centripetal theory, if the earth had no motion of rotation. The rotation causes these winds to be deflected in approaching the centre, and the result is an inner spiral motion round a centre, over which a continuous ascensional movement of the air is going on.

The latest authorities on the subject of cyclones in the Indian Ocean and Bay of Bengal are Messrs. Meldrum, Blandford, and Willson. Mr. Meldrum, who has made a lengthened study of the cyclones of the Indian Ocean, and has traced out a connection between solar spot frequency and cyclone prevalence, frequency, maintains that in the Southern Indian Ocean they are primarily due to the action of lateral parallel opposite currents of winds. In the intermediate belt between the opposite winds the mass of air is in a state of comparative calm, and in consequence of the friction on opposite sides, it gradually acquires a rotatory motion. In this theory the rotatory motion and the barometric depression at and near the centre primarily result from the action of the parallel and opposite winds. Mr. Willson maintained the same theory. His opinion, as given briefly in the report on the Meteorology of Bengal for 1874, is as follows:—"I have elsewhere stated that in the cases which I had been enabled to examine it appeared highly probable that cyclones in the Bay of Bengal, like those in the Southern Indian Ocean, were generated between parallel wind currents blowing in opposite directions, and that the determining causes were probably not local, but far removed from the place of the storm's origin; that in fact the unusual vigour of the opposing winds which precedes the generation of such storms is probably produced in the first instance by abnormally high pressure some 10 or 15 days beforehand on both sides of, but far removed from, the belt which afterwards becomes the battle ground of the opposite currents. In the case of the cyclone under report (the cyclone of 3rd to 5th May, 1874) no doubt whatever can be entertained of the previous existence of the opposite winds, and it is equally certain that about eight days beforehand the pressures to the eastward, and to the westward especially, were very much above the average for the season."

The full explanation of his views and their extension to the October cyclones of the Bay of Bengal is given by Mr. Willson in his report on the Midnapore cyclone. The following extract will suffice to show its nature:—

"It appears to me that the theory of opposite currents, perhaps slightly modified in accordance with local circumstances, would account for the formation of this cyclone, as well as the local depression theory. The winds were N. E. over all the Bay north of latitude  $17^{\circ}$ , and W. S. W. south of latitude  $15^{\circ}$ . It seems therefore not improbable that long before the N. E. surface wind commences to blow with any strength, there is an upper N. E. current from the region of high pressure to the region of relatively low pressure. This current is drier, colder, and heavier than the opposing damp W. S. W. current, which must therefore be forced upwards along the belt where the winds collide and where the N. E. current descends. The W. S. W. current appears to be always the more powerful of the two. This fact is explained in the present instance by the high pressure at Nancowry compared with the pressure over Bengal. However, it would seem probable that a very gentle N. E. current, or even a calm dense atmosphere would be sufficient to check and force upwards the powerful but less dense W. S. W. monsoon, thereby producing the enormous precipitation of moisture which is always observed near the place of the origin of a cyclone, and which probably plays a very important part in its formation. As the precipitation of moisture continues, the atmospheric pressure diminishes along the head of the W. S. W. monsoon. The north-easterly current hence becomes more vigorous, and gradually extends northwards as a strong surface-wind. Ultimately the N. E. current becomes sufficiently powerful to generate the cyclone. The above is a short sketch of how it appears to me the theory of opposite currents may be applied to account for the formation of the cyclones of the Bay of Bengal."

Mr. Blandford's theory is given briefly in an appendix to his paper on "The Winds of Northern India." It is what has been termed the local depression theory. A calm state of the atmosphere, or one in which the winds are light and variable over the open sea, is the first condition favourable to the production of cyclones. The second condition is a high or moderately high temperature. The consequence of this combination of conditions will be the production

and ascent of a large quantity of vapour, which will be condensed with the liberation of its latent heat over the area of its production, instead of its being carried away to some distant origin. If this state of things last for some days, the atmospheric pressure will be locally lowered, causing, or tending to cause, an indraught of air towards the place of minimum pressure. One further condition appears to be essential. The actual formation is finally determined by the inrush of a saturated stormy current from the S. W. or W. S. W.

## METEOROLOGY AT THE PARIS EXHIBITION.

*Continued from Page 152.*

SECOND only to Redier among the continental exhibitors were Hottinger et Cie, of Zurich, who have succeeded to the business of J. Goldschmid, who exhibited such marvellously sensitive aneroids at the South Kensington Loan Exhibition. Their case was crowded with instruments. We will begin with Dr. Koppe's **per cent. hygrometer**, which may be shortly described as a Saussure's hygrometer,\* with an arrangement for adjusting the index to the true reading. A long paper in which this instrument is engraved and described appeared in the *Zeitschrift* for February 15th, 1878, under the title "On the estimation of humidity by means of Psychrometers and Hair Hygrometers, and on a very judicious combination of the two instruments." We recommend both the instrument and the paper to any one interested in the anomalous results afforded by Dry and Wet Bulb Thermometers at temperatures near 32°, and at very low temperatures also. We pass on to **aneroid barometers**, for which the firm has always been celebrated. They are all on the Goldschmid or Weilenmann system, that is to say, without any chains, and with micrometer contact pieces something after the style of those proposed to be made by Mr. Loseby, of Leicester. The delicacy of their reading is simply marvellous; one of them, 3 inches in diameter and 2½ inches high, is guaranteed to read to 0·005 mm. or to 0·0002 of an inch! If the atmospheric pressure would but remain steady, such an instrument would almost beat a measuring tape. Of course such precision is not attained without some trouble, but it is not excessive; there is no doubt that in giving the vacuum box scarcely any work to do, the true principle of a good aneroid is adopted; and lastly, no one can say that £6 is too high a price. We cannot praise their **self-recording aneroid**; it may be the best of its class—we do not say that it is not—but now that it is possible at a moderate cost to get a *continuous* trace showing all the delicate oscillations of atmospheric pressure, we cannot recommend an instrument which only records the pressure at one instant during each hour. The **self-recording hygrometer** exhibited by this firm seemed to us a cheap and useful instrument, although probably many Englishmen will think otherwise when we state that the thermometer was a metallic one, and the humidity was obtained from a hair. Everybody cannot buy a Kew thermograph at £120, but many a small establishment might be able to spare £16, and by carefully adjusting to the readings of standard instruments we believe very useful results might be obtained: one special recommenda-

\* See Met. Mag., vol. II., pp. 66.

tion is that neither light, nor photography is required. The firm also exhibited a **self-recording rain gauge**, which we hope to describe fully on another occasion.

Tonnélet, of Paris, exhibited a very good series of **Fortin barometers** of the pattern chiefly used in England. Alvergnyat showed a **barometer** with all three arrangements for correcting for the variation of the level of the mercury in the cistern, viz., a fixed ivory point, an ivory point attached to the scale and moveable with it, and a plunger of the same diameter as the tube.

There were a great many exhibitors of **ordinary aneroids**, but none call for special notice. Arronit had an **aneroid** of a pattern resembling one which we first saw used in Clum's Aëloscope, viz., with one dial for the ordinary scale of millimetres and another for the tenths of a millimetre. In Clum's instrument the hand travelled once round the dial for each barometric inch, and the inch was shown by a separate scale near the centre. Eon showed a **rain gauge** in which the depth of rain was to be read through a glass plate; it would fail utterly in frosty weather; perhaps it was only intended for summer or in-door use. Aléy showed the most tasteful series of **ornamental thermometers** we have ever seen. The **high-class thermometers** of Baudin appeared very good, but without testing them it is rather a farce to express an opinion.

We may mention here the *full equipment of meteorological instruments*, for the Normal Schools of which a set was exhibited.

**Thermometer Stand**, Montsouris pattern (see *Met. Mag.* vol. xiii. page 49).

**Barometer**, Fortin's pattern, made by Salleron.

**Maximum Thermometer**, Negretti's pattern, made by Baudin.

**Minimum**                   "                   Rutherford's   "                   "                   "

**Dry Bulb**                   "                   "                   "                   "

**Wet Bulb**                   "                   "                   "                   "

**Hair Hygrometer**, by Salleron.

**Piche's Vaporimeter**, by Salleron.

**Solar Radiation Black Bulb in vacuo**, by Salleron.

"                   "                   **Clear**                   "                   "                   "

**Ozonoscope.**

Hervé-Mangon's **electrically recording anemometer** was exhibited in several places, most of them being made by Hardy.

Theorell's **meteorograph** was also there. The distinguishing feature of his instrument is that instead of giving a continuous pencil or photographic curve, which for purposes of calculation must be converted by the observers into numerical values, this meteorograph prints the values on a strip of paper. The merits and demerits of this arrangement are very evenly balanced. It is a great advantage to be saved the trouble of tabulating the values from the curves, but it is a great disadvantage not to know what occurs in the intervals which occur between successive printings by the instrument, even if they occur each 15 minutes. For instance, the indication of the inclination of a cyclone axis which can be deduced from the difference between



the time of passage of a barometric minimum, and that of the change of the wind's direction and force at the earth's surface, could not be ascertained by this instrument.

It is hopeless to try to report upon the Maps, Charts, Books, Photographs, and Diagrams exhibited, they were so numerous. We can only specify a few.

Prof. A. R. Harlachier sent on behalf of the *Service Hydrométrique de la Bohême* a very fine series of diagrams of the regime of the Elbe and the Moldau. Prof. Raulin sent a map of **the rainfall of the whole of France**, showing total fall, but tinted chiefly to show seasonal distribution. M. Hébert had forwarded on behalf of the Commission Météorologique de la Haute Vienne, an elaborate report upon **the Storms of 1876**, with excellent MS. charts. The Comte Sansac de Touchimbert, of Poitiers, sent a photograph of his **thermometer stand**, respecting which we can hardly do better than transcribe our original note, "just like a *tall mushroom* !"

### RAINFALL STATIONS.

I FIND considerable difficulty in sufficiently impressing my correspondents with the importance of at once reporting the death or removal of neighbouring observers, and the commencement of new sets of observations. The three essential qualifications of a good rainfall organization are accuracy, continuity, and equality of the geographical distribution of stations. As regards the last two my correspondents could help very greatly if, whenever they hear of any change of residence, &c., among their neighbouring observers, they would send a post card to report it—even if the same event were reported by two or three, no harm would be done. This request applies especially to the County Superintendents, to whom one naturally looks for such help.

I have been led to these remarks by having just completed the annual examination of the entire list of observers, because I feel that in spite of the great care we take to render our list as perfect as possible, some of the observers are probably dead, others removed, and others prevented from continuing their records. Judging from past experience, these cases are not one per cent., but still they might be reduced almost to infinity, and therefore I invite the assistance above indicated.

It appears, now that all the stations are plotted on the map (no light matter with about 2,000 stations), that there are still some rather large districts in which no observations are being made. The following are some of the principal, and any assistance in obtaining observations from them will be most acceptable.

*Districts and Towns from the neighbourhood of which Returns of Rainfall are much required.*

#### ENGLAND.

Ashbourne, Derbyshire  
Castle Cary, Somerset  
Chagford, Devon  
Dorchester, Dorset  
Folkingham, Lincoln

Goathland, York, N.R.  
Kirkby Moorside, York, N.R.  
Kirtton, Lincolnshire  
Newmarket, Cambridge  
Whitchurch, Hants

## WALES.

Builth, Brecon  
 New Radnor, Radnor  
 Tregaron, Cardigan

Llanfyllin, Montgomery  
 Llanrwst, Denbigh

## SCOTLAND.

Huntly, Aberdeen  
 Kilmordan, Argyll

Loch Rannoch, Perth  
 Spital, Perth

Also in the S.E. of Ayrshire, along the Caledonian Canal, and in most parts of Ross and Sutherland.

## IRELAND.

Bailyborough, Cavan  
 Bangor, Mayo  
 Connemara, Galway

Dunmanway, Cork  
 Kanturk, Cork

It will be remembered that there is now no grant or fund whence rain gauges can be supplied gratis; but accurate instruments verified can be obtained from 15s. upwards.

G. J. SYMONS.

62, Camden Square, N. W.

## ESTIMATION OF OZONE.

ALTHOUGH the enquiry upon this subject in our last number was addressed to the Editor, we thought that by leaving it unanswered, some replies might be elicited. Not one having come to hand, we wrote to Dr. Fox, who replies as follows:—

“The answer to the question is simply this, that ozone is now estimated—by those who are tired of the old inaccurate and worthless method—in one of three ways.

1. By means of test papers made with the purest iodide of potassium *without starch*, over which a known amount of air is passed by the help of aspirators.
2. By means of Houzeau's test papers, which alone register ozone to the exclusion of the other air purifiers, namely, peroxide of hydrogen and nitrous acid.
3. By quantitative chemical analysis. Known and measured quantities of air are passed through a solution of an arsenite, which is oxidized, and becomes converted into an arsenate. The amount that undergoes or does not undergo this change is measured.”

It now seems desirable to follow up the subject by ascertaining where observations are made by these several methods, specifying which or whether more than one method is adopted at each station.

We find that in the last Quarterly Return of the Registrar General the amount of ozone is reported by the observers at—

Guernsey,	Oxford,	Kelstern,	Silloth,
Helston,	Gloucester,	Eccles,	Carlisle.
Torquay,	Somerleyton,	Hull,	
Strathfield Turgiss,	Nottingham,	Cockermouth,	

It will tend to put our knowledge on a better footing if each of these observers will kindly send word what method he adopts. We have also seen recent reports on the amount of ozone at the Royal Observatory, Greenwich; it will be interesting to know the method adopted at that establishment.

## THE WEATHER IN NOVEMBER.

DURING the first week of November the changes in barometric pressure over Western Europe were both considerable and important. Readings were generally highest to the westward of Ireland, while a large depression was shown over Scandinavia. Besides this main depression, subsidiary disturbances passed south-eastwards over or near these Islands. At first they were comparatively slight, and the northerly wind which prevailed generally was not very strong, except in the east. On the evening of the 7th the mercury fell briskly in the N.W. with a south-westerly wind, and a deep depression passed south-eastwards over England, causing fresh to strong northerly gales in its rear on all but our northern coasts. As this disturbance passed away over Germany, the barometer rose extremely rapidly, but during the 9th a fall of half-an-inch took place in the N.W. ; a deep depression advanced to these coasts and fresh south-westerly gales sprang up. During the following day (10th) gales and heavy rains were general. On the 11th the disturbance was moving away over Norway, the barometer was rising, and strong northerly winds prevailed ; but in the evening of the same day and the morning following the barometer was falling again, and three depressions were shown. One of these was in the N., a second in the N.E., and a third in the S.W. Northerly winds still continued, and increased to a hard gale in the N. and S.W. during the 12th. On the 13th a broad band of low readings stretched across France and the North Sea to Norway, within which four distinct minima were observable. In the evening pressure recovered again, and the depression in the S.E. was apparently filling up. The next morning, however, the disturbance was deepening again, and on the 14th steep gradients prevailed over western Europe, and severe northerly to north-easterly gales were again experienced on our coasts. On the 16th the depression still lay over the Baltic in the neighbourhood of Holland, the wind circulating round it as on the previous day, though with less force. The mercury was falling nearly everywhere.

The weather during the third week was very much quieter than that of its predecessors. A cyclone which lay over the southern portion of the North Sea on the 17th occasioned rather fresh northerly winds on our coasts, and southerly winds in Denmark, subsequently filled up and moved away southward, the wind gradually became N.E., and an area of high pressure was formed over these Islands. On the 19th, a well-marked anticyclone stretched from Ireland across England and the North Sea to Denmark, and this general distribution, though occasionally slightly modified, lasted till the close of the week. The temperature was low over England, though comparatively high over Scotland.

For the rest of the month N. and N.E. winds were the most prevalent, and the latter blew a fresh gale all along our east coasts during the night of the 27th and all through the 28th, accompanied by a good deal of cold rain. On the 29th a change occurred ; a depression travelling in a southerly direction passed down our western coasts during the day, causing some rather fresh W. to N.W. winds in those regions with rainy weather, while N. airs and fine weather were experienced in the E. Aurora borealis and lightning were seen in Caithness on the night of the 29th.

The first half of the month was characterised by considerable atmospheric disturbances, with general falls of rain, hail, and snow, and in the second week thunderstorms in some places. The third week was the quietest, the weather, though cloudy and very foggy, being dry. The last week of the month was cold generally ; very dull, foggy, and wet in the S.E. and E., but much finer in the W. and N., especially in the earlier part of the week. Temperature was low for the greater part of the month, and oscillated considerably. Frosts were also experienced on many nights.

H. E. M.

## HEAVY SNOW-FALL.

*To the Editor of the Meteorological Magazine.*

SIR,—On the night of the 11th there was a fall of snow which is generally acknowledged to have been heavier than any remembered to have ever fallen in so short a time, and which I had supposed to be an impossible fall. It drifted to some extent, but its average depth was  $10\frac{1}{2}$  inches. My rain-gauge (1 foot above the ground) registered 0·673 in., which was evidently much below the true value ; so at 1 p.m. on the 12th I inverted the funnel on the snow, where it appeared to be the average depth ; but it was too deep to take up all at once, so I first took up the upper part, and then the remainder. I found that the  $10\frac{1}{2}$  inches when melted yielded 1·626 in. of water, of which 1·033 in. was yielded by the upper 4·9 in. of snow. I was so surprised at the result—the proportion of water to snow being so much larger than usual—that I made an approximate measurement on the 13th, at 10.30 p.m., near the same spot, when the depth of snow was reduced to 7 in. ; it then yielded 1·55 in. And on the 14th, at 1.30 p.m., the snow being reduced to 5·8 in. deep, it yielded 1·528 in., of which 0·784 in. was from the upper 2·2 in. It had been a thaw nearly all the time since the snow fell, and 0·01 in. of rain fell between the first two measurements.

It seems that it would be no exaggeration to set down the snow-fall at 1·63 in. of water, of which 1·60 in. belongs to the 11th. I intend to have an iron cylinder made, the same diameter as the funnel, so as to be prepared if such a snow-fall should ever occur again.

The ratio of water to snow (including the rain) is shown in the following table :—

Measured.	Depth of snow.	Ratio of water to snow.		
		Upper part.	Lower part.	Whole.
Nov. 12th, 1 p.m. ....	in. 10·5	in. ·211	in. ·106	in. ·155
„ 13th, 10.30 p.m. ...	7·0			·220
„ 14th, 1.30 p.m. ...	5·8	·356	·207	·263

Much damage was done to spouts, shrubs, &c., by the weight of the snow. There was a thunderstorm during the snow-fall, with most dazzling lightning, nearest at 5.15 a.m. On the 15th we had a great storm from the N.N.E. I do not know whether the rain ever ceased from 7 p.m. on the 14th to the middle of the night of the 15th, but 1·51 in. fell.

It is very likely that this month will prove the wettest recorded for the last 19 years ; it will be so if more than 0·3 in. falls in the 10 days yet remaining, 5·47 in. having fallen already.—Yours truly,

T. W. BACKHOUSE.

*Sunderland, Nov. 24th, 1878.*

# PERIODIC COLD?

*To the Editor of the Meteorological Magazine.*

SIR,—Is there any truth in the theory that exceptionally cold weather recurs every 41 years? I believe the only two authenticated instances in which the thermometer fell below zero in London were December 25th, 1796, and January 20th, 1838, just 41 years apart. As it is now 41 years since the latter date, to prove the truth of the above theory we ought to have very severe weather during the coming winter.—Yours truly,

W. P. SWAINSON.

277, Camden Road, London, N., Dec. 12th, 1878.

## SUPPLEMENTARY TABLE OF RAINFALL IN NOV., 1878.

[For the Counties, Latitudes, and Longitudes of most of these Stations, see Met. Mag., Vol. X., p. 28., but the list is under revision.]

Div.	Station.	Total Rain.	Div.	Station.	Total Rain.
		in.			in.
II.	Acol .....	4.80	XI.	Castle Malgwyn ...	6.08
„	Littlehampton .....	2.84	„	Nantgwilt, Rhayader ...	5.61
„	Hailsham .....	4.66	„	Carno .....	4.61
„	St. Lawrence, I. of W....	4.21	„	Rhug, Corwen .....	...
„	Strathfield Turgiss .....	3.58	„	Port Madoc .....	5.19
III.	Addington Manor.....	2.99	XII.	Carsphairn .....	...
„	Oxford .....	2.24	„	Melrose .....	4.87
„	Northampton .....	2.73	XV.	Gruinart .....	2.87
„	Cambridge.....	4.63	XVI.	Grandtully .....	...
IV.	Sheering .....	5.07	XVII.	Tomintoul.....	7.14
„	Diss .....	5.65	„	Keith .....	8.20
„	Swaffham .....	6.60	XVIII.	Dalwhinnie .....	6.67
V.	Alderbury, Salisbury ...	2.17	„	Auchnasheen .....	3.48
„	Compton Bassett .....	3.15	„	Springfield, Tain .....	2.37
„	Dartmoor .....	6.25	„	Glenfinnan .....	4.91
„	Langtree, Torrington ..	6.35	XIX.	Watten .....	3.16
„	Cosgarne, St. Austell ...	6.61	XX.	Glenville, Fermoy ...	2.51
„	Taunton.....	4.66	„	Tralee .....	3.81
VI.	Bristol .....	3.22	„	Tipperary .....	2.32
„	Sansaw .....	5.89	„	Newcastle W., Limerick	3.14
„	Cheadle .....	2.37	„	Kilrush .....	2.55
„	Bickenhill Vicarage.....	3.02	XXI.	Kilkenny .....	1.38
VII.	Coston, Melton Mowbray	4.01	„	Kilsallaghan .....	1.39
„	Bucknall .....	3.97	„	Twyford, Athlone .....	1.29
VIII.	Walton, Liverpool .....	2.06	„	Belvedere, Mullingar ..	...
„	Broughton-in-Furness ..	2.78	XXII.	Ballinasloe.....	1.78
IX.	Stanley, Wakefield . ...	2.13	„	Kylemore .....	5.41
„	Mickley, Ripon .....	4.42	„	Carriack on Shannon.....	1.37
X.	Gainford .....	...	XXIII.	Rockcorry .....	1.31
„	Unthank Hall .....	3.53	„	Warrenpoint.....	1.40
„	Shap .....	3.34	„	Newtownards ...	2.01
XI.	Llanfrechfa .....	5.06	„	Bushmills .....	3.45
„	Solva .....	5.65	„	Buncrana .....	5.36

## NOVEMBER, 1878.

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.	Difference from average 1860-5	Greatest Fall in 24 hours.		Max.			Min.					
				Dpth	Date.	Deg.	Date.		Deg.	Date.				
ENGLAND.														
I.	Camden Town .....	2.95	+	.54	.51	15	17	53.5	25	29.4	30	6	15	
II.	Maidstone (Hunton Court)...	3.78	+	.75	.45	15	17	...	...	...	...	...	...	
III.	Selborne (The Wakes).....	3.62	+	.08	.73	9	18	54.0	10	29.5	12§	13	19	
III.	Hitchen .....	3.85	+	1.71	.89	27	20	48.0	10*	27.0	29	16	...	
IV.	Banbury .....	3.63	+	1.43	.59	24	17	50.5	10	27.0	29	18	...	
IV.	Bury St. Edmunds (Culford)...	5.16	+	2.77	1.10	15	22	52.0	25	20.0	29	14	23	
V.	Norwich (Sprowston) .....	7.54	...	...	1.31	15	23	...	...	...	...	...	...	
V.	Bridport .....	2.63	—	.53	.39	9	15	...	...	...	...	...	...	
"	Barnstaple .....	4.64	+	.50	.99	9	17	53.0	25	31.0	3†	...	...	
"	Bodmin .....	5.47	+	.49	.62	9	24	53.0	10	29.0	20	10	14	
VI.	Cirencester .....	3.41	+	.62	.85	15	14	...	...	...	...	...	...	
"	Shifnal (Haughton Hall) .....	3.60	+	2.03	.77	10	13	47.0	9	24.0	27	20	26	
"	Tenbury (Orleton) .....	3.21	+	.74	1.10	9	14	50.3	3	27.0	27	14	16	
VII.	Leicester (Town Museum) ...	3.25	...	...	.56	24	19	49.4	1	23.5	21	9	23	
"	Boston .....	4.31	+	2.17	.91	14	18	48.0	1†	25.0	30	13	...	
"	Grimsby (Killingholme) .....	4.92	...	...	1.11	15	21	49.0	1	27.0	12	9	...	
"	Mansfield .....	2.43	...	...	.51	9	15	47.6	2	24.9	21	17	19	
VIII.	Manchester (Ardwick).....	2.04	—	.59	.64	9	11	49.0	10	28.0	27§	13	...	
IX.	York .....	4.24	+	2.26	.81	11	16	49.5	20	25.0	12	17	...	
"	Skipton (Arncliffe) .....	5.69	—	.76	1.25	7	19	46.0	18	24.0	25	10	...	
X.	North Shields .....	6.40	+	3.76	1.33	26	26	48.0	18	26.0	12	6	8	
"	Borrowdale (Seathwaite) .....	5.82	—	10.85	2.50	9	11	...	...	...	...	...	...	
XI.	Cardiff (Crockherbtown) .....	3.06	...	...	.84	9	13	52.0	10	27.8	23	6	...	
"	Haverfordwest .....	6.72	+	1.05	1.50	9	18	49.0	4	24.0	25	13	24	
"	Aberdovey .....	3.08	...	...	1.35	9	17	56.0	1	30.0	27**	5	...	
"	Llandudno .....	3.32	+	.16	.82	9	16	52.2	10	30.8	26	1	...	
XII.	Dumfries (Crichton Asylum) .....	...	...	...	...	...	...	...	...	...	...	...	...	
"	Hawick (Silverbut Hall) .....	4.15	...	...	.71	16	18	...	...	...	...	...	...	
XIV.	Glasgow (Cessnock Park) ...	1.73	—	1.02	.53	9	11	...	...	...	...	...	...	
XVI.	Mull (Quinish) .....	4.97	...	...	1.34	9	18	49.0	26	...	...	...	...	
"	Loch Leven .....	1.70	—	1.95	.60	26	...	...	...	...	...	...	...	
"	Tyndrum (Ewick) .....	...	...	...	...	...	...	...	...	...	...	...	...	
"	Arbroath .....	2.26	—	.63	.48	24	14	48.0	20	27.0	29	4	...	
XVII.	Braemar .....	4.58	+	1.76	.55	16	19	44.8	10	20.0	9	15	26	
"	Aberdeen .....	3.87	...	...	.55	24	26	49.2	21	27.8	29	6	22	
XVIII.	Gairloch .....	6.60	...	...	.81	13	25	...	...	...	...	...	...	
"	Portree .....	9.01	—	1.47	1.23	16	27	...	...	...	...	...	...	
"	Inverness (Culloden) .....	2.94	+	.35	.95	25	18	49.4	20	25.2	28	9	21	
XIX.	Dunrobin .....	5.30	+	2.99	1.47	12	19	50.2	21	25.0	27	15	...	
"	Sandwick .....	3.61	—	.39	.52	9	26	50.2	20	27.0	24	4	17	
XX.	Caherciveen Darrynane Abbey .....	3.19	...	...	.62	9	14	...	...	...	...	...	...	
"	Cork .....	2.86	...	...	.85	10	10	...	...	...	...	...	...	
"	Waterford .....	1.85	—	2.10	.84	9	18	52.0	3, 10	27.0	9, 26	15	...	
"	Killaloe .....	2.59	—	2.30	1.32	9	10	55.0	2	19.0	26	15	...	
XXI.	Portarlinton .....	1.65	—	2.27	.53	9	16	51.0	9	23.0	11	25	...	
"	Monkstown, Dublin .....	.96	—	1.93	.47	9	9	...	...	19.0	25	...	...	
XXII.	Galway .....	2.04	...	...	1.05	9	14	54.0	10	25.0	26	11	...	
XXIII.	Waringstown .....	1.84	...	...	.33	11	21	51.0	4, 7	21.0	11	20	27	
"	Edenfel (Omagh) .....	2.91	...	...	.47	9	21	48.0	1†	20.0	25	18	...	
"	Ballyshannon .....	4.67	...	...	1.47	14	11	...	...	...	...	...	...	

\* And 24, 25. † And 2, 10. ‡ And 2, 9. § And 29. || And 30. ¶ And 20, 21. \*\* And 29.

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

# METEOROLOGICAL NOTES ON NOVEMBER.

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

## ENGLAND.

SELBORNE.—A very foggy, damp, ungenial month; very little S, and not lying. Prevailing wind N.W.

BANBURY.—Thunder on 8th. A good deal of high wind.

CULFORD.—A month of excessive rainfall, and consequent disastrous floods. Exceedingly cold, damp, sunless weather, with some S, but less fog than usual. High wind on the 8th and two following days, and again on the 27th. Mean temp. 38°·6.

SPROWSTON.—The wettest month known in Norfolk. The rain, which fell every day in the first fortnight, culminated in a fall of 1·31 in. on the 15th, flooding the lower parts of Norwich, and doing damage to mills and cottages, amounting to thousands of pounds. The marshes along the Norwich and Yarmouth line are covered with water, and will be for some weeks. Wheat sowing has been much hindered, and it is impossible to work heavy land. Rainfall 1½ in. above the fall in November, 1875, which, till this year, was unparalleled.

SHIFNAL.—An unusually unpleasant November. Fog, R, S, and frost alternating throughout after the first six days, which were clear and frosty. The max. temp. never reached 48°, and although it was frosty on twenty nights, it was not severe enough to form ice half an inch thick. Wind, with a few exceptions, persistently from N. and N.W. Fieldfares first seen on 3rd.

ORLETON.—The temp. of the month was rather more than 3° below the average, but it was generally even, and the fluctuations of the bar. were slow and not great. S on 12th and 24th; very heavy R night on 9th–10th, flooding the brooks and rivers. The sky was generally cloudy, and the wind was frequently very rough. No T or L.

BOSTON.—The heavy rainfall in the middle of the month, together with a fall of snow caused the floods to rise very rapidly in the river Witham, and some of the protecting banks giving way, a considerable tract of fenland near Lincoln was submerged. The continued wet has seriously interfered with the completion of the wheat sowing, and much that was sown has been destroyed. An unusual amount of fog during this month, and the weather very cold and damp.

GRIMSBY.—The month was cold and wet; gale late at night on 9th, continuing till daybreak of 10th; 3 in. of snow at night on 11th.

YORK.—Month remarkably cold; 11 in. of snow on 12th; far heavier in the direction of Thirsk and Malton, but none at Scarborough.

ARNcliffe.—A very winterly month. Severe snowstorm on 11th.

NORTH SHIELDS.—Thunderstorm on 11th. Aurora on 5th.

## WALES.

HAVERFORDWEST.—The weather during the first 16 days fearfully wild. Stormy throughout, with uniformly low temp. L on 2nd, 9th, 10th, 13th, and 27th. Precellly Hflls covered with S several days during the month; furious gales of frequent occurrence. Slight shock of earthquake about 0.45 p.m. on 10th. Very frosty and wintry from the 18th to the 27th. Altogether one of the most wintry Novembers for the last 29 years. Wind from N.N.W. the first third, and from N.N.E. and E. the last two-thirds of the month.

ABERDOVEY.—A fine calm clear month. Prevailing wind N. No S except on one night; very little frost.

LLANDUDNO.—The month on the whole was cold, sunless, and stormy, but there were a few very fine days. Though there were only three nights of frost, the mean temp. was 3°·5 below the average, and no less than 5°·8 below November, 1877.

## SCOTLAND.

SILVERBUT HALL.—On the whole a very mild November. Very squally on the 15th and 16th. Heavy snowfalls on 8th, 9th and 26th.

QUINISH.—The month was unusually fine, the wind being almost invariably from N. and E. On some days near the end of the month the sun was actually very hot. Scarcely any S, and very little frost.

BRAEMAR.—Severe storm of S and drift on 11th.

ABERDEEN.—A month of dull, cold, raw, damp weather. Mean temp.  $38^{\circ}\cdot 8$ ,  $1^{\circ}\cdot 4$  below the average; rainfall about the average; L on 5th, H on seven days.

PORTREE.—On the whole a cold unsettled month. Solar halo on 3rd; heavy gale on 15th and 19th; S on 5 days.

DUNROBIN.—Weather on the whole favourable for outdoor operations, which are consequently far advanced for the season.

SANDWICK.—November was colder than the mean, owing to the prevalence of N. winds, which began on the 24th of October and blew on 23 days in Nov. Ground sprinkled with S on the 7th and 8th, and a good deal of frost from the 23rd to the end. No heavy fall of S as in some places further south.

## IRELAND.

DARRYNANE.—A fine frosty month, with almost constant E. and N.E. wind; S on 11th.

CORK.—S in. of S on 11th.

WATERFORD.—Month colder than usual. Mist frequent about 20th.

KILLALOE.—Cold, but very fine; a good deal of sharp frost, particularly on 26th, with thick fog. Mean temp. much below average. Some S on 27th.

MONKSTOWN.—The coldest and (with the exception of November, 1867) the driest November for many years. A remarkable prevalence of northerly winds and unusually severe frost, which occurred without intermission from 12th to 27th.

WARINGSTOWN.—A very remarkable month; frost almost continuous, but the ther. never fell very low.

EDENFEL, OMAGH.—The severest November for many years; northerly wind prevailed almost the entire month, accompanied till the 20th chiefly by R and sleet, and towards the end by hard frost.

BALLYSHANNON.—The month was severe and wintry, and the temperature unusually low; on the 12th the ther. registered  $12^{\circ}$ . H on 7th, S on 11th, and 12th. Hoar frost from 24th to 28th.

## DENSE FOGS.

*To the Editor of the Meteorological Magazine.*

SIR,—We have had here two or three days of unusually dense fogs, and now the ponds and ditches are covered with a greyish scum. This would seem to infer that the fog was not composed entirely of watery particles.

The wind had been in the north for a week or ten days previously. Is it possible that we have experienced some of the effects of an eruption of Heckla, or some other Icelandic volcano?

Perhaps some of your other subscribers may have noticed something of the kind.—Yours truly,

SAMUEL KING.

*Elswick Lodge, November 23rd, 1878.*

[In all such cases a portion of the material should be collected and analyzed. We think the origin is more probably nearer home—perhaps the furnaces at Barrow, about 20 miles N.W. Have any such effects been simultaneously noticed in the Orkneys, or on Loch Tay or Loch Katrine?—ED.]



# RAINFALL AT ST. LAWRENCE RECTORY, ISLE OF WIGHT.

Latitude 50° 35' 6" N. Longitude 1° 14' 24" W.  
Diameter of guage, 5 inches. Height above ground, 1 foot. Height above sea level, 75 feet.  
Years 1868-77 inclusive.

Year.		JAN.	FEB.	MAR.	APRIL	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.	Total Inches
1868	Inches.	4.00	1.08	1.27	3.14	1.30	0.54	0.68	4.36	2.56	3.72	1.37	7.31	31.33
1869	"	3.46	2.58	2.60	1.11	4.72	2.15	1.17	0.98	4.19	2.27	2.00	3.71	30.94
1870	"	1.83	2.20	1.79	0.33	1.23	0.25	1.60	1.24	1.59	4.59	2.28	3.06	21.99
1871	"	3.18	1.35	0.96	3.53	0.06	3.02	4.14	1.46	5.70	2.09	0.47	1.17	26.13
1872	"	5.84	2.06	3.60	1.31	2.76	1.88	3.23	1.09	1.70	5.15	5.31	6.02	39.95
1873	"	4.24	3.04	2.35	0.72	0.89	2.15	1.84	1.57	2.38	5.03	2.99	0.85	28.05
1874	"	2.14	1.35	0.76	2.34	0.62	2.26	0.56	1.45	3.63	4.64	3.17	2.68	25.59
1875	"	5.06	2.83	0.77	1.44	0.93	2.04	3.15	1.57	1.95	5.61	5.63	0.97	31.95
1876	"	0.73	3.54	3.82	1.69	0.27	0.88	0.93	4.66	4.39	1.75	4.43	8.21	35.30
1877	"	7.35	1.90	2.48	2.56	2.20	0.76	2.19	2.47	1.57	2.78	9.13	2.04	37.43
Average of 10 years each month.	Inches.	3.78	2.19	2.04	1.81	1.49	1.49	1.94	2.08	2.96	3.76	3.67	3.60	30.86
Rainfall for the year, 1878.		1.90	2.18	2.26	2.78	2.77	0.80	3.54	5.72	2.08	3.42	4.21	1.93	33.59

St. Lawrence Rectory, Isle of Wight, Jan. 1st, 1879. C. MALDEN.