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THE WATER CONTENTS OF THE ATMOSPHERE IN RELATION TO HEAVY RAINFALL.

By W. H. Dines, F.R.S.

The difficulty in this matter is that one must postulate certain wind conditions which may be far from the reality. It is easy to calculate the total amount of water in a column of saturated air obeying the usual law as to decrease of temperature with height and at a given temperature at the bottom, but before the vapour can be extracted all the bottom air must rise, and, of course, that means that fresh air must come in to take its place, and this fresh air hopelessly complicates the matter.

Some time ago the total water contents of the air as recorded by the humidity records of 250 registering balloons were worked up with the following results for England and the Continent :—

In the winter the total equivalent rainfall is about ·40 in., with a range from ·25 in. to ·80 in.; in summer the mean is about ·80 in., with a range from ·50 in. to 1·50 in. The amount seems to depend chiefly on the temperature and but little on anything else, *i.e.*, if the air is warm there is almost certain to be plenty of moisture and conversely. Practically all the water is contained in the first few kilometres.

The total water contents of a column of the atmosphere expressed as rainfall are given in the following table.

It is assumed that the air is just at the saturation point throughout, and that the fall of temperature is 10° F. per kilometre of height. This is about the average rate in the lower strata, and it is only the lower strata that matter. Water vapour at temperatures below 5° F. are neglected.

	°F.			*in.*
Ground temperature	80	..	Total contents	2·86
,, ,,	70	..	,, ,,	1·90
,, ,,	60	..	,, ,,	1·24
,, ,,	50	..	,, ,,	·84
,, ,,	40	..	,, ,,	·53
,, ,,	30	..	,, ,,	·33
,, ,,	20	..	,, ,,	·18

The values used were interpolated from Davis' Elementary Meteorology. A graphical method has been used but the errors should not exceed 5 per cent.

The amount of water entering per day a given area on certain arbitrary assumptions as to the strength and direction and height of the inflowing winds, may be arrived at by the following method. Consider a circular area of 100 kilometres radius. In general it is found that the wind is parallel to the isobars at a height of half a kilometre. Take, therefore, an inflowing wind of 500 metres (1660 ft.) height, with a component velocity of 10 metres per second (22·5 miles per hour), at right angles to the boundary. The amount of air entering per day in cubic metres is equal to $500 \times 2\pi \times 100000 \times 10 \times 24 \times 60 \times 60$. This is the number of cubic centimetres of water entering if each cubic metre contains one gramme. Assume that all this water vapour is condensed.

Rainfall area $= \pi (100000)^2$ square metres.

Average Rainfall (total amount in grammes per square metre) $= \dfrac{\pi \times 24 \times 6 \times 6 \times 10^{11}}{\pi\, 10^{10}} = 24 \times 360 = 8640.$

8640 grammes per square metre = 8640 cubic centimetres per 10000 square centimetres = a rainfall of ·864 centimetres, or 8·64 millimetres.

From Davis, graphically, we get the approximate values :—

° F.								
At 80	one saturated cubic metre contains					25·2	grammes	of water.
,, 70	,,	,,	,,	,,	,,	18·4	,,	,,
,, 60	,,	,,	,,	,,	,,	13·0	,,	,,
,, 50	,,	,,	,,	,,	,,	9·4	,,	,,
,, 40	,,	,,	,,	,,	,,	6·2	,,	,,
,, 30	,,	,,	,,	,,	,,	4·5	,,	,,

Hence the following values :—

° F.							mm.
Air entering at	80	should give a rainfall of	8·64	×	25·2	=	218
,,	,, 70	,,	,,	,,	,,	,,	159
,,	,, 60	,,	,,	,,	,,	,,	112
,,	,, 50	,,	,,	,,	,,	,,	81
,,	,, 40	,,	,,	,,	,,	,,	54
,,	,, 30	,,	,,	,,	,,	,,	39

On changing to inches :—

At	80°	70°	60°	50°	40°	30° F.
Rainfall .	8·58	6·62	4·42	3·20	2·13	1·53 in.

To change to miles instead of kilometres :—

If the radius of the circular area be doubled the amount of the inflowing wind is doubled, but the rainfall area is increased four-fold, therefore the average rainfall is halved. Hence, for an area of 100 miles radius instead of 100 kilometres, the rainfall must be reduced by 5/8, and taking 10 miles per hour instead of 10 metres per second it must be further reduced by multiplying by 10/22·5.

At.....	80°	70°	60°	50°	40°	30°
Rainfall ..	2·40	1·84	1·23	·89	·59	·43 in.

If the air entering the area at 80° F. left it at 60° F., the rainfall would be 2·40—1·23, and so on for entering and leaving at other temperatures.

The circle gives the minimum rainfall because it contains the largest area of any figure in the smallest perimeter; for an oval the rainfall would be greater. Also the rainfall is the average over the whole area, in reality it would be concentrated into parts of the area.

In the above remarks it is assumed that all rain is due to dynamic cooling. All heavy rain is certainly so caused. The supposition that the water-bringing winds enter a rainy area from all sides is probably far from the truth, but the figures show that very heavy rainfalls must be due to inflowing winds, for the air over any given area at any time does not contain water enough to produce them.

Correspondence.

To the Editor of Symons's Meteorological Magazine.

WATERSPOUT CLOUD EFFECT.

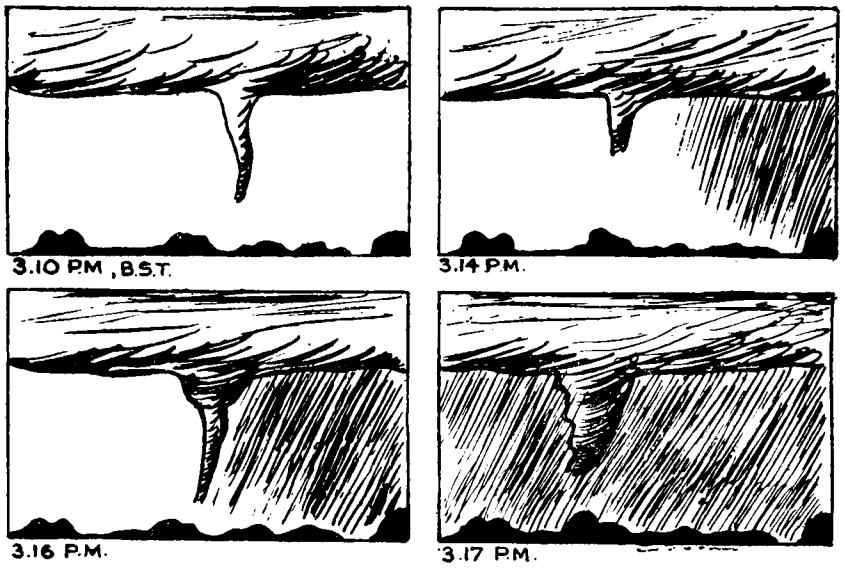
At Northampton, one August day, I witnessed the terrestrial equivalent of a waterspout.

At 3.10 p.m., looking northwards, I noticed a clearly defined slate grey funnel-shaped suspension from the rear and lowest portion of the base of a large, irregularly constructed Nimbo-cumulus, which spread slowly southwards precipitating rain accompanied by thunder and leaving as an aftermath an extensive and dense upper canopy of cloud from which rain continued to fall for two hours at Northampton. Eye-witnesses in the immediate neighbourhood of the phenomenon have described it as resembling a balloon and refer to the swaying motion of the funnel, but I have been unable to acquire any positive information regarding violent wind effects or so-called cloud-bursts.

At 3.14 the funnel diminished considerably in size, but by 3.16 had rapidly revived in a slightly different form only to disintegrate and disappear a minute later within a dense rain curtain which spread from right to left coinciding with the occurrence of the first thunder heard by me. The mass of scud forming the rear limit of the low-hanging base reached my zenith at 3.50 and was obviously in a state of the greatest agitation.

Of rain only a few drops, and these of exceptionally large size, reached earth at this time, but steady rain followed from the upper canopy and continued for two hours. Fitful south-westerly and

north-westerly gusts were also noted at this period, but with this exception only very light and variable breezes from the west were experienced before, during and after the storm. The sky gradually cleared during the evening.



I was enabled to get into touch with witnesses through the medium of the respective rectors of the parishes north of Northampton to whom I am very grateful for their help. The complete concordance of descriptions is as satisfactory as unusual, but what is remarkable and not without significance is the fact that, of the crowds of people out-of-doors on a Saturday afternoon in a large town, so very few appear to have noticed what is surely a most unusual spectacle.

Additional facts justifiy the following conclusions :—

Origin :—Its brief existence seems to have begun and ended within the basin of one of the tributaries of the river Nene.

Dimensions :—Its diameter was about 700 feet at the top of the funnel diminishing to, say, 150 feet for the greater part of its length. The base of the cloud from which the funnel was suspended was about 3,000 feet above the ground, and the length of the spout rather more than 2,000 feet.

Speed :—The spout took 7 minutes to travel half a mile and the cloud base of scud referred to, or, perhaps more properly, the process of which the agitated scud was merely the visible sign, would appear to have travelled at the same slow rate. One witness states that it had an anti-clockwise motion and " . . . . it burst and simply drenched us in a moment."

A. S. MARTIN-SMITH, Lieut.

71, Wood Street, Barnet, Herts, August 19th, 1918

THE GREEN FLASH.

MR. COBBOLD'S note in this month's *Meteorological Magazine*, p. 90, of his observation on February 15th, 1906, was no doubt induced by my notes in last year's volume at p. 100. May I be allowed space to call attention to the fact that what Mr. Cobbold, like many other Observers in the *Meteorological Magazine* of 1905 and 1906, describes as a green "flash" is in fact a change in the apparent colour of a small sector of the sun during an appreciable, though short space of time, and is not really to be defined as a flash. What I, and I think a few other Observers, have described was a ray or rays of light of green colour darting out from the sun's limb at its disappearance, and quite momentary, and so a true flash.

If we are to arrive at a satisfactory explanation, we must carefully distinguish the two phenomena. JAMES G. WOOD.

115, Sutherland Avenue, W. 9, October 6th, 1918.

MR. PAUL COBBOLD appears, from his letter published in your last Magazine, to be puzzled that, when a larger portion of the sun's disc appeared above the horizon, the "Green Flash" disappeared, seen when only a small portion of the sun was visible.

Is it not likely that this was owing to the :—

(i.) Stronger light of the sun, or

(ii.) To a difference in the density of the smoke.

Anyone who can remember the autumn of the Krakatoa eruption will recall the unanswered questionings which arose about the marvellous atmospheric effects—green suns, blue moons and gorgeous sunsets, till the startling news of the eruption came to hand, and we learnt that the air was full of volcanic dust.

In a similar way was not smoke capable of changing the light, in the case referred to by Mr. Cobbold ?

ONE WHO SAW THE EFFECTS OF THE

September 17th, 1918. KRAKATOA ERUPTION.

[We agree with the correspondent whose letter is given above that the green colour given to the disc of the sun when seen through a veil of smoke is akin to the Krakatoa phenomena. The subject of the green suns of thirty-five years ago was very fully dealt with by Mr. C. Michie Smith, of Madras. The phenomenon, as Mr. Wood points out, is different altogether from the momentary green rays seen at sunset and sunrise.—ED. *S.M.M.*]

OUR RAINFALL TABLES.

WE regret that the difficulty referred to last month has again prevented the publication of our rainfall tables. We propose, however, to print these and to circulate them to our readers at some future time.

THE WORK OF THE METEOROLOGICAL OFFICE.

We have just received the thirteenth annual report of the Meteorological Committee for the year ended 31st March, 1918 (Cd. 9143, price 2d.), and the special circumstances of the time make it appropriate to refer to it at some length. Our readers include the great majority of those who, before the war, were in the habit of looking forward to the appearance of the daily, weekly, monthly, annual and occasional publications of the Meteorological Office and of utilizing their contents for scientific or economic purposes. The evils of war are brought home very keenly to those loyal and patriotic citizens by such restrictions on liberty as the suppression of the publications of the Meteorological Office. The fact that some of these publications if issued promptly might conceivably be useful to the enemy if conveyed to him only makes the honest patriot suffer the more from the indignity of being treated as a potential traitor to his country. Added to that, as he does not know who is responsible for the restriction, he is apt to be haunted by the fear that the veil of mystery may serve as a screen for departmental inefficiency and the doubt whether the activities he followed with such interest in time of peace may have been slackened or stopped.

If such vain fears have found a place in any reader's mind the relief which the Annual Report affords must be as complete as it is welcome, for it shows that far from being slackened the activities of the Meteorological Office have been greatly stimulated, the volume of its work increased and its usefulness carried into new spheres. The Report does not, of course, refer to the changes announced in our issue for June last, which belong to the present official year. As for 1917-18 the Report says :—

"The most noteworthy feature of the year is the great development of pressing demands for expert meteorological assistance, and the prospect of still larger demands in the future, as regards the Naval, Military and Air Services. The Committee have to note the establishment of a Naval Meteorological Service under a director attached to the Hydrographic Office, a large extension of the Meteorological Section, R.E., various projects in connection with the Royal Flying Corps arranged in conjunction with the Office by Major G. I. Taylor, R.A.F., and the prospect of a large meteorological organization in connection with the Royal Air Force."

Some particulars are given of the development of the Meteorological Section of the Royal Engineers under the charge of Colonel Lyons. In this connection it is noted that a Home Unit has been established "to meet the requirements of a number of military services," with headquarters on Salisbury Plain, under the charge of Captain C. J. P. Cave. The selection of men for this Unit and their training are undertaken at the Meteorological Office.

The Forecast Division has been re-organized to meet a greatly increased demand for forecasts, of course, for military and naval purposes only, and continuous attendance at the Office for this purpose has been introduced.

The Meteorological Office has also taken into its system the Committee on Atmospheric Pollution. All the increased work in every department is, of course, hampered by the difficulty of securing a sufficient staff, and this necessarily falls more heavily on the old essential duties of the Office than on the new departures which are largely under military conditions.

The most interesting thing by far in the Report before us is the indication of future developments given in the following terms :—

" It is obvious that there must be distributing centres in charge of competent meteorologists in various centres as well as London, whether they be under the control of the Meteorological Committee or not. And as the various Dominions beyond the seas will themselves require some provision for compiling and utilising meteorological information some co-operative organisation is called for on the part of the Imperial Government in conjunction with the Local Governments. This wide extension of its outlook which must be faced if the Office is to continue to be the central national and imperial establishment for meteorology has been before the Committee on several occasions, in the first place with reference to the development of the organisation within the Office to meet the increased requirements for information of different kinds ; and, secondly, with reference to application for the acceleration of the supply of information in distant parts of the Kingdom, which can only be satisfied by local centres of distribution.

" In response to a request from the Ministry of Reconstruction for a report on the steps taken by the Committee with reference to post-war problems a memorandum was prepared and submitted setting out the peculiarities of the British meteorological services depending upon the history of the development of meteorological work in this Country and the organization necessary for completing the service. It was pointed out that as the work of the Office originated in the study of the meteorology of the sea exclusively, the detailed study of rainfall which is obviously a vital part of general meteorology and which is the fundamental study of practically all national meteorological establishments in the Dominions and in foreign countries, is still in this Country, in accordance with traditions, left in charge of a private organization, and also that the municipal authorities in this Country make no provision as a general rule for recording their experiences of the weather for the guidance of their successors ; thus all the information required for climatological questions to supplement what appears in the Daily Weather Report is left almost exclusively to

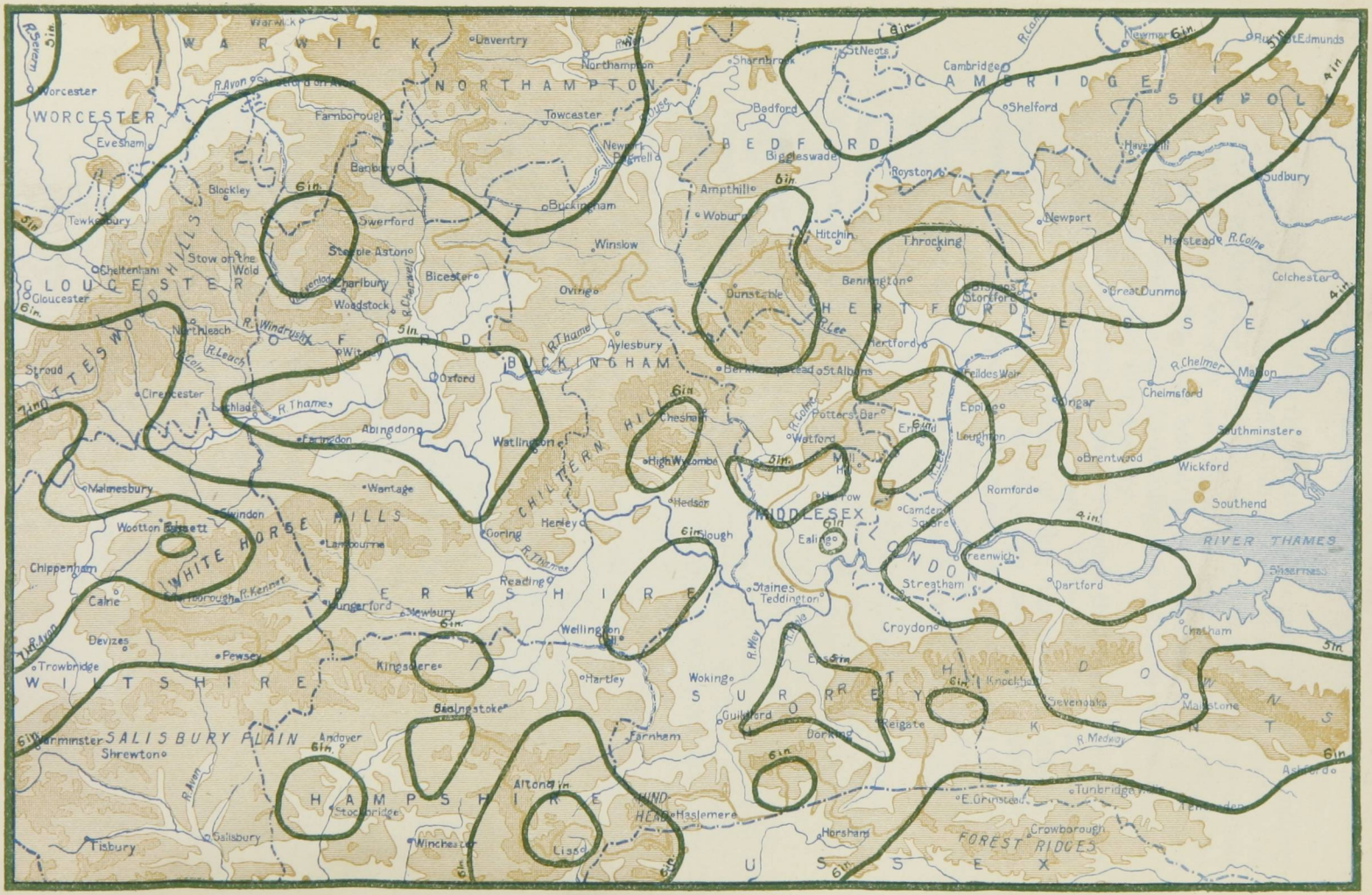
private effort. Now that the weather is recognised to be of primary importance in so many affairs of life and the requirements of so many departments of the Navy, the Army and the Air Force include a knowledge of weather conditions, not only at the surface in the various parts of the globe but at elevations which have up to now been of interest to the meteorologist alone, some more comprehensive organisation is necessary.

"And it is felt that the steps towards this organization cannot be postponed until after the war. While on the one hand the war makes the development of the organization difficult on account of the difficulty of obtaining staff and materials for observatories and experimental work, yet, on the other hand, the war has shown the special importance of certain meteorological problems the solution of which cannot await the conclusion of hostilities."

We have long felt that the British Rainfall Organization, to which reference is made in the foregoing quotation, was fulfilling a duty of national importance which in all other countries has been undertaken by the Government. We believe that the courageous enterprise of Mr. G. J. Symons has established the rainfall observations in this country on a wider basis than has been accomplished by any State system in the world. The time is long past when the responsibility for the abandonment of rainfall research in this country to private enterprise could profitably be discussed, and we are happy to think that the passage we have quoted implies that the Government is no longer bound by the old tradition of with-holding recognition from the work which was a fresh outcast from official favour in the days before "Symons's Monthly Rain Circular" developed into "Symons's Meteorological Magazine." We should be glad to think that the time is ripe for the participation of the Rainfall Organization in a wider scheme of national meteorological organizations which should encourage local associations for the collection of data for headquarters as well as the dissemination of data from headquarters. For many years to come the shock of the war will continue to embarrass private enterprise and to throw in an increased degree upon the State the duty of sustaining those useful activities which in unbroken peace could safely be left to the more natural process of spontaneous development. Whether this be so or not we are very sure that the great body of voluntary rainfall Observers will continue to serve their country by collecting the information the enormous value of which is still far too little recognized by the public as a whole.

ERRATUM—Page 79, Table VII, Col. 2, January—*for* 8·8 *read* 0·8.

THAMES VALLEY RAINFALL. SEPTEMBER, 1918.



Symons's Meteorological Magazine

*Watershed of River Thames above Teddington, and River Lee above Feildes Weir.

Isohyetals

THE RAINFALL OF SEPTEMBER, 1918.

For many years past most parts of the British Isles have experienced a succession of comparatively dry Septembers and for the country as a whole it is certainly necessary to go back as far as 1896 for any parallel to the abnormal wetness of the month just completed. The table of rainfall on page 104 shows that the rainfall of the month was in excess of the average at every station quoted, representing all parts of the British Isles, and that it was double the average or more at 35 out of the 54 stations, including practically all those in England and Wales. The greatest excess occurred in England, particularly in the centre and south; more than three times the average fell at three stations in the north Midlands. More than twice the average also fell in most parts of Ireland, the total reaching 289 per cent. of the average at Courtown, in Co. Wexford. Scotland was relatively the least rainy of the countries, but more than twice the average fell in the south. The smallest percentage excess was 8 per cent. in Mull.

Parts of the east of Great Britain had rather less than 4 inches of rain during the month, but more than 6 inches fell over a number of isolated areas in the south-east, the largest of which extended from Chichester nearly to Canterbury. One or two stations in these areas had as much as 7 inches, but in no case did the rainfall reach the amounts recorded in the same district in September, 1896, when a considerable part of the south-eastern counties had more than 9 inches and some stations more than 10 inches. At Camden Square, however, the total fall of 5·68 in. was the largest recorded in September in 61 years' observations, exceeding that in 1896 by ·17 in. The duration of rainfall was 72·8 hours, or 47·4 hours above the average.

In September, 1918, more than 6 inches fell also over the whole of the western portion of Great Britain, save the Cheshire Plain and part of the North Wales coast. The whole of the interior of Wales, almost the whole of the Pennines, and parts of Dartmoor and Exmoor, had more than 10 inches, the total rising to more than 20 inches in the centre of the Lake District and to 30 inches on Snowdon. The West Highlands were not so wet, having more than 8 inches over the district generally and as much as 10 inches only in isolated patches. The total was less than 3 inches at one or two points on the east coast. The fall in Ireland exceeded 6 inches except in the centre and east and was less than 5 inches only on a narrow strip of the east coast, but the amounts recorded in the west were more moderate than was the case in England and Wales, and more than 10 inches was, as in Scotland, very local.

Taking the countries as a whole the general rainfall expressed as a percentage of the average was as follows :—England and Wales, 247 per cent.; Scotland, 150 per cent.; Ireland, 209 per cent.; British Isles, 207 per cent.

RAINFALL TABLE FOR SEPTEMBER, 1918.

STATION.	COUNTY.	RAINFALL.						
		Aver. 1875–1909. in.	1918. in.	Diff. from Av. in.	Per cent. of Av.	Max. in 24 hours. in.	Max. in 24 hours. Date.	Nos. of Day
Camden Square	*London*	2·00	5·68	+3·68	284	1·23	29	23
Tenterden	*Kent*	2·25	6·26	+4·01	278	1·45	29	21
Arundel (Patching)	*Sussex*	2·58	7·46	+4·88	289	1·40	29	21
Fordingbridge (Oaklands)	*Hampshire*	2·39	5·70	+3·31	239	1·19	29	26
Oxford (Magdalen College)	*Oxfordshire*	1·98	4·58	+2·60	230	1·13	29	24
Wellingborough (Swanspool)	*Northampn*	2·13	4·77	+2·64	225	1·17	29	24
Bury St. Edmunds (Westley)	*Suffolk*	2·18	5·88	+3·70	270	1·27	29	25
Geldeston [Beccles]	*Norfolk*	2·13	3·73	+1·60	176	1·37	29	23
Polapit Tamar [Launceston]	*Devon*	3·11	8·40	+5·29	270	1·31	29	27
Rousdon [Lyme Regis]	,,	2·69	6·29	+3·60	235	1·40	29	27
Stroud (Field Place)	*Gloucester*	2·39	6·40	+4·01	268	1·26	30	24
Church Stretton (Wolstaston)	*Shropshire*	2·40	7·34	+4·94	306	·86	4	30
Boston	*Lincoln*	2·07	4·21	+2·14	204	·71	4	23
Worksop (Hodsock Priory)	*Nottingham*	1·84	4·26	+2·42	231	·61	15	26
Mickleover Manor	*Derbyshire*	2·11	6·35	+4·24	301	·84	4	25
Congleton (Buglawton Vic.)	*Cheshire*	2·67	5·62	+2·95	211	·55	1	30
Southport (Hesketh Park)	*Lancashire*	3·09	8·49	+5·40	274	1·35	15	29
Wetherby (Ribston Hall)	*York, W.R.*	2·11	6·95	+4·84	329	1·00	15	24
Hull (Pearson Park)	,, *E.R.*	2·05	4·14	+2·09	202	·70	15	26
Newcastle (Town Moor)	*North'land*	2·00	5·30	+3·30	265	1·48	15	25
Borrowdale (Seathwaite)	*Cumberland*	11·28	22·25	+10·97	197	...	...	...
Cardiff (Ely)	*Glamorgan*	3·61	10·69	+7·08	296	1·09	18	29
Haverfordwest	*Pembroke*	3·91	8·25	+4·34	211	1·21	29	28
Aberystwyth (Gogerddan)	*Cardigan*	3·89	9·90	+6·01	255	1·21	3	29
Llandudno	*Carnarvon*	2·50	6·95	+4·45	279	1·35	15	27
Cargen [Dumfries]	*Kirkcudbrt.*	3·34	7·29	+3·95	218	2·34	15	21
Marchmont House	*Berwick*	2·67	5·72	+3·05	214	1·86	15	20
Girvan (Pinmore)	*Ayr*	4·30	5·65	+1·35	131	·78	16	25
Glasgow (Queen's Park)	*Renfrew*	2·99	6·32	+3·33	211	1·16	17	22
Islay (Eallabus)	*Argyll*	4·49	7·51	+3·02	167	1·31	9	24
Mull (Quinish)	,,	5·20	5·61	+ ·41	108	1·12	7	22
Balquhidder (Stronvar)	*Perth*	5·81	8·03	+2·22	138	1·60	19	23
Dundee (Eastern Necropolis)	*Forfar*	2·34	3·85	+1·51	164	·91	15	16
Braemar	*Aberdeen*	2·73	4·54	+1·81	166	·75	15	23
Aberdeen (Cranford)	,,	2·69	4·42	+1·73	164	·77	10, 15	20
Gordon Castle	*Moray*	2·58	4·66	+2·08	181	...	...	...
Drumnadrochit	*Inverness*	2·94	4·70	+1·76	160	·50	7	25
Fort William	,,	6·66	7·88	+1·22	119	1·32	22	23
Loch Torridon (Bendamph)	*Ross*	7·28	9·39	+2·11	129	·95	7	23
Dunrobin Castle	*Sutherland*	2·51	3·45	+ ·94	137	·55	16	17
Glanmire (Lota Lodge)	*Cork*	3·20	6·63	+3·43	207	1·20	15	23
Killarney (District Asylum)	*Kerry*	3·79	7·59	+3·80	200	·82	16	30
Waterford (Brook Lodge)	*Waterford*	3·19	7·97	+4 78	250	1·44	3	25
Nenagh (Castle Lough)	*Tipperary*	3·16	7·37	+4·21	233	1·04	21	23
Ennistymon House	*Clare*	4·22	8·20	+3·98	194	1·22	21	27
Gorey (Courtown House)	*Wexford*	2·78	8·01	+5·23	289	1·41	15	23
Abbey Leix (Blandsfort)	*Queen's Co.*	2·93	5·47	+2·54	187	·78	15	24
Dublin (Fitz William Square)	*Dublin*	2·06	4·87	+2·81	236	1·26	15	26
Mullingar (Belvedere)	*Westmeath*	3·02	5·52	+2·50	183	·97	15	22
Crossmolina (Enniscoe)	*Mayo*	4·42	7·83	+3·41	178	·98	15	26
Cong (The Glebe)	,,	4·05	...	...	...	...	...	...
Collooney (Markree Obsy.)	*Sligo*	3·65	8·24	+4·59	226	1·21	16	27
Seaforde	*Down*	3·25	5·05	+1·80	155	1·72	15	27
Ballymena (Harryville)	*Antrim*	3·43	7·17	+3·74	209	1·70	15	26
Omagh (Edenfel)	*Tyrone*	3·39	7·18	+3·79	211	1·10	15	27

SUPPLEMENTARY RAINFALL, SEPTEMBER, 1918.

Div.	STATION.	Rain inches.	Div.	STATION.	Rain inches.
II.	Warlingham, Redvers Road..	5·69	XI.	Lligwy	7·29
,,	Ramsgate	4·29	,,	Douglas, Isle of Man	9·64
,,	Hailsham	6·77	XII.	Stoneykirk, Ardwell House...	5·92
,,	Totland Bay, Aston House...	5·05	,,	Carsphairn, Shiel	10·63
,,	Stockbridge, Ashley..	5·17	,,	Langholm, Drove Road	8·81
,,	Grayshott	6·23	XIII.	Selkirk, The Hangingshaw..	6·28
III.	Harrow Weald, Hill House...	4·84	,,	North Berwick Reservoir	4·69
,,	Pitsford, Sedgebrook	4·06	,,	Edinburgh, Royal Observaty.	4·40
,,	Woburn, Milton Bryant	4·92	XIV.	Biggar	4·78
,,	Chatteris, The Priory	5·37	,,	Maybole, Knockdon Farm ...	6·49
IV.	Elsenham, Gaunts End	4·61	XV.	Buchlyvie, The Manse	6·65
,,	Shoeburyness	4·33	,,	Ardgour House	9·29
,,	Colchester, Hill Ho., Lexden	3·66	,,	Oban	5·49
,,	Ipswich, Rookwood, Copdock	3·92	,,	Campbeltown, Witchburn ..	...
,,	Aylsham, Rippon Hall	4·94	,,	Holy Loch, Ardnadam	8·73
,,	Swaffham	5·41	,,	Tiree, Cornaigmore	...
V.	Bishops Cannings	6·10	XVI.	Glenquey	6·80
,,	Weymouth	5·77	,,	Loch Rannoch Dall	5·85
,,	Ashburton, Druid House..	10·92	,,	Blair Atholl	3·92
,,	Cullompton	7·46	,,	Coupar Angus	3·34
,,	Lynmouth, Rock House ..	9·81	,,	Montrose, Sunnyside Asylum.	2·72
,,	Okehampton, Oaklands..	9·10	XVII.	Balmoral	4·59
,,	Hartland Abbey	7·41	,,	Fyvie Castle	4·91
,,	St. Austell, Trevarna	7·95	,,	Keith Station ..	7·34
,,	North Cadbury Rectory	5·00	XVIII.	Rothiemurchus	4·43
VI.	Clifton, Stoke Bishop	10·61	,,	Loch Quoich, Loan	18·25
,,	Ledbury, Underdown	5·37	,,	Skye, Dunvegan	9·03
,,	Shifnal, Hatton Grange	5·26	,,	Fortrose	3·15
,,	Droitwich	4·98	,,	Glencarron Lodge	9.55
,,	Blockley, Upton Wold	5·64	XIX.	Tongue Manse	4·91
VII.	Grantham, Saltersford	3·72	,,	Melvich	4·18
,,	Louth Westgate	4·31	,,	Loch More, Achfary	8·99
,,	Bawtry, Hesley Hall	4·63	XX.	Dunmanway, The Rectory ..	9·31
,,	Whaley Bridge, Mosley Hall	9·35	,,	Mitchelstown Castle	7·03
,,	Derby, Midland Railway	5·35	,,	Gap of Dunloe Gearahameen	12·90
VIII.	Nantwich, Dorfold Hall	5·78	,,	Darrynane Abbey	7·86
,,	Bolton, Queen's Park	12·71	,,	Clonmel, Bruce Villa	7·18
,,	Lancaster, Strathspey	10·49	,,	Broadford, Hurdlestown	8·12
IX.	Langsett Moor, Up. Midhope	8·87	XXI.	Enniscorthy, Ballyhyland...	8·33
,,	Scarborough, Scalby	6·41	,,	Rathnew, Clonmannon	5·68
,,	Ingleby Greenhow	5·13	,,	Ballycumber, Moorock Lodge	5·33
,,	Mickleton	7·90	,,	Balbriggan, Ardgillan ..	4·91
X.	Bellingham, High Green Manor	5·84	,,	Castle Forbes Gardens	6·11
,,	Ilderton, Lilburn Cottage ...	5·39	XXII.	Ballynahinch Castle	7·55
,,	Keswick, The Bank	13·67	,,	Woodlawn	6·56
XI.	Llanfrechfa Grange	10·06	,,	Westport, St. Helens ...	4·70
,,	Treherbert, Tyn-y-waun	17·64	,,	Dugort, Slievemore Hotel ...	7·95
,,	Carmarthen, The Friary	9·76	XXIII.	Enniskillen, Portora	5·73
,,	Fishguard, Goodwick Station.	7·98	,,	Dartrey [Cootehill] ..	5·84
,,	Crickhowell, Tal-y-maes	8·00	,,	Warrenpoint, Manor House ..	4·28
,,	Gwernargllwydd	4·00	,,	Belfast, Cave Hill Road	5·72
,,	Birmingham WW., Tyrmynydd	11·64	,,	Glenarm Castle	7·97
,,	Lake Vyrnwy	13·88	,,	Londonderry, Creggan Res...	6·80
,,	Llangynhafal, Plas Drâw	5·35	,,	Milford, The Manse	7·36
,,	Rhwibryfdir	28·32	,,	Killybegs	9·80
,,	Dolgelly, Bryntirion	14·72			

Climatological Table for the British Empire, April, 1918.

STATIONS. (*Those in italics are South of the Equator.*)	Absolute. Maximum. Temp.	Date.	Absolute. Minimum. Temp.	Date.	Average. Max.	Min.	Dew Point.	Humidity.	Absolute. Max. in Sun.	Min. on Grass.	Total Rain Depth.	Days.	Aver. Cloud.
	°		°		°	°	°	0-100	°	°	inches		
London, Camden Square	69·4	25	31·4	19	53·4	38·0	...	87	114·6	24·9	3·24	20	8·7
Malta	71·8	20	52·0	10	64·7	55·9	...	81	129·0	42·5	·30	3	2·5
Lagos	90·3	12	70·2	5	88·2	75·3	74·1	74	150·4	68·0	4·15	10	7·5
Cape Town	97·4	5	43·0	10	76·6	53·3	52·3	65	...	...	1·03	6	3·7
Johannesburg	77·0	11	37·4	2	70·7	48·4	44·0	65	...	37·9	...	...	2·7
Mauritius	84·9	6	65·8	24	80·8	70·7	68·2	79	...	60·8	7·30	20	7·0
Bloemfontein	79·8	12	36·6	20	74·2	45·2	44·3	56	..	...	·01	1	2·2
Calcutta...	101·2	6	66·8	19	94·4	74·0	69·6	67	...	58·0	4·73	2	2·7
Madras	99·2	27	68·5	1	93·3	76·2	75·0	78	158·4	64·6	·00	0	1·7
Colombo, Ceylon ...	92·6	9	71·4	30	89·4	74·8	73·1	79	157·2	66·8	4·53	9	4·7
Hongkong	84·0	29	58·5	13	75·0	67·0	65·8	84	...	...	4·44	12	6·7
Sydney	83·6	4	51·4	30	71·3	56·1	56·9	80	132·0	46·5	4·71	24	5·4
Melbourne	76·4	11	40·6	21	66·0	51·0	49·2	71	127·9	30·4	1·61	15	6·4
Adelaide	83·4	12	45·7	17	72·1	54·8	50·1	61	144·0	35·5	·88	10	5·1
Perth	92·4	18	54·3	11	77·2	61·3	58·9	72	151·4	45·3	2·25	8	6·4
Coolgardie	88·0	18	45·0	24	75·7	56·4	52·0	61	152·0	42·4	3·56	10	5·3
Brisbane	86·2	6	53·7	29	76·5	58·7	58·1	72	146·4	49·1	1·70	10	4·2
Hobart, Tasmania ..	68·1	12	40·1	22	59·9	46·9	43·2	66	124·2	32·3	1·99	15	6·6
Wellington ...	61·4	7	48·9	26	52·9	58·2	51·4	78	145·0	29·1	3·53	16	6·9
Jamaica, Kingston ..	88·4	7	67·4	1	86·1	70·4	69·0	79	...	...	3·16	7	4·0
Grenada	86·0	2, 27	69·0	25	84·0	72·0	...	71	138·0	...	1·60	10	4·5
Toronto	69·0	15	22·7	19	53·0	34·3	28·8	64	121·2	19·0	1·41	10	5·2
Fredericton	71·0	28	18·0	*a*	52·7	27·5	27·3	57	...	...	2·73	4	4·1
St. John, N.B. ...	60·5	29	18·7	18	48·2	30·1	28·6	68	121·2	18·5	2·57	9	4·4
Victoria, B.C.	69·8	21	33·0	1	56·3	41·3	38·0	67	126·8	23·0	·35	5	3·8

a—3, 8, 12..

Johannesburg.—Bright sunshine 289·4 hours.

COLOMBO, CEYLON.—Mean temp. 82°·2, or 0°·4 below, dew point 1·5 below and R 2·65 in. below averages. Mean hourly velocity of wind 4·0 miles.

HONGKONG.—Mean temp. 70·4. Bright sunshine 158·6 hours. Mean hourly velocity of wind 10·6 miles.

Melbourne.—Temp. 1·0° below, and R ·67 in. below, averages.

Adelaide.—Mean temp. 0·6 in. below, and R ·97 in. below, averages.

Perth.—Cyclonic gale on 21st. Wind velocity 61 miles an hour

Coolgardie.—Temp. 0·9 in. above, and R nearly three inches above, average.

Brisbane.—Temp. 3°·3 below, and R 1·93 in. below, averages.

Hobart.—Mean temp. 1·7 in. below, and R 0·9 in. above, averages.

Wellington.—Mean temp. 0°·8 above, and R ·46 in. below, averages. Bright sunshine, 127·1 hours.