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London Smoke Fogs.

By DR. J. S. OWENS.

THE Advisory Committee on Atmospheric Pollution have always realised that a measurement of impurities deposited from the air, such as has been made for some years by means of large open-topped gauge vessels similar in principle to rain gauges, gave an incomplete statement of the case. A large proportion of the total impurity is so finely divided that there is little tendency to settle; the particles are so small that the slightest turbulence in the air is sufficient to keep them practically permanently suspended. It was therefore necessary to supplement measurements of deposit with some method of ascertaining the quantity of suspended matter in order to get a more complete view of the case. It is obvious that in any discussion of smoke-fogs suspended impurity is the important thing.

A method of measuring suspended impurity in cities has been devised and has now been in continuous operation in London for some months. Briefly, the method consists in the use of an automatic instrument* which filters a fixed volume of air through a small disc of white filter paper at short intervals. The impurities are left behind on the paper and, by the aid of a carefully calibrated scale of shades, provide a measure of the quantity of impurity in known units. Instruments have been set up at the Meteorological Office, South Kensington, at Kew Observatory, and at the

* Sixth Report of the Committee for the investigation of Atmospheric Pollution, p. 15.

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author's office at 47, Victoria Street, Westminster. Continuous records are now available since October last, and it appears probable that entirely new light will be thrown on the question of source of impurity by means of these records.

Curves have been drawn showing in each case the mean amount of suspended impurity for each hour over a number of days. This has been done for ordinary week-days, excluding Saturdays and Sundays, and also for Saturdays and Sundays separately.

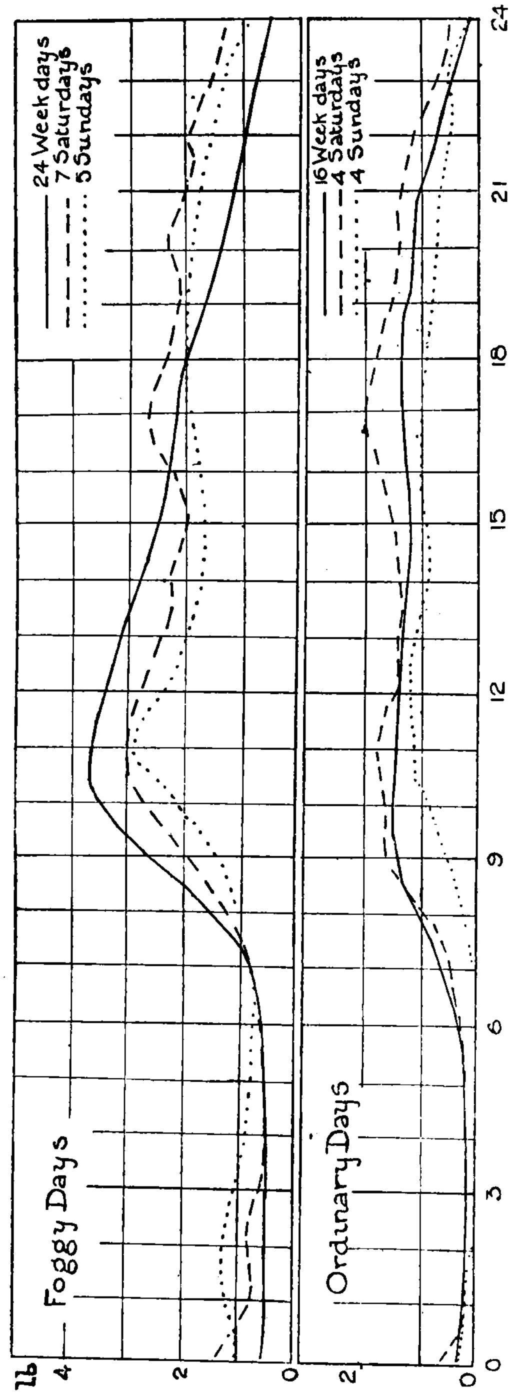
A study of these curves brings to light certain information bearing upon the source of the impurity, and should enable us ultimately to state definitely what proportion of the suspended impurity is due to domestic heating and cooking fires and what to factory furnaces.

The curves mentioned are reproduced here for reference, and each group of days has been split up into foggy and non-foggy days, the non-foggy days being taken as those in which the maximum impurity at any period did not exceed Shade 4 on the scale of shades or, say, 2·16 lb. per million cubic yards. The foggy days were taken as those in which the impurity exceeded this figure at some time during the 24 hours.

Features common to all Curves.—Referring now to the curves, it will be observed that there are certain features common to all: between midnight and early morning the air is at its purest. On week-days and Saturdays about 6 a.m. and on Sundays about 7 a.m. a rapid increase in the amount of impurity begins. This is continued to a maximum at about 11 a.m. on week-days and Saturdays, and somewhat later, about 12 noon, on Sundays. In the afternoon there is a general tendency for the impurity to diminish in quantity; this is very well marked in the curve for foggy week-days, but it is distinct in all the curves. About 5 p.m. (17 h.) most of the curves show a slight peak, and about 10 p.m. (22 h.) a rapid fall commences which continues up to midnight, when the quantity approaches the minimum.

It appears legitimate to infer from the above that the comparatively pure period between midnight and early morning is due to all fires and furnaces being out of operation. The commencement of the rise of the impurity at about 6 a.m. is clearly connected with the starting-up again of fires and furnaces. The peak about 5 o'clock in the afternoon suggests a tea-time rise, and the falling off at about 10 p.m. is evidently connected with the letting out of fires.

If the impurity is due chiefly to domestic smoke, we should expect to find little difference in the quantity recorded on Saturday afternoons and Sundays when compared with other



SUSPENDED IMPURITY IN LONDON AIR.

Variation at Westminster in the number of pounds of dirt in a 100-yard cube on selected days in the winter 1920–21.

week-days. On the other hand, if the impurity is due chiefly to industrial furnaces, then Saturday afternoon and the whole of Sunday should show a very marked difference when compared with other days. Referring to the curves for days without abnormal fog, as these give a better indication of the source of the impurity than foggy days when some abnormal meteorological condition exists, we find that so far as the data at present available indicate there is not an outstanding difference to be observed in the amount of impurity on Saturdays, Sundays, or week-days; the Saturday curve shows somewhat the largest amount of impurity, the Sunday curve shows the least, but there is not a great difference.

Referring now to the curve for non-foggy Saturdays, there is no sudden falling off in the amount of smoke after 1 o'clock, when most factories close; on the contrary, there is a distinct rise and a very well marked peak at 5 o'clock, the same peak as is to be observed in the curve for foggy Saturdays. The inference is clear that since the shutting down of factories does not bring about a marked reduction in the quantity of impurity recorded, the factory fires are not mainly responsible for the impurity. Thus, both the quantity of suspended matter and its distribution point towards the domestic heating and cooking fires as being mainly responsible.

Turning to the much disputed question as to the relative proportions of factory and domestic smoke, we find that something approaching definite information is contained in the curves.

Consider the elementary case of a uniform stream of air which receives the smoke emitted by a certain chimney, and suppose that records are taken further down the stream. As long as all other conditions remain constant any variation in quantity of smoke emitted will cause, a little later, a corresponding variation in impurity recorded. Under such conditions the records of suspended impurity are also records of rate of smoke emission. If now a sufficient number of normal winter days be taken, that is, days without conditions which cause that banking up of impurities resulting in smoke-fog, the corresponding curves may be regarded as showing relative smoke production. Further, since rate of smoke production multiplied by the time gives total smoke produced, the areas enclosed between the curves and the base are proportional to the total smoke produced in 24 hours.

On week-days we have both domestic and factory fires in operation, while on Sundays we have domestic fires only, or practically so, hence the area enclosed by the curve for non-foggy Sundays deducted from that for non-foggy week-days should give, in some unit, the smoke produced by factories on week-days. If then W is equal to the area of the week-day curve, and S is equal to that of the Sunday curve, the proportion of domestic smoke to factory smoke in the air of London is approximately equal to $\frac{S}{W-S}$. The assumption is made that the amount of domestic smoke produced on Sundays is the same as on week-days.

In the curves 16 week-days are included, but only four Sundays, and it may be that when more data are available the result will be somewhat different, but treating the curves as indicated gives the ratio of domestic to factory smoke as two to one. The domestic fires appear, therefore, to be responsible for two-thirds of the total smoke in Westminster.

Whether this ratio holds for other parts of London, and what it is in other cities, are questions which can only be answered when continuous records are available for the particular places considered. This is, however, believed to be the first time that a reliable method has been made available for fixing the relative importance of factory and domestic fires as sources of atmospheric pollution.

OFFICIAL NOTICES.

Lectures in Meteorology.

THE course of lectures by Sir Napier Shaw, F.R.S., for the University of London on "An Historical Review of Meteorological Theory" which was announced in the *Meteorological Magazine* for January, 1921, has been postponed until the summer term. The lectures will be held on Fridays at 3 p.m., beginning April 29th, 1921.

Climatological Stations.

Crathes.—It is to be regretted that Mr. J. Smith, of Pinewood, Crathes, has been compelled to give up his meteorological observations. The majority of the instruments have been taken over, however, by Mr. W. S. Kemp, who has set up a station at the schoolhouse, some two miles from Pinewood. The sunshine recorder, however, remains at Pinewood. Observations from Pinewood have been published since 1904; the situation is described in Mr. Smith's papers on the Relation of Rainfall to the Depth of Water in a Well (Journal of the Scottish Meteorological Society, Vols. XIV. and XVI.).

Summer Time Act.

It is officially announced that "Summer Time" will come into force this year at 2 a.m. G.M.T. on the morning of Sunday, April 3rd, and will continue until 2 a.m. G.M.T. on the morning of Monday, October 3rd.

After the public clocks have been altered, each hour of observation for the climatological record should remain the same by G.M.T., and should, therefore, be one hour later by Public Time.

Observers are reminded that it is important to state explicitly the standard of time on all communications with regard to natural phenomena observed during the summer months, and also that the times of observations printed in the *Monthly Weather Report* should be checked at the beginning and end of the summer-time period.

Discussions at the Meteorological Office.

The discussion on February 7th, 1921, was opened by Mr. W. W. Bryant, who brought before the meeting a paper by H. H. Clayton on "Variation in Solar Radiation and the Weather" (Smithsonian Misc. Coll., Vol. 71, No. 3).

The paper deals mainly with the statistical results obtained from the comparison of the variations of the observed values of solar radiation and the variations of temperature in Argentina, a comparison which leads the author to the conclusion that weather, as distinguished from climate, has its origin in the variations in solar radiation, and could therefore be forecasted if these variations were accurately known.

The results gain an additional interest from the use which the Director of the Argentine Weather Service has already made of them for forecasting temperature and rainfall. A decrease in solar radiation is followed by a fall of temperature in Central Argentina three or four days later, and consequently by rain at about the same interval; and as the radiation-values are available the day after observation, forecasts can be made for one or two days ahead.

An interesting question referred to in the discussion of the paper was that of finding a single index figure which would measure the degree of storminess in the atmosphere at any time, and the suggestion was made that such an index might be obtained by taking the "root mean square" of the departure of pressure from the normal for a *réseau* of stations over the Globe.

The meeting on Monday, February 21st, was devoted to Dr. G. C. Simpson's *Antarctic Meteorology*.* Mr. Lempfert

* A review of this work was published in the *Meteorological Magazine*, July 1920, p. 105.

gave an account of the work, laying special stress on the results obtained by the use of the Dines anemometer, on the scientific imagination with which the daily maps had been constructed, usually with observations for only three stations as far apart as Lerwick, Oxford and Hamburg, and on the theory of pressure waves put forward to explain the sequence of weather at these observing stations.

The view that the pressure "waves" were really highs and lows akin to those of our own latitude, but with a general drift from the South Pole over the Ross Sea, was put forward in the discussion, but Dr. Simpson was not able to accept it. With reference to the katabatic winds rolling off the great Antarctic Plateau to which the blizzards of McMurdo Sound had previously been attributed, Dr. Simpson pointed out that the orographical conditions would not favour such winds since the highest ground was generally along the edge of the plateau.

With reference to the account of the discussion of auroral observations at the Haldde Observatory (*Met. Mag.*, Feb. 1921, p. 7), Dr. Chree points out that the average height of the lower limit of the aurora was found to be at 108 km., not at 100 km. The azimuths of the ends of the bands were not reckoned from the magnetic meridian, but from the great circle through the poles of the first zonal harmonic in the Gaussian expression for the magnetic field of the whole earth.

The Royal Aeronautical Society.

A MEETING of this Society was held on February 3rd (Dr. G. C. Simpson, Director of the Meteorological Office, being in the chair), when Major Gordon Dobson gave a paper on *The Use of Meteorology to Aviation, and Vice Versâ.* The lecturer said that meteorology could aid aviation in two main ways, by providing a daily weather service and by issuing statistical information. He dealt chiefly with the first aspect of the subject, and discussed the essentials of an ideal weather service fully developed without restriction in finance. Such a service should give (1) the force and direction of the wind at various heights; (2) the levels of the cloud sheets; (3) an indication of the localities where low cloud reached to the ground or where fog existed; (4) a general forecast of the weather, especially with regard to squalls and thunderstorms, and could be provided either by the circulation of forecasts from a central office or by direct communication from places along the route to the starting point. Both systems depend ultimately on local observations. Various methods were available for obtaining upper air observations at a given place, but Major Dobson advocated the use of small kite balloons carrying instruments but not observers. The balloons should be stationed 30 to 50 miles off the line of the route to avoid the danger of collision, and one balloon to each 150 to 200 miles should suffice. Probably 10,000 feet would be a sufficient height to set as a limit to the observations, as commercial flying would presumably not be carried on at higher altitudes.

Colonel E. Gold emphasised the fact that observations, however numerous, made at stations along the line of a route could not in themselves be sufficient. Conditions have time to change, especially during a long flight, and more than half the accidents due to bad weather arise from conditions becoming bad during a flight, not through being so at the start. Colonel Gold gave an interesting illustration of this fact from his own experience in France during the war. A squadron of aeroplanes was about to start on an expedition in weather which would have been reported as satisfactory from anywhere in the neighbourhood or on the route. A forecast based on more extensive observations was, however, issued, and the squadron did not set out. Had they done so they would probably all have been lost, as severe weather came up in a short time. The forecast is therefore essential, and this must be based on a wider range of stations than those near a given route. Adequate upper air forecasts could be made from a comparatively small number of stations of the type suggested by Major Dobson, say 12 over Western Europe and four or five in the British Isles.

General Brancker said that meteorology was the life-blood of aviation. He did not, however, regard the prevention of accidents as the principal object of the meteorological service. Weather conditions would have to be studied and forecasted solely from the point of view of regularity of travel. He considered that intervals of 150 or 200 miles between reporting stations were too big, four being required on the London–Paris route (220 miles).

In summing up the discussion Dr. Simpson criticised the use of kite balloons as expensive and dangerous to aviators, and also as requiring considerable time to get results. He considered that the method of direct readings made on aeroplane flights was the best. He looked forward to the time when every pilot would be a meteorologist.

The Royal Meteorological Society.

A SPECIAL meeting of the Society was held on February 16th at 70, Victoria Street, S.W.2 (Mr. R. H. Hooker, President, in the chair), for the purpose of discussing a resolution by Capt. D. Brunt, who moved that it was desirable that the ordinary meetings should in future be held at 5 p.m. instead of 8 p.m. An amendment, moved by Mr. W. W. Bryant, that the matter should be referred to the fellows by means of a card-vote, was carried.

An ordinary meeting followed, at which Mr. M. de C. S. Salter read a paper on "A new method of constructing Average Monthly Rainfall Maps." The method of weighting short rainfall records in order to compute the equivalent value for a long period, although applicable to the construction of an average annual map, fails when applied to monthly maps on account of the greater variability of the fall over such short periods as a month. The factor of monthly rainfall which shows the simplest regional arrangement is the "isomeric" distribution of the average monthly rainfall. An isomeric rainfall map is constructed by plotting the percentage which the average rainfall in any month forms of the average in the whole year. On account of the simplicity of distribution isomeric maps can be constructed with fewer data than isohyetal maps which show the actual fall.

The method used was to construct a highly detailed isohyetal map of the average annual rainfall and to combine it successively with each of twelve monthly isomeric maps compiled from a smaller number of data. For the purpose of the annual map Dr. Mill's incomplete survey maps on the scale of 2 miles to one inch were copied on the scale of 20 miles to one inch, and supplemented by 1,160 additional points. The isomeric maps used were compiled from 550 monthly averages for the period 1881–1915.

The resultant average maps appear to have the advantage of a high general level of accuracy, whilst showing more detail than is feasible by any other method.

The discussion turned principally on the validity of the method Dr. G. C. Simpson expressed the belief that it should be capable of mathematical demonstration, and Mr. Whipple, Mr. Corless and the President discussed this aspect. Mr. Brooks drew attention to the fact that the method did not throw any light on the details of the orographical control of rainfall at different seasons. Mr. Glasspoole, who had taken a large part in the work, mentioned the severe test of the accuracy of the data which the method provided. He estimated that the annual map was built up from about 12,000,000 daily observations of rainfall, the equivalent of a year's work for 500 men.

An account of Mr. G. A. Clarke's paper on "An unusual Pilot Balloon Trajectory," was given by Mr. J. S. Dines.

The balloon in question was sent up at Aberdeen on June 30th, 1920, in the afternoon, and followed with a single theodolite. It ascended very slowly at first, so that after six minutes the elevation was only 4°. Subsequently the apparent rate of ascent increased and the elevation at the end of the eleventh minute was 12° 40′. Working up the observations on the usual assumptions of the one-theodolite method led to very improbable results, and the correct interpretation appears to be that there were actually vigorous downward and upward currents of about six miles an hour combined with the horizontal current of 24 miles an hour. The general direction of the wind was from WSW., a quarter which is notoriously squally at Aberdeen, and the author cites corroborative evidence for the irregularity of the wind on the particular day.

In the discussion Mr. J. S. Dines mentioned that he had not met with such strong vertical currents in his long series of observations with two theodolites. Mr. S. P. Holloway gave an account of observations made at Malin Head, when on one occasion a balloon was carried by the wind first out to sea and then back to land.

Correspondence.

To the *Editors*, "*Meteorological Magazine*."

Weather Lore.

YOUR correspondent in the January number of the *Meteorological Magazine*, page 281, says "The first half of the couplet (on the weather) is plausible enough; but does experience bear out the second line?"

In my long experience it does very fully, and even this spring I have seen my old version come quite true, "Evening grey and morning red, put on your hat or you'll wet your head," and the converse equally so, "Evening red and morning grey is a sure sign of a fine day."

"January warm, the Lord have mercy," is new, and quaint.

THEREZA STORY MASKELYNE.

Basset Down, Swindon, Wilts, February 18th, 1921.

REFERRING to the remarks on this subject in the *Meteorological Magazine* for January 1921, and with reference to the old proverb, " Red at night is the shepherd's delight, red in the morning the shepherd's warning," I may say my experience has proved the second half of this couplet to be more often correct than the first half, and that a red sunrise, especially in the winter time, invariably denotes wind and rain.

A good example took place here on January 5th last, when between 8 h. and 8 h. 20 m. the eastern sky was illumined by a brilliant red colour. During the forenoon the sky became cloudy to overcast, and by the afternoon rain had set in, and continued squally and wet throughout the night. On examination of the *Daily Weather Report* (British Section) for 7 h. of January 5th, a deep cyclone lay over Iceland, while the observer was situated on the extreme edge of the system of relatively high pressure lying to the south-east.

On January 21st a similar display occurred, but on this occasion a south-westerly gale (force 8) was in progress at the time of observation, and continued more or less throughout the day, with rain at times, culminating in the evening in heavy squalls of whole gale force (10 estimated). The phenomena should be recorded by observers. Three colours could be noted: (1) bright yellow, (2) light crimson, (3) dark red. The question is one that might be raised at the next international conference and suitable symbols provided.

C. F. PRIESTLEY.

" *Rockcliffe*," 20, *Murdieston Street, Greenock, February 7th*, 1921.

IN connection with the notes on Weather Lore in the January and February numbers the following adage, quoted in *Symons's Meteorological Magazine*, Vol. 4, p. 14, may not be without interest :—

" When January calends are summery, say
'Twill be winterly weather till calends of May."

JOHN GLASSPOOLE.

62, *Camden Square, N.W.*1, *March 9th*, 1921.

March Easters and Wet Summers.

FOR some reason or another, there seems to be a very marked relationship between March Easters and wet or " weak " summers. Out of the eleven Easters which have fallen in March during the last 50 years, *i.e.*, 1871–1920, only two have had dry summers, five have been wet and four have been conspicuous for rain, chill and gloom.

This induction certainly does not augur well for the coming season, and I hope it may be upset.

A. C. F. LUTTRELL.

Lea Combe House, Axminster, Devon, February 28th, 1921.

NOTES AND QUERIES.

Mirage on the Gulf of Finland, May 1st, 1919.

VARIOUS reports from meteorological logs are reproduced on the back of the *Meteorological Chart of the East Indian Seas* for March 1921. The following interesting note is taken from the Remark Book of H.M.S. "Cleopatra," dated May 1st, 1919, in Lat. 59° 47′ N., Long. 26° 5′ E :—

"The weather was fine, hot sun, bc., wind ESE., about 1–2, sea 1. Barometer 29·90 (55°), air 43° F., sea 39° F. The ice presented a curious mirage effect, being reflected upwards. When first sighted with the sun on it, it looked very like a continuous line of chalk cliffs in a slight haze; with the sun behind it, small detached pieces appeared as dark blurred objects which might be anything, and might be mistaken for land. On closing it, it was found to be floating not more than a foot or so above water. No appreciable change of temperature was experienced, although the wind was off the ice.

"A very curious effect—probably due to the hot sun on the water—was observed with regard to other ships. At 8.29, sun bearing S. 48° E. (true), the rear ship in the line bearing N. 21° E. 6,000 yards was distorted to about double its height; while the leading ship, bearing N. 35° E. 6,000 yards, was reduced in height, her quarter deck appearing almost awash. The remaining ships were very blurred and distorted, their heights being increased. Their shapes changed rapidly on approach, but did not become normal until within 2 miles."

The thermometer readings here stated do not suffice to provide the full explanation of the phenomena. It seems likely that there was, so to speak, a sandwich of very cold air, the temperature being 39° F. immediately over the water, about 32° F. in a shallow current blowing from the ice-field, and 43° F. at deck level. In such cases additional observations giving the temperature close to the water and at the highest accessible point would be of great value.

A point of considerable interest is the fact that the mirage was observed with the sun behind the ice floes, and that the floes appeared as black objects. In contrast with this observation, Dr. John Ball's remark* concerning the mirage of the desert may be quoted: "It may be mere accident, but the author has never observed a mirage under the sun's position, but always in that part of the horizon which lies away from it. The ordinary explanation of mirage does not appear to require any condition as to the sun's position in relation to the illusion."

* On the topographical and geological results of a reconnaissance survey of Jebel Garra, &c., Survey Department, Egypt, Cairo, 1902, p. 40. An instructive sketch of a mirage, worked up from a photograph, is reproduced in this Memoir.

Mirage across the Bay of Plenty.

Lt.-Col. D. C. Bates sends from New Zealand a cutting from the *Bay of Plenty Times* of December 6th, 1920:—

"Anyone who happened to be looking out to the eastward from the higher portions of the town yesterday afternoon between four and five o'clock might have observed a very unusual meteorological occurrence in these parts, due to an unusually refractive condition of the atmosphere. Colonel G. A. Ward, who had the good luck to see it, gives us the following notes:—'There appears to have been a layer or bank of air lying over the land and sea to the east of the town of most unusual refractive power. Looking across the harbour and narrow strip of mainland (Matapihi-Whareroa) between the harbour and the sea, from my residence, the island of Motiti is always plainly visible, and in a few places, through dips in the intervening low-lying land, small glimpses of the sea between. Of the curious and almost detached high lump at the south-east end of the island, only just the very top is normally visible, the distance being twelve miles. Plate Island, 21 miles away, is almost entirely hidden by the intervening land. Yesterday (Sunday) afternoon, between 4 and 5 o'clock, the whole of the three objects named and the intervening sea were, by an extraordinary effect of refraction, lifted into plain view, and in addition distorted by vertical extension to between two and three times their natural height; to such an extent was this done that, even viewed through powerful field glasses, details were scarcely recognisable owing to the blurred out-of-focus effect produced. A broad strip of blue sea intervened between the mainland and Motiti for its whole length, and even between the mainland and Plate Island a narrow strip of sea was visible at the base of the island, which loomed up like a great grey bulk, flanked on the left by two towering pinnacles and on the right by one, vertical optical extensions of normally small prominences. All this time there was a dark grey-blue band on the horizon, about as high as the islands appeared to rise. Soon after 4.30 this bank appeared to condense from the surface of the sea towards its upper margin, its colour along the top edge becoming much darker, till it resembled a thick dark-coloured cable stretched from island to island. This phase only lasted a few minutes, and then, beginning at the south-east end of the main portion of Motiti, it slowly faded out, as a chalk line would disappear on a blackboard if a sponge, invisible to the eye, were slowly passed along it. As this occurred the islands began to shrink down to their normal size and usual position, Motiti appearing to thin itself down to its usual height and settle back till most of its base was hidden by the intervening land, while Plate Island, like an island of one's dreams, sank slowly out of sight and disappeared. I may add that I have seen occasional freaks of refraction, but never before one to equal this, though I have read of such in other lands.

This morning, Monday, I notice refractive distortion becoming unusually prominent with the increasing heat of the day. At 7 a.m. Plate Island was not distinguishable; now, 10 a.m., about one-third of its height is thus made visible.'"

[The explanation of the black band which is such a remarkable feature of this interesting description may be as follows:—The light which reached the observer from the "band" must have come from a narrow strip of sky beyond the islands. The total amount of light being the same as would have been received from this strip in normal circumstances, whilst the apparent width was much greater, the intensity was reduced and the band appeared dark in contrast with the rest of the sky.—Ed. M.M.].

The Characteristics of Gales on the Coast of Venezuela.

A NOTE received from Senor L. Ugueto, Director of the Observatorio Cajigal, states that the season of gales on the coast of Venezuela extends normally from December to the middle of March, but occasionally begins even in October. The wind blows from west or north-west on several successive days, reaching a maximum in the afternoon or early evening, and falling off in the night and early morning. The winds are cold, bringing temperatures of 45° F. or even less, and humid, but they are accompanied by a clear sky with only a few cirrus or cirro-cumulus clouds. They are generally associated with a slight fall of the barometer. At other seasons of the year less violent winds from the same direction bring overcast skies and heavy rain.

The gales from east or south-east are less violent; they occur always between noon and 16 h., are warm and dry, with a clear sky, and have no appreciable relation to the barometer. They are evidently Föhn-like winds from the mountains of Macarao and Los Teques, which rise to 2,500 m. a few kilometres to the east-south-east.

Squalls at Night on the Lee Side of a Mountainous Island.

THE following extract from the meteorological log of the S.S. "Krasnoiarsk" (Captain W. Tingey; observer, Mr. E. J. Berry) is reproduced from the same chart as the note on p. 40:—

> "Whilst passing to the northward of Sokotra between 7 p.m. and 2.30 a.m. on August 5th and 6th, 1920, distance about 7 miles off, violent squalls were experienced, clearly defining the causes of wind. Between the squalls, which were of ½ to 1 hour duration, force of wind was about 2 to 3. The temperature was then about 80° F., which during the squalls fell to 74° F. The warm atmosphere seemed to be rising and forming cloud in the zenith, the cooler air rushing in to take its place sweeping obliquely from the mountains, causing squalls of about force 8. Before and after clearing the lee of the island the force of monsoon was 5."

Sokotra is an island in the Indian Ocean, about 200 miles from the Arabian coast. Its length from east to west is 71 miles, its greatest breadth 22. The peaks of the central mass rise to about 4,000 feet. The log of the "Krasnoiarsk" shows that the sea-temperature was about 70° F.

Solar Radiation and Sunspots.

NEW light on the cause of the variations in the intensity of the solar heat stream is thrown by recent comparisons*

* H. H. Clayton, "*Nature*," January 13th, 1921, p. 631.

between the positions of spots on the solar disc as recorded at the Observatory of the University of La Plata and the observation of solar radiation at the Smithsonian Solar Observatory at Calama, Chile. It is found that when spots are on the margin of the sun the total radiation is as much as ½ per cent. above the average, whilst spots in the centre of the disc bring the radiation slightly below the average. Mr. Clayton's theory to account for the former result is that when the solar eruptions which are known to surround regions where spots are numerous stretch out beyond the edge of the visible sun they increase the total radiation. On the other hand, with the spot in the middle of the sun's disc, absorption in the cold centre of the spot may, he thinks, reduce the total emergent radiation.

Soaring Flight: An Unsolved Riddle.

AN interesting paper, "The Problem of Soaring Flight," by Dr. E. H. Hankin, is published in the *Proceedings of the Cambridge Philosophical Society* for January 1921. Dr. Hankin has made careful observations not only of the soaring birds, but of flying-fishes and of dragon-flies, and in this paper he summarises his conclusions. He holds that neither occasional unobserved flapping of the wings nor the utilisation of atmospheric turbulence can provide an explanation of soaring. Against the latter hypothesis he cites, for instance, observations of the flight of vultures gliding in air so full of aerial seeds as to suggest a snowstorm, the floating seeds being in a slow equable movement that showed no turbulence. Dr. Hankin's conclusion is that soaring flight is inexplicable in the light of existing knowledge. "In the case of soaring flight at slow speed a proof exists that the energy involved is derived from the sun's rays. But the mode by which it becomes available to the soaring animal is, as yet, a complete mystery. Direct observation having failed to point the way to a solution, it is to be hoped that the subject will be attacked with the aid of an experimental investigation. It is only in this way that an explanation of the problem is likely to be attained."

The discovery that the flight of dragon-flies is of the same type as that of the great birds should facilitate experimental investigation. Another opening for research is afforded by his account of the *puttung*, a toy kite used by boys in India, which flies vertically over its string and even flies up wind when struck by a sudden gust. Such a kite should be brought into the service of the meteorologist.

The Parkin Prize.

THE following notice has been received from Dr. J. S. Fowler, Secretary of the Royal College of Physicians of Edinburgh :—

> In terms of the Bequest made to the Royal College of Physicians of Edinburgh by the late Dr. John Parkin, Fellow of the College, a Prize is offered for the best Essay on certain subjects connected with Medicine.
>
> The subject of the Essay for the present period is, in the terms of the deed :—
>
> "On the effects of volcanic action in the production of epidemic diseases in the animal and in the vegetable creation, and in the production of hurricanes and abnormal atmospherical vicissitudes."
>
> The prize is of the value of One Hundred Pounds, and is open to Competitors of all Nations.
>
> Essays, which must be written in English, must be received by the Secretary not later than December 31st, 1921. Each Essay must bear a motto, and be accompanied by a sealed envelope bearing the same motto outside and the author's name inside.
>
> The successful Candidate must publish his Essay at his own expense, and present a printed copy to the College within three months after the adjudication of the Prize.

It may be recalled that Dr. Parkin (1801–86) was a London physician and twice visited the West Indies, on the second occasion as an agent of the Government, to study and combat disastrous outbreaks of cholera. He became convinced that cholera was in some measure due to the atmospheric conditions which attend or follow volcanic disturbances. Hence his bequest of 1,500*l.* to the Royal College of Physicians of Edinburgh for founding the Prize, the competition for which is now announced. It is understood that a similar bequest was made to the Académie des Sciences, Paris.

A Safe Place for the Grass Minimum Thermometer.

IT is customary to caution observers not to leave grass minimum thermometers exposed during the day. The Meteorological Office is now supplying a suitable fitting, a little piece of wood with a hole through the middle, to be screwed inside the Stevenson screen so that the thermometer can be kept safely in the correct position, *i.e.*, bulb downwards, when not in use. The thermometer leans against the corner of the screen with the bulb resting in a little cup.

Reviews.

Clouds; a descriptive illustrated guide-book to the observation and classification of Clouds. Geo. Aubourne Clarke. 8vo, pp. xvi + 136. Constable and Co., 1920. Price 21s. net.

THE development of aviation in recent years, coupled with the many observations made with pilot balloons and in other ways, has added so much to our knowledge of the atmosphere that all textbooks on that subject have become more or less out of date. Hence the publication of a new book on clouds, written by a professional observer and introduced by Sir Napier Shaw as "a substantial addition to the growing edifice of the study of weather," raises great hopes in the mind of a student of meteorology. The author himself describes it as an explanatory guide-book to cloud observation prepared chiefly for those who are engaged in the teaching of meteorology. As such, we naturally look for some description of the methods employed and turn to the first chapter, entitled "The observation of the clouds," to find nothing but a short introduction to the International Classification which follows in detail in Chapter II. This is succeeded by four other chapters which are brief essays on the subjects they deal with, embodying some of the discoveries made in the last few years, and therefore giving on those points information which is otherwise only to be culled from original papers. We note for special commendation the passages in Chapter IV. dealing with the vertical temperature gradient, or lapse-rate, and its relation to cloud formation. On page 71 the author points out that whereas ascending air may be cooled as little as 3° F. per 1,000 feet of ascent, descending air must be warmed at the adiabatic rate of 5½° F. per 1,000 feet. This is true of dry air, but not if cloud particles are evaporated in the process.

The two chapters which follow are comparatively slight, dealing mainly and shortly with the distribution of clouds over the British Islands during different types of weather. Frequent references to other works are given, but the teacher is not spared from the necessity of looking them up.

These chapters are clearly written and illustrated by sufficient diagrams, but we doubt if the coloured plates add much to the attractiveness of the interesting letterpress.

The best part of the whole book is reserved for Section II., which consists of about 70 excellent photographs of clouds, many of which are most beautifully reproduced. Here we have a real guide to the names of clouds, which an observer will find useful enough. Each photograph has a short description appended, in many cases with notes of the attendant weather. In the introduction the author says " they represent a selection from several hundred pictures taken at Aberdeen by methods which were varied so as to give the best possible representation of each particular type." But there is no description of even one of those methods! If the author would substitute for the chapter which he calls " The observation of the clouds " a clear description of the apparatus used (such as the nephoscope), and how to use it, together with directions for making records and taking satisfactory photographs, his book might become a guide of real value to those for whose use it is intended.

The high cost of everything just now suggests that good photographic illustration must be expensive, but few teachers will be ready to pay a guinea for a book which only deals with a part of meteorology. In my opinion it would have been wiser, therefore, to have omitted the plates in Section I., and even to have sacrificed some of the duplicates in Section II. if by those means the price could have been substantially reduced.

Anyone would be glad to possess the book as it is, but the best part is Section II., and we should be glad to see that more generally available. A. W. CLAYDEN.

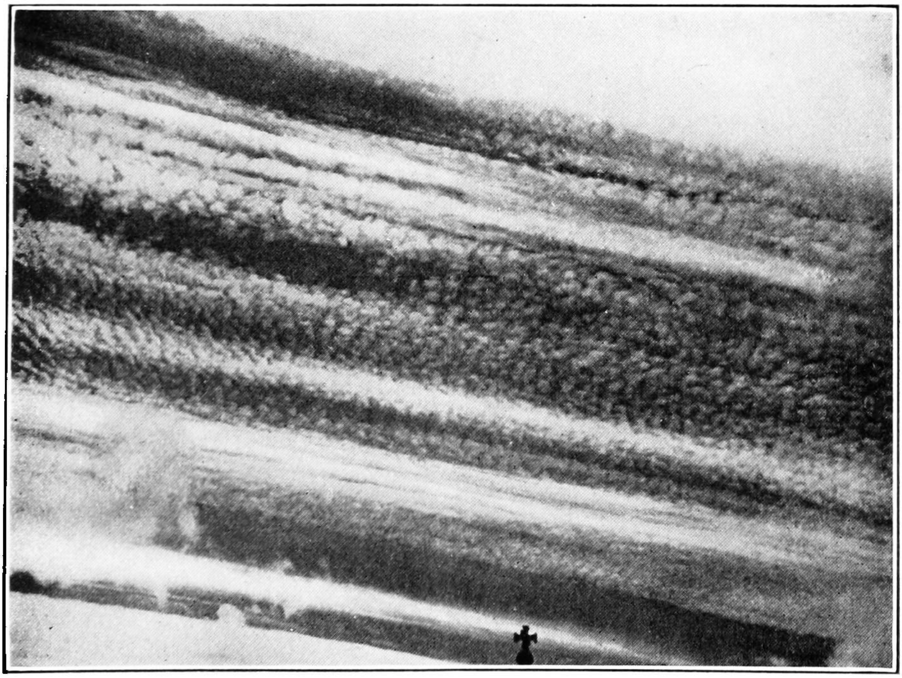
[By the courtesy of Messrs. Constable we are able to give reproductions of two illustrations from " Clouds." The notes printed with these illustrations are as follows :—

" A. *Cirro-cumulus.*—Intensely white high cloud in radiating bands, At the upper left-hand corner it will be seen that the cloud is opening up into the familiar globular masses of cirro-cumulus. The height of these bands was probably about 20,000 feet, while the broken cumulus below was not more than 5,000 feet high.

B. *Cirro-cumulus.*—The same bands mentioned above as they appeared some time later and in a different part of the sky, which accounts for their different apparent orientation. The character of cirro-cumulus is now well developed and wave motion can be seen in the bands both longitudinally and transversely. These bands were not less than 250 miles in length."]

O problema das seccas do Nordeste resolvido por Luiz Mariano de Barros Fournier. (The Problem of Drought in North-east Brazil.) Rio de Janeiro, 1920. Size 8vo, pp. 166.

THIS pamphlet has been published by the author, who is a cavalry officer with a training in engineering, with a view to interesting the world at large in his project for solving the problem of the deficient rainfall in the north-east of



CIRRO-CUMULUS CLOUDS.

ILLUSTRATIONS FROM "CLOUDS" BY G. A. CLARKE, F.R.P.S., F.R.Met.Soc.

(Published by Constable and Co., Ltd. 21s. net. Postage extra.)

Brazil. The area affected—400,000 square miles in the States of Bahia, Piauhy, Maranhão and Ceará—has an annual rainfall of less than 1,000 mm. (40 inches), which is barely sufficient in a tropical country, and in addition fluctuates widely, so that at average intervals of about five years the rains fail and widespread distress ensues. The author's solution is to build a dam nearly 44 miles long near Quixeramobim, so reversing the flow of a number of streams and forming a reservoir with an area of about 1,500 square miles. The evaporation from this reservoir is expected to provide a sufficient increase of rainfall to carry the region above the fear of drought, and in addition the seepage will benefit the surrounding soil.

The meteorological parts of the book are written in a general way, which make detailed criticism difficult, but it may be remarked that meteorological experience is decidedly against expecting any appreciable amelioration from the presence of such a comparatively small water surface. The pamphlet is a remarkable parallel to a book with a similar object recently published by E. H. L. Schwartz,* of South Africa, and reviewed in the January number of the *Quarterly Journal of the Royal Meteorological Society.*

Climatic Cycles and Tree-Growth, by Professor A. E. Douglass. Publication No. 289 of the Carnegie Institution of Washington. Size 10 × 7, pp. 127, 12 plates. Washington, 1919.

PROFESSOR DOUGLASS's study of the annual rings of trees in relation to climate and solar activity has overcome to a considerable extent the difficulties Sir Robert Christison foresaw when he first brought the question before the Scottish Meteorological Society in 1880. The first tree-section considered was the yellow pine of the arid regions of Flagstaff, Arizona, where the critical problem of the tree is to survive periods of drought. The annual increments are recognised by the rings or red tissues which denote the close of the annual period of growth, the tree's year ending in the autumn. The degree of accuracy with which these tree-growths represent the annual rainfall was found to be as much as 70 per cent. in recent years, and this accuracy presumably extends over centuries. The agreement was substantially increased by the use of a formula involving a correction for moisture conservation. Trees from other areas, including Europe, were also examined (*see* this Magazine, Vol. 50 (1915), page 21).

* *The Kalahari, or Thirstland Redemption.* Cape Town and London, 1920.

Difficulty was experienced in the identification of the series of yearly rings. With scanty winter and summer precipitation the rings were meagre, there being no additional growth for the summer rains. Double rings occurred with spring drought and were indicative of the distribution of the rainfall throughout the year. Trees which grew on hills, relying on the snow and rain as it came, showed great variation; those of the valleys showed slight variation from year to year. In some of the older trees a change from one type to the other was noticed. The major characteristics of the trees in mountain regions were alike over distances of 56–60 miles.

While the trees of drier climates showed conspicuously a relation to the rainfall, the wet climate trees prominently indicated the solar rhythm in their growth, and this became more certain as the tree record extended further back. This and "the suggestive correlation existing in the dates of maxima and minima found in the tree growth, rainfall, temperature and solar phenomena point towards a physical connection between solar activity and terrestrial weather."

Details are given of the elaborate methods employed, including the "automatic optical periodograph" used in the analysis of the periods, together with tables of mean tree growths for various districts for each year as far back in one case as B.C. 1220, and a most comprehensive bibliography of the subject. J. G.

Obituary.

News is received of the death, on January 25th, 1921, of *Señor Tomás de Azcárate* in his 72nd year. He was for eighteen years director of the San Fernando *Instituto y Observatorio de Marina*, an important centre for meteorological, magnetic and seismic observations.

The death, on February 16th, 1921, of *Mr. Charles Grover* is announced. Mr. Grover, who was in his 79th year, was astronomical assistant and meteorological observer to the late Sir C. E. Peek, Bart., of Rousdon, Devon, and had been in charge of the instruments there for many years. The observations from Rousdon, which have been utilised at the Meteorological Office since 1886, cease with Mr. Grover's death.

The death of *Mrs. H. Edith Purchas*, of Chasedale, Ross-on-Wye, on February 17th, 1921, is reported. In 1914

Mrs. Purchas organised a meteorological station in conjunction with Mr. F. J. Parsons, and whilst he was on service with the Meteorological Section, R.E., she accepted full responsibility for the observations, and in spite of her years took a majority of the readings, three times a day, herself. The combination of a high sense of duty with much kindliness was characteristic of a charming personality.

News in Brief.

The Observatorio Meteorologico la escuela Normal de Varones, Honduras, Central America, commenced in August 1920 the publication of a Monthly "Boletin," of which two numbers have now been received. The greater part of the publication is devoted to the daily observations, taken at 7, 14 and 21 h., and completed by self-recording instruments, but in addition there are articles on the barometric formula and on local geography. Observations from a well-equipped station in this meteorologically little known region were greatly to be desired, and it is to be hoped that the "Boletin" will continue to appear regularly.

On March 9th, at the Cambridge University Aeronautical Society, Sir Napier Shaw, F.R.S., delivered a lecture on "The Artificial Control of the Weather." A report of the paper will be given in the next issue of this magazine.

On February 27th the barometer at Valencia Observatory rose to 1048·3 mb. The highest recorded reading at Valencia is 1053·2 mb. on January 28th, 1905, and the highest for the British Isles is 1055 mb. at Aberdeen on January 31st, 1902.

From 2 h. on February 1st until 10 h. on February 3rd (56 hours) "dead calm" was registered continuously by the anemometer at Alnwick Castle, Northumberland; and at the Groyne Lighthouse, South Shields, no wind above five miles per hour was registered during the same period.

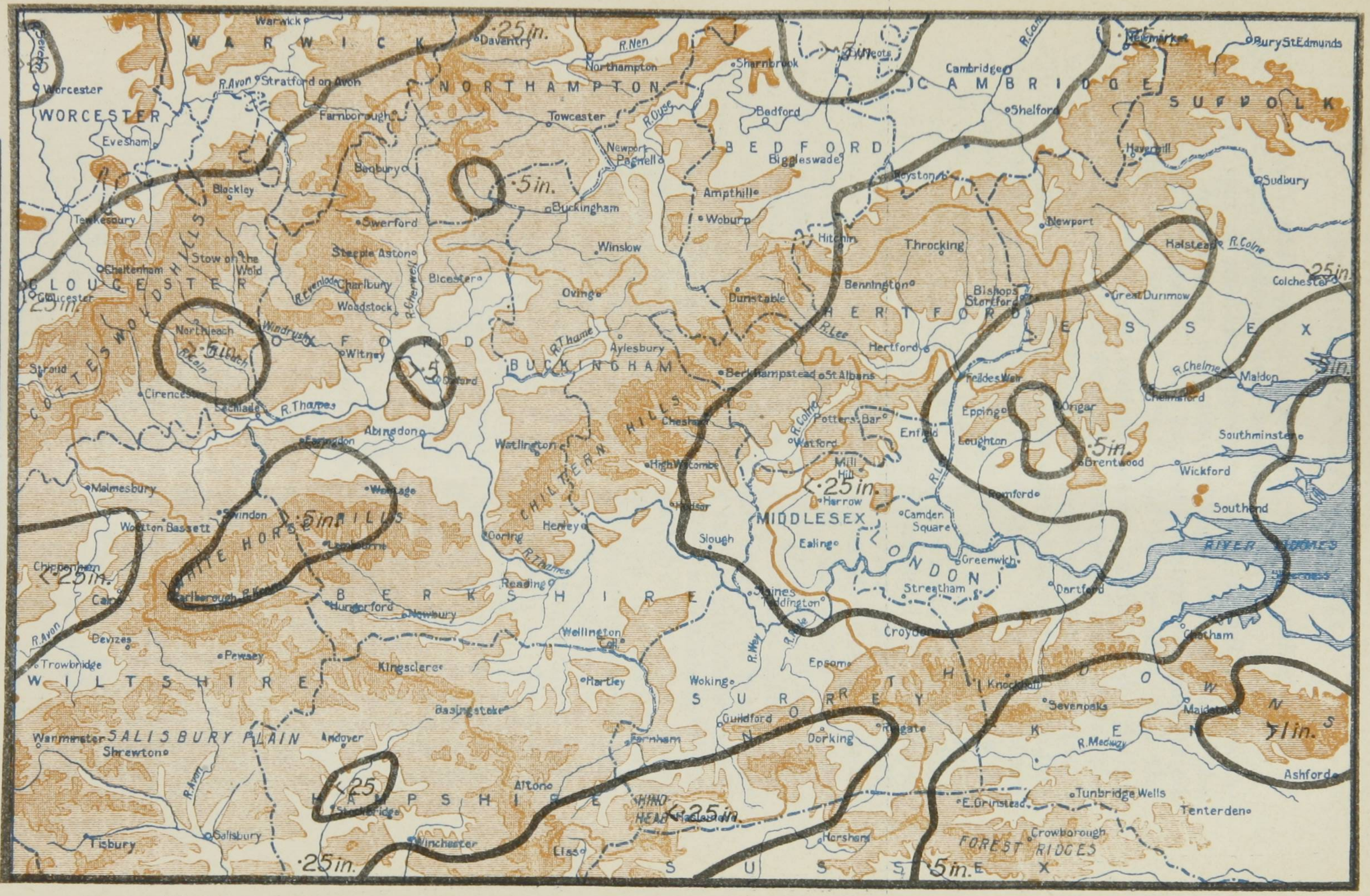
Earthquake Record.—A moderate earthquake was recorded on the seismograph at Eskdalemuir, in S.W. Scotland, on Sunday, February 27th, at 18 h. 36 m. It is calculated that the centre of the disturbance was approximately 1,790 kilometres distant in a south-easterly direction, *i.e.*, in the neighbourhood of Central Italy.

The Weather of February 1921.

THE pressure distribution over west and north-west Europe during the month was largely dominated by a series of important anticyclones. In consequence, strong winds and gales were rare, and the rainfall was small except in the Mediterranean area. Temperature was mostly high for the time of year in western Europe and Iceland, but severe frost prevailed at times over Sweden. Depressions followed paths well to the northward or southward of the British Isles.

A depression which arrived from the Atlantic on the closing day of January, became stationary over Northern England and filled up, and a short spell of quiet weather with local frost and fog over the British Isles followed. Meanwhile a secondary moved eastward over France to Central Europe before filling up, causing rain or snow at several stations. A small anticyclone over Scandinavia increased in size and intensity, and was the dominant feature of the pressure distribution from the 4th to the 9th of the month. From the 5th to the 8th there was a spell of east wind over England, with cold dull weather, but no frost, though over Central Europe there was frost and occasional snow. The west of Ireland came under the influence of Atlantic depressions, and there was a good deal of rain, Valencia Observatory having 16 mm. on the 3rd, 26 mm. on the 4th, and 18 mm. on the 7th. One of these systems caused a southerly gale in West Ireland on the 4th, and in the western part of the English Channel on the 5th before it filled up, and there was also a southerly gale on the latter date in Caithness and the Shetlands. Pressure remained low over Iceland, and on the morning of the 8th there was a shallow secondary trough over Ireland, with cold air behind it. This system dispersed, and a large new anticyclone developed rapidly over Ireland, while the Scandinavian anticyclone moved quickly away south-eastward owing to the appearance of a depression over the North Cape. Pressure exceeded 1044 mb. over most of Ireland and south-west Scotland on the morning of the 10th, and subsequently the anticyclone withdrew to a position off north-west Ireland and remained almost stationary till the 17th, decreasing slowly in intensity. A warm current from the Atlantic spread round the stationary anticyclone, and the weather became unseasonably mild over Western Europe, and especially over the British Isles, although the sky was mainly overcast. In Sweden there was some severe frost, the temperature being −22° F. at Saerna on the morning of the 15th. A depression which moved east-south-east from Iceland caused a total rainfall of 34 mm. of rain at Lerwick

THAMES VALLEY RAINFALL.—FEBRUARY, 1921.



ALTITUDE SCALE Below 250 feet | 250 to 500 feet | 500 to 1000 feet | Above 1000 feet

SCALE OF MILES 0 5 10 15 20

Meteorological Magazine.

Watershed of River Thames above Teddington, and River ... Isohyetals

H.M. Stationery Office Press, Kingsway W.C.2.

Ps. 5550/203. Wt. 105. P35. 1250. 3/21.

on the 14th and 15th, and smaller falls in other parts of Scotland and in Scandinavia and Germany.

In the rear of another depression which moved east-south-east from Iceland, an important change took place in the distribution of pressure. The highest pressure was transferred from south-west Ireland to Scotland by the 18th, and the system withdrew to east central Europe by the 22nd. Severe frost set in over southern Poland and eastern Czecho-Slovakia, with a temperature about 0° F. on several successive mornings. Over western Europe there was a south-east current, with fine weather and frosty nights but warm days. The daily range of temperature was unusually high, being as much as 33° F. at South Farnborough on the 22nd. On the two following days temperature reached 60° F. at a few stations in England and France. On the 25th a large anticyclone developed rapidly off south-west Ireland. There was a warm southerly current over western Europe, and the cold current in front of the fresh anticyclone displaced this and caused rain over the British Isles and North France between the 24th and 26th, and local thunder in England on the night of the 24th. The rainfall on the 25th exceeded 20 mm. locally in south-east England, and was the only important fall in the whole month in that area. On the 26th the barometer at Valencia Observatory reached 1048 mb., but the anticyclone soon moved south and decreased in intensity, and on the 28th a mild westerly current was again established over north-west Europe, with rain in north and west Scotland, and in Norway.

In the Mediterranean area shallow depressions caused some heavy rainstorms, particularly in the first half of the month. There were heavy falls of rain in Italy and South France, and Sanguinaire (Corsica) received 32 mm. on the 5th and 60 mm. on the 6th. At Gibraltar there were 51 mm. on the 10th and 102 mm. on the 11th; the rainstorm was accompanied by a south-east wind which reached the force of a strong gale on the evening of the 11th, and thunderstorms were reported on the 11th both at 7 h. and 18 h., and also at 7 h. on the 12th. At this time there was a shallow depression over Morocco, and this with the anticyclone lying over Ireland led to a cold north-east current over France and Spain, Madrid reporting "snow-lying" on the morning of the 11th. After the 20th the anticyclone over Central Europe extended over Italy, but shallow depressions over north-west Africa and associated secondaries caused further heavy local rainstorms further west, Madrid having 26 mm. on the 26th. A cold north-east wind prevailed in Athens from the 23rd to the 25th, with maximum temperature below 40° F. on these three days and slight snow on the evening of the 23rd.

(*Continued on* p. 56.)

Rainfall Table for February 1921.

STATION.	COUNTY.	Aver. 1881—1915.	1921.		Per cent. of Av.	Max. in 24 hrs.		No. of Rain Days.
		in.	in.	mm.		in.	Date.	
Camden Square	*London*	1·67	·18	5	11	·15	25	4
Tenterden (View Tower)	*Kent*	1·97	·64	16	32	·43	25	8
Arundel (Patching Farm)	*Sussex*	2·21	·79	20	36	·50	25	2
Fordingbridge (Oaklands)	*Hampshire*	2·49	·39	10	16	·17	24	8
Oxford (Magdalen College)	*Oxfordshire*	1·58	·56	14	35	·29	25	6
Wellingborough (Swanspool)	*Northampton*	1·61	·30	8	19	·26	25	4
Hawkedon Rectory	*Suffolk*	1·52	·14	4	9	·10	25	5
Norwich (Eaton)	*Norfolk*	1·64	·33	8	20	·10	11	9
Launceston (Polapit Tamar)	*Devon*	3·21	·22	6	7	·13	24	4
Sidmouth (Sidmount)	,,	2·50	·38	10	15	·24	25	3
Ross (Chasedale Observatory)	*Herefordshire*	2·01	·16	4	8	·15	25	2
Church Stretton (Wolstaston)	*Shropshire*	2·20	·37	9	17	·23	25	3
Boston (Black Sluice)	*Lincoln*	1·46	·44	11	30	·28	25	5
Worksop (Hodsock Priory)	*Nottingham*	1·54	·20	5	13	·16	25	3
Mickleover Manor	*Derbyshire*	1·65	·34	9	21	·27	25	5
Southport (Hesketh Park)	*Lancashire*	2·10	·38	10	18	·27	24	5
Harrogate (Harlow Moor Ob.)	*York, W. R.*	2·09	·14	4	7	·04	25	7
Hull (Pearson Park)	,, *E. R.*	1·66	·30	8	18	·13	25	8
Newcastle (Town Moor)	*North'land*	1·59	·20	5	13	·05	6	7
Borrowdale (Seathwaite)	*Cumberland*	11·87	1·30	33	11	..	..	..
Cardiff (Ely Pumping Stn.)	*Glamorgan*	3·00	·06	2	2	·02	24	5
Haverfordwest (Gram. Sch.)	*Pembroke*	3·48	·32	8	9	·14	24	5
Aberystwyth (Gogerddan)	*Cardigan*	3·17	·41	10	13	·27	24	3
Llandudno	*Carnarvon*	2·08	·39	10	19	·32	24	4
Dumfries (Cargen)	*Kirkcudbrt.*	3·88	·42	11	11	·18	23	6
Marchmont House	*Berwick*	2·08	·60	15	29	·34	1	5
Girvan (Pinmore)	*Ayr*	4·27	·98	25	23	·42	24	13
Glasgow (Queen's Park)	*Renfrew*	2·94	·83	21	28	·36	24	9
Islay (Eallabus)	*Argyll*	4·19	2·68	68	64	·49	15	17
Lochgilphead	,,	4·74	4·19	221	56	·53	..	..
Loch Dhu	*Perth*	7·45	2·50	64	34	·60	15,28	11
Dundee (Eastern Necropolis)	*Forfar*	1·88	·46	12	24	·21	24	7
Braemar (Bank)	*Aberdeen*	2·73	·56	14	21	·45	24	4
Aberdeen (Cranford)	,,	2·32	1·13	29	49	·26	6	11
Gordon Castle	*Moray*	1·92	·45	11	23	·24	24	7
Fort William (Atholl Bank)	*Inverness*	7·42	3·79	96	51	·81	15	15
Alness (Ardross Castle)	*Ross*	3·30	·88	22	27	·27	24	11
Loch Torridon (Bendamph)	,,	7·90	3·70	94	47	·61	15	17
Stornoway	,,	4·46	2·52	64	57	·38	3	19
Wick	*Caithness*	2·27	1·13	29	50	·34	24	16
Glanmire (Lota Lodge)	*Cork*	3·95	2·43	62	62	·75	7	8
Killarney (District Asylum)	*Kerry*	5·22	3·32	84	64	1·75	4	11
Waterford (Brook Lodge)	*Waterford*	3·26	2·34	59	72	·55	23	7
Nenagh (Castle Lough)	*Tipperary*	3·12	1·86	47	60	·82	4	13
Ennistymon House	*Clare*	3·40	2·52	64	74	1·09	4	11
Gorey (Courtown House)	*Wexford*	2·81	1·11	28	40	·35	4	7
Abbey Leix (Blandsfort)	*Queen's Co.*	2·68	1·12	28	42	·35	7, 24	10
Dublin (FitzWilliam Square)	*Dublin*	1·89	·70	18	37	·30	24	7
Mullingar (Belvedere)	*Westmeath*	2·78	·34	9	12	·22	24	5
Woodlawn	*Galway*	2·97	1·49	38	50	·50	4	13
Crossmolina (Enniscoe)	*Mayo*	4·46	2·57	65	58	·72	4	12
Collooney (Markree Obsy.)	*Sligo*	3·43	1·94	49	57	·72	4	13
Seaforde	*Down*	3·05	·84	21	28	·39	3	5
Ballymena (Harryville)	*Antrim*	3·24	1·44	37	44	·41	24	11
Omagh (Edenfel)	*Tyrone*	2·98	1·01	26	34	·33	3	13

Supplementary Rainfall, February 1921.

Div.	STATION.	RAIN. in.	RAIN. mm.
II	Ramsgate	·65	16
,,	Sevenoaks, Speldhurst	·69	18
,,	Hailsham Vicarage	·77	20
,,	Totland Bay, Aston	·19	5
,,	Ashley, Old Manor Ho.	·27	7
,,	Grayshott	·20	5
,,	Ufton Nervet	·32	8
III.	Harrow Weald, Hill Ho.	·18	5
,,	Pitsford, Sedgebrook	·31	8
,,	Chatteris, The Priory	·49	12
IV.	Elsenham, Gaunts End	·12	3
,,	Lexden, Hill House	·16	4
,,	Aylsham, Rippon Hall	·46	12
,,	Swaffham	·31	8
V.	Devizes, Highclere	·45	11
,,	Weymouth	·30	8
,,	Ashburton, Druid Ho.	·30	8
,,	Cullompton	·26	6
,,	Hartland Abbey	·27	7
,,	St. Austell, Trevarna	·59	15
,,	North Cadbury Rec.	·24	6
,,	Cutcombe, Wheddon Cr.	·18	5
VI.	Clifton, Stoke Bishop	·29	7
,,	Ledbury, Underdown	·23	6
,,	Shifnal, Hatton Grange	·31	8
,,	Ashbourne, Mayfield	·29	7
,,	Barnt Green, Upwood	·15	4
,,	Blockley, Upton Wold	·31	8
VII.	Grantham, Saltersford	·33	8
,,	Louth, Westgate	·42	11
,,	Mansfield, West Bank	·31	8
VIII.	Nantwich, Dorfold Hall	·29	7
,,	Bolton, Queen's Park	·44	11
,,	Lancaster, Strathspey	·31	8
IX	Wath-upon-Dearne	·21	5
,,	Bradford, Lister Park	·13	3
,,	West Witton	.08	2
,,	Scarborough, Scalby	·36	9
,,	Ingleby Greenhow	..	..
,,	Mickleton	·20	5
X.	Bellingham	·30	8
,,	Ilderton, Lilburn	·17	4
,,	Orton	·15	4
XI.	Llanfrechfa Grange	·11	3
,,	Treherbert, Tyn-y-waun	·22	6
,,	Carmarthen, The Friary	·22	6
,,	Fishg'rd, Goodwick Stn.	·43	11
,,	Lampeter, Falcondale	·36	9
,,	Crickhowell, Talymaes	1·00	25
,,	B'ham W.W., Tyrmyndd	·30	8
,,	Lake Vyrnwy	·39	10
,,	Llangynhafal, P. Drâw	·59	15
,,	Oakley Quarries	·93	24
,,	Dolgelly, Bryntirion	·82	21
,,	*Snowdon, L. Llydaw	2·23	57
,,	Lligwy	·40	10
XII.	Stoneykirk, Ardwell Ho.	·71	18
,,	Carsphairn, Shiel	1·72	44

Div.	STATION.	RAIN. in.	RAIN. mm.
XII.	Langholm, Drove Rd.	·38	10
XIII.	Selkirk, Hangingshaw	·47	12
,,	North Berwick Res.	·30	8
,,	Edinburgh, Royal Ob.	·51	13
XIV.	Biggar	·5[illegible]	14
,,	Leadhills	2·04	52
,,	Maybole, Knockdon	1·57	40
XV.	Dougarie Lodge	1·24	32
,,	Inveraray Castle	2·76	70
,,	Holy Loch, Ardnadam	2·98	76
XVI.	Loch Venachar	1·20	30
,,	Glenquey Reservoir	1·20	30
,,	Loch Rannoch, Dall	1·50	38
,,	Trinafour	1·29	33
,,	Coupar Angus	·42	11
,,	Montrose Asylum	·45	11
XVII.	Logie Coldstone, Loanh'd	·44	11
,,	Fyvie Castle	·60	15
,,	Grantown-on-Spey	·70	18
XVIII.	Cluny Castle	1·44	37
,,	Loch Quoich, Loan	14·28	363
,,	Drumnadrochit	1·09	28
,,	Arisaig, Faire-na-Sguir	3·73	95
,,	Skye, Dunvegan	3·46	88
,,	Glencarron Lodge	6·82	173
,,	Dunrobin Castle	·82	21
XIX.	Tongue Manse	1·34	34
,,	Melvich Schoolhouse	·95	24
,,	Loch More, Achfary	6·31	160
XX.	Dunmanway Rectory	3·74	95
,,	Mitchelstown Castle	1·95	50
,,	Gearahameen	4·50	114
,,	Darrynane Abbey	3·83	97
,,	Clonmel, Bruce Villa	2·03	52
,,	Cashel, Ballinamona	1·72	44
,,	Roscrea, Timoney Pk.	1·15	29
,,	Foynes	2·90	74
,,	Broadford, Hurdlesto'n	2·16	55
XXI.	Kilkenny Castle	1·74	44
,,	Rathnew, Clonmannon	·84	21
,,	Hacketstown Rectory	1·74	44
,,	Ballycumber, Moorock	..	..
,,	Balbriggan, Ardgillan	·76	19
,,	Drogheda	·88	22
,,	Athlone, Twyford	·76	19
,,	Castle Forbes Gdns.	·67	17
XXII.	Ballynahinch Castle	2·35	60
,,	Galway Grammar Sch.	1·84	47
,,	Westport House	2·59	66
XXIII.	Enniskillen, Portora	·73	18
,,	Armagh Observatory	·98	25
,,	Warrenpoint	·99	25
,,	Belfast, Cave Hill Rd.	·78	20
,,	Glenarm Castle	·70	18
,,	Londonderry, Creggan	1·53	39
,,	Sion Mills	1·18	30
,,	Milford, The Manse	1·67	42
,,	Killybegs, Rockmount	2·90	74

* January, 29·11 in. 739 mm.

Climatological Table for the

STATIONS	PRESSURE		TEMPERATURE							
			Absolute				Mean Values			
	Mean of Day M.S.L. mb.	Diff. from Normal mb.	Max. °F.	Date	Min. °F.	Date	Max. °F.	Min. °F.	½ max. and min. °F.	Diff. from Normal °F.
London, Kew Observatory	1017·4	+0·6	72	12	40	13	64·6	49·6	57·1	0·0
Gibraltar	1016·9	+1·1	83	6, 9	58	24	79·5	68·0	73·7	+1·5
Malta	1017·4	+1·7	84	10, 11	69	25	80·6	71·1	75·9	+0·7
Sierra Leone	1013·3	+0·7	87	18,19,28	68	9	84·4	71·5	77·9	−1·2
Lagos, Nigeria	1014·1	+1·3	87	18	71	9	82·4	73·2	77·8	−0·3
Kaduna, Nigeria	1014·6	+3·1	89	6	63	1	83·9	66·4	75·1	−1·7
Zomba, Nyasaland	1012·8	−1·0	89	15,26,27	55	3, 7, 9	84·4	59·6	72·0	+2·9
Salisbury, Rhodesia	1012·9	−2·4	90	17	46	5, 6	85·8	53·1	69·5	+3·7
Cape Town	1017·4	−1·7	81	27	40	3	64·2	51·0	57·6	−0·3
Johannesburg	1016·1	−1·0	80	24	39	14	72·6	48·3	60·5	+1·2
Mauritius	..	..	..	..	..	..	..	..	..	..
Bloemfontein	1013·0	−2·0	83	23	31	15	72·2	43·4	57·8	−1·3
Calcutta, Alipore Obsy.	1002·9	−1·6	93	6	76	16	89·2	79·0	84·1	+1·1
Bombay	..	..	90	..	76	..	86·6	78·1	82·3	+1·6
Madras	..	..	103	30	74	21	95·7	78·8	87·3	+2·2
Colombo, Ceylon	1010·1	+0·5	87	13	73	21	85·3	76·4	80·9	−0·5
Hong Kong	1006·9	−1·4	90	3	73	12	85·6	77·6	81·6	+0·6
Sydney	1018·3	+2·3	79	7	44	27	66·9	51·5	59·2	+0·2
Melbourne	1018·5	+2·7	72	29	36	23	62·6	47·6	55·1	+1·1
Adelaide	1018·8	+1·3	77	29	40	27	64·8	49·5	57·1	+0·1
Perth, Western Australia	..	..	..	..	..	..	..	..	..	..
Coolgardie	1016·2	−0·9	89	22	37	30	72·7	47·3	60·0	+1·4
Brisbane	1018·3	+1·2	83	25	51	24	73·9	56·2	65·1	−0·2
Hobart, Tasmania	1016·1	+5·4	69	28	36	19	60·0	44·6	52·3	+1·5
Wellington, N.Z.	1016·0	+2·5	63	27	33	5	55·6	44·0	49·8	−1·7
Suva, Fiji	1013·7	−0·6	85	13	64	10	78·4	69·1	73·7	−0·8
Kingston, Jamaica	1012·8	+0·2	94	14	72	13	90·3	73·7	82·0	+0·5
Grenada, W.I.	1011·7	−0·1	89	5, 7	72	2, 3, 21	85·5	74·7	80·1	−0·1
Toronto	1015·8	−2·0	87	12	37	19	74·9	52·8	63·9	+4·7
Winnipeg	1010·2	−4·6	85	13	34	28, 29	70·9	48·0	59·5	+6·1
St. John, N.B.	1013·9	−3·6	79	26	37	20	63·5	49·8	56·7	+0·8
Victoria, B.C.	1012·1	−4·4	74	1	46	4	60·7	49·2	54·9	−0·7

LONDON, KEW OBSERVATORY.—Mean speed of wind 5·3 mi/hr ; 5 days with fog.
MALTA.—Prevailing wind direction NW. ; mean speed 3·4 mi/hr.
SIERRA LEONE.—Prevailing wind direction SW. ; 8 days with thunder heard.
SALISBURY, RHODESIA.—Prevailing wind direction NE. ; 1 day with thunder heard.
COLOMBO, CEYLON.—Prevailing wind direction SW. ; mean speed 6·0 mi/hr.

British Empire, September 1920.

TEMPERATURE Absolute Max. in Sun ° F.	TEMPERATURE Absolute Min. on Grass ° F.	Relative Humidity %	Mean Cloud Am'nt 0–10	PRECIPITATION Amount in.	PRECIPITATION Amount mm.	PRECIPITATION Diff. from Normal mm.	PRECIPITATION Days	BRIGHT SUNSHINE Hours per day	BRIGHT SUNSHINE Percentage of possible	STATIONS
125	33	79	7·0	2·45	62	+ 14	11	3·5	28	London, Kew Observatory
136	52	73	4·1	0·04	1	– 35	2	..	..	Gibraltar.
144	..	75	3·6	0·32	8	– 22	3	8·6	69	Malta.
..	..	81	8·0	25·33	643	– 84	27	..	..	Sierra Leone.
161	65	74	7·2	0·45	11	–119	5	..	..	Lagos, Nigeria.
..	..	84	..	13·27	337	+ 77	25	..	..	Kaduna, Nigeria.
..	..	66	1·1	0·00	0	– 9	0	..	..	Zomba, Nyasaland.
134	41	42	0·6	0·00	0	– 12	0	..	..	Salisbury, Rhodesia.
..	..	76	6·1	3·65	93	+ 36	13	..	..	Cape Town.
..	37	53	2·9	1·85	47	+ 23	3	8·8	74	Johannesburg.
..	..	..	..	..	..	..	..	..	..	Mauritius.
..	..	54	3·9	0·56	14	– 9	4	..	..	Bloemfontein.
..	73	74	7·9	9·36	238	– 25	11	..	..	Calcutta, Alipore Obsy.
131	71	81	5·9	4·05	103	–172	19	..	..	Bombay.
165	73	67	6·1	0·47	12	–119	5	..	..	Madras.
159	69	73	8·2	2·04	52	– 74	15	..	..	Colombo, Ceylon.
..	..	77	6·8	11·75	298	+ 52	15	6·9	57	Hong Kong.
133	39	69	4·9	1·05	27	– 47	17	6·1	..	Sydney.
132	33	72	6·3	4·80	122	+ 61	17	..	..	Melbourne.
143	28	66	5·8	1·51	38	– 12	11	..	..	Adelaide.
..	..	..	..	..	..	..	..	..	..	Perth, Western Australia.
152	32	45	3·9	0·87	22	+ 7	4	..	..	Coolgardie.
139	44	63	3·9	3·43	87	+ 34	11	..	..	Brisbane.
134	30	71	6·0	1·79	45	– 9	15	6·1	52	Hobart, Tasmania.
135	22	80	7·0	3·60	91	– 8	15	4·6	39	Wellington, N.Z.
..	..	91	7·6	9·51	242	+ 65	28	..	..	Suva, Fiji.
..	..	77	6·3	0·84	21	– 83	10	..	..	Kingston, Jamaica.
142	..	79	5·0	7·61	193	– 12	21	..	..	Grenada, W.I.
134	34	77	3·2	1·75	44	– 37	9	..	..	Toronto.
..	..	83	3·9	3·33	85	+ 35	11	..	..	Winnipeg.
135	33	87	6·5	3·13	80	– 15	11	..	..	St. John, N.B.
..	..	86	5·8	3·62	92	+ 41	14	..	..	Victoria, B.C.

HONG KONG.—Prevailing wind direction E. ; mean speed 10·4 mi/hr ; 3 days with thunder heard.

SUVA, FIJI.—1 day with thunder heard.

GRENADA.—Prevailing wind direction E.

Cloud and Fog.—For the greater part of the month the weather was of a type frequently associated with winter anticyclones, the sky being overcast with a uniform horizontal cloudsheet at about 2,000 or 3,000 feet. There was a spell of fine weather in England from the 20th till the 24th, inclusive. In this period there was morning fog at a few stations, and there was a good deal of fog from the 2nd to the 4th, but for the most part the visibility was fair to good, especially near the coast. C. K. M. D.

Rainfall in the British Isles, February 1921.

THE most noteworthy feature of the month was pronounced deficiency of rainfall such as had not been observed since the very dry Februaries of 1895 and 1891. Everywhere the rainfall was considerably below the average, and, as in 1895 and 1891, the deficiency mainly occurred in England and Wales. Less than 10 per cent. of the average (1881–1915) was recorded in broad bands from north Cornwall to the south of Shropshire, from Preston to Durham, and in Essex and Suffolk. More than 50 per cent. was recorded only in the south of Ireland and west of a line from Galway northwards along the coast to Wick. The grouping of the dry and rather wetter areas exhibited the characteristic arrangement from south-west to north-east. Rainfall of more than 25 mm. (1 inch) was confined to small mountain regions in England and Wales and the western half of Scotland, but it was general in Ireland with the exception of the eastern central basin. At Seathwaite the rainfall was the smallest noted in February since observations began in 1845, January of this year having been the wettest since 1873.

The general rainfall expressed as a percentage of the average was: England and Wales, 15; Scotland, 39; Ireland, 51; British Isles, 34.

In London (Camden Square) the rainfall was the lowest for February in 64 years' record, excepting February 1891 (·01 in.) and 1895 (·12 in.). Only two other months, April 1912 (·04 in.) and May 1896 (·14 in.), had a smaller total. The mean temperature, 40·7°, exceeded the average by 0·8°, but was 5·3° below the record high mean of January. Duration of rainfall, 8·5 hours. Evaporation, ·28 in.

Weather Abroad: February, 1921.

ON February 20th over a foot of snow fell in New York during ten hours, this being the heaviest fall experienced for 20 years. The snow was piled into drifts by the heavy gale, and traffic was completely disorganised. There was also a heavy fall of snow at Jerusalem on the 25th.

Rain began to fall in Jamaica during the first week of February, after months of drought during which some of the banana and cane-growing districts suffered considerably.

Partial but useful rains fell in Queensland and New South Wales during the early and middle parts of the month, but in Western Australia the fall was too light to be of benefit. Near the end of the month heavy rainstorms were occurring in South and Central Australia, and also over a considerable portion of New South Wales.