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ADMIRAL FITZROY.

THE GENESIS OF METEOROLOGY.

[THE following long and anonymous article, which appeared under the above headings in the *Dundee Advertiser* of October 31st, contains so many items of general interest that we have decided upon reprinting it, without, however, assuming responsibility for all the statements. Occasionally the writer has been misled, and where we have noticed this we have put a correction as a foot note. But we do not presume to imply that we have verified every statement, quite the contrary, and in the interest of truth we hope that any of our readers who notice other errors will mention them.—ED.

The science of modern meteorology may be said to have been founded by Admiral Robert FitzRoy (1). He was the son of General Lord Charles FitzRoy, second son of the third Duke of Grafton, and was born in June 1805. He entered the Navy in 1819, and became Lieutenant on board the "Adventure" in 1824. Through the death of Commander Stokes in 1828 he was promoted to the command of the "Beagle," and during the three succeeding years he completed the survey of the coasts of Patagonia and Terra del Fuego. He also commanded the "Beagle" during her famous voyage round the world in 1831-36, with Charles Darwin as naturalist; and it was during this voyage that Darwin conceived his idea of the origin of species. On FitzRoy's return he, in conjunction with Captain King, published in 1839 his *Narrative of the Surveying Voyages of the* "Adventure" *and the* "Beagle," in which he displayed considerable ability as an observer of Nature, though Darwin's *Journal of a Voyage round the World* necessarily became the classic record of this wonderful expedition. In 1841 FitzRoy was elected M.P. for Durham, and held that seat till 1843, when he was appointed Governor of New Zealand. For two years he kept this important

(1) Too sweeping an assertion.

position, but his endeavours to conserve the rights of the Maoris against the European settlers made him very unpopular, and in 1845 he resigned the Governorship and returned to England, having been practically recalled by the Government out of deference to the clamour of the Colonists. In 1846 he published his *Remarks on New Zealand*, in which he indicated the best policy for developing that important Colony. He resigned active service in 1850, and shortly afterwards was advanced to the rank of Vice-Admiral. His principal work was accomplished after 1854. In that year he was appointed meteorological statist to the Board of Trade, and in that office he carried out systematical investigations in meteorology, and devised the system of storm-signals which is still worked with great advantage to navigators. At first his storm-code was ridiculed as the revival of an effete fad among weather-prophets, but it was soon found that prophecy as to weather which was founded on accurate data such as his meteorological reports afforded was not to be despised. The system was speedily adopted, not only in this country but also on the Continent. The FitzRoy barometer, by which approaching storms may be foretold, is regarded as one of the triumphs of the nineteenth century ([2]). Admiral FitzRoy prosecuted his barometric studies with great energy. In 1863 he published his *Weather Book*, a work which contained the results of observation spread over many years. The labour entailed in the production of this work was so great that his mind gave way, and on 30th April, 1865, he committed suicide during a fit of mental depression ([3]). The storm-glass, or FitzRoy barometer, devised by him, will always be associated with his name. But though it was unquestionably invented by him without the least suspicion that it had been anticipated, it is not the less a fact that a similar weather-glass with camphor was constructed in London a century before FitzRoy's was designed ([4]). In 1649 Périer, the brother-in-law of Blaise Pascal (1623-1662), while engaged making experiments with Pascal to determine the weight of the atmosphere, enunciated the theory of "meteorological correspondences" by which storms could be foretold, which was identical with that of FitzRoy.

Ancient Weather Prophets.—Observations for the purpose of forecasting the weather are probably as old as the history of man, and traditional maxims on this subject exist in all savage nations. The

[2] No. The barometers called "FitzRoy barometers" were, we think, only brought out after his death; certainly he would have been horrified at the tiny tubes with which some of them are furnished.

[3] No. It was not the compilation of the *Weather Book*, but general worry, and the absence of fresh air and exercise which produced the catastrophe.

[4] The "storm-glass" and the "FitzRoy barometer" are two totally different things, and FitzRoy devised neither. He knew of the "storm-glass" and bestowed on it far too much time, but he never claimed to have devised it; on the contrary, he says in the *Weather Book*, "Considerably more than a century ago, what were called 'storm-glasses' were made in this country. Who was the inventor is now very uncertain; but they were sold *on Old London Bridge* at the sign of the *Looking Glass*."

Egyptians and the Hindus were acquainted with the periodicity of wind-storms at a very remote time, and allusions to what we now call the "trade-winds" are to be found in ancient Sanscrit writings and in Egyptian hieroglyphs. From Egypt the knowledge of meteorology was carried to Greece, and Democritus (460 B.C.—360 B.C.) was well acquainted with the theory of the winds held by the Eastern nations. Archimedes (287 B.C.—212 B.C.) was renowned as a weather-prophet able to foretell storms by the appearance of the sun, and by studying the phases of the moon. The study of atmospheric currents was so general at the beginning of the Christian era that Pliny (23 A.D.—79 A.D.) refers to the works of more than twenty authors devoted to this subject. The surest proof, however, of the skill of early agriculturists in forecasting the weather is afforded by Virgil (70 B.C.—19 B.C.). His *Georgics* is full of weather-wisdom, strikingly similar to that of the time before FitzRoy had made meteorology a definite science, and had systematised observations over a wide area. The following passage is only one of many in the *Georgics* bearing on this subject :—

> If to the swift-speeding Sun, and moons
> That follow in their cycle, thou shalt look,
> Ne'er thee to-morrow's hour shall lead astray,
> Nor by the crafts of cloudless night shalt thou
> Be tricked. What time the Moon first gathers in
> Returning fires, if she shall have embraced
> The sable ether with a darkling horn,
> Immense for tillers, and the deep, will rain
> Be brewing. But if she a maiden red
> Have o'er her visage poured, there will be wind.
> But if at her fourth rise—for that will prove
> The most unerring counsellor—undimmed,
> Nor with blunt horns, through heaven shall she career,
> Both all that day, and those which shall arise
> Therefrom to the completion of the month
> From rain and tempests will be free.

The last portion of the quotation is very remarkable. It is a distinct anticipation of the famous meteorological law discovered and announced by Marshal Bugeaud (1784—1849) in November 1841, and afterwards confirmed by M. de Conninx, to the effect that if the moon be clear and with upturned horns on the fourth day, the rest of the month will be free from wind and rain ([5]). According to Dr. J. W. Draper (1811—1882), author of that remarkable work, *The Intellectual Development of Europe*, the Arabs in the eleventh century were deep students of atmospheric phenomena. Alhazen (died 1038) knew that the pressure of the atmosphere lessened according to the height of the observer above the sea level; and estimated the difference of weight of a body in a condensed and in a rarefied atmosphere. He understood the Greek theory as to wind-currents, and dimly outlined the modern method of weather-forecasting by comparing the incidence of storms in different areas. The foretelling of stormy weather in

[5] But had not Virgil adopted the idea from Aratus ?—See *Met. Mag.*, vol. ii. (1867), p. 92.

connection with meteoric showers was described by Virgil, and indicated by Milton in *Paradise Lost*, centuries before it was scientifically explained by M. Coulvier-Gravier (6). From the Middle Ages the 10th of August has been regarded with special attention, as it has been noticed that meteor-showers on that day prelude a period of stormy weather. In the same way brilliant aurora-borealis displays frequently foretell storms, possibly because they show electrical disturbances in the atmosphere, which always accompany severe tornadoes. Sir Humphrey Davy's theory that the aurora is simply a manifestation of free electricity in a rarefied atmosphere is sufficient to explain the storms which usually follow exceptional displays of "the borealis race." (7) It will be seen from this outline of weather-wisdom that the prophet who forecasts storm or sunshine is not a modern innovation, though he has reduced his methods to a scientific basis.

THE BRITISH ASSOCIATION AT BRISTOL, 1898.

(*Concluded from p. 151.*)

The Classification of Polydiurnal Weather Types in relation to the Prolongation of the Daily Forecast in Western Europe.

By DOUGLAS ARCHIBALD, *M.A., F.R. Met. Soc.*

The results of modern meteorological investigation, whether official or amateur, statistical or synoptic, have shown the existence of specific types of weather embracing wide areas and intervals of time varying from several days to months, and seasons which tend to produce persistence or recurrence of the more ephemeral changes connected with the passage of the smaller, temporary, and movable cyclonic and anticyclonic systems.

These large weather types may be roughly classified as:—(1) Seasonal or x monthly, and (2) y daily.

The former appear, both in their normal and abnormal forms, most clearly in tropical countries, such as India, where the y daily changes are small and where the Summer season is always characterised by the formation of a permanent cyclonic area over Persia and North-West India, with subsidiary low pressure troughs over the Ganges basin, round which the so-called S.W. monsoon circulates with a complete reversal of pressure conditions at the opposite season.

These conditions in their normal form are evidently the result of seasonal actions due to the direct influence of the sun on the Asiatic continent and Indian Ocean, and stated thus, may be predicted to recur and form a large proportion of the seasonal forecast every year.

When, however, we descend from the general to the particular we find each year's S.W. and N.E. monsoon differ from that of every other year.

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6 But does anybody now believe in it?

7 But where is proof to be found that they "usually follow"?

Superposed on the regular normal x monthly type is what may be termed the yearly seasonal abnormal type, or z annual variation of the x monthly type, corresponding to which both the intensity and shape of the seasonal cyclone and anticyclone and the accompanying weather vary. Such type, however, once initiated at the critical commencing month of the season, is found to persist more or less all through. This is the practical basis of the seasonal or x monthly weather forecast of the Indian Service, so ably worked by Mr. Eliot, F.R.S., at Simla.

In Europe the seasonal type, though still manifest, is not large enough in comparison with the y daily changes to enter in at present as a specific factor in the forecast.

On the other hand, the restriction of the forecast to 24 or 36 hours is unnecessarily arbitrary in view of the study of y daily types foreshadowed by the late Honourable Ralph Abercromby and laboriously carried out by Professor Köppen and Professor J. Van Bebber in their recent discussion of "Die isobaren Typen des nordatlantischen Ozeans und West-Europas." [Hamburg, 1895.]

Abercromby, in his "Principles of Forecasting by means of Weather Charts," published by the Meteorological Council, classifies weather types under four heads—northerly, southerly, easterly, and westerly.

Professors Köppen and Van Bebber recognise twenty specific types of y daily weather.

A comparison of these with Abercromby's shows them to be all included in one or other of his four primary headings, of which they form specific sub-types.

The investigation further shows that :

(1) They admit of being more scientifically classified under the heads O oceanic, K continental, L littoral, P peripheral, N northerly, and S southerly. Sub-variations are denoted by suffixes, thus : O_s, O_k, O_l, O_n, &c.

(2) Certain groups occur preferably at each season, *i.e.*, the seasonal type or tendency partly controls the formation of the y daily types.

(3) The intensity and paths of travelling high and low pressure systems vary with each type and season.

(4) Their effect in raising or lowering temperature and otherwise materially altering the weather is specifically shown by comparisons at such places as Hamburg and Munich.

(5) Their average duration is found to be about four days, and this figure is remarkably constant on the average for all the twenty species.

(6) There appears to be a fairly definite tendency on the part of certain types to succeed other types or to recur, such recurrence in some cases approximating to the seasonal permanence exhibited in the tropics.

In fine, a science of weather types is growing up by which even now the weather may, with due regard to a sudden change of type, be provisionally forecasted in general terms, and particularly for agricultural purposes, for *half a week* or *more*.

The present daily forecast in England is admirable for the purpose for which it was primarily instituted, viz., storm warning.

For agricultural purposes it is too short, while its assumption of precision in the matter of rainfall for each sub-division is not always warranted by the results. The author, therefore, suggests that in view of the hopefulness of the field unlocked by Professors Köppen and Van Bebber, steps be taken to compare the past weather maps of the British office with the types they have determined, and that a supplemental forecast be presently attached to the daily forecast, giving a more general forecast of conditions likely to continue for three or four days, based on the ascertained presence of a certain type over Western Europe and as far over the Atlantic as can be determined through the aid of arriving ship's logs.

It would further be of primary importance in carrying out such extension of the forecast on the basis of the study of the position and movement of the barometric action-centres, to be able to have telegraphic communication with places situated near the normal position of the centres of such action-centres. Iceland, the Azores, West Russia, and Eastern Germany and Austria would appear to be the most important for such purposes.

The Great Assam Earthquake of June 12th, 1897, *by* R. D. OLDHAM.

The author said that this earthquake was the largest and, with a few possible exceptions, the most violent of which there was any record. The area over which the shock was sensible was not less than 1,750,000 square miles, while the focus occupied an area of 200 miles in length and 50 miles in width. If it had happened in England not a house would have been left standing between Manchester and London. Landslips on an unprecedented scale were produced in the Garo and Khasia hills and in the Himalayas north of Lower Assam. A number of lakes had been produced by changes of level due to the earth movements by which the earthquake was caused, and the mountain peaks had been moved both vertically and horizontally. Monuments of solid stone, and forest trees had been broken across by the violence of the shaking they had received. Communications of all kinds were interrupted; bridges were overthrown, displaced, and in some cases thrust bodily upwards to a height of as much as 20 ft., while the rails on the railways were twisted and bent. Earth fissures were formed over an area larger than the United Kingdom, and sand rents, from which sand and water were forced in streams to a height of 3 ft. to 5 ft. above the ground, were opened in incalculable numbers. The loss of life was

comparatively small, owing to the time of day at which the earthquake occurred—5 o'clock in the afternoon—and the damage done was reduced by the fact that there were no large cities within the area of *maximum* violence; but in extent and capacity of destruction, as distinguished from destruction actually accomplished, this earthquake surpassed any of which there was historical record, not even excepting the great earthquake of Lisbon of 1755. At the conclusion of the paper, which was copiously illustrated, he mentioned that the Government of Assam, the whole of whose offices were destroyed, were able to announce within five days that everything was in full swing again; and as to the railways, on which (for a length reaching as far as from Bristol to London and on to Dover) traffic was at first entirely suspended, in three weeks trains were running to their original timing.

REVIEW.

Congrès National d'Hygiène et de Climatologie médicale de la Belgique et du Congo. Seconde Partie. Congo (climat, constitution du sol et hygiène de l'état indépendant). Hayez, Bruxelles. 1898. Roy. 8vo. 646 pages, map, diagrams, and plates.

WE do not remember having seen Part I., but the above, Part II., is very welcome.

To those who recollect the maps of Africa issued even within the last fifty years, this bulky volume is very startling. Here is a nearly complete record of meteorological observations at sixty-five stations with names unknown, to $\frac{99}{100}$ths of the population of the world, and for the very area marked upon the maps of our youth as "Unexplored," we now have a map with all the rivers, villages, and towns duly named, and in the text, details of the climate, geology, food supplies, drainage, population, occupations, &c.

It is impossible to review such a book, it must have taken months to compile; how can a reviewer verify all the facts in a few days?

All that we can do is to indicate roughly the contents, and to record our opinion that *quâ* the portion of Africa between 4° N. and 12° S., and from the Atlantic to 30° E., it is indispensable to all who want to understand the country, whether from a physical or a commercial standpoint.

The book is based upon the replies to a series of questions sent by a committee of the *Soc. Roy. de Médicine publique de Belgique* to the principal Europeans residing in (or near) the Congo State. First come essays, meteorology by MM. Lancaster and Meuleman; geology by M. Cornet; diseases and statistics; and hygiene by MM. Bourguignon, Dreypondt, and Firket; and after these come reports upon the individual stations arranged alphabetically.

The importance of the article upon climate will be realised when it is remembered by whom it was written, and that it occupies nearly 150 pages besides numerous diagrams. All interested in Tropical climate must read it.

PUBLICATIONS OF THE ROYAL ALFRED OBSERVATORY, MAURITIUS.

IN accordance with the notice on p. 89 of the present volume, applications were received from the following institutions and persons, and their requests have been complied with as far as possible. Nearly a hundred-weight has been sent off to the undernoted, in the order of their application :—

New Hampshire State Library, Concord, U.S.A.
Roy.Meteor.Soc., London.
J. Baxendell, Esq., F.R.A.S., Observatory, Southport.
Kew Committee, Kew Observatory, Richmond, Surrey.
A. L. Rotch, Esq., Blue Hill Observatory, Mass., U.S.A.
Prof. Stupart, Meteorological Office, Toronto.
C. Stewart, Esq., Meteorological Commission, Cape Town.
A. J. Hale, Esq., Barrington Road, Crouch End, N.
Librarian, Johns Hopkins University, Baltimore, U.S.A.
Dr. L. Swift, Lowe Observatory, Echo Mountain, California.
Prof. Dr. Hellmann, Margarethenstrasse, Berlin.
Kansas University, Kansas, U.S.A.
Librarian, Linen Hall Library, Donegal Square, Belfast.
Hofrath Dr. J. Hann, Graz, Austria.
I. F. H. Carr Gregg, Esq., Birchwood, Burgess Hill, Sussex.
E. W. Ellerbeck, Esq., F.R.A.S., Observatory, Scarborough.
F. Campbell Bayard, Esq., LL.M., Pres. R.Met.Soc., Wallington.

There are still many copies for some years, and one or more for each year mentioned below. As will be seen, no consecutive sets can be supplied, but anyone interested in the subject has only to write for whatever he or she wishes, and to pay carriage if the latter exceeds a few pence.

REPORTS.

1878, 1879, 1881, 1882, 1883, 1884, 1885, 1887, 1888, 1889, 1890, 1891, 1894.

RESULTS.

1872, 1877, 1878, 1879, 1880, 1881, 1882, 1884, 1885, 1889, 1890, 1891, 1892, 1893, 1894, 1895.

I cannot undertake to store these reports indefinitely ; nearly six months' notice has been given, and I shall part with all not applied for early next year.

Copies of the Report for 1877 *and of the Results for* 1861, 1863, 1864 *and* 1865 *are much needed.*

THE METEOROLOGICAL SOCIETY OF THE MAURITIUS.

Nothing has yet been settled respecting the back issues of this Society, which are much wanted in Europe. I am quite ready to assist, but it rests with the authorities in Mauritius.

62, *Camden Square, N.W.* G. J. SYMONS.

THE DROUGHT AND THE COLOURS OF FLOWERS.

THE REV. W. WILKS made the following observations on the colouration of flowers of the present season. Similar changes were recorded in *Nature* last year by Mr. Hughes-Gibbs of Tarrant Gunville, Dorset:—"All through the exceptionally hot weather of the end of July and August, all scarlet flowers had a tinge of dull brown in them, pink had a shade of orange, yellow was very yellow, white was creamy. This was very marked—*e.g.*, in Dahlias. Thus, Fire King and Sunset, ordinarily two bright clear scarlet flowers, had a distinct dull brown tint overlying and spoiling utterly the usual scarlet, so much so, that having been away from home the first three weeks of the heat, I thought on my return that the Dahlias must have somehow got wrongly named. But now that the weather is cooler, the bright scarlet has come back, and the dull browny tint has gone, and all is as usual. The only shades of colour the heat seemed (to me) to suit, were the salmons, and they have been very fine and intense, having a sort of glow added to them."

Journal of Horticulture.

ROYAL METEOROLOGICAL SOCIETY.

THE opening Meeting of the Session was held on Wednesday evening, November 16th, at the Institution of Civil Engineers, Great George Street, Westminster, Mr. F. C. Bayard, LL.M., President, in the chair.

A Report on experiments upon the exposure of anemometers at different elevations, was presented by the Wind Force Committee. The experiments have been carried out by Mr. W. H. Dines and Capt. Wilson-Barker, on board H.M.S. "Worcester," off Greenhithe. Five pressure-tube anemometers were employed, the first being at the mizzen royal masthead; the second and third at the ends of the mizzen topsail yardarm; and the fourth and fifth on iron standards 15 feet above the bulwarks. The results show that the ship itself affected the indications of the lower anemometers, while some low hills and trees, which are a quarter of a mile away from the ship, to the south and south-west, also affected the wind velocity from those quarters. The Committee are of opinion that the general facts deducible from these observations bearing on the situation of instruments for testing wind force are: (1.) That anemometers must have a fairly clear exposure, and for a mile at least all round, there should be no hills, or anything higher than the position of the instruments. (2.) That on a ship the instrument should be 50 feet above the hull, but on land it will generally be necessary to carry the instrument somewhat higher, to be determined entirely by the local conditions. (3.) That no other form of anemometer offers such advantages as the pressure-tube, from the fact that it can be run up and secured easily

at this height above a building, and that the pipes and stays can be so slight as to offer no resistance to the wind, or cause any deflecting currents.

Capt. D. Wilson-Barker read a Paper giving the results of some observations which he had made on board ship with several patterns of hand anemometer with the view of comparing the estimated wind force with that indicated by the different instruments.

Mr. W. Marriott exhibited some lantern slides, showing the damage caused by the tornado which burst over Camberwell about 9.30 p.m. on October 29th. The damage was confined to an area of about half a square mile, and within that space, chimney-stacks were blown down, houses unroofed, trees uprooted, and windows broken.

BRITISH RAINFALL.

GREATLY to my regret, I have recently found that three observers have continued to use gauges, rusty, worn out, and quite unworthy of them.

I do not think that any reader of this Magazine would allow his instruments to become dilapidated, but one cannot tell, and there can be no harm in mentioning the fact, and in pointing out that every observer who neglects his instruments, or is careless in reading and entering the results, is not merely useless, but depreciates the value of the whole organisation.

A new and verified gauge can now be delivered to anyone in the British Isles for 16s. 6d., therefore there can be few cases where the cost of a new gauge can compel the use of a dilapidated one. I earnestly call attention to the matter before the arrival of the new year, and also to Rules I. to IV., and XVI.

G. J. S.

RAINFALL IN NICARAGUA.

THE total rainfall at Rivas, near the Pacific coast of Nicaragua, was 123·43 in. in 1897. Rivas is about four miles to the west of Lake Nicaragua, and nearly on the line of the proposed Nicaragua Canal. Previous records ranged from 30 in. to 90 in. for the year. On the Atlantic side of Nicaragua, at Greytown, the total rainfall in 1890 was 320·48 in. with 274·85 in. in the Deseado Valley, twelve miles inland.

[Schott gives the mean fall at Aspinwall (Lat. 9° 23′ N., Lon. 79° 53′ W.) for 6 years as 121·60 in.—ED.]

RESULTS OF METEOROLOGICAL OBSERVATIONS AT CAMDEN SQUARE FOR 40 YEARS, 1858–97.

NOVEMBER.

ELEMENTS.	MONTHLY MEANS OR TOTALS.									ABSOLUTE READINGS.					
				MEANS 9 A.M. AND 9 P.M.						EXTREMES AT 9 A.M. AND 9 P.M.					
						Highest Month.		Lowest Month.		Highest.		Lowest.			
	Mean, 40 years	Highest Month and Date.	Lowest Month and Date.		Mean.	Value.	Date.	Value.	Date.	Value.	Date.	Value.	Date.	Mean of all Highest	Mean of all Lowest.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Barometer (cor. & red.)	29·929	30·307	29·678	9 a.m.	29·931	30·313	1867	29·700	1872	30·741	21st, 1897	28·533	11th, 1891	30·484	29·156
		1867	'72, '77	9 p.m.	29·927	30·301	1867	29·653	1877	30·711	21st, 1897	28·760	18th, 1880	30·485	29·202
Shade Temp. Dry Bulb	42·8	48·9	36·9	9 a.m.	42·7	49·1	1881	36·9	1871	61·2	1st, 1867	23·8	23rd, 1858	54·8	31·2
		1881	1871	9 p.m.	42·9	48·8	1881	36·8	1871	59·7	7th, 1895	22·0	28th, 1890	54·3	32·3
Shade Temp. Max.	48·7	..	...	...	...	54·2	1881	43·6	1871	63·9	1st, 1894	28·6	28th, 1890	58·4	38·1
Shade Temp. Min.	37·7	...	...	...	...	43·3	'81, '88	32·8	1871	54·7	2nd, 1894	20·1	24th, 1858	49·6	27·2
Shade Temp. Wet Bulb	41·4	47·2	35·4	9 a.m.	41·3	47·2	1881	35·4	1871	60·2	1st, 1867	23·7	23rd, 1858	53·0	30·3
		1881	1871	9 p.m.	41·4	47·1	1881	35·4	1871	57·5	15th, 1895	20·9	28th, 1890	52·4	31·2
Solar Rad., black	63·6	...	...	...	...	70·5	1877	57·7	1885	98·1	1st, 1894	31·4	16th, 1887	88·0	41·9
Solar Rad., bright	52·0	...	...	...	...	57·5	1881	47·1	1878	73·8	1st, 1894	29·1	28th, 1890	64·4	39·1
Grass Minimum	33·7	...	..	...	...	39·1	1888	29·2	1896	52·7	7th, 1877	15·9	19th, 1861	46·9	22·8
Soil, 1 foot	44·4	...	...	...	...	46·8	1881	41·2	1896	52·6	1st, 1886	36·6	30th, 1879	48·7	39·8
Cloud	6·6	7·8	5·4	9 a.m.	6·7	8·7	'92, '97	4·9	1859	10	Every year	0	Various	10·0	0·5
		'92, '97	1865	9 p.m.	6·4	7·7	1875	5·2	1877	10	Every year	0	Various	10·0	0·1
Rainfall	2·30	4·65	·53	9 a.m.	1·19	2·45	1888	·21	1871	·80	29th, 1874	·00	Every year	·39	·00
		1861	1858	9 p.m.	1·11	2·91	1861	·33	1862	·98	13th, 1861	·00	Every year	·36	·00

Max. Rainfall in 24 hours, 1·42 in., 13th, 1861. Mean max. daily fall, ·58 in.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, JUNE, 1898.

STATIONS. (*Those in italics are South of the Equator.*)	Absolute. Maximum. Temp.	Absolute. Maximum. Date.	Absolute. Minimum. Temp.	Absolute. Minimum. Date.	Average. Max.	Average. Min.	Average. Dew Point.	Average. Humidity.	Absolute. Max. in Sun.	Absolute. Min. on Grass.	Total Rain. Depth.	Total Rain. Days.	Aver. Cloud.
	°		°		°	°	°	0-100	°	°	inches		
England, London	77·4	18	40·1	1	68·2	50·4	48·7	71	124·8	38·0	1·11	15	6·5
Malta	96·3	28	56·5	2	83·4	65·6	61·8	68	153·6	48·6	·00	0	1·3
Cape of Good Hope	79·2	24	34·1	18	63·9	46·6	46·6	83	...	...	3·33	9	4·3
Mauritius	76·6	8	57·3	2	74·9	63·6	59·8	74	120·9	47·9	1·11	11	4·5
Calcutta	97·3	22	71·7	1	90·9	78·3	77·3	81	160·8	69·5	9·15	13	7·6
Bombay	92·8	3	75·2	27	87·5	79·8	77·3	82	143·3	72·2	27·21	26	7·2
Ceylon, Colombo	91·0	1	74·0	15*b*	87·1	77·9	74·2	81	148·0	72·0	10·94	23	6·7
Melbourne	67·3	1	32·3	21	56·8	44·0	43·5	79	119·4	27·8	1·57	12	6·0
Adelaide	73·4	1	36·1	21	60·2	47·1	45·5	77	128·1	30·6	3·56	15	6·0
Sydney	65·8	11	41·5	28	60·2	49·1	48·0	87	110·0	32·0	6·42	18	5·1
Wellington	61·5	30	35·0	11	55·6	44·6	42·9	77	98·0	23·0	3·27	11	4·7
Auckland	68·0	23	41·5	2	59·6	47·3	44·3	71	112·0	37·0	3·98	12	4·7
Jamaica, Kingston	90·6	15*a*	70·0	3	87·8	73·1	70·3	71	...	...	3·39	5	...
Trinidad	92·0	3	69·0	*c*	88·8	70·8	71·7	78	164·0	61·0	6·46	20	...
Grenada	85·4	13	70·0	19	83·2	74·4	73·0	77	144·6	...	10·09	24	3·8
Toronto	90·0	30	45·6	23	74·6	55·9	56·9	73	109·0	...	1·95	8	5·0
New Brunswick, Fredericton	81·7	26	37·0	16	70·0	49·3	49·3	68	...	...	4·81	15	6·0
Manitoba, Winnipeg	85·4	19	32·2	2	71·7	49·0	...	...	...	...	6·10	15	6·6
British Columbia, Esquimalt	81·3	5	42·6	4	65·9	49·1	50·5	82	...	...	1·82	12	5·9

a—and 26. *b*—and 16. *c*—several days.

REMARKS.

CAMDEN SQUARE.—*In the table for April the entries should be: dew point 39°·8; humidity 74; cloud 4·7.*

MALTA.—Mean temp. 73°·4, or 1°·8 above average. Mean hourly velocity of wind 8·6 miles, or 0·1 below the average. Mean temp. of sea 70°·0. Slight earthquake about 11.5 p.m. on 2nd. J. F. DOBSON.

Mauritius.—Mean temp. of air 1°·0, of dew point 0°·8, and rainfall ·87 in. below, their respective averages. Mean hourly velocity of wind 11·2 miles, or 0·2 below the average; extremes, 30·8 on 7th and 2·4 on 2nd; prevailing direction E.S.E. T. F. CLAXTON.

CEYLON, COLOMBO.—Mean temp. of air 81°·7, or 0°·7 above, of dew point 0°·1 above, and rainfall 2·69 in. above, their respective averages. Mean hourly velocity of wind 10·1 miles; prevailing direction S.W. T8S on 11 days. H. O. BARNARD.

Adelaide.—A very seasonable month. Mean temp. 0°·1 below, and Rainfall ·79 in. above the mean for 41 years. C. TODD, F.R.S.

Sydney.—Temp. 0°·2 above, humidity 8·5 above, and rainfall ·73 in. above, their respective averages. H. C. RUSSELL, F.R.S.

Wellington.—Fine weather up to the middle of the month, with occasional showers; strong N.W. winds from 15th to 19th, reaching a gale at times; the remainder showery. H on 30th; frequent fogs; slight earthquake on 27th. Mean temp. 1°·1 above, and rainfall 1·82 below, their respective averages. R. B. GORE.

Auckland.—From 1st to 22nd remarkably fine and dry. Violent N.E. gale on 23rd, with 1·89 in. of R. Then squally and stormy, with frequent heavy showers to the end. T. F. CHEESEMAN.

TRINIDAD.—Rainfall 1·58 in. below the average of 30 years. J. H. HART.

SUPPLEMENTARY TABLE OF RAINFALL, NOVEMBER, 1898.

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

Div	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
I.	Uxbridge, Harefield Pk..	2·12	XI.	Builth, Abergwesyn Vic.	6·00
II.	Dorking, Abinger Hall .	4·76	,,	Rhayader, Nantgwillt ...	5·22
,,	Birchington, Thor	2·54	,,	Lake Vyrnwy	5·02
,,	Hailsham	3·54	,,	Corwen, Rhug	2·54
,,	Ryde, Thornbrough	5·30	,,	Criccieth, Talarvor	3·40
,,	Emsworth, Redlands ...	4·59	,,	I. of Man, Douglas	4·55
,,	Alton, Ashdell	4·85	XII.	Stoneykirk, Ardwell Ho.	3·27
III.	Oxford, Magdalen Col..	1·94	,,	New Galloway, Glenlee	6·96
,,	Banbury, Bloxham	2·84	,,	Moniaive, Maxwelton Ho.	5·02
,,	Northampton, Sedgebrook	1·91	,,	Lilliesleaf, Riddell	3·19
,,	Stamford, Duddington..	1·83	XIII.	N. Esk Res. [Penicuick]	7·50
,,	Alconbury	1·15	XIV.	Glasgow, Queen's Park..	4·67
,,	Wisbech, Bank House...	1·63	XV.	Inverary, Newtown	8·69
IV.	Southend	2·19	,,	Ballachulish, Ardsheal...	7·45
,,	Harlow, Sheering..... ...	...	,,	Islay, Gruinart School ...	2·09
,,	Colchester, Lexden	2·16	XVI.	Dollar.....	5·74
,,	Rendlesham Hall	2·66	,,	Balquhidder, Stronvar...	10·62
,,	Scole Rectory	2·41	,,	Coupar Angus Station...	4·98
,,	Swaffham	2·19	,,	Dalnaspidal H.R.S.....	...
V.	Salisbury, Alderbury ...	3·70	XVII.	Keith H.R.S.....	3·97
,,	Bishop's Cannings	3·55	,,	Forres H.R.S.	1·98
,,	Blandford, Whatcombe .	4·33	XVIII.	Fearn, Lower Pitkerrie..	1·77
,,	Ashburton, Holne Vic...	4·27	,,	N. Uist, Loch Maddy ...	...
,,	Okehampton, Oaklands.	3·53	,,	Invergarry.....	7·64
,,	Hartland Abbey	2·89	,,	Aviemore H.R.S.	2·26
,,	Lynton, Glenthorne ...	6·57	,,	Loch Ness, Drumnadrochit	4·00
,,	Probus, Lamellyn	4·10	XIX.	Invershin	5·10
,,	Wellington, The Avenue	4·73	,,	Durness.....	8·19
,,	North Cadbury Rectory	3·34	,,	Watten H.R.S.....	4·43
VI.	Clifton, Pembroke Road	3·16	XX.	Dunmanway, Coolkelure	6·38
,,	Ross, The Graig	1·99	,,	Cork, Wellesley Terrace	2·96
,,	Wem, Clive Vicarage ...	1·96	,,	Killarney, Woodlawn ..	5·83
,,	Wolverhampton, Tettenhall	1·68	,,	Caher, Duneske	4·22
,,	Cheadle, The Heath Ho.	2·57	,,	Ballingarry, Hazelfort...	5·49
,,	Coventry, Priory Row ..	2·18	,,	Limerick, Kilcornan ...	4·13
VII.	Grantham, Stainby	2·38	,,	Broadford, Hurdlestown	4·76
,,	Horncastle, Bucknall ...	1·86	,,	Miltown Malbay	5·28
,,	Worksop, Hodsck Priory	2·48	XXI.	Gorey, Courtown House	3·79
VIII.	Neston, Hinderton	1·33	,,	Athlone, Twyford	3·83
,,	Southport, Hesketh Park	3·02	,,	Mullingar, Belvedere ...	5·22
,,	Chatburn, Middlewood.	4·30	,,	Longford, Currygrane...	...
IX.	Melmerby, Baldersby ...	3·11	XXII.	Woodlawn	3·90
,,	Scarborough, Observat'y	...	,,	Crossmolina, Enniscoe ..	8·12
,,	Middleton, Mickleton ...	1·87	,,	Collooney, Markree Obs.	3·59
X.	Haltwhistle, Unthank...	3·40	,,	Ballinamore, Lawderdale	...
,,	Bamburgh	3·25	XXIII.	Warrenpoint.....	3·04
,,	Duddon Valley, Ulpha School	7·31	,,	Seaforde.....	3·15
,,	Keswick, The Bank	7·84	,,	Belfast, Springfield	3·64
XI.	Llanfrechfa Grange	5·15	,,	Bushmills, Dundarave..	3·34
,,	Llandovery	4·28	,,	Stewartstown	3·62
,,	Castle Malgwyn	4·77	,,	Killybegs	8·93
,,	Brecknock, The Barracks	2·72	,,	Horn Head	5·68

NOVEMBER, 1898.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1880-9.	Greatest Fall in 24 hours Dpth	Greatest Fall in 24 hours Date	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Max. Date	Min. Deg.	Min. Date.	No. of Nights below 32°. In shade.	No. of Nights below 32°. On grass.
			inches.	inches.	in.								
I.	ENGLAND.	London (Camden Square) ...	1·94	— ·72	·56	25	13	60·6	3	27·3	23	2	7
II.		Tenterden ...	2·28	— 1·11	·56	23	17	61·7	9	26·0	30	2	9
,,		Hartley Wintney ...	3·45	...	1·23	23	14	60·0	3	25·0	23	5	10
III.		Hitchin ...	2·31	— ·37	·44	23	16	60·0	2, 3	25·0	22	5	...
,,		Winslow (Addington) ...	1·82	— 1·11	·37	23	13	60·0	2	23·0	23	7	9
IV.		Bury St. Edmunds (Westley)	2·33	— ·22	·57	26	16	59·0	2	28·0	23	...	...
,,		Norwich (Brundall) ...	3·00	...	·92	26	19	60·8	2	29·2	23	3	10
V.		Winterbourne Steepleton ...	5·16	...	1·59	23	17	51·8	16	23·3	23	6	16
,,		Torquay (Cary Green)	3·99	...	1·10	23	14	60·9	16	32·2	29*c*	0	4
,,		Polapit Tamar [Launceston]..	2·57	— 1·77	·51	22	18	60·5	11	27·1	14*d*	6	8
VI.		Stroud (Upfield)	2·61	— ·72	·75	24	18	58·0	2, 3	28·0	22	4	...
,,		ChurchStretton(Woolstaston)	1·53	— 1·99	·39	24	18	59·0	16	26·0	23	6	10
,,		Worcester (Diglis Lock) ...	1·62	— 1·22	·35	25	12	...	...	...	...	...	...
VII.		Leicester (Rotherby Hall) ...	...	...	...	..	...	...	...	...	...	...	...
,,		Boston	1·60	— ·60	·52	26	15	60·0	2	26·0	23*c*	5	...
,,		Hesley Hall [Tickhill]...	2·06	+ ·04	·75	23	18	61·0	2	25·0	23	5	...
VIII.		Manchester(PlymouthGrove)	1·95	— 1·05	·49	12	15	61·0	9	27·0	22*e*	7	10
IX.		Wetherby (Ribston Hall) ..	3·50	+ 1·43	·95	23	17	...	...	...	...	...	...
,,		Skipton (Arncliffe) ...	3·62	— 3·13	·63	2	24	...	...	...	...	...	...
,,		Hull (Pearson Park).	2·24	+ ·23	·59	23	18	61·0	8, 15	26·0	23	5	8
X.		Newcastle (Town Moor) ...	3·30	+ ·90	·70	25	13	...	...	...	...	...	...
,,		Borrowdale (Seathwaite)...	16·85	+ 2·06	5·20?	1	20	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely)...	5·06	+ ·15	1·29	2	22	...	...	...	...	...	...
,,		Haverfordwest	6·09	+ ·23	1·27	22	24	58·7	3	33·7	1	0	11
,,		Aberystwith (Gogerddan) ...	3·92	— 1·19	·94	4	16	58·0	11	...	...	...	...
,,		Llandudno... ...	1·87	— 1·22	·38	12	20	63·0	2	29·0	23	2	...
XII.	SCOTLAND.	Cargen [Dumfries]	5·64	+ 1·08	2·18	1	15	58·0	2	19·0	29	7	...
XIII.		Edinburgh (Blacket Place)...	4·11	...	·90	25	20	61·0	2	20·3	29	4	8
XIV.		Colmonell	5·51	...	1·36	22	17	61·0	8	19·0	28	...	...
XV.		Tighnabruaich	6·81	...	1·33	1	21	53·0	1, 2	25·0	28	6	...
,,		Mull (Quinish)... ...	6·10	— ·89	2·01	1	20	...	...	...	...	...	...
XVI.		Loch Leven Sluices	5·90	+ 1·94	1·30	2	13	...	...	...	...	...	...
,,		Dundee (Eastern Necropolis)	4·35	+ 1·65	1·25	23	21	59·0	2	21·0	29	6	...
XVII.		Braemar	4·64	+ ·06	1·23	25	18	55·0	2	8·5	29	16	26
,,		Aberdeen (Cranford)	4·14	...	·80	12	20	59·0	2	19·0	28	12	...
,,		Cawdor (Budgate)	3·11	+ ·26	·78	12	17	...	...	...	...	...	...
XVIII		Strathconan [Beauly]	8·44	+ 1·88	1·60	2	14	...	...	...	...	...	...
,,		Glencarron Lodge... ...	9·06	...	2·67	1	20	61·0	12	17·6	29	7	...
XIX.		Dunrobin	3·82	+ ·99	·77	4	18	56·0	18	23·0	29	5	...
,,		S. Ronaldshay (Roeberry) ...	6·15	+ 2·73	1·57	23	23	52·0	7*b*	26·0	21	5	...
XX.	IRELAND.	Darrynane Abbey... ...	6·60	...	1·14	23	26	...	...	...	...	...	...
,,		Waterford (Brook Lodge) ...	2·95	— ·72	·50	22*a*	20	59·5	2	28·0	22	4	...
,,		O'Briensbridge (Ross)	6·80	...	1·25	22	19	..	...	...	...	...	...
XXI.		Carlow (Browne's Hill)	4·41	— 1·35	1·04	23	16	...	...	...	...	...	...
,,		Dublin (FitzWilliam Square)	4·44	+ 1·61	1·73	23	17	62·7	2	29·0	22	4	9
XXII.		Ballinasloe	4·10	+ ·19	·62	22	23	56·0	2	30·0	22	5	...
,,		Clifden (Kylemore)	10·48	...	1·93	22	25	...	...	...	...	...	...
XXIII		Waringstown	2·98	— ·12	·42	29	18	59·0	3, 4	25·0	22	10	14
,,		Londonderry (Creggan Res.).	4·47	— ·05	·81	24	21	...	...	...	...	...	...
,,		Omagh (Edenfel)	3·85	— ·02	·56	3	16	58·0	2	27·0	5	...	...

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

a—and 23. *b*—and 18, 19. *c*—and 30. *d*—and 23. *e*—and 29.

METEOROLOGICAL NOTES ON NOVEMBER, 1898.

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.

TENTERDEN.—Warm and dry till the 20th, after which 1·85 in. of R fell, but the total is only two-thirds of the average. Duration of sunshine 89 hours. Gardens were gay with flowers until the 22nd. Fog on 8th, 10th, 11th, and 14th. On 3rd the shade min. was 52°, and the grass min. 51°. S on 29th.

HARTLEY WINTNEY.—From 7th to 20th consisted of many calm days, with alternations of sun and fog, mildness, and little R; from 20th to the end was cold, dull, and wet. Oaks were in full leaf till 23rd, and heliotrope, dahlias, and begonias, were blooming till cut off by the frost on that day. Six hours' sunshine was recorded on 13th and on 22nd. L on 12th. Rainfall 1·06 in. above the average, and for the first 11 months of the year 4·20 in. below it.

ADDINGTON.—Generally very mild, with frequent fogs and hardly any frost until the evening of 22nd. On the morning of 23rd the ground was covered with about two inches of S, but R following, it did not remain long. Many tender plants were in flower, untouched by frost until 22nd; unusually late for dahlias, heliotrope, &c., to be seen in such fine condition. Fog on 10 days.

BURY ST. EDMUNDS, WESTLEY.—Very mild until 23rd, when the first frost cut tender plants in the gardens. The chalk wells at the close were shorter of water than had ever before been known.

NORWICH, BRUNDALL.—Very mild during the greater part of the month, the mean. temp of the first 19 days being identical with that of the first 19 days of last May. A high relative humidity was recorded, the mean 9 a.m. value for the month being 94. Fog on 9th, 10th and 11th. Gales from N.W. and N. on 21st, and N.E. on 28th. H and sleet on 22nd. Incessant R on 26th.

WINTERBOURNE STEEPLETON.—In the 32 days ending November 7th R was registered on all but 4, and on 20th another wet period began, with very low bar., high wind and heavy rains, and T and H on 25th. The mean temp. 45°·4, is 1°·1 above the average of 5 years. Fog daily from 9th to 12th.

TORQUAY, CARY GREEN.—November rainfall ·08 in. above the average, but total for the first 11 months of the year 7·06 in. below it. Mean temp. 49°·4, or 2°·2 above the average. Duration of sunshine 56 hours 40 mins., being 4 hours 25 mins. below the average; 12 sunless days.

POLAPIT TAMAR [LAUNCESTON].—Though generally damp, the rainfall for the month is very small. The total R for the first 11 months of the year is 3·71 in. less than the average. The prevailing characteristic was general absence of wind. Very thick fog on 6th, slight on 26th.

WOOLSTASTON.—The first three weeks were mild, dark and damp, with a great deal of fog. A heavy gale with driving S raged on 22nd and 23rd. Mean temp. 43°·9.

BOSTON.—Weather remarkably open except at the end of the month. Mean temp. 3°·5 above the average. Plums, apples and raspberries (due to a second crop) were gathered at the beginning of the month. Thrushes singing as if it were spring.

WALES.

HAVERFORDWEST.—The month was characterized by wet, with unusual mildness. Heavy squalls occurred on the morning of 13th, accompanied by T, L and very heavy R, and a short but severe TS on 25th, between 5 and 6.30 p.m. In the parish of Slebech, and on the Precelly range, torrents of R and H fell, doing great damage to the roads.

GOGERDDAN.—Very mild and damp, with very little sunshine. A little S on 28th.

SCOTLAND.

CARGEN [DUMFRIES].—The weather was dull and unsettled, with exceptionally low bar. pressure. The temp. was high up to the evening of the 19th; the mean from 1st to 18th being 46°, and from 19th to 30th 36°, but was very variable during the last 12 days; the mean on 26th being 42°, and on 29th 24°. On 1st 2·18 in. of R fell, the greatest recorded, with one exception, since observations commenced in 1860; the total for the 1st and 2nd, 2·74 in., also has only once been exceeded. A large area was flooded, but the tides being "neap," there was no damage from overflow of the Nith embankments. L on 3rd. S on 22nd and 29th. E. winds prevailed on 16 days, and sunshine was conspicuously absent. Strawberries show well-developed fruit, while snowdrops have been seen in full flower bud. R for the first 11 months of the year slightly above the average.

EDINBURGH, BLACKET PLACE.—Mean temp. 1°·6 above, and rainfall 56 per cent. in excess of, the average. Sunshine only half the mean. TS and H on 3rd; dense fog daily from 9th to 12th; S on 22nd, 23rd and 29th.

COLMONELL.—R ·30 in. more than, and mean temp. 2°·6 above, the average of 22 years. Many sheep on the hills covered by S on 22nd. L on 2nd.

TIGHNABRUAICH.—A wet, stormy month. Four inches of S on the ground on 22nd.

ABERDEEN, CRANFORD.—A very mild month, flowers blooming to the end in the open garden. Gales and heavy R from 22nd to 25th.

S. RONALDSHAY, ROEBERRY.—A cold, wet month. Mean temp. 42°·2, or 1°·0 below the average of 8 years.

IRELAND.

DARRYNANE ABBEY.—The first three weeks were mild, but from 21st to 28th was very cold. On 22nd, 23rd and 24th, 3·02 in. of R fell, accompanied by a strong N.E. gale. N.W. gale on 12th.

WATERFORD, BROOK LODGE.—S on the Comeragh mountains on 13th, and a fresh fall on 23rd.

O'BRIENSBRIDGE, ROSS.—Wild and wintry from beginning to end.

DUBLIN, FITZWILLIAM SQUARE.—Opening mild and changeable, with fresh S.W. winds, it afterwards became fine, quiet, and at times foggy. A brief period of frost on 22nd was followed by exceptionally heavy R, so that in 4 days 3·23 in. fell. High winds on 7 days, and a gale on 2nd and 3rd. Fog on 7 days. Solar halos on 1st and 22nd. H, or sleet and S, on 4 days. L on 3 days, and TS on 26th.

OMAGH, EDENFEL.—The weather continued extraordinarily fine and mild until the 22nd, when a series of violent gales from E. and N.E. completely changed its character and occasioned much damage over the country. The end of the month was finer.