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The Diurnal Variation in Atmospheric Pollution and in Electrical Potential Gradient.

By C. CHREE, Sc.D., F.R.S.

THIS short note is primarily due to a suggestion made by Mr. R. E. Watson, professional assistant at Kew Observatory. In selecting curves of atmospheric electricity potential gradient for a recent exhibition, I came across a case where the drop from the high potential, which is characteristic of thick fog, was exceptionally rapid. Discussing the subject with Mr. Watson, I expressed a belief that the rapid fall of potential gradient had synchronised with a rapid clearing of the fog. Mr. Watson, who has been taking an active interest in Dr. Owens's air pollution apparatus recently installed at Kew Observatory, at once suggested that my explanation might be tested by reference to the air pollution records, as the quantity of dirt in the atmosphere tended to be high during fog. The pollution records on being consulted were found to show an exceedingly rapid diminution in the dirt contents of the atmosphere during the rapid fall of potential gradient. This suggested that it would be of interest to compare the diurnal variations of pollution, electrical potential gradient and barometric pressure, the diurnal changes of the two latter elements being already known to resemble one another. The comparison is made graphically in the accompanying figure, which shows the diurnal inequalities of

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the three elements for the months of January, February and March combined For pollution, data were available for 1921 only. For the other elements normal values based on a number of years were employed.

By a diurnal inequality is meant the departure from the mean value for the day, a non-cyclic correction having been applied to bring the values for the first and second midnights into accord. To obtain the mean absolute value at any hour, one adds to the inequality figure for the hour the mean value of the element for the day. These mean daily values in the present case were—

for pollution, 0·92 shade number (0·29 milligrams per cubic metre);
for potential gradient, 383 volts per metre;
for barometric pressure, 1014·31 millibars.

The highest and lowest mean hourly values for the day were: for pollution, 1·56 shade number (at 10 h.) and 0·40 shade number (at 3 h.); for potential gradient, 455 and 290 volts per metre; for barometric pressure, 1014·76 and 1013·86 millibars.

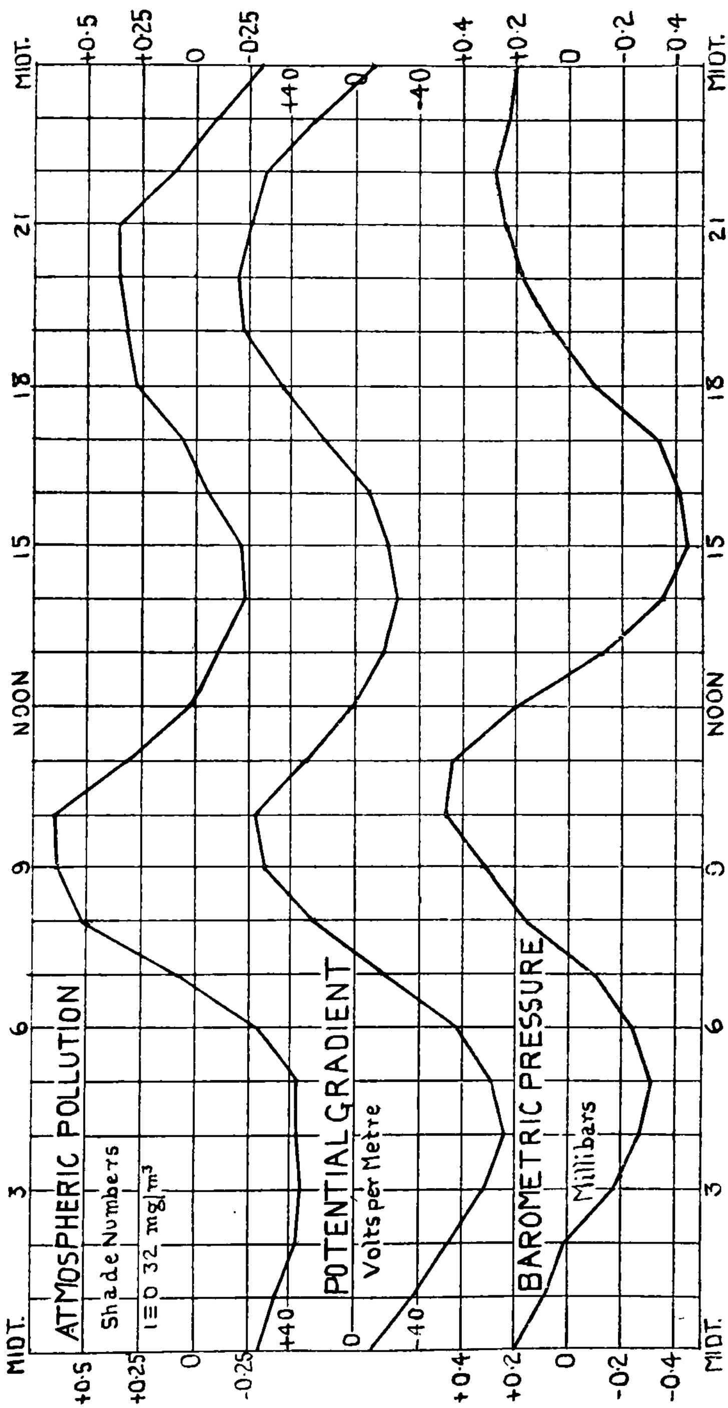
Undue weight must not be attached to three months' observations, but it is obvious that the resemblance between the pollution and potential gradient curves in the figure is fully as close as the resemblance between the latter and the pressure curve. The pollution and potential gradient curves appear closely in phase throughout the day, whereas the pressure curve shows a distinct lag, especially in the afternoon, as compared with the potential gradient curve.* The pollution curve agrees with the pressure curve in having the principal maximum in the forenoon, while it agrees with the potential gradient curve in having the principal minimum in the morning.

A resemblance between the pollution and the potential gradient curves was not exactly a surprise in view of the connection described some years ago between potential gradient at Kew and atmospheric opacity.† It was found that an increase of opacity was accompanied by an increase of potential gradient, and it is natural to suppose that the opacity of the atmosphere increases, *ceteris paribus*, with the amount of dirt present.

The potential gradient is proportional to the charge—normally negative—on the earth's surface. As the vertical

* The resemblance between the variations of potential-gradient and of barometric pressure is said by Gockel (Luft Elektrizität, p. 114) to have been first noted by Hann (Met. Zeit., 1889, Vol. 6, p. 95). It was, however, pointed out by J. D. Everett (Roy. Soc. Phil. Trans., 1868, pp. 347–361).

† Roy. Soc. Proc. A., Vol. 95, p. 210.



DIURNAL INEQUALITIES OF ATMOSPHERIC POLLUTION, POTENTIAL GRADIENT AND BAROMETRIC PRESSURE AT KEW OBSERVATORY FOR JANUARY, FEBRUARY AND MARCH.

electrical current in the atmosphere is usually downwards, implying a descent of positive ions or ascent of negative ions, the existence of a negative charge on the earth's surface suggests that somehow or other a continual supply of negative electricity comes from the interior and escapes into the atmosphere. The resemblance between the potential gradient and atmospheric pressure curve has been interpreted as showing that the escape of a negative emanation from the soil is influenced by the change of pressure, but the varying lag in the barometric pressure curve as compared with the potential gradient curve is, as I have pointed out before,* a difficulty which awaits explanation.

The escape of a negative charge from the earth's surface into the atmosphere would naturally depend on the mobility of the ions. If these were loaded up with dirt or aqueous vapour, their mobility, and so the air-earth current, would tend to fall, until the rise in potential gradient caused by the retention of its negative charge by the earth produced a balance. Thus it may well be that the variation in atmospheric pollution rather than the variation in pressure is responsible for the changes in the electric field.

There are, it should be remembered, a variety of sources of atmospheric pollution, and the greater or smaller amount of aqueous vapour present may be a vital factor in the electrical problem. But obviously, when adequate pollution data exist for all seasons of the year, a promising field of inquiry should present itself.

A serious difficulty in the previous study of the relation between potential gradient and atmospheric opacity arose from the inadequate supply of really distant objects for visibility observations in summer at Kew Observatory. The scale provided for use in Dr. Owens's pollution recorder during the early months of 1921 also promised to be more suitable for winter than for summer observations, but it is hoped that a modification which Dr. Owens has recently introduced will surmount this difficulty.

Results of the Ball Lightning Inquiry.

AS mentioned in our last issue, notices were inserted in the press about the end of July asking for information concerning ball lightning and related phenomena from eye-witnesses.

One hundred and thirteen descriptions of various phenomena were received either personally or by letter in reply to this inquiry. Many of them, however, did not satisfy the essential

* Roy. Soc. Phil. Trans. A., Vol. 106, pp. 329-334.

points in the description of ball lightning, which is a glowing mass, without any solid constituent, stationary or moving slowly in mid-air. The description supplied by Mrs. D —— referred to an example seen in the thunderstorm of June 26th, and a large number of the replies referred to the same storm. On this day the moon was nearly at the third quarter, and Venus was a morning star, rising unusually early. In seven cases it was clear from the steadiness of the light, which some observers had seen at intervals of hours or even days, that the observation referred to Venus. Five reports appeared to refer to the moon seen through the clouds; six objects were shown by their straight and swift movement to be meteors; six were clearly ordinary lightning of unusual violence (which in some cases acquired an appearance of lasting for several seconds owing to several flashes following one another along nearly the same track); three, sheet lightning, which is the appearance presented by the lower side of a cloud lit up by ordinary lightning; and nine, clouds just above the horizon and strongly illuminated by the setting or rising sun so as to appear self-luminous.

The definitely unusual objects reported included a lunar halo, a very fine will-o'-the-wisp, and a miniature tornado, with the typical cloud-form above it, which had removed most of the leaves from a tree. Sixty-five reports appeared to be consistent with the hypothesis that they referred to ball lightning.

A schedule of questions concerning the appearance and behaviour of the objects seen was sent to each of these observers. Out of these, forty-six sent replies. The further information thus obtained was enough to decide that six previously doubtful cases did not refer to ball lightning; two were clearly sheet lightning, one the moon seen through clouds, one ordinary lightning, and one a meteor. One referred to a sixteenth-century tradition, but the object reported was solid; it was possibly a meteorite. This left forty cases of probable ball lightning of which fairly complete descriptions were available.

The main result of the inquiry is that ball lightning is an extraordinarily variable phenomenon. Many observers reported having seen it sufficiently closely for a fairly reliable estimate of the linear dimensions to be made, and in most of these cases the diameter was between three inches and a foot. On the other hand, several were stated to be as high or nearly as high as the clouds; this was confirmed in a few cases by the object having been hidden from view by clouds passing in front of it. The estimated sizes of these high examples were sometimes given in inches or yards, but an object of such linear dimensions at such a height would have appeared like a bright point and not like an extended object. More usually it was given in terms of the size of the moon. Now, an object 2,000 feet above the ground, and with the same angular diameter as the moon, must have a linear diameter of at least 16 feet; and in one case such an object was reported to have four times the dimensions of the moon. The diameter therefore appears to range from three inches to something comparable with sixty feet.

The times during which the objects were visible, again, ranged from two seconds to twenty minutes; the numbers lasting for various times were as follows:—

Less than 10 seconds - - - -	8
10 to 60 seconds - - - -	3
1 minute to 5 minutes - - - -	20
More than 5 minutes - - - - -	6
Time not given - - - - -	3

These estimates were non-instrumental, and consequently are subject to considerable error; no observer appears to have timed the object by means of a watch. It is likely that the waiting caused several observers to over-estimate the time, and therefore that many balls said to have lasted more than a minute really lasted between ten seconds and a minute.

The colour, again, ranged from bluish-white to deep red. Two of the bluish-white objects lasted for only a few seconds, and were of small size, and therefore may be suspected of being ordinary lightning; but one of the best accounts obtained also referred to a bluish-white ball. The great majority of the balls, however, were reddish or yellowish.

The shape was usually round, but there were several cases of pear-shaped or elliptical objects. Most of these had their longest dimension vertical; and the pear-shaped bodies had their narrow ends downwards.

An attempt was made to find out whether the balls were surrounded by any glow, indicating a brush discharge or St. Elmo's fire. Twelve observers reported a glow round the ball (in one case flickering), and one of them another glow round neighbouring solid bodies. In thirteen cases there was no glow, and the remainder were undecided. In five cases sparks were emitted.

It has been suggested that ball lightning may be air so strongly heated by the passage of an ordinary flash that it glows for a notable time on its own account. Only one such case was reported, but few persons appear to have observed the origin of a ball. One observer reported a remarkable case of the appearance of three balls simultaneously, coming from a church spire at a point where it had just been struck by an ordinary flash.

The disappearance of the ball lightning was often observed. In four cases it burst into fragments and an explosion was heard. In all others the disappearance was silent, except in one or two instances when an ordinary flash occurred at the same time. The numbers that disappeared in various ways were as follows :—

Bursting, 4. Sudden and silent vanishing, 8. Gradual fading, 7.
Immersion in water, 2. Eclipse by solid obstruction, 5.

In the two cases classified as "immersion in water" the balls appear to have fallen into the sea, one after collision with another ball.

It was hoped to get definite observation about the same ball from several observers, and to utilise their observations of direction to find the actual path. On comparing descriptions, however, they were found to differ in duration, colour, or shape to such an extent that it appeared impossible that any two observers could have witnessed the same ball. Apparently the balls do not necessarily move with the wind, but further information is required before one can assert this definitely.

In no case was damage done by a ball. H. J.

Could the Drought of 1921 have been Forecasted?

By C. E. P. Brooks, M.Sc.

WHILE the abnormal weather of the past spring and summer in Europe is still fresh in everyone's memory, it is an interesting exercise to apply to these seasons the principles of the *Réseau Mondial* and, by constructing charts of pressure and temperature deviations from normal, to attempt a prompt elucidation of the phenomena. The exercise is also useful as testing how quickly it would be possible to draw such charts without the organisation of a telegraphic *Réseau* in the event of their being required for seasonal forecasting. For many parts of the world no information is yet available, but by making use of the data collected for the Climatological Table of the British Empire in this magazine and supplementing these by the monthly and daily reports of various countries, charts have actually been constructed for the months of December 1920 to June 1921 which cover in sufficient detail North America, the Atlantic, Europe, India and much of Africa.

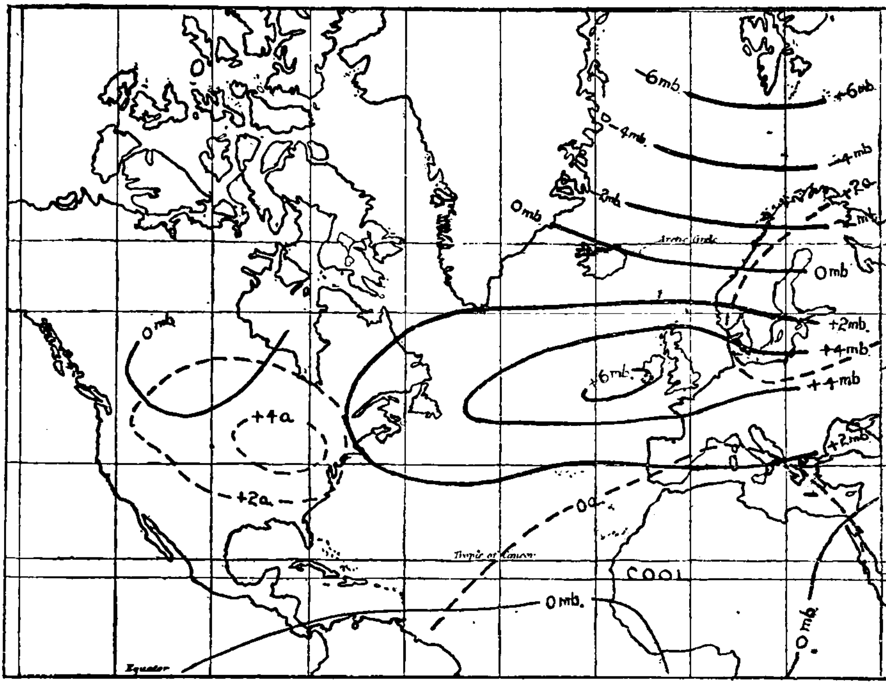
The chart for December 1920 shows a large area of pressure excess covering the whole of Europe, with a positive pressure isanomaly of 10 mb. over Scandinavia. Pressure was below normal in North America and Eastern Asia ; but above over most of the tropics. The temperature distribution is also remarkable, showing large areas of excess over continental Europe and North America, reaching 4a (7° F.) in places. The Atlantic was relatively cool, especially within the tropics. This month was dry on the whole. January 1921 showed pressure below normal over northern and central Europe, the deficiency exceeding 10 mb. in Scandinavia. France and the Mediterranean were above normal. Temperature remained unusually high over the temperate lands and low within the tropics. Owing to the low pressure and steep gradient for westerly winds, this was a rainy month in western Europe.

During the period of drought extending from February to June, anticyclonic conditions persisted with very little break over Europe and North America. The average deviations of pressure and temperature during these months are shown in the accompanying figure, where the continuous lines indicate the deviations of pressure from normal in millibars and the broken lines the deviations of temperature in degrees absolute. The results show a wide belt of abnormally high pressure extending from central Europe across the North Atlantic and reaching a maximum near Valencia (+6·2 mb.). In the north of Norway pressure was below normal, the deficiency reaching 6·5 mb. at Spitsbergen. In North America pressure was slightly above normal generally, but below over the districts south-west of Hudson Bay.

Over practically the whole region temperature was slightly below normal in the south, but much above normal in the north, the excess reaching 4·5a (8·1° F.) at Chicago. The abnormally high temperature of the ground over the continents must have contributed to the drought by keeping warm any moist air which found its way in from the oceans, and so making it more difficult for such air to deposit its moisture.

Most of the district covered by the chart suffered from drought, but there were rainy areas including the southern United States and the West Indies, northern and central Africa, the north of Norway and Spitsbergen, the latter station having abnormally heavy precipitation. There was also a small area of excess rainfall in Alberta and Saskatchewan. Mr. "Rainmaker" Hatfield has been operating at Medicine Hat in this district, but the area with rainfall considerably above normal extends at least as far as

Qu'Appelle, 350 miles from Medicine Hat, and the excess is probably to be attributed to the area of low pressure referred to in southern Canada and not to Mr. Hatfield's chemicals.



DEVIATIONS FROM THE NORMAL OF PRESSURE (—) AND TEMPERATURE (- - -) DURING THE PERIOD FEBRUARY TO JUNE 1921.

The districts where the drought was most severe are those along the southern side of the ridge of high pressure, including Switzerland and southern Russia. The pressure distribution favoured an excess of dry easterly and north-easterly winds in these localities, so that the supply of moist air from the Atlantic was very deficient.

The conditions shown in the figure are very similar to those brought out by the *Réseau Mondial* charts for 1911 (*British Meteorological and Magnetic Year Book*, 1911, Part V.), which indicate an area of high pressure over the Atlantic persisting from January to August, with a break in June. This state of things was also associated on the whole with high temperature and low rainfall over Europe, though less markedly than in 1921, and with temperatures below normal over the Atlantic and West Africa. High pressure in the Atlantic might conceivably be related to an excess of ice off Newfoundland, and it happens that in both 1911 and 1921 the ice conditions in the Atlantic were severe, but on the other hand in 1912, the iciest year on record in the North Atlantic, pressure was unusually low. As a matter of fact there is practically no correlation between the ice-conditions off Newfoundland in the spring, as shown in the curves constructed by the late Commander Hepworth,* and rainfall over the British Isles in either spring or summer.

The low pressure which prevailed in the Arctic Ocean, at North Cape and Spitsbergen, in 1911 and 1921 is perhaps a more important feature. The work of Exner (*Computer's Handbook*, Sec. V., p. 78) shows that low pressure over the Arctic basin in winter is normally associated with high pressure over the Atlantic west and south-west of Ireland and with high temperature over the British Isles in the same season. The reason for this connection is probably that when pressure is low over the Arctic, the Icelandic and Aleutian minima lie some distance north of their normal position, and the sub-tropical anticyclones move north in company. This actually happened both in 1911 and 1921 in the North Atlantic, and, as far as the scanty data available show, in the North Pacific also.

This discovery of Exner's may possibly be utilised in two ways. In the first place, low pressure and stormy conditions over the Arctic Ocean probably require high temperature, not only at the time, but for some months previously, in order to break up or melt the polar-ice and produce large areas of open water among the ice-fields, this being the most favourable condition for the development of storminess. Now we find that the last half of 1920 was marked by temperatures considerably above normal in the neighbourhood of North Cape, while in the winter of 1910–11 there was a slight excess near North Cape and a marked excess further east. Secondly, it appears from a study of the *Réseau Mondial* charts that if the winter pressure is low over the Arctic regions, there is a strong probability that spring pressure will also be low. This is to some extent confirmed by a study of nine years' data at Spitsbergen, where the winter pressure (December to February) has a correlation coefficient of +·82 with the pressure of the following spring (March to April). There is no reason to doubt that Exner's correlations, worked out for the winter months, hold for the spring months also, though this point will have to be proved.

It appears probable, then, that some idea of the rainfall of the spring and early summer in the British Isles can be obtained from a study of the pressures and temperatures of the Arctic basin during the preceding months, low Arctic

* *London, Meteorological Office, Geophysical Memoirs*, Nos. 1, 10.

pressure causing low British rainfall and high Arctic pressure, high British rainfall, but before any such relationship can be used for seasonal forecasting, a great deal of careful analysis will have to be done in order to find out the details and select the best data to be used as indices. Another problem which will have to be faced is the cause of what may be termed "anomalous periods," such as January 1921, which gave a month of heavy rainfall intercalated in a period of drought.

Meeting of the International Commission for the Scientific Investigation of the Upper Air, at Bergen.

THE preceding (7th) meeting of this Commission was held in Vienna in 1912, when, it may be recalled, Professor Bjerknes secured the adoption of a resolution for expressing pressure in millibars so far as information about the upper air was concerned. At that meeting the time was mainly occupied with business questions, and such scientific discussion as there was merely filled up the brief intervals which could be spared from the business meetings.

At the meeting at Bergen a new principle was adopted. The leading place was given to scientific contributions from the members of the Commission and other meteorologists interested in the work, on the ground that plans for international work could only be well devised if the members first got clear ideas about the objects to be aimed at in the investigations and about the methods of applying the observations to the solution of definite meteorological problems. This new procedure has advantages, but it is doubtful if it could be applied successfully except under the inspiration of a Bjerknes.

On Monday, July 25th, the delegates to the meeting were received by the President, Prof. V. Bjerknes, at the Geophysical Institute, and after an individual tea and collective photograph, they listened to an account by Mr. Bjerknes, junior, of further developments in the study of the Polar Front. The Scandinavian school finds that, broadly speaking, depressions occur in families of four, each following a track slightly further south than its predecessor, and the first and third of the family generally more intense than the second and fourth. On the average a new family begins every 6¼ days.

On July 26th and the following days the morning programme began at 10 a.m. and, after an interval for tea and cake from 12 to 12.15, continued until about 2.30 p.m. Charts of the day were brought to the meeting-room at about 4 p.m., and after they had been examined and discussed. the business sessions commenced at about 5 p.m.

A short account of the papers contributed to the scientific meetings is given in some 20 pages of the Report of the Proceedings. Six pages are devoted to an account of the business meetings and fifteen pages to Appendices.

The Commission had no difficulty in deciding that an international publication of the results of the investigation of the upper air on certain selected days should be continued. There was, however, much divergence of opinion as to the number of days on which ascents of *Ballons Sondes* should be made. A proposal of the British delegate, that daily ascents should be made for one complete month in each year, met with little support, and it was eventually agreed that the normal number of ascents in each year should be twenty-four: that twelve of these twenty-four should be daily ascents made in two separate periods of six days; that six of the ascents should be twelve-hourly made in a period of three days, and that the remaining six should be arranged by the President of the Commission for the time being. The dates fixed are to be in the middle weeks of the months shown in the following table, the years in heavy type indicating when the twelve-hourly ascents are to be made:—

J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1922				1922				1922			
	1923				**1923**				1923		
		1924				1924				**1924**	
			1925				1925				1925
1926				1926				**1926**			
	1927				1927				1927		
		1928					**1928**				1928

The form of publication of the results, both of registering ballons and of pilot balloons, was the subject of much discussion. In the case of registering balloons it was eventually agreed that the results for pressure and temperature should be published in graphic form, supplemented by a bulletin of tabular values, the exchange of these tables being effected by the Bureau of the Upper Air Commission. In the case of the observations of upper wind from pilot balloons, no agreement was reached in spite of much discussion and several votes, and it was decided that the form of publication of the data for wind should be left to the Bureau of the Commission, with the proviso that specimens should be circulated to the participating institutes before a final decision.

A complete report of the proceedings of the meeting has already been published with praiseworthy promptitude, and this report will be presented to the International Meteorological Committee at the meetings which will be held in London while this notice is still in the press.

The meeting was scientifically stimulating—how, indeed, could one be otherwise than stimulated by the Director (Devik) of an Observatory (Haldde) where winds of over 130 m.p.h. (average of ten minutes) have been recorded by an anemometer which had to be specially strengthened to prevent it being blown away! The delegates from different countries were received with the most cordial hospitality by the people of Bergen, and most of them were, I think, surprised at the very practical way in which the private shipowners showed what value they attached to the meteorological work of Professor Bjerknes and his staff. E. GOLD.

OFFICIAL NOTICES.

Lectures on Meteorology.

THE following is the provisional programme of lectures and classes for the 1921–22 session in the School of Meteorology, Imperial College of Science and Technology :—

1. *Open Introductory Course on Meteorology: Sir Napier Shaw, F.R.S.*—A course of ten lectures on "The Structure of the Atmosphere and the Meteorology of the Globe," second term, Fridays at 3.0 p.m., beginning January 20th, 1922.

2. *Short Courses of Lectures on Technical Subjects.*

 (i) *Fog: Sir Napier Shaw, F.R.S.*—A course of four lectures, first term, Mondays at 3.30 p.m., beginning October 10th, 1921.

 (ii) *The Winds above Clouds: Sir Napier Shaw, F.R.S.*—A course of three lectures, first term, Mondays at 3.30 p.m., beginning November 7th, 1921.

 (iii) *Terrestrial Magnetism: Dr. C. Chree, F.R.S.*—A course of four lectures, first term, Mondays at 3.30 p.m., beginning November 28th, 1921.

3. *General Course. On Physical and Dynamical Meteorology: Captain D. Brunt.*—First and second terms, Thursdays at 2.30 p.m., beginning October 13th, 1921.

Further particulars of these courses may be obtained from Sir Napier Shaw, School of Meteorology, Meteorological Office, Exhibition Road, South Kensington, S.W.7.

Discussions at the Meteorological Office.

THE series of meetings held at the Meteorological Office, South Kensington, for the informal discussion of important contributions to meteorological literature, will be continued this year.

The meetings will be held on Mondays, at 5 p.m., on the following dates:—October 17th and 31st; November 14th and 28th; December 12th, 1921; January 23rd, February 6th and 20th; March 6th and 20th, 1922.

At the first meeting, October 17th, Sir Napier Shaw, F.R.S., will open the discussion of a paper by Dr. C. F. Marvin on "The Law of the Geoidal Slope and Fallacies in Dynamic Meteorology" (*Monthly Weather Review*, October 1920).

Meteorological Stations.

Leith.—The Telegraphic Reporting Station which has been maintained at Leith since 1861 has been transferred to Inchkeith Lighthouse, which is in the Firth of Forth, about 3½ miles from Leith.

Mr. James Dobbie, who has acted as observer at Leith since 1915, retired on March 31st, and the continuance of regular observations could not be assured. As observations from this neighbourhood are necessary to the Forecast Service of the Meteorological Office, arrangements were made with the Commissioners of Northern Lights whereby the Lighthouse Staff at Inchkeith could continue the work. Reports from Inchkeith were started on June 23rd, 1921.

Official Publications.

Professional Notes, No. 20. The Relation of Bumpiness to Lapse of Temperature at El Kharka, near Cairo, from July 27th to August 3rd, 1920. Price 9*d.* net.

THIS professional note formed part of an official report received from Egypt and, so far as is known, constitutes the first investigation into the relation between bumpiness and the meteorological condition of the upper air.

The note gives an account, illustrated by temperature-height graphs, of 17 ascents to 10,000 feet made by an aeroplane on seven consecutive days. The maximum height to which bumps extended during the hottest part of the day varied from 4000–10,000 feet. It was found that on each occasion an inversion of temperature occurred, forming a limit to all vertical motion in the air. It was possible, therefore, to reach calm air by climbing 300 feet through the inversion. Below this level the bumps do not diminish greatly with height, since the temperature gradient is adiabatic, once convection has started. The inversion of temperature was usually found at the junction of the northerly and westerly currents. As this junction varies greatly in height during summer, the variation in the maximum height of bumps is accounted for.

The maximum shade temperature was found to give no indication of the height to which bumps would extend, but it appeared that if a sudden shift in the direction of wind-aloft was observed, then bumps would not extend above that height.

With regard to the nature of bumps, three distinct types were observed, viz., disturbed air, small vertical currents, and large vertical currents.

Professional Notes, No. 21. The Structure of the Atmosphere over Benson (Oxon.) on 3rd March 1920. By E. G. Bilham, B.Sc.

THIS note is an account of an inquiry based on a registering-balloon ascent recorded by Mr. W. H. Dines. This ascent gave indication of a fairly strong easterly current in the upper air over a westerly current at the surface, decreasing with height. Easterly components at great heights are not rare, but an easterly component occurring over a west or south-westerly current of appreciable thickness is unusual. It is also contrary to the general rule for a westerly component to decrease with height.

Investigation of the meteorological conditions on March 3rd showed that an unusually warm current existed above 5,000 feet.

Prof. V. Bjerknes has found that in a cyclone the surface of separation between the warm and cold currents takes the form of an inclined plane up which the warm air has to ascend. The writer of the note considers that this inquiry shows that similar conditions may exist in an anticyclone.

Correspondence.

To the *Editors, "Meteorological Magazine."*

Cloud Nomenclature.

THE new definition of cirro-cumulus clouds proposed by Dr. Charles F. Brooks contains the following :—

> "Small white flakes or tenuous globular masses which produce no diffraction colours near the sun or moon. . . . . . . Ci.Cu., being composed of ice particles, are usually bright in spite of their tenuity, and do not have the solid appearance characteristic of liquid-droplet, A.Cu. clouds."

On the other hand, Professor Humphreys, another distinguished American meteorologist, writes on page 535 of his recently published "Physics of the Air":—

"Thin and perhaps slowly evaporating cirro-stratus and cirro-cumulus clouds occasionally develop numerous iridescent borders and patches of irregular shape, especially red and green, at various distances from the sun up to 30° or more. A brilliantly coloured iridescent cloud of considerable area is justly regarded as one of the most beautiful of sky phenomena, but one of which until recently there was no satisfactory explanation. Simpson, however, has shown that the coloured patches in question, presumably, are only fragments of coronas formed by exceedingly small droplets of very approximately uniform size."

This appears to contradict two of the statements in Dr. Brooks's definition, for it states definitely that cirro-cumulus clouds do exhibit diffraction colours, and implies that they may be composed of water droplets. Of course, Dr. Brooks may not agree with Professor Humphreys, but until they have come to a mutual understanding I think we might continue to carry on with our old international definitions.

May I express the hope that our American colleagues will not give official countenance to changing the old definitions until the new proposals have been submitted to the International Meteorological Committee for discussion?

G. C. SIMPSON.

August 26th, 1921.

July Rainfall at Blue Hill Observatory.

IT may interest you to know that the month just ended, July 1921, was not only the wettest July since observations began at Blue Hill 36 years ago, but the wettest month of any name.

The total rainfall was 265 mm. (10·43 in.). The normal rainfall for July is 99 mm. (3·92 in.).

It is difficult properly to characterise the rainfall of a summer month owing to variability in the intensity of thunder showers. A downpour limited in duration and area may distort a record, or rather mask values, which more truly represent normal distribution of rain. Hence both frequency and intensity must be taken into account. There were no unusually heavy rainfalls during the month; but there was one on the last day of June. The month was normal as to frequency, rain falling on 11 days and a trace on one day, the normal being 12 days. The duration was 107 hours, about normal.

There are two long period records, New Bedford, 1814 to date, and Boston, 1818 to date, with which comparison may be made. In the former, heavier rainfalls have occurred only twice—in August 1826 and September 1850. In the Boston record August 1826 and July 1863 have slightly greater amounts. We may fairly conclude that, with the exception of August 1826, the month just ended had the heaviest rainfall in a period of 100 years. We also note that in August 1826 the rainfall was spasmodic, more than 60 per cent. falling in thunder showers on August 11th, 12th and 13th.

Furthermore, this section of the North Atlantic coast is now experiencing a maximum rainfall. At Blue Hill, for the past 19 months, there has been an average monthly excess of 36·8 mm. (1·4 in.).

Some months (7) have been below normal; but the departures have been small. On the other hand the plus values have been quite large, exceeding 100 per cent. in three instances.

There may be some correlation between excess of rain in this locality and a marked deficiency over north-western Europe. A barometric see-saw has long been suspected by meteorologists, and it may be that the present "hyperbar" (stagnant anticyclone) over Great Britain, France, Belgium and Holland offsets an "infrabar" (slow-moving cyclone) over the north-western Atlantic. ALEXANDER McADIE.

Blue Hill Observatory, Readville, Mass., August 2nd, 1921.

Heavy Rainfall of August 11th at Milton, Northants.

ON Thursday last, August 11th, we had a very severe storm at Milton, about three miles west of Peterborough, commencing at 3.25 p.m.; at 4.30 p.m. 1·91 in. of rain were measured. At 5.30 the total fall was 2·03 in. With the rain measured at 9 o'clock next morning the fall for the 24 hours was 2·25 in. I think that this is the heaviest fall that I can ever remember registering in the time, and thought that it might interest you. H. DEB. WILMOT.

The Milton Estate Office, Priestgate, Peterborough, August 16th, 1921.

Units for Meteorological Work.

MAY I as an amateur meteorologist give my experience of the new units? At first I "hated them" as cordially as the F.R.Met Soc. quoted by Mr. Cross in your columns, but I soon realised that for the barometer it was far more logical to use a unit of pressure rather than the inch, a unit of length. In some parts of Italy if you ask the peasant how far it is to a certain place, he will tell you that it is, say, three-quarters of an hour; he uses a unit of time to measure a length, and the result is rather vague. It is quite as illogical to use a unit of length for a pressure. As regards the actual use of units it is merely a matter of custom. When I first used millibars I had to make a mental calculation every time to know whether so many millibars meant a high or a low pressure even. During the war I had to use millibars, and now I find the position is reversed. I think in millibars, and inches have become a foreign language. If Mr. Cross would get a barometer graduated in millibars and read it frequently, looking at the same time at the Weather Charts in the daily papers, I feel sure that in a month he too would think in millibars.

But this is the crux of the question. The only barometers graduated in millibars are mercury barometers or expensive aneroids. Cannot instrument makers be induced to graduate inexpensive aneroids with millibar scales?

With regard to millimetres for rainfall I think some concession is necessary. Probably more than 95 per cent. of rainfall observers are amateurs who voluntarily supply their data. Their services cannot be dispensed with, and any attempt to force the use of millimetres would result in a great loss of observations. Results should be published in inches as well as millimetres, for everything should be done to interest the observers.

But when metric units are used the Meteorological Office should set a good example, or at any rate should be consistent in its publications.

In the *Daily Weather Report* heights of low cloud are given in feet; the upper wind abroad is given in miles per hour with heights in feet, but the number of feet are multiples of 500 metres, and this being so why not give the heights in metres? For the upper wind for the British Islands, miles per hour are used, and feet for heights, given in even thousands of feet. In the *Weekly Weather Report* wind velocities are given in metres per second with heights of anemometers in feet. In the *Geophysical Journal*, under soundings with pilot balloons, we find metres and metres per second. For temperature, Fahrenheit is used in the *Daily Weather Report*. In the *Weekly Weather Report* we find Fahrenheit in most places, but in the District Values of Temperature, absolute is used in some columns while Fahrenheit is used for the rest of the table. The diagram of upper air temperatures in the supplement to the *Daily Weather Report* gives pressure in millibars, temperature in Fahrenheit with a comparison with absolute below, while heights are in feet. There is, of course, no reason why millibars should not go with feet, but it seems somewhat of a *mésalliance.* Rainfall is given mostly in millimetres, but in some parts of the reports inches are also given.

Perhaps the most curious unit to be found in the Meteorological Office publications is that for atmospheric pollution; this is the pound per million cubic yards; there seems no reason whatever why metric units should not be used for this purpose. C. J. P. CAVE.

Bergen, July 23rd, 1921.

As you have asked your readers for their views on the above, I entirely agree with the remarks of Mr. Ellison in your last issue. The millimetre is the only new unit with which I am at all at home, it being easy to multiply by four to get hundredths of inches. Millibars and degrees absolute and the new units for depth of snow and force of wind are anathema. It was entir ly for this reason that I resigned membership of the Royal Meteorological Society. R. P. DANSEY.

Kentchurch Rectory, Hereford, July 22nd, 1921.

MAY I be allowed space to say that I quite agree with all those who protest against the enforced use of the new units for meteorological work?

As for the argument that we are doing it to benefit "posterity," we have already been told that the war was to benefit "posterity," but in what way it is likely to do so it is hard to see.

I have thoroughly studied the new units and gone into the *pros* and *cons* of the matter, and the conclusion I have arrived at is that the *old units* are the best for *practical purposes.*

D. W. HORNER, F.R.Met.Soc.

23, *Woodbury Park Road, Tunbridge Wells, August* 1921.

A Miniature Waterspout.

LAST Thursday, July 7th, about 7 p.m., driving across Holt Fleet Bridge over the Severn, about 7 miles from Worcester, I heard a loud hissing noise, and on looking at the water I saw a whirlpool leaving the one side and making straight across the river. It got larger as it went, and appeared to be about $1\frac{1}{2}$ yards in diameter, sending into the air a fountain of very fine spray about 3 or 4 yards high, which was prettily coloured. The whirl went round at a tremendous rate and the hissing noise was like escaping steam.

There was a sudden freshening of the wind about this time. WILLIAM T. WALKER.

12, *Bridge Street, Worcester, July 12th,* 1921.

Visibility on the Firth of Clyde.

On Sunday, August 14th, the atmosphere over this area was exceptionally clear. From a small hill behind the village of Tigh-na-bruaich, situated in the Kyles of Bute, the mountain of Merrick (2,764 feet) in Kirkcudbrightshire was visible to the naked eye at a distance of 64 miles.

About 20 miles of the Ayrshire coast became visible, the nearest point being Heads of Ayr, 40 miles, and the farthest away, 54 miles. At about 150 feet above the ground parts of the high land above the Ayrshire coast appeared like scattered islands in the sea, but at sea level this land completely disappeared, giving a good example of the rotundity of the earth's surface. The distance visible to the naked eye on this day was approximately equivalent to one degree of latitude, and, of course, to increase this distance by 360 gave the circumference of the earth, a fact rather difficult to perceive by the lay mind but at the same time emphasising the fact that our globe is not so big, after all. The gullies and ravines on the south side of Glen Sannox, on the Island of Arran, were clearly visible to the naked eye, a distance of over 20 miles.

This has been the most exceptional visibility known to the present writer for a number of years. On examination of the *Daily Weather Report* for Sunday, July 14th (International Section), it will be observed that there were light breezes from west-north-west at the time. Renfrew reported very good visibility (v9) for all observations taken during the day on this date.

Charles F. Priestley.

49, Brisbane Street, Greenock, August 29th, 1921.

[It is interesting to notice that, on the assumption that there is no refraction of the rays of light, an object 1,600 feet above sea level is just on the horizon of an observer at 150 feet, 64 miles away, so that in the case reported the top 1100 feet of the mountain would have been visible.—Ed. M.M.]

NOTES AND QUERIES.

The Setting Sun as a Photographic Subject.

The picture reproduced on the plate opposite is from a photograph by Mr. G. A. Clarke, of Aberdeen Observatory, who states that his camera was kept stationary whilst the plate was intermittently exposed at intervals of 6, 8, 6, 4 and 3 minutes. It will be observed that the trace of the sun's path on the photographic plate is concave upwards, and that the

THE SETTING SUN.

A photograph by Mr. G. A. Clarke at Aberdeen, June 6th, 1921.

shape of the sun near the horizon is elliptical with the long axis horizontal. As is well known, such effects are due to refraction of the sun's rays by our atmosphere. Atmospheric refraction increases the altitude but does not affect the azimuth of a celestial object.

At the time of sunset the lower limb of the sun is raised more that the upper limb, and therefore the vertical diameter is smaller than usual, whilst the diameter measured on a horizontal circle is not affected by refraction; hence the ellipticity of the photographic images near the horizon. The distant hills were slightly above the true horizon, so that the fullest effect of refraction cannot be seen. The last exposure was at 20 h. 48 m., the theoretical time of sunset being 20 h. 54 m.

The International Meteorological Committee.

THE International Meteorological Committee was convened to meet in London on September 12th under the presidency of Sir Napier Shaw, F.R.S. Opportunity was taken to arrange for meetings during the preceding week of the Commissions for the Réseau Mondial, for Polar Investigations, for Maritime Meteorology, for Aerial Navigation and for Weather Telegraphy. The social programme included a luncheon to the delegates on Friday, September 9th, at the Carlton, when Major-General Sir F. C. Sykes welcomed the guests on behalf of His Majesty's Government, and a reception by the Director of the Meteorological Office and Mrs. Simpson at South Kensington on September 7th.

The Observatory at Apia, Samoa.

To the cost of maintenance of the Observatory at Apia Samoa, which is being carried on by the Government of New Zealand, a contribution of one-half, *i.e.*, 800*l.*, a year is now being provided by the Imperial Government. The Observatory is to be maintained at full efficiency, magnetic, seismic, and climatological work being included in the programme.

The Brazilian Meteorological Service.

The *Directoria de Meteorologia e Astronomia* of the Brazilian Department of Agriculture has been divided into two separate services, the *Directoria de Meteorologia* and the *Observatorio Nacional*. The new Directoria de Meteorologia is under Sr. Sampaio Ferrez, who intends to continue the climatological work established in 1909 and to issue the information collected, but not published, during the last ten years. Great activity is anticipated in all branches of meteorology, especially in connection with forecasts, marine and upper-air investigations.

Humidity Observations as an Aid to estimating Cloud-Height.

An article by Prof. Alexander McAdie under the title "A Quick Method of Measuring Cloud Heights and Velocities" appears in Part IV., Vol. 83, of the Annals of the Astronomical Observatory of Harvard College.

The method described consists in estimating the height of the lowest clouds from a consideration of the surface humidity, and thence by means of a nephoscope determining their velocity. The latter part calls for no comment, and follows at once if the height can be accurately found.

To determine the cloud-height, Prof. McAdie computes the depression of the dew-point below the dry bulb temperature at the surface by means of a whirling psychrometer, multiplies this by an empirical factor, and so arrives at an estimate of the height at which the surface air, diffusing upwards by eddies and convection, would begin to condense moisture. The value of the whole process depends entirely on choosing suitable values of the factor, applicable to different types of weather. The empirical factors given in the paper are roughly proportional to the reciprocals of the probable lapse-rates of temperature, and seem to have been determined by direct comparison with accurate methods of finding cloud height.

In his discussion of the theory of the method Prof. McAdie makes the unwarranted assumption that if a sample of air with a dew-point y° C. below its temperature were raised adiabatically, it would begin to condense moisture at a height of $\frac{y}{9{\cdot}9}$ kilometres, where 9·9 is the adiabatic lapse-rate for dry air. There is no simple exact relation of this kind, because as the air ascends its pressure falls as well as its temperature, but a simple calculation shows that over the whole range of temperature and humidity met with in temperate regions the expression $\frac{y}{8{\cdot}2}$ gives an approximation close enough for practical purposes. As, however, an empirical factor has to be employed in any case, this slip does not affect the utility of the method.

A practical test was made at Valencia Observatory, the material used being pilot-balloon ascents made in 1920 and

1921, and also a number of observations of cloud height below 800 metres obtained by direct observation of cloud sheets on the neighbouring hills. Care was taken to use only such observations as it was reasonably certain gave the height of the lowest cloud layer prevailing at the time, and in addition all cases in which the surface wind did not exceed 4 metres per second were ruled out, as it was soon apparent that with very light winds the surface humidity had no relation to the conditions prevailing a few hundred metres up.

The dew-point was determined either directly from dry and wet bulb thermometers in a Stevenson screen or from a hair hygrometer standardised from them.

The height h in kilometres at which condensation would occur in a well-stirred atmosphere was computed, and its ratio to the actual cloud height, H kilometres, was determined.

This ratio h/H is denoted hereafter by x. The mean value of x was found to be ·59.

It was found that when the cloud height exceeded one kilometre x fell off rapidly with increasing height; in fact, the relative humidity at the surface practically ceased to fall with increasing cloud height above 1,200 metres, and the method may definitely be said to have failed in such cases. The distribution of the values of x found in 80 observations is shown in the following table:—

Limits for x	1·20 1·00	·99 ·90	·89 ·80	·79 ·70	·69 ·60	·59 ·50	·49 ·40	·39 ·30	·29 ·20
Frequency	5	1	6	9	14	15	19	6	5

There were four cases among the above in which the actual cloud height exceeded 1,500 m., the mean value of x being ·29. It seemed fairer to omit these under the circumstances, and when this was done the mean value of x became ·60 and the frequencies in the last two columns were reduced by 2 each.

If H had been computed from the formula $H = \frac{10}{6}h$, then in 42 per cent. of the 76 cases the error in H would not have exceeded ·25H and in 79 per cent. it would not have exceeded ·4H.

In addition the same observations were classified according to wind direction to see if better results could be obtained by modifying the factor according to the direction of the wind.

Wind direction	N–NNE.	NE–ENE.	E–ESE.	SE–SSE.	S–SSW.	SW–WSW.	W–WNW.	NW–NNW.
Frequency	2	1	4	10	17	18	15	9
Mean value of x	·73	·72	·52	·67	·58	·58	·60	·65

There is no well-defined tendency here, and with the limited number of observations available it is hardly possible to say with certainty that one direction differs from another.

The general conclusion arrived at is that there is some utility in the method, though the possible errors are rather large. There seems to be little difference as between different wind directions, and the method fails when the wind is very light and when the cloud height exceeds about 1,500 m. Subject to the above limitations, the working rule is:—Determine the depression of the dew point below the dry bulb in degrees Centigrade and divide by 5, when the cloud height will be given in kilometres. Alternatively, the depression in degrees Fahrenheit may be divided by 9, when the cloud height will again be given in kilometres. It would be instructive if this method could be tried at an inland station, as it seems possible that more consistent results might be obtained there than on the west coast where the surface humidity rarely falls to any low value.

L. H. G. Dines.

Reviews.

An Astronomical Theory of the Ice Age.

Das Klima des Eiszeitalters, von Rudolf Spitaler. Prag, 1921. (Lithographed.)

For half a century the cause of the immense ice-sheets of the Quaternary period has been one of the great unsolved problems of science. The theories put forward fall into two main classes, terrestrial and astronomical; the former seek the explanation in the earth itself, especially in changes of level and of land and sea distribution, the latter chiefly in variations of the obliquity of the ecliptic and of the eccentricity of the earth's orbit. In 1875 appeared an epoch-making book by J. Croll, in which abnormal climates were associated with high eccentricity. The hemisphere with winter in aphelion is cold because the long severe winter is far from being balanced by the short hot summer; at the same time the opposite hemisphere enjoys a mild equable climate. This theory commanded instant respect, and still finds a place in the text-books, but difficulties soon began to appear. The evidence strongly suggests that glacial periods did not alternate in the two hemispheres, but were simultaneous over the whole earth; even on the equator the snow line was brought low down. Moreover, on Mars the largest snow cap appears on the hemisphere with its winter in perihelion. Although Croll's reasoning was beautifully ingenious, he gave very few figures; while the date which he gives for the conclusion of the Ice Age, 80,000 years ago, has been shown by recent research to be far too remote, 15,000 years being nearer the mark.

The present book is a praiseworthy attempt to meet two of these objections, but though it makes interesting reading, supported by many pages of tables, the author cannot be said to have succeeded. The basis of the work is the calculation of the mean temperature of any latitude by the use of an equation which may be rewritten as follows:—

$$t_\phi = (245{\cdot}63 + 359{\cdot}78\, S_0 + 288{\cdot}94\, S)\,(1-n) + (235{\cdot}46 + 419{\cdot}55\, S)\, n,$$

where t_ϕ is the average temperature in any month in latitude ϕ and is given in degrees Centigrade on the absolute scale; S_0 is the average daily heat on a horizontal surface at the limit of the atmosphere during the year, and S that during the month, in the latitude in question (the units being so chosen that the amount at the equator during an equinoctial day is approximately 0·5); n is the fraction of land and $(1-n)$ that of water covered by the line of latitude. By equating n to unity or zero, this formula is made to give the theoretical temperatures over land and water spheres under present astronomical conditions (p. 8), and by making the appropriate changes in S_0 and S, under different astronomical conditions for the four seasons (pp. 79 to 88).

This part of the work is somewhat difficult to follow, owing to the use of the terms "land- and water-temperatures" for these theoretical distributions over spheres entirely land or entirely water. The author nowhere calculates the change of temperature over the present land areas, which is the important point for glacial theory, but the following figures from a table* on p. 82 will give some idea of the magnitudes

* In computing such tables the author assumes the validity of all the terms of his fundamental formula, even those independent of the local radiation. These independent terms represent, however, the spreading out over the world of the radiation we receive under present circumstances, and if those circumstances were changed these terms would have to be altered.

involved. They represent the difference from the present of the average temperatures of each latitude under maximum eccentricity (0·7775) and maximum obliquity (27° 48′), the distribution of land and water remaining unchanged.

—	Aphelion December.			Aphelion June..		
	Winter.	Summer.	Year.	Winter.	Summer.	Year.
	a.	a.	a.	a.	a.	a.
N. 60° - - -	−5·1	+8·5	−0·7	−2·6	−2·2	−0·7
30° - - -	−7·0	+6·9	−1·3	+0·3	−4·3	−1·3
Equator - -	−4·3	+1·8	−1·3	+0·7	−3·2	−1·3
S. 30° - - -	−3·6	+0·5	−1·1	+1 6	−3·0	−1·1
60° - - -	−1·2	−0·7	−0·6	+0·5	−1·1	−0·6

The author claims that these differences, ingeniously magnified by meteorological arguments, are sufficient to cause a glacial period in the hemisphere with winter in aphelion, but from this point his theory departs widely from Croll's. During the long severe winter great volumes of sea water are brought to a low temperature, and owing to their greater weight sink to the bottom of the ocean, where they remain cold and accumulate from year to year. But the water warmed during the short hot summer remains on the surface, where its heat is dissipated by evaporation and radiation. Thus throughout the cold period, lasting about 10,000 years, the ocean in that hemisphere is steadily growing colder, and this mass of cold water is sufficient to maintain a low temperature through the whole of the following period of 10,000 years with winter in perihelion, which would otherwise be a genial interval. In this way a period of great eccentricity becomes a glacial period over the whole earth, but with crests of maximum intensity alternating in the two hemispheres. Unfortunately the numerical basis of this theory is not presented, and it seems incredible that a deficiency of temperature could be thus maintained through so long a period. Further, the author is not a geologist, and derives his data as to the Ice Age very much at second hand. This entirely invalidates his chronology, and leads him into erroneous and sometimes absurd comparisons, as, for instance, when he gives the hardly distinguishable Laufen oscillation a duration equal to that of the last inter-glacial, which was long enough for immense changes in the face of Europe and in human culture.

Difficulties of printing in Czechoslovakia have caused this work to be lithographed; it is issued as a handsome quarto volume of 138 pages. C. E. P. B.

Obituary.

Mr. Richard Lamport, whose death occurred on August 25th, at the age of 79, entered the service of the late Mr. G. J. Symons in 1885, and retired from the staff of the British Rainfall Organization in October 1919, shortly after the transfer to Government control of the institution to whose history he had contributed during so long a period. After the death of Mr. Symons in 1900, and the retirement of Mr. Sowerby Wallis in 1903, Mr. Lamport's association with the office work had been considerably longer than that of any other member of the staff, and his experience was thus of great value in ensuring the continuity of the routine during the various changes through which the Organization has passed during the last twenty years. Previous experience in legal work fitted him in an especial degree for the place which he filled in the office, and his wonderful accuracy as a computer and copyist enabled him to carry out, with high efficiency, the whole of the work of filling in the permanent files of rainfall records. He was also responsible for the bulk of the checking of the ever increasing number of rainfall returns, and for the compilation of the rainfall and climatological tables appearing each month in this magazine.

Mr. Lamport's strong sense of duty and loyalty gave him a high place in the affection and esteem of his colleagues. He leaves a son and two daughters, one of whom succeeded him in his work in the office of the Organization after his retirement.

Errata.

It is regretted that the following misprints occurred in the August issue of this magazine:—

page 183, *for* $\frac{\delta p}{\delta n} = 2\omega p \sin\lambda$, *read* $\frac{\delta p}{\delta n} = 2\omega v p \sin\lambda$.

page 193, *for* "Benson," *read* "Besson."
page 196, *for* "rouse her to see it set before it vanished," *read* "rouse her to see it before it vanished."

News in Brief.

Capt. Amundsen arrived at Vancouver last month, while his schooner, the *Maud*, is to be repaired at Seattle and equipped with wireless. He intends to leave again for the Arctic early next spring, and is still determined, to prove his theory that by taking advantage of the right current a vessel frozen in the ice will drift across the Polar Sea in three to five years.

It is reported that a Norwegian scientific expedition left last month for Jan Mayen Island, which lies between Norway and Greenland. The expedition will establish a radio-station at Jan Mayen, which is to be connected with Norway, and the station will be used for meteorological service. It is anticipated that weather telegrams will be sent out regularly.

It is a curious fact that although oysters have been artificially cultivated for at least 2,000 years, and the great importance of the warmth of the water for successful breeding has long been known, yet the relation between breeding and temperature has only recently been put in a precise form. Dr. J. H. Orton, of the *British Marine Biological Association* at Plymouth, has now shown that the oyster begins to breed when the water has reached a temperature of approximately 60° F., and it continues to do so as long as there is no fall. During the last half-century 1893 was the record year in oyster-breeding, but it is thought that 1921 will beat this record.

A moderate earthquake was recorded by the seismograph at Eskdalemuir Observatory on Tuesday, August 23rd, at 21 h. 17 m. The actual locality is uncertain, but the distance is calculated to be at about 1,000 miles from the Observatory.

The Weather of August 1921.

Conditions were unsettled throughout the month, with depressions from the Atlantic crossing the British Isles. In the north and west the rainfall was large, but in the south-east of England it was again below normal, being much less than might have been expected from the distribution of pressure. In Scandinavia conditions were very disturbed for nearly the whole month, with frequent heavy rains. In France and Central Europe there was some heavy rain between the 10th and 24th, but conditions were fine near the beginning and end of the month. Temperature was considerably lower generally than it was in July, but there were some very hot days on the Continent early in the month.

From the 1st to the 5th pressure was lowest near the Faröe Islands, and small secondaries moved north-eastward over the British Isles. Heavy rain fell in the western districts on the 1st and again on the 5th, several stations having 20 mm. or more. A south-west gale was experienced on parts of the south-west coasts on the night of the 5th. Thunderstorms occurred rather widely in the north and west on the 2nd, and in the south-east on the 3rd. They were associated with a very low temperature in the upper air, the reading at

THAMES VALLEY RAINFALL, —— AUGUST, 1921.

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

Isohyetals

ALTITUDE SCALE

Below 250 feet	250 to 500 feet	500 to 1000 feet	Above 1000 feet

SCALE OF MILES: 0, 5, 10, 15, 20

H.M. Stationery Office Press, Kingsway W.C.2.
Ps. 3395/346. Wt. 26. D.P.15. 1250. 9/24.

13,600 feet over Baldonnel (Dublin) on the evening of the 2nd being 6° F., or 18° F. below normal. There was a cold northerly current over Iceland which curved round the stationary depression over the Faröe Islands. It is interesting to note that August 3rd, when thunderstorms occurred in south-east England, was the coolest day since July 5th, and that in that region there was no thunder during the hot weather, except very locally on July 17th.

The secondary which brought very heavy rain to our western districts on the 5th developed into an independent centre and moved north-east, attaining considerable depth over the Gulf of Bothnia on the 7th, where it remained until it filled up on the 10th.

Secondaries continued to cross the British Isles and maintained unsettled weather. A shallow depression moved slowly south-eastward over our Islands between the 9th and the 11th, and then moved north-east to Denmark. Heavy rain and thunder occurred locally, but parts of south-east England escaped until the 13th, when a small secondary brought very welcome rainfall, with thunder in places. At Pulham (Norfolk) there was a severe thunderstorm during the afternoon, in which 75 mm. of rain fell in an hour and twenty minutes, the total for the 12 hours being 80 mm. There were 52 mm. of rain at Lowestoft on the same afternoon.

During the first ten days of the month the weather in France and Germany was mainly fine and warm, though there were heavy local thunderstorm rains on the night of the 3rd, Berlin having 80 mm. The shallow depression which lay over the British Isles on the 10th expanded over a large area, and cooler unsettled weather became general, with heavy rain and thunder in many places. Temperature remained high in Poland until the 12th, reaching 99° F. on that date at Warsaw, but colder air then arrived from the west, the maximum at Warsaw being only 61° F. on the 14th. A fresh centre of low pressure developed over this area on the 12th, which moved north to the Baltic, and then turned westward and grew deeper, being centred over the Skagerrak on the 15th. There were gales in the Baltic and the north-east part of the North Sea, and heavy rain near the centre. The disturbance filled up rapidly on the 16th.

An anticyclone, which extended up from the Azores, caused a temporary improvement in the weather over the British Isles on the 14th and 15th, but a depression developed off the north-west of Ireland on the 16th and renewed unsettled weather. Rain fell generally except in the extreme east of England, being heaviest in the south of Scotland, and

(*Continued on* p. 238.)

Rainfall Table for August 1921.

STATION.	COUNTY.	Aver. 1881—1915. in.	1921. in.	1921. mm.	Per cent. of Av.	Max. in 24 hrs. in.	Max. in 24 hrs. Date.	No. of Rain Days
Camden Square	*London*	2·21	1·65	42	75	·74	23	9
Tenterden (View Town)	*Kent*	2·29	1·28	33	56	·39	23	11
Arundel (Patching Farm)	*Sussex*	2·52	1·76	45	70	·51	23	8
Fordingbridge (Oaklands)	*Hampshire*	2·63	1·62	41	62	·50	12	11
Oxford (Magdalen College)	*Oxfordshire*	2·25	1·51	38	67	·63	16	15
Wellingborough (Swanspool)	*Northampton*	2·38	2·14	54	90	·49	16	17
Hawkedon Rectory	*Suffolk*	2·59	1·76	45	68	·68	23	12
Norwich (Eaton)	*Norfolk*	2·37	1·52	39	64	·32	7	14
Launceston (Polapit Tamar)	*Devon*	3·18	2·61	66	82	·52	5	21
Sidmouth (Sidmount)	„	2·81	2·55	65	91	·65	21	17
Ross (Chasedale Observatory)	*Herefordshire*	2·57	2·34	59	91	·38	10	15
Church Stretton (Wolstaston)	*Shropshire*	3·25	4·72	120	145	·70	28	21
Boston (Black Sluice)	*Lincoln*	2·39	2·98	76	125	1·35	11	12
Worksop (Hodsock Priory)	*Nottingham*	2·45	3·92	100	160	1·38	11	16
Mickleover Manor	*Derbyshire*	2·72	4·79	122	176	1·07	5	20
Southport (Hesketh Park)	*Lancashire*	3·48	4·92	125	141	1·03	1	18
Harrogate (Harlow Moor Ob.)	*York, W. R.*	2·87	3·86	98	134	·89	28	20
Hull (Pearson Park)	„ *E. R.*	2·91	2·84	72	98	·76	28	17
Newcastle (Town Moor)	*North'land*	2·92	6·65	169	228	1·93	29	26
Borrowdale (Seathwaite)	*Cumberland*	11·57	14·45	367	125	..	..	..
Cardiff (Ely Pumping Stn.)	*Glamorgan*	4·32	3·18	81	74	·67	5	20
Haverfordwest (Gram. Sch.)	*Pembroke*	4·17	7·16	182	172	1·55	5	17
Aberystwyth (Gogerddan)	*Cardigan*	4·87	6·22	158	128	1·37	5	16
Llandudno	*Carnarvon*	3·02	3·94	100	130	1·26	2	21
Dumfries (Cargen)	*Kirkcudbrt.*	4·40	7·40	188	168	1·07	20	23
Marchmont House	*Berwick*	3·31	4·39	111	133	1·00	22	22
Girvan (Pinmore)	*Ayr*	4·45	5·40	137	121	·85	9	24
Glasgow (Queen's Park)	*Renfrew*	3·54	5·84	148	165	·77	29	21
Islay (Eallabus)	*Argyll*	4·36	4·78	121	110	·85	26	23
Mull (Quinish)	„	4·91	4·16	106	85	·70	9	25
Loch Dhu	*Perth*	6·75	9·60	244	142	1·70	16	21
Dundee (Eastern Necropolis)	*Forfar*	3·38	3·85	98	114	·77	16	22
Braemar (Bank)	*Aberdeen*	3·36	3·54	90	105	1·43	20	16
Aberdeen (Cranford)	„	2·88	1·96	50	68	·44	16	17
Gordon Castle	*Moray*	3·17	3·05	77	96	1·14	20	19
Fort William (Atholl Bank)	*Inverness*	6·14	5·12	130	83	·80	26	21
Alness (Ardross Castle)	*Ross*	2·95	2·21	56	75	·54	10	18
Loch Torridon (Bendamph)	„	6·60	4·59	117	70	·54	9	21
Stornoway	„	3·97	3·31	84	83	·73	5	21
Loch More (Achfary)	*Sutherland*	5·84	4·77	121	82	·87	26	21
Wick	*Caithness*	2·75	1·86	47	68	·38	20	24
Glanmire (Lota Lodge)	*Cork*	3·65	4·01	102	110	·75	1	20
Killarney (District Asylum)	*Kerry*	4·42	5·11	130	116	1·00	1	24
Waterford (Brook Lodge)	*Waterford*	3·83	5·08	129	133	1·10	5	19
Nenagh (Castle Lough)	*Tipperary*	3·95	3·91	99	99	·49	9	25
Ennistymon House	*Clare*	5·15	5·53	141	107	·91	9	24
Gorey (Courtown House)	*Wexford*	3·33	5·08	129	153	1·07	1	19
Abbey Leix (Blandsfort)	*Queen's Co.*	3·95	4·78	121	121	·60	1, 5	24
Dublin (FitzWilliam Square)	*Dublin*	3·04	2·56	65	84	·58	5	23
Mullingar (Belvedere)	*Westmeath*	4·17	3·64	93	87	·70	9	24
Woodlawn	*Galway*	4·58	3·82	97	83	·63	16	24
Crossmolina (Enniscoe)	*Mayo*	4·51	4·65	118	103	·65	27	24
Collooney (Markree Obsy.)	*Sligo*	4·32	6·04	153	140	·77	9, 31	26
Seaforde	*Down*	3·75	4·00	102	107	·54	9	21
Ballymena (Harryville)	*Antrim*	4·27	4·02	102	94	·64	27	25
Omagh (Edenfel)	*Tyrone*	4·27	3·58	91	84	·58	9	21

Supplementary Rainfall, August 1921.

Div.	STATION.	RAIN. in.	RAIN. mm.	Div.	STATION.	RAIN. in.	RAIN. mm.
II.	Ramsgate	1·03	26	XII.	Langholm, Drove Rd.	6·79	173
,,	Sevenoaks, Speldhurst	1·50	38	XIII.	Ettrick Manse	6·81	173
,,	Hailsham Vicarage	1·72	44	,,	North Berwick Res.	4·17	106
,,	Totland Bay, Aston	2·06	52	,,	Edinburgh, Royal Ob.	3·84	98
,,	Ashley, Old Manor Ho.	1·48	38	XIV.	Biggar	5·82	148
,,	Grayshott	2·34	59	,,	Leadhills	11·23	285
,,	Ufton Nervet	1·75	44	,,	Maybole, Knockdon	..	..
III.	Harrow Weald, Hill Ho.	1·81	46	XV.	Dougarie Lodge	5·55	141
,,	Pitsford, Sedgebrook	2·01	51	,,	Inveraray Castle	7·66	195
,,	Chatteris, The Priory	1·04	26	,,	Holy Loch, Ardnadam	8·93	227
IV.	Elsenham, Gaunts End	1·06	27	XVI.	Loch Venachar	7·20	183
,,	Lexden, Hill House	1·12	28	,,	Glenquey Reservoir	8·20	208
,,	Aylsham, Rippon Hall	1·64	42	,,	Loch Rannoch, Dall	4·06	103
,,	Swaffham	1·42	36	,,	Blair Atholl Gardens	4·16	106
V.	Devizes, Highclere	1·06	27	,,	Coupar Angus	3·99	101
,,	Weymouth	1·24	31	,,	Montrose Asylum	1·85	47
,,	Ashburton, Druid Ho.	..	..	XVII.	LogieColdstone,Loanh'd	2·27	58
,,	Cullompton	1·64	42	,,	Fyvie Castle	2·15	55
,,	Hartland Abbey	2·93	74	,,	Grantown-on-Spey	3·47	88
,,	St. Austell, Trevarna	2·75	70	XVIII.	Cluny Castle	4·16	106
,,	North Cadbury Rec.	1·35	34	,,	Loch Quoich, Loan	10·60	269
,,	Cutcombe,Wheddon Cr.	2·85	72	,,	Fortrose	2·14	54
VI.	Clifton, Stoke Bishop	..	..	,,	Faire-na Squir	4·23	107
,,	Ledbury, Underdown	2·69	68	,,	Skye, Dunvegan	5·21	132
,,	Shifnal.HattonGrange	3·69	94	,,	Loch Carron, Plockton	..	..
,,	Ashbourne, Mayfield	4·96	126	,,	Dunrobin Castle	2·03	51
,,	Barnt Green, Upwood	3·68	93	XIX.	Tongue Manse	3·24	82
,,	Blockley, Upton Wold	2·51	64	,,	Melvich Schoolhouse	2·68	68
VII.	Grantham, Saltersford	3·41	87	XX.	Dunmanway Rectory	5·36	136
,,	Louth, Westgate	3·78	96	,,	Mitchelstown Castle	5·31	135
,,	Mansfield, West Bank	3·98	101	,,	Gearahameen	9·00	229
VIII.	Nantwich, Dorfold Hall	4·10	104	,,	Darrynane Abbey	7·28	185
,,	Bolton, Queen's Park	5·93	150	,,	Clonmel, Bruce Villa	4·69	119
,,	Lancaster, Strathspey	7·35	187	,,	Cashel, Ballinamona	4·98	127
IX.	Rotherham	4·50	114	,,	Roscrea, Timoney Pk.	3·67	93
,,	Bradford, Lister Park	4·11	104	,,	Foynes	4·96	126
,,	West Witton	4·10	104	,,	Broadford, Hurdlesto'n	4·67	119
,,	Scarborough, Scalby	4·70	119	XXI.	Kilkenny Castle	4·54	115
,,	Middlesbro', Albert Pk.	5·46	139	,,	Rathnew, Clonmannon	3·33	85
,,	Mickleton	3·60	91	,,	Hacketstown Rectory	5·03	128
X.	Bellingham	6·74	171	,,	Balbriggan, Ardgillan	3·61	92
,,	Ilderton, Lilburn	5·07	129	,,	Drogheda	3·21	81
,,	Orton	7·76	197	,,	Athlone, Twyford	3·76	95
XI.	Llanfrechfa Grange	3·24	82	XXII.	Castle Forbes Gdns.	3·38	86
,,	Treherbert,Tyn-y-waun	9·46	240	,,	Ballynahinch Castle	6·09	155
,,	Carmarthen Friary	5·88	149	,,	Galway Grammar Sch.	5·04	128
,,	Llanwrda, Dolaucothy	7·72	196	XXIII.	Westport House	3·79	96
,,	Lampeter, Falcondale	6·44	164	,,	Enniskillen, Portora	..	..
,,	Cray Station	7·20	183	,,	Armagh Observatory	3·55	90
,,	B'ham W.W.,Tyrmyndd	6·25	159	,,	Warrenpoint	3·92	100
,,	Lake Vyrnwy	6·53	166	,,	Belfast, Cave Hill Rd.	4·10	104
,,	Llangynhafal, P. Drâw	3·78	96	,,	Glenarm Castle	4·01	102
,,	Oakley Quarries	14·55	370	,,	Londonderry, Creggan	4·75	121
,,	Dolgelly, Bryntirion	9·45	240	,,	Sion Mills	3·69	94
,,	Lligwy	6·15	156	,,	Milford, The Manse	4·79	122
XII.	Stoneykirk,ArdwellHo.	4·43	113	,,	Narin, Kiltoorish	3·95	100
,,	Carsphairn, Shiel	9·77	248	,,	Killybegs, Rockmount	5·70	145

Climatological Table for the

STATIONS	PRESSURE Mean M.S.L. mb.	PRESSURE Diff. from Normal mb.	TEMPERATURE Absolute Max. ° F.	Absolute Date	Absolute Min. ° F.	Absolute Date	Mean Values Max. ° F.	Mean Values Min. ° F.	Mean Values ½ max. and min. ° F.	Mean Values Diff. from Normal ° F.
London, Kew Observatory	1018·2	+4·4	63	24	29	3	53·8	39·2	46·5	+4·1
Gibraltar	1019·5	+3·7	70	21	48	21,22,31	61·7	52·3	57·0	−0·5
Malta	1019·2	+5·3	65	8	48	1	60·3	52·0	56·1	0·0
Sierra Leone	1009·8	−1·1	94	17,22,27	70	13	91·5	72·5	82·0	−0·6
Lagos, Nigeria	1011·5	+2·1	97	28	60	16	89·0	77·5	83·3	+0·4
Kaduna, Nigeria	1013·0	+4·9	99	25	59	3	92·5	67·0	79·7	−2·0
Zomba, Nyasaland	1009·6	−0·1	85	3	59	16	80·5	64·8	72·7	+2·0
Salisbury, Rhodesia	1009·5	−1·9	84	26, 27	55	15	79·7	60·7	70·2	+2·1
Cape Town	1014·7	+0·2	99	13	52	27	79·4	60·8	70·1	+1·9
Johannesburg	1014·3	+0·5	84	3	45	13	71·3	54·4	62·9	−0·4
Mauritius	..	..	..	..	..	..	..	..	..	..
Bloemfontein	..	..	87	2	48	13	77·9	57·6	67·7	+0·3
Calcutta, Alipore Obsy...	1007·3	−2·6	102	23	63	2	92·7	73·0	82·9	+2·8
Bombay	1009·1	−1·6	91	4	69	3	87·9	74·1	81·0	+1·5
Madras	1009·7	−1·1	95	18	68	1, 5	90·1	72·4	81·3	+0·3
Colombo, Ceylon	1009·8	−0·2	91	1	65	2	88·4	73·4	80·9	−1·1
Hong Kong	1015·9	+0·1	82	1	45	4	68·9	59·5	64·2	+0·9
Sydney	1018·5	+2·3	99	25	55	7	77·1	62·7	69·9	+0·7
Melbourne	1019·1	+2·3	95	24	43	27	75·5	54·6	65·1	+0·6
Adelaide	1019·0	+2·0	97	23	49	17	81·4	59·3	70·3	+0·4
Perth, Western Australia.	1014·3	−1·1	101	5	52	30	86·5	64·2	75·3	+4·5
Coolgardie	1014·8	0·0	102	20	46	31	89·5	60·1	74·8	+3·1
Brisbane	1016·9	+2·8	90	25	60	8, 22	79·5	65·8	72·7	−1·7
Hobart, Tasmania	1015·4	+1·3	89	14	42	27	69·2	51·6	60·4	+1·0
Wellington, N.Z.	1015·3	−1·7	77	16	43	9	67·5	53·2	60·3	−0·4
Suva, Fiji	1010·7	+2·2	93	9	70	30	87·6	72·8	80·2	+0·1
Kingston, Jamaica	1015·2	+0·2	90	27	66	29	86·9	68·5	77·7	+0·6
Grenada, W.I.	1012·8	−0·1	89	24, 25	68	11	82·7	71·5	77·1	−0·6
Toronto	1018·5	+1·5	70	26	7	4	47·0	30·1	38·5	+9·6
Winnipeg	1017·4	−1·4	44	29	−16	8	26·0	5·7	15·9	+1·5
St. John, N.B.	1019·3	+5·1	56	27	8	5	41·5	26·7	34·1	+5·7
Victoria, B.C.	1016·8	+1·0	56	30	30	11	49·7	38·1	43·9	+0·7

LONDON, KEW OBSERVATORY.—1 day with hail, 1 day with thunder heard, 2 days with fog. Mean speed of wind 9·8 mi/hr.

GIBRALTAR.—1 day with fog, 2 days with gale.

MALTA.—Prevailing wind direction WNW; mean speed 6·6 mi/hr.

SIERRA LEONE.—Prevailing wind direction SW.

December 1920.										
*Perth, W. Australia	1013·3	0·0	102	18	50	12	80·6	60·9	70·7	0·0

* Maximum in sun 166° F

British Empire, March 1921.

Temperature: Mean Wet Bulb. °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
43·9	18	74	6·6	1·33	34	− 9	14	4·0	35	London, Kew Observatory.
53·1	41	77	5·7	7·90	201	+ 79	6	..	..	Gibraltar.
..	..	81	5·4	2·47	63	+ 28	11	6·6	55	Malta.
74·7	..	63	3·1	0·11	3	− 25	1	..	..	Sierra Leone.
74·9	59	55	7·8	4·02	102	+ 6	5	..	..	Lagos, Nigeria.
64·7	..	49	..	0·02	1	− 9	1	..	..	Kaduna, Nigeria.
..	..	91	7·9	10·98	279	+ 69	26	..	..	Zomba, Nyasaland.
64·1	52	73	7·0	7·83	199	+ 92	18	..	..	Salisbury, Rhodesia.
63·9	..	65	3·0	0·28	7	− 17	5	..	..	Cape Town.
56·9	45	81	6·3	7·69	195	+ 88	16	5·8	48	Johannesburg.
..	..	..	..	..	..	..	..	..	..	Mauritius.
61·0	..	79	4·7	3·78	96	− 5	13	..	..	Bloemfontein.
73·7	53	46	1·8	0·73	19	− 13	1	..	..	Calcutta, Alipore Obsy.
73·3	60	66	0·5	0·00	0	− 1	0	..	..	Bombay.
75·3	..	82	1·1	0·00	0	− 5	0	..	..	Madras.
77·5	55	65	5·4	4·90	124	+ 12	11	..	..	Colombo, Ceylon.
60·0	..	78	7·8	4·51	114	+ 38	15	3·8	31	Hong Kong.
64·8	48	67	6·1	3·12	79	− 52	18	5·4	44	Sydney.
58·4	36	56	3·8	1·02	26	− 29	6	..	..	Melbourne.
59·3	37	46	2·5	1·65	42	+ 15	2	9·3	76	Adelaide.
65·5	46	50	1·7	0·95	24	+ 6	3	..	..	Perth, Western Australia.
63·7	40	35	1·1	0·13	3	− 16	1	..	..	Coolgardie.
68·1	56	74	6·3	7·86	200	+ 48	19	..	..	Brisbane.
52·5	35	59	5·4	0·77	20	− 22	12	8·7	70	Hobart, Tasmania.
55·4	30	72	5·3	1·29	33	− 50	11	6·4	52	Wellington, N.Z.
76·5	..	80	..	12·64	321	− 52	23	..	..	Suva, Fiji.
..	..	74	5·6	1·42	36	+ 10	8	..	..	Kingston, Jamaica.
71·9	..	72	4·7	4·07	103	+ 33	20	..	..	Grenada, W.I.
34·2	5	82	7·2	2·11	54	− 13	20	..	..	Toronto.
14·1	..	90	5·3	1·09	28	+ 1	9	..	..	Winnipeg.
31·7	7	83	6·2	4·64	118	+ 3	16	..	..	St. John, N.B.
40·2	26	81	6·0	1·23	31	− 34	16	..	..	Victoria, B.C.

COLOMBO, CEYLON.—Prevailing wind direction W.; mean speed 3·8 mi/hr; 4 days with thunder heard.

HONG KONG.—Prevailing wind direction ENE.; mean speed 9·4 mi/hr.

SUVA.—5 days with thunder heard.

GRENADA. Prevailing wind direction E.

62·1	39	52	3·3	0·16	4	− 11	3	..	..	Perth, W. Australia.

thunder occurred locally. The depression passed away to the south of France on the 17th and became less deep, and a ridge of high pressure formed over the British Isles, bringing fine weather generally on the 18th and 19th, though there was much fog on our north-east coasts. These were the warmest days of the month in most places, temperature exceeding 80° F. at several stations. The depression came back from France on the 20th, moving north to the neighbourhood of the Wash by the morning of the 22nd. The weather became overcast over the greater part of the country, and heavy local rain and thunder again occurred. The depression moved east and dispersed, but several places, including London, experienced thunderstorms on the 23rd.

Heavy rains and thunderstorms were renewed in France and Switzerland from the 17th to the 24th. On the 18th there were 94 mm. at Perpignan, on the south coast of France, and 98 mm. at Sanguinaire, in Corsica, and on the 22nd there were 135 mm. at Lugano, in southern Switzerland.

From the 25th till the end of the month a westerly type of weather again prevailed. The weather was mainly fair in southern England, France, and Central Europe, while Atlantic depressions brought rain to the northern districts of the British Isles and to Scandinavia. A secondary which formed off the Hebrides on the evening of the 26th developed quickly into a deep cyclone which moved away up the Norwegian coast. A new depression formed off the west of Ireland on the 28th, and moved eastward over England and then north-north-east to the Gulf of Bothnia, which it reached on the 31st, having become much deeper. It caused heavy rain along its track, the largest falls in the British Isles being in north-east England and south-west Scotland, to the left of the centre. On the night of the 28th Howden had a heavy thunderstorm and a total of 27 mm. of rain, and Tynemouth had 10 mm., followed by 44 mm. on the 29th. Except for thunderstorms on the coast of Kent during the early hours of the 29th, south-east England escaped rain from this depression altogether. A cold northerly current extended over the British Isles in the rear of the depression, temperature being very low in the north all day on the 29th, and low generally on the nights of the 29th and 30th, with local ground frost. The screened thermometer fell to 30° F. at Eskdalemuir and 30° F. at South Farnborough on the night of the 30th, and on the previous night fell to 40° F. as far west as Valencia Observatory.

On the grass a reading of 25° F. was recorded at Eskdalemuir and Greenwich on the night of the 30th. On the last day of the month a depression off the west of Ireland caused a warmer southerly current, with rain in the western districts.

Fog was persistent on our north-east coasts from the 18th to the 23rd, and extended as far south as Yarmouth at times from the 21st to the morning of the 24th. There was also thick fog over the Irish Sea on the 19th, which cleared during the 20th. There was local morning fog inland during this period, and low cloud and mist persisted all day locally from the 21st to the 24th. For the remainder of the month visibility was mainly good, though there was occasional mist or fog on our south-west coasts. C. K. M. D.

At the beginning of the month the drought was continuing in France with undiminished severity. Forest fires and the destruction of mills and farms were being reported daily, the largest being that of the forest of Vorey-sur-Azon, which at one time threatened the towns of Vorey and Bellevu. Heavy rain fell later in southern France, and severe floods on the Garonne and its tributaries followed. Snow fell in Savoy on the 15th. A violent storm considerably damaged Doua Wireless Station, near Lyons, about the same time, suspending communication with America and the Far East.

Heavy rain has fallen in many parts of Switzerland, breaking up the prolonged drought. Snow also fell in various parts of the Alps. A tornado swept over the Montreux district (Lake of Geneva) on the evening of the 3rd.

Hailstorms of exceptional violence occurred on the 16th in Bavaria and Württemberg, doing extensive damage. In some places large hailstones lay piled on the ground to the depth of a foot.

Great heat was being experienced in Italy at the beginning of the month.

Prolonged drought has ruined the Hungarian and Yugo-Slav maize crops, but the Austrian corn harvest is excellent.

The total rainfall of India from June 1st approximates to the normal or exceeds it everywhere except in eastern Rajputana. A telegram dated August 10th stated that the monsoon was strong in northern India, but weak in the Peninsula. Unprecedented floods have occurred in the Malia district of Kathiawar, and considerable damage has also been caused in Waziristan and other parts of the Afghanistan frontier.

The gales and floods in eastern Australia in July were followed in New South Wales and Victoria by the coldest weather experienced for a quarter of a century. Snow has fallen in districts where it has never been seen before.

The harvest in Canada has been early, but is satisfactory on the whole.

In the south-east of England generally the deficiency of rain continued throughout August. For the seven months February to August the fall was less than half the average over the country between Kent, Norfolk and Somerset. At Oxford only 42 per cent. and at Camden Square (London) only 44 per cent. of the average for this period was recorded.

Less than the average rainfall for August occurred generally south of a line from the Bristol Channel to the Wash, in the northern half of Scotland, and in the north and centre of Ireland. The area with deficiency over the British Isles was roughly equal to that with excess, although the deficiency was not well marked, falling only to about 40 per cent. below the average along the south-east coast. More than twice the average occurred locally near Newcastle, where the heavy rain of the 29th of about 2 in. (50 mm.) was the heaviest recorded in one day since 1913. Falls of less than 1 in. (25 mm.) for the month were confined to small areas in the south-east of England. Less than 3 in. (75 mm.) fell only to the south-east of a line from about Cardiff to Boston, over small areas in the east of Scotland, and in the neighbourhood of Dublin. The area with more than 6 in. (150 mm.) was unusually large, occupying the greater part of Wales and the south-western half of Scotland, considerable areas in the north of England, and the mountain regions of Kerry and Connemara. More than 10 in. (250 mm.) occurred in the usually wet areas of the United Kingdom, as much as 25 ins. being recorded in the Lake District. With the numerous thunderstorms of the month several heavy falls in short periods were recorded, of which that at Milton, near Peterborough, of 1·91 in. (49 mm.) in 65 minutes ranks as a "remarkable fall."

The general rainfall of August, expressed as a percentage of the average, was:—England and Wales, 115; Scotland, 106; Ireland, 108; British Isles, 110.

In London (Camden Square) the conditions were generally fair or fine, but with a good deal of cloud and occasional showers. The mean temperature, 63·7° F., was 1·3° above the average, and it was the twelfth successive month with temperature in excess of the average. Duration of rainfall, 15·0 hours; evaporation, 2·56 inches.
