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Colour

By E. C. Barton, F.P.S.L.

Colour is an effect produced in our eyes by certain constituent parts of white light, which come to us chiefly from "coloured" surfaces, that have the power of absorbing the other ingredients of the light that falls on them. White light is generally held to be "colourless", but it is actually a mixture of all the colours, as may be readily proved by repeating the experiment through which Newton first demonstrated the fact. If, as in that celebrated experiment, a narrow sunbeam is admitted into a darkened room through a slit in the shutter and allowed to fall on a suitably held prism, the sunbeam will be broken up into its constituent parts and projected on the opposite wall as a band of colours, and this colour band, as it issues from the first prism, if received on a second prism, will be found to become reunited and again form a band of white light.

This band of colours, commonly known as the "spectrum", has been the subject of deep study, especially since the discovery of its bearing on wireless problems, the transmission of both radio messages and of light having been found to consist of waves in the same medium—"ether."

The propagation of water waves on the ocean and of rhythmical air waves from a musical instrument, have long been known and they are of such a material kind as to be readily understood by investigators, but the transmission of waves through a solid such as glass or across a vacuum, demands the conception of a medium such as must exist between us and the stars, and be infinitely more attenuated than the rarest gas. It must also permeate all space, including the interior of both fluids and solids.

During the growth of our knowledge on the subject of ether waves, technical terms have come into use, which are chiefly derived from older studies of waves in their more familar forms of water waves and musical air waves. Thus waves from Daventry are said to measure 1,500 meters from " crest to crest " as though they referred to ocean waves, while Newcastle (with an ether wave frequency of 1,400 per second) is said to operate " at an octave above " that of Rome (with a wave frequency of 700), the word octave being taken from the musician who thus describes the relationship of two notes, one of which vibrates at twice the rate of the other.

Of all the types of vibration known to science, ether waves have the greatest range, extending over no less than 50 octaves, whereas ordinary water waves, from ocean billows down to half-inch ripples on a pond, cover only 14 octaves, and our range of musical hearing covers only 8 octaves, from the mosquito's sibilant song down to the deepest note of a long organ pipe. Ether waves not only transcend all other wave types in the matter of range, but also in regard to utility. Beginning with the longest ether waves at the lower end of the octaves, we find those used in radio-telegraphy, which range from miles down to inches in " crest to crest " measures. At the other end we find the X-ray waves, which measure only billionths of an inch, while intermediate between these extremes are found the " warmth waves."

Of all this great range of wave lengths, only a very small section—one octave—is devoted to the production of light. In this octave the shortest waves are those which produce the sensation of violet colour, while the longest give us the sensation of red. Between the violet and the red waves, the colours change gradually with every increase in length, through blue, green, yellow and orange, while just outside the visible octave, beyond the red, come the so-called " infra-red " waves, which are invisible to us, but are useful for seeing photographically through fog and haze. Just outside the octave at the other end are the " ultra-violet " waves, which are remarkable for their chemical activity.

Although coloured surfaces have been mentioned above as the main source of our colour sensations, there are other sources which are of great importance from a meteorological point of view, and therefore must now be considered. Chief amongst them is the colouration produced by "transparent" media, and especially by the passage of light through air. No substance, solid or fluid, is so transparent as to offer a perfectly free passage to light. In every case there is some loss, and the loss is greater for one particular set of wave lengths than for others.

Curiously enough, the primary cause of blue colouration in the midday sky is identical with that which produces red sunsets. In both cases the colouring arises from the light-scattering action of small air particles, which takes place in a manner that has been popularly explained by Lord Rayleigh and illustrated by a number of experiments. One of his experiments amounted to a repetition of the wave action commonly seen on a rush-fringed pond, when a gentle breeze has covered its surface with a mixture of little waves and still smaller ripples. As the mixture approaches the rushes, a difference in their behaviour will be observed, the little waves passing through the line of rushes with apparent ease, while the much smaller ripples are arrested and scattered in every direction, but chiefly sideways. This experiment represents, on a visible scale, the behaviour of air particles in scattering the smaller waves of blue and violet light, while allowing the coarser vibrations of the red to pass unhindered, or nearly so. If this scattering did not take place, and the shorter waves belonging to the blue end of the spectrum came through from the sun as successfully as the red, there would be no such thing as a blue sky. The direct rays of the sun would reach us in greater quantity and would appear less yellow in tint than at present, but on a cloudless day the sky would be inky black and so would all shadows. This condition of things would go on until suddenly the sun would disappear below the horizon and black night be upon us in a few seconds.

Fortunately these conditions do not prevail. Even at midday when the sunlight has only a few hundred miles thickness of air to traverse the blue wavelets scattered by the air particles at an angle of 30 or more degrees, are so abundant as to give to the heavens a bright blue colour from that angle down to the horizon. In moist climates such as that of Great Britain, this effect is much enhanced by the presence of water particles which on some days aid in sidetracking the short wave rays to such an extent that the distant hills become invisible. The red and infra-red waves, being less affected by the water vapour particles, are able to get through, and this has led to the invention of emulsions sensitive to infra-red rays for the purpose of photographically seeing such distant objects as the coast of France across the English Channel on a hazy day.

As mentioned above, the direct midday rays of the sun are slightly tinged with red and yellow, but it is toward the end of the day when the sun's rays have to pass through several thousand miles of denser air that they are completely stripped of their short-wave components, and only the red rays succeed in reaching us. If it were then possible to see the earth from a distance—say 100,000 miles away in space—we should then see New York in full sunshine while Bordeaux was lit by the " slanting rays " of the sun with one side of its towers bright red in colour. Further east France would be sunless and immersed in the "earth shadow", but Mont Blanc would still stand out vividly, appearing as a red glowing mass rising out of the "earth shadow" now covering the rest of France with darkness.

This illumination of high mountains by the red rays from the sinking sun is such a well-known phenomenon and such an immediate result of the purging of blue rays suffered by the rays from the setting sun, that little need further be said about it, but there are other phenomena connected with sunsets that are not so readily explained and yet must be mentioned here.

The first is the "counter twilight" (known in Germany as "Gegendämmerung"), which is seen in the east while the sun is sinking in the west and just disappearing from our sight. If a balloonist could rise to an altitude of fifty miles above the ground, the sun would then appear to him as standing well above the horizon and only faintly red, because he would be seeing the sun through a thousand miles of very thinly attenuated air (mostly one-hundredth of its density at our level). This means that the rays lighting up air particles to the east of us at his level will still have a fair amount of blue light in them although already tinged with sunset red. Hence comes the peculiar purple disk that appears at that moment in the east. Above us the sky is still blue, because we have above us some 400 miles of air and of this the upper half is still lit by white light as at midday. When the sun has sunk some degrees below our horizon, the process which made the "counter twilight" in the east, with its accompanying purple disk, is now transferred to the west. The blue sky above us now darkens rapidly, and above the departed sun there appears a large purple disk. Two green patches also appear one at each side of the purple disk and these are difficult to explain. They may be due to the transference of our blue sky production from overhead to the western horizon, where it is seen mingling with the yellow rim that surrounds the purple disk.

More striking than that of blue sky is the colour manifestation of the rainbow, which long remained a mystery, but was eventually made plain by the before-mentioned prism experiment of Newton. The rainbow may be considered as a large scale extension of the prismatic spectrum, its colours being due to the prismatic effect of countless water drops on rays from the sun. Remembering that the rainbow is always formed in a position "away from the sun", it is evident that the light rays must enter the drop of water and then be reflected once or twice internally so as to emerge from the drop in our direction. In doing so it does not emerge "squarely" from the drop's surface. It enters at a slight angle and emerges at the same angle to the small area through which it passes. These two small patches of surface may be considered flat enough to act as facets on a prism producing a colour zone as in Newton's experiment. When we look at a certain coloured part of the bow (say the green) we are receiving rays of that colour emitted from millions of drops that lie in that direction. From each drop there come out red and other colours as well as the green rays, but they proceed in other directions and therefore do not reach our eyes from that part of the bow. Those rays which emerge from the drop after one internal reflection form part of the more brilliant inner rainbow. Those which happen to make two reflections before emerging form part of the outer bow. Not only is this outer bow much fainter than the inner, but its colours follow in inverse order, the innermost and outermost colours of both bows being violet, while the red of one bow comes next to the red of the other bow.

The rise of modern industrial cities with their great output of smoke has provided us with another instance of the scattering of light by small particles. Here again the scattering of blue waves by small particles would, on a distant hillside, make the smoke appear blue, but is so active in robbing the sun's rays of their blue constituents as to allow only the red rays to reach the city dweller's eyes, although the smoke pall through which the sun's rays have to pass measures only a few hundred feet in thickness.

A similar effect arises in the sea wherever the water holds any appreciable quantity of mud in suspension, as in the Thames estuary. Here we find that the amount of material in suspension is intimately connected with the salinity of the water. A tumblerful of muddy water taken from the fresh water of the Mississippi mouths will remain muddy for many hours, but the addition of a pinch of salt will clear the water within a few minutes. Owing to the great evaporation from the waters of the Mediterranean, their salinity is high, so that no mud particles, however fine, can remain suspended in them. In consequence, only the blue and violet rays scattered by the water particles can come to our eyes. In the North sea, where the evaporation is low and the influx of river water is great, the salinity is low while the quantity of suspended matter is high, and the individual particles are so large as to give not only a yellowish tint, but also a certain opacity, which is in striking contrast to the transparency of the more saline Mediterranean waters.

Formerly sky and cloud colouring played a great part in weather forecasting but, owing to the high degree of precision attained by official forecasting to-day, the methods of the older weather prophets have lost their importance, although some of the old sayings are extremely interesting on account of the insight shown by these old observers. One notable example is that of the old rhyme concerning the morning rainbow as a " warning " of rain. Remembering that a rainbow always appears on the side " away from the sun " and that an evening bow could therefore not exist unless the sun was well down in the west, and furthermore that its rays would then be ineffective in rainbow making unless the intervening air were cloud free, the Kentish shepherd would know from the evening rainbow that skies were cloudless from Land's End to London and a dry night was assured for his flock.

Having now investigated colour from the spectacular side, it may well be considered from the economic aspect. In this realm its most important function is that of maintaining plant life, colour being of paramount importance in bringing about the chemical exchanges by which plants obtain the carbon required for building up their fibrous structures. In this chemical work, only the red and violet rays seem to play a part, the leaves, wherein most of this work is performed, being protected against the green, yellow and blue rays by the green covering, which allows the passage of red and violet rays for internal use, while scattering the rest, which would presumably spoil the processes. Concerning the subsequent changes of colour to autumn tints, little is known, but it may be inferred that a red covering protects the plant against frost by lowering the radiation of red and other " warmth " waves.

Another curious function of colour, which has only recently been discovered, is the influence of violet light and also of ultra-violet rays on the formation of calcareous structures in animals. It has been put to practical use in Alpine sanatoria for the building up of bones where they have been wasted by tubercular disease. More recently these rays have been successfully applied to increasing the supply of eggshell material to laying hens in winter.

A Slide-Rule for Hygrometric Calculations

E. G. Bilham, B.Sc., D.I.C.

Hygrometric calculations may be divided into three well-defined classes, (*a*) the determination of vapour pressure, dew point, relative humidity and moisture content from readings of dry- and wet-bulb thermometers, (*b*) the inter-conversion of different forms of expression of the hygrometric state of the atmosphere ; e.g. we may require to determine the moisture content, being given the temperature and the relative humidity, and (*c*) calculations relating to changes in the conditions ; e.g. we may require to determine the change of relative humidity resulting from a given rise of temperature in an air-mass whose initial temperature and relative humidity are known.

Hitherto it has been customary to use tables such as Glaisher's or the official " Hygrometric Tables (M.O. 265) " for calculations in class (*a*). It is not very convenient to use tables for calculations in class (*b*) or class (*c*) because the tables are usually constructed with dry-bulb temperature and depression of wet bulb as arguments. Consequently it is usual to perform such calculations with the aid of a table of saturation vapour pressures and an ordinary slide-rule.

John Welsh, Superintendent of Kew Observatory from 1852 to

1859, appears to have been the first to realise that ordinary psychometric reductions could be done very readily on a specially designed slide-rule*. One of Welsh's slide-rules is preserved at Kew Observatory, and another rule agreeing with his description in certain respects, but not in others, has been discovered in the Meteorological Office, South Kensington. Welsh's rule is of special interest because alternative scales are provided for the purpose of taking account of variations of atmospheric pressure. This refinement has now been abandoned by the compilers of hygrometric tables for use near sea level and has not been attempted in the slide-rule now to be described.

The following table shows the essential formulae commonly employed in hygrometry, together with the units used in "Hygrometric Tables (M.O. 265)" and on the new slide-rule.

Formulae.	Notation and Units.
Vapour Pressure. (i) $e = w_{t'} - A\,(t - t')$.	e = vapour pressure in millibars. w = saturation pressure in millibars at the temperature shown by the suffix.
Dew Point is the temperature t_d for which (ii) $e = w_{t_d}$	t = dry-bulb temperature in degrees Fahrenheit. t' = wet-bulb temperature in degrees Fahrenheit.
Relative Humidity (per cent.). (iii) R.H. $= 100 \times e/w_t$ *Moisture Content*†. (iv) $\delta = 216{\cdot}7 \times e/T$ *Saturation Deficit***. (v) $(w_t - e) = w_t\,(100 - \text{R.H.})/100$	t_d = dew point temperature in degrees Fahrenheit. A = Psychrometric constant. δ = density of water vapour in gm./m^3. $T = 273 + 5\,(t - 32)/9$ = dry-bulb temperature on absolute scale.

(i) is the simplified form of Regnault's formula adopted in "M.O. 265" and in the tables used in France (Angot), Germany (Assmann) and Norway (Birkeland). As a basis for the design of the rule the following values of A, taken from the Introduction to "M.O. 265" were regarded as appropriate.

	Wet bulb above 32° F.	*Wet bulb below* 32° *F*.
Stevenson screen	0·444	0·400
Aspirated psychrometer	0·368	0·368
Still air	0·667	0·69

Turning to Fig. 1 it will be seen that the rule comprises a stock,

* Welsh, J., *London Rep. Brit. Ass.* 1851. Transactions of Sections, p. 42.

† Computers' Handbook, Introduction p. 16.

** This formula is intended for the computation of saturation deficit when the dry-bulb temperature and relative humidity are known. Saturation deficit can be determined direct from dry- and wet-bulb readings, but the slide-rule is not well suited to that purpose.

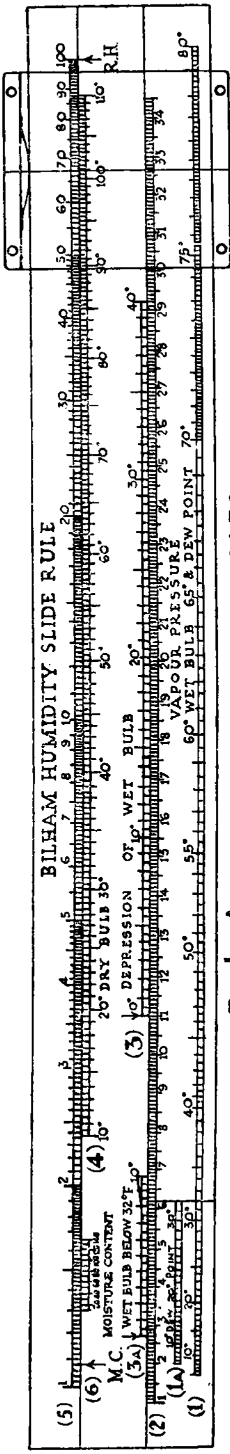


FIG. 1. ARRANGEMENT OF SCALES

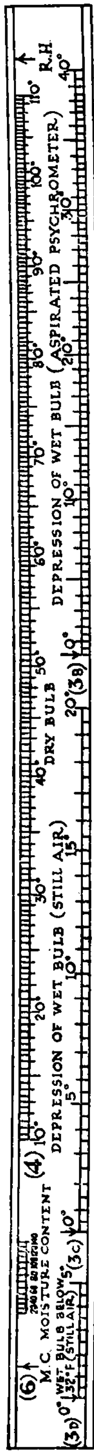


FIG. 2. SCALES ON REVERSE SIDE OF SLIDE

a slide and a cursor. The solution of equation (i) is performed on the lower half of the rule by means of two uniformly divided scales (2) and (3), together with a temperature scale (1), on which the graduations are placed so that saturation pressures appear vertically above them on scale (2). One division on scale (3) is 0·444 times the length of one division on scale (2). Scale (3A) is a supplementary scale in which one division is ·400 times the length of one division on scale (2) and is provided for use when t' is below 32° F. By reversing the slide (Fig. 2) scales appropriate to an aspirated psychrometer (3B), or to still air (3C and 3D), are rendered available. These scales are coloured red to avoid confusion with the standard scales on the front of the slide. The scales on the upper half of the rule are logarithmic scales and are provided for the purpose of determining the relative humidity and moisture content from a knowledge of the vapour pressure (e) and dry-bulb temperature (t). These scales are also used for miscellaneous calculations of classes (b) and (c).

The *modus operandi* of the rule may best be understood by an example; we will take the case, dry bulb (t) 62·3°F., wet bulb (t') 56·2° F., $t - t' = 6{\cdot}1°$ F.; required to find the vapour pressure, dew point, relative humidity and moisture content; the readings are assumed to have been taken in a Stevenson screen.

First set the cursor line over the wet-bulb reading 56·2° on scale (1); (under the cursor line the value of $w_{t'}$ will now appear on the uniform scale (2) but as this is not required it is not read off). Next move the slide until the value of $(t - t')$, namely 6·1° on scale (3), is under the cursor line; (this length on scale (3) is equivalent to $A\ (t - t')$). The zero index of scale (3) then points to 12·7 on scale (2), and this by equation (i) is the value of (e) the vapour pressure in millibars. Place the cursor line over this index and the line will then intersect the value of the dew point, namely 51° F. on scale (1). Now place the cursor line over the value of vapour pressure (namely 12·7 mb.) on scale (5), which is an ordinary logarithmic scale ranging from 1 to 100. Move the slide until the value of the dry-bulb temperature 62·3° on scale (4) comes under the cursor line. Scale (4) is a logarithmic scale in which the argument is the saturation pressure w_t at temperature t; consequently this operation is equivalent to dividing e by w_t. The index marked R.H. is so placed that it shows on scale (5) the value of this quotient multiplied by 100; that is to say it shows the relative humidity, namely 66 per cent. The cursor line is still over the value of e, 12·7 mb.; move the slide until the value of t (rounded to 62°) on scale (6) comes under the cursor line; scale (6) is a logarithmic scale in which the argument is the factor $216 \cdot 7/T$, equation (iii), and the index marked M.C. is so placed that it shows on scale (5) the result of multiplying e by this factor, that is to say, it shows the moisture content in gm./m³, namely 9·5.

If the wet-bulb reading had been below 32° F. we should have used scale (3A) in place of scale (3) and should have read off the dew point on scale (1A) instead of scale (1). The need for a special dew point scale in these circumstances arises from the fact that in "Hygrometric Tables, M.O. 265" it is assumed that when t' is below 32° F. the wet bulb is covered with ice; consequently saturation pressures over ice appear on scale (2) above the corresponding temperature on scale (1). The dew point is defined, however, as the temperature at which e is the saturation pressure over water. Consequently to get agreement with "M.O. 265" we must provide the supplementary scale (1A) the graduations of which correspond to saturation pressures over water on scale (2).

Working instructions :—For vapour pressure and dew point *.

1. Set cursor line over wet-bulb reading on scale (1).
2. Move slide until value of depression of wet bulb $(t - t')$ on scale (3) is under cursor line. (Use scale (3A) if wet-bulb reading is below 32° F.).

* These instructions apply to readings of thermometers in a Stevenson screen without artificial aspiration. When readings are made with aspirated thermometers use scale (3B) (coloured red on reverse of slide) instead of scales (3) and (3A). When readings are made in still air use scales (3C) and (3D).

3. Index of scale (3), marked with an arrow, then shows vapour pressure on scale (2). (The value is shown by index of scale (3A) when wet-bulb reading is below 32° F.). Read off value to 0·01 mb.
4. Dew point is obtained by setting cursor line over index of scale (3) and reading off on scale (1). (When wet bulb is below 32° F. set cursor line over index of scale (3A) and read off on scale (1A)).

For relative humidity.

5. Set cursor line over value of vapour pressure (obtained from 3), on scale (5).
6. Move slide until dry bulb reading on scale (4) is under cursor line. Index marked R.H. then shows relative humidity on scale (5).

For moisture content.

7. Having set cursor line as in 5 move slide until dry-bulb reading on scale (6) comes under cursor line. Index marked M.C. then shows moisture content in grams per cubic metre on scale (5).

Miscellaneous Calculations. The following examples illustrate the use of the rule in solving various classes of problems which frequently arise in meteorology and industry.

1. Air at 70° F., relative humidity 75 per cent.; determine (*a*) the moisture content, (*b*) the dew point and (*c*) the saturation deficit in millibars.

(*a*) Set R.H. index at 75 and place the cursor line over 70° on scale (4). This gives the vapour pressure 18·8 mb. on scale (5). Now bring 70° on scale (6) under the cursor line and read the M.C. index; this gives the moisture content, viz. 13·8 gm./m^3.

(*b*) Move the slide until R.H. index reads 100; the temperature for which 18·8 mb. is the saturation pressure is now under the cursor line, and this is the dew point, viz. 61·6° F.

(*c*) Set R.H. index to 25 (= 100 − relative humidity) and place cursor line over 70 on scale (4); the cursor line reading on scale (5), viz. 6·3 mb., is the saturation deficit.

2. Air at 45° F., relative humidity 90 per cent., is warmed to a temperature t °F. without adding or removing water; determine the new value of the relative humidity for various values of t.

Set R.H. index to 90 and place cursor line over 45° on scale (4). This gives the vapour pressure 9·2 mb. on scale (5) which is unaltered during the warming. Bring any desired value of t on scale (4) under the cursor line and the R.H. index will then show the corresponding value of the relative humidity, e.g. $t = 50°$, R.H. = 75 per cent.; $t = 60°$, R.H. = 52 per cent.; $t = 65°$, R.H. = 43·5 per cent.

The slide rule is obtainable from J. J. Hicks, 8, Hatton Garden, E.C.1, and the template necessary to make the rule is available in the Meteorological Office. A design for a "tropical pattern" with extended scale is also available.

OFFICIAL PUBLICATION

The following publication has recently been issued:—

PROFESSIONAL NOTES

No. 69. *The frequency of days with specified duration of sunshine.* By E. G. Bilham, B.Sc., D.I.C. and Lilian F. Lewis, B.Sc.

The paper discusses the incidence of sunshine in regard to the percentage frequency of days with (*a*) no sunshine, (*b*) more than 3 hours, (*c*) more than 6 hours, (*d*) more than 9 hours, (*e*) more than half the possible duration. Data in the first four categories are given for eighteen stations, and in the fifth category for six selected stations.

The results show that at most stations about half the days throughout the year have more than 3 hours of sunshine, and that in May, June and July about half the days have more than 6 hours. At Kew Observatory the frequency of days with more than half the possible sunshine varies from 11 per cent. in December to 41 per cent. in May.

Discussions at the Meteorological Office

The subject for discussion for the next meeting is:—

January 13th, 1935. *Comparison of the revealing powers of white and coloured headlight beams in fog.* By W. S. Stiles (The Illumination Engineer, April, 1935.) *Opener*—Dr. J. S. Owens.

Royal Meteorological Society

The opening meeting of this Society for the present session was held on Wednesday, November 20th in the Society's rooms at 49, Cromwell Road, South Kensington, Lt.-Col. E. Gold, D.S.O., F.R.S., President, in the Chair.

The Council of the Royal Meteorological Society has awarded the Symons Gold Medal for 1936 to Professor Dr. Wilhelm Schmidt, Director of the Central Institution for Meteorology and Geodynamics, Vienna. The medal is awarded biennially for distinguished work in connexion with meteorological science and will be presented at the Annual General Meeting of the Society on January 15th, 1936.

The following papers were read and discussed:—

R. C. Sutcliffe, B.Sc., Ph.D.—Surface resistance in atmospheric flow.

The formula for surface resistance to atmospheric flow, $F = \kappa\rho V_s^2$ where V_s is the velocity of the surface wind, ρ the density, and κ a non-dimensional constant, was proposed by G. I. Taylor, on an analogy with flow in pipes. In pipes the value of κ is 0·004, and Taylor gave a mean value of 0·0025 for κ in the case of flow of air over the ground. In this paper the value of κ is deduced from actual observed distributions of wind velocity at different heights, obtained by pilot balloons, no assumption being made as to the nature of eddy-viscosity. The mean value of κ so deduced is 0·006 over land, and 0·0004 over the sea.

J. Edmund Clark, Ivan D. Margary and C. J. P. Cave.—Report on the Phenological Observations in the British Isles, December, 1933 *to November,* 1934.

1934 fell little behind 1933 in favourable weather conditions, although this was less marked in the yearly totals. The better distribution of rainfall usefully re-acted against the droughts. The relatively favourable conditions in northern districts were even more pronounced. The normal 20 days lateness of north Scotland over south-west England fell to 9 days, while all parts south of the Humber were 3 days late. For the first time in 44 years the isakair table shows all Scotland and north-east England early, nearly all the rest of Great Britain being late. Hence Table VI, giving mean dates of flowering of selected plants, has a general value similar to the normal. Insect and bird tables confirm this. Also the spring migrant-spread across Ireland was most rapid. Farm and garden crops were excellent and autumn gardens brilliant up to the killing frosts that ended October.

M. T. Spence, B.Sc.—Temperature changes over short distances as shown by records in the Edinburgh district.

Temperature records for six meteorological stations in and around Edinburgh are examined and some of the differences in the records are discussed in relation to topographical and other features of the locality. It is found that, in summer, at the time of maximum temperature, the vertical gradient of temperature in a valley may average some four times the dry adiabatic " lapse-rate ". Rather big temperature differences are also found between the coast and a valley some four miles inland. The bearing of trees and hedges on the results is considered.

Correspondence

To the Editor, *Meteorological Magazine*

Water Spout seen from an Aeroplane

On November 3rd, whilst on a flight from Bengazi to Sirtie, across the southern portion of Sirtie Bay, I had the fortune to witness the complete formation and dispersion of a water spout.

The local conditions were—wind SW., 5–10 m.p.h. on the surface and W., 15 m.p.h. at 2,000 ft. My compass course was 270° and ahead appeared a long roll of nimbus cloud, from horizon to horizon, north-west to south-east. From the base of this cloud roll, which appeared to vary between 1,000 ft. and 1,500 ft., heavy rain was falling in patches but between the storms it was possible to see the sun shining on the water and coast line further west. The top of the cloud roll was ragged and appeared to be above 10,000 ft.—an extremely rough estimate.

At 8h. 1m., G.M.T., from the most dense part of the cloud in front of the heaviest rain and on my left a cone of cloud appeared to be hanging from the front of the base which was approximately 1,000 ft. At the same time spray appeared to be rising some distance forward of the cloud as if heavy seas were breaking against a partly submerged rock.

Realising that a water spout was forming and moving in a southerly to northerly direction, I altered my course to south-west, making to pass the spout to the south and also for a gap between two rain storms.

The point of the cloud cone was descending all the time and the spray which now appeared as a clockwise swirl of water was rising higher. An approximation of the heights was made at 700 ft. for the cloud cone and 100 ft. for the highest flung spray. There seemed to be no perceptible rise of spray or descent of the cone after this, but the space between the two points became opaque until they were joined by a thin line of swirling mist some 30 ft. in average thickness. This line became denser until it was almost as dark as the cloud and had in it spiral streaks of a much lighter colour.

During this time the spout had been passing from left to right across the nose of the aircraft and the column between the cone and the spray appeared to be vertical. Now on passing southward of the disturbance it was observed that the cone of cloud actually protruded forward and downward from the cloud base at an angle of some 70° from the vertical and that from about 1/3 of its length it was bent at a further angle of 50° to 60°, so that the column entered the spray almost vertically.

In the next few minutes the disturbance on the sea surface, which appeared to be travelling some 15 m.p.h. faster than the cloud base, had stretched the column to such an extent that the opaqueness about 1/3 of the height of the column above sea-level had begun to disappear and my final view of the phenomenon was of the cloud cone withdrawing to the cloud base and the swirl subsiding.

The whole period during which the spout was under observation was 16 minutes. Heights were estimated from the aircraft's altimeter and directions taken roughly from the pilot's compass.

ERNEST R. B. WHITE.

Gales of September 16th-17th, 1935.

It may be of interest to your readers to know that the effect of the gale here was similar to that in Cornwall. All windows facing south-west to west, not only here but as far inland as Newport, 8–9 miles away, were thickly coated with a greyish deposit which was salt to the taste, sparkled in the sun when dry and was difficult to wash off. The *County Press*, in a report on the storm, noted that the effect was the same in a violent storm about 60 years ago.

I think we may assume that the reason why the same thing does not happen in every violent storm is that, after a few showers at the beginning of the gale, the weather remained dry, so that the salt haze was carried along on the wind instead of being conducted to earth by moisture.

How air may be forced up to such a height as to cover the country for miles inland was apparent when, during one of the dry gales this autumn I saw clots of brownish sea-foam, flying through the air to the outskirts of Niton, having been carried over the face of the cliffs which rise to a height of 530 ft. or more.

The total destruction of foliage of hedges and trees must be regarded as due to the action of the salt carried by the wind for this reason :—all the foliage affected immediately wintered in an orderly way. Had the leaves been merely bruised, they would have hung on, drooping, until the normal time of wintering.

The sheltered woods I happened to see kept their summer green until the end of October.

R. S. Breton.

Pan Cottage, Niton, Isle of Wight, December 3rd, 1935.

Frequency of Calms in Winter

From the note by Mr. L. C. W. Bonacina in the October issue of this magazine, it would appear that the high frequency of calms in winter is far less apparent at stations in the eastern English Channel than at either Grayshott or Waltham Cross.

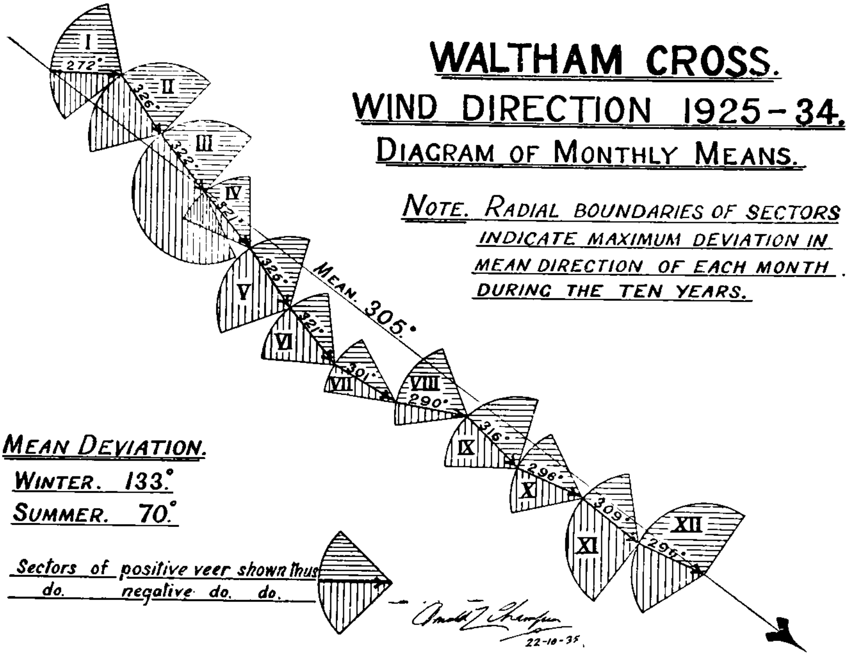
As a possible explanation, it may be that in winter, owing to the lower temperature and therefore greater density of the surface air, which has been chilled by radiation and contact with the ground (compared with corresponding air at the same pressure in summer), the pressure gradient may require to be slightly higher to impart to it a given velocity, than would otherwise be the case.

The influence of the sea at coastal stations in warming the surface air may partly explain the lower frequency of calms in the English Channel, there being less chance for the formation of inversions of temperature over the sea in winter than at valley stations inland; and for this reason the air over the sea would be the more easily disturbed by a small pressure gradient.

Regarding Mr. Bonacina's remark about breezes in summer being "just perceptible," the following data may be of interest.

I believe it is reasonably correct to assume that winds of moderate velocity are more steady in direction than the light airs associated with the calmer conditions of slack pressure gradient. If this is so, the higher frequency of calms in winter at Waltham Cross is supported by the higher constancy of directional flow in summer months.

In the attached diagram, the mean wind direction of each month during the 10 years 1925–34 is shown, together with the greatest mean deviation for any year during that period. It will be seen that in December the mean veer from the mean direction varied from + 78° to − 58°, an angular difference of 136° ; whereas in July the mean veer of any year was within the limits of + 30° and − 22°, a range of only 52°. The maximum possible deviation is



180°, therefore for the period in question the mean variability of wind direction in July was only 28 per cent. against a corresponding variation of 75 per cent. in December.

The actual values of mean direction for each month are probably much affected by the local topography,* and this must not be overlooked in considering the deviations. However, the comparative constancy of air flow in summer is as well marked as the high frequency of calms in winter.

DONALD L. CHAMPION.

7, Robinson Avenue, Goff's Oak, Waltham Cross, Herts, October 22nd, 1935.

Sun pillar seen from Worthy Down

A sun pillar, remarkable for its intense flame colour and well defined shape, was visible from this station on November 21st, 1935. It appeared just after sunset, 16h. 8m. and lasted until 16h. 20m. The sky, down to an elevation of about 7°, was covered by a layer of altocumulus and altostratus. Between this and the horizon to the south-west were clear patches and cirrus and cirrostratus clouds.

* See *Meteorological Magazine,* **67**, 1932, p. 129.

The sun pillar extended from the horizon to where it was interrupted by the altocumulus and altostratus layer at an elevation of 7°, direction 240°.

W. L. LINEHAM.

Meteorological Station, Worthy Down, Hants, November 22nd, 1935.

NOTES AND QUERIES

History of the British Flora in relation to Changes of Climate

On March 28th, 1935, the Royal Society held a " Discussion on the Origin and Relationships of the British Flora ", an account of which has been published in the Proceedings*. It makes interesting reading ; a succession of speakers traced the history of our flora from the early Tertiary through the vicissitudes of the Ice Age and the subsequent fluctuations to the present day. Throughout, the importance of climatic changes appears, sometimes expressly, at others only by implication.

The story begins in the Eocene with a tropical flora which Mrs. E. M. Reid derives, along with the climate which permitted it to flourish in the Thames Estuary, from Malaya by means of an elongated Mediterranean, the Tethys Sea (which a reporter of a former discussion appropriately rendered as the " tepid sea "). There followed a gradual cooling to which the flora reacted by migration, until as described by Prof. P. G. H. Boswell and Miss M. E. J. Chandler, the recurring advances of the ice sheets obliterated the entire flora over large areas of this country and reduced the remainder to a sparse gathering of northern species. The flora is sometimes described as Arctic, but Mr. A. J. Wilmott does not accept this view, since some of the species found in the so-called " arctic beds " will not now grow north of the Scottish lowlands. He finds the general flora of the Ice Age to resemble the present flora of Finland, and suggests that " the climate in southern England was warm enough to bring the glaciers to a standstill, and the evidence of the sub-glacial streams and large outwashes of gravel indicate summer warmth ". Prof. E. J. Salisbury on the other hand regards the conditions as having been quite unsuitable for the survival of the majority of species.

Whatever may be the decision about the more humble plants, there is little doubt that most of our forest trees at least were exterminated during the Ice Age. This results from the microscopic investigation of the pollen grains so remarkably preserved in peat bogs and similar deposits. These, as described by Dr. H. Godwin, show that in the lowest layers pine and birch alone were present. Later hazel, oak and elm appear, shortly followed by the alder, which quickly became dominant. Dr. Godwin writes : " The same general preponderance of alder pollen is found through so many British pollen diagrams that we can only conclude the former presence

* *London, Proc. R. Soc., B.* **118**, 1935, pp. 197–241.

of very widespread alder woods, and this suggests in turn that large parts of our primitive woodlands were seriously waterlogged before human activities were responsible for their clearance and drainage". Towards the close of our forest history (but still pre-Roman) there was a recrudescence of pine and birch which, if it forms a constant horizon, as appears to be the case, has " important climatic implications ". The exact climatic interpretation of the succession of trees* is a very difficult problem, which was rather outside the scope of the discussion. But these post-glacial changes, as Sir George Simpson pointed out, were of a different order of magnitude from those which produced the Ice Age.

An interesting point which emerged from the discussion is that two at least of the inter-glacial periods passed in their earlier stages through a similar floristic history to that of the post-glacial. Mr. Dewey said that the " sequences of fossil plant assemblages . . . of the Mindel-Riss inter-glaciation (of Denmark) correspond flora by flora with those of the Riss-Wurm, and show the gradual replacement of the arctic by the cold-temperate and that by warmer-temperate plants, and then the reversal of climatic conditions ". The culmination point was the dominance of deciduous trees characterised by the oak. In the post-glacial we have already reached and perhaps began to pass this culmination. It has often been said that we are still in the Ice Age. Will future generations be faced with the return of sub-arctic conditions ?

C. E. P. BROOKS.

Thunderstorms at Ramleh, November 7th-8th, 1935

Several unusually severe thunderstorms occurred here in the night of November 7th–8th. The day had been mainly fair and warm. No low clouds were observed but there was a good deal of cirrus and cirrostratus throughout the day. The sky was entirely covered with the latter cloud at 18h. G.M.T.† (20h. local time) when there was a fine lunar halo. The wind distribution differed but little from the normal, the usual light north-westerly sea breeze being succeeded by a period of calm in the late afternoon.

Lightning was first seen in the south about 20h. 30m. and in a few minutes the flashes were extremely vivid and almost continuous, so that it was possible to read newsprint on an unlighted verandah. The first thunderstorm broke at 20h. 50m. and appeared to be overhead with lightning from all quarters. The record of the autographic rain-gauge shows that about 18 mm. of rain fell in 10 minutes at the height of this storm. The rain ceased at 21h. 50m., but at 22h. 15m. fell again with renewed intensity; 20mm. were recorded in half an hour, of which 8 mm. fell in 5 minutes. There was no appre-

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* BROOKS, C. E. P. Post-glacial climates and the forests of Europe. *London, Q.J.R. Meteor. Soc.*, **60**, 1934, pp. 377–95.

† All times quoted are Greenwich Mean Time.

ciable rain from 23h. 5m. to 1h. 20m. but the remarkable lightning display continued with frequent thunder. At 1h. 20m. rain again set in and fell heavily until 3h., about 30 mm. being recorded in this period. The rain ceased finally at 5h. and the low nimbus and nimbostratus cloud gave place to a cloud sheet of altostratus with some altocumulus. The total rainfall measured at 6h. was 78·0mm. This was, with a single exception (December 9th, 1926, with 124·9 mm.), the heaviest day's rain recorded at Ramleh in 14 years' observations.

Sharp squalls occurred during the more severe phases of the storms, gusts up to 41 m.p.h. being recorded. The wind completely "boxed the compass" twice during the night, backing from N. at 21h. 30m. through W., S. and E. to N. by 23h. 15m. and then veering completely through 360° to N. again by 2h. After this it became fairly steady south-easterly at 8 to 12 m.p.h.

The effects of the electrical phenomena and of the unusually heavy rainfall were serious. At the wireless station all aerials except one were earthed but many electrical discharges were heard coincident with lightning flashes. Wet ropes on masts acted as conductors and lightning was observed passing to earth by this means. Power transmitters were put out of action and, when transmission became possible, resort was made to battery supplied stand-by sets. What appeared to be electrical discharges were seen on the metal wires suspended for the purpose of supporting mosquito nets and a knife on a wooden locker was observed to jump off on to the floor during the storm.

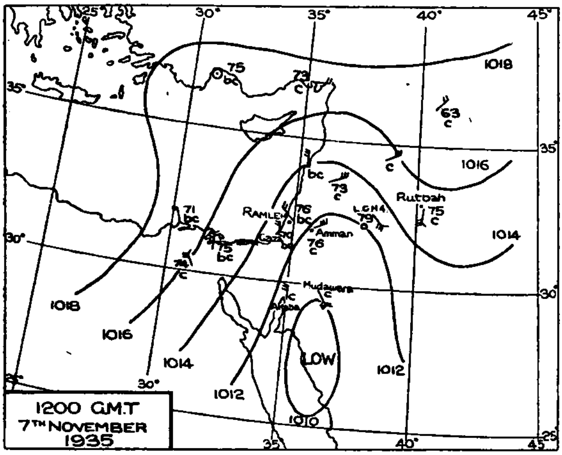
Extensive flooding occurred over a wide area and resulted in loss of life in some places. All the ground between the camp and Ramleh village was flooded, the water being more than knee deep in places. This flooding subsided rapidly, however, and the road between the camp and Ramleh became passable three hours after the rain ceased. Three children, two boys and a girl, were drowned in the floods in the Khalsa district. Five kilometres of the road between Metulla and Beweiziya were washed away and further rains hampered the work of reconstruction. It is stated that 40 shacks and 30 houses were washed away in the village of Khalsa and 20 shacks were swept away in the village of Beweiziya. At Maghar village a Bedouin child was swept out of a tent by the flood and drowned. As is usual during heavy rains the Wadis between Lydda and Nebi Danyal (to the north-east of Ramleh) were flooded and became impassable for three days.

Traffic on the Palestine Railways was held up by flooding of the track in several places. At kilo. 39 on the Jaffa-Jerusalem line there was a considerable accumulation of water on the south side. The opening in the bridge across the Wady Sarar here has a superficial area of eight square metres, but this was inadequate to release the flood water which came right up to the rail level and washed away 100 metres of track. This same Wady Sarar crosses the main line, Kantara-Haifa, just north of Yibna village. Some time ago the track in this section was raised by one metre but in spite of this the flood water reached rail level and the area under water was greater than on any occasion since the construction of the railway.

H. E. CARTER.

Meteorological Station, Ramleh, Palestine, November 12th, 1935.

[The isobaric situation over Palestine at 12h. G.M.T., 14h. local time, on November 7th, 1935, is shown on the attached map. There was a shallow depression over the northern end of the Red Sea. In front of this depression a well marked south-east to south current extended from the Red Sea over Trans-Jordan and western Iraq; behind, there was a colder north-north-west current of northerly origin. In a warm southerly current from the Red Sea, cloud of the cirrostratus and altostratus type frequently occurs over the desert area between Long. 35° and 40° E. and Lat. 29°–35° N., due partly to topography and partly to the forced ascent over a colder easterly current over Syria and a colder northerly current to the westward. As a result of this forced ascent, rain and thunderstorms, sometimes of unexpected intensity, occur in the above mentioned area, especially in May and October or November.



SYNOPTIC CHART

In this particular case the surface of separation between the two currents was probably just east of Ramleh and the exceptional rainfall was very local, only 0·4 mm. being reported from Gaza, 40 miles south by west of Ramleh. Further east, 4 mm. were reported from Landing Ground H4 and a trace from Rutbah. —J. DURWARD.]

REVIEWS

A suggested totalising anemometer for oceanographers. By J. N. Carruthers, D.Sc., F.Inst.P. Reprinted from the Hydrographic Review, Vol. XII, No. 1 (No. 23 of the series). Monaco, 1935.

In a recent issue of the *Hydrographic Review*, Dr. J. N. Carruthers of the Fisheries Laboratory, Lowestoft, describes an instrument which he has devised for giving the integrated run of the wind from different directions during a given period. The instrument was designed primarily for the use of oceanographers who are interested not so much in the wind force and direction at any particular hour as in the integrated wind over a period, this being the factor which is effective in the control of ocean currents. The operating part of the instrument consists of two parts, a Dines vane of streamline type and a small Robinson cup anemometer. The Dines vane is mounted on a mast and is directly connected by a vertical rod to a large upright cylindrical chamber open at the top and divided by radial partitions into eight equal segments. This radial chamber thus turns with the wind vane. Above the chamber near its circumference is an inlet pipe through which water passes. This inlet pipe does not rotate with the chamber but remains fixed in position and the water will thus fall into one or other of the compartments into which the chamber is divided, the actual compartment depending upon the wind direction. The cup anemometer which is mounted on a pole alongside the wind vane closes an electrical contact after a given number of cup revolutions and the resulting current energises an electromagnet which lifts a measured quantity of water from a reservoir and discharges it through the tube into the rotating chamber. It will be seen that the amount of water discharged in a certain time is proportional to the number of miles of wind which have passed the anemometer head in this time. If the wind direction has fluctuated during the period this water will be distributed amongst several compartments of the chamber. When an observation is taken the water is drawn from these compartments and the quantity found in each is a measure of the number of miles of wind from the corresponding direction. It would appear simpler to raise the water by direct mechanical means by the revolution of the cups and it is probable that such a method would be quite satisfactory. The author adopts the electrical method in order to avoid slowing down the movement of the cups by imposing any unnecessary resistance to their turning. While the introduction of electrical operation may perhaps be regarded as a somewhat non-essential refinement in another direction the design of the instrument seems to lack refinement, since no steps appear to have been taken to avoid the effect of evaporation from the chambers. Although the accuracy obtained may not be equal to that which would be given by computing the run of the wind from the hourly records of a Pressure Tube anemometer yet it is believed the instrument may find useful application not only by oceanographers but by others who are interested in the prevailing wind rather than in the wind movements hour by hour.

J. S. Dines.

India Meteorological Department, Scientific Notes, Vol. V, No. 60.—*A study of the atmospheric horizontal visibility at Bangalore.* By A. Ananthapadmanabha Rao.

The author has analysed the visibility observations made at Bangalore over a period of two years, and correlated them with humidity, wind force and direction, and type of cloud, and determined their seasonal and diurnal variations, etc. Such analyses as these do not often reveal anything new in the way of visibility theory—convection clouds, for instance, are usually associated with good visibility everywhere—but they are (or should be) of considerable use to the local forecaster in telling him quantitatively how the obscurity of the atmosphere will probably react to the general weather situation. Given a correct general forecast, the accuracy of prediction of local variations in visibility should improve as knowledge of local conditions increases.

In the present case, not only have we an analysis calculated to be of use to the forecaster, but we find evidence of an effect which, if it has been noticed before has not had much attention paid to it. Perhaps it is perculiar to, or most marked at, such places as Bangalore, for which not many analyses have appeared. As humidity decreases from 100 per cent the frequency of good visibility increases to a maximum in the range 71 to 80 per cent humidity and decreases with further decrease of humidity. The obvious explanation in terms of dust is given. One feels that this should be verified by experiment, and the exact conditions and places where the effect will and will not occur should be investigated in further detail.

M. G. BENNETT.

OBITUARY

Professor Sir John C. M'Lennan, K.B.E., F.R.S.—We much regret to learn of the death of Prof. M'Lennan due to a heart attack while travelling in France on October 9th. Prof. M'Lennan was born of Scottish parents in Ontario on April 14th, 1867, and after his graduation at the University of Toronto he joined the Cavendish Laboratory at Cambridge under Sir J. J. Thomson. In 1899 he returned to Toronto University, becoming assistant professor in 1902, and in 1904 Director of the physical laboratory there, which he did much to help build and which bears his name. Here he installed excellent apparatus especially for spectroscopy in which he was particularly interested. About this time he carried out many experiments on the "natural ionisation" in closed vessels, tracing the effects to minute quantities of radioactive materials. He also found that the penetrating radiation over land was greater than over water and deduced from this that a large part of the penetrating radiation came from radium.

During the War Prof. M'Lennan took an active part in the research work of the Admiralty and organised the extraction of helium from natural gases near Calgary. After the War he returned to Toronto and continued his work on spectroscopy, for which he was awarded a Royal Medal of the Royal Society in 1927. In 1928 he gave the Bakerian Lecture to the Society on "The Aurora and its spectrum," and in this he described how he and G. M. Shrum had proved in the laboratory that the notable green line in the spectrum was due to oxygen suitably mixed with argon. In 1923 M'Lennan liquefied helium at Toronto. Later he installed a cryogenic laboratory at Toronto in which he carried out numerous successful experiments on superconductivity in metals and certain alloys and chemical compounds.

He retired in 1932. Lord Rutherford, writing of his work in England since then, says, " largely through his (M'Lennan) influence the Union Minière of Brussels generously lent 5 gm. of radium to make a thorough investigation of the effects of mass radiation on cancerous growths. . . . This work is being carried out at the Radium Institute. M'Lennan threw himself whole-heartedly into this new line of work. . . . . His services to this investigation in radium beam therapy are indeed great."

M'Lennan was President of the Royal Society of Canada in 1924, and in 1926 was awarded the Flavelle Medal by that Society. In June, 1935, a K.B.E. was conferred upon him in recognition of his fundamental discoveries in physics and his scientific services.

BOOK RECEIVED

The Climate of the Netherlands A (*continued*). *Precipitation. Second part.* By Dr. C. Braak, K. Ned. Meteor. Inst., No. 102. Med. en Verh. 34a, 'sGravenhage, 1933.

This second part contains the revision of the tables of Vol. 15, the letterpress of which was revised in the first part; a review of this appeared in the *Meteorological Magazine*, **69**, 1934, p. 47.

Erratum

NOVEMBER 1935, p. 227, line 4 *for* " Eskalemuir 69 m.p.h. " *read* " Eskdalemuir 87 m.p.h."

The Weather for November, 1935.

Pressure was below normal over Greenland, Iceland, western, central and south-west Europe (except south Spain), the Bermudas, south-east United States and California, the greatest deficits being 10·2 mb. at Reykjavik, 2·2 mb. at Bermuda and 1·0 mb. in south Texas; elsewhere pressure was above normal, the greatest excesses being 16·3 mb. at Moscow, 15·3 mb. at Ekaterinburg, 10·4 mb. at Kodiak (Alaska) and 9·1 mb. near St. John's, Newfoundland. Temperature was above normal over Spitsbergen, northern and central Europe (about 9° F. in Norrland (Sweden)), but below normal in Portugal. Precipitation was in excess at Spitsbergen and in Sweden, but deficient in northern Norway.

The outstanding features of the weather of November over the British Isles were the excessive rainfall (except in north-west Scotland), the high temperatures during the first week of the month and the frequent strong winds. Minimum temperatures were generally high in the south, but in Ireland temperature was below normal most of the month. From the 1st to 6th complex low pressure areas passing across the British Isles gave mild unsettled weather with rain on many days but bright intervals. Much sun occurred in the west and north on the 1st and generally on the 6th, 8·0 hrs. at Dublin on the 1st and 7·8 hrs. at Edinburgh on the 6th. Thunderstorms were experienced in Ireland on the 1st and 3rd and at Ross-on-Wye on the 6th, and snow on the mountains in Scotland on the 1st. Rain fell on most days and gales were reported at times in the south-west and north on the 2nd–5th. Temperature was high during this time, the 3rd being the warmest day when 64° F. was reached at Cranwell, Barton and London, while at a few places on the south coast minimum temperature did not fall below 55° F. on the night of the 2nd–3rd. From the 6th–9th temperature was below normal while a complex shallow depression with centres moving across the country gave variable winds, strong at times with a gale in east Scotland on the 8th. Slight rain fell locally in the north and west with moderate rain becoming heavy on the 7th in the south, 1·79 in. at Patching (Sussex) and 1·53 in. at Guernsey. Fog occurred generally during this period and ground frosts. From the 10th to 15th depressions were centred to the north-west of the British Isles, giving mild (except in Ireland) unsettled weather with bright intervals but much rain, especially in the south-west, 2·26 in. at Holne (Devon) and 1·93 in. at St. Briavels (Gloucestershire) on the 14th. Fog occurred at times and thunderstorms at isolated places on the 12th and 15th. Snow fell on the hills in Ireland and Scotland on the 11th and 12th and hail generally even in the Channel Islands. On the 16th–18th a small vigorous depression was centred over the south of the country giving gales and heavy rain locally in England, 2·65 in. at Creech (Dorset) on the 16th and 1·85 in. at Tyn-y-Groes (Carnarvon) on the 17th. Floods occurred in many parts of the south and Midlands. On the 19th the depression to the west of the British Isles became less deep and extended south-east so that pressure was low to the south and high to the north and by the 23rd the anticyclone had extended over the whole country. Rain fell generally on the 19th–21st, but the 23rd and 24th were dry sunny days; Weymouth had 7·8 hrs. bright sunshine on the 23rd and Ventnor 7·7 hrs. on the 24th. Temperature fell generally during this period, the coldest days being the 24th and 25th; a maximum temperature of 35° F. was recorded at Dumfries and Penrith on the 24th and of 37° F. at Shoeburyness on the 25th, and a grass minimum temperature of 12° F. at Collumpton on the 25th, and of 13° F. at Eskdalemuir on the 24th. Fog occurred on many days between the 19th and 25th. By the 25th the deep depression to the west of Iceland was advancing eastwards, and from then to the end of the month extensive disturbances were passing across the country bringing unsettled weather, mild at times but cold later, with a few bright intervals but frequent rain. Snow occurred generally in Scotland on the 26th, 29th and 30th, and in north England and the Midlands on the 30th. Thunderstorms were reported locally on the 29th and 30th and gales in the south-west on the 30th. The distribution of bright sunshine for the month was as follows :—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway ...	53	+ 8	Chester ...	49	− 8
Aberdeen ...	47	−13	Ross-on-Wye ...	59	− 7
Dublin	104	+34	Falmouth ...	97	+18
Birr Castle ...	74	+13	Gorleston ...	49	−21
Valentia... ...	60	− 4	Kew	51	− 2

Miscellaneous notes on weather abroad culled from various sources

Abnormal weather occurred in the Mediterranean about the 1st doing damage to shipping. Mild weather with thunderstorms and rains of unusual violence was experienced on the Riviera on the 10th. Heavy and continuous rain in south-east France from about the 10th to 16th caused the rivers Rhône and Saône to rise and serious flooding occurred especially round Avignon. Several deaths were reported and landslips occurred near Fourvoirie destroying part of the Grande Chartreuse distillery, while many roads were closed. On the 17th the Paillon also overflowed ; Nice was flooded and landslips occurred in the neighbourhood. After this, fine weather prevailed but on the 21st further storms and heavy rains caused the Rhône to rise again and increased the floods for a short time. Much damage was caused in Switzerland by floods due to torrential rain on the 11th and 12th. Twenty-six lives were lost when a steamer sank on the 11th in the entrance to the Gulf of Smyrna during a northerly gale. Heavy rain in Portugal about the 19th caused serious floods especially at Viano do Castelo. Gales occurred off the coasts of Brittany on the 19th, a north-easterly gale in east Roumania on the 20th and gales along the south-east coast of France and the coasts of Corsica on the 21st. Severe weather with much snow prevailed in extreme north Italy about the 21st. Violent storms followed by torrential rain were experienced in Calabria (south Italy) on the 21st flooding much of the district ; 98 people were killed, several landslips occurred and many houses collapsed. Torrential rain fell again in the same region on the 24th. Thick fog occurred in Paris on the 24th. Winter navigation opened at Leningrad on the 25th and navigation closed at Oulu on the 29th. (*The Times*, November 4th–30th).

Communications between Mandalay and Rangoon were cut off by widespread floods on the 8th. A severe storm occurred off the east coast of Korea early in the month. The *Silverhazel* was wrecked in a tropical storm about 350 miles from Manila on the 9th, the winds continuing strong in force for about 3 days. A severe gale was experienced off north Formosa about the 20th. Floods occurred between Basra and Baghdad about the 25th. (*The Times*, November 9th–26th.)

The total rainfall for the month was considerably below normal over Australia except in a few isolated places, but above normal in most parts of Tasmania (cabled report from Australia).

A hurricane passed across southern Florida to the Gulf of Mexico on the 4th and four people were killed. A severe storm passed along the east coast of the United States on the 17th doing damage to shipping while the high seas caused floods. In the United States temperature was considerably above normal in the eastern regions during the first part of the month but gradually the cold weather of the west spread eastwards, while towards the end of the month temperature rose in the west. Rainfall was mainly above normal at first becoming deficient later. (*The Times*, November 5th–19th and *Washington, D.C.,U.S. Dept. Agric. Weekly Weather and Crop Bulletin.*)

Daily Readings at Kew Observatory, November, 1935

Date	Pressure, M.S.L. 13h.	Wind, Dir., Force 13h.	Temp.		Rel. Hum. 13h.	Rain.	Sun.	REMARKS. (see vol. 69, 1934, p. 1).
			Min.	Max.				
	mb.		°F.	°F.	%	in.	hrs.	
1	1006·1	SW.4	51	58	76	0·40	0·2	r 6h., 7h. r R 10h.–
2	1013·8	S.3	44	58	88	0·06	—	r–r_0 0h.–9h. [11h.
3	1008·3	SSE.3	52	62	73	0·04	5·9	r–r_0 23h.–24h.
4	1000·3	SSE.3	50	57	69	0·14	2·3	r–r_0 0h.–6h. [20h.
5	1001·3	SW.1	42	51	89	trace	—	F till 12h. r_0 17h. &
6	1008·2	SSW.3	38	50	73	—	3·0	r_0 13h. [22h.
7	997·7	ENE.3	38	47	85	1·02	—	r–r_0 7h., 9h., & 12h.–
8	998·8	S.3	37	47	87	0·24	—	F till 10h. r 10h.–23h.
9	993·3	SSW.3	44	51	73	0·10	3·4	r 9h.–10h. pr_0 23h.
10	1003·5	S.4	44	52	84	0·11	1·3	pr_0 morning. r–r_0 18h.
11	1009·3	SW.2	37	50	86	—	4·2	r_0 19h. [–22h.
12	1004·1	SW.2	45	49	74	0·22	4·0	r–r_0 1h.–6h. & 19h.–
13	1001·8	SW.3	39	47	79	0·40	2·5	r–r_0 2h.–9h. [23h.
14	1010·4	SSW.4	39	52	79	0·02	—	r_0 14h.–17h. & 20h.
15	1001·6	S.4	49	51	91	0·03	2·8	r 11h.–13h. & 21h.–
16	1001·7	SSE.3	41	49	77	0·41	1·6	r_0–r 1h.–18h. [22h.
17	980·4	WNW.3	45	49	92	0·63	—	r–r_0 0h.–21h.
18	998·4	W.3	45	49	80	0·02	0·1	r_0 5h., 7h. & 16h.–18h.
19	1004·2	SSE.4	37	51	64	0·05	0·4	r–r_0 19h.–24h.
20	997·7	ENE.3	46	51	88	0·16	—	r–r_0 0h.–3h., 14h.–19h.
21	1006·0	Calm	41	46	88	0·01	—	ir_0 14h.–20h. [& 24h.
22	1010·9	NE.2	44	47	85	—	—	
23	1013·5	NE.3	40	45	62	—	3·0	•
24	1019·9	NNW.2	33	43	68	—	5·8	x early.
25	1022·7	SW.2	29	40	84	—	0·1	x early. m all day.
26	1014·6	SW.4	31	49	68	—	2·2	x early. r_0 21h.
27	1016·7	WSW.3	37	47	75	—	3·2	
28	1000·9	SW.4	41	56	90	0·09	0·7	r–r_0 1h.–7h.
29	1009·3	WSW.3	41	50	69	—	3·8	r_0 17h. [22h.
30	1000·2	SW.4	42	47	77	0·21	—	r_0 9h.–12h. & 18h.–
*	1005·2	—	41	50	79	4·36	1·7	* Means or totals.

General Rainfall for November, 1935.

England and Wales ...	179	per cent. of the average 1881–1915.
Scotland	114	
Ireland	132	
British Isles	154	

Rainfall : November, 1935 : England and Wales

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Lond	Camden Square	3·83	162	*Leics*	Thornton Reservoir	5·13	227
Sur	Reigate, Wray Pk. Rd.	5·92	190	,,	Belvoir Castle	4·27	191
Kent	Tenterden, Ashenden	6·44	213	*Rut*	Ridlington	4·30	187
,,	Folkestone, Boro. San.	6·23	...	*Lincs*	Boston, Skirbeck	3·84	192
,,	Eden'bdg., Falconhurst	7·25	204	,,	Cranwell Aerodrome	4·88	261
,,	Sevenoaks, Speldhurst.	6·15	...	,,	Skegness, Marine Gdns.	3·15	146
Sus	Compton, Compton Ho.	8·65	227	,,	Louth, Westgate	4·92	191
,,	Patching Farm	7·64	214	,,	Brigg, Wrawby St.	3·82	...
,,	Eastbourne, Wil. Sq.	7·06	202	*Notts*	Worksop, Hodsock	4·05	206
,,	Heathfield, Barklye	8·60	232	*Derby*	Derby, L. M. & S. Rly.	4·90	227
Hants	Ventnor, Roy.Nat.Hos.	8·55	266	,,	Buxton, Terr. Slopes	7·14	153
,,	Fordingbridge, Oaklnds	8·20	240	*Ches*	Runcorn, Weston Pt.	3·93	142
,,	Ovington Rectory	8·44	254	*Lancs*	Manchester, Whit. Pk.	4·56	173
,,	Sherborne St. John	5·24	184	,,	Stonyhurst College	4·81	107
Herts	Royston, Therfield Rec.	4·02	172	,,	Southport, Bedford Pk.	3·50	111
Bucks	Slough, Upton	4·55	205	,,	Lancaster, Greg Obsy.	4·25	107
,,	H. Wycombe, Flackwell	5·02	195	*Yorks*	Wath-upon-Dearne	4·12	202
Oxf	Oxford, Mag. College	3·88	176	,,	Wakefield, Clarence Pk.	4·87	230
Nor	Wellingboro, Swanspool	3·62	168	,,	Oughtershaw Hall	8·33	...
,,	Oundle	3·07	...	,,	Wetherby, Ribston H.	5·16	221
Beds	Woburn, Exptl. Farm	3·48	155	,,	Hull, Pearson Park	3·73	170
Cam	Cambridge, Bot. Gdns.	3·05	158	,,	Holme-on-Spalding	4·20	193
Essex	Chelmsford, County Lab	4·29	191	,,	West Witton, Ivy Ho.	6·75	196
,,	Lexden Hill House	3·96	...	,,	Felixkirk, Mt. St. John.	5·13	209
Suff	Haughley House	3·48	...	,,	York, Museum Gdns.	4·09	196
,,	Campsea Ashe	4·20	189	,,	Pickering, Hungate	4·08	164
,,	Lowestoft Sec. School	3·07	131	,,	Scarborough	4·25	172
,,	Bury St. Ed., WestleyH.	3·81	166	,,	Middlesbrough	3·73	176
Norf.	Wells, Holkham Hall	3·20	149	,,	Baldersdale, Hury Res.	6·02	163
Wilts	Calne, Castle Walk	6·70	...	*Durh*	Ushaw College	5·01	197
,,	Porton, W.D. Exp'l. Stn	6·48	247	*Nor*	Newcastle, Town Moor.	3·69	168
Dor	Evershot, Melbury Ho.	9·67	227	,,	Bellingham, Highgreen	4·15	121
,,	Weymouth, Westham.	7·15	231	,,	Lilburn Tower Gdns.	3·96	118
,,	Shaftesbury, Abbey Ho.	6·38	197	*Cumb*	Carlisle, Scaleby Hall	3·13	104
Devon	Plymouth, The Hoe	8·05	220	,,	Borrowdale, Seathwaite	14·50	113
,,	Holne, Church Pk. Cott.	11·07	172	,,	Borrowdale, Moraine	11·30	110
,,	Teignmouth, Den Gdns.	5·79	181	,,	Keswick, High Hill	5·09	90
,,	Cullompton	5·85	170	*West*	Appleby, Castle Bank	3·01	91
,,	Sidmouth, U.D.C.	5·41	...	*Mon*	Abergavenny, Larchf'd	6·62	173
,,	Barnstaple, N. Dev.Ath	5·55	141	*Glam*	Ystalyfera, Wern Ho.	10·40	158
,,	Dartm'r, Cranmere Pool	11·00	...	,,	Cardiff, Ely P. Stn	6·29	151
,,	Okehampton, Uplands.	8·67	163	,,	Treherbert, Tynywaun.	13·09	...
Corn	Redruth, Trewirgie	6·98	143	*Carm*	Carmarthen, The Friary	9·15	184
,,	Penzance, Morrab Gdns.	7·17	157	*Pemb*	St. Ann's Hd, C. Gd. Stn.	4·86	128
,,	St. Austell, Trevarna	7·96	162	*Card*	Aberystwyth	4·94	...
Soms	Chewton Mendip	8·71	204	*Rad*	BirmW.W.Tyrmynydd	10·07	151
,,	Long Ashton	6·19	195	*Mont*	Lake Vyrnwy	7·40	133
,,	Street, Millfield	5·96	...	*Flint*	Sealand Aerodrome	3·57	...
Glos	Blockley	5·65	...	*Mer*	Dolgelley, Bontddu	7·76	125
,,	Cirencester, Gwynfa	6·47	217	*Carn*	Llandudno	3·43	119
Here	Ross, Birchlea	5·76	228	,,	Snowdon, L. Llydaw 9.	18·92	...
Salop	Church Stretton	7·00	238	*Ang*	Holyhead, Salt Island	6·02	145
,,	Shifnal, Hatton Grange	5·40	229	,,	Lligwy	5·91	...
Staffs	Market Drayt'n, Old Sp.	4·78	182	*Isle of Man*			
Worc	Ombersley, Holt Lock.	4·97	218		Douglas, Boro' Cem.	5·92	124
War	Alcester, Ragley Hall	5·07	219	*Guernsey*			
,,	Birminghm, Edgbaston	5·80	244		St. PeterP't.Grange Rd.	7·93	189

Rainfall : 1935 : November, Scotland and Ireland

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Wig .	Pt. William, Monreith.	5·97	138	*Suth* .	Melvich	4·09	102
,, .	New Luce School	6·81	133	,, .	Loch More, Achfary	5·60	65
Kirk .	Dalry, Glendarroch	7·78	130	*Caith* .	Wick	4·56	145
,, .	Carsphairn, Shiel	9·59	121	*Ork* .	Deerness	5·20	132
Dumf.	Dumfries, Crichton R.I.	6·29	181	*Shet* .	Lerwick	2·90	68
,, .	Eskdalemuir Obs	5·98	103	*Cork* .	Caheragh Rectory	6·15	...
Roxb .	Hawick, Wolfelee	4·08	105	,, .	Dunmanway Rectory	6·61	107
Selk .	Ettrick Manse	6·04	111	,, .	Cork, University Coll.	4·58	114
Peeb .	West Linton	5·12	...	,, .	Ballinacurra	4·33	108
Berw .	Marchmont House	3·75	125	,, .	Mallow, Longueville	5·03	134
E.Lot .	North Berwick Res	3·78	169	*Kerry*.	Valentia Obsy	8·36	153
Midl .	Edinburgh, Roy. Obs.	3·80	170	,, .	Gearhameen	13·20	136
Lan .	Auchtyfardle	5·93	...	,, .	Bally McElligott Rec.	6·52	...
Ayr .	Kilmarnock, Kay Pk.	4·50	...	,, .	Darrynane Abbey	7·23	142
,, .	Girvan, Pinmore	6·46	121	*Wat* .	Waterford, Gortmore	4·90	132
Renf .	Glasgow, Queen's Pk.	4·35	117	*Tip* .	Nenagh, Cas. Lough	5·06	126
,, .	Greenock, Prospect H.	5·83	91	,, .	Roscrea, Timoney Park	4·08	...
Bute .	Rothesay, Ardencraig	5·75	...	,, .	Cashel, Ballinamona	4·32	123
,, .	Dougarie Lodge	5·98	...	*Lim* .	Foynes, Coolnanes	5·73	143
Arg .	Ardgour House	8·47	...	,, .	Castleconnel Rec	4·51	...
,, .	Glen Etive	10·07	97	*Clare* .	Inagh, Mount Callan	8·92	...
,, .	Oban	3·00	...	,, .	Broadford, Hurdlest'n.	4·08	...
,, .	Poltalloch	6·10	110	*Wexf* .	Gorey, Courtown Ho.	4·47	128
,, .	Inveraray Castle	10·11	120	*Wick* .	Rathnew, Clonmannon.	5·05	...
,, .	Islay, Eallabus	7·53	140	*Carl* .	Hacketstown Rectory	5·05	129
,, .	Mull, Benmore	...	...	*Leix* .	Blandsfort House	4·77	143
,, .	Tiree	...	...	*Offaly*.	Birr Castle	4·03	130
Kinr .	Loch Leven Sluice	4·09	114	*Dublin*	Dublin, FitzWm. Sq.	3·46	130
Perth .	Loch Dhu	7·20	83	,, .	Balbriggan, Ardgillan	5·30	184
,, .	Balquhidder, Stronvar.	8·22	...	*Meath*.	Beauparc, St. Cloud	6·00	...
,, .	Crieff, Strathearn Hyd.	4·79	110	,, .	Kells, Headfort	4·41	130
,, .	Blair Castle Gardens	4·33	123	*W.M* .	Moate, Coolatore	3·82	...
Angus.	Kettins School	3·87	125	,, .	Mullingar, Belvedere	4·40	129
,, .	Pearsie House	4·65	...	*Long* .	Castle Forbes Gdns	4·28	119
,, .	Montrose, Sunnyside	4·53	171	*Gal* .	Galway, Grammar Sch.	14·84	...
Aber .	Braemar, Bank	4·76	124	,, .	Ballynahinch Castle	0·02	168
,, .	Logie Coldstone Sch.	3·99	130	,, .	Ahascragh, Clonbrock.	4·98	123
,, .	Aberdeen, King's Coll.	4·26	144	*Mayo*.	Blacksod Point	5·58	107
,, .	Fyvie Castle	4·44	128	,, .	Mallaranny	8·23	...
Moray	Gordon Castle	2·47	86	,, .	Westport House	7·01	143
,, .	Grantown-on-Spey	2·28	76	,, .	Delphi Lodge	13·19	127
Nairn.	Nairn	2·63	111	*Sligo* .	Markree Obsy	4·68	111
Inv's .	Ben Alder Lodge	4·75	...	*Cavan*.	Crossdoney, Kevit Cas.	4·74	...
,, .	Kingussie, The Birches.	3·22	...	*Ferm* .	Enniskillen, Portora	4·25	...
,, .	Inverness, Culduthel R.	2·69	...	*Arm* .	Armagh Obsy	3·88	137
,, .	Loch Quoich, Loan	9·75	...	*Down*.	Fofanny Reservoir	12·00	...
,, .	Glenquoich	...	...	,, .	Seaforde	5·49	145
,, .	Arisaig, Faire-na-Sguir.	...	...	,, .	Donaghadee, C. G. Stn.	4·62	151
,, .	Fort William, Glasdrum	7·38	...	,, .	Banbridge, Milltown	3·22	117
,, .	Skye, Dunvegan	4·81	...	*Antr* .	Belfast, Cavehill Rd.	5·19	...
,, .	Barra, Skallary	5·84	...	,, .	Aldergrove Aerodrome.	3·85	119
R&C .	Alness, Ardross Castle.	...	...	,, .	Ballymena, Harryville.	4·79	118
,, .	Ullapool	3·28	62	*Lon* .	Garvagh, Moneydig	5·77	...
,, .	Achnashellach	3·42	37	,, .	Londonderry, Creggan.	4·33	106
,, .	Stornoway	3·32	57	*Tyr* .	Omagh, Edenfel	5·79	152
Suth .	Lairg	3·29	82	*Don* .	Malin Head	3·73	...
,, .	Tongue	2·42	53	,, .	Killybegs, Rockmount.	3·08	...

Climatological Table for the British Empire, June, 1935

STATIONS.	PRESSURE. Mean of Day M.S.L.	PRESSURE. Diff. from Normal.	TEMPERATURE. Absolute. Max.	TEMPERATURE. Absolute. Min.	TEMPERATURE. Mean Values. Max.	TEMPERATURE. Mean Values. Min.	TEMPERATURE. Mean Values. ½ Max. and Min.	TEMPERATURE. Mean Values. Diff. from Normal	TEMPERATURE. 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.	1013·3	− 3·4	84	42	69·6	54·1	61·9	+ 2·7	55·8	83	6·9	3·87	+ 1·72	18	6·9	42
Gibraltar	1017·7	+ 0·4	92	58	79·0	61·7	70·3	− 0·2	60·0	80	3·1	0·17	− 0·37	3	...	...
Malta	1017·0	+ 1·8	91	60	80·9	68·1	74·5	+ 1·8	66·7	67	1·9	0·00	− 0·09	0	12·4	85
St. Helena	1015·9	+ 0·6	72	55	62·5	56·6	59·5	− 1·0	57·6	93	9·1	5·14	...	21	...	...
Freetown, Sierra Leone	1014·3	+ 2·3	88	68	84·8	72·0	78·4	− 1·9	75·3	86	8·8	32·86	+ 12·82	29	...	...
Lagos, Nigeria	1013·0	+ 0·6	87	69	83·7	73·9	78·8	− 0·7	74·7	89	8·8	21·18	+ 2·70	20	4·1	33
Kaduna, Nigeria	1008·8	...	92	64	85·7	68·8	77·3	+ 0·8	71·7	85	7·1	9·32	+ 2·23	20	7·1	56
Zomba, Nyasaland	1017·3	− 0·2	78	50	69·7	56·9	63·3	+ 0·4	56·1	73	6·9	0·33	− 0·15	4	...	...
Salisbury, Rhodesia	1021·0	− 1·1	73	36	67·3	41·2	54·3	− 2·6	48·4	60	2·3	0·45	+ 0·40	3	8·1	73
Cape Town	1021·8	+ 1·7	79	38	64·5	47·5	56·0	+ 0·3	48·1	72	4·7	1·54	− 2·96	9	...	...
Johannesburg	1022·6	+ 0·1	68	27	59·5	39·7	49·6	− 1·1	38·5	44	0·1	0·00	− 0·14	0	9·4	90
Mauritius	1018·2	− 0·8	80	61	75·7	66·0	70·9	+ 1·5	66·9	76	6·4	4·80	+ 2·00	17	5·7	52
Calcutta, Alipore Obsy.	999·9	+ 0·2	100	74	95·3	80·9	88·1	+ 3·0	80·5	80	7·5	4·05	− 7·86	9*	...	...
Bombay	1004·2	+ 0·2	93	73	89·7	79·2	84·5	+ 0·5	78·5	83	7·6	27·69	+ 7·82	17*	...	...
Madras	1003·0	− 0·8	108	76	99·2	81·8	90·5	+ 0·5	76·6	59	7·2	1·23	− 0·74	3*	...	...
Colombo, Ceylon	1009·0	+ 0·4	87	72	84·8	76·4	80·6	− 1·0	77·5	83	8·4	11·39	+ 4·07	25	5·0	40
Singapore	1009·0	+ 0·1	88	73	85·3	76·2	80·7	− 0·8	77·9	81	8·3	7·84	+ 0·97	15	5·3	43
Hongkong	1006·4	+ 0·6	90	76	86·9	78·7	82·8	+ 1·4	78·3	81	8·3	14·43	− 1·27	24	5·1	38
Sandakan	1009·0	...	92	73	88·5	75·4	81·9	+ 0·2	76·9	83	6·5	12·64	+ 5·14	25	...	...
Sydney, N.S.W.	1018·6	+ 0·7	71	40	62·6	46·0	54·3	− 0·4	48·0	70	4·8	4·82	+ 0·08	12	5·8	59
Melbourne	1020·2	+ 1·7	67	36	56·2	44·0	50·1	− 0·3	45·8	85	7·5	2·10	+ 0·04	19	2·4	25
Adelaide	1021·3	+ 2·2	67	40	60·0	46·9	53·5	0·0	48·7	74	7·2	2·68	− 0·42	18	3·6	37
Perth, W. Australia	1023·0	+ 5·0	78	41	63·7	49·2	56·5	− 0·3	50·4	71	6·1	4·13	− 2·81	14	4·9	49
Coolgardie	1022·8	+ 3·9	72	33	61·2	41·1	51·1	− 1·7	47·2	79	5·9	1·27	+ 0·01	6	...	...
Brisbane	1019·0	+ 0·7	77	41	70·0	50·2	60·1	− 0·1	52·8	63	4·3	0·06	− 2·73	2	6·9	67
Hobart, Tasmania	1016·5	+ 2·2	59	32	52·0	40·8	46·4	− 0·6	42·2	75	6·4	2·42	+ 0·19	11	3·7	41
Wellington, N.Z.	1006·1	− 8·8	61	32	53·0	42·7	47·9	− 1·6	45·5	82	6·9	2·80	− 1·97	16	3·2	35
Suva, Fiji	1013·7	+ 0·1	86	67	81·0	71·1	76·1	+ 1·4	71·7	87	6·9	4·67	− 2·04	17	4·4	40
Apia, Samoa	1011·6	0·0	87	70	84·6	73·2	78·9	+ 1·1	75·2	77	4·9	2·71	− 2·64	9	8·2	73
Kingston, Jamaica	1013·6	− 0·2	90	70	87·7	72·9	80·3	− 1·0	72·9	79	5·6	1·79	− 2·31	4	6·6	50
Grenada, W.I.	...	...	87	70	85	73	79	0·0	74	79	6	3·89	− 4·36	24	...	...
Toronto	1013·0	− 1·7	83	42	72·6	54·7	63·7	− 0·1	57·0	73	5·6	3·42	+ 0·76	16	8·1	53
Winnipeg	1009·9	− 1·9	84	29	67·5	48·0	57·7	− 4·6	49·4	77	6·0	4·15	+ 1·04	14	7·0	43
St. John, N.B.	1014·3	− 0·8	75	43	65·5	49·1	57·3	+ 0·8	53·9	83	7·5	4·35	+ 1·08	15	6·2	40
Victoria, B.C.	1016·5	− 0·3	83	44	65·0	50·3	57·7	+ 0·7	52·8	75	5·9	0·67	− 0·17	11	9·3	58

(29234) Wt. 18/32 1050 12/35 Hw. G.377