

# SYMONS'S

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# METEOROLOGICAL MAGAZINE.

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### INTERNATIONAL METEOROLOGY.

Two very important steps have been taken since our last issue; they have entirely different objects, have no connection one with the other, have their origin one in the New and one in the Old World, and yet are most appropriately treated under the single heading we have given above.

#### SYNCHRONOUS WEATHER CHARTS OF THE WORLD.

A twelvemonth since,\* when highly praising a publication of the Meteorological Committee, we urged them to give us daily weather maps of the Atlantic Ocean. They did not do so, and probably it is well they did not, for our Transatlantic friends have now inaugurated an even bolder scheme. At the Vienna Congress, last September, the energetic Superintendent of Weather Telegraphy in the United States, Brigadier-General Myers, submitted the following proposal:—

That it is desirable that, with a view to their exchange, at least *one* uniform observation of such character as to be suitable for the preparation of synoptic charts be taken and recorded daily and simultaneously at as many stations as practicable throughout the world. †

This scheme is now in operation, the time selected being that corresponding to 0.45 p.m., G.M.T. in London, or noon in longitude 11° W.; by the selection of this epoch it will fall in the night and early morning hours in the United States, where the observations will be made by General Myers' own staff, and in the day time over the whole of Europe and Africa, as well as the greater part of Asia. Observers resident in localities far removed from fixed observatories, and who are willing to assist, should volunteer at once,‡ as the system was inaugurated on Jan. 1, 1874, and daily charts are now in process of preparation.

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\* Met. Mag., vol. vii., p. 205, January 1873.

† Bericht, p. 58.

‡ Information as to the requirements can be obtained from Brigadier-General Myers, Signal Office, Washington, or R. H. Scott, Esq., F.R.S., Meteorological Office, Victoria-street, London, S.W.

## CLIMATOLOGICAL SUMMARY FOR THE BRITISH EMPIRE.

Under this head we have to note a less ambitious proposal than the above, but one of which it is not easy to foresee the probable development. Owing to certain correspondence published in "*The Colonies*," the proprietors of that periodical have resolved upon attempting to publish monthly synopses of the weather at between twenty and thirty widely-separated stations.

The information which it is intended to publish monthly for each station is the following :—

Shade temp. Absolute maximum and its date  
 Shade temp. Absolute minimum and its date  
 Shade temp. Average maximum  
 Shade temp. Average minimum  
 Mean temperature of Dew Point  
 Mean degree of Humidity  
 Absolute maximum in sun and its date  
 Absolute minimum on grass and its date  
 Total depth of Rain and the number of days on which it fell  
 Average amount of Cloud  
 And copious Remarks.

The organization is to be carried out under the supervision of Mr. Symons, and will probably embrace many, or most of the following cities or localities :—London, Calcutta, Bombay, Madras, Aden, Ceylon, Labuan, Singapore, Queensland, Sydney, Melbourne, Adelaide, West Australia, Hobart Town, Wellington and Christchurch in New Zealand, Mauritius, Natal, Cape of Good Hope, British Columbia, Newfoundland, Halifax, Toronto, British Honduras, and Barbadoes.

It is far too early to say more with regard to either of these new schemes than that each in its separate sphere is likely to be of considerable service, and merits the support of all who have the advancement of Meteorology at heart.

## THE ORTHOGRAPHY OF THE WORD EQUATORIAL.

*To the Editor of the Meteorological Magazine.*

SIR,—Your correspondent R. B., in writing on the orthography of the word *equatorial*, concerning which there had been raised a question as to whether it should end in *eal*, or in *ial*, says :—"There is not, I believe, a single instance in the English language of a word similarly formed ending in *eal*." He mentions *empyrean* and *ethereal* ; but these appear from his letter to be excluded from the argument on account of their being derived directly from the Greek. He might have added, and probably did intend to exclude, *boreal*, *heterogeneous*, *homogeneous*, *hymeneal*, and *purpureal*. But what has he to say respecting the following adjectives, which are certainly not derived directly from the Greek :—*corporeal*, *cuneal*, *funereal*, *lacteal*, *lineal*, *subterranean*, and *venereal*?

G. WASHINGTON MOON.

*December 20th, 1873.*

# NOTE ON A PROBABLE NOTICE OF AN AURORA BY JOSEPHUS AND TACITUS.

## ACCOUNT OF JOSEPHUS.

"Prior to the revolt and the first movements of the war. . . . On the 21st of the month Artemisius . . . Before sunset were seen around the whole country chariots poised in the air, and armed battalions speeding through the clouds, and investing the cities."<sup>a</sup>

## ACCOUNT OF TACITUS.

"Visce per cœlum concurrere acies, rutilantia arma, et subito nubium igne collucere templum."<sup>b</sup>

These accounts employ so exactly the language used by early historians of the aurora, that it seems worth while to examine how far the probabilities of the case agree with their being due to an appearance of this meteor.

"Before sunset" is rather a loose definition of the time, and probably merely indicates when attention was first drawn to the aurora; the full beauty of which, according to all experience, would occur later. In any case, it points unquestionably to a very grand display, as an aurora has only in few instances been seen in daylight, and I am not aware of another instance in so low a latitude.

"It is recorded to have been seen at London, C.W., on the 24th of July, 1848, at half-past 7 p.m., which is but a few minutes after sunset."<sup>c</sup>

Here we have one of the few recorded appearances in daylight, observed in July, one of the two months in which the aurora is but little seen.

The aurora of February 4th, 1872, is mentioned in Tristram's "Land of Moab," as having been seen there but little inferior in splendour to more northern latitudes.<sup>d</sup>

An aurora, bright, very extensive, and red in colour, might be expected to be seen in the time of year, and solar spot period most favourable for such displays. Neither agrees with the probable date of the meteor in question. The revolt broke out in August, A.D. 66,<sup>e</sup> and the 21st of Artemisius must fall on May 5th in that year. 66 is too soon after the previous spot minimum year, as "the progression from minimum to maximum is more rapid than from maximum to minimum,"<sup>f</sup> and June being the month of least frequency of auroras, May 5th becomes rather a late date.

Mairan mentions, under the date of January 28, 807 or 808, "Autres armées qui paroissent au ciel pendant la nuit, et d'une grandeur extrême." A transit of Mercury is recorded in the same year, and for this Kepler gives the date 808.<sup>g</sup> 809 was a spot minimum year. It will be remembered that the years about the last spot minimum, 1864 to 1866, were not without fine appearances of the aurora.

<sup>a</sup> Josephus, Traill, vol. II., fol. 197.

<sup>b</sup> I. Tacit: Hist: lib. V., cap. xiii., quoted in Keith's "Evidence of Prophecy," fol. 59, note.

<sup>c</sup> Phil. Mag., vol. XXXVI, new and united series, fol. 461. <sup>d</sup> Fol. 34.

<sup>e</sup> Josephus, Traill, vol II., fol. 171. <sup>f</sup> See "The Sun," Proctor, fol. 198.

<sup>g</sup> Mairan, fol. 190.

On the whole, I think we may have described in the accounts an aurora of remarkable extent and brightness; it does not seem possible in the present state of our information to carry the proof further.

W. D. HOWARD.

## OBSERVATIONS ON THE WEATHER AT CAMBRIDGE IN 1871, 1872, AND 1873.

	1871.	1872.	1873.
Mean temp. ....	47°1 ...	49°0 ...	47°5
Hottest by Day .....	Aug. 13	July 25	July 22, 23
	83° ...	84° ...	81°
Coldest by Night.....	Dec. 19	Mar. 21	Dec. 12
	16° ...	25° ...	21°
Days on which the max. was at or under 32° .....	10 ...	0 ...	4
Nights on which the min. was at or under 32° ... ..	81 ...	35 ...	72
Mean of bar. ....	29·8 ...	29·6 ...	29·8
Bar. highest .....	Mar. 2	April 7	Feb. 19
	30·2 ...	30·3 ...	30·4
Bar. lowest .....	Jan. 17	Jan. 24	Jan. 20
	28·6 ...	28·2 ...	28·2
	Inches.	Inches.	Inches.
Rainfall .....	19·20 ...	27·84 ...	21·30

[We reprint this in fac-simile as a good type of condensation of nearly all the important elements in a remarkably small space.]

J. NUTTER.

## PHENOMENA OF GREAT STORMS.

BY PROF. ELIAS LOOMIS.

[As indicative of the energetic way in which Meteorology is being prosecuted in the United States, we reprint with pleasure the two following articles, which appeared in the *New York Journal of the Telegraph*, for December 1st, 1873.]

This paper was described by title as "Some Results Derived from Examination of the United States Weather Maps."

The remarks I propose to make consist rather of a statement of what I am engaged in doing than of results which I am prepared to communicate. It is known to some persons that many years ago I undertook the investigation of certain storms, particularly Winter storms. Some 30 years ago I published in the transactions of the Philosophical Society of Philadelphia, my investigations of a remarkable storm which was experienced throughout the United States in December, 1836. This storm of December, 1836, was followed a few days after by a remarkable storm in New York, and many conjectured at that time that there was a connection between the two storms; and that the American storm crossed the Atlantic. Some years after, in 1856, I spent some time in Europe, and improved the opportunity to collect observations relating to this storm. I collected copies of meteorological journals for that period, and on my return undertook a new investigation of the phenomena of that storm, and of the American storm that preceded it. I have received maps regularly from the Department for about two years, and have preserved them carefully. I have thought it worth while, however, to undertake myself a systematic examination of these maps.

I first prepared a skeleton map upon precisely the same scale as the Washington maps, confining myself, however, to that portion of the country over which these storm tracks usually pass. Although these weather maps extend to the Pacific, the Department has never drawn isobaric lines extending beyond the Rocky Mountains with one exception, so that I was compelled to reduce the dimensions of my skeleton map, though retaining precisely the same scale. The first step consisted in transferring the tracks of all these barometric minima to this map.

The next step consisted in tabulating all these results. The lines on the maps are measured, and the dates and movements recorded in tables for two years. The direction of the storm track, and its motion per day, is indicated so that the tables show the progress in 24 hours of the barometric minima and their direction. He had complete tables for these months for two years. These tables, together, would show the average rate of progress of barometric minima and average direction. The average rate of progress each day for January was 680 miles; for February, 740 miles; for March, 940 miles; for April, 615 miles. The average for these four months was little less than 700 miles—a trifle less than 30 miles an hour. For the month of January the average direction of progress is 5 degrees north of east; that is the direction toward which the storm travels. It is very rare indeed that a storm travels toward the west, though we had one of that sort during the last week. There are only one or two decided cases of that kind in the period of two years. They almost invariably travel toward the east and a little north of east. For February the average is about 13 degrees north of east; for March, 11 degrees north of east; for April, 16 degrees north of east.

The object which I propose in this research will be to investigate the various circumstances which seem to cause these movements, the rate and the direction; to determine what other meteorological elements are connected with these. I tabulate with these numbers, therefore, a good many other points. One is a tabulation of what they call the "low," which means simply the lowest barometrical indication on the weather maps. Another is the fall in 24 hours—the fall of the barometer in that place where there is a "low." This is easily ascertained by consulting the map of the previous day at that place. The rise in the next 24 hours at the same place is found in the same way. Another element tabulated is the change of the "low." One day a "low" will be 29.4 in.; the next day it will be found some 500 miles east and perhaps will be 29.5 in. or 29.3 in. It will not be generally stationary from one day to another. In other words, the storm will be increasing or diminishing in violence.

There is one point in regard to which he could make a somewhat precise statement. It is what may be called the stationary "low;" that is a stationary storm. In general, these storms travel with considerable velocity; occasionally we find examples of storms stationary for 24 hours, sometimes two or three days; there are examples of very violent storms remaining stationary for four days. The European storm of 1836 was the memorable storm of the century in its violence, which extended through Great Britain and all over the continent. At that time there was formed a "low" almost exactly over Switzerland, which continued stationary for four days, and the isobaric curves at that time were quite symmetrical and nearly circular, though slightly elliptical. The depression of the barometer at the centre of the storm was from a half to three-quarters of an inch below the average minimum.

Similar phenomena have been noticed since then in many instances in Europe. The localities where they have been most frequently observed are off the Irish coast, or somewhere along the coast line from the north of Scotland, following down the English and French coasts to that of Spain. An average of notable cases of that sort were collated to the number of six or seven per annum, where the barometer sank very low and continued long at the same depression.

In examining the United States maps he had been struck with the circumstance that a storm travelling across the United States to Maine and New Brunswick would stop there, and the "low" be marked there for two or three successive days. There was no evidence whether the "low" proceeded beyond that point, as the map cannot give further information. However, by comparing these observations carefully, it will be found that the actual height of the barometer at these most

easterly stations continues the same during two or three successive days. Professor Loomis attributes this phenomenon to local causes. These are probably the characteristics of the surface of the country—the high ranges of mountains which force the currents of air upward, and cause condensation of moisture. In the case of Switzerland, this is occasioned by the Alps; in our country it is the high lands of Maine, and the White and Green Mountain ranges. When there is a barometric minimum in that region, the air on the south side comes in from the ocean, and will be drawn in from considerable distances, probably from over the warm waters of the Gulf Stream.

REMARKS BY PROF. HENRY.

Prof. Henry suggested that if the storm comes to the seaboard the air is constantly drawn in from sea, bringing an immense amount of vapour. This may continue several days, constituting at Boston, for instance, a long and violent north-east storm, when 50 or 75 miles back in the country the air is clear. The storm appears to be produced by the heating of the lower strata and their expansion; then the equilibrium being disturbed there is a rushing up of the moist air into a higher region, where it is condensed, and the caloric given out, whereby the effect is increased. The whole storm is wafted eastward till it comes to the seaboard, where it obtains a continued supply. In the interior the supply at a given point is soon exhausted, and this may be a cause of the storm moving eastward. During a storm at the seaboard there is a motion outward; the wind is blowing inward from the ocean below, but outward toward it above.

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## THE SIGNAL SERVICE—UNITED STATES.

The connection of the Signal Service with the lines of telegraph throughout the country renders its operations more or less important to all engaged in telegraphic service. The annual report of the Chief Signal Officer has just been published, from which we glean as follows:—

Systematic and continuous instruction of the army in military signalling and telegraphy during the past year, has been given at the Signal School of Instruction at Fort Whipple, Va., and in the Department of the Missouri. The recommendation made in previous reports, that special instruction at the Military Academy should be provided for, with a merit value given it, affecting the standing of the cadets, is renewed, and it is also suggested that to secure accuracy and uniformity, the officer to be in future charged with that instruction should have passed through the course at Fort Whipple.

Six commissioned officers have received instruction at Fort Whipple during the year. Sixty-seven private soldiers have been instructed as candidates for promotion to the grade of observer-sergeant, and 127 as assistants to observer-sergeants.

The whole number of stations from which the office now receives its stated meteoric reports is 92, of which 78 are the regular stations in the United States; 11 are in Canada; three in the West Indies. Of the stations in the United States, 13 have been added during the year; and of the Canadian, from which reports have been received by comity of exchange with the Dominion Meteorological Bureau, four are new. The regular telegraphic reports from Havana, Cuba, began on August 6; from Kingston, Jamaica, on September 18, and from Santiago de Cuba on September 29. Three other points in the islands of Porto Rico, Gaudaloupe, and Barbadoes, will be equipped as soon as observers can be designated.

The total number of tabulated bulletins issued and distributed at the several lake, seacoast, and river ports and inland cities has been 143,097, excluding the river bulletins of changes in depth of water of principal rivers. The total number of weather charts issued and distributed has been 320,770, and the press reports (exclusive of the publication of the synopsis and probabilities) have been 23,224. Nine thousand four hundred and two copies of "the weekly weather chronicle" and 6,896 of the "monthly weather review" have been furnished and gratuitously distributed to the press, agricultural and commercial associations, institutions of learning and scientific persons.

The office has, under the direction of the Secretary of War, continued its exertions to solve, for the special benefit of the agricultural interests, the problem of giving promptly the information contained in the daily weather reports to the many farming and other communities not now reached by telegraph, and for which the copies published by the press do not arrive in time for use. The plan adopted has been to divide the territory of the United States into districts, each district having a distributing point at or near the centre, from which two printed copies of the Synopses and Probabilities are forwarded by mail to all post-offices within the districts, and which can be reached by rail, steamer, or mail coach by 4 p.m. of the same day. This plan has been put in operation with the co-operation of the Post-office Department, the bulletins being exhibited in frames by each postmaster at each post-office as soon as received, and now provides for the regular distribution daily of 8,982 copies of the Weather Report, for display at 4,191 different post-offices.

For the study of the phenomena of the upper portions of the atmosphere, in view of the benefit of the deductions to be had from them, and to determine more accurately the proper reductions to be made for great elevations, stations have been established at favorable points. In addition to those on Mount Washington, N. H., and on Mount Mitchell, N. C., the difficult task of establishing a permanent telegraph station on the summit of Pike's Peak, at an elevation of 14,216 feet, has been accomplished with the sanction of the Secretary of War. A telegraph line has been built to connect the station with Colorado Springs, and it is now in operation.

The ascertained comparative accuracy of the deductions from reports, styled "Probabilities," has been more clearly presented in this than in preceding years. The percentage of verification has been mathematically computed for each of the geographical districts mentioned in the reports. The annual average of verifications has been as follows for the following named districts:

New England, 81.50; Middle States, 81.17; South Atlantic, 79.92; Lower Lakes, 78.90; Eastern Gulf, 77.16; Ohio Valley, 76.42; Western Gulf, 74.40; Upper Lakes, 75.25; North West, 74.00.

An additional duty was imposed upon the Secretary of War by the legislation of the last Congress, authorizing the establishment of signal stations at lighthouses and at such of the life-saving stations on the lake or sea coasts as may be suitably located for that purpose, and to connect the same with such points as may be necessary for the proper discharge of the duties of the Signal Service by means of a suitable telegraph line, in cases where no lines are in operation. In discharge of this duty, a telegraph line has been completed, ten miles in length, from Seaville to Peck's Beach, N. J., connecting at Seaville with the line of the Western Union Telegraph Company. The material is ready, and the work is in progress on the construction of a line from Sandy Hook to Barnegat Inlet, N. J., a distance of 50 miles, connecting with the Western Union line at Long Branch. These connections will allow of signals being displayed at the life-saving stations established at Sandy Hook, Long Branch, Barnegat, Atlantic City, Peck's Beach and Cape May. The plan in contemplation proposes the establishment of signal-stations at life-saving stations and lighthouses along the ocean coast of New Jersey, from Sandy Hook to Cape May, at distances of 25 miles from each other. A line is in process of erection from the village of Rockport, Mass., to Thatcher's Island Lighthouse, a distance of three miles and a half, of which one mile and a half will be cable. A line connecting the stations at life-saving stations and lighthouses along the coast, from Norfolk, Virginia, to Cape Hatteras, North Carolina, a distance of 137 miles, and on one of the most dangerous coasts of the United States, is in construction. It is expected that the above-mentioned lines will be completed during the present year. Attention is invited to the fact that the whole work now done in the erection of these lines, and to be done hereafter in operating them, has been done, and is to be done, by the officers and men of the Signal Service of the army.

The Chief Signal Officer refers to the proceedings of the Meteorological Congress of Vienna, held in pursuance of invitations officially issued by the Austrian Government, for a convention of persons charged with meteorological duties in

different countries. The adoption, by the unanimous vote of the Congress, of a proposition to the effect that it is desirable, with a view to their exchange, that at least one uniform observation, of such character as to be suitable for the preparation of synoptic charts, should be taken and recorded daily and simultaneously at as many stations as practicable throughout the world, is regarded as of special importance in reference to works of the kind now undertaken by the United States. This formal announcement, with such sanction, tends directly to the establishment of systems of signals and weather reports common among civilized nations.

Arrangements have already been made with Russia and Turkey to begin, on January 1, 1874, the exchange with the United States of one daily report, taken simultaneously at the different stations throughout the great territorial extent of the Russian and Turkish Empires and the United States. The co-operation of the systems of other nations is expected.

## REVIEWS.

*Report of the Director of the New York Meteorological Observatory for 1872.* New York: W. C. Bryant and Co. 1873. Large 8vo.

IN addition to giving in extenso the daily observations made at 7 a.m., 2 p.m., and 9 p.m., this report is devoted to three subjects—

(1.) Has the summer temperature of the Atlantic States undergone any modification?

(2.) What is the direction in which atmospheric fluctuations cross the United States?

(3.) Is it possible to trace the passage of American storms across the Atlantic, and predict the time of their arrival on the European coast?

It appears that in previous reports Mr. Draper has been discussing the question of modification in the climate of the Atlantic States with the following result—(1.) Taking the rainfall in successive periods of ten years each, he found that there had neither been an increase nor decrease. (2.) He found that the number of days the Hudson river remained closed, taken in periods of ten years from 1817 to 1866, always averaged 91. And (3.) That the records of New York, Philadelphia, Boston, and Charleston, for the winter months did not support the idea of any alteration in their average temperature. In the present report it is shown that there has been no decided change in the summer months.

In the course of the present inquiry the disturbing influence of the very cold year of 1836 was of course speedily noticed, and a set of diagrams showing its relative intensity in various parts of the States, and for contrast one diagram from St. Petersburg was given in the work before us, together with the following comment:—

“The period to which the year 1836 belongs is well worthy of attention. In some respects it seems to be an exception to the general uniformity, as appears from synoptic chart of the mean annual temperature, Plate 1. The mean annual temperature of New York began to decline in 1830, and continued so to do for two years; then it remained stationary for two years more, and then for two years—that is to say, to 1836—it fell again. Thus far it had fallen 7.2 degrees. It then commenced to rise, returning in the same manner that it had fallen, but only 5.8 degrees. In New York the fall had been from 54.8 to 47.6 degrees; the rise was from 47.6 to 53.4 degrees. This remarkable variation extended from Boston to New Orleans, along the Atlantic and Gulf coasts, but it did not occur in the interior of the continent, as at Fort Snelling, near St. Paul. In Plate 1, I have given



the curves for several American cities, and also for St. Petersburg, in Russia. I have introduced that of the last-named city, in which we do not detect this variation, because it seems to me to have much significance in the interpretation that should be given of the event. Variations such as this can be due only to one of two causes, astronomical or terrestrial. If the sun's light decline in brilliancy, there must be a decline in the mean temperature; if it increases, there must be an increase. Some persons might be disposed to refer the variation under consideration to that astronomical cause; but if such were the case the temperature should simultaneously change in all localities on the face of the earth. We should detect decline in St. Petersburg, and at Fort Snelling as clearly as in the Atlantic cities, or in those of the Gulf. Hence I infer that the cause in question was not of an astronomical nature, but of a local and temporary kind."

We should be glad to see this subject discussed more fully than it is in the present report. It is the salient feature in American records of temperature, and well worthy of thorough investigation. Moreover, in spite of Mr. Draper's quotation from St. Petersburg, we think it probable that some important light may be thrown upon the subject by a fuller discussion of European records. We are by no means sure that the five consecutive cool years at Greenwich (1836-40) were uninfluenced by the excessive coldness of the United States.

The second is the least able portion of this report. The Director has devoted several pages and charts to a discussion (based upon the signal-office maps) of the direction in which atmospheric fluctuations cross the United States; but it does not appear to us that he throws any new light upon the subject, and he finally sums up in the following words:—

"Then the general conclusion to be drawn from these tables and maps is, that these atmospheric disturbances cross the United States in a direction towards the east."

The third section of this report is brief, and so remarkable that we reprint it verbatim, omitting only the tables which occupy four pages, and of which doubtless any one willing to prosecute the subject could readily obtain a copy.

"If these meteorological waves cross the United States, why should they not also continue their course and cross the Atlantic ocean? With a view of answering this inquiry, I have collated the registers produced by the instruments at this Observatory with those obtained at Valencia and Falmouth, as given in the *Quarterly Weather Report*, published by the Meteorological Office of Great Britain, the distance under consideration being about 3,100 miles. From this it appears that there are many atmospheric waves which do cross the Atlantic, and that the time of their passage may, within certain limits, be predicted. If, in the case of an easterly wind which is travelling about 200 miles in twenty-four hours, we find the exact time of the lowest reading of the barometer, and ascertain its speed for 24 hours before, and 24 hours after that time, the mean of these two numbers will give the rate of the storm in 24 hours. If 4,200 be divided by this last number, the quotient will express the number of days required by the storm to cross from New York to Falmouth or Valencia.

If the above statement can be shown to hold good in the case of storms for two or three years, the result would be of great value to home and foreign commerce. It would indicate whether ship captains about to leave port might be delayed by approaching foul weather, whether they could get well out to sea before its occurrence, in what part of the ocean they might expect to encounter it, and what would be its duration.

As an explanation of the following tables, I will take the first example that they offer:

On the 4th of October, 1869, there occurred a low barometer (at this Observatory) at 1 p.m. In 24 hours previously the wind had made 313 miles, in the 24 subsequently it made 286 miles, the mean of these numbers being 299. This, divided into 4,200, gives the time of passage across the Atlantic, 14 days, and the date of its arrival at Falmouth, October 18th. The actual time of its arrival, as shown in the English Weather Reports, was on that day.

The table for 1869 commences in October, this being the month in which the self-recording instruments of this observatory were sufficiently advanced to furnish reliable registers. For the year 1870, we have a complete set of observations, both from our own and the English instruments. For the years 1871-2 I have compared our results with those of the quarterly weather reports from England, as far as I have received them.

It will be noticed in the tables that sometimes storms leaving this side of the Atlantic several days apart, arrive in the British Islands on the same day. When this is the case, the storm there is generally a very severe one. There are also instances in which the last storm overpasses the first by several days. It will also be observed that there are variations in the track of these atmospheric disturbances depending on the course they are pursuing when they leave the American coast, and this will determine the point at which they will be most severely felt on reaching Europe.

We are therefore brought by the foregoing discussion to this interesting conclusion that out of 86 atmospheric disturbances expected to cross the Atlantic, only 3 seem to have failed."

Considering (1) that there is no mention of the separation of motion of revolution from velocity of progression, (2) the wide difference in the motion after existing between "twenty-four hours before" and "twenty-four hours after," *e.g.* Jan. 4, 1872, 252 miles and 152 miles, and (3) that the direction of motion can surely hardly be uniform, we are much surprised at the frequent accuracy of agreement. To a great extent the system inaugurated by General Myers will test the reliance to be placed on this method; but it would be still better if the Atlantic Telegraph Company would grant the same privilege to meteorologists as they have done to astronomers, and allow Mr. Draper to send free of cost four words about three times in each month. All that would be required would be "Storm due February 8." Six months' trial would be worth years of post-facto compilations.

Judging by the terse and vigorous tone of the report no one would be more ready to accept this proposal than the able director of the New York Meteorological Observatory.

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*General Remarks on the Climate of Bombay.* By C. CHAMBERS, F.R.S., Superintendent of the Kolaba Observatory. [Appendix to Report of Bombay Harbour Board.] 39 pages, 8vo.

THIS pamphlet opens with a statement which, though a truism, is by no means so widely acted upon as it ought to be—

"To acquire distinct notions of the general nature and peculiarities of a particular season or year, it is necessary that a definite standard of comparison should be present to the mind, and it is convenient if practicable that the normal climatic conditions of the place should constitute that standard."

Acting up to this excellent rule, Mr. Chambers proceeds to state the position of the Kolaba observatory with respect to the native part of

Bombay. He then proceeds to point out that the special feature of Bombay weather is the marked division of each year into two seasons, the wet and the dry, the former beginning about June 5th and lasting about four months, the period in fact of the south-west monsoon, the commencement and close of which is generally marked by frequent and violent thunderstorms—while during it (in spite of about one day in five being rainless) nearly seventy inches of rain fall.\* The greatest fall on record in a short time is 4·22 in., between 3 and 4 p.m., on June 12, 1847.

The temperature of the air is very equable, the mean for the coldest month, (January  $73^{\circ}8$ ) and for the hottest (May  $83^{\circ}9$ ) only differing by  $10^{\circ}1$ , or less than the daily range during the winter months, which is at that period about  $12^{\circ}$ . The mean temp. of the year is  $79^{\circ}0$ .

The normal direction of the wind is W.N.W. with a velocity of  $6\frac{1}{2}$  miles per hour.

The year 1871 was principally remarkable for slight rainfall (40·58 in.), less in fact than any year on record, the nearest approach being 41·18 in. in 1855, while the average as above stated exceeds 70 inches, and in 1849 114·89 in. fell. Two other stations, viz., Bombay Fort and Byculla, being nearer to some low hills, had the larger yearly totals of 42·76 in. and 47·20 in. respectively.

The mean temperature  $80^{\circ}1$  was  $1^{\circ}1$  above the average, but the highest was only  $93^{\circ}3$ ; the minimum was  $66^{\circ}1$ .

In concluding this brief notice of a report which well repays careful reading, we venture to express the hope that in a future one Mr. Chambers will give us an abstract of some of the principal elements upon which his normal values are based, *e.g.*, he gives the average mean annual temperature as  $79^{\circ}0$ , elsewhere he shows that in 1871 this was exceeded by  $1^{\circ}1$ , but there is nothing to indicate the ordinary fluctuation of this element, or to show whether  $1^{\circ}1$  was or was not a remarkable excess. Nor is there any information as to the position of the instruments; possibly this has been given in a previous report, but if so a reference to it would have been acceptable.

## THE WINTER.

*To the Editor of the Meteorological Magazine.*

SIR,—The tardy appearance of snow this morning reminds me how very mild a winter we have had hitherto. Certainly the inhabitants of this part of the country would have little to complain of, if all winters were as mild, dry and fine, as this has so far been. We have had very little rain;  $2\frac{1}{2}$  inches in November, and only an inch in December, with nine days' rain, and for days together the roads were as dry as if it were summer. There has been absolutely no fog, and

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\* The average amounts are June, July, August, and September 67·37, October 2·29, and during the remaining seven months, November to May inclusive, only 1·15, total 70·81 in. Mr. Chambers gives 70·82, but either that is a misprint, or there is a slight error in his table.

at the time when it was so thick in London and all other low-lying parts of England, we enjoyed clear, bright and cloudless weather, with only one night of hard frost (min.  $22^{\circ}6$ ). It has been windy at times certainly; the gale of December 16th was next-door to a hurricane, and quite as bad as the gale of October 19th, 1869, at Whitby. I estimated the force of the squalls at 11 on Beaufort's scale, and I see that Mr. L. J. Crossley reports that the pressure several times exceeded 50 lbs. at Halifax, the recording-pencil going off the paper. A stone cross was blown off Aysgarth Church, with a massive stone to which it was attached, and innumerable slates were blown off buildings, and here and there a good many trees blown down. Three other gales about equalled in force the gale which visited the south of England on December 8th, 1872, viz., those on November 29th, December 21st, and January 1st, the force being 9 or 10. During the great storm of the 16th the barometer was steadily rising, the wind being most violent from 9 to 11 a.m., and the direction W.S.W. to W. In none of these gales have I observed any rapid movement of the barometer, the progression of the storms being, I suppose, nearly along the isobars, and not across them, as in gales from S.S.E. and S. I will not encumber your columns, therefore, with barometrical readings, but will gladly send them to anyone who wishes to work out the gradients, &c.

I will only observe further, how uniform, on the whole, the temperature of the last quarter has been. Thus—

	<i>Means of Temperature.</i>						<i>Extremes.</i>	
	9 a.m.	9 p.m.	Max.	Min.	9 a.m. & 9 p.m.	Max. & Min.	Mean temp.	Max. Min.
October	44.8	43.5	52.5	37.0	44.15	44.75	44.45	66 24.0
November	41.4	40.5	46.5	37.1	40.95	41.80	41.37	55 24.6
December	41.3	42.1	46.4	37.1	41.70	41.75	41.72	54 22.6

What will Mr. Brumham say this evenness prognosticates? I rather believe in his predictions, in spite of the temperature having been  $1^{\circ}5$  *above* the average last summer, instead of, I forget how much below. But I should like to know the grounds for his predictions—if they are of a nature that we can comprehend.

I am, Sir, your obedient servant,

F. W. STOW.

*Aysgarth, Bedale, January 3rd.*

DECEMBER, 1873.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.						TEMPERATURE.				No. of Nights below 32°	
		Total Fall.	Difference from average 1860-5	Greatest Fall in 24 hours.		Days on which $\frac{1}{10}$ or more fell.	Max.		Min.				
				Dpth	Date.		Deg.	Date.	Deg.	Date.			
I.	Camden Town .....	inches .48	inches — 1.02	in. .17	26	8	56.7	17	22.9	11	6	11	
II.	Maidstone (Linton Park).....	.46	— 1.37	.19	31	7	57.0	17	21.0	29	10	12	17
III.	Selborne (The Wakes).....	.56	— 2.19	.26	30	9	54.2	16	16.0	10	12	17	
IV.	Hitchin .....	.60	— .71	.24	26	9	50.0	2, 18	20.0	11§	13	...	
V.	Banbury .....	.80	— .87	.24	19	9	56.0	16	16.5	10§	12	...	
VI.	Bury St. Edmunds (Culford).....	.69	— .80	.20	25	8	55.0	16	20.0	11§	10	15	
VII.	Bridport .....	1.34	— 3.03	.20	30	5	56.0	11	21.0	11	8	...	
VIII.	Barnstaple.....	1.45	— 1.67	.24	19	18	53.5	19	26.0	10	...	...	
IX.	Bodmin .....	1.32	— 3.92	.37	30	17	53.0	16	29.0	12	4	7	
X.	Cirencester .....	.97	— 1.32	.29	25	9	...	...	...	...	...	...	
XI.	Shiffnal (Haughton Hall) ...	.85	— .83	.23	30	10	55.0	16	16.5	13	10	14	
XII.	Tenbury (Orleton) .....	.62	— 1.84	.25	26	9	58.0	16	15.5	13	15	16	
XIII.	Leicester (Wigston).....	.49	— 1.03	.15	26	8	57.0	16	22.0	11	10	...	
XIV.	Boston .....	.32	— 1.17	.08	19*	6	53.0	17	25.0	12	7	...	
XV.	Grimsby (Killingholme) .....	.27	...	.10	26	9	57.0	16	25.0	13	7	...	
XVI.	Derby.....	.26	— 1.29	.08	23	7	56.0	16	21.0	13	9	...	
XVII.	Manchester .....	.78	— 1.55	.17	22	10	59.0	16	22.0	12	9	13	
XVIII.	York .....	.38	— 1.42	.10	26	7	55.0	9	20.0	13	9	...	
XIX.	Skipton (Arncliffe) .....	3.57	— .98	.67	30	22	52.0	15	20.0	11	12	...	
XX.	North Shields .....	.29	— 1.91	.12	26	10	55.0	5†	27.5	29	6	12	
XXI.	Borrowdale (Seathwaite).....	11.74	— 5.21	1.80	30	24	...	...	...	...	...	...	
XXII.	Cardiff (Ely) .....	1.08	— 1.52	.30	30	9	...	...	...	...	...	...	
XXIII.	Haverfordwest .....	1.66	— 3.17	.33	30	18	53.0	1	21.5	10	6	11	
XXIV.	Rhayader (Cefnfaes).....	1.24	— 2.05	.20	3, 29	15	53.0	...	19.0	...	...	...	
XXV.	Llandudno.....	1.44	— .76	.64	19	12	55.4	17	30.0	12	2	...	
XXVI.	Dumfries .....	1.35	— 2.11	.32	15	19	56.0	15	23.0	28	6	11	
XXVII.	Hawick (Silverbut Hall).....	1.48	...	.28	21	14	...	...	...	...	...	...	
XXVIII.	Kilmarnock (Annanhill).....	2.18	...	.36	30	19	53.0	16	25.5	28	6	8	
XXIX.	Castle Toward .....	3.33	— 2.02	.45	21	20	53.0	3	...	...	6	...	
XXX.	Leven (Nookton) .....	1.56	— 1.22	.42	5	13	55.0	16	24.0	12	11	20	
XXXI.	Stirling (Deanston) .....	3.69	— .50	1.11	17	20	53.0	16	23.9	27	8	10	
XXXII.	Logierait .....	2.69	...	.41	23	17	55.0	1	25.0	6, 27	13	...	
XXXIII.	Braemar .....	3.16	— .61	.80	23	18	50.8	13	20.1	28	9	13	
XXXIV.	Aberdeen .....	1.91	...	.66	23	13	57.2	16	28.2	28	5	20	
XXXV.	Inverness (Culloden) .....	2.51	+ .50	.54	25	17	54.3	15	30.2	28	1	11	
XXXVI.	Portree .....	13.14	— 2.49	1.70	7	30	...	...	...	...	...	...	
XXXVII.	Loch Broom .....	8.16	...	.76	19	29	...	...	...	...	...	...	
XXXVIII.	Helmsdale .....	3.49	...	.58	15	23	...	...	...	...	...	...	
XXXIX.	Sandwick .....	4.29	+ .32	.96	12	22	53.0	16	31.6	28	1	6	
XL.	Caherciveen Darrynane Abbey	1.86	...	.39	30	21	...	...	...	...	...	...	
XLI.	Cork .....	.77	...	.30	30	20	...	...	...	...	...	...	
XLII.	Waterford .....	1.16	— 3.26	.29	31	15	57.0	15†	28.0	28	3	...	
XLIII.	Killaloe .....	2.52	— .97	.55	30	19	55.0	15	25.0	28	5	7	
XLIV.	Portarlinton .....	1.09	— 2.10	.28	19	22	57.0	16	26.5	27	5	...	
XLV.	Monkstown, Dublin .....	.71	— 1.91	.14	18	9	54.0	2	22.0	11§	7	...	
XLVI.	Galway .....	1.84	...	.27	15	19	55.0	2	27.0	28	3	...	
XLVII.	Bunninadden (Doo Castle) ...	1.63	...	...	...	...	...	...	...	...	...	...	
XLVIII.	Waringstown .....	.78	...	.21	28	12	57.0	15	25.0	27	10	15	
XLIX.	Edenfell (Omagh).....	1.55	...	.35	21	20	53.0	15	25.0	27	9	...	

\* And 27. + 17 & 23. † 16. § 12 || 13.  
 + Shows that the fall was above the average; — that it was below it.

## METEOROLOGICAL NOTES ON DECEMBER.

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

## ENGLAND.

LINTON PARK.—The driest and finest December I have on record for twenty years, that of 1857 being the nearest approach to it; Bar. high the greater part of the month, especially the first fourteen days, during which no measurable rain fell. Fogs frequent. Frosts, not severe, in second and last week. Winds (never high) veered from S. to W. and N., being only one day E. Altogether a remarkably fine month.

SELBORNE.—Fog nearly every day till the 20th. No snow. Prevailing winds the last half of month W.; Bar. remarkably high during the first fortnight, 30·46. Very mild on the 2nd, the min. ther. was 45°.

BANBURY.—On the 10th dense fog in the evening, 11th dense dry fog from 9.30 a.m. to 10 p.m., and on the 12th the same kind of fog from 8.30 p.m. to 10 p.m. On the 10th the fog only occupied the low ground, not extending to the higher ground, immediately S. of the town. I do not recollect any other noticeable instance of dry fog in these parts such as occurred on the 10th, 11th, and 12th, nor indeed any fog so dense, or of so long continuance. People who had lived in Banbury for years lost their way in the narrow streets; and many farmers and others attending Banbury market on the 11th had to leave their conveyances and walk home to the neighbouring villages, or to lead their horses all the way home.

CULFORD.—The weather during the month has been mild and fine for the season, with a preponderance of Westerly winds, being 27 to 4 of an Easterly direction. Average temperature of the month, 39°·2.

BODMIN.—This month has been remarkable for its excessive mildness and the absence of high wind, but more especially so for its small rainfall, being nearly four inches below the average of twenty-four years. Mean temperature of month 45°·8.

HAUGHTON HALL, SHIFNALL.—With the exception of one week, viz., from 10th to 15th inclusive, the month was remarkably mild and dry up to the 27th, till which day the rainfall was only ·12. On the day above mentioned († the 10th) frost set in suddenly and strong, the thermometer sinking at night to 23°, 18°, 17°, 16°, 20°, and 32°, on the six nights respectively, accompanied by fog with a most beautiful rime on the trees and herbage, and a very high Bar. Ice 1½ in. thick. On the 27th, after heavy rain at night, fog with rime set in again, though less severe, continuing to the close. Christmas-day was very mild. Vast quantities of holly berries. The wind throughout varied from N. to W. and S.W.

ORLETON.—The driest December for many years, but in 1846, only ·64 was registered. Bar. remarkably high and steady for the first half of the month. The temperature very variable, but rather below the average of the month. On the 9th severe frost set in and continued till the 15th with dense fogs and great rime in the valleys. Although many of the days were bright and sunny the rime remained on the trees from the morning of the 10th till the night of the 14th. On the 13th and 14th the river Teme was frozen over in many places. On the 16th a violent wind occurred. Bar. 30·41 on the 12th, min. temp. 15°·5 on the 13th.

WIGSTON.—With the exception of the very strong wind which passed over the midland and north midland counties on the 16th the month has been characterized by an unusual quietness in the atmosphere. Foggy weather has been experienced. A very small rain fall, less than half an inch during the month. The total fall during 1873 has been three inches below the average in this locality.

BOSTON.—December one of the driest ever known, the nearest being in 1857. Water is so scarce in the country that water-carts are in frequent requisition to fetch water for domestic purposes and for stock; this presents a great contrast to last year, when the fen-engines were working night and day to keep the water down, and nearly every part of the country was flooded.

GRIMSBY.—The driest month since I have kept a register (eight years). Many

pleasant days ; several rose trees have been in flower. The springs are very low. Stormy, with high temperature on the 16th.

DERBY.—December has been meteorologically a very remarkable month, the prevailing direction of the wind being W. and S.W., notwithstanding which the Bar. has been excessively high, and the rainfall less in quantity and fewer days on which it fell than has been registered in Derby for the last thirty years.

SEATHWAITE.—Rainfall 5 inches below the average, S on mountains on 22nd.

#### W A L E S.

HAVERFORDWEST.—I find, on reference, that no December during the last twenty-four years has produced such a small rainfall as this, 1857 comes the nearest, 1·88 in. The weather at the commencement was densely foggy and almost constant drizzling mist with extraordinarily high bar., this was succeeded by a week of very sharp frost and some low readings of the ther., the remainder of the month constantly rainy, damp, and mild. Heavy gale from the E. on the 29th. Stormy and cold at the end.

CEFNFAES.—The month has been mild and pleasant. Wind generally N.W. or S.W. Primroses and many other flowers in blossom.

LLANDUDNO.—A fine month. No fog, and only on two nights did the temperature fall below 32°, and then but slightly, the lowest being 30° on the 12th.

#### S C O T L A N D.

DUMFRIES.—The first week showery but mild, the second dry with occasional frost and fog, the latter half of the month showery with strong gales on several nights, and the last week three frosty nights followed by stormy weather. On the whole fine and mild for the season, the rainfall considerably below the average ; the temp. 3°·6 above that of Dec. 1872. Vegetation unusually forward, snowdrops one inch and a half above the ground, the whin or furze in bloom.

SILVERBUT HALL, HAWICK.—Heavy gales on the 14th, 15th, 21st, 22nd, 23rd, 24th and 29th. Very little frost, and the month on the whole has been more like March (for mildness) than December.

ANNANHILL, KILMARNOCK.—Great storm on 15th and 16th, S.W. to W.N.W., began about 5·30 p.m. on the 15th and ceased about 11 a.m. on the 16th. Gales also on nights of 5th, 8th, 9th, 21st and 23rd ; velocity on the 16th, seventy-six miles an hour. Rainfall small, month generally cloudy. Aurora in the W. on the 19th. In the middle of the month yellow jasmin, clematis, and some spring flowers in bloom in the open air, some frost towards the end of the month, but not severe, the min. 25°·5 on the 28th. Small-pox and typhoid fever very bad, death rate in the parish during the month 43 per 1000.

NOOKTON.—On the 16th violent gale in the night and again on the 21st.

LOGIERAIT.—Several severe gales, especially on the nights of the 14th and 21st. Temperature on the whole above the average. Spring flowers appearing. No snow during the month.

BRAEMAR.—The most genial December ever known in these parts. Aurora and falling stars on the 7th. Lunar halos on 1st and 4th.

ABERDEEN.—A month of unusually dry and mild weather, but with frequent gales, that of the 16th being very heavy.

CULLODEN.—Storm on the 16th ; the anemometer between 9 a.m. on the 15th and 9 a.m. on the 16th showed a horizontal movement in the air of 559 miles and by 9 a.m. on the 17th an additional 384 miles, making the total horizontal movement in the forty-eight hours 944 miles ; the greatest pressure on the square foot varied between thirty-one and thirty-six pounds ; the direction of the wind at the commencement of the storm was S.S.W. to S.W., but it gradually veered through W.S.W. and W. to W.N.W. on the morning of the 16th. This storm was very generally felt throughout Scotland and over the north of England, causing much damage to life and property. 30th a strong gale W.S.W.

PORTREE.—A very wet and squally month, a strong gale from S. all night on the 8th. A fearful hurricane from S. to W.S.W. from 7 p.m. on the 14th to 8 a.m. on the 15th ; loud thunder peal at 9 a.m. on the 14th ; TS from 5 to 7 a.m. on 31st. Snow, sleet and hail on the 23rd and four following days. Cattle and sheep healthy and thriving well on the pastures

**LOCHBROOM.**—This has been a most miserable month with only two dry days. The amount of rainfall (8·16) seldom exceeded in this district. Snow deep on the straths, and sometimes hard frosts were soon caused to disappear by another down-pour of rain, constant gales and an ample share in the hurricane that did so much damage over Britain.

**SANDWICK.**—December has had about the average quantity of rain, its temperature nearly 3° above the mean, and as usual in a warm winter it has been very stormy, the anemograph having traced more than 4,000 miles above the mean. A storm from 1 a.m. on 16th till 3 a.m. on 17th of 1380 miles in 26 hours, a mean of 53 miles, but 65 from 4 to 6 a.m. on 16th.

#### I R E L A N D.

**DARRYNANE ABBEY.**—The driest month since April 1872, and very mild but foggy. Wind W. and N.W. except 27th and 28th, when it was N.E. with fog.

**MONKSTOWN.**—There has been an unusual absence of R this month, although the atmosphere has been very damp, and the temperature high. Many trees (especially roses) budding, and thrushes, &c., singing.

**DOO CASTLE.**—Finest month of December on record. Very little R. till towards the close of the month. No frost.

**WARINGSTOWN.**—The driest and finest December that I can remember.

**OMAGH.**—The weather of the month, especially up to the 20th, remarkably fine and mild. Fields green, primroses and daisies in some places in bloom, and altogether like spring.

### BIBLIOGRAPHY OF EVAPORATION.

*To the Editor of the Meteorological Magazine.*

SIR,—May I beg of you to give, in an early number of your Meteorological Magazine, the names of such books or pamphlets as discuss to some purpose the subject of evaporation from the surface of water, or such as furnish reliable facts thereanent—or direct me where to apply for them—and you will confer a favour on your obedient servant,

JAMES P. KIRKWOOD, C.E.

50, Pierrepont Street, Brooklyn, New York, Jan. 1st, 1874.

[We cheerfully give a small contribution towards supplying the very reasonable request of Mr. Kirkwood. The literature, however, is almost as meagre as the collection of trustworthy data. Most of the principal papers are referred to, or quoted, in articles upon the subject, in the annual issues of *British Rainfall* from 1867 to 1872. The following short list may, however, be a useful supplement.—ED.]

On suiting the depth of Drainage to the circumstances of the soil. Oct. 1849.

By J. H. Charnock. [*Journal of Royal Agricultural Society*, Vol. X., pp. 507—519.]

Manual of Physical Research for India. By G. Buist.

Meteorology. By Sir J. Herschel. 8vo, 1862.

Manual of Hydrology. By N. Beardmore, 1862.

On the Evaporation from a Water Surface at St. Helena. By the Rev. S. Haughton, M.D. [*Read before the Royal Irish Academy*, June 27, 1864.]

On the determination of the real amount of Evaporation from the Surface of Water. By Rogers Field, B.A., and G. J. Symons. [*Read before the British Association*, August, 1869. Printed in *extenso* in *British Rainfall*, 1869.]

On Evaporation and Evaporation Gauges, with some remarks on the formation of Dew. By G. Dines. [*Proceedings of Meteorological Society*, Nov. 1870.]

On Evaporation, Rainfall, and Elastic Force of Vapour. By J. R. Mann. [*Proceedings of Meteorological Society*, March, 1871.]