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Abnormal Rainfalls

In continuation of the articles on "Extremes of Temperature" and "Abnormal Wind Velocities," published in the numbers of the *Meteorological Magazine* for August and October, some notes on abnormally heavy falls of rain in different periods may be of interest. As in the previous articles, the information does not pretend to be exhaustive, and no doubt many readers will be able to supply additional records of interest. The British Isles have already been adequately dealt with from time to time, and especially in Dr. Glasspoole's note on p. 18, so that we may confine our attention to extra-British regions.

Dealing first with annual totals, the name of Cherrapunji, in the Khasi Hills of Assam, springs at once to the mind. The official annual average here is 424·0 inches, but the official gauge is not in the wettest part of the area; 18 years observations at the Welsh Mission House gave an average fall of 441·7 inches, and 12 years at Shadwells House an average of 449·6 inches. "Cherra Poonjee is on the crest of the southern scarp, at an elevation of 4,000 feet, overlooking the plains of Sylhet. It stands on a little plateau of thick-bedded sandstones, bounded on two sides by precipices of 2,000 feet sheer descent, which close in gorges, debouching southwards on the plains. The south-west wind, after sweeping over the inundated alluvial tract, blows up these as well as on the southern face of the general scarp, and, having reached the heads of the gorges, ascends vertically. Thus, Cherra Poonjee in the summer monsoon season is sur-

rounded, or nearly so, by vertically ascending currents of saturated air, the dynamic cooling of which is the cause of the enormous precipitation which has made this place famous. Moreover, it is at the elevation of 4,000 feet, which Mr. Hill finds, in the Himalaya, to be that of maximum precipitation. It is almost certain that the annual average varies greatly in different parts of the station, although the whole extent of the plateau is not much more than a couple of square miles. Some of the earlier registers, which were those of rain-gauges near the centre of the plateau, show a higher rainfall than those kept in recent years further north, and under the lee of a ridge that crowns its western margin."*

The station of Manoyuram, at an elevation of about 3,500 feet and a short distance south of Cherrapunji, may be even wetter, a five year period giving an average of 498.65 inches, the months of June to August averaging over 100 inches each.

It is this extremely local nature of the fall which makes the true average rainfall of the Cherrapunji district so problematical. The earlier registers were kept at the old and now abandoned station, which was unquestionably wetter than the present station, but in addition the records themselves are open to doubt. A register for 1861, from which March is missing, gave the enormous total of 905.12 inches in the remaining eleven months, of which 336.14 inches are returned for July alone. "Of the circumstances under which these were kept nothing is known,"† but they are not confirmed by comparison with the rainfall at Sylhet, 20 miles away, for the same years. Better authenticated is the fall of 264 inches in August, 1841, when 30 inches or more fell on each of five successive days. The rainfall of Cherrapunji is the more remarkable when it is considered that very nearly the whole of it falls within the space of a few months. The average monthly falls are as follows:—

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
0.5	3.1	9.1	31.7	43.5	94.2	101.8	82.9	34.9	19.5	2.4	0.4

For many years Cherrapunji held its place as the wettest known spot on earth, but recent measurements in the Hawaiian Islands suggest a still higher annual total. On the windward slopes of Mount Waialeale, "during the periods August 2, 1911, to March 26, 1914, and May 31, 1915, to August 13, 1917, a total of 1,782 days, there was recorded...a total precipitation of 2,325 inches... In a 365-day year this would amount to 476 inches. The years 1918 and 1914, for which, unfortunately, no records were obtained, were the wettest since the local Weather Bureau office was established in the Hawaiian Islands. Though comparative estimates are always unsatisfactory,

* *Indian Meteor. Memoirs III.* (1886), p. 44.

† *London, Q. J. R. Meteor. Soc.*, 17 (1891), p. 149.

reliable records obtained at near-by stations indicate that both in 1914 and 1918 the rainfall at this station exceeded 600 inches,"* and the true annual average may well be above 500 inches. There are several other rainy spots in the islands (e.g. Honomu, 379 inches), which seem to justify Mr. Larrison's nickname of "Uncle Sam's Dampest Corner." The gauge on Mount Waialeale was very difficult of access, and was not visited regularly, so that monthly and daily totals are not available; at the regular stations the largest total in 24 hours was 31.95 inches at Honomu on February 20th, 1918.

The following note has been extracted from a paper *Flood Absorption in Tanks*, by S. K. Gurtu, Gwalior, 1916: "Mr. R. B. Joyner, C.I.E., M.I.C.E., Hydraulic Consulting Engineer, says, in a sketch of the Hydro-electric scheme of Bombay: 'It has hitherto always been thought that Cheraponji, in the Khasia Hills, had the greatest rainfall in the world, but in the catchment area of the Lakés for this scheme over 546 inches have been measured in one monsoon of which 440 inches (nearly 37 feet depth) fell in 31 consecutive days.' The conditions of Ghat catchment areas do not apply to the interior." The wettest place in Africa so far as is known is Debundscha Plantation, at the foot of the Cameroon Peak, totals for which are given on p. 16. With an annual average of 369.2 inches this station comes third on our list. For an eleven year period here, Hann gives an average of 412.2 inches, and at the neighbouring station of Bibundi, for an 8½ year period, 403.2 inches, but these would seem to refer to a series of abnormally rainy years. As these stations are very near sea level and the rainfall presumably increases upwards, much higher totals may occur on the slopes of the mountain. Some heavy rainfall totals are found in Formosa, where Kashōryo has an average of 282.5 inches, while at Funkiko as much as 82 inches fell in three days, causing heavy floods. Other rainy places are Tami Island, off Papua (254.7 inches); Greytown, Honduras (251 inches); Launglon, Burma (226.2 inches); Thandaung, Burma (226.1 inches); and Padupola, Ceylon (219.1 inches). At all these places the cause of the heavy rain is roughly the same as at Cherrapunji; moist warm air straight from its passage across the ocean striking a ridge of high ground at right angles to its course and being forced to ascend almost vertically.

The heaviest rainfall in Europe appears to occur at Crkvice, on the Gulf of Cattaro—again a hollow, ringed by mountains on three sides, on the fourth open to the sea and the prevailing southerly winds—where the annual average is 182.8 inches,

* LARRISON, G. K. "Uncle Sam's Dampest Corner." *M. W. Rev. Washington, D.C.*, 47 (1919), p. 303.

falling mainly in the winter half-year. The heaviest fall in any one year has been 241.3 inches. At the neighbouring station of Hermsburg 57.1 inches fell in October, 1889. The corresponding figures for the British Isles are:—computed annual average at Llyn Llydaw, Snowdon, 178 inches; heaviest fall in any one year 247 inches in 1909; and the most in one month 56.5 inches in October, 1909.

Australia appears to be the driest of the continents, the wettest station, Harvey Creek, on the north-east coast of Queensland, having an annual average of only 165.6 inches, of which 32.2 inches fall in March (16-year average). In 1921 the fall totalled 254.8 inches.

A useful table of the greatest rainfalls in 24 hours is given in the *Monthly Weather Review*.* The following amounts of over 30 inches are included:—

			inches.	
Baguio, Philippine Islands	..	46.0	..	June 14-15, 1911.
Cherrapunji, India	..	40.8	..	June 14, 1876.
Honomu, Hawaii	..	31.9	..	Feb. 20, 1918.
Nedunkem, Ceylon	..	31.8	..	Dec. 15-16, 1897.
Silver Hill, Jamaica	..	30.5	..	Nov. 6, 1909.

(114.5 inches fell in five days and 135 inches in eight days).

From other sources we have the following amounts:—

			inches.	
Funkiko, Japan	..	40.7	..	Aug. 31, 1911 and July 20, 1913.
Beerwah, Queensland	..	35.7	..	Feb. 2, 1893.
(77.3 inches in four days)				(<i>Met. Zs.</i> , 10, 1893, p. 150)
Tanabe, Japan	..	35.5	..	Aug. 19-20, 1889.
(this amount fell in 16 hours; 14.25 inches fell in four hours or 3.75 inches per hour.)				(<i>Met. Zs.</i> , 7, 1890, p. 283)

			inches.	
Port Douglas, Queensland	..	31.53	..	April, 1st, 1911.

The fall of 40 inches in 24 hours in Queensland given in the *Monthly Weather Review* cannot be substantiated.

			inches.	
Riposto, Sicily	..	18.3	..	Nov. 17, 1910.

(The largest known fall in 24 hours in Europe, with the doubtful exceptions of two falls, quoted in the *Monthly Weather Review*, 1919, p. 302, reference *Encyclopedia Britannica*. These falls are given as 30 inches at Genoa and 33 inches at Gibraltar, both in 26 hours, but as no other information can be found they must be distrusted).

* Vol. 47 (1919), p. 302.

From the *Indian Meteorological Memoirs*,* we obtain the following records of 30 inches or more in 24 hours:—

United Provinces Nagina, 32.4 inches.

Danipur, 30.4 „

Bengal Purnea, 35.0 „

Eastern Bengal and Assam .. Jowai, 40.1 „

(September 11, 1877).

Central India Rewah, 30.4 inches

The heaviest known fall in a short period occurred on May 1, 1908, at Porto Bello, where an autographic rain gauge recorded 2.47 inches in three minutes. Such records, however, depend on the presence of autographic instruments, and many heavy falls in a few minutes at places without these instruments must escape record.

According to Hellman (*Grenzwerte der Klimaelemente auf der Erde*) the greatest frequency of rain days occurs at Jaluit (Marshall Islands), the three years 1893 to 1895 having an average frequency of 336 days with rain (including "trace"), and 265 days with 1 mm. or more. Isleta de los Evangelistas, to the west of Magellan Strait, averages 317 days (1899-1909, 1912-13), Porto Bello, Nicaragua 310 days, Orange Bay near Cape Horn 306, and Kerguelen 303.

The question, which place has the smallest rainfall, resolves itself into the question "is there any place entirely without rainfall?" Hellman believes that there is not: "Even in the driest desert regions it very occasionally rains, and the remark frequently made by the oldest inhabitants that in their locality it has never yet rained, is often enough disproved by scientific travellers....There are, however, certainly places, in which in isolated years or even in several successive years no measureable rain falls. On the dry coasts of Chile and Peru, in south-west Africa, in Upper Egypt, in Australia, such cases are repeatedly determined. Formerly the Nile region at and above Assuan was considered to be quite rainless, but since a regular meteorological network has been established in Egypt, small rainfalls have often been recorded. Thus in Wadi Halfa during the ten years 1891-1900 there was no measurable rainfall, but drops of rain were observed altogether on 22 days, but not once in 1895 and 1898. In the surrounding desert there are at long intervals heavy rainstorms." On the other hand, travellers who have visited the Atacama desert have expressed the opinion that in parts of the desert it has not rained for centuries, the evidence for this being the condition of natural mummification in which bodies of some of the early Spanish explorers have been found.

C.E.P.B.

* Vol. 21, Part 3.

The Significance of Mean Cloudiness

By F. H. DIGHT, B.Sc.

Publications containing summaries of meteorological data often include values of the mean cloud amount as deduced from the observations at any given station over a stated period, but any reference to the frequency of "overcast" or "clear" days is often omitted. It is reasonable to expect that the frequency with which days of either of these types occur should stand in some relation to the mean cloud amount as observed at the station. If the relation be a simple one, then it can usefully be employed to indicate from the mean cloudiness the rather more interesting and often more useful value of the number of clear or overcast days which may reasonably be expected. It is proposed to set out below the results of an attempt to establish such a relation between the two quantities.

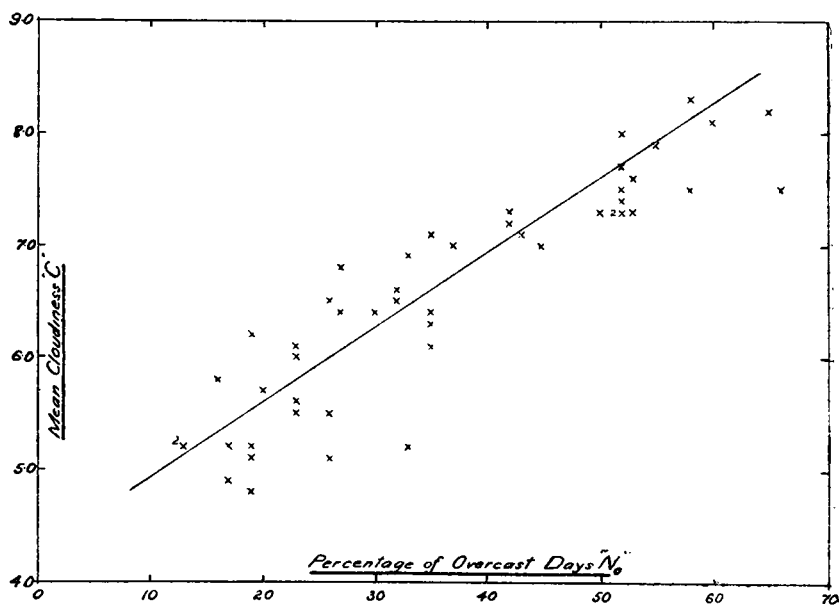


FIG. 1.

For this purpose the usual definitions of a "clear" and "overcast" day have been accepted here: a day has been classed as "overcast" when the mean value of the observed cloud amounts on that day was greater than eight tenths; when the mean value was less than two tenths the day was counted as "clear." The values collected were confined to the observations from a list of thirteen stations recording three observations per day, either at 7h., 13h., and 21h., or at 9h., 15h., and 21h. continuously throughout the years 1918-1920. In addition, the observations at Kew throughout 1921 have been used.

The general scheme was to count the number of overcast and clear days in each month, and to reduce these to a monthly percentage. The mean cloud amount for the month was also taken from the mean monthly values at the three hours of observation. The symbols used are :—

N_o = percentage of overcast days per month.

N_b = percentage of clear days per month.

C = mean monthly cloudiness.

In the first instance the values of N_o , N_b and C were abstracted for Kew for the twelve months of the four years 1918-1921, and the figures for each year were considered separately. It was soon obvious that corresponding values of N_o and C , and of N_b and C , could be fairly well represented by straight lines of the form $N_o = a_o + b_o C$ and $N_b = a_b + b_b C$, giving the relation between mean cloudiness and the percentage of overcast days in the first case, and between mean cloudiness and the percentage of clear days in the second. The method of least squares was then employed for the determination of the values of the constants a and b , which gave the best representation of the relation of N with C . The values obtained for the constants are shown as under :—

Kew	Overcast Days		Clear Days		Remarks on the year
	a_o	b_o	a_b	b_b	
1918	-82	18.0	44	-5.7	Wet year
1919	-64	14.9	46	-5.8	Dry year
1920	-61	14.6	32	-4.0	Dull, sunshine below normal
1921	-49	13.0	55	-7.0	Abnormally dry year
Mean	-64	15.0	44	-5.6	

The accompanying diagrams show the complete set of forty-eight observations over the four years plotted with the curve for the mean values of a and b shown above. Fig. 1 shows the values of N_o and C with the curve $N_o = 15C - 64$. Fig. 2 shows the values of N_b and C with the curve $N_b = 44 - 5.6C$.

In the second part of the investigation a similar use was made of the observations from the following list of thirteen reporting stations: Tynemouth, Yarmouth, Dungeness, South Farnborough, Holyhead, Pembroke, Portland, Falmouth and Scilly (A. stations); and Huddersfield, Oxford, Southport and Kew (B. stations). A. stations report at 7h. 13h. and 21h., and B. stations at 9h., 15h. and 21h. Separate equations were deduced from the January observations of the thirteen stations for each of the three years 1918-1920 in turn, and a similar set of six equations also obtained from the July values for the same years, giving the relation between N_o and C , and N_b and C . Finally,

values for the constants a and b were calculated from the complete set of observations, separately for January and July, over the whole period of three years.

The following table gives the values of the constants:—

	Overcast		Clear			Overcast		Clear	
	a_o	b_o	a_b	b_b		a_o	b_o	a_b	b_b
Jan. 1918	-54	13.5	56	-7.4	July 1918	-63	13.5	42	-5.7
Jan. 1919	-80	16.5	30	-3.9	July 1919	-60	13.4	44	-5.8
Jan. 1920	-84	16.7	36	-4.7	July 1920	-97	18.5	(5.5)	(-0.7)
Mean ..	-73	15.6	41	-5.3	Mean	-73	15.1	43	-5.7
Jan. 1918-20	-69	15.0	54	-7.2	July 1918-20	-70	15.1	22	-2.6

There is at once noticeable a marked agreement between the different groups of curves: to the apparent agreement of the three mean curves reference is made later. For the present it is necessary to call attention to the three most divergent values of the constants. Referring back to the Kew equations for 1921,

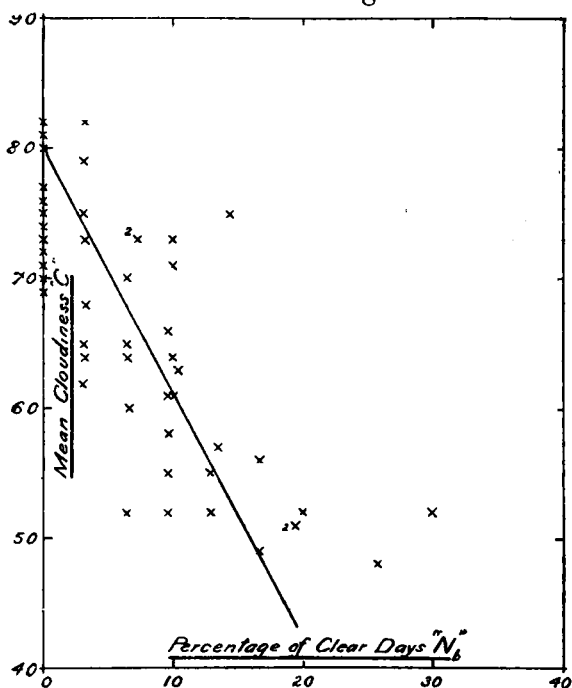


FIG. II.

it appears that they reflect the extended dry bright summer of that year, and this is particularly noticeable in the clear day relation. Of the four years 1918-1921, the lowest value of the mean cloud, the smallest number of overcast days, and the highest number of clear days are all credited to 1921. In September and October the high total of 15 clear days was recorded, and, of these, 9 occurred in September, bringing the total for the year to 41, against 17 in the previous year. A low figure for the mean cloudiness during these months was, however, counter-balanced to an appreciable extent by a very high value for January, so that the yearly mean was not exceptionally low.

The attempt to derive a clear day relation for July, 1920,

appears to be a complete failure. This is due to the fact that Dungeness was the only station to report a clear day, and the total reported from the thirteen stations for the month was one. Obviously, the equation can have no value, and was omitted when the mean value was required. There was a noticeable tendency in all the sets of observations for Dungeness to experience a smaller number of overcast days than any other station both during January and July, while in January the number of clear days was usually in excess. The total number of clear days at Dungeness recorded throughout January for the years 1918-1920 was 13, compared with the next highest figure of 9 at Falmouth, and it was found that the slope of the most representative clear day curve for January for the complete period 1918-1920 was due entirely to this high percentage of clear days at Dungeness. This explains why the difference between this curve and the mean curve of the 1918 and 1919 equations is so marked.

The position of the curves with reference to the axes might be anticipated to some extent when it is remembered that the number of overcast or clear days was not decided by a cloudiness of 10 or 0, as the case may be, but by the combination of individual cloud amounts ranging between 7 and 10, and 0 and 3 (*e.g.*, three cloud amounts of 10, 10, 7 count as an overcast day).

Some interesting equations result from a combination of the corresponding overcast and clear equations—we obtain

$$C = 5.5 + \frac{N_o - N_b}{22.2} \text{ for January,}$$

$$C = 5.4 + \frac{N_o - N_b}{20.8} \text{ for July,}$$

$$\text{and } C = 5.2 + \frac{N_o - N_b}{20.6} \text{ for the four years at Kew.}$$

If we put N_o and N_b both equal to 0 in these equations, the mean cloudiness comes out above 5.0 in all cases, indicating that there is a considerable frequency of days of mean cloudiness between six and seven tenths, or even more, which produce no overcast days. These equations may usefully be employed in checking cloud observations: errors in the number of overcast and clear days are unlikely, so that these reliable values can then be used to check the more uncertain observations of the partially cloudy days as revealed by the mean cloudiness, particularly where the error is consistently high or low. A table is given below in which are shown the actual and calculated values of C , using the above formulæ. The Kew equation has been used to find C for the year, as well as to determine a few of the monthly values. The seasonal equations have been used to give the monthly figure for a few of the stations already enumerated, and finally the method was applied to some other stations. The observations were

selected at random, and it is not proposed to discuss the figures, except to point out that Southport for July, 1920, and Plymouth for January, 1918, gave the largest discrepancies, and the formula appears to be accurate to 0.5 tenths of cloud.

Place & Year	C (calculated)	C (actual)	Place & Month	C (calculated)	C (actual)
Kew, 1919	6.5	6.5	Holyhead, Jan. 1920	6.5	6.8
„ 1921	6.2	6.3	Southport, July 1920	8.6	8.1
„ Dec. 1918	7.7	7.4	Plymouth, Jan. 1918	6.5	7.0
„ Sep. 1921	5.3	5.2	Ross, July 1919	7.5	7.6
Huddersfield, July 1918	6.2	6.3	Spurn Head, Jan. 1920	6.4	6.8

The similarity of the constants a and b in the mean equations, and the agreement between the combined equations, make it seem probable that they are in close agreement with some values of a and b , which may prove, on further investigation, to give a general equation applicable to the British Isles irrespective of season.

Discussions at the Meteorological Office

January 31st, 1927. *The way of the wind*. By W. J. Humphreys (Philadelphia, Pa., J. Franklin Inst. 200, 1925, pp. 279-304).
Opener—Mr. M. J. Thomas, B.Sc.

The paper deals with the variation of wind with height due to the facts that the earth is a rotating sphere and the air a viscous fluid. Referring to frictionless movements of the air, gradient for gradient, the maximum possible wind in an anticyclone is exactly twice that of a straight-away wind (straight isobars).

The effect of atmospheric turbulence on the direction and velocity of wind in the lower atmosphere is considered, and the equations of Ekman's Oceanographic Paper* converted to solve for straight-away winds instead of, as Ekman's paper demanded, down into the water for ocean drift. Assuming the density of the air, the pressure gradient, and the coefficient of eddy viscosity to be constant with height, the drift of air just above the surface is 45° to the right of the direction of surface movement relative to the air in the northern hemisphere, and the projection of the drift envelope on to the earth is an equiangular 45° or 135° spiral about the initial point of contact of air and surface.

The surface wind attains gradient speed both below and above the level at which the gradient direction is attained. Observa-

* "On the influence of the earth's rotation on ocean currents." By V. W. Ekman., Ark. Matem., Stockholm 2 (1905), No. 11.

tions in U.S.A show that on many occasions (all morning conditions) a well-defined maximum velocity occurs at $\frac{1}{2}$ km., and a well-pronounced minimum velocity at 1 km., the latter fact being due to the superposition of different wind systems.

The curve showing average wind velocities with height is similar to that obtained if there were no cyclonic, anticyclonic or other disturbances except turbulence in the flow of the air.

The subjects for discussion for the next meetings will be :—
February 28th. *Studies concerning the relation between the activity of the sun and of the earth's magnetism.* By L. A. Bauer and G. A. Duvall (Terr. Mag. 30 (1923), pp. 191-213 and 31 (1926), pp. 37-47). *Opener*—Mr. W. M. Witchell, B.Sc.
March 14th. *Les méthodes de prévision du temps.* By J. Rouch (Paris, 1924), (reviewed in the *Q.J.R. Meteor. Soc.* 50, 1924, p. 390). *Opener*—Mr. J. J. Somerville, B.A., B.L.

Royal Meteorological Society

The annual general meeting of the Royal Meteorological Society was held on Wednesday, January 19th, when Sir Gilbert Walker was re-elected president. The Buchan Prize, which is awarded biennially for the most important original papers contributed to the Society during the previous four years, was presented to Mr. C. K. M. Douglas. Sir Gilbert Walker delivered an address on "The Atlantic Ocean," in the course of which he directed attention to the value, when studying the movements of the atmosphere, of an understanding of oceanic circulations. He described the conditions of temperature, salinity, and density revealed by recent measurements in the Atlantic down to a depth of 10,000 feet or more. These throw light on the general character of the oceanic circulation, and indicate that though prevailing winds may set up surface currents, they probably produce no significant effect at a depth exceeding 700 feet. Icy water from the Arctic, and especially the Antarctic, flows towards and even beyond the equator at great depths, and as the air temperature is largely controlled by that of the sea, variations in the general circulation may provide the explanation of some of the big seasonal changes which occur in equatorial as well as in temperate regions.

Correspondence

To the Editor, *The Meteorological Magazine*

The Solar Halo of December 5th

There was an unusual solar halo yesterday first noticed near Brompton Cemetery at 10.40 a.m. and all over by 10.50 a.m. Round the sun and touching it was a broad circle of rusty

flame-coloured radiations, similar to what is commonly called a "watery moon," but much brighter. The outer diameter of this was about 9 times that of the sun's disc. Outside came a ring of clear sky two such diameters wide and beyond that a coloured circle of the same width as the clear ring, shewing two colours, viz. :—green (inside) and red (outside), far more brilliant than the others. A dark snow-cloud drifting along from the east obliterated the inner halo, while the outer one lost its green and red, but was still traceable on the west side by broken patches of vivid blue and pale yellow.

W. P. HASKETT-SMITH.

United University Club, Pall Mall East. December 6th, 1926.

Remarkably Long-lived Lunar Rainbow

For a full half-hour on the evening of November 23rd—from 8.30 to 9 o'clock—a remarkably fine and long-lived lunar rainbow was observed at Guernsey. The long shower that brought it into being began to fall just after 8 o'clock, at which hour the moon, clouded over, was but recently risen in the east-north-east. At 8.30 it emerged into a broad expanse of clear sky and the bow began forming in the northwest against an inky-dark cloud which covered more than half of the sky. Five minutes later the arc, of very large size, was complete and strikingly bright.

The remarkable feature about this moon-bow was that owing to the shower-cloud spreading eastwards very slowly (a dead calm prevailed) and the moon being low in the sky, the bow continued visible in its complete form until 9 o'clock when, our satellite at last becoming obscured, it disappeared quickly. Throughout its visibility the bow remained of a milky-white colour; no prismatic colours were observed at Les Blanchés.

BASIL T. ROWSWELL.

Les Blanchés, St. Martin's, Guernsey. December 21st, 1926.

The Detonating Meteor of October 2nd, 1926

In an interesting account of the detonating meteor of 1926, October 2nd, Mr. F. J. W. Whipple gives to A. Wegener credit for the idea that the detonations of fireballs and meteorites are due to the passing by of a projectile bow-wave. Wegener's papers on the Treysa meteorite of 1916, April 3rd, are very stimulating and suggestive; but the credit for this particular idea belongs to B. Doss. He published it with substantial evidence, based on E. Mach's photographic studies of projectiles and on other observations made on the target range, in a paper on the meteorite of Misshof, *Neues Jahrbuch für Mineralogie usw.*, 1892 I., pp. 71-113. His statement of conclusions is:

"that the report, like that of a cannon, which is so often heard, is nothing other than the sound head-wave . . . which initially travels with the same speed as the stone, and only begins to escape forward at that moment when the meteorite, by air-wave formation, by the production of air-vortices behind and by the friction of the air . . . has reached a velocity below the normal velocity of sound for the elevations in question." In an appended letter Mach expresses his agreement.

Perhaps the most interesting physical suggestion in Wegener's paper is, that the "disappearance" of a detonating fireball, or the ending of the luminous path of a stone-dropping meteor, coincides with this forward escape of the sound head-wave; and that, consequently, the velocity of a fireball at the moment of disappearance is the same for all. He thinks that this is somewhat above the normal velocity of a free sound-wave.

WILLARD J. FISHER.

Harvard College Observatory, Cambridge, Massachusetts, January 9th, 1927.

I am much obliged to Mr. Fisher for the reference to Doss's paper. It is remarkable that a theory published in 1892 has taken so long to become generally known.

With regard to Wegener's paper it should be noted that his suggestion* is that the meteor disappears from sight when the speed is reduced to 1,000 or 1,200 metres per second, the initial speed of an explosive wave. This is no less than three times the "normal velocity of a free sound wave." Wegener supposed that reduction of velocity to that of an explosive wave was the cause of disappearance of all meteors. This is, however, inconsistent with the analysis of Lindemann and Dobson, who demonstrate† that in the case of shooting stars no material deceleration will take place until 19/20ths of the mass has evaporated. According to these authors the shooting star disappears because it has been vaporised.

F. J. W. WHIPPLE.

Kew Observatory, Richmond. February 1st, 1927.

Extremes of Temperature

I read the article on "Extremes of Temperature" in the August number of the *Meteorological Magazine* with much interest. Hitherto I believed that the Braemar figure of -17° F. in February, 1895, was the lowest recorded temperature in the British Isles, but I see the even lower figure of -23° F. is given by Mr. Marriott as occurring at Blackadder in December, 1879. Is this minimum fully authenticated and accepted as a record?

* *Marburg, Schr. Ges. Natw.* 14 (1917), p. 71.

† *London, Proc. R. Soc.* 102 (1923), p. 419.

and are there any other minima recorded between -17°F. and -23°F. ?

It would also be interesting to know the highest minimum and lowest maximum recorded in Great Britain. I believe there have been some very high minima in recent summers. As to low minima, I remember there was an exceptional frost in Scotland a few years back in which maxima of 10°F. and 12°F. were recorded at Balmoral and Braemar.

Another interesting question is—what is the lowest temperature at which snow has fallen at or about sea level in Great Britain? I have a distinct recollection of a fall of snow near London in February, 1895, with the temperature at 12°F.

H. LANGFORD LEWIS.

5, New Square, Lincoln's Inn, London, November 2nd, 1926.

[Mr. P. I. Mulholland has kindly supplied the following notes:—

The authenticity of the minimum of -23°F. at Blackadder in December, 1879, is supported by the readings recorded at neighbouring stations. I can find no record amongst the publications of the Meteorological Office or in the issues of the *Quarterly Journal of the Royal Meteorological Society* of minima between -17°F. and -23°F.

With regard to high minima and low maxima, a table showing the warmest night and the coldest day at several stations in the British Isles has been published regularly in the *Monthly Weather Report, Annual Summary* since 1913. The following data have been extracted from those tables:—

	COLDEST DAY Period 1913—1925			WARMEST NIGHT Period 1913—1926		
	Temp.	Place	Date	Temp.	Place	Date
England and Wales	20°F.	Cheltenham	Feb. 7th, 1917	72°F.	Ventnor	July 13th, 1923
Scotland	10	Balmoral	Nov. 14th, 1919	69	Rothsay	July 14th, 1926
Ireland	25	Clongowes Wood (Kildare)	Jan. 16th, 1917	66	Cahir	Sept. 18th, 1915
					Armagh	July 9th, 1921
					Dublin	July 8th, 1921
					Ballinacurra	July 23rd, 1921
					Kilkenny	Aug. 9th, 1923
					Dublin	July 12th, 1926
					Kilkenny	

In a paper in the *Quarterly Journal** by the late W. Marriott entitled, "The frost of December, 1879, over the British Isles," there is a record of a maximum temperature at Appleby of 12.4°F. on December 7th.

With regard to the lowest temperature recorded during a fall of snow, it is difficult to get precise information. January, 1881, was a month of frequent and severe snowstorms; in *Hourly*

**London Q.J.R. Meteor. Soc.*, 6 (1880), p. 102.

Readings for January, 1881, the total amount of precipitation in the form of melted snow for Stonyhurst for the 24 hours ending at 10h. on January 16th is given as 0.063 in. and the lowest temperature during the same 24 hours as 7°F. (approximately). The maximum for the same period was 28.3°F. It is, however, impossible to say whether the snow was actually falling continuously during this period.

During the snowstorm of December 29th, 1908, the temperature at Richmond varied from 27.1°F. at 2 a.m. to 21.9°F. in the afternoon, and at Aberdeen from 27.7°F. at midnight to 30.7°F. in the afternoon.]

Dr. Hirth's Isonotides

The isonotides referred to in the October *Meteorological Magazine* are in my opinion wholly misleading if interpreted, as such lines of equal "moisture" may easily be, in any other sense than the restricted one mentioned by Dr. Hirth, namely, as an index of the necessity or otherwise for irrigation in different parts of the world. The physiological idea of "dryness" or "dampness" in climate is highly composite, comprising amount and frequency of rain, density and frequency of fog, state of soil and vapour pressure. The best numerical expression for this totality of influence is not the relation of rainfall to temperature, but the ratio of rainfall to evaporation—by no means the same thing, unless one gets down to detail. When Dr. Hirth's map is studied, there will be found the anomaly that whereas regions like Siberia and Canada, which are generally regarded as possessing a physiologically dry winter climate with dry crisp snow and low vapour pressure, are placed in the dampest climatic category, England, or the bulk of it, with an unmistakably damp type of winter climate as indicated by much higher vapour pressure, sodden soil and common alternatives of rain, fog and wet snow, goes in a drier category. The summer conditions differ less in the two types of climate, and do not matter in the present argument. The anomaly in question, as well as others which could be mentioned, shows that Dr. Hirth's "rain factors," on which his isonotides are based, cannot be used as a general expression for climatic "dampness," which is in reality an exceedingly complex condition.

L. C. W. BONACINA.

27, Tanza Road, Hampstead. October 25th, 1926.

[The discrepancy to which Mr. Bonacina refers, namely, that on Dr. Hirth's map the "rain factor" for the greater part of England is between 61 and 100, while that for central Siberia is above 100, is due to the low mean annual temperatures of Siberia, which are dominated by the extremely low temperatures of winter. For most practical purposes, so long as the maximum

temperature is below freezing point for a long period, it makes little difference whether the winter mean is -10°C. or -40°C. , but it makes a great difference to the mean annual temperature, and in such regions the latter has very little significance, so that the "rain-factor" should be limited to those regions in which the mean temperature of the coldest month is above 0°C. With this limitation the chart does seem to be of value, as is shown at once by a comparison with a map of areas of desert, grassland and forest. A chart of the ratio of rainfall to evaporation would doubtless be more satisfactory if only we could obtain comparable measures of evaporation from a sufficient number of stations. We regret that in the article on p. 214 of the October Magazine the name Hirth was given as Wirth.—ED. *M.M.*]

NOTES AND QUERIES

Heavy Rainfall in the Cameroons

The Surveyor-General for Nigeria has contributed some interesting figures as to the rainfall at Debundscha (latitude $4^{\circ}6' \text{N}$, longitude $8^{\circ}59' \text{E}$), which is situated practically at sea level, at the foot of the Cameroon Mountain, and 15 miles to the south-west of the peak, which rises to an altitude of 13,300 feet. The records were obtained by the manager of the Debundscha Plantation, with a raingauge of 113 mm. diameter.

For the fifteen years 1911 to 1925 the average fall was 369.2 inches, the annual totals ranging from 204.3 inches in 1924 to 572.3 inches in 1919. For the latter year the following details are given as to the rainfall in the individual months:—

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Amount (inches)	17.0	9.8	18.5	19.5	47.5	58.3	68.3	109.9	90.7	89.9	35.1	13.2
No. of Days	19	19	23	26	29	28	29	31	28	29	19	15
Highest in Day (inches)	5.1	3.3	2.6	2.6	10.0	11.9	7.5	11.0	9.9	11.4	7.5	3.3

In 1925, with an annual total of 353.2 inches, the monthly falls ranged from nil in January, to 65.1 inches in September. The average number of raindays in a year (1912, 1914-1925) is 267, so that it rains on nearly three days out of four, but, even so, the average amount in a day is nearly 1.4 inches. The maximum fall in a day was 14.6 inches in June, 1911, while in August, 1919, an average of 3.5 inches fell on every day of the month.

The prevailing winds at Debundscha are from west and south-west throughout the year, that is, they blow directly onshore and up the slopes of the mountain. The difference between the wet season in June to October and the "dry" season in December to

April, is probably due to two factors. In the northern summer, owing to the greater height of the sun, the equatorial belt of instability moves northwards, so that the air crossing the coast-line is able to rise up the slopes of the mountain instead of tending to flow round it as in the northern winter, when the sun is far to the south. But probably the previous history of the air also plays some part in the annual variation of rainfall: in the northern winter the air is derived from the north-east current over west Africa, which has curved round over the Gulf of Guinea and has, therefore, travelled for a comparatively short distance over the ocean, while in the northern summer the prevailing winds over this part of the Atlantic Ocean are derived from the south-east trade wind, which has become a south-west wind after crossing the equator, and has, therefore, travelled over the water surface for a long distance and acquired a high degree of humidity. The large totals are, of course, amply accounted for by the onshore winds and the high steep slopes of the mountains: it would be interesting to know what the rainfall is further up the slopes.

Damage by a Cyclone, Mauritius

An account of a cyclone which passed near Mauritius on April 19th and damaged the crops there, has been received from Mauritius Observatory by the courtesy of the Colonial Office. The cyclone moved at about 5 or 6 miles per hour on a south-southwesterly track, the centre passing at a minimum distance of about 50 miles from the island between 16h. and 18h. Squalls of 58 miles per hour were recorded at Pamplemousses between 6h. and 7h., and of 61 m.p.h. at Vacoas between 11h. and 12h. The weather conditions had been exceptionally favourable for the sugar crop up to the 19th, but afterwards there was drought and a considerable fall of temperature, so that the reduction in the crop, estimated at 15 per cent. on account of the cyclone, is likely to be increased.

The Florida Hurricane

The Editor of the *Monthly Weather Review* calls our attention to an error on page 208 of the October number of this Magazine in the sentence beginning "At Palm Beach" and ending "Lake Okeechobee," in the account of the Florida Hurricane. He says: "Lake Okeechobee, as is doubtless known, is 30-35 miles inland from Palm Beach. On the southwest shore of the lake a town known as Moore Haven has grown up in quite recent years. The level of the town is about 5 feet below that of the surface of the lake and is protected therefrom by a dyke. What happened was this: The northeast winds of the hurricane piled the waters up on the southwest shore of the lake, the dyke gave

way and the people in the town were drowned. We are still waiting for a revised list of the loss of life in connection with the storm."

Extremes of Rainfall over the British Isles

Extremes of rainfall can be considered for the various units of time, *e.g.*, the year, month, day, and even for shorter periods. In the case of the month and year, the distribution of the extreme values is largely controlled by the configuration of the land, while for shorter periods the largest values on record occur in the drier regions of central England, where convectional rains are more common. The extremes set out below cover records for the last sixty years which have been discussed in the annual volumes of British Rainfall. During this period the number of stations has increased from about 1,000 to 5,000. The stations are not evenly distributed over the British Isles, the more mountainous regions being but sparsely represented.

The wettest year over the British Isles as a whole was 1872 with 137 per cent. of the average, and the driest year, 1887 with 77 per cent.

The average annual rainfall exceeds 150 inches in the English Lake District, Snowdonia and the western Highlands of Scotland, while the annual rainfall is less than 20 inches in the Thames Estuary. Annual totals exceeding 240 inches were recorded at The Styte, at the head of Borrowdale in Cumberland, in 1872 and 1923, at Ben Nevis Observatory, in Inverness, in 1898, and at Llyn Llydaw on Snowdon in 1909. The rainfall in 1921 in the south-east of England was easily the smallest on record, as little as 10 inches being recorded at Margate.

The wettest month over the British Isles as a whole was December, 1876, and the driest months, June, 1925, and February, 1891. The largest actual values at individual stations are set out below :—

Station	County	Month	Amount Inches
Snowdon (Llyn Llydaw)	.. Carnarvon ..	October 1909	.. 56.54
Borrowdale (The Styte)	.. Cumberland..	January 1872	.. 50.05
Ben Nevis Observatory	.. Inverness ..	December 1900	.. 48.34

Several stations recorded no rain in February, 1891, July, 1911, June, 1921, and June, 1925. Such records occurred in the south-eastern portions of England, and of Wales, Scotland and Ireland. In February, 1891, some 270 stations situated in central and south-east England measured no rain for the month, while in June 1925, no rain was recorded over an area of 6,410 square miles, or an area equal to about 85 per cent. of the total area of Wales.

The distribution of the extreme annual values is very largely controlled by the configuration of the land, the largest values

occurring in the mountainous regions, and the smallest on the plains. The distribution of the monthly extremes reveals a second factor, viz., that the south-east of England is more liable to periods of little or no rain, while in the north-west rain falls more frequently. Thus, at Eallabus, in Islay, on the west coast of Scotland, rain fell every day from August 12th to November 8th, 1923, a period of 89 days, or nearly three months, the average annual rainfall at Eallabus being only about 50 inches a year. This second factor is shown very clearly in monthly and annual maps of the number of days with rain. They indicate that in general there is a steady increase in the number of days with rain from the south-east to north-west, even at stations with the same annual fall. The least number of days recorded in any year was in 1921, when there was less than 100 days of rain over a well-marked area in the neighbourhood of the Thames Estuary. In 1923 the north-west of Ireland had more than 300 days with rain, and Ballynahinch Castle, in Connemara, recorded 309 rain days in the same year.

It is of interest to consider the longest periods on record in these islands with no rain. In 1893, during the famous spring drought, some 20 stations in the south-east of England, mostly in Kent and Sussex, recorded no rain for a period of 50 days or more. Locally in this district there was a two months' drought from March 17th to May 16th. The year 1893 was unprecedented for periods of little or no rain.

The largest falls on record for one day (9h. to 9h.) are set out below:—

County	Station	Amount Inches	Date
Somerset ..	Bruton (Sexey's School) ..	9.56 ..	June 28th 1917.
" ..	Cannington (Brymore House) ..	9.40 ..	Aug. 18th 1924.
" ..	Bruton (King's School) ..	8.48 ..	June 28th 1917.
" ..	Aisholt (Timbercombe) ..	8.39 ..	June 28th 1917.
Inverness ..	Loch Quoich (Kinlochquoich) ..	8.20 ..	Oct. 11th 1916.
Cumberland	Borrowdale (Seathwaite) ..	8.03 ..	Nov. 12th 1897.

The average annual rainfall for the first four stations is 30 to 35 inches, while that for the fifth and sixth stations exceeds 100 inches; so that with the short interval of the day the controlling influence of configuration over the distribution of extreme values has practically disappeared.

The most widespread heavy rain on record occurred in East Anglia on August 25th and 26th, 1912, when 1,939 square miles received more than 4 inches, corresponding to a volume of rainfall of 154,133 million gallons.

Of the list of heavy falls in short periods, it is only possible to quote a few examples. The fall of 1.25 inches in five minutes reported at Preston in Lancashire, on August 10th, 1893, gives the largest rate on record, viz., 15 inches per hour. The largest

fall in half an hour is 2.90 inches recorded at Cowbridge in Glamorganshire on July 22nd, 1880, and in one hour that of 3.63 inches at Maidenhead, on July 2nd, 1913. The heavy rain of 4.65 inches in two and a half hours on June 16th, 1917, at Campden Hill, in west London, is worthy of mention, since this amount is the largest on record for London for a rainfall day. It has been estimated that during the unprecedented storm at Cannington, near Bridgwater, on the August 18th, 1924, as much as 8 inches of rain (and hail) fell in 5 hours.

The largest values occur in the south and east of Great Britain and of Ireland, and the distribution of these heavy falls in short periods appears to be quite independent of the configuration.
J.G.

Radiation from the Sky

RADIATION MEASURED AT BENSON, OXON, 1926.

Unit : one gramme calorie per square centimetre per day.

ATMOSPHERIC RADIATION only (dark heat rays)				
Averages for Readings				
		Oct.	Nov.	Dec.
Cloudless days :—				
Number of readings	n	4	6	6
Radiation from sky in zenith ...	πI	437	440	420
Total radiation from sky	J	470	467	446
Total radiation from horizontal black surface on earth	X	690	673	652
Net radiation from earth	$X-J$	220	206	206
DIFFUSE SOLAR RADIATION (luminous rays).				
Averages for Readings between 9 h. and 15 h. G.M.T.				
Cloudless days :—				
Number of readings	n_0	1	3	3
Radiation from sky in zenith ...	πI_0	52	15	14
Total radiation from sky	J_0	69	24	18
Cloudy days :—				
Number of readings	n_1	3	2	8
Radiation from sky in zenith ...	πI_1	185	61	24
Total radiation from sky	J_1	165	51	21

Unit for I = gramme calorie per day per steradian per square centimetre.

Unit for J and X = gramme calorie per day per square centimetre.

For description of instrument and methods of observation, see *The Meteorological Magazine*, October, 1920, and May, 1921.

Obituary

Professor Alfred de Quervain.—We regret to learn of the death on January 13th, at Zürich, of Professor de Quervain, at the comparatively early age of 47. Professor de Quervain was born on June 15th, 1879, in the Canton of Berne. He was educated at Neuchatel and Berne, and from 1898 until 1902 he assisted the late Teisserenc de Bort, at the Observatory at Trappes, in developing the exploration of the upper air by means of ballons-sondes. As a result of these researches the stratosphere was discovered in 1899. In 1901 de Quervain carried out ascents in Russia, obtaining observations of temperature up to 10 kilometres. From Trappes he went to Strasbourg, where he worked with Professor Hergesell and also acted as Secretary to the International Commission for Scientific Aeronautics. To overcome the difficulty of following balloons for long periods with an ordinary theodolite, he invented the theodolite with the reflecting prism, now generally adopted.

From Strasbourg Professor de Quervain returned to Zürich. In 1909 he was in Greenland as the leader of a joint German-Swiss expedition, and three years later he led a Swiss expedition which successfully crossed the inland ice from west to east, ending at Angmagalik where he was met by his wife. A short crossing near the southern extremity of the ice had been made by Nansen in 1888, but de Quervain was the first to traverse the real interior of Greenland, covering more than 400 miles and reaching a height of 8,200 feet. The scientific results of the expedition, discussed by de Quervain and Mercanton, are still the main source of our knowledge of the meteorology of the Greenland ice-sheet.

After the war, when the International Meteorological Committee met again to take up the difficult post-war problems of the international exchange of observations, de Quervain became a member of the Commission for Meteorological Telegraphy. He was also keenly interested in the establishment of an Observatory on the Jungfrauoch at a height of 3,500 metres, in which he enlisted the warm support of his colleagues. Owing to his unique knowledge of clouds he was elected Chairman of the Sub-Commission appointed in 1923 to consider the method of reporting observations of cloud and weather in the International code, but in 1924, before this task was completed, his health broke down. He never quite recovered, though he was able to be present at a meeting at Zürich in September, 1926, at which the Commission approved a new trial code based on his work, and expressed its warm appreciation of his services and its sympathy with him in his illness. His death so soon afterwards was quite unexpected.

Mr. Charles Harding.—The death of Mr. Charles Harding, which was announced in the January number, has removed from our midst the last of those who worked in the office under Admiral Fitzroy. Mr. Harding entered the Meteorological Department of the Board of Trade in 1861 as a boy of fifteen and did not finally retire until 1920. His active connexion with the office thus extended over very nearly sixty years. In the reconstruction in 1867 following on Fitzroy's death, Harding elected to remain with the office rather than accept service under the Board of Trade as a clerical officer. I believe I am right in saying that throughout his career he was engaged in the Marine Division, for over thirty years he was its Principal Assistant. He retired in 1911, but returned for part time duty during the war, and as has been already mentioned, remained on the active staff until 1920. The Harding family was closely associated with the office in its early days. The elder brother, James, was Chief Clerk for many years, and the father was also in its service.

In his younger days Charles Harding demonstrated his interest in meteorology by volunteering to take part in the ascents of manned balloons which the Meteorological Office undertook in 1880 and 1881. He made several ascents as observer, but fortunately for him he was not concerned in the fatal ascent on December 10th, 1881, in which Mr. Walter Powell, M.P., lost his life, which put an end to the active co-operation of the Office in the investigation of the upper atmosphere for many a year to come.

Harding was a Fellow of the Royal Meteorological Society and served on the Council for a number of years. He contributed a number of papers to the Society's Journal, for the most part dealing with periods of exceptional weather on the Oceans or over the British Islands, but in 1881 he had a paper in the Journal in which we find a suggestion for determining mean values over the ocean by the use of synchronous charts. That method of approaching the problem has since been used effectively by various writers. His last lengthy contribution to the Society's Journal was made in 1912 when he prepared, at the request of the Council, an account of the abnormal summer of that *annus mirabilis*, 1911.

Francis Campbell Bayard, LL.M.—The death occurred on January 22nd, 1927, at the age of 75, of Mr. Campbell Bayard, barrister-at-law of the Inner Temple. Mr. Bayard was keenly interested in meteorology and maintained a climatological station at Wallington, Surrey, from 1890 until April, 1926. His rainfall observations have been published in *British Rainfall* since 1885. In 1888, when he was honorary secretary of the

committee of the Croydon Natural History and Scientific Society he accepted charge of the arrangements for observing the daily rainfall round Croydon. In that year 34 stations sent in records to the society, but during the 37 years Mr. Bayard compiled these rainfall and other meteorological records for publication each month by the society the number increased to over 100. Since 1925, when he gave up this work, the contributing observers have forwarded their results direct to the Meteorological Office.

Mr. Bayard was elected a Fellow of the Royal Meteorological Society in 1884 and served for many years on the Council, becoming Secretary in 1892 on the death of Dr. Tripe, President in 1898 and 1899, and Secretary again from 1900 to 1915. He contributed a number of papers to the Society's Journals dealing mainly with climatological subjects.

We also regret to learn of the death of Lieut-Col. Henry Mellish, of Hodsock Priory, Notts, on February 2nd, at the age of 70.

We regret to announce the death on January 30th, in a motor-cycling accident, of Mr. W. A. Lambert, Grade III. Clerk of the Meteorological Office, stationed at Worthy Down, Hants.

News in Brief

The Eighth Annual Soirée of the Meteorological Office Staff was held on Friday, February 11th, at Australia House. A programme of music, conjuring and dancing, with a sketch by the South Kensington Amateur Dramatic Society, was enjoyed by some 200 past and present members of the Staff and their friends. The Outstations were well represented.

The sixth Annual Dinner of the Meteorological Office Staff, at Shoeburyness, was held on February 5th, at the Queen's Hotel, Westcliff. Mr. D. Brunt, Superintendent of Army Services, was the guest of the evening and a very pleasant time was spent. The musical programme consisted of instrumental and vocal solos, many of the items being original.

The Weather of January, 1927

Unsettled weather prevailed generally throughout January, although there were many bright intervals. Conditions at first were rather mild but after the 13th they became very wintry. During the first days of the month the winds were westerly, but on the 4th, in the rear of a depression which passed north of Scotland towards Scandinavia, they veered north, and there was a temporary drop in temperature, with snow or sleet in many

places. The mild westerly conditions were renewed on the 5th to 6th, and lasted until the 12th, when a depression deepened considerably as it approached our northwest coasts, causing widespread gales on the 12th and 13th, gusts of over 70 m.p.h. occurring in several places. During this period temperature rose as high as 58° F. at Balmoral on the 9th, and the rain, though frequent, was not heavy, except locally in Scotland, where 55 mm. (2.2 in.) were measured at Achnashellach on the 2nd, and 25 mm. (1.0 in.) at Ford on the 7th. After the 13th the temperature dropped considerably, and on the 15th frost persisted throughout the day at Aberdeen. There was more than a week of cold weather with frequent sleet or snow and much fog at times. Maximum temperatures did not exceed 40° F. in the north, and the lowest night temperatures of the month, 12° F. in the screen and 8° F. on the ground, occurred on the 20th at West Linton. On the 22nd and 23rd milder weather prevailed temporarily in some parts. During the last week conditions were very rough. Reports from ships on the Atlantic on the 24th indicated an unusually deep depression, which caused gales and heavy rain on our western coasts as it moved towards Iceland. Vigorous secondaries developed further south and passed across the British Isles on the 26th to 29th. On the 28th, in particular, gales of exceptional violence were experienced in the west, when a gust of 104 m.p.h. was recorded at Paisley, of 102 m.p.h. at Renfrew, and of 92 m.p.h. at both Lerwick and Pendennis. Thunderstorms occurred in some places, and heavy rain fell in several parts of south-western England, *e.g.*, 81 mm. (3.19 in.) fell at Holne, Devon, and 63 mm. (2.47 in.) at Tynywaum, Gloucester. After this the weather cleared temporarily, and fine sunny conditions were experienced on the 31st.

Pressure was below normal over northern and western Europe Iceland and Spitsbergen, the greatest deficit being 12.4 mb. at Wick, and above normal over Spain and Portugal and the greater part of the North Atlantic, an excess of 8.7 mb. being recorded at Horta (Azores). Temperature and rainfall were both above normal in Europe except in the north of the Scandinavian peninsula. In Sweden the rainfall was generally about twice the normal, and as much as three times the normal in Dalecarlia. At Spitsbergen temperature was above normal and rainfall below normal.

A sudden rise in temperature owing to the föhn wind took place in Switzerland on the 7th and again on the 13th, causing rain to fall up to a level of 2,500 ft. and the rivers to rise rapidly in the lower regions. In neither case did the warm period last longer than 24 hours. On the 14th it was reported that part of the Ems was flooded and that the Moselle and the Rhine (near Cologne) were rising rapidly. A heavy fall of snow occurred

on the 18th in the Lozère, the north of the Hérault, and the Haute-Auvergne, and later in the month bad weather prevailed in many parts of Italy. Floods and landslides were reported near Bologna and Palma and snow fell heavily in the foothills round Padua and Bergamo. Owing to the heavy gales a steamer sank with the loss of 15 lives at San Esteban de Pravia. Severe ice conditions were experienced on the Baltic in the middle of the month, and on the 24th and 25th an unusually thick fog lay over the Black Sea. In Transcaucasia a snowstorm did much damage on the 6th and 7th. The severe drought experienced in southern Palestine for so long was broken on the 18th when heavy rain was reported from Beersheba, Gaza, and Hebron. Floods occurred in Malaya at the beginning of the month and at the end heavy rains were again experienced in the same area.

A heat wave, said to be the severest for 15 years, swept over South Australia during the first part of the month, the temperature on five successive days being over 100° F., with a maximum in Adelaide of nearly 109° F., and in the country of 113° F. The highest temperature ever recorded at Adelaide was 116° F. in 1858. Floods due to the recent heavy rains have caused great damage to railways and bridges in Queensland.

The summer in the Transvaal has been abnormally dry and during January the drought continued. Three rivers, the Olifant, the Koedoes, and the Selati, are reported to be absolutely dry and wells and springs are failing. It is estimated that 40,000 cattle are dead.

Mild weather was experienced in the United States to the west of the Mississippi at the beginning of the month and in the south-eastern States after the 18th, but on the 26th a cold spell occurred in the eastern States causing much distress.

Gales were experienced frequently in the North Atlantic, force 10 (59 m.p.h.) being reported on the 5th, 12th, 24th, 25th, 26th, and 28th.

The special message from Brazil states that the rainfall was scarce over the whole country, being 64 mm., 133 mm. and 49 mm. below normal in the northern, central and southern districts respectively. Numerous depressions passed across the country. The cane crop in the north has suffered from the lack of rain but the crops in the centre and south are in good condition. Pressure at Rio de Janeiro was 0.1 mb. above normal and temperature 0.4° F. below normal.

Rainfall, January—General Distribution

England and Wales	..	122	} per cent. of the average 1881-1915.
Scotland	.. .. .	130
Ireland	.. .. .	132
British Isles	.. .. .	126

Rainfall: January, 1927: England and Wales

CO.	STATION.	In.	mm.	Per- cent. of Av.	CO.	STATION.	In.	mm.	Per- cent. of Av.
<i>London.</i>	Camden Square	1.78	45	96	<i>War.</i>	Birmingham, Edgbaston	2.77	70	137
<i>Sur.</i>	Reigate, The Knowle . .	2.44	62	108	<i>Leics</i>	Thornton Reservoir . .	2.67	68	135
<i>Kent.</i>	Tenterden, Ashenden . .	2.19	56	102	"	Belvoir Castle	1.72	44	97
"	Folkestone, Boro. San.	2.51	64	...	<i>Rut.</i>	Ridlington	1.93	49	...
"	Margate, Cliftonville . .	1.41	36	85	<i>Linc.</i>	Boston, Skirbeck	1.84	47	114
"	Sevenoaks, Speldhurst . .	2.69	68	...	"	Lincoln, Sessions House	1.44	37	86
<i>Sus.</i>	Patching Farm	2.34	59	90	"	Skegness, Marine Gdns.	1.59	40	92
"	Brighton, Old Steyne . .	1.95	49	81	"	Louth, Westgate	1.50	38	69
"	Tottingworth Park	3.02	77	112	"	Brigg	1.77	45	99
<i>Hants.</i>	Ventnor, Roy. Nat. Hos.	2.59	66	101	<i>Notts.</i>	Worksop, Hodsock . . . .	...	...	...
"	Fordingbridge, Oaklands	3.10	79	112	<i>Derby</i>	Mickleover, Clyde Ho. . .	2.01	51	100
"	Ovington Rectory	3.11	79	115	"	Buxton, Devon. Hos. . .	4.48	114	100
"	Sherborne St. John	2.56	65	110	<i>Ches.</i>	Runcorn, Weston Pt. . . .	3.94	100	166
<i>Berks.</i>	Wellington College	1.84	47	93	"	Nantwich, Dorfold Hall	2.48	63	...
"	Newbury, Greenham	2.76	70	119	<i>Lancs</i>	Manchester, Whit. Pk. . .	3.57	91	142
<i>Herts.</i>	Benington House . . . . .	...	...	...	"	Stonyhurst College	5.43	138	127
<i>Bucks.</i>	High Wycombe	2.50	64	120	"	Southport, Hesketh Pk . .	3.75	95	147
<i>Oxf.</i>	Oxford, Mag. College . . .	2.26	57	131	"	Lancaster, Strathspey . .	4.19	106	...
<i>Nor.</i>	Pitsford, Sedgebrook . . .	2.43	62	131	<i>Yorks</i>	Wath-upon-Deerne	1.80	46	94
"	Oundle	1.46	37	...	"	Bradford, Lister Pk. . . .	2.99	76	104
<i>Beds.</i>	Woburn, Crawley Mill . . .	2.15	55	126	"	Oughtershaw Hall	9.34	237	...
<i>Cam.</i>	Cambridge, Bot. Gdns. . . .	1.64	42	109	"	Wetherby, Ribston H. . . .	1.95	50	95
<i>Essex.</i>	Chelmsford, County Lab . .	1.61	41	105	"	Hull, Pearson Park	1.57	40	87
"	Lexden, Hill House	1.42	36	...	"	Holme-on-Spalding	1.63	41	...
<i>Suff.</i>	Hawkedon Rectory	1.52	39	87	"	West Witton, Ivy Ho. . . .	...	...	...
"	Haughley House . . . . .	.87	22	...	"	Felixkirk, Mt. St. John . .	2.33	59	117
<i>Norfol.</i>	Beccles, Geldeston	1.12	28	67	"	Pickering, Hungate	2.09	53	...
"	Norwich, Eaton . . . . .	...	...	...	"	Scarborough	1.71	43	85
"	Blakeney	2.17	55	126	"	Middlesbrough	1.43	36	89
"	Swaffham	2.20	56	119	"	Baldersdale, Hury Res. . .	2.33	59	...
<i>Wills.</i>	Devizes, Highclere	3.87	98	178	<i>Durh.</i>	Ushaw College	1.51	38	74
"	Bishops Cannings	3.54	90	153	<i>Nor.</i>	Newcastle, Town Moor . .	1.36	35	67
<i>Dor.</i>	Evershot, Melbury Ho. . . .	3.96	101	114	"	Bellingham, Highgreen . .	3.04	77	...
"	Creech Grange	2.57	65	...	"	Lilburn Tower Gdns. . . .	1.80	46	...
"	Shaftesbury, Abbey Ho. . . .	2.55	65	98	<i>Cumb.</i>	Geltsdale	3.44	87	...
<i>Devon.</i>	Plymouth, The Hoe	4.59	117	138	"	Carlisle, Scaleby Hall . .	3.89	99	157
"	Polapit Tamar	8.02	204	216	"	Seathwaite M.	20.00	508	151
"	Ashburton, Druid Ho. . . .	8.23	209	162	<i>Glam.</i>	Cardiff, Ely P. Stn. . . .	4.98	126	132
"	Cullompton	5.50	140	170	"	Treherbert, Tynywaun . .	10.93	278	...
"	Sidmouth, Sidmount	3.48	89	122	<i>Carm.</i>	Carmarthen Friary	5.91	150	135
"	Filleigh, Castle Hill	8.09	205	...	"	Llanwrda, Dolaucothy . .	8.00	203	150
"	Barnstaple, N. Dev. Ath. . .	5.94	151	182	<i>Pemb.</i>	Haverfordwest, School . .	4.91	125	107
<i>Corn.</i>	Redruth, Trewirgie	7.80	198	185	<i>Card.</i>	Gogerddan	5.28	134	129
"	Penzance, Morrab Gdn. . . .	6.76	172	178	"	Cardigan, County Sch. . .	4.84	123	...
"	St. Austell, Trevarna	8.16	207	191	<i>Brec.</i>	Crickhowell, Talymaes . .	6.00	152	...
<i>Soms.</i>	Chewtun Mendip	5.10	130	133	<i>Rad.</i>	Birm. W. W. Tyrmynydd . .	9.24	235	147
"	Street, Hind Hayes	3.16	80	...	<i>Mont.</i>	Lake Vyrnwy	7.99	203	142
<i>Glos.</i>	Clifton College	3.31	84	117	<i>Denb.</i>	Llangynhafal	3.01	76	...
"	Cirencester, Gwynfa	3.56	90	138	<i>Mer.</i>	Dolgelley, Bryntirion . .	7.26	184	128
<i>Here.</i>	Ross, Birchlea	3.38	86	140	<i>Carn.</i>	Llandudno	2.00	51	78
"	Ledbury, Underdown	3.20	81	146	"	Snowdon, L. Llydaw 9 . .	17.87	454	...
<i>Salop.</i>	Church Stretton	3.17	81	125	<i>Ang.</i>	Holyhead, Salt Island . .	3.41	87	117
"	Shifnal, Hatton Grange . . .	1.82	46	94	"	Lligwy	2.90	74	...
<i>Staff.</i>	Tea, The Heath Ho.	2.85	72	111	<i>Isle of Man</i>	Douglas, Boro' Cem. . . .	3.79	96	113
<i>Worc.</i>	Ombersley, Holt Lock	3.16	80	165	<i>Guernsey</i>	St. Peter P't, Grange Rd .	4.59	117	157
"	Blockley, Upton Wold	3.43	87	146					
<i>War.</i>	Farnborough	3.06	78	142					

Rainfall: January, 1927: Scotland and Ireland

CO.	STATION	In.	mm.	Per- cent. of Av.	CO.	STATION.	In.	mm.	Per- cent. of Av.
<i>Wigt.</i>	Stoneykirk, Ardwell Ho	4.31	109	146	<i>Suth.</i>	Loch More, Achfary ...	12.14	308	167
"	Pt. William, Monreith . . .	4.27	108	...	<i>Caith</i>	Wick	2.46	62	100
<i>Kirk.</i>	Carsphairn, Shiel.	11.59	294	...	<i>Ork.</i>	Pomona, Deerness	3.99	101	116
"	Dumfries, Cargen	5.43	138	136	<i>Shet.</i>	Lerwick	6.94	176	163
<i>Roxb.</i>	Branxholme	3.36	85	123					
<i>Selk.</i>	Ettrick Manse	8.17	207	...	<i>Cork.</i>	Caheragh Rectory	6.55	166	...
<i>Berk.</i>	Marchmont House	2.40	61	107	"	Dunmanway Rectory . .	6.90	175	111
<i>Hadd.</i>	North Berwick Res. . . .	1.33	34	77	"	Ballinacurra	4.06	103	102
<i>Midl.</i>	Edinburgh, Roy. Obs. . .	2.23	57	128	"	Glanmire, Lota Lo. . .	5.35	136	124
<i>Lan.</i>	Biggar . . . . .	...	...	...	<i>Kerry</i>	Valentia Obsy.	6.10	155	111
"	Leadhills	9.82	249	...	"	Killarney Asylum . . .	...	...	...
<i>Ayr.</i>	Kilmarnock, Agric. C. . .	5.62	143	165	"	Darrynane Abbey . . .	7.65	194	153
"	Girvan, Pinmore	7.21	183	153	<i>Wat.</i>	Waterford, Brook Lo. .	3.08	78	84
<i>Renf.</i>	Glasgow, Queen's Pk. . .	5.35	136	160	<i>Tip.</i>	Nenagh, Cas. Lough . .	5.02	128	127
"	Greenock, Prospect H. . .	9.94	252	145	"	Roscrea, Timoney Park .	3.54	90	...
<i>Bute.</i>	Rothsay, Ardenraig . . .	7.98	203	178	"	Cashel, Ballinamona . .	4.58	116	121
"	Dougarie Lodge	6.53	166	...	<i>Lim.</i>	Foynes, Coolnanes . . .	7.74	197	205
<i>Arg.</i>	Ardgour House	16.56	421	...	"	Castleconnell Rec. . . .	5.07	129	...
"	Manse of Glenorchy . . .	13.71	348	...	<i>Clare</i>	Inagh, Mount Callan . .	10.72	272	...
"	Oban	8.91	226	...	"	Broadford, Hurdlest'n .	6.03	153	...
"	Poltalloch	8.51	216	168	<i>Wexf.</i>	Newtownbarry	4.15	105	...
"	Inveraray Castle	15.23	387	185	"	Gorey, Courtown Ho. . .	3.23	82	104
"	Islay, Eallabus	7.28	185	156	<i>Kilk.</i>	Kilkenny Castle . . . . .	...	...	...
"	Mull, Benmore . . . . .	...	...	...	<i>Wic.</i>	Rathnew, Clonmannon . .	2.45	62	...
<i>Kinr.</i>	Loch Leven Sluice	3.19	81	101	<i>Carl.</i>	Hacketstown Rectory . .	3.45	88	97
<i>Perth</i>	Loch Dhu	11.60	295	128	<i>QCo.</i>	Blandsfort House	3.81	97	116
"	Balquhider, Stronvar . . .	11.91	303	...	"	Mountmellick . . . . .	...	...	...
"	Crieff, Strathearn Hyd. . .	5.01	127	124	<i>KCo.</i>	Birr Castle	3.38	86	119
"	Blair Castle Gardens . . .	4.85	123	146	<i>Dubl.</i>	Dublin, FitzWm. Sq. . .	2.12	54	93
"	Coupar Angus School . . .	...	...	...	"	Balbriggan, Ardgillan . .	2.44	62	107
<i>Forf.</i>	Dundee, E. Necropolis . .	1.91	49	98	<i>Me'th</i>	Beauparc, St. Cloud . . .	2.86	73	...
"	Pearsie House	2.17	55	...	"	Kells, Headfort	3.35	85	106
"	Montrose, Sunnyside . . .	1.81	46	91	<i>W.M.</i>	Moate, Coolatore . . . .	...	...	...
<i>Aber.</i>	Braemar, Bank	2.60	66	82	"	Mullingar, Belvedere . .	3.50	89	109
"	Logie Coldstone Sch. . . .	2.58	66	117	<i>Long</i>	Castle Forbes Gdns. . . .	4.61	117	138
"	Aberdeen, King's Coll. . .	1.87	47	86	<i>Gal.</i>	Ballynahinch Castle . . .	8.59	218	138
"	Fyvie Castle	2.23	57	...	"	Galway, Grammar Sch. . .	4.76	121	...
<i>Mor.</i>	Gordon Castle	2.15	55	106	<i>Mayo</i>	Mallaranny	9.67	246	...
"	Grantown-on-Spey	3.42	87	141	"	Westport House	7.97	202	171
<i>Na.</i>	Nairn, Delnies	2.52	64	127	"	Delphi Lodge	14.29	363	...
<i>Inv.</i>	Ben Alder Lodge	6.78	172	...	<i>Sligo</i>	Markree Obsy.	8.96	228	228
"	Kingussie, The Birches . .	4.40	112	...	<i>Cav'n</i>	Belturbet, Cloverhill . .	3.34	85	112
"	Loch Quoich, Loan	22.30	566	...	<i>Ferm</i>	Enniskillen, Portora . .	5.25	133	...
"	Glenquoich . . . . .	...	...	...	<i>Arm.</i>	Armagh Obsy.	3.34	85	133
"	Inverness, Culduthel R. .	3.76	96	...	<i>Down</i>	Fofanny Reservoir	4.77	121	...
"	Arisaig, Faire-na-Squir . .	8.84	225	...	"	Seaforde	2.91	74	93
"	Fort William	13.84	352	144	"	Donaghadee, C. Stn. . .	3.10	79	122
"	Skye, Dunvegan	9.63	245	...	"	Banbridge, Milltown . .	2.48	63	111
"	Barra, Castlebay	4.91	125	...	<i>Antr.</i>	Belfast, Cavehill Rd. . .	4.44	113	...
<i>R&C</i>	Alness, Ardross Cas. . . .	5.47	139	144	"	Glenarm Castle	6.07	154	...
"	Ullapool	7.92	201	...	"	Ballymena, Harryville .	4.04	103	109
"	Torridon, Bendamph	14.09	358	150	<i>Lon.</i>	Londonderry, Creggan . .	7.26	184	202
"	Achnashellach	14.87	377	...	<i>Tyr.</i>	Donaghmore	4.25	108	...
"	Stornoway	6.88	175	133	"	Omagh, Edenfel	4.74	120	134
<i>Suth.</i>	Lairg	5.93	151	...	<i>Don.</i>	Malin Head	5.10	129	195
"	Tongue Manse	4.51	115	114	"	Duntanaghy	7.26	184	179
"	Melvich School	2.97	75	90	"	Killybegs, Rockmount . .	10.28	261	184

Climatological Table for the British Empire, August, 1926

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am't	PRECIPITATION		BRIGHT SUNSHINE	
	Mean of Day M.S.L. Normal	Diff. from Normal	Absolute		Mean Values			Mean	Am't Normal			Diff. from Normal	Days	Hours per day	Percentage of possible
			Max.	Min.	Max.	Min.	1 max. 2 min.			Diff. from Normal	Wet Bulb.				
London, Kew Obsy.	1018.7	+ 3.4	82	46	72.1	55.0	63.5	+ 1.9	86	6.2	15	11	6.7	46	
Gibraltar	1017.0	+ 0.3	88	66	82.7	69.5	76.1	+ 0.1	82	4.7	4	2	...	...
Malta	1017.2	+ 1.9	86	68	80.8	70.7	75.7	+ 3.4	83	2.3	0	0	11.2	83	
St. Helena	1016.3	+ 2.5	65	51	59.2	53.8	56.5	+ 1.4	94	3.6	72	22	...	...
Sierra Leone	1013.9	+ 1.2	86	69	83.5	72.7	78.1	+ 0.2	87	8.2	65	29	...	...
Lagos, Nigeria	1012.3	+ 1.3	83	70	80.2	72.8	76.5	+ 1.2	85	7.8	7	6	...	...
Kaduna, Nigeria	1015.1	+ 1.3	87	63	83.1	65.7	74.4	+ 0.5	86	1.9	589	29	...	...
Zomba, Nyasaland	1024.7	+ 2.2	84	46	75.8	53.1	64.5	+ 0.4	66	4.7	2	4	...	...
Salisbury, Rhodesia	1019.1	+ 0.7	84	35	75.1	44.5	59.8	+ 0.4	45	0.9	0	0	10.1	88	
Cape Town	1021.6	+ 1.4	75	35	63.1	47.6	55.3	+ 0.3	85	5.1	76	12	...	...
Johannesburg	1022.6	+ 1.6	77	23	67.4	44.3	55.9	+ 1.6	41	0.6	0	0	10.2	92	
Mauritius . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein . . . . .	...	...	79	19	70.4	32.3	51.3	+ 0.9	48	1.4	0	0	...	...
Calcutta, Alipore Obsy.	999.6	- 1.4	91	75	87.6	79.0	83.3	+ 0.3	91	8.5	539	18*	...	...
Bombay	1004.3	- 1.6	87	76	84.7	78.0	81.3	+ 0.6	87	9.0	564	25*	...	...
Madras	1005.6	+ 0.1	101	73	95.3	77.8	86.5	+ 0.6	73	8.9	118	9*	...	...
Colombo, Ceylon	1009.4	+ 0.3	87	72	86.4	77.2	81.8	+ 0.7	78	7.2	135	18	6.7	54	
Hongkong	1006.7	+ 1.6	93	74	86.7	78.2	82.5	+ 0.4	81	7.5	203	17	7.0	54	
Sandakan . . . . .	...	...	91	71	88.4	75.7	82.1	+ 0.3	84	...	98	8	...	...
Sydney	1016.1	- 2.1	76	42	65.5	48.0	56.7	+ 1.7	68	4.4	24	10	6.9	63	
Melbourne	1015.2	- 2.9	66	32	57.9	44.0	50.9	+ 0.2	78	6.6	39	21	4.7	44	
Adelaide	1016.2	- 3.1	72	38	61.4	45.8	53.6	+ 0.4	69	5.8	106	16	5.5	51	
Perth, W. Australia	1019.1	+ 0.3	68	39	62.1	48.9	55.5	+ 0.4	72	7.1	155	24	4.4	40	
Coolgardie	1018.4	- 0.9	78	32	64.4	39.8	52.1	+ 1.5	52	3.7	10	4	...	...
Brisbane	1018.4	- 0.8	80	41	74.1	51.9	63.0	+ 2.6	61	2.7	10	5	9.2	83	
Hobart, Tasmania	1010.1	- 3.5	63	34	55.3	41.3	48.3	+ 0.3	72	6.3	48	21	5.4	52	
Wellington, N.Z.	1013.4	- 1.7	60	33	54.4	42.9	48.7	+ 0.1	77	6.9	75	21	4.1	39	
Suva, Fiji	1015.9	+ 1.6	84	62	79.7	67.8	73.7	+ 0.0	76	6.4	22	11	5.7	50	
Apia, Samoa	1013.6	+ 1.4	88	70	85.4	74.1	79.7	+ 1.9	78	5.9	97	11	7.8	67	
Kingston, Jamaica	1013.7	+ 0.2	95	69	89.7	73.4	81.5	+ 0.0	85	4.3	167	13	8.2	65	
Grenada, W.I.	1014.1	+ 1.5	90	73	86.1	75.9	81.0	+ 1.5	82	5.2	204	24	...	...
Toronto	1014.9	- 0.5	86	50	76.4	60.6	68.5	+ 1.9	77	5.6	155	16	6.4	46	
Winnipeg	1015.1	+ 1.2	92	43	75.1	53.5	64.3	+ 1.3	...	5.3	82	12	7.9	54	
St. John, N.B.	1015.3	- 0.1	83	46	67.7	53.4	60.5	+ 0.1	80	5.3	45	14	6.5	46	
Victoria, B.C.	1015.9	- 1.3	81	50	67.4	52.2	59.8	+ 0.3	82	6.0	29	7	8.2	57	

*For Indian stations a rain day is a day on which 0.1 in. (2.5 mm.) or more rain has fallen.

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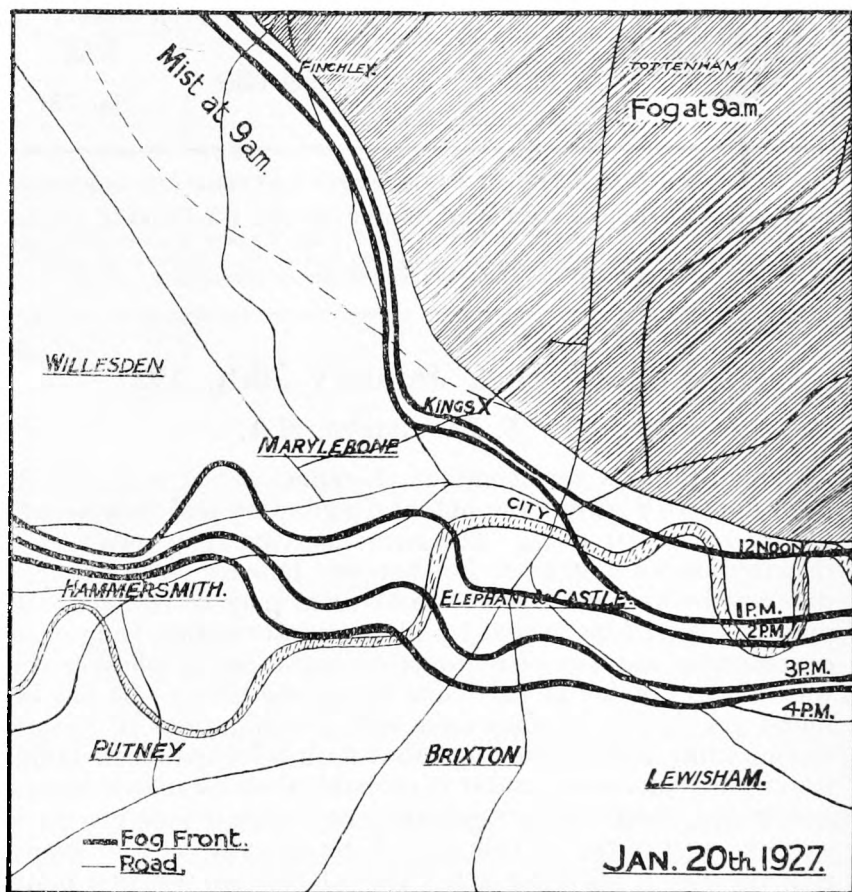
London Fog, January 20th, 1927

By J. FAIRGRIEVE, M.A.

Although fog is a very common phenomenon yet very little has been done to find out the actual distribution and movement of fog on particular days. The accompanying map indicates the distribution of fog over London on January 20th, 1927, at different hours; from this its movement may be inferred. The map has been constructed by plotting information from a very considerable number of non-meteorologists as to whether there was or was not fog at particular times and places. It has been found previously in connexion with investigations of thunderstorms some fifteen years ago that such information in London is extremely accurate, and it is probable that the map is accurate within the limits of cartographic error except possibly on the extreme west of the area shown. Internal evidence also suggests that the map is fairly correct. The information was first plotted for each hour on maps on the scale of an inch to a mile and the fog front on each map transferred to the summary map here reproduced.

At 9 a.m. fog lay densely over the area shaded on the northeast of the map. The Lea valley was covered and the fog extended a considerable distance to the east but its limits in that direction have not been determined. Along its southern front the fog at this time thinned out very quickly but to the west of the fog area, which extended over Highgate, a misty belt stretched over the

higher ground for some three miles before it gave way to sunshine. Fog was also lying thickly on the Brent Valley between Harrow and Ealing and reached at least to Southall, but further detailed information in this area is lacking. Conditions remained almost unchanged for several hours though on the southern front fog slowly extended through the narrow misty belt, and by 12 noon there was an abrupt transition along a line from Euston



DISTRIBUTION OF FOG.

Road to Liverpool Street and the north of the Isle of Dogs ; to the north was dense fog, to the south, bright sunshine. The Brent valley fog also moved a little southward about 9 o'clock but it never topped the Ealing ridge. Finchley and the higher land to north and south remained misty rather than foggy. Then about noon the fog front on the east moved slowly southward while the western front remained steady for an hour, but between one and two moved fairly quickly south-westwards and

flooded all over west London though it is not certain that it did go over the north western part of the area shown. Thereafter the whole front moved slowly southwards till about 4 o'clock. It is rather remarkable that the sinuosities on the front remain hour after hour; these sinuosities are shown not only on the hourly maps but on intermediate half-hourly maps (not reproduced). Shortly after 4 o'clock the advance stopped and the fog began to disappear, being apparently blown northwestwards, the east and south clearing first and the north and west remaining foggy for the longest time.

Two problems, at least, present themselves. (1) Air in the fog area probably had a different density from that in the fog-free area. It is curious that the presumably colder air did not push in under the presumably warmer air to the south but that there was a stationary vertical division between the two for some hours. Why? (2) The problem of the continued existence of the sinuosities on the fog front is a minor one but it is also interesting.

An Early Essay in Co-operative Meteorology : The Great Storm of 1703

By C. E. P. BROOKS, D.Sc.

On the night of November 26th to 27th, 1703, the southern half of England was visited by a storm which appears to have been without parallel for at least three hundred years, and possibly for far longer. The force of the wind was so great that masses of lead from the roofs were rolled up and carried considerable distances, and enormous numbers of trees were blown down, while during the night the Eddystone lighthouse was destroyed. There was no official meteorological service in those days, but fortunately there was in London an energetic annalist—Daniel Defoe, of *Robinson Crusoe* fame—who immediately set about compiling for posterity a record of the event. His first step was to insert in the public press—the *Gazette*—an advertisement calling for reports from all parts of the country. As a result he received a great number of letters, which he published, with some notes and discussion, in a volume well known to meteorologists.*

The discussion is almost entirely limited to a summary of the damages sustained, but a glance at the volume showed that the material which Defoe had collected might well, in the hands of a Le Verrier, have laid the foundations of synoptic meteorology more than a century earlier than was actually the case. Even

* The Storm: or a Collection of the most Remarkable Casualties and Disasters which happened in the late *Dreadful* Tempest both by Sea and land. London, 1704.

at this distance of time the re-construction of the meteorology of the storm is not without interest and profit. In compiling the following account some additional data collected by Mr. H. Harries have also been utilised.*

It appears that for nearly a fortnight before the fatal date very strong westerly gales had prevailed, suggesting the presence of a deep persistent depression between Iceland and Scotland. We also read that a few days before the 27th there was an unusual tempest on the coast of Florida and Virginia which may

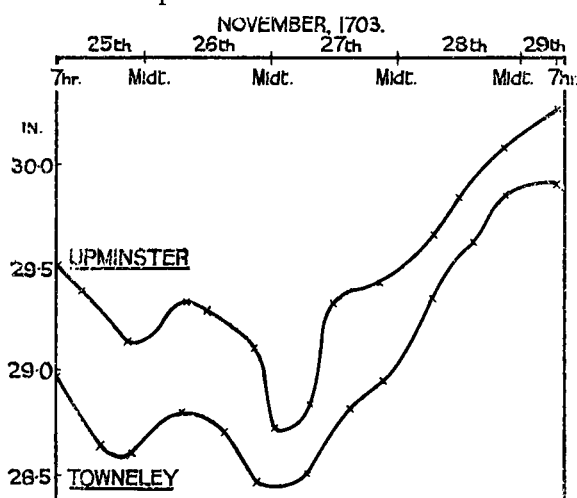


Fig. 1. Barometer readings.

have been a West Indian hurricane. Presumably this tempest, following the usual track, passed out into the North Atlantic east of Newfoundland, but of its history over the ocean we have no data because, of the ships which were at sea and presumably encountered it, none returned to report.

It seems, however,

that a circular storm, whether this or another we cannot tell, appeared south of the main depression as a deep secondary. On the 26th the primary depression was centred somewhere near the Shetland Islands, and the secondary lay over Ireland, where the wind backed to SW in the morning, while at Milford Haven it was blowing a hard gale from S by E at 1 p.m., and at the entrance to the English Channel the wind backed from WNW to SW by S early in the day. Over the whole of south-west England from Cornwall to Monmouth and Shaftesbury the storm winds began from SW and veered to NW, and the greatest damage was done by the latter winds. At Wiltmire near Shaftesbury, for example, the north windows of the church were damaged. Over south-eastern England the winds began from SSW and veered to W, but the greatest damage was done by winds from SW or WSW. There are no reports of damage from north of $52\frac{1}{2}^{\circ}$ N, and it is expressly stated that at Hull and Grimsby the storm was not exceptionally severe; unfortunately the direction of the wind cannot be determined. The reports of the time of greatest wind force or damage are sufficiently numerous

* The Great Storm of 1703. An Anniversary Study.

and concordant for isochrones to be drawn. These run from west-northwest to east-southeast in the west and from northwest to southeast in the east. The isochrone of 3 a.m. of the 27th passes from Pembroke towards the Isle of Wight, that of 4 a.m. through Swansea and Bristol, that of 5 a.m. east of Oxford and through London, and that of 6 a.m. through eastern Suffolk. At the Hague the wind blew from SW with great strength from 4 a.m. to 10 a.m. and on the night of the 27th the storm reached Hanover and Copenhagen.

The wind directions about 4 a.m. on November 27th are shown by the arrows in fig. 2. These appear to blow round a point in the midlands, and suggest a secondary depression which at that time was centred somewhere near Nottingham. The information about the veer of the wind and the isochrones of greatest force show that the depression travelled very rapidly along a slightly curved path across central Wales and the Midlands to the Wash. The concentration of the damage to the south of the centre points to a great congestion of isobars there, while to the north the isobars opened out—in fact, Mr. Harries

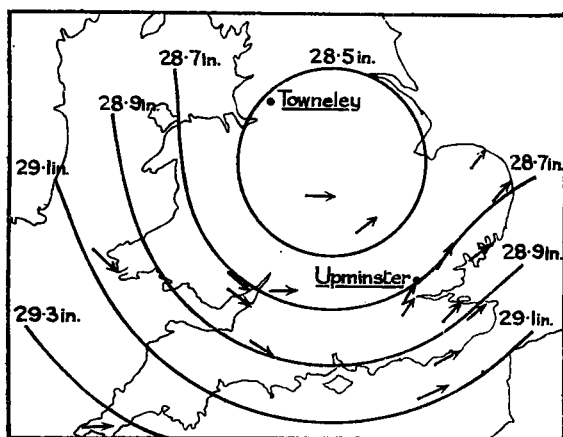


Fig. 2. Pressure and Wind about 4 a.m., Nov., 27th, 1703.

notes that the *Deal Castle* at Scarborough had such light winds at midnight that she set sail to the south, and did not run into bad weather until off Yarmouth. The northerly gale which followed the storm indicates a rapid rise of pressure in its rear. Fortunately these conjectures about the pressure distribution can be confirmed by some actual barometer readings at Towneley, in Lancashire, and at Upminster, in Essex. These are shown in Fig. 1. They are presumably uncorrected, but the difference of nearly 0.5 in. between Towneley and Upminster on the 25th is of the correct order of magnitude for a deep depression centred southeast of Iceland, and the relative pressures at the two stations may therefore be accepted as reasonably correct. The Rev. W. Derham, F.R.S., kept an almost continuous watch on his barometer at Upminster, and while the reading of 28.72 in. at 12.30 a.m. was actually the lowest, he states that the mercury remained at nearly the same level for some four hours. The Towneley curve also

notes that the *Deal Castle* at Scarborough had such light winds at midnight that she set sail to the south, and did not run into bad weather until off Yarmouth. The northerly gale which followed the storm indicates a rapid rise of pressure in its rear.

Fortunately these conjectures about

suggests a flat minimum, and these readings indicate that the secondary had a large open centre or "eye." The rapid rise of pressure at both stations after the centre had passed confirms the steep gradient in the rear of the storm. It will be noticed that as the centre approached, the two curves closed up rapidly, the difference decreasing from 0.55 in. at 7h. on the 26th to only 0.25 in. at about 1h. on the 27th. Evidently the centre passed between Towneley and Upminster, but nearer the former than the latter. Taking the barometer readings at their face value, we may draw an isobar of 28.5 in. passing just to the northwest of Towneley (Fig. 2). Completing a circle with its centre at Nottingham, we find the same isobar passing northwest of Cambridge. Probably an ellipse with its major axis extending from north-northwest to south-southeast would be better than a circle. The isobar of 28.7 in. passes just north of London and continuing with the same gradient, that of 28.9 in. runs across Kent, and that of 29.1 in. along the Channel.

Reading between the lines of Defoe's account, one remarks several peculiarities in the storm. A large number of houses were unroofed, but one finds no mention of the contents being damaged by heavy rain, in fact the great majority of the accounts do not mention rain at all. The chief exceptions are the ships in the English Channel, where the supposed rain may really have been flying spray. It is true that there was a rainstorm at Upminster between 9 and 10 p.m. on the night of the 25th, in which 1.65 lines (ca. 0.15 in.) fell, but that was more than 24 hours before the crisis of the storm, and the next mention of rain in Derham's detailed account is "a hasty shower of rain" at 4 p.m. on the 27th, several hours after the worst of the storm had passed. The high tides in the Severn on the night of the 26th and of the Thames on the 28th were due to the wind and not to heavy rain. Another peculiarity is the rarity of any mention of squalls; the period of strongest wind is generally given as several hours. These two peculiarities, together with the extraordinary strength of the wind, lead one to speculate as to whether the storm was an ordinary secondary depression or whether it may not have been an intense example of a vortex. It presents several points of similarity with the depression of March 24th, 1895, which was described by Sir Napier Shaw* as an example of a rotating column of air: "It began (at Cambridge) about 2 o'clock on the afternoon, and by 6 o'clock many of the oldest and strongest trees had been uprooted, some buildings had been demolished, and a great deal of minor damage done. The remarkable feature of the gale was that, in the Eastern Counties, it was unattended with any rainfall, either before or

* *Revolving Fluid in the Atmosphere. London, Proc. R. Soc., Ser. A, vol. 94, 1917-18, p. 34. See especially Fig. 5.*

during or after the strong wind." If this parallel is correct, the whirl of 1703 must have been on an exceptionally large scale.

Severe gales were subsequently reported from France, Germany, the Baltic, Sweden, Finland and northern Russia, but it is uncertain to what extent these were due to the primary depression, and to what extent to the secondary. Over England the storm was succeeded by an intense anticyclone, for on the 28th there was a north wind of unusual violence in the North Sea, which caused a very high tide in the Thames. This anticyclone held for three weeks or a month, during which the weather was generally fine, a fortunate circumstance in view of the number of houses which had been unroofed.

The storm produced some interesting peculiarities. It was generally accompanied by lightning, though as previously stated the rainfall appears to have been slight. The noise of the wind drowned the sound of the thunder. A veritable "spout" or tornado was observed at 4 p.m. on the 26th near Oxford, while at Tewkesbury and near Shaftesbury the trees which were blown down fell in various directions. In Kent the trees and grass were covered by a deposit of salt as far as 25 miles from the sea. Finally, among the buildings of London the wind produced remarkable eddies, and the damage to the roofs took place mainly on the eastern or leeward sides of the houses.

OFFICIAL PUBLICATIONS

GEOPHYSICAL MEMOIRS—

No. 33. *The Variation of Meteorological elements at St. Helena and at some other places in the Atlantic Region.* By C. E. P. Brooks, D.Sc. (M.O. 286c).

In temperate latitudes any "secular" or progressive change of climate which may exist is usually masked by the large irregular variations from year to year. Nearer the equator the irregular changes are smaller, and examples of secular change occasionally show up clearly. An example of this is found at St. Helena, where observations have been carried out since 1892. These show (1) a persistent rise of pressure at the average rate of nearly 0.1 mb. a year; (2) an increase of wind velocity from 1892 until 1903, followed by a steady decrease averaging 0.2 miles per hour each year; (3) a steady rise of the mean daily maximum temperature (0.2° F. per year) while the minimum temperature remains unchanged. The changes are attributed to the gradual northward movement, probably combined with an increase in intensity, of the South Atlantic sub-tropical anticyclone. At the same time there appears to have been an increase in the intensity of the North Atlantic sub-tropical anticyclone, but

probably without any change of position. It is considered probable that the phenomena form part of some world-wide change during the past thirty years, traces of which have been found in several scattered areas.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, February 16th, at 49, Cromwell Road, South Kensington, Sir Gilbert Walker, C.S.I., F.R.S., President, in the Chair.

J. Glasspoole, M.Sc., Ph.D.—The Variability of Average Monthly Rainfall throughout the Year.

The distribution of the annual average rainfall throughout the year at stations in the British Isles is not uniform, the winter months being wetter than those of the spring and early summer. The variability of the monthly averages for the 35 years 1881 to 1915 has been calculated for some 350 stations in two ways. In the first the range has been used, *i.e.*, the difference between the largest and smallest monthly averages. It varies from 1 in. at stations along the east coast and in central England, to 9.8 in. at both Glenquoich, in the western Highlands of Scotland, and Seathwaite in the English Lake District. The distribution of the range is shown to bear considerable relation to that of the average daily rainfall, the latter value being adopted in preference to the annual total because of the unequal lengths of the months. Calling the range *R* and the daily rainfall *M*, the relation of *M* and *R* is given fairly closely by the equation

$$R = -0.14 + 19M + 41M^2.$$

The second method makes use of the mean deviation of average values of *M* for the individual months from the value of *M* for the year. This deviation is expressed as a percentage of the annual mean, and varies from 11 per cent. in central England to over 25 per cent. in Dartmoor, the Lake District, parts of Wales and the Western Highlands of Scotland. The distribution presents features unlike that of the map of the average annual rainfall.

The variability of the averages for longer periods is shown to be slightly smaller than that for the 35 years, minor irregularities in the distribution being smoothed out with a longer period.

L. F. Richardson, D.Sc., F.R.S., and Denis Proctor.—Diffusion over Distances ranging from 3 km. to 86 km. (Memoir No. 1.)

See *Meteorological Magazine*, Vol. 61, 1926, p. 192.

The Civil Service Sports Council has awarded the Duke of York's Cup to the Air Ministry as being the Department with the best all-round sports record for 1926.

Correspondence

To the Editor, *The Meteorologica! Magazine*

Old-fashioned Winters

May I be allowed to comment upon the interesting article appearing in your January issue under the above heading by Mr. M. T. Spence? In the article mentioned he seems to have definitely come to the conclusion that to assume that winters are different now to those experienced (say) 30 to 40 years ago is an entirely erroneous idea.

How does Mr. Spence account for the fact that since that of 1894-95 we have only had *one* winter (1916-17) worthy of the name? Also, why was it that, some thirty to thirty-five years since, ironmongers used to regularly stock a large supply of skates every winter, and now they do not? It is unfortunate that the table kept by the National Skating Club of the number of days skating in Regent's Park goes no further than 1904, because later years would probably show a consistent falling off in the number of those days.

But the most telling point against there being no change in climate is shown by the Brückner Cycle, a cycle of 35 years, accepted, I believe, by most meteorologists. In 1854-5-6, extremely cold winters prevailed; 35 years later, in 1889-90-91, similar conditions were experienced, and I can remember seeing the Thames, near Blackfriars Bridge, completely covered with ice-floes sufficient to impede and finally prevent all river traffic. The old Government vessel "Buzzard" resembled the ship of an Arctic explorer hemmed in by ice. Now, 35 years later, we get cold winters, but instead of more or less continuous temperatures of between 20° and 35° F., we get temperatures of between 30° and 45° F., which makes all the difference between frost and no frost. In the early nineties of the last century there were many days together in London when the thermometer failed to rise above the freezing point; this very seldom happens now.

Did space permit, I could give notes of evidence I have received from time to time from correspondents in all parts of the world—Australia, Egypt and Switzerland, to name a few—from which the only conclusion which can be arrived at is, that a definite "flattening" of extremes of temperature is taking place; in other words, neither is the heat of summer so great, nor the cold of winter so severe as it was even in the latter half of the last century.

Doubtless, as shown by Mr. Spence, mild winters did take place in England in olden times, but then they were the exception, and gave rise to remarks as to their extraordinary nature,

now they are the rule, and a cold winter is considered the remarkable phenomenon.

D. W. HORNER.

63, *Canute Road, Clive Vale, Hastings, January 27th, 1927.*

[Mr. Horner's statement that recent winters have been mild compared with winters 30 or 40 years ago is borne out by the 85 years temperature record at Greenwich. This fact was taken into consideration in the article referred to but in view of the high frequency of mild winter months before 1886, it was cited as giving no proof of a progressive change in climate. It would appear, therefore, that Mr. Horner has interpreted the last paragraph of the article in a way which was not intended. Mr. Horner's interpretation would appear possible only if the term "old fashioned" as applied to cold winters originated from a comparison between the mildness of recent winters and the coldness of winters 30 or 40 years ago. One of the main points of the article, however, was to show how the term might have originated in popular parlance at any time in, say, the last two centuries due to our having "at uncertain intervals a vigorous season of many week's duration attended with deep snows and clear atmosphere common to more northern latitudes" (Luke Howard). Mr. Horner's remarks are, in the writer's view, an illustration of this very point.

With regard to the Brückner Cycle, Professor Turner showed* that a period of 40 years would suit Brückner's table of cold winters at least equally as well as 35 years and that the evidence seemed to show that Brückner adopted too short a period: furthermore the whole range of the 35-year temperature cycle is, according to Brückner, only about 1.3° F. The variations of temperature in two 35-year periods cannot therefore be relied on to reveal changes in climate.

Mr. Horner states that mild winters in olden times gave rise to remarks because of their extraordinary nature. In Lowe's *Chronology of the Seasons* the coldness of winter is more frequently remarked upon than its mildness.

M.T.S.

With regard to the question of "flattening of extremes," see the review of Professor W. J. Humphreys' book on p. 45. Ed. M.M.]

I was much interested in Mr. Spence's article on the above subject in the January issue of the *Meteorological Magazine*. May I suggest lines on which further investigations might be made.

The average person when speaking of a "change of climate" is usually thinking, not of the past two or three hundred years, but of the comparatively short space of time within his or her own recollection, 50, 60, perhaps 70 years. There may be

* London: *Q.J.R. Meteor. Soc.*, xli. (1915) p. 323.

readers of this magazine who have access to records dating back to the middle of last century, and could thus compare the 35 years 1855-1890, with the succeeding 35 years, 1890-1925, in respect of the following: (1) Number of days with snow; (2) Number of days snow-lying; (3) Number of days temperature did not exceed 32° ; (4) Number of nights with screen frost.

One feels that such an investigation would yield interesting results, and settle the vexed question of "milder winters" once and for all, especially if each month could be dealt with separately.

G. C. WOOLDRIDGE.

Milestone House, Leicester Road, Ashby-de-la-Zouch, January 22nd, 1927.

Rainfall 1926, Bristol District

I read with interest your article on rainfall for 1926 and the various differences of percentage in different parts of the British Isles, and venture to give variations of the fall in so small an area as Bristol, from records of observers north, south, east, west. The late Mr. Robert Sturge's records from 1856 to 1911 show a sequence of probably a three years' system of light, heavier and heaviest following each other with but very few breaks. 1912 apparently altered this, and a two years' sequence set in, continuing up to the present. If, however, we take the Clifton record alone, it shows but a slight increase on the lighter fall of last year, only 0.15 in., while the whole district shows the system still in force. 1925 was 1.29 in. above the normal for the period 1881 to 1915, and 1926 1.48 in., thus showing the necessity of taking the average of a district for rainfall instead of one locality. Clifton itself shows a remarkable difference in the rainfall, and suburbs not half a mile apart much difference, as the following figures will show.

	in.		in.
City	33.56	Clifton ..	
Bishopston	35.77	Oakfield Road ..	36.19
Redland	34.89	Clifton College ..	34.66
St. Andrews Park ..	36.68	Tyndalls Park Road ..	35.72

These give an average of 35.35 in.—the normal is 33.97 in. for Clifton.

HENRY A. ROGERS.

Redland, Bristol, January 24th, 1927.

Duration of Rainfall. A Query

On June 13th, 1903, rain commenced in London at 1 p.m., and continued without intermission, but with varying intensity, till 11.30 p.m. on the 15th. The total duration as recorded at Camden Square was thus $58\frac{1}{2}$ hours of absolutely unbroken rainfall, although the rain came near to stopping for an hour or two during the forenoon of the 14th, and the total yield during the interval was 3.44 inches. This appears to be London's

longest duration of continuous rain ever recorded, and it would, therefore, be a matter of great interest to know if any rainfall observer in the country who possesses a self-recording gauge has ever registered an equal or longer duration. One emphasises the condition of absolute continuity of rain in this query because, of course, it is no very uncommon thing to get several consecutive wet days with but brief intermissions of the rainfall. In view of the comparative paucity of automatic rain-gauges it may be that London holds the "record" among such gauges. But any one at all familiar with the severity of bad weather in the mountainous districts of these islands where rain that ceases in the plains will so often simply change its quality from a heavy type to a driving drizzle with mist, will scarcely doubt that durations of 60 hours of unceasing rain or snow must comparatively often be greatly exceeded.

L. C. W. BONACINA.

27, Tanza Road, Hampstead. December 15th, 1926.

Iridescent Cloud

About three o'clock this afternoon the sun was behind a heavy bank of nimbus cloud, causing the cloud to have a "silver edge." High above this bank at about, I should think, five thousand feet, was a layer of alto-stratus slightly ridged or "waved" at the western edge. The cloud would be at an angle of about 45° from the horizontal and I would subtend an angle of something like 35° between it and the sun. As a matter of fact I measured it with a clinometer as well as I could, estimating the probable position of the sun behind the cloud-bank. The sky behind the alto-stratus cloud was blue, but for about 45 minutes the ridged western edge of this cloud was coloured with alternate bands of green and pink. As many as five or six of these could be seen at one time lying normal to a line from them to the sun. The colours had the same limpid translucence of those in rainbows. The pink sometimes darkened into a lavender hue.

While I was watching, an isolated nimbus cloud trailed past at an altitude of perhaps six or eight hundred feet. It seemed to pass through a double band of green and pink light. I would subtend approximately the same angle between it and the sun as I did between the alto-stratus cloud and the sun. Yet the alto-stratus with to-day's ground temperature would almost certainly be composed of ice crystals and the nimbus cloud of drops of water.

DONALD E. WEBSTER.

172, Ladykirk Road, Newcastle-on-Tyne. January 2nd, 1927.

The first part of the account is consistent with the hypothesis that the writer is describing iridescent cloud. Stone (*Nature*,

1887, Vol. 35, p. 581, quoted by Pernter-Exner, p. 461) gives 5° to 45° for the distance from the sun. Mr. Webster's idea that the alto-stratus was composed of ice-crystals is natural, but according to Simpson (*London, Q. J. R. Meteor. Soc.*, 1912, p. 296) the iridescence is evidence for the existence of super-cooled drops.

The iridescence over the nimbus cloud is puzzling, however. Could it be an illusion?

F. J. W. W.

NOTES AND QUERIES

Halos in India

Mr. A. Nimmo has sent the following note on a halo observed by his nephew, Mr. G. Sherriff, at Ladakh, in the Himalayas.

"I wonder if you can explain the halo round the sun that I saw in Ladakh. There was an ordinary halo round the sun nearly every day, and it always meant snow in an hour or two, but in this case the sun was on the circumference of the halo, not in the centre. I asked the Padre in Leh about it, and he said he had often seen them in the cold weather, as well as other kinds. I made the following note and drew a diagram of it in my diary at the time:—

" 'Before the snow started this morning there was a curious halo which I have never seen before. The halo was not round the sun, but the sun was on the circumference of the halo, and the halo had two little patches of rainbow, one on either side of the sun, at 22° from it. The sun was about 40° from the horizon. Probably it is common, but I have never seen it before.' "

The halo phenomenon was the parhelic circle or mock-sun ring. The interesting point about the observation is the absence of any circular halo round the sun. This indicates that the crystals in the air at the time were all prisms with vertical axes: the mock-sun ring would be due to the reflection of light from such crystals, the coloured parhelia to refraction through the crystals. This is not the only way in which a mock-sun ring can be formed. In the March issue of the *Meteorological Magazine*† there is a fine halo complex which is to be attributed to crystals with horizontal axes, and in that case the mock-sun ring appeared; possibly the light was reflected from the vertical planes at the end of the crystals.

As far as I know, the parhelic circle has not been observed before without any circular halo surrounding the sun. This is not stated explicitly by Pernter,* but one gets the impression in reading what he has to say.

F. J. W. WHIPPLE.

† p. 38.

* PERNTER, J. M., AND EXNER, F. M., *Meteorologische Optik*, 2nd Edn. Vienna and Leipzig, 1922, p. 306.

Disastrous Storm at Hongkong, July 18th-19th

By the courtesy of the Director of Naval Intelligence, we have received copies of the *Hongkong Weekly Press* for July 24th, and the *Overland China Mail* for July 29th, containing a full account of the remarkable thunderstorm which visited Hongkong on the night of July 18th to 19th, 1926, in the course of which 19·885 in. of rain fell in a period of eight hours. From the accounts in these periodicals, the following details have been compiled. A number of striking photographs of the damage accompanied these papers.

On Saturday, July 17th, a typhoon—the first of the season—was reported in the China Sea, apparently heading directly for Hongkong, and typhoon warnings were issued. When within a hundred miles of the island, however, it turned northward and crossed the coast of China near Swatow, after which it became stationary and began to fill up. Sunday in Hongkong was dull and overcast, with sharp squalls of rain in the afternoon, but the evening was comparatively fine, and all danger seemed to have passed. Soon after midnight, however, it began to rain again, and between 2 and 3 a.m. 0·545 in. was recorded. At 3 a.m. rain began to fall very heavily, accompanied by violent thunder and lightning. The falls during the next eight hours were as follows :—

a.m.	inches	a.m.	inches	a.m.	inches
3-4 ..	1·095	6-7 ..	2·640	9-10 ..	3·200
4-5 ..	3·965	7-8 ..	2·005	10-11 ..	1·040
5-6 ..	2·900	8-9 ..	2·240		

From 11 a.m. on the 18th to 11 a.m. on the 19th the fall was 21·435 inches. The rainfall established many records for Hongkong. The total for 24 hours was, in fact, exceeded by a fall of 27·44 inches on May 29th to 30th, 1889, but the largest fall previously recorded in eight hours was 13·48 inches on July 15th, 1886, and the largest fall in an hour 3·48 inches on the same date.

As may be imagined, the storm did an enormous amount of damage. Hongkong is a mountainous island, and immediately behind the city the ground rises steeply to Victoria Peak, at a height of 1,774 feet, which is distant little more than a mile from the coast, and is an important residential centre connected with the harbour by a tramway and several roads. The water poured down the slopes into the city in cataracts, and flooded the low ground in places to a depth of several feet. The regular water channels and drains were quite unable to cope with the run-off, and the roads were torn up for long distances. At two points the mains burst and threw up columns of water as high as the first floors of the buildings, in one case pushing through the stonework a large tree which had been swept down by the torrent. In other cases the water washed away the foundations of the roads and formed underground rivers.

Lightning added to the havoc, especially when about 4 a.m. a firework factory was struck, the fireworks and powder being exploded, fortunately without causing any fatalities. In the harbour two ships were struck. In the whole storm the loss of life appears to have been much smaller than was to be expected, the most serious event being the destruction of a pumping station by a large boulder ("as big as a tramcar") set free by a landslide, four men being killed and others injured.

The people of Hongkong rose to the occasion, and, in spite of the roads being impassable for wheeled traffic, and in places four feet deep in water and mud, the motto on Monday morning was "business as usual," even though it was necessary to wade to work in a bathing dress and coat, with one's clothes in a parcel on one's back!

Note on the Clyde Floods, November 5th, 1926

On Friday, November 5th, severe flooding, accompanied by a southwesterly gale, occurred at Glasgow, and at other places along the banks of the Clyde. Mr. J. J. Somerville, Meteorologist-in-Charge at Renfrew Aerodrome, has forwarded a note in which he summarises factors contributing to this flooding, which was of an exceptional nature in the Clyde area, as follows:

A deep low appeared off the west of Scotland on the preceding day, and gave heavy rainfall in the Clyde valley in the early morning of the 5th. At Renfrew heavy rain occurred between midnight and 5h. Beginning at 2h., on the 5th, a southerly gale was recorded by the Dines anemometer at the Coats Observatory, Paisley, the wind changing to south-west between 10h. and 11h., and to west-south-west between 11h. and 12h.

In ordinary circumstances a south-westerly gale would impede the discharge of flood water in the Clyde, but in this case there was the additional factor that high tide was due at noon, about half an hour after the gale had changed to a direction almost in a direct line with the advance of the tide. The flooding may thus be attributed to the tidal rise (originated by the gale) in the river which was already rising owing to the heavy rainfall. Such a combination of circumstances seems to be rather rare, as the Harbour Authorities state that the level reached in this case had not been attained since 1882.

Reviews

Das Gewitter. By Prof. Dr. A. Gockel. 8×6, pp. viii. + 316. *Illus.* Berlin and Bonn. Ferd. Dümmlers. Verlag. 1925.

The above work on thunderstorms, by one of the foremost authorities on the subject, is a revision of an earlier edition which appeared under the same title in 1906. So many developments

have taken place in atmospheric electricity during the past twenty years that many parts of the book have been re-written and others enlarged. The book is not difficult to read, being of the popular descriptive type, and only the broad outlines of the relevant theoretical considerations are given.

A typical summer thunderstorm is first described in detail, and the varying phenomena are so ably recounted that one immediately pictures some such actual storm, with enhanced effects, from one's own experience. Then follow chapters devoted to the various forms of lightning with their associated meteorological conditions, and several excellent photographs are included. Fork, sheet, ball, bead lightning and St. Elmo's fire are all adequately dealt with in turn. In the author's opinion, it is still difficult to decide whether lightning is oscillatory or not, nor does he attempt a definite explanation of ball lightning, which has always proved puzzling. This kind of lightning is considered as a final stage of fork lightning, and although the idea of a thunderbolt passing through an open door or down a chimney is flouted as an optical illusion, the phenomenon itself cannot be so regarded on account of the large number of authentic observations which have been put on record. In support of this view, twenty-six reliable detailed observations are quoted of ball lightning occurring in Europe—information which should prove of considerable value to anyone making a special study of this phenomenon.

After treating of thunder, the disastrous effects of thunderstorms on life, buildings, shipping, &c., are dealt with, and statistics from many countries have been extracted. When one realises the large number of flashes of lightning which must occur throughout the world in the course of a year, the number which prove destructive must be considered as relatively very small indeed. As a means of protection against lightning, the lightning conductor receives ample treatment as to both its history and development.

From this point the book becomes almost purely meteorological in character, and a short account is given of the earth's electric field, the radio-activity of the atmosphere, and ions, and the part which they play as condensation nuclei.

Several theories for the origin of the electricity of thunderstorms are mentioned, but emphasis is given to the generally accepted theory, due to Dr. Simpson, that a thundercloud is a huge electrical machine capable of generating large quantities of electricity rapidly enough to supply the energy for lightning flashes in the short intervals which occur between flashes. Gockel thinks, however, that sufficient importance has not been attached to the frozen state in which cloud droplets must exist at the low temperatures attained in thunderclouds. Several

illustrations are shown of the different stages in the formation of a thundercloud by the undercutting of warm air by cold air, and a few old synoptic charts are introduced to illustrate the weather types associated with widespread thunderstorms on the continent. The daily and yearly variation of thunderstorms are briefly discussed, and an inconclusive comparison with sun-spot frequency is quoted. A chapter is also added on the geographical distribution of thunderstorms, but in this connexion a map would have been distinctly useful. Space is also found for the photography of lightning, "atmospherics," and forecasting thunderstorms.

In conclusion, the author exhibits his interest in hail, which so frequently accompanies thunderstorms, by a lengthy account of the formation of hail and the varied characters it assumes, bringing more actual observations to his aid.

Full justice has been done to the subject, and the book forms about as comprehensive a survey of the thunderstorm in all its phases as anyone could wish for.

R.E.W.

Rain Making and other weather vagaries. By W. J. Humphreys, size $5\frac{1}{2} \times 7\frac{1}{2}$, pp. x. + 157, London, Baillière, Tindall & Cox; and Baltimore, The Williams and Wilkins Co. 11s. 6d. net.

Professor Humphreys is very severe in his treatment of what he terms "meteorological mumpsimuses." A mumpsimus (one confesses to a lingering doubt whether the plural should not be "mumpsimi") is a foolish and futile superstition of the credible, such as a belief in the practical possibility of rain-making, hail-shooting, or the artificial dissipation of fog, and the author shows over and over again, with his customary lucidity, that all such claims are foredoomed to failure, because the power available is insignificant in comparison with the scale of the natural phenomena which it is desired to influence; moreover, even this small amount of power is seldom applied with full knowledge and efficiency. The "pluviculturalist" of the twentieth century is no nearer to the accomplishment of his object than was his savage prototype the "medicine man," and this scientific and, at the same time, readable account of his shortcomings can do nothing but good.

The latter half of the book deals with other common fallacies, such as the influence of the moon and the planets on the weather, "key-days" such as St. Swithin's, the weather omens of animals and plants, the myth of the old-fashioned winter, &c. With the greater part of these strictures one is heartily in accord, though some allowance might be made for the poetic imagery which inspired many of the sayings. But one feels that the possibility of a change in climate or in the character of the winters

has perhaps been dismissed a trifle summarily ; small changes of climate, or what comes to the same thing, climatic waves of the order of a hundred years or more, are definitely shown by some long meteorological records. In central Europe the winters of the present century have averaged 4° F. warmer than those of the last half of the nineteenth century (*Meteorological Magazine*, 57, 1922, p. 203). Moreover, even where the means have remained almost unchanged, the weather in many parts of the world has shown a curious tendency to become less variable from year to year in this century than in the last (*Geogr. Rev.*, New York, N.Y., 11, 1921, p. 133). These occasional examples of agreement between popular belief and systematic records are probably purely accidental however, and in no sense contravene the author's conclusion that the source of such persistent popular beliefs lies not in the weather, but in ourselves and our changing outlook with increasing age.

Obituary

Lieutenant-Colonel Henry Mellish.—Col. Mellish, whose sudden death on February 2nd—he had taken his regular meteorological observations as usual in the morning—was reported in the last number of the *Meteorological Magazine*, will be sorely missed both in his own county of Nottingham and by meteorologists in all parts of the country. The son of Lieutenant-Colonel W. L. M. Mellish, he was born at Hodsock Priory on October 31st, 1856 ; he was educated at Eton, where he became an excellent rifle shot, and at Balliol College, Oxford, where he obtained first classes in Mathematical Moderations in 1877 and in Natural Science in 1879. In 1882 he was called to the Bar by the Inner Temple and joined the Midland Circuit. His father having died, he succeeded to the property on coming of age in 1877, and devoted himself mainly to the encouragement of agriculture and to local government in Nottinghamshire, becoming alderman and vice-chairman of the Notts County Council, a county magistrate and deputy lieutenant, and chairman on the Education Committee. He maintained his interest in rifle shooting, and shot for England in the match for the Elcho Shield on over twenty occasions, while on his private range at Hodsock he carried out ballistic experiments which are described in F. W. Jones's recent book "The Hodsock Ballistic Tables."

Col. Mellish's interest in meteorology dates back for more than fifty years. In 1876 he began rainfall observations at Hodsock Priory, and between 1879, when he became a Fellow of the Royal Meteorological Society, and 1881 he set up a complete climatological station in the beautiful gardens of the Priory. His observations have been published regularly in a

series of annual booklets, and in his report for 1925 he was able to include normals for 50 or 45 years for all elements.* The value to meteorology of such a long and completely homogeneous series of observations can hardly be overestimated. In addition to this he took an active part in the work of the Royal Meteorological Society, serving on the Council from 1902 until 1925, and acting as President in 1909 and 1910. His two presidential addresses reflect the character of his interests—"Some relations of meteorology with agriculture" and "The present position of British climatology," the latter including a very valuable bibliography of British climatological literature. "He habitually made the journey from Worksop to attend committee meetings, and was an enthusiastic supporter of the Society, generous with his time, money and energy alike." He was also associated with the development of rainfall observing, and was a trustee of the British Rainfall Organization Fund. In the words of a correspondent of *The Times*, "He will be remembered as an unselfish English gentleman of the finest type, as a first-rate man of business, and as an ideal chairman of a committee, whose lucid commonsense, illuminated always by kindness, simplified many a difficult decision."

News in Brief

Mr. G. M. B. Dobson, M.A., D.Sc., University lecturer in Meteorology, Oxford, has been recommended by the Council for election into the Royal Society.

According to *Water and Water Engineering* the scheme of Prof. E. H. L. Schwarz for improving the Kalahari district† has been rejected by the Government expedition sent to investigate under Dr. Du Toit. A calculation of the levels at different points in the area has shown that the waters captured by the Zambesi could never have supplied a lake system of any considerable size. A considerable volume of water does flow southwards into the Kalahari under flood conditions but such floods occur infrequently and cannot be relied on.

The Weather of February, 1927

Cold anticyclonic conditions prevailed generally during the first part of the month, but after the 19th the weather became mild and unsettled, with rain at times. On the night of the 1st to 2nd, a secondary depression crossed southern England and some large measurements of precipitation were recorded in the south, 41 mm. (1.61 in.) at Folkestone, and 31 mm. (1.22 in.) at Cullompton being among the greatest. Snow lay on the

* See *Meteorological Magazine*, 61 (1926), p. 117.

† See *Meteorological Magazine*, 60 (1925), p. 262.

ground in many parts of the country, the average depth at Biggin Hill being 8 in., and at Oxford, Hampstead, and Rothamsted, about 3 in. on the 2nd. On the same day a screen minimum of 15° F. was recorded at Eskdalemuir, and a grass minimum of 10° F. at Renfrew. Fresh to strong SW winds veering NW prevailed on the 3rd and 4th, but by the 6th anticyclonic conditions were established and persisted over the greater part of the country until about the 19th. During this period much mist or fog prevailed, particularly from the 11th to 17th, and was especially persistent in the eastern districts of England and in the English Channel. Little or no rain occurred from the 7th to 19th except in the western and north-western districts which came occasionally under the influence of the depression centred near Iceland. Temperature was low from the 8th to 13th, on the 12th the maximum at Leafield was as low as 27° F., and at Birmingham, Hereford and Oundle as low as 29° F., while screen minima below 20° F. were registered at a few places, the lowest 13° F. occurring at West Witton on the 13th. From the 19th onwards conditions became mild and unsettled with rain at times but with some fair colder periods. Hail was reported at several places on the 23rd and snow occurred at Shaftesbury (Dorset) on the 23rd and 24th. The rainfall was heavy locally, 68 mm. (2.67 in.) being recorded at Carnarvon on the 27th. On the 22nd a depression centred off the west of Ireland caused strong winds and gales in the western part of the English Channel, Scilly recording force 9 (49 m.p.h.) at 2h. on the 23rd. Gales were also experienced in the southern part of the country from the 26th to 28th when force 9 was reached at Plymouth (Cattewater) and Falmouth (Pendennis) on the night of the 26th to 27th. The total rainfall for the month varied considerably, being more than twice the normal at many stations in the southern and eastern districts of England and as little as 19 per cent. of the normal at Braemar.

Pressure was above normal over western Europe, the Azores and Bermuda, the excess being as much as 5.5 mb. at Skagen, 5.3 mb. at Bermuda, and 5.2 mb. at Vardo, and below normal over the greater part of the North Atlantic, western Iceland, Greenland and Spitsbergen, the greatest deficit being 5.6 mb. at 50° N, 30° W. Temperature and rainfall were generally above normal except in central Europe where the temperature was a little below normal. In western Svealand the precipitation was twice the normal.

Cold weather was reported from many parts of France about the 10th, with much snow on the Vosges and the western Pyrenees. The temperature fell to 14° F. at Remirecourt, Vosges on the 10th, and the Lake of Annecy was partially frozen over. At the same time much damage was done in the central regions of Corsica by a violent storm followed by a heavy fall of snow.

It is reported that this is the first time on record that avalanches have occurred in Corsica. Eighteen people were killed by the avalanches. Intense cold accompanied by a heavy fall of snow occurred in Constantinople on the 11th and 12th during which time storms made navigation on the Black Sea difficult. After the long cold spell heavy rain fell in Switzerland on the 22nd and 23rd. The Föhn wind began to blow on the 25th and the warmer weather and rain continued until after the 28th, except in the Engadine. Another landslide occurred at Roquebillière on the 26th destroying still further the village which partially disappeared last November.

As the result of the heavy snowfall in North Japan all communications were suspended about the 15th in the Niigata province, where 62 people were killed and 29 are missing. Heavy rains fell in the Malay States causing serious landslides at the beginning of the month.

A cyclone accompanied by very heavy rain struck the northern districts of Queensland at 11 p.m. on the 9th. The rivers overflowed their banks and whole townships were under water. Forty people were drowned. The flood waters did not abate until after the 15th. A sudden change from northerly to southerly winds with a fall of temperature checked, on the 13th, the bush fires which threatened to lay waste large areas in Victoria.

A storm swept the Pacific coast states of America on the 14th and 15th, and the distress and damage in southern California were intensified by the fact that heavy rain and strong winds continued for four days. Road and railway bridges were washed away in the Los Angeles and San Diego districts and large areas flooded. A tornado struck several places in Louisiana and Mississippi on the 17th, and on the 20th a gale coming from the Atlantic passed along the eastern coastal districts. The high tide, made higher by the gale, flooded several of the towns. Sixty-nine people were killed as a result of the three storms.

The special message from Brazil states that the rainfall in the northern and southern districts was very scarce, being 52 mm. and 68 mm. below normal respectively, while in the central districts it was abundant, with 80 mm. above normal. The distribution of pressure was abnormal. The coffee, cotton, and cane crops were in good condition. At Rio de Janeiro pressure was 0.1 mb. below normal and temperature 0.2° F. below normal.

Rainfall, February, 1927—General Distribution

England and Wales	..	134	} per cent. of the average 1881-1915.
Scotland	.. ..	67
Ireland	.. ..	88
British Isles	.. ..	<u>108</u>

Rainfall: February, 1927: England and Wales

CO.	STATION.	In.	mm.	Per- cent. of Av.	CO.	STATION.	In.	mm.	Per- cent. of Av.
<i>Lond.</i>	Camden Square	3.34	85	200	<i>War.</i>	Birmingham, Edgbaston	2.89	73	171
<i>Sur.</i>	Reigate, The Knowle . .	4.68	119	228	<i>Leics.</i>	Thornton Reservoir . .	2.06	52	123
<i>Kent.</i>	Tenterden, Ashenden . .	3.83	97	195	"	Belvoir Castle	2.00	51	120
"	Folkestone, Boro. San.	4.10	104	...	<i>Rut.</i>	Ridlington	2.32	59	...
"	Margate, Cliftonville . .	4.77	121	206	<i>Linc.</i>	Boston, Skirbeck	2.20	56	151
"	Sevenoaks, Speldhurst . .	2.84	72	206	"	Lincoln, Sessions House	1.39	35	96
<i>Sus.</i>	Patching Farm	4.22	107	191	"	Skegness, Marine Gdns.	1.90	48	124
"	Brighton, Old Steyne . .	3.26	83	160	"	Louth, Westgate	1.87	47	97
"	Tottingworth Park	4.40	112	187	"	Brigg	1.60	41	93
<i>Hants.</i>	Ventnor, Roy. Nat. Hos.	3.87	98	184	<i>Notts.</i>	Worksop, Hodsock . . . .	...	...	...
"	Fordingbridge, Oaklands	4.26	108	171	<i>Derby</i>	Mickleover, Clyde Ho. .	1.46	37	88
"	Ovington Rectory	5.36	136	206	"	Buxton, Devon. Hos. . .	2.63	67	70
"	Sherborne St. John	4.44	113	202	<i>Ches.</i>	Runcorn, Weston Pt. . . .	1.19	30	64
<i>Berks.</i>	Wellington College	3.81	97	202	"	Nantwich, Dorfold Hall	1.42	36	...
"	Newbury, Greenham	4.28	109	195	<i>Lancs.</i>	Manchester, Whit. Pk. . .	1.41	36	73
<i>Herts.</i>	Benington House . . . . .	...	...	...	"	Stonyhurst College	2.07	53	62
<i>Bucks.</i>	High Wycombe	4.26	108	230	"	Southport, Hesketh Pk . .	1.91	49	91
<i>Oxf.</i>	Oxford, Mag. College . . .	3.98	101	252	"	Lancaster, Strathspey . .	2.94	75	...
<i>Nor.</i>	Pitsford, Sedgebrook . . .	3.02	77	181	<i>Yorks.</i>	Wath-upon-Deerne . . . .	.99	25	60
"	Oundle	1.86	47	...	"	Bradford, Lister Pk. . . .	1.58	40	68
<i>Beds.</i>	Woburn, Crawley Mill . . .	2.87	73	194	"	Oughtershaw Hall	4.20	107	...
<i>Cam.</i>	Cambridge, Bot. Gdns. . . .	2.73	69	213	"	Wetherby, Ribston H. . . .	.88	22	51
<i>Essex.</i>	Chelmsford, County Lab . .	3.42	87	231	"	Hull, Pearson Park	1.25	32	75
"	Lexden, Hill House	3.01	76	...	"	Holme-on-Spalding	1.46	37	...
<i>Suff.</i>	Hawkedon Rectory	3.05	77	200	"	West Witton, Ivy Ho. . . .	1.50	38	...
"	Haughley House	2.15	55	...	"	Felixkirk, Mt. St. John . .	1.29	33	...
<i>Norfol.</i>	Beccles, Geldeston	1.98	50	145	"	Pickering, Hungate	1.45	37	...
"	Norwich, Eaton	2.11	54	129	"	Scarborough	1.15	29	68
"	Blakeney	2.10	53	142	"	Middlesbrough . . . . .	.56	14	43
"	Swaffham	2.15	55	137	"	Baldersdale, Hury Res. . .	1.23	31	...
<i>Wilts.</i>	Devizes, Highclere	4.37	111	220	<i>Durh.</i>	Ushaw College . . . . .	.85	22	53
"	Bishops Cannings	3.68	93	174	<i>Nor.</i>	Newcastle, Town Moor. . .	.60	15	38
<i>Dor.</i>	Evershot, Melbury Ho. . . .	4.45	113	142	"	Bellingham, Highgreen . .	1.28	33	...
"	Crech Grange	3.46	88	...	"	Lilburn Tower Gdns. . . .	.76	19	...
"	Shaftesbury, Abbey Ho. . . .	3.79	96	164	<i>Cumb.</i>	Geltsdale	1.29	33	...
<i>Devon.</i>	Plymouth, The Hoe	3.21	81	108	"	Carlisle, Scaleby Hall . .	1.74	44	78
"	Polapit Tamar	3.68	93	115	"	Seathwaite M.	12.11	308	102
"	Ashburton, Druid Ho. . . .	5.10	130	108	<i>Glam.</i>	Cardiff, Ely P. Stn.	3.57	91	119
"	Cullompton	4.38	111	157	"	Treherbert, Tynywaun . .	7.40	188	...
"	Sidmouth, Sidmount	2.79	71	112	<i>Carmi.</i>	Carmarthen Friary	3.56	90	96
"	Filleigh, Castle Hill	4.25	108	...	"	Llanwrda, Dolaucothy . .	5.25	133	120
"	Barnstaple, N. Dev. Ath. . .	3.38	86	125	<i>Pemb.</i>	Haverfordwest, School . .	3.76	96	108
<i>Corn.</i>	Redruth, Trewrigg	3.45	88	91	<i>Card.</i>	Gogerddan	3.97	101	125
"	Penzance, Morrab Gdn. . . .	2.91	74	87	"	Cardigan, County Sch. . .	3.21	82	...
"	St. Austell, Trevarna	3.73	95	97	<i>Brec.</i>	Crickhowell, Talymaes . .	4.60	117	...
<i>Som.</i>	Chewton Mendip	4.80	122	142	<i>Rad.</i>	Birm. W.W. Tyrmynydd . .	5.82	148	111
"	Street, Hind Hayes	3.29	84	...	<i>Mont.</i>	Lake Vyrnwy	4.08	104	90
<i>Glos.</i>	Clifton College	3.44	87	146	<i>Denb.</i>	Llangynhafal	2.09	53	...
"	Cirencester, Gwynfa	4.00	102	172	<i>Mer.</i>	Dolgelly, Bryntirion . . .	5.25	133	118
<i>Here.</i>	Ross, Birchlea	3.17	81	158	<i>Carn.</i>	Llandudno	1.50	38	72
"	Ledbury, Underdown	2.83	72	156	"	Snowdon, L. Llydaw 9 . .	11.73	298	...
<i>Salop.</i>	Church Stretton	3.16	80	144	<i>Ang.</i>	Holyhead, Salt Island . .	2.91	74	119
"	Shifnal, Hatton Grange . . .	1.62	41	100	"	Lligwy	2.28	58	...
<i>Staff.</i>	Tea, The Heath Ho. . . . .	...	...	...	<i>Isle of Man</i>				
<i>Worc.</i>	Ombersley, Holt Lock	2.51	64	153	"	Douglas, Boro' Cem. . . .	2.71	69	85
"	Blockley, Upton Wold	3.27	83	144	<i>Guernsey</i>				
<i>War.</i>	Farnborough	3.69	94	179	"	St. Peter P't, Grange Rd .	2.06	52	84

Rainfall: February, 1927: Scotland and Ireland

CO.	STATION	In.	mm.	Per- cent. of Av.	CO.	STATION.	In.	mm.	Per- cent. of Av.
<i>Wigt.</i>	Stoneykirk, Ardwell Ho	2.13	54	81	<i>Suth.</i>	Loch More, Achfary...	2.66	68	40
"	Pt. William, Monreith.	2.66	68	...	<i>Caith.</i>	Wick	1.98	50	87
<i>Kirk.</i>	Carsphairn, Shiel.	4.84	123	...	<i>Ork.</i>	Pomona, Deerness	2.19	56	73
"	Dumfries, Cargen	3.21	82	83	<i>Shet.</i>	Lerwick	3.22	82	102
<i>Roxb.</i>	Bransholme	1.07	27	41					
<i>Selk.</i>	Ettrick Manse	2.52	64	...	<i>Cork.</i>	Caheragh Rectory	3.47	88	...
<i>Berk.</i>	Marchmont House	1.03	26	50	"	Dunmanway Rectory.	3.31	84	57
<i>Hadd.</i>	North Berwick Res. ....	.98	25	63	"	Ballinacurra	3.11	79	83
<i>Midl.</i>	Edinburgh, Roy. Obs. .	1.05	27	66	"	Glanmire, Lota Lo. ...	3.01	76	76
<i>Lan.</i>	Biggar .....	...	...	...	<i>Kerry</i>	Valentia Obsy.	4.02	102	77
"	Leadhills	3.43	87	...	"	Killarney Asylum	2.96	75	57
<i>Ayr.</i>	Kilmarnock, Agric. C. .	2.23	57	78	"	Darrynane Abbey	3.38	86	73
"	Girvan, Pinmore	2.78	71	65	<i>Wat.</i>	Waterford, Brook Lo. .	1.74	44	53
<i>Renf.</i>	Glasgow, Queen's Pk. .	1.97	50	67	<i>Tip.</i>	Nenagh, Cas. Lough . .	2.55	65	82
<i>Bute.</i>	Greenock, Prospect H. .	4.25	108	76	"	Roscrea, Timoney Park	3.79	96	...
"	Rothsay, Ardencraig. .	3.20	81	80	"	Cashel, Ballinamona ..	3.02	77	94
"	Dougarie Lodge	2.59	66	...	<i>Lim.</i>	Foynes, Coolnanes	3.09	79	97
<i>Arg.</i>	Ardgour House	6.73	171	...	"	Castleconnell Rec.	2.75	70	...
"	Manse of Glenorchy. .	4.51	115	...	<i>Clare</i>	Inagh, Mount Callan ..	3.71	94	...
"	Oban	3.62	92	...	"	Broadford, Hurdleat'n.	3.11	79	...
"	Poltalloch	4.00	102	93	<i>Wexf.</i>	Newtownbarry	3.49	89	...
"	Inveraray Castle	7.05	179	104	"	Gorey, Courtown Ho. . .	2.69	68	96
"	Islay, Eallabus.	3.51	89	84	<i>Kilk.</i>	Kilkenny Castle	2.51	64	99
"	Mull, Benmore	9.40	239	...	<i>Wic.</i>	Rathnew, Clonmannon	2.73	69	...
<i>Kinn.</i>	Loch Leven Sluice	1.79	45	63	<i>Carl.</i>	Hacketstown Rectory .	4.85	123	162
<i>Perth.</i>	Loch Dhu	5.80	147	78	<i>QCo.</i>	Blandsfort House.	3.49	89	130
"	Balquhider, Stronvar. .	2.43	62	...	"	Mountmellick	3.34	85	...
"	Crieff, Strathearn Hyd. .	2.15	55	61	<i>KCo.</i>	Birr Castle	2.43	62	106
"	Blair Castle Gardens . .	1.26	32	45	<i>Dubl.</i>	Dublin, FitzWm. Sq. . .	2.49	63	132
"	Coupar Angus School. .	...	...	...	"	Balbriggan, Ardgillan .	2.67	68	136
<i>Forf.</i>	Dundee, E. Necropolis. .	1.31	33	70	<i>Me'th.</i>	Beauparc, St. Cloud . .	2.54	65	...
"	Pearsie House	1.85	47	...	"	Kells, Headfort.	2.79	71	103
"	Montrose, Sunnyside. .	1.56	40	85	<i>W.M.</i>	Moate, Coolatore. ....	...	...	...
<i>Aber.</i>	Braemar, Bank .....	...	...	...	"	Mullingar, Belvedere .	3.19	81	115
"	Logie Coldstone Sch. . .	1.17	30	56	<i>Long</i>	Castle Forbes Gdns. ...	2.99	76	105
"	Aberdeen, King's Coll. .	1.83	47	89	<i>Gal.</i>	Ballynahinch Castle . .	6.15	156	120
"	Fyvie Castle	1.10	28	...	"	Galway, Grammar Sch. .	2.75	70	...
<i>Mor.</i>	Gordon Castle	1.20	30	63	<i>Mayo</i>	Mallaranny	5.48	139	...
"	Grantown-on-Spey .....	.76	19	36	"	Westport House	3.21	82	81
<i>Na.</i>	Nairn, Delnies .....	.99	25	55	"	Delphi Lodge	8.29	211	...
<i>Inv.</i>	Ben Alder Lodge .....	...	...	...	<i>Sligo</i>	Markree Obsy.	2.70	69	77
"	Kingussie, The Birches .	.94	24	...	<i>Cav'n</i>	Belturbet, Cloverhill. .	1.70	43	65
"	Loch Quoich, Loan ....	...	...	...	<i>Ferm.</i>	Enniskillen, Portora . .	2.64	67	...
"	Glenquoich .....	...	...	...	<i>Arm.</i>	Armagh Obsy.	1.40	36	66
"	Inverness, Culduthel R. .	.94	24	...	<i>Down</i>	Fofanny Reservoir	5.84	148	...
"	Arisaig, Faire-na-Squir .	2.94	75	...	"	Seaford	3.07	78	101
"	Fort William	4.14	105	55	"	Donaghadee, C. Stn. . .	1.89	48	82
"	Skye, Dunvegan	4.52	115	...	"	Banbridge, Milltown . .	1.35	34	65
"	Barra, Castlebay	1.72	44	...	<i>Antr.</i>	Belfast, Cavehill Rd. .	1.69	43	...
<i>R&C.</i>	Alness, Ardross Cas. . .	...	...	...	"	Glenarm Castle	2.65	67	...
"	Ullapool	1.53	39	...	"	Ballymena, Harryville	1.93	49	60
"	Torricon, Bendamph. . .	3.53	90	45	<i>Lon.</i>	Londonderry, Creggan	2.12	54	66
"	Achnashellach	3.20	81	...	<i>Tyr.</i>	Donaghmore	2.40	61	...
"	Stornoway	2.13	54	48	"	Omagh, Edenfel.	2.06	52	69
<i>Suth.</i>	Lairg	1.90	48	...	<i>Don.</i>	Malin Head	1.60	41	66
"	Tongue Manse	1.25	32	36	"	Dunfanaghy	2.21	56	62
"	Melvich School	1.74	44	58	"	Killybegs, Rockmount. .	4.38	111	88

Climatological Table for the British Empire, September, 1926

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am't	PRECIPITATION			BRIGHT SUNSHINE		
	Mean of Day M.S.L.	Diff from Normal	Max.	Min.	Mean Values			Mean	Am't			Diff. from Normal	Days	Hours per day	Per-cent- age of possi- ble.		
					Max.	Min.	max. 1 and 2 min.									Diff. from Normal	Wet Bulb.
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	%	0-10	mm.	mm.					
London, Kew Obsy.	1019.6	+ 2.2	84	39	52.5	68.0	60.3	74.7	53.9	92	7.1	37	11	10	4.3	34	
Gibraltar	1018.0	+ 0.7	89	64	69.8	79.6	74.7	76.7	67.9	82	5.1	2	33	2	...	...
Malta	1018.6	+ 1.7	88	61	71.9	81.4	76.7	76.7	71.6	85	3.4	28	4	3	9.2	74	
St. Helena	1014.8	+ 1.5	61	50	57.7	57.7	55.5	55.5	53.9	95	4.3	69	8	23	...	...
Sierra Leone	1012.6	+ 0.4	89	69	78.5	85.4	78.5	78.5	75.0	86	7.5	644	79	25	...	...
Lagos, Nigeria	1010.9	+ 1.9	84	71	82.1	82.1	77.7	77.7	74.7	86	8.4	281	147	18	...	...
Kaduna, Nigeria	1013.9	+ 1.1	89	62	66.6	86.1	76.3	76.3	70.8	78	1.9	348	56	24	...	...
Zomba, Nyasaland	1019.2	+ 0.7	90	50	58.6	84.0	71.3	71.3	...	55	2.0	0	8	0	...	...
Salisbury, Rhodesia	1011.9	+ 1.5	89	41	53.9	82.3	68.1	68.1	56.0	42	0.8	0	7	0	9.0	75	
Cape Town	1020.2	+ 1.1	81	42	48.6	65.5	57.1	57.1	51.5	83	5.0	46	12	10	...	...
Johannesburg	1016.6	+ 1.0	81	36	47.4	70.4	58.9	58.9	47.4	48	2.1	19	5	1	9.3	78	
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	89	27	...	73.5	40.1	56.8	84.6	47	2.7	17	6	5	...	...
Calcutta, Alipore Obsy.	1004.2	- 0.3	94	76	89.0	79.1	84.1	84.1	79.6	89	7.8	155	96	12*	...	...
Bombay	1006.4	+ 1.6	88	75	85.5	77.7	81.6	81.6	77.1	87	6.6	228	43	13*	...	...
Madras	1006.0	- 0.5	99	71	93.6	77.0	85.3	85.3	77.3	77	7.6	43	84	5*	...	...
Colombo, Ceylon	1009.0	- 1.0	88	73	86.1	77.0	81.5	81.5	78.0	77	8.3	240	91	19	5.1	42	
Hongkong	1007.7	- 0.7	92	74	86.4	77.6	82.0	82.0	77.3	77	6.3	439	185	17	7.1	58	
Sandakan	...	...	91	73	87.8	74.9	81.3	81.3	76.5	85	...	277	38	17	...	...
Sydney	1020.7	+ 4.7	85	44	68.6	86.6	50.9	59.7	54.4	63	4.1	41	32	6	7.6	64	
Melbourne	1020.2	+ 4.4	84	37	65.9	84.7	47.8	56.9	51.8	67	5.6	29	32	14	5.7	48	
Adelaide	1020.0	+ 2.7	88	41	69.2	86.0	50.5	58.9	53.0	61	6.1	61	9	13	6.6	56	
Perth, W. Australia	1018.0	+ 0.1	85	43	68.0	86.0	49.9	58.9	55.1	68	4.6	99	14	17	7.5	64	
Ooligardie	1017.6	+ 0.5	89	35	74.7	86.7	47.7	61.2	50.2	39	2.1	20	5	5	...	...
Brisbane	1021.5	+ 4.2	86	49	74.4	86.4	55.3	64.9	59.1	60	4.3	61	9	12	8.1	68	
Hobart, Tasmania	1016.8	+ 6.1	82	31	59.3	84.6	44.6	51.9	46.3	65	7.1	47	7	17	5.3	45	
Wellington, N.Z.	1014.8	+ 0.2	65	32	57.9	79.9	45.8	51.9	48.7	68	5.4	49	52	14	5.1	43	
Suva, Fiji	1014.9	+ 0.6	86	63	79.4	86.4	69.9	74.7	71.4	84	8.7	345	168	21	2.9	24	
Apia, Samoa	1012.9	+ 0.8	88	71	85.0	85.0	74.4	79.7	76.5	77	5.0	84	46	11	7.8	65	
Kingston, Jamaica	1011.5	- 0.7	92	69	88.0	88.0	73.0	80.5	72.5	87	5.3	74	30	8	6.4	52	
Grenada, W.I.	1012.1	+ 0.4	92	70	86.9	86.9	76.0	81.5	77.8	81	6.4	187	23	17	...	...
Toronto	1018.9	+ 1.1	80	36	66.8	81.2	59.0	61.5	53.8	85	6.9	145	64	12	4.8	38	
Winnipeg	1015.7	+ 0.9	79	26	60.1	74.5	42.8	51.5	...	...	6.7	96	38	13	5.3	42
St. John, N.B.	1020.0	+ 2.5	74	38	62.1	74.5	47.5	54.8	51.9	...	5.5	64	31	11	6.6	52	
Victoria, B.C.	1015.8	- 0.7	77	40	64.4	77.4	48.5	56.5	51.7	70	4.1	23	28	7	8.4	66	

*For Indian stations a rain day is a day on which 0.1 in. (2.5 mm.) or more rain has fallen.

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"The Circulation of Air in Stevenson Screens as shown by Corrosion"

By J. C. HUDSON, M.Sc., D.I.C., A.R.C.S.

These experiments are part of a research on which the author is engaged for the Atmospheric Corrosion Committee of the British Non-Ferrous Metals Research Association. The object of the investigation is to compare the effects of atmospheric exposure, under widely different climatic conditions, on typical non-ferrous materials, and one of the quantitative tests proposed for this purpose is based on a determination of the increase in weight brought about by the reaction of the metals with the atmosphere. This method, introduced by Vernon, has been extensively applied by him to the study of tarnish films in indoor atmospheres* but it is not suitable for complete exposure tests, since the rain falling on the specimens removes some of the corrosion product and vitiates the results. In order to avoid this difficulty, tests have been carried out on specimens sheltered in Stevenson Screens, which were recommended for the purpose on the grounds that uniform conditions of exposure would be obtained.

The results have shown that there is a surprising lack of uniformity in the conditions inside a Stevenson Screen with respect to corrosion. It has been found that the extent to which

* W. H. J. VERNON. *London, Trans. Faraday Soc.* 19 (1923) p. 839; 23 (1927) p. 113; *London, J. Chem. Soc.* 129 (1926) p. 2273.

a specimen is corroded largely depends on its position ; thus there is a progressive diminution in corrosion from the bottom to the top of the screen. The differences observed in the corrosion of similar specimens in different parts of the screen may amount to several hundred per cent. and are much too large to permit of the use of Stevenson Screens for comparative corrosion tests on individual specimens of different materials. It has been shown, however, that corrosion tests may be satisfactorily

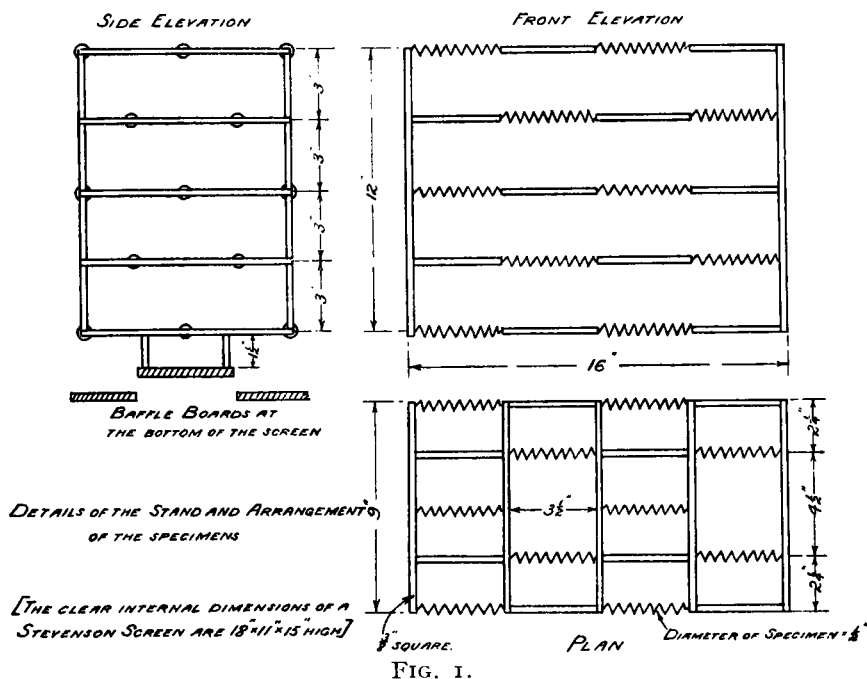


FIG. 1.

conducted in a Stevenson Screen, if they are made, not on one, but on several specimens of each material, placed in positions so chosen that, however much the individual results may vary, the aggregate weight increments of each set of specimens are strictly comparable.

The connexion between corrosion and position in the screen was first observed during some experiments carried out on the roof of the Royal School of Mines at South Kensington but the experiments were repeated at the Royal Botanic Gardens, Regent's Park, in order to ensure that the observations were not purely the effect of local conditions. The method of investigation consisted in exposing fifty copper coils in known positions inside the screen ; the specimens were weighed before and after corrosion, and, by this means, a direct calibration of the interior of the screen with regard to corrosion was effected.

The specimens were 160 cm. lengths of 21 S.W.G. copper wire

(0.032 in.), wound into a coil on a half inch mandril. During exposure, the specimens were supported in five horizontal "layers" of ten on a light wooden frame, as shown in Fig. 1. The vertical distance between two layers was 3 in. and the lowest layer was $1\frac{1}{2}$ in. above the baffle board at the bottom of the screen.

The results obtained are shown in Fig. 2, where the weight increments have been inserted in the positions that the specimens occupied on the stand. The weight increments are in milligrams and refer to 14 days' exposure at the Royal Botanic Gardens during the month of January. The large differences in the

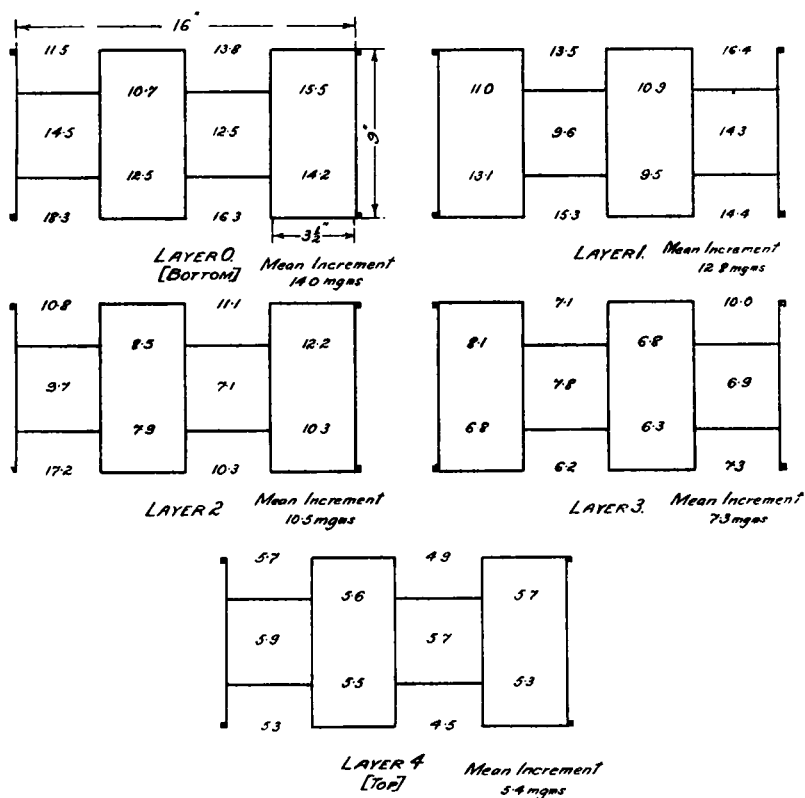


FIG. 2.

corrosion of specimens in different parts of the screen and the marked diminution in corrosion from the bottom upwards are very evident, both from the diagram and from the following table, in which the mean weight increment of the ten coils in each layer has been expressed as a percentage of the mean increment for the whole screen. Two series of figures are given in the table, which refer to 14 and 28 days' exposure respectively; for the second period of 14 days, the stand was replaced in the

screen back to front. It will be seen that this reversal of the specimens has had no effect on the vertical distribution of the corrosion differences, but a more detailed study of the individual weight increments showed that the disparity between specimens in the same layer had been considerably reduced.

CORROSION IN EACH LAYER AS A PERCENTAGE OF THE MEAN
VALUE FOR THE SCREEN.

Layer.	Distance from Bottom (in.)	Percentage Corrosion.	
		After 14 days.	After 28 days.
0	1.5	140	136
1	4.5	128	128
2	7.5	105	106
3	10.5	73	70
4	13.5	54	54

The observed differences are too large to be attributed to any mutual protection on the part of the specimens and an explanation may perhaps be found in the fact that the quantity of air flowing over the specimens varies in different parts of the screen. It seems probable that the greater part of the air circulates through the relatively large channels between the baffle boards at the bottom; if so, the amount of air passing over the specimens will steadily diminish towards the top of the screen and, since the greatest corrosion will undoubtedly be associated with the greatest circulation of air, this will account for the greater corrosion at the bottom. It may be added that this view is confirmed by an examination of the soot deposit on the inner walls of the screen, which also diminishes from the bottom upwards, and it is interesting to note that, in some experiments, definite differences were found in the corrosion at the back and the front of the screen, which were probably due to the direction of the prevailing winds.

There seems to be little doubt, as a result of the corrosion tests, that the conditions inside a Stevenson Screen are not uniform and may vary within much wider limits than has hitherto been realised. Further, it is possible that the differences may not be confined to corrosion. How far this lack of uniformity may affect the observations of temperature, humidity and the other physical measurements, made inside the screen, is a matter for meteorologists to decide.

The author understands that trouble is sometimes experienced from the corrosion of instruments placed in Stevenson Screens. The results of these experiments seem to show that, in some cases, corrosion might be reduced by moving the instruments to a more favourable position. If any alteration in the screen were contemplated, attention might be paid with advantage to

the bottom, for it is probable that a reduction in the distance between the baffle boards would diminish the corrosion to an appreciable extent ; the limiting distance would, of course, be determined by the necessity of non-interference with the meteorological functions of the screen and would be a matter for experiment.

As regards the composition of the metallic parts of the instruments, it is probable that the most suitable material will depend on the climate. In a London atmosphere, copper, aluminium and phosphor bronze are definitely superior to most of the other non-ferrous materials, *when exposed in a Stevenson Screen*. The use of perforated metal shields to protect the instruments might be of value ; perhaps copper would be the best material for this purpose, since its corrosion products are relatively non-hygroscopic, whilst, in the case of zinc or brass, copious condensation would occur, which might easily do more harm than good.

The author is indebted to the Council of the British Non-Ferrous Metals Research Association for permission to publish this paper and to his colleague, Dr. W. H. J. Vernon, for much valuable assistance and advice. He would also like to acknowledge his indebtedness to the Director and several members of the staff of the Meteorological Office for their kindness in granting facilities and supplying meteorological data.

The Detonating Meteor of February 25th, 1927

By F. J. W. WHIPPLE, M.A., F.INST.P.

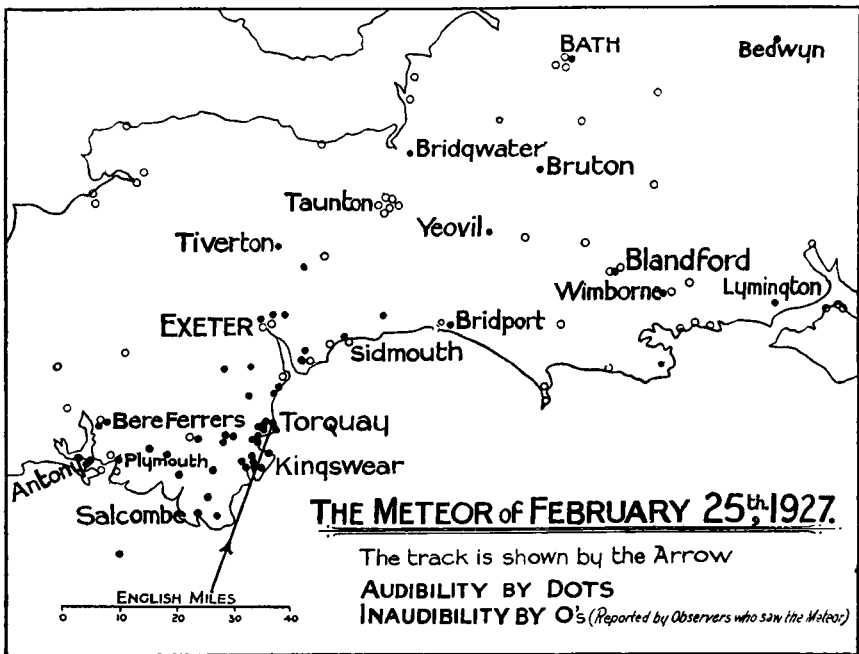
The brilliant meteor which appeared a few minutes before midnight on February 25th was seen over a large area, including London, the southern and south midland counties of England and south Wales. The first accounts which were published in the London papers came from Herefordshire, where the meteor was not heard, and it was not until ten days later that I learned that there had been detonations audible in Devonshire and elsewhere. A request for further information was then circulated in the newspapers. With the aid of the reports received in response to this request and of information kindly placed at my disposal by Mr. Denning I have been able to prepare a map of the region of audibility.

The final determination of the track of the meteor has not yet been made. The line shown on the map from 14 miles south of Salcombe to Torquay is certainly not much wrong. There is, however, considerable doubt as to the height of the track above ground and it is not safe to give any numerical estimate at present. The inclination of the track to the horizon was about 40° .

The meteor was very brilliant. Mr. Denning summarizes the

observations thus: "Suddenly the sky was illuminated with dazzling effect and observers saw a ball of fire slowly traversing a short path, vanishing amid a rain of sparks and with a second outburst of light perhaps equal to the first. . . . Some people estimated the size of the meteor's incandescent head as equal to that of the full moon but all are agreed that its brilliancy greatly exceeded that of our satellite." Of course the illumination was not so strong at great distances. Nevertheless, to an observer as far away as Chatham, nearly 200 miles from Torquay, it was the finest sight he had ever seen in the heavens.

The accounts of the audibility of the meteor are interesting. In several cases the observer thought that he heard a rushing



sound whilst the meteor was in sight; numerous observers report that they heard a sound like thunder within a few seconds and it is difficult to decide whether this was an illusion or merely a bad estimate of the time. Unfortunately this difficulty occurs with some of the most interesting records. One is that of Mr. J. Foster who was sailing down the English Channel on the yacht *Palatina* and was about 10 miles S.E. by S. from the Eddystone Lighthouse. His report runs as follows: "The ship seemed as if she were suddenly put under the rays of a brilliant searchlight . . . it travelled at great speed sloping down at an angle of about 45° in a N.N.W. direction lasting for a period of about 5 seconds. While travelling it slightly changed colour; starting white it changed to a pink and finally to a bluish tint;

the best description I can give is to liken its tail to that of a kite. About two or three seconds had elapsed after its disappearance when a slight rumbling noise was heard, one of the crew remarking about it having exploded." Another observer on board the yacht considers that "the noise which resembled distant thunder started quite fifteen seconds after the meteor burst." Yet the nearest point of the meteor's track through the air must have been nearly 40 miles away, so that we should have expected an interval of four or five minutes. Again, the signalman on duty at Bedwyn Signal Box, near Hungerford, saw the meteor and "a few seconds after this heard a noise like thunder at a distance and this disturbed the pheasants in the woods." In both these cases I am inclined to accept the evidence of audibility and ignore the difficulty about the time. Another difficult case is presented by a letter from Portland: "A second or two after I saw the meteor, I and another person who was with me at the time, distinctly heard a report or noise which sounded somewhat like the distant banging of a door." This observation I have not ventured to show on the map.

Most of the accounts of audibility compare the noise to thunder: at Torquay, one observer thought the sound was like the firing of a single cylinder engine; another says that all observers agree that the roar that followed was subterranean and another states that it was "like the noise that follows shot firing under ground." His curious sensation is described thus by an observer at Paignton: "A rumbling started, it seemed away over the other side of Torquay and came right over us and yet it seemed as if it were through us." At Modbury the sound was thought to come from an earthquake.

At Babbacombe, just north of Torquay, it was estimated that the noise lasted three minutes, and at Teignmouth, the "rumbling seemed as if it might be thousands of drums rolling directly over our heads . . . lasted for quite a minute or two." At Kingswear, there were "a number of loud detonations, which, whilst being distinctly separate, followed one another so quickly as to resemble the abnormally loud rumbling of thunder."

As will be seen from the map the principal area in which the noise was generally audible is well defined. It is bounded on the west by a line from Tiverton, through Exeter and Totnes to Bere Ferrers and thence to Antony, a little west of Plymouth. To the north-east of the end of the track the sounds were heard at Exmouth, Sidmouth, and Colyton, and near Bridport, though a second observer at Sidmouth, two at Budleigh Salterton, and two at Charmouth, heard nothing. Antony and Torpoint are the only places in Cornwall from which there are positive reports, and the sound did not reach the north of Devonshire. There is

definite negative evidence from five observers at Taunton, but at Bridgwater one observer reported a rumbling sound.

To the east we have observations at Lymington, where two observers, husband and wife, both heard a distant rumble. This is the more remarkable as no sound was heard by observers at Cowes, Boscombe, and Southampton. In the same direction a lady at Witchampton, Wimborne, heard distant noises—short sharp detonations—“such as one associates with night firing at sea,” but another observer at Wimborne says: “there was no detonation whatever.” From Blandford there are two negative reports, but a good positive one. “After the space of about $1\frac{1}{2}$ minutes in the far distance I heard a succession of ‘booms’ about four or five in number. It did not sound like thunder but something like a number of guns being fired a great way off. The booms followed each other quickly.”

From Lower Odcombe, near Yeovil, we have a report: “almost immediately I heard a noise very much like thunder and a few seconds after that my bed shook so violently I thought someone was in the room shaking it”; and from Bruton, Somerset, we learn of a chauffeur who “heard three distinct explosions. The first woke him up, then two others followed quickly . . . Immediately after the explosions there was a distinct vibration which caused the window in his bedroom to rattle.”

It is remarkable that the scattered observations all come from the north-east of the meteor's track. There are no comparable ones from the north of Devonshire, or from Cornwall or Wales. The suggestion of an earthquake at Yeovil and Bruton is of peculiar interest. It looks as if a powerful air-wave came to earth in a small area about 60 miles from the track of the meteor.

The most precise estimate of the interval between the sight and sound of the meteor was made by Mr. W. R. C. Atkins, at Antony, about 5 miles west of Plymouth. He writes: “between $3\frac{1}{4}$ and $3\frac{1}{2}$ minutes later I heard a dull roar. The duration of the sound was roughly two seconds.” It is a pity we have no precise knowledge of the height of the meteor's path to combine with this information. We may note, however, that the short duration of the sounds suggests that they proceeded from the meteor when it was high up in the atmosphere; the meteor was much broken up in the latter part of its career, and then sent out a succession of sound waves.

All the observations seem to be consistent with the ideas which I advocated in my article on the meteor of October 2nd, 1926, *i.e.*, the sounds are due to the waves caused by the meteor driving the air before it and the breaking up of the meteor is due to the centrifugal force generated by spin.

Our discussion has only been concerned with the last incident

in the life of a meteor, but the question where meteors come from is of more general interest, and therefore, I want to add a few words about a remarkable theory recently published by Prof. R. Schwinner, of Graz.* The theory is based on the generalization that as no meteorites are found in any but the most recent geological formations† no meteorites can have fallen on the earth until quite recent times. How recent may be judged from the fact that men of the stone age, though they sought diligently for stones and found many varieties, appear not to have discovered any meteoric iron. Schwinner's hypothesis is that some 50,000 years ago the solar system reached a part of space occupied by a swarm of meteorites. We are still making our way through this swarm.

Estimates of the mass of the meteors lost in our atmosphere and of the meteorites which reach the ground are available. A mean value of 6,000 tons per annum is adopted. Making due allowance for the velocity of the solar system, Schwinner finds the average density of meteoric matter in the part of space we are traversing. On the assumption that we have reached the middle he finds the total mass of the meteoric matter to be about 2,000 times that of the earth.

To explain the origin of the meteor swarm, Schwinner postulates the explosion of a star or a large planet. This explosion may have taken place long before the solar system encountered the swarm. Whether cosmogonists will find the theory acceptable remains to be seen. Will they be able to explain why the unfortunate little star came to grief?

Bergen Daily Charts

By C. K. M. DOUGLAS, B.A.

Since February 1st, 1927, the Geophysical Institute at Bergen has issued a special daily weather chart based on observations at 7h., covering the whole of Europe and the eastern Atlantic, and also Greenland and the Azores. In a circular issued at the commencement of the series, it is stated that the fundamental conceptions of the Norwegian meteorologists remain unaltered, and that recent progress has been concerned chiefly with indirect methods of distinguishing different masses of air, and of tracing fronts where they are not very obvious. The fundamental ideas include the division of the chart into areas covered by more or less homogeneous masses of air, separated by surfaces of discontinuity, or belts of steep horizontal temperature gradient. The latter present difficulties for cartographical purposes, but

* Gerlands Beiträge zur Geophysik 16 (1927) pp. 195-222.

† cf G. P. Merrill, Proc. Amer. Phil. Soc. 65, p. 119 (quoted in *Nature*, April 2, 1927, p. 508).

J. Bjerknes has recently come to the conclusion that the intermediate air is for the most part not a product of mixing, but consists of degenerate polar air, warmed dynamically by descending motion, in addition to the frequent warming over the sea.* If it is agreed that the line of discontinuity should be drawn at the boundary between the intermediate air and the warm mass of air, the problem of linking up the polar front is much simplified.

The Bergen charts contain all the ordinary features of synoptic charts, and in addition show the various fronts, warm fronts, cold fronts, and occlusions being marked in different colours, and also the associated rain areas. A new and valuable feature consists of descriptions of the different air masses, written in English. These descriptions naturally show considerable variety, and the large size of the maps allows them to be quite long when necessary. We can only refer here to the commonest types of description, which are usually quite brief, *e.g.*, Tropical Air, Genuine Polar Air, Maritime Polar Air, etc.

The following are the main characteristics of the most typical masses of air :—

- (A) Tropical Air : used for currents originating in really low latitudes ; it is warm throughout the troposphere, with a stable lapse-rate in the lower layers ; stratus cloud, drizzle and sea fog frequent.
- (B) Genuine Polar Air : air arriving directly from Arctic regions ; it is very cold at all heights in the troposphere, and becomes showery when crossing the sea.
- (C) Maritime Polar Air : polar air which has crossed a long stretch of warm sea ; it is mild in winter in the lower layers, but has a high lapse-rate and is accompanied by showery weather. This appears to be the most frequently occurring type of air, at least in winter.
- (D) Returning Maritime Polar Air : when polar air extends within the boundaries of a sub-tropical “ high,” it appears to spread into a relatively shallow layer and is also warmed up ; if it then moves north-east it resembles Tropical Air but is less warm, and is apt to have dry anti-cyclonic air above.
- (E) Continental Air : superficially cold in winter, warm and dry in summer.

It may be mentioned that warm air is not necessarily “Tropical Air.” The abnormally warm air over England about March 17th, when day temperatures rose to 60° F., was marked as “Returning Continental Air.” There can be little doubt that the warmth on that occasion, and also on March 21st, when day temperature reached 65° F., was due primarily to descent in the anti-cyclone,

* *Meteorological Magazine* 61 (1926) p. 32.

aided by the warming of the surface layers by solar heating in France. Similar conditions some weeks earlier would have given cold foggy weather in the mornings, and locally all day.

Anyone desirous of really understanding Norwegian methods of forecasting would find these charts of great value. A 24-hour interval is rather long, but the numbering of the fronts enables them to be followed from day to day. The variety of weather conditions is so great that a knowledge of synoptic meteorology can only be obtained by following a long series of charts.

Royal Meteorological Society

The monthly meeting of the Society held on Wednesday evening, March 16th, at 49, Cromwell Road, with Sir Gilbert Walker, C.S.I., F.R.S., President, in the Chair, was devoted to the customary March lecture (The Symons Memorial Lecture).

Professor G. I. Taylor, F.R.S.—Turbulence.

Turbulence is a condition of motion in a stream of fluid which occurs when it flows past solid surfaces or when two layers of fluid flow over one another. Though the details of the motion are too complicated for mathematical analysis many things are known about the effect of turbulence on the condition of the atmosphere and about the mean values of quantities connected with turbulence.

The lecturer discussed the effect of turbulence in propagating heat and water vapour into the atmosphere and its connexion with the friction of the wind on the ground. Turbulence increases the diffusing power of air till it is 100,000 times as great as that of air at rest. In the case of tidal motions in the sea the analogous effect is so great that it is possible to prove that turbulence is responsible for the gradual slowing down of the earth's rotation, and consequent lengthening of the day which astronomers have been able to observe. Some observations of the details of turbulence show that eddying motion in the atmosphere is spread out equally in all directions in space. Records of a universally jointed wind vane were shown proving that at some height above the ground vertical and lateral components of eddying motion are equal.

The lecture was illustrated by an experiment showing the effect of stratification of density in preventing the formation of turbulence.

Errata

February, 1927—p. 24, line 24, *delete* "of 102 m.p.h. at Renfrew." Line 25, the gust of 92 m.p.h. at Pendennis was recorded in the early morning of the 29th.

March, 1927, p. 34, line 26, *for* "1.65 lines (ca. 0.15 in.)" *read* "0.33 in."

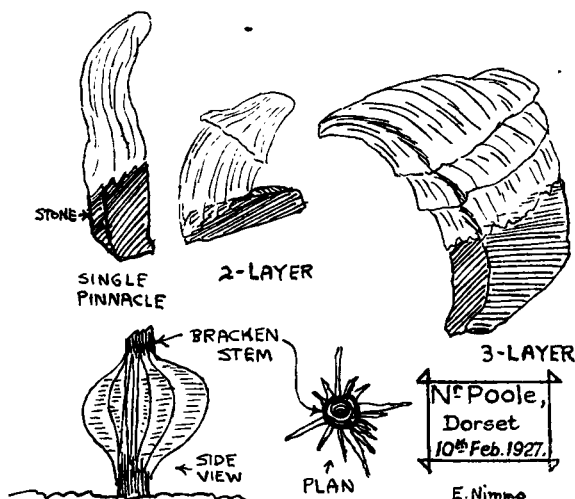
Correspondence

To the Editor, *The Meteorological Magazine*

Ice Pinnacles

After I had read yesterday an article on ice pinnacles in an old number of the *Meteorological Magazine* (April, 1922, p. 71), my brother told me of some he had seen that day. These I inspected this morning and found there were certain differences from the

description referred to in the magazine. The soil is sandy, not chalky, and the pinnacles were always on small flints. They showed very clearly the striation mentioned by Mr. Latchmore, but were not hollow, some were much curved and twisted and many showed two or even three distinct layers, as though they had



been added to on successive days, and as we have had similar weather three days running this seems possible. Although there were thousands of stones apparently of the same nature and similarly set in the ground the pinnacles only appeared here and there.

I also observed a quite different form, on dead bracken stems. This was a series of roughly semi-circular plates attached to the stem by their diameters and radiating in all directions so that the plan view was like a many-armed star fish; the "arms" were sometimes straight, sometimes bent or twisted and were all striated at right angles to the diameter of the semi-circle and to the stem. The phenomenon of pushing up crusts of earth, etc., by little ice columns was very common and widespread at the time.

Weather conditions :—

		Grass	Min.	Max.	Wind.
February 8th	..	27	36	NE to E	force 3—5
" 9th	..	30	35	ENE	" 2—3
" 10th	..	27	—	ENE	" 2

There has been no snow, rain or dew, and the grass is quite dry.

E. NIMMO.

Churley, Grange Road, Broadstone, Dorset. February 10th, 1927.

Frozen Raindrops

The following observation, which is new to me, may interest your readers. On February 13th, after a thick country mist, the trees were dripping heavily with moisture towards nightfall. During the night the temperature in the screen fell to 26° , and the next morning the ground was sprinkled with frozen raindrops, of the size of small hailstones, but transparent, not laminated nor milky in appearance.

F. R. WALTERS.

Pinecroft, Farnham, Surrey. February 17th, 1927.

Snow in the Isle of Wight

On Thursday morning, February 24th, at about 9.30, rain set in with a WSW wind and temperature 42° at Shanklin, Isle of Wight, and continued heavily until about 10.30 when it changed to sleet and wet snow, the temperature falling rapidly to 34° during the afternoon. I mention this because I see no reference to any sleet or snow anywhere that day in the south of England, only a snow shower at Eskdalemuir, in Scotland, and sleet at Birmingham. Can it be that the Isle of Wight had local sleet? Calshot and Southsea only had rain which is rather curious, especially as the Isle of Wight usually escapes these visitations when other south coast resorts have snow or sleet.

J. E. COWPER.

Public Schools Club, 61, Curzon Street, W 1, February 26th, 1927.

Rainfall in Devon

As February and March are two of the driest months of the year the rainfall for the first quarter of this year has been very remarkable. For the first three months the total was 22.37 in. January 9.78 in., February 5.39 in., March 7.20 in.

This station is 855 ft. above sea-level—the ground slopes, with minor undulations, to the English Channel, distant 19 miles—off Plymouth Sound. Two or three miles to the east and north-east the land is from 1,500 to 1,900 ft. high, to the north-west 1,160 ft.

H. K. G. ROGERS.

Seaforde, Mary Tavy, S. Devon. April 1st, 1927.

February Filldyke

The name "Filldyke" applied to February is unfortunate, as it induces those who are unacquainted with the facts to assume that February is a wet month, which of course it is not.

Is there no other explanation for the saying? Can it not have arisen from the melting of the snow filling the dykes, in an already saturated soil? Or may it not possibly refer to the usual filling

the dyke, for irrigating the meadows, by farmers, as is customary in that month? According to the reports in the papers the rainfall of February was this year double the average. Surely they refer to London and southeast England and that should be stated. Here with no rain at all from the 8th to the 18th (both inclusive) and a total fall only about $\frac{1}{2}$ in. above average, February was by no means a wet month, many days were brilliantly sunny, and it was a vast improvement on February, 1926.

CHARLES P. HOOKER.

Wyeland House, Hereford, March 4th, 1927.

[The area with double the normal rainfall for February included only the eastern half of the Thames Valley. South of a line from Dolgelly to the Wash the rainfall exceeded normal, north of that line it decreased to about 50 per cent. in Durham. For further details see table on p. 50.—ED. M.M.]

NOTES AND QUERIES

Old Fashioned Winters

In connexion with the article by Mr. M. T. Spence on "Old Fashioned Winters" in the *Meteorological Magazine* for January, 1927, the following quotation may not be without interest, since it indicates that the question is by no means new. "We have one of the old fashioned winters, snow and frost, not fulfilling the word of those who were quite sure the seasons were altered." The quotation is taken from *The Weather Calendar*, arranged by Mrs. Henry Head, where it is credited to a letter written by Edward Fitzgerald at Bradfield Rectory on December 27th, 1853.
J.G.

Cloudburst Cavities

In the *Meteorological Magazine* for October, 1924, p. 214, details were given of a cavity found in a field at Cannington, after unprecedented heavy rainfall, when 9.40 inches was recorded for the rainfall day of August 18th, 1924. An investigation showed that there had been little washing away of the top layer of soil, and that the cavity had been caused by a subsidence.

While inspecting some rain-gauges on the moors near the source of the River Wear in Durham, a more striking cavity was pointed out by the local farmer who read the gauges maintained by the Durham County Water Board. The site was at an altitude of about 1,900 feet, between the Wellhope and Burnhope Burns, and about 1 mile from the borders of Cumberland. At that point, the county boundary coincides with the most westerly limit of the catchment area of these streams. Although the damage was done during a heavy afternoon thunderstorm as

long ago as 1916, the main features are still apparent. The top layer of grass and peat had been washed away to a depth of about 4 feet over an area about 20 yards by 40 yards, and deposited just below. The gradient was only about 1 in 10, and the catchment area at this point was small, it being only about a quarter of a mile to the summit, Lamb's Head, 2,127 feet high. The cavity appeared to be quite different from the other scars on the moors, which could be accounted for by the sudden rush of water from a large area, or to the undercutting of the hillside by a stream in flood.

These phenomena, due to intense local rains, are by no means uncommon, although they seem apparently to be confined to the wetter parts of the British Isles, and, consequently, to sparsely inhabited regions. Some other examples may be briefly recalled :—

British Rainfall, 1893, p. 14. A description is given of a waterspout on the Cheviots on July 2nd, 1893, when over 30 to 40 acres of the upper layer of peat was ploughed up to a depth of some five feet, and piled in enormous masses.

Meteorological Magazine, 1904, p. 125. On September 9th, 1903, on the steep slope below Llyn Llydaw, in Snowdonia, a waterspout is described as excavating the ground in a semi-circular form to a depth of about 3 feet and measuring about 20 feet across.

British Rainfall, 1907, p. 33. Following the severe thunderstorm of July 22nd, the Rev. R. P. Dansey found a hole 10 to 12 yards across, and about 5 feet deep. The effects of the storm are illustrated by photographs.

In each case a large amount of earth has been displaced by some enormous, yet local force. At this stage it is a matter of conjecture whether the sole agent has been exceptionally heavy rain falling practically as a solid mass, *i.e.*, rain (or hail) which would normally fall over a large area, being held up by upward currents and deposited over a very small area after the cessation of these currents. In the Cannington area, where about 8 inches of rain fell in 5 hours, the evidence of erosion caused by the water actually falling over a small area was quite apparent, although far less than that specified in the cases above. If the cavities are caused by rain alone, the amount must be therefore far larger than that recorded in the Cannington area, although it is not possible at this stage to give a closer estimate. Falling rain is entirely held up by currents of air moving upwards with a velocity greater than 24 feet per second. These cavities may in some way be connected with abnormally strong upward currents. In the case of the cavity at Wear Head, the deposit was further down the hillside. This suggested that even if the extremely heavy rain had not been responsible entirely for the

actual scooping out of the mass of earth, rain certainly had played some part in moving it.

J.G.

Rime and Associated Phenomena

On Friday, February 11th, when the south of England was covered with fog, there was a great deposit of rime on the trees in Arundel Park and the neighbourhood. On the South Downs some phenomena, which may be well known to those who live in hill country, but which my son and I observed as novelties, are, I think, worth placing on record.

The rime as we saw it on Saturday morning was heavy enough to bend the tree branches. We were told that at Warming Camp (on the Downs to the east of the Arun) boughs are sometimes broken off by the weight. In the light breeze the fragments of rime from the trees pelted the passer-by in no pleasant fashion. In places the rime blown from the trees lay to the depth of an inch. Rime on the ground has not the brilliance of fresh snow: it makes a rather dirty grey. The crystals, formed apparently like so many needles all pointing up-wind, hold together when they fall and lie on the ground side by side. They leave the mother twig quite clean. The first dropping rime that we saw was in front of Arundel Church and there the rime fell as little tablets of ice about a centimetre square; the rime crystals had fused together. In general, the crystals looked as if they could be separated from their neighbours with a little patience.

The heaviest deposits of rime were on the trees exposed to the north-east, and especially where there was a moderate slope up to them on that side. From a distance, however, the grey patches under the trees and bushes were more conspicuous than the unfallen rime. There was of course rime on the grass. The deposit on the wiry grass stalks was curious, however, in that very frequently it changed sides half-way up. The deposit on the lower half of the stalk pointed into the wind (the north-east wind which prevailed when the rime was formed) but on the upper half the deposit was on the lee side, behaving, so to speak, like a flag. Is it possible that the rime can actually at some stage of its growth be blown round without being blown off the stalk?

It is usual to associate "glaze" with rime, both being explained as deposits of ice from super-cooled water drops. I was surprised, however, when my son found pieces of ice embedded in an earth bank. Each of these pieces of ice was encrusted on a fragment of chalk. A chalk fragment about two inches square and half an inch thick might carry a lump of ice or rather a brittle crown of ice about an inch high. This encrustation on the chalk could hardly be called a glaze. The phenomenon occurred close to

trees with a very liberal deposit of rime. Unfortunately there were no other stones in the bank where the phenomenon was at its best, so we cannot say whether chalk has any special merits. There was no sign of glaze or frost on the roads, which at the time of the observation, a little after noon, were perfectly dry.

Captain Cave, whose house is on the South Downs, has been so good as to give me his experience of this phenomenon. He writes : " I have frequently seen ice encrusted on chalk ; it used to be common at Ditcham and occurred mostly in rather sheltered places under trees. It certainly did not occur on flints, or I should have noticed it."

With regard to the dirty appearance of rime, Captain Cave writes : " On January 27th and 28th, 1909, there was a great development of rime at Ditcham ; it was extremely black and when melted it made a black liquid. Round the trees where it had fallen, it left a dark mark on the grass, etc., when it had melted. The Meteorological Office sent a sample to the Government Laboratory ; they reported that the melted sample contained 70 parts per 100,000 of solid matter consisting of soot and 16 parts per 100,000 of resinous matter. I suppose the soot came from London. A neighbour of mine said he had seen the black rime a number of years previously."

F. J. W. WHIPPLE.

The West of England Blizzard in March, 1891

The easterly hurricane of blinding powdery snow which ravaged the south-western counties of England on March 9th and 10th, 1891, and affected more or less the whole of southern England, with a secondary area of great intensity in Kent, has not been so well remembered by meteorologists as the similar, though rather more widespread, visitation of January 18th and 19th, 1881.

It is, therefore, of interest to draw attention to a little known book* published in April, 1891, but now very scarce, of which a copy may be found in the library of the Royal Meteorological Society. There was considerable loss of life, especially at sea along the grim Cornish coast. No comment is needed as to the terrible nature of the visitation when it is mentioned that on the night of March 9th numbers of trains in every part of Cornwall, Devon and West Somerset were not merely blocked but in many instances literally buried in immense drifts, the railway officials and others having to face an almost overpowering situation in

* The Blizzard in the West : Being a Record and Story of the Disastrous Storm which raged throughout Devon and Cornwall, and West Somerset, on the night of March 9th, 1891. With illustrations. London : Simpkin, Marshall, Hamilton, Kent & Co., Ltd. Devonport : A. H. Swiss.

the attempt to bring sustenance to the unfortunate travellers. I have recently verified in the British Museum that the "Zulu Express" of those days, which left Paddington as usual at 3 p.m. on Monday, the 9th, arrived at Plymouth at 8.30 p.m. on the 13th, having been imprisoned for four whole days at Brent on a southern spur of Dartmoor. The plight of the passengers was not known in London till the 14th, nor reported in any detail in the daily press until the 15th or 16th, so complete was the isolation of the western counties through the collapse of telegraph poles and the blocking of road and rail by the enormous accumulations of snow. The cyclone, after depositing what is generally estimated in round numbers as two feet of snow in Cornwall and Devon, and a smaller quantity farther east, passed up the English Channel to Holland; but it was followed in the sore-stricken western counties by a secondary development which caused a renewal of the gale and snowstorm, some localities having had the same amount of snow over again.

The Devonshire lanes remained blocked till the end of March or later, and it is said that the last traces of the snow had not disappeared from the higher parts of Dartmoor and Exmoor until June. It will be recalled that this snow storm followed the great frost from November 25th—January 22nd, 1890-91, which, in respect of duration and low day maxima, was almost the "record" frost of the nineteenth century in southern England. Nor did the March blizzard end this inclement season, for the weather remained generally bleak in England with local falls of snow or sleet, and in the third week of May, after a sudden burst of summer heat the week before, some six inches of snow fell over a wide area in East Anglia.

The similar storm of January 18th and 19th, 1881, was also very severe in the south-western counties, but the area of maximum intensity lay further east than in 1891, namely in Dorset, Wiltshire, Hampshire, and the Isle of Wight. In this case, also, a secondary depression on the 20th doubled the snowfall in the Isle of Wight which had had nearly 2 feet of snow in the main storm—an interesting parallel.

Both January, 1881, and March, 1891, were snowstorms of the first magnitude, and were of a type notably less often seen in the south of England than in the north.

L. C. W. BONACINA.

The Gale of January 28th, 1927

In the article in the February issue of the *Meteorological Magazine* on the "Weather of January, 1927," mention was made of some high wind velocities at certain stations in the British Isles during the exceptionally violent gale on January 28th, the most notable

gale experienced in the British Isles during the past winter, which caused the loss of several lives and did considerable damage. The gale, which was associated with a deep depression off the north-west coast of Ireland, affected the greater part of the British Isles but was most severely felt in the western districts. Records of high wind velocities from two other stations in exposed situations have since become available which exceed those already quoted. At Dunfanaghy, on the north coast of Donegal, the wind attained the force of a hurricane for a brief period during the afternoon of the 28th; several gusts exceeding 100 m.p.h. were recorded between 1 p.m. and 2 p.m., and in a gust at 1.40 p.m. the wind attained the remarkable velocity of 109 m.p.h., the highest velocity hitherto recorded in the British Isles with the exception of a gust of more than 110 m.p.h. recorded at Quilty (Clare), on January 27th, 1920, about which doubt exists.* The highest mean velocity for a period of 60 minutes at an exact hour was 74 m.p.h. and ranks next to the highest hourly velocity (measured at an exact hour) ever recorded at a Meteorological Office Anemograph Station, viz., 78 m.p.h. at Fleetwood, on December 22nd, 1894. At Tiree, off the west coast of Scotland, several gusts exceeding 90 m.p.h. occurred between 3 p.m. and 4 p.m. on the 28th, the highest recorded being 108 m.p.h. at 3.30 p.m. (direction, 240° from north). These high velocities were apparently associated with a local increase in the general wind current due to the development of secondary disturbances to the south-east of the main depression.

It should be mentioned that Dunfanaghy and Tiree are new stations, the anemometers having been in regular operation only since the commencement of 1927 and that they provide the first information based on anemograph records regarding the maximum velocities experienced in these districts which are known to be the stormiest in the British Isles. The possibility of even higher velocities than those mentioned having occurred in the north-western districts of the British Isles in some previous year cannot therefore be excluded.

P.I.M.

News in Brief

The University of Cambridge has awarded the Adams Prize for the period 1925-26 to Dr. Harold Jeffreys, F.R.S., for an essay on "The Constitution of the Interior of the Earth and the Propagation of Waves through the Interior and over the Surface of the Earth." The prize is awarded biennially for an essay on some branch of natural philosophy and is of the value of about £250.

* *Meteorological Magazine* 57 (1922) p. 102.

The Weather of March, 1927

The weather of March was on the whole changeable and mild with south-westerly winds prevailing in the southern districts. During the early part of the month conditions were very unsettled and depressions frequently passed over or near the British Isles. Gales were experienced on several parts of the coasts, notably along the English Channel and Irish Sea, and there was heavy rain at times, *e.g.*, 38 mm. (1·51 in.) fell at Delamere, Cheshire, on the 1st, 47 mm. (1·87 in.) at Penrhyn Quarries on the 4th, and 22 mm. (.87 in.) at Lympne on the 10th. Snow was reported from a few northern stations and hail and thunder locally, in particular thunderstorms occurred in many parts of southern England on the 10th. Subsequently an anticyclone passed across Ireland and Scotland to Scandinavia giving north-easterly to easterly winds over England and Ireland, and colder weather generally. On the 14th the temperature did not rise above 38° F. all day at Leafeld, or above 40° F. at several other stations. Slight snow fell at Harrogate. The lowest minimum temperatures of the month were also experienced at this period, 18° F. in the screen at Balmoral on the 13th, and 14° F. on the ground at Birr Castle and Rhayader on the 15th. Meanwhile, further depressions approaching from the Atlantic caused a renewal of rough rainy weather in the extreme west, while the withdrawal of the anticyclone southwards across Germany was associated with more southerly winds over Great Britain and higher temperatures. Maximum readings rose above 50° F. again on the 16th and reached or exceeded 60° F. in most parts on the 19th to 21st. On the latter date, 68° F. was recorded in London and Cambridge. On the 22nd cyclonic conditions spread from the west to the eastern counties and an unsettled type of weather prevailed until the end of the month with further high winds and gales at times, frequent rain, local thunderstorms, and hail, but some good sunshine records, *e.g.*, 11·7 hours at Tiree on the 27th, and 11·0 hours at Falmouth on the 29th. The rainfall measurements amounted to 54 mm. (2·11 in.) at Bettws Garmon, Carnarvon, on the 25th, and 52 mm. (2·05 in.) at Delphi, Mayo, on the 31st. Some of the roughest weather of the month occurred on the 31st, when a depression deepened considerably as it moved across southern Ireland to England. Strong gales were experienced in south-west England and a gust of 85 m.p.h. was reported from the Scilly Isles.

Pressure was below normal over western Europe, the greater part of the North Atlantic, Iceland and Spitsbergen, the greatest deficit being 10·2 mb. at Reykjavik, and above normal in the north of Scandinavia, and Russia, in south Europe and at the Azores and Bermuda. This distribution was associated with

generally south to southwesterly winds over western Europe. Temperature and rainfall were mainly above normal except in Scandinavia where the rainfall was below normal.

A third landslide occurred at Roquebillière on the night of March 1st, but little damage was done. About the 5th, heavy falls of snow were experienced in the southern part of central France, communications in several places being interrupted. Heavy snow again occurred near Lyons on the 13th, and there were serious floods on the Seine and in south-west and south France about that time. Owing to the hard winter packs of wolves have invaded villages in the mountainous districts of north and central Spain and caused considerable loss among the cattle. Warm sunny weather was enjoyed in Switzerland and north Italy from the 23rd to 28th, but in consequence numerous avalanches of snow occurred in the Swiss Alps.

A fall of hailstones (reported to be as large as oranges) did much damage to railway buildings and to stocks of unhusked rice at Wuntha (Burma) at the beginning of the month. On the 3rd a violent cyclone crossed Madagascar following a line from Tamatave to the north of Antananarivo. Two missionaries and 18 natives are reported to have been killed. Five ships were sunk at Tamatave and the material damage was great. Heavy rain amounting to 12 in. at Blantyre and 17 in. in the Zambesi Valley fell in three days during the week ending the 12th and caused extensive floods. The Zambesi rose 6 ft. very suddenly on the 9th, making a breach 200 ft. long in the railway between Chindio and Zuezue. During a thunderstorm at Pretoria on the 23rd lumps of ice two and three inches in diameter are reported to have fallen over the town for half an hour followed by a deluge of rain.

A severe gale did much damage to shipping in the neighbourhood of Cape Hatteras and off the Virginia coast on the 2nd, and a tornado swept over south-west Arkansas on the 17th, killing seven people. More than 20 lives were lost as the result of floods following on heavy rains in the province of Jujuy, Argentina.

The special message from Brazil states that the rainfall in the northern and central districts was irregular in distribution with averages 22 mm. and 5 mm. below normal respectively, and that in the southern districts the average was 44 mm. above normal. The weather was generally favourable to the crops, especially the cotton, coffee and sugar. Pressure changes were more frequent than in the previous month. Pressure at Rio de Janeiro was 0.5 mb. below normal and temperature 0.4° F. above normal.

Rainfall, March, 1927—General Distribution

England and Wales ..	136	} per cent. of the average 1881-1915.
Scotland	93	
Ireland	138	
British Isles	<u>126</u>	

Rainfall: March, 1927: England and Wales

CO.	STATION.	In.	mm.	Per- cent. of Av.	CO.	STATION.	In.	mm.	Per- cent. of Av.
<i>Lond.</i>	Camden Square	2.57	65	141	<i>War.</i>	Birmingham, Edgbaston	2.52	64	132
<i>Sur.</i>	Reigate, The Knowle . .	3.63	92	165	<i>Leics</i>	Thornton Reservoir . .	2.59	66	141
<i>Kent.</i>	Tenterden, Ashenden . .	3.80	97	178	"	Belvoir Castle	2.08	53	115
"	Folkestone, Boro. San.	2.94	75	...	<i>Rut.</i>	Ridlington	1.92	49	...
"	Margate, Cliftonville . .	1.73	44	109	<i>Linc.</i>	Boston, Skirbeck	1.92	49	123
"	Sevenoaks, Speldhurst . .	4.12	105	...	"	Lincoln, Sessions House	1.51	38	97
<i>Sus.</i>	Patching Farm	3.69	94	172	"	Skegness, Marine Gdns.	1.52	39	92
"	Brighton, Old Steyne . .	3.26	83	161	"	Louth, Westgate	1.81	46	85
"	Tottingworth Park	4.99	127	199	"	Brigg . . . . .	...	...	...
<i>Hants</i>	Ventnor, Roy. Nat. Hos.	3.17	81	155	<i>Notts.</i>	Worksop, Hodsock	2.03	52	120
"	Fordingbridge, Oaklands	4.35	110	187	<i>Derby</i>	Mickleover, Clyde Ho. . .	2.31	59	130
"	Ovington Rectory	4.18	106	161	"	Buxton, Devon. Hos. . .	5.25	133	127
"	Sherborne St. John	3.43	87	153	<i>Ches.</i>	Runcorn, Weston Pt. . . .	3.40	86	168
<i>Berks</i>	Wellington College	2.61	66	132	"	Nantwich, Dorfold Hall	3.10	79	...
"	Newbury, Greenham	3.66	93	161	<i>Lancs</i>	Manchester, Whit. Pk. . .	3.23	82	143
<i>Herts.</i>	Benington House . . . . .	...	...	...	"	Stonyhurst College	4.19	106	113
<i>Bucks</i>	High Wycombe	2.92	74	150	"	Southport, Hesketh Pk	3.52	89	158
<i>Oxf.</i>	Oxford, Mag. College . . .	2.33	59	152	"	Lancaster, Strathspey . .	3.58	91	...
<i>Nor.</i>	Pitsford, Sedgebrook . . .	2.31	59	131	<i>Yorks</i>	Wath-upon-Deerne	1.76	45	101
"	Oundle	1.57	40	...	"	Bradford, Lister Pk. . . .	3.13	80	129
<i>Beds.</i>	Woburn, Crawley Mill . . .	2.09	53	122	"	Oughtershaw Hall	7.88	200	...
<i>Cam.</i>	Cambridge, Bot. Gdns. . .	1.72	44	117	"	Wetherby, Ribston H. . . .	1.62	41	83
<i>Essex</i>	Chelmsford, County Lab	1.97	50	114	"	Hull, Pearson Park	1.27	32	70
"	Lexden, Hill House	1.85	47	...	"	Holme-on-Spalding	1.16	29	...
<i>Suff.</i>	Hawkedon Rectory	2.02	51	106	"	West Witton, Ivy Ho. . . .	2.84	72	...
"	Haughley House	1.84	47	...	"	Felixkirk, Mt. St. John	2.29	58	...
<i>Norfol.</i>	Beccles, Geldeston	1.80	46	105	"	Pickering, Hungate	1.42	36	...
"	Norwich, Eaton . . . . .	...	...	...	"	Scarborough . . . . .	.97	25	54
"	Blakeney	1.91	49	117	"	Middlesbrough	1.83	46	116
"	Swaffham . . . . .	...	...	...	"	Baldersdale, Hury Res. . .	2.66	68	...
<i>Wills.</i>	Devizes, Highclere	3.65	93	174	<i>Durh.</i>	Ushaw College	1.99	51	90
"	Bishops Canninga	3.07	78	137	<i>Nor.</i>	Newcastle, Town Moor . .	1.60	41	76
<i>Dor.</i>	Evershot, Melbury Ho. . . .	4.81	122	162	"	Bellingham, Highgreen	3.00	76	...
"	Creech Grange	3.76	96	...	"	Lilburn Tower Gdns. . . .	3.01	76	...
"	Shaftesbury, Abbey Ho. . . .	3.65	93	155	<i>Cumb</i>	Geltsdale	2.86	73	...
<i>Devon</i>	Plymouth, The Hoe	4.10	104	141	"	Carlisle, Scaleby Hall . .	2.87	73	117
"	Polapit Tamar	5.42	138	182	"	Seathwaite M. . . . .	...	...	...
"	Ashburton, Druid Ho.	6.71	170	151	<i>Glam.</i>	Cardiff, Ely P. Stn.	4.21	107	131
"	Cullompton	4.69	119	171	"	Treherbert, Tynywaun	8.76	223	...
"	Sidmouth, Sidmount	4.19	107	172	<i>Carm</i>	Carmarthen Friary	5.03	128	133
"	Filleigh, Castle Hill	5.34	136	...	"	Llanwrda, Dolaucothy . .	7.44	189	161
"	Barnstaple, N. Dev. Ath. . .	3.83	97	146	<i>Pemb</i>	Haverfordwest, School	4.11	104	121
<i>Corn.</i>	Redruth, Trewirgie	4.37	111	121	<i>Card.</i>	Gogerddan	4.94	125	143
"	Penzance, Morrab Gdn. . . .	3.97	101	124	"	Cardigan, County Sch. . .	3.50	80	...
"	St. Austell, Trevarna	4.66	118	136	<i>Brec.</i>	Crickhowell, Talymaes	5.40	137	...
<i>Soms</i>	Chewton Mendip	5.03	128	141	<i>Rad.</i>	Birm. W. W. Tyrmynydd	7.22	183	135
"	Street, Hind Hayes	3.55	90	...	<i>Mont.</i>	Lake Vyrnwy	5.37	136	126
<i>Glos.</i>	Clifton College	2.95	75	117	<i>Denb.</i>	Llangynhafal	3.91	99	...
"	Cirencester, Gwynfa	3.14	80	136	<i>Mer.</i>	Dolgelly, Bryntirion . .	6.11	155	124
<i>Here.</i>	Ross, Birchlea	2.82	72	139	<i>Carn.</i>	Llandudno	3.61	92	167
"	Ledbury, Underdown	2.20	56	116	"	Snowdon, L. Llydaw 9	18.17	462	...
<i>Salop</i>	Church Stretton	3.32	84	141	<i>Ang.</i>	Holyhead, Salt Island . .	4.17	106	159
"	Shifnal, Hatton Grange	2.32	59	126	"	Lligwy	3.64	92	...
<i>Staff.</i>	Tean, The Heath Ho. . . . .	...	...	...	<i>Isle of Man</i>				
<i>Worc.</i>	Ombersley, Holt Lock	2.29	58	135		Douglas, Boro' Cem. . . .	...	...	...
"	Blockley, Upton Wold	3.05	77	142	<i>Guernsey</i>				
<i>War.</i>	Farnborough	2.93	74	138		St. Peter P't. Grange Rd	4.07	103	165

Rainfall: March, 1927: Scotland and Ireland

CO.	STATION	In.	mm.	Per- cent. of Av.	CO.	STATION.	In.	mm.	Per- cent. of Av.
<i>Wigt.</i>	Stoneykirk, Ardwell Ho	...	..	...	<i>Suth.</i>	Loch More, Achfary...	5.36	136	83
"	Pt. William, Monreith.	4.09	104	...	<i>Caith.</i>	Wick	1.61	41	71
<i>Kirk.</i>	Carsphairn, Shiel.	8.00	203	...	<i>Ork.</i>	Pomona, Deerness	2.24	57	80
"	Dumfries, Cargen	4.08	104	113	<i>Shet.</i>	Lerwick	3.97	101	126
<i>Roxb.</i>	Bransholme	1.94	49	67					
<i>Selk.</i>	Ettrick Manse	4.58	116	...	<i>Cork.</i>	Caheragh Rectory	6.78	172	...
<i>Berk.</i>	Marchmont House	2.67	68	101	"	Dunmanway Rectory.	6.76	172	138
<i>Hadd.</i>	North Berwick Res.	1.74	44	93	"	Ballinacurra	4.27	108	151
<i>Midl.</i>	Edinburgh, Roy. Obs. .	1.59	41	89	"	Glanmire, Lota Lo. ...	5.42	138	175
<i>Lan.</i>	Biggar .....	...	...	...	<i>Kerry</i>	Valentia Obsy. ....	...	...	...
"	Leadhills	5.59	142	...	"	Killarney Asylum .....	...	...	...
<i>Ayr.</i>	Kilmarnock, Agric. C. .	2.46	63	88	"	Darrynane Abbey	6.13	156	150
"	Girvan, Pinmore	6.09	155	161	<i>Wat.</i>	Waterford, Brook Lo. .	4.46	113	163
<i>Renf.</i>	Glasgow, Queen's Pk. .	2.64	67	101	<i>Tip.</i>	Nenagh, Cas. Lough . .	4.33	110	140
"	Greenock, Prospect H. .	4.76	121	97	"	Roscrea, Timoney Park	4.27	108	...
<i>Bute.</i>	Rothsay, Ardenraig . .	5.05	128	141	"	Cashel, Ballinamona . .	4.80	122	175
"	Dougarie Lodge	4.28	109	...	<i>Lim.</i>	Foynes, Coolmanes . . .	3.88	99	132
<i>Arg.</i>	Ardgour House	6.96	177	...	"	Castleconnell Rec.	3.78	96	...
"	Manse of Glenorchy . .	5.44	138	...	<i>Clare</i>	Inagh, Mount Callan . .	6.15	156	...
"	Oban	3.86	98	...	"	Broadford, Hurdleat'n .	4.02	102	...
"	Poltalloch	4.29	109	112	<i>Wexf.</i>	Newtownbarry	6.37	162	...
"	Inveraray Castle	7.00	178	110	"	Gorey, Courtown Ho. . .	5.13	130	222
"	Islay, Ballabus	3.64	92	95	<i>Kilk.</i>	Kilkenny Castle .....	...	...	...
"	Mull, Benmore	9.00	229	...	<i>Wic.</i>	Rathnew, Clonmannon .	3.46	88	...
<i>Kinr.</i>	Loch Leven Sluice	2.81	71	94	<i>Carl.</i>	Hacketstown Rectory .	5.69	145	203
<i>Perth</i>	Loch Dhu	7.05	179	107	<i>QCo.</i>	Blandsfort House	3.73	95	142
"	Balquhiddy, Stronvar. .	6.24	158	...	"	Mountmellick	5.07	129	...
"	Crieff, Strathearn Hyd. .	3.99	101	125	<i>KCo.</i>	Birr Castle	3.44	87	143
"	Blair Castle Gardens . .	2.62	67	100	<i>Dubl.</i>	Dublin, FitzWm. Sq. . .	3.08	78	159
"	Coupar Angus School. .	...	...	...	"	Balbriggan, Ardgillan .	3.27	83	163
<i>Forf.</i>	Dundee, E. Necropolis .	2.41	61	117	<i>Me'th</i>	Beauparc, St. Cloud . .	3.85	98	...
"	Pearsie House	3.85	98	...	"	Kells, Headfort	3.82	97	139
"	Montrose, Sunnyside . .	...	...	...	<i>W.M.</i>	Moate, Coolatore .....	...	...	...
<i>Aber.</i>	Braemar, Bank	2.10	53	71	"	Mullingar, Belvedere .	3.48	88	129
"	Logie Coldstone Sch. . .	1.91	49	73	<i>Long</i>	Castle Forbes Gdns. . .	4.05	103	137
"	Aberdeen, King's Coll. .	2.04	52	85	<i>Gal.</i>	Ballynahinch Castle . .	8.33	212	163
"	Fyvie Castle	2.71	69	...	"	Galway, Grammar Sch. .	3.91	99	...
<i>Mor.</i>	Gordon Castle	2.13	54	92	<i>Mayo</i>	Mallaranny	7.23	184	...
"	Grantown-on-Spey	1.87	47	71	"	Westport House	5.21	132	134
<i>Na.</i>	Nairn, Delnies	1.63	41	87	"	Delphi Lodge	12.49	317	...
<i>Inv.</i>	Ben Alder Lodge	2.83	72	...	<i>Sligo</i>	Markree Obsy. ....	...	...	...
"	Kingussie, The Birches .	1.32	34	...	<i>Cav'n</i>	Belturbet, Cloverhill. .	3.27	83	118
"	Loch Quoich, Loan	10.00	254	...	<i>Ferm</i>	Enniskillen, Portora . .	4.24	108	...
"	Glenquoich	7.84	199	81	<i>Arm.</i>	Armagh Obsy.	2.33	59	99
"	Inverness, Culduthel R. .	1.59	40	...	<i>Down</i>	Fofanny Reservoir . . .	7.56	192	...
"	Arisaig, Faire-na-Squir .	3.51	89	...	"	Seaforde	3.29	84	113
"	Fort William	4.86	123	71	"	Donaghadee, C. Stn. . .	3.21	81	146
"	Skye, Dunvegan	4.82	122	...	"	Banbridge, Milltown . .	2.51	64	115
"	Barra, Castlebay	2.60	66	...	<i>Antr.</i>	Belfast, Cavehill Rd. .	2.80	71	...
<i>R&C</i>	Alness, Ardross Cas. . .	1.88	48	58	"	Glenarm Castle	3.03	77	...
"	Ullapool	3.65	93	...	"	Ballymena, Harryville	2.97	75	94
"	Torridon, Bendamph. . .	6.76	172	90	<i>Lon.</i>	Londonderry, Creggan .	3.48	88	109
"	Achnashellach	6.96	177	...	<i>Tyr.</i>	Donaghmore	3.07	78	...
"	Stornoway	2.82	72	69	"	Omagh, Edenfel	3.53	90	112
<i>Suth.</i>	Lairg	2.30	58	...	<i>Don.</i>	Malin Head	2.06	52	89
"	Tongue Manse	2.15	55	64	"	Dunfanaghy	3.03	77	83
"	Melvich School	1.91	49	67	"	Killybegs, Rockmount. .	4.77	121	94

Climatological Table for the British Empire, October, 1926

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am't	PRECIPITATION		BRIGHT SUNSHINE			
	Mean of Day M.S.L. Normal	Diff. from Normal	Absolute		Mean Values				Mean			Am't	Diff. from Normal	Days	Hours per day	Percentage of possible	
			Max.	Min.	Max.	Min.	max. and min.	Diff. from Normal									Wet Bulb.
London, Kew Obsy.	1012.9	-1.1	69	28	54.5	41.4	47.9	-2.0	42.9	89	6.9	52	-17	16	2.8	26	
Gibraltar	1013.6	-3.6	80	53	74.0	65.3	69.7	+3.6	63.8	81	7.0	188	+104	11	...	...
Malta	1018.1	+1.5	83	60	77.1	67.9	72.5	+1.6	68.1	83	2.8	5	-68	2	9.3	82	
St. Helena	1014.1	+1.9	76	52	61.1	53.8	57.5	-1.3	54.5	91	3.8	23	-26	7	...	...
Sierra Leone	1011.3	-0.3	91	69	87.3	72.5	79.9	-0.2	75.6	81	5.5	210	-111	24	...	...
Lagos, Nigeria	1009.2	-2.5	88	70	85.9	75.2	80.5	+1.0	77.0	83	7.5	96	-101	11	...	...
Kaduna, Nigeria	1013.7	+1.4	93	...	89.1	...	...	...	70.7	61	2.0	70	+15	3	...	...
Zomba, Nyasaland	1018.6	+1.6	95	50	86.3	62.7	74.5	+0.4	...	59	2.2	20	+18	1	...	...
Salisbury, Rhodesia	1009.3	-1.5	92	46	86.3	57.4	71.9	+1.2	58.8	37	2.0	4	-25	2	9.1	73	
Cape Town	1015.7	-1.7	83	43	69.3	51.1	60.2	-1.0	55.2	76	5.3	68	+26	12	...	...
Johannesburg	1013.2	-0.4	87	39	76.6	51.4	64.0	+1.3	52.0	48	2.1	38	-27	5	9.6	76	
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	92	36	79.3	50.1	64.7	+0.1	53.8	46	3.6	47	+	4	...	...
Calcutta, Alipore Obsy.	1007.8	-1.6	91	66	87.9	74.6	81.3	+0.6	74.8	83	4.5	102	+	4	7*	...	
Bombay	1008.7	-1.1	93	73	87.6	77.2	82.4	+0.1	76.1	83	4.9	33	-9	2*	...	...
Madras	1007.9	-1.0	99	68	91.3	73.8	82.5	+0.2	76.5	79	6.1	187	-111	9*	...	...
Colombo, Ceylon	1008.9	-1.4	88	72	86.5	76.0	81.3	+1.0	77.9	76	7.2	315	-17	21	6.5	54	
Hongkong	1012.9	-0.7	87	63	79.0	70.9	74.9	-2.0	68.9	72	6.5	83	-40	10	5.7	49	
Sandakan	...	...	91	73	87.6	75.0	81.3	-0.2	76.8	85	...	458	+204	18	...	...
Sydney	1009.1	-5.8	97	46	76.5	55.4	65.9	+2.4	58.8	49	3.8	9	-73	8	8.9	70	
Melbourne	1008.0	-6.7	83	39	68.7	50.0	59.3	+1.7	53.4	60	7.0	47	-19	16	6.1	48	
Adelaide	1010.8	-5.2	90	43	72.7	50.9	61.8	-0.1	54.4	52	7.1	59	+15	11	7.9	61	
Perth, W. Australia	1014.0	-2.8	87	48	69.1	54.2	61.7	+0.7	56.9	62	6.5	93	+39	19	6.5	51	
Coolgardie	1011.8	-3.4	98	43	80.6	52.2	66.4	+2.8	52.9	29	2.1	7	-12	3	...	...
Brisbane	1012.5	-3.7	97	50	82.0	60.3	71.1	+1.3	62.9	54	3.0	22	-43	6	9.6	77	
Hobart, Tasmania	1001.8	-8.8	80	38	62.6	47.7	55.1	+1.1	49.5	65	7.7	137	+80	25	5.6	42	
Wellington, N.Z.	1009.2	-3.9	69	36	60.6	49.5	55.1	+0.8	52.3	77	8.0	171	+67	20	4.3	33	
Suva, Fiji	1012.7	-0.5	90	67	83.3	70.9	77.1	+1.1	72.4	74	7.2	82	+116	15	5.9	47	
Apia, Samoa	1011.2	-0.3	88	66	85.5	72.5	79.0	+0.6	75.3	72	5.0	174	+20	8	8.4	68	
Kingston, Jamaica	1010.7	-0.8	90	70	87.0	72.9	79.9	-0.6	72.1	89	5.7	67	-123	8	7.0	59	
Grenada, W.I.	1011.2	+0.6	89	72	84.8	75.2	80.0	-0.1	77.5	85	6.3	245	+51	25	...	...
Toronto	1013.2	-4.8	79	30	54.3	40.1	47.2	+0.3	42.6	85	6.4	81	+19	18	3.8	34	
Winnipeg	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
St. John, N.B.	1011.5	-5.0	64	29	53.3	41.0	47.1	+1.8	43.3	77	6.0	239	+124	12	4.2	38	
Victoria, B.C.	1016.1	-1.5	66	42	58.0	47.5	52.7	+2.3	49.7	85	7.1	74	+	14	4.4	40	

*For Indian stations a rain day is a day on which 0.1 in. (2.5 mm.) or more rain has fallen.

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The Meteorology of Solar Eclipses

By E. W. BARLOW, B.Sc.

A most important astronomical event, so far as our country is concerned, will occur on June 29th next, when a total eclipse of the sun will be visible over limited areas in northern England and north Wales. A total eclipse is an event of great rarity in any circumscribed region, although, if the earth be taken as a whole, there are normally about ten such eclipses in every eighteen years. The last total eclipse visible within the British Isles took place on May 22nd, 1724; the next, after that of the present year, will be on August 11th, 1999. The interval between successive occurrences in any definite place is variable, but averages 360 years.

The purpose of this article is to give a very brief outline of the effects of solar eclipses on meteorological conditions. There is quite an extensive literature on the subject, and it has been found necessary to exclude the influence of the eclipse shadow upon atmospheric electricity and terrestrial magnetism. Eclipse meteorology is unique; the conditions which are superimposed upon the momentary atmospheric state cannot be produced by any other event or combination of events. The conical shadow thrown by the moon, from which all direct solar radiation is cut off, surrounded by the penumbral shadow, traverses the atmosphere with a velocity depending on the circumstances of

the eclipse and the latitude of the place of observation ; it usually lies between 1,100 and 6,000 miles per hour, but is greater in extreme cases. The broader meteorological effects, such as the fall of temperature, are obvious, but a detailed study of observations made at past eclipses reveals many interesting facts and some inconsistencies.

On June 29th the sun will rise totally eclipsed at a point in the Atlantic Ocean southwest of Ireland. The belt of totality first touches land at Bardsey Island, and its central line passes over Criccieth, nearly over Snowdon and Colwyn Bay, over Southport, thence crossing northern England to Hartlepool. The width of the belt is about 28 miles in north Wales and 31 miles at Hartlepool. The shadow subsequently crosses the North Sea and enters Norway. The speed of the shadow is 5,400 miles per hour, and the time at which totality occurs is about 5h. 24m. G.M.T. The maximum possible duration of totality is less than 6 minutes for the latitudes of the British Isles and nearly 8 minutes at the equator, but such durations are of the most extreme rarity. The duration this year is only 22 seconds in Wales, and 24 seconds on the east coast. For stations not in the centre of the belt the duration is decreased. The partial phase extends from about 4h. 30m. to 6h. 20m. G.M.T., and the sun's altitude at totality is approximately 10° at the western and 13° at the eastern end of the belt. In London 96 per cent of the sun's disc will be covered.

The influence which the eclipse exercises on solar radiation received depends on a number of factors, but broadly speaking the radiation at any time is proportional to the extent of the unobscured sun. During totality the radiation is negative, i.e., the outgoing radiation from the earth is of measurable amount, having on some occasions exceeded 0.1 gram-calorie per square centimetre per minute. The diffuse sky radiation during totality was estimated on June 8th, 1918, to be of the order of 0.0001 gram-calorie. Light diminution is very gradual in the early partial phases, and very rapid just before totality. During the total phase light is received from two sources, the solar appendages, chiefly the corona, and the partially illuminated atmosphere lying at the moment just outside the umbral shadow. Of these the former is by far the largest contributor, but the illumination from both causes varies with the circumstances of individual eclipses. During a short totality it is in general greater, and on June 29th may be expected to be three or even four times that of the full moon.

The fall of temperature is one of the most clearly defined phenomena, but is influenced by many factors. A table compiled by H. H. Clayton of 12 total eclipses from 1878 to 1905,

after correction for diurnal variation, shows maximum falls varying from 1.5° F. to 8.1° F. The amount of fall varies with the character of the station, being for the eclipses cited 1.5° F. over the open ocean, 3.2° F. on a small tropical island, and 5.5° to 8.1° F. over large land areas. Over land areas the fall shows a latitude effect with a minimum in high latitudes and a maximum at the equator. The recovery of normal values appears to take place simultaneously with the end of the eclipse, in the upper air, over the ocean and on small islands, but is delayed from 1 to $2\frac{1}{2}$ hours after the end of the eclipse in continental situations. The temperature normally begins to fall 20 minutes after first contact, and the minimum occurs from 2 to 20 minutes after totality. Kite meteorograph observations from the "Otaria" in 1905 gave a fall of only 1° F. at 300m. above the Atlantic Ocean. Temperature variation is therefore probably confined to a very shallow layer not exceeding 300m. or 400m. above the earth's surface. At hill stations the fall is usually less than at low level stations, but comparisons are not always consistent.

Changes of vapour pressure are more difficult to distinguish, but there appears to be an increase of vapour pressure up to a time 30 to 50 minutes preceding totality, a minimum pressure at totality, and a second maximum about 30 minutes afterwards. This is characteristic only of stations in or near the total belt, but applies both on the ground and at 300m. The decrease is as large over the ocean as over large land areas. Relative humidity is acted on by opposing factors, the decrease in vapour pressure and the decrease in temperature. Over land areas the relative humidity usually rises to a maximum at the time of minimum temperature through preponderance of the second factor. Dew is often formed on the ground near the time of mid-eclipse. Cloud changes which appear to be definitely associated with the eclipse and also the formation of fog have been noted.

The variation of atmospheric pressure is not conspicuous with ordinary instruments, but observations with these and with microbarographs have produced considerable but not conclusive evidence to show that the eclipse curve has two minima and three chief maxima, the latter occurring at totality and about 75 minutes before and after it. The fluctuation is of the order of 0.2mb.

A diminution in wind velocity is a feature almost as marked as the temperature fall. The minimum usually agrees closely with the time of minimum temperature. There are also strong evidences of maxima represented by gusts of increased velocity occurring 30 to 50 minutes before and 40 to 60 minutes after

totality. The production of winds with definite cyclonic circulation has been observed on some occasions but not on others. The resultant eclipse wind, however, frequently shows a definite succession of changes, with a reversal of direction before and after totality ; it can never be large as the temperature gradient produced by the shadow is comparatively small.

The optical phenomena are of considerable interest ; the colours of sky, clouds and landscape are usually very striking and subject to rapid changes about the time of totality. While the sun is completely obscured the light is of very peculiar quality, and appears to justify adjectives such as "livid" and "unnatural," by which it is usually described. Vitiating of distance estimates is a noticeable feature at this time. The approaching umbral shadow is indigo or blackish, and may be seen, from an elevated position, to pass points at known distances. As it reaches the observer definite pulsations, probably diffraction phenomena, may be observed. The best known of eclipse optical phenomena are the "shadow-bands" These are observed about 5 minutes before totality, and therefore definitely before the umbral shadow has reached the observer, and again after it has left him. The shadow-bands thus have no connexion with the pulsation of the shadow edge. The phenomenon consists of undulating dark bands, separated by light spaces, following one another in a direction usually normal to the tangent to the crests. The bands are visible on the ground, but are best seen if a sheet is laid down, or on snow, or on the walls of white houses. The bands appear to flicker and, while sometimes of considerable regularity, are often very vague and confused. Their speed is also inconstant, varying from about 3 to 25 m.p.h., and, therefore, very much slower than the speed of the moon's shadow. This is one of several facts which have disproved the theory that the bands are diffraction fringes bordering the moon's shadow. The bands were photographed for the first time in 1925 in the United States, and they have been observed up to a height of 3,800m. on sheets hung below manned balloons. The general inference is that they are caused by the diminishing crescent of light penetrating air strata differing in their thermal and hygrometrical conditions, and, therefore, in their refractive power. Other optical phenomena have been observed, and possibly some remain to be discovered.

There are four points which should be noted by intending observers. (1) An open site, free from interference by people, should be selected. (2) It is advisable to secure the services of a friend, as the time is too short to see and do everything oneself. (3) A programme should be planned and adequately rehearsed beforehand. (4) The sun should not be looked at without coloured or smoked glass until totality has actually begun.

For the total phase field glasses without any protection will enhance the spectacle.

In conclusion, may I emphasise the fact that the opportunity afforded next June of seeing a total solar eclipse is literally that of a lifetime. Even if a journey abroad be possible, there will be no such favourable European eclipse as the Spanish one of 1905 for many years to come. Quite apart from the interest of possible meteorological work, the occasion is one of extraordinary beauty, and many people are of opinion that it constitutes the most sublime and awe-inspiring phenomenon that Nature has to offer. The chief of the great solar appendages revealed by a total eclipse is the brilliant greenish or pearly-white corona, which has never been seen or photographed at any other time, and the structure of which varies with the 11-year solar cycle. The scarlet hydrogen prominences are also likely to be well seen in the present state of solar activity. The impressiveness of an eclipse is, however, by no means confined to its astronomical features. The onrush of the great shadow, the fall of temperature, the vivid sky colouration, the effect on birds, animals and flowers, and the strange all-pervading stillness—each of these contributes to form an experience which is both unique and unforgettable. The first ray of returning sunlight strikes the earth like a flash of lightning, and life is re-established. In the words of Professor H. H. Turner, "We have seen a vision and are awake again."

Rainfall Atlas of the British Isles*

By J. FAIRGRIEVE, M.A.

This long-expected atlas has at last appeared. There is probably no subject in which co-operation is so necessary in order that results of even moderate value should be obtained as meteorology, and there is probably no section of meteorology in which co-operation is so vital as is the study of rainfall. If we add that there is no country where that co-operation has been so ungrudgingly given as Great Britain and that this atlas embodies the results of this co-operative work we have the reason for the high value that must be placed on it. It is a summary of the labours of some 10,000 persons in carefully recording observations day by day, and it has a most illuminating introduction by Dr. Mill, a fitting tribute to the carrying out of the work by the man to whom the work owes most. This introduction by the greatest authority on British rainfall is a model of exposition of a most difficult subject.

* See advertisement p. vi.

The complicated circumstances under which the atlas has been issued are all clearly explained in the introduction. Here it is enough to say that the Royal Meteorological Society undertook the preparation of this atlas as the first contribution of the endowment fund to rainfall research, this fund coming to it from the British Rainfall Organization when the latter, with its records, was taken over by the Meteorological Office. The atlas was planned by a committee of the Society and executed under the direction of the late M. de Carle Salter by Dr. John Glasspoole.

In effect the atlas consists of three parts: (1) Three full page maps, on the scale of 60 miles to an inch, showing the rainfall distribution in the average year based on the thirty-five year period, 1881-1915, in the very wet year 1872, and in the very dry year 1887; (2) A series of fifty-six half-page maps showing for each year from 1868 to 1923 the distribution of rainfall expressed as a percentage of the average; (3) Twelve full-page maps showing the distribution of average rainfall for each month of the year for the period 1881-1915. Sections (1) and (3) are really the work of Dr. Mill and Mr. Salter, while the preparation of the maps in section (2) was carried out by Dr. Glasspoole.

The average rainfall map is the pivot on which all the others turn. As has been said it is the average for the thirty-five years 1881-1915, but this is merely the period to which all observations have been reduced. Practically every available piece of evidence has been included in the construction of what is surely the most accurate rainfall map in existence, though on a larger scale parts at least could have been shown more accurately still. About half of the area has been mapped at one time or another by Dr. Mill and Mr. Salter on a scale of two miles to an inch. As one who was privileged to see the methods by which this work was carried on, the reviewer would like to bear testimony to its extraordinary brilliancy and accuracy. A short but extremely interesting paper by Mr. Salter on "the preparation of a rainfall map of the British Isles," published by the Institute of Water Engineers, gives a little insight into the care which was taken and indicates also something of the brilliant intuition which was lost to rainfall research with Mr. Salter's death. Naturally, these large scale maps were utilised in the construction of the average map here produced.

The maps of the wettest and driest years are reproduced as samples of the yearly maps which have been constructed every year since 1868 by the British Rainfall Organization, and as giving an indication of the extremes to which the British Isles are subject, but it is pointed out that 1872 was the wettest year over only half of the area and 1887 the driest year over only two-fifths of the area.

The full-page maps of average rainfall for the months on the scale of 60 miles to an inch "constitute," as Dr. Mill says, "perhaps the most interesting as well as the most beautiful feature of the atlas. They present for the first time a satisfactory picture of the progress of rainfall from month to month in a normal year." It may be doubted, perhaps, whether "normal" is quite the right word. The average annual map is normal in the sense that it cannot differ appreciably from that constructed from observations taken day by day through any other consecutive thirty-five years in the last, or next, few centuries, but it is not so certain that the average rainfall for the months would remain the same; the average map for September is the average for 1881-1915, but probably not for another thirty-five year period. The maps are not only new but they have been constructed on a new principle; isomeric maps for the months were made, and the monthly maps were produced by a very ingenious combination of each isomeric map in turn with the average annual map. The result is that now for the first time accurate monthly maps of rainfall in Britain are available for reference on a scale never before attempted. One cannot easily compare them as one can the smaller maps on one page in the Atlas of Meteorology, and of course the varying lengths of the months make accurate comparison impossible, but these maps state the facts simply, and one cannot have everything.

The second section of fifty-six half-page maps is historical and gives the first accurate presentation of the fluctuation of rainfall over our island for a long period. Like the monthly maps these are based on the average annual map and each shows the variation from the average of the rainfall for a particular year. The jazziness of these comes rather as a shock after the solidity and respectability of the annual and monthly maps. The latter are excellent pieces of work from the cartographic point of view. While retaining the convention that blue stands for water another principle is acted on which is scarcely yet recognised as such, i.e., that in many maps the practical point of departure for measurement is not zero. It is recognised in orographical maps by the use of green and brown to stand for low and high respectively, where the psychological standpoint is somewhere between the two. Here the principle is recognised by giving a touch of purple to the blue shades which represent rainfall above 40 in., or 1,000 mm., on the annual map, and 4 in., or 100 mm., on the monthly maps. The effect is entirely good, strong and simple. The series of annual maps also very naturally recognises the average as the point of departure and uses blue for above and yellow for below the average, but this does not give sufficient range, and the jazz effect is enhanced by using red for departures much below the average and green for departures much above.

Though not unpleasing the effect is startling and distracts attention from the story which the maps tell except in one important point, i.e., that the jazziness when translated into terms of rainfall emphasises the remarkable fact that in such a small area as Great Britain the rainfall has never in 56 years had the same percentage variation all over the country. There are never fewer than five tints of colour, each indicating a 10 per cent variation, and seven or more occur in 60 per cent of the maps. There are two maps which require ten grades and these are almost the inverse of each other, 1880 when the north-west was dry and the southeast wet, and 1921 when the southeast was dry and the northwest wet. But jazz or no jazz these maps are fascinating. There is a curious run of maps with many tints from 1870 till 1883, and another from 1916 onwards; one speculates, too, on the differences which would have been made if the year had run from July to June.

It seems greedy when so much is given to ask for more but it may be suggested that the complement of the historical series of annual maps would be the isomeric series of monthly maps; no doubt they are to be found in the files of the Journal, but there they are rather buried, and in a future edition of the Rainfall Atlas of the British Isles they should certainly find a place even if they are reproduced four on a page. But this is for the future. At present we are delighted with what we have and we do not know which we admire most, the accuracy of the annual map, the cleverness and freshness of the monthly maps, or the march of these delightfully jazzy historical maps. They are all good.

Official Publications

GEOPHYSICAL MEMOIRS—

No. 32. *Hourly Character Figures of Magnetic Disturbance at Kew Observatory, Richmond, 1913-23.* By J. M. Stagg, M.A., B.Sc. (M.O. 286b).

Magnetic character figures (0, 1 and 2) have been assigned to every hour of the eleven years 1913-23, and the figures have been tabulated to show the daily distribution of total and component characters (1's and 2's) in the different months and seasons and for the year. From the hourly figures mean monthly character figures have also been derived, and their annual variation examined. The influence of the sunspot cycle on the diurnal and annual variations of the magnetic characters is investigated.

From the monthly character figures mean annual figures have been derived, which are compared with those derived from the whole-day characters at Kew and Fskdalemuir Observatories,

as well as with those published by the authorities at de Bilt as being internationally representative. The similarity between the last mentioned and the annual means of the Kew hourly characters is very pronounced.

No. 34. *The effect of fluctuations of the Gulf Stream on the distribution of pressure over the eastern North Atlantic and western Europe.* By C. E. P. Brooks, D.Sc. (M.O. 286d).

Tradition ascribes the favourable climate of western Europe to the waters of the Gulf Stream ; that being granted, we may reasonably suppose that fluctuations in the strength of the Gulf Stream play some part in the variations of European weather from year to year and from season to season. This effect is investigated in detail, and is found to be real and appreciable, but complex.

The origin of the Gulf Stream is the warm surface water driven into the Equatorial Current by the north-east and south-east trade winds ; passing through the West Indies or round the Gulf of Mexico, this warm water travels along the American coast to Newfoundland, whence it is driven eastwards by the prevailing westerly winds. From the eastern tropical Atlantic to the west coast of Europe the journey takes a year or fifteen months, and strong trade winds are reflected after this interval in the surface temperatures of the North Atlantic west of Ireland. The effects of the north-east trade differ from those of the south-east trade however, in a way which may be clear by an example. If the north-east trade is unusually strong in January to March of one year, the surface temperature west of Ireland will be high in January to March of the following year, but this effect is transitory, and is succeeded by a rapid fall, so that from April to December the temperature will be below normal. On the other hand, suppose the south-east trade to be above normal from January to March of one year. No effect will be noticed until April of the following year, when the surface temperature will rise, and will remain above normal until December. These differences are due to the shape of the Atlantic, and particularly to the great bulge of West Africa.

It was found that when the North Atlantic is warm, pressure tends to be low near Iceland and Greenland but high over the Azores and western Europe. The relations between the strength of the trade winds and the subsequent pressure over western Europe and the eastern Atlantic were then examined directly, and it was found that a period of strong north-east trade winds tends to be followed twelve months later by high pressure over the Azores and western Europe and by low pressure over Iceland, a combination favourable to westerly winds and mild rather fine weather over Britain. This lasts only for three months, and for the next nine months the opposite effect holds—a tendency for

low pressure and rainy weather over the British Isles. A period of strong south-east trade winds tends to be followed fifteen months later by high pressure over the Azores and western Europe and low pressure over Iceland, and this fine-weather tendency lasts for nine months. The opposite conditions—periods of weak trade winds, have the reverse effects.

The Gulf Stream is modified by conditions in other parts of the Atlantic—in the Gulf of Mexico, the neighbourhood of Bermuda, the Newfoundland Banks, and the mid-Atlantic between Iceland and the Azores, but these modifications are less important than the original impulses due to the trade winds, which are thus shown to be numbered among the makers of British weather.

PROFESSIONAL NOTES—

No. 46. *A Note on Bumpiness at Cranwell, Lincolnshire, during the period 1st December, 1925, to 30th April, 1926.*
By W. H. Pick, B.Sc., and G. A. Bull, B.Sc. (M.O. 273f).

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, April 20th, at 49, Cromwell Road, South Kensington, Sir Gilbert Walker, C.S.I., F.R.S., President, in the chair. A Report of the Committee on Atmospheric and Weather, entitled "The Range of Atmospheric," was introduced by Mr. R. A. Watson Watt, convener of the Committee. The report deals with the distances over which an atmospheric may produce disturbance of broadcast reception. The Committee organised experiments in which observers in the British Isles, Norway, Germany, France, Spain, Morocco and Madeira, recorded disturbance of broadcast talks, while the sources of the atmospheric were identified by wireless position-finding by the organisation set up by the Department of Scientific and Industrial Research on the advice of its Radio Research Board.

Many of the sources were found to lie in regions of meteorological disturbance, and a subsequent report on these meteorological relations is promised. Meanwhile examples are cited of cases in which atmospheric from beyond the Azores disturbed the reception of Daventry's signals in Paris and of London's signals in Aberdeen, and of the disturbance of reception in Spain, France, Madeira, the British Isles and Norway by atmospheric from a thunderstorm at Rome.

The Committee concludes that very many atmospheric are heard at distances exceeding 1,800 miles from their sources, and that the distances may reach at least 4,500 miles.

They find no evidence of the presence of many atmospheric with a short range of disturbing effect.

The presentation of the report was followed by a discussion of great interest, in which the principal speakers were :—Mr. O. F. Brown, Capt. Brunt, Dr. Chree, Mr. D. L. Eckersley, Mr. J. F. Herd, Sir Henry Jackson, Col. Leigh, Sir N. Shaw, Dr. Simpson, Capt. Slee, R.N., and Capt. A. D. G. West.

A special meeting of the Society was held on Thursday, April 28th, when the Rt. Hon. Sir Samuel Hoare, Bart., C.M.G., M.P., the Secretary of State for Air, gave an account of his recent flight to India to a large and appreciative audience.

Correspondence

To the Editor, *The Meteorological Magazine*

Explosion at Butaritari.

The following letter from the Acting District Officer at Butaritari has been received by the courtesy of the Secretary of State for the Colonies.

"I have the honour to inform you that on Friday October 8th, 1926 at about 10.55 a.m. a large explosion followed by vibrating rumbles was heard to the northwest of the Government Station, Butaritari. At the time the sky was clear and the wind slight from the south. It was certainly not thunder and no lightning was seen or reported.

During Friday reports came in from Kuma, Keusa, Tainimaika and Ukiana and on Saturday from Pikati and Makin, of having heard the same explosion and from the same direction.

The cause of this loud explosion aroused great speculation amongst the Europeans and natives and personally I attribute it to a falling meteorite. No peculiar atmospheric disturbances have been witnessed since then.

PHILIP C. SPAIN."

Gilbert and Ellice Islands Colony, Butaritari. October 9th, 1926.

Mammato-Cumulus Cloud at Cranwell, Lincolnshire

The occurrence of mammato-cumulus cloud at Cranwell, Lincs., during the period stretching from January 1st, 1920, to October 12th, 1926, has been analysed, and in view of the rarity of the cloud in question, it is thought that the results of that analysis may not be without interest.

In the period considered there were 35 days upon which the cloud form in question occurred. Taking winter to include the months December to February; spring, March to May; summer,

June to August; and autumn, September to November, the seasonal distribution is shown in the following table:—

Season.	Number of days examined.	Number of days M-cu occurred.	Percentage.
Winter	601	3	0.5
Spring	644	12	1.9
Summer	644	18	2.8
Autumn	588	2	0.3

The table reveals that summer and spring in the order named are the seasons most marked by the occurrence of mammato-cumulus, and that autumn and winter seldom have the cloud.

Of the 35 days upon which mammato-cumulus was observed precipitation occurred at Cranwell on 27, but on only 14 of these days did precipitation occur at the actual time of observation of the cloud. On one of the 14 precipitation days hail occurred, accompanying the cloud, and in one other case within the hour following the occurrence.

On five of the 35 days of occurrence thunder occurred actually at Cranwell, but the *Daily Weather Reports* issued by the Meteorological Office, Air Ministry, show that on 12 of the days storms occurred in either the Midland or Eastern Districts of England, these including the five cases of occurrence at Cranwell.

On 23 of the 35 days of occurrence of mammato-cumulus, cumulo-nimbus was observed at some time or another, and on 15 occasions it both preceded and followed the occurrence of the mammato-cumulus; on five it preceded only, and on three it followed only.

In three cases line-squalls occurred at Cranwell within the hour preceding the noting of the mammato-cumulus cloud. In no other case did line-squalls occur at any time during the day of the appearance of mammato-cumulus.

With regard to the map conditions prevailing, 25 of the 35 cases could be definitely associated with the rears of depressions, eight with the fronts of depressions, one with a col, and one with an anticyclone, occurring right in the centre of the system.

WILLIAM H. PICK.

G. A. WRIGHT.

R.A.F. Cadet College, Cranwell, Sleaford, Lincs. October 19th, 1926.

Errata

April, 1927, page 72, line 33. For "27th," read "28th," and for "29th," read "30th."

Millibar Barograph Charts

To those who use charts reading in millibars on the recording barometers, it may be of interest to know that I have this week received from a well-known foreign firm of instrument makers a sample of a "millibar" chart in which approximately 25.4 "millibars" are made to correspond to a pressure of "one inch of mercury." The chart appears to be a millimetre chart which has been re-numbered so that the 1,000 "millibar" line is almost in the correct position. If these charts have been supplied to anyone and used with the common type of barograph, for which instruments the charts are apparently intended, large errors may result. It may be noted that if we take 750 millimetres to correspond to 1 bar, which is a fairly close approximation, millimetres may easily be converted into millibars by multiplying the former by four-thirds.

S. MORRIS BOWER.

Langley Terrace, Huddersfield. January 6th, 1927.

NOTES AND QUERIES

The Mississippi Floods

The flood danger, present every spring in the valley of the Mississippi, has at last materialised into a disaster of the first magnitude. The stage for such a disaster was set many years ago, when the great river, which for ages had wandered at large over a level plain more than a hundred miles across, was confined within bounds by a system of levees. It bears great quantities of silt, and this, formerly spread over a wide area, was now deposited on the actual river bed, raising it gradually. The levees were raised in turn and finally the river became a sort of elevated aqueduct, the upper surface of the water in time of flood being many feet above the surrounding country. The pressure of this mass of water is enormous, and, should a levee break beneath it, the low country would be quickly flooded.

Over the greater part of the enormous Mississippi drainage, the rains of September, 1926, were excessive; in the central valleys the amount of rain was the greatest ever measured in September and in some places the greatest ever measured in any one month. Many rivers were consequently in flood. October again had rainfall above normal though not to the marked extent of September. In November the precipitation was above normal in the northern and eastern States, but not in the southern.

The *Monthly Weather Review* for December, 1926, published by the U.S. Weather Bureau, mentions the "general and disastrous floods in the southern streams tributary to the Ohio

River, an unprecedented occurrence within the last 54 years." The chief rivers affected in December were the Cumberland and the Tennessee. The immediate causes of the floods were two periods of excessive rainfall, December 20th—21st and December 24th—25th, following on moderate to heavy rain from December 8th—13th. Over the drainage area of the Cumberland River an average of 4.25 inches fell on December 20th—21st, and of 3.5 inches on December 24th—25th. The area most affected was from Carthage to Nashville, Tenn., the crest of the flood was 19 feet above flood stage at Carthage and 16 feet at Nashville. Much of the city of Nashville was under water. Corresponding rises occurred in the Ohio River and by the end of December part of it was in flood.

Although over most of the United States January, 1927, was an exceptionally dry month, the Ohio valley again had a rainfall in excess of the normal, and towards the end of the month the river was in flood as far up as Pittsburg. The effect of the rain was aggravated by the prevailing high temperatures melting the snow and ice. The Cumberland and Tennessee rivers had receded, but the northern tributaries of the Ohio were generally in flood though not seriously.

During February and March rain fell in part (or the whole) of the affected area—the valleys of the Lower Mississippi and Ohio—on 14 and 17 days respectively. On February 12th and 13th rain fell over a large area in association with a series of small depressions. On the 13th some local falls were very heavy, 4.32 inches being recorded at New Orleans. Again on the 18th a deep depression, centred over the south-west corner of Kansas, caused general rainfall including a local very heavy fall of 6.88 inches at Vicksburg, Miss. A depression moving in a north-easterly direction across the centre of the United States on March 11th—12th caused moderate to heavy rain over a large area. On the 11th 4.86 inches fell at Nashville and on the 12th 3.76 inches fell at Vicksburg and 3.16 inches at Nashville.

At the end of March the tables of River Stages given in the U.S. Daily Weather Reports show that the Ohio was in flood from Evansville, Ind., to Cairo, Ill., and the Lower Mississippi was in flood from Memphis, Tenn., to New Orleans.

Rain was plentiful in April, moderate falls occurring nearly every day. Very heavy rain fell locally from 13th—15th; 3.34 inches fell on the two days 13th and 14th at Fort Smith, Ark., 3.10 inches fell at Little Rock, Ark., and 6.41 inches were reported from Alexandria, La., on the 14th. On the 15th 3.80 inches fell at Memphis, and on the same day New Orleans was flooded by a fall of 14 inches. During the eight weeks ending April 26th Memphis had had 25.5 inches of rain, Little Rock 21.4 inches, and New Orleans 20.7 inches.

The tables of River Stages during April show the Mississippi from Cairo to New Orleans rising steadily. Levees were breached at Dorena on the 17th and at St. John's Bayou, near New Madrid, on the 19th, and a levee near Greenville gave way on the 21st. The Missouri reached flood stage at St. Louis on the 4th and at Kansas City on the 19th. The Arkansas River reached flood stage at Fort Smith on the 14th and on the 15th it had risen another 14 feet. Probably the heavy rains of the 13th-15th were partly responsible for this sudden large rise. Flood stage at Little Rock was reached on the 15th and on the 20th a levee near Little Rock was breached. At the time of writing the crest of the flood is approaching New Orleans, and a wide breach has been dynamited in the levees below that town in hopes of saving it, but with what success remains to be seen.

The Great Storm of 1703

Mr. H. Harries, in a communication which is too long to print in full, takes exception to some of the suggestions made in the article on "The Great Storm of 1703," which appeared in the *Meteorological Magazine* for March. Unfortunately Mr. Harries' article to which I referred briefly did not come to my notice until my own was in proof, and in my attempt to reconstruct the meteorological situation of the day I was unable to give adequate consideration to all the facts which Mr. Harries had extracted from Admiralty logs preserved in the Public Record Office and other sources. In the light of these facts some of the suggestions made require to be modified. Incidentally, it is gratifying to find that De Foe's remark that the "sea was swept clear of shipping" need not be taken literally in so far as the King's ships are concerned. The winds off the Yorkshire coast appear to have been westerly on November 27th and not easterly as suggested by the closed isobars on the map which accompanied my article. Readers who are interested should refer to Mr. Harries' article which appeared in the *Cornhill Magazine* for November, 1897.

C.E.P.B.

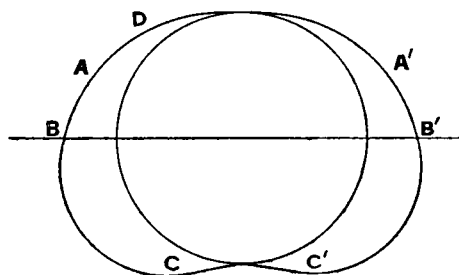
A halo with brilliant arcs of contact, April 2nd, 1927

On the morning of April 2nd, 1927, a halo of 22° with both upper and lower arcs of contact was observed at South Farnborough and at Croydon, as well as at Kew Observatory.

Mr. C. C. Newman reports that at South Farnborough the halo was first observed at 10h. 30m. G.M.T. and the phenomenon continued until 11h. 0m., when the sun was obscured from view by low clouds. At Croydon the commencement of the halo was

observed by Mr. J. G. Goodyear at 10h. 45m. and was visible at that time only as bright patches of colour above and below the sun. By 11h. the complete halo and two arcs were visible, all brightly coloured. A similar development was observed at Kew Observatory a few minutes later, and here also the phenomenon was soon obscured by low cloud. The height of the sun at 10h. 30m. was about 39° , at 11h. about 41° , so that it is of interest to compare the observations with Pernter's diagram for the circumscribing halo computed for the case in which the sun is 40° above the horizon. The computation is based on the assumptions that the phenomenon is due to the refraction of light through ice crystals in the form of hexagonal prisms, and that the crystals tend to settle down with their axes horizontal.

The diagram (Pernter-Exner, 2nd Edition, Fig. 154, p. 391) is reproduced herewith. The letters are not in the original.



The South Farnborough observer says "the upper arc of contact appeared to be a portion of an ellipse. The semi-major axis of the ellipse was about 30° . The lower arc of contact appeared to be a portion of a circle of diameter 22° ."

The observer's sketch shews that the arcs AA', CC' of Pernter's diagram were seen.

At Croydon "the top arc was visible on either side down to points level with the sun's disc, but the lower, though definitely an arc bent away from the halo, was visible on either side for only a short distance. The semi-major axis of the ellipse of which the top arc of contact formed a part was about 29° ." In this case the arcs seen were apparently BB' and CC'.

At Kew the upper arc was clearer on the west than on the east, so that we saw DA' and CC'. I tried to see some faint illumination connecting the upper and lower arcs, but I could not detect any. On theoretical grounds, the illumination should be very weak indeed. The upper and lower arcs were so well developed on this occasion that I should doubt whether conditions could have been much more favourable. It seems unlikely that the complete heart-shaped circumscribing halo computed for the solar elevation 40° can ever be observed.

F. J. W. WHIPPLE.

Catalogue of Scientific Instruments published by Short & Mason, Ltd.

Messrs. Short & Mason's new catalogue which came to hand

recently contains numerous features of interest to the meteorologist. The first section deals with aneroids and opens with a useful article on the construction of aneroids, followed by a table of equivalents of altitudes and pressures, assuming a mean temperature of 50° F. In future editions this table will presumably be replaced or supplemented by the new International table in which account is taken of the normal lapse rate of temperature.

The numerous types of aneroid barometers and barographs made by this well-known firm are well described and illustrated. Frankly, we do not care for the word "stormograph" as a generic name for an aneroid barograph, while the use of the name "micro-barograph" for the improved, open-scale barograph is likely to give rise to confusion with the well-known instrument of that name designed by Shaw and Dines.

The Meteorological Office pattern thermograph is listed on p. 25, where details will also be found of a combined wet and dry bulb instrument on similar lines. In the section on rain-gauges and measures, we welcome the inclusion of the taper-pattern measure now adopted by the Office as the official pattern. Two rain-gauges of the tilting-bucket type, one indicating and the other recording, are listed. We should like to have seen a continuously-recording gauge included, for although bucket gauges may give a considerable amount of interesting information regarding the intensity of rainfall, they do not permit of the tabulation of rainfall duration with accuracy.

Other sections of meteorological interest are those dealing with anemometers (p. 46), airmeters (p. 47), the Campbell-Stokes sunshine recorder (p. 51), meteorological thermometers (p. 60), and charts (p. 68).

'Comparison of Grass Minimum Thermometer Readings at South Farnborough

The following results obtained with grass minimum thermometers at South Farnborough are interesting as an illustration of the variations in grass minimum temperature which can result from a slight difference in exposure. The thermometers were in good agreement when exposed side by side, but when separated in the positions shown on the diagram, they differed appreciably, the difference being always in the same direction, and amounting on occasions to 6° F

It has been suspected for some time that considerable local variation in the ground temperature occurs in the neighbourhood of the station at South Farnborough, due to the amount and disposition of trees, shrubs, &c., and to the patchy nature of the very prevalent fog, but such differences as these now

recorded were hardly expected from exposures only fourteen feet apart, and apparently not differing greatly in character.

The season at which the observations were made, however, would certainly accentuate any difference due to exposure, for surrounding trees were still in full leaf although ground frosts were being recorded.

Date.	Position A.	Position B.	A—B.	Date.	Position A.	Position B.	A—B.
	°F	°F	°F		°F	°F	°F
Oct. 1st	34	28	6	Oct. 20th	31	25	6
2nd	44	40	4	21st	33	28	5
3rd	42	37	5	22nd	35	32	3
4th	46	42	4	23rd	25	20	5
5th	53	51	2	24th	24	19	5
6th	47	42	5	25th	33	31	2
7th	46	42	4	26th	32	29	3
8th	44	39	5	27th	26	24	2
9th	41	35	6	28th	37	34	3
10th	39	37	2	29th	39	39	0
11th	34	28	6	30th	36	35	1
12th	41	37	4	31st	31	29	2
13th	49	48	1				
14th	51	48	3	Nov. 1st	23	19	4
15th	45	43	2	2nd	38	37	1
16th	42	41	1	3rd	32	29	3
17th	41	39	2	4th	33	29	4
18th	24	22	2	5th	45	45	0
19th	22	17	5	6th	38	36	2

If the difference column (A—B) is plotted against temperatures in position B, a very irregular sequence of points is obtained. If the mean values of the difference are used, where the same temperature occurs more than once in column B, a more regular sequence is obtained, which indicates roughly that the difference increases the lower the ground temperature becomes. But the irregularity of the single observation points suggests that other factors, such as local eddies in the immediate vicinity of the thermometers, play a part in determining the temperature recorded.

E.T.

Review

Nature Notes for Ocean Voyagers. By Captain A. Carpenter, A.M., D.S.O., R.N. ; and Captain Sir David Wilson Barker, R.D., R.N.R. Size 9×6 pp. xi.+212, *illus.* London : C. Griffin & Co., Ltd., 1926, 10s. 6d. *net.*

This, the second edition of *Nature Notes for Ocean Voyagers*,

will be welcomed by all those who go down to the sea in ships. Many of the chapters in this new edition have been completely revised and others have been added together with many new illustrations. The authors are careful to point out that the book has been written particularly for ocean voyagers who have no knowledge of the "wonders of the deep," and not for those who wish to do some work for science and already have some knowledge of the ocean and the plants and animals living therein. In the opinion of the writer of this review, who has himself spent 25 years at sea, the authors are too modest, for the book contains a mass of information of interest not only to those who have little knowledge of the sea but to sailors and others of a more scientific bent.

It is written in a popular form and delightfully illustrated and gives a comprehensive survey of the phenomena and conditions of life in the ocean's depths and on the surface of the sea.

The authors have both spent a great part of their lives afloat and have been in intimate association with the life about which they write and many of the notes are based on personal observation. They describe the general conditions of the sea, its circulation and temperature, and the methods by which the ocean depths have been explored. Life in the ocean is fully discussed and some interesting notes given on the habits and development of fish and of birds and reptiles frequently seen on an ocean voyage. Some remarkable photographs illustrate these chapters. The chapter on whales and other mammals has been completely revised and an endeavour made to describe them correctly under the many names they have—thrilling stories are related of the power and ferocity occasionally displayed by these monsters of the deep.

No book written particularly for ocean voyagers would be complete without a chapter on weather, for their comfort, if not safety, depends on it. We find here a description of pressure and winds over the different oceans of the world, a table of seasons of tropical storms; a diagram showing a variety of weather types, and some interesting cloud studies. An excellent photograph of a cloud shadow and a remarkable illustration of a waterspout are also given.

A chapter on waves follows, with some exceedingly good illustrations of rough seas. Sir David W. Barker has made a study of the subject and he can therefore speak with some authority. Other subjects dealt with in the book are: Plant Life and Seaweed, Boring and Surface destructive animals, Light and phosphorescence and Coral.

The volume ends with descriptions of mythical sea monsters and old sea customs, a chapter on the mysteries of the deep in which is recalled the story of the "Marie Celeste," a ship found

at sea under full sail without a soul on board. With the many additional notes and chapters and a full and complete index, the second edition of this book is undoubtedly an advance on the former edition and is altogether a most fascinating little volume.

L. G. G.

News in Brief

Group Captain P. F. M. Fellowes, Director of Airship Development, accompanied by Mr. M. A. Giblett, Superintendent of Airship Meteorology, left England this month for South Africa, Australia and New Zealand, to discuss the erection of mooring masts for the use of the new Empire airships.

We learn from *The Times* that the Council of the Royal Aeronautical Society has decided to award the Society's gold medal to Dr. L. Prandtl, of Gottingen University, in recognition of his work on aerodynamics. The medal will be presented on May 16th when Dr. Prandtl will deliver the fifteenth Wilbur Wright memorial lecture.

The Weather of April, 1927

The weather of April, 1927, can be divided into three definite periods—unsettled, then fine and warm, and lastly fair but cold.

On the 9th thunderstorms accompanied by heavy hail occurred in London. At Hampstead hail lay 1 inch thick on the ground and in drifts the depth was 3 inches. Northerly winds with lower temperatures prevailed for a few days, but by the 12th the southern districts came under the influence of an anticyclone to the south-west of the British Isles and temperatures rose to 60°F. and over. In the northern districts however the weather was changeable and showery. Rain fell generally in the south of England on the night of the 14—15th, and on the 15th and 16th day temperatures failed to rise above 55° F. Conditions gradually improved over the week-end and fair warm weather was experienced in England during most of the next week. The highest temperatures occurred on the 21st when 70° F. was recorded at some stations. In the rear of a depression which passed north-eastwards towards Scandinavia however the winds became northerly and temperatures fell considerably on the 23rd. Showers of hail and snow fell in Scotland and northern England. The weather continued cold though sunny until the end of the month.

The total rainfall for the month varied considerably ; Storno-

way had 164 mm. (6·5 in.) or 87 mm. (3·4 in.) more than the average, Valentia had only 35 mm. (1·38 in.) being 58 mm. (2·3 in.) less than the average. At Kew the total for the first nine days amounted to rather more than the average for April, but the following three weeks were so dry that the whole month only showed an excess of 6 mm. (.24 in.).

Pressure was below normal over northern Europe and the North Atlantic north of 52° N., the greatest deficit being 15·1 mb. at Rost in Norway; the deficit of 8 mb. in southern Sweden is the greatest on record in April. Pressure was above normal over Europe and the North Atlantic south of this latitude, the excess reaching 5 mb. between Corunna and Madrid. Temperature was about normal except at Spitsbergen where it was 8° F. below. Rainfall was generally near normal, but was 50 per cent. above in parts of Sweden (Gothland and eastern Svealand).

Towards the end of the month floods occurred in northern Germany, the Oder, the Elbe and the Havel all being over their banks. On the 12th and 13th the worst "levanter" storm for many years raged in the western Mediterranean. In the harbour of Melilla four ships were wrecked, and in the town several houses collapsed; at Malaga torrents of red rain fell, and the east coast of Spain suffered damage from the waves.

Thousands of acres were reported to be flooded in Manitoba, and the floods in the Mississippi area reached disastrous proportions before the end of the month (see p. 89). On the night of the 12th-13th a tornado wrecked the town of Rock Springs, Texas, and on the night of the 18th-19th tornadoes passed over Kansas, Oklahoma, Texas and Missouri.

On the 15th and 16th very heavy rains fell in the coastal districts of Australia from Sydney to Newcastle. At some of the resorts in the Blue Mountains the falls exceeded 11 in. in 48 hours.

The special message from Brazil states that the rainfall in the northern districts was 64 mm. above normal, and that it was below normal in the central and southern districts by 77 mm. and 36 mm. respectively. Crops were generally in good condition, except the vegetables in the central and southern regions. Pressure changes were frequent. At Rio de Janeiro the pressure was 0·8 mb., and the temperature 0·9° F. above normal.

Rainfall, April, 1927—General Distribution

England and Wales	..	107	} per cent. of the average 1881-1915.
Scotland	.. ..	145
Ireland	.. ..	69
British Isles	.. ..	107

Rainfall: April, 1927: England and Wales

CO.	STATION.	In.	mm.	Per- cent. of Av.	CO.	STATION.	In.	mm.	Per- cent. of Av.
<i>Lond.</i>	Camden Square	2.02	51	131	<i>War.</i>	Birmingham, Edgbaston	1.50	38	86
<i>Sur.</i>	Reigate, The Knowle ..	2.13	54	137	<i>Leics.</i>	Thornton Reservoir ..	1.74	44	102
<i>Kent.</i>	Tenterden, Ashenden ..	1.64	42	101	"	Belvoir Castle	1.94	49	127
"	Folkestone, Boro. San.	...	...	...	<i>Rut.</i>	Ridlington	1.95	50	...
"	Margate, Cliftonville ..	1.42	36	105	<i>Linc.</i>	Boston, Skirbeck	2.37	60	176
"	Sevenoaks, Speldhurst ..	2.04	52	...	"	Lincoln, Sessions House	1.61	41	116
<i>Sus.</i>	Patching Farm	2.19	56	125	"	Skegness, Marine Gdns.	1.61	41	120
"	Brighton, Old Steyne ..	1.72	44	106	"	Louth, Westgate	2.01	51	120
"	Tottingworth Park	2.18	55	118	"	Brigg	2.25	57	143
<i>Hants.</i>	Ventnor, Roy. Nat. Hos.	1.79	45	107	<i>Notts.</i>	Workshop, Hodsock ...	1.76	45	120
"	Fordingbridge, Oaklands	2.29	58	125	<i>Derby</i>	Mickleover, Clyde Ho.	2.46	62	142
"	Ovington Rectory	2.24	57	119	"	Buxton, Devon. Hos. ..	4.16	106	141
"	Sherborne St. John	1.93	49	109	<i>Ches.</i>	Runcorn, Weston Pt. ...	2.57	65	148
<i>Berks.</i>	Wellington College	1.59	40	99	"	Nantwich, Dorfold Hall	2.41	61	...
"	Newbury, Greenham	2.14	54	118	<i>Lancs.</i>	Manchester, Whit. Pk.	2.05	52	107
<i>Herts.</i>	Benington House	1.71	43	112	"	Stonyhurst College	3.79	96	140
<i>Bucks.</i>	High Wycombe	1.66	42	106	"	Southport, Hesketh Pk	1.07	27	58
<i>Oxf.</i>	Oxford, Mag. College ..	1.73	44	112	"	Lancaster, Strathspey ..	1.92	49	...
<i>Nor.</i>	Pitsford, Sedgebrook ..	1.55	39	101	<i>Yorks.</i>	Wath-upon-Deerne ...	1.96	50	124
"	Oundle	1.31	33	...	"	Bradford, Lister Pk. ...	2.69	68	134
<i>Beds.</i>	Woburn, Crawley Mill ..	1.35	34	90	"	Oughtershaw Hall	5.87	149	...
<i>Cam.</i>	Cambridge, Bot. Gdns. ...	...	...	...	"	Wetherby, Ribston H. ...	1.51	38	86
<i>Essex.</i>	Chelmsford, County Lab	1.47	37	115	"	Hull, Pearson Park	2.74	70	176
"	Lexden, Hill House	1.99	51	...	"	Holme-on-Spalding ...	1.99	51	...
<i>Suff.</i>	Hawkedon Rectory	2.49	63	162	"	West Witton, Ivy Ho. ...	2.41	61	...
"	Haughley House	2.01	51	...	"	Felixkirk, Mt. St. John	1.56	40	...
<i>Norfol.</i>	Beccles, Geldeston	1.46	37	99	"	Pickering, Hungate ...	2.15	55	...
"	Norwich, Eaton	1.55	39	91	"	Scarborough	2.20	56	141
"	Blakeney	1.66	42	130	"	Middlesbrough	1.41	36	103
"	Swaffham .....	...	...	...	"	Baldersdale, Hury Res.	2.27	58	...
<i>Wilts.</i>	Devizes, Highclere	1.60	41	84	<i>Durh.</i>	Ushaw College	1.60	41	85
"	Bishops Cannings	1.93	49	96	<i>Nor.</i>	Newcastle, Town Moor.	2.05	52	125
<i>Dor.</i>	Evershot, Melbury Ho. ...	2.03	52	86	"	Bellingham, Highgreen	2.23	57	...
"	Creech Grange	2.63	67	...	"	Lilburn Tower Gdns. ...	1.36	35	...
"	Shaftesbury, Abbey Ho. ...	1.70	43	80	<i>Cumb.</i>	Geltsdale	2.54	65	...
<i>Devon.</i>	Plymouth, The Hoe	2.29	58	101	"	Carlisle, Scaleby Hall .	...	...	...
"	Polapit Tamar	2.20	56	94	"	Seathwaite M.	13.01	330	175
"	Ashburton, Druid Ho. ...	2.81	71	92	<i>Glam.</i>	Cardiff, Ely P. Stn.	1.95	50	77
"	Cullompton	2.12	54	93	"	Treherbert, Tynywaun	3.87	98	...
"	Sidmouth, Sidmount ..	1.98	50	93	<i>Carm.</i>	Carmarthen Friary	2.09	53	76
"	Filleigh, Castle Hill ...	2.83	72	...	"	Llanwrda, Dolaucothy.	3.31	84	100
"	Barnstaple, N. Dev. Ath.	1.92	49	91	<i>Pemb.</i>	Haverfordwest, School	1.98	50	76
<i>Corn.</i>	Redruth, Trewirgie	2.49	63	86	<i>Card.</i>	Gogerddan	2.88	73	110
"	Penzance, Morrab Gdn.	3.09	79	127	"	Cardigan, County Sch. ...	2.02	51	...
"	St. Austell, Trevarna ..	3.32	84	118	<i>Brec.</i>	Crickhowell, Talymaes	2.00	51	...
<i>Soms.</i>	Chewton Mendip	2.45	62	82	<i>Rad.</i>	Birm. W. W. Tyrmynydd	3.86	98	105
"	Street, Hind Hayes	1.50	38	...	<i>Mont.</i>	Lake Vyrnwy	3.46	88	115
<i>Glos.</i>	Clifton College	1.28	33	60	<i>Denb.</i>	Langynhafal	1.83	46	...
"	Cirencester, Gwynfa ..	1.63	41	87	<i>Mer.</i>	Dolgelly, Bryntirion ..	4.30	109	118
<i>Here.</i>	Ross, Birchlea	1.17	30	62	<i>Carn.</i>	Llandudno	1.13	29	62
"	Ledbury, Underdown ..	1.29	33	71	"	Snowdon, L. Llydaw 9	8.37	213	...
<i>Salop.</i>	Church Stretton	1.99	51	92	<i>Ang.</i>	Holyhead, Salt Island.	.81	21	39
"	Shifnal, Hatton Grange	1.27	32	76	"	Lligwy	1.07	27	...
<i>Staff.</i>	Tean, The Heath Ho. ...	...	...	...	<i>Isle of Man</i>				
<i>Worc.</i>	Ombersley, Holt Lock ..	1.17	30	77		Douglas, Boro' Cem. ...	1.76	45	72
"	Blockley, Upton Wold ..	1.94	49	100	<i>Guernsey</i>				
<i>War.</i>	Farnborough	2.25	57	115		St. Peter P't. Grange Rd	2.45	62	122

Rainfall: April, 1927: Scotland and Ireland

CO.	STATION	In.	mm.	Per- cent. of Av.	CO.	STATION.	In.	mm.	Per- cent. of Av.
<i>Wigt.</i>	Stoneykirk, Ardwell Ho	1.98	50	94	<i>Suth.</i>	Loch More, Achfary...	15.37	390	317
"	Pt. William, Monreith.	1.94	49	...	<i>Caith.</i>	Wick	4.21	107	212
<i>Kirk.</i>	Carsphairn, Shiel.	5.90	150	...	<i>Ork.</i>	Pomona, Deerness	6.10	155	295
"	Dumfries, Cargen	2.58	66	97	<i>Shet.</i>	Lerwick	6.03	153	264
<i>Roxb.</i>	Branxholme	1.57	40	83					
<i>Selk.</i>	Ettrick Manse	3.24	82	...	<i>Cork.</i>	Caheragh Rectory	2.07	53	...
<i>Berk.</i>	Marchmont House	1.82	46	90	"	Dunmanway Rectory .	1.60	41	39
<i>Hadd.</i>	North Berwick Res. ....	.70	18	50	"	Ballinacurra	1.52	39	59
<i>Midl.</i>	Edinburgh, Roy. Obs. .	1.60	41	116	"	Glanmire, Lota Lo. ...	1.29	33	46
<i>Lan.</i>	Biggar .....	...	...	...	"	Valentia Obsy.	1.37	35	37
"	Leadhills	5.13	130	...	<i>Kerry</i>	Killarney Asylum.	1.29	33	39
<i>Ayr.</i>	Kilmarnock, Agric. C. .	3.31	84	161	"	Darrynane Abbey	1.75	44	51
"	Girvan, Pinmore	3.27	83	110	<i>Wat.</i>	Waterford, Brook Lo. .	1.25	32	49
<i>Renf.</i>	Glasgow, Queen's Pk. .	2.27	58	115	<i>Tip.</i>	Nenagh, Cas. Lough. .	1.95	50	78
"	Greenock, Prospect H. .	4.10	104	113	"	Roscrea, Timoney Park	1.61	41	...
<i>Bute.</i>	Rothsay, Ardenraig. .	4.76	121	160	"	Cashel, Ballinamona .	1.24	31	50
"	Dougarie Lodge	2.91	74	...	<i>Lim.</i>	Foynes, Coolinanes ...	1.98	50	81
<i>Arg.</i>	Ardgour House	13.08	332	...	"	Castleconnell Rec.	1.53	39	...
"	Manse of Glenorchy. .	...	...	...	<i>Clare</i>	Inagh, Mount Callan .	3.12	79	...
"	Oban	4.95	126	...	"	Brodford, Hurdlest'n.	1.55	39	...
"	Poltalloch	4.94	125	164	<i>Wexf.</i>	Newtownbarry	1.42	36	...
"	Inveraray Castle	7.26	184	158	"	Gorey, Courtown Ho. .	1.87	47	85
"	Islay, Eallabus	4.14	105	144	<i>Kilk.</i>	Kilkenny Castle .....	.85	21	39
"	Mull, Benmore	15.00	381	...	<i>Wic.</i>	Rathnew, Clonmannon	1.16	29	...
<i>Kinr.</i>	Loch Leven Sluice ....	.99	25	52	<i>Carl.</i>	Hacketstown Rectory .	1.34	34	51
<i>Perth</i>	Loch Dhu	5.10	130	108	<i>QCo.</i>	Blandsfort House	1.25	32	48
"	Balquhadder, Stronvar.	3.94	100	...	"	Mountmellick	1.79	45	...
"	Crieff, Strathearn Hyd.	1.42	36	65	<i>KCo.</i>	Birr Castle	1.54	39	72
"	Blair Castle Gardens .	2.01	51	95	<i>Dubl.</i>	Dublin, FitzWm. Sq. .	1.23	31	65
<i>Forf.</i>	Kettins School	1.41	36	85	"	Baibriggan, Ardgillan .	1.12	28	57
"	Dundee, E. Necropolis .	.96	24	56	<i>Me'th</i>	Beauparc, St. Cloud .	1.10	28	...
"	Pearsie House	1.24	31	...	"	Kells, Headfort	1.16	29	46
"	Montrose, Sunnyside .	1.47	37	81	<i>W.M.</i>	Moate, Coolatore	1.48	38	...
<i>Aber.</i>	Braemar, Bank	1.85	47	78	"	Mullingar, Belvedere .	1.54	39	65
"	Logie Coldstone Sch. .	2.38	60	118	<i>Long</i>	Castle Forbes Gdns. .	1.39	35	58
"	Aberdeen, King's Coll. .	2.35	60	126	<i>Gal.</i>	Ballynahinch Castle .	3.33	85	94
"	Fyvie Castle	3.87	98	...	"	Galway, Grammar Sch.	1.84	47	...
<i>Mor.</i>	Gordon Castle	2.80	71	160	<i>Mayo</i>	Mallaranny	4.05	103	...
"	Grantown-on-Spey	3.83	97	194	"	Westport House	2.07	53	77
<i>Na.</i>	Nairn, Delnies	2.10	53	140	"	Delphi Lodge	5.60	142	...
<i>Inv.</i>	Ben Alder Lodge	3.88	99	...	<i>Sligo</i>	Markree Obsy.	1.89	48	71
"	Kingussie, The Birches	3.52	89	...	<i>Cav'n</i>	Belturbet, Cloverhill. .	1.48	38	65
"	Loch Quoich, Loan ....	...	...	...	<i>Ferm</i>	Enniskillen, Portora .	1.82	46	...
"	Glenquoich	13.68	347	210	<i>Arm.</i>	Armagh Obsy.	1.32	33	63
"	Inverness, Culduthel R.	1.97	50	...	<i>Down</i>	Fofanny Reservoir ...	3.05	77	...
"	Arisaig, Faire-na-Squir	...	...	...	"	Seaforde	1.88	48	72
"	Fort William	9.43	240	211	"	Donaghadee, C. Stn. .	1.26	32	63
"	Skye, Dunvegan	6.11	155	...	"	Banbridge, Milltown .	1.31	33	64
"	Barra, Castlebay	3.31	84	...	<i>Antr.</i>	Belfast, Cavehill Rd. .	1.68	43	...
<i>R&C</i>	Alness, Ardross Cas. .	3.27	83	135	"	Glenarm Castle	2.68	68	...
"	Ullapool	8.02	203	...	"	Ballymena, Harryville	2.54	65	96
"	Torricon, Bendamph. .	11.43	290	219	<i>Lon.</i>	Londonderry, Creggan	2.47	63	96
"	Achnashellach	12.82	325	...	<i>Tyr.</i>	Donaghmore	1.78	45	...
"	Stornoway	6.47	164	213	"	Omagh, Edenfel	1.75	44	67
<i>Suth.</i>	Lairg	5.23	133	...	<i>Don.</i>	Malin Head	2.94	75	149
"	Tongue Manse	4.97	126	190	"	Dunfanaghy	3.19	81	118
"	Melvich School	3.61	92	155	"	Killybegs, Rockmount.	4.69	119	130

Climatological Table for the British Empire, November, 1926

STATIONS	PRESSURE		TEMPERATURE							Rela- tive Humi- dity	Mean Cloud Am't	PRECIPITATION		BRIGHT SUNSHINE		
	Mean of Day M.S.L.	Diff. from Normal	Absolute	Mean Values					Mean Am't			Diff. from Normal	Days	Hours per day	Per- cent- age of possi- ble.	
				Max.	Min.	1 max. and 1 min.	Diff. from Normal	Mean Bulb.								
																° F.
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	%	0-10	mm.	mm.				
London, Kew Obsy.	1003.6	-11.0	56	29	50.0	40.3	45.1	+1.1	42.5	8.1	130	74	20	1.4	15	
Gibraltar	1016.0	-2.0	70	46	64.1	52.1	58.1	-2.4	52.1	8.2	153	9	17	...	...
Malta	1017.2	+0.7	77	56	72.1	65.2	68.7	+4.8	65.1	85	94	3	7	6.3	62	
St. Helena	1013.1	+1.7	65	53	60.2	54.3	57.3	-2.8	55.3	92	49	6	20	...	...
Sierra Leone	1011.2	+0.3	90	69	86.5	73.6	80.1	-1.1	76.5	83	151	21	15	...	...
Lagos, Nigeria	1008.5	-2.3	89	70	86.9	74.4	80.7	-0.7	76.7	81	139	73	8	...	...
Kaduna, Nigeria	1013.8	+2.5	94	50	90.4	60.8	75.6	-0.6	65.4	45	1	2	1	...	...
Zomba, Nyasaland	1016.1	+1.1	94	47	87.0	56.8	71.9	-3.6	...	62	70	60	9	...	...
Salisbury, Rhodesia	1009.2	-0.6	92	52	84.7	59.0	71.9	+1.2	62.2	50	33	61	9	7.3	57	
Cape Town	1016.9	+1.1	93	46	73.9	55.6	64.7	+0.3	57.9	66	12	15	4	...	...
Johannesburg	...	...	84	45	74.6	52.2	63.4	-0.1	53.9	62	120	6	14	8.3	62	
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	88	39	78.4	57.1	67.7	-0.7	55.2	68	83	25	10	...	...
Calcutta, Alipore Obsy.	1013.4	+0.1	87	56	81.9	62.6	72.3	-0.8	62.6	76	3.1	0	0*	...	...
Bombay	1011.4	-0.6	94	68	87.3	72.5	79.9	-0.6	68.9	71	1.4	0	0*	...	...
Madras	1011.6	+0.3	89	60	84.9	70.0	77.5	-1.4	73.7	84	6.5	310	52	6*	...	
Colombo, Ceylon	1009.7	-0.4	92	67	86.6	73.0	79.8	-0.1	76.4	74	6.0	260	19	15	7.2	61
Hongkong	1017.7	+0.1	83	61	73.4	65.0	69.2	-0.4	63.4	69	5.0	126	83	3	6.8	62
Sandakan	...	...	90	73	87.4	75.2	81.3	+0.5	77.0	82	...	310	62	16	...	...
Sydney	1014.3	+0.6	96	52	77.5	59.0	68.3	+1.2	61.3	48	3.6	3	68	4	9.4	68
Melbourne	1015.2	+1.0	101	43	72.4	51.7	62.1	+0.8	54.5	56	6.8	28	28	12	7.1	51
Adelaide	1017.6	+2.5	100	43	78.6	55.4	67.0	+0.1	56.1	38	5.4	20	9	7	9.7	70
Perth, W. Australia	1015.7	+0.4	96	48	76.7	58.0	67.3	+1.3	60.6	57	5.5	40	20	12	8.4	61
Ooogardie	1014.1	+1.0	102	48	87.6	59.0	73.3	+2.5	57.4	33	3.8	7	10	4	...	...
Brisbane	1016.2	+1.7	96	56	82.9	63.7	73.3	-0.3	65.4	54	3.5	44	49	3	10.2	76
Hobart, Tasmania	1007.9	-1.5	89	39	66.0	47.5	56.7	-0.5	50.3	54	6.6	23	41	15	8.8	61
Wellington, N.Z.	1008.7	-3.4	65	41	61.4	50.7	56.1	-0.8	52.4	72	5.4	123	34	20	6.7	47
Suva, Fiji	1011.4	+0.3	87	69	83.4	73.2	78.3	+1.1	74.0	79	7.8	164	78	19	5.4	42
Apia, Samoa	1009.9	+0.4	88	72	85.3	75.0	80.1	+1.4	77.5	80	6.4	361	125	24	5.9	46
Kingston, Jamaica	1011.9	-0.5	89	69	86.7	71.9	79.3	0.0	70.8	89	3.4	51	29	7	8.4	74
Grenada, W.I.	1011.3	+1.0	87	71	84.7	74.8	79.7	+0.4	77.5	83	5.7	266	53	18	...	...
Toronto	1015.9	-0.9	63	15	43.2	31.6	37.4	+1.1	33.5	80	8.7	97	22	14	2.1	22
Winnipeg	1020.4	+3.7	40	-18	22.3	12.2	17.3	-3.5	15.5	38	8.1	0	24	0	2.1	23
St. John, N.B.	1018.3	+4.4	57	13	44.9	30.6	37.7	-1.0	34.6	84	6.3	100	12	16	3.3	35
Victoria, B.C.	1012.7	-2.8	60	38	51.8	44.2	48.0	+3.6	45.8	85	7.7	80	84	18	2.7	29

*For Indian stations a rain day is a day on which 0.1 in. (2.5 mm.) or more rain has fallen.

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The Design of Raingauges

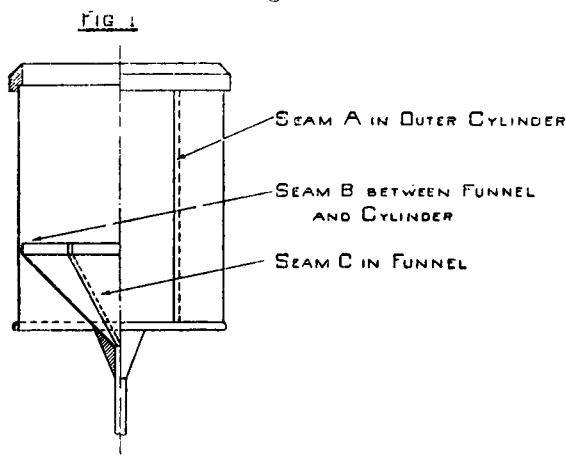
By E. G. BILHAM, B.Sc., D.I.C.

To ensure satisfactory service over a long period of years it is important that a raingauge should be soundly constructed of good material. The existing Meteorological Office specification provides for the use of sheet copper of adequate weight and also states that all joints are to be water-tight and carefully soldered. However well made a joint may be, it constitutes, nevertheless, a weak point. The development of a leak at a seam is the commonest source of uncertainty in rainfall observations, and the elimination of soldered joints may now be regarded as the most pressing problem in the design of gauges.

The ordinary raingauge of the Snowdon or Meteorological Office pattern is provided with a funnel of the pattern illustrated diagrammatically in Fig. 1. There are three important seams, a vertical seam, A, where the edges of the cylinder are brought together, a horizontal seam, B, where the sloping funnel is attached to the inside of the cylinder, and a seam, C, in the sloping funnel. A leak in A may let in rain striking the outside of the cylinder. A large proportion of the rain entering by this means would undoubtedly find its way into the receiving can, thus adding to the measured amount of rain. A leak in B could not increase the measured fall, but would diminish it, because some of the rain entering the funnel would run straight down the inside of the cylinder into the outer vessel instead of being

collected. A leak in C might conceivably cause some slight loss if it occurred near the top.

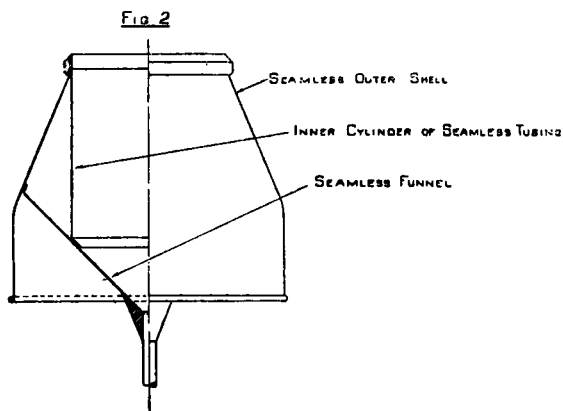
Other parts of the gauge in which leaks have to be watched for are the collecting can and the outer vessel. A leak in the



can is easily detected; a leak in the outer vessel, though of less consequence should be remedied at the first opportunity. Leaks in the funnel are much more difficult to detect and the measured amounts of rainfall may be seriously affected before the need for repairs is realised.

It follows, therefore, that the funnel should be the first part of the gauge to receive the attention of the designer.

In the course of designing, in the Instruments Division of the Meteorological Office, a mountain gauge of large capacity the form of construction of the funnel illustrated in Fig. 2 was devised. Here there are three separate continuous pieces of metal and the only joints are the soldered annular contacts



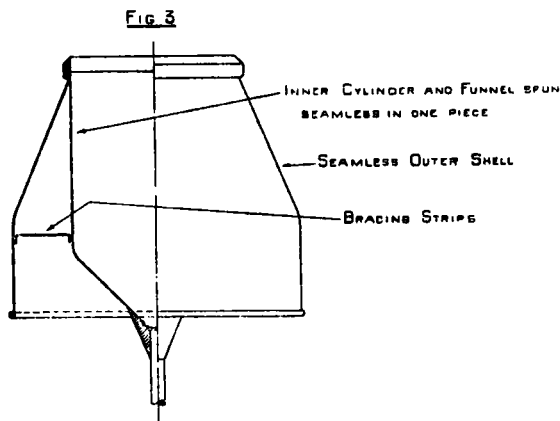
where the separate pieces meet. It will be seen that these joints are so arranged that even if leakage develops at any point the catch of rain cannot possibly be affected. While making a funnel of this type, Mr. W. A. Rollason, of 52, Hatton Garden, E.C. 1, was led to

suggest the simplified form shown in Fig. 3. Here the number of pieces is reduced to two, with a single annular joint at the rim, where it is well protected by the brass ring. Each piece is "spun" into the form shown and has no vertical seam.

Mr. Rollason's form has the advantage that it can readily be adapted to suit a gauge of the ordinary form for daily measurements. This is merely a matter of reducing the diameter of the

outer cone, at the base, till it is very nearly the same as that of the inner funnel portion. The resulting "funnel" is then of nearly the same outward appearance as the ordinary funnel illustrated in Fig. 1, but is seamless and double-walled. Gauges constructed in this manner have been put under test at certain stations.

Experiments are also being made in the use of seamless copper



tubing for the construction of rain-gauges. By this means, all vertical seams can be avoided, not only in the funnel, but in the outer vessel and the inner can. There would remain, however, the seam B in Fig. 1, although the seam C could be eliminated by spin-

ning the funnel itself. Moreover, if copper tubing is used for the outer vessel, the splayed form of base, which is a valuable feature of the Meteorological Office pattern, could not be retained. Nevertheless, the use of this material offers very marked advantages, especially for the construction of mountain gauges of the Bradford pattern, in which the depth of the collected rainfall is determined by means of a dip rod. Copper tubing can be made to a high degree of uniformity in the area of cross section, and, in consequence, the volume of water in a vessel made of such tubing is accurately proportional to the depth, if the bottom is flat.

The Marine Barometer

The specification for the marine type of Kew pattern barometer has recently been under consideration. Three matters to receive attention were :—

- (A) The limits between which the "falling time" should be measured.
- (B) The value of the falling time, and
- (c) The amount of latitude which should be allowed to the manufacturer in realising the specified value of the falling time.

The old specification, dating from 1854, stated that the falling

time between 1.5 inches and 0.5 inch above the steady height of the barometer should lie between 3 and 6 minutes. The inch has now been replaced by the millibar as the official unit of pressure, and consequently it is desirable to express the values of the limits as round numbers of millibars. At first sight it might appear that the best course would be to convert 1.5 inches and 0.5 inch to millibars and round off to the nearest millibar, giving the values 51 and 17 millibars. There is, however, another point to take into consideration. The "falling time" is related to the "lagging time," the latter term being defined as the interval by which the barometric indications lag behind the changes actually occurring. It can be shown that if the damping is caused by non-turbulent flow through a capillary tube the fall of the mercury will follow a logarithmic law. Further, provided the fall is logarithmic, if the upper limit is made e times the lower limit— e being the base of Napierian logarithms, 2.718—the "falling time" will be equal to the "lagging time." It is clearly advantageous to secure this equality since it enables us to say precisely that the barometric pressure had the value shown by the reading at a time, t , before the time of reading, t being the falling time. Fortunately, this advantage can be secured with very little modification of past practice. The value 50 millibars suggests itself naturally as the upper limit, and the lower limit then becomes $50/e$ or 18 millibars, and these values have accordingly been adopted as the limits.

Under head (B) the old standard value of the falling time was $4\frac{1}{2}$ minutes and this was retained unchanged. Owing, however, to the slight narrowing of the limits under head (A) a slight lengthening of the time has virtually been made.

With regard to (C) it was decided that barometers would be accepted if the actual falling time did not differ from the specified value by more than $\frac{1}{2}$ minute. In order to ensure that the fall of the mercury should follow a logarithmic law, it was specified that the damping should be produced by the use of capillary tubing in the barometer tube and not by means of a constriction. Experience has shown that makers can work, without inconvenience, within narrower limits than those of the old specification and there was reason to believe that a falling time of 3 minutes was too short. Expressed in terms of the old limits, the new barometers have falling times between $4\frac{1}{2}$ and $5\frac{1}{2}$ minutes approximately.

Twelve barometers made by Messrs. S. & A. Calderara in accordance with this specification have recently been examined at the National Physical Laboratory, and the results obtained offer striking evidence of the accuracy with which a barometer maker can work to a definite specification at the present day.

In no case did the falling time actually realised differ from the specified mean value of $4\frac{1}{2}$ minutes by more than 15 seconds, while four of the barometers had falling times differing only 5 seconds from $4\frac{1}{2}$ minutes. The mean value for the 12 barometers was 4 minutes 39 seconds.

It should perhaps be emphasised that the new specification is merely a provisional one. It is hoped that before long some further experimental evidence will be available for guidance in coming to a decision as to whether the falling time should be increased.

E.G.B.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, May 18th, at 49, Cromwell Road, South Kensington, Sir Gilbert Walker, C.S.I., F.R.S., President, in the Chair.

Harold Jeffreys, D.Sc., F.R.S.—Cyclones and the General Circulation.

It appears that if there were no variation of temperature with latitude the atmosphere could rotate with the earth like a rigid body, and this would be a stable state. But increase of temperature towards the equator implies that the velocity from the west must increase with height, and in these conditions it appears that frictional interaction between different layers of the air and between the lowest layer and the ground would suffice to destroy any motion symmetrical about the earth's axis. Irregular horizontal interchange of air must therefore be developed, and it seems that this implies a system of cyclones resembling in their main features those we know. One effect of the interchange would be that the normal winds at the surface must be on the whole as much easterly as westerly, and reasons are suggested to explain why the easterly prevailing winds are near the equator and the westerly ones in higher latitudes. It seems probable that this mechanism would give slow anticyclonic circulations near the poles, apart from possible local conditions tending to reverse or intensify such circulations.

George M. Meyer, B.A., Assoc.M.Inst.C.E.—Early Water-mills in relation to Changes in the Rainfall of East Kent.

Records of water-mills in Domesday and in mediæval law-suits show that the streams of the district were of greater volume at the end of the eleventh century than to-day, and that the decrease was rapid about 1275. Early in the fourteenth century silt was carried down by the Gestling or North Stream, whereas now practically none is brought down by that stream nor by the Stour near its mouth. In the second part of the paper detailed reasons are given for considering that in this district the varying

discharge of the streams represents approximately the changes in the rainfall. These variations had a profound effect upon the silting up of local harbours, a point which may well affect the choice of site for a new harbour if expected industrial developments in Kent materialize.

S. Morris Bower, — Report on Winter Thunderstorms in the British Islands from January 1st to March 31st, 1926.

The report contains charts and tables showing the distribution and frequency of thunderstorms during the above period, based on the records of about fifteen hundred observers. Further maps showing the areas affected by certain storms, and a chart of the tracks of associated depressions are included. The widespread thunderstorms about February 16th, 1926, which appear to have accompanied the passage of five squall lines, are specially treated, and maps indicating by isochronous lines the movements of the various storms are given. Figures showing the diurnal variation in the frequency of winter thunderstorms in 1925 and 1926 are included and discussed.

Correspondence

To the Editor, *The Meteorological Magazine*

Remarkably Long-lived Lunar Rainbow

I can easily go one better than Mr. Rowswell as regards the above. I extract the following from my meteorological journal: "December 11th, 1900. Another remarkable lunar rainbow, very bright, colours were seen in the primary bow, which lasted continuously from 10.55 p.m. to 12.40 a.m. on the 12th and perhaps longer; a most unusual duration; faint traces only of the secondary bow." The word "another" refers to a double lunar rainbow seen on October 4th, 1900, of which a description was inserted in the *Meteorological Magazine*, vol. 35 (1900), p. 138.

CHARLES L. BROOK.

Harewood Lodge, Meltham, Yorks., February 21st, 1927.

Lightning Discharges

The work done by F. W. Peek, Jr., of the General Electric Company at the High Tension Laboratory of this Company at Pittsfield, Massachusetts, on "Lightning and other High Voltage Phenomena," is of such direct value in connexion with the study of thunderstorms that I have with his consent made the following abstract of the results of the experiments.

These experiments were undertaken to determine fundamental principles from the standpoint of pure research, and at the same time to better the insulation of apparatus and the protection of high voltage transmission lines. Briefly, artificial lightning was

produced by a lightning generator supplying 2,000,000 volts above ground. The discharge produces a loud sharp explosive report, and the power is of the order of millions of kilowatts for a few millionths of a second. Currents as high as 10,000 ampères have been obtained. The voltages increase at the rate of millions of volts per second.

A model was made to scale representing cloud and transmission line. It was found that when a flash occurred from this model cloud, 1 per cent. of its voltage was induced on the model line. It is known that the voltage induced on an actual line under similar conditions is sometimes of the order of 1,000,000. Hence the voltage of an actual flash of lightning may be 100,000,000, which means 330 kv/m (kilo-volts per metre) as the gradient in the most dense part of the electric field, or where the flash occurs; and a gradient of less than a third of this a short distance away. It is estimated from voltage, size and height of clouds, that the current is of the order of 80,000 ampères and the energy 13,500 kilowatt seconds or 3.8 kw. hours.

"This energy," Dr. Peek says, "is sufficient to operate an automobile about 5 miles or an electric toaster for a day. Since this energy is dissipated in a very short time the power may be several thousand million kilowatts."

"A study was made using models built to scale to determine the protective value of lightning rods. . . . Tests show that lightning from a cloud overhead does not always strike the highest object."

When the discharge point of the cloud is moving, the area protected by a rod 1.85 per cent. of cloud height is as follows. When the cloud is directly above the rod, 84 per cent. of the strokes hit the rod and 16 per cent. hit the ground. Within a radius four times the rod height, there were no ground hits. As the discharge point of the cloud moves away, the number of ground hits increases rapidly and is 100 per cent. at twelve times the rod height.

What then are the chances of being struck? If the cloud is overhead and distant about 300 metres, a man will be hit 15 times out of every hundred strokes. This refers to vertical strokes and it must be remembered that a majority of strokes are horizontal, that is from cloud to cloud. A man flat on the ground would be struck about once in every hundred strokes. This, however, does not mean that we should lie flat under trees; nor do the ratios given above apply when the location is near a wire fence or under a tree.

An edifice five metres high would be struck 84 times out of a hundred vertical flashes; but if the cloud moved one hundred metres, there would be no stroke.

Full details of Dr. Peek's experiments can be found in

Smithsonian Report, 1927, p. 169-198, and in the *Journal of Franklin Institute*, February, 1925.

ALEXANDER MCADIE.

Harvard University, Blue Hill Observatory, Readville, Mass.

February 8th, 1927.

The Frost of April 30th

Not having seen any notice of this in your pages and thinking that such a severe frost ought not to go unrecorded I beg to send a few remarks on its effect in South Herefordshire. During 40 years observations I have never known such a severe visitation so late in the season. The exposed thermometer 4 ft. above ground sank to 16°F. Although it was a "dry" frost the damage done was immense. Sycamore leaves were crumpled up on hedges and on some trees; laburnum leaves and blossoms were frizzled up. My walnut tree this last week of May is as bare as in January. Perhaps the most remarkable sight is the oaks; on very low ground the young buds were completely frizzled; on ground perhaps 50 ft. higher some trees are now, at the end of May like huge mushrooms and afford a remarkable illustration of the weight and density of cold air, the lower two-thirds of the trees being a mass of shrivelled-up foliage and quite bare, while the upper one-third, above the severest frost, is a bower of green; altogether they are a remarkable sight, the tallest oaks show the effect most and are just like huge mushrooms or umbrellas.

Needless to say the promise of a magnificent fruit crop has been completely nullified, at any rate on low ground.

R. P. DANSEY.

Kentchurch Rectory, Hereford. May 23rd, 1927.

Severe Winters

In regard to the discussion on this subject, my impression is that it is not being viewed in quite the right perspective.

The decade 1885-1895 was an outstandingly cold and snowy one in the nineteenth century, and since then we seem simply to have reverted to the normal standard of our temperate English climate. I do not think Mr. Horner's statement, that we have had no winter "worthy the name" since that of 1894-95, except 1916-17, is quite happy. There have been, if not many severe winters, at any rate many very severe spells and months this century, and I would particularly like to draw Mr. Horner's attention to the following seasons:—

1899-1900. A spell of general frost and snow in mid-December, followed in the first half of February by an extremely heavy snowfall with severe cold, in every corner of the British Isles.

The snowfall of February, 1900, was referred to in "British Rainfall, 1900," as probably "unprecedented" for the British Isles as a whole.

1900-1901. January, February and March were months of moderate frost and, especially the last two, were snowy generally. About March 20th the amount of snow lying on Dartmoor was said to be not far short of that after the famous blizzard in March, 1891. At the end of March the north of England had a terrible snowstorm.

1901-1902. In mid-December a paralyzing snowstorm affected northern England, followed by some skating. February, 1902, was a month of widespread and severe frost with general skating. The late Canon Rawnsley gave a fine poetical description of the skating on Derwentwater.*

1906-07. Widespread snowstorms of great severity in Christmas week, with disastrous blizzards in east of Scotland. A good deal of frost between mid-January and mid-February.

1908-09. A winter marked by spells of acute cold. The first just after Christmas was most intense in the south-east of England. Late in January came a week's intense fog-frost with very copious deposits of rime. Finally in late February and early March came a snow-spell with hard frosts of a character reminiscent of February, 1900. This is one of the snowiest spells in our annals taking the British Isles as a whole.

1909-10. Mild in England, but both November and January had intense skating frosts in Scotland.

1915-16. This winter was noteworthy for the very cold November, very warm January and the accentuated snowspell of February and March recalling that of 1909 without the intense cold. The mountain snowfall of March was enormous, it being estimated that an aggregate of 10 feet fell in the Black Mountains of South Wales and in parts of the Pennines.

1916-17. The well remembered series of cold snowy months extended from December to April. The frost in early February was intense with skating in every corner of England. The terrific Irish snowstorms in January and April, especially April, bear comparison with such blizzards as those of January, 1881, in southern England; March, 1891, in south-western England; and March, 1886 and March, 1888, in northern England and Scotland.

1917-18. December was generally cold, having the lowest mean temperature in London of any December since 1890, whilst early in January a very intense frost prevailed in the north, Loch Lomond being frozen over, said to be the first time since 1895.

1918-19. General skating in February, which in Scotland was more severe than February, 1917.

* *Meteorological Magazine* 37 (1902), p. 19.

1923-24. Severe frost in November, and all through the winter there were frequent falls of snow.

1925-26. Widespread frost and heavy snowfalls through November, December, and a bit of January. In the south of England the frost before Christmas was of a more faltering character, but in the north it was the real thing with a long spell of skating. If there ever was an "old-fashioned Christmas" in Scotland it was surely that of 1925.

The above list does not, of course, include every spell of frost and snow, because these occur every year, but only the more prominent.

It seems to me that the picture it gives is about what should be expected in a country where, after all, rainy south-westerly winds off a warm ocean being normal, frosts must necessarily, as a rule, be of short duration.

In addition, I would draw attention to the relatively large number of skating frosts which November has provided in the first quarter of this century, to wit 1904, 1910, 1915, 1919, 1921, 1923, and 1925 in many parts of England, if not in London. In Scotland the frost in the first half of November, 1919 was extraordinarily intense, not only for the first half of that month, but for any time of the year.

Finally in bleak springs I think this century has been very liberal when one recalls the furious snowstorms in the following Aprils, 1903, 1908, 1911, 1917 and 1919, not to mention the Marches which are too much the rule.

L. C. W. BONACINA.

27, Tanza Road, Hampstead, N.W. 3. March 22nd, 1927.

NOTES AND QUERIES

Ground Frosts

At stations which report in connexion with the daily weather service the grass minimum thermometer is read at 7h. and the number of ground frosts in the climatological summaries from these stations is based upon the 7h. observations.

Questions have been raised from time to time as to the number of ground frosts which are not recorded on this basis but which would have been recorded had the thermometers been read at 9h. or some later hour. A summary has accordingly been prepared for the year 1926 based upon readings of the grass minimum thermometer made both at 7h. and 9h. at four observatories, Kew, Aberdeen, Valentia, and Eskdalemuir.

The following table shows the number of ground frosts actually recorded from the observatories at 7h. and the additional number which would have been recorded if the observations had been made at 9h. The second part of the table shows the number of

occasions on which the readings at 7h. and 9h. were identical, the number of occasions on which they differed by less than 1°F , between 1°F and 2°F , and so on. It will be seen from the table that observations at 9h. would have given only one more ground frost than observations at 7h. except at Aberdeen where there would have been two more. The readings at 7h. and 9h. are identical in more than 90 per cent. of the days. The readings of the grass minimum thermometer at 7h. may therefore be regarded as satisfactory for the computation of the number of ground frosts.

	Number of Ground Frosts at 7h.	Additional Ground Frosts at 9h.	Number of occasions of differences between 7h. and 9h. readings.				
			0°0'	0°1'–1°0'	1°1'–2°0'	2°1'–3°0'	3°1' or more
Aberdeen ...	84	2	346	12	3	3	1
Kew ...	82	1	333	14	8	7	3
Valentia ...	16	1	341	11	8	4	1
Eskdalemuir...	104	1	336	13	12	2	2

Stands for Stevenson Screens

The particulars published by the Meteorological Office in the past relating to the construction of the Stevenson screen specify that the stand should be made of oak. This material is not, however, suitable for use in the tropics, and attention has been given recently to the development of an all-metal stand suitable for general adoption. Before a change could be made it was necessary to make certain that the substitution of steel for wood did not affect the records of temperature in the Stevenson screen. A trial was, therefore, made at Kew Observatory, a comparison over several months being made between the readings of thermometers in screens supported on oak and steel stands respectively. The results showed no differences which could be attributed to the stands. It may be mentioned incidentally that the thermal capacity of a steel stand may be made very much less than that of the ordinary oak stand. Had any difference been found, therefore, it might have been expected that the readings in a screen on a steel stand would agree more closely with the actual conditions than those in a screen on a wooden stand.

Apart from the question of durability a steel stand has many advantages over a wooden one. Its bulk is much less and it is easier to assemble. It is not likely to warp and disturb the adjustment of the screen after erection and it can, if desired, be easily bedded in concrete. Stands for large and ordinary size screens can be made of similar design, the only difference

required being in the lengths of the cross pieces which connect the two ends.

A number of steel stands have now been obtained for use with the large Stevenson screen. They consist simply of four uprights of $1\frac{1}{4}$ inch by $\frac{3}{16}$ inch angle iron connected by cross pieces of similar material at the top and bottom. Diagonal rods of mild steel strip, 1 inch by $\frac{1}{8}$ inch, are provided on the sides and ends for stiffening purposes, and square foot-plates are attached to each leg to give a firm base in the ground. The ends are supplied as complete units rivetted together, the front cross piece and tie rods being supplied loose with the necessary bolts and screws for assembling at the station. The stands will be painted white and will certainly not be less attractive in appearance than the ordinary form of oak stand.

Radiation from the Sky

RADIATION MEASURED AT BENSON, OXON, 1927.

Unit: one gramme calorie per square centimetre per day.

ATMOSPHERIC RADIATION only (dark heat rays)				
Averages for Readings				
		Jan.	Feb.	Mar.
Cloudless days:—				
Number of readings ...	n	7	8	3
Radiation from sky in zenith ...	πI	390	390	452
Total radiation from sky ...	J	410	419	488
Total radiation from horizontal black surface on earth ...	X	607	652	742
Net radiation from earth ...	$X-J$	197	233	254
DIFFUSE SOLAR RADIATION (luminous rays).				
Averages for Readings between 9 h. and 15 h. G.M.T.				
Cloudless days:—				
Number of readings ...	n_0	0	3	3
Radiation from sky in zenith ...	πI_0	..	17	37
Total radiation from sky ...	J_0	..	28	59
Cloudy days:—				
Number of readings ...	n_1	0	2	2
Radiation from sky in zenith ...	πI_1	..	35	40
Total radiation from sky ...	J_1	..	29	37

Unit for I = gramme calorie per day per steradian per square centimetre.

Unit for J and X = gramme calorie per day per square centimetre.

For description of instrument and methods of observation, see *The Meteorological Magazine*, October, 1920, and May, 1921.

The Autumnal Land Breeze

The Meteorological Office circular, No. 42 (December, 1919), contains a paragraph headed "The Autumnal Land Breeze," in which it is shown that clear indications of the prevalence of a flow of air towards the Irish Sea were to be found in the *Weekly Weather Reports* for October of that year. It was explained that in addition to the absence of a general circulation a necessary condition for the development of a continuous land breeze is that the temperature of the sea water should be higher than the maximum reached by the air over the land during the day.

A week in which the necessary conditions were well developed was the week ending October 23rd, 1926, when the mean temperature over the British Isles was 9° F. below the normal for the week, the mean maximum for the week did not reach 50° F. in any district except the Channel Islands, and mainly anticyclonic conditions prevailed.

The following are the frequencies of the components of wind direction and the mean value of the velocities at Holyhead, Kingstown (near Dublin) and Valentia, based on the anemometer records at 3h, 9h, 15h and 21h, each day of the week.

Com- ponent	Holyhead.		Kingstown.		Valentia.	
	Frequency.	Mean Value mi/hr.	Frequency.	Mean Value mi/hr.	Frequency.	Mean Value mi/hr.
South	13	4	6	3	2	2
North	8	11	17	6	22	4
West	3	8	20	7	3	5
East	21	9	7	10	24	9

The prevalence of the west component in the wind direction at Kingstown compared with the other two stations is very marked. Isobars based on the mean pressure for the week at telegraphic stations show an average gradient for easterly winds across the Irish Sea.

The same phenomenon is to be found in other cold weeks in the autumn since 1919, *e.g.*

Week ending November 12th, 1921, mean temperature over the British Isles 7° F. below normal.

		Holyhead.	Kingstown.	Valentia.
Frequency of	West Component ..	9	18	4
	East Component ..	13	3	20

Week ending November 24th, 1923, mean temperature over the British Isles 6° F. below normal.

		Holyhead.	Kingstown.	Valentia.
Frequency of	West Component ..	13	26	6
	East Component ..	8	0	16

Week ending November 21st, 1925, mean temperature over the British Isles 5° F. below normal.

		Holyhead.	Kingstown.	Valentia.
Frequency of	West Component ..	0	5	0
	East Component ..	26	12	14

As a contrast to these conditions may be cited the week ending July 17th, 1926, when the mean temperature over the British Isles was 6° F. above normal, the mean minimum for England northwest (including North Wales) 59.8° F., for the South of Ireland 59.5° F., and the mean temperature of the Irish Sea for July 58° F.

		Holyhead.	Kingstown.	Valentia.
Frequency of	West Component ..	15	5	6
	East Component ..	8	21	14

M. T. SPENCE.

Geophysical Work in Greenland

On May 25th an expedition of the Topographical Section of the Danish General Staff left for Greenland under the leadership of Captain F. C. Jørgensen. The main purpose of the expedition is to survey Greenland, and its headquarters will be at Disko Island, but a wireless station is to be erected at Scoresby Sound in latitude 70° N. on the east coast, where seismological and meteorological observations will be carried on. This will be a valuable addition to the network of Arctic reporting stations.

New Geophysical Magazine

The Central Meteorological Observatory of Japan has recently issued the first two numbers of a new journal entitled the *Geophysical Magazine*, which is to be devoted to geophysics, including meteorology, terrestrial magnetism and atmospheric electricity.

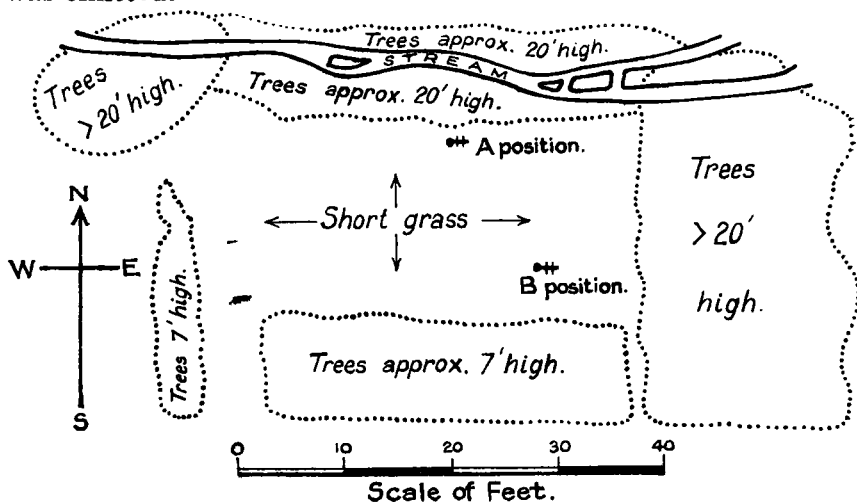
In the preface to the first number Prof. T. Okada gives as the reason for adding another to the series of journals issued by the Central Meteorological Observatory, that hitherto most of the papers published by the members of the Japanese weather service, although of much interest to European meteorologists, have been unnoticed simply because they are written in a language not easily intelligible to western people. To remedy this defect and so help towards a better understanding between European and Japanese meteorologists this magazine will contain short notes and abstracts in English, French or German, of the papers published by the members of the Japanese weather service. Longer memoirs will continue to be printed in the *Bulletin of the Central Meteorological Observatory* and other publications.

The first number of the magazine contains four papers, none of

which are of direct meteorological interest, but the second number includes a paper by T. Utumi, giving a "Statistical proof of Okada's law on the behaviour of cyclones and anti-cyclones."

Erratum

We regret that the following diagram illustrating the article on "Comparison of Grass Minimum Thermometer Readings at South Farnborough," on page 93 of the May magazine, was omitted.



Reviews

Solar activity and long-period weather changes. By Henry Helm Clayton. Washington, D.C., Smiths. Inst. Misc. Coll. Vol. 78, No. 4. 1926.

In this paper Mr. Clayton returns to the subject of the connexion between variations of the solar constant, as observed at the Smithsonian Astrophysical Observatories, and terrestrial weather, dealing now with monthly averages instead of with the individual daily observations. The first method adopted to demonstrate a relationship is briefly as follows: The monthly means of solar radiation for the years 1918 to 1924 are classed as low (1911—1930), medium, and high (1951—1960). For a number of stations in North America the average deviations of temperature from normal were calculated for the months of low solar radiation, for one and two months before low solar radiation, and for one to twelve months after low solar radiation. To eliminate secular and long-period variations each of these fifteen values was expressed as a deviation from the mean of the whole set of fifteen. The same procedure was then followed for the months of high solar radiation. The values of temperature

deviation for the months of low radiation and for one to four months following are then correlated with the corresponding values accompanying and following high radiation; this gives high negative coefficients. It is claimed that these sets of figures are "entirely independent of each other and there is no obvious reason why they should be correlated with each other except through their relation to solar values."

It is difficult to assign any meaning to correlation coefficients obtained from only five average values in this way, but apart from that, the statement that the figures are independent does not seem to be justified. The total number of observations used is not stated, but is presumably 84. Of these 27 are classed as low and 17 as high. Consider the following procedure: 84 numbers are taken at random and their average value found. Of these 84 numbers, 27 are selected, again at random, and their mean expressed as a deviation from the mean of the whole 84; call this set A. From the remaining 57 numbers, set B, of 17 numbers, is selected, again at random, and its mean expressed as a deviation from the average of the whole 84. If most of the high numbers happen to be included in set A, so that its deviation is positive, the chances are that the deviation of set B will be negative and *vice versa*. If the whole procedure is repeated several times, the deviations of the A's would have a negative correlation with the deviations of the B's, which would probably be .3 or .4. The coefficients obtained by Mr. Clayton are much higher than this, indicating that there is probably some relationship, but the method of correlation does not seem to be the best way to express it.

From this part of the work Mr. Clayton concludes that "there are two pulses accompanying and following each high and low solar value, (1) a rise or a depression of temperature accompanying the high or low solar value, and (2) a similar departure about three months later."

Deviations from normal are next calculated for pressure, temperature and rainfall, winter and summer being considered separately, for the months of low and high solar radiation, and the differences high—low were obtained, data from 47 American stations being utilised. It is believed that there is a relation between sunspot numbers and solar radiation, and in order to check the results obtained from the latter, the deviations from normal of pressure, temperature and rainfall accompanying low, medium and high sunspot numbers since 1856 are obtained for the same stations, together with the differences, high—low. These two similar investigations gave for winter and for summer, for each element, some 47 pairs of differences, one of each pair referring to extreme values of solar radiation, the other to extreme values of sunspots for a much longer period. For each

half-year and element, the two sets of differences are then correlated, giving the following coefficients :—

pressure	..	winter	+ .56	summer	+ .45
temperature	..	winter	+ .62	summer	+ .50

The correlation coefficients for the rainfall differences are not given, but the results for pressure and temperature do seem to be significant, and to bear the interpretation which Mr. Clayton puts upon them, namely, "that higher solar-radiation values prevail at times of numerous sunspots, and that definite geographically located weather changes attend changes in the solar activity, whichever measure of it we employ."

The remainder of the paper is devoted to the further discussion of the geographical aspect, to the annual variation of the relationships, and to answering various objections which have been raised against previous work on the subject.

C. E. P. B.

Om Isforholdene i Danske Farvande, Aarene 1861-1906. By C. I. H. Speersneider. Size 10×7, pp. 83, Copenhagen. Publikationer fra Det. Danske Meteorologiske Institut, Meddelelser Nr. 6.

This paper contains a summary of ice conditions in the western Baltic and the waters east of Denmark from the year 1861 to 1906 as well as a table giving the ice conditions in the Sound from 1861 to 1926. This summary is also generalised under the different geographical localities and the formation of ice in the different channels is discussed. The author points out an interesting process of ice formation, namely, "Subsurface" ice. In the Kattegat after prolonged frost the salt water becomes very cold, but does not freeze on account of its high salinity. If, however, fresher water from the Baltic flows over this cold salt water, the under side of the fresher water is cooled down below freezing point, ice needles are formed out and rise from below to the surface, or under favourable conditions pancake ice may even be generated. The importance of this process is that owing to the rising of the ice, there is never any protecting sheet between the fresh and salt water, with the result that under the right conditions freezing is very extensive and rapid and may be even of considerable danger to small craft.

C.S.D.

Books Received

Apia Observatory, Samoa. Report for 1923, Wellington, 1926.

India Weather Review, annual summary for 1924.

Report on the Administration of the Meteorological Department of the Government of India in 1925-26, and a note on the long established Observatories of Madras and Bombay.

Report on Rainfall Registration in Mysore for 1925. By C. Seshachar, M.A., Bangalore, Govt. Press, 1926.

Meteorology in Mysore for 1925, being the results of observations at Bangalore, Mysore, Hassan and Chitaldrug. Thirty-third annual report. By C. Seshachar, M.A., Bangalore, 1926.

Obituary

Professor Edouard Brückner.—We regret to learn of the death of Professor Edouard Brückner, on May 21st, at the age of 64 years. Professor Brückner is well-known to all meteorologists from the weather cycle of about 35 years which bears his name, and which is probably the best-founded of all meteorological periodicities. It is stated that he discovered this cycle in 1887; apparently it was known several centuries before, for it is mentioned by Sir Francis Bacon, but until Brückner published in 1890 his noteworthy compilation "Klimaschwankungen seit 1700" it had never been scientifically demonstrated. Among his other meteorological publications may be mentioned his "Berichten über den Fortschritt der geographischen Meteorologie" (1891, 1894, 1899); "Einfluss der Schneedecke auf das Klima der Alpen" (1893) and "Klimaschwankungen 1813—1912 in Vorderindien" (1918).

E. Brückner was born at Jena on July 29th, 1862, his father being Alexander Brückner the historian, which perhaps accounts for his able treatment of historical sources in "Klimaschwankungen." He received the degree of Ph.D. at Munich in 1885, and from 1886 to 1888 he was assistant editor of the *Meteorologische Zeitschrift*. His work was not mainly meteorological however, for in 1891 he became Professor of Geography at Bern, and in 1906 Professor of Geography at Vienna, which post he held until his death, and he did a great deal to explore the boundary science of geology and meteorology which is known as palæoclimatology. He collaborated with A. Penck in studying the Quaternary history of the Alps, a fortunate association which produced "Die Alpen im Eiszeitalter," three large volumes published between 1901 and 1909, providing at once the first sure proof of the succession of glacial advances and retreats, a nomenclature which is firmly rooted in the literature of glaciology, and a model of painstaking exploration, critical comparison and lucid exposition.

The Weather of May, 1927

The weather of May was in general fair and cool in the north, rather warmer in the south. On the morning of the 1st severe frost was experienced in most places, the temperature falling to 18° F. in the screen at Eskdalemuir, and to 14° F. on the grass there and at Greenwich, but this was followed later in the week

by a change to fairer conditions with a marked rise in temperature in England and Ireland. Day temperatures between 70° and 80° F. occurred in many parts; 81° F. was recorded at Tottenham on the 7th, and 87° F. at Ford (Argyllshire) on the 8th. In the extreme northwest of Scotland, however, there was no rise, and day temperatures did not exceed 55° F. during this period. Thunderstorms occurred locally on several days and among the larger rainfall measurements were 66 mm. (2.58 in.) at Aasleagh (Mayo) on the 1st, and 31 mm. (1.22 in.) at Edinburgh on the 4th. After the 9th, the winds became temporarily more northerly, temperature dropped considerably and some sleet was experienced on the northeast coasts on the morning of the 13th. By the 14th, however, the approach of a depression off the Hebrides caused southwesterly winds and warmer generally unsettled weather. On the 16th, a thunderstorm at Rothesay was reported to be the most severe experienced at that station for over twenty years. A belt of high pressure subsequently extended across the British Isles giving a few days fine, sunny weather, with temperature rising to nearly 70° F. in some cases, but there was a renewal of unsettled conditions with rain locally by the 20th. Heavy rain again occurred on the 23rd when 41 mm. (1.61 in.) were measured at Ford (Argyllshire) and 38 mm. (1.50 in.) at Dungeon Ghyll (Westmoreland) on the 23rd. After this the weather was mainly fair until the end of the month, with local showers and cool northerly winds, except in the south, where the temperature varied a good deal, some high maxima being experienced on a few days, *e.g.*, 77° F. at London on the 24th, 74° at Southampton on the 25th, and 71° F. at London and South Farnborough on the 30th. The total sunshine was well below the average in the north but somewhat above it in the south.

Pressure was above normal in a belt extending from Greenland across the British Isles to the western Mediterranean, the greatest excess being 5.1 mb. at Seydisfjord. Pressure was below normal over the North Atlantic from Newfoundland to Portugal and also over eastern Scandinavia. Temperature was above normal, except in Scotland and Scandinavia, and rainfall below normal, except in southern Sweden and Spitsbergen.

Heavy rain and thunderstorms about the 13th caused much damage in central Switzerland where several rivers overflowed their banks, and in consequence of the warm weather the road over the Simplon Pass was open much earlier than usual. Abnormally cold frosts at night damaged vineyards and orchards in Hungary about the middle of the month, and at the same time forest fires, fanned by high winds, were raging along the River Khilok (Siberia). On the 23rd, a severe storm occurred on the Adriatic, and on the same day heavy rain on the Serra da Estrella

(Continued on p. 124.)

Rainfall: May, 1927: England and Wales

CO.	STATION.	In.	mm.	Per- cent. of Av.	CO.	STATION.	In.	mm.	Per- cent. of Av.
<i>Lond.</i>	Camden Square	1.29	33	73	<i>War.</i>	Birmingham, Edgbaston	1.96	50	92
<i>Sur.</i>	Reigate, The Knowle . .	1.14	29	67	<i>Leics</i>	Thornton Reservoir . .	1.34	34	67
<i>Kent.</i>	Tenterden, Ashenden . .	.60	15	38	"	Belvoir Castle . . . . .	.79	20	37
"	Folkestone, Boro. San. . .	...	...	...	<i>Rut.</i>	Ridlington . . . . .	.88	22	...
"	Margate, Cliftonville . .	.47	12	30	<i>Linc.</i>	Boston, Skirbeck	1.06	27	60
"	Sevenoaks, Speldhurst . .	1.28	33	...	"	Lincoln, Sessions House	1.00	25	53
<i>Sus.</i>	Patching Farm	1.10	28	59	"	Skegness, Marine Gdns.	.78	20	46
"	Brighton, Old Steyne . .	.99	25	61	"	Louth, Westgate	1.02	26	50
"	Tottingworth Park . . . .	.73	19	41	"	Brigg . . . . .	.93	24	50
<i>Hants</i>	Ventnor, Roy. Nat. Hos. .	.62	16	36	<i>Notts.</i>	Worksop, Hodsock	1.10	28	55
"	Fordingbridge, Oaklands .	.80	20	38	<i>Derby</i>	Mickleover, Clyde Ho. .	1.92	49	97
"	Ovington Rectory	1.13	29	52	"	Buxton, Devon. Hos. . .	1.59	41	51
"	Sherborne St. John	1.71	43	88	<i>Ches.</i>	Runcorn, Weston Pt. . .	1.34	34	58
<i>Berks</i>	Wellington College	1.12	28	60	"	Nantwich, Dorfold Hall	1.52	39	...
"	Newbury, Greenham . . .	1.57	40	84	<i>Lancs</i>	Manchester, Whit. Pk. . .	1.41	36	67
<i>Herts.</i>	Benington House . . . .	.96	25	51	"	Stonyhurst College . . .	1.24	31	44
<i>Bucks</i>	High Wycombe	1.41	36	80	"	Southport, Hesketh Pk .	1.18	30	56
<i>Oxf.</i>	Oxford, Mag. College . . .	.86	22	48	"	Lancaster, Strathspey . .	1.91	49	...
<i>Nor.</i>	Pitsford, Sedgebrook . . .	.94	24	49	<i>Yorks</i>	Wath-upon-Deerne . . . .	.97	25	48
"	Uundle . . . . .	.63	16	...	"	Bradford, Lister Pk. . . .	1.38	35	66
<i>Beds.</i>	Woburn, Crawley Mill . .	.70	18	36	"	Oughtershaw Hall	2.55	65	...
<i>Cam.</i>	Cambridge, Bot. Gdns. . .	...	...	...	"	Wetherby, Ribston H. . .	1.72	44	83
<i>Essex</i>	Chelmsford, County Lab . .	.95	24	66	"	Hull, Pearson Park . . . .	.85	22	44
"	Lexden, Hill House . . . .	.70	18	...	"	Holme-on-Spalding	1.16	29	...
<i>Suff.</i>	Hawkedon Rectory . . . .	.49	12	26	"	West Witton, Ivy Ho. . .	2.05	52	...
"	Haughley House . . . . .	.53	13	...	"	Felixkirk, Mt. St. John .	1.77	45	94
<i>Norfol.</i>	Beccles, Geldeston . . . .	.42	11	24	"	Pickering, Hungate . . .	1.07	27	...
"	Norwich, Eaton . . . . .	.63	16	33	"	Scarborough . . . . .	.94	24	49
"	Blakeney . . . . .	.74	19	47	"	Middlesbrough	1.66	42	86
"	Little Dunham . . . . .	.76	19	39	"	Baldersdale, Hury Res. .	1.92	49	...
<i>Wilts.</i>	Devizes, Highclere . . . .	.92	23	51	<i>Durh.</i>	Ushaw College	1.67	42	77
"	Bishops Cannings	1.09	28	56	<i>Nor.</i>	Newcastle, Town Moor . .	1.52	39	75
<i>Dor.</i>	Evershot, Melbury Ho. . .	1.39	35	68	"	Bellingham, Highgreen .	2.10	53	...
"	Creech Grange	1.31	33	...	"	Lilburn Tower Gdns. . . .	1.89	48	...
"	Shaftesbury, Abbey Ho. .	1.59	41	75	<i>Cumb.</i>	Geltsdale	2.66	68	...
<i>Devon</i>	Plymouth, The Hoe . . . .	.38	10	18	"	Carlisle, Scaleby Hall . .	1.98	50	83
"	Polapit Tamar . . . . .	.83	21	41	"	Seathwaite M. . . . .	...	...	...
"	Ashburton, Druid Ho. . .	.68	17	25	<i>Glam.</i>	Cardiff, Ely P. Stn. . . .	1.66	42	66
"	Cullompton . . . . .	.60	15	28	"	Treherbert, Tynywaun .	3.83	97	...
"	Sidmouth, Sidmount . . .	.76	19	39	<i>Carm</i>	Carmarthen Friary	2.05	52	74
"	Filleigh, Castle Hill . . .	1.26	32	...	"	Llanwrda, Dolaucothy . .	2.16	55	64
"	Barnstaple, N. Dev. Ath. .	.99	25	48	<i>Pemb.</i>	Haverfordwest, School . .	1.44	37	58
<i>Corn.</i>	Redruth, Trewirgie	1.02	26	44	<i>Card.</i>	Gogerddan	2.34	59	89
"	Penzance, Morrab Gdn. . .	.99	25	45	"	Cardigan, County Sch. . .	2.03	52	...
"	St. Austell, Trevarna . . .	.76	19	31	<i>Brec.</i>	Crickhowell, Talymaes . .	2.00	51	...
<i>Somis</i>	Chewton Mendip	1.40	36	51	<i>Rad.</i>	Birm. W. W. Tyrmynydd .	2.11	54	62
"	Street, Hind Hayes	1.68	43	...	<i>Mont.</i>	Lake Vyrnwy	2.32	59	74
<i>Glos.</i>	Clifton College	1.04	32	50	<i>Denb.</i>	Llangynhafal	1.74	44	...
"	Cirencester, Gwynfa . . .	1.10	28	53	<i>Mer.</i>	Dolgelly, Bryntirion . . .	2.69	68	81
<i>Here.</i>	Ross, Birchlea	1.04	26	49	<i>Carn.</i>	Llandudno	1.26	32	66
"	Ledbury, Underdown . . .	.98	25	48	"	Snowdon, L. Llydaw 9 . .	4.97	126	...
<i>Salop</i>	Church Stretton	1.28	33	50	<i>Ang.</i>	Holyhead, Salt Island . .	1.13	29	58
"	Shifnal, Hatton Grange . .	1.40	36	68	"	Lligwy . . . . .	.81	21	...
<i>Staff.</i>	Tean, The Heath Ho. . . .	...	...	...	<i>Isle of Man</i>	Douglas, Boro' Cem. . . .	...	...	...
<i>Worc.</i>	Ombersley, Holt Lock . . .	1.43	36	70	<i>Guernsey</i>	St. Peter P't. Grange Rd .	.81	21	48
"	Blockley, Upton Wold . . .	1.43	36	66					
<i>War.</i>	Farnborough	1.04	26	46					

Rainfall: May, 1927: Scotland and Ireland

CO.	STATION	In.	mm.	Per- cent. of Av.	CO.	STATION.	In.	mm.	Per- cent. of Av.
<i>Wigt.</i>	Stoneykirk, Ardwell Ho	1.55	39	62	<i>Suth.</i>	Loch More, Achlary...	5.42	138	123
"	Pt. William, Monreith.	2.71	69	...	<i>Caith.</i>	Wick	2.07	53	100
<i>Kirk.</i>	Carsphairn, Shiel.	4.28	109	...	<i>Ork.</i>	Pomona, Dcerness	1.83	46	92
"	Dumfries, Cargen	2.65	67	88	<i>Shet.</i>	Lerwick	1.84	47	88
<i>Roxb.</i>	Branxholme	1.30	33	58					
<i>Seik.</i>	Ettrick Manse	3.73	95	...	<i>Cork.</i>	Caheragh Rectory	1.84	47	...
<i>Berk.</i>	Marchmont House	2.78	71	113	"	Dunmanway Rectory.	3.01	76	89
<i>Hadd.</i>	North Berwick Res.	1.57	40	79	"	Ballinacurra	2.04	52	86
<i>Midl.</i>	Edinburgh, Roy. Obs. .	2.10	53	112	"	Glanmire, Lota Lo. ...	2.29	58	94
<i>Lan.</i>	Biggar .....	...	...	...	<i>Kerry</i>	Valentia Obsy.	2.34	59	74
"	Leadhills .....	...	...	...	"	Killarney Asylum	1.63	41	53
<i>Ayr.</i>	Kilmarnock, Agric. C. .	1.96	50	85	"	Darrynane Abbey	2.58	66	87
"	Girvan, Pinmore	2.83	72	95	<i>Wat.</i>	Waterford, Brook Lo. .	1.87	47	81
<i>Renf.</i>	Glasgow, Queen's Pk. .	2.26	57	93	<i>Tip.</i>	Nenagh, Cas. Lough ...	1.62	41	66
"	Greenock, Prospect H. .	4.23	107	123	"	Roscrea, Timoney Park	1.13	29	...
<i>Bute.</i>	Rothsay, Ardenraig. .	4.20	107	139	"	(ashel, Ballinamona ..	1.05	27	44
"	Dougarie Lodge	3.31	84	...	<i>Lim.</i>	Foynes, Coolnanes	1.64	42	70
<i>Arg.</i>	Ardgour House	4.50	114	...	"	Castleconnell Rec.	1.48	38	...
"	Manse of Glenorchy. .	4.62	117	...	<i>Clare</i>	Inagh, Mount Callan .	2.95	75	...
"	Oban	2.74	70	...	"	Broadford, Hurdlest'n.	1.27	32	...
"	Poltalloch	3.65	93	126	<i>Wexf.</i>	Newtownbarry	1.54	39	...
"	Inveraray Castle	4.96	126	126	"	Gorey, Courtown Ho. .	1.52	39	68
"	Islay, Eallabus	3.19	81	120	<i>Kilk.</i>	Kilkenny Castle	1.41	36	64
"	Mull, Benmore	7.90	201	...	<i>Wic.</i>	Rathnew, Clonmannon .	1.21	31	...
<i>Kinn.</i>	Loch Leven Sluice	2.32	59	95	<i>Carl.</i>	Hacketstown Rectory .	1.64	42	63
<i>Perth</i>	Loch Dhu	3.60	91	80	<i>QCo.</i>	Blandsfort House	1.45	37	60
"	Balquhider, Stronvar. .	2.57	65	...	"	Mountmellick	1.13	29	...
"	Crief, Strathearn Hyd. .	2.03	52	82	<i>KCo.</i>	Birr Castle .....	.79	20	35
"	Blair Castle Gardens .	2.41	61	119	<i>Dubl.</i>	Dublin, FitzWm. Sq. .	.77	20	38
<i>Forf.</i>	Kettins School	2.51	64	103	"	Balbriggan, Ardgillan .	1.09	28	52
"	Dundee, E. Necropolis .	2.39	61	114	<i>Me'th</i>	Beauparc, St. Cloud ..	1.77	45	...
"	Pearsie House	2.37	60	...	"	Kells, Headfort	1.57	40	58
"	Montrose, Sunnyside. .	...	...	...	<i>W.M.</i>	Moate, Coolatore	1.38	35	...
<i>Aber.</i>	Braemar, Bank	1.64	42	69	"	Mullingar, Belvedere .	1.32	34	54
"	Logie Coldstone Sch. .	2.00	51	80	<i>Long</i>	Castle Forbes Gdns. ...	1.55	39	60
"	Aberdeen, King's Coll. .	2.58	66	111	<i>Gal.</i>	Ballynahinch Castle .	2.40	61	67
"	Fyvie Castle	3.51	89	...	"	Galway, Grammar Sch. .	1.73	44	...
<i>Mor.</i>	Gordon Castle	2.44	62	115	<i>Mayo</i>	Mallaranny	2.03	52	...
"	Grantown-on-Spey	4.11	104	176	"	Westport House	2.15	55	75
<i>Na.</i>	Nairn, Delnies	2.30	58	72	"	Delphi Lodge	4.17	106	...
<i>Inu.</i>	Ben Alder Lodge .....	...	...	...	<i>Sligo</i>	Markree Obsy.	2.02	51	72
"	Kingussie, The Birches	2.37	60	...	<i>Cav'n</i>	Belturbet, Cloverhill. .	1.49	38	60
"	Loch Quoich, Loan	5.00	127	...	<i>Ferm</i>	Enniskillen, Portora .	1.53	39	...
"	Glenquoich	4.89	124	90	<i>Arm.</i>	Armagh Obsy.	1.54	39	65
"	Inverness, Culduthel R.	1.93	49	...	<i>Doun</i>	Fofanny Reservoir ...	3.63	92	...
"	Arisaig, Faire-na-Squir	...	...	...	"	Seaforde	1.69	43	64
"	Fort William	3.11	79	78	"	Donaghadee, C. Stn. .	1.51	38	67
"	Skye, Dunvegan	2.97	75	...	"	Banbridge, Milltown .	1.38	35	61
"	Barra, Castlebay .....	...	...	...	<i>Antr.</i>	Belfast, Cavehill Rd. .	1.73	44	...
<i>R & C</i>	Alness, Ardross Cas. .	2.37	60	91	"	Glenarm Castle	2.74	70	...
"	Ullapool	2.00	51	...	"	Ballymena, Harryville	1.95	50	68
"	Torridon, Bendamph. .	4.64	118	162	<i>Lon.</i>	Londonderry, Creggan	1.45	37	55
"	Achnashellach	3.98	101	...	<i>Tyr.</i>	Donaghmore	2.06	52	...
"	Stornoway	1.81	46	71	"	Omagh, Edenfel	1.46	37	56
<i>Suth.</i>	Lairg	1.91	49	...	<i>Don.</i>	Malin Head	1.74	44	88
"	Tongue Manse	2.10	53	88	"	Dunfanaghy	1.25	32	48
"	Melvich School	2.62	67	128	"	Killybegs, Rockmount.	1.96	50	54

Climatological Table for the British Empire, December, 1926

STATIONS	PRESSURE		TEMPERATURE								PRECIPITATION			BRIGHT SUNSHINE		
	Mean of Day from M.S.L.	Diff. from Normal	Absolute		Mean Values				Mean Cloud Am't	Relative Humidity	Am't	Diff. from Normal	Days	Hours per day	Per- cent- age of possi- ble	
			Max.	Min.	Max.	Min.	1 max. and 2 min.	Diff. from Normal								Wet Bulb
London, Kew Obsy.	1026.5	+12.8	50	29	44.1	35.8	39.9	-0.4	37.7	6	-52	5	1.7	22		
Gibraltar	1020.4	+0.3	68	36	59.9	49.9	54.9	-1.1	48.8	9	-133	2	...	...
Malta	1015.0	+1.6	68	48	61.0	53.9	57.5	-0.4	53.5	51	-43	10	4.9	51		
St. Helena	1012.2	+1.4	69	55	62.7	56.1	59.4	-2.8	57.5	47	-3	17	...	...
Sierra Leone	1010.8	-0.1	90	70	87.5	74.4	80.9	-0.5	76.4	11	-25	2	...	...
Lagos, Nigeria	1008.1	-2.4	91	70	87.9	74.2	81.1	-0.4	75.8	2	18	1	...	...
Kaduna, Nigeria	1015.1	+2.3	95	52	88.8	57.7	73.3	0.0	58.6	0	0	0	...	...
Zomba, Nyasaland	1014.5	+0.4	92	48	81.8	51.4	66.6	-6.5	...	395	+123	26	...	...
Salisbury, Rhodesia	1007.6	+1.6	91	55	79.0	60.5	69.7	-0.1	63.8	211	+64	20	4.8	36		
Cape Town	1014.2	-0.1	90	47	77.6	58.7	68.1	+0.2	61.0	2	-19	1	...	...
Johannesburg	1010.4	-0.1	86	51	77.5	56.8	67.1	+2.0	58.0	115	-23	16	8.3	61		
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	96	48	87.8	58.9	73.3	+1.5	62.5	51	-11	9	...	...
Calcutta, Alipore Obsy.	1014.2	-1.5	83	55	77.8	58.8	68.3	+1.8	58.9	18	+13	2*	...	...
Bombay	1011.9	-1.6	87	65	84.7	69.2	76.9	-0.6	65.3	0	1	0*	...	...
Madras	1012.3	-1.2	87	58	84.8	67.4	76.1	-0.6	71.0	27	-121	3*	...	...
Colombo, Ceylon	1009.3	-1.4	90	69	86.9	72.8	79.9	+0.9	75.4	142	+10	12	8.2	70		
Hongkong	1019.8	+0.1	77	43	67.1	59.0	63.1	+0.1	57.6	12	-17	3	4.5	42		
Sandakan	...	...	88	73	85.4	74.8	80.1	0.0	76.5	1116	+667	25	...	...
Sydney	1012.4	+0.5	104	57	74.7	61.2	67.9	-2.2	63.2	188	+114	16	6.4	44		
Melbourne	1012.4	-0.1	98	46	77.6	55.3	66.5	+2.2	58.6	32	-27	9	6.7	51		
Adelaide	1012.8	-0.4	103	50	80.1	57.8	68.9	-2.2	57.6	35	+10	6	8.9	62		
Perth, W. Australia	1013.5	+0.3	102	50	83.5	60.4	71.9	+1.2	61.5	1	14	2	11.3	79		
Coalgardie	1012.5	+1.3	104	45	87.3	58.2	72.7	-3.1	57.4	11	-7	4	...	...
Brisbane	1011.4	-0.6	93	63	83.1	66.8	74.9	-1.5	68.2	241	+118	18	7.1	52		
Hobart, Tasmania	1010.5	+0.8	81	41	68.7	51.1	59.9	-0.5	54.5	34	-16	15	8.5	56		
Wellington, N.Z.	1014.4	+2.2	75	41	65.3	52.0	58.7	-1.7	55.8	96	+14	12	6.8	45		
Suva, Fiji	1010.5	+1.9	91	68	85.7	73.7	79.7	+0.8	74.3	119	-189	17	6.4	48		
Apia, Samoa	1009.8	+1.4	89	73	84.8	74.9	79.9	+0.6	77.4	555	+209	22	5.6	44		
Kingston, Jamaica	1014.0	+0.0	88	66	85.3	68.0	76.7	-1.0	66.6	21	-20	2	9.6	86		
Grenada, W.I.	1012.2	+0.7	88	72	84.9	73.7	79.3	+1.2	73.7	50	-135	14	...	...
Toronto	1019.2	+1.8	43	-3	30.1	17.8	23.9	-2.3	21.4	37	-35	14	2.1	23		
Winnipeg	1017.5	-0.4	35	-28	10.9	-3.7	3.6	-2.1	2.0	107	+1	0	2.9	35		
St. John, N.B.	1014.0	-0.2	43	-4	28.3	13.9	21.1	-3.3	17.7	107	+1	17	3.7	42		
Victoria, B.C.	1017.5	+0.7	55	19	45.2	37.7	41.5	0.0	39.5	99	-51	20	1.2	14		

*For Indian stations a rain day is a day on which 0.1 in. (2.5 mm.) or more rain has fallen.

Climatological Table for the British Empire for the Year 1926

STATIONS	PRESSURE		TEMPERATURE						Mean Cloud Amt.	PRECIPITATION		BRIGHT SUNSHINE			
	Mean of Day M.S.L. Normal	Diff. from Normal	Absolute		Mean Values					Rela- tive Humi- dity %	Amt.	Diff. from Normal	Days	Hours per day	Per- cent- age of pos- si- ble.
			Max.	Min.	Max.	Min.	1 max. 2 min.	Mean Wet Bulb.							
London, Kew Obsy. . .	1014.8	- 0.6	85	18	57.4	44.5	50.9	+ 1.2	46.2	7.2	603	- 3	162	3.6	30
Gibraltar.	1017.7	- 0.2	90	36	70.7	59.0	64.9	+	57.8	5.1	664	-245	77	...	...
Malta	1016.0	+ 0.1	89	45	70.6	61.6	66.1	0.0	61.9	4.6	354	-150	58	8.0	66
St. Helena	1014.2	+ 2.8	76	50	63.8	57.1	60.4	- 1.6	58.5	3.9	745	-273	219	...	...
Sierra Leone	1012.1	+ 0.7	95	69	87.5	74.0	80.7	0.0	75.4	5.5	3285	-708	170	...	...
Lagos, Nigeria	1009.7	- 1.7	93	68	86.6	75.4	81.0	+ 0.5	76.4	7.8	1931	+111	128	...	...
Kaduna, Nigeria	1013.7	+ 1.3	103	...	88.7	...	...	...	65.7	2.5	1771	+521	121	...	...
Zomba, Nyasaland . . .	1019.1	+ 0.8	95	46	79.8	58.7	69.3	- 0.1	...	6.2	1985	+628	138	...	...
Salisbury, Rhodesia . .	1012.7	- 0.7	92	35	78.0	53.9	66.0	+ 0.7	58.0	3.7	889	+ 77	96	7.9	66
Cape Town	1018.1	+ 1.1	98	35	71.4	53.2	62.3	0.0	55.4	4.3	505	-139	88	...	...
Johannesburg.	1016.6	+ 0.5	88	21	71.5	49.9	60.7	+ 1.2	51.0	2.4	699	-145	88	8.9	74
Mauritius . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloufontein . . . . .	...	...	101	12	76.2	46.2	61.2	- 0.2	51.2	2.9	510	- 85	57	...	...
Calcutta, Alipore Obsy. .	1007.7	+ 0.1	107	49	87.6	71.1	79.4	+ 0.7	71.9	5.4	1934	+345	89*	...	...
Bombay	1008.9	- 0.3	94	63	86.7	75.7	81.2	+ 0.7	73.3	4.1	1845	+ 12	83*	...	...
Madras	1009.0	+ 0.2	110	58	92.1	75.3	83.7	+ 0.7	75.8	5.7	798	-491	45*	...	...
Colombo, Ceylon	1009.6	- 0.4	93	66	87.5	75.1	81.3	+ 0.6	77.3	6.7	2667	+561	204	6.8	56
Hong Kong	1013.1	+ 0.5	93	43	76.0	68.2	72.1	- 0.2	67.6	7.6	2560	+428	139	5.0	41
Nandakan . . . . .	...	...	93	71	87.7	75.5	81.6	+ 0.3	76.7	...	3798	+758	149	...	...
Sydney	1015.1	- 0.8	108	42	72.5	56.4	64.4	+ 1.2	58.5	4.9	943	-273	127	7.0	58
Melbourne	1015.4	- 0.9	104	32	68.4	50.8	59.6	+ 1.2	53.4	6.7	521	-126	149	5.7	47
Adelaide	1016.4	- 0.6	104	37	72.9	53.3	63.1	+ 1.2	54.2	5.4	562	+ 23	116	7.4	60
Perth, W. Australia . .	1015.9	- 0.5	106	39	72.8	55.7	64.2	0.0	57.8	6.3	1250	+389	167	7.0	56
Coolgardie	1015.5	- 0.5	110	31	77.5	52.3	64.9	+ 0.4	53.8	4.9	241	- 17	57	...	...
Brisbane	1016.0	+ 0.2	97	41	79.1	60.4	69.8	+ 0.9	62.7	3.0	783	-350	106	8.2	68
Hobart, Tasmania	1011.5	- 1.1	91	31	62.6	47.4	55.0	+ 0.7	49.0	4.2	656	+ 54	187	6.2	50
Wellington, N.Z.	1013.9	- 0.8	81	32	61.5	49.2	55.4	+ 0.1	52.1	6.3	1076	-146	172	5.5	46
Suva, Fiji	1012.0	+ 0.6	91	62	81.6	71.6	76.6	- 0.4	72.9	7.2	2651	-203	219	4.9	41
Apia, Samoa	1010.6	+ 0.3	91	66	85.4	74.7	80.0	+ 1.5	76.9	5.9	2629	- 85	176	6.7	56
Kingston, Jamaica	1013.4	- 0.3	95	64	87.8	71.5	79.6	+ 0.3	70.4	3.5	500	-361	67	...	...
Grenada, W.I.	1013.6	+ 1.4	92	70	85.1	74.6	79.8	+ 1.0	75.2	5.5	1508	-426	199	...	...
Toronto	1014.9	- 1.5	91	- 5	51.5	36.1	43.8	+ 0.6	38.7	6.1	961	+111	163	5.3	43
Winnipeg	1015.6	- 0.6	98	- 29	46.0	27.0	36.5	- 2.2	...	5.7	441	- 93	91	5.6	43
St. John, N.B.	1012.5	- 2.2	83	-13	47.1	32.6	39.8	- 1.4	36.3	5.9	1345	+125	165	5.3	43
Victoria, B.C.	1016.8	+ 0.4	85	19	58.0	46.1	52.1	+ 2.6	48.3	6.6	535	-292	139	6.1	46

* For Indian stations a rain day is a day on which 0.1 in. (2.5 mm.) or more rain has fallen.

(Continued from p. 119.)

(Portugal) caused the mountain torrents to overflow and destroy many bridges and houses.

A sudden severe frost occurring unusually late in the year did much damage to the mulberry crops in central Japan about the 13th, and in India a gale lasting four hours severed communications and wrecked many buildings at Mussooree, United Provinces, on the 31st. A steamer plying between the islands of the Philippines was sunk during a typhoon on the 28th and 108 people were drowned.

Flood waters on the Assiniboine river swept away temporary dykes at Brandon, Manitoba, on the 3rd, the water rising 18 ins. in 24 hours. From then until the 16th, the Seine, Red, and Assiniboine rivers continued to rise and the floods extended, but by the 20th the water was gradually retreating and the weather had improved. Between the 20th and 24th, however, continuous heavy rain again occurred in most of the Prairie Provinces, causing much anxiety. The floods in the Mississippi basin continued throughout the month. Heavy rains occurred fairly frequently in this area and were probably partly responsible for the rises in the river which took place, according to the river stages table, even after the flood crest, which was just below Arkansas City on the 1st, had passed. Fresh breaches in the levees occurred almost every day; the levees at Bayou des Glaises were broken on the 13th, those at Melville on the 17th, and those at McCrea on the 24th, so that practically the whole of the "Sugar Bowl" area was inundated owing to these breaches on both sides of the Atchafalanga river. By the 23rd, the dreaded flood crest had disappeared from the Mississippi river and conditions were improving, but heavy rain in Ohio, Missouri, and the Upper Mississippi valleys, brought a second flood crest to the river and a new tide, though of smaller proportions than that of May, was sweeping southwards past Helena, Arkansas, on June 1st, and inundating thousands of acres again. On May 7th-9th, tornadoes swept across Arkansas, Missouri, Texas, and Illinois, and about 150 people were killed. After a long spell of dry weather light rain fell at Buenos Aires on the 23rd.

The special message from Brazil states that the rainfall was scarce over the whole country, being 60 mm., 41 mm. and 49 mm. below normal in the northern, central and southern districts respectively. The first frosts of the year occurred in the middle of the month. The crops were generally in good condition in spite of the lack of rain. Pressure at Rio de Janeiro was 0.7 mb. above normal and temperature normal.

Rainfall, May, 1927—General Distribution

England and Wales	..	56	} per cent. of the average 1881-1915.
Scotland	100	
Ireland	65	
British Isles	69	

<h1 style="margin: 0;">The Meteorological Magazine</h1>				
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The Manual of Meteorology, Vol. I. Meteorology in History*

By E. VAN EVERDINGEN

If I remember well, Sir Napier told us on a certain occasion that he had written Part IV. (Vol. IV.) of this *Manual* in reply to the simple question : If the wind at the surface is given, what is the wind in the upper air ? According to the preface of Vol. I., a more complicated problem presented itself here, and the author wants this Volume, (1) to serve as a textbook for students of meteorology ; (2) " to present the study of meteorology not only as making use of nearly all the sciences and most of the arts, but also as a world study of a special and individual character going back inevitably to the very dawn of history . . . , " and looking forward to the advantages to be derived from modern science ; (3) to serve as a stimulus for the scientific activity in meteorology on the part of the amateur.

It is not surprising that the size of the volume has grown accordingly, and yet the author has come to the conclusion that the thing really wanted would be an encyclopædia or dictionary in ten parts, one part to be brought up to date each year. That may be true, but we think many readers will prefer the present system, in spite of the fact that every condensation is to a certain extent arbitrary and must leave some categories more or less disappointed ; the admirably clear way in which the problems

* By Sir Napier Shaw, LL.D., Sc.D., F.R.S., with the assistance of Elaine Austin ; 8vo. 10½ × 7½, pp. xx+339, *Illus.* London : Cambridge University Press, 1926. 30s. net.

are indicated, the many reproductions of historical documents or typical diagrams and maps and the numerous references to the literature of the subject must cause this *Manual* to be looked upon as a treasure by all categories.

Chapter I., "Meteorology in European Culture," sketches the fluctuations in the interest attached to weather influences and to the study of the weather from the earliest times to the present moment, and the spreading of civilisation from ancient Egypt, nearly independent of "weather," over Europe where these influences are more and more important, so much so that for the author "weather" seems to be identical with changeable or bad weather ("Egypt, a genial climate and *no* weather.")

The following Chapters, II.-VII., together about 100 pages, and devoted to the history of meteorology before the invention of the barometer, therefore start with a description of Weather and Climate in the world as known to the ancients—but Chapter II. serves another useful purpose in explaining international weather symbols, instrumental and non-instrumental observations, and concludes with climatological tables for twelve stations round the Mediterranean with Richmond for comparison. An unusually large space is devoted to frequency of winds in four quadrants and moisture. Chapter III. gives a very thorough treatment of the measurement of time and the kalendar, enabling the correlation of old climatological data with the present kalendar, and ends with kalendar-reform and a recommendation of the May-year. No mention is made of the practice in many meteorological quarters to take December to February as the winter-season and so on, for which practice similar advantages may be claimed without the disadvantage of eliminating the month as a unit. Chapters IV.-V. illustrate applications of meteorology to agriculture and navigation by quotations from poets and historians and from Aristotle, the time-scale being indicated at the head of these Chapters by names and life-periods of classical authors or the times of origin ascribed to bible-books. In the same way Chapter VI. on the variability of the Mediterranean climate is headed by a list of geological periods or maxima and minima of rainfall and storminess according to Brooks, Brückner and Pettersson. The author's conclusion is that there is no evidence of a big variation in this climate, the diminution in the cultivated area being partly due to the irreversible action of transport of sand and soil. Chapter VII. deals with weather-lore, astrology and almanacs and is very effectively headed by the poem by Erasmus Darwin (translated in various languages), giving 35 signs of rain in 42 lines. The "wholesale adoption of previous ideas" by various writers is here taken as an indication that the maxims were in reasonably good accord with their experience—it might be ascribed likewise to a lack

of experience and of trustworthy statistics. Sir Napier mentions the small number of attempts to verify the signs quoted for instance in connexion with the popular belief in the moon as weather-agent. Here van Bebbber's "Handbuch der ausübenden Witterungskunde" and the literature on Falb's prognostics might have been quoted. The chapter concludes with the prospect of a certain justification of astrology through recent hypotheses on the influence of the planets on sunspot-activity.

Chapter VIII. "The reign of the barometer as weather-glass: Pioneers in the science of weather," is headed by the dates of the invention of the barometer, the gaseous laws, the laws of gravitation and motion and the law of conservation of energy and the discovery of the variation of temperature with height, the combination of the aspects of the laboratory with those of the atmosphere as a whole, necessary for the development of meteorology as a science. A sketch of this development is given in the form of 74 biographical notes from Bacon and Galilei to Mayer and Ferrel, Désains and Secchi, 24 among these treating of authors who wrote on meteorological theory. The sketch is completed by a list of the classical papers selected for reprinting by Hellmann. The use of the barometer and weather glass is illustrated by giving FitzRoy's instructions in detail. As a warning, a series of weather-maps is printed, indicating an increase of the wind at a certain station from light to gale force without any change in the barometer—only an example of the many instances in which local observations, however accurate, will fail to solve a problem which can only be approached by deriving the laws of the general circulation from an observation of the whole atmosphere as far as accessible. This leads up to Chapter IX., "Meteorology as an international Science: the Meteorological Library." The historical line is continued by mentioning the successive Chiefs of the more important meteorological Institutes all over the world, and the Officers of the International Meteorological Organisation: it is illustrated by many portraits of famous meteorologists and two Conference-groups.

The first proposals for a Réseau Mondial mark a new era, and international co-operation has been improved continuously—the author's view of the future is expressed as follows:—

"This (the next) step certainly involves an international weather-office with adequate funds to initiate and maintain observations which are not part of the economic necessities of any special country. . . . Hence we arrive at the idea not merely of an international bureau . . . but of a real international meteorological college where the meteorology of the globe can be studied and developed under conditions necessary for real success."

Chapters X. and XI. describe the Meteorological Observatory for the Surface Air and the Upper Air, the former preceded by an international list of instructions to observers, the latter by dates ranging from the first thermometer raised by kites in 1749 to the first pilot balloon ascent in 1909 and the portraits of physicists and meteorologists associated with upper air research.

The instrumental equipment of a modern surface-air observatory is described in detail, and the difficulties of reduction to standard exposure are mentioned. Reference to continental methods might have been more complete.

Cloud forms are discussed as an introduction to upper air research and represented by no less than 74 pictures, generally very well selected from various sources. In addition to the 10 international classes, lenticular clouds, cirro-nebula, alto-cumulus castellatus and pallio-nimbus are specially mentioned. A classification is proposed comprising unit-clouds, parts of these, assemblies (disorderly or in lines), one or two systems of parallel lines, stratified clouds and cloudiness without boundary.

Subsequent paragraphs treat measurement of cloud height and cloud motion, meteorological optics, pilot balloons and the various methods for upper air soundings, among which, however, the use of aeroplanes does not receive the attention which the present widespread application deserves.

Chapter XII., "The Meteorological Laboratory," is devoted to the instruments for exploring the energy changes in the atmosphere, measurement of radiation and relation of energy to wave-length, and includes visibility, dust counters, lightning conductors, atmospheric electricity and terrestrial magnetism.

Chapter XIII. discusses arithmetical and graphical manipulation of observational results, projections, logarithmic scales, isopleths, nomograms, wind-roses and vector-diagrams, periodicity and correlation. Chapter XIV. on "The Analysis of Air-movement into the General Circulation and the Cyclone" is headed by the dates of the first regular weather maps in various countries. The history of the development of synoptic meteorology is only briefly discussed, the reader being referred to Hildebrandsson and Teisserenc de Bort's *Les bases de la météorologie dynamique* for more detail. However, the reproduction of the first weather maps by Brandes (1820) and Buys Ballot (1852) and of two of the first British weather maps (1861 and 1863) is sufficient to give an idea of the progress which has been made since then.

The last, Chapter XV., "Meteorological Theory in History" is not much more than an index of memoirs, contained in Cleveland Abbé's translations of papers on dynamical meteorology, *Mémoires originaux*, selected by Marcel Brillouin, and a few others, selected by the author. The general remark is made that many of these theories have contributed little to the

development of our science because the authors chose the conditions such that they would fit their equations, instead of trying to describe the motion in such a way that the forces would be deduced from it.

From our brief sketch of the contents of this remarkable book it is evident that it covers the entire domain of meteorology, but that the history of the dawn of that science is treated more fully than its recent development, a more ample discussion of meteorological theory being reserved for Vol. III. The meteorological world is waiting anxiously for this volume, especially after the exposition of the principles which Sir Napier has laid down in this volume—may it be given to him to complete the whole work before long!

The Effects of Changing Temperature on the Readings of a Marine Barometer

By E. G. BILHAM, B.Sc., D.I.C.

When the readings of a barometer are corrected for temperature, it is necessary to assume that the mean temperature of the barometer is the same as that indicated by the attached thermometer, the latter having been corrected for any known thermometric error. When conditions are absolutely steady, there is no doubt as to the validity of this assumption. When the external temperature is changing, however, the temperature of the mercury, the tube, the case and the attached thermometer may all be different and there is, moreover, an additional complication due to the fact that marine barometers are fitted with capillary tubes or constrictions in order to damp the movement of the mercury. It is a matter of some importance, therefore, to ascertain (A) what sort of errors may occur, (B) what type of attached thermometer gives the nearest approach to the truth, when the temperature is changing.

The problem arose, primarily, in connexion with the design of the Gold correction slide for marine barometers. As this instrument may not be familiar to many readers of the *Meteorological Magazine*, some particulars of its construction will be given. It is well known, of course, that the readings of a mercurial barometer normally require correction for temperature, gravity, height above sea level and index error. If we assume for the moment that the index error is zero, it is clear that the corrections for gravity and height can be expressed in terms of equivalent variations of temperature. For example, raising a barometer 27 feet lowers the readings by one millibar, and exactly the same effect would be produced by cooling the whole barometer by about 6° C. Similarly, a change of latitude from 45° to 34°

is approximately equivalent to cooling the barometer 6° C. Now consider the attached thermometer. The ordinary process consists in reading the temperature and applying a correction, but it is clear that a scale of millibars could be provided to give the correction directly. In the Gold slide such a scale is provided and arrangements are made for moving it up or down to take account of the height and latitude. In this way the total correction may be read off opposite the top of the mercury in the attached thermometer without reference to tables. The instrument is supplied as a complete unit for attachment to a marine barometer in place of the ordinary attached thermometer, provision being made for making the necessary adjustment for index error.

It will be realised that there are important differences in design between the ordinary attached thermometer and the Gold slide. In the former, the bulb usually passes through an opening in the brass case of the barometer and lies fairly close to the barometer tube. In the latter, the bulb is more or less embedded in the substantial brass stock, and it might be expected, therefore, that there would be differences in the rapidity of response to variations of temperature. The experiments now to be described were made for the purpose of ascertaining what differences existed and which type of instrument gave the best results.

In the first experiment, two marine barometers, A.247 (with Gold slide) and A.301 (with ordinary attached thermometer)

Time from Start Minutes.	Room Temperature	Temperature by Gold Slide (G) (A.247)	Temperature by attached thermometer (A) (A.301)	G — A
0	292.4a.	306.3a.	306.3a.	0
2		304.4a.	302.5a.	1.9a.
4		302.8a.	300.7a.	2.1a.
6	292.6a.	301.6a.	299.5a.	2.1a.
8		300.3a.	298.3a.	2.0a.
10		299.4a.	298.1a.	1.3a.
12	292.9a.	298.7a.	297.7a.	1.0a.
17	293.3a.	297.3a.	296.8a.	0.5a.
22	293.3a.	296.0a.	295.9a.	0.1a.
32	293.3a.	295.0a.	295.0a.	0
42	293.5a.	294.1a.	294.6a.	—0.5a.
57	293.5a.	293.5a.	294.1a.	—0.6a.
72	293.5a.	293.5a.	293.8a.	—0.3a.
87	293.4a.	293.4a.	293.6a.	—0.2a.

were placed in a small room which had been warmed to a temperature of about 307° a. and allowed to remain there for an hour to ensure that conditions had become uniform. They were then quickly and simultaneously transferred to an adjoining room,

free from draughts, in which the temperature was initially 292.4a. Readings of the Gold slide thermometer on A.247 and of the attached thermometer of A.301 were then taken, first at intervals of one minute, subsequently at longer intervals, until both had reached final steady values. The results are summarised in the above table.

These results are distinctly remarkable and offer some features which are not easy to explain. In particular, the intersection of the cooling curves at 295.0a. is noteworthy. It seemed reasonable, however, to conclude that the Gold slide was less susceptible to rapid variations of external temperature than the ordinary attached thermometer, and was, therefore, likely to be a better index to the true barometric temperature. To test this conclusion, another experiment was made. The barometers were carefully compared with a standard barometer and then placed in the warming chamber, where, after a temperature of about 307a. had been maintained for about an hour, they were allowed to cool for fifteen minutes, the heat having been turned off. They were then brought into the cool room and readings both of the barometers and thermometers were taken at intervals. Each reading was reduced by the ordinary methods to the same conditions as the standard barometer (which was in a room on the floor below) and corrections were applied for index error. The reduced readings obviously constitute data from which the errors associated with the two types of thermometer may be compared. The results were as follows:—

Time from Start	A.247 (with Gold Slide)			A.301 (with attached thermometer)		
	Temperature	Barometer as read	Barometer Reduced	Temperature	Barometer as read	Barometer Reduced
min.	°a.	mbs.	mbs.	°a.	mbs.	mbs.
15	301.3	1018.0	1016.2	300.7	1018.2	1016.5
17	300.3	1017.9	1016.2	299.1	1018.2	1016.7
19	299.5	1017.7	1016.2	298.5	1018.1	1016.7
22	298.5	1017.6	1016.2	297.8	1018.0	1016.8
24	297.7	1017.6	1016.4	297.4	1017.7	1016.5
26	297.4	1017.5	1016.4	296.9	1017.6	1016.5
28	296.6	1017.4	1016.5	296.7	1017.6	1016.6
30	296.4	1017.3	1016.4	296.4	1017.5	1016.5
32	296.2	1017.2	1016.2	296.2	1017.4	1016.4
37	295.2	1017.0	1016.2	295.2	1017.2	1016.4
42	295.0	1016.9	1016.2	294.9	1017.1	1016.4
47	294.5	1016.9	1016.2	294.6	1017.0	1016.3
52	293.9	1016.9	1016.3	294.2	1016.9	1016.3
57	293.6	1016.8	1016.3	294.1	1016.8	1016.2
62	293.6	1016.6	1016.1	294.0	1016.6	1016.0

Reading of Standard (corrected for index error) = 1016.0 at 289.2a.

It will be seen that in both cases the reduced readings are too high, due to the fact that the thermometers were cooling more rapidly than the mass of the barometer. The errors are smaller in the case of the Gold slide, however, and it seems justifiable to conclude that a thermometer mounting of massive type and high thermal capacity is by no means disadvantageous. Another point to notice is that the errors are at a maximum from 20 to 30 minutes after cooling has begun. If, therefore, a barometer is brought from a warm room into a cold room, it is better to take a reading immediately than to wait half an hour. It is better still to wait an hour as conditions will have reached a steady state after that interval.

Official Publications

GEOPHYSICAL MEMOIRS—

No. 35. *A Comparison of the Records from British Magnetic Stations, Underground and Surface.* By C. Chree, Sc.D., LL.D., F.R.S., and R. E. Watson, B.Sc. (M.O. 286e).

Since March, 1918, a weekly bulletin has been published of two-hourly values of magnetic declination (pointing of the compass needle). Until the end of 1924, this was based on the records at Kew Observatory. The object of the present investigation was to shed light on the question of how far data from a station in the south of England are serviceable in other parts of Great Britain, especially in the mining areas. Results obtained in 1923, underground and at the surface of a coal mine at Sandwell Park, near Birmingham, are compared with synchronous results from Kew, Eskdalemuir and Lerwick observatories. A general tendency is observed in declination changes to increase in size as we go north. The increase in the regular changes on quiet days is small and near mid-winter may even become a decrease. But on highly disturbed days, or even on quieter days in the case of short period changes, the increase with latitude is rapid. The changes observed in the intensity of the horizontal force at Lerwick sometimes differed immensely both in amplitude and type from those elsewhere.

Royal Meteorological Society

The last monthly meeting of the Society for the present session was held on June 15th, at 49, Cromwell Road, South Kensington, Sir Gilbert Walker, C.S.I., F.R.S., President, in the Chair.

J. Edmund Clark, I. D. Margary and R. Marshall.—Report on the Phenological Observations in the British Isles, December, 1925, to November, 1926.

The thirty-sixth report of the new series deals with 373 sets

of records, a number greater than in any previous year. Yet large areas remain very meagrely represented, particularly the western halves of Ireland and Scotland, and all Scotland north of Inverness. Fresh observers in these districts would be warmly welcomed. Increasing public recognition of the interest and value of the work is evidenced by the co-operation of the Ministry of Agriculture, the response to the appeal for international work, and the fact that the first of six popular talks on Meteorology broadcasted from 2LO, was by Mr. Margary on Phenology and has brought in many valuable enquiries. The Report sketches the history of the Royal Meteorological Society's work from its inception in 1875 under the Rev. F. A. Preston, of Marlborough College, its re-organization in 1891 by Mr. E. Mawley, and its gradual development along the lines laid down by him. The present report shows that the five weeks cold spell preceding Christmas, 1925, retarded the first indications of the new season's growth, but this was quickly neutralised by warmth equally abnormal, culminating in the closing week of winter and continued on to give that most acceptable burst of summer at Easter. In consequence flower, bird and insect records were very early up to mid-April, notable being those of the arrival of cuckoo and swallow and flowering of hawthorn. Then everything was retarded by a prolonged spell of cold, worst about mid-May, injuring the fruit crop, particularly apples. June was cool and very dry and in many parts July brought a deluge. Yet in the end, field crops cheered farmers, being helped by a dry summer and fairly warm August, warm September and early October. Grain expectations however failed of full realisation upon threshing. Destructive mid-October frosts damaged late potatoes and practically wiped out autumn colouring. Very striking were the many records of the return after this of swallows and housemartins, often lingering all through November and in some cases into December.

G. C. Simpson, C.B., D.Sc., F.R.S.—Past Climates.

The paper discusses from the meteorological point of view the possible changes in climate which can be brought about by changes in the physical condition of the earth's surface—chiefly changes in the extent and distribution of the land masses and changes in their height—unaccompanied by any variation in solar radiation. It is shown that the zonal distribution of temperature cannot be materially changed and that there must always have been a cold polar zone, a warm tropical zone and an intermediate temperate zone, all very similar to those which exist to-day. Further a detailed examination of the existing variations in mean annual temperature along various circles of latitude leads to the conclusion that no rearrangement of land and water could have produced larger variations of mean annual

temperature than are to be found in the northern hemisphere to-day. A discussion of the existing sheet of inland ice which covers Greenland gives good reason for believing that the ice sheet which covered northwest Europe during the last great ice-age could not have been caused by the elevation of Scandinavia. Finally a discussion of the present conditions in tropical regions, where in the coldest parts the snow-line is to-day more than 5,000 metres above sea-level, leads to the conclusion that ice could never reach sea-level within the tropics.

H. M. Treloar, B.Sc.—The Variation of Eddy Viscosity with Wind Velocity and Season. A study based on pilot balloon observations at Melbourne.

Correspondence

To the Editor, *The Meteorological Magazine*

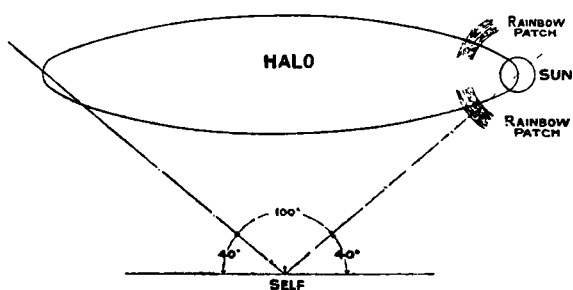
Halos in India

After reading your note about the parhelic circle, in the *Meteorological Magazine* for March 27th, p. 41, I have looked through the collection of optical phenomena in our annual publication. I find six or seven cases in 35 years in which part of the parhelic circle was seen without the common halo of 22° being visible, sometimes a tangent arc being present, sometimes a vertical column. But when the parhelic circle extended over a considerable azimuthal distance, always the ordinary circular halo was present also, as may be easily explained. Does the case quoted by you form an exception? Your correspondent does not say so in the extract of his letter. If he does not mention the ordinary halo it may be because that did not want any explanation.

E. VAN EVERDINGEN.

Koninklijk Nederlandsch Meteorologisch Instituut, De Bilt. April 2nd, 1927

[In view of Prof. van Everdingen's evidence for the uniqueness



of the phenomenon, we reproduce Mr. Sheriff's sketch. It will be seen that there is no indication of the occurrence of a circular halo round the sun. Moreover, the description "patches of

rainbow" is appropriate for parhelia rather than for little arcs of the 22° halo.—ED. M.M.]

Lightning Discharges

In the *Meteorological Magazine* for June, 1927, you published a letter from Professor McAdie in which he described the work of Mr. F. W. Peek, Jr., on "Lightning and other High Voltage Phenomena." Mr. Peek comes to the conclusion that the energy of a lightning discharge is 3.8 kilowatt hours; that is "sufficient to operate an electric toaster for a day." This estimate is so widely different from the one made by Professor C. T. R. Wilson* and generally adopted by workers in atmospheric electricity that attention must be called to the discrepancy. Professor Wilson, on sound physical reasoning, estimated the average energy of a lightning discharge to be 2,800 kilowatt hours, which is more than 700 times the value estimated by Mr. Peek. One lightning flash an hour, on Professor Wilson's estimate, would provide all the electrical power required by a modern industrial city of 100,000 inhabitants—24 million British thermal units per annum—thus a large generating station is more suitable for comparison with a thunderstorm than an electric toaster.

May I also point out that Mr. Peek's experiments on the chances of being struck by a lightning flash were made before the physics of a lightning flash had been worked out.† Mr. Peek does not differentiate between discharges from positively and negatively charged clouds, and his estimate of 300 metres as the height at which lightning discharges start is very much too low. Recent work indicates that in this respect also Mr. Peek's experiments are not satisfactory guides to the actual phenomena of thunderstorms.

G. C. SIMPSON.

June 25th, 1927.

The Gale at Tiree

The reading of 108 m.p.h. obtained at Tiree‡ on January 28th last within a few months of the commencement of wind records in the island was of exceptional interest and made one wonder whether the new station was going to beat all previous records for high winds. Some interesting light is thrown upon this point by the very large number of uprooted trees which have been noticed in the Loch Fyne and Oban districts during the course of a trip up the west coast of Scotland. The extent of the damage and its wide distribution shows that it was not the

* "Investigations on Lightning Discharges and on the electric field of thunderstorms," by C. T. R. Wilson. *London Phil. Trans.* A. Vol. 221, 1920, p. 73.

† "On Lightning." By G. C. Simpson. *London Proc. R. Soc. A.* Vol. 111, 1926, p. 56; and "The Mechanism of a Thunderstorm." By G. C. Simpson. *London Proc. R. Soc. A.* Vol. 114, 1927, p. 376.

‡ See *Meteorological Magazine* 62 (1927), p. 70.

result of an isolated squall or a localized high wind ; evidently a wind of quite unusual strength swept across this belt of country sometime during the past winter. It thus appears probable that there is no reason to anticipate a frequent repetition of similar high readings from Tiree.

J. S. DINES.

Kyle of Lochalsh. May 31st, 1927.

Grass Minimum Temperatures

With regard to your note in the May number, about local variations in grass minimum temperatures, you may be interested in the undermentioned observations, taken near Godalming, (A) from a position near bushes, etc., and (B) from a depression of about two feet in very open ground, about 60 yards away. The latter position is in a kind of furrow in heath land, otherwise no lower than (A), where fern is often cut by frost while that around is untouched. The thermometers read the same when placed side by side.

Date	(A)	(B)	Screen Minimum.
April 30th—May 1st ..	19°	8°	29°
May 22nd—23rd.. ..	25°	17°	34·5°

G. WESTON.

38, *Chester Terrace, S.W.1. May 23rd, 1927.*

NOTES AND QUERIES

The Weather of the Eclipse

The early morning of June 29th, when the total eclipse of the sun took place, was generally cloudy over the whole of the British Isles. The previous evening the skies had cleared somewhat giving rise to the hope that an interval of fairer weather would coincide with the time of the eclipse but a depression over the north of Scotland was moving slowly southwards and was centred over Ireland at 7h. G.M.T. on the 29th. There was a considerable increase in the amount of cloud during the night and in numerous places in the south and in Wales rain was falling at the time of the eclipse. In the region of totality however there were many breaks in the cloud layer, for example, the Town Clerk of West Hartlepool writes in the *Times* that "At West Hartlepool watchers were sadly disappointed for at the moment of totality the sun failed to emerge from behind the banks of dense grey cloud but an excellent view was obtained by hundreds of observers on the uplands from 1 to 3 miles inland and westward from the town." Equally variable conditions prevailed over the whole of northern England and southern Scotland. At Southport and other towns in the west mist partially obscured the view. Owing to the dense clouds and to the fact that the time of

eclipse occurred so shortly after sunrise the effects of the eclipse on the general meteorological conditions, of which an account was given in the May number of the *Meteorological Magazine*, p. 77, were considerably less than during past eclipses. Mr. Seton Gordon, of Inverness-shire, writes that on the Cairngorms, where there was a thin mist at 3,000 ft., the view of the eclipse was excellent and the temperature fell from 38° F. to 33° F. in 15 minutes, rising again to 35° F. in the next ten minutes.

Mr. Baxendell, of Fernley Observatory, Southport, who was carrying out a programme of meteorological observations during the eclipse has sent the following report:—

“The weather outlook had really appeared hopeless, but, as by a miracle, the clouds dispersed in time, and, after one alarming temporary return, cleared quite away just before the most important period, and kept off until they did not matter. But the sky was remarkably misty—one could not call it smoke-hazy, it appeared far more ‘watery’ than ‘brownish’—and though the solar corona and two prominences were so bright that the view was most gratifying to everyone but the astronomers, all the meteorological effects of the eclipse were ‘watered-down’ deplorably, those upon wind being the only ones really well shown. Throughout the entire morning there was no trace of any charring of the card of the sunshine recorder. We do not possess a micro-barograph, but our open-scale Dines barogram shows no variations that can be attributed with the slightest certainty to the eclipse.

“In Hesketh Park (amongst trees) the large Dines thermograph only fell 0.2°, and the daily-pattern Richard hair hygrometer was a straight line. At a special station on the foreshore, the daily-pattern thermogram, contained in a Stevenson Screen, showed a total fall of only 0.4°, and the daily-pattern hair hygrometer a minute increase of less than 1 per cent. of relative humidity. The really useful results were those obtained (at the Marshside Anemograph Station) by means of the three special instruments kindly lent by the Meteorological Office. The Assmann psychrometer readings showed a fall of air temperature of 0.9°, and of evaporation temperature of 0.6°, the minimum in each case occurring at, I think, almost exactly 5.34 G.M.T., and the readings then being Dry=47.9°; Wet=47.0°.

“The wind effects are very well shown on the autographic records from the ‘quick-run’ instruments. But the wind was so light that, but for our exposure and sensitive instruments, they could not have been secured. The falling-off, and after-the-event recovery, of ‘mean wind’ speed, was only 2 or 3 m.p.h. A 6 m.p.h. wind dropped to 4 m.p.h. at 5.28 or 5.29, and then returned to 6 m.p.h. The greater steadiness of the wind during

the important time was well marked. The effect of the central part of the eclipse on wind direction was even more obvious. From a direction of about 146° , the wind backed to 118° at 5.30, returning afterwards (by about 5.47) to nearly the former azimuth.

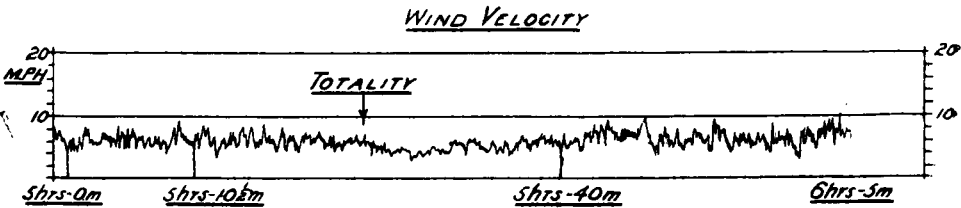
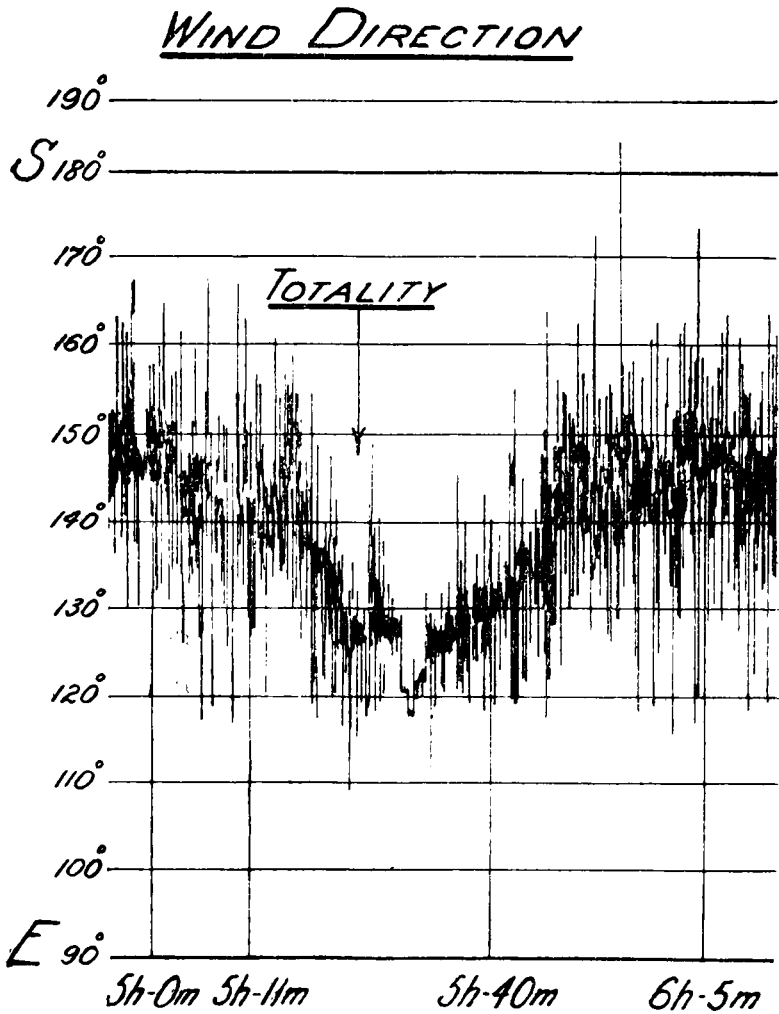
"I am sure the wind extremes occurred a few minutes before those of temperature and humidity. The lag of both, as compared with totality, was doubtless due to the wind having come to us over nearly as much land as is possible in England, instead of off our sea.

"There was no defined front to the moon's shadow, but many thought it very dark, though I did not. The indigo tint of the blackness on the sky was very decided. I could see no 'shadow bands' whatever. The sky haze later became worse, resembling the volcanic dust summer of 1912, but whiter."

The records of wind speed and direction obtained at Southport during the eclipse are reproduced. It may be noted that the duration of totality at Southport was about 23 seconds and that the time of totality there was 5h. 24m. G.M.T.

Mr. E. W. Barlow, who was observing at Colwyn Bay, writes that :—

"The morning of June 29th was heavily overcast at Colwyn Bay and intermittent light rain fell so that no direct observation of the sun was possible. My observing station, at a height of some 300 feet above sea level in private grounds, commanded a view from Snowdonia to the Lancashire coast, but in spite of the open situation there was, with one exception, no perceptible air movement during the time I was out, from 5h. to 7h. 30m. B.S.T. The exception constituted a striking gust occurring about half-an-hour after first contact, lasting only two or three seconds and developing a velocity estimated at 7-10 miles per hour. It thus had similar characteristics to the eclipse gusts observed on previous occasions. The coming of the shadow at totality was very impressive. Up to this time the decrease of light was less than I expected; the shadow rose quickly in the south as a dark mass of clear indigo colour. As it swept over, darkness fell with extreme suddenness. Ten to fifteen seconds later the returning light was observed coming from the south-west, of a golden-grey colour in distinction to the general smoke-grey colour just previous to totality. A little later the shadow left us with the suddenness of an electric light being switched on and from thence daylight increased rapidly. There was a complete absence of the vivid coloration experienced at most eclipses probably owing to the thickness of the cloud layer, the under surface of which was at an altitude of 2,000 to 2,500 feet. The darkness of totality was considerable, only the nearer parts of the landscape remaining visible."



AUTOGRAPHIC RECORDS, SOUTHPORT, JUNE 29TH, 1927.

A Wind Spout at Lindenberg.

The following interesting notes have been translated from the Report of the Lindenberg Aeronautical Observatory for August, 1926.

During the afternoon of June 4th, 1926, the short powerful cone of a wind spout made its appearance at the south end of a thick bank of cumulus, which spread over Lindenberg from south to north, and from which a few big rain drops had fallen a few minutes previously. I noticed the cone shortly after its formation just as I was going to move away from the distance meter with which the cloud measurements given below had been effected. As the distance meter had already been adjusted for all kinds of measurements, I was able at once to take reliable measurements of the wind spout. The following values were obtained :—

Time.	Distance of centre of cone.	Corresponding angle of elevation.	Altitude of this point above the ground.	Azimuth of this point.	Horizontal distance.
h. m.	metres	°	metres	°	metres
18 00	1,970	23'5	780	181	1,820
18 03	2,100	20'3	730	169	2,000

Azimuth angle 180° is S. ; degrees read anti-clockwise.

The apparent width of the cone and its centre were found by means of the distance meter as 1.3°. This angle corresponds at about 2,000 metres distance from the object to a diameter of the cone amounting to 50 metres.

In observing the phenomenon it was noted that the sharpness of the edge of the cone varied ; it was, however, possible to take measurements at moments when the edge showed up clearest, so that good focussing of the distance meter was possible. Five minutes after it was first noticed, the cone was slightly longer, and the low cloud which had obscured the upper part had disintegrated. I was personally unable to note any rotation of the wind spout at the outset, but Dr. Duckert noted a rotation in the final stage. For some considerable time afterwards a vortex movement of the cloud particles could be observed in the cloud in which the wind spout occurred.

The direction of travel of the wind spout was east-south-east to west-north-west. The length of the cone was estimated at 6°, which corresponds to a length of approximately 200 metres.

In connexion with the wind spout, the following cloud measurements carried out a quarter of an hour previous to the

occurrence of the phenomenon, are of interest :—

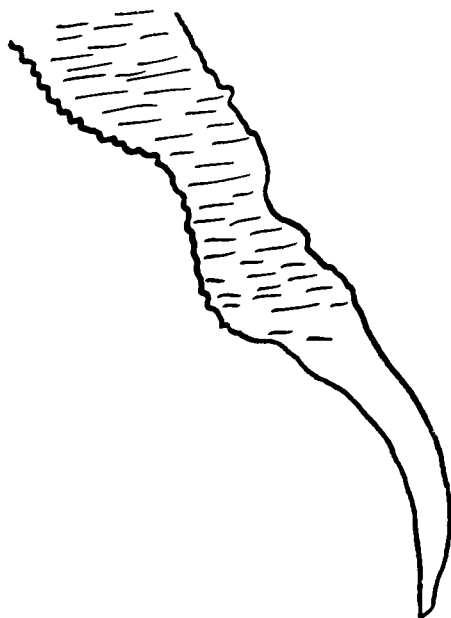
Type of Cloud.	Distance.	Angle of Elevation.	Altitude above ground.	Remarks.
Cumulus top to north-west	km. 7·8	° 30·8	metres 4,000	—
	7·4	30·8	3,800	—
	5·75	21·0	2,060	At outset
	5·87	22·0	2,200	After 20 secs.
	5·86	22·9	2,280	„ 100 „
	5·87	23·9	2,330	„ 150 „

The last line shows an upward vertical velocity of 1·8 metres per second.

Bright summer lightning was observed to the west-south-west at 22h.

H. TROEGER.

On June 4th, 1926, at 18h. 7m., Herr Troeger called my attention to a very well developed wind spout existing in a bank of cumulus cloud south of Lindenberg, which he had been observing for some time. The form changed very little at first. The sketch of the phenomenon done shortly afterwards was practically as shown in the figure.



The altitude of the lower edge of the cone was estimated at about 500 metres. The total length of the wind spout was 700 to 800 metres, and the diameter at the part indicated was about 40 metres.

The cone was surrounded by small masses of well-defined cumulus cloud. It was difficult at first to recognise any rotation of the formation. When, however, the wind spout in its path approached the cumulus cloud, I clearly saw how the scud was

torn away from the hazy-looking formation : soon the rotation of the actual wind spout could be clearly seen. About 18h. 12m. I could determine the rotation very clearly. In about 12 to 13 seconds it reached the point indicated in the figure. In an astonishingly short time a very extensive cumulus bank was completely sucked in. The path travelled by the wind spout was indicated by a particularly cloudless bit of sky, though fragments of scud were whirled about. As the rotation gradually became less marked, the disintegrating force decreased, and about 18h. 15m. the wind spout was no longer to be seen.

Dr. P. DUCKERT.

Early Sumerian Climatology

Prof. H. v. Ficker* calls attention to a remark by Prof. Ungad that in the speech of the ancient Sumerians the points of the compass are designated as follows : East, mountain ; West, rainstorm ; North, wind-squall ; South, cloud. From this combination he deduces that the early home of the Sumerians was in western Turkestan, which has just that geographical and climatological combination. The mountains to the east are the high Pamirs ; the north wind brings cold waves from the Arctic but no rain, while the south wind brings cloud over the mountains of Afghanistan to the south, but is felt in the plains as a dry Föhn-like wind. Only the west wind brings rain. Prof. Ficker remarks that the designations for north, south and west constitute a climatology of West Turkestan " of a brevity foreign to most climatological treatises."

Review

Observing Water-surface Temperatures at Sea. By C. F. Brooks. Washington, D.C., M.W. Rev. June, 1926. Vol. 54. pp. 241-254.

When meteorological observations at sea were first systematised by Maury in 1851, it was laid down that the temperature of the sea surface should be obtained by dipping a canvas bucket over the side of the ship and observing the temperature of the water so obtained. In those days when ships had low freeboard, the interval from the drawing of the water to the reading of the thermometer was short, but with a modern ship the drawing up of the bucket to a height of 65 feet or more affords time for any errors introduced to be multiplied. Dr. Brooks in this paper delivers a general attack on this method. From observations made in the *Empress of Britain* during a cruise to the West Indies in the spring of 1924 he arrays a mass of statistics which

* Klimatologische Bemerkungen über Turkestan. By H. v. Ficker, Leipzig, Mitt. Ges. Erdk., 1925, p. 42.

shows conclusively that errors are frequently made in these observations of the order 2° F. or more. He then discusses to what these errors are due and concludes that probably the most important source of error is the cooling by evaporation from the wet surface of the bucket. Dr. Brooks, however, proposes radical changes in the procedure of taking sea temperatures which he maintains will lead to more satisfactory results. He proposes that the water should be drawn from over the stern of the ship (where the haul is comparatively short) and in a metal bucket, but as an alternative (to which he shows marked favour) he suggests that thermographs should be connected to the water flowing through the condenser intake of the ship's engines.

It is natural that this latter method should be criticised on account of the depth from which the condenser intake draws its water, since to the meteorologist the temperature of the surface film of the sea is of interest only. The author of the paper, however, concludes that the condenser intake will show the true surface temperature in winter and in windy weather at any season when the mixing of surface layer is vigorous, and that in summer its indication will differ from surface temperatures by no more than 0 to 0.6° F. on the average, with an error of 2° F. not oftener than about 2 per cent.

C.S.D.

News in Brief

Mr. G. B. Hamlin, of Burlow, Horeham Road, Sussex, reports that there was continuous rain there for 17.8 hours on July 1st and that between 3h. 10m. and 18h. 30m. he recorded 57.7 mm.

The expedition, planned by Dr. Dumbrava, under the patronage of the French and Belgian Royal Geographical Societies, with the object of making a general study of the east coast of Greenland, its inland ice fields and its meteorological conditions, will sail from Copenhagen in the middle of July on a Danish Government boat for Angmagssalik, which will be its base for the sixteen months the expedition proposes to be in Greenland.

Following on two or three vivid flashes of lightning during a thunderstorm in Sheffield on June 27th, a "thunderbolt" fell in Scotland Street, throwing off sparks as it came down and striking the earth with a loud explosion.

With this number the measurements of rainfall in the Climatological Table for the British Empire are expressed in inches

instead of in millimetres. The column of millimetres is also omitted from the Rainfall Table for the British Isles.

The Weather of June, 1927

The weather of the month was generally unsettled and cool, except for a short period around the 16th in southeastern England when temperature rose above 80° F. For the first fortnight cool, rather unsettled thundery conditions prevailed with many bright periods but occasional local heavy rain; 1.48 in. fell at Banbridge (Down) on the 7th, and 1.44 in. at Mount Callan (Clare) on the 9th. In most districts, however, rainfall during this period was below the normal and in some places there was extremely little. Sunshine was variable; at Inchkeith more than 16½ hours were recorded on the 14th. Temperature in the screen fell to 32° F. or below at a few Scotch stations while ground frosts occurred at several places in various parts of the country, the lowest ground temperature recorded being 23° F. at Eskdalemuir on the 10th, at Balmoral on the 11th, and at Rounton on the 15th. On the 16th a deep depression was situated over the Atlantic and a shallow depression over the western Mediterranean. In consequence the air over southeastern England was drawn from the Mediterranean region and some high temperatures were recorded; the highest maximum, 85° F., occurred in London. Elsewhere much cloud prevailed with heavy rain locally, 1.53 in. at Carnarvon, 1.48 in. at Mary Tavy (Devon), 1.35 in. at Douglas, and 1.30 in. at Crieff. From the 16th onwards the character of the weather changed to a more disturbed type. Depressions moving across the country brought high winds and local gales with heavy rain at times. Wind force 9 (50 m.p.h.) was reported from Inchkeith and Malin Head on the 21st, and from Pembroke on the 24th, while a gust of 71 m.p.h. was recorded at Paisley on the 21st. Noteworthy rainfall was registered at Eskdalemuir on the 18th between 17h. and 18h. when 0.23 in. fell in 6 minutes, and 0.34 in. in 10 minutes. After the 27th the winds decreased in force but a complex system of low pressure areas continued over the British Isles causing much rain, among the heaviest falls being that of 1.90 in. at Tottingworth Park, Sussex, on the 30th.

Pressure was below normal over western Europe except for Spain and Italy, the greatest deficit being 6.2 mb. at Florö and 6.1 mb. at Aberdeen, and above normal over the North Atlantic from Spitsbergen and Iceland to the Azores and Bermuda. There was also an area with pressure below normal over Newfoundland and Nova Scotia. Temperature was below normal and rainfall above normal generally except for the extreme

southwest. In northwest Gothaland (Sweden) the rainfall was three times the normal.

During the first part of the month the weather over Europe was stormy and thundery. On the evening of the 1st a whirlwind swept across eastern Holland into Germany destroying everything in its path, which extended from Milligen to Tudderuen and then to Lingen and south Oldenburg. Seven people were killed. On the 2nd and 3rd violent thunderstorms occurred generally in Switzerland and south Germany, and a water-spout was observed over Morges on the Lake of Geneva. Within a few minutes of its appearance the streets were flooded to a depth of 1 foot. Owing to the storms many rivers in western Switzerland overflowed their banks and the crops were damaged. On the 9th it was reported that hailstorms had destroyed field crops and fruit in many parts of upper Austria. Severe thunderstorms also occurred in northern Italy on the 11th, and later hailstorms did much damage in White Russia. Owing to excessive rains during the latter part of the month, with intervals of summer heat, the enormous volumes of snow, which at midsummer still lay on the high mountains, melted with great suddenness and produced serious floods in east Norway. Five lives were lost.

Heavy rain occurred in Bombay on the 14th and 15th flooding a great part of the city, $14\frac{1}{2}$ in. being recorded during the two days. Heavy rain also fell on the Ghats and at Poona but the wind was then still northerly instead of southwesterly.

During most of the month beneficial rains, bringing relief from severe drought, occurred generally in the southeast and southwest States of America, except in southern Florida. In Missouri and Arkansas the rainfall was excessive between the 15th and 21st. The new flood in the tributaries of the Mississippi in its middle stretches which began at the end of May again inundated several thousand acres in Arkansas, and the southern part of the Mississippi is still largely flooded.

The special message from Brazil states that the rainfall in the northern and central districts was scarce, being 69 mm. and 22 mm. below normal respectively, and in the southern districts copious with 78 mm. above normal. Six anticyclones passed across the country and stormy weather was experienced in south Brazil and River Plate owing to the frequent passage of low pressure areas in the south. Frosts occurred in the southern districts during the last ten days. The crops were generally in good condition. At Rio de Janeiro pressure was 0.4 mb. below normal and temperature 0.4° F. below normal.

Rainfall, June, 1927—General Distribution

England and Wales	..	163	} per cent. of the average 1881-1915.
Scotland	.. .. .	165
Ireland	.. .. .	135
British Isles	.. .. .	158

Rainfall: June, 1927: England and Wales

CO.	STATION.	In.	Per- cent. of Av.	CO.	STATION.	In.	Per- cent. of Av.
<i>Lond.</i>	Camden Square	2.80	139	<i>War.</i>	Birmingham, Edgbaston	4.15	179
<i>Sur.</i>	Reigate, The Knowle..	4.20	216	<i>Leics</i>	Thornton Reservoir ..	4.93	228
<i>Kent.</i>	Tenterden, Ashenden..	4.25	222	"	Belvoir Castle.....	4.33	227
"	Folkestone, Boro. San.	...	...	<i>Rut.</i>	Ridlington	4.72	...
"	Margate, Cliftonville..	3.53	202	<i>Linc.</i>	Boston, Skirbeck	3.34	184
"	Sevenoaks, Speldhurst.	4.30	...	"	Lincoln, Sessions House	2.88	142
<i>Sus.</i>	Patching Farm	3.70	183	"	Skegness, Marine Gdns.	3.28	182
"	Brighton, Old Steyne ..	3.78	210	"	Louth, Westgate	3.30	153
"	Tottingworth Park....	7.20	129	"	Brigg .....	...	...
<i>Hants</i>	Ventnor, Roy. Nat. Hos.	2.28	125	<i>Notts.</i>	Worksop, Hodsock	2.90	146
"	Fordingbridge, Oaklands	2.73	148	<i>Derby</i>	Mickleover, Clyde Ho..	4.67	195
"	Ovington Rectory	3.28	141	"	Buxton, Devon. Hos. ..	7.81	242
"	Sherborne St. John ...	3.26	153	<i>Ches.</i>	Runcorn, Weston Pt. ...	4.69	182
<i>Berks</i>	Wellington College ...	2.60	120	"	Nantwich, Dorfold Hall	5.18	...
"	Newbury, Greenham ...	3.19	147	<i>Lancs</i>	Manchester, Whit. Pk.	4.72	179
<i>Herts.</i>	Benington House	3.33	162	"	Stonyhurst College....	4.00	130
<i>Bucks</i>	High Wycombe	3.80	195	"	Southport, Hesketh Pk	3.09	142
<i>Oxf.</i>	Oxford, Mag. College ..	2.94	138	"	Lancaster, Strathspey.	3.50	...
<i>Nor.</i>	Pitsford, Sedgebrook ..	4.01	208	<i>Yorks</i>	Wath-upon-Dearne ...	2.20	99
"	Oundle .....	...	...	"	Bradford, Lister Pk. ...	3.24	138
<i>Beds.</i>	Woburn, Crawley Mill.	3.27	167	"	Oughtershaw Hall	5.47	...
<i>Cam.</i>	Cambridge, Bot. Gdns.	...	...	"	Wetherby, Ribston H. ..	2.65	126
<i>Essex</i>	Chelmsford, County Lab	3.04	160	"	Hull, Pearson Park ...	2.80	136
"	Lexden, Hill House ...	3.68	...	"	Holme-on-Spalding ...	2.59	...
<i>Suff.</i>	Hawkedon Rectory	3.42	165	"	West Witton, Ivy Ho. ..	2.37	...
"	Haughley House	3.56	...	"	Felixkirk, Mt. St. John	3.11	142
<i>Norf.</i>	Beccles, Geldeston	4.03	224	"	Pickering, Hungate ...	3.31	...
"	Norwich, Eaton .....	...	...	"	Scarborough.....	3.25	177
"	Blakeney	3.87	208	"	Middlesbrough	2.31	122
"	Little Dunham	5.37	240	"	Baldersdale, Hury Res.	2.44	...
<i>Wills.</i>	Devizes, Highclere	3.02	134	<i>Durh.</i>	Ushaw College	3.25	150
"	Bishops Cannings	3.16	131	<i>Nor.</i>	Newcastle, Town Moor.	3.83	176
<i>Dor.</i>	Evershot, Melbury Ho.	2.82	124	"	Bellingham, Highgreen	3.38	...
"	Creech Grange	3.40	...	"	Lilburn Tower Gdns. ...	2.61	...
"	Shaftesbury, Abbey Ho.	2.81	121	<i>Cumb</i>	Geltsdale.....	3.87	...
<i>Devon</i>	Plymouth, The Hoe ...	3.19	148	"	Carlisle, Scaleby Hall ..	3.61	143
"	Polapit Tamar	2.57	120	"	Seathwaite M.	11.01	169
"	Ashburton, Druid Ho. ..	3.24	127	<i>Glam.</i>	Cardiff, Ely P. Stn.	3.48	140
"	Cullompton	2.76	130	"	Treherbert, Tynywaun	6.27	...
"	Sidmouth, Sidmount ...	2.28	109	<i>Carm</i>	Carmarthen Friary	3.79	132
"	Filleigh, Castle Hill ...	3.56	...	"	Llanwrda, Dolaucothy.	5.88	173
"	Barnstaple, N.Dev.Ath.	2.21	99	<i>Pemb</i>	Haverfordwest, School	3.27	121
<i>Corn.</i>	Redruth, Trewirgie ...	3.56	143	<i>Card.</i>	Gogerddan	7.04	226
"	Penzance, Morrab Gdn.	3.26	147	"	Cardigan, County Sch. ..	3.01	...
"	St. Austell, Trevarna ..	3.43	132	<i>Wrec.</i>	Crickhowell, Talymaes	4.60	...
<i>Soms</i>	Chewton Mendip	4.62	156	<i>Rad.</i>	Birm. W. W. Tyrmynydd	6.72	205
"	Street, Hind Hayes ...	2.83	...	<i>Mont.</i>	Lake Vyrnwy	7.25	229
<i>Glos.</i>	Clifton College	3.38	136	<i>Denb.</i>	Llangynhafal	4.89	...
"	Cirencester, Gwynfa ..	3.88	162	<i>Mer.</i>	Dolgelly, Bryntirion ..	9.28	267
<i>Here.</i>	Ross, Birchlea	2.87	132	<i>Carn.</i>	Llandudno	3.27	161
"	Ledbury, Underdown. ..	3.32	147	"	Snowdon, L. Llydaw 9	16.29	...
<i>Salop</i>	Church Stretton	4.42	183	<i>Ang.</i>	Holyhead, Salt Island.	3.69	172
"	Shifnal, Hatton Grange	4.40	197	"	Lligwy	4.38	...
<i>Staff.</i>	Tea, The Heath Ho. ...	...	...	<i>Isle of Man</i>			
<i>Worc.</i>	Ombersley, Holt Lock ..	3.15	139		Douglas, Boro' Cem. ...	4.59	190
"	Blockley, Upton Wold ..	3.88	146	<i>Guernsey</i>			
<i>War.</i>	Farnborough	5.08	214		St. Peter P't. Grange Rd	3.11	168

Rainfall: June, 1927: Scotland and Ireland

CO.	STATION	In.	Per- cent. of Av.	CO.	STATION.	In.	Per- cent. of Av.
<i>Wigt.</i>	Stoneykirk, Ardwell Ho	3.26	134	<i>Suth.</i>	Loch More, Achfary...	7.30	197
"	Pt. William, Monreith.	3.43	...	<i>Caith</i>	Wick	2.89	161
<i>Kirk.</i>	Carsphairn, Shiel.	6.65	...	<i>Ork.</i>	Pomona, Dcerness	3.10	169
"	Dumfries, Cargen	4.43	159	<i>Shet.</i>	Lerwick	2.85	160
<i>Roxb.</i>	Branxholme	3.08	137		-----	...	...
<i>Selk.</i>	Ettrick Manse	4.76	...	<i>Cork.</i>	Caheragh Rectory	3.22	...
<i>Berk.</i>	Marchmont House	3.74	162	"	Dunmanway Rectory.	3.22	92
<i>Hadd.</i>	North Berwick Res.	2.23	134	"	Ballinacurra	2.40	92
<i>Midl.</i>	Edinburgh, Roy. Obs.	2.98	161	"	Glanmire, Lota Lo. ...	3.20	118
<i>Lan.</i>	Biggar .....	...	...	<i>Kerry</i>	Valentia Obsy. ....	...	...
"	Leadhills	5.86	...	"	Killarney Asylum	5.13	176
<i>Ayr.</i>	Kilmarnock, Agric. C.	4.84	220	"	Darrynane Abbey	4.16	132
"	Girvan, Pinmore	4.52	156	<i>Wat.</i>	Waterford, Brook Lo..	3.93	146
<i>Renf.</i>	Glasgow, Queen's Pk.	3.99	173	<i>Tip.</i>	Nenagh, Cas. Lough...	4.38	179
"	Greenock, Prospect H.	4.64	141	"	Roscrea, Timoney Park	3.50	...
<i>Bute.</i>	Rothsay, Ardenraig ..	4.80	156	"	Cashel, Ballinamona ..	3.42	148
"	Dougarie Lodge	4.91	...	<i>Lim.</i>	Foynes, Coolnanes	5.37	208
<i>Arg.</i>	Ardgour House	7.30	...	"	Castleconnell Rec.	4.47	...
"	Manse of Glenorchy ..	6.65	...	<i>Clare</i>	Inagh, Mount Callan ..	7.54	...
"	Oban	4.73	...	"	Broadford, Hurdlest'n.	4.79	...
"	Poltalloch	3.98	131	<i>Wexf</i>	Newtownbarry	3.75	...
"	Inveraray Castle	6.52	165	"	Gorey, Courtown Ho...	3.42	141
"	Islay, Eallabus	4.65	178	<i>Kilk.</i>	Kilkenny Castle	2.91	120
"	Mull, Benmore	9.20	...	<i>Wic.</i>	Rathnew, Clonmannon	3.21	...
<i>Kinr.</i>	Loch Leven Sluice	3.38	154	<i>Carl.</i>	Hacketstown Rectory .	...	...
<i>Perth</i>	Loch Dhu	6.90	161	<i>QCo.</i>	Blandsfort House	3.64	141
"	Balquhidder, Stronvar.	4.78	...	"	Mountmellick	3.49	...
"	Crieff, Strathearn Hyd.	4.80	182	<i>KCo.</i>	Birr Castle	2.78	120
"	Blair Castle Gardens ..	2.61	132	<i>Dubl.</i>	Dublin, FitzWm. Sq...	2.49	128
<i>Forf.</i>	Kettins School	2.54	136	"	Balbriggan, Ardgillan .	2.26	112
"	Dundee, E. Necropolis.	2.53	141	<i>Me'th</i>	Beauparc, St. Cloud ..	2.58	...
"	Pearsie House	4.13	...	"	Kells, Headfort	2.32	88
"	Montrose, Sunnyside ..	2.88	173	<i>W.M</i>	Moate, Coolatore	2.50	...
<i>Aber.</i>	Braemar, Bank	3.63	185	"	Mullingar, Belvedere .	2.31	89
"	Logie Coldstone Sch. ..	3.76	193	<i>Long</i>	Castle Forbes Gdns. ...	3.11	121
"	Aberdeen, King's Coll..	2.54	149	<i>Gal.</i>	Ballynahinch Castle ..	5.58	158
"	Fyvie Castle	3.62	...	"	Galway, Grammar Sch.	...	...
<i>Mor.</i>	Gordon Castle	4.16	204	<i>Mayo</i>	Mallaranny	5.00	...
"	Grantown-on-Spey	4.09	182	"	Westport House	4.09	151
<i>Na.</i>	Nairn, Delnies	3.51	199	"	Delphi Lodge	7.38	...
<i>Inv.</i>	Ben Alder Lodge	3.81	...	<i>Sligo</i>	Markree Obsy.	3.32	110
"	Kingussie, The Birches	2.63	...	<i>Cav'n</i>	Belturbet, Cloverhill..	3.36	138
"	Loch Quoich, Loan	9.75	...	<i>Ferm</i>	Enniskillen, Portora ..	3.56	...
"	Glenquoich	8.95	182	<i>Arm.</i>	Armagh Obsy.	2.91	115
"	Inverness, Culduthel R.	2.76	...	<i>Doun</i>	Fofanny Reservoir ...	4.98	...
"	Arisaig, Faire-na-Squir	3.50	...	"	Seaforde	3.34	121
"	Fort William	5.71	159	"	Donaghadee, C. Stn...	3.58	154
"	Skye, Dunvegan	3.76	...	"	Banbridge, Milltown ..	4.54	177
"	Barra, Castlebay .....	...	...	<i>Antr.</i>	Belfast, Cavehill Rd. .	4.47	...
<i>R&C</i>	Alness, Ardross Cas. ..	3.44	152	"	Glenarm Castle	3.56	...
"	Ullapool	4.41	...	"	Ballymena, Harryville	4.42	152
"	Torriden, Bendamph ..	6.32	155	<i>Lon.</i>	Londonderry, Creggan	3.85	136
"	Achnashellach	6.49	...	<i>Tyr.</i>	Donaghmore	3.84	...
"	Stornoway	3.76	162	"	Omagh, Edenfel	3.54	125
<i>Suth.</i>	Lairg	3.24	...	<i>Don.</i>	Malin Head	3.78	177
"	Tongue Manse	4.49	219	"	Dunfanaghy	3.68	129
"	Melvich School	3.35	173	"	Killybegs, Rockmount.	...	...

Climatological Table for the British Empire, January, 1927

STATIONS	PRESSURE		TEMPERATURE						Rela- tive Humi- dity	Mean Cloud Am't	PRECIPITATION		BRIGHT SUNSHINE			
	Mean of Day M.S.L.	Diff. from Normal	Absolute	Mean Values			Mean	Am't in.			Diff. from Normal in.	Days	Hours per day	Per- cent- age of possi- ble.		
				Max.	Min.	Max. and min.									Diff. from Normal	Wet Bulb
London, Kew Obsy. . .	1010.0	- 7.6	53	26	45.9	36.0	40.9	+ 2.0	37.8	89	6.1	1.91	+ 0.15	19	1.7	17
Gibraltar	1023.7	+ 2.5	70	42	60.6	48.5	54.5	- 0.3	49.0	82	4.3	2.28	- 2.78	12	...	...
Malta	1016.4	- 1.2	64	45	58.5	51.4	54.9	- 0.4	50.9	79	6.2	1.77	- 1.44	15	5.4	55
St. Helena	1011.5	+ 1.6	69	57	65.0	59.1	62.1	- 2.4	59.8	93	3.6	1.63	- 1.34	17	...	...
Sierra Leone	1011.1	+ 0.3	90	66	87.9	72.2	80.1	- 1.2	70.8	65	2.4	0.00	- 0.41	0	...	...
Lagos, Nigeria	1008.2	- 1.7	91	68	87.5	72.3	79.9	- 1.0	71.2	77	7.8	2.49	+ 1.42	3	...	...
Kaduna, Nigeria . . . . .	...	...	97	51	87.4	57.6	72.5	- 0.9	53.8	25	...	0.00	0	0	...	...
Zomba, Nyasaland	1007.7	+ 0.3	86	...	81.8	...	...	...	...	81	8.1	11.39	+ 0.93	17	...	...
Salisbury, Rhodesia	1007.5	- 0.8	88	49	80.9	59.1	70.0	+ 0.3	62.9	65	5.3	3.84	- 3.63	9	7.9	60
Cape Town	1013.6	+ 0.2	97	53	82.3	62.1	72.2	+ 2.3	64.1	68	2.2	0.18	- 0.52	2	...	...
Johannesburg	1010.3	+ 0.7	93	45	80.6	57.0	68.8	+ 2.3	60.0	67	3.1	5.01	- 1.16	14	8.0	59
Mauritius . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	1014.7	- 0.5	102	49	90.5	61.6	76.1	+ 2.9	61.7	49	2.4	2.56	- 1.46	8	...	...
Calcutta, Alipore Obsy.	1014.7	- 0.5	85	49	77.4	58.2	67.8	+ 1.4	59.3	89	4.6	0.35	0	1*	...	...
Bombay	1012.1	- 1.5	85	63	81.3	66.6	73.9	- 1.4	63.1	71	1.6	0.00	- 0.10	0*	...	...
Madras	1013.0	- 1.1	88	63	85.5	68.3	76.9	+ 0.8	72.3	87	5.5	0.57	- 0.82	2*	...	...
Colombo, Ceylon	1010.0	- 1.5	90	67	86.5	72.3	79.4	+ 0.3	75.2	76	5.9	5.66	+ 2.16	9	7.4	63
Hongkong	1019.0	- 0.8	75	47	64.2	56.3	60.3	+ 0.1	55.4	73	7.4	0.31	- 1.06	3	4.4	41
Sandakan . . . . .	...	...	89	74	85.9	75.4	80.7	+ 0.9	76.7	85	...	15.45	- 3.00	17	...	...
Sydney	1013.1	+ 0.6	90	56	77.0	64.5	70.7	- 1.0	66.2	70	6.7	4.11	+ 0.38	14	6.7	48
Melbourne	1014.1	+ 1.2	106	48	79.7	58.0	68.9	+ 1.4	59.7	55	6.0	0.60	- 1.25	6	7.9	55
Adelaide	1013.5	+ 0.5	110	51	87.3	62.1	74.7	+ 0.8	60.1	31	3.9	0.27	- 0.46	3	10.5	74
Perth, W. Australia	1011.5	- 1.0	102	53	82.6	60.2	71.4	- 2.5	62.7	56	3.0	0.47	+ 0.13	6	10.8	78
Coorgardie	1012.6	+ 1.2	111	49	89.8	59.3	74.5	- 2.9	58.4	40	3.1	0.71	+ 0.24	3	...	...
Brisbane	1011.7	+ 0.4	88	65	81.9	68.8	75.3	- 1.9	70.8	75	6.9	22.43	+ 16.16	19	6.8	49
Hobart, Tasmania . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Wellington, N.Z.	1017.5	+ 4.2	81	44	70.5	56.6	63.5	+ 1.0	59.3	65	5.2	0.68	- 2.65	9	7.7	52
Suva, Fiji	1006.4	- 1.3	91	70	85.6	74.1	79.9	- 0.0	75.8	83	7.9	31.61	+ 20.89	27	3.8	29
Apia, Samoa	1009.3	+ 1.4	89	71	84.9	74.8	79.9	+ 0.9	77.5	81	7.1	28.80	+ 11.99	26	5.1	40
Kingston, Jamaica	1015.5	+ 0.4	89	62	85.3	67.9	76.6	- 0.2	66.3	87	4.6	0.07	- 0.89	3	9.0	80
Grenada, W.I. . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Toronto	1021.6	+ 4.2	44	- 17	28.1	14.6	21.3	- 0.8	17.9	75	6.8	1.57	- 1.30	14	2.9	31
Winnipeg	1021.7	+ 1.9	38	- 32	9.0	- 4.8	2.1	+ 6.5	- 0.9	76	3.9	0.35	- 0.47	5	4.2	49
St. John, N.B.	1016.4	+ 0.7	46	- 9	30.3	17.1	23.7	+ 4.5	20.0	81	6.1	4.62	- 0.18	15	2.7	30
Victoria, B.C.	1016.3	+ 1.0	51	- 21	42.6	37.0	39.8	- 0.3	37.1	81	8.5	2.62	- 1.89	15	1.8	21

*For Indian stations a rain day is a day on which 0.1 in. or more rain has fallen.



A MAMMULATED CLOUD SHEET, WHITLEY BAY, JULY 5TH, 11H.

<h1 style="margin: 0;">The Meteorological Magazine</h1>				
	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center; padding: 5px;">Vol. 62</td> </tr> <tr> <td style="text-align: center; padding: 5px;">August 1927</td> </tr> <tr> <td style="text-align: center; padding: 5px;">No. 739</td> </tr> </table>	Vol. 62	August 1927	No. 739
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The Cup Anemometer

By T. W. VERNON JONES, B.Sc.

As an instrument for measurements of wind velocity, the cup anemometer has occupied an important position in meteorological work since the middle of last century. During recent years it has been largely superseded by the pressure tube anemometer, which not only gives more accurate results but also shows the structure of the wind, as well as its mean velocity over a given period. For some purposes, however, the cup anemometer is still of great value, more particularly in cases where the run of the wind over a considerable period is required; and moreover on the grounds of its much greater portability and cheapness, it is probable that the small cup anemometer will continue to be used for meteorological observations for many years to come.

The records from a cup anemometer are generally obtained in one of three ways; a trace is made upon a moving chart, a revolution counter of the ordinary type is attached to the instrument, or the anemometer may be designed to complete an electrical circuit after a known number of revolutions have been made. Whatever method is adopted, the interpretation of the results and the determination of the wind speed depends upon an accurate knowledge of the "Robinson factor" of the instrument, that is, the ratio of the wind velocity to the velocity of the centres of the cups.

Since the time of Dr. Robinson's original experiments with cup anemometers, many observations have been made to determine factors for obtaining the true wind velocity from the rate

of revolution of the cups. These factors have been obtained in several ways: in the earlier experiments the instrument under test was attached to an arm and whirled in a circle at a known speed. Dr. Robinson himself used this method, but came to the conclusion that the results obtained were doubtful, owing to the difficulty of allowing for the air which was dragged along by the arm of the whirling machine and by the anemometer itself. More recently, comparisons of a cup anemometer set up side by side with a pressure tube anemometer have been made, or experiments have been carried out in a wind-tunnel. The great advantage of calibrating a cup anemometer by comparison with a pressure tube anemometer is that the gustiness of the wind can be taken into consideration. On the other hand measurements in a modern wind-tunnel can be made with very great precision and delicacy, although normally it is a steady and non-gusty wind which is used. The difficulty in calibrating a cup anemometer is to allow for its inertia, as, when subjected to intermittent impulses, the cups spin continuously. It is at low speeds particularly that the inertia effect has to be considered, and unfortunately at low speeds comparisons with a pressure tube anemometer are apt to be unreliable owing to the comparative insensitiveness of this latter type of instrument in light winds.

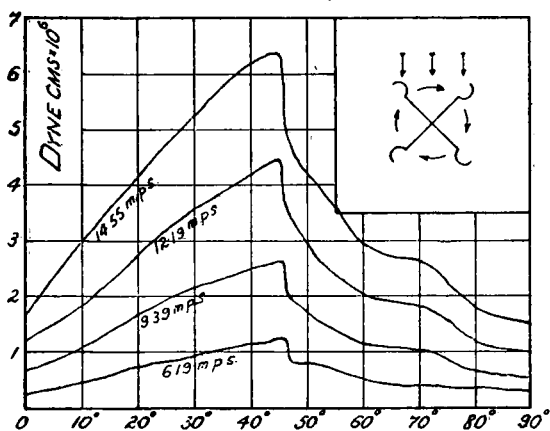
Dr. Robinson's original experiments* with a small cup anemometer, led him to adopt the factor 3 for all his instruments; he came to the conclusion later, however, that the factor varied according to the type of instrument in use, and it was shown still later that the factor varied also with the wind velocity. Cup anemometers of many sizes are now in use for different purposes, and the factors of these instruments of standard size have been determined with considerable accuracy for all wind speeds.

It has been recently pointed out, however, by J. Patterson† that no systematic series of experiments has ever been made to determine the best form of cup anemometer; that is to say, to find out whether large cups are better than small, long arms better than short, or whether four cups in an anemometer system are better than any other number. Patterson's observations were made in the wind-tunnel at the University of Toronto and consisted of a large number of measurements of torque and of factor at different wind speeds for various sizes and types of cup anemometers. The static torque was obtained by observing the actual turning moment which had to be applied to the cups to keep them stationary at a given wind speed.

* *Dublin, Proc. R. Irish Acad.* 22 (1850), p 159.

† The Cup Anemometer, by J. Patterson, M.A., F.R.S.C. *Ottawa, Trans. R. Soc. Canada. Third Series, XX, Sec. III, 1926.*

It had been generally assumed that the static torque was greatest when a four cup anemometer was placed so that two of the arms of the anemometer were parallel to the wind direction and the other two at right angles to it. Patterson's experiments show, however, that this is not the case; the minimum static torque occurs when the anemometer is so placed, and the maximum when the anemometer is turned through 45° from this position. Curves showing the variation of static torque on a four cup anemometer of standard Canadian pattern for a rotation of the head through 90° are given in the accompanying figure. The angular position of the anemometer head is plotted horizontally and the static torque vertically. The zero position is



when one arm is parallel to the wind direction and facing the wind, and the angular position increases from 0° to 90° as the anemometer head is turned clockwise through a right angle. The wind speed in metres per second is shown on each curve.

These curves are characteristic of the static torque acting on a four cup anemometer; but it was found that in the case of anemometers with short arms and comparatively large cups a much more constant value for the static torque through a revolution was obtained; that is, the curves, though of the same form, were much flatter. It was found, also, that the more constant the static torque, the more constant was the factor of the anemometer for different wind velocities. This smaller variability of torque and factor is to be attributed to the fact that when short arms are used the cups are close together, and exert a shielding effect upon one another. This was conclusively proved by Patterson, by measurements made of the static torque on a single cup throughout a complete revolution, firstly by itself, and secondly when shielded by the other three cups. For short arms, the difference between the shielded and unshielded results was very considerable, but it became less with longer arms. For arms double the diameter of the cups and longer, the shielding effect was found to be negligible. A constant factor for all wind speeds is a highly desirable feature in a cup anemometer, and in the paper under notice, it is shown

that, by using extremely short arms, the factor can to all intents and purposes be made constant for all velocities. The disadvantage of short arms is that the torque obtained is comparatively small, and, to offset this, Patterson tried the effect of semi-cylindrical cups on the short arms. He found that a much greater torque could be obtained thus, but that the cups revolved with nearly half the velocity of the wind, and at high speeds the centrifugal force was very great, involving undue wear on the bearings of the instrument.

It was shown also by a large number of measurements, that a somewhat more constant torque and factor were obtained by using a three cup anemometer system than with four cups, and these experiments have led to the adoption of a three cup anemometer as a standard instrument in the Canadian Meteorological Service. This new standard has cups 5 inches in diameter and arms 6.3 inches long. It is interesting to compare the size of this instrument with the two small standard four cup anemometers used in the British Meteorological Office. The electric cup anemometer has cups 3.05 inches in diameter and arms 4 inches long, and the self indicating instrument 3 inch cups and $7\frac{3}{8}$ inch arms. It had been a general assumption that the four cup anemometer was better, in that it gave a more constant torque through a revolution. This was due to lack of observations, and based on the belief that the maximum torque occurred in the zero position instead of the 45° position.

A general equation which would enable the factor of any anemometer system to be calculated from its dimensions had not been developed before the publication of this paper, although satisfactory equations for particular anemometer systems and the form of a general equation had been given. From considerations of the static and dynamic torque obtained in this experimental work, and allowing for the fact that when an anemometer is in rotation the wind stream lines are turned somewhat due to the eddies produced by the shape of the cup, Patterson has developed an equation for calculating the factor of any cup anemometer. The equation has been developed, neglecting the effects of friction and interference between the cups. This means, of course, that it can be applied only to anemometer systems with comparatively long arms, and, for such systems, the values of the factor calculated from Patterson's equation are found to agree quite well with values determined experimentally.

Perhaps the most important fact brought out in this paper is that the three cup anemometer does possess definite advantages over the traditional four cup system, and it is a fact which should be noted by all those interested in anemometry.

OFFICIAL NOTICES

A Course of Training for Observers

The fifth course of training for meteorological observers will be held at Kew Observatory, commencing at 10 a.m. on Monday, September 19th, and terminating on the morning of Friday, September 23rd. Kew Observatory, situated in the Old Deer Park, Richmond, is about $\frac{3}{4}$ mile from Richmond station, which is easily reached from any part of London by train or omnibus.

The syllabus will comprise the following subjects :—

Meteorological instruments and methods of observation.

The recording of observations and their transmission to the Meteorological Office.

The Weather Map : charting of observations distributed by wireless-telegraphy.

British climatology.

The aim of the course is threefold :—

(A) to provide a sound foundation in meteorological observation for those who have had little or no previous experience of the work ; (B) to deal with the difficulties encountered by the more advanced observer ; (C) to develop consistency of method. In particular, such difficulties as may arise in instrumental manipulation and in the detailed compilation of the pocket and permanent registers will be considered as fully as possible.

The course is addressed primarily to observers at stations which report regularly to the Meteorological Office. Others will, however, be admitted, at the discretion of the Director, as far as the accommodation permits. Applications for tickets of admission should be made to the Director, Meteorological Office, Air Ministry, Kingsway, London, W.C. 2. There will be no fee for the course, but travelling and other incidental expenses incurred by observers attending the course will in no case be paid by the Meteorological Office.

Correspondence

To the Editor, *The Meteorological Magazine*

A Lunar Rainbow at Aberdeen

At 21h. 43m. G.M.T. on May 15th a well-marked lunar rainbow was observed at Aberdeen. A brilliantly full moon, moderate rain showers and dark cumulo-nimbus clouds massing along the northern sky supplied the requisite conditions. The bow appeared as a rather dim, colourless arc probably slightly narrower than the average narrow solar rainbow. Persisting until 21h. 48m., when the moon was obscured by cloud, the bow re-appeared at 21h. 51m. and lasted until 21h. 54m.

The dimple is very small however and might well be missed in nature.

Latitude of Aberdeen = 57° . Declination on May 11th, $17^{\circ} 45'$ N. Elevation of sun at 10h. G.M.T. approximately 45° . —F.J.W.W.]

Aurora Australis

In the Melbourne "*Sun*," dated April 22nd, 1927, a correspondent refers to a "sky display" on April 14th, seen from the neighbourhood about 9.30 p.m. and again between 10 and 10.30 p.m. His description of a red glow above beams of white light in the east and south-east, looks like the Aurora Australis.

G. C. WOOLDRIDGE.

Leicester Road, Ashby-de-la-Zouch. June 11th, 1927.

Early Summer Conditions in the Highlands.

What struck me most during my holiday in Scotland was the appalling damage wrought by the gale of January 28th, mentioned by Mr. Dines in the July number of the magazine. To speak of hundreds of trees down would be a misnomer, you see woods absolutely prone, and the occasional trees still upright are the exception; thousands of trees lying in inextricable confusion five months after the storm. This is specially noticeable up the Great Glen; Loch Lochy side seems to have suffered as badly as any place. I motored from Fort William to Inverness and back by bus and saw the destruction. At Fort William the pier was partly washed away and water got into the station. It was the worst storm ever known.

Loch Laggan suffered badly and hundreds of trees down at Ardverikie—Sir John Ramsden's place—but not so bad as Loch Lochy and the Great Glen.

I made many ascents; the weather was very clear and cold with occasional showers and one could see the Cairngorms pure white above 4,000 ft. till about June 12th. On June 14th there appeared bare patches in the white covering. On Ben Nevis on Whit Monday, June 6th, there were about 7 ft. snow, so that one could step on to the roof of the old Observatory without using hands; it was calm, sunny and cloudy and temperature 38° - 40° at 2.15 (S.T.). No continuous snow below 4,000 ft. on south-west and west sides though drifts as low as 2,300 ft. On June 9th I was on Aonach Beag (4,060) and had the record temperature of 32° at 2.45 p.m. (S.T.); snow cap quite frozen and summit rocks had icicles hanging to them, cloudy, sunny and clear day, north airs.

June 14th I saw the sun set from Ben Lawers (3,984) at 10.15 p.m. (S.T.); very clear and light north airs and temperature 34°

at sunset ; the shadow of the Ben rose up the hills to the south-east and was finally projected into the sky, a wonderful sight. Marvellous view from Goat Fell in Arran to Ben Wyvis. There seemed more snow than usual for the time of year above 3,900 ft. and less than usual below that level. The depth at the summit of Ben Nevis and Cairngorms was remarkable for June. There were several inches of fresh snow on Ben Nevis on June 3rd which lay to 3,000 ft. and it was so cold that this was still lying on June 10th.

I have since heard that Ben Nevis had fresh snow down to below 2,200 ft. about June 25th, and it was well into July before the snow cap on the summit had dissolved into separate beds. A friend of mine who used to do duty at the summit Observatory tells me that he never remembers seeing so much snow on the hill top in July.

R. P. DANSEY.

Kentchurch Rectory, Hereford. August 6th, 1927.

Waterspout on Loch Leven

An interesting account of a waterspout observed on Loch Leven, on Wednesday, June 8th, has been furnished me by Lieuts. Garnett and Trail, R.N., of Leuchars R.A.F. Training Base, who were out fishing on the Loch on that day. It is recounted here in their own words as nearly as possible.

The officers arrived at Loch Leven at 11.30 a.m., B.S.T., in very heavy rain accompanied by a slight breeze from the west. About noon the wind fell to a calm and with a clearing sky the air temperature rose rapidly. Judged by the movement of the remaining cloud the wind at 2,000-3,000 feet had no decided direction. Presently the sky clouded from the south-west while the wind on the surface was easterly though not exceeding 5 m.p.h. By about 2 p.m. the sky was overcast and at 2.30 rain fell heavily with no wind. A thunderstorm was in progress to the west, probably between Kinross and Stirling. At this stage the officers began to encounter difficulty in casting. At times the last five or six feet of cast would not remain on the water. After renewed attempts at throwing the line the gut with four flies attached persisted in rising from the water and more than once remained nearly vertical, staying in that position for about half a minute before sinking back. While this was taking place very heavy rain continued and there was no wind.

During the next hour the wind rose again to force 2 or 3 but seemed to blow from all directions in turn. It never remained steady for more than 10 minutes. At 4 p.m. it fell away to calm again but was soon followed by violent squalls with wind force 7 to 8 mainly from a southerly point. Simultaneously clouds became low and rain began to fall heavily. At this stage while

watching the north side of the Loch at a distance of a quarter of a mile the surface showed signs of violent disturbance, and presently the water in that neighbourhood took on a rapid anti-clockwise movement and rose to a height of 15 to 20 feet. It then began to move about over the surface of the Loch covering an area of 2 or 3 acres in its peregrinations. The surface of the water in its vicinity was violently agitated over an area extending 10 to 15 feet around the base of the spout and frequently produced a dense spray. The spout itself varied in height from 7 or 8 feet to about 20 feet but kept the diameter of its base fairly steady within the limits of 15 and 20 feet. It tapered to about three-quarters of its base at the top, which was ragged and clouded in spray.

During these considerable vertical and horizontal movements of the waterspout, the clouds were 800-1,000 feet above the water surface. At the lower layer of the cloud above the waterspout an extension emerged for a distance of 50 to 100 feet, tapering off from the cloud downwards. At the place of emergence both the cloud base and the projection were well defined. While the Loch counterpart moved about, the lower end of this trunk-like protuberance swayed about, following its motion. The entire phenomenon lasted about a quarter of an hour, after which the wind fell to calm though the heavy rain continued for two hours. Just after 6 p.m. a wind, 8-10 m.p.h., sprang up from the north-northwest and continuous rain gave place to showers. Clear sky and calm prevailed later in the evening.

J. M. STAGG.

Leuchars. June 9th, 1927.

[In a lecture on line squalls delivered before the Royal Aeronautical Society in March of this year, Mr. Giblett associated waterspouts with line squalls and stated that the seat of their occurrence appeared to be the region of strong air convergence immediately below the squall cloud which marks the forward edge of the advancing cold air. This would seem to be borne out in the present instance. The synoptic charts for June 8th indicate a cold front, although it is not very clearly defined, and the occurrence of the waterspout phenomenon would appear to coincide with the arrival of cold air from the north-northwest. This is supported by the fact that shortly after the waterspout movements were observed, the north-northwest wind sprang up and the sky cleared, the latter phenomenon probably coinciding with the arrival of the cold air at ground level.—F.E.]

Erratum

July, 1927, page 135, line 16, *for* "British thermal units" *read* "Board of Trade units" and note one Board of Trade unit equals one kilowatt hour.

NOTES AND QUERIES

A Mammilated Cloud Sheet at Whitley Bay

The photograph of mammato cloud which forms the frontispiece of this volume of the magazine was taken by Mrs. E. Watts, of Whitley Bay, Northumberland, from the promenade there, at 11h. on July 5th. She writes that "It was a beautiful morning to commence with, then suddenly the clouds as shown began to roll up from the southwest rapidly. Everybody here described it as a padded quilt and expected anything. However it ended in a very heavy thunderstorm followed by floods."

Notes on Conditions prevailing during Thundery Weather about July 10th-13th, 1927

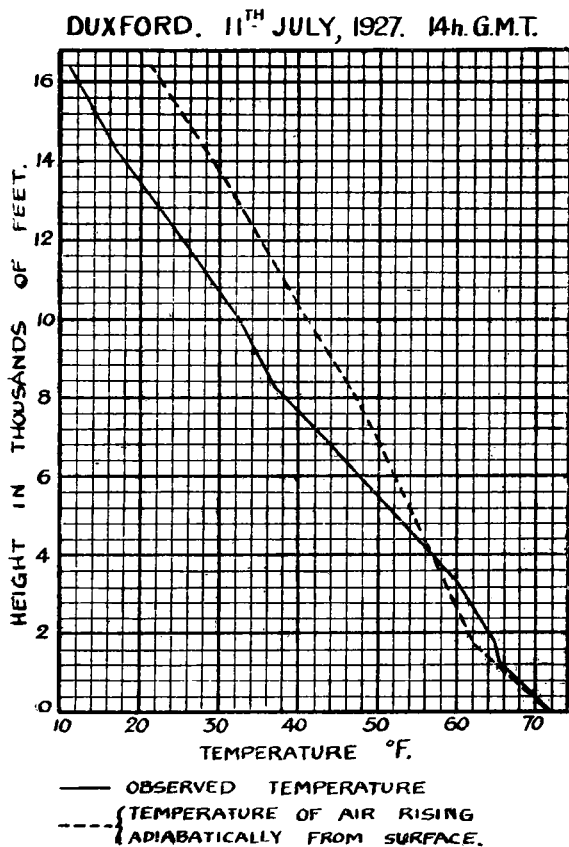
On Sunday, July 10th, the first day of the local thunderstorms, there was a rather deep depression over Germany and an anti-cyclone to westward of Ireland. Winds were northerly over the British Isles, but temperature nevertheless rose to about 80° F. over a large part of England, showing a considerable rise since the previous day, and exceeded 75° F. over parts of Scotland. The high temperatures are explained by the fact that the air originated in an easterly current which prevailed for some days over southern Scandinavia and the Baltic. Day temperatures in these districts ranged from 70° F. to 80° F., and (except on the west coast of Norway) the humidity was rather high, dewpoints being above 60° F. at several stations. The mean July temperature of the North Sea is about 57° F., so that a surface temperature inversion must inevitably have been formed as the warm air crossed the cool sea, but the passage was rapid and the inversion was evidently quickly removed by sunshine in the British Isles. The damp state of the ground after three weeks of unsettled weather no doubt further increased the water content of the air.

By the morning of the 11th a shallow depression had formed over the southern part of England, and persisted some days, with light indefinite winds. The storm over London on the afternoon of the 11th moved slowly in an upper current from south to north, but the origin of the air remained unchanged.

The diagram shows the upper air temperatures observed that afternoon at Duxford, near Cambridge, compared with the temperature which would have been assumed by air rising from the earth's surface under adiabatic conditions. The rising air would have become saturated at about 1,800 feet (an unusually low level for a warm day) and would thereafter have followed its "saturated adiabatic" curve. It may be noticed that from 8,000 feet up to at least 16,000 feet the rising air would have been

about 10° F. warmer than its environment. Under these conditions powerful upward currents of great vertical extent were inevitable as soon as large cloud masses penetrated into this region, and it is unlikely that the rising currents came to rest before reaching the stratosphere. Temperatures between 8,000 and 16,000 feet were about normal for the season, the instability being due entirely to the warm damp air near the surface.

At Duxford the relative humidity dropped from 78 to 61 per



cent. between about 1,000 and 2,000 feet, and the lapse-rate in that layer was small, both features being most unusual for a summer afternoon at an inland station. There was fog along the east coast in the morning, and this probably drifted inland from the Wash in the northerly current still prevailing. Duxford is only 50 miles from the Wash, and probably the comparatively recent dissolution of the fog explained the abnormal conditions. At stations further west afternoon temperatures before the thunderstorms ranged from 75° F. to 78° F.,

and the water content was about the same as at Duxford. It is therefore reasonable to assume that over most of the country there was no stable layer at about 2,000 feet (such as is shown in the diagram for Duxford), that the cloud base was not lower than 2,500 to 3,000 feet, and that the degree of instability up above was somewhat greater than is shown in the diagram.

Next day a sheet of low stratus cloud from the North Sea persisted over the eastern half of England, but further west, where there was some sunshine, thunderstorms again developed. Thunderstorms also occurred on the south-east coast during the

night of July 12th—13th. At Duxford on the 13th there was a temperature inversion of 9° F. between 2,800 and 3,400 feet, above the stratus clouds, temperature having fallen 15° F. at about 2,000 feet since the 11th. The air was damp above the inversion, being actually saturated at 5,000 feet, with unstable conditions for saturated air above that level, which explains the occurrence of thunderstorms during the previous night.

The majority of the thunderstorms were of a perfectly straightforward diurnal convectional type. The unusual feature was the source of the warm damp air.

C.K.M.D.

Rainfall associated with Thunderstorms of July, 1927

On more than half the days in July heavy falls of rain associated with thunderstorms were recorded somewhere in the British Isles. According to the available information those during the night of the 6th to 7th, the afternoon of the 11th and on the 21st were most widespread.

Rainfall in Kent, July 6th–7th. During the night of the 6th to 7th, more than 1 in. fell to the east of a line from the Wash to St. Leonards, as well as over part of the North Yorkshire Moors. More than 2 in. was recorded at Sheringham (near Cromer), between Colchester and Clacton and in the south-east of Kent. At Deal the fall just exceeded 3 in. Of the total fall at Dover (2.81 in.) as much as 2.3 in. occurred between 19h. 40m.* on the 6th and 0h. 40m. on the 7th at the fairly uniform rate of .45 in. an hour. Persistent heavy rain was, therefore, the main feature of the storm. The storm was one of the worst experienced at Dover for many years. At times the streets were almost impassable and vivid lightning lit up the town. The rain commenced rather earlier to the south-west and later further north. At Norwich and Sheringham it rained from 2h. to 9h. on the 7th.

Rainfall in London, July 11th. The rainfall over London during the afternoon of the 11th presented features of unusual interest. More than 1 in. fell over large areas stretching from Kew Gardens to Alexandra Palace and from Carshalton to Battersea Park, as well as locally in Bermondsey and Forest Hill. The fall exceeded 2 in. over an area between Hammersmith Bridge, Wormwood Scrubbs and Kensington Gardens. The largest amounts recorded were:—

Kensington (Holland House)	..	3.42 in.
„ (Cam House)	.. ..	2.93 „
Hammersmith Pumping Station	..	2.65 „
Kensington (Campden Hill)	..	2.45 „

The rainfall gradient was very steep since in the Strand, on

* All times specified are G.M.T.

Putney Common and at Sudbury, 4 miles east, 4 miles south and 6 miles north-west of Holland House respectively the fall was less than half an inch. The rain commenced about 13h. 45m. in the South Kensington and Balham districts and as late as 14h. 30m. at Kings Cross and in the north-east of London. It ceased at about 16h. in the west and at 16h. 30m. in the north-east.

Estimates of the intensity of the rainfall are available from the charts of the autographic gauges maintained at certain stations in the area :—

Station	Amount		Duration		Rate per hour
	in.		min.		in.
Kensington Palace	1.00		12		5.00
Balham High Road	1.50		18		5.00
Hammersmith Pumping Station	2.00		36		3.33
Campden Hill	2.00		38		3.16

There is little doubt that in parts of Kensington the intensity of rainfall even surpassed that actually recorded by the autographic gauges.

The rainfall of July 11th over London was remarkably similar to that of June 16th, 1917, both in general distribution and in the duration of the storm. In 1917, however, there was no rain at all to the south-east of a line from Wimbledon to Liverpool Street, while the falls in the Kensington area were generally larger, as much as 4.65 in. being recorded in less than 2 hours and a half at Campden Hill. This constituted one of the most extreme instances of prolonged intense rainfall ever observed in the British Isles and incidentally gave the largest daily fall on record for London. The sewers and storm relief works could not cope with the intense rainfall of July 11th and much flooding occurred. It has been estimated that the amount of water falling in these two hours in Hammersmith, Fulham, Hampstead, Kensington and parts of Wandsworth, was equivalent to an open river, 100 yards wide and 4 feet deep flowing at a normal walking pace of 3 miles an hour. Fortunately when the storm began the tide in the River Thames had been falling for some hours, so that the discharge of the rain-water to the sea was not impeded.

Another unusual feature of the storm was the intense darkness. The temperature at Kensington during the storm dropped 10° F.

From Worthing the cumulus clouds to the north during the afternoon were very impressive, while the coast from Beachy Head to the Isle of Wight and the South Downs could be seen bathed in sunshine. In the late afternoon one massed cumulus cloud towering above all the others was noted.

Rainfall, July 11th, outside London. The rainfall also exceeded 1 in. on the rainfall day of the 11th over isolated areas in the

south of England—in Exmoor, the Mendips, near Marlborough, Lechlade and Farnborough (Hampshire)—and in the Midlands near Wolverhampton and the southern Pennines, and near Strathaven (Lanarkshire). At Wolverhampton 3.70 in. was recorded as a result of two storms in the afternoon and evening. Very considerable damage by floods occurred in the Staffordshire and Oldham districts, although it is not possible at present to define the amount or intensity of the rainfall with any precision.

Rainfall July 21st. Heavy falls on the 21st accompanied by extensive floods, were reported from Ashton-under-Lyne, Stalybridge, Sunderland, Glasgow and Greenock. At Chew Valley and at Brushes Reservoir to the east of Ashton-under-Lyne 2.2 in. and 1.8 in. respectively is reported to have fallen in an hour.

J.G.

Weather Notes in the Fugger News-Letters

The great business house of Fugger in the sixteenth century spread its activities over all Europe, and to its headquarters in Augsburg came letters from correspondents in the chief cities, filled with the news, the hopes and the fears of the day. These "news-letters" were carefully filed, and ultimately found their way into the Vienna State Library, where they lay unnoticed until a few years ago, when a first selection was published in Vienna and subsequently translated into English. This series deals mainly with continental news; a second series concerned primarily with English activities has also been published by The Bodley Head.* The volumes cover the years 1568 to 1605, and I thought it worth while to search the extracts for any weather notes which might occur.

The contents of the books are of extraordinary historical interest, and from that point of view the books are well worth reading, but meteorologically the result of the search was disappointing; references to the weather are far less frequent than might have been expected from business correspondents in a seafaring and agricultural age. The times were very stirring, there was no lack of news, and perhaps either the original correspondents or the editor of the volume, or both, had so much material that the weather news went to the wall. In the whole of the first volume only two references to weather were noted:

1596, April 25th. "On the evening of St. Mark's Day there arose (in Rome) a terrible storm which lasted more than half-an-hour."

On July 18th, 1597, it rained blood near Vienna. [It is doubtful, however, whether the "rain" fell from heaven or from a cut in the tail of an ox].

* The Fugger News-Letters. Being a selection of unpublished letters from the Correspondents of the House of Fugger during the years 1568-1605, 2 Vols., London, John Lane, the Bodley Head, 1924, 1926.

The second volume, however, contains five important references to seasons :

In October 1579, in England, "fearful rough weather with rain, heavy snow and unusual cold, such as has not been experienced for sixty years."

In October 1590, the weather in Flanders was very wet and cold.

January 1597. In England, "the rain lasts day and night, and the country is waterlogged."

May 1598. In Holland "the bad weather has again done much damage."

August 1598. In England, "Weather for the crops remains splendid."

It appears that the autumn of 1588 may have been unusually stormy in the Atlantic. In addition to the well-known storm of May 30th which sprang up suddenly and lasted an hour, disabling many ships of the Armada, we hear that in September Drake was unable to stay at sea because of the gales, and in October Spanish ships were driven ashore in Ireland by a south-westerly gale. On April 16th, 1580, there was an earthquake in Flanders, France and England, "Some towers and houses collapsed." In the summer of 1582 there was rough weather off the coast of Brazil. In March, 1589, eight vessels were lost along the English (Channel) coast, in November, 1589, Spanish ships were damaged and sunk in a storm, and in November, 1596, a similar fate overtook a Spanish fleet going to Ireland.

A report of great interest is that for September, 1594, from Antwerp, reporting the discovery of the north-east passage to India, "behind Norway." "The sailing is very good there, but one must be careful to choose the months of June, July and August, as at all other times the channel will be found to be icebound."

C. E. P. B.

Fencing around Rain-Gauges

During 1925 and 1926 records are available from a fenced and unfenced rain gauge, both 8 in. in diameter with rims 1 ft. above the ground, at the Telegraphic Reporting Station, Portland Bill, Dorset. The ground on which the gauges stand is 32 feet above sea level with an upward slope from southeast to northwest, the approximate gradient being 1 in 15. The site is a very open one, devoid of trees and buildings other than the lighthouse. The winds felt here should be practically those of the open sea in the vicinity, and during strong winds it is possible that too little rain is recorded owing to the gauges being over-exposed. The standard gauge is erected 50 yards northeast of the lighthouse, the tower of which is 136 ft. high from base to vane. Owing to frequent interference by visitors the standard gauge was surrounded with a chestnut pale fence on February 1st, 1925, and remained fenced until March 13th, 1926, when it became necessary to remove the fence, and records were thereafter again obtained from the unfenced gauge.

The fence was 3 ft. 6 in. high with pales 5 in. apart, and enclosed a circle 30 ft. in diameter, the rain-gauge being in the centre of the circle. It was expected that a fence of the type used, by breaking the force of the wind over the gauge, would increase the catch, and the provision of a check gauge enabled this point to be examined. The unfenced check gauge was erected 50 yards north-northwest of the standard gauge, during December, 1924, and remained in this position until August 6th, 1926, when it was run over by a motor car and destroyed.

The following table compares the monthly results :—

	Standard Gauge (both unfenced)	Check Gauge (fenced)		Standard Gauge (fenced)	Check Gauge (unfenced)
	mm.	mm.		mm.	mm.
1925. Jan. ...	113.4	113.5	1925. Feb. ...	102.9	105.9
1926. Apr. ...	80.6	79.3	„ Mar. ...	9.7	9.7
„ May ...	31.9	30.9	„ Apr. ...	56.9	57.4
„ June ...	50.1	51.1	„ May ...	75.4	75.4
„ July ...	25.0	24.0	„ June ...	12.9	12.9
			„ July ...	73.3	74.0
			„ Aug. ...	49.3	49.4
			„ Sep. ...	79.8	79.7
			„ Oct. ...	100.0	99.5
			„ Nov. ...	65.4	63.2
			„ Dec. ...	87.4	86.8
			1926. Jan. ...	88.7	88.3
			„ Feb. ...	44.1	44.4
			„ Mar. ...	7.6	7.3
Totals ...	301.0	298.8		853.4	853.9

During the five months when both gauges were unfenced the standard gauge, with a total measurement of 301 mm., shows an excess over the check gauge of 2.2 mm. only, and covering the period of fourteen months, when the standard gauge was fenced, there is a deficit of 0.5 mm. between this gauge and the check gauge. Bearing in mind the extremely exposed position of the site the agreement between the two gauges is remarkably close, the figures showing that if the chestnut pale fence has any effect at all on the gauge, such effect is a very small one, and is not in the direction of increasing the catch of the gauge.

The standard gauge, above referred to, is being maintained in its original position, but unfenced, for the present. A new check gauge was erected 30 yds. west of the lighthouse on the 9th September, 1926, and was surrounded with the chestnut pale fence, originally round the standard gauge, at the end of October, 1926. It is proposed, ultimately, to adopt this new site as the standard one at Portland Bill, and to discontinue the records from the old gauge.

SPENCER RUSSELL.

Radiation from the Sky

RADIATION MEASURED AT BENSON, OXON, 1927.

Unit: one gramme calorie per square centimetre per day.

ATMOSPHERIC RADIATION only (dark heat rays)				
Averages for Readings				
		April	May	June
Cloudless days :—				
Number of readings	n	2	13	5
Radiation from sky in zenith ...	πI	493	521	531
Total radiation from sky ...	J	526	556	562
Total radiation from horizontal				
black surface on earth ...	X	714	752	789
Net radiation from earth ...	$X-J$	188	196	227
DIFFUSE SOLAR RADIATION (luminous rays).				
Averages for Readings between 9 h. and 15 h. G.M.T.				
Cloudless days :—				
Number of readings	n_0	0	1	2
Radiation from sky in zenith ...	πI_0	..	100	90
Total radiation from sky ...	J_0	..	115	92
Cloudy days :—				
Number of readings	n_1	0	1	1
Radiation from sky in zenith ...	πI_1	..	65	284
Total radiation from sky ...	J_1	..	47	216

Unit for I = gramme calorie per day per steradian per square centimetre.

Unit for J and X = gramme calorie per day per square centimetre.

For description of instrument and methods of observation, see *The Meteorological Magazine*, October, 1920, and May, 1921.

Reviews

über Luftdruckwellen. By Paul Mildner. Leipzig. Veröff. Geophysik Inst. Univ. Ser. II., Band 3, Heft 3, pp. 173-238, 1926.

The earliest daily weather charts covered a comparatively small area, in which as a rule only one anticyclone or depression was visible at one time, and early studies of synoptic meteorology generally regarded each anticyclone or depression as an entity to be studied without reference to its neighbours. The extension of the synoptic area led to the recognition of families or series of depressions, and the isobars which form the boundary between such a series and the anticyclonic belt on its equatorial side

often showed a very neat wave form advancing from west to east round the globe. Such a series of waves passing over a fixed station leave their record in wave-like oscillations of the curve of pressure at the station. A regular oscillation which has persisted for some time in the past may be expected to persist for a time in the future. Hence F. Vercelli in 1923 initiated the analysis of barograms into their constituent periodicities, and employed the results to give experimental forecasts for a week in advance. The theory was further developed by L. Weickmann*, who sought for points at which the constituent curves either all reached maxima or minima together or all passed through points of inflexion together. In the first case the pressure curve to the right of the point will be a direct reflection of the curve to the left; in the second case it will be an inverse reflection. Weickmann was able to pick out on curves of pressure a number of such points, which he termed "points of symmetry." As a rule they can only be recognised when both halves of the curve are available and the opportunity for a forecast has gone by, but the phenomena offer a promising field for study. The present paper is a continuation of Weickmann's researches.

There is considerable evidence for the existence of pressure waves of about 8 and 24 days, and the author accordingly selects them for study. Over the interval from December 10th, 1923, to February 19th, 1924, he calculates by harmonic analysis the amplitude and phase of these waves at a large number of stations in Europe, north Africa, and the North Atlantic. The results when plotted yield a great deal of information about the characteristics of such waves, and show that during the interval in question the variations of pressure over Europe and the Arctic were in fact dominated by the 24-day pressure wave, which reached an amplitude of 17 mb. over Spitsbergen and 14 mb. at Scilly. The author, however, closes on a note of warning; such results are valid only for the interval actually covered by the analysis. Different intervals give different results, and until the causes of these differences are known, extrapolation is unsafe. He suggests, however, that the waves spread out from certain action centres, especially the Arctic Ocean and the Azores anticyclone, and that the variations from year to year are due to the conditions in these centres, which may be of cosmic origin.

El Gran Temporal de Nieve del 28 al 31 de Agosto de 1923. By Guillermo Hoxmark. Buenos Aires, Anal. Soc. Cien. Argentina, Tome 101, pp. 5-10, 1926.

The area over which snow fell in the Argentine was about 193,000 square miles, mainly over the Central Pampas. The storm was

* Wellen im Luftmeer. By L. Weickmann, *Leipzig, Abh. Sächs. Akad. Wiss.*, Vol. 39, No. 2, 1924.

associated with the northward passage of an anticyclone from Patagonia while at the same time a depression moved south-westward across north-eastern Argentina. It was in the area of steep gradient and polar winds between these two systems that the snow fell. The snowstorm was disastrous, many thousands of horses, cattle and sheep being destroyed.

Books Received

- Terrestrial Magnetism in the Twentieth Century.* By D. L. Hazard. Smithsonian Report for 1925, pp. 243-256. Washington D.C., 1926.
- Jaarboek, Koninklijk Nederlandsch Meteorologisch Instituut, 1924.* A. Meteorologie. B. Aard-magnetisme (No. 98). Utrecht, 1925.
- Ergebnisse Aerologischer Beobachtungen, 1924.* K. Ned. Meteor. Inst. (No. 106A). Utrecht, 1925.
- Onweders, Optische Verschijnselen, enz in Nederland.* Naar Vrijwillige Waarnemingen in 1923. Deel XLIII. K. Ned. Meteor. Inst. No. 81. Amsterdam, 1925.
- Royal Alfred Observatory, Mauritius, Annual Report, 1925, and Results of Magnetical and Meteorological Observations for September to December, 1925.*
- Nautisk-Meteorologisk Aarbog, 1926.* Copenhagen, 1927.
- Falmouth Observatory, Meteorological Notes and Tables for the Year 1926.* By J. B. Phillips. Falmouth, 1927.
- Monthly Rainfall of India for 1925.* Calcutta, 1927.

Obituary

Mrs. G. M. Whipple.—We regret to learn of the death of Mrs. Whipple which occurred at Highgate on August 6th in her 82nd year. Mrs. Whipple was the daughter of Mr. Robert Beckley who was on the staff of Kew Observatory for many years. She married in 1871 Mr. G. M. Whipple then first assistant and later (from 1876 to his death in 1893) Superintendent of the Observatory. One of her three surviving sons succeeded Dr. Chree as Superintendent of the same Observatory in 1925.

News in Brief

The degree of Ph.D. (Science) has been conferred by the University of London on R. E. Watson, B.Sc., for a magnetic research which was carried out in a coal mine near Birmingham in 1923.

Staff News. Civil Service Lawn Tennis Championships, Women's Doubles, winners Miss Lovell and Miss Quennell. Women's Singles, Class B, runner-up Miss Quennell.

The Weather of July, 1927

Unsettled thundery weather with many fair periods prevailed generally throughout the month. With the exception of the 10th, which was sunny and warm, rain occurred on most days between the 1st and 11th, the heaviest falls being on the night of the 6th-7th when a severe thunderstorm was experienced over the eastern and south-eastern districts of England* and on the 11th when a thunderstorm of unusual intensity occurred in London and southeast England†. Heavy rain, including 1.65 inch at Portland Bill, also fell on the 1st when a depression remained centred near the Straits of Dover throughout the day. Another depression deepening considerably as it approached our western coasts brought gales to Cornwall and Scilly Isles on the morning of the 4th. By Sunday the 10th the low pressure system which had dominated the weather during the earlier part of the month began to move away eastwards and a ridge of high pressure over the Atlantic extended northeast over Ireland and Scotland giving fair weather in the north and west of these countries for some days. At the same time shallow areas of low pressure were situated over England and further thunderstorms developed locally in southern England and Wales. After the 14th the unsettled sunless' conditions were confined to the southeast of England and on the 18th and 19th the anticyclone moved across Great Britain giving fine warm weather over nearly the whole country during those two days. A fresh depression however was approaching our southwest coasts, and an unsettled type of weather was renewed and maintained from the 20th to the end of the month, though on several days good sunshine records were obtained locally, *e.g.*, 14.3 hours at Margate on the 25th. The highest temperature reported during the month was 82° F. at Worksop on the 10th, but at most stations in the south the mean monthly temperature was below normal. At Ross-on-Wye it was dullest July since records began there in 1914, but in northwest Scotland there was an excess of sunshine.

Pressure was below normal generally except over Scandinavia, Newfoundland, Nova Scotia, Bermuda, and the south of the Iberian Peninsula, the greatest deficit being 4.9 mb. at Valentia and the greatest excess 6.3 mb. at Vardö. Temperature was generally above normal and rainfall below normal in Scandinavia (except for parts of Sweden, where the rainfall was in excess) and the northern part of the British Isles, and temperature below and rainfall above normal in southwestern and central Europe. At Spitsbergen both elements were below normal.

* See p. 160.

† See p. 158.

Severe thunderstorms and heavy rain followed by floods were the main features of the weather over Europe. Storms and floods occurred round Paris on the 6th and over France generally on the 11th. On the 8th an exceptionally severe thunderstorm broke over the highlands of Saxony. Three villages were nearly destroyed and about 150 people killed. Other severe storms and floods were reported from south Russia, Caucasus and Turkestan on the 3rd, from Upper Austria and Brussels on the 12th, from Westphalia on the 15th-17th, from Switzerland on the 15th-17th, and again on the 23rd, from Isère and Germany on the 22nd-24th and from Lombardy and Venetia on the 23rd. Early in the month hot sunny weather occurred in south France and Italy, and a heat wave swept over Yugoslavia, 104° F. being reported from Skoplye on the 2nd.

The heat wave which occurred in Cairo about the 6th was said to be the most unpleasant experienced for 20 years owing to the combination of high temperatures with high humidities.

The monsoon at Bombay has been very "vigorous," 42 in. of rain being recorded at Colaba Point up to the 8th. As a result extensive floods occurred in Gujarat and Kathiawar throughout the rest of the month. On the 28th an abnormal rainfall of 6 in. was experienced at Balasore (Calcutta) and neighbouring districts have been flooded. A typhoon wrought havoc among the districts of the Canton delta (Hongkong) on the 25th and 10,000 people have been drowned near Changshowfu Amoy, as a result of the mountain flood in the Fukien Province.

It was reported on the 8th that the drought in west Queensland was still continuing but plentiful rains fell in the agricultural districts of South Australia about the 22nd.

Storms doing much damage to the crops were experienced in Alberta, Saskatchewan and Manitoba on the 9th-12th, and hailstorms later in the month. A heat wave occurred in the eastern States of America on the 13th-14th.

The special message from Brazil states that the rainfall in the northern districts was 63 mm. above the normal and in the central and southern districts 12 mm. and 39 mm. below normal respectively. Four anticyclones passed across the country and frosts and high winds were experienced at the beginning and end of the month in southern Brazil. The cotton, cane, coffee and cocoa harvests were good generally. Pressure at Rio de Janeiro was 3.7 mb. above normal and temperature 1.3° F. below normal.

Rainfall, July, 1927—General Distribution

England and Wales	..	133	} per cent. of the average 1881-1915.
Scotland	.. .. .	99
Ireland	.. .. .	113
British Isles	.. .. .	<u>120</u>

Rainfall: July, 1927: England and Wales

CO.	STATION.	In.	Per- cent. of Av.	CO.	STATION.	In.	Per- cent. of Av.
<i>Lond.</i>	Camden Square	3.24	136	<i>Leics</i>	Thornton Reservoir ..	2.70	109
<i>Sur.</i>	Reigate, The Knowle ..	2.69	128	"	Belvoir Castle	2.39	98
<i>Kent.</i>	Tenterden, Ashenden ..	4.66	223	<i>Rut.</i>	Ridlington	2.36	...
"	Folkestone, Boro. San.	4.70	...	<i>Linc.</i>	Boston, Skirbeck	2.01	91
"	Margate, Cliftonville ..	4.90	248	"	Lincoln, Sessions House	2.13	96
"	Sevenoaks, Speldhurst ..	2.78	...	"	Skegness, Marine Gdns.	...	...
<i>Sus.</i>	Patching Farm	3.16	132	"	Louth, Westgate	2.16	86
"	Brighton, Old Steyne ..	1.41	65	"	Brigg	2.84	122
"	Tottingworth Park	3.65	146	<i>Notts.</i>	Worksop, Hodsock	2.41	106
<i>Hants</i>	Ventnor, Roy. Nat. Hos.	3.61	179	<i>Derby</i>	Mickleover, Clyde Ho. .	2.72	111
"	Fordingbridge, Oaklands	3.42	171	"	Buxton, Devon. Hos. .	3.54	90
"	Ovington Rectory	4.19	162	<i>Ches.</i>	Runcorn, Weston Pt. .	2.27	83
"	Sherborne St. John	5.01	224	"	Lancaster, Dorfold Hall	2.23	...
<i>Berks</i>	Wellington College	3.76	182	<i>Lancs</i>	Manchester, Whit. Pk. .	1.87	57
"	Newbury, Greenham	3.31	149	"	Stonyhurst College	4.93	127
<i>Herts.</i>	Benington House	2.16	89	"	Southport, Hesketh Pk.	2.88	101
<i>Bucks</i>	High Wycombe	3.71	188	"	Lancaster, Strathspey .	3.96	...
<i>Oxf.</i>	Oxford, Mag. College ..	2.85	126	<i>Yorks</i>	Wath-upon-Deerne	2.36	94
<i>Nor.</i>	Pitsford, Sedgebrook ..	2.86	121	"	Bradford, Lister Pk. .	3.94	143
"	Oundle	2.39	...	"	Oughtershaw Hall	6.15	...
<i> Beds.</i>	Woburn, Crawley Mill .	1.79	80	"	Wetherby, Ribston H. .	4.77	191
<i>Cam.</i>	Cambridge, Bot. Gdns. .	1.68	78	"	Hull, Pearson Park	3.08	132
<i>Essex</i>	Chelmsford, County Lab.	2.18	102	"	Holme-on-Spalding	2.95	...
"	Lexden, Hill House	3.52	...	"	West Witton, Ivy Ho. .	4.61	...
<i>Suff.</i>	Hawkedon Rectory	3.90	160	"	Felixkirk, Mt. St. John	4.58	168
"	Haughley House	2.92	...	"	Pickering, Hungate	2.27	...
<i>Norfol.</i>	Beccles, Geldeston	1.83	79	"	Scarborough	2.36	97
"	Norwich, Eaton	2.47	95	"	Middlesbrough	4.32	169
"	Blakeney	2.59	115	"	Baldersdale, Hury Res.	4.79	...
"	Little Dunham	3.68	134	<i>Durh.</i>	Ushaw College	3.55	127
<i>Wilts.</i>	Devizes, Highclere	5.19	224	<i>Nor.</i>	Newcastle, Town Moor .	3.69	139
"	Bishops Cannings	4.25	171	"	Bellingham, Highgreen	3.80	...
<i>Dor.</i>	Evershot, Melbury Ho. .	3.98	157	"	Lilburn Tower Gdns. .	3.87	...
"	Creech Grange	2.25	...	<i>Cumb.</i>	Geltsdale	4.14	...
"	Shaftesbury, Abbey Ho. .	2.00	78	"	Carlisle, Scaleby Hall .	4.37	134
<i>Devon</i>	Plymouth, The Hoe	3.57	129	"	Seathwaite M. ....	...	...
"	Polapit Tamar	3.86	143	"	Keswick	6.17	...
"	Ashburton, Druid Ho. .	5.19	170	<i>Glam.</i>	Cardiff, Ely P. Stn. .	4.38	141
"	Cullompton	3.27	122	"	Treherbert, Tynywaun	9.81	...
"	Sidmouth, Sidmount	3.57	142	<i>Carm.</i>	Carmarthen Friary	5.52	157
"	Filleigh, Castle Hill	5.04	...	"	Llanwrda, Dolaucothy .	7.56	174
"	Barnstaple, N. Dev. Ath.	3.92	148	<i>Pemb.</i>	Haverfordwest, School	3.80	119
<i>Corn.</i>	Redruth, Trewirgie	4.31	141	<i>Card.</i>	Gogerddan	5.52	143
"	Penzance, Morrab Gdn. .	2.40	88	"	Cardigan, County Sch. .	3.55	...
"	St. Austell, Trevarna	3.57	107	<i>Brec.</i>	Crickhowell, Talymaes	5.60	...
<i>Som.</i>	Chewton Mendip	5.39	155	<i>Rad.</i>	Birm. W. W. Tyrmynydd	6.26	152
"	Street, Hind Hayes	4.23	...	<i>Mont.</i>	Lake Vyrnwy	4.83	141
<i>Glos.</i>	Clifton College	5.13	181	<i>Denb.</i>	Llangynhafal	2.25	...
"	Cirencester, Gwynfa	3.49	135	<i>Mer.</i>	Dolgelly, Bryntirion .	6.16	145
<i>Here.</i>	Ross, Birchelea	3.37	149	<i>Carn.</i>	Llandudno	1.68	70
"	Ledbury, Underdown	3.40	150	"	Snowdon, L. Llydaw 9	12.73	...
<i>Salop</i>	Church Stretton	2.09	85	<i>Ang.</i>	Holyhead, Salt Island .	1.64	63
"	Shifnal, Hatton Grange	2.73	121	"	Lligwy	1.20	...
<i>Worc.</i>	Ombersley, Holt Lock .	4.00	187	<i>Isle of Man</i>	Douglas, Boro' Cem. .	2.84	93
"	Blockley, Upton Wold .	3.33	137	<i>Guernsey</i>	St. Peter P't. Grange Rd	3.05	151
<i>War.</i>	Farnborough	3.63	142				
"	Birmingham, Edgbaston	3.12	134				

Rainfall: July, 1927: Scotland and Ireland

CO.	STATION	In.	Per- cent. of Av.	CO.	STATION.	In.	Per- cent. of Av.
<i>Wigt.</i>	Stoneykirk, Ardwell Ho	3.46	119	<i>Suth.</i>	Loch More, Achfary ...	2.25	42
"	Pt. William, Monreith .	2.28	...	<i>Caith</i>	Wick	1.28	49
<i>Kirk.</i>	Carsphairn, Shiel.	6.27	...	<i>Ork</i>	Pomona, Deerness	1.72	67
"	Dumfries, Cargen	6.28	194	<i>Shet.</i>	Lerwick	1.96	86
<i>Roxb.</i>	Branxholme	2.60	86	<i>Cork.</i>	Caheragh Rectory	4.17	...
<i>Selk.</i>	Ettrick Manse	4.52	...	"	Dunmanway Rectory .	4.84	123
<i>Berk.</i>	Marchmont House	3.40	112	"	Ballinacurra	4.00	143
<i>Hadd</i>	North Berwick Res.	2.34	91	"	Glanmire, Lota Lo. ...	4.73	163
<i>Midl</i>	Edinburgh, Roy. Obs. .	2.22	84	<i>Kerry</i>	Valentia Obsy.	3.95	104
<i>Lan.</i>	Biggar .....	...	...	"	Gearahameen	9.50	...
"	Leadhills	3.85	...	"	Killarney Asylum, ...	...	...
<i>Ayr.</i>	Kilmarnock, Agric. C. .	4.51	145	"	Darrynane Abbey	3.69	97
"	Girvan, Pinmore	3.69	101	<i>Wat.</i>	Waterford, Brook Lo. .	4.99	154
<i>Renf.</i>	Glasgow, Queen's Pk. .	3.83	131	<i>Tip.</i>	Nenagh, Cas. Lough ...	2.81	90
"	Greenock, Prospect H. .	4.75	96	"	Roscrea, Timoney Park	3.96	...
<i>Bute.</i>	Rothsay, Ardencraig .	4.43	112	"	Cashel, Ballinamona ..	4.87	168
"	Dougarie Lodge	3.92	...	<i>Lim.</i>	Foynes, Coolnanes	2.13	69
<i>Arg.</i>	Ardgour House	4.04	...	"	Castleconnell Rec.	3.03	...
"	Manse of Glenorchy .	4.61	...	<i>Clare</i>	Inagh, Mount Callan .	3.53	...
"	Oban	3.83	...	"	Broadford, Hurdlest'n .	2.70	...
"	Pottalloch	3.19	77	<i>Wexf</i>	Newtownbarry	4.61	...
"	Inveraray Castle	4.46	90	"	Gorey, Courtown Ho. ...	2.68	91
"	Islay, Eallabus	4.35	128	<i>Kilk.</i>	Kilkenny Castle	4.28	152
"	Mull, Benmore	8.80	...	<i>Wic.</i>	Rathnew, Clonmannon .	2.81	...
<i>Kinr.</i>	Loch Leven Sluice	3.42	119	<i>Carl.</i>	Hacketstown Rectory .	5.18	150
<i>Perth</i>	Loch Dhu	6.00	124	<i>QCo.</i>	Blandsfort House	4.50	144
"	Balquhiddel, Stronvar. .	5.50	...	"	Mountmellick	3.35	...
"	Crieff, Strathearn Hyd. .	4.65	157	<i>KCo.</i>	Birr Castle	2.96	100
"	Blair Castle Gardens .	5.77	225	<i>Dubl.</i>	Dublin, FitzWm. Sq. ...	2.83	111
<i>Forf.</i>	Kettins School	2.76	117	"	Balbriggan, Ardgillan .	3.48	128
"	Dundee, E. Necropolis .	2.17	79	<i>Me'th</i>	Beauparc, St. Cloud .	4.17	...
"	Pearsie House	2.40	...	"	Kells, Headfort	3.44	108
"	Montrose, Sunnyside .	1.75	67	<i>W.M</i>	Moate, Coolatore	3.08	...
<i>Aber.</i>	Braemar, Bank	2.66	114	"	Mullingar, Belvedere .	3.34	105
"	Logie Coldstone Sch. .	2.62	89	<i>Long</i>	Castle Forbes Gdns. ...	2.42	78
"	Aberdeen, King's Coll. .	1.88	67	<i>Gal.</i>	Ballynahinch Castle .	3.89	94
"	Fyvie Castle	1.43	...	"	Galway, Grammar Sch. .	2.54	...
<i>Mor.</i>	Gordon Castle	1.16	36	<i>Mayo</i>	Mallaranny	5.07	...
"	Grantown-on-Spey	3.17	103	"	Westport House	3.86	124
<i>Na.</i>	Nairn, Delnies	1.76	66	"	Delphi Lodge	6.76	...
<i>Inv.</i>	Ben Alder Lodge	4.33	...	<i>Sligo</i>	Markree Obsy.	3.16	91
"	Kingussie, The Birches .	2.23	...	<i>Cav'n</i>	Belturbet, Cloverhill..	2.59	83
"	Loch Quoich, Loan	5.00	...	<i>Ferm</i>	Enniskillen, Portora .	...	...
"	Glenquoich	3.53	55	<i>Arm.</i>	Armagh Obsy.	2.57	89
"	Inverness, Culduthel R. .	2.91	...	<i>Down</i>	Fofanny Reservoir ...	7.57	...
"	Arisaig, Faire-na-Squir .	2.95	...	"	Seaforde	3.33	104
"	Fort William	4.07	84	"	Donaghadee, C. Stn. ...	3.74	134
"	Skye, Dunvegan	4.77	...	"	Banbridge, Milltown .	4.14	127
"	Barra, Castlebay .....	...	...	<i>Antr.</i>	Belfast, Cavehill Rd. .	3.07	...
<i>R&C</i>	Ainess, Ardross Cas. .	3.56	117	"	Glenarm Castle	3.22	...
"	Ullapool	2.82	...	"	Ballymena, Harryville	3.55	104
"	Torridon, Bendamph .	4.23	78	<i>Lon.</i>	Londonderry, Creggan .	2.77	76
"	Achnashellach	4.77	...	<i>Tyr.</i>	Donaghmore	3.11	...
"	Stornoway	3.92	129	"	Omagh, Edenfel	3.13	92
<i>Suth.</i>	Lairg	3.42	...	<i>Don.</i>	Malin Head	3.89	137
"	Tongue Manse	1.77	58	"	Dunfanaghy	3.53	102
"	Melvich School	1.70	61	"	Killybegs, Rockmount .	4.38	100

Climatological Table for the British Empire, February, 1927

STATIONS	PRESSURE		TEMPERATURE						Relative Humidity	Mean Cloud Am't	PRECIPITATION		BRIGHT SUNSHINE			
	Mean of Day M.S.L.	Diff. from Normal	Absolute		Mean Values						Am't	Diff. from Normal	Days	Hours per day	Percentage of possible.	
			Max.	Min.	Max.	Min.	1 max. and 2 min.	Diff. from Normal								Wet Bulb.
London, Kew Obsy.	1018.3	+ 2.3	54	25	45.0	35.1	40.1	0.0	37.0	91	3.40	+ 1.86	14	1.2	12	
Gibraltar	1021.0	+ 1.0	70	45	60.7	48.2	54.5	- 1.4	49.3	85	5.84	+ 1.62	18	...	65	
Malta	1019.6	+ 2.9	68	45	58.3	49.4	53.9	- 1.4	49.7	82	1.74	- 0.46	9	7.1	...	
St. Helena	1011.6	+ 2.0	73	58	68.1	60.3	64.2	+ 2.2	61.8	93	1.57	- 2.23	...	...	...
Sierra Leone	1011.3	+ 0.5	95	71	89.3	74.4	81.9	+ 0.4	74.9	74	0.00	- 0.30	0	...	...
Lagos, Nigeria	1007.9	- 2.2	93	71	88.1	74.8	81.5	- 0.7	77.5	85	2.35	+ 0.28	3	...	...
Kaduna, Nigeria	1015.3	+ 3.3	97	57	91.5	62.3	76.9	0.0	63.2	47	0.00	- 0.04	0	...	...
Zomba, Nyasaland	1008.0	+ 0.1	88	...	80.7	...	...	...	...	8.5	10.83	+ 0.22	20	...	...
Salisbury, Rhodesia	1008.1	- 0.8	84	53	78.5	59.1	68.8	0.0	62.8	72	5.29	- 2.11	10	7.2	57	
Cape Town	1013.2	- 0.2	101	55	80.8	63.0	71.9	+ 1.6	63.2	73	2.6	+ 0.72	6	...	...
Johannesburg	1011.4	- 0.1	87	51	77.4	54.9	66.1	+ 0.7	58.5	74	3.5	- 3.83	12	7.8	60	
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	96	49	84.4	59.4	71.9	0.0	59.9	60	0.70	- 2.75	8	...	...
Calcutta, Alipore Obsy.	1013.0	- 0.3	88	54	82.4	61.6	72.0	+ 1.0	61.3	79	2.6	+ 0.09	2*	...	...
Bombay	1012.3	- 0.4	85	63	82.8	68.4	75.6	0.0	64.7	70	1.4	+ 0.01	0*	...	...
Madras	1012.7	- 0.2	98	65	88.5	69.7	79.1	+ 1.4	73.2	83	4.0	- 0.32	0*	...	...
Colombo, Ceylon	1011.0	- 0.1	90	70	87.6	72.9	80.3	+ 0.6	76.2	74	6.0	+ 1.60	11	7.9	66	
Hongkong	1017.8	- 0.9	74	46	62.2	55.2	58.7	- 0.4	55.0	80	9.0	+ 2.75	11	1.5	14	
Sandakan	...	...	89	74	87.4	75.7	81.5	+ 1.4	76.9	82	...	- 0.82	11	...	...
Sydney	1013.4	- 0.7	98	56	77.5	63.6	70.5	- 0.8	64.4	64	6.1	- 3.42	9	6.9	51	
Melbourne	1012.2	- 2.3	101	49	78.6	57.1	67.9	+ 0.5	57.9	52	4.8	- 0.97	5	8.2	60	
Adelaide	1014.2	- 0.1	107	51	81.5	58.8	70.1	+ 4.0	58.0	41	5.5	+ 0.25	3	8.8	66	
Perth, W. Australia	1014.0	+ 1.0	100	49	83.0	61.1	72.1	- 2.0	61.5	51	3.9	- 0.30	2	9.8	74	
Coalgardie	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Brisbane	1012.7	+ 0.2	93	64	83.8	68.5	76.1	- 0.4	70.7	71	5.4	- 0.82	11	7.7	59	
Hobart, Tasmania	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Wellington, N.Z.	1012.3	- 3.5	84	47	73.4	57.3	65.3	+ 2.8	...	68	5.2	- 1.32	7	8.2	60	
Suva, Fiji	1006.7	- 1.0	91	71	87.1	74.6	80.9	+ 0.4	76.6	81	6.8	+ 3.97	24	5.7	45	
Apia, Samoa	1010.0	+ 1.6	88	72	82.9	74.8	78.9	- 0.1	77.1	81	7.8	+ 2.24	25	4.3	35	
Kingston, Jamaica	1016.5	+ 1.2	88	63	84.6	66.9	75.7	- 0.8	65.0	86	2.6	+ 0.42	5	9.4	82	
Grenada, W.I.	1011.5	- 1.8	87	70	83.3	72.0	77.7	+ 0.6	72.3	75	3.9	+ 2.29	21	...	...
Toronto	1016.2	- 1.8	47	8	32.9	21.1	27.0	+ 5.3	22.9	77	6.8	- 0.54	13	2.6	25	
Winnipeg	1019.3	- 2.5	41	- 24	14.6	- 1.5	6.5	+ 7.1	...	...	5.8	- 0.45	10	3.6	36
St. John, N.B.	1015.9	+ 1.8	38	- 3	24.9	11.0	17.9	- 2.0	13.9	74	6.8	- 0.92	14	3.2	31	
Victoria, B.C.	1011.7	- 4.2	52	31	47.8	38.0	42.9	+ 2.6	39.5	85	6.8	- 1.02	12	4.5	45	

*For Indian stations a rain day is a day on which 0.1 in. or more rain has fallen.

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The Expedition of the "Meteor"

The issue, as a reprint from the *Zeitschrift der Gesellschaft für Erdkunde, Berlin*, of the fourth section of the preliminary report of the German Atlantic Expedition in the "Meteor," which carries the account up to the return of the vessel into home waters, calls for a short notice of the objects and achievements of this successor of the "Challenger" and the "Gazelle." The "Meteor" expedition owed its inception to the late Dr. Alfred Merz, who in the course of many years study of observations of oceanic temperature and salinity had developed a new theory of the oceanic circulation. Merz considered that the old idea of a circulation in two halves, nearly symmetrical about the equator, extending from the surface to the bottom, with the water rising near the equator and descending in high latitudes, does not fit the facts, and he formed a picture of an exchange of water between the northern and southern hemispheres, the stream lines crossing the equator generally horizontally, a circulation of the old type being found only in the surface layer of about 150 metres depth, and then only within the tropics. The new theory, however, was based on only few and scattered observations of temperature and salinity, which were especially scanty at depths greater than 1,000 metres, and Merz wished to test it by means of a comprehensive series of observations at all depths.

The first proposal for the expedition was made in 1919, and was warmly supported by the German Admiralty, the recently-

built gunboat "Meteor" being allocated for the work. In 1920 Merz brought forward plans for a three-year voyage in the Pacific, but at that time financial conditions were too stringent, and it was not until 1924 that the expedition was sanctioned in the more limited form of a two-year expedition in the Atlantic. The plan was still built around the investigation of the oceanic circulation, and included a series of fourteen voyages across the Atlantic, more or less parallel with the lines of latitude, between 20° N. and the northern edge of the Antarctic ice, which the "Meteor" was not built to withstand. On each of these transverse voyages soundings were to be made at a number of points, to determine the temperature and salinity at all depths, and where possible to obtain actual measurements of the current at different levels. In this way Merz hoped to bring all important branches of the great inter-hemispherical circulation into his scheme. The hydrographical part of the work was to be completed by detailed measurements of the rainfall and evaporation, to determine the balance of movement of water across the surface. Then if the accessions of water from rivers and the melting of land ice could be estimated, for the first time the water exchanges of a great ocean would be known. With regard to the heat exchanges Merz was less sanguine, but he proposed a system of measurements of the incoming and outgoing radiation. Further, a meteorological station of the first order was to be erected on deck for continuous registration in the lower layers of the atmosphere, while the higher layers were to be investigated by means of pilot balloons, registering balloons and kites, so that the study of the atmospheric circulation would go hand in hand with that of the oceanic circulation. The opportunity would also be taken for studies of marine biology, geology and chemistry.

This programme, ambitious though it seemed, was fully realised; all was ready in January, 1925, and on the 20th of that month the "Meteor" set out on a trial expedition to Teneriffe and Madeira, returning on February 17th. As a result of the experience gained on this trip a number of minor alterations were carried out, and on April 16th, 1925, the ship started on the expedition proper. The equipment, both human and instrumental, was very thorough. In addition to Dr. Merz, the leader, there were four oceanographers, a geologist, a biologist, a chemist and two meteorologists (Dr. Reger, of Lindenberg, and Dr. Kuhlbrodt, of the Deutsche Seewarte), while many of the ship's officers also took part in the scientific work, such as observations of terrestrial magnetism and atmospheric electricity. The meteorological arrangements are of special interest. The screen was placed on the roof of the chart-house on the bridge, but as it was doubtful if this exposure would be satisfactory,

four resistance thermometers were installed in different situations, one being at the head of the foremast at a height of 28 metres. In addition, observations were taken regularly with an Assmann psychrometer. Three anemometers were installed, that on the foremast being 31 metres above the sea. There were three barographs with monthly, weekly and three-day clocks for studying pressure waves of different periods. A complete set of eye observations was taken regularly three times daily, and in addition hourly observations of wind, cloud, etc., were made from the bridge.

The "Meteor" reached Buenos Aires without incident, and on June 3rd set out on its first "profile" across the Atlantic, in latitude 42 degrees south. But at the fifth sounding station Dr. Merz, who had been ill for some time, became so much worse that it was decided to return to Buenos Aires in order that he could receive proper medical care. He never saw again the expedition which he had done so much to make possible, for he died on August 16th, at the early age of 45. Meanwhile, the interrupted voyage had been resumed under the leadership of Captain Spiess, while the oceanographical observations were under the charge of Dr. Wüst. Space will not permit us to follow the crossings in detail; it is sufficient to remark that the plans of the expedition were carried out in full, the fifth crossing being from west to east in latitude 55° S., with deviations southward to Deception Island off Graham Land, and to the point 63° S., 5° E., the thirteenth and fourteenth crossings north of the equator between northern Brazil and the Cape Verde Islands. In all temperature and salinity soundings were made at 310 "stations," while 67,300 echo soundings gave a greatly improved picture of the topography of the Atlantic. The party returned to Wilhelmshaven on May 29th, 1927, after a journey of 67,500 nautical miles.

It is too early yet to be able to say much about the scientific results of the expedition, but it seems certain that the oceanographical theories of its founder are confirmed. The third report contains diagrams* showing the distribution of salinity and temperature along two sections from the Antarctic Continent to the equator, in the eastern and western Atlantic basins respectively. Apart from the shallow surface layer of warm saline water between the equator and about 40°, these show three main streams. From the Weddell Sea two streams move northward; the *Zwischenstrom* (Intermediate Current) consisting of water of very low salinity resulting from the melting of ice, travels along the surface as far as 40° S., and then dives under the equatorial surface layer, while the *Bodenstrom* (Bottom Current), consisting of water of moderate salinity but very low

*Zs. Ges. Erdk., Berlin, 1927, pp. 132-3.

temperature, travels northward along the ocean floor, but penetrates as far as the equator in the western basin only. Between these two northward flowing currents is the Tiefenstrom (Deep Current) of high salinity but moderate temperature, flowing southward across the equator between depths of 1,500 and 3,500 metres. The minor details of the circulation are governed to a very great extent by the topography, a relationship which also was foreseen by Merz.

The meteorological part of the work seems to have been carried out as thoroughly as the oceanographical part. In all 812 pilot balloons were sent up, an average of more than one a day. Some of the crossings were in very cloudy regions, and in order to make use of favourable gaps in the clouds large balloons were employed. At first the balloons were generally given an ascensional velocity of 400 metres per minute, but later it was necessary to reduce this owing to the deterioration of the balloons. Three hundred and sixty balloons reached 5,000 metres and 194 reached 10,000 metres, while several exceeded 20,000 metres. In addition, kite ascents were made on 217 occasions, but only a few successful ascents of registering balloons could be made. No summary of this great mass of material has yet been published, but the expedition is said to have shown that the variability of wind conditions in the tropics is much greater than was hitherto supposed, and that there is no anti-trade in the old sense. The importance of the material consists not only in its amount, but in its systematic spacing, and when full results are available they should throw new light on many other problems of the atmospheric circulation. Thus, both on the oceanographical and aerological sides the full plan of the expedition will have been abundantly completed, and though the chief architect did not live to reap his triumph in person, the results will be a lasting memorial to his name.

C. E. P. B.

An Historical Catalogue

The traditional quiet domestic life of King George III. and his consort is well illustrated by the interest they showed in science. The Office of Astronomer Royal was filled for the greater part of the reign by Nevil Maskelyne, and on two occasions at least their Majesties visited Greenwich. From the year 1782 William Herschel was working near Windsor under the direct patronage of the King, with a salary paid from the Royal private purse, and, it has been said, though the evidence is insufficient, with the title of Royal Astronomer. Twelve years before the discovery of Uranus there had been a King's Astronomer, Dr. Stephen Charles Triboudet Demainbray, who was in charge of

the King's Private Observatory at Richmond, in Surrey, and was succeeded in that office by his son about the time of Herschel's achievement, so there were three workers in the celestial science, each with a regal title.

The history of the foundation of the King's Observatory is told briefly in a memoir with the lengthy title "An old catalogue, and what it tells us of the scientific instruments and curios collected by Queen Charlotte and King George III.," by Mr. R. S. Whipple,* brother of the present Superintendent of the Kew Observatory, which is the modern name of the buildings established by King George. Dr. Demainbray, who was born in England but was of French Huguenot descent, had been taught some science by Dr. Desaguliers at Westminster school, and adopting scientific study as a career, himself lectured in turn at Edinburgh and Dublin and then at various places in France, where he made a great reputation. In 1754 he returned to England to act as tutor to George III. when Prince of Wales, and also to Queen Charlotte before her marriage in 1761, and it was doubtless due to his inspiration that these royal personages acquired the taste for science that led to the building of the King's Observatory at Richmond shortly before the Transit of Venus of 1769. That observatory was maintained at the expense of the British Government until 1841, when it was decided that its upkeep should be discontinued. The building passed into the hands of the British Association and became what has since been known as the Kew Observatory, and its contents were distributed amongst various institutions and individuals. Several of the astronomical instruments were sent to the Armagh Observatory, instruments of various kinds to King's College, London, curios and specimens to the British Museum and to the College of Surgeons, whilst some of the articles passed into the possession of private individuals. Among the latter was the catalogue here spoken of, which by good chance was preserved by the family of Stephen Peter Rigand, Savilian Professor of Astronomy at Oxford and Radcliffe Observer, who was a grandson of Dr. S. C. T. Demainbray. It was presented by his son to the Kew Observatory in 1855.

This is the history of the catalogue that has lain among the archives of the Observatory since that date, and has now been made available for general inspection by Mr. Whipple. The original is in manuscript on twenty-three foolscap pages, a photographic copy of the first of which is given. The main catalogue is a list comprising 322 items, described as "the Philosophical (*sic*) Instruments Her Majesty has deposited in the Royal Observatory at Richmond and to this is added

* Reprinted from the *Proceedings of the Optical Convention*, 1926. Aberdeen University Press.

a list of 76 presents, made by Sundry Persons to Her Majesty's collection," the latter being almost entirely animal or mineral specimens, or other curiosities that might have been brought from foreign parts by travellers. The collection of philosophical instruments was apparently begun by Dr. Demainbray in 1740, and was put at the disposal of the Royal family when he became connected with them, and was added to as time went on. Among the optical items are models showing the paths of light rays through lenses and lens systems by means of coloured threads; Scioptric balls used for illuminating microscopes or other instruments, the ball being mounted in the frame of a window; specimens of a kind of toy called Polyoptric pictures whose purpose it is to make distorted or disjointed pictures complete by optical means. As to other sciences there are pieces of apparatus to illustrate mechanical pneumatic and hydrostatic principles and miscellaneous models and pictures that need not be particularized. Entry No. 78 is an electrical machine and apparatus which with Hawkbee's large electrical machine (No. 6) are the only items relating to the new science.

Mr. Whipple claims our gratitude for having brought to light this evidence of popular knowledge in the middle of the eighteenth century. He has, moreover, given descriptions of some of the more obscure with pictures that he has been able to obtain from the instruments that are now at King's College, but possibly the most entertaining pages are those that describe the observations of the Transit of Venus of June 3rd, 1769, made at Richmond Observatory, now published, it is believed, for the first time by the courtesy of the Delegacy of King's College, who put a manuscript notebook written by Dr. Demainbray, now in their library, at Mr. Whipple's disposal. The entry of the planet on to the disc took place about an hour before sunset. The King and Queen with two serene Highnesses, Col. Desaguliers, a son of the Doctor, a favourite at Court, and the Rev. Mr. Wollaston went to Richmond, and all except the Queen observed the phenomenon. His Majesty used a short reflector which may be that with a 6-inch mirror now at Armagh. In the words of the record he "was the first who saw the penumbra of Venus touching the edge of the sun's disk." He indicated this to Dr. Demainbray who was attending His Majesty as time-recorder and using a Shelton clock, of which there were several in the Observatory, whose error and rate had been previously determined. The mean time of first external contact was found to be 7 h. 7 m. 55 s. according to the King's observation. Col. Desaguliers and the Rev. Mr. Wollaston who were attended by Benjg. Vulliamy to mark the exact time, saw it within half a second of His Majesty, and Messrs Sisson, Vulliamy Sen. (Justin) and Cuff (who were

in the upper dome room) rang a bell to give notice of their seeing it, nearly at the instant Col. Desaguliers and the Rev. Mr. Wollaston spoke. Their serene Highnesses, Prince Ernest and Prince George, attended by Mr. Stephen Rigand saw it last as they were in a separate apartment. They were heard to call out as the Dome bell rang. The following notes are added in red ink to these observations of first contact in the record. "The interval of these times could not exceed one second. I (Dr. Demainbray) must also add that His Majesty thinks he saw it before he gave his signal to Dr. Demainbray who attended at the regulator, and that Mr. Sisson (fearful of giving a false alarm) waited an instant before he caused Mr. Cuff to ring the bell."

It might be said, judging from the accordance, that the observing was particularly good, or on the other hand it may have been that his loyal subjects waited for the King to declare the event, and then supported him whole-heartedly. The internal contact appears not to have been observed with such unanimity. The sky was cloudless and these distinguished observers apparently saw the "black drop" though they did not call it so, but Dr. Demainbray says that the vapours near the horizon did not admit of the body of Venus to appear perfectly circular but caused rugged asperities round the edge which created, he presumed, inequalities in the times of judging of the contacts and gives the time of first internal contact 7 h. 25 m. 44 s. not saying how this was arrived at. A final note states that the observers in turn saw through Dollond's achromatic telescope a ring of coloured light round Venus when on the sun, like a faint rainbow.

These observations can scarcely be of scientific value, but Mr. Whipple is to be thanked for having unearthed them and published the account as a complement to this catalogue which together throw an interesting sidelight on a Royal hobby.

H. P. HOLLIS.

The Visibility of Coloured Tails in Pilot Balloon Ascents

It has been found in practice under ideal conditions that the tail method of obtaining the height of pilot balloons is almost as accurate as the double theodolite method. In the former method the tail consists of a sheet of white foolscap of dimensions about 12 in. by 8 in., wired with aluminium wire along the upper edge and gummed along the lower edge and connected to the balloon by a double length of cotton thread. The length from the centre of the balloon to the centre of the pendant is 30 feet or 60 feet according to the height required to be measured. A 30 foot tail gives good results up to 8,000 feet. For greater

heights than this a 60 foot tail would be necessary. This method is fairly accurate when used where :—

1. The wind is fairly strong so that the angle of elevation of the balloon does not exceed 30° or 40° .

2. The tail is steady having little or no oscillation in the vertical plane.

3. The pendant shows up distinctly so that the observer is enabled to read accurately the apparent length of the tail on the micrometer in the eye-piece of the theodolite.

In this note the writer is only concerned with the third condition above. To facilitate the reading of the tail in the eye-piece of the theodolite different coloured pendants were introduced for use with different backgrounds. Pendants coloured in red, white, silver and black on one side with a polished surface, together with the ordinary sheet of white foolscap were recommended for use to stations where tail ascents were regularly carried out. At Larkhill most tail ascents were, and even now under normal conditions are, carried out with the ordinary pendant of white foolscap. It was found desirable, however, to determine to what extent coloured pendants are an improvement over the ordinary pendant of white foolscap when used with different types of sky for backgrounds.

A series of ascents were made and it was arranged that all four types of pendants were used with each type of background in order that the visibility of each coloured pendant be compared one with the other. Four types of sky were chosen to include every sort of background likely to be met with during pilot balloon work at any station. They were :—

1. Blue (sky clear of cloud or with very fine cirrus or haze).

2. White (sky semi or wholly covered with cumulus forms).

3. Light grey (sky clouded by strato-cumulus or stratus types).

4. Dark grey (sky clouded by nimbus or stratus types).

Twenty-gram balloons of 70-in. circumference were used and these were filled with hydrogen to lift 70.7 gm. with the ordinary tail and white pendant. An extra lift of 3 gm. was given to allow for the coloured pendant in order to ensure a vertical velocity of about 500 feet per minute. It may be noted that a 70 in. balloon, filled to give the extra lift required when a coloured pendant is used, is just about filled to the limit of its capacity. In ascents where heights of above 8,000 feet are required involving the use of a 60 ft. tail a 90 in. balloon would be necessary. The balloons were followed until lost up to heights ranging from 2,000 to 8,000 feet according to the conditions of the sky. Under conditions 1 and 2 above we were

able to follow the balloons to heights between 4,000 and 8,000 feet ; under conditions 3 and 4 heights below 4,000 feet only could be obtained except when the sky showed alto-stratus types only, when heights above this were reached. It was assumed that it would not be of any use to follow balloons with a 30 foot tail above 8,000 feet owing to the fact that the readings obtained by the tail method above this height do not usually give very reliable information as to the height of the balloon.

The visibility of the red, white, silver and black tails against each of the four backgrounds were considered in turn and the following are the results of the observations :—

RED TAIL.

Blue sky : The tail showed well up to about 4,000 feet after which the observer relied on the flashing of sunlight on the polished surface. Readings up to 8,000 feet have been obtained.

White sky : The tail could be seen distinctly until lost in cloud at between 4,000 and 5,000 feet.

Light grey sky : Ascents up to 4,000 feet were obtained, the tail being very distinct until lost.

Dark grey sky : The visibility of the tail was fairly good. Heights of about 2,000 feet were obtained.

WHITE TAIL.

Blue sky : The tail showed brilliantly white up to heights of about 8,000 feet.

White sky : The visibility was fairly good except when the tail showed against the shadows of cumulus cloud. Heights above 4,000 feet were obtained.

Light grey sky : The tail appeared dark grey and was quite distinct up to over 7,000 feet.

Dark grey sky : The visibility was only fair but sufficiently good up to 2,000 feet.

SILVER TAIL.

Blue sky : The tail was perfectly distinct up to about 7,000 feet but not nearly so clear when haze was present.

White sky : The visibility was fair up to 3,000 feet after which the observer had to rely upon the flashing of the silvered surface.

Light grey sky : The tail appeared dark and white alternately up to 3,000 feet after which it was seen in flashes of white.

Dark grey sky : The visibility was only fair until lost at about 2,000 feet.

BLACK TAIL.

Blue sky : The tail was fairly distinct up to 5,000 feet.

White sky : The visibility was very good until the tail was lost in cloud above 5,000 feet.

Light grey sky : The tail was quite distinct up to about 4,000 feet.

Dark grey sky : The visibility was poor to fair up to heights below 2,000 feet only.

It will easily be seen from the above that the ordinary white and red pendants are generally the most serviceable. The black and silver pendants need seldom be used since, under almost all conditions either the red or the white ones can always be seen with sufficient distinctness to allow observers to make accurate readings. In the ordinary pilot balloon work at Larkhill involving meteor reports for gunners results are only required to cover a maximum height of about 6,500 feet corresponding to a time of flight of projectiles of 40 seconds. For this purpose the ordinary white and the red pendants are the only ones really necessary, and in almost every case the white pendant only need be used. When wind readings are required at heights well above 8,000 feet, in which a 90 in. balloon and a 60 foot tail would be used, then the silver pendant would certainly be of use, for the flashing of the polished surface would help the observer to follow the tail.

The table given below is a summary of the observations described above and suggests the most suitable pendant to be used for the different conditions of sky.

Sky.	Pendant.
Clear Blue	Red when any haze is present. White up to 8,000 feet. Silver above 8,000 feet.
White.. ..	Red.
Light Grey	White or Red.
Dark Grey	Red or White.

In conclusion, balloons coloured in red, white and blue, are usually supplied to stations, and, of the three, undoubtedly the red is the most suitable colour for general use.

M. J. THOMAS.

OFFICIAL NOTICES

Agricultural Meteorological Conference

The Annual Conference of observers and others interested in the Crop Weather Scheme will be held at the Meteorological Office, South Kensington, on Thursday and Friday, the 22nd and 23rd September, when papers will be read on various aspects of the work.

An account of the Conference of 1926 will be found in the *Meteorological Magazine* for October, 1926, p. 212.

Discussions at the Meteorological Office

The series of meetings for the discussion of recent contributions to meteorological literature, especially in foreign and colonial journals, will be resumed at the Meteorological Office during the session 1927-8. The meetings will be held on alternate Mondays at 5 p.m., beginning on Monday, October 10th, 1927, when Dr. G. C. Simpson, C.B., F.R.S., will open a discussion on "Recent Researches on Lightning in America."

The dates for subsequent meetings are as follows :—

October 24th ; November 7th and 21st ; December 5th, 1927 ; January 16th and 30th ; February 13th and 27th ; March 12th, 1928.

The Director of the Meteorological Office wishes it to be known that visitors are welcomed at these meetings. Tea is provided before each meeting.

Correspondence

To the Editor, *The Meteorological Magazine*

The Storms of July 10th—12th

A heavier rainfall was recorded in my rain-gauge as the result of the above-mentioned storm than is mentioned in your note in the *Meteorological Magazine* for August : the amount measured here being 4.10 in. for the 24 hours ending 9 a.m. (G.M.T.) on July 11th. Rather different amounts were recorded within a few miles of us : Col. Chrystie measured 1.77 in. at Shortheath (about $4\frac{1}{2}$ miles to the west), and the Rev. H. R. Huband 3.5 in. at Ipsley Lodge (on the Hog's Back, about 1 mile to the north), as mentioned in the *Farnham Herald* for July 16th, 1927, which gives a full account of the storm in this part of Surrey. I have daily records of rainfall here since August, 1901 ; and the heaviest previous records were 2.39 in. on March 29th, 1917, and 2.22 in. on December 9th, 1914. I have no other records of over 2 in. in 24 hours. Our monthly rainfall here averages about $2\frac{1}{2}$ in. ; but there have been 24 records in the 26 years of over 5 in., five of over 6 in., one of 7.88 in. (December, 1911), one of 8.54 in. (October, 1903), and one of 9.22 in. (December, 1914). This June we had a rainfall of 5.07 in., and last month one of 5.83 in.

F. R. WALTERS.

Pinecroft, Crooksbury Ridge, Farnham. August 19th, 1927.

[The previous largest daily fall of rain on record in Surrey was 4.07 in. recorded at the Wisley on July 22nd, 1924. This appears to be the only fall exceeding 4 inches on record for that county.—J.G.]

I do not see it mentioned in the August Magazine that on July 11th there was practically no rain here. I only measured a

"trace" on the morning of the 12th, but on Tuesday, July 12th, there was a sharp thunderstorm with a downpour of rain between 4 and 5 p.m. B.S.T. I was out about one mile to the southwest where it rained heavily but nothing out of the way, but the men and maids here said they had never seen anything like it. Mould was washed out of the garden beds and gravel from the paths on to the lawn. Next morning, July 13th, I measured 1.14 in., which must have nearly all fallen in about an hour. I was told that at Faygate to the northeast, and Rudgwick to the northwest, no rain fell. ETHEL M. ALLCARD.

Wimblehurst, Horsham, Sussex. August 19th, 1927.

Lord Phillimore, in writing about the heavy rainfall in London of July 11th,* comments on the greater damage to the paths at Holland House (on the rising ground to the north of High Street, Kensington) than that at Cam House. The two gauges are only some 300 yards apart, that at Holland House recording 3.92 in., or .50 in. more during the rainfall day than that at Cam House. At Cam House some of the gravel was washed clean of all the smaller sand and some garden earth was washed on to the paths. On the other hand, at Holland House deep cavities 3 ft. 6 in. deep and 3 ft. wide were washed in the paths. Two 9-inch walls were washed down with the pressure of water for a length of 70 yards. The rainfall during the actual storm of 2 hours is reported to have been 3.35 in. The mischief at both places was much less than that of the great storm of June 16th, 1917.

A report has also been received of a fall of 4.21 in. on the rainfall day of July 11th at Strinesdale, near Oldham. The storm was local, and was apparently confined to a width of about two miles, travelling up from the southwest and receding in the same direction. A heavy fall was also reported from Hanwell to the west of London, but the gauge was not of a standard pattern, and it is only possible to say that probably 4 in. of rain fell there. J. G.

The Cup Anemometer

The article by Mr. Vernon-Jones on the above subject in the August number of *The Meteorological Magazine* leads us to send a photograph of a three-cup anemometer which was constructed here some time ago. It possesses the additional feature of being direct reading. The indicating portion consists of a Stewart magnetic speedometer connected to the cup spindle by suitable gear wheels. The object of employing three cups in this case was

*See *Meteorological Magazine* 62 (1927), p. 160.



THREE-CUP ANEMOMETER

to make the correction to the observed readings as small as possible by virtue of the comparatively constant "factor" of the three-cup instrument. It is clear, however, that the best procedure would be to graduate the indicator scale directly from the calibration figures for the head.

The instrument shown in the photograph possesses 5-in. cups on 6.3-in. arms, and is provided with a cone and cup ball bearing at the top.

Since making this instrument we have learnt that Messrs. Elliott Brothers of Westminster make a somewhat similar direct reading anemometer with four cups.

E. L. DAVIES.

N. K. JOHNSON.

Porton, Wilts. August 30th, 1927.

[Messrs. Short and Mason, Walthamstow, have also produced three-cup anemometers with ball bearings. An illustration of the standard Meteorological Office pattern indicating anemometer with four cups will be found in "Observer's Handbook," Plate I.—E. G. B.]

The Play of the Winds

The industrialisation of Mersey side is rapidly developing, and one of the signs of this growth is the large number of tall chimneys which are seen on both sides of the river. This concentration is particularly noticeable on the east, that is the Liverpool side. The city of Liverpool lies on a low plateau or platform, roughly triangular in shape, the base of which lies along the river side. The plateau is undulating but at the north and south ends at distances varying from one to three miles from the river, the land rises abruptly to a height of nearly 200 ft. The chimneys lie mainly on this plateau close to the river and are sheltered on the east by this abrupt rise of land. The topography of the city provides a stage on which the wind currents can play as they list with the smoke of the chimneys.

On Friday, June 10th, at 8 a.m. G.M.T., the play enacted by the lower air currents and demonstrated by the smoke of these chimneys was dramatic and very beautiful, as viewed from the deck of a Wallasey ferry steamer during the 10 minutes of its passage from Seacombe to Liverpool. The smoke from the north end of the plateau, from the neighbourhood of Seaforth, moved southwards towards Liverpool; the smoke from the south end, from the neighbourhood of Dingle Point, moved north towards Liverpool. The two opposing air currents met about one mile north from the Liverpool Town Hall; within this central area of meeting, which was about half a mile in extent, the smoke rose perpendicularly. Above it hung a dense black cloud. The

silence and gentleness of these air movements added greatly to the impressiveness of the scene. The wind was light and no rain fell. From a study of the Daily Weather Maps (British and International Sections) it is clear that during the few days immediately preceding Friday, June 10th, the British Isles was the meeting place of dissimilar pressure zones. On Thursday the 9th the east and north shores were covered by the rear of a Scandinavian cyclone; the south west areas were on the north margin of an anticyclone; from the Icelandic area another anticyclone was pushing its way to the south-east, while a second cyclone was moving east towards south Ireland and the Bay of Biscay. The Irish sea, the Midlands and south-east England offered a narrow transitional zone between these conflicting areas. On Friday two islands of high pressure formed within this zone; one lay over the North Channel the other over the Fenland region. A north-westerly wind had dominated England for two days and reinforced by the high pressure, over the North Channel, perhaps accounted for the northerly current which moved from Seaforth to Liverpool. On Thursday an easterly current appeared in Norfolk. It would be very interesting if it were found that the easterly current of the 9th over Norfolk, and the high pressure of the 10th over the Fenlands were related, and were responsible for the currents which carried the smoke north from Garston over Liverpool. Probably it is more likely that local variations helped to produce these opposing currents.

LILY WINCHESTER.

School of Geography, University of Liverpool. June 17th, 1927.

Ball Lightning at Cattewater

On March 23rd at 23h. 45m. G.M.T. there occurred a brilliant blue flash followed immediately by a crashing explosion resembling nothing so much as the bursting of high explosive. On the following morning a letter was inserted in the local press (*Western Morning News* and *Evening Herald*) requesting witnesses of the phenomenon to send a brief account to this office. A good deal of reliable data has been obtained and it appears certain that ball lightning was experienced. It seems evident that Cattewater was the centre of the disturbance as no damage is reported elsewhere and all accounts point to it being the centre. In Plymouth and neighbouring districts, a very vivid flash (blue) followed immediately by a very heavy explosion was observed.

The manager of the local Navy, Army and Air Force Institute, at Cattewater, reports that at 12h. 45m. he and his wife observed a "ball of fire of a greenish blue colour and about three times the size of a football sink past their bedroom window and two or

three seconds later ascend to about 6 ft. and explode." The building shook and much plaster came down. Sparks were noticed flying from the ball before the explosion. After, a pungent smell of sulphur was observed.

Damage done to the camp was as follows :—

1. Most electric lights fused and in one case a main switch protected by an iron shield was blown to bits.

2. About nine inches was blown off the top of the mast carrying the wind sleeve, on the round tower. Two holes about 4 inches deep and about the size of saucers were made in the solid concrete roof of the tower. Two steel guys supporting the mast were snapped. The wind at the time was about 23 m.p.h. with a gust at 23h. 45m. of 34m. p.h., direction west.

3. A small concrete shed, the door of which was locked, and situated near the tower, had the door blown open and the lock smashed. A large hole about 10 inches in diameter was blown through the base of the northern wall—thickness of wall 6 inches. Some of the matchboard lining was torn off and a small cigarette tin was badly twisted. Much plaster fell.

Mr. G. Vigg, caretaker R.N. Dockyard, Turnchapel, about $1\frac{1}{4}$ miles south-east of Cattewater, reports seeing at 12h. 44m. a ball of flame about three times the size of a football coming from due south and revolving with sparks shooting from it. He immediately went indoors and just had time to close the door when a terrific explosion occurred. The building shook and the telephone bell started ringing. The village constable who was out of doors and within 50 yards was knocked down. Both report a smell of sulphur after the explosion.

Mrs. Dodd, living some $1\frac{1}{2}$ miles north-west of Cattewater, at Stoke, reports "following the loud noise of an explosion there appeared a mass in the sky about three times the size of a football, of a red and yellow colour which appeared to be revolving as it made its travelling from south to north-east."

Rain and hail showers were frequent during the evening of the 23rd and were followed by continuous rain. All observers state that the wind was west or nearly so. At 23h. 5m. temperature rose 2° F., and at 23h. 50m. fell 4° F.

W. L. ANDREW.

Cattewater, Plymouth. March 29th, 1927.

Earth Tremor at Amman, Transjordan, July 11th, 1927

At about 13h. 10m. G.M.T. a succession of three earth tremors were experienced, the three together lasting for a duration of from one to one and a half minutes and causing considerable damage to surrounding districts.

It seemed that, without warning, the floor began to heave, and the buildings swayed, this no sooner became apparent than a second shock, even more severe, made itself felt, the floor being not unlike the deck of a ship in a rough sea, and yet a third tremor disturbed us, the whole earth seemed alive, walls of buildings cracked, masonry fell, huge rocks, displaced by the shock, rolled down amid clouds of dust into the Wadi, taking everything within their path.

From the village of Amman huge clouds of dust arose, from which it is gathered a considerable amount of damage has been caused. Some damage was done to the meteorological instruments, especially the microbarograph and anemobiograph, while the barograph, thermograph and hygrograph showed traces of the shock.

C. FALCONER.

Meteorological Section, R.A.F., Amman, Transjordan.

NOTES AND QUERIES

Note on the Highland and Agricultural Show. Edinburgh, July 26th—29th, 1927

The useful purpose served by the meteorological exhibit at the Highland and Agricultural Show in Glasgow, 1925, encouraged a repetition this year when the show was held at Edinburgh.

In addition to the usual display, material comprising meteorological instruments, autographic records, synoptic charts and the much admired collection of cloud photographs belonging to Mr. G. A. Clarke, Aberdeen, a series of large scale diagrams depicting the structure and life history of a depression according to the Bergen School were specially prepared at the Edinburgh Office. The general interest shown in these diagrams by all visitors to the exhibit, and the attention paid to demonstrations of the receipt of synoptic information and the preparation and issue of forecasts, gave ample evidence of the increasing regard for meteorological work in Scotland. There was more than one instance of a visitor returning to the exhibit with the remainder of his family in order that all might learn about the much broadcasted depression.

Remarks made by farmers to the effect that their activities are largely controlled by the forecast of the previous evening were very common. The opinion was equally frequently expressed that south-east England seemed to have all the weather of the British Isles; Scotland had to be content with the remainder. One farmer from the extreme west of Argyllshire, on the other hand, explained that the Air Ministry forecasts were of little use to him for a different reason. On many

occasions of the approach of a depression he had already established a fair acquaintance with the quality of its warm front before its existence was indicated by the evening bulletin.

Association of Special Libraries and Information Bureaux

The Fourth Conference of this Association will meet at Trinity College, Cambridge, on September 23rd to 26th, when it is expected that some 200 organisations will be represented. Following a reception by Sir J. J. Thomson, O.M., Master of Trinity, the Presidential Address will be delivered by Sir Geoffrey Butler, K.B.E. Sir Henry Lyons will speak on "Recent developments in connexion with the Science Library, South Kensington," and Sir Richard Gregory on "Standards of book selection in science and technology"; other subjects dealt with will include "Printing, reprinting and abstracting scientific literature; possible economies" and "The Special Library from the administrative standpoint, with special reference to methods of indexing and filing." The Conference is open to all interested, whether members of the Association or not; a copy of the detailed programme and other particulars can be obtained from the Secretary, ASLIB, 38, Bloomsbury Square, London, W.C. 1.

Meteorological Conditions on German Air Routes

During the summer a series of brief publications has been received from the Aeronautical Observatory, Lindenberg, Berlin, dealing with meteorological features of special interest or importance to the air routes operated in different parts of Germany. These notes have been prepared by the local meteorologists who are responsible for the supply of weather information to the company operating these routes, and who are familiar with the orographical features of the districts flown over and the weather phenomena peculiar to these districts. The series promises to be particularly useful to the aircraft company, the pilots and the meteorologists themselves.

Rain Falling through Drizzle

It is known that rain sometimes falls through drizzle, but until quite recently no information has been available as to the frequency of the phenomenon in this country.

Since December 1st, 1926, however, observers at the Meteorological Office stations have had instructions to take particular notice of the details of such phenomenon and submit a report

after two months' observations, viz., December, 1926, and January, 1927. A tabular summary of extracts of these reports is set out below.

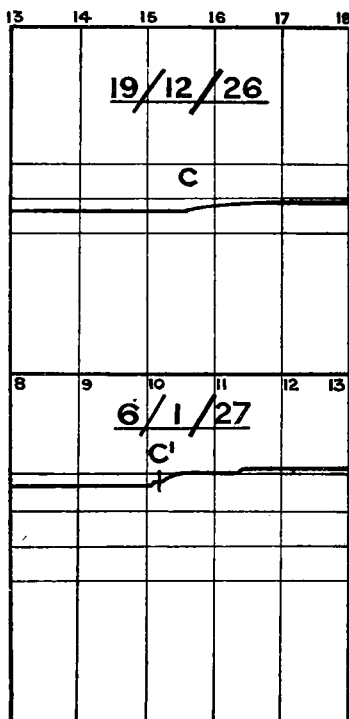
Station.	Date.	Time of occurrence of the phenomenon.	Remarks.
Felixstowe ...	19.12.26	15h. 30m. For a few minutes.	(See report below).
Felixstowe ...	6.1.27	10h. and 10h. 8m. For a few minutes.	(See report below).
Croydon ...	26.1.27	10h.	Continuous light drizzle with occasional rain.
Lympne ...	6.12.26	12h. 50m.	Observation confirmed by other members of the staff.
Lympne ...	3.1.27	17h.—17h. 30m.	Drizzle occurred during continuous light rain.
Holyhead ...	5.12.26	15h.—15h. 15m.	Uniform layer of cloud at 500 ft. Drizzle ceased after rain.
Holyhead ...	8.1.27	6h. 50m.—8h.	Intermittent rain through drizzle.
Renfrew ...	9.1.27	7h. 15m.	$\frac{1}{4}$ ths nimbus rain through continuous slight drizzle.
Worthy Down ...	12.1.27	17h.—18h.	Rain through slight continuous drizzle. Strong S wind which veered sharply from S by W to SW at 21h. 20m.
Worthy Down ...	18.3.27	6h. 45m.—6h. 55m.	(See report below).

The second report from Lympne is noteworthy as being the only occasion on which the drizzle occurred after rain had set in. In all other instances the rain occurred during a period of drizzle. The longest period during which the phenomenon persisted is reported from Holyhead where intermittent rain fell through drizzle from 6h. 50m. to 8h. on January 8th, 1927. The two Felixstowe cases have been investigated rather closely and the fuller report, which includes autographic records for the station, is as follows:—

Two occasions of rain falling through drizzle have been recorded during the past two months.

(1) December 19th, 1926.

Sky half covered with strato-cumulus and alto-cumulus at 14h. 20m. This stratus approached from the west and light drizzle commenced at 14h. 30m. with a fair sky which became covered with stratus at about 14h. 40m. This disappeared again at 16h. 40m. when drizzle ceased. Rain fell through the drizzle for a short period at 15h. 30m. Wind on the surface at that time was westerly, force 3. Barometer falling slightly 13h. to 15h. then steady.



Record of Hyetograph at
FELIXSTOWE.

(2) January 6th, 1927.

Sky very cloudy with strato-cumulus at 7h., developed into stratus (3,000 feet) by about 8h. 30m. and lowering to about 1,500 feet when drizzle commenced at 9h. 10m. and ceased temporarily at 11h. 30m. Rain fell through drizzle for a few minutes at 10h. and again at 10h. 8m. Wind on the surface SW force 2 at 7h., backing to S by 10h. and increasing to force 4. Barometer falling continuously.

The charts and autographic records for the two days in question have been investigated for the position and travel of "fronts" and in both cases the phenomenon seems to be associated with the arrival of a kind of minute cold front in between the arrivals of the two more pronounced warm fronts. On the surface, the temperature drop in each case was very small but very definite and similar. It is thought that this drop of 1° F., roughly, in each case is only a slight indication of perhaps a greater drop at higher levels. The wind charts also bear great resemblance in that in both cases the phenomenon occurred at the end of a small backing of the wind and shortly after the wind on the surface had increased and reached the steady stage. In both cases the hyetograph chart shows clearly, at C and C¹, the arrival of the rain after the drop of temperature. Drizzle was persistent throughout the whole process. An examination of the weather charts at the nearest fundamental hours on both occasions discloses quite clearly the presence of the two warm fronts referred to above.

It would be interesting to know whether an investigation of

the phenomenon occurring at the other stations would bring out similar features.

In conclusion, it should be noted that at no two stations is the phenomenon reported approximately at the same time or even on the same day. This would lead one to suppose that the process is a local one and not necessarily a phenomenon which persists and travels with the warm fronts. C. W. LAMB.

The following additional particulars regarding the occurrence at Worthy Down have been supplied by Mr. C. V. Ockenden.

The observer's direction of motion was northwest to southeast, up and over a bare saddle-back ridge running east and west. The wind at the time was SSE 5—8 m.p.h. A 4—6 minute periodicity in intensity of rainfall is just discernible on the hyetogram, and this has been noticed before (*e.g.*, 3h.—4h. on March 4th, 1927) in air of equatorial origin. Small changes of wind direction occur with the same order of frequency, indicative of minor "whirls" associated with up-currents between the ground and the cloud layer (500 feet in the present instance).

On the morning of March 18th, during a ten-minute walk across the aerodrome between 6h. 45m. and 6h. 55m. G.M.T., rain was noticed falling through drizzle in two separate "waves," in this way: To start with, continuous drizzle only was falling; within the first half-minute drops of rain intruded themselves, gradually increasing in number for about $1\frac{1}{4}$ minute until precipitation fell in the proportion (approx.) 70 per cent. rain and 30 per cent. drizzle. This maximum was maintained for about $\frac{1}{2}$ minute, and then the amount of rain diminished gradually, until drizzle only was falling. The whole "wave" occupied a space of about 4 minutes, and was repeated.

A New Catalogue of Standard Thermometers by Negretti & Zambra

A new catalogue of standard thermometers has recently reached us from Messrs. Negretti & Zambra. The catalogue is well illustrated and very comprehensive, numerous alternative patterns being shown for ordinary, maximum, minimum, grass minimum and earth thermometers. For each of these classes of instruments, the Meteorological Office standard pattern is included. Under the heading of hygrometers, the reader is offered a choice of several instruments alternative to the ordinary wet and dry bulb exposed in a Stevenson screen. Two types of whirling hygrometer are shown as well as the Assmann psychrometer, Regnault's, Daniell's and Dines's hygrometers.

In the section on recording thermometers and hygrometers, the mercury-in-steel transmitting thermometer, in which this firm has specialised, takes the leading place. Besides their obvious use of providing a continuous reading of the dry and

wet bulb records, twin pen instruments are also readily adaptable for recording soil temperatures at two different depths. The most ambitious instrument illustrated in the catalogue is, however, the aspirated wet and dry bulb recorder in which the mercury transmission principle is adopted, and in addition a fan, driven by a small motor, is included to aspirate a continuous current of air over the bulbs after the manner of the Assmann psychrometer. The use of this instrument seems to offer the best alternative at present available to the expensive photographic wet and dry bulb recorders installed at British Observatories.

Not the least interesting feature of the catalogue is the historical introduction followed by notes on manufacture. The reader will gain much interesting information relating to thermometers from this section.

E. G. B.

Weather and Life

We have received a set of numbers of a popular but scientific meteorological periodical published by the Ukraine Meteorological Service under the above title. This magazine, which is similar in its scope to the *Meteorological Magazine* or *Das Wetter*, is prepared by the voluntary work of a number of collaborators among the staff of the Ukraine Service, and this allows it to be issued at the low price of about five shillings for twelve monthly numbers. The contents appear to be of considerable interest—we notice, for example, a long account of Bjerknes' theory of cyclones—but, being entirely in the language of the Ukraine, are not likely to appeal to many English readers.

Angoran Meteorological Service

In 1925 a meteorological service for Angora was organised under the authority of His Excellency Sabri Bey, the Minister of Agriculture of the Turkish Republic. Dr. A. Rethly was made Director of the new service and observations were started at Angora Observatory on November 12th with the instruments donated by the Hungarian Meteorological Service.

The new service commenced its series of publications with the issue of Monthly Weather Reports for November and December, 1925, containing daily observations at 7h., 14h. and 21h. for the Observatory at Angora. In 1926 the work of the service was considerably extended and many new stations were established. The report for 1927 contains in addition to the full observations for Angora, temperature, cloud and rainfall for 12 stations and data from 39 rainfall stations.

Reviews

Typen van den Regenval in Nederlandsch-Indië. By Dr. J. Boerema. Kon. Magn. Meteor. Obs. Batavia. Verh. No. 18, Size 11×7, pp. iv.+58 (Dutch)+54 (English). *Illus.* Batavia, 1926.

The subject matter of this publication is not completely defined by the title "Rainfall types in the Netherlands Indies," it being only the types of the distribution of average monthly rainfall throughout the year which are discussed. The treatment of the subject is similar to that adopted by Prof. G. Hellmann when dealing with the rainfall of Europe.*

The general features of the climate of the Archipelago were discussed in Vol. 1 of this series, where maps were published showing the months of the greatest and least rainfall†. In the present publication two maps are reproduced. That of Sumatra, Borneo and Celebes is on the scale of 1 : 2,500,000 (40 miles to 1 inch) and that for Java and Madura on the scale of 1 : 500,000 (8 miles to 1 inch). Each map is divided into zones, for each of which the average monthly rainfall in millimetres is shown diagrammatically, a correction being applied so that the length of each month can be counted as 30 days. The division is naturally somewhat arbitrary since the variation in the rainfall is gradual. In all 153 types are discussed.

In considering the causes of the variation from place to place it is important to realise that the islands cover a considerable area, extending from latitude 5° N to 10° S and from longitude 95° E to 140° E. The distribution of the rainfall in each zone is considered in relation to three factors:—

(A) Though the whole area experiences a high temperature the ascension of air is not uniform. The highest temperature follows, with some retardation, the variation in the sun's declination. Near the equator maxima occur in March and September, although there is relatively a small range in the monthly amounts. With increasing latitude both northwards and southwards, the two rainy seasons approach each other, joining about 8° N and 8° S in zones with a single tropical rainy season, which occurs during the summer of the relative hemisphere.

(B) The monsoon rains of this region originate by the alternate warming and cooling of the continents of Australia and Asia. During the southern summer the temperature over north-western

Academie/

* Untersuchungen über die jährliche Periode der Niederschläge in Europa. Sitzungsberichte der Preussischen ~~Academie~~ der Wissenschaften. March 27th, 1924.

† Het Klimat Van Nederlandsch-Indië. By C. Braak. *Kon. Magn Meteor. Obs., Batavia.* Verh. No. 8, Vol. 1., Part III. (Reviewed in the *Meteorological Magazine*, 58, 1923, p. 265).

Australia rises, the air ascends and the south-east trade wind is replaced by the north-west monsoon. At the same time there is a high pressure over Asia and the outflowing air reinforces the north-east trade wind as a north-east monsoon, and passing over the equator changes gradually into the north-west monsoon. When the sun is north of the equator the wind system is reversed, but as the air moves over a short distance of sea it becomes less moist than in the previous case. Moreover, it is a descending rather than an ascending current and therefore less likely to produce rain.

(c) The third factor is that of the orography of the land, which tends to accentuate the differences in the monthly rainfall which have already been discussed.

A brief mention may be made of some of the actual types. In the mountainous region of Central Java there is in Type 22 a wide range in the average monthly amounts from 650 mm. in January and February, at the time of the west monsoon, to 50 mm. in July and August. In Type 71 the rainfall in each of the three months July, August and September, is less than 10 mm. The area concerned is the southern half of the island of Timor, which is one of the islands nearest to the continent of Australia. Near Singapore, in Type 33, 1,500 miles to the north-west of Timor, more than 230 mm. of rain occurs in each of these three months. The distribution of the rainfall throughout the year is discussed for each of the 153 zones in relation to the factors enumerated above.

J. G.

Anales del Observatorio Nacional de San Bartolomé en los Andes Colombianos. Observaciones meteorológicas de 1924. Bogota. 1927.

This forms the second annual volume of observations published by the meteorological service of Colombia* since the inauguration of the new observatory at Bogota in September, 1922. The first annual volume dealt exclusively with the values of the various elements for Bogota, but this new volume contains, in addition, data of the rainfall and the mean and extreme temperature for each month at four secondary stations, Tunja, Pasto, Bucaramanga and Ibagué, together with the rainfall at three other stations. Father Sarasola is to be congratulated on the continued progress made by this new meteorological service.

The Weather of August, 1927

The most striking feature of the weather of the month was the excessive rainfall in most districts except for the north of Scotland. On the 1st (Bank Holiday) rain fell continuously in

* See *Meteorological Magazine* 60 (1925), p. 172.

many parts of southern England though fairer conditions prevailed in the west and north. During the next few days an anticyclone moved across our islands to Scandinavia giving generally warm sunny weather though local thunderstorms began to develop on the 5th—6th. By this time a depression was approaching southwest Ireland and from then onwards until near the end of the month our weather was dominated by a succession of depressions which passed over or very near the British Isles giving unsettled weather (except in north Scotland) with many bright intervals. Rain fell on most days and local thunderstorms occurred frequently. Amongst some of the heaviest falls may be mentioned 2.15 in. at Mallarany (Mayo) on the 6th, 2.28 in. at Harrogate and 2.22 in. at Marchmont (Berwick), both on the 8th, on which date over 1.5 in. fell in several parts of northeast England and southeast Scotland. Arlington (Devon) had 1.61 in. on the 11th followed by 1.30 in. on the 12th. On the 14th Mallarany again had 2.73 in., Claerwen (Radnor) had 2.95 in. on the 15th and Llanddeusant (Carmarthen) 2.20 in. on the 21st. After the 24th the depressions passed to the north of the British Isles giving unsettled weather in the north while pressure was high over England with a consequent improvement of the weather there. With the exception of isolated heavy falls in Wales on the 27th, when as much as 3.87 in. were measured at Cwm Dyli, Snowdon, the rainfall was not heavy. In southeast England little or no rain fell for several days and temperature rose considerably, the last day being in some parts of the south the hottest during the month. Only twice was 80° F. reported during the month, at Cullompton on the 5th and at Cranwell on the 6th. Strong winds were experienced at times in the English Channel during the second half of the month while gale force was reached on a few occasions, notably on the 22nd. In the north of Scotland the month was generally fair and sunny, the total rainfall being below normal and the sunshine above normal.

Pressure was below normal over western Europe, Iceland and part of the North Atlantic, the greatest deficit being 5.9 mb. at Birr Castle (Ireland), and above normal over Spitsbergen, eastern and northern Scandinavia, Italy, Spain, Newfoundland and Bermuda. Temperature was above normal except in Switzerland, Germany and Portugal, and rainfall was above normal except in parts of eastern and northern Scandinavia; in southern Sweden it was as much as double the normal.

Throughout the month storms and heavy rains accompanied by floods were continually reported from central Europe the worst storms being over Switzerland on the 2nd, when much damage was done in the Cantons of Berne and Vaud, and over

Switzerland, southeast France and the districts round Cologne on the 11th, when waterspouts were seen in the Jura and Lake Geneva regions. A landslide occurred on the 21st in the Bernese Oberland owing to the heavy rains. Heavy rains caused floods near Bruges on the 22nd, and floods occurred in eastern Siberia from the 17th to 23rd, when 100 people were drowned. The severe storms during the night of the 30th—31st caused heavy floods in eastern Galicia and 180 people were drowned in the valleys. In south France and Italy meanwhile drought prevailed during most of the month. From the 10th—28th forest fires raged intermittently on the French Riviera, on the 17th and 18th forest fires fanned by strong winds swept across parts of Corsica, and on the 18th a forest fire lasting 24 hours was reported near Alassio on the Italian Riviera. On the 28th a violent storm occurred in northeast Italy and snow fell on the Alps down to a level of 4,200 ft. and on the Dalmatian mountains.

By the 12th the disastrous floods in the Kathiawar Peninsula mentioned on p. 169 of the August magazine had subsided. A launch with about 40 people on board was destroyed by a typhoon in Manila Harbour on the 19th and a typhoon swept across Hongkong on the 21st. It was reported on the 29th that torrential autumnal rains, which had occurred unusually early in the season, had caused 51 deaths, mostly by landslides, and widespread floods in Kyushu and Shikoku, Japan.

As a result of the severe drought on the borders of Portuguese East Africa and on the Komatipoort district there was an invasion of Swaziland by herds of wildebeestes.

A violent rain and thunderstorm, bringing relief from the heat wave, swept across New York and the neighbourhood on the 1st, and the mean temperature for the month was generally below normal for the eastern and central States. Light frosts occurred early in the month in Saskatchewan and parts of Manitoba and Alberta. A severe storm passed over Nova Scotia about the 24th, twelve people being killed.

The special message from Brazil states that the rainfall in the northern regions was 52 mm. below the normal, and that in the central and southern regions the distribution was irregular with totals equal to normal and 13 mm. above normal respectively. Five anticyclones passed across the country. In the south depressions were numerous with frequent high winds. Crops were generally in good condition. At Rio de Janeiro pressure was 1.7 mb. below normal, and temperature 0.2° F. below normal.

Rainfall, August, 1927—General Distribution

England and Wales	..	155	} per cent. of the average 1881-1915.
Scotland	.. .. .	121
Ireland	.. .. .	126
British Isles	.. .. .	<u>140</u>

Rainfall: August, 1927: England and Wales

CO.	STATION.	In.	Per- cent. of Av.	CO.	STATION.	In.	Per- cent. of Av.
<i>London</i>	Camden Square	3.97	180	<i>Leics</i>	Thornton Reservoir . .	3.31	118
<i>Sur.</i>	Reigate, The Knowle . .	5.03	218	<i>"</i>	Belvoir Castle	2.09	80
<i>Kent.</i>	Tenterden, Ashenden . .	3.91	171	<i>Rut.</i>	Ridlington	4.37	...
<i>"</i>	Folkestone, Boro. San.	3.91	...	<i>Linc.</i>	Boston, Skirbeck	3.72	156
<i>"</i>	Margate, Cliftonville . .	2.79	145	<i>"</i>	Lincoln, Sessions House	2.71	110
<i>"</i>	Sevenoaks, Speldhurst . .	4.94	...	<i>"</i>	Skegness, Marine Gdns.	4.56	187
<i>Sus.</i>	Patching Farm	5.61	222	<i>"</i>	Louth, Westgate	5.39	192
<i>"</i>	Brighton, Old Steyne . .	4.03	185	<i>"</i>	Brigg . . . . .	...	...
<i>"</i>	Tottingworth Park	5.81	215	<i>Notts.</i>	Worksop, Hodsock	3.77	154
<i>Hants</i>	Ventnor, Roy. Nat. Hos.	3.13	157	<i>Derby</i>	Mickleover, Clyde Ho. . .	3.35	123
<i>"</i>	Fordingbridge, Oaklands	3.85	156	<i>"</i>	Buxton, Devon. Hos. . . .	5.88	134
<i>"</i>	Ovington Rectory	3.90	144	<i>Ches.</i>	Runcorn, Weston Pt. . . .	5.23	145
<i>"</i>	Sherborne St. John	2.63	109	<i>"</i>	Nantwich, Dorfold Hall	4.55	...
<i>Berks</i>	Wellington College	3.46	149	<i>Lancs</i>	Manchester, Whit. Pk. . . .	4.06	118
<i>"</i>	Newbury, Greenham	3.54	135	<i>"</i>	Stonyhurst College	7.13	141
<i>Herts.</i>	Benington House . . . . .	...	...	<i>"</i>	Southport, Hesketh Pk . .	5.21	150
<i>Bucks</i>	High Wycombe	5.15	222	<i>"</i>	Lancaster, Strathspey . . .	6.55	...
<i>Oxf.</i>	Oxford, Mag. College . . .	3.97	177	<i>Yorks</i>	Wath-upon-Dearne	5.15	214
<i>Nor.</i>	Pitsford, Sedgebrook . . .	3.41	141	<i>"</i>	Bradford, Lister Pk. . . .	5.54	204
<i>"</i>	Oundle	2.98	...	<i>"</i>	Oughtershaw Hall	10.54	...
<i>Beds.</i>	Woburn, Crawley Mill . . .	3.19	138	<i>"</i>	Wetherby, Ribston H. . . .	5.56	204
<i>Cam.</i>	Cambridge, Bot. Gdns. . . .	2.46	105	<i>"</i>	Hull, Pearson Park	5.65	194
<i>Essex</i>	Chelmsford, County Lab . .	3.96	183	<i>"</i>	Holme-on-Spalding	3.03	...
<i>"</i>	Lexden, Hill House	2.62	...	<i>"</i>	West Witton, Ivy Ho. . . .	7.81	...
<i>Suff.</i>	Hawkedon Rectory	2.69	104	<i>"</i>	Felixkirk, Mt. St. John . .	5.65	198
<i>"</i>	Haughley House	4.12	...	<i>"</i>	Pickering, Hungate	5.83	...
<i>Norfol.</i>	Beccles, Geldeston	2.72	126	<i>"</i>	Scarborough . . . . .	...	...
<i>"</i>	Norwich, Eaton	3.35	142	<i>"</i>	Middlesbrough	4.69	171
<i>"</i>	Blakeney	3.53	156	<i>"</i>	Baldersdale, Hury Res. . .	7.32	...
<i>"</i>	Little Dunham	3.31	122	<i>Durh.</i>	Ushaw College	5.96	205
<i>Wilts.</i>	Devizes, Highclere	4.62	161	<i>Nor.</i>	Newcastle, Town Moor . . .	5.30	200
<i>"</i>	Bishops Cannings	4.44	143	<i>"</i>	Bellingham, Highgreen . .	7.00	...
<i>Dor.</i>	Evershot, Melbury Ho. . . .	4.25	135	<i>"</i>	Lilburn Tower Gdns. . . .	5.19	...
<i>"</i>	Creech Grange	4.17	...	<i>Cumb.</i>	Geltsdale	5.86	...
<i>"</i>	Shaftesbury, Abbey Ho. . . .	4.34	149	<i>"</i>	Carlisle, Scaley Hall . . .	5.26	128
<i>Devon</i>	Plymouth, The Hoe	3.42	111	<i>"</i>	Seathwaite M. . . . .	...	...
<i>"</i>	Polapit Tamar	3.12	98	<i>"</i>	Keswick	6.11	...
<i>"</i>	Ashburton, Druid Ho.	4.37	117	<i>Glam.</i>	Cardiff, Ely P. Stn.	5.38	125
<i>"</i>	Cullompton	2.67	88	<i>"</i>	Treherbert, Tynywaun . . .	14.14	...
<i>"</i>	Sidmouth, Sidmount	2.99	106	<i>Carm</i>	Carmarthen Friary	7.92	170
<i>"</i>	Filleigh, Castle Hill	5.07	...	<i>"</i>	Llanwrda, Dolaucothy . . .	10.11	184
<i>"</i>	Barnstaple, N. Dev. Ath. . .	5.03	152	<i>Pemb.</i>	Haverfordwest, School . . .	6.92	166
<i>Corn.</i>	Redruth, Trewirgie	4.31	126	<i>Card.</i>	Gogerddan	7.58	156
<i>"</i>	Penzance, Morrab Gdn. . . .	3.76	119	<i>"</i>	Cardigan, County Sch. . . .	5.64	...
<i>"</i>	St. Austell, Trevarna	4.56	126	<i>Brec.</i>	Crickhowell, Talymaes . . .	8.70	...
<i>Soms</i>	Chewton Mendip	6.08	135	<i>Rad.</i>	Birm. W. W. Tyrmynydd . .	10.38	193
<i>"</i>	Street, Hind Hayes	3.34	...	<i>Mont.</i>	Lake Vyrnwy	9.01	174
<i>Glos.</i>	Clifton College	4.15	119	<i>Denb.</i>	Llangynhafal	6.07	...
<i>"</i>	Cirencester, Gwynfa	4.88	163	<i>Mer.</i>	Dolgelly, Bryntirion	10.53	187
<i>Here.</i>	Ross, Birchlea	4.89	191	<i>Carm.</i>	Llandudno	6.83	226
<i>"</i>	Ledbury, Underdown	4.98	191	<i>"</i>	Snowdon, L. Llydaw 9 . . .	23.95	...
<i>Salop</i>	Church Stretton	6.51	200	<i>Ang.</i>	Holyhead, Salt Island . . .	5.89	185
<i>"</i>	Shifnal, Hatton Grange . . .	3.89	138	<i>"</i>	Lligwy	6.26	...
<i>Worc.</i>	Omborley, Holt Lock	4.48	167	<i>Isle of Man</i>			
<i>"</i>	Blockley, Upton Wold	4.18	142	<i>"</i>	Douglas, Boro' Cem. . . .	5.56	146
<i>War.</i>	Farnborough	3.67	134	<i>Guernsey</i>			
<i>"</i>	Birmingham, Edgbaston . .	3.74	138	<i>"</i>	St. Peter P't. Grange Rd . .	3.04	129

Rainfall: August, 1927: Scotland and Ireland

CO.	STATION	In.	Per- cent. of Av.	CO.	STATION.	In.	Per- cent. of Av.
<i>Wigt.</i>	Stoneykirk, Ardwell Ho	4.17	111	<i>Suth.</i>	Loch More, Achfary...	5.65	97
"	Pt. William, Monreith.	3.64	...	<i>Caith</i>	Wick .....	...	...
<i>Kirk.</i>	Carsphairn, Shiel.	7.72	...	<i>Ork.</i>	Pomona, Deerness	1.23	43
"	Dumfries, Cargen.	7.15	163	<i>Shet.</i>	Lerwick	1.25	41
<i>Roxb.</i>	Braxholme	5.71	177	<i>Cork.</i>	Caheragh Rectory	5.16	...
<i>Selk.</i>	Ettrick Manse	7.22	...	"	Dunmanway Rectory.	5.23	111
<i>Berk.</i>	Marchmont House	7.94	240	"	Ballinacurra	4.58	123
<i>Hadd.</i>	North Berwick Res.	6.10	193	"	Glanmire, Lota Lo.	5.98	164
<i>Midl.</i>	Edinburgh, Roy. Obs.	6.79	220	<i>Kerry</i>	Valentia Obsy.	4.89	102
<i>Lan.</i>	Biggar .....	...	...	"	Gearahameen	10.30	...
"	Leadhills .....	...	...	"	Killarney Asylum	7.17	162
<i>Ayr.</i>	Kilmarnock, Agric. C.	4.08	104	"	Darrynane Abbey	6.04	139
"	Girvan, Pinmore	3.24	73	<i>Wat.</i>	Waterford, Brook Lo.	4.27	112
<i>Renf.</i>	Glasgow, Queen's Pk.	5.69	161	<i>Tip.</i>	Nenagh, Cas. Lough	4.22	107
"	Greenock, Prospect H.	6.86	126	"	Roscrea, Timoney Park	5.66	...
<i>Bute.</i>	Rothsay, Ardenraig	4.53	93	"	Cashel, Ballinamona	4.85	137
"	Dougarie Lodge	2.74	...	<i>Lim.</i>	Foynes, Coolnanes	3.46	90
<i>Arg.</i>	Ardgour House	7.59	...	"	Castleconnell Rec.	3.83	...
"	Manse of Glenorchy.	8.12	...	<i>Clare</i>	Inagh, Mount Callan ..	6.47	...
"	Oban	5.29	...	"	Broadford, Hurdle's n.	5.73	...
"	Poltalloch	7.13	146	<i>Wexf.</i>	Newtownbarry	5.32	...
"	Inveraray Castle	8.52	130	"	Gorey, Courtown Ho.	4.82	145
"	Islay, Ballabus	3.26	75	<i>Kilk.</i>	Kilkenny Castle	3.93	113
"	Mull, Benmore	9.02	...	<i>Wic.</i>	Rathnew, Clonmannon ..	4.24	...
<i>Kinr.</i>	Loch Leven Sluice	7.10	185	<i>Carl.</i>	Hacketstown Rectory ..	6.21	153
<i>Perth</i>	Loch Dhu .....	...	...	<i>QCo.</i>	Blandsfort House	6.38	161
"	Balquhidder, Stronvar.	8.09	...	"	Mountmellick	4.90	...
"	Crieff, Strathearn Hyd.	6.68	159	<i>KCo.</i>	Birr Castle	4.29	110
"	Blair Castle Gardens ..	4.25	126	<i>Dubl.</i>	Dublin, FitzWm. Sq.	6.81	224
<i>Forf.</i>	Kettins School	4.50	136	"	Balbriggan, Ardgillan ..	4.77	140
"	Dundee, E. Necropolis ..	5.58	165	<i>Me'th</i>	Beauparc, St. Cloud ..	4.43	...
"	Pearsie House	5.02	...	"	Kells, Headfort	4.27	103
"	Montrose, Sunnyside ..	3.19	114	<i>W.M.</i>	Moate, Coolatore	5.18	...
<i>Aber.</i>	Braemar, Bank	3.42	100	"	Mullingar, Belvedere ..	5.07	122
"	Logie Coldstone Sch.	5.21	164	"	Castle Forbes Gdns.	4.67	114
"	Aberdeen, King's Coll.	2.26	83	<i>Long</i>	Ballynahinch Castle ..	8.81	161
"	Fyvie Castle	2.03	...	<i>Gal.</i>	Galway, Grammar Sch.	5.36	...
<i>Mor.</i>	Gordon Castle	2.06	65	<i>Mayo</i>	Mallaranny	10.97	...
"	Grantown-on-Spey	3.65	114	"	Westport House	7.29	180
<i>Na.</i>	Nairn, Delnies	3.05	127	"	Delphi Lodge	10.37	...
<i>Inv.</i>	Ben Alder Lodge	3.75	...	<i>Sligo</i>	Markree Obsy.	7.31	168
"	Kingussie, The Birches ..	4.26	...	<i>Cav'n</i>	Belturbet, Cloverhill.	4.30	116
"	Loch Quoich, Loan	7.40	...	<i>Ferm</i>	Enniskillen, Portora ..	...	...
"	Glenquoich	6.83	83	<i>Arm.</i>	Armagh Obsy.	4.46	123
"	Inverness, Culduthel R.	3.83	...	<i>Down</i>	Fofanny Reservoir	6.67	...
"	Arisaig, Faire-na-Squir ..	3.60	...	"	Seaforde	3.97	106
"	Fort William	7.05	114	"	Donaghadee, C. Stn.	3.52	106
"	Skye, Dunvegan	4.01	...	"	Banbridge, Milltown ..	4.57	131
"	Barra, Castlebay .....	...	...	<i>Antr.</i>	Belfast, Cavehill Rd.	3.43	...
<i>R&C</i>	Alness, Ardross Cas.	3.76	127	"	Glenarm Castle	3.83	...
"	Ullapool	2.65	...	"	Ballymena, Harryville ..	3.08	72
"	Torricon, Bendamph.	5.19	79	<i>Lon.</i>	Londonderry, Creggan ..	3.89	84
"	Achnashellach	5.72	...	<i>Tyr.</i>	Donaghmore	4.06	...
"	Stornoway	2.72	69	"	Omagh, Edenfel	3.63	85
<i>Suth.</i>	Lairg	1.90	...	<i>Don.</i>	Malin Head	3.05	87
"	Tongue Manse	2.88	99	"	Dunfanaghy	4.94	112
"	Melvich School	1.58	53	"	Killybegs, Rockmount.	6.30	113

Climatological Table for the British Empire, March, 1927

STATIONS	PRESSURE		TEMPERATURE						Relative Humidity	Mean Cloud Am't	PRECIPITATION			BRIGHT SUNSHINE		
	Mean of Day M.S.L.	Diff. from Normal	Absolute		Mean Values						Am't	Diff. from Normal	Days	Hours per day	Per-centage of possible	
			Max.	Min.	Max.	Min.	1/2 and 2 min.	Diff. from Normal								Wet Bulb.
London, Kew Obsy.	1007.5	- 5.9	65	31	52.5	40.5	46.5	+ 4.1	87	6.7	2.19	17	3.8	32		
Gibraltar	1022.0	+ 5.0	69	45	63.0	51.7	57.3	- 0.2	80	4.8	0.94	9	6.6	56		
Malta	1016.3	+ 1.5	74	50	62.3	54.0	58.1	+ 1.0	82	6.0	1.22	6				
St. Helena	1012.3	+ 2.9	71	57	68.5	61.6	65.1	- 1.7	94	3.5	4.41	20				
Sierra Leone	1011.5	+ 0.8	91	72	88.9	75.1	82.0	- 0.4	74	4.0	0.22	3				
Lagos, Nigeria	1007.6	- 1.8	89	69	88.4	74.7	81.5	- 1.8	82	7.8	2.78	6				
Kaduna, Nigeria	1014.9	+ 3.8	99	...	93.9	74.7	...	...	72	...	0.00	0		
Zomba, Nyasaland	1009.5	- 0.2	84	...	78.7	...	...	...	80	8.2	7.12	19		
Salisbury, Rhodesia	1010.7	- 0.8	81	48	76.8	56.4	66.6	- 1.6	72	5.3	2.13	12	7.4	61		
Cape Town	1015.1	+ 0.6	101	51	81.5	59.1	70.3	+ 2.2	76	3.5	0.33	3				
Johannesburg	1014.6	+ 0.5	85	46	72.6	52.9	62.7	- 0.6	71	4.0	2.96	14	6.6	54		
Mauritius . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein . . . . .	...	...	91	50	77.1	57.3	67.2	- 0.2	74	4.2	5.17	10		
Calcutta, Alipore Obsy.	1009.1	- 0.8	99	54	90.5	67.0	78.7	- 1.4	80	2.0	0.16	1*				
Bombay	1008.8	- 2.1	94	67	86.4	72.4	79.4	- 0.1	66	1.9	0.03	0*				
Madras	1009.1	- 1.8	94	70	90.6	74.9	82.7	+ 1.6	77	5.8	0.00	0*				
Colombo, Ceylon	1008.5	- 1.9	90	71	87.7	74.2	80.9	- 0.4	77	7.0	5.91	22	5.7	47		
Hongkong	1015.0	- 1.1	77	47	63.6	57.0	60.3	- 3.0	81	9.0	4.53	13	2.1	18		
Sandakan . . . . .	...	...	89	74	87.5	76.1	81.8	+ 0.7	82	...	6.36	13		
Sydney	1014.5	- 1.7	101	54	76.2	62.5	69.3	0.0	72	6.1	3.69	17	6.3	51		
Melbourne	1016.1	- 0.9	95	41	73.1	50.4	61.7	- 2.8	59	6.3	1.34	8	5.9	48		
Adelaide	1015.9	- 1.2	98	51	78.9	58.2	68.5	- 1.3	43	5.9	0.99	7	7.0	57		
Perth, W. Australia	1012.8	- 2.5	86	50	76.0	60.6	68.3	- 2.8	63	7.1	1.88	9	5.5	45		
Coorgardie	1012.9	- 1.9	100	50	80.0	58.5	69.3	- 2.4	59	6.4	4.91	7				
Brisbane	1013.5	- 0.9	92	61	81.3	66.8	74.1	- 0.2	78	7.1	7.88	23	5.6	46		
Hobart, Tasmania	1013.7	- 0.3	81	43	63.6	49.1	56.3	- 3.1	68	7.3	1.44	15	5.6	46		
Wellington, N.Z.	1014.0	- 3.2	76	46	68.0	56.4	62.2	+ 1.7	65	5.1	3.39	12	7.3	59		
Suva, Fiji	1009.1	+ 0.6	92	73	89.8	74.7	82.3	+ 2.2	77	5.5	4.48	20	8.0	66		
Apia, Samoa	1010.8	+ 1.6	88	72	85.1	74.6	79.9	+ 0.6	81	6.0	8.11	21	6.4	53		
Kingston, Jamaica	1015.3	+ 0.4	88	63	85.9	67.1	76.5	- 0.6	83	0.1	0.42	1	10.0	83		
Grenada, W.I. . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Toronto	1019.9	+ 2.9	59	10	41.7	28.6	35.1	+ 6.2	78	5.4	2.26	12	4.9	41		
Winnipeg	1018.0	- 0.8	52	-5	35.6	19.7	27.7	+ 13.3	83	4.2	0.48	7	6.0	51		
St. John, N.B.	1016.6	+ 2.4	52	11	32.8	24.1	28.5	+ 0.1	76	5.7	2.64	8	5.0	42		
Victoria, B.C.	1018.1	+ 2.3	56	32	49.2	38.8	44.0	+ 0.8	79	6.8	1.55	13	5.3	45		

*For Indian stations a rain day is a day on which 0.1 in. or more rain has fallen.

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British Association for the Advancement of Science. Meeting at Leeds, August 31st to September 7th, 1927

The meeting of the British Association at Leeds will long be remembered as one of the most successful of recent years. The excellent arrangements made by the local committee, not only for the conduct of the meeting itself, but also for the comfort and entertainment of their guests, were by no means the least of the factors which contributed to its success. Both the City of Leeds and the University seemed determined to give the members of the Association an unforgettable impression of true Yorkshire hospitality. In the words of Sir Oliver Lodge, it was "a great and friendly meeting."

As in the case of the Oxford meeting last year, there were no papers in Section A which could be described as purely meteorological in character. Professor J. J. Nolan's paper on "Ionization in the Lower Atmosphere," in which the author gave a lucid account of recent experimental work on this subject carried out in Ireland, was, perhaps, the closest approach to meteorology in the transactions of this section. There was another link with meteorology in the paper by Dr. W. Kolhörster, describing experimental work in Germany on penetrating rays. Meteorology also found a place in the transactions of other sections. On September 3rd the Forestry sub-section devoted a three-hour session to the much-debated question of the effect of forests on climate. Papers on the subject were read by

Dr. T. F. Chipp, assistant director of the Royal Botanical Gardens at Kew, by Dr. C. E. P. Brooks and by Dr. A. W. Borthwick, professor of forestry at Aberdeen University, and were followed by a very keen discussion in which the foresters showed themselves very reluctant to accept the view of the meteorologists that forests have no practical effect on rainfall. On September 5th papers were read at the Textile Section by Mr. E. E. Canney, on "Cotton-growing Policy, the Influence of Climate on Staple Quality," and by Dr. Guy Barr and Miss I. Hadfield, on "The Nature of the Action of Sunlight on Cotton." On September 6th, a combined discussion was arranged between the sections of Mathematics and Physics, Geology and Botany on "Climates of the Past," in which Professor A. C. Seward, Dr. G. C. Simpson and Dr. C. E. P. Brooks took part.

The report of the Committee on the Investigation of the Upper Air, which was presented during the meeting, showed gratifying activity during the past year. The Committee was re-appointed with the addition of the name of Dr. L. F. Richardson, F.R.S., and a monetary grant was sanctioned towards defraying the expenses of a co-operative investigation of the upper air to be carried out on selected occasions with the help of Universities and the Science Departments of Schools.

As in past years the Meteorological Office, Air Ministry, with the collaboration of the Signals Branch, organised a demonstration of weather forecasting based on broadcast synoptic data which was received locally by wireless. The demonstration was given daily in the Law Library at the Town Hall, which was in close proximity to the Reception Room, and attracted considerable attention not only from members of the Association but also from the local Press, several papers publishing the special forecasts for the Leeds area which their representatives obtained from the meteorologist in charge of the demonstration. A "Local Daily Weather Report" was prepared and copies circulated to the various sectional meeting rooms and to hotels and hostels where members were accommodated. The morning and afternoon synoptic charts were also reproduced on a large scale map which occupied a prominent position in the Reception Room.

In addition to the demonstration of forecasting, a comprehensive exhibit of instruments and diagrams was arranged. Among distinctive features of the exhibit may be mentioned a series of five rain-gauges, illustrating recent improvements in the design of these instruments; a model of a climatological station, in which each detail was faithfully represented, kindly lent for the purpose by Messrs. Negretti and Zambra; a large-scale rainfall map of the Leeds District; a series of beautiful cloud photographs lent by Mr. C. J. P. Cave, and an exhibit illustrating

the meteorological arrangements on the London-Continental air routes.

The Meteorological Luncheon was held at Powolny's Restaurant the day before the concluding meeting of the Association and proved an exceedingly successful function in spite of the relatively small attendance. The latter was inevitable owing to the fact that a large number of meteorologists and geophysicists, who would have been present normally, were attending an international Conference at Prague. The following were present at the luncheon :—

Dr. G. C. Simpson, C.B., F.R.S. (in the Chair) ; Professor D'Arcy Thompson, C.B., F.R.S. ; Professor A. Fowler, F.R.S., and Mrs. Fowler ; Lady Lockyer ; Professor J. J. Nolan ; Professor A. M. Tyndall, Recorder of Section A ; Professor E. H. Neville ; the Reverend Father O'Connor, S.J. ; Dr. Vaughan Cornish ; Dr. H. Borns ; Dr. J. S. Owens and Mrs. Owens ; Captain F. Entwistle and Mr. W. M. H. Greaves, Secretaries of Section A, and Mrs. Greaves ; Dr. H. Jeffreys, F.R.S. ; Dr. C. E. P. Brooks ; Major W. S. Tucker ; Dr. C. B. Fawcett ; Mr. R. Stoneley and Mrs. Stoneley ; Mr. G. Merton and Mrs. Merton ; Mr. R. F. Budden ; Mr. E. W. Bliss ; and Mr. R. H. Mathews.

In the speeches which followed the loyal toast, several references were made to the unseasonable summer which was just drawing to a close. Dr. Simpson in the opening speech welcoming the guests caused much amusement by quoting the ditty,

“ Dirty days hath September,
April, June and November.
From January up to May
The rain it raineth every day.
All the rest have thirty-one
Without a blessed gleam of sun.
If any of them had two and thirty
They'd be just as wet and twice as dirty.”

Professor D'Arcy Thompson in a witty speech proposed the toast of “ Meteorology and Allied Sciences.” Professor J. J. Nolan in replying to the toast said that Meteorology can propound more problems to General Science than General Science can well solve. Father O'Connor in proposing the toast of “ The British Association,” to which Professor Tyndall subsequently replied, referred to the fact that Stonyhurst College would shortly be celebrating its centenary as a meteorological station.

No account of the Leeds meeting would be complete without a reference to the local arrangements for the entertainment of the members of the British Association. Two excellent handbooks had been prepared, one a general handbook of the Leeds area illustrated by maps and diagrams, which contained a section on meteorology including rainfall, and the other a handbook for members taking part in the various excursions which

covered a wide area around Leeds. The Lord Mayor and Lady Mayoress of Leeds held a reception at the City Art Gallery on the evening of September 1st, at which H.R.H. Princess Mary, Viscountess Lascelles and Viscount Lascelles were present. On the evening of the 6th, the University held a reception for members of the Association, which included a display of exhibits in the various departments. The display included an exhibit illustrating atmospheric pollution, which was arranged by Professor J. B. Cohen, Dr. J. S. Owens, Dr. J. R. Ashworth and Dr. Leonard Hill. Other local arrangements included garden parties, a dance, and a concert arranged by the Leeds Choral Union.

F. E.

The Wet Summer of 1927

The year 1927 apparently started with the determination to emulate its memorable predecessor of 1924, for after a very dry December, heavy rain began to fall in Scotland on the 1st or 2nd, and January as a whole was wet and stormy. The next three months provided us with a moderate rainfall, rather above the average over the country as a whole (see Table 1). A dry and sunny May gave hopes of a fine summer, but these hopes were doomed to disappointment, for from June to September the rainfall has been well above the average in England at least, while a more serious drawback has been the persistent character of the wet weather. The county cricket season has been remarkable for the number of matches abandoned without any result, often with less than six hours' play, and on all sides one hears laments of spoilt holidays.

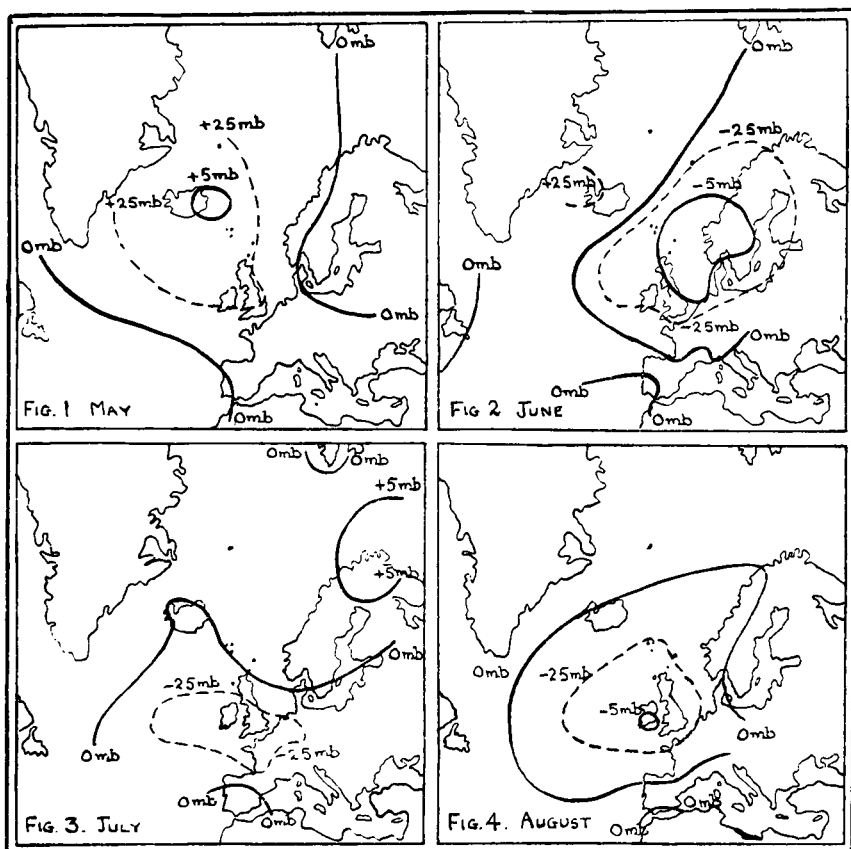
TABLE I. RAINFALL (PERCENTAGE OF NORMAL) DURING 1927.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Average
England and Wales ...	122	134	136	107	56	163	133	155	233	139
Scotland ...	130	67	93	145	100	165	99	121	200	123
Ireland ...	132	88	138	69	65	135	113	126	159	116
British Isles ...	126	108	126	107	69	158	120	140	209	130

Table 1 shows that the percentage excess has generally been greater in England and Wales than in Scotland or Ireland, especially from June to September. This is a characteristic of the cyclonic type of wet season,* an inference which is borne out by the charts of deviation of pressure from normal, shown

* The fluctuations of annual rainfall in the British Isles considered cartographically. By M. de C. S. Salter and J. Glasspoole. *London, Q.J.R. Meteor. Soc.*, 49, 1923, p. 213.

in figs. 2 to 4, the greatest deficit of pressure occurring in the neighbourhood of the British Isles in all three summer months. In this type the wet weather is due to the passage of a number of depressions across the British Isles from west to east or from south-west to north-east, and the greatest deficit of pressure from normal is found over the British Isles. In September pressure was more than 5 mb. below normal over the whole of the British Isles and nearly 10 mb. below in northern Scotland.



PRESSURE ANOMALIES, 1927.

In discussing previous wet seasons in the British Isles it was found* that prolonged spells of rainy weather were generally associated with some factor which tended to cause a low surface temperature in the North Atlantic Ocean.

The factors which were found to have the greatest importance were four :—

1. The north-east trade wind in the Atlantic.
2. The south-east trade wind in the Atlantic.

* Pressure distributions associated with wet seasons in the British Isles. By C. E. P. Brooks. *London, Q. J. R. Meteor. Soc.*, 52, 1926, p. 387.

3. The pressure difference between Newfoundland and southern Greenland, which is regarded as a measure of the strength of the north-west winds along the Labrador current.

4. The amount of ice in the East Greenland Current.

Recent work* has shown that a strong north-east trade wind tends to be followed 12 months later by low pressure in the far north (Stykkisholm and Vardö) and by high pressure over western Europe (Valentia, Paris, Berlin and Bergen). A weak north-east trade has the opposite tendency. Variations of the south-east trade have similar effects to those of the north-east trade, but occurring after an interval of 15 to 21 months instead of 12 months.

TABLE 2. DEPARTURES FROM NORMAL OF VARIOUS FACTORS OF BRITISH WEATHER.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
North-east Trade Velocity (m.p.h.), 1926	-2.0	-1.4	-1.2	-1.0	-1.1	-2.1	-1.8	-1.0	-1.2	-0.1	+1.4	+0.5
South-east Trade Velocity (m.p.h.), 1925							+0.7	+2.0	-2.2	+0.7	+0.2	-2.5
1926	+0.2	+0.9	+1.8	+0.9	+0.9	+0.9	-2.5	-3.6	-1.6	-3.1	-0.4	-1.3
Pressure diff. (mb.)												
St. Johns 60°N, 44°W. { 1925												-3
1926	0	-4	0	-1	-3	+1	-1	-1	0	-4	+14	+1
1927	+3	+3	+6	+3	-3	-1	+2	+1				
Temperature Jan Mayen, 1927				-6.0	-2.3	-1.5	+1.3	+0.2				

A large pressure difference between Newfoundland and southern Greenland, associated with north-west winds which drive cold water into the North Atlantic circulation, would be expected to have the reverse effect to strong trade winds. It is found that this is to some extent the case, a large pressure difference tending to be followed three months later by low pressure at Stykkisholm, Valentia and Berlin, but by high pressure at the Azores. Variations of the pressure difference during the winter months, when the Labrador Current is ice-laden, especially from December to March inclusive, are much more effective than those during the summer months. There appears to be a recrudescence of the effect at a later stage, for a large pressure difference is followed twelve months later by high pressure at Vardö and low pressure at Valentia and Berlin, but these relationships have not yet been completely explored.

The fourth factor is the influence of ice in the Greenland Sea. This is most effective during the three months April to June, and appears to have a two-fold consequence. A large amount

* The effect of fluctuations of the Gulf Stream on the distribution of pressure over the eastern North Atlantic and western Europe. By C. E. P. Brooks. *London, Meteor. Office, Geophys. Mem. No. 34, 1926.*

of ice tends to be associated with a contemporary excess of pressure over Iceland, while in the following autumn and winter an area of pressure deficit tends to develop over the British Isles.* No information is yet available as to the ice conditions in the Greenland Sea during 1927, but it has been found that temperature at Jan Mayen is a useful index, much ice being associated with a low temperature and *vice versa*.

The variations of these four factors, velocity of the north-east trade wind and south-east trade wind, pressure difference between Newfoundland and south Greenland, and Jan Mayen temperature, are shown in Table 2. It is to be remarked that the velocity of the north-east trade wind is not known directly, but has been calculated from the values of pressure at the Azores, Gibraltar and Sierra Leone.† The velocity of the south-east trade wind is given by the anemometer at St. Helena, but unfortunately the figures for January to June, 1925, are not available.

This table shows that the north-east trade wind was abnormally weak throughout the first nine months of 1926, which would give a persistent tendency for low pressure over western Europe during the corresponding months of 1927. The velocity of the south-east trade wind was not especially abnormal, and the pressure difference between Newfoundland and Greenland was nearly normal until October, 1926, but this pressure difference shows a marked excess in the important period from December, 1926, to March, 1927. This would give a tendency for low pressure over western Europe during the months of April, May and June. Finally, the low temperatures at Jan Mayen in April to June indicate that there was more ice than usual in the Greenland Sea in those months. This would give

TABLE 3. DEVIATIONS OF PRESSURE FROM NORMAL IN MILLIBARS.

1927	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Kew	-7.3	+2.3	-5.8	+0.3	+2.2	-3.7	-3.4	-3.4	-8.1
Isafjord	-2.6	-1.8	-8.9	-4.5	+3.5	+4.3	-0.6	+1.2	+5.4

a tendency for pressure to be above normal over Iceland during April to June, and for pressure to be below normal over the British Isles from September onwards. The resultant of all these tendencies was for pressure to be persistently below normal over the British Isles throughout January to September, 1927, with the greatest deficit in the latter month, and for pressure generally above normal over Iceland during the months of April,

*Polareis und atmosphärische Schwankungen. By W. Wiese. *Stockholm, Geog. Ann.*, 6, 1924, p. 273.

† London, Meteor. Office, *Geophys. Mem.* No. 34.

May and June. The deviations of pressure from normal which actually occurred at Kew and Isafjord are shown in Table 3.

The general agreement of these pressure deviations and the tendencies deduced from the oceanic causes is fairly good, but of course the slowly changing oceanic effects are incompetent to account for rapid fluctuations of pressure from one month to the next. The pressure distribution during May (fig. 1) is especially interesting, as the one fine month of the year in England. It appears that the high pressure which brought the fine weather was part of a large area of pressure excess centred over Iceland, probably associated with the excess of Greenland Sea ice.

C. E. P. B.

The Wet Summer in the Isle of Wight

The summer of 1927 has been so persistently wet that some comments and statistics seem interesting.

As far as Shanklin is concerned, the four months June-September were the wettest since records began in 1906, as much as 17.47 inches falling. The nearest approach to this was 14.78 inches in 1912. The three months July, August and September, 1927, were also the wettest known, with 14.62 inches against 12.80 inches in 1918. The period January-September, or the first nine months of 1927, was wetter than any preceding year since 1906. The number of rainy days was also a record for the period June-September, rain falling on 73 days out of a possible 122, while during the period July-September, precipitation was measured on 58 days out of a possible 92. Rain fell on 15 days in June, 20 in July, and 19 days each in August and September. July has never before had so many wet days. September, which one hoped would make amends for the preceding wet months, turned out the wettest month of the year so far, and with the exception of 1918, the wettest September on record. In 1918, 7.68 inches fell, in 1927, 7.32 inches. The fall of 2.09 inches on the 14th was the heaviest twenty-four-hour fall in September on record, and it is rare for two days in one month to measure more than one inch of rain, viz., 2.09 inches on the 14th, and 1.23 inches on the 23rd. At Newport there was one day with over 2 inches of rain, and two other days during September with more than one inch—a very exceptional occurrence. Thunder was heard in Shanklin on five days in September, this was also a record, no other month since 1906 producing more than four days of thunder. In contrast to this wet spell, the period April 9th-June 15th gave only 1.14 inches of rain at Shanklin. Between June 16th and August 31st there were never more than four consecutive days without rain.

J. E. COWPER.

Wet Summers

The recent wet summer adds interest to the results of an investigation on the extremes of seasonal rainfall. The following statistics refer to the summer half-years, April to September, during the period 1870 to 1926. It has been shown previously that the wettest summers on record over the British Isles as a whole were those of 1879 and 1924. The wettest summer varies however, in different districts.

The years 1872, 1873, 1874, 1877, 1880, 1892, 1898, 1904, 1918, 1920, 1923 and 1924, all gave summers which were the wettest in some part of the British Isles. Such years were therefore most frequent in the 'seventies and in the 'twenties. In fact, the areas which did not experience the wettest summer during these two decades were relatively small. The wettest summer was 1918 in the extreme north of Scotland, 1892 in the English Lake District, 1904 in Co. Kerry and 1898 in Co. Clare. The summers of 1879, 1877, 1924 and 1872 were the wettest over the largest areas. The summer of 1879 was the wettest over England and Wales south of a line from Cardigan, Monmouth and King's Lynn, as well as in the south-east of Scotland from Mull to Wigtown and in the extreme north-west and south-east of Ireland; 1877 along the east coast from Hull to Edinburgh and in North Wales; 1924 over the greater part of northern and central Ireland, over the Grampians and as far east as Aberdeen and also in the Valley of the Severn; 1872 in the neighbourhood of the southern Pennines, and in parts of Scotland, *e.g.*, in the counties of Berwick, Perth and Banff and in the outer Hebrides. The summer of 1923 ranked as the wettest in parts of the south-west of Scotland, including Islay and Dumfries.

It is of interest to recall that the wet summer of 1879 was followed by the driest winter, October to March, on record, over roughly three-quarters of the whole British Isles.

The fall of the wettest summer was less than 140 per cent. of the average summer fall for the period 1881 to 1915, only at stations along coastal strips of Argyll, Caithness, Waterford, Clare and Donegal. The falls generally were more than 150 per cent. and exceeded 175 per cent. over large areas in the southern half of England and Wales. At London and Spalding, the fall of the summers of 1879 and 1880 respectively exceeded twice the average fall at these stations.

The statistics referred to above have been used as a standard for a comparison of the fall of 1927. It appears that although the rainfall of the last summer was remarkably heavy, exceeding 150 per cent. of the average summer fall in the south-east of England and of Scotland, appreciably larger falls are on record in all parts of the British Isles.

J. G.

Discussions at the Meteorological Office

The subjects for discussion for the next meetings will be :—

October 24th. *Sur l'erreur moyenne des moyennes mensuelles des éléments magnétiques observées à l'observatoire de Rude Skov.*

By D. la Cour (Copenhagen, Dansk Meteor. Inst. Publ. No. 1, 1927). *Opener*—Dr. C. Chree, F.R.S.

November 7th. *Richtung von Wind und Wolken auf Teneriffa.*

By H. v. Ficker (Wien, SitzBer. Ak. Wiss. IIa, 135, 1926, pp. 307-22; also in Wien, Festschr. ZentAnst. Meteor. Geodyn., 1926, pp. 15-30). *Opener*—Mr. W. H. Bigg, B.Sc.

Correspondence

To the Editor, *The Meteorological Magazine*

Old-fashioned Winters

In the March issue of the *Meteorological Magazine* I suggested lines on which investigations might be made to solve the question of "milder winters." As a result of this, Mr. A. W. Preston very kindly prepared and placed at my disposal a summary of records kept by him for many years at Eaton, Norwich, and from a diary in his possession kept by the late Mr. Whistlecroft, in Suffolk, from 1830-90; the two records thus covering nearly 100 years. The results, however, are not so conclusive as I hoped would be the case.

As regards temperature, the winters of the twentieth century certainly show a longer period of relatively mild winters than during the previous sixty years, particularly in the case of day maxima. In the ten years 1850-9, when the number of night frosts was low, the days with a maximum reading below 32° were more numerous than during the last quarter century. Of the 31 winters when there were no maximum temperatures below 32°, no fewer than fifteen have occurred since 1900.

The number of screen frosts does not show such a marked decrease, although fewer in the present century than during the period 1860-1900.

Full records of snow are available only since 1883, and show little variation.

Several interesting facts are revealed, one being the severity of the winter 1887-8 exceeding, as regards snow and screen frosts, the perhaps more severe and continuous cold periods of 1891 and 1895, while the ten-year period with most snow days was 1900-9. Ten-year period with greatest number of days snow lying was 1890-9. Greatest number of screen frosts 1880-9; greatest number of days 32° or below, 1830-9. The winter 1887-8 had the most snow days, snow lying and screen frosts, 1837-8, the largest number of days on which tempera-

ture did not exceed 32° . Year with least number of snow days, 1858-9. Least number days snow lying 1895-6 (following the severe winter 1894-5), year with least number of screen frosts, 1845-6.

Finally it appears that another 20 or 30 years must elapse before a satisfactory answer can be given to the question "Are winters becoming milder?" Also, assuming that the present tendency for milder conditions is continued, it seems probable that the next two or three winters must be decidedly on the cold side, especially as regards snow, in order to reach anything like the average of 1910-19.

G. C. WOOLDRIDGE.

Leicester Road, Packington, Ashby-de-la-Zouch. Sept. 22nd, 1927.

An Interesting Cloud Formation

The cloud formation subsequent to the passage of the central regions of a cyclone over Nottingham on August 18th gave interesting indications of wind structure.

Rain fell steadily from soon after midnight till about 14h. 15m. with an east-southeast wind; the sky then cleared in the east while a thunderstorm formed and drove up from the south-southwest. As its rear passed over about 15h. the wind changed suddenly to west-northwest and in the southwest a magnificent bank of cumulo-nimbus was revealed lying from west-northwest to east-southeast. When first observed at 15h. 5m. it had three massive heads. The most northerly was soon seen to be collapsing and the middle one growing; within a few minutes this latter ceased to grow and collapsed rapidly while the most southerly towered up, the most northerly being now reduced to a thin ragged cloud. By 15h. 15m. the most southerly of the three was being outstripped by a new head still further to the southeast. It was noticed that as the cloud heaps fell they drifted to west-northwest while low clouds along the chain were plainly moving in the opposite direction. Further observation was prevented for the time by intervening clouds.

The whole phenomenon suggested a northwesterly wind cutting under a southeasterly one and setting up vast waves with cumulo-nimbus on their crests, the heads being carried along in the upper current. The most striking part was the speed with which these tremendous masses of vapour appeared and disappeared. During 20 minutes' observation three cloud heads, apparently 15,000 to 20,000 ft. high were thrown up, and in each case at least half (in the first nearly all) of the mass either precipitated or evaporated. There was no false cirrus, but a clearing in the clouds at 16h. showed that the whole of this

portion of the cloud range had dwindled to a thin cirrus-like band.

The observation was made from Longeaton, about 8 miles southwest of Nottingham; it would be interesting to know if very heavy rain fell in the neighbourhood of Kingston-on-Soar over which the cloud range seemed to lie.

R. FRANCIS GRANGER.

Lenton Fields Climatological Station, Nottingham. August 18th, 1927.

Waterspout at Ulverston

On August 24th I was walking along the shore of Morecambe Bay and to all appearances a storm was imminent. Heavy cumulus clouds were gathering over the Bay, although the movement of the clouds was scarcely perceptible, in fact there was hardly a breath of wind.

My attention was attracted to a funnel-shaped streamer which was hanging from a cloud right in the thick of the stormiest looking part. Presently this streamer gradually dispersed with a curious wavy movement which reminded me of the disturbance produced by radiation on a hot day. As I watched, the streamer was sent out again, and I can only describe it as though the bottom of the cloud burst and the contents came streaming out in much the same fashion as I would expect the contents of a sack of flour to pour out. In a few minutes the streamer again dispersed. This process was repeated for some time—twenty minutes or half an hour at least—until finally the streamer crept down the sky in a long straight band with a curious dark line down the middle. Slowly the whole thing melted away, a slight wind sprang up and before I could move a dozen yards I was in the heaviest downpour I have ever experienced.

I might mention that the rain was local only, the town of Ulverston less than a mile away being entirely out of the zone.

C. J. SMITH.

1, *School View, Bardsea, Ulverston, Lancs. August 29th, 1927.*

NOTES AND QUERIES

Meteorology and Agriculture

It is a commonplace that the weather has important effects upon the magnitude and quality of field crops, not only in the sowing, growing and harvesting seasons, but also during the weeks which precede sowing, when the ground is being prepared, and in some cases during the weeks following harvest when the produce is lying in the stack or other form of storage.

Until a few years ago, there were in Great Britain no organized

means of collecting accurate information from all parts of the country on the subject of the relation of weather to crops in order to elucidate the complicated and difficult problems which arise. Organizations exist which deal with observations in agriculture alone and in meteorology alone, but the task of applying the one set of observations to the other has been left to isolated workers in the one science or the other who have been attracted by the subject. Thus, the Ministry of Agriculture publishes statistics of estimated yields of crops, while the Meteorological Office publishes district values of temperature, rainfall and sunshine week by week. The valuable work of Sir Napier Shaw and of Mr. R. H. Hooker in correlating data extracted from these two sources is well known.

In America, where the U.S. Weather Bureau forms part of the U.S. Department of Agriculture, there is a special branch of the Bureau which deals specifically with the subject, but in most other foreign countries there are no organized means of prosecuting this special application of meteorology.

In 1922 the Ministry of Agriculture and Fisheries, acting in co-operation with the Board of Agriculture for Scotland, appointed a committee to study the problem. The Committee arranged an "Agricultural-Meteorological Scheme" (usually called a "crop-weather scheme"). This consists in the collection and circulation of agricultural and meteorological observations or summaries made side by side at a number (about 22) of Agricultural Colleges or Agricultural Research Institutions throughout the country. A description of the scheme by Mr. W. R. Black, of the Ministry of Agriculture, Secretary of the Committee, appeared in *The Journal of the Ministry of Agriculture*, Vol. 33, 1926, pp. 321-331. Sir Napier Shaw is chairman of the Committee, and the Meteorological Office is represented upon it.

The observers who contribute to this scheme are distributed over the whole of Great Britain, from Craibstone near Aberdeen to Wye in Kent and Gulval in Cornwall, and in the ordinary course it would therefore be seldom that they would meet to exchange views. On the other hand, those who have to prepare and publish the official agricultural and meteorological data in London need to acquire personal contact with the observers and other workers on the subject. To provide for these requirements it is the practice to hold "paper-reading discussions" every year, to which all concerned are invited. Such meetings were held at the Meteorological Office, South Kensington, under the chairmanship of Sir Napier Shaw on Thursday and Friday, September 22nd and 23rd, 1927, when the following papers were read and discussed: "The week as a phenological unit," by Sir Napier Shaw, F.R.S.; "Rothamsted temperature records," by Mr. T. B. Hoblyn, of the Rothamsted experimental station;

"The effects of temperature and humidity on the changes in weight of crops in storage," by Mr. G. V. Jacks, of the Rothamsted experimental station; "Changes during storage in the stack," by Mr. W. S. Gibson, of the East Anglian Institute of Agriculture, Chelmsford, and Dr. W. Goodwin, of the South-eastern Agricultural College, Wye, Kent; "The effect of temperature on the keeping quality and bacterial content of milk," by Capt. H. Barkworth, of the South-eastern Agricultural College, Wye, Kent; "The effect of meteorological conditions on the amount and nutritive value of pasture and hay," by Prof. R. G. Stapledon, of the Welsh Plant Breeding station, Aberystwyth; "The effect of meteorological conditions on the rate of growth of pasture grass," by Dr. H. E. Woodman, of the Animal Nutrition Research Institute, Cambridge; "Temperature and the food requirements of animals," by Prof. T. B. Wood, of the Animal Nutrition Research Institute, Cambridge; "The effect of ultra-violet light on animal nutrition," by Dr. H. E. Magee, of the Rowett Research Institute, Aberdeen, and "The meteorological factors affecting sheep," by Mr. J. E. Nichols, of the Animal Breeding Research Department, University of Edinburgh. There can be no doubt of the great value of these discussions in widening the outlook and focussing ideas, and considerable benefit would result if they could be held more frequently. Clearly we are only at the threshold of the subject, and much depends on the results of the next few years' work. We shall look forward with interest to the issue of the report of the meeting in due course.

R. C.

Course of Training for Observers

A Course of Instruction for meteorological observers was held this year at Kew Observatory from September 19th to 23rd. During the first three days instruction was given in the equipment and exposure of a climatological station, the recording of the observations and their transmission to the Meteorological Office, and the special meteorological observations in connexion with the scheme for obtaining data suitable for the correlation of weather and crops instituted a few years ago by the Ministry of Agriculture and Fisheries and the Board of Agriculture for Scotland in co-operation with the Meteorological Office.

This part of the course was attended by eight observers from Crop Weather stations, two members of the staff of the Ministry of Agriculture and Fisheries and seven observers from other climatological stations.

During the last two days of the course, instruction was given in the routine of observations at health resort stations whose

reports are issued daily to the Press, in the charting of observations, distributed by wireless telegraphy and in climatology. This part of the course was not attended by the observers from Crop Weather stations.

The Annual Variation of Cirrus Cloud at Kimberley

Table 1 gives the average number of times per month, for four standard daylight hours of observation, upon which cirrus of any kind has been observed alone in the sky, other cloud forms being absent, together with the corresponding percentages of sky covered. For the purpose of making the frequencies comparable one with another they have all been reduced to a uniform month of thirty days. Night observations at 20h. and 23h. are also made; but these are not used here, the determination of faint cirrus on a night sky being largely a matter of illumination by the moon. The period is the 26 years 1900 to 1925.

Upon the whole there are two maxima in the year both in frequency and in quantity: in June and in September; and this rule is closely followed at each of the standard hours. The minimum frequencies come in February and in August, excepting that at 8h. which falls a little later into March; also the minimum percentages of sky covered are irregular in their incidence.

The rule of the diurnal variation appears to be that there is a decrease of frequency from early morning to mid afternoon, followed by an increase until perhaps sunset.

TABLE 1.—CIRRUS ALONE. MEAN MONTHLY FREQUENCIES AND PERCENTAGE OF SKY COVERED.

		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
8 h	Times.	4.0	3.9	3.2	4.1	4.4	6.3	4.4	4.3	7.1	6.8	6.0	4.6	59.0
	Per cent.	41	40	42	38	43	46	41	41	44	40	38	43	41
11 h	Times.	2.4	1.8	2.2	3.6	4.5	5.2	4.4	3.7	6.5	5.8	3.6	2.7	46.3
	Per cent.	38	40	42	29	45	45	43	47	48	43	43	44	42
14 h	Times.	0.9	0.5	0.9	2.6	4.1	5.2	4.1	4.4	5.3	4.2	2.7	1.2	36.1
	Per cent.	43	32	40	32	35	40	40	43	48	47	41	33	41
17 h	Times.	1.1	0.9	1.5	3.3	4.8	6.2	5.5	5.2	6.2	5.8	3.7	1.7	46.3
	Per cent.	44	40	38	31	34	34	35	34	41	43	38	37	37
Day	Times.	8.4	7.1	7.8	13.6	17.8	22.9	18.4	17.6	25.1	22.6	16.0	10.2	187.7
	Per cent.	41	38	40	33	39	41	40	41	45	43	40	39	40

Table 2 is a summarised mean of all cirrus observed at the standard daylight hours, whether other cloud forms be present

or not. It differs somewhat from Table 1. May takes something from the June maximum, while October displaces September.

TABLE 2.—MEAN MONTHLY FREQUENCIES OF ALL DAYS WITH CIRRUS.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
8 h ...	5.9	6.8	5.2	5.6	5.6	6.7	4.9	4.8	7.9	8.5	8.0	6.7	76.7
11 h ...	6.4	6.5	6.3	6.4	6.3	6.4	5.7	5.1	9.0	9.3	7.7	7.6	82.7
14 h ...	4.9	4.9	5.1	5.4	7.5	6.9	5.7	6.0	8.2	8.4	7.2	5.3	75.5
17 h ...	4.1	5.3	5.3	6.1	7.4	7.3	6.5	6.5	8.5	8.5	7.0	5.0	77.6
Day ...	21.3	23.6	22.0	23.5	26.8	27.3	22.8	22.4	33.6	34.7	29.9	24.6	312.5

ber. There is, moreover, a third maximum in February in place of the definite minimum of Table 1. There is no great variation during the day, the outstanding feature being a rise (instead of a fall) in frequency from 8h. to 11h. In interpreting these results it has to be remembered that cirrus may frequently be present in the sky though hidden by a lower cloud sheet. Another small point is that owing to difficulties of seeing—of which a bad horizon is the worst—one or another of the five observers who at one time and another from first to last have been responsible for the observations have sometimes noted "stratus" where a stratiform cloud may happen to have been cirro-stratus, though doubtless most often strato-cumulus. Taking the registers as they stand, however, the mean number of all observations of cirrus for the year is 317, or, say, on 79 days. The range of frequency is from 53 days in 1901 to 103 days in 1910. For cirrus alone the range is from 28 days in 1914 to 67 in 1906. Throughout the four years 1911 to 1914 there was a remarkable minimum of days with cirrus alone.

TABLE 3.—YEARLY TOTALS OF CIRRI'S DAYS.

Middle Year	...	...	...	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912
Cirrus alone	...	...	...	46	46	51	51	52	50	51	44	40	39	37
All days with Cirrus	...	...	...	64	68	74	77	79	83	86	86	85	87	81

Middle Year	...	...	...	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923
Cirrus alone	...	...	...	39	41	47	49	53	52	52	51	50	53	50
All days with Cirrus	...	...	...	80	77	79	81	83	83	84	82	82	86	82

The yearly totals of cirrus frequency, averaged in sets of five, are given in Table 3. It would be interesting to know whether cirrus phenomena in other parts of the world correspond with these. For the first twenty years or so there is quite a good

correlation with Wolfer's sunspot numbers ; but the last two years spoil the effect. The mean direction of motion of cirrus over Kimberley has a very large westerly component. Table 4 is added for purposes of comparison.

TABLE 4.—AVERAGE DAILY PERCENTAGE OF CLOUD.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
8 h ...	34	36	33	28	28	23	19	19	29	30	25	31	28
11 h ...	37	40	36	26	27	24	19	18	36	36	33	35	31
14 h ...	51	53	46	37	29	21	19	20	34	41	41	48	37
17 h ...	49	52	43	31	26	20	17	17	36	40	40	44	35
20 h ...	42	43	36	27	18	15	14	13	21	30	29	38	27
23 h ...	35	40	32	22	20	17	13	12	24	28	26	32	25
Year ...	42	44	38	29	25	19	17	17	28	36	32	38	30

J. R. SUTTON.

The Spanish Meteorological Society

We have received the first two numbers (January—April, 1927) of the *Anales de la Sociedad Española de Meteorología*, a new society which has been formed to further the development of meteorological studies in Spain. The first President of the Society is Colonel Enrique Meseguer, the Director of the Spanish Meteorological Service, who contributes a paper on "The Flights to Guinea and Meteorology," illustrated by folding maps including a coloured plate of the climatic provinces of northern Africa. The issue includes also a study by M. Doporto on orographic rainfall with special reference to the Sierra de Grazalema, and several other papers, meteorological notes and a summary of the weather. The second number of the *Anales* maintains the high standard of the first. All meteorologists will join in wishing success to the new Society.

Reviews

Jahresbericht (34) des *Sonnblick-Vereines für das Jahr* 1925.

Edited by W. Schmidt. Size 11×8, pp. 32. Wien, Julius Springer, 1927, 2 Reichsmark.

An account of the founding and early history of the Sonnblick Observatory appeared in the *Meteorological Magazine* for 1926, p. 172. In July 1900, the Observatory, which had fallen on evil days, was handed over to the Bavarian state and reopened, and the present annual volume records the celebration of the 25th anniversary of this reorganisation, which was held on October 4th, a party of meteorologists foregathering at the Observatory and spending the night there. The number also contains an

obituary notice of Matthias Mayacher, who assisted in the building of the Observatory in 1885, and became assistant observer in 1893 and chief observer from 1908 until 1923, except for a period of war service. His death came only a week after the anniversary celebrations. Other articles are "High Rambles in the Sonnblick Group," by Dr. A. Smekal; "American High-level Observatories," by Dr. W. E. Bernheimer; "Snow Conditions in the Sonnblick Region," by Dr. A. Roschkott, and the usual meteorological tables for 1925. An artistic frontispiece shows fog drifting over the Sonnblick.

Deutsches Meteorologisches Jahrbuch 1925, Freistaat Sachsen.

Edited by Prof. Dr. E. Alt. $12\frac{1}{2} \times 10\frac{1}{2}$. Dresden, 1926.

In addition to the usual very complete tables of meteorological observations, this volume contains an interesting appendix by G. Dietschold on the periodic 24-hourly variation of the mean temperature of the lowest air-layer, based on the diurnal variation of temperature at 343 stations. The variations are considered from the point of view, not of local time but of Greenwich time, so that while some places are cooling down with the approach of night, others are warming up. These changes do not entirely cancel out however; a cartographic determination shows that the lowest layer of air over the earth as a whole reaches its highest temperature about 10h. G.M.T., with a departure of $+0.35^{\circ}$ C. in January and $+0.33^{\circ}$ C. in July, and its lowest temperature about 0h. G.M.T. with a departure of -0.38° C. in both months.

Obituary

Professor Svante Arrhenius.—At Stockholm on October 2nd the death occurred of Prof. Svante Arrhenius at the age of 68. Prof. Arrhenius was born at Wijk, near Uppsala, on February 19th, 1859. He studied at a number of European universities, and during the years 1881-84, at Stockholm, he worked at the theory of electrolytic dissociation, which is his claim to rank as one of the founders of the modern science of physical chemistry. He was also interested in meteorology, astronomy and geophysics, and he is well known for his theory that geological changes of climate were due to variations in the amount of carbon dioxide in the atmosphere. This theory, although now discredited, attracted great attention at the time. He also published papers dealing with auroræ and terrestrial and atmospheric electricity, and with vulcanology. Perhaps the best known of his books is "Worlds in the Making," of which an English translation appeared in 1908, where he put forward a conception of life universally diffused, constantly being emitted from all habitable worlds in the form of tiny spores which wander through space

for years or for ages, the vast majority of them only to meet with destruction, but some few to find resting-place on a body which, like our own earth, has reached the habitable stage in its history. Others of his books are "The Destinies of the Stars" and the "Lehrbuch der kosmischen Physik."

Professor Arrhenius received the Nobel prize for physics in 1903, and in 1905 was appointed Director of the Nobel Institute for Physical Chemistry in Stockholm, which position he held until his death. He received honours and awards from a number of universities and learned societies in this country, among these being the Davy medal of the Royal Society and the Faraday medal of the Chemical Society.

Frank Walter Snell.—We regret to announce the death, which occurred suddenly on October 9th, at the age of 60 years, of Mr. F. W. Snell, who had been on the staff of the Meteorological Office since 1889. Mr. Snell was a skilled telegraphist, originally in the Telegraph Department of the G.P.O., and in March, 1889, accepted the offer of a similar appointment in the Telegraph Branch (now Forecast Division) of the Office. He remained in this division for many years, operating the Morse Sounder of the direct private wire which connected the Forecast Division with the Central Telegraph Office, until the removal of the Office to South Kensington in 1910. His duties, during this period, included the reception of the telegraphic weather reports and despatching the forecasts, gale warnings, etc. In May, 1915, he was promoted Staff Assistant and transferred to the Instruments Division, where he remained until his death.

Mr. Snell was a native of Devon, coming of an old farming stock, and throughout his career maintained an enthusiastic interest in the countryside and in agricultural pursuits. He was a widower, and leaves a son and three daughters

A. T. B.

• Erratum

September, 1927, page 183, line 30, for "2.39 in. on March 29th, 1917,"—read "2.39 in. on May 29th, 1917."

The Weather of September, 1927

Heavy rain and a lack of sunshine were the chief characteristics of the weather of September, and in the north and west the temperature was considerably below normal. At the beginning of the month a belt of high pressure extended over the British Isles giving mainly dry warm weather for a few days, but the approach of depressions from the Atlantic and France caused a renewal of unsettled conditions on the 5th. Rain fell repeatedly, sometimes in very large amounts, and strong winds and gales occurred at times. Over 1.5 in. of rain were measured in parts

of Scotland and northeast England on the 6th, *e.g.*, 1.92 in. fell at Pickering (Yorkshire) and 1.69 in. at Aberdeen. Thunderstorms developed locally in southern England on the 10th. After a temporary improvement on the 11th and 12th a complex depression caused some very wet weather in central, southern and eastern England round the 14th; 2.70 in. fell at Basset Down (Wilts) on the 15th, 2.58 in. at Selbourne (Hants), 2.48 in. at Brighton, 2.41 in. at Portsmouth and 2.25 in. at Titchfield (Hants) and Fritton (Suffolk) on the 14th. At Norwich 2.11 in. fell on the 14th and 1.94 in. on the 15th. From the 16th to 19th the rainfall was smaller and occurred chiefly at night, the 17th and 18th in particular being fine warm days with over 10 hours bright sunshine in many parts except the extreme south on the 18th. Further heavy rain occurred again from the 20th to 24th; among the largest measurements being 3.01 in. at Dungeon Ghyll (Westmoreland) and 2.40 in. at Inagh (Clare) on the 20th, 3.31 in. at Blaenau (Merioneth) and 2.10 in. at Edinburgh and Marchmont on the 21st, 2.72 in. at Montrose on the 22nd and 2.50 in. at St. Michael's on Wyre (Lancashire) on the 24th. A secondary depression which developed off our southwest coasts deepened rapidly as it passed to the North Sea and caused gales at exposed places on the 23rd. In its rear rather cold northerly winds and bright, though not settled, weather prevailed for a few days. Before the end of the month, however, milder, south-westerly winds were renewed with some further heavy rain and local gales at times. The total sunshine for the month was very low in many places, being more than 40 hours below normal at Kew and Falmouth.

Pressure was below normal in Newfoundland, Bermuda and western and central Europe with the exception of the western part of the Iberian Peninsula, the greatest deficit amounting to 9.8 mb. at Aberdeen. Pressure was above normal at Spitsbergen, eastern Greenland, Iceland, central North Atlantic and the Azores, the greatest excess being 5.4 mb. at Isafjord. Temperature was below normal on the western seaboard but above normal in central Europe and Spitsbergen, and rainfall, with the exception of the extreme south, was considerably above normal. In central Sweden it was as much as $2\frac{1}{2}$ times the normal.

On the 4th the first appreciable amount of rain fell on the French Riviera since April 11th. The floods in eastern Galicia continued during the early part of the month, the highest level of the Vistula being recorded at Warsaw on the 6th. Storms followed by floods occurred in North Portugal on the 2nd and in eastern Spain between the 5th and 9th. Low temperatures prevailed in Switzerland about the middle of the month and snow fell down to a level of 5,000 ft. On the lower levels there

was heavy rain and floods occurred in the Arve Valley on the 18th. Severe storms and heavy rain were experienced in eastern Switzerland, the upper Rhine Valley and the Austrian Tyrol from the 23rd-26th, and the floods were aggravated by a warm strong Föhn wind. The weather was much colder and drier on the 28th and 29th and the floods began to subside. Eleven people in all were drowned. Storms and floods were also experienced in many parts of north Italy from the 24th-26th.

A typhoon, lasting about one and a half hours and accompanied by a typhoon wave, wrecked the towns of Kojima and Nakamura near Nagasaki, Japan, on the 13th and caused floods and much damage in the surrounding districts; about 700 people were killed. On the 14th a tornado about sixty yards wide passed over Yokohama and on the same day heavy rain and floods occurred in Tokyo. Good rains fell in the Bombay Presidency between the 15th and 22nd, putting an end to the long drought over the Deccan and Carnatic and thus saving the crops. In the Gujarat area, which was flooded in July, the crops are doing well.

Unprecedented frosts occurred on the Murray River settlements, Australia, from Renmark to the mouth of the river on the night of 24th-25th, and extensive destruction has been caused to the fruit crops, especially the sultanas.

Heavy rain seriously delayed harvesting in British Columbia and the Maritime Provinces, but the weather conditions in Quebec and Ontario were favourable. In the Prairie Provinces heavy rain fell on the 13th and 14th. A severe storm accompanied by a great wave occurred on the west coast of Mexico on the 6th and incessant rain fell from the 8th-11th on the Central Plateau. Many lives were lost and floods occurred. A tornado lasting five minutes swept across St. Louis on the 29th. The wind was reported to have a velocity of 90 m.p.h. Ninety people were killed.

The special message from Brazil states that the rainfall in the northern and central districts was 0.9 in. and 0.5 in. below normal respectively, and that the distribution in the southern districts was irregular with 1.0 in. above normal. Numerous depressions passed across the south of the country and were associated with high winds and unsettled weather. The number of anticyclones was smaller than last month. The crops were in good condition except the vegetables, which were badly affected by late frosts. Pressure at Rio de Janeiro was 0.4 mb. above normal and 0.4° F. above normal.

Rainfall, September, 1927—General Distribution

England and Wales	..	233	} per cent. of the average 1881-1915.
Scotland	.. .. .	200
Ireland	.. .. .	159
British Isles	.. .. .	209

Rainfall: September, 1927: England and Wales

CO.	STATION.	In.	Per- cent. of Av.	CO.	STATION.	In.	Per- cent. of Av.
<i>London.</i>	Camden Square	4.77	262	<i>Leics.</i>	Thornton Reservoir ..	5.10	282
<i>Sur.</i>	Reigate, The Knowle ..	5.68	291	"	Belvoir Castle	3.98	213
<i>Kent.</i>	Tenterden, Ashenden ..	3.37	158	<i>Rut.</i>	Ridlington	4.02	...
"	Folkestone, Boro. San.	3.32	...	<i>Linc.</i>	Boston, Skirbeck	3.33	189
"	Margate, Cliftonville ..	2.74	139	"	Lincoln, Sessions House	3.44	223
"	Sevenoaks, Speldhurst ..	5.15	...	"	Skegness, Marine Gdns.	3.53	195
<i>Sus.</i>	Patching Farm	6.49	270	"	Louth, Westgate	3.83	190
"	Brighton, Old Steyne ..	6.31	302	"	Brigg	3.47	205
"	Tottingworth Park . . .	5.53	226	<i>Notts.</i>	Worksop, Hodsock . . .	4.26	280
<i>Hants.</i>	Ventnor, Roy. Nat. Hos.	7.30	294	<i>Derby.</i>	Derby	4.43	...
"	Fordingbridge, Oaklands	5.55	258	"	Buxton, Devon. Hos. . .	6.75	208
"	Ovington Rectory . . .	7.01	306	<i>Ches.</i>	Runcorn, Weston Pt. . .	6.64	248
"	Sherborne St. John . . .	6.50	317	"	Nantwich, Dorfold Hall	3.76	...
<i>Berks.</i>	Wellington College . . .	4.94	268	<i>Lancs.</i>	Manchester, Whit. Pk.	5.69	239
"	Newbury, Greenham . .	6.17	306	"	Stonyhurst College . . .	9.04	236
<i>Herts.</i>	Benington House . . .	4.18	230	"	Southport, Hesketh Pk	5.09	185
<i>Bucks.</i>	High Wycombe	6.04	320	"	Lancaster, Strathspey .	6.77	...
<i>Oxf.</i>	Oxford, Mag. College . .	5.30	316	<i>Yorks.</i>	Wath-upon-Deerne . . .	3.71	235
<i>Nor.</i>	Pitsford, Sedgebrook . .	4.36	242	"	Bradford, Lister Pk. . .	4.07	197
"	Oundle	3.81	...	"	Oughtershaw Hall . . .	9.09	...
<i>Beds.</i>	Woburn, Crawley Mill .	4.37	244	"	Wetherby, Ribston H. . .	3.56	198
<i>Cam.</i>	Cambridge, Bot. Gdns. .	3.48	216	"	Hull, Pearson Park . . .	3.45	201
<i>Essex.</i>	Chelmsford, County Lab	4.17	242	"	Holme-on-Spalding . . .	4.11	...
"	Lexden, Hill House . . .	3.37	...	"	West Witton, Ivy Ho. .	4.87	...
<i>Suff.</i>	Hawkedon Rectory . . .	5.00	259	"	Felixkirk, Mt. St. John	5.09	280
"	Haughley House	2.85	...	"	Pickering, Hungate . . .	6.34	...
<i>Norfol.</i>	Beccles, Geldeston . . .	3.98	206	"	Scarborough	3.73	208
"	Norwich, Eaton	7.15	334	"	Middlesbrough	3.37	203
"	Blakeney	3.61	194	"	Baldersdale, Hury Res.	5.76	...
"	Little Dunham	3.71	161	<i>Durh.</i>	Ushaw College	4.21	210
<i>Wills.</i>	Devizes, Highclere . . .	5.84	286	<i>Nor.</i>	Newcastle, Town Moor .	3.49	171
"	Bishops Cannings . . .	5.98	273	"	Bellingham, Highgreen	4.63	...
<i>Dor.</i>	Evershot, Melbury Ho. .	6.59	248	"	Lilburn Tower Gdns. . .	5.44	...
"	Crech Grange	7.66	...	"	Geltsdale	8.10	...
"	Shaftesbury, Abbey Ho. .	6.40	263	<i>Cumb.</i>	Carlisle, Scaleby Hall .	7.10	263
<i>Devon.</i>	Plymouth, The Hoe . . .	5.85	230	"	Seathwaite M. . . . .	...	...
"	Polapit Tamar	7.61	272	"	Keswick, High Hill . . .	7.75	...
"	Ashburton, Druid Ho. .	7.11	229	<i>Glam.</i>	Cardiff, Ely P. Stn. . . .	7.58	244
"	Cullompton	5.15	229	"	Treherbert, Tynywaun	11.78	...
"	Sidmouth, Sidmount . .	5.51	240	<i>Carm.</i>	Carmarthen Friary . . .	4.92	142
"	Filleigh, Castle Hill . .	8.05	...	"	Llanwrda, Dolaucothy .	7.29	179
"	Barnstaple, N. Dev. Ath.	7.21	267	<i>Pemb.</i>	Haverfordwest, School	5.71	161
<i>Corn.</i>	Redruth, Trewirgic . . .	6.96	223	<i>Card.</i>	Gogerddan	7.03	193
"	Penzance, Morrab Gdn. .	5.80	198	"	Cardigan, County Sch. .	4.73	...
"	St. Austell, Trevarna . .	7.07	222	<i>Brec.</i>	Crickhowell, Tallymaes	7.50	...
<i>Soms.</i>	Chewton Mendip	8.44	275	<i>Rad.</i>	Birm. W. W. Tyrmynydd	6.53	169
"	Street, Hind Hayes . . .	6.63	...	<i>Mont.</i>	Lake Vyrnwy	6.77	192
<i>Glos.</i>	Clifton College	6.28	267	<i>Denb.</i>	Llangynhafal	6.11	...
"	Cirencester, Gwynfa . .	5.60	254	<i>Mer.</i>	Dolgelly, Bryntirion . .	6.54	154
<i>Here.</i>	Ross, Birchlea	4.95	258	<i>Carn.</i>	Llandudno	4.58	201
"	Ledbury, Underdown . .	4.90	257	"	Snowdon, L. Llydaw 9	20.70	...
<i>Salop.</i>	Church Stretton	4.23	208	<i>Ang.</i>	Holyhead, Salt Island .	3.41	127
"	Shifnal, Hatton Grange	3.06	159	"	Lligwy	4.93	...
<i>Worc.</i>	Ombersley, Holt Lock . .	3.78	214	<i>Isle of Man</i>			
"	Blockley, Upton Wold . .	5.82	277	"	Douglas, Boro' Cem. . .	6.75	206
<i>War.</i>	Farnborough	5.83	274	<i>Guernsey</i>			
"	Birmingham, Edgbaston	4.59	256	"	St. Peter P't. Grange Rd	7.20	277

Rainfall: September, 1927: Scotland and Ireland

CO.	STATION	In.	Per- cent. of Av.	CO.	STATION.	In.	Per- cent. of Av.
<i>Wigt.</i>	Stoneykirk, Ardwell Ho.	5.97	214	<i>Suth.</i>	Loch More, Achfary . . .	10.37	180
<i>"</i>	Pt. William, Monreith .	6.30	...	<i>Caith</i>	Wick	3.28	131
<i>Kirk.</i>	Carsphairn, Shiel.	8.57	...	<i>Ork</i>	Pomona, Deerness . . .	3.34	115
<i>"</i>	Dumfries, Cargen	7.66	261	<i>Shet.</i>	Lerwick	3.60	120
<i>Roxb.</i>	Branxholme . . . . .	...	...	<i>Cork.</i>	Caheragh Rectory . . .	4.45	...
<i>Selk.</i>	Ettrick Manse	9.22	...	<i>"</i>	Dunmanway Rectory .	4.51	110
<i>Berk.</i>	Marchmont House	6.04	250	<i>"</i>	Ballinacurra	3.07	122
<i>Hadd.</i>	North Berwick Res. . . .	5.51	264	<i>"</i>	Glanmire, Lota Lo. . .	3.33	119
<i>Midl.</i>	Edinburgh, Roy. Obs. . .	7.91	421	<i>Kerry</i>	Valentia Obsy.	5.27	127
<i>Lan.</i>	Biggar . . . . .	...	...	<i>"</i>	Gearahameen	9.80	...
<i>"</i>	Leadhills . . . . .	...	...	<i>"</i>	Killarney Asylum . .	6.30	176
<i>Ayr.</i>	Kilmarnock, Agric. C. . .	7.07	231	<i>"</i>	Darrynane Abbey . . .	5.51	155
<i>"</i>	Girvan, Pinmore	6.55	171	<i>Wat.</i>	Waterford, Brook Lo. .	3.52	127
<i>Renf.</i>	Glasgow, Queen's Pk. . .	6.60	238	<i>Tip.</i>	Nenagh, Cas. Lough . .	5.15	183
<i>"</i>	Greenock, Prospect H. . .	9.49	200	<i>"</i>	Roscrea, Timoney Park	3.15	...
<i>Bute.</i>	Rothsay, Ardenraig . . .	7.65	189	<i>"</i>	Cashel, Ballinamona . .	3.14	128
<i>"</i>	Dougarie Lodge	5.12	...	<i>Lim.</i>	Foynes, Coolmanes . . .	5.38	187
<i>Arg.</i>	Ardgour House	8.04	...	<i>"</i>	Castleconnell Rec. . . .	5.03	...
<i>"</i>	Manse of Glenorchy . . .	8.64	...	<i>Clare</i>	Inagh, Mount Callan . .	8.93	...
<i>"</i>	Oban	5.46	...	<i>"</i>	Broadford, Hurdlest'n .	5.66	...
<i>"</i>	Poltalloch	5.52	121	<i>Wexf.</i>	Newtownbarry	2.87	...
<i>"</i>	Inveraray Castle	9.75	152	<i>"</i>	Gorey, Courtown Ho. . .	2.37	96
<i>"</i>	Islay, Eallabus	6.43	154	<i>Kilk.</i>	Kilkenny Castle	2.87	124
<i>"</i>	Mull, Benmore	12.00	...	<i>Wic.</i>	Broadnew, Clonmannon .	2.48	...
<i>"</i>	Tiree	3.96	...	<i>Carl.</i>	Hacketstown Rectory . .	2.91	104
<i>Kinv.</i>	Loch Leven Sluice	7.46	290	<i>QCo.</i>	Blandsfort House	3.41	125
<i>Perth</i>	Loch Dhu	7.10	124	<i>"</i>	Mountmellick	4.32	...
<i>"</i>	Balquhiddie, Stronvar. .	6.83	...	<i>KCo.</i>	Birr Castle	4.88	...
<i>"</i>	Crieff, Strathearn Hyd. .	3.91	137	<i>Dubl.</i>	Dublin, FitzWm. Sq. . .	2.85	148
<i>"</i>	Blair Castle Gardens . .	4.10	173	<i>"</i>	Balbriggan, Ardgillan .	3.87	190
<i>Forf.</i>	Kettins School	3.43	172	<i>Me'th</i>	Beauparc, St. Cloud . .	4.69	...
<i>"</i>	Dundee, E. Necropolis . .	5.32	256	<i>"</i>	Kells, Headfort	4.07	153
<i>"</i>	Pearsie House	3.89	...	<i>W.M</i>	Moate, Coolatore . . . .	...	...
<i>"</i>	Montrose, Sunnyside . .	5.87	295	<i>"</i>	Mullingar, Belvedere . .	4.45	167
<i>Aber.</i>	Braemar, Bank	4.22	168	<i>Long</i>	Castle Forbes Gdns. . .	5.43	189
<i>"</i>	Logie Coldstone Sch. . .	5.32	228	<i>Gal.</i>	Ballynahinch Castle . .	9.97	210
<i>"</i>	Aberdeen, King's Coll. .	6.38	288	<i>"</i>	Galway, Grammar Sch. .	5.84	...
<i>"</i>	Fyvie Castle	7.22	...	<i>Mayo</i>	Mallaranny	9.14	...
<i>Mor.</i>	Gordon Castle	6.98	280	<i>"</i>	Westport House	6.92	195
<i>"</i>	Grantown-on-Spey	6.03	243	<i>"</i>	Delphi Lodge	13.65	...
<i>Na.</i>	Nairn, Delnies	5.11	232	<i>Sligo</i>	Markree Obsy.	6.13	183
<i>Inv.</i>	Ben Alder Lodge	6.26	...	<i>Cav'n</i>	Belturbet, Cloverhill . .	4.21	170
<i>"</i>	Kingussie, The Birches . .	3.85	...	<i>Ferm</i>	Enniskillen, Portora . .	4.51	...
<i>"</i>	Loch Quoich, Loan	12.00	...	<i>Arm.</i>	Armagh Obsy.	5.27	214
<i>"</i>	Glenquoich	10.70	124	<i>Doun</i>	Fofanny Reservoir . . .	5.85	...
<i>"</i>	Inverness, Culduthel R. .	5.65	...	<i>"</i>	Seaforde	4.90	178
<i>"</i>	Arisaig, Faire-na-Squir . .	4.71	...	<i>"</i>	Donaghadee, C. Stn. . .	4.36	183
<i>"</i>	Fort William	7.51	119	<i>"</i>	Banbridge, Milltown . .	4.57	186
<i>"</i>	Skye, Dunvegan	5.25	...	<i>Antr.</i>	Belfast, Cavehill Rd. .	5.85	...
<i>R&C</i>	Alness, Ardross Cas. . .	6.43	220	<i>"</i>	Glenarm Castle	6.18	...
<i>"</i>	Ullapool	7.18	...	<i>"</i>	Ballymena, Harryville .	5.48	176
<i>"</i>	Torrison, Bendamph . . .	8.36	120	<i>Lon.</i>	Londonderry, Creggan . .	5.40	164
<i>"</i>	Achnashellach	8.04	...	<i>Tyr.</i>	Donaghmore	4.95	...
<i>"</i>	Stornoway	6.12	155	<i>"</i>	Omagh, Edenfel	4.31	141
<i>Suth.</i>	Lairg	4.83	...	<i>Don.</i>	Malin Head	4.39	167
<i>"</i>	Tongue	5.71	181	<i>"</i>	Dunfanaghy	5.15	149
<i>"</i>	Melvich	4.76	170	<i>"</i>	Killybegs, Rockmount .	7.09	154

Climatological Table for the British Empire, April, 1927

STATIONS	PRESSURE			TEMPERATURE								Mean Cloud Am't	PRECIPITATION			BRIGHT SUNSHINE	
	Mean of Day M.S.L.	Diff. from Normal	mb.	Absolute		Mean Values					Mean		Am't in.	Diff. from Normal	Days	Hours per day	Per-centage of possible.
				Max.	Min.	Max.	Min.	1/2 and min.	Diff. from Normal	Wet Bulb.							
London, Kew Obsy. . .	1014.3	- 0.1	70	55.4	41.0	48.2	+ 0.9	41.8	82	6.0	1.78	+ 0.33	12	5.7	41		
Gibraltar	1017.4	+ 0.9	79	67.9	53.9	60.9	- 0.1	52.5	78	3.8	1.30	- 1.38	4	..	..
Malta	1015.2	+ 1.2	71	64.6	55.4	60.0	- 0.9	56.2	82	4.4	0.35	- 0.51	4	9.8	75		
St. Helena	1011.3	+ 1.2	72	67.0	60.4	63.7	- 2.1	61.0	89	3.0	3.36	- 0.51	19	..	..
Sierra Leone	1010.9	+ 0.1	91	88.1	75.1	81.6	- 0.8	76.2	77	6.6	6.90	+ 2.84	9	..	..
Lagos, Nigeria	1008.5	- 1.3	91	88.0	77.0	82.5	0.0	77.9	81	6.7	3.37	- 2.38	8	..	..
Kaduna, Nigeria	1013.9	+ 3.2	98	93.5	..	..	..	75.2	71	..	2.81	- 0.48	6	..	..
Zomba, Nyasaland . . .	1012.0	- 0.5	83	78.4	59.3	68.9	- 0.4	..	80	7.0	6.34	+ 2.68	19	..	..
Salisbury, Rhodesia . .	1012.6	- 1.1	81	76.0	54.9	65.5	- 0.2	59.6	67	4.6	2.37	+ 1.38	7	6.7	57		
Cape Town	1016.0	- 0.3	101	76.5	55.4	65.9	+ 2.7	57.2	82	3.8	1.35	- 0.57	7	..	..
Johannesburg	1015.8	+ 0.3	77	70.3	49.5	59.9	+ 0.1	52.2	64	2.1	1.82	+ 0.08	8	8.3	73		
Mauritius . . . . .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Bloemfontein . . . . .	..	..	77	72.4	48.7	60.5	- 0.3	53.0	75	2.4	1.17	- 0.96	4	..	..
Calcutta, Alipore Obsy. .	1005.0	- 1.3	103	97.5	77.5	87.5	+ 1.8	77.8	81	3.6	2.07	+ 0.18	3*	..	..
Bombay	1008.0	- 0.8	92	88.5	76.5	82.5	- 0.6	74.0	74	2.1	0.00	- 0.05	0*	..	..
Madras	1007.3	- 1.1	101	94.7	78.9	86.8	+ 1.5	78.3	73	3.5	0.00	- 0.53	0*	..	..
Colombo, Ceylon	1008.6	- 0.5	91	88.9	75.4	82.1	- 0.5	78.8	73	6.7	11.00	+ 2.70	15	7.6	62		
Hongkong	1013.6	+ 0.9	78	71.6	64.1	67.9	- 2.9	64.5	83	8.3	7.13	+ 1.83	16	3.5	29		
Sandakan . . . . .	..	..	91	88.8	75.9	82.3	- 0.0	78.0	89	..	3.44	- 0.63	7	..	..
Sydney	1016.6	- 1.9	84	70.0	57.0	63.5	- 1.2	59.0	81	6.7	18.58	+ 13.01	18	4.5	40		
Melbourne	1020.4	+ 1.0	82	65.3	50.5	57.9	- 1.6	52.7	71	5.3	0.57	- 1.68	7	4.5	40		
Adelaide	1021.3	+ 1.3	87	72.2	52.2	62.2	- 1.7	54.2	55	4.2	0.16	- 1.59	3	7.3	66		
Perth, W. Australia . . .	1018.4	- 0.1	94	80.8	60.0	70.4	+ 3.8	61.4	55	4.2	1.32	- 0.26	6	8.4	74		
Coolgardie . . . . .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Brisbane	1015.2	- 2.4	85	78.7	61.5	70.1	- 0.2	63.9	73	3.7	2.07	- 1.52	6	7.8	68		
Hobart, Tasmania	1017.8	+ 3.3	70	60.5	47.2	53.9	- 1.2	48.4	67	7.0	0.52	- 1.37	11	4.8	44		
Wellington, N.Z.	1014.3	- 3.8	67	62.8	49.9	56.3	- 0.6	52.5	69	5.7	1.53	- 2.35	11	5.7	52		
Suva, Fiji	1010.6	+ 0.0	91	88.0	74.5	81.3	+ 2.6	76.3	81	6.2	10.46	- 0.82	25	6.4	55		
Apia, Samoa	1010.6	+ 0.7	88	86.0	74.4	80.2	+ 1.3	77.3	79	4.1	10.68	+ 0.44	14	7.8	66		
Kingston, Jamaica	1013.5	- 0.6	89	86.3	69.3	77.8	- 0.6	68.8	82	3.0	0.90	- 0.34	5	9.6	77		
Grenada, W.I.	1008.7	- 3.7	87	84.6	73.9	79.3	+ 0.4	74.9	77	5.7	6.32	+ 4.04	21	..	..
Toronto	1018.8	+ 3.3	74	52.3	34.6	43.5	+ 2.1	35.9	61	5.4	1.03	- 1.37	11	7.4	55		
Winnipeg	1017.4	+ 0.4	69	48.1	31.5	39.8	+ 2.0	32.9	83	6.4	2.43	+ 0.94	10	5.0	36		
St. John, N.B.	1009.8	- 3.8	61	46.2	30.7	38.5	- 0.5	34.3	71	4.7	2.43	+ 1.08	7	7.1	53		
Victoria, B.C.	1016.9	- 0.4	62	53.3	40.3	46.8	- 0.9	42.8	72	6.7	0.82	- 0.91	11	6.2	45		

* For Indian stations a rain day is a day on which 0.1 in. or more rain has fallen.

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World Weather Records.*

The investigation of relationships between the meteorological conditions in different parts of the world by means of correlation coefficients, which is associated especially with the names of Sir Gilbert Walker and Professor F. M. Exner, has demonstrated unexpected connexions between pairs of stations often far distant, and has added considerably to our knowledge of the circulation of the atmosphere. The calculation of correlation coefficients is itself a sufficiently laborious process, but probably an even greater impediment to the study of world meteorology by this method has been the labour of collecting data for a number of stations over long periods, and the difficulty of assuring oneself that the figures, when collected, are not vitiated by changes in the height of the barometer above sea-level, in the hours of observation or in the exposure of the thermometers or rain-gauge. There may easily be some discontinuity in the series which, while small enough to stand a chance of escaping notice, is yet large enough to spoil the series for the purposes of correlation. Professor Exner was fully alive to this difficulty, and at the International Meteorological Conference at Utrecht

**Smithsonian Miscellaneous Collections*, Vol. 79. World Weather Records, collected from official sources by Dr. Felix Exner, Sir Gilbert Walker, Dr. G. C. Simpson, H. Helm Clayton, Robert C. Mossman; assembled and arranged for publication by H. Helm Clayton. Published under grant from John A. Roebling (Publication 2913). City of Washington, August 22nd, 1927, pp. vii. + 1199.

in 1923 he brought forward a proposal for the compilation by all Meteorological Services of long series of meteorological data for selected stations in their areas, at intervals of 500 or 1,000 kilometres. Monthly and annual means of pressure, temperature and precipitation were to be included, and the tables were to go back as far as possible, provided homogeneity was maintained. The last point was strongly emphasised. The International Conference passed a resolution supporting the proposal, and invited the following gentlemen to see to the execution of the resolution :—

Dr. (Sir Gilbert) Walker for the stations of Asia.

Prof. Exner for the stations of Europe.

Mr. Clayton for the stations of America.

Dr. Simpson for the stations of Africa, Australasia and the Oceans.

Mr. R. C. Mossman afterwards took charge of the collection of data from South America.

The compilation was commenced at the end of 1923, the collectors writing to the Directors of the various meteorological services in their areas for copies of their long records, with full explanations of the corrections applied to the readings, etc. The various Directors, almost without exception, realised the importance of the scheme, and contributed their best efforts to its furtherance, and in spite of the great amount of labour involved the work went forward steadily, and by September, 1926, when the International Meteorological Committee met in Vienna, the collection of the data was practically completed.

The question of publication had at first been left in abeyance, but at that meeting Mr. H. H. Clayton was able to announce that the cost of publication would be defrayed by an American donor, Mr. John A. Roebling. The work was to be published by the Smithsonian Institution of Washington, and Mr. Clayton agreed to act as Editor to see the tables through the press.

Copies of the completed volume have now been received in this country, and present an imposing appearance. Issued as Volume 79 of the Smithsonian Miscellaneous Collections, the book comprises 1,199 octavo pages, and bears the title *World Weather Records*, which, grandiose as it seems at first sight, is yet nothing more than a simple statement of fact, for the book includes tables for 385 stations in all latitudes from Upnivik in 72° 47' N., to Laurie Island in the South Orkneys in 60° 44' S. Of these stations, 25 are in Africa, 101 in Asia, 62 in Europe, 93 in North America, 43 in South America, and 61 in Australasia and the Oceanic Islands. The arrangement of this great mass of material naturally required considerable forethought; the investigator might require a station by name, or the nearest station to some particular point. It was also neces-

sary to decide whether to keep all the tables for each station together, or whether to collect in separate parts all the pressures, all the temperatures and all the rainfalls. Various suggestions were made, but no one is likely to quarrel with the arrangement actually adopted, which is "alphabetically by grand divisions." That is, all the stations in Africa are arranged alphabetically, then all those in Asia, and so on; at the foot of each table are given the monthly averages for the whole period. The tables are completed by an appendix giving the monthly relative sunspot numbers from 1749 to 1925. They are followed by a double index, first an alphabetical index of stations and countries, and then a geographical index arranged by ten-degree zones of latitude in the order in which the stations would appear in the Réseau Mondial; this index gives also the co-ordinates of the stations. One could have wished that it had not been necessary to separate the notes and explanations from the tables themselves, but where so much is given, one must not cavil, and it is easy to see that this arrangement has saved a great deal of space. Incidentally some of these notes give the history of the stations in great detail, and are instructive examples of the art or science of handling meteorological statistics. In the matter of units, the collectors have adopted a wise compromise by publishing all the tables in the units in which they were supplied. Where practice in different countries is so diverse, it would have been invidious to select one set of units rather than another as a standard, quite apart from the enormous labour and risk of error involved in making the conversions.

The material presented in this publication will be of incalculable assistance to meteorological research. To take an example which is only one among many, some years ago monthly charts of deviation of pressure from normal over the northern hemisphere were required for as long a period as possible. With the help of a few compilations, such as the 73 stations collected by the Solar Physics Committee, it was found possible to construct such charts for the period 1873 to 1900, but the years from 1901 until the beginning of the Réseau Mondial in 1910 could not be undertaken, because it would have been necessary to extract almost all the data year by year from the various monthly and annual reports, while some of it had not even been published and would have had to be obtained by correspondence. Had this volume been available then, the charts could have been drawn in half the time. Thus all meteorologists will agree with the final words of Mr. Clayton's preface: "Meteorology stands deeply indebted to Mr. John A. Roebbing for providing the means to publish this long-desired collection of fundamental data, which cannot but be of great use in future theoretical and practical researches," but they will wish to add their thanks to

all the Directors and others who have co-operated, to the five collectors, and especially to Mr. Clayton for his labours, which must indeed have been herculean, in assembling and arranging the matter and seeing it through the Press.

Every year adds its quota to the meteorological statistics garnered in the monthly and annual reports issued by the various meteorological services. The tables in *World Weather Records* mostly end in 1920 (the American stations and some others extend to 1923, or even 1925), and in another few years the investigator will find himself faced by the labour of extracting the data for the years 1921 to 1930, to add to those in the present volume, before he is able to begin his calculations. But the international effort so worthily began cannot be allowed to lapse, and means must be found to issue a supplementary volume every ten years, as envisaged in Professor Exner's original proposal.

Official Publications

Annual Report of the Meteorological Committee to the Air Council for the year ended 31st March, 1927. (M.O. 298.)

The year under review is the seventy-second year of the Meteorological Office. The report follows the lines of those for previous years, the chief features of interest for this year being : the review of the work of the British Climatology Division, resulting in the decision to discontinue the weekly issues of the *Weekly Weather Report* and publish it in future as an annual volume ; the establishment of a civilian meteorological service in Egypt and Palestine, with headquarters at Heliopolis ; and the international meteorological meetings held in September, 1926, at Zürich and Vienna.

Discussions at the Meteorological Office

The subjects for discussion for the next meetings will be :—

November 21st. *Untersuchungen über die jährliche Periode der Niederschläge in Europa.* By G. Hellmann (Berlin, Sitz Ber. Ak. Wiss., No. 11, 1924, pp. 122-52). *Opener*—Dr. J. Glasspoole.

December 5th. *Application à l'Afrique du Nord de la méthode Norvégienne de prévision du temps.* By L. Petitjean (Alger, 1927). *Opener*—W. C. Kaye, B.Sc.

Correspondence

To the Editor, *The Meteorological Magazine*

The Play of the Winds

The article on the above subject in the September number of the *Meteorological Magazine*, relating to opposing air currents

in the lower atmosphere over Liverpool on the morning of Friday, June 10th, affords an opportunity of considering to what extent local topography of the land may affect the course of the wind.

In the first place it is highly probable that the easterly current over Norfolk on June 9th was related to the high pressure over the Fenlands on June 10th, and this supply of air could conceivably travel slowly towards Liverpool. From an examination of the topography of Liverpool and its environs, the open course of the River Mersey between Bromborough, on the one side, and Garston, on the other, would supply the only likely passage for a light southerly wind—whilst the mouth of the river would pilot a northerly wind towards Liverpool. Clearly then, local topography would have reinforced the existing meteorological conditions of “converging winds” towards Liverpool.

It might be interesting to here record an example of “diverging winds” in the lower atmosphere produced by a light flow of air towards a natural barrier. The phenomenon was observed at Dundee some while ago, but was sufficiently impressive as to cause the date to be noted—July 5th, 1923. As with Liverpool, so does Dundee possess a large number of tall factory chimneys. The southern side of the town is undulating, and is bounded by the Firth of Tay, but at approximately three miles to the north of this southern boundary is a prominence—The Law—a hill which rises to a height of 572 feet above sea level. It was at the summit of this hill, and looking towards the south, that I observed one afternoon the smoke drift from factory chimneys, assisted by a light southerly wind, approach, and then, as if divided by a wedge, split into two currents, the one travelling eastwards and the other westwards. Truly a natural cause, but a rather unnatural sight.

P. R. ZEALLEY.

Larkhill. October 5th, 1927.

Monthly Distribution of Storms

Having for many years past noticed a certain tendency for storms, and such like atmospheric disturbances, to occur with greater frequency on about the middle of the month than on any other day thereof, I took the trouble about ten days ago to tabulate the exact number of these occurrences—for the whole of the nineteenth century—from a volume of Haydn's *Dictionary of Dates*. A copy of the results, which can easily be verified, is shown in Table 1. Roughly speaking, the number of storms would appear to gradually increase up to about the 11th, 12th and 13th, and then to gradually abate numerically.

It is difficult to accept the notion that our arbitrary calendar

has any effect on storms, and it is equally difficult to my mind to regard "chance" as having anything to do with the figures.

E. G. MILWARD.

Lyndhurst, Westland Green, Little Hadham, Herts. October 15th, 1927.

TABLE I. Total number of storms 523.

Date	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th	
Storms	11	22	15	5	4	12	20	14	20	24	29	36	29	14	20	
Date	16th	17th	18th	19th	20th	21st	22nd	23rd	24th	25th	26th	27th	28th	29th	30th	(31st)
Storms	26	12	14	10	17	15	14	14	23	14	26	19	15	14	6	(9)

[The odds against a distribution of this nature arising by chance are appreciable. If 514 events (i.e., omitting nine which occurred on the 31st) were distributed at random amongst 30 days, an irregular series of figures would result. These figures, like any random succession of numbers, could be expressed as a Fourier series, but the probable amplitude of any term would be only 1·3 events. The numbers found by Mr. Milward give a well-marked 30-day wave with an amplitude of 4·2 events, and the probability of an amplitude of this size arising by chance is one in about 500 (this supposes that all the 514 events tabulated by Mr. Milward are independent). As some of the storms extended over and are entered to more than one date, these odds should be decreased, and if we suppose that on an average one storm is entered to two successive days, the odds come down to only one in thirty. The 30-day wave has its maximum on the 14th, and its minimum on the 29th.

By way of a test, the dates of a number of gales and thunderstorms given by E. J. Lowe (*Chronology of the Seasons*) from 1514 to July, 1752, were tabulated, with the following results:—

Dates ..	1st-5th	6th-10th	11th-15th	16th-20th	21st-25th	26th-30th	Total
Gales ..	19	13	13	9	13	21	88
Thunderstorms	20	17	21	14	18	18	108
All Storms ..	39	30	34	23	31	39	196

Both gales and thunderstorms show a similar 30-day wave, though it is much more regular in the case of the gales than in the thunderstorms. The combined figures have an amplitude of 1·2 events on a total of 196, or 0·6 per cent., which agrees well with Mr. Milward's 4·2 on a total of 514, or 0·8 per cent. The maximum frequency occurs on the 1st, and the minimum on the 16th, or thirteen days before the dates calculated from Mr. Milward's figures. At first sight this discrepancy appears fatal, but in September, 1752, eleven days were added to the calendar (which is why the count was stopped in that year), and

in the majority of Lowe's records the dates have not been corrected for this change of calendar. If we add these eleven days, we get for 1514-1750 the maximum on the 12th, minimum on the 27th, a good agreement with the nineteenth century.

The data in the *Dictionary of Dates* include storms all over the world, but the majority refer to the British Isles : those quoted from Lowe refer only to the British Isles.

The effect is best shown in the winter, but persists throughout the year, as is shown by the following table, which was compiled by tabulating month by month the entries in Haydn's *Dictionary of Dates* from 1800 to 1900 :—

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug	Sept.	Oct.	Nov.	Dec.
No. of storms	70	35	39	15	16	23	11	51	41	68	60	68
Date of maximum	17th	12th	8th	3rd	13th	13th	10th	15th	12th	21st	17th	6th
Amplitude per cent.	1.3	3.2	2.2	0.9	2.1	0.3	2.3	1.9	1.6	3.0	1.1	0.8

In this table the "date of maximum" is the day of the month on which the sine curve with a 30-day period which best fits the observations, reaches its maximum, and the amplitude per cent. is the amplitude of that sine curve, multiplied by 100 and divided by the number of storms in that month. The probable percentage amplitude which would be given by a number of events distributed among thirty days at random is, for fifteen events, 1.4 per cent., for thirty events, 1.0 per cent., and for sixty events, 0.7 per cent. The amplitude found exceeds the chance amplitude for all months except April and December, and is more than twice the chance amplitude in February, March, August and October. In ten of the months the dates of maximum occur between the 8th and 17th.

The phenomenon was next sought in the daily values of pressure at Greenwich, which have been conveniently summarised for the years 1854 to 1873 in one of the publications of the Royal Observatory, but no trace was found there of any periodicity of pressure with a length of thirty days. Actually, the lowest daily mean occurs on the 8th, and the lowest 5-day mean on the 21st to 25th.

From the statistics quoted above, the balance of probabilities seems to be rather in the direction of the existence of a real tendency for storms to occur in the middle of the month, but it is very difficult to find any satisfactory meteorological basis, and the matter requires further investigation before it can be finally accepted. The irregular lengths of the calendar months do not constitute a serious objection, for if the phenomena be regarded as due to a periodicity of exactly one-twelfth of the

year, or 30·44 days, the dates of maxima would not vary by more than about two days throughout the year. An alternative and perhaps more likely hypothesis would be that a recurrence of *about* thirty days starts afresh each year at approximately the same time.—C. E. P. BROOKS.]

Irregular Optical Phenomenon

The following particulars refer to an irregular optical phenomenon observed from the meteorological station at Grayshott shortly before 9h. G.M.T. to-day. At 8h. 35m. the sun was shining through light cirrus. An iridescent band, perfectly straight, was seen vertically above the sun. The red was nearest the sun, the blue being furthest away. The width of the band was about $1\frac{1}{2}^{\circ}$, the length $4\frac{1}{2}^{\circ}$, and the distance from the sun about 9° - 10° . The sky beneath the line was darker than that above it. The phenomenon was visible for about five minutes. At 8h. 55m. it reappeared. The band was longer, with ends curved down. It was slightly further away from the sun (*circa* 11°), and much brighter, lasting for over an hour. There were no coronæ or halos visible.

S. E. ASHMORE.

Windwhistle Cottage, Grayshott, Hindhead, Surrey. September 25th, 1927.

Minimum Temperatures as recorded in the Stevenson Screen and in an adjacent Transport Shed with an open end

The investigation was prompted by repeated enquiries from Officers on the Unit for the actual differences likely to occur between the minimum temperatures inside and outside the shed used as an Officers' garage. The garage is one end of the Station Transport Shed which is situated just inside the camp, and about 150 yards away from the Stevenson Screen. The open side faces west-north-west and the height of the shed is about 35 to 40 feet. A wooden lock-up box, thoroughly ventilated by means of a system of holes on all sides, was fixed to a support in the middle of the shed at a height of $4\frac{1}{2}$ feet above the ground. The series of readings which lasted about a month (January, 1926) included a cold spell not normally experienced at this station. The minimum thermometer in the shed was set and read at 18h. and 9h. respectively, and compared carefully with the Stevenson screen readings (shade minimum) for the same times.

The three main factors that regulate the differences in temperature under such circumstances are, the radiation effect and the wind speed and direction. In Table I. are given the

differences that occur between the two thermometers with different shade minima and show clearly how the greatest differences occur at the lowest temperature ; Table II. gives the

TABLE I. DIFFERENCES OF MINIMUM TEMPERATURES WITH DIFFERENT SHADE MINIMA.

15°—30° F.		30°—39° F.		39°—42° F.	
Shade min.	Diff.	Shade min.	Diff.	Shade min.	Diff.
°F.	°F.	°F.	°F.	°F.	°F.
15.2	7.8	31.6	0.4	39.1	0.1
16.2	4.1	32.8	0.2	39.1	0.7
25.0	2.0	33.0	0.0	40.5	3.3
26.0	4.5	33.7	0.5	41.8	0.2
27.8	0.7	36.8	1.6	41.9	0.9
30.0	1.0	37.2	1.3	42.0	1.2
		38.8	—0.3	42.1	0.0

differences associated with different states of the sky (cloud amounts), and Table III. those differences associated with wind velocities. The period of time throughout is 18h. to 9h.

Some measure of the protection afforded by the shed is obtained by taking a mean of the values as recorded during the coldest period, January 12th to 22nd. For these ten occasions the mean difference works out at 2.1° F. More can probably be learned however by inspecting the individual occasions and treating each on its merits.

TABLE II. DIFFERENCES OF MINIMUM TEMPERATURES WITH DIFFERENT CLOUD AMOUNTS.

b (0—2 tenths)		bc (3—7 tenths)		c or o (8—10 tenths)	
Weather	Diff.	Weather	Diff.	Weather	Diff.
	°F.		°F.		°F.
bm	7.8	bc	1.2	o-oss _m	2.0
bm _x	4.5	bz-bc	0.4	o-oms _j	1.0
cm-bm _{fx}	4.1	bm _x -bc _x	0.2	cm-o	0.9
bw-bcw _{m_j}	3.3	b-bc _j p _j	0.1	c-cq _{os}	0.7
bw-bx	1.6	cm _j -bmc	0.0	om _j	0.5
bm _o	1.3			bz _j c-c	0.2
bw	0.7			cm	0.0
				cm _o	0.0

The greatest difference 7.8° F. occurred on the night of January 15th—16th, with a screen temperature of 15.2° F. and a shed temperature of 23.0° F. There was little or no wind during the period preceding the fall in temperature, so that the big disparity in the readings was chiefly due to radiation which was set up by a clear sky and no wind. On the following night the screen temperature was about the same, but the difference

4.1° F. was much smaller. In this case the shed temperature dropped down to 20.3° F., the screen recording 16.2° F., a light north-west wind finding easy access to the middle of the shed and an overcast sky reducing the fall due to radiation outside to a minimum. A difference of 2.0° F. on January 14th—15th is worth investigating in reference to a difference of 4.5° F. on January 20th—21st, the screen temperature being about the same in each case (one 25° F. and the other 26° F. respectively).

TABLE III. DIFFERENCES OF MINIMUM TEMPERATURES WITH DIFFERENT MEAN WIND SPEEDS AND DIRECTIONS.

Wind 0—10 m.p.h.		Wind 10—15 m.p.h.		Wind 15—30 m.p.h.	
Direction	Diff.	Direction	Diff.	Direction	Diff.
Calm	7.8° F.	S	1.6° F.	SSW	1.2° F.
Calm	4.5	S to SE	0.9	NW	1.0
NW	4.1	E to S	0.5	NE	0.7
SSW	3.3	SSW	0.2	S	0.7
ENE	2.0	SW	0.0	E	0.4
E	1.3	E to SE	0.0	SW	0.1
W	0.2			SW to W	-0.3

The night of January 14th—15th was overcast with snow falling, so that radiation would be almost negligible, whereas on January 20th—21st the sky was clear, so producing the radiation effect. In other words the difference of 2.5° F. appears to be practically all a radiation effect. Both nights were calm.

In the same way the other occasions could be discussed, and it would be found that there is little difference between the two sets of readings, apart from the occasions when the radiation effect is operating, and that is usually of course in calm weather. On days of strong wind the readings are usually about the same. Opportunities for making comparisons during frost periods are rare in this part of England, and it is thought that the figures do give information which has not been available before.

C. W. LAMB.

R.A.F. Station, Felixstowe. July 30th, 1927.

NOTES AND QUERIES

The Hours of Reading the 1-foot Earth Thermometer

Captain E. R. Taylor, of Ardgillan, Balbriggan, has been following up a suggestion by Mr. Baxendell, of Southport, that 9 a.m. is not a good hour for the daily reading of the 1-foot earth thermometer. At that depth the diurnal range is still appreciable, but owing to the lag resulting from the time occupied by the downward conduction of the daily temperature wave 9h.

falls near the minimum. As the diurnal increase is more rapid than the decrease, the maximum probably occurs near 17h. or 18h., and in 1921 Mr. Baxendell initiated a second reading at 17h. At Ardgillan a reading at 17½h. was instituted on March 5th, 1924. Capt. Taylor now sends us an analysis of the results, summarised in the accompanying table, from which it appears that the reading at 17 or 17½h. averages as much as 1·6° F. higher than that at 9h., the difference being greatest in early summer and least in winter.

3 years 1924/5—1926/7			Apr.-June	July-Sept.	Oct.-Dec.	Jan.-Mar.	Year
Ardgillan							
9h.	...	...	52·7	60·0	45·2	41·8	49·9
17½h.	...	...	55·0	62·0	46·0	42·9	51·5
Diff.	...	...	2·3	2·0	0·8	1·1	1·6
Southport							
9h.	...	...	54·5	62·0	43·2	40·2	50·0
17h.	...	...	57·1	64·0	43·8	41·3	51·6
Diff.	...	...	2·6	2·0	0·6	1·1	1·6

It is to be remarked that the diurnal wave of temperature does not penetrate with appreciable amplitude to a depth of 4 feet, so that for observations at that depth the hour of observation is of little importance.

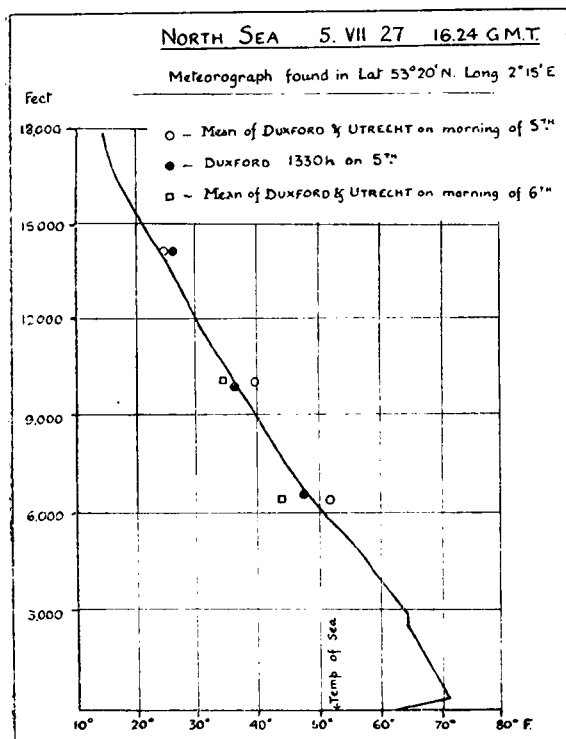
Sounding Balloon Ascent over the North Sea

On the evening of July 5th a sounding balloon apparatus was released from H.M.S. *Fitzroy*, with a Dines Meteorograph attached.

The apparatus consisted of two Hutchinson balloons arranged in tandem, the upper balloon (2,016 grammes), which acted as the lifter, was inflated to give a free lift of 7 lb., and was attached to an automatic dropper set to release it at a height of 5½ kilometres. The lower balloon (800 grammes) was given a lift of 3½ lb., and was permanently attached to the line carrying the instruments, for the purpose of steadying it on its downward flight, and for preventing it going into the sea. At the bottom end of the line was attached a sea anchor float made of canvas, and weighing approximately 3 lb., which served to anchor the balloon, and so prevent it drifting with the wind. On the day in question a moderate S.E. breeze was blowing, with cloudy weather and good visibility, but the weather conditions were generally unsettled.

On being released, the apparatus took a north-westerly course, gradually veering to the eastward as its height increased, the balloons were followed by means of a sextant for eleven minutes, and then disappeared into cloud; the estimated height at that time was 7,000 feet. From a report received from the Meteor-

logical Office earlier in the day the wind at 20,000 feet was estimated to reach a speed of 60 m.p.h., and it was therefore reckoned that the apparatus should be picked up 36° , 25 miles from the position from which it was released. The ship thereupon proceeded to this position, but no trace of the apparatus was found. On July 15th the meteorograph was recovered by a trawler, after having been at the bottom of the North Sea for ten days. The instrument was little damaged, and will be used again after adjustment and cleaning up.



The record has been examined by Mr. L. H. G. Dines at Kew Observatory, and has been found to be quite legible. It gives a very remarkable surface temperature inversion, as shown on the accompanying diagram. Mr. Dines was able to trace on the record the point when the instrument went into the sea, where the pressure increased greatly; the temperature recorded at this point was $53^{\circ}F$., and the temperature of the sea taken on board H.M.S. *Fitzroy*

agrees favourably with this, and verifies the accuracy of the record.

In examination of the weather chart for 18h. on July 5th it is noted that the temperature over France and Germany was much higher than that existing over the British Isles. The warm air, with a surface temperature of nearly 80° , having a lapse rate rather less than the dry adiabatic, flowed northward, and in its progression over the North Sea was cooled by contact with a colder sea, and this cooler air was apparently spread upwards by turbulence through about 330 feet.

It is known that inversions of temperature of this kind must frequently be formed over the sea during the summer months, but in the absence of direct measurement their presence can only

be inferred. It is particularly fortunate that the instrument was ultimately recovered in the present case, when such a striking example of an inversion of this type was encountered.

L. G. GARBETT.

Note on the Lasting Qualities of Small Rubber Balloons.

As is well known, observations of upper wind velocity and direction made on behalf of the Meteorological Office, involve the use of small rubber balloons which are filled with hydrogen and then released. In the ordinary course, cheap balloons of the type manufactured for use as toys are found quite satisfactory, but failure occurs occasionally, the balloon bursting either during inflation or within a short time of its release. It has been found that such failures are due to two distinct causes:—

(A) Development of weak spots or pin holes in the rubber.

(B) Deterioration of the fabric of the balloon in storage.

With regard to (A) there is reason to suspect that liability to develop weak spots is associated with certain dyes, used to tint the rubber sheet, and investigations are proceeding at the factories supplying the balloons.

The other source of trouble, that due to deterioration of the fabric, is to a considerable extent in the hands of the observers using the balloons. It has always been emphasised that, as far as possible, the balloons should be used when fresh. Any attempt to preserve balloons for long periods is almost certain to result in a considerable proportion of failures. Deterioration is found to be accelerated by variations of temperature, and the best place to store balloons is, therefore, one in which such variation is not great. Any ordinary living room or general office usually fulfils these requirements.

In order to obtain more precise data as to the period during which balloons can safely be stored under exceptional conditions, an experiment has recently been carried out by the Instruments Division in collaboration with the Meteorological Office, Heliopolis. A number of balloons recently delivered by the manufacturer were forwarded without special protection, by parcels post in July last, to Heliopolis, where they were divided into three batches. The first batch was returned immediately upon receipt of the balloons, the second after storage for one month, and the third batch after storage for two months. In each case the balloons were undyed, and were found to be in perfect condition. It seems reasonable to conclude, therefore, that balloons may ordinarily be expected to survive the journey to the tropics and two months' storage during the hot weather without appreciable deterioration. It should not ordinarily be

necessary to store balloons for a period exceeding two months, even in the tropics.

Further evidence has recently come to hand which indicates that a period of two months may even be greatly exceeded without failure. Before H.M.S. *Renown* left this country to convey T.R.H. the Duke and Duchess of York for a six months' cruise round the world, a number of pilot balloons were put on board in order that observations might be taken by the Meteorological Officer. Some of these balloons were unused at the end of the cruise, and were returned to the Meteorological Office, where they were tested and found to be in perfect condition. Some of the balloons referred to were dyed. It is not intended to assert that this standard of performance could be expected from all pilot balloons, but it does indicate that small rubber balloons of good manufacture are considerably more durable than has sometimes been supposed.

A Somersetshire Weather Diary

The Meteorological Office has recently received on loan from the Right Honorable Henry Hobhouse, of Hadspen House, Castle Cary, a manuscript weather register covering the period 1828 to 1854, with a record for part of the year 1805.

The diarist was the late Rt. Hon. Henry Hobhouse (1776-1854). After distinguished services to the State he retired in 1827, and commenced his weather record in 1828 at Hadspen House. This was maintained until his death in 1854. He was well known for his extensive knowledge of the State Archives, and edited the State Papers of Henry VIII. All his meteorological observations were made at Hadspen House, which is situated about $1\frac{1}{2}$ miles east-south-east of Castle Cary, Somerset. It is 420 feet above mean sea level, on the south-west side of a wooded hill which rises to about 500 feet. The observations are both eye and instrumental, the latter comprising temperature and pressure. At first these are given twice daily, but in the later years only once daily. There is no record of rainfall. Gaps of a few weeks are frequent in the summer months, especially in the later years of the record. No precise information is given of the type or exposure of the instruments, and such information is, unfortunately, not now available.

The instrumental readings themselves are of little permanent value. As is usual in old manuscript records, the barometric readings are all low. The mean pressure for January from this record was reduced and found to be 29.33 in. After allowing about 0.42 in. for lack of correction for height above mean sea level, the value, 29.75 in., so obtained is still about 0.3 in. below the normal mean pressure for January. Difficulties also exist

as to the temperature readings. Up to September, 1849, the temperature is given as at the time of observation, but after this date the single reading of temperature is replaced by two readings called "highest" and "lowest" respectively. It is impossible to say what is intended by these figures. They are not genuine maximum and minimum temperatures, as on some days credited with frost the "lowest" reading is over 40° F. The only hint as to exposure is a note made in July, 1847, to the effect that "on bright mornings the Thermometer on the East side of the House is 3 or 4 degrees higher than that on the West."

RAIN DAYS—HADSPEN HOUSE.

Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1828	8	9	6	17	17	11	20	20	14	7	11	12
1829	5	8	9	21	7	13	17	16	24	14	3	3
1830	4	6	5	17	14	17	19	24	20	11	13	12
1831	6	...	...	13	6	14	13	14	14	17	8	10
1832	7	2	11	11	13	13	6	18	6	15	15	10
1833	8	16	6	14	4	16	12	6	13	9	11	17
1834	16	8	7	7	8	...	18	16	7	7	8	7
1835	7	...	11	10	14	10	7	10	23	16	13	4
1836	14	8	19	16	3	14	12	18	17	11	21	10
1837	12	...	...	...	...	...	11	17	11	13	...	12
1838	2	7	8	11	...	...	15	10	9	12	10	11
1839	14	...	...	9	9	13	20	11	21	11	16	16
1840	18	...	5	6	...	...	19	9	14	12	14	4
1841	11*	9*	16	14	...	...	17	18	16	17	10	15
1842	8	...	13*	3	11*	4*	10	12	14	6	16	6
1843	15	6	8	18	18	14*	...	...	4	17	12	3
1844	10	9	5	5	...	...	10*	15	10	16	11	5
1845	11	6	4	10	...	...	15	17	12	10	11	13
1846	15	8	16	15	...	...	...	13*	8	17	...	4
1847	5	6	12	11	...	...	6	11	12	12	3	12
1848	9	12	15	17	...	...	17	23*	9	16	4	12
1849	11	7	2	13	...	...	9*	8	9	4	8	5
1850	6	10	2	...	...	...	10*	14*	9	6	1	4
1851	15	3	13	5	...	...	9*	11	6	11	7	3
1852	11	8	2	2	...	...	6	13	9	...	...	...
1853	14	6	7	7	...	...	...	9	8	...	...	5
1854	10	7*	7	6	...	...	...	...	...	...	...	...

* A number of observations have been missed rendering the exact total uncertain.

A ... signifies that so many observations have been missed that it is impossible to give any figures at all.

The valuable part of the record is undoubtedly the weather diary, which includes some phenological observations. The weather diary gives a day-to-day account of the weather, which, although often restricted to a single word, is nevertheless sufficient for the construction of tables showing the number of occurrences of rain, snow, thunder, and other elements. In this connexion it is interesting to note that the diarist attached some importance to sunset as a determining moment in the course of weather. Such phrases as "rain continued till sunset," "wind rises after sunset" and "wind W., changes at sunset to E." are common. The phenological records deal with the arrival and departure of the swallow, the first hearing of the cuckoo, the date of blossoming of a number of trees, dates of harvesting and sundry other observations. A summary of the eye observations has been

prepared, and will be deposited in the Library of the Meteorological Office.

DAYS WITH SNOW—HADSPEN HOUSE.

Year	Jan.	Feb.	Mar.	April	May	Oct.	Nov.	Dec.
1828	4	2	0	0	0	0	0	0
1829	6	1	1	1	0	0	1	6
1830	9	5	0	3	0	0	0	7
1831	3	...	...	0	0	0	1	1
1832	2	0	2	0	0	0	1	0
1833	0	2	6	0	0	0	1	1
1834	0	0	0	1	0	0	0	0
1835	3	...	1	2	0	0	0	2
1836	5	4	2	3	0	0	0	5
1837	3	...	...	...	0	0	...	2
1838	4	2	0	4	0	2	0	0
1839	5	...	...	1	2	0	1	0
1840	0	...	2	1	0	0	0	4
1841	6?	1	0	0	0	0	2	2
1842	4	...	0	0	0	0	0	0
1843	3	3	0	5	0	0	0	0
1844	2	7	0	0	0	0	1	2
1845	2	4	7	0	0	0	0	2
1846	0	0	1	0	0	0	...	1
1847	3	8	2	2	0	0	0	1
1848	6	0	2	2	0	1	1	0
1849	1	1	0	5	0	0	0	1
1850	2	0	4	...	0	0	0	0
1851	0	0	1	0	0	0	1	0
1852	1	1	0	0	0	0	...	0
1853	0	17	7	1	2?	0	...	...
1854	5	0	1	0	0	...	...	5

No snow is recorded in the months June, July, August and September.

A ... signifies that so many observations have been missed that it is impossible to give any figures at all.

Our thanks are due to the Rt. Hon. Henry Hobhouse for so kindly granting an opportunity for inspecting and studying this interesting record, which he has now presented to the Royal Meteorological Society Library.

C. E. BRITTON.

Prize Competition for Teachers

The Council of the Royal Meteorological Society, with a view to encouraging the study of weather in schools, invite teachers to send in essays on that subject.

The Council consider that the essay should include a description of the work which is actually being carried out or has been carried out by the teacher and his class. The essays should be limited to 2,000 words, but may be accompanied by examples of pupils' work. They should be received by the Society not later than June 30th, 1928.

It is proposed to allot three prizes of £5, £3, and £2, but these amounts may be varied at the discretion of the Council. It is hoped to publish the winning essay or essays in the *Quarterly Journal*, in which event 40 reprints will be supplied to the author.

Radiation from the Sky

RADIATION MEASURED AT BENSON, OXON, 1927.

Unit : one gramme calorie per square centimetre per day.

ATMOSPHERIC RADIATION only (dark heat rays)				
Averages for Readings				
		July	Aug.	Sept.
Cloudless days :—				
Number of readings	n	1	1	4
Radiation from sky in zenith ...	πI	600	658	496
Total radiation from sky ...	J	630	690	524
Total radiation from horizontal black surface on earth ...	X	788	816	689
Net radiation from earth ...	$X-J$	158	126	165
DIFFUSE SOLAR RADIATION (luminous rays).				
Averages for Readings between 9 h. and 15 h. G.M.T.				
Cloudless days :—				
Number of readings	n_0	0	0	1
Radiation from sky in zenith ...	πI_0	..	..	22
Total radiation from sky ...	J_0	..	..	38
Cloudy days :—				
Number of readings	n_1	2	2	2
Radiation from sky in zenith ...	πI_1	153	100	130
Total radiation from sky ...	J_1	110	170	95

Unit for I = gramme calorie per day per steradian per square centimetre.
Unit for J and X = gramme calorie per day per square centimetre.
For description of instrument and methods of observation, see *The Meteorological Magazine*, October, 1920, and May, 1921.

Reviews

A Group of Solar Changes. By C. G. Abbot. Size $9\frac{3}{4}$ by $6\frac{1}{2}$, pp. 16. Washington D.C. Smiths. Inst. Misc. Coll., Vol. 80, No. 2, 1927.

Dr. Abbot is untiring in his search for new proofs of the reality of fluctuations in the solar constant. The present paper is primarily devoted to a new method of comparison, which “depends on the selection of moments when the sun is equally high above the horizon, the atmosphere equally clear, the quantity of atmospheric water vapour identical, and the month

of the year the same," so that the reduction in the intensity of radiation by the atmosphere is very nearly the same, any small differences being eliminated by taking groups of similar days. The mean seasonal or annual values obtained in this way agree closely with the general mean values previously obtained ; thus supporting the reality of the variations from year to year, and they also agree with the variations of the relative sunspot number, though "the increase of solar radiation attending a given increase of sunspot numbers is decidedly greater when the total spottedness is small than when it is large."

The harmonic analysis of 77 months of solar radiation values shows a well-marked periodicity of $25\frac{3}{4}$ months which is common in meteorological series. Unfortunately these results are only given graphically, the amplitudes and phases not being stated in figures. Curves are also given to show the close similarity between the monthly means of solar radiation and first the ultra-violet radiation recorded by Pettit, secondly the intensity of long-range radio-signals.

C. E. P. BROOKS.

Climatología Agrícola. By Enrique Alcaraz. Size $8\frac{1}{2} \times 6$, Vol. I, pp. 216 + 22 charts. Vol. II., pp. 371 + 14 charts. *Illus.* Madrid, 1925.

This extensive and well produced treatise, in two volumes, consists of three main sections :—

General and descriptive climatology.

Climate in its relation to agriculture, vegetation, flora, fauna and their distribution over the globe.

A detailed study of the climate and agricultural activities of the Iberian Peninsula.

General climatology is developed along the usual lines. At the end of the first volume reproductions from standard works are included to illustrate the normal distribution in winter and summer of temperature and pressure over the globe, of winds over the oceans, and the main tracks of depressions across Europe. There are also maps of each of the continents showing land above and below 200 metres.

For the purposes of descriptive climatology, climates are classified as follows :—

Equatorial.

Tropical ; sub-divided into normal, monsoon and desert.

Sub-tropical ; sub-divided into normal, monsoon and desert.

Temperate ; sub-divided into normal, monsoon and desert.

Frigid ; sub-divided into normal and desert.

There are thus twelve general types of climate in the author's

classification. Tables of temperature and rainfall for selected stations illustrating the characteristics of each type are given. Maps at the end of the second volume show the distribution of the types over each of the continents.

A general discussion on soil formation and the adaptation of animals and plants to varying soils and climate, as well as descriptions of the flora, fauna, vegetation and agricultural activities peculiar to each of the climatic types, are included in this work.

The author's discussion of the climate of the Iberian Peninsula and its bearing on agricultural activities is thorough. In this section, sub-tropical and temperate climates are sub-divided into oceanic, continental, "transition" and "sub-desert" types. The map of the Peninsula and part of the north coast of Africa, coloured to show the regional distribution of these climatic types in that area, is particularly interesting and instructive. The whole work forms one of the most complete text-books of agricultural meteorology available.

M. T. SPENCE.

Obituary

Mr. J. Ernest Grubb.—We regret to learn of the death on October 9th, in his 85th year, of Mr. Grubb at his house at Seskin, Carrick-on-Suir, not far from Waterford. Mr. Grubb was born at Clonmel, but lived practically all his life at Carrick, where he was a prominent figure in public affairs. Throughout his life he took a keen interest in meteorology. From 1865-1870 he contributed rainfall records from Deerpark Lodge, near Carrick, to the Meteorological Office, and in 1900 he established a climatological station at Seskin, at which the usual observations have been taken twice a day ever since. During the troublous times in Ireland between 1920 and 1923, the respect in which he was held on both sides, and especially his being a Quaker, enabled him to assist in reconciling the warring elements. His son writes "during the disturbances in this district a few years ago, the taking of the observations were never missed, because my father explained to the Irregulars who were in the neighbourhood what the meteorological instruments were, and that it was necessary to visit them at night. Hence, when they saw our lantern on the top of the hill they did not fire at it." For many years he contributed to *Symons' Meteorological Magazine*, and later to the *Meteorological Magazine*, his last communication being on a horizontal rainbow he had seen on April 8th, 1926. We are glad to learn that his son and two daughters are continuing all the observations.

The Weather of October, 1927

Quiet dry anticyclonic conditions prevailed generally during the earlier part of the month, but from the 19th onwards the weather was warm and unsettled, with gales at times. A complex low pressure system, which passed across the British Isles on the 1st and 2nd, caused gales on many parts of the coast, and heavy rain in Scotland and Wales, *e.g.*, 2·24 in., fell at Ford and 1·37 in. at Llanuwchllyn (Merioneth) on the 1st. In the rear of these depressions an anticyclone spread in from the Atlantic and remained centred over or near these islands until the 16th. Much fog developed locally at night or in the early morning, and persisted upon some occasions during the daytime also in a few places. In many parts, however, the weather was very fine and warm by day, 72° F. at Huddersfield on the 7th, though cold at night, 24° F. (in the screen) at West Linton on the 5th. During this period the weather was on the whole dry, though towards the later part a good deal of cloud developed, the days were colder, and showers became more frequent. After the 15th the centre of the anticyclone moved still further south-west, and westerly winds prevailed over the whole kingdom, causing a general rise in temperature. Maximum readings of over 60° F. were recorded in many places, 67° F. being reached at Cambridge on the 25th, and night minima were remarkably high, especially on the morning of the 27th, when 60° F. was read at two or three stations, and 61° F. at Bath. Although these warm conditions set in about the 16th, the weather continued mainly fair and dry until the 21st, when a depression advancing eastwards across Ireland caused general heavy rain. From then until the end of the month the conditions were rainy and windy; among the heaviest rainfalls being 2·99 in. on the 24th and 2·90 in. on the 26th at Festiniog (Merioneth), 2·28 in. at Rathnew (Wicklow) on the 21st, 1·88 in. at Brecon on the 27th. Widespread, destructive gales were experienced on the 28-29th, when an intense depression passed rapidly across the central regions of the British Isles, Gusts of over 70 m.p.h. were registered at various stations, one of 96 m.p.h. at Southport, and one of 89 m.p.h. at Weaver Point (Cork). Mean hourly wind velocities exceeding 50 m.p.h. occurred at numerous places, the highest one being 70 m.p.h. at Southport.

Pressure was above normal over south-western and central Europe, the British Isles, Iceland and Bermuda, the greatest excess being 6·5 mb. at Isafjord. Pressure was below normal over Scandinavia and the greater part of the North Atlantic, the deficit amounting to 8·4 mb. at Horta and 5·3 mb. in eastern Norrland. Temperature was above normal and rainfall below normal from Spitsbergen to Zürich and Lisbon except in Scotland,

where the rainfall was above normal, and Sweden, where the temperature was below normal and the rainfall about 40 per cent. above normal.

A severe storm swept across the North Sea and Denmark on the 2nd, doing damage to shipping and communications. Heavy rain followed by floods occurred in Bourgas, Bulgaria on the 13th, in the valleys of the Drave and Morava, in Yugoslavia on the 21st, and at Skutari, Albania on the 23rd. The first snow of the winter fell in the Eifel district on the 9th. After a gale, which damaged forests and telephone lines, snow fell heavily on the 23rd in the Alps down to a level of 2,700 ft., and the roads over the Alpine passes became blocked. The severe storm experienced over the British Isles on the 28th-29th, passed across the North Sea to Denmark on the 30th, causing some loss of life.

Heavy rain caused damage to the Sind-Pishin section of the North-western railway of India on the 2nd. On the 4th and 5th serious floods were reported along the banks of the Irrawaddy River, in the Insein district near Rangoon.

Useful rains fell in many parts of Queensland during the early part of the month, and later heavy rain fell in many of the agricultural districts of South Australia, but large parts of these districts still need rain.

Unusual weather conditions prevailed in the United States during the first days of the month, 85° F. was the maximum temperature recorded at New York, 90° F. at Albany and 97° F. at Lancaster (Philadelphia) on the 1st, while heavy snow fell at Laramie, Wyoming. Heavy rain fell in the eastern United States between the 2nd and 20th, and floods occurred in many parts, especially Pennsylvania. At the end of the month serious floods began again in New England. The southern limit of freezing weather was generally more northerly than usual throughout the month. Storms occurred at Rio de Janeiro on the 8th, and the high tides flooded parts of the town.

Many gales occurred in the Atlantic.

The special message from Brazil states that the rainfall in the northern and central regions was scarce, being .7 in. and 2.1 in. below normal respectively, but plentiful in the southern regions, with .5 in. above normal. Eight anticyclones passed across the country during the month, but the weather was generally unsettled, with an abnormally low temperature over the country as a whole. Gales were frequent in the south. The condition of the crops, except cocoa, was satisfactory. Pressure at Rio de Janeiro was 0.1 mb. above normal, and temperature 0.5° F. above normal.

Rainfall, October, 1927—General Distribution

England and Wales	..	69	} per cent. of the average 1881-1915.
Scotland	.. .. .	139
Ireland	.. .. .	94
British Isles	.. .. .	90

Rainfall: October, 1927: England and Wales

CO.	STATION.	In.	Per- cent. of Av.	CO.	STATION.	In.	Per- cent. of Av.
<i>London.</i>	Camden Square	1.29	49	<i>Leics</i>	Thornton Reservoir ..	1.99	71
<i>Sur.</i>	Reigate, The Knowle ..	2.20	70	"	Belvoir Castle	2.01	74
<i>Kent.</i>	Tenterden, Ashenden ..	1.84	53	<i>Rut.</i>	Ridlington	2.03	...
"	Folkestone, Boro. San.	1.08	...	<i>Linc.</i>	Boston, Skirbeck	2.74	100
"	Margate, Cliftonville ..	0.91	31	"	Lincoln, Sessions House	1.49	58
"	Sevenoaks, Speldhurst ..	1.87	...	"	Skegness, Marine Gdns.	2.09	76
<i>Sus.</i>	Patching Farm	2.42	61	"	Louth, Westgate	1.81	56
"	Brighton, Old Steyne ..	2.02	52	"	Brigg	1.51	51
"	Tottingworth Park	3.71	89	<i>Notts.</i>	Worksop, Hodsock	1.71	65
<i>Hants</i>	Ventnor, Roy. Nat. Hos.	1.98	50	<i>Derby</i>	Derby	2.17	83
"	Fordingbridge, Oaklands	2.52	61	"	Buxton, Devon. Hos. ...	3.91	80
"	Ovington Rectory .....	...	...	<i>Ches.</i>	Runcorn, Weston Pt. ...	2.56	74
"	Sherborne St. John	1.87	53	"	Nantwich, Dorfold Hall	2.88	...
<i>Berks</i>	Wellington College	1.19	36	<i>Lancs</i>	Manchester, Whit. Pk. ...	2.46	75
"	Newbury, Greenham	2.55	73	"	Stonyhurst College	4.25	95
<i>Herts.</i>	Benington House	1.94	71	"	Southport, Hesketh Pk ...	3.05	86
<i>Bucks</i>	High Wycombe	2.68	86	"	Lancaster, Strathspey ...	3.78	...
<i>Oxf.</i>	Oxford, Mag. College ..	1.90	68	<i>Yorks</i>	Wath-upon-Deerne ...	1.65	60
<i>Nor.</i>	Pitsford, Sedgebrook ..	1.93	72	"	Bradford, Lister Pk. ...	3.74	107
"	Oundle	1.43	...	"	Oughershaw Hall	8.97	...
<i>Beds.</i>	Woburn, Crawley Mill ..	1.20	45	"	Wetherby, Ribston H. ...	2.39	80
<i>Cam.</i>	Cambridge, Bot. Gdns. ...	1.60	68	"	Hull, Pearson Park ...	1.90	64
<i>Essex</i>	Chelmsford, County Lab	1.93	79	"	Holme-on-Spalding ...	2.03	...
"	Lexden, Hill House	2.13	...	"	West Witton, Ivy Ho. ...	4.14	...
<i>Suff.</i>	Hawkedon Rectory	2.10	78	"	Felixkirk, Mt. St. John ...	2.41	84
"	Haughley House	1.97	...	"	Pickering, Hungate ...	2.58	...
<i>Norfol.</i>	Beccles, Geldeston	2.35	83	"	Scarborough	1.99	64
"	Norwich, Eaton	2.60	83	"	Middlesbrough	2.19	73
"	Blakeney	2.17	83	"	Baldersdale, Hury Res.	3.13	...
"	Little Dunham	2.84	91	<i>Durh.</i>	Ushaw College	1.56	45
<i>Wills.</i>	Devizes, Highclere	1.90	61	<i>Nor.</i>	Newcastle, Town Moor.	1.55	48
"	Bishops Cannings	2.17	65	"	Bellingham, Highgreen	3.41	...
<i>Dor.</i>	Evershot, Melbury Ho. ...	4.49	97	"	Lilburn Tower Gdns. ...	2.48	...
"	Creech Grange	3.10	...	<i>Cumb.</i>	Geltsdale	2.57	...
"	Shaftesbury, Abbey Ho. ...	2.46	63	"	Carlisle, Scaleby Hall ...	1.92	57
<i>Devon</i>	Plymouth, The Hoe	2.51	63	"	Seathwaite M. ....	...	...
"	Polapit Tamar	2.94	61	"	Keswick, High Hill	7.55	...
"	Ashburton, Druid Ho. ...	3.90	64	<i>Glam.</i>	Cardiff, Ely P. Stn.	4.08	85
"	Cullompton	2.31	56	"	Treherbert, Tynywaun	10.61	...
"	Sidmouth, Sidmount ..	1.56	42	<i>Carm.</i>	Carmarthen Friary	3.76	66
"	Filleigh, Castle Hill ...	3.47	...	"	Llanwrda, Dolaucothy.	6.86	108
"	Barnstaple, N. Dev. Ath.	2.22	49	<i>Pemb.</i>	Haverfordwest, School	3.40	63
<i>Corn.</i>	Redruth, Trewirgie ...	2.95	56	<i>Card.</i>	Gogerddan	4.97	94
"	Penzance, Morrab Gdn. ...	2.66	57	"	Cardigan, County Sch. ...	2.12	...
"	St. Austell, Trevarna ...	2.40	46	<i>Brec.</i>	Crickhowell, Talymaes	4.30	...
<i>Soms.</i>	Chewton Mendip	3.79	79	<i>Rad.</i>	Birm. W. W. Tyrmynydd	5.27	80
"	Street, Hind Hayes ...	2.40	...	<i>Mont.</i>	Lake Vyrnwy	8.91	156
<i>Glos.</i>	Clifton College	2.57	68	<i>Denb.</i>	Llangynhafal	3.14	...
"	Cirencester, Gwynfa ...	2.09	63	<i>Mer.</i>	Dolgelly, Bryntirion ..	5.76	95
<i>Here.</i>	Redd, Birchlea	2.65	80	<i>Carn.</i>	Llandudno	2.11	59
"	Ledbury, Underdown ...	2.08	68	"	Snowdon, L. Llydaw 9	18.25	...
<i>Salop.</i>	Church Stretton	2.68	74	<i>Ang.</i>	Holyhead, Salt Island.	2.96	74
"	Shifnal, Hatton Grange	1.97	70	"	Llwgwy	3.46	...
<i>Worc.</i>	Ombersley, Holt Lock ...	1.56	58	<i>Isle of Man</i>	Douglas, Boro' Cem. ...	4.40	97
"	Blockley, Upton Wold ...	1.86	57	<i>Guernsey</i>	St. Peter P't. Grange Rd	1.59	35
<i>War.</i>	Farnborough	1.59	50				
"	Birmingham, Edgbaston	1.77	64				

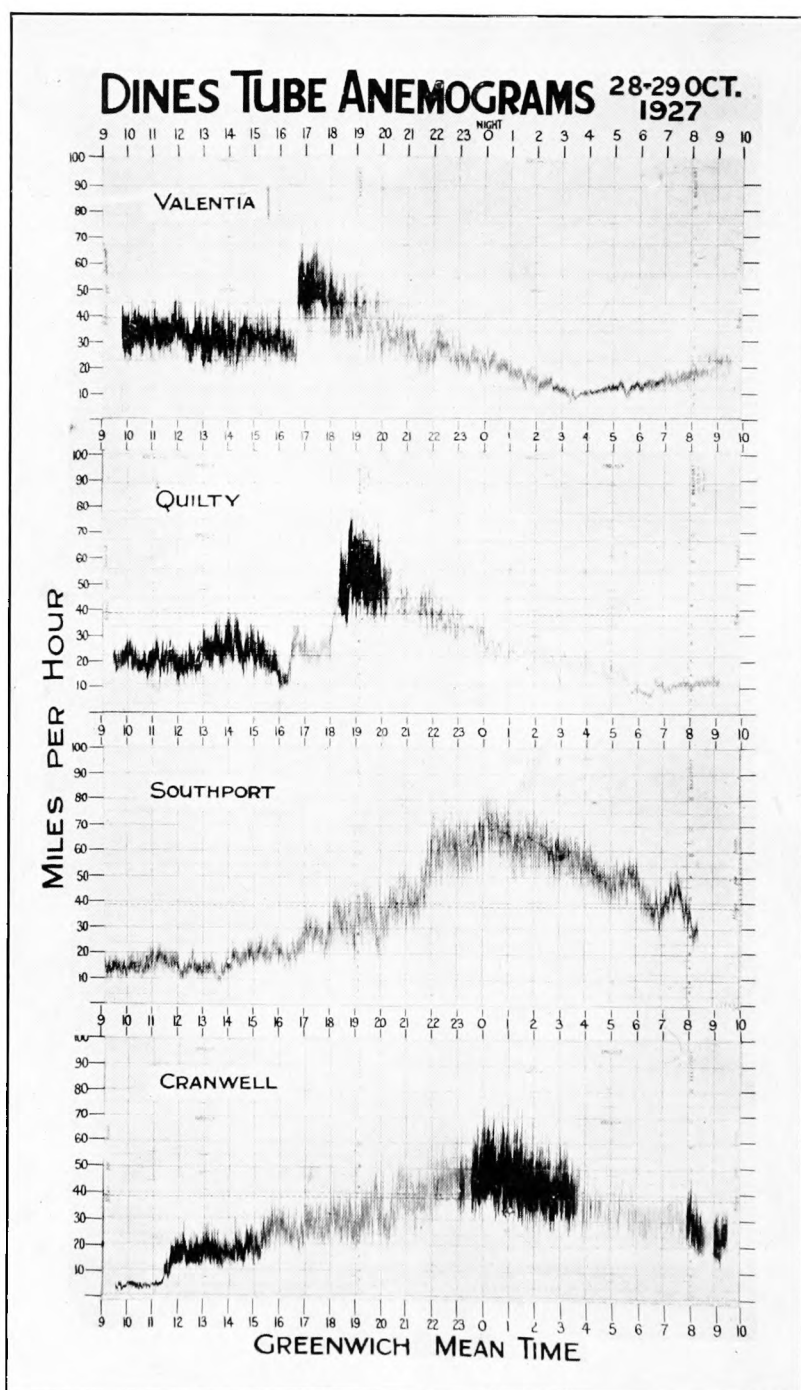
Rainfall: October, 1927: Scotland and Ireland

CO.	STATION.	In.	Per- cent. of Av.	CO.	STATION.	In.	Per- cent. of Av.
<i>Wigt.</i>	Stoneykirk, Ardwell Ho.	5.08	140	<i>Suth.</i>	Loch More, Achfary ...	10.53	135
"	Pt. William, Monreith .	4.59	...	<i>Caith</i>	Wick	4.00	135
<i>Kirk.</i>	Carsphairn, Shiel.	9.26	...	<i>Ork.</i>	Pomona, Deerness	6.15	162
"	Dumfries, Cargen	4.90	112	<i>Shet.</i>	Lerwick	3.56	90
<i>Roxb.</i>	Branxholme .....	...	...	<i>Cork.</i>	Caheragh Rectory	5.33	...
<i>Selk.</i>	Ettrick Manse	8.83	...	"	Dunmanway Rectory .	6.06	101
<i>Berk.</i>	Marchmont House	2.71	71	"	Ballinacurra	3.31	82
<i>Hadd.</i>	North Berwick Res.	3.01	102	"	Glanmire, Lota Lo. ...	3.83	92
<i>Midl.</i>	Edinburgh, Roy. Obs. ...	3.13	120	<i>Kerry</i>	Valentia Obsy.	4.34	78
<i>Lan.</i>	Biggar .....	...	...	"	Gearahameen	8.50	...
"	Leadhills .....	...	...	"	Killarney Asylum. ...	4.84	90
<i>Ayr.</i>	Kilmarnock, Agric. C. ...	4.43	126	"	Darrynane Abbey	5.00	99
"	Girvan, Pinmore	5.45	109	<i>Wat.</i>	Waterford, Brook Lo. .	3.01	77
<i>Renf.</i>	Glasgow, Queen's Pk. ...	4.76	147	<i>Tip.</i>	Nenagh, Cas. Lough ...	2.81	83
"	Greenock, Prospect H. ...	7.91	147	"	Roscrea, Timoney Park	2.08	...
<i>Bute.</i>	Rothsay, Ardencraig. ...	6.16	140	"	Cashel, Ballinamona ...	2.44	68
"	Dougarie Lodge	4.22	...	<i>Lim.</i>	Foynes, Coolnanes	2.24	59
<i>Arg.</i>	Ardgour House	9.88	...	"	Castleconnell Rec.	2.17	...
"	Manse of Glenorchy ..	9.24	...	<i>Clare</i>	Inagh, Mount Callan ..	4.23	...
"	Oban	7.26	...	"	Broadford, Hurdlest'n. .	3.29	...
"	Poltalloch	6.57	133	<i>Wexf.</i>	Newtownbarry	4.26	...
"	Inveraray Castle	10.91	156	"	Gorey, Courtown Ho. ...	3.85	109
"	Islay, Fallabus	5.64	118	<i>Kilk.</i>	Kilkenny Castle	2.60	83
"	Mull, Benmore	17.60	...	<i>Wic.</i>	Rathnew, Clonmannon ...	3.77	...
"	Tiree	6.28	...	<i>Carl.</i>	Hacketstown Rectory .	3.58	94
<i>Kinr.</i>	Loch Leven Sluice	5.57	...	<i>QCo.</i>	Blandsfort House	2.33	66
<i>Pert.</i>	Loch Dhu	9.85	138	"	Mountmellick	2.66	...
"	Balquhidder, Stronvar. .	8.31	...	<i>KCo.</i>	Birr Castle	2.13	...
"	Crieff, Strathearn Hyd. .	6.12	156	<i>Dubl.</i>	Dublin, FitzWm. Sq. ...	2.79	104
"	Blair Castle Gardens ..	4.38	141	"	Balbriggan, Ardgillan .	3.78	140
<i>Forf.</i>	Kettins School	4.57	160	<i>Me'th</i>	Beauparc, St. Cloud ..	3.52	...
"	Dundee, E. Necropolis. .	5.26	198	"	Kells, Headfort	3.30	99
"	Pearsie House	6.07	...	<i>W.M.</i>	Moate, Coolatore	2.95	...
"	Montrose, Sunnyside ..	...	...	"	Mullingar, Belvedere .	2.77	89
<i>Aber.</i>	Braemar, Bank	5.59	149	<i>Long</i>	Castle Forbes Gdns. ...	3.71	114
"	Logie Coldstone Sch. ...	3.90	120	<i>Gal.</i>	Ballynahinch Castle ..	5.98	100
"	Aberdeen, King's Coll. .	3.34	111	"	Galway, Grammar Sch. .	2.68	...
"	Fyvie Castle	3.91	...	<i>Mayo</i>	Mallaranny	5.89	...
<i>Mor.</i>	Gordon Castle	4.32	137	"	Westport House	3.15	70
"	Grantown-on-Spey	4.25	143	"	Delphi Lodge	6.61	...
<i>Na.</i>	Nairn, Delnies	3.93	167	<i>Sligo</i>	Markree Obsy.	2.64	64
<i>Inv.</i>	Ben Alder Lodge	5.47	...	<i>Cav'n</i>	Belturbet, Cloverhill. .	2.74	94
"	Kingussie, The Birches .	4.05	...	<i>Ferm.</i>	Enniskillen, Portora ..	2.05	...
"	Loch Quoich, Loan	14.10	...	<i>Arm.</i>	Armagh Obsy.	2.24	82
"	Glenquoich	16.83	168	<i>Down</i>	Fofanny Reservoir ...	8.18	...
"	Inverness, Culduthel R. .	4.31	...	"	Seaforde	3.80	107
"	Arisaig, Faire-na-Squir .	6.24	...	"	Donaghadee, C. Stn. ...	3.26	113
"	Fort William	7.53	106	"	Banbridge, Milltown ..	3.20	116
"	Skye, Dunvegan	7.54	...	<i>Antr.</i>	Belfast, Cavehill Rd. .	3.45	...
<i>R&C</i>	Alness, Ardross Cas. ...	6.70	174	"	Glenarm Castle	4.58	...
"	Ullapool	6.75	...	"	Ballymena, Harryville .	4.11	111
"	Torridon, Bendamph. .	9.03	113	<i>Lon.</i>	Londonderry, Creggan .	4.11	112
"	Achnashellach	9.69	...	<i>Tyr.</i>	Donaghmore	3.38	...
"	Stornoway	7.37	142	"	Omagh, Edenfel	3.23	88
<i>Suth.</i>	Laing	4.73	...	<i>Don.</i>	Malin Head	4.43	150
"	Tongue	6.22	148	"	Dunfanaghy	4.36	99
"	Melvieh	7.92	216	"	Killybegs, Rockmount .	4.28	77

Climatological Table for the British Empire, May, 1927

STATIONS	PRESSURE			TEMPERATURE							Relative Humidity	Mean Cloud Am't	PRECIPITATION			BRIGHT SUNSHINE	
	Mean of Day M.S.L.	Diff. from Normal	mb.	Absolute	Mean Values				Mean	Am't			Diff. from Normal	Days	Hours per day	Per- cent- age of possi- ble.	
					Max.	Min.	1 max. and 2 min.	Diff. from Normal									
																	° F.
London, Kew Obsy.	1018.0	+ 2.1	75	33	64.0	46.0	55.0	1.6	47.8	80	5.2	1.09	0.63	7	7.7	49	
Gibraltar	1015.2	- 0.9	79	52	73.9	59.4	66.7	+ 1.2	58.8	84	4.9	0.77	0.96	4	...	...
Malta	1015.2	+ 0.2	84	59	72.1	62.4	67.3	+ 1.4	62.5	79	5.6	0.13	0.28	1	9.0	64	
St. Helena	1014.2	+ 3.0	68	56	64.8	58.9	61.9	- 1.7	59.3	89	3.3	3.32	0.83	19	...	...
Sierra Leone	1012.1	+ 0.9	92	70	88.7	73.7	81.2	- 0.3	76.8	80	5.8	9.52	1.95	21	...	...
Lagos, Nigeria	1009.8	- 1.2	90	72	87.5	76.1	81.8	0.0	77.1	82	5.5	8.19	2.28	15	...	...
Kaduna, Nigeria	1014.7	+ 1.6	94	...	88.8	...	...	...	71.9	70	1.8	6.33	0.39	13	...	...
Zomba, Nyasaland	1016.7	+ 1.6	83	48	75.6	54.2	64.9	- 0.9	...	76	5.0	0.11	0.93	3	...	...
Salisbury, Rhodesia	1017.4	+ 0.2	81	37	73.8	46.3	60.1	- 0.5	53.4	53	1.5	0.22	0.32	2	8.7	77	
Cape Town	1020.6	+ 2.6	89	39	66.8	50.0	58.4	- 0.5	50.9	85	4.4	2.99	0.84	10	...	...
Johannesburg	1021.0	+ 1.0	78	28	66.0	45.1	55.5	+ 1.1	44.3	46	1.6	0.00	0.76	0	9.1	84	
Mauritius . . . . .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	1003.7	+ 0.2	78	26	66.8	38.9	52.9	+ 0.2	42.0	64	3.2	0.00	1.18	0	...	...
Calcutta, Alipore Obsy.	1007.6	+ 0.2	99	70	94.7	77.8	86.3	+ 0.3	79.1	81	5.6	4.91	0.84	6*	...	...
Bombay	1007.6	+ 0.2	93	77	90.8	80.8	85.8	- 0.1	77.5	75	4.7	0.00	0.55	0*	...	...
Madras	1005.2	- 0.2	109	77	99.8	82.0	90.9	- 1.0	78.3	61	4.8	0.37	0.70	2*	...	...
Colombo, Ceylon	1009.2	+ 0.6	89	71	86.9	77.3	82.1	- 0.4	78.7	80	9.0	22.65	9.97	22	4.8	39	
Hongkong	1008.6	- 0.8	89	66	80.5	72.3	76.4	- 1.0	73.2	85	8.3	25.45	13.85	19	3.8	29	
Sandakan . . . . .	...	...	91	74	89.0	75.7	82.3	- 0.3	77.5	83	...	7.34	1.43	14	...	...
Sydney	1016.2	- 2.4	78	42	66.8	50.6	58.7	- 0.1	51.3	71	3.1	1.63	3.50	8	6.8	65	
Melbourne	1017.4	- 2.1	73	51	61.3	46.9	54.1	0.0	48.4	72	6.7	1.91	0.27	15	4.0	33	
Adelaide	1019.6	- 0.5	83	38	66.1	49.5	57.8	- 0.1	50.3	59	5.9	2.19	0.57	15	5.2	51	
Perth, W. Australia	1018.9	+ 0.4	86	43	68.8	51.2	60.0	- 0.6	54.9	71	5.0	4.85	0.09	12	6.2	59	
Coolgardie	1019.4	- 0.4	86	36	69.6	45.7	57.7	+ 0.1	40.0	56	3.2	0.83	0.53	4	...	...
Brisbane	1017.5	- 1.3	83	45	75.5	53.6	64.5	0.0	56.3	61	2.2	0.02	2.81	1	9.0	84	
Hobart, Tasmania	1010.9	- 4.7	67	36	56.7	44.3	50.5	+ 0.1	44.4	68	6.1	2.87	1.01	18	4.3	44	
Wellington, N.Z.	1014.9	- 0.7	63	36	57.9	46.0	51.9	- 0.8	49.4	78	7.5	5.77	1.09	13	4.1	42	
Suva, Fiji	1011.7	- 1.1	90	69	84.5	72.9	78.7	+ 2.2	74.7	85	6.6	8.17	1.99	18	4.6	41	
Apia, Samoa	1011.2	+ 0.1	87	71	85.6	75.2	80.4	+ 2.0	77.4	79	4.3	7.59	2.08	15	7.8	68	
Kingston, Jamaica	1013.6	+ 0.5	91	70	88.4	72.0	80.2	+ 0.5	72.1	79	3.2	1.47	2.92	9	9.1	70	
Grenada, W.I.	1009.9	- 2.6	89	70	85.9	74.9	80.4	+ 0.8	75.2	72	5.4	3.46	1.13	16	...	...
Toronto	1011.9	- 2.9	89	35	60.7	44.8	52.7	- 0.0	46.6	74	7.0	3.22	0.22	16	5.2	35	
Winnipeg	1014.3	- 0.0	72	31	56.2	40.9	48.5	- 3.1	41.4	74	6.2	4.70	2.40	12	4.1	27	
St. John, N.B.	1012.2	- 1.8	64	31	54.8	39.9	47.5	- 0.4	43.3	73	6.5	2.36	1.35	18	5.2	35	
Victoria, B.C.	1018.2	+ 1.8	68	40	57.7	45.2	51.5	- 1.6	47.8	73	6.3	0.77	0.53	7	8.3	55	

*For Indian stations a rain day is a day on which 0.1 in. or more rain has fallen.



M.O. 294.

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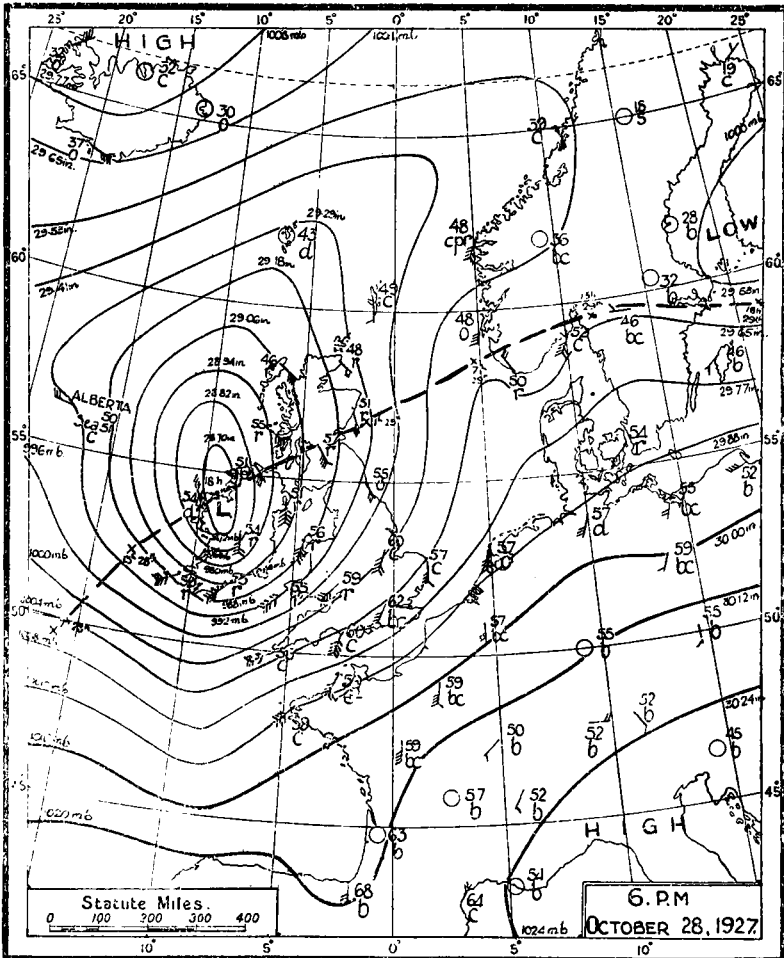
The Storm of October 28th—29th, 1927

By J. CRICHTON, M.A., B.Sc.

On October 27th, 1927, a depression was indicated in the neighbourhood of the Azores. Observations at 1h. on the 28th indicated that the depression had approached our south-west coasts but the observations did not give any idea of its intensity, this being largely due to the lack of observations in the area where it was developing. More observations, however, were received at 7h. and from these it became evident that the depression was a vigorous one and that it would deepen and cause widespread gales as it moved northeastwards across the British Isles. The weather map on page 250 gives the position of the depression at 18h. on the 28th and in addition shows the track of its centre, the times and dates corresponding with the positions of the centre at the hours of 7, 13 and 18 on the 28th and of 1, 7 and 13 on the 29th. It will be seen that the depression traversed the British Isles in less than twenty-four hours.

A preliminary examination of the autographic records indicates that the depression had a decided warm sector as it approached Ireland and that, although this sector partially remained as it crossed the British Isles, the centre of the depression during its passage was occluded. The warm front ran throughout practically east and west and passed Valentia, Scilly and Plymouth between 3h. and 4h. on the 28th, arrived at Calshot about 5h.,

Chester, Cranwell and Bircham-Newton between 11h. and 12h., Aldergrove between 12h. and 13h. and Leuchars and Renfrew about 16h. The cold fronts were not so well marked, the air in the rear of the depression being very mild and dry. The times of passage of what might be termed the main cold front were as follows: at Valentia between 13h. and 14h., Scilly 14h. 30m.,



Plymouth 14h. 45m., Ross-on-Wye and Chester 16h., Aldergrove 16h. 40m., Calshot 17h. 30m., Renfrew 18h., Cranwell 18h. 10m., Bircham Newton 19h. 15m. and Leuchars about 21h. It will be seen that the cold front progressed more rapidly northeastwards than eastwards and resulted in the depression becoming quickly occluded. By 7h. on the 29th the depression was entirely occluded, the occlusion ran southsoutheast from its centre, skirted the coast of Denmark, turned towards west and ran through Holland, Belgium and northern France to the Bay

of Biscay. The cold fronts were very numerous and some of the later ones were more intense as regards wind changes. They did not, however, produce much change in temperature. On the barographic records the warm and cold fronts were ill-defined and scarcely traceable.

The rise of the barometer in the rear of the depression was phenomenal and at Valentia it was a record for the station; there the rise was at the rate of 14.5 mb. during 3 hours. As a consequence of this rapid rise the gales were most intense and destructive in the rear of the depression; the passage of each cold front was marked particularly in Ireland and Scotland by large and sudden increases in the velocity of the wind. The records of the wind velocity at Valentia and Quilty (Co. Clare), shown in the figure facing p. 249, clearly indicate these rapid changes. At Valentia between 16h. 35m. and 16h. 40m. on the 28th the wind veered sharply from SW by W to W, and the mean velocity jumped from 26 m.p.h. to 52 m.p.h.

The following very interesting report was received at the Meteorological Office, Air Ministry, from the Captain of the SS. *Aluania*, "At 12h. 50m. G.M.T. approximate position $51^{\circ} 28' N$, $14^{\circ} 4' W$, wind was S, force 6, barometer having fallen steadily to 28.69 in. [971.5 mb.]. At 13h. 20m. G.M.T. in approximate position $51^{\circ} 26' N$, $13^{\circ} 52' W$ wind suddenly shifted to WNW and increased to force 11, the barometer rising rapidly until now at 14h. 50m. G.M.T. Lat. $51^{\circ} 9' N$, Long. $13^{\circ} 18' W$, it stands at 29.00 in. [982.0 mb.]. The wind maintained its direction and force." This report, assuming the barometer is correct, indicates approximately the position of the centre of the depression at 13h. on the 28th and also probably the greatest depth the depression reached.

The passage across northwest Ireland of the centre was also distinctly marked by the lightness of the winds. At Dunfanaghy Road, Co. Donegal, the wind between 18h. 30m. and 21h. did not average more than 5 m.p.h., it started to increase in velocity at 21h. and by 22h. 50m. it was averaging more than 50 m.p.h., and at 23h. 35m. there was a gust of 74 m.p.h. This sudden increase of wind was responsible for the destruction of many small fishing craft and the loss of life to a number of fishermen. The following extracts, taken from *The Times* of October 31st, 1927, illustrate this:—

"Several fishing boats engaged in the herring fishery in Lackan Bay, Co. Mayo, put to sea about a quarter to six, when the night was fine and starry. They dropped their nets about 250 yards from the shore, and had made an excellent catch when the storm suddenly broke over them. The fishermen immediately tried to reach the shore, but two of the boats were dashed against the rocks by the squall and

broken into pieces, and their entire crews (ten in all) were drowned."

"Another disaster occurred in Cleggan Bay, about eight miles north of Clifden, County Galway. A number of boats put off from Rossadelisk on Friday evening and cast their nets. About 7 o'clock a fierce squall struck them and all were swamped, except one boat, which cut its nets adrift and made for safety."

The destructive gale did not confine itself to Ireland but all the British Isles south of the track of the centre suffered. Many lives were lost through buildings, etc., being blown down and much general damage was done to property. Telephonic and telegraphic communication was seriously interrupted as many land lines were down. In Morecambe Bay, Fleetwood suffered severely on account of the giving way of the sea wall and for days the town and surrounding country remained flooded.

Below, a few of the maximum gusts in miles per hour are given, illustrating the intensity and extent of the storm :—

Southport	96	Sealand	82	Scilly	77	Spurn Head	74
Weaver Point	89	Cranwell	80	Falmouth	75	Eskdalemuir	74
Quilty	85	Valentia	79	Newcastle	75	Edinburgh	60
Holyhead	85	Fleetwood	78	Aldergrove	74	Kew	53

At Southport the mean velocity for the hour 23h. 30m. on the 28th to oh. 30m. on the 29th was 70 m.p.h., while at Sealand between 22h. and midnight on the 28th the wind velocity ranged between 4 and 80 m.p.h.

With the Meteorological Section, R.A.F. Reserve at Cranwell

On Monday, October 3rd, 1927, there came into being a new and interesting addition to the activities of the Royal Air Force, when a small group of 16 members of the Royal Air Force Reserve, Meteorological Section, assembled at Cranwell, Lincs, for the first period of reserve training. Of this number, 12 were members of the staff of the Meteorological Office, the remaining 4 being R.A.F. Reserve personnel with meteorological experience, chiefly in the Near East. The total force comprised 2 Officers, 10 Corporals and 4 Leading Aircraftsmen. Fortunately, most of the new arrivals had become acquainted previously during the course of their civilian duties, and the "shaking down" was pleasant and not without its humorous side; one arrival in the "wee sma' hours" of the Tuesday morning left none of the assembled company long in doubt as to his place of origin. The 14 "other ranks" had been allotted a roomy and comfortable hut to themselves for their sojourn in these strange surroundings, and a regular R.A.F. Sergeant had been detailed as mentor. Any

possible misgivings as to the nature of their reception were speedily dissipated by the tactful manner in which this sergeant discharged his friendly duties. Excellent arrangements had been made for the comfort of everybody concerned, and it was not long before the amenities of the camp were discovered. It was agreed generally that the food was very good.

It took some little time to comply with the service formalities, and to collect uniform and kit ; but on Wednesday morning the transformation was complete, and 14 meteorological airmen appeared at 8 a.m. for parade and half an hour's squad drill under the tactful sergeant. • This daily parade was an enjoyable feature of the training, during which no comments were heard anent the well-known property of a sergeant's heart to resist fracture, in spite of the fact that one diminutive corporal had to learn that the command " Left turn " referred to his " other left." By 9 o'clock the company had assembled at a vacant hangar, which they proceeded to transform into Meteorological Headquarters.

After this, things proceeded smoothly and comfortably ; from 9 a.m. onwards we were no longer concerned with the routine of the regular forces ; in our own hangar and on the adjacent aerodrome things meteorological were the order of the day. A second order station was set up, and the company divided into three groups, two working outside, with the third working inside on the charts. The prevalence of mist and light winds necessitated, however, that the grouping should be flexible, and it was arranged that everyone should receive practice in the routine with which they were least familiar from others who had had wider experience. In this way, for example, those unfamiliar with pilot balloon observations were enabled to gain useful knowledge. Regular observations were taken, involving the use of air meters for wind speeds and directions, and the incidental duties of fixing visibility objects and the making of barometer correction cards were carried out. The work was not, however, free from interruption ; at 10 a.m. a travelling canteen created a diversion ; the dinner time break from 12 noon to 2 p.m., and the cessation of duty at 4 p.m. were points to be observed with unfailing regularity. There were also three pay parades in twelve days ! In addition to the practical work, the theoretical side was not forgotten. The theory of various types of balloon ascents and of the method of computation and compilation of artillery telegrams were dealt with in a series of lectures, and those responsible for these lectures were especially gratified at their immediate success and popularity and at the interest shown in the theory of operations which otherwise might tend to become merely mechanical routine.

Sleaford, Lincoln and Nottingham supplied attractions for after-duty hours, in addition to those to be found in and around

the camp, a not inconsiderable fact, when it is recalled that Wednesday and Saturday afternoons were free, and that troops without bayonets were not required at Church Parade on Sunday, and that late passes were the general order.

It was unanimously agreed that the twelve days' course had been a thoroughly enjoyable and useful experience. Our thanks are due to the Officers and Non-Commissioned Officers with whom we were brought into contact for the manner in which things were made to run smoothly for us at all times, and the fact that the course coincided with the best weather of the "summer" guarantees us a hearty welcome next year.

F. H. DIGHT.

Discussions at the Meteorological Office

October 10th, 1927. *Recent researches on lightning in America.*
Opener—Dr. G. C. Simpson, F.R.S.

The Director, in opening the first discussion of the new session, took as his subject a number of papers which have recently appeared in the technical journals of American electrical engineers. These papers deal mainly with the surges produced by lightning on high voltage transmission lines. The effects of such surges are always serious, as they put voltages on the electrical installation which they cannot withstand. The provision of lightning arresters minimises the actual damage done; but many surges put the lines out of action, and this is a serious matter for the machinery to which they supply power. The engineers of the Westinghouse Electric and Manufacturing Company have made a special study of surges, and Messrs. J. F. Peters, J. H. Cox and J. W. Legg have done particularly valuable work.

In order to determine the frequency of surges and to obtain some idea of the magnitude of the voltages induced in the lines, an interesting self-recording instrument, called the Klydonograph, has been developed. Three or four rods, each connected to one of the transmission lines, rest point down on a roll of photographic film, which is slowly drawn under them. When the potential on a line, due to a surge, rises to a certain value, an electrical discharge takes place from the point of the rod in contact with the film. Each discharge leaves a record, similar to the well-known Lichtenberg figures, from which a considerable amount of information can be deduced regarding the sign of the surge, its intensity and whether it occurred abruptly or relatively slowly.

Klydonographs have been in use on a number of transmission lines in America during two summers, and Mr. Cox has discussed the results. The number of positive and negative surges, and

their relative intensity, are given in the following table, a positive surge being one which would be produced if the line received an excess of positive electricity.

NUMBER OF SURGES.

Intensity			1	2	3	4	5	6
Positive	...	...	446	51	29	19	12	6
Negative	...	...	5	6	10	6	10	11

In addition, there were a large number of surges, the polarity of which was both positive and negative, due to the oscillations set up across the lightning arresters.

Mr. Cox draws attention to the large number of positive surges compared with the small number of negative surges, and explains this in the following way. The negative surges are, as the table shows, mainly strong, more than half being of strengths 4, 5 and 6, and Mr. Cox considers that these were due to direct hits on the lines. When a lightning flash does not strike the line, but goes to earth near to the line, it induces a surge of the opposite polarity, and, of course, of much less intensity; in this way positive surges are set up. Mr. Cox concludes from this that only discharges from negatively charged clouds produce surges on transmission lines. He explains this result by pointing out that according to the mechanism of a lightning flash recently described by Dr. Simpson in a paper "On Lightning," a negative discharge is much more intense and abrupt than a positive discharge. Hence, the induced surges, which depend on the rate at which the electrical field changes, are much larger in the case of negative than of positive discharges, thus accounting for the absence of negative surges due to positive discharges.

In the subsequent discussion, Dr. Simpson criticised Mr. Cox's explanation of the relative frequency of positive and negative surges. He said, that according to his examination of over 400 photographs of lightning, positive lightning discharges occurred at least four times as frequently as negative discharges. If, therefore, Mr. Cox was right in ascribing all the negative surges to direct hits from negative flashes, there should be at least four times as many direct hits from positive discharges. He also pointed out that on theoretical grounds it is very unlikely that an induced surge can ever be sufficiently intense to cause the large surges recorded by the Klydonograph. Dr. Simpson was therefore of the opinion that practically all the surges recorded were due to direct hits from lightning flashes, and that the relative number of positive and negative surges represents the relative frequency of flashes from positively and negatively charged clouds. When it is remembered that a positive discharge is always branched, and the end of any branch may strike the

line, while every negative discharge has its full intensity in one stem at ground level, the relative frequency of weak positive discharges is explained.

The subject for discussion for the next meeting will be :—
January 16th, 1928. On the solar curve as dating the ice age, the New York moraine, and Niagara Falls through the Swedish time-scale. By G. de Geer (Geog. Ann. Stockholm 8, 1926, pp. 253-285), and other papers. *Opener*
—Dr. C. E. P. Brooks.

Royal Meteorological Society

The Council of the Royal Meteorological Society has awarded the Symons memorial gold medal for 1928 to Professor Dr. Hugo Hergesell, Director of the Aeronautical Observatory, Lindenberg, for distinguished work in connexion with meteorological science. The medal, which is awarded biennially, will be presented at the annual general meeting on January 18th, 1928.

The monthly meeting of the Society was held on Wednesday, November 16th at 49, Cromwell Road, South Kensington, Sir Gilbert Walker, C.S.I., F.R.S., President, in the chair.
C. E. P. Brooks, D.Sc.—The Influence of Forests on Rainfall and Run-off.

Of the water vapour which is condensed as rainfall over the land, about two-thirds is provided by evaporation over the oceans, and the remaining third by evaporation and transpiration over the land. The latter contribution is made up of the evaporation of rainfall intercepted by foliage, evaporation from the soil, and transpiration, and estimates are made of these three factors for forests, crop or grass land, and bare soil. The figures are expressed as percentages of an average rainfall of 30 inches a year ; for forests they give : interception, 15 ; evaporation from soil, 7 ; transpiration, 25 ; total, 47 per cent. For crops : evaporation from soil, 17 ; transpiration, 37 ; total, 54 per cent. For bare soil : evaporation, 30 per cent. Thus, the replacement of forests by crops would tend to increase the supply of moisture to the air, and, therefore, the general rainfall slightly ; replacement by bare soil would decrease the general rainfall slightly. The changes in the run-off are likely to be more noticeable ; replacement of forests by crops would decrease the run-off by 15 per cent., and make it less regular ; replacement by bare soil would increase the run-off, but would make it highly irregular. A forest 30 feet high may be considered as adding about 30 feet to the effective height of the ground, and this should increase the

local orographical rainfall by one or two per cent. Data obtained in various localities were examined in detail: at Mauritius, deforestation has resulted in a decrease by two or three per cent., while in Sweden, Germany and India the rainfall at forest stations is about one per cent. greater than that at neighbouring stations in the open, after making allowance for differences of exposure. The question of fog and dew was also examined, and it was found that under average conditions their total effect is slight.

C. K. M. Douglas, B.A.—The Secondary Depression on the night of January 28th-29th, 1927.

The discontinuities associated with this intense and deepening secondary depression were examined in detail by means of autographic records at a number of stations, some of which are reproduced in the paper. The results have a bearing on the recent work of Dr. J. Bjerknes, who has shown that the polar air behind a cold front is frequently warmed dynamically by descending movement until it is about as warm as the air in the "warm sector." About 70 miles behind the first cold front there was a "dry front," with a rise of temperature and sharp fall of relative humidity, separating air kept cold and damp by the rain, and air behind the rain area which had been warmed at the dry adiabatic rate when it descended. Near the centre of the secondary depression a "secondary warm sector" was developed after the original warm sector was "occluded," *i.e.*, displaced entirely from the lower layers of the atmosphere.

E. Kidson, D.Sc., F.Inst.P.—The Circulation of the Atmosphere over Melbourne.

It has been shown that it is possible to obtain estimates of wind velocity at high levels by means of nephoscope observations with accuracy sufficient at least for most purposes, both practical and theoretical. No other means is at present available for securing a comparable amount of data for the same levels in a climate such as that of Melbourne. These upper winds are freed from the purely local effects which make the treatment of surface winds so difficult. Much information can, therefore, be deduced from them regarding the general circulation. On the other hand, it is clear that large-scale local effects are still of great importance, so that the conclusions which can be drawn from the observations at one station are very limited. An attempt is made to find some relationship between the cirrus velocities and component values of cirrus velocities, and a number of other elements. Amongst these elements are the latitude variation of the travelling anti-cyclones of Australia, rainfall, pressure and wheat yield. The relationships are not simple, and the author confesses that so far he has been unable to obtain a clear mental picture of the processes involved.

Correspondence

To the Editor, *The Meteorological Magazine*

Fog of November 26th—27th, 1927

I have often observed considerable variations in the density of fog over short distances, and I was therefore impressed by the comparative uniformity of the fog this morning at Golders Green (about 10 a.m. on November 26th). I made almost continuous observations in walking a distance of over a mile from ground at an altitude of 300 feet to ground at an altitude of about 250 feet. The distance of visibility varied only between 14 yards and 18 yards. (The distance of visibility when I arrived in Victoria Street was well over 100 yards, and in Kingsway about 100 yards.) When I returned to Golders Green at 1 p.m. the visibility was only 7 yards on the low ground : higher up it was more variable : in some places it was 18 to 20 yards, and in others only 8-10 yards. The daylight was reasonably good : the objects observed were small trees and lamp-posts, and the ordinary criterion of visibility was used. The passage from non-visible to visible was comparatively sharp.

E. GOLD.

The time and space relationships of the fog in the London district were very interesting, and the following observations should be read in the light of my note in the *Meteorological Magazine* for February, 1925.

At 8.30 a.m. on November 26th, on the lower slopes of Hampstead Heath, the fog was very dense and damp, and there was hoar frost on the grass.

On reaching about the 300-foot contour, I rapidly walked out of the fog into brilliant sunshine and a light mild southerly breeze on the summit of the Heath at 450 feet. I anticipated this change, since the fog below, though dense, was young, and, therefore, probably shallow. This result agrees with that of the balloon reported to have been sent up at Richmond, though, of course, the thickness of a fog in the free air might quite well be different from that in the vicinity of a hill. The temperature, which was 36° down below, was certainly higher at the top, but, unfortunately, I omitted to visit the Hampstead Observatory to verify this. So striking was the contrast in the scene between the lower and higher slopes of the Hampstead ridge, that I could hardly believe it was not a time change instead of merely a space change. That it was entirely the latter, however, is proved by the fact that, on descending, I rapidly re-entered the fog at about the level of the Hampstead Tube station. The fog henceforth remained dense along the whole of my walking route to South Kensington. In the open district of St. John's Wood the fog

was extremely dense, but, as I anticipated would be the case, it thinned noticeably in the close-built business thoroughfare of Baker Street, where the pavements which hitherto had been wet were quite dry. The colour had also changed from white to yellow.

As I got near Marble Arch, the vicinity of Hyde Park was making itself felt, for great woolly banks of vapour were rolling down the side streets. In Hyde Park—always a great pool of fog when there is any about—it was just as dense as on the lower slopes of Hampstead Heath, and the temperature was even lower. Here, also, there was hoar-frost on the grass, though the trees were not in either place laden with rime, as the temperature of the air was above freezing.

As the day wore on there was no disposition for the fog to disperse, at all events north of the Thames, and at 1 p.m. the temperature in Hyde Park was still 34° , and the fog both thick and dense. In Knightsbridge about that time, although this is a close-built business street, there was some disposition for the fog to roll in the way that is so embarrassing to traffic. At King's Cross terminus, about 2 p.m., I observed a number of belated expresses arriving impressively through the gloom of a great and widespread winter fog. On returning to Hampstead at 3 p.m. I found the summit of the Heath enveloped; that is to say, the fog had grown upwards during the day. Apparently it is only close to the Winter Solstice, say a month on either side between November 21st and January 21st, that a fog has a good chance to grow during the daytime. The extension of the fog in height towards evening appears to have acted as a screen to radiation during the ensuing night, preventing it from becoming thick at low levels; for on the following morning of Sunday, November 27th, the distribution at Hampstead was the opposite of the previous morning, the fog being dense, with drizzle on the summit, but nothing more than a light mist below.

I should like once again to emphasize the importance in the discussion of London fogs of keeping the conception of the water element and the smoke element separate. It does seem to be the case that, as compared with the nineteenth century, the fogs of Central London are diminishing in severity as regards both water and smoke elements, consequent upon better drainage on the one hand, and upon smoke abatement on the other. We know little in London proper of the really severe water fogs, raw, damp, freezing, that they get down in the Essex marshes along the Thames Estuary by Muck Flats, Canvey and Foulness.

Finally, may I remark that it would be much better not to use the term "fog" for the night-like darkness of November 23rd. "Smoke-haze" is the proper term for that.

L. C. W. BONACINA.

27, Tanza Road, Hampstead, N.W. 3. November 29th, 1927.

Winter Thunderstorms

In October last an appeal* was made to readers of the *Meteorological Magazine* for reports of any thunder or lightning they might observe between October, 1926, and March, 1927. Efforts were made to secure the co-operation of observers in all parts of the British Isles. I am very much obliged to the large number of observers who were good enough to supply information.

During the period thunderstorms occurred somewhere in the British Isles on 96 days out of 182, as indicated in the following table :—

	England.	Wales.	Scotland.	Ireland.	British Isles.
1926					
October ...	16	11	10	9	21
November ...	18	11	10	12	20
December ...	5	1	4	0	8
1927					
January ...	14	8	16	14	23
February ...	6	1	3	2	7
March ...	14	5	3	7	17
TOTAL ...	73	37	46	44	96

The main stormy areas in England and Wales were in Devon and Cornwall, Sussex and Surrey, the Lake District, south-west Yorkshire and the Severn Valley. In Scotland the central part of the west coast was particularly disturbed. The prominent belt free from thunder stretching from Dorset to The Wash, which has been almost an annual feature of the storm distribution maps, was again marked.

The storm census is being continued during the present winter, and I shall again be grateful to any readers who may be good enough to send me reports of any thunder or lightning they may observe before April 1st next. A note of the place, date and time of the occurrence, with the direction in which the lightning was seen, especially at night, will be very valuable. Additional information concerning the duration, movements and severity of the storm, the accompanying weather conditions and temperature changes, will be extremely welcome.

S. MORRIS BOWER.

Langley Terrace, Oakes, Huddersfield. October 31st, 1927.

Minimum Temperatures on "Radiation Nights"

With "winter" defined as the months October to March (inclusive), and a "radiation night" as one in which the mean cloud

* *Vide Meteorological Magazine* 61 (1926), p. 217 and p. 237.

amount at 18h., 1h. and 7h. was $\frac{4}{10}$ ths or less, this note endeavours to find the relation between the screen minimum and grass minimum temperatures (both measured at 7 h., and both thermometers having standard and very good exposures) that has existed at Cranwell, Lincolnshire, which is 240 feet (approx.) above sea level, during the period October 1st, 1920, to March 31st, 1927, "winter" only being considered, on "radiation nights."

In determining the equations representing the relationships (using the usual graphical method) a three-fold differentiation was made with regard to wind speed during the night, as measured by a Dines anemometer whose head is 43 feet above ground level, taking the average of the readings at 18h., 1h. and 7h. as criteria.

Using T as the screen minimum temperature, and G, the grass minimum temperature, the three equations found were as follow :—

Mean Wind Speed.	Equation.	No. of Cases available.
8 m.p.h. or less	$T = 0.84 G + 11$	75
8 m.p.h. to 15 m.p.h.	$T = 0.89 G + 8$	94
15 m.p.h. or more.	$T = 0.94 G + 5$	50

In each case the closeness of the points on the graphs to the lines represented by the above equations was most striking.

W. H. PICK.

J. PATON.

R.A.F. Station, Cranwell, Lincolnshire, October 7th, 1927.

Road Mirages

To the motorist nowadays, the road mirage is a commonplace occurrence ; in fact, on some days the mirages are so numerous as to become almost a source of annoyance when driving. Probably the best effects are seen by the passenger in the low-built sidecar of the modern combination. It is a curious fact that no particular notice seems to have been taken of these mirages until comparatively recently, the first published description of a mirage appearing on a road in this country which I have been able to trace is by Alexander Ramage in the *Proceedings of the Royal Society of Edinburgh* in 1918. No doubt these mirages are due to the manner in which the road surface is now treated with tar and small stones or sand ; personally, I have never observed a mirage on an untarred macadam surface, but tarred roads were quite common before 1918.

The phenomenon was first brought to the notice of the general public during the hot summer of 1921 by the press, and for some

time it was a lunch time amusement of the Londoner to lie on his stomach by Admiralty Arch in order to observe the mirage in the Mall.

A point regarding these road mirages, which has always seemed somewhat inexplicable to me, is the fact that they do not appear to be disturbed by passing traffic. I know of a stretch of main road in south-west London, where, looking from the top of the hill, a very good mirage may be observed on almost any warm and sunny day in the summer. There are tram lines laid along this road, with a fairly frequent tram service running, and a constant stream of buses and cars passing up and down. The traffic along the road is particularly heavy at week ends, as it is one of the main ways out into Surrey, used by the small car owner and the motor cyclist. Yet on some Saturdays and Sundays I have known a mirage to persist nearly all day long.

The formation of a mirage must be due to a certain temperature distribution close to the ground surface, and one would think that the passage of a constant stream of vehicles of all descriptions would so stir up the air as to destroy this distribution. Even assuming that the mirage is due to the temperature distribution for a very short distance above the road surface only, the turbulence produced actually on the ground by the passage of a motor car is very considerable, if one is to judge by the effect on small pieces of paper, leaves, &c.

T. W. VERNON JONES.

The Fouling of Barometer Tubes

In the introductory remarks of a paper entitled "On the Union of Helium with Mercury," by J. J. Manley, M.A., in the *Philosophical Magazine* for October, 1927, the following statement occurs:—

"It is well known that when a barometer tube containing its normal column of mercury is moved up and down, electric charges are generated upon the glass. If a little gas be present within the tube a feeble glow is produced, and this is usually accompanied by chemical action, and a consequent decrease in pressure. In many cases also the glass walls become stained and ultimately coated with solid matter; this readily happens when the experiment is made with oxygen, nitrogen or air."

It has been shown that dirt in the vicinity of the top of the mercury column will cause the meniscus to vanish and result in positive errors of reading of about 1 mb. (*Geophysical Memoirs*, No. 27). During a recent inspection tour I came across several more barometers which exhibited similar symptoms, *e.g.* no meniscus and readings too high. In the time available during inspection, it was impossible, of course, to determine the range

of tube fouling in each case. It seems possible that Manley's experiments may throw some light on the processes causing the fouling of barometer tubes. Assuming the presence of a minute quantity of air in a tube, the rise and fall of the mercury during atmospheric changes may generate minute charges on the glass and give rise to chemical action. Under such conditions the fouling would take a very long time. It would be interesting however, to know whether marine barometers become afflicted in this way more frequently owing to pumping action at sea than station barometers.

N. H. SMITH.

R.A.F. Station, Bircham Newton, Norfolk, November 3rd, 1927.

Waterspout over southern North Sea

At my request Squadron Leader Livock, D.F.C., of this station, has written out an account of the unusual weather he and his passengers experienced on a long endurance trip over the North Sea. I thought it would make interesting reading, especially in view of the article published in the August number of the Magazine, "Waterspout on Loch Leven." The account is set out below.

"Southampton Flying Boat N.218 left Felixstowe at 9h. 30m. on August 25th, 1927, for an endurance and wireless test over the North Sea. The course followed was Felixstowe—Hook of Holland—Flamboro' Head—Felixstowe.

"The weather at the start was hazy, with thin clouds at 700 feet, wind W., 10 m.p.h. The flying boat kept above the thin clouds for the first hour or so, when it became necessary to descend to within 400 feet of the water owing to the increasing density of the clouds.

"Shortly afterwards, at 11h., and roughly in a position 15 miles west of Schouen Island, whilst skirting a heavy rain storm, my attention was drawn by the pilot (Flight-Lieut. Sawyer) to what appeared to be a complete waterspout about 5 miles south of us, reaching from a layer of clouds at about 1,000 feet to another layer at about 300 or 400 feet. This lower cloud seemed to reach right down to the water. The upper cloud was very dark and thundery looking; the lower one looked like a thick haze. The waterspout had the appearance of a very definite and clear-cut column of black cloud, thicker at the top and bottom than in the centre, and having a decided regular bend in the middle—like a bow.

"This phenomenon remained for fully five minutes, after which a layer of low cloud hid it from view, and it was not seen again. I do not think it could possibly have been a streak of cloud, as it was so sharply defined and clear cut at the edges. It looked exactly like some photographs I have seen recently in

various periodicals of waterspouts during tornadoes in Florida.

"During the rest of the flight the weather was also extraordinary. Mostly it was clear and sunny, but frequent and very heavy rainstorms were met all the way from Holland to the Yorkshire coast. The rainstorms were exceptionally heavy—in fact, some of them were quite tropical in their intensity. All these rainstorms were very local, some only being a few hundred yards in diameter. The wind during most of the flight was constantly changing force and direction. The weather, in fact, generally was very similar to that experienced in the Straits of Malacca during the so-called wet season, or the Indian Ocean during the period immediately following the south-west monsoon. I have never before seen these conditions in the North Sea, at any rate in such a pronounced form. In fact, the conditions, except of course from the temperature point of view, were entirely tropical."

The remarks by F. E. at the conclusion of the article on "Waterspout on Loch Leven" would appear to apply to the present case. He states that, in accordance with Mr. Giblett's view, waterspouts are associated with line squall phenomena, and in particular the region of strong air convergence immediately below the squall cloud which marks the forward edge of the advancing cold air.

The 7h. synoptic chart for August 25th shows a ridge of high pressure extending north-eastwards across the British Isles from an anticyclone off our south-west coasts. During the day the ridge moved south-eastwards, and a depression centred to the north-west of Iceland moved away north-eastwards.

Associated with this ridge, a very definite tongue of cold air can be identified on the maps. Continuing to move south-eastwards, this advancing air must have reached a position off the west of Denmark about 10h. in the morning, where strong air convergence, due to the cold air undercutting the warm air, would give rise to the waterspout phenomena on the lines indicated by Mr. Giblett.

C. W. LAMB.

Felixstowe, September 14th, 1927.

NOTES AND QUERIES

Heavy Rainfall in Rhodesia

The *Meteorological Report of Southern Rhodesia* for the year ending June 30th, 1926, contains particulars of abnormally heavy rainfalls during September, 1925, January and March, 1926.

September was the wettest on record except for 1901. The precipitation occurred mostly in the form of thunderstorms and

hailstorms. In October the rainfall was only slightly below normal, but in November and December the totals were so small that the planting season was a difficult one. There has been only one previous November on record during which the average rainfall was lower, viz., November, 1912, when the mean was 0.46 in. It was in January, in eastern Mashonaland, that the most continuous heavy rain occurred. Here the average rainfall was 33.90 in. as compared with a normal of 12.97 in. The maximum falls occurred at Brackenbury and Springvale, both in the Melsetter District, and constituted new records for the Colony, the previous highest monthly total having been 54.10 in. at Mount Selinda in January, 1918. The daily records given below indicate the abnormal rainfall between the 6th and 20th.

Date	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th
Brackenbury	—	1.10	—	—	0.86	3.76	3.90	4.20	4.25	3.65	4.10	3.80	3.80	4.60
Springvale ...	—	—	0.13	0.19	0.54	2.04	1.03	0.26	1.32	3.02	1.13	2.05	9.17	3.07
Date	15th	16th	17th	18th	19th	20th	21st	22nd	23rd	24th	25th	26th-30th	31st	Total
Brackenbury	4.22	3.99	3.91	4.32	3.03	3.10	—	—	0.65	—	0.26	—	0.67	62.17
Springvale ...	3.04	5.53	4.58	7.04	5.01	7.19	—	—	—	—	—	—	—	56.81

Continuous heavy rain was also experienced between January 9th and 20th in the Umtali district, when totals of 29.76 in. and 26.59 in. were recorded for the 12 days at Stapleford and Chimeze respectively. Owing to these heavy rains "abnormal floods were experienced along the eastern border, which resulted in extensive washaways on the railway between Umtali and Beira. The damage was so serious that communication was not resumed until April."

A storm of unparalleled intensity occurred at Tjompani, in Bulalima-Mangwe district, on the night of March 7th, 1926. The observer (Mr. F. Rayner) states: "At 7 p.m. on the 7th, a black heavy cloud a few miles north-west from here assumed a funnel shape and started in this direction; lightning was very vivid and continuous. The waterspout burst near here, and a wall of water came against a light south-east wind. We got it at 8 p.m., and in 40 minutes 6 inches fell. It passed on then to the mission and Plumtree direction. It was followed by a gentle rain. Storm was only about 3 miles wide; much lighter south-west from here, where only 1 inch fell."

New Rainfall Record

According to the *Bulletin of the American Meteorological Society*,* the record for intense rainfall (2.47 in. in 3 minutes at Porto Bello, Panama, on November 29th, 1911) was broken during

*Vol. 8, 1927, p. 142.

the early morning of April 5th, 1926, at Opid's Camp on the west front of the San Gabriel Range, California, when 1.02 in. of rain fell in one minute. The fall was measured by a Fergusson weighing rain-gauge with a good exposure. "By a lucky chance the observer, John T. Opid, had set up a second gauge of the same pattern in order to compare it with the station gauge previous to its installation at another camp some miles away. Thus it happened that the shower was recorded by two gauges, and the records were practically identical."

Heavy Daily Falls of Rain in France during 1926*

While details of the heavy falls of rain during 1926 in the British Isles are still fresh in our minds, it may not be without interest to refer to the extremes recorded in France. M. J. Sanson (Sous-Chef de Section technique à l'Office National Météorologique) shows that there were 34 records of more than 100 mm. (3.94 in.) in 24 hours in the course of the year. The corresponding number for the British Isles is very close, being 29, but the extreme values are considerably less than those recorded in France. The largest value for these islands was 6.05 in. on July 18th at Abergwesyn (Nantneuadd) in the mountains to the west of Llanwrtyd Wells in Central Wales. In France this amount was exceeded on four occasions, the largest falls being 7.48 in. on September 1st at the Mont-Aigoual (Gard) and 7.39 in. on November 18th at Trigance (Var), both in the extreme south-east of the country. In the British Isles the daily falls exceeding 100 mm. were distributed about equally between summer and winter months, but in France four-fifths of such falls occurred in September, October and November. The heavy falls in the British Isles for 1926 were fairly well distributed, some occurring in each country, and in the plains as well as in the mountain areas, but in France they were mainly confined to the mountains south of latitude 45°, *i.e.*, roughly south of Bordeaux and Valence. In the mountainous south-eastern portion of France between the Rhone and the Alps, the autumn is usually very wet, October being the wettest month of the year.

As the year 1926 was generally very wet in France, the heavy daily falls were not so marked as might have been expected. In the British Isles, with only a slight excess, the number of heavy falls was about the average.

It is interesting to recall that while the largest daily falls available for the British Isles are 9.56 in. at Bruton on June 28th, 1917, and 9.40 in. at Cannington on August 18th, 1924, those in

* *Les grandes pluies en France pendant l'année 1926.* By M. J. Sanson, Météorologie, Paris, 3 (1927) pp. 221, 222.

France have exceeded 10 inches on a number of occasions. Some of the largest amounts are :—

	Inches.
Joyeuse (Ardèche), 9th October, 1827	31·18
L'Observatoire de Perpignan (Pyrénées Orient), 26th October, 1915	17·13
Le Mont-Aigoual (Gard), 20th May, 1917	14·52
Bessèges (Gard), 24th September, 1919	11·81
Orange (Vaucluse), 23rd September, 1924	11·33

It will be noticed that all these stations are situated in the extreme south-east of France, and that four out of the five entries occur in the autumn. The largest fall on record was measured 100 years ago, when it rained continuously for 22 hours.

J. GLASSPOOLE.

Air Temperatures during rain at Kimberley

A good soaking rain of some duration, at Kimberley, will, in a few hours, be accompanied by a cooling of the air to a degree which will alter very little until the end of the shower. Immediately afterwards the temperature mostly rises again by day, and often by night. For example—

On March 15th, 1926 :

Hour	...	...	...	14	15	16	17	18
Temperature (°F.)	...	...	...	75·4	56·5	57·3	61·0	61·9
Rainfall (inch)	...	...	...	...	·710	·060	·060	—

Lowest temperature observed 56°·5, average (mean of mean daily max. and min.) for March, 1926, 72°·3, difference 15°·8.

On January 26th, 1923 :

Hour	...	14	15	16	17	18	19	20	21	22	23	Midt.	1
Temp. (°F.)	...	71·2	64·0	61·0	61·0	61·0	61·0	61·0	61·0	62·0	62·1	62·5	63·5
Rain (inch)	...	·130	·430	·190	·001	·009	·040	·080	·040	·009	·008	·010	—

Lowest temperature observed 61°·0, average (mean of mean daily max. and min.) for January, 1923, 75°·9, difference 14°·9.

The minimum temperature of the air during these continued showers is, perhaps, of some interest.

Suppose we tabulate for each month of the ten years 1916 to 1925 the lowest temperature reached by the air during each rain spell lasting some hours in which the humidity rises above 90 per cent. Then take the average of these minima for any given month and compare it with the mean temperature of the month. The table below shows that the differences between these monthly averages and monthly means vary progressively from midsummer to midwinter.

For each month of Column A—

Column B gives the number of continued showers satisfying the humidity conditions.

Column C the average of the minimum temperatures reached by the air during these showers.

Column D the lowest, and Column E the highest, of these minima.

Column F the mean temperatures of the air for the months that have the rain. They differ a little from the normal means.

Column G the differences $F - C$.

According to the table there is a difference in December of more than 13° F. between the mean temperature of the air and the average minimum during rain; whereas in May the corresponding difference is less than 2° . June has to be left out of account for lack of material.

TEMPERATURE OF AIR DURING RAIN, 1916 TO 1925.

	Frequency	Average Minimum	Lowest Minimum	Highest Minimum	Monthly Mean	Difference $F - C$
A	B	C	D	E	F	G
Jan. ...	7	63.3	59.0	66.8	76.1	12.8
Feb. ...	15	63.3	57.2	66.2	73.4	10.1
Mar. ...	24	61.6	55.5	67.5	69.3	7.7
Apr. ...	7	58.2	54.0	65.1	62.1	3.9
May ...	8	51.7	48.5	53.2	53.6	1.9
June ...	1	39.7	—	—	47.7	—
July ...	4	45.6	41.5	49.8	49.2	3.6
Aug. ...	4	46.6	43.6	51.1	53.9	7.3
Sept. ...	3	52.8	48.9	57.0	61.0	8.2
Oct. ...	5	58.2	53.5	60.2	68.9	10.7
Nov. ...	7	59.0	55.0	61.5	70.9	11.9
Dec. ...	8	61.2	58.0	65.0	74.4	13.2

J. R. SUTTON.

East-Monsoon Forecasting in Java*

The first forecasts of seasonal rainfall in Java were based on the well-known three-year periodicity of barometric pressure at Batavia and Port Darwin.^(†) Periodicities are treacherous allies, however, and the method has not been so successful as it promised, and in this paper Dr. Berlage investigates the reasons for the occasional failures; in doing so he develops a new, empirical method of forecasting. The basis of the formula is the observed fact that the change of pressure at Port Darwin is closely related to the sea temperature south of Celebes; the winds associated with the pressures also affect the sea temperature, so that "the interaction of air-pressure and temperature...generates regular oscillations of both elements about their normal values if no external causes intervene." The forecasting formula for the rains of the second half of the east monsoon (July to September),

*East-Monsoon Forecasting in Java. by Dr. H. P. Berlage, Jr. *K. Mag. Meteor. Obs. Batavia, Verh.* No. 20. Size $10\frac{1}{2} \times 7\frac{1}{2}$, pp. 42. *Illus.* Batavia, 1927.

† See *Meteorological Magazine* 55 (1920), p. 205.

therefore begins with the pressure at Batavia in the preceding December to February and in the December to February before that ("what will be, does not only depend on what is, but also on what has been") and air temperature at Singapore, as the best available representative of the sea temperature. This gives satisfactory results in most years, but there are some exceptions. These are allowed for partly by introducing a wind component, which is ingeniously derived from the ratios of rainfalls on different sides of a mountain in south-west Celebes. The rainfalls for west Java calculated by this combined formula have a correlation of .85 with the observed rainfalls (1879 to 1924). So far only purely local elements have been considered, but a still further improvement is obtained by making use of the observed coincidence that the rare rains of northern Peru, which fall only once in seven (6-8) years, are almost invariably followed by droughts in Java. This relationship is allowed for by deducting 10 cm. from the forecasted rainfall for those years, and the final forecasts have a correlation with observed values of .86 in west Java, .81 in central Java and .72 in east Java. A closer approximation is for the present barred by the fact that sudden rises of pressure and droughts occur exactly at sunspot minima, and it is not yet possible to forecast the minima of sunspots. The paper is an interesting example of the gradual approach to perfection by tracing failures to disturbing causes and so bringing more and more factors into the formula.

Mysore Meteorological Memoirs

The first of the *Mysore Meteorological Memoirs* was published as early as 1901, and contained hourly values of barometric pressure for each of the years 1895-8, but only the monthly means of the hourly values of each of the other elements (dry and wet bulb temperatures, vapour pressure, humidity, rain, wind and sunshine) recorded at the Bangalore Observatory. The second memoir also contained only monthly averages of the hourly means for all elements, including pressure for each of the quadrennial periods 1895-8, 1899-1902 and 1903-6, and for the twelve-year period 1895-1906. Since then the hourly values for each year have been published as separate memoirs, those for 1909-13 (Memoirs V.-IX.) having just been received.

Control readings of a standard barometer are taken ten times a day, and of a standard thermometer six times daily. The pluviograph and anemograph are both of the Beckley type. As it was found that, even with a cloudless sky, the strength of the solar image was insufficient to char the card for half-an-hour after sunrise and half-an-hour before sunset, the maximum period of sunshine between sunrise and sunset has been taken

to be an hour less in estimating the percentage of bright sunshine. It is gratifying to note the progress which the Mysore Meteorological Department is making towards bringing their publications up to date.

Reviews

Climate and Geography. By O. J. R. Howarth. Size $7\frac{1}{4} \times 4\frac{3}{4}$, pp. 61. *Illus.* The Oxford Geographers, Oxford University Press, 1927.

This useful little book is stated to have been written "to supplement where desirable the sections on climate in geographical text-books." In about 50 pages of text it contains a good deal of information calculated to be of value to teachers, including a chart of the annual range of mean monthly temperatures and an account of the "polar front" theory of cyclones. An appendix includes tables of monthly mean temperature and rainfall for a number of stations typical of different climates. The preface states that the book has been written in collaboration with Mr. M. A. Giblett.

The Brückner Cycle of climatic oscillations in the United States.

By A. J. Henry, *Annals of Association of American Geographers*, June, 1927, pp. 60-71. Hamilton, New York.

Professor A. J. Henry has examined a number of long series of meteorological records, especially regional averages for the United States, with a view to determining whether series of warm or cold, or of wet or dry years occur around the dates given by Brückner as the maxima and minima of his 35-year cycle of temperature and rainfall. He finds that there are such sequences of abnormal years, but that the average interval between them is from 9 to 16 years instead of 35 years. Some of the maxima or minima agree with Brückner's dates, but there is nothing to distinguish them from the other maxima and minima occurring at intermediate dates. This result does not disprove the reality of Brückner cycle, which, as Prof. Henry himself remarks, was supported by overwhelming evidence, and has never been seriously questioned, but it brings out clearly that its amplitude is not large enough to dominate the changes of a few years' duration. In order to demonstrate the existence of the longer cycle, the data must either be analysed into an harmonic series or smoothed by averaging over a period of about fifteen years.

C. E. P. BROOKS.

News in Brief

Lieut. Col. E. L. Bond, D.S.O., R.A., has been appointed Representative of the War Office on the Meteorological Committee in place of Lieut. Col. J. U. Hope, D.S.O., R.A., who

has been elected Secretary of the Ordnance Committee.

The Academy of Sciences has decided to divide the Nobel Physics Prize for 1927 into two halves, one of which is awarded to Prof. C. T. R. Wilson, of Cambridge, for his method of observing electrified particles. The other recipient is Prof. A. Compton, of Chicago.

According to *The Times*, it is announced in Johannesburg that Dr. Robert Innes, Union Astronomer since 1911, is retiring at the end of the year. Dr. Innes went to South Africa in 1896 as Secretary of the Royal Observatory at the Cape, becoming Director of Meteorology (Transvaal) in 1903.

The Weather of November, 1927

Cold unsettled weather prevailed generally throughout November, with the exception of the first few days, during which the conditions were mild, with moderate to strong southwesterly winds and much rain. Temperatures higher than any previously recorded in November were reported on the 2nd from Eskdalemuir (59° F.), Aberdeen (63° F.), Yarmouth (64° F.) and Tynemouth (67° F.), and on the 3rd, from Kew Observatory (64° F.), where the previous maximum was 63° F. in 1876. Among the largest rainfall amounts were 4.03 in. at Treherbert (Glamorgan) and 2.47 in. at Cardiff on the 1st, and 2.30 in. at Strathspey (Lancaster) on the 2nd. As the low pressure system shifted northeast, the winds became first westerly, then northerly, and increased to gale force locally on the 5th-6th. Sleet, hail and snow fell in the north, and thunderstorms and heavy rain occurred locally, East Ayton (Yorkshire) having 1.73 in., and Llanerchymedd (Anglesey) 1.55 in., both on the 7th. The drop in temperature was very striking. At Kew, for example, the maximum on the 8th was 38° F., 26° F. lower than on the 3rd, while the minimum readings showed similar differences. On the morning of the 9th a screen minimum temperature of 18° F. was registered at West Linton, and a grass minimum of 11° F. at Blackpool. Snow lay on the ground in Scotland and northeast England, and on the 8th was 8 in. deep at Balmoral and 11 in. deep at Slochd (Inverness). Further strong northerly winds and gales occurred on the 7th to 11th, gusts of about 60 m.p.h. being measured at Tiree (Hebrides) and in northwest England, and snow, sleet and hail fell again in various places in both Scotland and England, the depth of snow lying being 17 in. at Slochd (Inverness) on the 11th. The lowest screen temperature of the month (13° F.) was recorded at Balmoral on the 13th. On the 14th the winds backed, and during the next few days somewhat milder conditions prevailed with southerly winds, but between the 18th and 21st the wind shifted to the east and became strong at times,

with gales at a few exposed places. From the 22nd to 28th quiet cloudy weather occurred in the southeast and Midlands, with much fog at times, especially on the 26th, when it lasted most of the day. In the north and west the winds were mainly southwesterly in direction and strong in force during most of this time, and the weather unsettled with local rain. On the 29th heavy rain in southeast England, *e.g.*, 1.57 in. at Upton Grey (Hampshire) was associated with a shallow trough of low pressure which passed across these islands in the early morning. In its rear, the weather over the country became cloudy to fine, with much morning mist or fog.

Pressure was above normal in a belt stretching from northern Scandinavia across the Netherlands, British Isles and North Atlantic to Bermuda and Newfoundland, and also in Italy and south-east France, the greatest excess being 7.2 mb. at St. John's, Newfoundland. Pressure was below normal in Spitsbergen, Iceland and most of Spain, France and Switzerland. Temperature was below normal over the whole of Europe except in parts of Switzerland and at Spitsbergen, the deficit amounting to 9°—11° F. in the north-west of Dalecarlia (Sweden). Precipitation was generally above normal in the districts surrounding the North Sea and Spitsbergen and below normal in northern Scandinavia and Switzerland.

Stormy weather prevailed generally over Europe from the 9th to 11th, the gales causing much damage to shipping along the coasts of Spain, Portugal and south France and in the Tyrrhenian and Adriatic seas, while severe floods followed the heavy rains in northern France, western Germany and Switzerland. In Switzerland the floods soon abated somewhat in consequence of a large drop in the temperature and the heavy snowfalls, which occurred after the 10th and which caused the ski-ing season to begin much earlier than usual. The drop in temperature was not confined to Switzerland and between the 13th and 15th trains and trams in Lithuania, Latvia and Estonia were held up for many hours on account of the heavy snow, and owing to the severe cold shipping ceased for the season in the upper Norrland about the 15th, and wolves have been seen in larger numbers than usual on the eastern borders of Poland. Thunderstorms and gales caused loss of life in Spain between the 18th and 21st and snow was reported in Asturias and the Spanish zone in Morocco.

Much of the crops in the citrus orchards in the northern Transvaal were destroyed by hail on the 6th and many animals were killed. As the result of the heavy rain in Morocco, Safi, a port on the Atlantic coast, suffered serious damage on the 23rd owing to the flooding of the river which passes through the

town. Torrential rains in western Algeria caused the bursting of the Wad Fergoug dam on the 25th and in consequence about 900 square miles of the low lying Perrégaux, Mostaganen and Ténès districts were flooded. It is estimated that about 2,000 people lost their lives. Villages isolated by the water received food supplies by aeroplane. Heavy rain continued to fall until the 30th when the Wad Chélif also overflowed its banks. By the 1st the weather had become fine and the floods were abating.

A severe storm swept across Nellore (India) on the 5th followed by floods. Much damage was done and it is believed that about 200 people were killed. Violent storms were also reported from the Arabian Sea and Bombay on the 12th when nearly 5 in. of rain fell at Bombay. Several ships were sunk.

Rains of unprecedented violence occurred during the first few days of the month in the New England States of Vermont, Massachusetts and Connecticut, and these were followed by widespread floods as many of the river dams and reservoirs on the Connecticut river and its tributaries burst. Many villages and small towns were wiped out as the crest of the flood passed down the river. By the 7th the floods had begun to subside in Vermont and New Hampshire and by the 8th in the more southern states. Below Hartford the river widens rapidly and the floods were not serious. About 150 people were drowned and the distress of the homeless was accentuated by the severe cold. Relief work was carried out mainly by means of aeroplanes. On the 5th the floods extended northwards to the eastern townships of Quebec where much damage was done and 9 people were drowned. By the 7th these rivers were also returning to their normal level and a drying sun was improving the conditions. On the 17th a violent storm swept across Washington, New York State and parts of Pennsylvania, a rainstorm caused further difficulties in the flooded districts of Vermont, and in the west a blizzard brought 2 in. of snow over northern Illinois, Indiana and southern Wisconsin.

The special message from Brazil states that in the central districts the rainfall was very scarce, being 4.0 in. below normal, in the northern districts the average was 0.5 in. below normal and in the southern districts the distribution was irregular, but the average was 1.6 in. above normal. Six anticyclones passed across the country and depressions were frequent in the south and were associated with abnormally high temperatures in the Argentine and southern Brazil. At Rio de Janeiro pressure was 0.9 mb. above normal and temperature 0.7° F. above normal.

Rainfall, November, 1927—General Distribution

England and Wales	..	121	} per cent. of the average 1881-1915.
Scotland	.. .. .	106
Ireland	.. .. .	93
British Isles	.. .. .	111

Rainfall: November, 1927: England and Wales

CO.	STATION.	In.	Per- cent. of Av.	CO.	STATION.	In.	Per- cent. of Av.
<i>Lond.</i>	Camden Square	2.60	110	<i>Leics</i>	Thornton Reservoir ..	3.76	166
<i>Sur.</i>	Reigate, The Knowle ..	2.97	102	"	Belvoir Castle	3.12	140
<i>Kent.</i>	Tenterden, Asbenden ..	3.02	100	<i>Rut.</i>	Ridlington	3.31	...
"	Folkestone, Boro. San.	3.57	...	<i>Linc.</i>	Boston, Skirbeck	3.15	158
"	Margate, Cliftonville ..	2.65	110	"	Lincoln, Sessions House	2.52	134
"	Sevenoaks, Speldhurst ..	3.17	...	"	Skegness, Marine Gdns.	2.84	131
<i>Sus.</i>	Patching Farm	3.55	100	"	Louth, Westgate	3.39	131
"	Brighton, Old Steyne ..	3.39	106	"	Brigg .....	...	...
"	Tottingworth Park	4.16	112	<i>Notts.</i>	Worksop, Hodsock	2.30	117
<i>Hants</i>	Ventnor, Roy. Nat. Hos.	3.55	111	<i>Derby</i>	Derby	3.14	145
"	Fordingbridge, Oaklands	3.78	111	"	Buxton, Devon. Hos. ..	4.77	102
"	Ovington Rectory	4.48	135	<i>Ches.</i>	Runcorn, Weston Pt. ...	3.82	138
"	Sherborne St. John	3.84	135	"	Nantwich, Dorfold Hall	2.86	...
<i>Berks</i>	Wellington College	3.08	120	<i>Lancs</i>	Manchester, Whit. Pk. ...	3.22	122
"	Newbury, Greenham	3.24	116	"	Stonyhurst College	5.49	122
<i>Herts</i>	Benington House	2.54	107	"	Southport, Hesketh Pk	4.28	136
<i>Bucks</i>	High Wycombe	3.82	153	"	Lancaster, Strathspey .	5.02	...
<i>Oxf.</i>	Oxford, Mag. College ..	2.60	118	<i>Yorks</i>	Wath-upon-Deerne	2.59	127
<i>Nor.</i>	Pitsford, Sedgbrook	3.00	136	"	Bradford, Lister Pk. ...	3.43	117
"	Oundle	2.55	...	"	Oughtershaw Hall	7.86	...
<i>Beds.</i>	Woburn, Crawley Mill ..	2.17	97	"	Wetherby, Ribston H. ...	2.49	106
<i>Cam.</i>	Cambridge, Bot. Gdns. ...	2.22	115	"	Hull, Pearson Park	2.47	113
<i>Essex</i>	Chelmsford, County Lab	2.32	103	"	Holme-on-Spalding	2.56	...
"	Lexden, Hill House	2.23	...	"	West Witton, Ivy Ho. ...	4.09	...
<i>Suff.</i>	Hawkedon Rectory	2.87	126	"	Felixkirk, Mt. St. John	3.18	130
"	Haughley House	2.26	...	"	Pickering, Hungate	4.30	...
<i>Norfol.</i>	Beccles, Geldeston	3.96	170	"	Scarborough	4.6	181
"	Norwich, Eaton	5.17	201	"	Middlesbrough	3.73	176
"	Blakeney	2.59	117	"	Baldersdale, Hury Res. .	4.40	...
"	Little Dunham	3.44	133	<i>Durh.</i>	Ushaw College	2.19	86
<i>Wills.</i>	Devizes, Highclere	2.62	99	<i>Nor.</i>	Newcastle, Town Moor .	2.77	115
"	Bishops Cannings	2.80	98	"	Bellingham, Highgreen	3.82	...
<i>Dor.</i>	Evershot, Melbury Ho. ...	3.77	88	"	Lilburn Tower Gdns. ...	3.45	...
"	Creech Grange	4.13	...	<i>Cumb</i>	Geltsdale	4.98	...
"	Shaftesbury, Abbey Ho. ...	3.44	106	"	Carlisle, Scaleby Hall .	4.25	142
<i>Devon</i>	Plymouth, The Hoe	4.39	120	"	Seathwaite M. ....	...	...
"	Polapit Tamar	4.08	96	"	Keswick, High Hill	4.72	...
"	Ashburton, Druid Ho. ...	4.41	78	<i>Glam.</i>	Cardiff, Ely P. Stn.	5.90	142
"	Cullompton	4.03	117	"	Treherbert, Tynywaun	9.69	...
"	Sidmouth, Sidmount	3.23	104	<i>Carm</i>	Carmarthen Friary	5.95	119
"	Filleigh, Castle Hill	3.81	...	"	Llanwrda, Dolaucothy .	6.13	104
"	Barnstaple, N.Dev.Ath. ...	3.75	95	<i>Pemb</i>	Haverfordwest, School	6.83	136
<i>Corn.</i>	Redruth, Trevirgie	5.00	103	<i>Card.</i>	Gogerddan	3.27	69
"	Penzance, Morrab Gdn. ...	4.02	88	"	Cardigan, County Sch. ...	4.99	...
"	St. Austell, Trevarna ..	4.60	94	<i>Brec.</i>	Crickhowell, Talymaes	5.00	...
<i>Soms</i>	Chewton Mendip	5.03	118	<i>Rad.</i>	Birm. W.W.Tyrmynydd	4.41	66
"	Street, Hind Hayes	2.95	...	<i>Mont.</i>	Lake Vyrnwy	7.76	140
<i>Glos.</i>	Clifton College	3.21	102	<i>Denb.</i>	Llangynhafal	4.49	...
"	Cirencester, Gwynfa	2.54	85	<i>Mer.</i>	Dolgelly, Bryntirion ..	6.80	110
<i>Here.</i>	Ross, Bitchlea	3.01	119	<i>Carn.</i>	Llandudno	5.11	165
"	Ledbury, Underdown	3.08	126	"	Snowdon, L. Llydaw 9	20.46	...
<i>Salop.</i>	Church Stretton	4.48	153	<i>Ang.</i>	Holyhead, Salt Island .	6.00	145
"	Shifnal, Hatton Grange	3.11	130	"	Lligwy	7.47	...
<i>Worc.</i>	Ombersley, Holt Lock	3.07	135	<i>Isle of Man</i>			
"	Blockley, Upton Wold	2.95	100	"	Douglas, Boro' Cem. ...	5.01	106
<i>War.</i>	Farnborough	3.35	122	<i>Guernsey</i>			
"	Birmingham, Edgbaston	3.83	161	"	St. Peter P't. Grange Rd	4.40	105

Rainfall: November, 1927: Scotland and Ireland

CO.	STATION.	In.	Per- cent. of Av.	CO.	STATION.	In.	Per- cent. of Av.
<i>Arg.</i>	Stoneykirk, Ardwell Ho.	4.71	118	<i>Suth.</i>	Loch More, Achтары...	8.34	98
"	Pt. William, Monreith.	5.13	...	<i>Caith.</i>	Wick	3.63	116
<i>Kirk.</i>	Carsphairn, Shiel.	7.80	...	<i>Ork.</i>	Pomona, Deerness	4.50	115
"	Dumfries, Cargen.....	5.46	121	<i>Shet.</i>	Lerwick	6.05	142
<i>Rorb.</i>	Branzholm	2.24	68	<i>Cork.</i>	Caheragh Rectory	6.08	...
<i>Selk.</i>	Ettrick Manse	5.69	...	"	Dunmanway Rectory.	6.21	100
<i>Berk.</i>	Marchmont House	3.31	110	"	Ballinacurra	4.04	101
<i>Hadd.</i>	North Berwick Res.	1.89	84	"	Glanmire, Lota Lo.	4.17	97
<i>Midl.</i>	Edinburgh, Roy. Obs..	1.40	65	<i>Kerry</i>	Valentia Obsy.	4.12	76
<i>Lan.</i>	Biggar .....	...	...	"	Gearahameen	9.90	...
"	Leadhills .....	...	...	"	Killarney Asylum.....	5.64	101
<i>Ayr.</i>	Kilmarnock, Agric. C.	4.93	131	"	Darrynane Abbey	4.34	87
"	Girvan, Pinmore	5.74	108	<i>Wat.</i>	Waterford, Brook Lo..	3.94	104
<i>Renf.</i>	Glasgow, Queen's Pk..	3.86	103	<i>Tip.</i>	Nenagh, Cas. Lough...	3.17	79
"	Greenock, Prospect H..	8.28	129	"	Roscrea, Timoney Park	2.74	...
<i>Bute.</i>	Rothsary, Ardenraig.	5.44	107	"	Cashel, Ballinamona ..	2.54	78
"	Dougarie Lodge	6.96	...	<i>Lim.</i>	Foynes, Coolmanes ..	2.92	72
<i>Arg.</i>	Ardgour House	10.76	...	"	Castleconnell Rec.	2.50	...
"	Manse of Glenorchy..	8.90	...	<i>Clare</i>	Inagh, Mount Callan ..	3.28	...
"	Oban	5.42	...	"	Broadford, Hurdlest'n.	3.20	...
"	Poltalloch	5.18	92	<i>Wexf.</i>	Newtownbarry	3.39	...
"	Inveraray Castle	10.69	127	"	Gorey, Courtown Ho..	2.97	85
"	Islay, Fallabus	5.73	106	<i>Kilk.</i>	Kilkenny Castle	2.85	93
"	Null, Benmore	9.80	...	<i>Wic.</i>	Rathnew, Clonmannon ..	3.28	...
"	Tiree	4.25	...	<i>Carl.</i>	Hacketstown Rectory ..	3.07	79
<i>Kinn.</i>	Loch Leven Sluice	3.56	99	<i>QCo.</i>	Blandsfort House	2.66	80
<i>Perth</i>	Loch Dhu	9.05	103	"	Mountmellick	3.21	...
"	Balquhiddie, Stronvar.	7.97	...	<i>KCo.</i>	Birr Castle	2.48	80
"	Crieff, Strathearn Hyd.	3.35	77	<i>Dubl.</i>	Dublin, FitzWm. Sq..	2.41	90
"	Blair Castle Gardens ..	...	...	"	Balbriggan, Ardgillan ..	3.63	126
<i>Forf.</i>	Kettins School	3.04	109	<i>Me'th.</i>	Beauparc, St. Cloud ..	2.70	...
"	Dundee, E. Necropolis ..	2.97	122	"	Kells, Headfort	2.77	81
"	Pearsie House	3.33	...	<i>W.M.</i>	Moate, Coolatore	2.02	...
"	Montrose, Sunnyside ..	2.14	81	"	Mullingar, Belvedere ..	2.34	69
<i>Aber.</i>	Braemar, Bank	3.01	78	<i>Long</i>	Castle Forbes Gdns.	2.38	66
"	Logie Coldstone Sch.	3.72	121	<i>Gal.</i>	Ballynahinch Castle ..	5.00	84
"	Aberdeen, King's Coll..	3.99	135	"	Galway, Grammar Sch.	2.79	...
"	Fyvie Castle	5.64	...	<i>Mayo</i>	Mallaranny	6.33	...
<i>Mor.</i>	Gordon Castle	2.83	98	"	Westport House	4.24	87
"	Grantown-on-Spey	3.93	131	"	Delphi Lodge	10.44	...
<i>Na.</i>	Nairn, Delnies	2.56	108	<i>Sligo</i>	Markree Obsy.	3.86	93
<i>Inu.</i>	Ben Alder Lodge	4.85	...	<i>Cav'n</i>	Belturbet, Cloverhill..	2.52	81
"	Kingussie, The Birches ..	3.65	...	<i>Ferm.</i>	Enniskillen, Portora ..	3.59	...
"	Loch Quoich, Loan .....	...	...	<i>Arm.</i>	Armagh Obsy.	3.40	120
"	Glenquoich	11.79	97	<i>Doun.</i>	Fofanny Reservoir	9.15	...
"	Inverness, Culduthel R.	2.08	...	"	Seaforde	3.84	101
"	Arisaig, Faire-na-Squir ..	5.31	...	"	Donaghadee, C. Stn..	3.35	110
"	Fort William	8.31	102	"	Banbridge, Milltown ..	3.42	124
"	Skye, Dunvegan	7.36	...	<i>Antr.</i>	Belfast, Cavehill Rd..	4.35	...
<i>R&C</i>	Alness, Ardross Cas. ..	3.25	81	"	Glenarm Castle	5.79	...
"	Ullapool	5.07	...	"	Ballymena, Harryville ..	4.20	104
"	Torridon, Bendamph..	9.55	103	<i>Lon.</i>	Londonderry, Creggan ..	4.64	113
"	Achnashellach	8.42	...	<i>Tyr.</i>	Donaghmore	4.36	...
"	Stornoway	5.66	97	"	Omagh, Edenfel	3.97	105
<i>Suth.</i>	Lairg	4.07	...	<i>Don.</i>	Malin Head	3.66	112
"	Tongue	4.83	105	"	Dunstanaghy	4.25	90
"	Melvich	5.11	128	"	Killybegs, Rockmount ..	6.88	109

Climatological Table for the British Empire, June, 1927

STATIONS	PRESSURE			TEMPERATURE							Relative Humidity	PRECIPITATION			BRIGHT SUNSHINE		
	Mean of Day M.S.L.	Diff. from Normal	n.b.	Absolute		Mean Values			Mean	Mean Cloud Am't		Am't from Normal	Diff. from Normal	Days	Hours per day	Percentage of possible	
				Max.	Min.	Max.	Min.	1/2 and 3/4									Wet Bulb
London, Kew Obsy.	1013.2	- 3.5	80	43	64.9	49.5	57.2	- 2.0	50.3	6.6	2.53	+ 0.38	16	5.4	33		
Gibraltar	1016.4	- 1.0	86	59	80.3	64.5	72.4	+ 1.9	63.1	5.5	0.19	- 0.29	1	...	...
Malta	1016.2	+ 0.6	91	62	82.5	69.9	76.2	+ 3.5	68.7	2.4	0.00	- 0.09	0	11.9	82		
St. Helena	1014.7	+ 1.9	73	55	64.2	57.5	60.9	- 0.1	58.3	2.9	1.19	- 2.88	13	...	...
Sierra Leone	1013.1	+ 1.1	90	68	86.6	72.0	79.3	- 1.0	75.4	6.4	20.46	+ 0.42	25	...	...
Lagos, Nigeria	1011.2	- 1.7	89	70	84.7	74.6	79.7	+ 0.4	75.4	5.5	7.08	- 11.57	14	...	...
Kaduna, Nigeria	1015.4	+ 1.6	91	...	86.0	...	...	...	71.8	...	5.49	- 2.36	14	...	...
Zomba, Nyasaland	1020.4	+ 2.9	80	41	70.1	49.5	59.8	- 3.1	...	5.5	0.52	+ 0.04	8	...	...
Salisbury, Rhodesia	1021.7	+ 0.8	76	33	69.1	40.5	54.8	- 2.1	48.6	1.9	0.00	- 0.05	0	9.2	83		
Cape Town	1021.6	+ 1.5	84	38	69.1	48.1	58.6	+ 2.9	48.4	2.8	1.69	- 2.82	5	...	...
Johannesburg	1025.5	+ 2.1	69	32	61.0	40.8	50.9	+ 0.2	40.7	1.1	0.00	- 0.14	0	9.2	88		
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	70	21	62.7	31.9	47.3	- 0.3	34.6	2.2	0.00	- 0.47	0	...	...
Calcutta, Alipore Obsy.	1000.2	+ 0.5	101	75	92.3	80.2	86.3	+ 1.2	81.1	7.5	11.45	- 0.45	11*	...	...
Bombay	1004.6	+ 0.6	93	74	88.2	79.8	84.0	+ 0.1	78.2	7.0	32.52	+ 12.65	16*	...	...
Madras	1003.9	+ 0.1	109	76	99.5	81.2	90.3	+ 0.2	76.4	6.9	3.53	+ 1.64	7*	...	...
Colombo, Ceylon	1009.3	+ 0.6	87	73	85.6	77.0	81.3	- 0.4	78.3	8.7	8.64	+ 0.67	24	5.3	42		
Hongkong	1005.7	- 0.4	91	74	85.9	78.7	82.3	+ 0.9	78.5	8.0	11.68	- 4.41	20	6.4	47		
Sandakan	...	...	91	74	87.7	74.9	81.3	- 0.4	77.4	...	5.56	- 1.74	14	...	...
Sydney	1021.5	+ 3.7	70	39	60.7	45.7	53.2	- 1.4	46.8	4.9	4.18	- 0.59	15	4.8	48		
Melbourne	1022.0	+ 3.5	65	30	56.6	40.2	48.4	- 2.0	42.9	6.4	1.35	- 0.74	15	4.3	45		
Adelaide	1021.0	+ 2.0	68	36	60.4	45.8	53.1	- 0.4	46.8	6.1	1.56	- 1.59	11	4.0	41		
Perth, W. Australia	1015.4	- 2.5	71	41	63.6	48.5	56.1	- 0.7	51.6	6.4	7.98	+ 1.06	16	4.4	44		
Coolgardie	1017.3	- 1.8	69	33	59.9	41.7	50.8	- 1.9	47.2	5.4	1.54	+ 0.31	11	...	...
Brisbane	1020.3	+ 2.2	79	44	69.1	51.6	60.3	+ 0.1	53.5	4.6	3.21	+ 0.58	8	6.5	63		
Hobart, Tasmania	1019.1	+ 4.8	60	32	50.4	38.7	44.5	- 2.3	39.4	5.7	1.16	- 1.04	13	4.2	47		
Wellington, N.Z.	1017.9	+ 3.0	57	31	52.8	41.6	47.2	- 2.2	44.9	7.3	5.44	+ 0.67	17	3.6	39		
Suva, Fiji	1013.9	+ 0.3	88	65	81.1	70.7	75.9	+ 1.0	72.0	6.4	9.91	+ 3.76	18	4.6	42		
Ap a. Samoa	1012.6	+ 1.0	87	72	84.9	75.0	79.9	+ 2.1	76.9	6.3	4.10	- 3.72	5	9.9	75		
Kingston, Jamaica	1014.2	+ 0.4	91	71	88.9	73.5	81.2	- 0.1	72.1	4.0	0.38	- 0.90	24	...	...
Grenada, W.I.	1009.5	- 3.6	88	72	85.0	75.2	80.1	+ 1.2	75.9	8.1	9.22	+ 0.24	10	10.1	66		
Toronto	1015.0	+ 0.7	95	39	72.2	50.8	61.5	- 1.1	56.1	4.5	2.52	- 1.47	14	8.3	51		
Winnipeg	1011.9	- 0.6	85	35	71.6	51.2	61.4	- 0.8	53.6	4.8	1.79	- 1.79	8	8.2	53		
St. John, N.B.	1013.7	- 0.3	76	39	64.3	47.0	55.7	+ 0.8	50.9	5.1	3.77	+ 0.50	8	8.2	53		
Victoria, B.C.	1016.2	- 0.7	82	47	65.0	50.6	57.8	+ 0.8	53.4	6.1	0.84	- 0.09	6	8.7	54		

*For Indian stations a rain day is a day on which 0.1 in. or more rain has fallen.

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Effect of the Gale of October 28th on Electrical Transmission Lines

In last month's *Meteorological Magazine* Mr. Crichton gave an account of the gale which occurred over the British Isles on October 28th last. Since that account was written attention has been drawn to a peculiarity of the gale which will be of interest to readers of the magazine.

A few days after the gale a number of electrical engineers wrote to enquire whether there had been any abnormal electric or magnetic phenomena accompanying the gale, for considerable trouble had been experienced with overhead transmission lines during and after the gale. In all cases the trouble had been the same: the automatic switches which are set to break the current when it exceeds a definite amount were constantly in action, indicating an excess current in the lines.

The gale commenced soon after midday on Friday, October 28th, reached its maximum at midnight and was practically over by 7 a.m. on Saturday morning. The surprising point in the reports received from the engineers was that while the trouble commenced in south Wales on the Friday evening, when the gale was at its height, no trouble was experienced in the Midlands until Saturday, when the gale had been over nearly 12 hours. The trouble continued everywhere until the early hours of Sunday morning, when it disappeared as mysteriously as it had appeared.

An examination of the electrograms at Kew and Eskdalemuir showed that there were no abnormal electrical effects and no magnetic storm was reported. It was clear, therefore, that the trouble was not due to atmospheric electricity or to terrestrial magnetism. In view of the difference in time of the commencement of the trouble in south Wales and in the Midlands, it was difficult to see how any meteorological factor could be the cause.

The first clue to the solution of the problem was contained in a letter from Mr. Parsons, the observer at Ross-on-Wye, in which it was stated :—

“ A curious thing occurred with the gale of the 28th/29th. On the morning of the latter date I found the lens of the sunshine-recorder covered with a ‘ smeary ’ substance like mud or butter, the ball appeared non-transparent as if ‘ frosted.’ I rubbed my finger on the ball and on putting it to my tongue noticed a strong salty taste. Some friends of mine experienced a similar deposit on their windows (facing west and southwest). The northeast part of the lens was hardly affected. The air was very dry at the time (humidity 60 per cent. and less).

“ I have had similar experience before with strong winds (especially from west) and low humidity, but never so pronounced as on this last occasion.

“ The ‘ smeary ’ substance, moreover, was difficult to remove all at once. A subsequent fall of rain washed the last traces away.

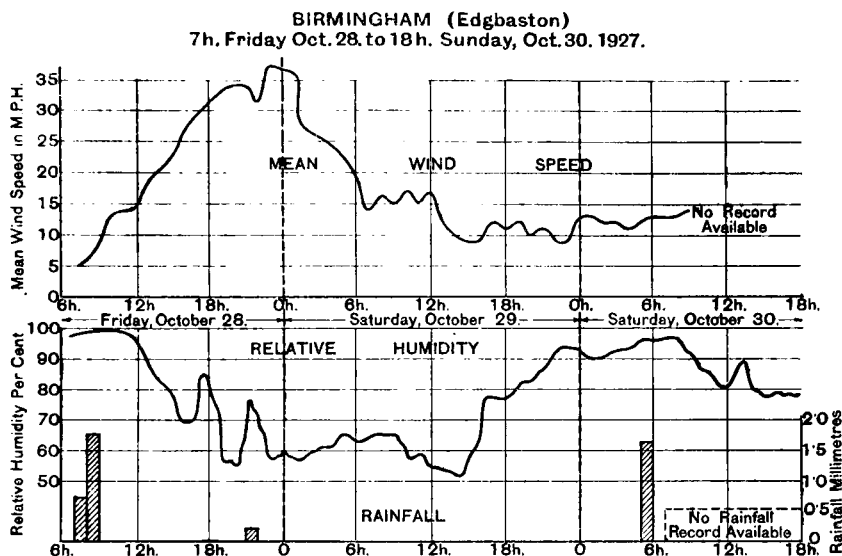
“ Could the ‘ salt ’ have been due to sea-spray borne by the gale from the Bristol Channel (22 miles away as the crow flies) ? ”

An examination of the records from a number of stations showed that when the gale set in the air became very dry, the relative humidity falling to 50 per cent. in places. The air remained dry after the gale was over, but at about 4 p.m. on Saturday there was a rapid rise in relative humidity which rose in the course of an hour or two from 50 to 80 per cent., and then continued to rise until the air became nearly saturated. The curves of wind velocity, relative humidity and rain at Birmingham are shown on the accompanying diagram. The cause of the engineers’ trouble now became clear, and the following explanation, which has been accepted by all the engineers, was given.

During the gale, which was from the southwest, great quantities of spray were blown up by the wind all along the west coast. The spray was carried inland by the wind and coated the insulators of the power lines in south Wales with a layer of salt water which practically short circuited them, so that the safety switches came into action. As the spray-laden wind passed inland the water was evaporated owing to the low humidity of the air. By

the time the air had reached the Midlands the spray had been reduced to salt crystals.

Sea salt is hygroscopic; therefore, the crystals remained sufficiently damp to stick on the insulators of the power lines in



the Midlands, but the coating of salt was too dry to destroy the insulation completely. When the air became damp on Saturday evening the insulation failed here also, just 24 hours after the failure in south Wales. In the early morning of Sunday rain became general; this washed the insulators clean and the trouble was over.

In connexion with this experience it is interesting to consider what quantities of salt must be spread all over the country side during our frequent southwesterly gales.

The Cold Spells of December, 1927

By C. K. M. DOUGLAS, B.A.

During the second half of November and the early part of December, there were several periods when high pressure over Scandinavia caused easterly winds over central and western Europe. There was a good deal of frost over Germany, but the cold air was only a shallow layer, and when it reached the British Isles its temperature was consistently above the freezing point, with dull weather. About December 12th a very large anti-cyclone came down from the northward between north Greenland and Spitsbergen, and eventually covered Iceland and Scandinavia. In consequence a great outbreak of genuine polar air spread over the whole of Europe except Spain, reaching the

British Isles from the east. On December 14th a depression moving east-south-east across our southwest districts caused a snowfall over central and northern England, Wales, and the extreme south of Scotland (6 in. at Cranwell), most of which lay for a week. The very cold air reached eastern England on the 16th and soon spread over the whole country, and though, of course, the temperature was higher in the extreme southwest than in other districts, it was much below the normal. During the next few days screen minimum temperatures below 20° F. were rather frequent (e.g., 5° F. at Balmoral on the 17th and 18th, 9° F. at Nairn on the 18th, 15° F. at Croydon and Shoeburyness on the 19th), but the coldness of the days was the most marked feature, the temperature being continuously below the freezing point for five days at many places over a large area. Such spells of cold days were frequent between 1890 and 1895, but have been very rare since then, especially in the south, though the cold spell of early 1917 was much longer, with some colder nights.

The very cold period from December 16th to 20th was accompanied by occasional snow, but amounts were mostly trifling except over a comparatively narrow strip up the east coast, where observers reported a few inches of dry snow lying right down to sea level. This unusual occurrence may be attributed to very cold air aloft, the temperature being down to 5° F. at 5,800 feet over Farnborough (Hants) on the 19th.

On the 20th the Scandinavian anticyclone decreased in intensity and passed away quickly southeastward, while a deep Atlantic depression approached the southwest of Ireland. In consequence mild air came in quickly from the southwest and a "glazed frost" occurred in London and many other parts of England, which caused great inconvenience and numerous street accidents. At Croydon the temperature in the early part of the night fell to 19° F. in the screen and 12° F. on the grass, and the rain began to fall at about 1.30 a.m., with the air temperature still below the freezing point. Fortunately the rainfall was small, averaging about 3 mm. (0.12 in.) in London before 7 a.m., but, nevertheless, the glazed frost was probably the worst which has occurred in the Metropolis since January 17th, 1903, when there was a very similar development.* It would be interesting to know whether a really severe "ice storm" has ever been recorded in this country. How serious the effects of such storms can be in the United States is well shown by some remarkable photographs in the *Monthly Weather Review* for February, 1922.

On the previous day (December 20th) there had already been a large rise of temperature in the upper air, amounting to no less than 25° F. at about 5,000 feet over Farnborough in 28 hours,

* See *British Rainfall*, 1903, p. [4].

a large inversion having developed between 3,000 and 4,000 feet. On the morning of the 21st an inversion of 20° F. was observed at Utrecht between the ground and 3,300 feet, and both on the 20th and 21st there was very dry air above the inversions at Utrecht, indicating that the air had descended and been warmed by compression. Such warm dry air at about 3,000 feet is always found at the western boundary of an anticyclone (on the 20th the anticyclone still included Holland and southeast England within its boundaries), and there can be no doubt that it played an important part both in preventing snowfall and in limiting the amount of precipitation, which was small (except in the southwest districts) considering the pronounced nature of the "warm front" at the earth's surface (see fig. 1).

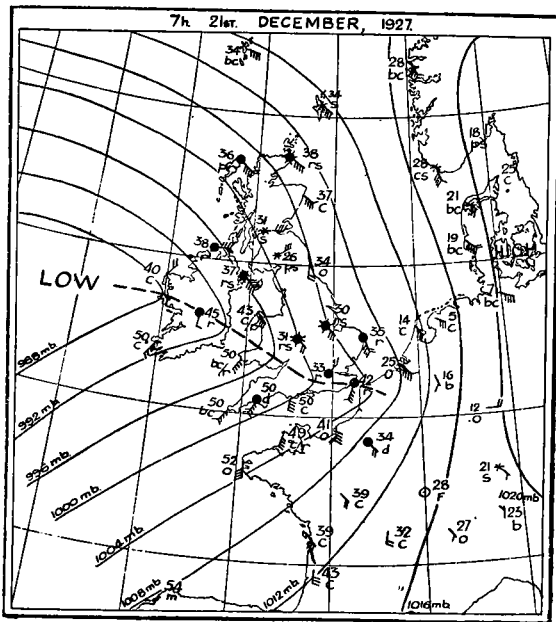


FIG. 1. Chart for the morning of the glazed frost.

On the following day, December 22nd, a very deep depression crossed the British Isles with heavy rainfall generally. In the rear of this system cold northeasterly winds spread back from Scandinavia across our northern districts, with renewed frost and snow on the high ground after a very short break. A "polar front" was practically stationary over southern England on the 24th, and during the following night a deep depression developed over the western part of the English Channel. On Christmas day there was snow in the Midlands but continuous heavy rain in the south of England. Towards evening the cold air spread southwards (see fig. 2) and the rain turned to snow, which fell heavily throughout the night over nearly the whole of southern England, and throughout Boxing Day and the following

night in the southeastern counties. Precipitation for the 48 hours from 7h. 25th exceeded 40 mm. (1·6 in.) at several stations, and reached 60 mm. (2·4 in.) at Lympne, in southeast Kent, but much of this fell as rain; the snow did not reach Lympne until the 26th. The mean depth of the snow exceeded a foot on the higher ground over a large area, but near sea level there was considerably less, much of it having melted. At some places on the east and southeast coasts there was no snow lying. The

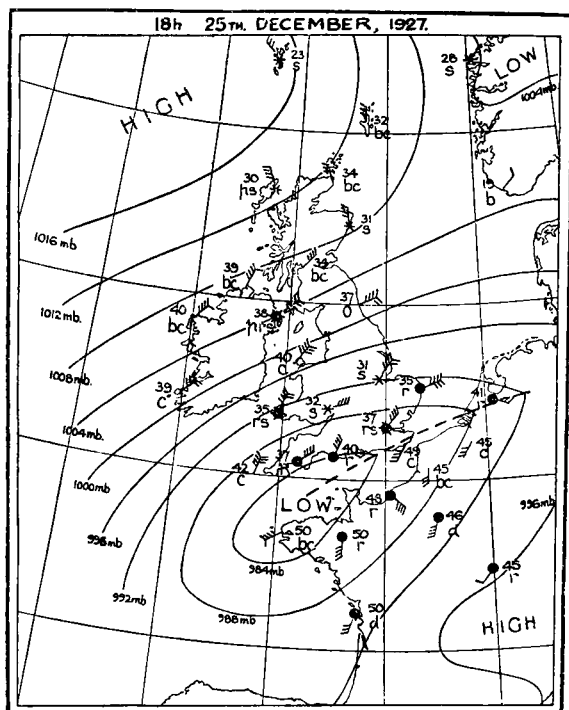


FIG. 2. Chart for evening of Christmas Day, the commencement of the great snowstorm over southern England.

snow was of the soft clinging type and broke down numerous overhead wires and branches of trees wherever there was shelter from the wind. In spite of this there was very severe drifting, with serious interruption of rail and road communication. The northeast wind was practically up to gale force inland at exposed places, and winds of this strength will drift any snow which is not water-logged or crusted. The strong winds continued till the 29th with further drifting, the weather being fine and frosty. Drifts as deep as twenty feet were reported from Salisbury Plain, while broad drifts of closely packed snow of about six feet in depth were very numerous, with sastrugi and small cornices. Some villages were isolated for days, and many of the main roads were blocked till the New Year.

Returning to fig. 2 for a more detailed study, we may note the dotted line marking the polar front, which had become much sharper during the afternoon, and was being pushed slowly southeastwards. The deep depression over the western part of the English Channel moved slowly southeastward and filled up, and a large anticyclone came in over northern Scotland and increased greatly in intensity, maintaining the strong northeast to east winds in southern districts, with a prolonged gale in the English Channel. Subsequently the anticyclone moved slowly eastward across Scandinavia, and milder weather spread in over the southwest districts on the night of December 30th, but only became general on the night of January 1st, when an intense depression skirted our northwest coasts. Further snow occurred in some districts on December 31st, notably in Wales, the Midlands and London, but near the south coast of England there was rain. When the strong winds died down there was some severe frost, the screen minimum being 13° F. at Croydon on the morning of December 30th and 11° F. at Eskdalemuir on the morning of January 1st.

To find a parallel to recent conditions in southern England, one must go back to the historic storms of January 1881 and March 1891. It may be noted that the 1881 storm immediately followed severe frost, and was accompanied by a lower temperature than that of 1927, so that fine powdery snow drifted about even in the streets of London.

Weather and Antiquaries

The publication by the Royal Meteorological Society of a paper by Mr. G. M. Meyer on the early history of water-mills in east Kent, and its bearing on variations of rainfall in the eleventh to fourteenth centuries,* affords an opportunity of calling the attention of antiquaries and historians to the contributions which they may sometimes be able to make to British climatology. Mr. Meyer's contention is that records of water-mills in Domesday and in mediæval law-suits show that the streams of east Kent were more powerful at the end of the eleventh century than they are to-day, and that the decrease was most rapid about 1275. There is some other independent evidence to the same effect. For example, a count of the British records of storms and floods on the one hand, and of droughts on the other hand, shows that from 1051 to 1250 there were recorded 23 floods and 21 droughts, while from 1251 to 1400 the records give 14 floods and 27 droughts. Another happening which may have some bearing on changes of rainfall is that in the thirteenth or fourteenth century the Little

* Early Water mills in relation to changes in the rainfall of east Kent. By G. M. Meyer. *London, Q.J.R. Meteor. Soc.*, 53 (1927), p. 407.

Hundred River, in Suffolk, was closed by a shingle bar which grew across its mouth, one possible explanation being that owing to a decrease of rainfall the stream ceased to be sufficiently powerful to keep clear a channel to the sea.

Each of these three lines of evidence, taken alone, may be susceptible of some explanation other than a change of rainfall. The flow of the east Kent streams may have been affected by some obscure factor which Mr. Meyer has not taken into account, or he may have made insufficient allowance for the factors, such as underground drainage, which he has included. The change in the ratio of floods to droughts may simply result from the operation of chance in the making and preserving of records. The blocking of the Little Hundred River may be due to a change in the currents of the North Sea, and have nothing to do with the rainfall. But the three pieces of evidence together, all pointing to a decrease of rainfall at about the same time, have a cumulative value, and add greatly to the probability that the suspected decrease was real.

The water-mills of east Kent cannot be an isolated instance. All over the country there must be similar records of the past which have a bearing on the climatic conditions of Great Britain before the commencement of instrumental meteorology. No doubt a great many such have already come to the notice of antiquaries who, being engaged in some definite line of research, have not cared to follow up what seem to be side issues. It may be that some particular fact, taken by itself, is meaningless, but taken in conjunction with similar facts from other parts of the country, it may become significant. Mr. Meyer has suggested an instance from the history of the Brent marsh on the River Brue in Somersetshire. This marsh had been drained some time before 1304, but the drainage works had been allowed to fall out of repair. From 1304 to 1335 new drainage works were carried out. This may mean nothing, but if it appears that the drainage works of other marshes in different parts of the country were also allowed to fall out of repair in the last half of the thirteenth century and repaired early in the fourteenth, it would suggest the intercalation of a relatively dry period between two periods of heavier rainfall.

In suggesting to antiquaries and historians that they should note and publish such records which may have a bearing on weather conditions, one is not asking them for a disinterested service. Climatic conditions form part of the stage on which the drama of British history has been carried out. History is not only a record of wars, rebellions and the enactment of laws; behind all these are the variations of the harvests, the price of corn, and all those factors which make the difference between content and unrest in an agricultural population. When the

record is more fully known, one may find that the villainy of a bad king was the villainy of the weather, or that a reign of happy memory happened to coincide with a series of good seasons. Such changes, too, may have their influence on the growth of religious movements. A picturesque example occurs in Bede's *Ecclesiastical History of England*, Book IV., Chapter 13* ; " But Bishop Wilfrid, while preaching the Gospel to the people (the South Saxons, A.D. 681), not only delivered them from the misery of eternal damnation, but also from a terrible calamity of temporal death. For no rain had fallen in that district for three years before his arrival in the province, whereupon a grievous famine fell upon the people and pitilessly destroyed them But on the very day on which the nation received the Baptism of the faith, there fell a soft but plentiful rain, the earth revived, the fields grew green again, and the season was pleasant and fruitful." This incident will be familiar to readers of Kipling in the story of " The Conversion of St. Wilfrid." The duration and severity of the drought are no doubt exaggerated, but any further evidence would be very welcome.

OFFICIAL NOTICE

Precipitation

Difficulties have arisen from time to time in regard to the meaning of certain words such as " continuous," " occasional," &c., in connexion with precipitation.

The following notes are a summary of the rules which have been drawn up for the guidance both of the observers who make the reports, and of the meteorologists who interpret the reports.
Use of the word " continuous."

Strictly speaking, the word " continuous " is not appropriate to a report of present weather, but as the present weather code covers the weather of the past hour and no weather before that period, the word " continuous " for the present weather code must be decided by what has happened in the past hour. All the observer therefore has to do is to decide whether the rain (precipitation) which he is reporting appears to him to be continuous or not in view of the experience of the past hour.

In reports of past weather, a break of only ten minutes' duration in a period of continuous rainfall can be disregarded, but a break of half an hour must be taken into account. The duration of precipitation necessary to justify the use of the word " continuous " in reports of past weather cannot be rigidly fixed. If it rained without a break for two hours it should undoubtedly be described as " continuous rain." If it rained

* A. M. Sellar's translation, London, 1907, p. 246.

for only half an hour it would not be called continuous rain. If it rained for an hour in the middle of a period without rain, it would not be necessary to describe it as continuous, *e.g.*, the description in Beaufort letters o, or, o, would be appropriate. If, however, the hour's rain came at the beginning of a period, and was the continuation of continuous rain which had been reported in the last report, it would still be reported as continuous rain in the new report.

Occasional Precipitation—Showers.

In general, showers are of short duration, and the fair periods between the showers are usually characterised by definite clearances of the sky. The clouds which give the showers are isolated clouds. The precipitation does not usually last more than fifteen minutes, although it may sometimes last for half an hour or more.

Occasional precipitation, on the other hand, usually lasts for a longer time than showers, and the weather in the periods between the precipitation is usually cloudy or overcast. The experienced observer will usually decide from the type of cloud which description to use.

Drizzle—Slight rain.

Drizzle is not "rain in small amount," but "precipitation in which the drops are very small." Slight rain, on the other hand, is precipitation in which the drops are of appreciable size (they may even be large drops), but are relatively few in number. Observers should decide from the combined effect of the number and size of the drops whether the precipitation is slight, moderate or heavy.

There are some occasions when rain is observed to be falling through drizzle: both the drizzle and the rain should be noted in the register.

Discussions at the Meteorological Office

The subjects for discussion for the next meetings will be :—
January 30th. *Les sondages aérologiques par avion et la théorie des cyclones de Bjerknes.* By J. Jaumotte (Bruxelles, Ciel et Terre, 43, 1927, pp. 31-36 and 49-54). *Opener*—Mr. E. V. Newnham, B.Sc.

February 13th. *Wolken und Gleitflächen.* By G. Stüve (Lindenberg, Arbeit. Preuss. Aerol. Obs., 15, 1926, pp. 214-224) and other papers. *Opener*—Mr. R. F. Budden, M.A.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, December 14th, at 49, Cromwell Road, South Kensington,

Sir Gilbert T. Walker, C.S.I., F.R.S., President, in the chair.

Sir Napier Shaw, R. G. K. Lempfert and E. E. Austin.—International Commission for the Upper Air; Report on the International Days of 1923.

A specimen volume was shown consisting of four parts, the first an introduction, regulations laid down by the Commission, and a list of stations in all parts of the world which may contribute information; the second a list of data for each international day and maps of distribution of pressure over the northern and southern hemisphere for that day; the third a tabular statement of the data for the upper air reported to the Commission; and the fourth a graphical representation of the results of registering balloons on an entropy diagram. The paper explains the way in which the details of the maps, tables and diagrams were arrived at as a development of the ideas expressed in the *Réseau Mondial*, which is published annually by the Meteorological Office on the lines of the work on *Dynamic Meteorology and Hydrography* by Prof. V. Bjerknes and others. The volume contains the first maps of the distribution of pressure for the whole globe and indicator-diagrams for expressing the energy relations of the atmosphere as disclosed by observations with registering balloons.

Correspondence

To the Editor, *The Meteorological Magazine*

The Storm of October 28th—29th, 1927

I had been hoping to see an account of the storm of October 28th-29th, and have now read the account of it by Mr. J. Crichton in your last number.

This laboratory has for a considerable time maintained in constant operation on the Varne Lightvessel, a long period current meter, which is customarily left down working at the depth of about 6 fathoms for periods of three lunar days. This lightvessel is situated roughly midway between Folkestone and Boulogne, and the instrument in use there serves to register the "make" of water through the Straits of Dover, over and above the oscillatory streams due to the tides.

We have amassed a large amount of data relative to the variation of the currents with changing winds and barometric pressure distributions, but the currents in advance of, and at the time of occurrence of, this storm seem to be of more than usual interest.

It is not possible to go into any detail here, but it may interest your contributor and some of your readers to see the following figures relating to the currents registered at the time in the

Straits of Dover. No doubt, a consideration of wind and pressure distribution would be valuable in this connexion.

Three-day Period.				Current (towards true direction).		
(15-18) October, 1927	..	..	1.6 miles per day	N.	8°	E.
(19-27) " 1927	..	..	2.5 " "	N.	22°	E.
(22-25) " 1927	..	..	6.6 " "	N.	52°	E.
(25-28) " 1927	..	..	10.1 " "	N.	54°	E.
(28-31) " 1927	..	..	7.3 " "	N.	42°	E.
31st October to 3rd November, 1927			3.8 " "	N.	45°	E.
(4-7) November, 1927	..	..	2.6 " "	N.	38°	E.

It is very interesting to note the waxing and waning of the residual current with its maximal value at the time of the storm. The fact that the observations refer to three-day periods, results in the actual current at the precise time of chief interest being masked. No doubt the current was much stronger for one particular day, but, in any case, the net flow of water in the three-day period was abnormally large.

Only once in three years has a stronger flow of water been registered at the Varne Lightvessel. This was during the period 19th to 22nd of November, 1926.

J. N. CARRUTHERS.

Fisheries Laboratory, Lowestoft, Suffolk. December 29th, 1927.

Star-shaped Snowflakes

There were slight showers of snow here in the early morning hours of December 14th. In the thin sprinkling of snow which was lying at 7h. there were numerous crystal aggregates in the form of regular six-pointed stars. The diagonal measurement of the largest stars was about four to five millimetres. Similar stars were observed among the small snowflakes which fell at 9h. on the same day. The speed of the north-easterly wind did not exceed 15 m.p.h. at the surface. The air temperature was 32.1° F. at 9h., the minimum read at 7h. being 30.0° F.

Star-shaped snowflakes such as described may be fairly common, but this is my first experience of them.

H. W. L. ABSALOM.

The Observatory, Eskdalemuir, Langholm, December 15th, 1927.

Mirage at Sea

Mr. W. R. Butterfield (the Observer at Hastings) reports that on December 16th during "most of the afternoon a form of mirage occurred off Hastings. Ships passing up and down the Channel appeared to be raised above the horizon, and their inverted images were clearly visible below. I could not myself see the French coastline, but other observers declared that they had seen it."

Miss C. M. Botley, a well-known resident at Hastings, adds to the above account that "these observations were made between 15h. and 16h., and that the afternoon was more or less cloudy with a north-easterly wind and very good visibility. Unfortunately it was impossible to obtain the sea temperature. There had been snow in the morning."

The maximum temperature as recorded in the screen that day at Hastings was 34° F.

Sunset Colours and Cloud Forms as Aids to Weather Forecasting

Being on holiday at Clevedon, Somerset, from September 6th to 20th, I availed myself of the opportunity of forecasting from sunsets and cloud forms where it is claimed Turner gave us some of his fine examples. I was rewarded with one of the most brilliant sunsets I have seen for many a long year on the 9th, showing the sun setting between parallels of lenticular stratus interspersed with golden yellow and red colours, and I concluded rain would follow. The barometer was unstable, and the wind backing or veering, all giving confidence to such a forecast. On the 19th the sun went down as a great enlarged disc and the after glow cast yellow and red on cirro-stratus cloud; rain fell in the morning of 20th, but the day was bright and fair.

At home on September 28th in the early evening I was struck by the appearance of a remarkable cloud formation, a long line of boat-shaped front with beaded cumulus edge and stratus base, stretching from south to north, and in the centre nearest north squares of stratus on front edge with parallels of stratus strips on each side of square with frilled edges; just previously I had noticed scud cloud, medium and small moving from south to north. I concluded a gale would follow, it did on the 29th with rain, the front formation reminding me of a Noah's Ark cloud I had seen at Hastings in July, 1922, when a great gale followed. On the 29th I noted yellow and red sunset after rain, and I decided for light showers with fair periods; the 30th was fine, with two light showers in afternoon of 0.02 in. I make use of instruments by daily observation and forecasts at sunset, cloud formation and sunset colours affording valuable assistance in successful results.

HENRY A. ROGERS.

31, Fernbank Road, Redland, Bristol. October 4th, 1927.

Ground Horizontal Visibility and Convection

In the *Meteorological Magazine* for April, 1924, p. 63, and for December, 1925, p. 260, were given the results of an investigation

into the relationship between upward convection currents and ground horizontal visibility at 13h., and that investigation has now been continued over a total of eight summers, 1920-1927 inclusive. As in the previous notes, the criterion for the presence of convection currents upward is taken in the continued investigation to be the presence of cumulus or cumulo-nimbus cloud at or about 13h. The extended results obtained are shown in the accompanying table, and further emphasise the conclusion previously arrived at, that convection days are more likely to be accompanied by good visibility, that is, a visibility of 13 miles or more, than are non-convection days, and are extremely unlikely to be accompanied by poor visibility, that is, a visibility of less than $2\frac{1}{4}$ miles.

Cumulus or Cumulo- Nimbus at or about 13 h.	Total No. of Ob- servations.	Ground Horizontal Visibility at 13h.					
		13 miles or more.		$2\frac{1}{4}$ miles or more but not reaching 13 miles.		Less than $2\frac{1}{4}$ miles.	
		Total No.	Per cent.	Total No.	Per cent.	Total No.	Per cent.
Present	1,023	508	49.4	517	50.3	3	0.3
Absent	436	110	25.2	310	71.1	16	3.7

WILLIAM H. PICK.

R.A.F. Station, Cranwell, Lincolnshire. November 15th, 1927.

The Lasting Qualities of Small Rubber Balloons

The article on the lasting qualities of rubber balloons in the November number of the *Meteorological Magazine* suggests that it may be of interest to some of your readers to know of a method of preventing rubber from perishing that has been in use at Helwan Observatory, Egypt, for many years. All objects of rubber, balloons, tubing, etc., are there stored in a chest which under a perforated shelf has a pan containing turpentine. Vapour from the turpentine keeps the rubber in a fresh and pliant state for years, though when exposed to the outside air in hot dry climates it hardens and perishes very quickly. I believe this simple but effective method is but little known.

H. KNOX-SHAW.

Radcliffe Observatory, Oxford, November 30th, 1927.

NOTES AND QUERIES

Dust Devils

In looking through meteorological literature relating to dust devils some time ago I was unable to find any definite observa-

tions of the direction of rotation of actual dust devils. In some cases the assertion was made that the dust devils usually rotated in a cyclonic direction; in other cases it was asserted that the dust devils rotated sometimes in one direction and sometimes in another.

The meteorological services in the Middle East (Lower Egypt and Palestine) and in Iraq were therefore asked to note when possible the actual direction of rotation of dust devils and any other features of interest in connexion with them. The direction of rotation was specified as cyclonic if the direction was in the same sense as that of the winds in a cyclone and anticyclonic if the rotation was in the same sense as the winds in an anticyclone (of the Northern Hemisphere). It appears from the reports of actual observations from April to October, 1927, that the rotation is sometimes in one direction and sometimes in another. Out of the reports of 54 dust devils which have been received from Middle East, 26 were cyclonic and 24 were anticyclonic; in the remaining 4 the direction of rotation was not determined. Out of 33 dust devils of which reports have been received from Iraq, 17 were cyclonic and 11 were anticyclonic; in the remaining 5 the direction of rotation was not determined. The majority of the dust devils observed occurred in the months May-September.

The estimated heights of dust devils vary considerably. In some cases they are estimated to be as low as 10 or 20 feet; in other cases as high as 2,000 feet or 3,000 feet. The speed with which they move also varies considerably. It may be as low as 4 miles per hour; it may be as high as 30 miles per hour. On one or two occasions dust devils have passed in very close proximity to the observation stations. On May 24th, 1927, a dust devil moving at a speed of 30 to 35 miles per hour from west to east, passed through the enclosure in which the meteorological hut at Abu Sueir is situated. It produced a gust of 35 miles per hour on the anemobiograph and the microbarograph record fell suddenly about half an inch on the chart and rose again immediately. This corresponds roughly with a depression of about 1 millibar in the pressure. The direction of rotation was cyclonic and the height was estimated to be 1,000 feet. Another dust devil which passed quite close to the hut at Abu Sueir on July 29th was moving from north to south with a speed of 20 to 25 miles per hour. On this occasion the barograph chart showed a fall of pressure of about one millibar and the anemobiograph a gust of 30 miles per hour. The direction of rotation of this devil was anticyclonic and its height was estimated to be 150 feet.

A complete discussion of the observations has not yet been

made, but these facts may be of interest to the readers of the *Meteorological Magazine*.

E. GOLD.

Abnormal Rainfalls

In the article under the above title in the *Meteorological Magazine* for February, 1927, on page 4, is quoted an amount of 35·7 in. at Beerwah, Queensland, on February 2nd, 1893. Mr. Inigo Jones, who recorded the observation referred to, writes that the station is not really Beerwah, which is on the coast flats and has not so much rain, but Crohamhurst, in a valley basin formed by the Blackall and Durundur Ranges and facing south-east, which is the direction of the wind on the advancing quadrant of the tropical storms coming down the coast and hence is the chief rain-bearing wind. He also sends further details showing the following succession of heavy falls in 1893: January 30th, 2·368 in.; January 31st, 10·775 in.; February 1st, 20·056 in.; February 2nd, 35·714 in.; February 3rd, 10·76 in.; February 4th, 1·690 in. Other heavy falls at the same station were: 1898—January 9th, 19·415 in.; January 10th, 15·955 in.; March 6th, 16·230 in.; March 7th, 17·070 in.

The Rainfall of 1927

While popularly 1927 will be remembered as a year of dismal weather, the worst in a series of 6 consecutive wet years, those who keep statistics must join with the country gentleman who, when abruptly asked some 200 years ago by the taciturn Swift "Pray, sir, do you remember any good weather?" was able to answer "Yes, sir, . . . I remember a great deal of good weather." The rainfall of 1927 has been exceeded in nearly all parts of the country by that of other years within living memory, and the year contained a number of unusually dry periods. During February there was less than half the average rainfall in the northern half of Scotland and in the north-east of England. May was generally dry and markedly so in the south and south-east of England, where the month was warm and sunny. In most districts also the first half of October was fine and dry. The year 1927 was unusually prolific in meteorological peculiarities to the last. In December, while the south-east of England experienced more than the average of rain and snow, the English Lake District and Scotland were relatively dry. In Keswick the total for the month was only 1·45 in. or just over 20 per cent. of the average. Over Scotland generally it was the driest December since before 1870 with the one exception of that of 1890.

Over the British Isles the rainfall exceeded the average in every month, except May, October and December, but there was a well-

marked excess only in June, August and September. September was the wettest month of the year, although it was not as wet as that of 1918. Although the total rainfall of the six summer months was remarkably heavy, exceeding 150 per cent. of the average summer fall in the south-east of England and of Scotland, appreciably larger falls are on record in all parts of the British Isles. The run of wet months from June to September was the most striking feature of the rainfall of the year, being wetter over the British Isles generally than similar periods in any year back to 1879, when the fall was slightly greater.

One of the most unusual features of the rainfall during the year in London was the intense fall of over 3 in. during the afternoon thunderstorm of July 11th, when 2 in. fell in little over half an hour. The rainfall of August Bank holiday in the south-east of England was not remarkable, although its incidence influenced considerably the popular impression of the weather of the year. In London (Camden Square) the total for the year of 33.84 in. was 9.37 in. or 38 per cent. in excess of the average of the period 1881 to 1915. It was, however, the wettest year only since 1916, and the duration of rainfall, 568 hours, was exceeded as recently as 1919 and 1916.

There were considerable areas with less than the average during 1927 along the north-west coast of Scotland, from the Isle of Mull to Cape Wrath, in central and northern Ireland from Westmeath to Loch Foyle, and in the extreme south-west of Wales and of Ireland. The deficiencies were everywhere less than 10 per cent. Over Ireland more than 110 per cent. occurred over large areas in Connemara, round Cork and Mallow and along parts of the east coast, but the fall does not appear to have exceeded 120 per cent. In Scotland falls exceeding 120 per cent. were wide-spread in the south-east and east, while rather more than 130 per cent. was recorded in the neighbourhood of Edinburgh and Haddington. In England and Wales there was more than 130 per cent. over three well defined areas, part of Dartmoor, a narrow strip from Worcester to Northampton and a much larger area stretching from Bath to Oxford in the north-west to Ventnor, Brighton and Folkestone in the south. In the last mentioned area falls exceeding 140 were widespread. At High Wycombe the total was the largest for 80 years.

From the information at present available the following general values for 1927 have been computed:—

England and Wales	..	43.8 in.	124	} per cent. of average 1881-1915
Scotland	.. ..	57.2 in.	114
Ireland	.. ..	46.2 in.	107
British Isles	.. ..	48.9 in.	118

The annual values were considerably exceeded for Scotland and Ireland in 1924, and for England, in 5 years out of the last 100,

namely 1903, 1882, 1872, 1852 and 1848, when the computed values were 128, 127, 144, 137 and 129 per cent. of the average respectively. Over the British Isles generally 1927 was wetter than any year since 1903, though it differed little from 1924 and 1912.

—
J. GLASSPOOLE.

Obituary

William Henry Dines, F.R.S.—All readers of this magazine will have heard with profound regret of the death of Mr. W. H. Dines, which occurred on Christmas Eve at the Old Observatory, Benson, and will desire to express their sympathy with Mrs. Dines and with his two sons, who are our colleagues on the staff of the Office.

Interest in meteorology may almost be said to be hereditary in the Dines family, for Mr. Dines's father was the inventor of the dew-point hygrometer, which still goes by his name, and is described in most text-books of physics. To many of us it has constituted our first acquaintance with meteorology.

Mr. W. H. Dines was born in 1855. He served an apprenticeship as a railway engineer, and then proceeded to Corpus Christi College, Cambridge, where he read mathematics and graduated as a Wrangler in 1881. From that time onwards he devoted himself to meteorology, but did not hold an official position. He was in the true and best sense of the word an amateur, never seeking to enhance his personal reputation, still less to secure financial advantages for himself, but he has left an indelible impress on the progress of the science. Of an exceedingly reticent and retiring nature, he was essentially an individual worker, yet a great deal of his work was done in co-operation with others. His early work on wind pressure was in co-operation with the Wind Pressure Committee of the Royal Meteorological Society. It gave us the pressure-tube anemometer, which made it possible to measure transient gusts of wind, an indispensable preliminary to the development of our modern ideas of turbulence.

Dines had reached middle life when the observational study of the upper air came into its own. The material resources available for such work in this country were meagre in the extreme when compared with what was provided elsewhere, especially in Germany. The Joint Upper Air Committee of the British Association and the Royal Meteorological Society, which was responsible for inaugurating such work as could be undertaken here, was fortunate in securing Dines as its active worker. The early work was carried out with kites at Mr. Dines's house at Oxshott, or from a steam vessel off Crinan on the west coast of Scotland. No doubt, his engineering training stood him in good stead in developing his methods. He exhibited an almost uncanny facility in devising, at a minimum of cost, apparatus which worked and achieved the results which he had set out to

obtain. The story is set out with all modesty in his Presidential Address to the Royal Meteorological Society in 1903. Practically all the apparatus, kites, meteorographs, winches, &c., were made in Mr. Dines's own workshop, much of it by his own hands.

Subsequently the Meteorological Office was able to render more assistance, and Mr. Dines transferred his work to Pyrton Hill, and ultimately to Benson. The investigation of the higher regions of the atmosphere by means of registering balloons was included in the programme. Here Dines struck an entirely original line in the design of the meteorograph which he used. To economise weight he dispensed with the clock, which was used by all other workers in this field, and contented himself with obtaining a pressure-temperature record of the ascent on a scale so small that the curve had to be tabulated with the help of a reading microscope. This apparatus has made it possible for this country to contribute a large number of observations extending well into the stratosphere to the collection of data for international days collected under the auspices of the International Commission for the Exploration of the Upper Air. Dines's contribution to the study of the upper air was, however, not confined to the sphere of the observer and deviser of observational methods. He also took an active share in the discussion of the results.

In his later years he was impelled to the study of radiation and here again we find him active both as designer of instruments and as observer and student. It is gratifying to note that despite his failing health he was able to maintain his scientific interests almost up to the end, for it is only a few months since he contributed, with the co-operation of his son, L. H. G. Dines, a paper to the *Memoirs of the Royal Meteorological Society* on "Monthly Mean Values of Radiation from Various Parts of the Sky at Benson." Mr. Dines was elected a Fellow of the Royal Society in 1905, and was awarded the Symon's Gold Medal of the Royal Meteorological Society in 1914.

R. K. G. LEMPFERT.

The Weather of December, 1927

During the first half of the month the weather was generally unsettled with a moderate temperature, but later (except for a few days) the conditions became very cold and wintry, with frequent strong easterly winds and gales. For the first ten days pressure was high over Scandinavia and low on the Atlantic to the westward of the British Isles, and weather was generally dry in the eastern districts. On the 5th the Atlantic depression temporarily spread eastwards, causing mild conditions in most districts and southerly gales and much rain in the west and north. After the 6th the weather was cloudy, and temperature

fell gradually as the southerly winds backed to east. On the 14th a shallow depression moved eastward across southern Ireland and England, and rain, sleet or snow occurred in the south on the 13th and 14th. Heavy rain also fell in southern Ireland on the 16th, when as much as 3·16 in. were recorded at Aasleagh (Mayo) and 2·24 in. at Inagh (Clara). From the 11th pressure had been high over Iceland and Scandinavia, and now a wedge of high pressure extended southwards over the North Sea and Great Britain. Very cold air reached this country from northeast Europe*, and for five days from the 16th-20th inclusive temperature remained below freezing point day and night over a large area in southeast England, the Midlands and parts of Scotland. The lowest temperatures recorded during this period were 5° F. in the screen at Balmoral on the 17th and 18th, and -4° F. on the grass at Balmoral on the 17th. On the night of the 20th-21st heavy rain, associated with a deep depression which was advancing from the Atlantic, fell in the west, and on the morning of the 21st glazed frost occurred in the southeast districts. Precipitation amounted to 2·88 in. at Mourne (Down) and 2·65 in. at Treherbert (Glamorgan) on the 21st. Temperature rose rapidly, but the mild weather proved to be of only temporary character, and wintry conditions were renewed in the north on the 24th, in the south on the 25th. Heavy rain, sleet and snow occurred on the 25th and 26th, with a northeasterly gale in the south on the night of the 25th-26th. Wintry conditions then prevailed to the end of the month, except in the western districts, where milder conditions set in on the 31st.

Pressure was above normal over northwest Europe, Iceland, Spitsbergen and Bermuda, the greatest excess being 15·6 mb. at Thorshavn, and below normal over central and southwest Europe, most of the North Atlantic and the Azores, the largest deficits being 13·3 mb. at Lat. 50° N, Long. 30° W, and 10·9 mb. at Bayonne. This distribution was associated with easterly winds from the Baltic to the British Isles and north France. Temperature was below normal over the British Isles and southern Scandinavia and above normal over Spitsbergen, northern Scandinavia and Portugal. Precipitation was above normal over Spitsbergen, northern Norway and southern British Isles and below normal from southern Sweden to the northern British Isles.

Violent hailstorms destroyed part of the orange crop in districts round Valencia (Spain), and severe weather was also reported from Malaga and Castile on the 6th. At Castile there was a sudden change to fine weather on the 8th. Extreme cold

* See p. 279.

occurred in Portugal early in the month. After three weeks' sunshine snow fell in Switzerland down to 3,000 ft. on the 12th. On the 18th a spell of very cold weather set in over the whole of Europe, thick snow occurred on the Riviera, and at Rome also there was a light covering of snow. In Germany and southeast Europe the cold was unusually severe. A glazed frost in Paris and neighbouring towns on the 21st and in Berlin on the 22nd, caused many accidents. This was the commencement of a general thaw, and the Föhn wind disposed of most of the snow up to 4,500 ft. in Switzerland. The gales in the North Sea, English Channel and parts of France caused much damage and held up communications between England and the Continent on the 27th and 28th, and an abnormally high tide, due to the sirocco, prevailed in the Bay of Naples on the 28th. Intense cold, frosty conditions again set in over central Europe about the 29th.

Serious floods were reported from northern Morocco from the 26th-31st, 1,800 sq. miles being under water. Relief was sent to the stranded people by means of aeroplanes.

Dense fog occurred over the Sea of Marmora on the 27th. A blizzard raged throughout western Japan on Christmas Eve, interrupting communications by land and sea.

Following torrential rains, the rivers in the Longreach district of Queensland were flooded on the 28th.

The gales, heavy snow and low temperatures which had been prevalent in Canada and the north-west of the United States extended on the 8th to the Middle West States, and the cold was felt as far south as the Gulf of Mexico. Many people have died in consequence of the cold and gales. Severe storms were also reported on the Great Lakes from the 8th to 10th, and the ice blockade was forming. Heavy rains on the 13th and 14th caused the Arkansas and White rivers to overflow.

Many severe gales occurred on the North Atlantic.

The special message from Brazil states that seven anticyclones passed across the country and the pressure distribution was very unstable and the weather unsettled but mainly dry. The rainfall was scarce, being 1.1 in., 1.9 in. and 2.2 in. below normal in the northern, central and southern districts respectively. All crops are suffering from lack of rain. Pressure at Rio de Janeiro was 0.3 mb. below normal and temperature 0.2° F. above normal.

Rainfall, December, 1927—General Distribution

England and Wales	..	95	} per cent. of the average 1881-1915.
Scotland	.. .. .	44
Ireland	.. .. .	75
British Isles	.. .. .	<u>78</u>

Rainfall: December, 1927: England and Wales

CO.	STATION.	In.	Per- cent. of Av.	CO.	STATION	In.	Per- cent. of Av.
<i>London.</i>	Camden Square	4.17	175	<i>Leics.</i>	Thornton Reservoir . .	2.22	83
<i>Sur.</i>	Reigate, The Knowle . .	5.90	197	<i>Rut.</i>	Belvoir Castle	2.55	104
<i>Kent.</i>	Tenterden, Ashenden . .	4.69	151	<i>Linc.</i>	Ridlington	2.33	...
<i>"</i>	Folkestone, Boro. San.	4.84	...	<i>"</i>	Boston, Skirbeck	2.62	122
<i>"</i>	Margate, Cliftonville . .	2.87	126	<i>"</i>	Lincoln, Sessions House	2.73	125
<i>"</i>	Sevenoaks, Speldhurst . .	5.94	...	<i>"</i>	Skegness, Marine Gdns.	2.55	116
<i>Sus.</i>	Patching Farm	4.76	142	<i>"</i>	Louth, Westgate	2.98	107
<i>"</i>	Brighton, Old Steyne . .	4.44	143	<i>"</i>	Brigg . . . . .	...	...
<i>"</i>	Tottingworth Park	5.02	136	<i>Notts.</i>	Worksop, Hodsock	2.34	99
<i>Hants.</i>	Ventnor, Roy. Nat. Hos.	3.72	113	<i>Derby</i>	Derby	2.19	84
<i>"</i>	Fordingbridge, Oaklands	4.31	109	<i>"</i>	Buxton, Devon. Hos. . .	1.94	34
<i>"</i>	Ovington Rectory	3.71	94	<i>Ches.</i>	Runcorn, Weston Pt. . .	1.71	54
<i>"</i>	Sherborne St. John	3.59	109	<i>"</i>	Nantwich, Dorfold Hall	1.44	...
<i>Berks.</i>	Wellington College	3.64	126	<i>Lancs.</i>	Manchester, Whit. Pk. . .	1.04	32
<i>"</i>	Newbury, Greenham	3.85	120	<i>"</i>	Stonyhurst College	1.23	25
<i>Herts.</i>	Benington House	2.83	114	<i>"</i>	Southport, Hesketh Pk . .	1.22	38
<i>Bucks.</i>	High Wycombe	3.63	124	<i>"</i>	Lancaster, Strathspey . .	1.14	...
<i>Oxf.</i>	Oxford, Mag. College . . .	3.38	146	<i>Yorks.</i>	Wath-upon-Deerne	1.87	79
<i>Nor.</i>	Pitsford, Sedgebrook . . .	2.51	104	<i>"</i>	Bradford, Lister Pk. . . .	2.67	80
<i>"</i>	Oundle	2.39	...	<i>"</i>	Oughtershaw Hall	2.26	...
<i>Beds.</i>	Woburn, Crawley Mill . . .	2.52	108	<i>"</i>	Wetherby, Ribston H. . . .	2.19	89
<i>Cam.</i>	Cambridge, Bot. Gdns. . . .	2.04	106	<i>"</i>	Hull, Pearson Park	2.84	118
<i>Essex.</i>	Chelmsford, County Lab . .	2.53	114	<i>"</i>	Holme-on-Spalding	2.27	...
<i>"</i>	Lexden, Hill House	2.47	...	<i>"</i>	West Witton, Ivy Ho. . . .	3.32	...
<i>Suff.</i>	Hawkedon Rectory	2.40	99	<i>"</i>	Felixkirk, Mt. St. John . .	2.04	85
<i>"</i>	Haughley House	1.57	...	<i>"</i>	Pickering, Hungate	2.39	...
<i>Norf.</i>	Beccles, Geldeston	2.52	110	<i>"</i>	Scarborough	2.13	90
<i>"</i>	Norwich, Eaton	2.79	107	<i>"</i>	Middlesbrough	1.77	91
<i>"</i>	Blakeney	1.28	58	<i>"</i>	Baldersdale, Hury Res. . .	2.20	...
<i>"</i>	Little Dunham	2.22	91	<i>Durh.</i>	Ushaw College	3.22	129
<i>Wilts.</i>	Devizes, Highclere	3.09	101	<i>Nor.</i>	Newcastle, Town Moor . .	4.44	184
<i>"</i>	Bishops Cannings	2.96	90	<i>"</i>	Bellingham, Highgreen . .	2.99	...
<i>Dor.</i>	Evershot, Melbury Ho. . . .	5.05	98	<i>"</i>	Lilburn Tower Gdns. . . .	3.67	...
<i>"</i>	Creech Grange	5.01	...	<i>Cumb.</i>	Geltsdale	1.44	...
<i>"</i>	Shaftesbury, Abbey Ho. . .	3.54	98	<i>"</i>	Carlisle, Scaleby Hall . .	.86	27
<i>Devon.</i>	Plymouth, The Hoe	4.78	92	<i>"</i>	Seathwaite M. . . . .	...	...
<i>"</i>	Polapit Tamar	4.86	95	<i>"</i>	Keswick, High Hill	1.45	...
<i>"</i>	Ashburton, Druid Ho. . . .	6.51	86	<i>Glam.</i>	Cardiff, Ely P. Stn. . . .	3.02	59
<i>"</i>	Cullompton	3.51	80	<i>"</i>	Treherbert, Tynywaun . .	6.21	...
<i>"</i>	Sidmouth, Sidmount	4.00	102	<i>Carm.</i>	Carmarthen Friary	3.97	69
<i>"</i>	Filleigh, Castle Hill	2.99	...	<i>"</i>	Llanwrda, Dolaucothy . .	3.96	57
<i>"</i>	Barnstaple, N. Dev. Ath. . .	2.73	62	<i>Pemb.</i>	Haverfordwest, School . .	4.12	72
<i>Corn.</i>	Redruth, Trewirgie	4.66	74	<i>Card.</i>	Gogerddan	3.09	61
<i>"</i>	Penzance, Morrab Gdn. . . .	4.51	79	<i>"</i>	Cardigan, County Sch. . .	2.49	...
<i>"</i>	St. Austell, Trevarna	5.00	82	<i>Brec.</i>	Crickhowell, Talymaes . .	4.40	...
<i>Soms.</i>	Chewton Mendip	3.72	69	<i>Rad.</i>	Birm. W.W. Tyrmynydd . .	3.94	48
<i>"</i>	Street, Hind Hayes	2.74	...	<i>Mont.</i>	Lake Vyrnwy	2.85	42
<i>Glos.</i>	Clifton College	3.42	89	<i>Denb.</i>	Llangynhafal	1.22	...
<i>"</i>	Cirencester, Gwynfa	3.43	102	<i>Mer.</i>	Dolgelly, Bryntirion . . .	2.37	35
<i>Here.</i>	Ross, Birchlea	2.89	97	<i>Carn.</i>	Llandudno	1.69	55
<i>"</i>	Ledbury, Underdown	2.28	81	<i>"</i>	Snowdon, L. Llydaw 9 . .	3.37	...
<i>Salop.</i>	Church Stretton	2.69	80	<i>Ang.</i>	Holyhead, Salt Island . .	2.54	61
<i>"</i>	Shifnal, Hatton Grange . . .	1.75	68	<i>"</i>	Lligwy	1.57	...
<i>Worc.</i>	Ombersley, Holt Lock	2.33	89	<i>Isle of Man</i>	Douglas, Boro' Cem. . . .	3.42	68
<i>"</i>	Blockley, Upton Wold	3.38	104	<i>Guernsey</i>	St. Peter P't. Grange Rd .	3.89	95
<i>War.</i>	Farnborough	2.52	86				
<i>"</i>	Birmingham, Edgbaston . .	2.87	107				

Rainfall: December, 1927: Scotland and Ireland

CO.	STATION.	In.	Per- cent. of Av.	CO.	STATION.	In.	Per- cent. of Av.
<i>Wigt.</i>	Stoneykirk, Ardwell Ho	1.79	44	<i>Suth.</i>	Loch More, Achfary ...	1.33	14
"	Pt. William, Monreith .	2.42	...	<i>Caith</i>	Wick .....	.88	29
<i>Kirk.</i>	Carsphairn, Shiel.	2.14	...	<i>Ork.</i>	Pomona, Deerness	1.34	32
"	Dumfries, Cargen	2.16	40	<i>Shet.</i>	Lerwick	1.59	33
<i>Dumf.</i>	Eskdalemuir Obs. ....	...	...	<i>Cork.</i>	Caheragh Rectory	7.45	...
<i>Roxb.</i>	Branxholm	2.17	59	"	Dunmanway Rectory .	8.87	110
<i>Selk.</i>	Ettrick Manse	2.67	...	"	Ballinacurra	6.50	127
<i>Peeb.</i>	Castlecraig .....	...	...	"	Glanmire, Lota Lo. ...	7.68	140
<i>Berk.</i>	Marchmont House	2.72	95	<i>Kerry</i>	Valentia Obsy.	6.52	98
<i>Hadd.</i>	North Berwick Res.	2.77	129	"	Gearahameen	6.90	...
<i>Midl.</i>	Edinburgh, Roy. Obs. .	1.44	67	"	Killarney Asylum	4.70	65
<i>Ayr.</i>	Kilmarnock, Agric. C. .	.73	17	"	Darrynane Abbey	5.58	95
"	Girvan, Pinmore's	1.60	27	<i>Wat.</i>	Waterford, Brook Lo. .	5.73	122
<i>Renf.</i>	Glasgow, Queen's Pk. .	.78	18	<i>Tip.</i>	Nenagh, Cas. Lough . .	3.63	79
"	Greenock, Prospect H. .	1.38	18	"	Roscrea, Timoney Park	1.49	...
<i>Bute.</i>	Rothsay, Ardencraig .	1.63	30	"	Cashel, Ballinamona . .	4.67	107
"	Dougarie Lodge	2.28	...	<i>Lim.</i>	Foynes, Coolnanes	3.49	74
<i>Arg.</i>	Ardgour House .....	.41	...	"	Castleconnell Rec.	3.26	...
"	Manse of Glenorchy . .	.96	...	<i>Clare</i>	Inagh, Mount Callan . .	7.69	...
"	Oban .....	.26	...	"	Broadford, Hurdlest'n .	3.73	...
"	Poltalloch	1.29	20	<i>Wexf.</i>	Newtownbarry	5.67	...
"	Inveraray Castle .....	.91	9	"	Gorey, Courtown Ho. . .	3.99	105
"	Islay, Fallabus	1.61	27	<i>Kilk.</i>	Kilkenny Castle	3.79	110
"	Mull, Benmore .....	...	...	<i>Wic.</i>	Rathnew, Clonmannon .	3.86	...
"	Tiree	1.38	...	<i>Carl.</i>	Hacketstown Rectory .	3.41	83
<i>Kinr.</i>	Loch Leven Sluice	2.03	52	<i>QCo.</i>	Blandsfort House	3.27	89
<i>Perth</i>	Loch Dhu	2.65	26	"	Mountmellick	2.28	...
"	Balquhidder, Stronvar .	2.09	...	<i>KCo.</i>	Birr Castle	2.16	66
"	Crieff, Strathearn Hyd. .	1.76	39	<i>Dubl.</i>	Dublin, FitzWm. Sq. . .	2.51	101
"	Blair Castle Gardens . .	1.34	35	"	Balbriggan, Ardgillan .	2.35	81
<i>Forf.</i>	Kettins School	2.40	80	<i>Me'th</i>	Beauparc, St. Cloud . .	3.13	...
"	Dundee, E. Necropolis .	2.02	76	"	Kells, Headfort	2.63	69
"	Pearsie House	2.44	...	<i>W.M.</i>	Moate, Coolatore	2.59	...
"	Montrose, Sunnyside . .	2.79	100	"	Mullingar, Belvedere .	2.50	68
<i>Aber.</i>	Braemar, Bank	1.43	40	<i>Long</i>	Castle Forbes Gdns. . .	2.44	61
"	Logie Coldstone Sch. . .	1.83	65	<i>Gal.</i>	Ballynahinch Castle . .	3.15	42
"	Aberdeen, King's Coll. .	2.46	76	"	Galway, Grammar Sch. .	5.28	...
"	Fyvie Castle	3.22	...	<i>Mayo</i>	Mallaranny	4.11	...
<i>Mor.</i>	Gordon Castle	2.24	83	"	Westport House	4.92	86
"	Grantown-on-Spey	1.34	49	"	Delphi Lodge	6.43	...
<i>Na.</i>	Nairn, Delnies	1.08	49	<i>Sligo</i>	Markree Obsy.	1.77	37
<i>Inu.</i>	Ben Alder Lodge	1.65	...	<i>Cav'n</i>	Belturbet, Cloverhill . .	2.03	55
"	Kingussie, The Birches .	.52	...	<i>Ferm</i>	Enniskillen, Portora . .	1.53	...
"	Loch Quoich, Loan ....	.50	...	<i>Arm.</i>	Armagh Obsy.	1.83	58
"	Glenquoich .....	.50	3	<i>Down</i>	Fofanny Reservoir ...	8.17	...
"	Inverness, Culduthel R. .	1.24	...	"	Seaforde	4.39	107
"	Arisaig, Faire-na-Squir .	.40	...	"	Donaghadee, C. Stn. . .	2.57	81
"	Fort William .....	.48	47	"	Banbridge, Milltown . .	1.83	63
"	Skye, Dunvegan	1.12	...	<i>Antr.</i>	Belfast, Cavehill Rd. .	2.85	...
<i>R&C</i>	Alness, Ardross Cas. . .	1.71	41	"	Glenarm Castle	2.60	...
"	Ullapool .....	.07	...	"	Ballymena, Harryville	2.02	45
"	Torricon, Bendamph. . .	.50	5	<i>Lon.</i>	Londonderry, Creggan .	1.12	26
"	Achnashellach .....	.49	...	<i>Tyr.</i>	Donaghmore	2.37	...
"	Stornoway	1.17	19	"	Omagh, Edenfel	1.60	38
<i>Suth.</i>	Lairg	1.11	...	<i>Don.</i>	Malin Head	1.61	18
"	Tongue .....	.90	18	"	Dunfanaghy	1.25	24
"	Melvich .....	.94	22	"	Killybegs, Rockmount .	2.26	31

Climatological Table for the British Empire, July, 1927

STATIONS	PRESSURE		TEMPERATURE							Rela- tive Humi- dity	Mean Cloud Am't	PRECIPITATION			BRIGHT SUNSHINE		
	Mean of Day M.S.L.	Diff. from Normal	Absolute		Mean Values							Mean Cloud Am't	Am't in.	Diff. from Normal	Days	Hours per day	Per- cent- age of possi- ble.
			Max.	Min.	Max.	Min.	1 max. 2 min.	Diff. from Normal	Mean Bulb.								
London, Kew Obsy.	1012.7	- 3.1	79	45	68.4	55.0	61.7	- 1.0	86	8.3	3.00	+ 0.83	11	4.1	25		
Gibraltar	1016.5	- 0.3	88	61	82.8	64.7	73.7	- 1.1	81	2.6	0.00	- 0.03	0	...	...
Malta	1014.2	- 1.1	94	73	86.3	75.0	80.7	+ 2.4	78	1.8	0.00	- 0.05	0	12.7	89		
St. Helena	1017.1	+ 3.5	63	52	61.1	55.2	58.1	- 0.9	91	3.3	3.73	- 0.30	18	...	...
Sierra Leone	1014.6	+ 1.9	89	70	83.8	72.1	77.9	- 0.7	86	7.8	34.16	- 1.42	25	...	...
Lagos, Nigeria	1012.5	- 1.3	84	72	81.3	74.3	77.8	- 0.2	85	4.1	8.57	- 2.11	13	...	...
Kaduna, Nigeria	1015.6	+ 1.6	86	...	82.6	...	...	...	85	...	10.90	+ 2.70	20	...	...
Zomba, Nyasaland	1020.8	+ 2.3	77	43	70.9	50.3	60.6	- 1.4	70	5.6	0.05	- 0.30	2	...	...
Salisbury, Rhodesia	1021.3	+ 0.6	76	32	70.4	43.4	56.9	+ 0.8	56	2.8	0.01	- 0.02	1	8.6	77		
Cape Town	1023.4	+ 2.1	85	38	64.1	48.8	56.5	+ 1.8	87	5.8	1.74	- 1.91	10	...	...
Johannesburg	1026.5	+ 1.9	74	33	61.4	40.1	50.7	+ 0.2	61	0.2	1.78	+ 1.45	3	8.9	84		
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloufontein	...	...	71	25	63.1	34.7	48.9	+ 1.6	67	1.5	0.37	- 0.01	2	...	...
Calcutta, Alipore Obsy.	998.3	- 0.9	94	76	89.2	79.2	84.2	+ 0.7	89	8.6	8.48	- 4.03	13*	...	...
Bombay	1003.1	- 0.8	87	77	84.4	78.4	81.4	+ 0.1	77.3	8.9	16.85	- 7.42	25*	...	...
Madras	1004.3	- 0.2	102	75	96.5	80.0	88.3	+ 0.9	75.1	64	1.17	- 2.77	6*	...	...
Colombo, Ceylon	1009.5	+ 0.3	87	72	85.4	76.8	81.1	0.0	77.7	79	2.87	- 3.56	11	6.4	51		
Hongkong	1004.1	- 0.7	91	75	86.5	78.5	82.5	0.0	79.1	86	18.73	+ 5.35	24	5.2	39		
Sandakan	...	...	92	73	88.5	75.9	82.2	+ 0.4	76.8	84	5.76	- 0.79	14	...	...
Sydney	1014.2	- 4.3	73	40	63.5	44.6	54.1	+ 1.4	45.5	64	2.1	0.30	- 4.54	4	7.3	72	
Melbourne	1014.8	- 4.3	60	34	55.5	43.5	49.5	+ 0.9	45.6	80	6.8	2.83	+ 1.00	20	3.5	35	
Adelaide	1017.3	- 3.1	67	37	59.4	44.9	52.1	+ 0.4	47.2	80	6.6	2.73	+ 0.08	15	4.4	44	
Perth, W. Australia	1018.5	- 0.5	67	38	61.7	47.6	54.7	- 0.5	50.6	79	6.5	6.23	- 0.22	19	5.1	50	
Coolgardie	1019.8	- 0.1	67	33	58.8	42.2	50.5	- 0.7	46.3	74	4.3	1.29	+ 0.38	13	
Brisbane	1016.7	- 1.8	79	39	70.4	47.5	58.9	+ 0.4	50.0	63	2.5	0.52	- 1.82	4	8.6	81	
Hobart, Tasmania	1010.8	- 3.0	59	32	51.6	41.6	46.6	+ 1.2	41.9	77	7.0	2.30	+ 0.16	24	3.1	33	
Wellington, N.Z.	1010.6	- 3.3	60	32	53.9	42.9	48.4	+ 0.7	46.0	79	6.9	3.46	- 2.17	20	3.3	35	
Suva, Fiji	1013.8	- 0.4	88	63	80.5	70.0	75.3	+ 1.7	70.5	82	6.8	3.47	- 1.13	19	5.3	48	
Apia, Samoa	1012.3	+ 0.3	86	72	84.6	75.0	79.8	- 2.6	75.8	77	4.0	3.36	+ 0.72	15	8.1	71	
Kingston, Jamaica	1014.8	+ 0.1	92	71	89.5	73.5	81.5	- 0.2	72.1	82	4.9	3.41	+ 1.79	4	9.1	69	
Grenada, W.I.	1010.6	- 2.6	89	72	86.1	75.3	80.7	+ 1.7	76.1	79	5.1	6.83	- 2.96	22	
Toronto	1014.3	+ 0.2	91	47	78.3	59.3	68.8	+ 0.6	62.4	76	4.8	5.87	+ 2.83	9	8.9	59	
Winnipeg	1015.0	+ 2.3	90	41	76.7	54.3	65.5	- 0.7	57.7	80	3.3	1.14	- 2.02	11	8.7	55	
St. John, N.B.	1015.1	+ 1.4	79	45	67.3	54.0	60.7	+ 0.3	58.1	89	7.2	6.89	+ 3.26	16	5.0	33	
Victoria, B.C.	1018.9	+ 2.2	89	50	67.5	52.2	59.9	- 0.4	52.0	54	3.9	0.21	- 0.15	3	11.3	72	

*For Indian stations a rain day is a day on which 0.1 in. or more rain has fallen.