


AUTOGRAPHIC RECORDS.

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The Gale of January 12th, 1930

By F. H. DIGHT, B.Sc., A.Inst.P.

Recent issues of the *Meteorological Magazine* have contained several references to the stormy weather which characterised the three closing months of 1929, especially over the southern half of the British Isles. The account of the storm of Armistice Day* had hardly reached the printers before the greater part of the Kingdom was subjected to a further heavy buffetting by another severe gale on December 6th-7th. It was during this storm that the record wind gust velocity for Great Britain of 111 m.p.h. was recorded in the Scilly Isles. December, in fact, ultimately proved to be the stormiest month of the three, and there is little doubt that when the complete data come to be analysed, the period October to December, 1929, from the combined point of view of persistence and severity of the storms in the southern half of the British Isles will prove to be the stormiest period on record since the late 'nineties. Actually the period will need to include the first half of January, 1930, as it was not until Sunday, January 12th, that the climax of the stormy weather was reached. During the afternoon and evening of that day, the greater part of England and Wales, and to a lesser extent southern Ireland, were swept by a terrific gale. Inland, in parts of southern and southeastern England the wind reached speeds far in excess of those previously recorded by autographic instruments at inland stations. There was some loss of life, though

*See *Meteorological Magazine* 64, 1929, p. 249.

apparently rather less than in November, 1928, possibly because of the day and the time at which the gale reached the height of its fury. Considerable structural damage was reported; an enormous number of trees were felled, and telephone and telegraphic services disorganised. The greatest tragedy of the storm was the disaster which befell the Admiralty tug *St. Genny* which, hove to about 35 miles off Ushant, foundered at the height of the storm with the loss of 23 of her crew.

At 7 a.m. on Sunday, January 12th, a deep depression near the Faeroes, which had been responsible for a boisterous Saturday afternoon during which snow fell heavily for a time in many parts of England, was becoming less deep and pressure was rising generally with fair weather except in extreme southwestern Ireland. Although there were indications of a new disturbance well to northwest of the Azores at 1 a.m., there seemed no reason to connect this with a fall of the barometer at Valentia at 7 a.m., particularly as it was already raining there. It was not until later that the report from S.S. *Megantic* (Lat. $51^{\circ} 12' N.$ Long. $19^{\circ} 54' W.$) giving a light southeast wind with a pressure of 974 mb., and adding the additional information that the barometer was falling more than 2 mb. per hour, suggested that a deepening secondary disturbance was rapidly approaching southwest Ireland. A conservative estimate shows that the average rate of travel of the centre between 1 a.m. and 7 a.m. could have been little less than the phenomenal speed of 80 m.p.h. During the next six hours it maintained an average speed of 75 m.p.h. and at 1 p.m. was centred over western Ireland, the pressure at Valentia, south of the "eye" of the storm, being as low as 971mb. The disturbance had not yet attained its maximum depth; at 6 p.m. the centre was over the Lake District, having travelled 350 miles in an eastnortheast direction in the intervening five hours, while the pressure had fallen to less than 966 mb. Thereafter, although maintaining its direction of motion, the average speed fell away considerably, and between 6 p.m. on the 12th and 1 a.m. on the 13th dropped to 44 m.p.h. When at 7 a.m. the centre was located over Denmark the pressure at the centre had risen to 980 mb. The total fall of pressure in southern England associated with the depression averaged 18 mb. and the approximate duration of the fall, in the southeast, 8 hours. The largest fall of pressure in 3 hours shown by the reporting stations was one of 13 mb. at Sealand (Chester) between 1 p.m. and 4 p.m. The rise which set in at the height of the storm was much more pronounced; at Valentia pressure rose 11 mb. in the first hour, and at Kew and various places in southeast England the rate was 6 mb. in the first hour.

With the approach of the disturbance the light southwest winds in southwest Ireland backed to south and freshened

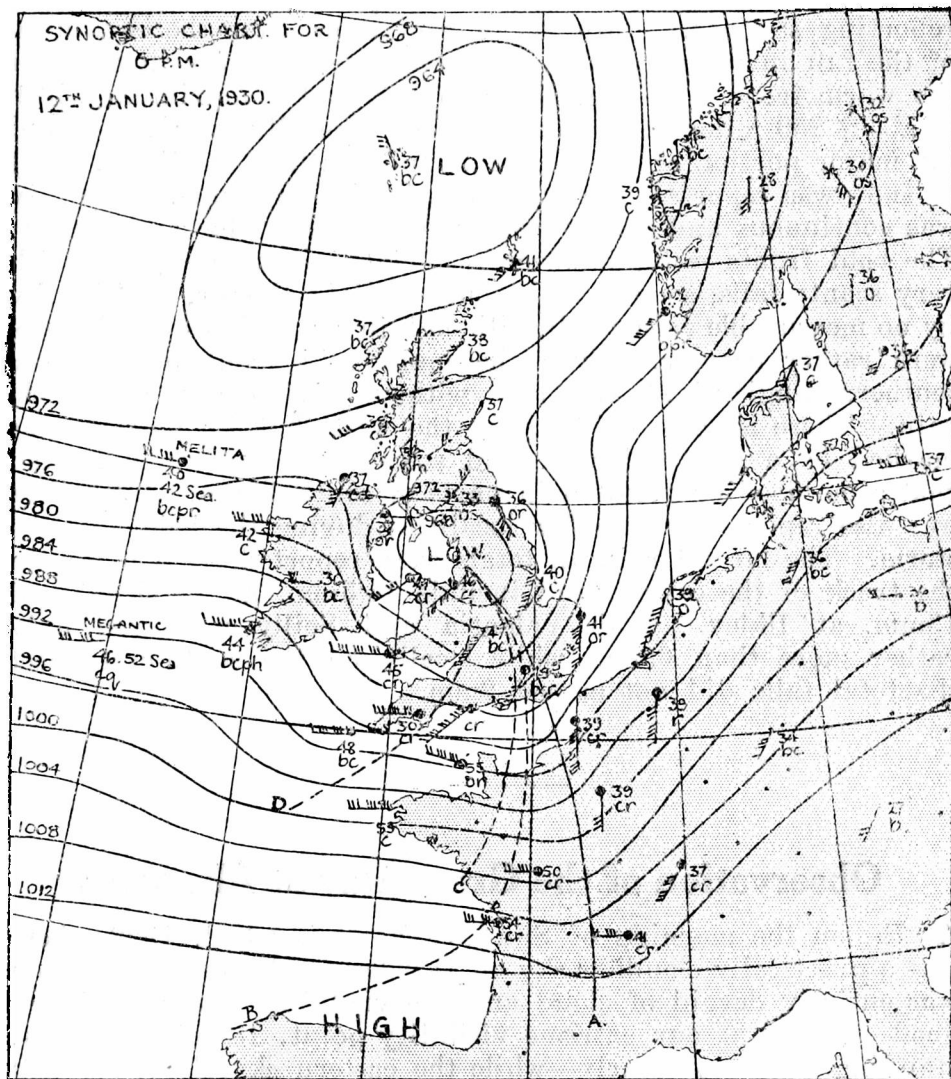
rapidly, gale force being reached at Valentia at 11 a.m.; gale force was reached at Scilly about the same time. It was not until after 10 a.m. that the winds over England and Wales started to back, but thereafter the sequence of events moved rapidly. At 1 p.m. a southwesterly gale was raging from southern Ireland to Brittany and the northern half of the Bay of Biscay, and, as later information showed, had already become a strong gale (force 9 Beaufort) over the open sea. Three hours later force 7 Beaufort was reported generally over southeast England, and the wind was still slowly increasing. As will be seen later the structure of the depression was complex, and it was with the last of three "cold fronts" that the fury of the gale was associated. This struck Valentia in a violent squall at 2.50 p.m.; the wind veered to NW. and increased quickly to a strong gale, reaching 77 m.p.h. in a gust. A whole gale from the west (force 10 Beaufort) was blowing off our southwest coast and the coast of South Wales by 6 p.m., and the full force of the storm was beginning to be felt in Wales and western England. During the next two or three hours the wind increased over the Midlands and eastern England, London experiencing the height of the gale between 8.30 and 9 p.m. The strongest winds lasted for about an hour, after which the speed fell away moderately quickly. The highest hourly wind speeds recorded were:—Scilly 65 m.p.h. with a gust of 97 m.p.h., Falmouth (Pendennis) 63 m.p.h., gust 102 m.p.h., Shoeburyness and Croydon 51 m.p.h. with gusts of 83 m.p.h. and 77 m.p.h. respectively. The gust velocity of 83 m.p.h. at Shoeburyness at 10 p.m. was a record for the station. Other violent gusts were 83 m.p.h. at Cardington (at 150 feet above the ground), 83 m.p.h. at Worthy Down, Winchester (a station record), and 75 m.p.h. at Plymouth and Spurn Head. The most remarkable figures, however, were obtained at Larkhill, where the mean hourly wind speed rose to 70 m.p.h. at 8 p.m., with a gust of 94 m.p.h. Not only was this the highest hourly wind reported for the storm, but in view of the inland situation represents an exceptional velocity, which most probably constitutes a record for a station in the British Isles so far from the coast. The highest mean speed recorded at Meteorological Office stations in the British Isles is 78 m.p.h. recorded at Fleetwood on December 22nd, 1894. It is hardly surprising, therefore, that the reports of damage to trees, buildings and livestock in parts of Wiltshire provide the most melancholy tale of destruction the writer has yet seen. A reliable authority asserted that in the immediate vicinity of the small market town of Devizes "something like 500 trees were swept down in that hour's fury of the elements on that Sunday evening." Mr. R. G. C. Sandeman, writing from Dan y Park, Crickhowell, south Wales, says: "From 4 p.m. to 7.35 p.m. it blew a whole gale with

gusts of 65-70 m.p.h.* At 7.35 p.m. there was a terrific gust of 80 m.p.h. which blew down eight elm trees in our park. This is the highest velocity I have ever recorded here. The glass rose from 28.60 in. (968.5 mb.) to 28.80 in. (975.3 mb.) just after this gust and the wind moderated. The storm has done extensive damage to our woods and some of them look as if they had been shelled, the trees being snapped off like carrots” Southeast England has probably not suffered such extensive damage since the great blizzard of March, 1916, when a heavy fall of snow added to the destruction caused by the gale.

An examination of the autographic records from selected stations revealed the complex structure of the southern section of the depression. The records obtained at Croydon have been reproduced as showing the essential features of the sequence of events typical in southern England, and should be examined in conjunction with the synoptic chart for 6 p.m., also reproduced. At that time the storm was already at its worst in the west. The barogram traces, with one exception, are remarkably similar. They show a very steady fall of pressure in front of the depression with a slight but definite check as the warm front passed. The minimum occurred some time later. The depression had a distinct and rather extensive warm sector at 1 p.m., for the warm front had then reached Falmouth, while a skip 160 miles further west reported continuous moderate fog. By 6 p.m., however, the warm sector had been reduced to a comparatively narrow belt at the surface. The warm front, reaching Valentia at 11.15 a.m., and Scilly rather earlier was marked by a sharp veer of the wind and an increase in the rate of rise in temperature. It advanced eastnortheast, reaching Holyhead and Larkhill at 3 p.m., Croydon at 4.10 p.m., and Felixstowe soon after 7 p.m. In eastern districts the wind veer was not so sharp, although temperature showed a decided rise with the entry of the warm air. The position of the warm front at 6 p.m. is indicated on the chart by the full line A: the broken lines B, C and D represent the first, second and third cold fronts respectively. The three cold fronts can be traced across from Valentia to Croydon. At the first-named station their passage is most marked on the thermogram where the first at 12.10 p.m. abruptly checked the temperature rise, while the second and third at 1.10 p.m. and 2.45 p.m. both resulted in sharp drops in temperature; the first two were also accompanied by slight veers of the wind, while the third, which heralded the height of the gale, veered the wind from WSW. to NW., and caused the rapid rise in pressure to which reference has already been made. At Croydon the first cold front at 5.45 p.m. brought a marked partial clearing of the sky, and effectively stopped

*Negretti & Zambra Dial type recorder; 16 feet above the roof, 54 feet above ground.

the downward trend of the barometer. The effect on the temperature was less decisive, and although temperature ceased to rise for a time, a further definite rise occurred soon afterwards. It was in the sector between the first and second cold fronts that temperature reached its highest point for the day, often well above 50°F . The second cold front, which passed Croydon at 7.10 p.m., had only a slight effect on the pressure curve;



the wind veer was very slight and there was little increase in speed, but temperature fell away sharply. This sequence was typical of all the records examined in Southern England. In the later stages the first cold front showed little inclination to overtake the warm front. The final and all-important front was accompanied by a marked increase in wind force, a definite, but not sudden, veer in direction, a very rapid rise in pressure,

and a further sharp fall in temperature. It reached Pendennis at 4.10 p.m., Holyhead 6.30 p.m., Larkhill 7 p.m., and Worthy Down half an hour later. It struck London at 8.15 p.m. and I'elixstowe at about 10 p.m., and in every case the full fury of the gale was experienced from the west in the hour subsequent to the passage of the cold front.

Another interesting feature of the storm was the comparatively small amounts of rain reported, at any rate at the lower level reporting stations. Rain set in very soon after the beginning of the fall in pressure, the rain area extending far in front of the warm front. At 13h. the rain belt had a maximum width of about 250 miles and it was raining generally over Wales and the major portion of the Midlands and southern England. Sleet or snow was reported locally at first in the Midlands. The rain was continuous and steady until the arrival of the warm front. The cold fronts were, however, associated in many parts with very scanty falls, sometimes by only a slight shower, and locally by no measurable rain at all, although in some places the showers were rather heavier. Even the main cold front passed over southern England at any rate without giving any noticeable rain. There is some evidence in the west that its passage was marked by a heavy shower, and some press reports indicated that some flooding resulted in parts of south Wales. Lightning was also reported from a few localities during the height of the storm. The largest rainfall totals were reported from places in the track of the centre, and include 14.5mm. at Holyhead and 13mm. at Ilkley. Both Valentia and Scilly measured only rather more than 6mm., while locally on the south-east coast the total falls did not exceed 2mm.

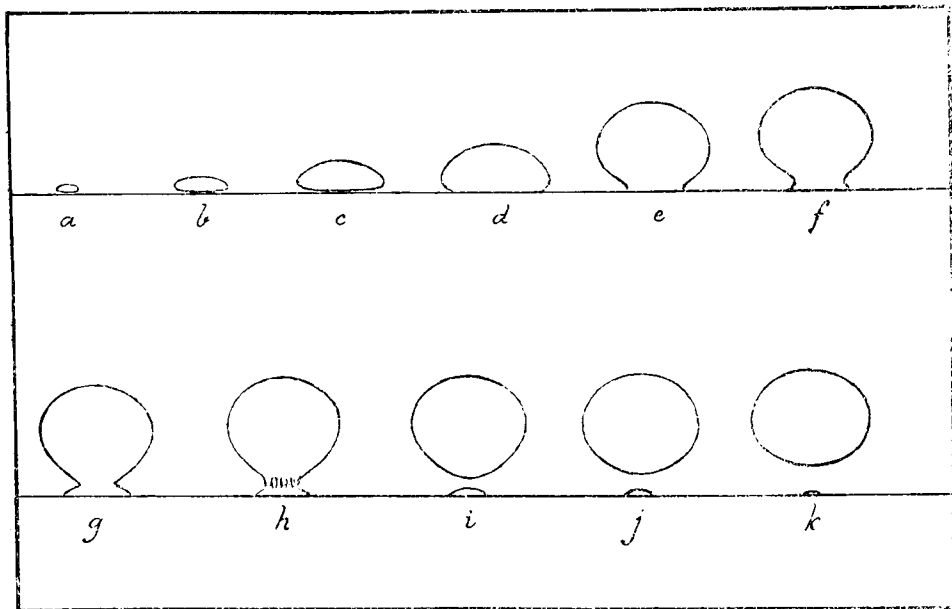
Observation of the Green Ray at Aberdeen

At 7h. on the morning of Sunday, November 3rd, 1929, there was a practically cloudless sky at Aberdeen. The eastern horizon was entirely devoid of cloud and the visibility was remarkably good—objects at our extreme visibility point, 18 miles distant, standing out very clearly—while the eastern sky showed a belt of deep orange colour, shading gradually into the clear green-blue above it. The exceptional degree of visibility indicated that the strong orange coloration owed nothing to selective absorption by local atmospheric pollution; it must therefore have been due to the presence of fine particles in the higher layers of the atmosphere generally.

The conditions were therefore deemed very favourable for observing the phenomenon of the "Green Ray," and a telescope

of 3 inches clear aperture, fitted with a terrestrial eyepiece, was directed to the point where the sun should first appear above the horizon.

The expectation was amply justified, for the first appearance of the sun was a small flattened button-shaped spot—*a* in the figure—of intense green light which was followed almost immediately by strong yellow as the segment of light took definite shape (*b* in figure). During the time that the sun continued rising through the successive stages *c* to *i*, its upper limb remained fringed with a definite though gradually narrowing edge of green, which was still faintly discernible even at the *k* stage. The changes of form through which the sun's disc passed are shown in the figure; in the first stages *a*, *b* and *c* the lower edge seemed to be



separated very slightly from the sea-horizon; at *d* it appeared to be in contact therewith, while in the succeeding stages the disc seemed to be joined to the horizon-line by a connecting strip whose appearance altered as shown in stages *e* to *h*. This connecting strip appeared to be due to some "mirage" effect, for, at the instant of separation from the sun's disc—stage *h*—the last connexions took the form of flickering orange-red flames in rapid vertical motion between disc and reflection. Separation was complete at stage *i*, when the sun's disc had an ovoid form, flattened at the top, but extended and much pointed below, the lower edge being orange-red while the upper edge was still narrowly green. The final disappearance of the lower reflected segment of light occurred at stage *k*, when the sun's lower limb was about a

quarter of a degree above the horizon, and at that time the disc had assumed its normal ellipsoidal form, with a vertical axis between 80 and 85 per cent. of the length of the horizontal one.

This telescopic observation, having been made at sunrise, confirms the theory that the green ray is a truly optical effect, due to the refraction of the sun's rays by the atmosphere, and that it is not merely an effect due to the physiological reactions of the retina, as has been suggested when the ray has been observed at the time of sunset. The persistence of the green fringe on the upper limb until after the complete disc was visible above the horizon disposes finally of the latter explanation, as does equally the presence of a reddish fringe on the lower limb.

The observation lasted six or seven minutes, and during the whole time no difficulty was experienced in observing the sun's disc directly through the telescope without in any way screening or reducing the light. The absorption of light by the atmosphere, despite the extreme visibility, must therefore have been very considerable. The dark spotted areas on the sun's disc were plainly visible, and so also were the surrounding facular areas, which appeared definitely brighter than the rest of the disc.

There is one further point worthy of remark—a physiological one. The sun was observed throughout with my right eye, the left one remaining closed. After the observation, when I viewed the general landscape with my right eye only, the whole field of view was darkened and suffused with a strong magenta-violet tint, as compared with its normal appearance to the left eye. This effect gradually disappeared, but endured for fully five minutes before both eyes gave the same normal view. This would suggest that the retina of my right eye had become fatigued and temporarily insensitive to the yellow-green light rays, to which magenta-violet is the complementary colour.

G. A. CLARKE.

It is interesting to compare Mr. Starr's friends' experience of the green flash as described in the January issue of the *Meteorological Magazine* with that of a Mr. E. M. Dence, who wrote to *The Times* (August 19th, 1929) as follows:—

“My wife was with me and as we had protected our eyes up to the last few seconds we were both able to agree that the transformation to green was unmistakable.”

It will be noted that Mr. and Mrs. Dence took practically the same precautions as the observers at Jaffa, but with a different result.

CICELY M. BOTLEY.

Guildables, 17, Holmesdale Gardens, Hastings. January 23rd, 1930.

OFFICIAL PUBLICATIONS

The following publication has recently been issued.

PROFESSIONAL NOTES.

No. 53. *The Relation between the Duration of Bright Sunshine registered by a Campbell-Stokes Sunshine Recorder and the Estimated Amount of Cloud.* By C. E. P. Brooks, D.Sc. (M.O. 273m.)

The paper assumes that when the sun is below a certain level it will fail to burn the card in a Campbell-Stokes recorder. On the other hand, some visible cloud is too thin to prevent the sun from burning the card, and the further assumption is made that this thin cloud is high cirriform cloud and that the amount visible is proportional to $c(1 - c)$ where c is the proportion of the sky covered by cloud. The relation between duration of sunshine s , expressed as a fraction of time between sunrise and sunset, time w during which sun is below 5° , expressed as a similar fraction, and cloudiness c can therefore be written:

$$s/(1 - c) = (1 + tc)(1 - aw)$$

where t and a are constants. From monthly normals of sunshine and cloudiness during the same years at a number of stations, the values of the constants t and a are determined; t is found to be equal to 0.6, and is independent of latitude, while a varies from about 1 at inland places in high latitudes to 2 in middle latitudes. At mountain and some desert stations a is very small, showing that the sun burns the card when just above the horizon; in great cities it is very large, 3.5 at Greenwich, showing that owing to the smoky atmosphere the sun does not burn the card until it is on the average 17° above the horizon.

Monthly sunshine averages calculated from mean cloudiness by this formula agree well with the observed amounts, the average error at Valentia being less than two per cent.

Discussions at the Meteorological Office

The subjects for discussion for the next two meetings will be:—
February 24th.—*On the relation between the rotation of the sun*

and variations in atmospheric temperatures. By K. F. Wasserfall. (Oslo, Norske Videnskaps-Akademi, Geofys. Pub. 5, No. 10. 1929.) *Opener*—Mr. D. W. Johnston, B.Sc.

March 10th.—Dr. G. C. Simpson, C.B., F.R.S., will explain the programme, which has been proposed by the International Meteorological Committee which met in Copenhagen in 1929, for a second Polar Year in 1932-3.

Royal Meteorological Society

The Annual General Meeting of the Society was held on Wednesday, January 15th, at 49, Cromwell Road, Sir Richard Gregory, D.Sc., President, in the Chair.

The Symons Gold Medal, which is awarded biennially for distinguished work in connexion with meteorological science, was presented to Dr. G. C. Simpson, C.B., F.R.S., Director of the Meteorological Office, Air Ministry, and the Council of the Society for the ensuing year was duly elected, the new President being Mr. R. G. K. Lempfert, C.B.E., M.A., F.Inst.P.

Sir Richard Gregory addressed the Fellows on "Weather Cycles and Weather Recurrences."

When Joseph interpreted Pharaoh's dream of seven fat kine and seven lean kine as signifying seven years of plenty and seven of famine, his prediction was probably based upon a weather cycle or period of about fourteen years. Though the periodicity could not have been very highly developed it was sufficiently well marked to influence the general character of the seasons. The predictions made by Elijah and Elisha may have been founded upon knowledge of this kind of general periodicity preserved by the priests.

The extraordinary weather of the year 1929—frosts, droughts, floods and gales—gives renewed interest to the question whether these abnormal phenomena return in regular cycles or whether their occurrence is irregular. Innumerable weather cycles have been described, of which the best known are the Brückner cycle of about 35 years and the sunspot cycle of eleven years. The Brückner cycle is an alternation of groups of years which are on the whole cool and wet with groups of years which are on the whole warm and dry; it is useless for forecasting the weather of individual years. It may, however, be important in business affairs, where profits may accumulate during long runs of generally favourable years, to be dissipated when conditions become generally unfavourable. In the rainfall of the British Isles a fifty-year cycle is far more evident than the Brückner cycle, and gave us, for example, wet periods in the 1870's and the 1920's. The eleven year sunspot cycle is important in tropical regions, and is strictly reflected in variations of the level of Lake Victoria, but is almost non-existent in the weather of the British Isles.

From time to time shorter cycles appear in our weather. Between 1868 and 1886 every fifth year was outstandingly wet; from 1887 to 1909 every third year was wet; while from 1910 to 1922 the odd years were all dry and the even years wet. Each of these cycles while it lasted, was astonishingly regular, but each broke down just when it seemed to be definitely established, and such cycles are useless for forecasting.

There are other weather cycles, especially in rainfall, having a length from five or six days to a month. A possible seven-day cycle has been discovered in the manufacturing town of Rochdale, where the rainfall on Sunday, when the air is comparatively clean, is on the average less than that on the other days

of the week, when the air is smoky from the factory chimneys. A more general cycle of five or six days probably exists over the greater part of the northern hemisphere, but these short cycles are too indefinite and irregular to be of service in forecasting, and attempts to employ them for predictions several weeks in advance have not met with any appreciable success.

The best known examples of weather recurrences are Buchan's warm and cold spells, supposed to return at about the same dates each year. These were discovered from observations in Scotland in the middle of the nineteenth century, and there is no warrant for expecting to find the same recurrences in the weather of southeast England in the twentieth century. The general conclusion is that neither weather cycles nor weather recurrences are at present of any value in forecasting coming weather for any particular year, month or day.

Correspondence

To the Editor, *The Meteorological Magazine*.

Range of Visibility in a Fog

The fog this morning at Golders Green was very dense; the visibility about 10 a.m. was between 15 and 20 yards. Half an hour later in Kingsway I observed the visibility to be between 150 and 200 yards. That contrast is in itself interesting, but the purpose of my letter is not primarily to draw attention to this. By a piece of good fortune I was able to make an observation of the difference between ordinary visibility and the visibility of a light in a thick fog, and the result was to me, at any rate, sufficiently surprising to make me want to tell it in the hope that others might be able to contribute from their experience similar observations under varying conditions.

Although the fog was thick the light was moderately good, *i.e.*, the light was not bad enough for the street lamps to be lit. One lamp, however, about 200 yards north of the entrance to Golders Green station on the Finchley Road, was being cleaned by a workman who had lit it. The distance at which I could distinguish the lamp-post and the workman (who was at the top of a ladder and at about the same level as the light) was between 15 and 20 yards; but I could see the light between 10 and 15 yards further away. I ought to mention that the lamp was an incandescent gas lamp and that both the lamp and the workman would have had a "sky" background, if the fog had not been so thick that no "sky" could be distinguished.

I had anticipated that in a very dense fog the difference between the distance of visibility of a light and the distance of visibility of an ordinary object would not be more than 2 or

3 yards. It appears, however, from this observation that the light is visible at a distance greater by more than 50 per cent. I observed a similar difference between the distance of visibility of a red light at the top of an automatic ticket machine at the entrance to the station and the distance of visibility of the machine itself.

In Kingsway the lamps were alight; the lamp standards in the centre of the road I could distinguish at a distance rather greater than twice the distance between them; but I could see the light of the second standard beyond the last standard directly visible, *i.e.*, about 150 yards further away. The outline of Bush House, on the other hand, could be seen about as far away as the furthest light visible, although the details of the building itself could not be distinguished at all at that distance. The sun was visible at Kingsway though not at Golders Green.

E. GOLD.

January 21st, 1930.

Smoking Sea

The phenomenon described by Mr. T. H. Applegate in the December number of the *Meteorological Magazine* can be observed in winter even in very temperate climates. In the Cloud Photography Exhibition held last June at Barcelona by the International Cloud Commission, this fact could be seen reproduced in a very striking manner in some copies obtained by our assistant, Mr. J. Pons and belonging to the archives of the "Fundacio C. Rabell."

Close to the coasts of Catalonia, and more particularly before the creeks of the "Costa Brava," between Blanes and Port-Bou, smoking sea appears at sunrise on the calm days of December and January, when the Iberic anticyclone is predominant. In such circumstances, the cold "terral" or landwinds, produced by the strong irradiation which has prevailed during a cloudless night, come in contact with the warm Mediterranean stream which runs along our coast from south towards the north; the difference of temperature between the air and water masses reaches easily 22° or 25° F., and the mouth of every one of these slow air currents is then marked by a field of characteristic condensations.

These condensations do not mix in a continuous fog, as the sun, which rises splendid in such days, soon makes an end of the "terral." Their forms are rather discontinuous, and it is not rare to see them as a multitude of "fog-flames" of very short duration but several meters high.

E. FONTSERÉ.

Servicio Meteorologico de Cataluna, Barcelona. January 4th, 1930.

Lightning and Gales

The record-breaking gale of the night of December 6th-7th was very remarkable in that it was accompanied by lightning for several hours. I have often observed a flash or two at the passage of the trough of a depression, or during squally showers in its rear, but never anything like this before in winter.

This depression was not preceded by the usual cirrus, cirro-stratus, alto-stratus succession; the morning was showery, with cumulo-nimbus, and at 1 p.m. a large area of dark cloud moved up from the southwest; in the distance I thought it was merely another anvil-type cumulo-nimbus, such as we had been having during the morning, but it advanced much more slowly, and eventually resolved itself into an area of alto-stratus with fracto-stratus beneath, but it showed a much more sudden transition from blue sky to heavy cloud than is usual in an advancing depression. At 4 p.m. rain commenced and was pretty heavy and steady till 7.30 p.m. when 0.32 in. had fallen. After this the rain was not at all heavy, only 0.29 in. falling all the rest of the night, but the lightning persisted in the most extraordinary way—I saw the first flash about 7 p.m. and the last about 1.30 a.m., and between 9 p.m. and 12.30 p.m. I counted nearly 100 flashes, which is far more than I have ever seen before in the winter, and all the time an exceptionally strong gale was raging. The barometer was very low for the south of England and falling slowly all the time. I do not know if you have experienced anything similar but this combination of a great gale with persistent lightning is new to me.

Another remarkable though less impressive, feature of the weather lately is that for 22 successive days the maximum here has been 50° or over.

E. NIMMO.

Chinley, Grange Road, Broadstone, Dorset. December 10th, 1929.

"Windrush" at Street, Somerset

Mr. J. Edmund Clark informs us that at 6.20 p.m. on December 6th, 1929, four big elms along Portway, Street, Somerset, crashed all together within 50 yards as well as the largest local pear tree, 40 feet high. This was part of a "windrush" three miles long from southsouthwest to northnortheast, which was parallel with another four miles distant. The barometric trace showed a remarkable instantaneous rise and fall of .007 in. (0.2 mb.) during a pause of 1½ hours halfway down a rapid fall to 28.38 ins. (961 mb.).

Red Rainbow

On November 7th, 1929, a halo was observed between 7.0 and 7.10 G.M.T. from a point 5 miles south of this station. The halo appeared in the cirro-nebula clouds which covered the sky

at the time, and took the form of a red bow at a vertical angle of about 45° , the centre bearing northwest from the point of observation. The bow was similar in position to the rainbow which has been seen on previous occasions at this time. The sky in the east was observed to be very red at the time; the sun had not then risen. As the light grew stronger the bow gradually disappeared, fading first at the centre.

E. W. BLAIR.

Royal Naval Cordite Factory, Holton Heath, Wareham. December 8th, 1929.

Colouring of Evening Sky

I have observed on two occasions a sky phenomenon similar to that described by Mr. Southcombe in the December magazine. Both occasions were at sunrise. On November 5th, 1926, the sky was uniformly covered with nimbus and heavy rain was falling, when the whole sky became suffused with a pink tint. The phenomenon was repeated on January 21st, 1928. This time the range of visibility was not more than 100 yards and light drizzle was falling. In both cases the pink colour was of the same intensity in all parts of the sky.

S. E. ASHMORE.

Windwhistle Cottage, Grayshott, Hindhead, Surrey. December 27th, 1929.

I have frequently observed the red colour that sometimes comes over a clouded sky at sunset. I have always considered it to be due to a layer of high cloud becoming a brilliant red under the setting sun; when this happens in the absence of low cloud everything is suffused with a red glow. When the sky is overcast with low clouds all the light that reaches the ground (or what is the same thing, the under surface of the low clouds) at sunset, or just after, is the light from the sky above; if this is predominantly red the effect will be exactly that described by Mr. H. W. Southcombe in the December number of the *Meteorological Magazine*. I think the effect may often be seen if carefully looked for, and just occasionally it is very marked. The conditions would seem to be a layer of low cloud, detached masses of high cloud, either cirro-cumulus or high alto-cumulus, and a clear sky to the west above the layer of low cloud.

C. J. P. CAVE.

Stoner Hill, Petersfield. January 22nd, 1930.

Unusual Audibility

With reference to the article "Unusual Audibility," appearing in the August *Meteorological Magazine*, may I be allowed to make a few comments.

I am convinced that, given the most ideal conditions it is extremely doubtful whether the bursting of such a balloon could

be heard at even 5,000ft., and as far as I am able to ascertain one has not previously been heard above 1,000ft. Having had nearly ten years' experience in making pilot-balloon ascents during which there have necessarily been a number of bursts at various levels I must admit that the noise has entirely escaped me. Mr. Baxter mentions that a 12 m.p.h. wind was blowing at the time, which would not have made the conditions ideal for hearing such a faint sound, and yet he says the noise was quite distinct. I am wondering whether Mr. Baxter has witnessed and heard anti-aircraft shells bursting at those high levels (14,000 and 17,000ft.), or whether he has himself flown at those heights in order to appreciate what 3-4 miles above the ground means.

I am convinced that what Mr. Baxter heard was a distant gunshot or some such noise, and that to hear the bursting of a small balloon at such heights is utterly impossible.

J. G. GOODYEAR.

R.A.F. Station, Upper Heyford, Oxon. August 23rd, 1929.

NOTES AND QUERIES

A Storm of Snow and Ice in America

From December 17th to 20th, 1929, the north-eastern parts of the United States, and especially Maine, were visited by one of the worst storms of snow and ice on record there. The storm is of interest, not only for the material damage and the remarkable character of the weather, but for the abnormal barometric distribution which caused the phenomena.

On the morning of December 16th an anticyclone lay over southern Canada, and this persisted until late on the 19th. It was very intense; at 8 a.m. on the 17th pressure was 1047 mb. at Prince Albert, Saskatchewan, and at 8 a.m. on the 18th 1052 mb. over North Dakota. On the 17th the northerly winds associated with it brought snow over Maine. On the southern flank of this anticyclone a depression traversed the United States, growing in intensity. On the 16th it travelled south-eastwards from Idaho to a position northeast of the Gulf of Mexico. On the 17th it continued eastwards, and at 8 a.m. on the 18th it was centred over Tennessee. Over the eastern United States there were accordingly two great wind systems; in the north a cold northeasterly current blowing on the southeastern margin of the anticyclone, and in the south a warm southerly current on the eastern side of the depression. These two winds met over the northeastern States, where in a distance of less than 100 miles from north to south temperature rose by 30°F.

The southerly current brought fog, mist and rain, and must have been saturated with moisture. Though no direct evidence is available, there can be no doubt that where it met the north-

easterly winds it rose and continued northwards at a height of a few thousand feet. The rising air produced heavy rain, which became super-cooled as it fell through the lower layer of air from northeast, at a temperature of 20° to 30° , and froze whenever it touched a solid object.

On the morning of the 19th the depression was centred over Pennsylvania and these conditions were accentuated, temperature rising 40° in 100 miles. Southeast of the depression were southerly winds with rain and fog, northeast of the centre northerly winds with super-cooled rain, and still further northeast, on the margin of the anticyclone, northeasterly winds with snow. To the west of the depression a northerly blizzard was blowing over the central States.

On the 20th the centre of the depression crossed Maine. The southerly winds extended to the coast at Portland, temperature rose rapidly well above the freezing point, and the ice-storm was over. Then in the evening the cold northwesterly winds in the rear of the centre spread eastwards, and there was a sharp frost; as the *Lewiston Evening Journal* expressed it: "temperatures again hit the toboggan." At Auburn the maximum temperatures were 22°F. on December 17th, 30° on December 18th (at midnight, after being 24° all the afternoon), 32° on December 19th. On the 20th the thermometer rose rapidly to 38° at noon, with the onset of southerly winds, and fell again as quickly in the evening.

The total precipitation was 2.15 inches of water; this included $6\frac{1}{4}$ inches of snow, equivalent to 0.6 inch of rain, the remaining $1\frac{1}{2}$ inches falling as super-cooled rain.

Mr. Earl C. Austin has kindly sent us copies of two American papers, as well as a long letter descriptive of the storm, and the following particulars have been extracted from these sources. The storm area covered most of the United States from the Rocky Mountains to the Atlantic coast and from Canada to the Gulf of Mexico, but was especially severe in the northeast, for which the experiences at Auburn and Portland, Maine, are typical. At Auburn it began on the 17th as a mild snowstorm, which became heavier as the evening came on. About 10 p.m. the snow turned to super-cooled rain, which in America is known as sleet. This froze on every object it touched, giving the result known in this country as glazed frost. This freezing rain continued throughout the night of the 17th and nearly the whole of the 18th. By the morning of the 19th everything, houses, trees, wires, poles, were sheets of ice, trees and wires being nearly at breaking point. The 19th was cloudy and overcast with thick mist and drizzle but in the evening this again turned to heavy freezing rain which fell with a strong wind. The electric wires broke under the weight of ice, light and power failed, and the cities were in darkness. On the morning of

the 20th rain fell in torrents; trees, wires and poles were falling all over Auburn and Lewiston. That night the cities were pitch dark and completely isolated. On the ground in the streets were 5 or 6 inches of snow, covered by a crust of ice an inch thick, the whole littered with branches of trees. In Portland conditions were even worse, the fine old elms, oaks and other shade trees in the famous avenues looking as if they had been shelled by artillery. On the morning of the 20th with the near approach of the centre of the depression, there were thunderstorms in many parts of New England, the sound of the thunder mingling with the crash of breaking trees; at Springfield, Mass., a house was struck by lightning. No street cars ran for two days, the schools were closed and there were many accidents, several people being killed by skidding motor cars. The damage was estimated at millions of dollars, and the storm was in general the most severe for half a century.

Frequency of Fogs of Different Depths

The inversion which exists above a fog gives a rough indication of the height of the surface of the fog if the temperature gradient is known. At Leafield, Oxfordshire, continuous records of temperature gradient are kept by means of recording thermometers at 4ft., 40ft., 100ft., 185ft., and 285ft. In the following frequency table the approximate height of the base of the large inversion is given for every occasion on which fog was observed (visibility less than 1,000yds.) during the year July, 1928, to June, 1929.

Height.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June
feet.												
>> 300	1	2	1	...	...	1	3	...	...	1
> 300	5	...	3	5	6	...	1	...	...	1
200-300	2	...	1	3	3	...	1	...	...	...
100-200	1	1	1	1	2	2	2	1	1	...
40-100	1	...	...	...	...	...	...
< 40	1	...	1	...	1	2	...	...	...
Intermittent ground fogs	1	...	1	1	...	...	...	...
All heights	9	4	7	11	12	5	9	1	1	2

Very often, when the fog was of great vertical thickness, there was a perfectly steady lapse up to 300ft., similar to the temperature gradient observed when the sky is heavily overcast; these fogs are entered in the table as having the inversion much greater than 300ft. up. On other occasions no marked inver-

sion was recorded, but the lapse rate was unsteady, indicating that the fog did not extend very much higher than 300ft; these have been entered as having the inversion slightly more than 300ft. up. If we take it that the top of the fog is at the level of the base of the inversion (and eye observations of the depth of shallow ground fogs support this suggestion), the entries in the left-hand column give the height of the top of the fog. When the level of the inversion was changing during the fog, as it frequently did, the height given is that during the middle of the foggy period.

Of the 61 fogs observed, 31 were ground fogs (upper surface below 300ft.). The annual distribution of frequencies is much the same for ground fogs and deep fogs, with a maximum in midwinter, and secondary maxima in September and March. The scarcity of fogs in the summer months is a little misleading; probably a few ground fogs occurred at dawn and passed unnoticed, as no observer is on duty between 18h. 30m. and 6h. 30m. When blue sky or higher clouds could be seen in the zenith, the fog was in no case deeper than 300ft.

Leafield, owing to its position on the top of a ridge, suffers from three more or less distinct types of fog:—

1. Radiation fog, filling the valleys on calm clear nights, and sometimes spreading over the high ground in the early morning as a shallow layer.

2. General fog, covering a large area of country during calm weather in winter. Of the general fogs mentioned during the year in the Meteorological Office *Supplement to the Daily Weather Report*, 13 were observed at Leafield. These were only of moderate thickness; four were greater than 300ft., but none much greater.

3. Low stratus, coming right down on to the high ground, leaving the valleys clear. Does not require calm weather for its formation. Probably most of the fogs whose thickness is much greater than 300ft. are of this type.

G. S. P. HEYWOOD.

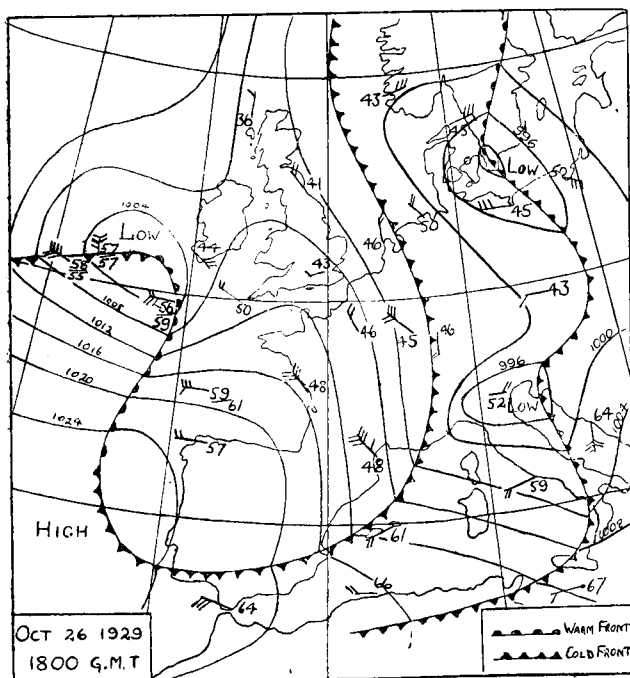
The Importance of Atlantic Ship Observations for Mediterranean Forecasting

Although over the central Mediterranean forecasting presents its own peculiar problems it might at least be thought to be free from that source of many past forecast failures in the British Isles: the unknown situation over the Atlantic. As an illustration of the value of Atlantic ship observations at a station so far distant as Malta attention is drawn to the conditions from October 26th to 27th, 1929.

At 7h. G.M.T. on the 26th a depression had formed over north Italy as is normally the case when cold air enters the Mediter-

ranean from France. The cold air had already spread over the Balearics and Sardinia and was expected to reach Malta that night, giving a change from light southwesterly to fresh or strong northwesterly winds. A second cold front was also moving southeastwards across France and was expected to cause further deepening of the depression over Italy. After the arrival of the cold air at Malta a period of showery northwesterly conditions was anticipated. At this time only one ship observation was received from the Atlantic, sufficient to indicate a shallow low somewhere to the west of Ireland but naturally not enough to enable an accurate analysis to be made.

At 13h. G.M.T. changes were taking place as foreseen. The Italian depression had deepened; the first cold front had almost reached Sicily; whilst the second had entered the northwest Mediterranean from France. No change in the morning forecast was thought to be necessary; there appeared to be a distinct possibility of a heavy squall with the arrival of the cold air. At this time again only one ship observation was available from the



Atlantic, confirming the existence of an eastward-moving depression west of Ireland but not leading one to anticipate any immediate effect for the central Mediterranean. Three ship observations at 18h. enabled an analysis to be made and it was then seen that the Atlantic depression would influence the Mediterranean shortly. The situation at 18h. on the 26th is shown in the figure with the

routine frontal analysis. All information received by wireless telegraphy was used for the analysis but without supplementing from daily weather reports. Temperatures and winds for a few stations only are given in the diagram; ship observations of sea temperatures are plotted below the air temperatures, the difference between air and sea temperatures being a most useful factor in air mass analysis. The depression off the west of Ireland was apparently a development on a wave in the front lying northwestwards across the Atlantic. Subse-

quently it behaved as a normal Bjerknes cyclone and had reached the Bay of Biscay at 7h. on the 27th, the northwest Mediterranean at 18h., the Tyrrhenian Sea at 7h. on the 28th and the Ionian Sea at 18h. on the 28th. The northwest winds at Malta were completely cut off and it was not until after the passage of this depression that the northwesterly conditions really set in, with a squall to 58 m.p.h. about noon on the 28th, some 36 hours later than originally expected.

R. C. SUTCLIFFE.

Review

Annales de l'Observatoire National d'Athènes. Edited by D. Eginitis. Tome X, Size 12 × 9½ in., pp. cvi + 539. *Illus.* Athens, 1929.

This volume deals with the period 1923 to 1926. Summaries are given of astronomical, meteorological and seismographic observations at the Observatory of Athens, also of meteorological observations at 28 second- and third-order stations and at 34 rainfall stations in Greece. There is also a "macroseismic catalogue," a list of earthquake movements, perceptible without instruments, recorded at various places in Greece. In 1926, 122 such were recorded; most of them were of no more than feeble intensity, but the earthquake of June 26th, 1926, caused much damage in Crete, and was felt over a wide area. A number of short papers form an introduction to the volume, of these may be mentioned a note on the Corinth earthquake of April 22nd, 1928, by Professor Eginitis, a note on visibility at Athens by A. N. Livathinos, and a note on air temperature at Athens by T. Th. Fintiklis. The last mentioned determines normals from the observations of 1894-1923. and examines the variability of temperature by statistical methods.

S. T. A. MIRRLEES.

The influence of Sea Disturbance on Surface Temperature. By P. M. van Riel. Koninklijk Nederlandsch Meteorologisch Instituut. No. 102. Mededeelingen en Verhandelingen 30. For this investigation the data from Dutch ships are used, the selected areas being two in the temperate latitudes of the North Atlantic, one in the equatorial Atlantic, one in the western coastal area of the South Atlantic and one in the equatorial Indian Ocean. The purpose of the inquiry is to determine whether the ordinary bucket method of obtaining sea temperatures gives results that approximate to real surface conditions. This is found to be the case where all observations are utilised for normal values. The consequence of increasing sea disturbance from mean smooth to mean moderate, is a fall of

surface temperature of about 0.5°C . in the temperate zone in summer and in the equatorial Indian Ocean. For the equatorial Atlantic the fall is only half this amount. The effect on the decrease of the amplitude of the daily range, which is slight, is also discussed. It is further shown that the effect due to increasing sea disturbance is in general unconnected with the accompanying increase in cloudiness.

E. W. BARLOW.

Summary of Indian Rainfall for the Fifty Years, 1875-1924.

Memoirs of the Indian Meteorological Department,
Vol. XXV, Part II, 1928, pp. 94 + map.

This paper gives for the 15 divisions of India general rainfall amounts for each month of the fifty years, 1875-1924. The values are given both as percentages of the average and as departures in actual inches. If the existing rainfall stations had initially been established uniformly over India and had been continuously maintained with standard instruments in standard exposures, the preparation of such a summary would be relatively simple. Prior to the reorganisation of the meteorological service by Sir John Eliot in 1890, reliable records were few. The increase in the number of stations at this period is illustrated by the figures for Punjab (East and North) which changed from 23 in 1890 to 120 in 1891.

The accuracy of the final results is affected not only by the amount of data, but by the amount of time which can be expended in carrying out each computation. The ideal method involves the preparation of rainfall maps for each district both for the average rainfall and for individual months, and the determination of the general amount by subdividing the whole area into smaller zones for which the rainfall can be estimated by inspection. This method is obviously laborious, and a more practical scheme, and one frequently adopted in this country, is to convert the individual monthly amounts into percentages of the average monthly values and to take a mean. If the stations are uniformly distributed the final value is the mean percentage for that area. If, as is usually the case, the general rainfall for the district month by month is required, then the selection of the stations should be proportional to the average rainfall. There should be more stations in the wet districts, since an excess of say 10 per cent. of the average in a wet region corresponds to more rain than a similar excess at a station in a dry region. In practice, however, it is found that, if stations uniformly distributed are used the errors in the final values are not large, since the percentage values change but slowly from place to place.

A third method has been adopted in this paper. The mean of the actual rainfall amounts is taken, together with the mean of the corresponding averages. This method is obviously not

so good, since a station with a very large average exerts too strong an influence, while one with a small average may have practically no effect at all. This difficulty is obviated by the use of percentages. In the paper records from stations at altitudes of more than 3,500ft. had to be omitted in certain cases, although such regions were left relatively unrepresented thereby.

This method of obtaining the general values is a factor which must be taken into account in considering the correlation coefficients which are included in the paper.

A striking feature of the tables is the number of months in which the rainfall over whole districts, which are of the order of 50,000 sq. miles is given as 0 per cent. This occurred in the state of Hyderabad during 17 out of 50 Januaries. On the other hand it is not unusual for the general fall to be between 1,000 and 2,000 per cent. of the average. The rainfall of Hyderabad during January 1922 was 2.52in. which with an average of .14in. gives a percentage of 1,687. It will be recalled that the correlation coefficient between two sets of data depends very largely on the accord on the occasions of extremes. With so variable a rainfall this point is of particular importance in considering the actual values of the correlations and a long period seems necessary before reliable values can be obtained. The inclusion of one or two dot diagrams would have been of assistance in this connexion and might suggest a classification into types with large and small relationship.

One naturally turns to the tables of correlation coefficients with particular interest because of the use made of them in forecasting by Sir Gilbert Walker. They emphasise that the monsoon rains of Burma have either no relationship, or a slight tendency to vary inversely with the rainfall of other divisions. It is also noticed that with the extension of the period to 50 years the relationship between the rainfall of January to April and that of July, which previously gave a correlation of $-.53$, is now only $-.37$. This relationship between winter rains and subsequent monsoon rains is examined in detail and it is shown that the significant correlations are concentrated in March.

J. GLASSPOOLE.

Books Received

Bulletin Météorologique du département de l'Hérault publié sous les auspices du Conseil Général. Années 1924-5. Montpellier, 1928.

Apia Observatory, Samoa. Report for 1926. Wellington, 1929.

Deutsches Meteorologisches Jahrbuch, 1926, Freie Hansestadt Bremen. Edited by Dr. A. Mey, Bremen, 1928.

Deutsches Meteorologisches Jahrbuch für 1919-20, Freistaat Sachsen. Edited by Prof. Dr. E. Alt, Dresden, 1928.

News in Brief

Dr. Louis A. Bauer, Director of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington since the establishment of the department on April 1st, 1904, retired from this position on January 1st, 1930, with the title of director emeritus. He is succeeded by Mr. John A. Fleming, with the title of acting director.

Corrigendum

January, 1930, p. 277, lines 14-18, and p. 279, lines 28-31. The temperature and sunshine records at Rothamsted date back to 1878 and 1890 respectively, and not as stated to 1852. The earliest records at this station are those of rainfall, which has been measured continuously with the same gauge since February, 1853.

The Weather of January, 1930

The weather of January was unsettled and wet with frequent gales during the first fortnight. Pressure was almost continuously low south of Iceland, the average pressure for the month being more than 10 mb. below normal over Scotland and Ireland, and slightly less than 10mb. in England. Winds were for the most part between south and west and the temperature high for the time of year in England, and often also in Scotland and Ireland. Maxima frequently exceeded 50° F.; on the 7th they reached 54° F. at Aberdeen, 56° F. at Dublin and Manchester, and on the 19th 60° F. at Bath and 59° F. at Greenwich; the latter was a record since 1841. Only on a few occasions were the maxima generally below 40° F. even in Scotland, *e.g.*, on the 11th-15th, during which period the lowest maximum was 33° F. at Nairn and Birr Castle on the 11th and on the 25th-28th during which the lowest maxima were 33° F. at Renfrew and 34° F. at Harrogate and Armagh on the 26th. Minimum temperatures also were often high in the south, 50° F. being recorded locally on the 14th and 19th, but there were several severe frosts notably on the 16th, 21st, 26th, 28th and 31st, 10° F. was recorded on the ground at Burnley on the 16th, 12° F. on the 21st and 14° F. on the 28th and 31st. High winds and gales were experienced throughout the month, but were most frequent and widespread during the first fortnight. The most severe gale occurred on the 12th.* The total rainfall was excessive except at a few places on the east coast. At Ross-on-Wye the total was the highest since 1869, and at Valentia the record has been broken for each of the three successive months November, December and January. From about the 15th-21st

* See page 1.

there was a period of little or no rain in the south, but in other districts precipitation (though sometimes slight) occurred on most days throughout the month. Among the heaviest falls were 3·20 in. at Fofanny (Co. Down) on the 31st, 2·45 in. at Rosthwaite (Cumberland) on the 1st, 2·33 in. at Tynywaun (Glamorgan) on the 10th, and 2·30 in. at Achnacarry (Inverness) on the 6th. Snow was reported from various parts of Scotland, Ireland and north England from about the 9th to 16th, and again from the 27th-30th, with snow lying to a depth of $1\frac{1}{2}$ in. at Inverness and Rothesay on the 11th and 2 in. at Marchmont on the 27th. Thunderstorms occurred at isolated places on the 1st-3rd, on the 11th and on the 26th-28th. Mist or fog were widespread on the 16th and on the mornings of the 21st and 26th-31st. The sunniest days of the month were the 2nd, 6th, 15th, 20th, 25th, 29th and 30th; 7·1 hrs. were recorded at Ventnor and Eastbourne on the 6th, 7·0 hrs. at Blackpool and Southport on the 15th and 8·2 hrs. at Weymouth on the 29th. The distribution of sunshine for the month was as follows:—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway	30	+ 2	Valentia	45	— 3
Aberdeen	67	+19	Liverpool	57	+ 2
Dublin	55	— 2	Falmouth	58	0
Birr Castle	55	+ 6	Kew	42	— 1

Pressure was below normal over western and northern Europe, Spitsbergen, Iceland and the northeastern part of the North Atlantic the greatest deficit being 16·9mb. at Thorshavn (Faeroes), and above normal in Newfoundland, Bermuda and the Azores, the greatest excess being 9·2mb. at St. John's. Temperature was above normal over western Europe, being as much as 13°F. in excess at Haparanda. Rainfall, except over the British Isles and parts of Sweden was generally deficient.

Owing to the wet weather large boulders fell from the top of the "Rock" of Gibraltar above the village of Caleta, causing extensive damage to the rainwater catchments. Severe storms were experienced off the southern Norwegian coasts about the 10th. Very mild weather prevailed in Scandinavia, Finland and north Russia throughout the month with very little ice in the Baltic. The föhn wind was experienced in Switzerland from the 27th-31st, with the result that the snow melted up to a level of at least 3,000 ft. and temperature rose above 60° F. in the valleys of the Rhine and Reuss. Owing to heavy rain during the later part of the month floods occurred in several low-lying parts of the Riviera, but these were subsiding by the 29th. Gales were experienced in the southern part of the Bay of Biscay on the 27th and at Gibraltar on the 31st.

Unprecedented floods at Kidete (some 25 miles west of Kilosa) following heavy rain stopped all railway communication between

Dar-es-Salaam and Dodoma on the 6th. The level of Gombo Lake at Kidete Station on the 10th was $5\frac{1}{2}$ ft. above the rails, 3 miles of which were under water and rain was still falling. By the 22nd the floods were subsiding steadily. A southeasterly gale occurred at Cape Town from the 18th to 21st, and a storm was also experienced in Rif on the 25th.

In consequence of heavy rains in Central Australia and the pastoral districts of Queensland the river Finke is running for the first time in seven years, and the Bulloo, Warrego and Thomson rivers and Cooper's Creek are several miles wide, the flood water from the latter reaching Lake Eyre for the first time for 10 years. The damage to the railway and towns is regarded as nothing compared with the great benefit the rains will ensure for years to the stock. A sudden severe blizzard with thunder and lightning occurred on Mount Cook, New Zealand, on the 19th, during which six people were killed near the Tasman glacier.

From the 1st-9th central Canada and the eastern States experienced generally mild weather; temperature reached 66° at New York on the 9th, and many rivers were free of ice. A cold spell swept across the western States about the 5th, extended to the Mississippi River area before the 14th, to the Atlantic States, the following week, and continued over the most of the States until the end of the month. Several deaths occurred from cold on the 18th-23rd, when the temperature continued below 0°F. at many places throughout the day. Precipitation was slight at first but was afterwards heavy, floods resulting in the Mississippi river area from the 10th. Heavy snowfalls later in the month intensified the sufferings of the flood victims. A storm was experienced at Sao Paulo, Brazil, on the 11th and four people were killed in a cyclone at Cordoba, Argentina, on the 29th.

The special message from Brazil states that the rainfall was scarce over the whole country with an average of 0.16in., 3.58in. and 0.87in. below normal in the northern, central and southern regions respectively. Six anticyclones passed across the country. The proximity of the Atlantic anticyclones to the east coast caused excessive heat and little rain over most of the country. Crops were generally in good condition except the cereals in the south, which were suffering from lack of rain. At Rio de Janeiro pressure was 0.5mb. above normal and temperature 2.5°F. above normal.

Rainfall, January, 1930.—General Distribution

	Year	
England and Wales	170	} per cent of the average 1881-1915.
Scotland ...	131	
Ireland ...	152	
British Isles	<u>157</u>	

Rainfall: January, 1930: England and Wales

Co.	STATION	In.	Per- cent of Av.	Co.	STATION	In.	Per- cent of Av.
<i>Lond</i>	Camden Square.....	2.51	135	<i>Leics</i>	Belvoir Castle.....	2.76	156
<i>Sur</i>	Reigate, Alvington....	3.76	157	<i>Rut</i>	Ridlington.....	2.91	...
<i>Kent</i>	Tenterden, Ashenden...	2.83	133	<i>Linc</i>	Boston, Skirbeck.....	1.93	119
"	Folkestone, Boro. San...	2.45	...	"	Lincoln.....	...	...
"	Margate, Cliftonville...	2.02	122	"	Skegness, Marine Gdns	1.56	90
"	Sevenoaks, Speldhurst	3.19	...	"	Louth, Westgate.....	2.73	126
<i>Sus</i>	Patching Farm.....	3.83	147	"	Brigg, Wrawby St....	2.60	...
"	Brighton, Old Steyne..	2.86	118	<i>Notts</i>	Worksop, Hodsock....	3.13	177
"	Heathfield, Barklye...	4.84	179	<i>Derby</i>	Derby, L. M. & S. Rly.	3.60	186
<i>Hants</i>	Ventnor, Roy. Nat. Hos.	4.43	172	"	Buxton, Devon Hos....	6.33	142
"	Fordingbridge, Oaklands	4.96	180	<i>Ches</i>	Runcorn, Weston Pt...	4.01	169
"	Ovington Rectory.....	6.19	229	"	Nantwich, Dorfold Hall	4.66	...
"	Sherborne St. John....	4.15	178	<i>Lancs</i>	Manchester, Whit. Pk.	4.02	160
<i>Berks</i>	Wellington College....	...	...	"	Stonyhurst College....	6.06	142
"	Newbury, Greenham...	4.25	184	"	Southport, Hesketh Pk	4.88	191
<i>Herts</i>	Welwyn Garden City...	1.98	...	"	Lancaster, Strathspey	6.56	...
<i>Bucks</i>	High Wycombe.....	3.97	190	<i>Yorks</i>	Wath-upon-Deerne....	3.15	164
<i>Oxf</i>	Oxford, Mag. College..	2.47	145	"	Bradford, Lister Pk...	5.43	189
<i>Nor</i>	Pitsford, Sedgebrook...	3.20	172	"	Oughtershaw Hall.....	13.05	...
"	Oundle.....	1.78	...	"	Wetherby, Ribston H.	4.20	204
<i>Beds</i>	Woburn, Crawley Mill	2.69	157	"	Hull, Pearson Park....	2.50	139
<i>Cam</i>	Cambridge, Bot. Gdns.	1.64	109	"	Holme-on-Spalding....	2.75	...
<i>Essex</i>	Chelmsford, County Lab	1.81	118	"	West Witton, Ivy Ho.	6.47	...
"	Lexden Hill House....	1.74	...	"	Felixkirk, Mt. St. John	3.99	199
<i>Suff</i>	Hawkedon Rectory....	1.85	106	"	Pickering, Hungate....	3.44	...
"	Haughley House.....	1.32	...	"	Scarborough.....	2.99	149
<i>Norfolk</i>	Norwich, Eaton.....	1.91	97	"	Middlesbrough.....	2.71	169
"	Wells, Holkham Hall	1.70	117	"	Baldersdale, Hury Res.	6.37	...
"	Little Dunham.....	2.09	107	<i>Durh</i>	Ushaw College.....	3.35	163
<i>Wilts</i>	Devizes, Highclere....	4.28	197	<i>Nor</i>	Newcastle, Town Moor	3.21	157
"	Bishops Cannings.....	3.76	164	"	Bellingham, Highgreen	4.06	...
<i>Dor</i>	Evershot, Melbury Ho.	8.29	238	"	Lilburn Tower Gdns....	2.70	...
"	Creech Grange.....	4.33	...	<i>Cumb</i>	Geltsdale.....	5.60	...
"	Shaftesbury, Abbey Ho.	3.93	151	"	Carlisle, Scaleby Hall	4.40	178
<i>Devon</i>	Plymouth, The Hoe....	6.22	187	"	Borrowdale, Seathwaite	21.75	164
"	Polapit Tamar.....	7.04	189	"	Borrowdale, Rosthwaite	19.03	...
"	Ashburton, Druid Ho.	...	...	"	Keswick, High Hill....	9.97	...
"	Cullompton.....	6.11	188	<i>Glam</i>	Cardiff, Ely P. Stn....	6.22	165
"	Sidmouth, Sidmount...	...	...	"	Treherbert, Tynywaun	18.14	...
"	Filleigh, Castle Hill...	6.47	...	<i>Carm</i>	Carmarthen Friary....	9.56	218
"	Barnstaple, N. Dev. Ath.	5.77	176	"	Llanwrda.....	9.83	184
<i>Corn</i>	Redruth, Trewirgie....	8.41	199	<i>Pemb</i>	Haverfordwest, School	8.61	...
"	Penzance, Morrab Gdn.	8.23	217	<i>Card</i>	Aberystwyth.....	5.69	...
"	St. Austell, Trevarna...	8.11	190	"	Cardigan, County Sch.	7.39	...
<i>Soms</i>	Chewton Mendip.....	6.17	161	<i>Brec</i>	Crickhowell, Talymaes	9.20	...
"	Long Ashton.....	5.33	...	<i>Rad</i>	Birm W. W. Tyrmynydd	10.31	164
"	Street, Millfield.....	3.46	...	<i>Mont</i>	Lake Vyrwy.....	8.88	157
<i>Glos</i>	Cirencester, Gwynfa...	4.68	187	<i>Denb</i>	Llangynhafal.....	5.46	...
<i>Here</i>	Ross, Birchlea.....	5.07	210	<i>Mer</i>	Dolgelly, Bryntirion...	9.25	163
"	Ledbury, Underdown..	4.60	209	<i>Carn</i>	Llandudno.....	4.75	184
<i>Salop</i>	Church Stretton.....	6.68	264	"	Snowdon, L. Llydaw 9	...	...
"	Shifnal, Hatton Grange	4.02	207	<i>Ang</i>	Holyhead, Salt Island	5.87	202
<i>Worc</i>	Ombersley, Holt Lock	4.35	226	"	Lligwy.....	5.56	...
"	Blockley.....	4.79	...	<i>Isle of Man</i>			
<i>War</i>	Farnborough.....	4.65	216		Douglas, Boro' Cem....	6.37	190
"	Birmingham, Edgbaston	4.97	246	<i>Guernsey</i>			
<i>Leics</i>	Thornton Reservoir....	3.34	169		St. Peter P't. Grange Rd.	5.98	204

Rainfall : January, 1930 : Scotland and Ireland

Co.	STATION	In.	Per- cent of Av.	Co.	STATION	In.	Per- cent of Av.
<i>Wigt.</i>	Stoneykirk, Ardwell Ho.	...	...	<i>Suth.</i>	Loch More, Achfary...	10'02	138
"	Pt. William, Monreith	5'64	...	<i>Caith.</i>	Wick.....	2'01	81
<i>Kirk.</i>	Carsphairn, Shiel.....	12'66	...	<i>Ork.</i>	Pomona, Deerness.....	3'08	89
"	Dumfries, Cargen.....	6'95	174	<i>Shet.</i>	Lerwick.....	5'80	136
<i>Dumf.</i>	Eskdalemuir Obs.....	10'84	200	<i>Cork.</i>	Caheragh Rectory.....	9'60	...
<i>Roxb.</i>	Braxholm.....	5'68	207	"	Dunmanway Rectory...	11'48	184
<i>Selk.</i>	Ettrick Manse.....	10'14	...	"	Ballinacurra.....	4'86	122
<i>Peeb.</i>	West Linton.....	4'75	...	"	Glanmire, Lota Lo....	6'74	157
<i>Berk.</i>	Marchmont House.....	2'12	94	<i>Kerry.</i>	Valentia Obsy.....	10'96	200
<i>Hadd.</i>	North Berwick Res....	1'69	98	"	Gearahameen.....	18'30	...
<i>Midl.</i>	Edinburgh, Roy. Obs.	3'03	176	"	Killarney Asylum....	...	...
<i>Ayr.</i>	Kilmarnock, Agric. C.	4'89	143	"	Darrynane Abbey.....	8'52	170
"	Girvan, Pinmore..	6'18	131	<i>Wat.</i>	Waterford, Brook Lo...	4'97	135
<i>Renf.</i>	Glasgow, Queen's Pk..	5'59	167	<i>Tip.</i>	Nenagh, Cas. Lough...	7'56	191
"	Greenock, Prospect H.	10'61	155	"	Roscrea, Timoney Park	5'42	...
<i>Bute.</i>	Rothsay, Ardenraig.	5'83	130	"	Cashel, Ballinamona...	5'73	151
"	Dougarie Lodge.....	4'85	...	<i>Lim.</i>	Foynes, Coolnanes.....	7'98	211
<i>Arg.</i>	Ardgour House.....	18'00	...	"	Castleconnel Rec.....	5'74	...
"	Manse of Glenorchy...	12'66	...	<i>Clare.</i>	Inagh, Mount Callan...	8'40	...
"	Oban.....	8'79	...	"	Broadford, Hurdlest'n.	6'86	...
"	Poltalloch.....	6'96	137	<i>Wexf.</i>	Newtownbarry.....	...	...
"	Inveraray Castle....	12'23	149	"	Gorey, Courtown Ho...	5'44	174
"	Islay, Eallabus.....	6'78	145	<i>Kilk.</i>	Kilkenny Castle.....	4'59	143
"	Mull, Benmore.....	...	...	<i>Wic.</i>	Rathnew, Clonmaunon	5'46	...
"	Tiree.....	...	...	<i>Carl.</i>	Hacketstown Rectory...	5'21	147
<i>Kinr.</i>	Loch Leven Sluice.....	3'59	114	<i>Leix.</i>	Blandsfort House.....	6'02	183
<i>Perth.</i>	Loch Dhu.....	13'85	152	"	Mountmellick.....	6'11	...
"	Balquhider, Stronvar	14'35	...	<i>Off'ly.</i>	Birr Castle.....	4'92	174
"	Crieff, Strathearn Hyd.	5'19	129	<i>Dubl.</i>	Dublin, FitzWm. Sq...	3'58	156
"	Blair Castle Gardens...	5'52	166	"	Balbriggan, Ardgillan.	4'13	180
"	Dalnaspidal Lodge....	...	...	<i>Me'th.</i>	Beauparc, St. Cloud...	4'06	...
<i>Angus.</i>	Kettins School.....	3'68	155	"	Kells, Headfort.....	4'64	147
"	Dundee, E. Necropolis	1'97	101	<i>W.M.</i>	Moate, Coolatore.....	3'37	...
"	Pearsie House.....	2'85	...	"	Mullingar, Belvedere..	4'16	130
"	Montrose, Sunnyside...	1'74	87	<i>Long.</i>	Castle Forbes Gdns.....	4'62	139
<i>Aber.</i>	Braemar, Bank.....	4'30	135	<i>Gal.</i>	Ballynahinch Castle...	9'23	145
"	Logie Coldstone Sch...	2'31	104	"	Galway, Grammar Sch.	4'47	...
"	Aberdeen, King's Coll.	1'85	85	<i>Mayo.</i>	Mallaranny.....	7'81	...
"	Fyvie Castle.....	2'25	...	"	Westport House.....	6'78	146
<i>Moray.</i>	Gordon Castle.....	1'66	82	"	Delphi Lodge.....	16'71	...
"	Grantown-on-Spey.....	2'63	109	<i>Sligo.</i>	Markree Obsy.....	4'25	108
<i>Nairn.</i>	Nairn, Delnies.....	2'14	108	<i>Cav'n.</i>	Belturbet, Cloverhill...	3'69	123
<i>Inv.</i>	Kingussie, The Birches	5'25	...	<i>Ferm.</i>	Enniskillen, Portora...	3'13	...
"	Loch Quoich, Loan....	20'75	...	<i>Arm.</i>	Armagh Obsy.....	4'02	160
"	Glenquoich.....	19'92	145	<i>Down.</i>	Fofanny Reservoir.....	13'02	...
"	Inverness, Culduthel R.	3'09	...	"	Seaforde.....	4'82	156
"	Arisaig, Faire-na-Squir	7'92	...	"	Donaghadee, C. Stn...	4'43	174
"	Fort William.....	16'53	...	"	Banbridge, Milltown...	4'13	...
"	Skye, Dunvegan.....	9'32	...	<i>Antr.</i>	Belfast, Cavehill Rd...	4'12	...
<i>R & C.</i>	Alness, Ardross Cas...	4'01	106	"	Glenarm Castle.....	5'76	...
"	Ullapool.....	6'11	...	"	Ballymena, Harryville	4'70	127
"	Torridon, Bendamph...	14'66	156	<i>Lon.</i>	Londonderry, Creggan	4'20	117
"	Achnashellach.....	12'89	...	<i>Tyr.</i>	Donaghmore.....	4'88	...
"	Stornoway.....	6'62	128	"	Omagh, Edenfel.....	4'51	127
<i>Suth.</i>	Lairg.....	2'99	...	<i>Don.</i>	Malin Head.....	4'36	...
"	Tongue.....	3'73	95	"	Dunfanaghy.....	6'61	...
"	Melvich.....	5'00	...	"	Killybegs, Rockmount.	4'60	82

Climatological Table for the British Empire, August, 1929.

STATIONS	PRESSURE		TEMPERATURE										Relative Humidity.	PRECIPITATION		BRIGHT SUNSHINE	
	Mean of Day M.S.L.	Diff. from Normal	Absolute		Mean Values						Mean Cloud Am't	Am't		Diff. from Normal	Days	Hours per day	Per-centage of possi-ble
			Max.	Min.	Max.	Min.	1/2 max. min.		Diff. from Normal	Wet Bulb.							
							° F.	° F.									
London, Kew Obsy.	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	in.	in.	9	6.0	42
Gibraltar.....	1016.1	+ 0.8	85	47	70.5	54.0	62.3	+ 0.7	55.1	6.3	2.16	85	—	—	0.08	1	..
Malta.....	1015.5	- 1.2	91	64	83.8	68.5	76.1	+ 0.1	67.2	4.8	0.04	83	—	—	0.10	1	..
St. Helena.....	1014.4	- 0.9	88	62	82.4	72.0	77.2	+ 1.9	72.4	8.1	2.0	81	2.0	0.04	1	11.6	86
Sierra Leone.....	1016.5	+ 2.8	61	52	56.6	53.6	55.1	- 2.8	54.9	93	2.69	93	8.9	2.69	1.03	23	..
Lagos, Nigeria.....	1014.4	+ 1.7	84	69	80.5	72.1	76.3	+ 1.6	73.6	89	29.00	89	6.3	29.00	7.57	26	..
Kaduna, Nigeria.....	1012.8	- 0.8	87	71	82.8	73.2	78.0	+ 0.3	73.4	83	0.81	83	9.0	0.81	1.99	10	..
Zomba, Nyasaland.....	1015.9	+ 2.1	86	..	82.3	..	..	..	69.0	85	19.66	85	..	19.66	9.98	27	..
Salisbury, Rhodesia.....	1017.6	+ 0.8	84	47	72.2	54.3	63.3	- 1.6	5.3	69	0.70	69	5.3	0.70	0.33	5	..
Cape Town.....	1018.4	+ 0.5	82	36	71.1	44.9	58.0	- 2.2	48.6	43	2.1	43	2.1	0.00	0.08	0	9.9
Johannesburg.....	1020.8	+ 0.6	78	39	64.4	51.1	57.7	+ 2.1	51.4	86	1.94	86	4.9	1.94	1.43	10	..
Mauritius.....	1023.7	+ 0.9	80	31	64.0	41.7	52.9	+ 1.4	40.7	50	0.00	50	1.8	0.00	0.51	0	9.7
Bloufontein.....	1020.3	- 0.2	77	57	73.9	62.2	68.1	- 0.4	64.6	72	2.17	72	4.8	2.17	0.18	25	7.5
Calcutta, Alipore Obsy.	1000.5	- 0.5	92	77	88.8	78.5	83.8	+ 0.8	79.3	..	11.29	..	..	11.29	18*	..	..
Bombay.....	1005.9	- 0.3	87	74	85.9	76.5	81.2	+ 0.5	76.1	82	6.06	82	8.5	6.06	8.39	16*	..
Madras.....	1005.2	- 0.3	99	74	94.2	77.6	85.9	0.0	75.5	74	4.48	74	7.1	4.48	0.16	9*	..
Colombo, Ceylon.....	1010.3	+ 0.6	87	72	85.2	76.6	80.9	- 0.2	76.3	77	0.31	77	7.8	0.31	2.82	4	6.8
Hongkong.....	1004.2	- 0.9	91	75	85.8	77.6	81.7	- 0.4	78.2	84	20.02	84	7.6	20.02	5.97	20	5.8
Sandakan.....	..	..	92	74	89.5	75.3	82.4	+ 0.6	77.3	82	2.83	..	..	2.83	5.23	4	..
Sydney, N.S.W.....	1018.3	+ 0.1	80	39	64.5	46.5	55.5	+ 0.5	48.9	70	3.90	70	4.0	3.90	0.89	14	6.9
Melbourne.....	1017.6	- 0.5	68	30	57.4	42.4	49.9	- 1.2	45.4	75	2.00	75	6.5	2.00	0.19	18	4.4
Adelaide.....	1018.6	- 0.7	71	36	60.5	44.3	52.4	- 1.6	46.8	65	1.51	65	5.3	1.51	1.00	15	5.9
Perth, W. Australia.....	1018.9	+ 0.1	77	42	63.5	48.6	56.1	+ 0.2	50.2	69	3.34	69	4.9	3.34	2.28	18	7.0
Coolgardie.....	1019.8	+ 0.5	75	33	63.2	41.1	52.1	- 1.5	45.1	58	0.47	58	3.7	0.47	0.55	6	..
Brisbane.....	1019.9	+ 0.7	83	42	71.8	50.8	61.3	+ 0.9	54.2	67	0.95	67	3.2	0.95	1.18	4	8.7
Hobart, Tasmania.....	1013.4	- 0.2	63	32	55.7	39.9	47.8	- 0.2	42.3	70	0.65	70	6.2	0.65	1.19	13	5.4
Wellington, N.Z.....	1016.7	+ 1.6	81	35	51.5	41.8	46.7	- 1.9	44.4	78	5.39	78	6.5	5.39	0.90	16	5.0
Suva, Fiji.....	1014.7	+ 0.4	86	62	77.4	68.3	73.9	- 0.8	68.5	79	10.48	79	7.9	10.48	2.24	21	3.5
Apia, Samoa.....	1011.9	- 0.3	86	68	83.2	73.7	78.5	+ 0.7	74.6	73	2.89	73	4.9	2.89	0.26	10	7.9
Kingston, Jamaica.....	1013.5	- 0.8	90	70	88.6	73.6	81.1	- 0.4	72.5	86	6.22	86	4.2	6.22	2.72	10	8.1
Grenada, W.I.....	1009.8	- 2.8	90	71	87.2	73.8	80.5	+ 1.0	74.5	86	8.22	86	5.2	8.22	1.36	24	..
Toronto.....	1015.6	+ 0.2	88	49	75.5	55.3	65.4	+ 1.2	57.8	71	1.94	71	3.7	1.94	0.83	9	8.7
Winnipeg.....	1014.7	+ 0.8	100	37	81.9	54.7	68.3	+ 5.3	54.4	83	0.55	83	3.9	0.55	1.89	5	9.6
St. John, N.B.....	1013.6	- 1.0	77	49	68.9	54.3	61.6	+ 1.0	57.3	79	3.34	79	5.3	3.34	0.52	12	7.2
Victoria, B.C.....	1017.2	- 0.8	84	49	68.1	52.2	60.1	+ 0.0	55.5	77	0.26	77	3.7	0.26	0.59	2	10.3

EXPLANATION: The Observations for London, Kew Observatory for January 1928 and Year 1928 should read—
 1016.1, 1015.5, 1014.4, 1016.5, 1014.4, 1012.8, 1015.9, 1017.6, 1018.4, 1020.8, 1023.7, 1020.3, 1000.5, 1005.9, 1005.2, 1010.3, 1004.2, 1018.3, 1017.6, 1018.6, 1018.9, 1019.8, 1019.9, 1013.4, 1016.7, 1014.7, 1011.9, 1013.5, 1009.8, 1015.6, 1014.7, 1013.6, 1017.2