

Symons's Meteorological Magazine.

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OUR NEW VOLUME.

WITH this number commences the thirty-ninth volume of *Symons's Meteorological Magazine*, and the fourth under its present editorship. It has been our aim to maintain the interest and utility of the Magazine, though when we turn back to the earlier volumes, when each issue rang with the clash of arms of eager controversialists, we feel that the interest has often been allowed to flag. Such a state of things is not as it should be, and we trust that we are not in error in our belief that the twentieth century is about to witness a rapid advance in meteorological science. By the early reports of the meetings of the Royal Meteorological Society, the Scottish Meteorological Society, and the Cosmical Physics Section of the British Association, our readers are kept aware of all that is passing in the meteorological life of these islands, and it is only want of space, not want of will on our part, that prevents the survey from being world-wide. This year we propose, though we do not promise, to maintain the size of the magazine at twenty pages, and we have several articles of special interest in contemplation, as to which it will be safer to abstain from prediction until the promises on which we depend are in course of fulfilment.

The increase in the attention bestowed on matters meteorological during the recent heavy rains promises to lead to permanent results by increasing the number of observers, and it has had a marked effect in accelerating the promptitude with which the returns for *British Rainfall* have come in. It has long been characteristic of the British Rainfall Organization that all classes worked together to advance this little corner of science without distinction of person. It would be difficult to say off-hand whether Clergymen, Doctors, Engineers, Farmers, or Gardeners (the order is alphabetical) are doing most, but all are doing much. The Prime Minister has expressly authorised his gardener at Whittingehame to send in returns of rainfall, and many members of both Houses of Parliament take a practical interest in the work.

His Majesty the King has recently honoured the Rainfall Organization by accepting with a gracious message of thanks a copy of the

various publications, and he has been pleased to direct that returns from the rain gauges in all the Royal Gardens shall be sent in regularly for insertion in *British Rainfall*. The record from Windsor has long graced the pages; those from Sandringham and Balmoral will appear in the new volume of *British Rainfall*, and that at Buckingham Palace will fill up a gap in the rain returns of London.

Pleasing as it is to be encouraged by the countenance of those in the highest places, we do not forget that one of our most faithful and valued correspondents is a railway porter, observing not by the orders of his superiors but out of love for the work, and that many others earn their bread by the hardest toil. Our hope is to do the best we can in discussing the records with which all the observers entrust us.



ATMOSPHERIC PRESSURE AS A FACTOR OF CLIMATE.

By L. BONACINA.

It is only by treating meteorological phenomena as the product of so many climatic factors that we are enabled to afford a satisfactory explanation of the atmospheric conditions of any portion of the Earth's surface.

We propose in this article to resolve climate, a term which we may define to be the average state of the weather over a given area, into its constituent factors, so that if from some remote or little-known land sufficient geographical data were received, we should be able to synthesize, as it were, its theoretical climate, which would bear a very close resemblance to its actual one. By adopting such a method of analysis, the fact, for instance, that the mean annual temperature of London is 49° F. becomes vested with a real interest;* for if we knew nothing about the climate of London we could from the possession of certain geographical and geological data relating to the city, infer that the climatic conditions were those of the colder portion of the temperate zone with an approximate mean annual temperature of 50° F.

The chief factors which are involved in the formation of the climate of any locality may be classified as follows:—(a) latitude of the locality, (b) its altitude, (c) physical features, that is whether it is composed of land or water, whether it is an arid desert or covered with vegetation, (d) proximity to the sea, to ocean currents, to mountain ranges, etc., (e) geological formation, (f) the average distribution of pressure as indicated by the configuration of the

* The results of a long series of observations taken at the Royal Observatory, Greenwich, fix the mean annual temperature at 49°·2 F. The more central London stations give a value a degree or two higher. When we reflect upon the enormous extent to which the processes of combustion and respiration take place within the metropolitan area, we need not be surprised at the apparent discrepancy. [The mean of the 9 a.m., 9 p.m., max., and min. temperatures for 45 years at Camden Square is 49°·8.—*Ed. S.M.M.*]

isobars. These factors, of course, interact with one another in the most complex manner in their resultant effect, and it is frequently very difficult to judge to what extent a particular type of weather may be due to the operation of any one of them.

With regard to the relative significance of the climatic factors we may say that in the tropics latitude and altitude play the most important part, but that in the temperate zones the influence of isobars is nearly as great, and sometimes altogether masks the effects of latitude. In the case of the British Isles, the average configuration of the isobars has a most pronounced effect. Thus, were the normal distribution of pressure over Britain anti-cyclonic instead of cyclonic, the influence of a northern latitude would be strongly felt, and the winters would be incomparably severer than they are.*

The mildness of the climate of the British Isles compared with that of many other countries between the same parallels of latitude is frequently attributed to the fact that their western shores are bathed by a body of warm water known as the Gulf Stream. We admit this reservedly. The power of the Gulf Stream to raise the temperature of the air in England is entirely dependent upon the prevailing distribution of atmospheric pressure. Pressure is normally low, especially in winter, in the neighbourhood of Iceland; a gradient for westerly or south-westerly winds across Great Britain is thus set up, and in this way the modifying influence of the Gulf Stream becomes apparent. That the direct influence of the Gulf Stream is imperceptible during the persistence of anti-cyclones is proved by the fact that when anticyclonic conditions of similar intensity dominate the weather over the British Isles, frosts are developed in the most central parts of Ireland almost equal in severity to those experienced in the most central parts of England and Scotland.† Moreover, the warming influence of the Atlantic Ocean is probably inappreciable on those occasions when a cyclonic disturbance traverses these islands in an easterly direction. Depressions move rapidly, continually affecting fresh masses of air, and only their southern outskirts would be fed by air from the Atlantic.

We have here, however, to take special cognizance of the fact that the mean annual temperature of Britain is raised at least 10° F. by the prevailing south-westerly winds, which, blowing as they frequently do from a great distance, doubtless receive an additional store of thermal energy from the warm waters of the Gulf Stream. We have now to observe that, though the configuration of the isobars

* The mean January temperature at Greenwich would be about 20° F., instead of 37° F. as it now is.

† In February, 1895, the minima in the screen were 6° at Parsonstown, 7° at Greenwich and -5° at Loughboro' in Leicestershire. In February, 1902, the respective minima were 13°, 14°, and 8°. In January, 1881, they were 6°, 8°, and 2°. Presuming that anti-cyclonic conditions of equal intensity prevailed all over the British Isles, we see that the recorded temperatures show no relation to proximity to any body of warm water off the western coast, but merely to distance from the sea.

deserves to be ranked as one of the most important factors of the climate of western Europe generally, in some parts of the world the formation of isobaric systems appears, on the contrary, to be a function of climate. Thus the persistent winter anti-cyclones of Canada and Siberia may be safely attributed to the intense cold which in those countries reigns supreme for a longer or shorter period of the year. The increase of pressure thus occasioned by the great cold will in turn promote a further reduction of temperature by permitting terrestrial radiation to take place more freely. We see then in what an intricate manner temperature and pressure may react upon one another. Even in the British Isles, where cyclones and anti-cyclones are merely accidents, as it were, in the general circulation of the atmosphere we may frequently notice this interaction of pressure and temperature. If anti-cyclonic conditions should happen to set in at a time when the country is covered with snow they will persist much longer than, *cæteris paribus*, they otherwise would do, in accordance with the principle that masses of snow produce a further diminution of temperature, and consequent increase of pressure. Doubtless the great frost of 1895 was protracted in this way.

With regard to the mutual relationship between low pressures and temperature, we are perfectly justified in asserting that the convection theory of cyclones, which ascribes their origin to the ascent of masses of heated air, will not account for those of north-western Europe. There are, on the contrary, good reasons for believing that the rapid variations of temperature associated with the passage of winter cyclones are the product, not the cause of cyclone action. We are not at present concerned with the complex problems relating to the distribution and variations of temperature in cyclones; suffice it to say that the convection theory, in so far as it appertains to British cyclones, is totally disproved by the well-ascertained facts that the ascending current in a cyclone is frequently colder than the descending current in the adjacent anti-cyclone, and that atmospheric disturbances are most frequent and violent during the cold months of the year. We must, nevertheless, not forget that if there should happen to be an unstable temperature gradient, that is to say, if the air ascending in the centre of the cyclone should possess a higher temperature than the surrounding air, the system will develop increased energy.* It will be obvious, then, that a constant succession of cyclones must constitute an important factor of climate in a country where such disturbances are not initiated by local variations of temperature.

With regard to the origin of cyclones, we can only say that they are the product of the general circulation of the atmosphere, just as the countless eddies which indent the surface of a river originate in

* Thunderstorms are, no doubt, due to the sudden uprush of warm, moist air, resulting in rapid condensation of vapour and increase of electrical potential.

the forward motion of the water itself. Until, however, something more is known of the complex laws which regulate the phenomena of fluids in motion, any speculation as to the conditions requisite for the production of an atmospheric cyclone can amount to no more than a surmise.

Although the sun's rays are required to set the atmosphere in motion by exciting differences of temperature, the actual distribution of pressure over the surface of the globe is rendered extremely complex by the Earth's axial rotation, together with the unknown laws which control the movements of a circulating fluid, so that while all cyclones and anti-cyclones are ultimately traceable to the great thermal slope from the equator to the poles, they in turn react to a greater or less extent upon climate, constituting an important factor in the relative distribution of temperature, wind and rainfall.



THE CLIMATE OF THE BRITISH EMPIRE DURING 1902.

THIS summary should properly have appeared in the previous volume, but although belated, we feel that it should not be excluded. Considerable additions to the list of stations comprised in the climatological tables for the British Empire, have been made during the year 1902, but it is hardly necessary to remind our readers that it is still very far from being fully representative of all the varying climates of the Empire.

Of the new stations Madras is perhaps the most remarkable, since it provides the highest mean annual temperature that has ever been recorded in these tables. Coolgardie also immediately makes an appearance in the summary of extremes, with the very high mean daily range of $25^{\circ}\cdot 5$, thus taking the place of Winnipeg, which has provided this item uninterruptedly for 16 years, though it must be noted that Coolgardie owes its great range to high maxima, whereas Winnipeg owed it to low minima. The mean temperature at Winnipeg, for 1902, is the highest since 1879, and although the minimum reached $-36^{\circ}\cdot 1$, it has seldom been so high in former years. The returns from the arctic station at Dawson were again unfortunately incomplete, but it is worthy of note that the minima of the four months, January, February, November and December, were respectively $-50^{\circ}\cdot 0$, $-49^{\circ}\cdot 0$, $-48^{\circ}\cdot 0$, and $-51^{\circ}\cdot 0$, while in December the mean maximum was $-16^{\circ}\cdot 7$, and the mean minimum $-28^{\circ}\cdot 2$. The rainfall was greatest, as usual, at Colombo, where the fall was heavier, with one slight exception, than in any year since 1878.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE FOR 1902.

STATIONS.	ABSOLUTE.			AVERAGE.					ABSOLUTE.		TOTAL RAIN.		AVER- AGE.	
	Maximum. Temp.	Date.	Minimum. Temp.	Max.	Min.	Mean.	Dew Point.	Humidity	Max. in Sun.	Min. on Grass.	Depth.	Days.		
<i>Those in Italics are South of the Equator.</i>													Cloud.	
London	85.1	July 15	15.8	February 16	57.4	42.9	50.1	43.5	79	132.1	14.3	20.84	162	0-10
Malta	99.7	July 25	40.4	February 17	72.5	59.3	65.9	56.3	76	148.3	34.1	24.84	66	6.6
Lagos, W. Africa	95.1	April 13	66.1	December 29	86.4	75.7	81.1	74.7	79	148.0	...	45.94	70	3.3
Cape Town	98.9	March 20	38.3	August 18	70.6	54.4	62.5	53.0	72	...	...	33.74	122	4.6
Durban	105.6	September 23	47.4	June 14	79.2	61.0	70.1	...	...	156.1	...	41.18	160	4.6
Mauritius	89.9	November 20	51.9	August 12	81.8	68.0	74.9	65.6	75	159.2	44.8	47.11	184	5.7
Calcutta* .....	...	.....	...	.....	...	...	...	...	...	159.0	41.1	62.28	83	4.5
Bombay	94.9	June 3	64.1	February 7	87.4	76.6	82.0	72.9	75	143.5	54.9	71.97	100	3.8
Madras	108.0	May 8	62.2	February 6	91.0	75.4	83.2	72.0	76	153.0	58.2	54.44	104	4.6
Kodaikanal	75.2	March 23 May 7	39.4	January 26	64.7	51.3	58.0	...	75	145.3	27.2	72.53	184	5.3
Colombo, Ceylon	93.4	March 5	65.2	January 24	87.3	75.5	81.4	73.3	80	158.0	61.3	117.01	198	5.8
Hongkong	92.2	July 27	40.5	February 4	78.2	69.6	73.9	65.3	76	150.6	...	97.52	136	6.3
Melbourne	103.0	January 31	29.6	August 14	67.0	49.1	58.0	47.3	71	161.7	21.3	23.08	102	6.0
Adelaide.....	111.4	February 11	36.9	(June 26 July 9, 10	73.7	53.1	63.4	47.3	59	167.9	30.9	16.02	124	4.8
Coolgardie	108.6	December 20	31.9	July 30	77.9	52.4	65.1	...	...	...	24.0	14.69	51	3.5
Sydney	100.0	December 24	40.3	August 1	69.7	56.5	63.1	...	73	151.2	31.8	43.07	176	4.8
Wellington	81.0	January 13	32.0	July 17	60.6	47.8	54.2	44.5	71	136.0	24.0	38.75	201	5.8
Auckland	79.5	March 1	38.5	July 17	63.1	51.7	57.4	46.6	67	144.0	33.0	38.28	184	5.1
Jamaica, Negril Pnt.	...	.....	...	.....	85.9	72.2	79.1	71.9	78	...	...	50.78	123	...
Trinidad	97.0	December 1	61.0	January 5	87.6	69.6	78.6	73.4	82	177.0	58.0	55.34	139	...
Grenada	90.8	May 18	68.4	June 30	83.4	74.1	78.8	70.5	74	160.0	...	70.86	226	2.9
Toronto	91.0	July 8	-3.3	December 9	54.2	37.4	45.8	39.6	78	107.8	-10.2	31.04	155	6.3
Fredericton, N.B.	84.7	June 2	-22.0	February 12	52.0	20.6	41.7	30.8	60	...	...	49.66	147	5.9
Winnipeg	91.2	August 5	-36.1	January 27	48.6	26.6	37.6	...	...	...	...	20.22	98	5.7
Victoria, B.C.	86.2	July 19	12.3	January 25	55.9	44.5	50.2	...	...	...	...	26.45	151	6.5

* Thermometer shed under repair February 11th-20th.

SUMMARY.

<i>Highest Temp. in Shade</i>	111°·4 at Adelaide on February 11th.
<i>Lowest</i> " "	—36°·1 at Winnipeg on January 27th.
<i>Greatest Range in year</i>	127°·3 at Winnipeg.
<i>Least</i> " "	22°·4 at Grenada.
<i>Greatest Mean Daily Range</i> ...	25°·5 at Coolgardie.
<i>Least</i> " "	8°·6 at Hongkong.
<i>Highest Mean Temp.</i>	83°·2 at Madras.
<i>Lowest</i> " "	37°·6 at Winnipeg.
<i>Driest Station</i>	Adelaide, mean humidity, 59.
<i>Dampest</i> "	Trinidad " " 82.
<i>Highest Temp. in Sun</i>	177°·0 at Trinidad.
<i>Lowest Temp. on Grass*</i>	—10°·2 at Toronto.
<i>Greatest Rainfall</i>	117·01 in. at Colombo, Ceylon.
<i>Least</i> "	14·69 in. at Coolgardie.
<i>Most Cloud</i> ..	6·6 at London.
<i>Least</i> "	2·9 at Grenada.

Correspondence.

To the Editor of Symons's Meteorological Magazine.

BELVILLE'S JOURNALS.

I HAVE been considering the point raised by you in your editorial note last month, with reference to the rainfall of 1824, and I am still of the opinion that the record was made at the Royal Observatory. I am aware that Mr. Eaton, in his account of Belville's Journals, given in his paper on "The Mean Temperature of the Air at Greenwich" ("Quarterly Journal, Royal Meteorological Society," vol. xiv., January, 1888), inclines to the belief that the entries in the Royal Observatory M.S. Journal, from 1822 to 1826, are transcripts of Belville's observations at Park Row and Park Terrace. But it would appear that Belville on changing his residence in 1822 did not remove the rain gauge from the Observatory, and it continued in use there until 1878, and is now in the Observatory Museum. The rain table cited by you was drawn up many years ago by Mr. Glaisher, and all the values in the early years (prior to 1841) were raised in the proportion of ten to eleven, under a mistaken notion with regard to the position of the gauge.

W. C. NASH.

Blackheath, 9th February, 1904.

* The minimum on grass is not recorded at the other Canadian stations. In every case the extreme conditions refer only to the stations quoted in the Climatological Table. It is quite possible that other places in the empire were hotter, colder, wetter or drier, than any here cited.

THE STUDY OF SUNSPOT CYCLES.

The method suggested by Mr. J. Edmund Clark, in Vol. **38**, p. 136, for arranging the years in order to obtain meteorological means conforming to the sunspot cycle, seems to me a useful one. However, the years of maxima given by him do not conform in many cases with the years recently given by Wolfer in the revision of the relative sunspot numbers. (See the *Astronomische Mittheilungen*, vol. **93**, and the *United States Monthly Weather Review* for April, 1902).

Also, there seems to me more joining of two years in one in the scheme of Mr. Clark than is necessary. Hence I have arranged the years in the following manner. In this scheme the years of maxima and minima all conform with the dates given by Wolfer, except the maximum of 1804. In this case there was a prolonged maximum, extending from 1802—1805, and it seems to me the maximum more properly belongs in 1804 rather than in 1805, as given by Wolfer.

A Plan for Reduction of Years to Mean Sunspot Curve.

CYCLE.	Min.											Max.	Wolfer's Maxima.
	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.		
1745'0—1750'3...	45	6	7	8	9	50	1	2	2-3	3	4	1750'3	
1755'2—1766'5...	55	6	7-8	9	0	61	2	3	3-4	4	5	1761'5	
1766'5—1775'5 ..	66	7	7	8	8	69	0	1	2	3	4	1769'7	
1775'5—1784'7...	75	6	6	7	7	78	9	0	1	2	3	1778'4	
1784'7—1798'3...	84	5	6	6	7	88	9	0-1	2-4	5-6	7	1788'1	
1798'3—1810'6...	98	9	0	1-2	3	04	5	6	7	8	9	1805'2	
1810'6—1823'3...	10	1	2-3	4	5	16	7	8	9-0	1	2	1816'4	
1823'3—1833'9...	23	4	5-6	7	8	29	0	1	1	2	2	1829'9	
1833'9—1843'5...	33	4	5	5	6	37	8	9	0	1	2	1837'2	
1843'5—1856'0...	43	4	5	6	7	48	9	0	1-2	3	4	1848'1	
1856'0—1867'2...	55	6	7	8	9	60	1	2	3-4	5	6	1860'1	
1867'2—1878'9..	67	8	8	9	9	70	1	2-3	4	5-6	7	1870'6	
1878'9—1889'6...	78	9	0	1	2	83	4	5	6	7	8	1883'9	
1889'6—1901'5 ..	89	0	1	2	3	94	5	6	7-8	9	0	1894'1	

HENRY HELM CLAYTON.

Hyde Park, Mass., U.S.A., Jan. 24, 1904.

SQUALLS OF JANUARY 13th-14th.

I should like to know whether what I observed here on Wednesday, January 13th, was observed by other readers of this Magazine. Between 9.30 and 10 p.m. there were three flashes of lightning seen over the Channel. At 11.30 p.m. a squall came over here, wind being W. to S.W., accompanied with hail, thunder and lightning, lasting about ten minutes.

Then at 2.30 a.m. on Thursday morning the same occurrence was witnessed, the lightning lasting longer. At 5.30 a.m. there was another squall of a like nature, the lightning lasting longer than the other two.

What I think is curious is that they all commenced at the half hours. All the squalls had hail, which on making its first appear-

ance was accompanied by a bright flash of lightning and a loud clap of thunder. My recording barometer went down to 29·06 inches at 5.30 and was wavy from 2 to 6 o'clock.

HENRY NEWBY.

32, Magdalen Road, St. Leonards-on-Sea, Jan. 14th, 1904.

[Many correspondents refer to the thunderstorms of January 13th—14th, which were general over the south of England. At least one of the squalls referred to in the above letter was of exceptional severity, as is shown by the following extract from *The Times* of January 15th :—

“ A severe gale broke over Brighton and Hove in the early hours of yesterday morning. At 2 p.m.* a squall swept over the towns, doing considerable damage. A number of chimney stacks were blown down, and some of the streets were strewn with slates. A lady had a wonderful escape at the Princes Hotel, Hove. A stack of five chimneys fell from a height of about 50 ft. upon the roof of the hotel on the west side. The roof gave way, and the lady, who occupied a bedroom beneath, was almost buried in the wreckage. The building was very strongly constructed, and one of the beams supporting the roof, falling crosswise into the room, helped to prop up the sheets of lead flung down from the roof, and thus a kind of protective canopy was formed over the bed, and to this the occupant owed her life, though she sustained a severe wound. A bell was close to her, but she was unable to reach it, and had to lie exposed to the fury of the storm until 7 o'clock, when she was rescued.”

It is an interesting fact that the Redier barograph at Camden Square recorded a sudden fall of ·025 inch and an almost immediate recovery at 2.30 a.m., the period of this abrupt reduction of pressure being so short that the downward and upward movement of the pencil showed only a single line, and did not interfere with the steady fall of the barometer which was in progress at the time.]—ED. *S.M.M.*

METEOROLOGICAL NEWS AND NOTES.

THE HEAVY RAINFALL OF 1903 will not soon be forgotten. It has made for itself a place in literature, and a correspondent recalls to our attention that the pluviometric conditions are thus enshrined in the felicitous dog Latin of the Westminster School Play :—

“ *Totum annum pluvit felibus et canibus.*”

MR. WILLIAM S. BRUCE, of the Scottish National Antarctic Expedition, has offered to hand over Omond House and Copeland Observatory, in the South Orkneys, to the Argentine Meteorological Office, and to give four scientific men chosen by them a free passage and eighteen months' provisions, if they will undertake to continue during the next year the meteorological and magnetical work which the Scottish Expedition has initiated and carried on during the past year. We have reason to believe that this offer will be accepted and that Mr. R. C. Mossman, Meteorologist to the Scottish Expedition,

* This is obviously a misprint for 2 a.m.—ED. *S.M.M.*

will remain in charge of the station. The Scottish Expedition hoped to continue meteorological and other research to the south-east of the South Orkneys during the present season. A labour strike in Buenos Aires has, however, seriously impeded the refitting of the "Scotia," and the summer has already almost passed.

ROYAL METEOROLOGICAL SOCIETY.

THE Annual General Meeting of this Society was held on Wednesday, January 20th, at the Institution of Civil Engineers, Great George Street, Westminster, Captain D. Wilson-Barker, President, in the chair.

The Council in their Report congratulated the Society on the steady increase in the number of Fellows. The Symons Gold Medal had been awarded to Hofrath Dr. Julius Hann, of Vienna, in consideration of his eminent services to the science of Meteorology. The Society's Howard Silver Medal, annually awarded to the cadets of "H.M.S. Worcester," had been gained by Cadet H. Wormell for his essay on "The use of Clouds in forecasting the Weather." A new section had been added to the *Quarterly Journal*, entitled "Meteorological Literature," which gives the titles of such papers as appear to be of general interest, bearing on Meteorology, in the periodicals which are received in the Society's Library. The Council also referred to the Kite Observations carried out by Mr. Dines during the past summer on the west coast of Scotland, which had been made under very unfavourable conditions as regards both the weather and the vessel which had to be employed.

The Report having been adopted and the usual votes of thanks passed, the President read from the Council minutes a statement of Dr. Julius Hann's services to Meteorology, and then with a few appropriate words handed the Symons Gold Medal to Count L. Széchenyi, First Secretary to the Austro Hungarian Embassy, who was present to receive it on behalf of Dr. Hann.

The President then delivered an address on "The Present Condition of Ocean Meteorology." He said that he had chosen that subject because he believed that the solution of many weather problems must be sought in close study of atmospheric conditions over oceanic areas. He referred to the early workers in meteorological science, Captain Maury in America and Admiral FitzRoy in this country, and also to the addresses on the subject delivered to the Society some years ago by Dr. R. H. Scott. The President then sketched the present state of our knowledge, illustrating his remarks by numerous slides of isobaric, isothermal and other maps of the various oceans drawn on Flamsteed's projection. He reviewed the meteorological work of different nations, pointing out the energetic action of the United States in particular, and also of Germany and Great Britain. He was of opinion that we had reached the limits to which it was possible for us to go in weather forecasting with the

meteorological knowledge at present within our reach. What was now required was a liberal infusion of scientific imagination into our methods. It was to be hoped that a meteorological Darwin might appear, to set us once for all in the path for which we were groping. In conclusion, he regretted the want of liberality shown by the Government in affording financial aid for the development of this important science; and he urged the necessity of interesting the youth of the country in the matter, by making it a special subject of the curriculum in schools and colleges.

A vote of thanks having been passed to the President for his address, the scrutineers of the ballot announced that the following gentlemen had been elected the Officers and Council for the ensuing year :—

President—Captain D. Wilson-Barker. *Vice-Presidents*—Mr. W. H. Dines, Mr. J. Hopkinson, Mr. H. Mellish, and Dr. W. N. Shaw, F.R.S. *Treasurer*—Dr. C. Theodore Williams. *Secretaries*—Mr. F. Campbell Bayard and Dr. H. R. Mill. *Foreign Secretary*—Dr. R. H. Scott, F.R.S. *Council*—Mr. R. Bentley, Mr. J. Y. Buchanan, F.R.S., Capt. W. F. Caborne, C.B., Mr. R. H. Curtis, Dr. H. N. Dickson, Mr. F. Druce, Sir J. Eliot, F.R.S., Mr. W. Ellis, F.R.S., Capt. M. W. C. Hepworth, C.B., Mr. R. Inwards, Mr. Baldwin Latham, and Mr. E. Mawley.

The Annual General Meeting was preceded by a brief Ordinary Meeting, at which the following gentlemen were elected Fellows :—Mr C. Beadle, Mr. H. Garnett, Mr. C. W. Nicholl, and Mr. W. I. Walker.

BEN NEVIS OBSERVATIONS AND WEATHER FORECASTS.

By the courtesy of Dr. A. Buchan, F.R.S., we have been favoured with a copy of the Report of the Committee on Meteorological Observations on Ben Nevis, presented to the British Association at the Southport meeting in 1903.

It contains the following interesting statement of the views of the Director of the Observatory as to the possibility of utilizing the observations for the purpose of weather forecasts :—

Some of the results have a special bearing on forecasting. One or two illustrative cases may be here added.

1. The occurrence of small differences of temperature between Ben Nevis and Fort William, associated with very low humidities at Ben Nevis and great dampness at Fort William, and the relations of this state of things to the stability and continuance of an anticyclone, and also to thunderstorms and those heavy local rains commonly denoted as thunder-showers, have been reported on.

2. The occurrence of long-continued periods of saturation of the air at the top of Ben Nevis, as indicative of a condition of the atmosphere favourable to the development and continuance of stormy weather.

3. A marked difference in the *direction* of the wind on the summit from that at surrounding low-level stations. Such a difference most commonly occurs when Ben Nevis lies between a cyclone and an anticyclone, and may be

indicative of the direction of movement either of the cyclone or the anti-cyclone.

4. The predictive aspects of *very strong* winds on the summit of Ben Nevis accompanied, notwithstanding their great force, with very low temperatures there and great differences of temperature between the summit and Fort William, and the intimate connection of the whole with cyclonic weather, have been pointed out. Recent kite observations have made us tolerably familiar with this remarkable phase of the cyclone, and to Ben Nevis we may look for important contributions of illustrative data.

5. The difference between the Ben Nevis and Fort William barometers when both are reduced to sea-level. This difference, when it amounts to several hundredths of an inch, clearly points to an abnormal condition of the air between the summit and Fort William in respect to the vertical gradient of temperature or humidity, or both.

The investigation of some of the points raised in this discussion has been a chief subject of inquiry during the past eighteen months. The inquiry is a discussion of the hourly observations of pressure, temperature, humidity, sunshine, winds and rainfall at the two Observatories in their inter-relations, more especially as regards the bearings of the results on weather changes.

The principal point to be kept in view is the relation of the differences of temperature at the two Observatories to the differences of their sea-level pressure at the time. An illustration will explain this. During the last three days of September, 1895, the sky over Scotland was clear, sunshine strong, humidity high, night temperatures unusually high, and dews heavy, with calms or light winds. On these days while at the top temperature was very high and the air clear and very dry, at Fort William, under a sky equally clear and temperature high, the air showed a large humidity, and this state of moisture extended to a height of about 2,000 feet, or nearly halfway to the summit. Thus, then, while the barometer at the top was under an atmosphere wholly anticyclonic, with its accompanying dry dense air, the barometer at Fort William was not so circumstanced. On the other hand, it was under the pressure of such dry dense air, above the height of 2,000 feet only, whereas from this height down to sea-level it was under the pressure of air whose humidity was large and pressure therefore much reduced. The result was that the sea-level pressure at Fort William was 0.050 inch lower than it would have been if the dry dense air of the anticyclone had been continued down to Fort William. This is confirmatory of what is to be expected, that the greater density of dry air as shown in our laboratories prevails equally in the free atmosphere.

The first part of the discussion is virtually finished, the chief result of which is this:—1. When the differences of mean temperature of the day is only $12^{\circ}0$ or less, then the sea-level pressure calculated for the top of the mountain is markedly greater than at Fort William. 2. When the difference of temperature is $18^{\circ}0$ or greater, then the sea-level pressure for the summit is markedly lower than at Fort William. In the former case the meteorological conditions are anticyclonic, the weather being then clear, dry, and practically rainless; and in the latter case the conditions are cyclonic, the accompanying weather being dull, humid, and rainy. In the course of this discussion it has been marked that the reduced hourly values from day to day often indicate that the transition from the anticyclonic to the cyclonic type of weather, and *vice*

versa, is slow, sometimes extending over several days, thus prolonging the time for the prediction of the more important weather changes.

It may be remarked that the result here empirically arrived at is in accordance with the principle laid down by Dalton, that 'air charged with vapour or vaporised air is specifically lighter than when without the vapour; or in other words, the more vapour any given quantity of atmospheric air has in it, the less is its specific gravity.'

The precursor and accompaniment of the heaviest and most widespread rains is when the sea-level pressure for the summit is very greatly lower than the sea-level pressure at Fort William. This indicates the saturation of the atmosphere to a great height, while at Fort William, and, say, 2,000 feet higher, the point of saturation due to the advancing cyclone has not yet taken place.

On the other hand, when this point of saturation has been reached, then the sea-level pressure for the summit shows less difference from the sea-level pressure at Fort William. The changes of pressure which occur at the two Observatories as a cyclone advances and passes on are particularly interesting and instructive.

It is remarkable that comparatively few observations, when the difference of the temperature has exceeded $22^{\circ}\cdot 0$, could be utilised in this inquiry, because in such cases high winds prevailed, resulting in 'pumping' of the barometer. These differences of temperature, rising even to $27^{\circ}\cdot 0$, are however extremely valuable for weather prediction, inasmuch as they often precede and accompany very severe storms of wind and rain. They arise from an extraordinary lowering of the temperature at the summit while at Fort William no such lowering of temperature occurs. This is a peculiarity which kites and balloon ascents have recently familiarised us with, and it forms a prime factor in all inquiries into the theory of the cyclone, about which opinion at present is so much divided.

RAINFALL ON THE RIVER BANN, CO. DOWN, AT BANBRIDGE AND LOUGH ISLAND REAVY RESERVOIR FOR 40 YEARS FROM 1862 TO 1901.

BY JOHN SMYTH, M.A., M.Inst.C.E.I.

(*Concluded.*)

THE Tables of monthly rainfall, published in the number of this Magazine for December last, will be brought up to the end of 1903 by the following additions.—

STATION.	October. ins.	November. ins.	December ins.	TOTAL
Milltown, Banbridge	4·6	2·1	2·3	38·4
Bann Reservoir	8·5	2·2	6·7	60·1

The greatest ten-year average at Bann Reservoir, Lough Island Reavy, is 49·05 from 1894 to 1903, which exceeds the greatest ten-year average in the 40 years, 1862-1901. Although the ten months' rainfall ending November 30th, 1903, is the greatest on record, yet the year's rainfall at Lough Island Reavy was less than that of 1872.

Some interest attaches to the monthly aggregates of rainfall in each year, and these are accordingly added.

Summary of Rainfall at Milltown, Banbridge, co. Down.

YEAR.	Jan.	First 2 mos.	First 3 mos.	First 4 mos.	First 5 mos.	First 6 mos.	First 7 mos.	First 8 mos.	First 9 mos.	First 10 mos.	First 11 mos.	12 mos
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
1862.....	3.6	4.6	7.3	10.1	13.9	16.7	20.2	22.0	23.9	27.5	30.1	33.2
1863.....	3.1	3.9	5.6	6.9	9.4	12.1	12.9	16.7	19.7	25.3	27.6	29.4
1864.....	1.4	2.6	4.6	6.7	8.5	11.1	12.4	14.8	17.3	19.7	23.2	25.2
1865.....	2.7	5.4	7.6	8.2	12.4	12.9	14.4	17.1	17.4	23.4	26.9	29.1
1866.....	3.5	5.8	8.3	9.8	10.7	12.8	14.9	17.6	21.1	23.1	25.4	28.1
1867.....	3.7	5.4	7.4	11.2	14.1	15.1	21.5	23.5	25.2	29.5	30.3	31.9
1868.....	2.5	4.7	7.6	9.7	12.0	12.7	13.6	17.6	19.2	21.0	23.5	28.0
1869.....	3.4	7.5	9.4	11.4	13.5	14.4	15.9	17.5	21.4	22.9	26.0	29.2
1870.....	3.0	5.4	6.5	7.6	9.2	10.2	12.0	13.6	16.1	23.3	25.1	27.6
1871.....	3.1	5.9	7.3	10.2	11.0	12.8	16.8	20.2	23.8	26.1	27.7	29.6
Average of 10 years	3.0	5.2	7.2	9.2	11.5	13.1	15.5	18.1	20.5	24.2	26.6	29.1
1872.....	4.1	7.6	10.0	14.1	16.8	20.4	23.7	27.9	32.3	36.8	41.0	46.6
1873.....	4.0	5.1	7.4	7.9	9.8	11.3	15.4	19.8	22.5	25.2	27.0	27.6
1874.....	1.7	3.5	4.8	6.5	7.2	8.3	11.2	15.6	18.5	22.1	25.3	28.3
1875.....	3.9	5.7	6.7	7.1	8.6	11.9	15.8	18.2	22.9	26.4	29.7	31.4
1876.....	1.1	4.5	7.4	9.5	10.0	12.0	14.0	16.9	20.3	24.8	28.3	36.0
1877.....	5.9	8.3	11.9	15.0	18.5	20.9	25.7	29.1	31.2	33.9	37.2	40.0
1878.....	3.1	5.1	6.6	8.0	11.8	14.8	15.2	17.7	21.0	23.9	25.4	26.9
1879.....	2.3	3.8	5.8	7.5	11.3	15.3	21.4	25.2	29.6	30.7	32.0	33.3
1880.....	1.0	3.5	5.3	9.0	9.6	12.5	17.3	18.2	21.4	22.6	25.0	27.6
1881.....	0.7	3.5	6.4	8.1	10.7	14.9	17.8	22.5	24.7	28.2	32.0	35.0
Average of 20 years	2.9	5.1	7.2	9.2	11.4	13.6	16.6	19.6	22.5	25.8	28.4	31.1
1882.....	1.9	4.0	6.4	9.1	12.0	15.1	20.1	23.7	28.0	30.4	35.0	37.6
1883.....	3.5	6.6	8.1	9.5	11.5	13.6	18.3	22.1	25.8	28.4	31.7	33.6
1884.....	3.8	7.2	9.9	11.8	13.9	14.7	17.6	19.4	22.4	24.8	27.3	30.4
1885.....	2.2	5.9	7.5	9.5	11.3	12.0	13.9	15.3	19.9	23.0	24.6	26.6
1886.....	3.8	5.9	8.5	9.9	15.0	16.4	19.9	22.3	24.7	28.8	31.7	36.1
1887.....	2.5	3.5	5.0	7.0	8.5	9.2	11.9	14.0	17.0	18.9	21.4	23.1
1888.....	1.8	2.3	5.7	7.4	10.1	14.5	19.1	21.8	22.8	23.9	27.8	30.2
1889.....	1.8	3.9	6.2	9.5	12.9	13.2	16.9	24.5	26.2	29.4	31.0	33.9
1890.....	3.3	4.6	7.3	8.4	9.9	12.8	14.9	17.5	20.7	22.2	28.2	29.9
1891.....	1.1	1.3	2.5	5.0	8.1	11.1	14.0	19.3	21.2	24.8	27.2	31.1
Average of 30 years	2.8	4.8	7.2	9.1	11.4	13.5	16.6	19.7	22.6	25.7	28.5	31.2
1892.....	2.1	3.9	4.5	5.3	8.7	11.8	14.4	19.9	22.8	25.8	29.3	31.1
1893.....	2.7	5.2	5.9	7.0	7.9	9.5	12.2	16.5	18.2	20.0	21.4	24.0
1894.....	2.9	4.8	5.9	8.3	9.9	13.4	16.7	19.0	19.3	24.3	26.0	28.8
1895.....	1.9	2.6	5.7	7.7	7.9	10.4	15.1	20.1	20.6	24.1	27.5	30.3
1896.....	1.7	3.0	6.0	7.3	7.6	10.1	17.5	19.5	24.0	26.1	26.8	30.6
1897.....	1.8	3.6	7.8	10.2	11.9	16.4	18.1	22.1	24.2	26.4	29.6	32.8
1898.....	1.2	3.8	4.7	8.2	11.9	14.9	15.5	19.1	23.9	27.1	29.1	31.0
1899.....	2.8	5.3	6.7	9.6	13.2	15.6	19.1	20.3	23.7	25.5	28.3	32.3
1900.....	2.0	4.3	5.2	6.9	9.6	12.8	15.8	20.6	22.4	26.0	30.9	34.1
1901.....	2.8	4.2	6.3	8.4	9.9	12.6	13.7	18.0	21.5	24.1	28.1	31.3
Average of 40 years	2.6	4.7	6.9	8.8	11.0	13.3	16.4	19.7	22.5	25.5	28.3	31.1
1902.....	1.9	4.4	6.0	8.6	12.1	14.3	17.9	20.3	24.0	25.3	28.6	31.0
1903.....	4.3	6.1	10.0	10.9	13.2	14.4	20.4	25.5	29.4	34.0	36.1	38.4

*Summary of Rainfall at Bann Reservoir, Lough Island Reavy,
near Castlewellán.*

YEAR	Jan.	First 2 mos.	First 3 mos.	First 4 mos.	First 5 mos.	First 6 mos.	First 7 mos.	First 8 mos.	First 9 mos.	First 10 mos.	First 11 mos.	12 mos.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
1862.....	6.0	8.6	14.2	17.5	20.5	25.5	29.9	31.9	33.9	39.6	44.6	52.9
1863.....	4.3	5.3	10.2	11.2	13.6	17.0	17.8	23.0	25.0	36.8	40.3	42.8
1864.....	5.2	6.4	13.1	15.1	16.8	19.5	21.1	22.9	26.0	30.5	40.8	44.7
1865.....	5.0	8.7	10.6	11.1	15.7	16.5	19.4	23.9	24.2	36.2	45.5	52.3
1866.....	7.7	11.7	20.1	24.0	24.9	29.9	31.3	35.3	41.7	46.5	50.4	54.6
1867.....	4.4	6.4	13.5	18.5	26.7	27.2	33.7	35.4	38.4	45.0	45.5	47.2
1868.....	3.8	5.5	8.6	9.9	12.3	12.5	12.9	19.9	22.4	24.3	32.2	43.3
1869.....	7.1	9.7	11.6	12.8	14.9	15.0	16.2	17.8	22.5	23.3	25.2	28.9
1870.....	5.9	14.3	15.2	16.0	19.4	19.9	20.8	22.4	25.2	39.9	42.4	48.1
1871.....	4.5	11.0	13.1	18.4	18.9	20.7	24.0	26.4	32.1	37.1	40.4	43.0
Average of 10 years	5.4	8.8	13.0	15.4	18.4	20.4	22.7	25.9	29.1	35.9	40.7	45.8
1872.....	7.2	16.2	19.2	22.8	24.3	27.6	30.7	34.0	38.0	43.4	50.2	61.2
1873.....	6.2	7.0	11.4	11.7	12.9	14.8	19.0	22.9	24.8	26.4	30.4	31.2
1874.....	2.1	6.1	6.9	9.9	10.2	10.9	12.9	16.8	21.6	27.9	31.5	35.5
1875.....	7.1	8.3	9.7	10.0	12.2	16.0	19.2	22.0	27.6	33.9	39.0	41.4
1876.....	2.3	6.0	8.1	10.1	10.3	12.3	13.1	16.5	22.3	31.2	39.9	52.9
1877.....	11.9	13.6	17.2	22.8	26.6	29.9	32.6	36.8	38.7	42.5	48.5	54.1
1878.....	2.2	6.4	6.8	8.6	15.5	18.4	18.8	21.4	26.2	30.3	31.2	31.9
1879.....	2.7	5.7	7.9	11.4	13.0	19.1	25.0	29.7	36.9	37.8	38.7	39.8
1880.....	1.1	5.5	7.2	13.0	13.1	16.1	22.3	22.6	27.1	29.4	32.9	33.8
1881.....	0.4	5.0	9.7	10.4	11.2	15.2	16.0	19.6	20.8	23.6	29.6	34.4
Average of 20 years	4.8	8.4	11.7	14.3	16.6	19.2	21.8	25.1	28.8	34.3	39.0	43.7
1882.....	1.6	7.5	10.0	16.1	18.5	21.2	25.9	30.4	34.8	41.7	48.3	53.1
1883.....	5.8	15.0	16.9	18.7	20.0	20.7	23.2	26.7	35.7	39.7	42.4	43.3
1884.....	5.7	13.6	21.0	23.1	25.6	25.9	28.9	30.2	32.1	33.8	38.1	40.6
1885.....	3.8	9.8	12.2	18.8	20.8	21.2	22.0	24.1	31.5	35.5	40.5	40.9
1886.....	2.2	4.4	7.8	9.6	13.3	16.6	19.9	21.9	24.1	33.2	37.0	42.3
1887.....	3.9	4.9	5.6	6.9	7.9	8.7	11.8	14.8	17.9	20.4	24.4	26.5
1888.....	1.6	1.6	7.2	10.0	14.1	19.3	25.9	27.4	27.9	29.1	37.5	43.3
1889.....	6.3	6.7	9.9	16.0	22.3	22.3	25.8	30.4	32.9	40.5	41.4	44.7
1890.....	4.8	7.5	13.2	15.2	17.7	20.5	22.5	26.7	31.1	32.4	43.3	46.3
1891.....	1.6	1.9	3.7	10.0	13.5	20.0	22.9	31.3	33.8	44.2	52.9	59.0
Average of 30 years	4.5	8.0	11.4	14.3	16.9	19.3	22.2	25.5	29.2	34.5	39.5	43.8
1892.....	4.1	6.0	6.5	7.4	11.6	15.2	17.0	23.2	27.1	34.0	40.0	41.3
1893.....	5.7	9.3	9.9	11.1	12.1	13.9	16.8	21.4	22.9	24.4	27.0	33.1
1894.....	5.9	8.8	9.4	13.9	17.9	21.7	25.6	27.8	28.1	39.0	44.7	48.6
1895.....	3.6	4.1	9.0	12.7	12.8	14.0	19.2	26.1	26.4	29.9	38.0	42.1
1896.....	1.8	4.6	8.3	9.3	9.7	13.1	19.8	21.7	28.5	30.9	33.1	40.3
1897.....	3.1	5.8	12.7	16.1	17.7	23.8	25.5	32.4	34.8	38.9	42.7	48.6
1898.....	1.9	4.7	5.7	12.4	17.0	21.3	21.8	25.5	29.5	34.6	39.1	43.0
1899.....	5.5	11.2	13.2	17.8	22.4	25.6	29.2	31.0	34.6	36.0	41.5	49.9
1900.....	3.3	8.7	9.7	12.3	17.2	20.6	25.0	30.1	31.3	37.0	44.2	49.1
1901.....	6.9	10.3	13.6	17.9	20.1	23.8	25.5	28.8	35.8	40.4	45.0	49.6
Average of 40 years	4.4	7.8	11.0	14.0	16.7	19.3	22.3	25.8	29.4	34.5	39.5	44.0
1902.....	3.3	8.9	11.1	16.2	23.2	27.3	32.5	37.0	41.8	44.5	54.3	59.2
1903.....	7.4	12.4	20.0	21.8	24.6	25.8	31.5	37.4	42.7	51.2	53.4	60.1

RAINFALL AND TEMPERATURE, JANUARY, 1904.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables in <i>British Rainfall</i> to which each station belongs.]	RAINFALL.				Days on which ·01 or more fell.	TEMPERATURE.						No. of Nights below 32°.	
		Total Fall.	Diff. from average, 1890-9.	Greatest in 24 hours.			Max.		Min.					
				Depth.	Date.		Deg.	Date.	Deg.	Date.	Shade	Grass		
		inches.	inches.	in.										
I.	London (Camden Square) ...	2·33	+ ·62	·35	30	22	55·3	13	25·1	1	13	22		
II.	Tenterden.....	3·71	+ 1·72	·48	27, 30	23	51·4	13	23·0	1	10	22		
	Hartley Wintney	3·21	+ 1·26	·63	30	22	54·0	13	20·0	1	13	22		
III.	Hitchin	2·19	+ ·48	·46	30	20	54·0	13	23·0	22	16	...		
	Winslow (Addington)	2·73	+ 1·02	·51	30	21	52·0	13	20·0	23	20	24		
IV.	Bury St. Edmunds (Westley) ...	1·72	+ 0·3	·28	30	17	54·0	13	25·0	17	...	...
	Brundall	1·51	— ·16	·26	31	20	55·0	13	23·2	23	11	21		
V.	Alderbury	4·89	+ 2·38	·72	27	23	47·0	28, 29	24·0	19	15	...		
	Winterborne Steepleton	6·43	...	·72	30	23	50·9	13	23·0	23	11	18		
	Torquay (Cary Green)	5·56	...	·92	29	21	54·1	19	31·5	1	1	13		
	Polapit Tamar [Launceston]	6·19	+ 2·86	·72	13	25	53·6	13	22·1	23	7	12		
VI.	Stroud (Upfield)	3·77	+ 1·56	·43	31	23	52·0	18	27·0	22	14	...		
	Church Stretton (Woolstaston)	3·13	+ ·67	·45	13	25	50·5	12, 18	24·0	1, 2	15	...		
	Bromsgrove (Stoke Newington)	2·27	+ ·58	·33	27	17	49·0	27	21·0	22	20	...		
VII.	Boston	1·57	+ ·19	·35	31	13	50·0	13	27·0	6	...	...
	Bawtry (Hesley Hall)	1·68	+ ·27	·38	31	19	54·0	13	24·0	22	16	...		
	Derby (Midland Railway)	2·05	+ ·45	·30	31	20	52·0	13, 27	25·0	23	13	...		
VIII.	Bolton (The Park)	3·67	+ ·62	·79	12	25	50·5	27	26·8	1, 2	9	21		
IX.	Wetherby (Ribston Hall) ...	2·46	+ ·80	·41	8	19	...	...	...	...	...	...
	Arncliffe Vicarage	7·62	+ 1·24	1·06	7	22	...	...	...	...	...	...
	Hull (Pearson Park)	1·43	— ·24	·30	12	15	53·0	13	27·0	22	10	26		
X.	Newcastle (Town Moor) ...	1·76	— ·05	·48	12	17	...	...	...	...	...	...
	Borrowdale (Seathwaite) ...	15·90	+ 1·05	2·84	9	18	...	...	...	...	...	...
XI.	Cardiff (Ely)	5·37	+ 1·81	·95	7	23	...	...	...	...	...	...
	Haverfordwest (High St.) ..	5·71	+ 1·09	·95	6	22	50·9	13	26·5	1	4	14		
	Aberystwith (Gogerddan) ..	4·79	+ ·54	·81	12	21	53·0	26	22·0	5, 23	12	...		
	Llandudno	3·48	+ ·95	·49	8	22	54·0	27	25·5	1	3	...		
XII.	Cargen [Dumfries]	4·02	— ·56	·69	9	19	51·0	19	27·0	2	12	...		
XIII.	Edinburgh (Royal Observatory) ..	2·87	...	·45	7, 31	15	50·3	27	28·5	2	7	15		
XIV.	Colmonell	4·90	+ ·06	·60	30	18	50·0	19, 27	31·0	31	...	...
XV.	Tighnabruach	7·34	...	1·08	10	22	52·0	8	26·0	15	11	13		
	Mull (Quinish)	7·13	+ ·90	·81	6	24	...	...	...	...	...	...
XVI.	Loch Leven Sluices	2·71	— ·59	·75	11	16	...	...	...	...	...	...
	Dundee (Eastern Necropolis) ..	1·85	— ·68	·40	31	17	51·4	18	29·4	16	8	...		
XVII.	Braemar	3·65	+ ·87	·56	29	22	49·2	18	25·0	31	16	29		
	Aberdeen (Cranford)	2·32	— ·40	·39	31	24	51·0	18	26·0	11, 23	14	...		
	Cawdor (Budgate)	1·61	— ·61	·48	13	15	...	...	...	...	...	...
XVIII.	Strathconan (Dalbreac)	6·56	+ 2·02	1·08	29	...	...	...	...	...	...	...
	Glencarron Lodge	10·67	+ ·28	1·23	6	25	51·0	27	25·7	5	11	...		
XIX.	Dunrobin Castle	1·18	— 1·44	·20	28	13	52·0	18, 22	26·5	25	15	...		
	Castletown	1·86	...	·47	14	22	48·0	18a	26·0	25	15	...		
XX.	Killarney	8·53	+ 2·88	1·22	3	24	53·0	13	33·0	26	0	...		
	Waterford (Brook Lodge) ...	4·97	+ 1·45	·98	2	21	51·5	7	28·0	22	7	...		
	Broadford (Hurdlestown) ...	3·90	+ ·77	·46	9	26	46·0	7	26·0	31	5	...		
XXI.	Carlow (Browne's Hill)	4·01	+ ·94	·67	4	23	...	...	...	...	...	...
	Dublin (Fitz William Square) ..	2·54	+ ·40	·55	3	19	54·8	27	31·5	16	3	11		
XXII.	Ballinasloe	4·03	+ ·59	·49	13	27	58·5	26	27·0	1, 31	14	...		
	Clifden (Kylemore House) ..	9·95	+ 1·98	1·58	6	23	...	...	...	...	...	...
XXIII.	Seaforde	3·05	— ·36	·58	3	18	50·0	18, 19	...	...	...	...
	Londonderry (Creggan Res.) ..	5·22	+ 1·56	·69	9	25	...	...	...	...	...	...
	Omagh (Edenfel)	4·64	+ 1·13	·60	12	23	50·0	26	28·0	30	12	21		

+ Shows that the fall was above the average; — that it was below it. a and 22nd, 23rd.

SUPPLEMENTARY RAINFALL, JANUARY, 1904.

Div.	STATION.	Rain. inches	Div.	STATION.	Rain. inches
II.	Dorking, Abinger Hall	5·20	XI.	New Radnor, Ednol	5·07
,,	Sheppey, Leysdown	2·65	,,	Rhayader, Nantgwillt ...	8·57
,,	Hailsham	5·45	,,	Lake Vyrnwy	6·04
,,	Crowborough	5·96	,,	Ruthin, Plâs Drâw.....	3·18
,,	Ryde, Beldornie Tower.....	...	,,	Criccieth, Talarvor.....	3·53
,,	Emsworth, Redlands.....	4·10	,,	Anglesey, Lligwy	4·65
,,	Alton, Ashdell	6·10	,,	Douglas, Woodville	3·10
,,	Newbury, Welford Park ...	4·55	XII.	Stoneykirk, Ardwell House	2·97
III.	Harrow Weald	2·85	,,	Dalry, Old Garroch	6·43
,,	Oxford, Magdalen College..	2·84	,,	Langholm, Drove Road.....	5·13
,,	Banbury, Bloxham.....	3·17	,,	Moniaive, Maxwellton House	4·66
,,	Pitsford, Sedgebrook.....	2·41	,,	Lilliesleaf, Riddell	2·96
,,	Huntingdon, Brampton.....	1·81	XIII.	N. Esk Reservoir [Penicuik]	3·25
,,	Wisbech, Bank House	1·47	XIV.	Maybole, Knockdon Farm..	3·29
IV.	Southend	2·22	,,	Glasgow, Queen's Park .....	...
,,	Colchester, Lexden.....	2·14	XV.	Inveraray, Newtown	6·69
,,	Saffron Waldon, Newport...	2·13	,,	Ballachulish, Ardsheal	11·47
,,	Rendlesham Hall	1·86	,,	Campbeltown, Redknowe...	4·85
,,	Swaffham	1·80	,,	Islay, Eallabus	5·82
,,	Blakeney	1·27	XVI.	Dollar	2·93
V.	Bishop's Cannings	3·54	,,	Balquhider, Stronvar	8·40
,,	Ashburton, Druid House ...	9·17	,,	Coupar Angus Station	2·07
,,	Okehampton, Oaklands.....	7·27	,,	Blair Atholl.....	3·39
,,	Hartland Abbey	5·16	,,	Montrose, Sunnyside.....	2·19
,,	Lynmouth, Rock House ...	6·02	XVII.	Alford, Lynturk Manse ...	1·28
,,	Probus, Lamellyn	5·93	,,	Keith, H.R.S.	1·27
,,	Wellington, The Avenue ...	4·00	XVIII.	Fearn, Lower Pitkerrie.....	...
,,	North Cadbury Rectory ..	3·40	,,	S. Uist, Askernish	4·60
VI.	Clifton, Pembroke Road ...	3·58	,,	Invergarry	8·55
,,	Moreton-in-Marsh, Longboro'	3·55	,,	Aviemore, Alvie Manse.....	2·10
,,	Ross, The Graig	3·10	,,	Loch Ness, Drumnadrochit.	3·61
,,	Shifnal, Hatton Grange.....	2·80	XIX.	Invershin	1·64
,,	Wem Rectory	2·52	,,	Altnaharra	3·21
,,	Cheadle, The Heath House.	2·56	,,	Bettyhill ..	2·60
,,	Coventry, Kingswood	2·71	,,	Watten, H.R.S.	1·34
VII.	Market Overton	2·75	XX.	Cork, Wellesley Terrace ...	5·30
,,	Market Rasen	1·67	,,	Darrynane Abbey	7·08
,,	Worksop, Hodsock Priory..	1·96	,,	Glenam [Clonmell]	5·54
VIII.	Neston, Hinderton.....	2·15	,,	Ballingarry, Hazelfort	3·61
,,	Southport, Hesketh Park...	2·86	,,	Milton Malbay	5·69
,,	Chatburn, Middlewood	3·75	XXI.	Gorey, Courtown House ...	3·82
,,	Duddon Valley, Seathwaite Vic.	10·65	,,	Moynalty, Westland	3·95
IX.	Langsett Moor, Up. Midhope	5·14	,,	Athlone, Twyford	3·37
,,	Baldersby	2·52	,,	Mullingar, Belvedere.....	3·44
,,	Scalby, Silverdale	2·54	XXII.	Woodlawn	4·23
,,	Ingleby Greenhow Vicarage	2·69	,,	Westport, Murrisk Abbey..	7·42
,,	Middleton, Mickleton	2·56	,,	Crossmolina, Enniscoe	6·53
X.	Beltingham	2·54	,,	Collooney, Markree Obsy...	4·63
,,	Bamburgh.....	1·79	XXIII.	Enniskillen, Portora	3·56
,,	Keswick, The Bank	7·14	,,	Warrenpoint	3·55
,,	Melmerby Rectory	3·70	,,	Banbridge, Milltown	2·80
XI.	Llanfrechfa Grange.....	6·19	,,	Belfast, Springfield	3·45
,,	Treherbert, Tyn-y-waun ...	13·49	,,	Bushmills, Dundarave	4·12
,,	Llandovery, Tonn	5·47	,,	Stewartstown	3·53
,,	Castle Malgwyn	6·48	,,	Killybegs	5·32
,,	Llandefaelog-fach	5·27	,,	Horn Head	5·22

METEOROLOGICAL NOTES ON JANUARY, 1904.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Temp. for Temperature; 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.

LONDON, CAMDEN SQUARE.—Very little relief was experienced from the gloomy and ungenial conditions which prevailed in December, and dark, damp weather continued almost throughout, with temperature nearly always above the average. Measurable R fell on 26 days and the total duration was 79·5 hours, whilst the duration of sunshine reached only 20·5 hours. Mean temp. $39^{\circ}5$, or $1^{\circ}4$ above the average.

TENTERDEN.—The first half was warm and showery, and the end very wet, but it was colder from 15th to 26th, with alternate frost and thaw. TS and violent gale from 1.35 to 2.35 a.m. on 14th. Duration of sunshine 38 hours.

SHEPPEY, LEYSDOWN.—A mild, rainy month, with much wind from 7th to 14th. Sharp TS on the early morning of 13th. The temp. was below 32° all day only on 1st and 24th.

CROWBOROUGH.—A wet, gloomy month, with R considerably in excess of the average and the greatest in January since 1877. Frost occurred on 11 days. T and L on 31st and S and H. Mean temp. $37^{\circ}4$.

HARTLEY WINTNEY.—A black January. The weather was varied, cloud and gloom prevailing. Slight frost in the first and third weeks. Distant TS on 13th and L on 13th, 14th and 15th. Ozone on 18 days with a mean of 4·4.

WINSLOW, ADDINGTON.—A very disheartening month for all employed on the land, the ground being in a complete state of saturation.

PITSFORD, SEDGEBROOK.—A cold, wet, dull and wretched month. R 75 in. above the average of 10 years. Mean temp. $37^{\circ}6$.

NORWICH, BRUNDALL.—Dull and damp, with mean temp. $1^{\circ}0$ above the average. The seventh mild January in succession.

WINTERBORNE STEEPLETON.—R nearly double the average of 11 years, and mean temp. nearly $1^{\circ}0$ above the average.

TORQUAY, CARY GREEN.—R 2·31 in. above the average. Mean temp. $44^{\circ}1$, or $1^{\circ}3$ above the average. Duration of sunshine 53·4 hours, or 8·5 hours below the average. Mean amount of ozone 4·6; max. 8·0 on 15th and 27th, min. 1·0.

ASHBURTON, DRUID HOUSE.—Heavy R at times, and cold with H and S in the middle of the month, preceded by T and L on 13th.

NORTH CADBURY RECTORY.—No S and little frost. The pond was higher than ever seen before; the ground saturated and all farm work stopped.

CLIFTON, PEMBROKE ROAD.—Wet and mild, except a week of dry weather with frost and high bar. from 18th to 25th. T, L and H at 8·45 p.m. on 13th.

ROSS, THE GRAIG.—The temp. was above the average both by day and night, and the number and severity of frosts were less than usual. The R was somewhat more than the average and the number of rainy days much more. Gloomy and cloudy, and the meadows almost always saturated with water.

WORKSOP, HODSOCK PRIORY.—Dull and mild, with no S or sharp frost.

BOLTON, THE PARK.—Dull, with 22 days absolutely without sunshine, whilst the mean relative humidity, 93, was the highest on record. Mean temp. $38^{\circ}6$, or $0^{\circ}6$ above the average. Duration of sunshine 11·5 hours, or 9·5 hours below the average. Slight S occurred on 3 days.

SOUTHPORT, HESKETH PARK.—Humid and rather mild, with low bar. and a deficiency of sunshine, the total duration being 10 hours below the average and the mean temp. $1^{\circ}2$ above the average. The total R was only 17 in. above the average. Gales on 7 days. Fogs on 10 days. Ice on lake on 7 days.

SEATHWAITE VICARAGE.—Uniformly mild and almost continuously wet with but one slight fall of S on 15th.

HULL, PEARSON PARK.—Extremely dull and sunless, with frequent fog or mist, and periods of cold with H on 10th and sleet on 2nd. Gale on 14th.

BAMBURGH.—As a whole very mild with light and moderate winds. Slight frost, no S, and little fog. Not at all seasonable.

WALES AND THE ISLANDS.

LLANFRECHFA GRANGE.—Mild, with very little frost and much fog and mist.

LLANDOVERY.—An unusually large number of wet days and frequency of stormy weather. Mean shade temp. $39^{\circ}\cdot 8$. Prevailing wind S.W.

HAVEFORDWEST.—Cold, dry and cloudy, with S.E. wind to 3rd, after which a cold, wet period set in lasting more or less till the 20th. Finer and drier to 26th, and from that date to the end alternate frosty nights and rainy days. Stormy from 12th to 15th. Duration of bright sunshine $31\cdot 6$ hours.

ABERYSTWITH, GOGERDDAN.—Very mild, with little frost, a great deal of R and no S. Great storm on the evening of 13th, with wind chiefly N.W. and S.W.

DOUGLAS, WOODVILLE.—R below, and temp. generally above, the average, and unusual number of fine and even sunny days, but much stormy weather and some three violent gales. Slight S fell on 2 days, H on 4, and there was much L on 12th and 13th. Many spring flowers were already in bloom.

SCOTLAND.

MONIAIVE, MAXWELTON HOUSE.—Wet and cold but not severe, except from 16th to 25th, when it was dry. A little S on 25th and 31st, but no heavy fall.

LILLIESLEAF, RIDDELL.—Wind high and continually W. or S.W. The temp. kept round freezing point. No S.

INVERARAY, NEWTOWN.—Mild, unsettled and rainy.

BALLACHULISH, ARDSHEAL.—Mild and wet. R $4\cdot 46$ in. above the average.

MULL, QUINISH.—Sharp frost for the first few days. Thereafter mild and very wet, with short and sudden gales from S. to S.W.

COUPAR ANGUS.—Wet days above, but R slightly below, the average. Mean temp., $37^{\circ}\cdot 1$, was $1^{\circ}\cdot 7$ above the average.

ABERDEEN, CRANFORD.—Wet with overcast sky and few bright days, but very little S. Light wind from S., S.W. and W.

LYNTURK MANSE.—The last fortnight was specially fine for the season. Very little S for the month.

DRUMNADROCHIT.—R 15 in. below, but rainy days 1 above, the average. Distant T on 10th whilst S was falling.

GOLSPIE, DUNROBIN CASTLE.—Fairly open and suitable for outdoor operations, though changeable.

ALTNAHARRA.—Very fair and open, and though generally very cold, there were some exceptionally mild days.

CASTLETOWN.—Fresh open weather. S.E. to S.W. winds in the first part, with frosty nights. On 14th the bar. fell to $28\cdot 55$ in., and on 15th and 16th there was a strong N.W. gale. In the latter part N.W., W. and S. winds.

IRELAND.

CORK, WELLESLEY TERRACE.—R $1\cdot 30$ in. over the average. Anti-cyclone on 27th, accompanied by high bar., calm and dry atmosphere and fog. Great storm from S.W. on 29th. Sleet and some S on 31st. T and L on 4th and 27th.

MILTOWN MALBAY.—Generally cold and stormy, with much T, L, and H, except one mild week from 16th to 23rd, with sea-fog and mist. Although it was boisterous and squally, there was no great storm.

DUBLIN, FITZWILLIAM SQUARE.—An open, dull, damp month, with frequent R. The mean temp. was $42^{\circ}\cdot 6$, or $1^{\circ}\cdot 0$ above the average of 30 years.

COLLOONEY, MARKREE OBSERVATORY.—Although R fell on 27 days, the total was not above the average. Very mild throughout. Wind generally from S.E. to S.W. and W. with a few gales. H on 4 days, T on 1, L on 4, and fog on 2.

BELFAST, SPRINGFIELD.—An average January, and on the whole satisfactory, frost being rather prominent.

OMAGH, EDENFEL.—The first fortnight was very wet, raw and unsettled. A coldish and drier spell followed, with a return to wet and humid weather at the end. The temp. was above the average, and it could hardly be said that the ground was once covered with S, so short was its duration.

Climatological Table for the British Empire, August, 1903.

STATIONS. (Those in italics are South of the Equator.)	Absolute.				Average.				Absolute.		Total Rain.		Aver.
	Maximum.		Minimum.		Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days.	
	Temp.	Date.	Temp.	Date.									
	°		°		°	°	°	0-100	°	°	inches		
London, Camden Square	80·6	8	45·4	11	70·1	52·4	52·2	75	125·3	41·4	4·24	18	5·4
Malta.....	96·3	14	63·5	17 ^a	87·5	68·4	66·5	71	145·3	58·2	·00	0	0·6
Lagos, W. Africa	84·1	27	70·6	13	81·2	73·1	70·7	78	144·0	68·0	·69	13	...
Cape Town	77·2	21	39·6	20	62·2	46·2	46·2	74	...	...	3·22	14	4·4
Durban, Natal	84·2	7	49·2	19	76·6	56·7	...	...	133·6	...	1·85	7	3·3
Mauritius.....	78·7	1	56·3	22	75·9	62·3	58·7	71	141·1	49·0	1·77	19	6·5
Calcutta.....	90·0	5	74·8	8	87·9	78·4	77·8	86	156·2	73·6	10·17	17	8·7
Bombay.....	87·1	17	74·1	21	84·4	77·5	76·1	86	140·7	73·2	18·23	26	8·3
Madras	100·5	4	72·9	17	92·9	77·2	74·0	77	142·8	72·0	7·88	14	6·3
Kodaikanal	65·4	8, 10	50·4	10	62·3	52·4	51·8	86	144·6	42·1	12·94	19	7·9
Colombo, Ceylon.....	90·5	21	71·6	11	87·0	77·1	72·3	78	146·3	70·0	7·54	18	6·7
Hongkong.....	91·2	1	73·1	17	85·8	77·1	75·8	85	142·7	...	14·97	21	6·9
Melbourne.....	67·8	31	30·3	29	58·2	41·1	40·7	72	127·8	23·5	·48	8	5·4
Adelaide	70·0	9	37·7	6	53·8	45·4	43·5	71	126·7	29·6	2·34	14	5·3
Coolgardie	76·2	22	34·4	3	65·0	42·6	40·7	61	144·2	27·6	·65	4	3·6
Sydney	70·0	11	42·9	13	60·3	47·4	42·8	75	98·0	31·9	5·16	16	4·7
Wellington	62·7	12	31·0	2	51·6	40·7	39·6	79	108·0	21·0	9·88	23	6·7
Auckland	61·0	10	38·5	4	56·3	46·4	42·3	72	120·0	35·5	3·37	20	6·1
Jamaica, Negril Point..	92·1	10	69·7	29	87·0	73·6	71·1	81	...	...	11·25	21	...
Trinidad .....	...	...	...	...	...	...	...	...	...	...	...	...	...
Grenada	88·2	4	72·0	28	84·1	74·7	71·9	78	147·0	...	14·59	27	4·3
Toronto	83·0	6	46·9	1	72·1	55·4	55·9	77	101·2	42·9	3·65	11	6·0
St. John's, N.B.....	77·7	22	38·0	29	70·9	47·4	48·8	59	...	...	3·18	12	4·9
Winnipeg	83·0	31	37·0	8	72·5	49·8	2·00	15	5·6
Victoria, B.C.	73·7	17	43·2	31	66·4	52·7	1·06	8	5·6
Dawson

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MALTA.—Mean temp. of air 1°·2 below, dew point 0°·4 and R ·08 in. below averages. Mean hourly velocity of wind 6·7 miles, or 0·6 below average. Mean temp. of sea 79°·4.

LAGOS, W. AFRICA.—Mean hourly velocity of wind 9 miles.

MAURITIUS.—Mean temp. of air 0°·4 above, dew point 0°·8 above and R ·58 in., below averages. Mean hourly velocity of wind 12·5 miles, or 0·2 below average; extremes, 30·8 on 18th and 1·7 on 21st; prevailing direction E.S.E.

MADRAS.—TSS on 8 days. Bright sunshine 136·1 hours.

KODAIKANAL.—Mean temp. of air 56°·0. Mean velocity of wind 323 miles per day. Bright sunshine 95·5 hours.

COLOMBO, CEYLON.—Mean temp. of air 81°·2 or 0°·5 above, of dew point 0°·9 below and R 3·88 in. above averages. Mean hourly velocity of wind 8·6 miles, prevailing direction S.W. TSS on 4 days.

HONGKONG.—Mean temp. of air 80°·9. Sunshine 158 hours. Mean hourly velocity of wind 8·7 miles.

SYDNEY.—Mean temp. of air 0°·9 below, humidity 1·4, and R 1·90 in. above, averages.

WELLINGTON.—Mean temp. of air 2°·3 below, and R 4·68 in. above, averages.

AUCKLAND.—Mean temp. of air 1°·0, and R nearly one inch below averages.