Frontispiece

[*Photo: W. G. Busbridge*

N. K. JOHNSON, M.Sc., A.R.C.S.

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MR. N. K. JOHNSON

Following upon the retirement of Sir George Simpson, Mr. N. K. Johnson, M.Sc., A.R.C.S., took up his duties as Director of the Meteorological Office on September 3rd, 1938.

Mr. Johnson, who is a native of Canterbury, received his scientific training at the Royal College of Science, South Kensington. After taking his Honours Degree in Physics he remained at the College for a short while as Assistant Demonstrator and also carried out research work in astrophysics under Professor A. Fowler, F.R.S. In 1913 he became assistant to Sir Norman Lockyer and Dr. W. J. S. Lockyer at the Hill Observatory, Sidmouth, a post which he relinquished for service in the Royal Air Force during the war. After the war he was appointed Professional Assistant in the Meteorological Office and was posted to Shoeburyness. Here, in addition to his routine duties, he found time for much useful research work and published several papers including "A comparison of the anemometer records for Shoeburyness and the Maplin Lighthouse" (M.O. *Prof. Notes* No. 28) and "The behaviour of pilot balloons at great heights" (*Quart. J. R. met. Soc.*, **48**, pp. 49–59). In 1921 a meteorological section was established at the War Department Experimental Station, Porton, and Mr. Johnson was seconded to the War Office to take charge. This position afforded great scope for an officer possessing a natural inclination towards experimental research work and he tackled the difficult problems which confronted him with great success. Much of this work was of a secret nature, but he published a number of papers, including the well known Geophysical Memoir (No. 46) on "A study of the vertical gradient of temperature in the atmosphere near the ground." For this work he designed an entirely original system for recording differences of temperature over short vertical distances, in which use was made of continuously aspirated electrical resistance thermometers and a multiple thread recorder. By this means the thermal structure of the lower layers of the atmosphere was fully revealed and studied for the first time. Other papers included "The measurement of the lapse rate of temperature by an optical method" (with O. F. T. Roberts) (*Quart. J. R. met. Soc.*, **51**, pp. 131–138), "Some measurements of temperatures near the surface in various kinds of soils" (with E. L. Davies) (*Quart. J. R. met. Soc.*, **53**, pp. 45–59) and "Atmospheric oscillations shown by the microbarograph" (*Quart. J. R. met. Soc.*, **55**, pp. 19–30).

In 1928 the post of Director of Experiments at Porton fell vacant and Mr. Johnson received the appointment, thus terminating for a time his attachment to the Meteorological Office. Later he received further promotion to the post of Chief Superintendent of the Chemical Defence Research Department, War Office.

Mr. Johnson brings to his new appointment a high reputation as an investigator of meteorological problems, combined with wide experience as an administrator of a scientific department concerned with service questions. All readers of the Magazine will join us in wishing him success as Director of the Meteorological Office.

Sunshine Records at Health Resorts

In an article entitled "The 'sunshine race': an exposure" which appeared on August 21st, the Meteorological Correspondent of *The Observer* drew attention to the fact that the cards used for recording sunshine could be manipulated in various ways so as to increase the apparent duration of sunshine. The article went on to state that it was known for certain that this nefarious practice was adopted at some of the coast towns in southern and eastern England.

This article gave rise to much comment and a letter on the subject was addressed by Dr. A. Cox, Secretary of the British Health Resorts Association, to the Superintendent of the British Climatology Division, Meteorological Office. The following reply was sent:

Dear Dr. Cox,

Your letter of August 23rd has been sent on to me here, where I am on leave until September 12th.

It is of course *possible* to falsify any sort of instrumental record, but it is not at all easy to produce a false sunshine record which would deceive an expert. Every health resort in association with the Meteorological Office has to send up its sunshine cards for scrutiny at the end of every month. The cards are examined by staff experienced in the work, and any case of apparent falsification is brought to my personal notice. Having regard to the large number of co-operating stations, cases of the sort are infrequent, and I can assure you that they are dealt with promptly and effectively.

With these safeguards, I think it may reasonably be claimed that the sunshine records from co-operating health resorts form a reliable body of statistics, and they are accepted as such for official purposes.

Yours sincerely,

E. G. BILHAM.

Froxfield, Hants, August 27th, 1938.

The substance of this reply was included in a letter dated August 30th sent by Dr. Cox to the Editor of *The Observer*. Dr. Cox's letter has not been published and we therefore take the present opportunity to correct the unfortunate impression which may have been created by the article in *The Observer*.

Readers of this Magazine are aware of the fact that the health resorts provide a large proportion of the official climatological data of this country, and that they do so voluntarily and efficiently. Moreover, a charge against the bona fides of the health resorts involves also a charge—of negligence at least—against the Director of the Meteorological Office by whose authority the data are communicated to the Press and included in official publications.

It is surprising and unfortunate that so responsible a newspaper as *The Observer* should not only have given publicity to this charge without further enquiry as to the facts, but should then have closed its columns to Dr. Cox. The Secretary of the Association, which works in close co-operation with the Meteorological Office and with influential medical bodies for the purpose of promulgating reliable information about British spas and health resorts, was surely entitled to a hearing.

Wave Motion in the Upper Air

BY G. A. BULL, B.SC.

On November 16th, 1936, a pronounced wave-like variation of wind was observed over southern Scotland. Special interest attaches to this occasion because pilot balloons were sent up at frequent intervals from Abbotsinch during the occurrence there of the waves. The ascents were made using the tail method, so as to obtain information about the vertical as well as the horizontal motion of the atmosphere. The results of these ascents were given by R. T. Andrews in the *Meteorological Magazine* of August, 1937. The present note is an extension of the one by Andrews and summarizes the results of a theoretical investigation, using the hydrodynamical theory of wave motion.

It is assumed, in the first place, that the waves were due to the oscillations of a roughly horizontal surface of discontinuity. Reasons for believing this to be true will appear later. The theory of such oscillations is given, with applications to several special cases, in a paper by Dr. Goldie entitled, " Waves at an approximately horizontal surface of discontinuity in the atmosphere " (*Quart. J. R. met. Soc.*,

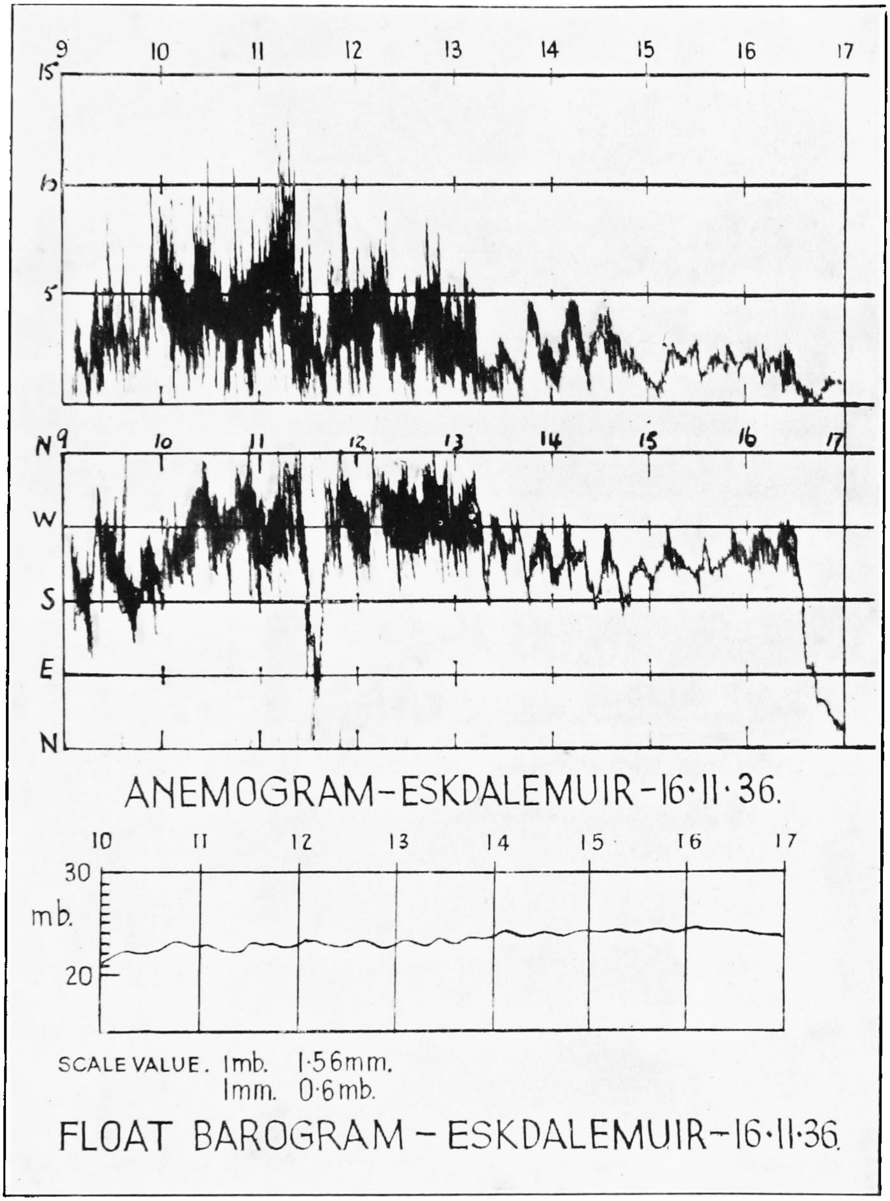
51, pp. 239–246). The general theory is, of course, given in all the text-books of hydrodynamics.

The first result of the theory is that the wind should give wavy speed and direction traces on the anemogram. A glance at the Abbotsinch anemogram reproduced as the frontispiece to the August, 1937, number of this Magazine, shows this to be the case. If the oscillations had been due to convectional cells, the wind variations would have been saw-toothed in shape showing a very rapid rise to a maximum, and then a gradual dying away.

The second result is that the pressure should show a wave-like variation of the same periodicity as the wind, and either exactly in the same phase as, or exactly in the opposite phase to, the wind variations. That is, to a wind maximum should correspond exactly a pressure maximum, or exactly a pressure minimum. There is no barograph at Abbotsinch sufficiently sensitive to show the small variations in pressure but there are two such barographs at Eskdalemuir and both of these and the Eskdalemuir anemogram (Fig. 1) show the oscillations. At Eskdalemuir the pressure oscillations were of the same periodicity as the wind oscillations and were almost exactly in opposite phase. Pressure minima or maxima occurred within four minutes of the corresponding wind maxima, with a wave period of twenty minutes. In many cases agreement is exact so far as can be judged from the records. The period of the Eskdalemuir variations agrees with those at Abbotsinch and the amplitudes were about the same.

Given the amplitudes and periods of the simultaneous pressure and wind waves at the same place, it is possible to calculate the velocity and direction of motion of the waves and derive an upper limit to the height of the waved surface of discontinuity. The Eskdalemuir data give a wave velocity of 6 mi./hr. from WNW and an upper limit of 4,000 feet for the height of the surface of discontinuity. In this connection, it is worth noting that a record of upper air temperature obtained over Mildenhall at 0700 G.M.T. showed an inversion between 3,000 and 4,000 feet. The air above this inversion was much drier (relative humidity 40 per cent.), suggesting that subsidence in the wedge of high pressure, which extended from south to north over the British Isles, was responsible for the inversion. It seems likely, therefore, that the oscillations took place on this inversion, although there are no direct observations of it nearer than Mildenhall. Since there are no pressure data from Abbotsinch all that can be said is that the waves there were moving from either WNW or ESE, as an examination of the anemogram shows that the variable wind due to the oscillation, and added to the mean wind, blew from these two directions alternately. The result obtained from the Eskdalemuir data, of course, strongly suggests that the waves over Abbotsinch were moving from WNW.

We can now turn to the vertical velocities shown by the Abbotsinch pilot balloon observations.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10 11 12 13 14 15 16 17
30
mb.
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SCALE VALUE. 1mb. 1·56mm.
1mm. 0·6mb.
FLOAT BAROGRAM-ESKDALEMUIR-16·11·36.

Fig. 1.

All that the theory has, qualitatively, to say about the connection between the waved surface, the vertical currents and the surface pressure changes, is given in the diagram (Fig. 2). The waves are supposed to be moving from left to right with velocity V. Maxima

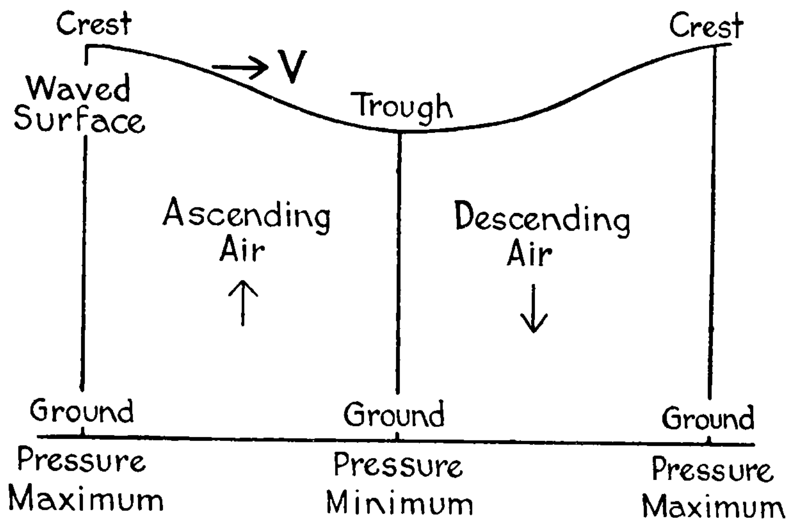

FIG. 2.—VERTICAL MOTION AND PRESSURE CHANGES UNDER WAVED SURFACE.

of pressure at the ground occur beneath crests, and minima beneath troughs of the waved surface. The air ascends beneath the forward half of the wave, and descends beneath the rearward half. The connection between the wind changes at the ground is more complicated. The wind waves are in phase with the waves on the surface of discontinuity, if the quantity V-U, where U is the component of the mean wind in the direction of the waves, is positive, and are in opposite phase if V–U is negative. At Eskdalemuir V–U was negative as the opposition in phase of the pressure and wind waves shows at once, since the pressure waves are in phase with the waves of the waved surface.

We can now consider what sort of vertical currents pilot balloons should register when released at crests and troughs of the wind waves. The following table gives all the possibilities.

Notation.
- V Velocity of waves.
- U Component of mean wind from left to right parallel to direction of wave motion.
- U′ Maximum value of added wind due to wave motion.
- |V| Numerical value of V irrespective of sign.

Case I

V and U same sign (taken as positive).
V greater than U (wind and pressure waves in phase).

(*a*) Balloon released at wind crest.
Balloon enters rising air at first if $U + U' > V$. Possible.
Balloon enters descending air at first if $U + U' < V$. Possible.

(*b*) Balloon released at wind trough.
Balloon enters rising air at first if $V > (U - U')$. Possible.
Balloon enters descending air at first if $V < (U - U')$. Not possible.

Case II

V less than U (wind and pressure waves in opposite phase).

(*a*) Balloon released at wind crest.
Balloon enters rising air at first if $V > (U + U')$. Not possible.
Balloon enters descending air at first if $V < (U + U')$. Possible.

(*b*) Balloon released at wind trough.
Balloon enters rising air at first if $V < (U - U')$. Possible.
Balloon enters descending air at first if $V > (U - U')$. Possible.

Case III

V and U of opposite signs (wind and pressure waves in opposite phase).

(*a*) Balloon released at wind crest.
Balloon enters rising air at first if $|V| > (U + U')$. Possible.
Balloon enters descending air at first if $|V| < (U + U')$. Possible.

(*b*) Balloon released at wind trough.
Balloon enters rising air at first if $|V| > (U - U')$. Possible.
Balloon enters descending air at first if $|V| < (U - U')$. Possible.

If the waves were of the same speed and direction at Abbotsinch as at Eskdalemuir (6 mi./hr. from WNW.) then since the wind velocity at the crests in that direction was greater than the wave velocity, balloons released at crests should show a descending motion of the air in the lower layers. The wind velocity near the ground at troughs in the direction of wave motion was rather less than that of the waves so that balloons released at troughs should also show descending air motion.

Actually, all the balloons released at crests registered, with one slight exception, definite rising motion while all those released at troughs showed descending motion. The facts concerning these vertical currents are detailed in Table II of Andrews' paper. The behaviour of the balloons released at troughs agrees with the theory but the behaviour of the others does not. Possible explanations of this are (1) that the wave speed and direction and so the connection between the phases of wind and pressure waves were different at Abbotsinch from what they were at Eskdalemuir, (2) that the arrangement of vertical currents is greatly distorted by friction near the ground. Owing to the absence of a sensitive barograph at Abbotsinch (1) cannot be tested. The waves there were certainly coming from either WNW or ESE and the former direction seems much the more likely in view of the wind direction in the upper air and the Eskdalemuir data. The second possibility is also difficult to test.

There is a simple relation between the time spent and distance covered by a balloon in the free air in either a descending or ascending current and the wave-velocity and period. Suppose that the wind has a component in the direction of motion of the waves which is greater than the wave-velocity. Then if D is the distance travelled by the balloon in the direction of wave-motion in the time t spent in either an ascending or descending current, and λ is the wave-length and V the wave-velocity, then $D = Vt + \lambda/2$ which may be written $D = V(t + \frac{T}{2})$ where T is the wave period. D and t can be taken from the pilot balloon sheets and T from the anemogram. Inserting numerical values for various ascending and descending currents recorded by the balloons in the free air, values for V are obtained ranging from 3 to 6 mi./hr. These values are in good agreement with the value of 6 mi./hr. obtained from the wind and pressure records at Eskdalemuir.

According to theory the magnitude of the vertical currents should increase rapidly with height in the lower layer and then decrease again in the upper layer. The results show an increase with height in the first 2,000 to 3,000 feet but there is not much evidence of a decrease at higher levels. No balloon recorded a vertical current greater than 120 ft./min. (1⅓ mi./hr.) in the lowest 600 feet. Out of 89 observations of vertical currents, 59 (irrespective of sign) are less than 300 ft./min. (3 mi./hr.). One value is 900 ft./min. (10 mi./hr.) but that is quite exceptional.

The theory thus accounts for the observed occurrences, with the exception of the kind of rising current recorded by those balloons released at crests of wind waves. The most likely explanation of this seems to lie in a distortion of the boundaries between rising and falling currents near the ground.

A puzzling occurrence at Abbotsinch is the existence of fluctuations in relative humidity as shown by the hygrograph in the screen. These fluctuations are superposed on the ordinary diurnal range, and agree closely with the wind variations. As the wind rose so did the relative humidity, and as it fell so did humidity. The range was only 3 to 4 per cent. No variations are shown on the thermograph. If the variations in relative humidity were reflections of temperature changes, then the latter should have had a range of 1° to 2° F., which should easily have been registered by the thermograph. It is possible that the difference in ventilation of the hairs with the changing wind speed accounts for this phenomenon.

Correspondence

To the Editor, *Meteorological Magazine*

Symons's Thunderstorm Survey of 1858

After reading the first two articles in the *Meteorological Magazine* of August, 1938, it is interesting to note that " Thunderstorms and Accidents from Lightning in 1858" was put on record in a manuscript * of 25 pages neatly written by G. J. Symons at the age of twenty for reading before the British Association.

In an opening paragraph we find : " The following report has been compiled from private information furnished by the gentlemen named on the preceding page, and one or two other sources ; material aid as to the localities visited has also been derived from the returns of the British Meteorological Society.

Newspaper reports are never inserted until they have been personally verified."

In 1858 Symons received reports of thunderstorms, thunder or lightning on 118 days from 727 stations ; on 21 days in June alone 194 stations reported the phenomena.

The resulting casualties during the year included 7 men killed, 25 men and women injured, 28 horses, 2 cows and 43 sheep killed, 27 buildings and 1 railway train struck.

R. M. POULTER.

Meteorological Office, South Farnborough, Hants, 9th September, 1938.

The West of England Thunderstorm of August 4th, 1938

Mr. Douglas in his valuable article in the September number, very rightly refers to the west country thunderstorm of August 4th as a prominent landmark in the meteorological history of the south-west of England. During the last few weeks I have met or heard from a number of people who experienced the storm in various parts of Devon and Cornwall, and they all lay stress not only on the intensity of rain and hail but also on the truly terrible character of the thunder and lightning which after a duration of eleven hours not unnaturally caused consternation here and there among country people and fishing folk. Thunder is less frequent in the south-western counties than in midland, eastern and northern England, but I do not think it is realized how prone Devon and Cornwall are to a type of thunderstorm which, developing at night, is for violence and duration probably the most impressive and spectacular that we experience in Britain. I could quote many instances of the kind.

L. C. W. BONACINA.

13, Christchurch Hill, Hampstead, N.W.3, September 30th, 1938.

* In the files of the Meteorological Office, South Farnborough.

The Prediction of Minimum Temperature on Clear Days at Selected Stations in India

The reprint of a paper with the above heading by Mr. Narasimhan and the present writer (reprinted from the *Indian Journal of Agricultural Science*, VII, part 5, October, 1937) was reviewed in the *Meteorological Magazine* for August, 1938 (pp 182–184). Table IV of our paper had been printed *correctly* in the original journal, but, strangely enough, at the reprint stage certain misprints crept in, which were unfortunately unnoticed by us. The misprints relate to some of the values of b_v in the regression equations expressing the minimum temperature as a function of the maximum temperature X and the vapour pressure V of the previous afternoon (i.e. $N = b_x X + b_v V +$ Constant, where b_x and b_v are constants for each station). The errata are given below—

Station	Value of b_v	
	For	*Read*
Bombay	38·12	8·12
Poona	4·71	34·71
Hyderabad Deccan	3·70	13·70
Bangalore	3·46	23·46
Madura	5·16	15·16
Madras	4·93	24·93
Vizagapatam	8·88	28·88
Jacobabad	6·22	16·22

When the *correct* values of b_v are examined it will be seen that the variability from station to station is not quite so large as is shown by the *incorrect* values. The mean value of b_v is of the order of 23 ; twelve out of the nineteen values lie between 21 and 37, five between 13 and 18 and only two between 8 and 12. This takes away some of the force of the reviewer's criticism of the statistical results discussed in the paper. Such results do serve to summarise the relevant climatological information in a useful manner and to indicate how far they may be of use for practical purposes like forecasting. It was, of course, not intended to use the statistical results for verifying radiation theory.

The relative merits of Ångström's formula $\left(\frac{S}{\sigma T^4} = A - B \times 10^{-\gamma e}\right)$ and Brunt's expression $\left(\frac{S}{\sigma T^4} = a + b\sqrt{e}\right)$ have been referred to in the review. A discussion on the subject will be found in a paper by Raman (*Proc. Ind. Acad. Sc.*, **1**, 11, pp. 815–821, 1935) and in another by Ramanathan and the present writer (*Proc. Ind. Acad. Sc.*, **1**, 11, pp. 822–829, 1935). In the first paper it was shown by actual computations that Brunt's expression should be considered as an approximation of Ångström's formula for values of vapour pressure ranging from 2 to 30 mb. In the latter paper, using Weber and Randall's latest measurements (*Phys. Rev.*, **40**, p. 385, 1932), we showed that the values of the absorption coefficient of water vapour used by earlier workers (from Hettner's measurements) were too high in the region 10·5 — 15μ. With the help of the revised values the physical basis for Ångström's formula was also indicated.

I may point out that we have fully realised the modifying influence of feeble turbulence (which is seldom entirely absent during night) on nocturnal cooling and, as mentioned at the end of Part I of our paper, experimental work on the subject is actually in progress.

L. A. RAMDAS.

Poona 5, September 8th, 1938.

The Sound of Lightning

On August 19th, 1938, a thunderstorm occurred in the vicinity of the Royal Observatory, Hong Kong. There had been several flashes followed by claps and rolls, and the interval suggested a distance of half to two miles. Quite suddenly there was a flash accompanied by a sound similar to the blowing of a fuse or the tearing of a small piece of silk. The sound lasted perhaps a quarter of a second and was simultaneous with the flash or followed it immediately. The thunder clap came quite two seconds later. The phenomenon was observed by both of us, and also by the lady stenographer, all in different parts of the building.

The "swishing" sound of lightning has been discussed by C. J. P. Cave in the *Meteorological Magazine* for July, 1934. When he noted the phenomenon the lightning, swish and thunder were practically simultaneous, and the interesting point about the present observation is that there was a very definite interval between the swish and the thunder. If the clap of thunder was the sound caused by the lightning flash as it reached the ground, the interval between flash and clap would indicate that the lightning struck at a distance of about 2,000 feet from the Observatory. If this were the case, it would be difficult to account for the swish. Our impression is that the lightning struck the typhoon signal mast, a steel structure 150 feet high standing a few yards from the building, and that the thunderclap was immediately overhead. (The height of the cloud base at the time was estimated at 2,000–2,500 feet.) If the swish were due to the strike, and the thunderclap two seconds later to the discharge in the clouds, as the respective distances seem to indicate, how can the interval of silence between the swish and the clap be accounted for?

G. S. P. HEYWOOD.
L. STARBUCK.

Royal Observatory, Hong Kong, August 20th, 1938.

Elliptical Solar Halo at Leuchars, May 30th, 1938

A very brilliant solar halo was observed at Leuchars on May 30th, 1938, lasting from 08h. to 15h. G.M.T. Angular measurements were obtained by means of a theodolite and from these measurements it was apparent that the halo was elliptical. At 9h. 15m., measurements gave the sun's elevation as 43° and azimuth 119°. The minor axis was found to subtend an angle of 44° and the major axis, parallel to the horizon, 64°, when the top of the halo had an elevation of 65° and the azimuths of the ends of the major axis 87° and 151°.

A very brilliant arc of upper contact, with ends bent downwards, and an almost complete mock sun ring were seen. Brilliant mock suns were formed at the intersection of the arc of contact and the mock sun ring (each 40° from the sun) and less intense mock suns at points 124° from the sun on the mock sun ring. The mock sun ring which did not extend to the elliptical halo or pass through the sun, had an elevation of 43° in all directions. The mock sun at 355° was considerably more brilliant than the one at 243° but not quite so brilliant as those 40° from the sun. The most brilliant points of the phenomenon were the highest and lowest extremities of the 22° halo and the mock suns 40° from the sun. These points were coloured faintly, red being nearest the sun in each case, while there was a diffused white glow between the arc of contact and the halo.

By 9h. 30m., the mock sun ring and the arc of contact had disappeared and only the halo of 22° was visible, lasting very faintly until 15h. During the period the sky was covered with 5/10 to 9/10 of cirro-stratus with small amounts of large cumulus and the wind, which was calm at first, became westerly gradually increasing to force 5.

On November 16th, 1931 (see *Meteorological Magazine*, Vol. 66. 1931, p. 290)* a somewhat similar halo was observed here and it was remarked then that it was probably only a coincidence that the 18th was the wettest November day recorded at Leuchars. In the present case we had 25 mm. of rain in the 48 hours beginning at 15h. on the 31st.

G. Froude.
J. R. Sandison.

Meteorological Office, Leuchars, Fife, May 30th, 1938.

Unusual Solar Haloes

My wife reports that yesterday afternoon from 2h. 45m. to 4h. 30m. (B.S.T.) a coloured solar halo was visible from the garden here, but was oval (not elliptic) instead of circular. We have seen some half dozen solar haloes recently, some coloured, some not, so she is familiar with their usual appearance, and of course lunar haloes are also familiar to her. I was unfortunately away from home all the afternoon and the halo was no longer visible on my return at 5h. 30m.

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* *See also* article on page 172 of the August issue of this Magazine.

The upper half of the halo was semicircular as usual, but the lower half suggested that it was being slightly pulled down at the lowest point, thus giving the lower half a semi-elliptical outline. The colour was faint but unmistakable, the inner part of the halo being tinged with red all round.

During the time she saw it my wife viewed it from various parts of the garden at different times to remove the possibility of optical illusion; but the (literally) oval shape was constant. I am quite at a loss to account for this and shall be glad to hear whether such an occurrence has been noted before. I may add that the sky exhibited the hazy look characteristic of halo conditions and small feathery wisps of dark cloud crossed it pretty frequently, carried by the north-west wind from right to left.

The only suggestion I can make is that this remarkable phenomenon was caused in some way by refraction. But how?

C. NICHOLSON.

Tresillian, Truro, Cornwall, September 6th, 1938.

A $23\frac{1}{2}°$ halo was visible here on September 2nd from 9h. to 14h. G.M.T., devoid of any trimmings; especially perfect from 11h. 45m. to 13h. 30m. On a cloudless blue sky at 8h. a very lofty, thin haze first developed from W to NNW covering the sky by 9h. except for a low arch from E by N to SSW. The sky below was so free of haze that twenty miles of the Mendips, visible from the village here, stood out clearly, stretching from NE to NW, the summits closest to us west of Wells strikingly so, though ten miles away.

The very homogeneous haze was denser by 11h. 45m. but still so translucent that it was painful to look at the sun without dark glasses. Yet the area inside the halo looked very dark, especially compared with that outside, right up to the sun.

The halo itself was sharply defined, with colours from red to greenish blue. About 12h. 30m. lofty cumuli formed in fairly opaque patches, darkening the sun or obscuring parts of the halo. An hour or so later an arch of blue sky began to rise from W to WNW and the haze above it to thin out. It disappeared at about 14h., the cumuli following suit, giving a glorious late afternoon.

J. EDMUND CLARK.

Burleigh Redroofs, Street.

Snow in July, 1938

The Rev. E. F. Robson asks us to point out that his letter of August 3rd, published on page 208 of the September issue of this Magazine, should have referred to snow on July 9th, 1938, and not on June 9th.

Height calculations ; a simple method

I sometimes find I want to know the approximate height to which an observation of pressure and temperature in the upper atmosphere refers. I have discovered that I can get it with fair approximation from the tephigram by the following simple rule :—

" Take the difference between the *potential* temperature and the actual temperature (in degrees F). Multiply by 2 and subtract 10 per cent. from the result. This gives the value of the height above the 1,000 mb. level in 100's of feet. The potential temperature is read very easily from the diagram.

Examples :

1. Pressure 500 mb., Temperature $-7°$ F. Potential Temperature 92·5°. Difference 99·5°. Height 17,900 feet.
2. Pressure 637 mb., Temperature 13° F. Potential Temperature 78°. Difference 65°. Height 11,700 feet.

If the surface pressure is greater than 1,000 mb. add 0·3 times the excess $= 0{\cdot}3 \times (P - 1{,}000)$ and vice versa if it is less than 1,000 mb., e.g. surface pressure 1,017 mb., add $0{\cdot}3 \times 17 = 5$, i.e., 500 feet to the value obtained as above."

The error in the height obtained in this way is usually not more than 100 feet for heights up to 20,000 feet. For example the true height of the 400 mb. level in Table I of Mr. E. G. Bilham's Professional Note No. 80 is given as 23,560 feet : the height computed in the simple manner described is 23,440 feet.

E. GOLD.

Meteorological Office, London, August 10th, 1938.

The Great Gale of June 1, 1938

It may be worth putting on record the extraordinary change in the colour of the blasted foliage ; for many miles the hedgerows of thorn were black, the sycamores and planes were a hideous dirty yellowy clay colour, other trees reddish brown. The effect was most striking as we coached many miles along the Dorset coast in early June.

Wasn't this the action of the salt upon the leaves rather than the mechanical action of buffeting suggested by the Editor ?

EDITH E. WILDE.

Milesdown, Winchester, August 24th, 1938.

[Mr. Norman E. Neville, of Fareham, has sent a sample leaf taken from a chestnut, very low on the tree, which shows marked discolouration on the edges and on lines running inwards parallel with the veins.

It would be interesting to hear from any inland observer who noticed an actual deposit of salt on foliage or other objects after this gale.—EDITOR.]

Experiments with No-lift Balloons

I read Mr. Mirrlees' article on experiments with no-lift balloons in your issue for September with considerable interest as many years ago I endeavoured to obtain information on surface turbulence by this means. I had to abandon the method owing to the great difficulty experienced in maintaining a true no-lift condition with the balloons used. If a day was one of broken sunshine, as soon as the sun came from behind a cloud the balloon would warm up and start rising at a considerable rate ; even on overcast days there seemed great difficulty in maintaining equilibrium between the balloon and the surrounding air. If it be assumed that the resistance to the movement of the balloon through the air varies as the square of the velocity it is apparent that a very small driving force will cause the balloon to move at quite an appreciable rate, and I calculate that a 10° F. rise of temperature of the gas in the balloon will give a rate of ascent of between 1 and 2 feet per second to a balloon which is in equilibrium when the temperature of the gas equals that of the air. As the balloon is subject to little or no ventilation, solar heating may easily raise its temperature by 10° or more and the disturbing effect of intermittent sunshine on the no-lift balloon is thus apparent. It would be of interest to know whether Mr. Mirrlees found significant differences between observations on occasions of sunshine and those on occasions of overcast sky ?

J. S. Dines.

Meteorological Office, October 4th, 1938.

NOTES AND QUERIES

Waterspouts off Bexhill

On the morning of September 1st, 1938, a number of waterspouts formed in the English Channel near Bexhill. The waterspouts attracted considerable interest in the daily press and accounts therein varied considerably.

Two reports were received at Croydon : one from Mr. Sargent, the Curator of Bexhill Museum, and this is quoted in full below : the other was from Mr. Duggan, who was piloting a machine bound from Paris to Croydon. The accounts are of interest because of the description of the formation of the waterspouts. It will be seen that Mr. Duggan's account indicates the existence of a considerable vortex between the cloud and sea before there was any visible connection between the two.

Two waterspouts were seen by Mr. Duggan near the English coast at approximately 1000 B.S.T. The first was a fully formed waterspout about three miles south of Bexhill. The cloud base was estimated at 1,200 feet. The waterspout was leaning about 30° from the vertical and he estimated the thickness to be 150 feet. The inclination to the vertical gradually increased and the column broke up. Whilst this one was breaking up he noticed a pronounced lashing up of the sea about 1 mile from the waterspout. It seemed as if a small area of the sea was being whipped by a strong local wind and the spray was being swept up to form a cone : almost vertically over this disturbance a pronounced bulge grew downwards from the cloud base. The bulge from the cloud and the cone of spray from the sea both extended in length until they met about halfway, forming a nearly vertical waterspout of diameter about 400 feet. When last seen this waterspout was seen to be gradually inclining away from the vertical.

The following account was received from Mr. Sargent :—

"Five waterspouts, appearing successively, were observed off Bexhill between 0945 and 1010 B.S.T. on Thursday, September 1st, 1938. They were associated with a typical nimbus cloud with a base estimated at 1,500 feet, travelling from west to east. The northern boundary of the cloud passed over the town and there was a brief shower. Wind was light, westerly, becoming calm after the passage of the cloud. Visibility was good. The writer saw the last three waterspouts from the sea-front : their distance appeared to be about two miles. In one, the sea disturbance at the point of contact appeared to be considerable. Each waterspout commenced as an elongated pointed projection appearing pale grey against the dark cloud base, gradually increasing in length, assuming a graceful double curve, and becoming much attenuated and indistinct at its base. A small patch of sea became agitated, there was much spray, and one could clearly see the point of contact some seconds before there was any obvious connection between cloud and water. In one case the disturbance of the sea appeared to form a ring of spray with an apparently clear centre. Some observers stated that they could distinguish a rotating motion of the stem of the waterspouts, but I could not detect this (even with binoculars) in those which came within my personal observation.

"At one time two or three elongated cone-shaped extensions depended from the cloud, as of waterspouts in the process of formation but they did not develop. There was no apparent disturbance of the sea beneath, and they rapidly diminished in size and disappeared."

The meteorological conditions during this display were of the kind usually associated with waterspouts. The winds were light : a rather weak anticyclone was centred over Belgium and the wind at 1,500 feet in the eastern end of the Channel was 170°, 10 mi/hr. The normal temperature of the sea for the season in this part of the Channel is 61° F. The temperature of the free air at 3,000 feet was 46° F. which gave an average lapse-rate approximating to the dry adiabatic. Humidity considerations would provide for the cumulus bases to be about 2,500 feet. The fact that the cloud base was estimated to be as low as 1,200 feet showed a considerable lowering of the base (due perhaps to cooling on evaporation of rain from the main cloud) which would result in a lapse-rate between surface and cloud base considerably in excess of that in the free atmosphere—which was approximating to the dry adiabatic.

C. J. M. AARENSEN.

The following account has been received from Mr. A. E. Moon, of Clive Vale, Hastings :—

" At 8h. 55m. (G.M.T.) to-day, September 1st, 1938, an unusually well developed water-spout was observed to WSW, with a shorter funnel to the east of it. The spout reached down to the surface of the sea, where a distinct white patch (apparently raised above the general sea level) could be seen ; a similar patch was also present under the short funnel. At 9h. 5m. all that remained of the spout was a long flat-S-shaped shaft of a light greyish colour touching the sea but not the cloud ; the white patch on the sea was still present. Shortly afterwards the shaft vanished very suddenly. Just to the west of this another short funnel formed and this was in very active motion, fragments of it appearing to rise very rapidly into the base of the cloud. The first water-spout and its remains had a definite drift from east to west between cloud and sea, i.e., the base of the spout being somewhat in advance of the summit. The water-spouts were at a distance of about two miles and the cloud base (which was not unusually heavy, not more so than a large cumulus cloud) in their vicinity about 1,000 feet above sea level ; cloud overhead was about 2,500 feet above station level. Low cloud at 3,000 feet at 7h. was moving from 180° at 10 m.p.h. A little before 9h. there was a very slight rain shower."

Waterspout on Lagan Canal

The Linen Industry Research Association, who are responsible for the rainfall station at Lambeg (Glenmore House) Co. Antrim, report that a waterspout was observed by three members of the staff. It was seen on the Lagan Canal at 13h. 30m. on September 9th, 1938, and reached a height of about three feet.

A Fireball seen at Broken Hill, Northern Rhodesia

A curious fireball passed near Broken Hill on the evening of April 28th, being first noticed about 8 p.m. when fairly high in the sky but somewhat to the west. It was luminous, orange in colour, and roughly pear-shaped, with a round head " about the size of a football ", and a tapering tail from which sparks or streamers emerged as from a firework. The total length appeared to be about three times the diameter of the head.

The object moved slowly across the sky from south to north, and was lost to view after about half an hour. Soon afterwards there was a loud detonation which caused a perceptible earth tremor, and was generally mistaken for late blasting on the mine. During the greater part of its course, the object gave light enough to read by, the brilliance diminishing only as it passed away to the north.

Some native witnesses claim to have seen the fireball burst and scatter, while others distinguished three " bangs " in the explosion though they did not see it. Unfortunately no statement of the interval between the visible and audible explosions is obtainable.

A report from Victoria Falls states that the fireball was seen there too at about 8 p.m., and that it appeared in the sky behind the Hotel and moved slowly northwards till lost to view. If we allow half an hour between the zenithal appearances at the Falls and Broken Hill respectively, its velocity must have been some 600 mi./hr. the direction of travel being from SSW to NNE. As the final explosion was visible to some watchers but not to others, while nothing was seen of the object at Ndola, 100 miles to the north, the end point could not have been far beyond Broken Hill. This suggests a rapid deceleration in the last half hour, and the apparent slowness of movement even at the Falls seems to indicate a path curving down towards the earth's surface from a considerable height, possibly from outer space.

[In forwarding this account, Mr. J. Coventry adds :—

" Strangely enough, another report came to hand some time later of a similar occurrence near Ndola. A coloured man stated that when travelling from Nkana to Ndola on the 20th of June at 6.30 p.m., he saw 'a lump of fire about the size of a big drum' descending through the sky about four miles away, scattering sparks as it fell. He was so terrified by the sight that he got off his motor cycle and took refuge in prayer.

It would be interesting to know whether these strange visitants can be associated with known meteoric showers, or other such phenomena."]

Observation of a Radio Sonde Balloon with the Unaided Eye

During the flight of a Radio Sonde balloon sent up from Kew Observatory on September 13th, Mr. H. D. Henley was able to keep the balloon in sight with the unaided eye for a period of 49 minutes. At the end of that time the balloon was at its greatest height, about 9½ miles, as was learned from the radio signals. The balloon came down rather faster than it went up and fell at Cliffe-at-Hoo, near Rochester and 35 miles from the Observatory, so Mr. Henley's observation must have extended to a distance of about 20 miles in a direct line. It is reckoned that the diameter of the balloon at its highest point was about 12 feet so that the angular diameter, as seen from Kew, was about 24″.

For comparison it may be mentioned that the angular diameter of Venus, when the planet is nearest to us, is about 65″. At that time the planet turns its unilluminated side to us. When the planet is at the greatest apparent distance from the sun we see half of the illuminated side ; the angular diameter is then about 23″. This is the most likely time for observations of Venus in the daytime. Whether the balloon or the planet would be the brighter object cannot be decided as there is no information as to the proportion of the light falling on it which is reflected by an inflated balloon.

The Exceptional Warmth of March, 1938

Many comments were made at the time on the unusually high mean temperature experienced in the British Isles in March of this year. It is now possible to place on record the exceptional nature of the warmth and its almost universal extent over the British Isles. In 1923, the Meteorological Office produced Section IV of the " Book of Normals ", which included the range and variation of temperature at a number of selected stations throughout the country. In this section are given the highest and lowest mean monthly temperatures for each of the twelve months at the stations under consideration for periods ending in 1921 and going back, in the majority of cases, to 1871. This table has been completed for the month of March up to 1938 except in the case of a few stations for which data are not now available. The results show the remarkable fact that throughout the British Isles March, 1938, had the highest mean temperature on record for March at all the stations examined except at Lerwick, Dungeness and the Scilly Isles.

The attached table gives for 26 stations the highest mean temperature for March from the earliest year to 1937 and the value for 1938. The last column in the table gives the deviation of the value for 1938 from the previous record. It will be noticed that in some instances the value for 1938 exceeds the previous record by more than 3° F. ; for example, 3·3° F. at Buxton, 3·9° F. at Armagh, 4·5° F. at Aberdeen and 5·3° F. at North Shields. At Oxford the record goes back to 1815 and the value in 1938, 49·9° F. is 2·6° F. higher than the previous record which occurred in 1822.

It is noteworthy that March, 1938, followed an unusually cold March in 1937. Using the same selection of stations we find that with a few exceptions March, 1937,was the coldest March since before 1920. It was not, however, the coldest March on record ; at numerous stations the coldest March occurred in 1883 or 1892 ; in parts of Scotland it was registered in 1919 and locally in north Scotland in 1891. The difference between the monthly mean temperatures in March, 1937, and March, 1938, is striking ; it amounted to 15·8° F. at Balmoral, 12·2° F. at Tynemouth, 12·1° F. at Aberdeen, 10·9° F. at Armagh and 9·4° F. at Kew Observatory. The average annual range of mean temperature at these stations is only 19·9° F., 18·8° F., 17·7° F., 18·3° F. and 22·5° F. respectively.

The abnormal warmth of March, 1938, was not limited to the British Isles ; its extent is indicated in the *Meteorological Magazine* for April, 1938, p. 75. The exceptional character of the excessive warmth in Germany is given by W. Piersig (1) in an article entitled " Milder März—Kühler Sommer ? " and in the " Deutscher Witterungsbericht für März, 1938 ". We read that it was the warmest March at Munich in 100 years and at Köslin, Hanover, Erfurt, Cassel, Frankfort-o/M and Cleve since 1851.

L. F. LEWIS.

(1) *W. Piersig. Leipzig, Z. angew. Met., June, 1938.*

Table 1. Highest Mean Temperature in March at Selected Stations

Station	Period	Highest Mean	Year	1938 Mean	Deviation of 1938 from previous record
		°F.		°F.	°F.
Lerwick... ...	1871–1937	44·5	1929	44·3	− 0·2
Deerness ...	1871–1937	43·5	1929	44·7	+ **1·2**
Stornoway ...	1871–1937	44·7	1933	46·3	+ **1·6**
Fort William ...	*1884–1937	45·0	1933	46·7	+ **1·7**
Aberdeen ...	1881–1937	43·9	{1882, 1935}	48·4	+ **4·5**
Edinburgh (Leith and Blackford Hill).	1871–1937	46·4	1874	47·7	+ **1·3**
Rothesay ...	1876–1937	44·4	1894	46·7	+ **2·3**
Douglas... ...	1878–1937	44·8	1929	47·2	+ **2·4**
Tynemouth ...	1871–1937	44·8	1921	50·1	+ **5·3**
Yarmouth ...	1872–1937	45·9	1921	48·8	+ **2·9**
Cambridge ...	1876–1937	46·6	1893	48·5	+ **1·9**
Buxton	1875–1937	42·5	1920	45·8	+ **3·3**
Oxford	1871–1937	46·7	1933	49·9	+ **3·2**
Greenwich ...	1841–1937	47·5	1841	49·7	+ **2·2**
Kew	1871–1937	46·7	1912	49·3	+ **2·6**
Dungeness ...	1886–1937	46·5	1903	45·6	− 0·9
Southampton ...	1871–1937	47·5	1896	49·3	+ **1·8**
Southport ...	1871–1937	45·5	1933	47·0	+ **1·5**
Stonyhurst ...	1871–1937	45·0	1871	46·5	+ **1·5**
Holyhead ...	1872–1937	46·9	{1893, 1933}	48·1	+ **1·2**
Falmouth ...	1871–1937	48·3	1933	49·2	+ **0·9**
Dublin (Phoenix Park).	1881–1937	45·5	1893	48·5	+ **3·0**
Armagh... ...	1871–1937	45·2	1893	49·1	+ **3·9**
Valentia Obsy....	1871–1937	48·9	1893	49·3	+ **0·4**
Scilly	1871–1937	49·3	1893	48·7	− 0·6
Jersey	1871–1937	50·0	1893	50·2	+ **0·2**

* 1884–1923, 1932–1937.

L. F. Lewis.

New Climatological Stations

New climatological stations, approved by the Meteorological Office have recently been set up by Mr. J. Porter at Garvagh (Moneydig), Co. Londonderry, by Mr. N. H. Middlebrook at Boston (Freiston Road), Lincs., and by Mr. Martin A. F. Sutton at the Royal Seed Establishment, Reading.

REVIEW

Relations between interdiurnal pressure and temperature variations in the troposphere and stratosphere over North America. By B. Haurwitz and W. E. Turnbull, Ottawa, Canadian Meteorological Memoirs, Vol. I, No. 3, pp. 67–92 (1938).

This is the third number of a new series of memoirs which should be a valuable organ for the communication of the results of the scientific work of the Canadian Meteorological Office, as well as a direct encouragement to its staff to embark on research.

The paper is a study of observational material which as yet, at least in relation to the extent of the North American continent, is scanty by comparison with the upper air data available for the relatively small area across the central part of western Europe to which most European data relate. But the American observations—and chiefly the eastern ones—have a new interest, for there the arriving air masses are of mainly continental type, having mostly travelled a considerable distance across the great land area lying to west and north. The European observational area on the other hand, with a great body of ocean occupying the corresponding position, has almost precisely reversed air-mass experiences.

Denoting the pressure and temperature changes at any given level from one day to the next by ΔP, ΔT, the first results noted are that surface pressure is more influenced by the temperature variations in the lowest layer than is the case in Europe. In 67 per cent. of cases the surface value of ΔP is of opposite sign to that of ΔT in the lowest kilometre and in only 33 per cent. of cases is it of the same sign; in Europe the percentages are 62 per cent. and 38 per cent. The absolute mean values of the temperature variations in the lower troposphere are also decidedly larger in North America than in Europe—some 70 per cent. greater in the lowest two kilometres, and becoming about equal at 8 km. It is to be noted particularly that this arises rather from the extent to which lower level variations in Europe are damped down by surface influence than from any amplification of lower level as compared with higher level variations in North America. In fact, the mean interdiurnal temperature variation in North America is practically the same (around 4° C.) from surface level up to about 14 km., after which it falls off, whilst in Europe the mean starts at only about 2° C. at surface levels and rises to around 4° C. in the levels from 8 to 12 km. (upper troposphere and lower stratosphere), afterwards falling off again as in North America.

The correlation between the pressure near the surface and the height of the tropopause (H) is found to be small, of the order of 0·30 or less, but the correlation between P_5 and H is $+0\cdot89 \pm 0\cdot02$ for the American ascents and $+0\cdot82 \pm 0\cdot04$ for the Canadian ascents, values similar to those found by W. H. Dines for P_9 and H, from European ascents. The correlation between the pressure at

1 km. and the mean temperature up to 9 km. is small, but the correlation between P_9 and the mean temperature up to 9 km. is very high.

The memoir is entirely statistical, but it is expected that sufficient aerological material will be available soon to permit the study of some weather situations of special interest to be undertaken with special reference to the developments in the stratosphere and the higher troposphere. Such a study would be useful not only in itself, but because the comparison with corresponding European studies would be an important contribution to more general problems.

A. H. R. Goldie.

BOOKS RECEIVED

Rothamsted Experimental Station, Lawes Agricultural Trust. Report for 1937 (Meteorology, pp. 87–89), St. Albans, 1938.

Hong Kong : Annual Report of the Director of the Royal Observatory for the year 1937, Hong Kong, 1938.

Borough of Dover. Meteorological Report for 1937, Dover, 1938.

OBITUARY

Willis Ray Gregg. We regret to announce the death on September 14th, 1938, of Dr. W. R. Gregg, Chief of the United States Weather Bureau since 1934.

Gustaf Melander. We regret to announce the death on August 25th, 1938, of Professor G. Melander, formerly Director of the Central Meteorological Institute of Finland.

ERRATA

March, 1938. Page 52. Mean temperature for February.

for

Kew temperature, mean, 40·1°F: diff. from average −1·2°F.

read

„ „ „ 41·6°F: „ „ „ +0·5°F.

September, 1938. Page 224. Mean temperature for August.

for

Kew temperature, mean, 61·3°F: diff. from average − 1·4°F.

read

„ „ „ 63·7°F: „ „ „ + 0·7°F.

September, 1938. Page 203, line 5, *for* 1908, *read* 1938.

The Weather of September, 1938

Mean pressure was above 1020 mb. over the Atlantic west of Spain and Morocco, reaching 1025 mb. west of the Azores, and falling rather rapidly to 1004 mb. over south Greenland, Iceland and Spitzbergen. In Europe pressure rose towards the ESE from 1012 mb. in north-west Scotland to 1019 mb. in 20° E.; no data were received from Russia or Siberia. Pressure was 5 mb. above normal in mid-Atlantic and in the eastern Baltic, and 4 mb. below normal at Spitzbergen. In North America the highest values, 1017 mb., occurred round the Great Lakes, decreasing to 1012 mb. in southern California; deviations from normal were slight. No data were received for Canada.

Mean temperature was above 90° F. in central Egypt and Arabia, about 70° F. in the Mediterranean, 60° F. in central Europe, 54–59° F. over the British Isles and 48–57° F. in Scandinavia. In the United States they ranged from 80° F. in the south to about 60° F. near the Great Lakes. Temperatures were generally above normal, by more than 5° F. in Finland, Denmark and the north-western U.S.A., but southern Europe was slightly below normal. Rainfall generally differed little from normal but was rather heavy on the western coasts of Europe from central Scandinavia southwards and locally in the middle west of America.

Over northern and eastern India pressure was below 1005 mb. and slightly below normal, increasing south-eastwards to more than 1020 mb. in south-eastern Australia where it was 4 mb. above normal; New Zealand was also 3 to 4 mb. above normal. Temperature was above 80° F. in India and the tropics, 70° F. in Australia about 25° S., and 60° F. in southern Australia and 50° F. in central New Zealand. Temperatures were above normal over most of India, Siam, western and southern Australia, and below normal over French Indo-China, central and north-eastern Australia. Rainfall was deficient over all Australia and most of India, but there were large local excesses at Allahabad (16 inches, 9 inches above normal), Vizagapatam and Port Blair.

The weather of the month over the British Isles was dull, with mean temperature above the average. Rainfall exceeded the average in Scotland but in England and Ireland the distribution was variable.

On the 1st pressure was very uniform and weather cool with showers and bright intervals and local thunderstorms. During the following days pressure was high off the south-west coasts, while depressions moved south-east from the neighbourhood of Iceland causing rather unsettled, cool weather. Rain fell on the evening of the 2nd in the northern half of the country and on the 3rd over a somewhat wider area including east England though the south of England and South Ireland escaped. The depression which moved south-east over the country from the 5th to 7th caused rain at times in most places. Records of bright sunshine were good on the 2nd, particularly in England and southern Scotland, where the majority of stations registered more than 10 hours. Locally in the north and west of Scotland good records were obtained on the 7th; Lerwick and Stornoway reported 11·9 hours and 11·5 hours respectively. Low screen minima were registered locally on the first three days; for example, 26° F. at Dalwhinnie and 31° F. at Rhayader and Eskdalemuir on the 2nd and 31° F. at South Farnborough on the 3rd.

Between the 8th and 12th an extension of a large anti-cyclone on the Atlantic moved slowly southeast over the British Isles; rainfall was mostly slight during this period, though it was heavier in the north of Scotland on the 10th. Temperature continued rather low over most of England until the 10th but rose somewhat in Scotland and Ireland; on the 8th maxima of 73° F. and 71° F. were registered at Armagh and Fort Augustus respectively. The 12th was warm generally and 80° F. was reached or slightly exceeded at a number of stations in east and south-east England. The 13th was also warm in England and Ireland.

A trough of low pressure associated with a depression over Scandinavia moved south-east over the British Isles on the 13th and 14th; rainfall was moderately heavy locally in the north on the 13th and some rain occurred in most districts on the 14th. Cool polar air in the rear of this disturbance caused a considerable fall of temperature. A further period of unsettled weather ensued; between the 16th and 19th a depression off north-west Ireland moved in slowly over the British Isles and on the 20th and 21st secondaries to a depression south-west of Iceland travelled north-east over the country. Considerable rain fell at times and local thunderstorms were reported from the 17th to 19th and on the 21st; among the heavier falls of rain were 1·59 in. at Eskdalemuir on the 16th, 1·89 in. at Borrowdale, Cumberland, on the 17th and 1·65 in. at Bath, 1·81 in. at Purton, Wilts., and 2·17 in. at Weston Park, Warwick, on the 18th. On the 22nd an intense depression approached the west of Ireland and on the 23rd it moved north and became much less deep; gales were reported in the west and north on the 22nd and 23rd and rain occurred in the west and north on the 22nd and more generally on the 23rd, but many places in south-east and east England had little or none. Temperatures were high on the 23rd and 24th and reached 80° F. locally in south-east and east England. Between the 24th and 26th shallow secondaries moved northward over the British Isles causing rain at times and local thunder; a fall of 1·50 in. occurred at Tottenham, 1·59 in. at Furneaux Pelham, Hertford, and 1·75 in. at Much Hadham, Hertford on the 24th. On the 27th and 28th a depression south of Ireland moved north-east and on the 29th and 30th a low pressure system covered the British Isles; the weather was unsettled, with occasional rain but with periods of bright sunshine. Heavy rain occurred locally in south-east England on the 27th; 1·72 in. was measured at Heathfield, Sussex and 1·86 in. at Warbleton, Sussex.

The distribution of bright sunshine for the month was as follows:—

	Total hrs.	Diff. from average hrs.		Total hrs.	Diff. from average hrs.
Stornoway ..	112	+2	Chester ..	99	−31
Aberdeen ..	115	−11	Ross-on-Wye	105	−31
Dublin	84	−46	Falmouth ..	147	−11
Birr Castle ..	100	−19	Gorleston ..	137	−21
Valentia ..	107	−20	Kew.. ..	125	−21

Kew temperature, mean, 58·9°F: diff. from average, +0·4°F.

Miscellaneous notes on weather abroad from various sources

Snow fell in the Alps and Pyrenees in the early part of September—the earliest fall for many years. Heavy rain and hail caused serious floods in France and north-west Spain on the 10th; crops were damaged and many people were killed and injured in accidents due to subsidence of railway tracks and skidding cars. A series of typhoons swept across Japan between the 1st and 5th. The torrential rains and violent winds caused widespread damage to houses, bridges and ships, and over 100 persons are reported killed and thousands injured or rendered homeless. The monsoon continued weak in India with the exception of the Peninsula, Bengal experiencing flooding more severe than normal. Heavy rains in Quebec caused landslides and floods on the 1st, and 12 people were drowned. Hurricanes were reported from the West Indies on the 20th, and from New York and across to Canada on the 21st. Rivers burst their banks and whole towns in the north-eastern states were devastated. Over 500 lives were lost and the damage to property is estimated at £40,000,000. South Carolina was struck by a typhoon which caused 2 deaths on the 29th. In Argentine high temperatures were experienced during the month, the shade maximum at Buenos Aires reaching 89·4° F. on the 28th. The highest temperature reported on this date was 109·4° F. at Catamarca.

The Nile flood continued to rise to an abnormal level and incessant heavy rain in the Sudan caused houses to collapse in Khartoum.

(*The Times*—various dates.)

Seaplane struck by lightning

Mr. J. Durward writes to say that the seaplane *Cassiopeia*, in which he was a passenger was struck by lightning on September 8th, between St. Nazaire and Marseilles. No damage occurred and the pilot reached Marseilles safely although his hat was burned off his head and his hair singed.

Daily Readings at Kew Observatory, September, 1938

Date	Pressure, M.S.L. 13h.	Wind, Dir., Force 13h.	Temp. Min.	Temp. Max.	Rel. Hum. 13h.	Rain	Sun	REMARKS
	mb.		°F.	°F.	%	in.	hrs.	
1	1018·1	SSE. 2	42	65	61	0·02	4·2	ir_0 17h.–21h.
2	20·0	WSW 2	45	63	47	—	10·2	mw early.
3	22·2	WNW 2	42	63	50	trace	8·6	w early, r_0 22h.
4	23·0	NW 3	50	62	53	trace	4·1	pr_0 6h.
5	23·4	NW 3	45	64	50	—	3·1	w early.
6	14·2	SSW 3	52	64	80	0·07	0·4	pr 10h., tlr 18h.
7	09·2	NNE 2	52	63	60	0·09	3·1	r_0–R 18h.–22h.
8	20·0	NNE 5	52	63	75	trace	3·3	d_0 12h.
9	22·9	N 4	53	62	68	—	3·3	
10	23·8	NNE 3	51	64	55	—	3·0	
11	24·0	WNW 2	44	68	69	—	1·2	fe till 8h.
12	22·9	W 2	60	76	61	—	7·8	w late.
13	21·9	SW 2	57	76	63	—	8·3	
14	14·3	W 3	56	72	63	0·02	4·2	r–r_0 17h.–19h.
15	22·7	NW 2	48	61	49	—	10·4	
16	22·2	S 3	41	65	49	—	5·7	w early.
17	13·6	SW 4	49	69	51	trace	5·1	r_0 21h.
18	10·9	SSW 4	60	68	77	0·15	3·2	r_0 10h., r–r_0 22h.–24h.
19	08·7	S 2	56	65	70	0·06	1·3	r_0–r 0h.–2h., pr_0 10h.
20	03·8	SSW 4	54	65	73	0·06	1·2	r–r_0 4h.–7h. & 22h.–
21	07·2	SSW 2	53	61	85	0·05	0·0	ir_0 10h.–17h. [23h
22	14·9	S 4	52	67	60	—	10·3	w early.
23	12·6	SSE 3	56	76	58	trace	6·9	w early, pr_0 17 h.
24	12·1	SSE 2	57	72	67	0·40	1·3	ir_0–r 17h.–24h.
25	12·9	S 2	60	69	86	0·03	2·5	ir_0 0h.–10h. [23h
26	13·6	S 2	50	65	77	0·04	0·0	F–f 0h.–9h., r_0 17h.
27	16·1	SE 2	55	63	74	0·83	0·8	r r_0 0h.–7h., 16h.–22h.
28	12·9	SSW 3	53	63	85	0·01	0·7	pr_0 0h. & 13h.
29	12·1	SW 2	55	64	66	0·04	3·5	r_0 4h.–5h. & 8h.–10h.
30	1014·1	SSE 4	47	65	59	0·07	7·7	r–r_0 16h.–17h.
*	1016·3	—	51	66	65	1·94	4·2	*Means or Totals.

General Rainfall for September, 1938

England and Wales	94	per cent of the average 1881–1915.
Scotland	127	
Ireland	105	
British Isles ...	105	

Rainfall : September, 1938 : England and Wales

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Lond .	Camden Square	2·38	131	*War* .	Birminghm, Edgbaston	1·90	106
Sur .	Reigate, Wray Pk. Rd.	2·59	125	*Leics* .	Thornton Reservoir	2·50	138
Kent .	Tenterden, Ashenden	2·57	120	,, .	Belvoir Castle	2·52	135
,, .	Folkestone, Boro. San.	1·91	...	*Rut* .	Ridlington	1·58	82
,, .	Margate, Cliftonville	2·38	121	*Lincs* .	Boston, Skirbeck	2·43	138
,, .	Eden'bdg., Falconhurst	2·58	114	,, .	Cranwell Aerodrome	2·24	126
Sus .	Compton, Compton Ho.	1·91	68	,, .	Skegness, Marine Gdns.	3·21	177
,, .	Patching Farm	2·37	99	,, .	Louth, Westgate	2·07	102
,, .	Eastbourne, Wil. Sq.	2·53	101	,, .	Brigg, Wrawby St.	2·50	...
Hants .	Ventnor, Roy.Nat.Hos.	1·91	77	*Notts* .	Mansfield, Carr Bank	2·29	124
,, .	Southampton,East Park	1·69	77	*Derby* .	Derby, The Arboretum	2·91	169
,, .	Ovington Rectory	1·05	46	,, .	Buxton, Terrace Slopes	3·32	103
,, .	Sherborne St. John	·79	39	*Ches* .	Bidston Obsy	1·68	70
Herts .	Royston,Therfield Rec.	2·55	136	*Lancs* .	Manchester, Whit. Pk.	1·83	77
Bucks .	Slough, Upton	1·68	95	,, .	Stonyhurst College	2·05	54
Oxf .	Oxford, Radcliffe	2·14	125	,, .	Southport, Bedford Pk.	2·24	81
N'hant	Wellingboro, Swanspool	1·90	105	,, .	Ulverston, Poaka Beck	3·40	80
,, .	Oundle	1·73	...	,, .	Lancaster, Greg Obsy.	2·01	59
Beds .	Woburn, Exptl. Farm	1·29	72	,, .	Blackpool	1·53	54
Cam .	Cambridge, Bot. Gdns.	3·34	207	*Yorks* .	Wath-upon-Dearne	2·08	132
,, .	March	2·14	119	,, .	Wakefield,Clarence Pk.	2·43	152
Essex .	Chelmsford,County Gdns	3·48	202	,, .	Oughtershaw Hall	2·83	...
,, .	Lexden Hill House	1·57	...	,, .	Wetherby, Ribston H.	2·21	123
Suff .	Haughley House	2·52	...	,, .	Hull, Pearson Park	2·16	126
,, .	Rendlesham Hall	2·30	88	,, .	Holme-on-Spalding	2·58	148
,, .	Lowestoft Sec. School	2·60	133	,, .	Felixkirk, Mt. St. John.	2·41	132
,, .	Bury St. Ed., WestleyH.	2·08	105	,, .	York, Museum Gdns.	1·66	102
Norf. .	Wells, Holkham Hall	1·82	96	,, .	Pickering, Houndgate	1·83	96
Wilts .	Porton, W.D. Exp'l. Stn	1·41	81	,, .	Scarborough	1·36	76
,, .	Bishops Cannings	2·80	128	,, .	Middlesbrough	1·76	106
Dor .	Weymouth, Westham.	2·01	96	,, .	Baldersdale, Hury Res.	1·88	75
,, .	Beaminster, East St.	1·91	75	*Durh* .	Ushaw College	1·98	99
,, .	Shaftesbury	1·80	74	*Nor* .	Newcastle, Leazes Pk.	2·48	125
Devon.	Plymouth, The Hoe	1·85	73	,, .	Bellingham, Highgreen	1·74	73
,, .	Holne, Church Pk. Cott.	2·14	60	,, .	Lilburn Tower Gdns.	1·65	70
,, .	Teignmouth, Den Gdns.	1·26	64	*Cumb*.	Carlisle, Scaleby Hall	2·57	95
,, .	Cullompton	1·58	70	,, .	Borrowdale, Seathwaite	7·50	80
,, .	Sidmouth, U.D.C.	1·33	...	,, .	Thirlmere, Dale Head H.	5·59	86
,, .	Barnstaple, N. Dev.Ath	1·23	46	,, .	Keswick, High Hill	3·65	86
,, .	Dartm'r,Cranmere Pool	3·40	...	,, .	Ravenglass, The Grove	3·16	94
,, .	Okehampton, Uplands.	1·45	45	*West* .	Appleby, Castle Bank	1·79	71
Corn .	Redruth, Trewirgie	2·44	78	*Mon* .	Abergavenny, Larchf'd	2·58	110
,, .	Penzance, Morrab Gdns.	2·87	98	*Glam* .	Ystalyfera, Wern Ho.	2·71	62
,, .	St. Austell, Trevarna	2·32	73	,, .	Treherbert, Tynywaun.	4·17	...
Soms .	Chewton Mendip	2·74	89	,, .	Cardiff, Penylan	1·67	55
,, .	Long Ashton	2·28	95	*Carm* .	Carmarthen,M. & P. Sch.	2·64	73
,, .	Street, Millfield	1·93	87	*Card* .	Aberystwyth	2·92	...
Glos .	Blockley	2·25	...	*Rad* .	BirmW.W.Tyrmynydd	1·77	46
,, .	Cirencester, Gwynfa	3·51	160	*Mont* .	Lake Vyrnwy	2·15	61
Here .	Ross-on-Wye	1·15	60	*Flint* .	Sealand Aerodrome	·96	50
,, .	Kington, Lynhales	1·28	60	*Mer* .	Blaenau Festiniog	4·16	58
Salop .	Church Stretton	1·43	70	,, .	Dolgelley, Bontddu	3·08	72
,, .	Shifnal, Hatton Grange	1·39	72	*Carn* .	Llandudno	1·77	83
,, .	Cheswardine Hall	1·32	65	,, .	Snowdon, L. Llydaw 9.	10·80	...
Worc .	Malvern, Free Library	1·56	81	*Ang* .	Holyhead, Salt Island	1·94	72
,, .	Ombersley, Holt Lock.	1·51	85	,, .	Lligwy	2·42	...
War .	Alcester, Ragley Hall	2·09	117	*I. Man*	Douglas, Boro' Cem.	3·32	102

Rainfall: September, 1938: Scotland and Ireland

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent. of Av.
Guern.	St.Peter P't.Grange Rd.	1.60	62	*R&C*	Stornoway,C.GuardStn.	4·19	112
Wig	Pt. William, Monreith.	4·72	162	*Suth*	Lairg	3·83	135
„	New Luce School	4·48	125	„	Skerray Borgie	...	...
Kirk	Dalry, Glendarroch	4·92	134	„	Melvich	2·59	93
Dumf.	Eskdalemuir Obs.	4·69	127	„	Loch More, Achfary	7·48	130
Roxb	Hawick, Wolfelee	2.59	101	*Caith*	Wick	2·93	117
„	Kelso, Broomlands	2.08	109	*Ork*	Deerness	2·29	79
Peeb	Stobo Castle	3·01	119	*Shet*	Lerwick Observatory	2·41	80
Berw	Marchmont House	2·47	102	*Cork*	Cork, University Coll.	2·71	101
E.Lot	North Berwick Res.	3·24	155	„	Roches Point, C.G. Stn.	3·62	122
Midl	Edinburgh, Blackfd. H.	2·15	105	„	Mallow, Longueville	2·66	111
Lan	Auchtyfardle	3·21	...	*Kerry*	Valentia Observatory	5·94	143
Ayr	Kilmarnock, Kay Park	4·16	...	„	Gearhameen	6·30	103
„	Girvan, Pinmore	4·85	127	„	Bally McElligott Rec.	4·44	...
„	Glen Afton, Ayr San.	5·13	132	„	Darrynane Abbey	4·01	113
Renf	Glasgow, Queen's Park	3·44	124	*Wat*	Waterford, Gortmore	3·26	119
„	Greenock, Prospect H.	5·03	112	*Tip*	Nenagh, Castle Lough.	1·96	70
Bute	Rothesay, Ardencraig	5·55	137	„	Cashel, Ballinamona	3·09	128
„	Dougarie Lodge	4·92	129	*Lim*	Foynes, Coolnanes	3·21	111
Arg	Loch Sunart, G'dale	7·10	113	„	Limerick, Mulgrave St.	4·40	167
„	Ardgour House	8·50	...	*Clare*	Inagh, Mount Callan	...	...
„	Glen Etive	11·83	153	*Wexf*	Gorey, Courtown Ho.	2·51	102
„	Oban	5·70	...	*Wick*	Rathnew, Clonmannon.	2·41	...
„	Poltalloch	5·17	113	*Carl*	Bagnalstown,Fenagh H.	2·66	108
„	Inveraray Castle	9·52	148	„	Hacketstown Rectory	2·44	87
„	Islay, Eallabus	3·96	95	*Leix*	Blandsfort House	3·10	114
„	Mull, Benmore	16·30	142	*Offaly*	Birr Castle	2·04	89
„	Tiree	4·86	131	*Kild*	Straffan House	2·04	91
Kinr	Loch Leven Sluice	4·45	173	*Dublin*	Dublin, Phoenix Park	1·37	72
Fife	Leuchars Aerodrome	2·93	152	*Meath.*	Kells, Headfort	2·08	78
Perth	Loch Dhu	7·65	134	*W.M*	Moate, Coolatore	...	...
„	Crieff, Strathearn Hyd.	4·21	147	„	Mullingar, Belvedere	2·09	78
„	Blair Castle Gardens	3·76	159	*Long*	Castle Forbes Gdns.	2·54	88
Angus.	Kettins School	2·78	126	*Gal*	Galway, Grammar Sch.	2·18	69
„	Pearsie House	4·58	...	„	Ballynahinch Castle	5·86	123
„	Montrose, Sunnyside	3·51	176	„	Ahascragh, Clonbrock.	2·45	79
Aber	Balmoral Castle Gdns.	2·81	117	*Rosc*	Strokestown, C'node	2·47	91
„	Logie Coldstone Sch.	4·26	183	*Mayo.*	Blacksod Point	3·96	102
„	Aberdeen Observatory.	3·60	162	„	Mallaranny	5·81	...
„	New Deer School House	2·22	88	„	Westport House	3·56	100
Moray	Gordon Castle	3·84	154	„	Delphi Lodge	9·44	125
„	Grantown-on-Spey	4·04	163	*Sligo*	Markree Castle	3·27	98
Nairn.	Nairn	3·44	156	*Cavan.*	Crossdoney, Kevit Cas.	2·72	...
Inv's	Ben Alder Lodge	4·90	...	*Ferm*	Crom Castle	2·55	91
„	Kingussie, The Birches.	3·29	...	*Arm*	Armagh Obsy	2·17	88
„	Loch Ness, Foyers	3·31	113	*Down.*	Fofanny Reservoir	5·82	...
„	Inverness, Culduthel R.	2·89	123	„	Seaforde	3·17	115
„	Loch Quoich, Loan	9·25	...	„	Donaghadee, C. G. Stn.	3·05	128
„	Glenquoich	9·66	112	*Antr*	Belfast,Queen's Univ.	2·59	101
„	Arisaig House	6·63	110	„	Aldergrove Aerodrome.	2·75	111
„	Glenleven, Corrour	...	...	„	Ballymena, Harryville.	3·75	121
„	Fort William, Glasdrum	5·17	...	*Lon*	Garvagh, Moneydig	3·05	...
„	Skye, Dunvegan	6·71	...	„	Londonderry, Creggan.	3·15	95
„	Barra, Skallary	4·23	...	*Tyr*	Omagh, Edenfel	2·40	79
R&C.	Tain, Ardlarach	3·57	142	*Don*	Malin Head	3·67	113
„	Ullapool	4·43	118	„	Dunfanaghy	...	...
„	Achnashellach	5·57	77	„	Dunkineely	2·59	...

Climatological Table for the British Empire, April, 1938

STATIONS.	PRESSURE. Mean of Day M.S.L.	PRESSURE. Diff. from Normal.	TEMPERATURE. Absolute. Max.	Absolute. Min.	Mean Values. Max.	Mean Values. Min.	Mean Values. ½ Max. and Min.	Mean Values. Diff. from Normal.	Mean Wet Bulb.	Relative Humidity	Mean Cloud Am'nt	PRECIPITATION. Am'nt.	PRECIPITATION. Diff. from Normal.	PRECIPITATION. Days	BRIGHT SUNSHINE. Hours per day.	BRIGHT SUNSHINE. Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0–10	in.	in.			
London, Kew Obsy.	1026·2	+11·8	63	30	54·1	38·7	46·4	− 0·7	39·6	80	7·2	0·09	− 1·36	3	5·0	36
Gibraltar	1014·8	− 1·6	71	50	62·5	54·6	58·5	− 2·4	53·7	82	7·1	3·13	...	15	...	...
Malta	1013·8	+ 0·4	71	47	62·0	52·6	57·3	− 3·6	52·9	79	5·9	1·09	+ 0·23	10	7·8	60
St. Helena	1015·5	− 1·1	70	59	67·8	60·7	64·3	0·0	62·0	91	8·0	2·22	− 1·00	17	...	...
Freetown, Sierra Leone	1010·2	+ 1·1	92	74	88·2	76·0	82·1	...	75·3	73	4·7	0·77	− 3·29	4	...	...
Lagos, Nigeria	1009·5	+ 0·1	91	72	88·3	76·0	82·1	− 0·7	77·0	82	6·5	6·03	− 0·05	13	6·3	52
Kaduna, Nigeria	1008·5	...	100	63	95·0	72·0	83·5	+ 1·3	70·8	66	4·9	2·04	− 1·04	7	9·2	75
Zomba, Nyasaland	1010·8	− 1·7	83	58	79·0	64·6	71·8	+ 2·5	69·7	83	6·0	3·37	− 0·29	9	...	...
Salisbury, Rhodesia	1012·3	− 1·8	84	51	78·9	56·2	67·5	+ 1·8	61·1	70	3·4	1·33	...	5	9·0	77
Cape Town	1015·2	− 1·2	86	48	71·9	55·6	63·7	+ 0·5	57·3	88	5·0	3·13	+ 1·26	12	...	...
Johannesburg	1013·6	− 1·7	79	43	70·0	52·7	61·3	+ 1·3	53·3	64	4·2	5·27	+ 3·53	9	6·9	60
Mauritius	1014·1	+ 0·2	85	60	81·7	69·8	75·7	− 0·1	72·7	77	5·6	4·64	− 0·48	16	6·7	58
Calcutta, Alipore Obsy.	1006·0	− 0·3	107	75	99·0	79·7	89·3	+ 3·7	78·8	78	3·6	0·01	− 2·17	0*	...	...
Bombay	1008·1	− 0·7	93	74	90·7	78·3	84·5	+ 1·4	76·3	74	3·1	0·00	− 0·05	0*	...	...
Madras	1008·0	− 0·4	96	75	91·7	78·1	84·9	− 0·4	78·5	73	5·2	0·00	− 0·63	0*	...	...
Colombo, Ceylon	1009·0	+ 0·3	88	72	86·8	75·3	81·1	− 1·6	78·0	80	6·5	15·57	+ 5·84	27	6·7	55
Singapore	1009·2	+ 0·3	90	73	86·7	75·7	81·2	− 0·4	78·5	78	6·9	8·81	+ 1·18	20	5·4	45
Hongkong	1012·2	− 0·4	86	61	77·7	68·1	72·9	+ 2·1	67·7	71	4·7	1·85	− 3·80	5	6·8	54
Sandakan	1008·1	...	90	73	87·3	76·0	81·7	− 0·5	77·7	85	8·4	9·26	+ 4·77	17	...	...
Sydney, N.S.W.	1015·6	− 2·8	88	49	74·3	59·7	67·0	+ 2·3	60·8	67	4·6	2·39	− 3·13	11	6·2	55
Melbourne	1014·9	− 4·6	95	42	72·8	52·7	62·7	+ 3·2	55·3	69	5·7	1·05	− 1·12	7	5·7	51
Adelaide	1016·6	− 3·2	99	44	75·1	56·3	65·7	+ 1·8	57·3	56	5·6	5·81	+ 4·09	11	5·3	48
Perth, W. Australia	1017·2	− 1·2	94	45	74·8	56·7	65·7	− 1·1	58·2	64	5·8	1·85	+ 0·20	5	7·1	63
Coolgardie	1016·2	− 2·1	102	42	80·0	55·3	67·7	+ 2·7	60·3	76	3·9	0·12	− 0·84	2	...	...
Brisbane	1014·2	− 3·4	94	50	80·6	62·6	71·6	+ 1·3	64·2	69	4·2	1·01	− 2·76	8	7·7	67
Hobart, Tasmania	1013·5	− 1·3	80	40	64·1	49·0	56·5	+ 1·3	51·5	72	6·4	1·28	− 0·57	15	4·3	39
Wellington, N.Z.	1019·1	+ 1·0	81	46	65·4	54·4	59·9	+ 2·8	58·2	87	8·4	7·12	+ 3·24	20	2·9	26
Suva, Fiji	1011·4	+ 0·8	88	69	85·3	73·7	79·5	+ 0·9	75·3	83	3·8	4·96	− 7·25	18	5·6	48
Apia, Samoa	1009·8	− 0·1	88	73	85·5	74·6	80·1	+ 1·2	76·5	80	5·1	6·55	− 3·60	16	7·0	59
Kingston, Jamaica	1014·2	+ 0·1	88	66	85·4	68·8	77·1	− 1·3	68·0	78	2·7	0·37	− 0·87	4	5·8	46
Grenada, W.I.	1011·7	− 0·8	88	70	86	72	79	+ 0·1	73	74	6	7·84	+ 5·68	18	...	...
Toronto	1016·4	+ 0·3	83	20	54·2	38·2	46·2	+ 4·1	39·0	69	5·9	1·75	− 0·54	11	5·6	42
Winnipeg	1016·0	− 0·7	69	4	49·5	26·1	37·8	+ 0·1	26·5	73	4·2	1·10	− 0·30	8	6·8	50
St. John, N.B.	1016·3	+ 2·9	68	12	47·3	33·1	40·2	+ 1·2	35·3	82	8·0	4·15	+ 0·64	18	4·6	34
Victoria, B.C.	1017·6	+ 0·1	63	34	56·6	43·5	50·1	+ 2·2	48·3	86	6·2	1·91	+ 0·39	8	10·5	77

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

(44046) Wt. 21/31 1,250 10/38 Hw. G.377/6