(facing p. 229)

Dominion Photo

BALLOON CARRYING RADIO-SONDE BEFORE BEING RELEASED AT WELLINGTON, NEW ZEALAND, (SEE P. 238)

M.O. 371.

The Meteorological Magazine

Air Ministry: Meteorological Office

Vol. 69
Nov. 1934
No. 826

LONDON: PRINTED AND PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE
To be purchased directly from H.M. STATIONERY OFFICE at the following addresses: ADASTRAL HOUSE, KINGSWAY, LONDON, W.C.2; 120, GEORGE STREET, EDINBURGH 2; YORK STREET, MANCHESTER 1; 1, ST. ANDREW'S CRESCENT, CARDIFF; 80, CHICHESTER STREET, BELFAST; or through any Bookseller.

Sir Arthur Schuster

By the death of Sir Arthur Schuster on October 14th, 1934, the geophysical sciences lost one who had been an active worker for over half a century. This is not the place, nor is the present writer qualified, to give a detailed account of Sir Arthur Schuster's career*. But there are some aspects of his work which are of particular interest to meteorologists. Sir Arthur's connexion with the Meteorological Office began with his appointment as a member of the Meteorological Council in 1901. When the Meteorological Committee was formed in 1905, he was appointed as a representative of the Royal Society, and he continued to serve in this capacity until failing health forced him to retire in 1932. When, on the transfer of the Meteorological Office to the Air Ministry, the Meteorological Committee was re-organised, Schuster was appointed as its first Vice-Chairman, and he retained this office until he retired from the Committee. He presided at many of the meetings in the absence of the Chairman (the Under-Secretary of State for Air), who was frequently prevented from attending by the pressure of Parliamentary and other business.

Sir Arthur Schuster's interest in Meteorology was not confined to his membership of the Meteorological Committee. In 1905 he founded a Department of Meteorology in the University of Manchester. The first lecturer in this department was G. C. Simpson, the present Director of the Meteorological Office, and it was he who

* An account of Sir Arthur Schuster's more general activities, by Dr. G. C. Simpson, C.B., F.R.S., is to be found in *Nature, London*, 134, 1934, p. 595.

initiated the upper air observations at Manchester. His successor in charge of the department was J. E. Petavel, now Sir Joseph Petavel, Director of the National Physical Laboratory. In 1906 Schuster founded a Readership in Meteorology in the University of Cambridge, and this Readership was held by E. Gold from 1907 to 1910, and by G. I. Taylor from 1912 to 1915. These two foundations were thus effective in starting four striking careers.

In 1910 Schuster presented to Eskdalemuir Observatory a Galitzin seismograph (which later was removed to Kew), and so made it possible for the Observatory to co-operate in seismological research. Schuster was familiar with the needs of Seismology, as he had served as Chairman of the Seismological Committee of the old International Association of Academies.

During the whole of his career Schuster maintained an active interest in Geophysics. His studies in Terrestrial Magnetism led him to devise the "Schuster Periodogram," which for the first time laid down a practical criterion for estimating the utility of the results of harmonic analysis. This method was first described in *Terrestrial Magnetism* in 1898, but it was later modified and improved in a paper published in the *Transactions of the Cambridge Philosophical Society*. The periodogram has been adopted as a standard method in many sciences, but more particularly in Meteorology, and it has formed the basis of all subsequent investigations of periodicity.

In addition to his direct contributions to the geophysical sciences, and what we may call his material contributions of instruments and foundations, we owe to Schuster no small debt for his readiness and capacity in matters of organisation. As a member of the Meteorological Committee he took the liveliest interest in the work of the Office, and he usually had quite definite and well-founded views on the matters brought before the Committee. It was through being Secretary of the Meteorological Committee that the present writer came into contact with Sir Arthur Schuster. Up to the time when his health began to fail, Schuster never failed to impress by the keenness of his interest and the clarity of his views ; and at all times he left the clear impression of a gracious and kindly personality.

D. BRUNT.

Nocturnal Cooling and the Prediction of Minimum Temperatures

The note by Col. Gold* on the results obtained by Mr. Andrews† in connexion with prediction of minimum temperatures at Larkhill has been read with much interest as, in the course of an investigation

* See *Meteorological Magazine*, 69, 1934, p. 88.
† Ibid 69, 1934, p. 61.

by one of us, the effect of temperature and aqueous vapour pressure on the decrease of the lapse rate of temperature in the lowest layers of the atmosphere in the early evening, when the sky was clear, was considered. The radiation from the ground to a clear sky at night, and even before sunset, rapidly cools the surface and consequently the air in contact with the surface: this radiative cooling will gradually extend upwards with the result that the lapse rate will be reversed and an inversion will develop in a shallow layer of air in contact with the ground. The problem considered was the relation between the time interval, in minutes after sunset, of the occurrence of zero lapse rate between heights of 1·1m. and 16·2m. above the desert at Ismailia, Egypt, and temperature and vapour pressure at 1·1m. for a given value of the wind velocity at the upper level when the sky was clear. It was found that the time interval plus a constant was directly proportional to the vapour pressure and inversely proportional to the absolute temperature.

Thus for a given value of the wind velocity

$$t + A = B\frac{e}{T}$$

where t = the time interval after sunset,
e = vapour pressure at time of zero lapse rate,
T = absolute temperature at time of zero lapse rate.

The relative humidity on the occasions fulfilling the specified conditions of state of sky was less than 90 per cent. in every case, but if it is assumed that the derived equation can be extrapolated to occasions when the air is saturated, it is seen that the time of occurrence of zero lapse rate gets later if both temperature and vapour pressure increase to maintain 100 per cent. relative humidity, or in other words the rate of cooling decreases with increasing temperature for constant relative humidity. Mr. Andrews' figures, however, shew that at Larkhill the amount of cooling between 15h. and the time of minimum temperature increases with the temperature for constant relative humidity, and in order to determine whether the cooling during the night at Ismailia bore a similar relation to the relative humidity as that derived from considerations of the formation of nocturnal inversions, observations of temperature and relative humidity at 15h. zone time, and the depression of the minimum temperature below the temperature at 15h. zone time, were extracted for all occasions during the winter months November, 1931, to February, 1932, when the sky cleared at any time during the night and the mean wind velocity between 15h. and 8h. the following morning was less than 10 m.p.h. The number of occasions available was sufficient to enable isopleths of temperature at 15h. to be plotted as a function of the relative humidity at 15h. and the difference between the temperature at 15h. and the minimum temperature, (T—M), for the three values 60°, 70° and 80° F.

TABLE I

Mean Difference between 15h. temperature and minimum screen temperature, on clear or partly clear nights when the mean wind speed was less than 10 m.p.h. at Ismailia, November, 1931, to February, 1932.

Temperature at 15h.	55°–64° F.	65°–74° F.	75°–84° F.	85°–94° F.
Rel. Hum. 15h.	Temperature Difference (T—M) °F.			
80–89 per cent. ...	9	—	—	—
70–79 „ ...	12	—	—	—
60–69 „ ...	—	—	—	—
50–59 „ ...	15	19	21	—
40–49 „ ...	17	21	22	—
30–39 „ ...	20	22	24	—
20–29 „ ...	—	27	29	—
10–19 „ ...	28	29	31	—
<10 „ ...	31	—	29	36

Table I shews that the cooling in this case increases with temperature for constant relative humidity which is in agreement with the result obtained by Mr. Andrews. The relation referred to in connexion with the time of occurrence of zero lapse rate is in agreement with what one would expect if radiation operated alone, and suggests that any cause other than radiation which is operative in increasing the nocturnal cooling does not have any effect before an inversion has developed at the surface.

If the amount of cooling $(T - M)$ is plotted against the difference between the temperature and the dew point temperature $(T - D)$ a series of approximately parallel straight lines is obtained, the formula for which is found to be :—

$$(T - M) = 0{\cdot}4\,(T - D) + 0{\cdot}25\,T - 6$$

compared with the following for Larkhill :—

$$(T - M) = 0{\cdot}4\,(T - D) + 0{\cdot}15\,T + 5{\cdot}5$$

where T = temperature at 15h. in degrees F.,
D = dew point temperature at 15h. in degrees F.,
M = minimum temperature in degrees F.

It will be seen that the values of the constants in this formula differ from those obtained for Larkhill under similar conditions of sky and wind velocity although the slope of the series of lines connecting $(T - M)$ and $(T - D)$ is approximately the same for both places. This leads to the inference that the rate at which the difference between the temperature at 15h. and the minimum temperature changes with respect to the difference between the air temperature at 15h. and the dew point at 15h. is the same for both places, but that the amount of cooling is dependent on locality and length of night. In connexion with the amount of cooling it might be mentioned that the mean wind velocity during the nights considered was approximately 6 m.p.h.

In order to consider the matter further the observations of temperature and relative humidity at 17h. and the depression of the minimum temperature below the 17h. temperature were extracted for the postulated conditions of sky and wind velocity in June to August, 1932. The time of 17h. was chosen as being very approximately the same time before sunset as was 15h. in winter. The figures thus obtained are given in Table II below :—

TABLE II

Mean Difference between the 17h. temperature and the minimum screen temperature on clear or partly clear nights when the mean wind speed was less than 10 m.p.h. at Ismailia, June to August, 1932.

Temperature at 17h.	65°–74° F.	75°–84° F.	85°–94° F.	95°–104° F.
Rel. Hum. 17h.	Temperature Difference (T—M) °F.			
60–69 per cent. ...	14	—	—	—
50–59 „ ...	—	18·5	19	—
40–49 „ ...	18	19	20	—
30–39 „ ...	—	22	22	—
20–29 „ ...	23	25	26	24
10–20 „ ...	—	—	28	31

The values of $(T - M)$ 17h. derived from the above figures when plotted against the corresponding value of $(T - D)$ 17 h., excluding those for 100° F., give points lying on three approximately parallel straight lines the equations of which are of the form

$$(T - M) = 0{\cdot}35\,(T - D) + \text{Const.}$$

so that at Ismailia, Egypt even in summer the rate at which $(T - M)$ varies with respect to $(T - D)$ is very nearly the same as at Larkhill, England in winter. The value of the constant is smaller than in the case of the figures in Table I and this is probably due to the occurrence of a higher mean wind velocity during the night in summer and also to a shorter night.

The foregoing results thus suggest that the formula obtained for the prediction of minimum temperature at Larkhill requires to be modified only as regards the value of the numerical constant and the coefficient of the term involving temperature alone before it can be applied to other localities.

WILLIAM D. FLOWER.
F. DAVIES.

The reading of Mr. Andrews' note on the prediction of minimum temperatures in the April issue of the *Meteorological Magazine* and the subsequent note on the formula connecting $(T - M)$ and

T and $(T - D)$ derived by Col. Gold from Mr. Andrews' diagram in the May issue has led to an investigation of the minimum and 15h. temperature readings observed at Catterick in order to see whether the Larkhill formula $(T - M) = 5{\cdot}5 + 3/20T + 2/5$ $(T - D)$ applies here.

In the original note 13 years observations were available for investigation whereas, only 3 years are available at Catterick;

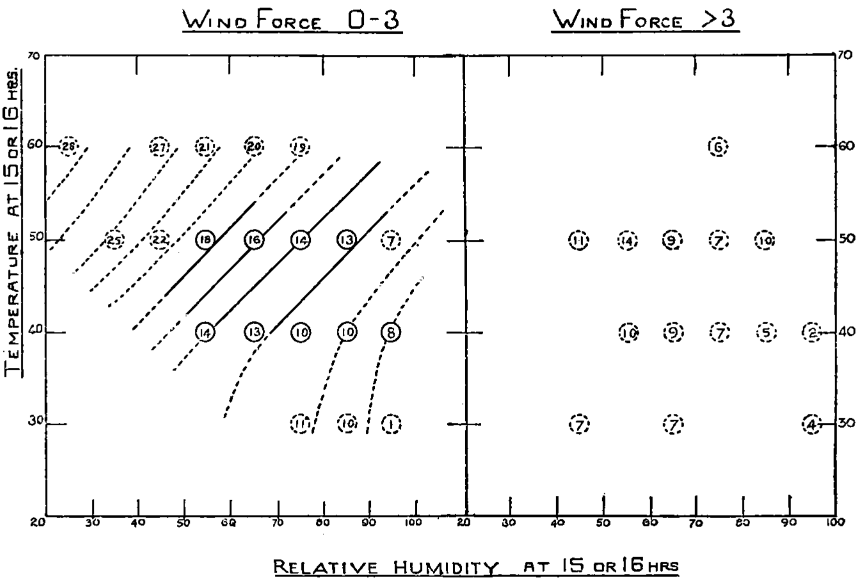


FIG. 1.

however, it was found that for winds of force 0–3 there were a sufficient number of occasions for use that would give an isopleth diagram similar to the one produced at Larkhill. See Fig. 1. From the little data available deviations from the means are to be expected; to differentiate between the reliable and the unreliable readings dotted circles have been used in the diagram to denote that 10 or less occasions were available for the plotting of the points.

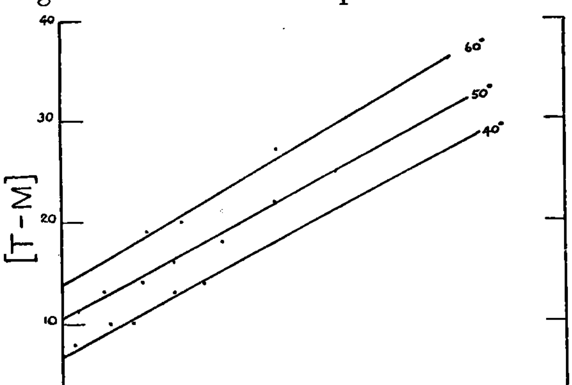


FIG. 2.

The amount of cooling $(T - M)$ was then plotted against $(T - D)$ as suggested by Col. Gold and from the resulting straight line graph the following formula was derived.

$$(T - M) = -7 + 7/20T + \tfrac{1}{2}(T - D)$$

This formula applicable to Catterick tends to show that the values of the constants are variable, this is what one would expect when considering the varying topographical surroundings of different stations.

W. R. MORGANS.

OFFICIAL PUBLICATION

The Meteorological Observer's Handbook. New Edition, 1934 (M.O. 191).

The "Meteorological Observer's Handbook" in continuation of Dr. Scott's "Instructions in the Use of Meteorological Instruments" (1875, reprinted 1885) was originally issued in 1908. The new edition forms a complete guide to the care and manipulation of meteorological instruments, and in the making of observations at ground level, both instrumental and non-instrumental. The book is divided into three parts. Part I contains instructions for making the observations which constitute the routine of a normal climatological station. Part II is devoted to autographic instruments and Part III consists of Tables. A collection of photographs of clouds is added as an Appendix. The numerous illustrations have in most cases been specially prepared for this edition.

The Handbook is addressed primarily to observers in the British Isles, but in order to meet the requirements of observers in Crown Colonies who are not in close touch with the meteorological services of any of the Dominions, modifications in the practice commonly followed at home, which are made necessary by differences of climate, are referred to in footnotes or otherwise.

Discussions at the Meteorological Office

The subjects for discussion for the next two meetings are :—

November 26th, 1934. (1) *The Indian south-west monsoon and the structure of depressions associated with it.* By K. R. Ramanathan and K. P. Ramakrishnan ; and (2) *On the physical characteristics of fronts during the Indian south-west monsoon.* By N. K. Sur. (Ind. Meteor. Mem., Poona, Vol. 26, 1933, Parts 2 and 3.) *Opener*—Mr. R. P. Batty, B.A.

December 10th, 1934. *Ionization balance of the atmosphere.* By V. F. Hess. (Beitr. Geophysik, Leipzig, SuppBd. II, 1933, p. 95.) (In German.) *Opener*—Mr. P. A. Sheppard, B.Sc.

Correspondence

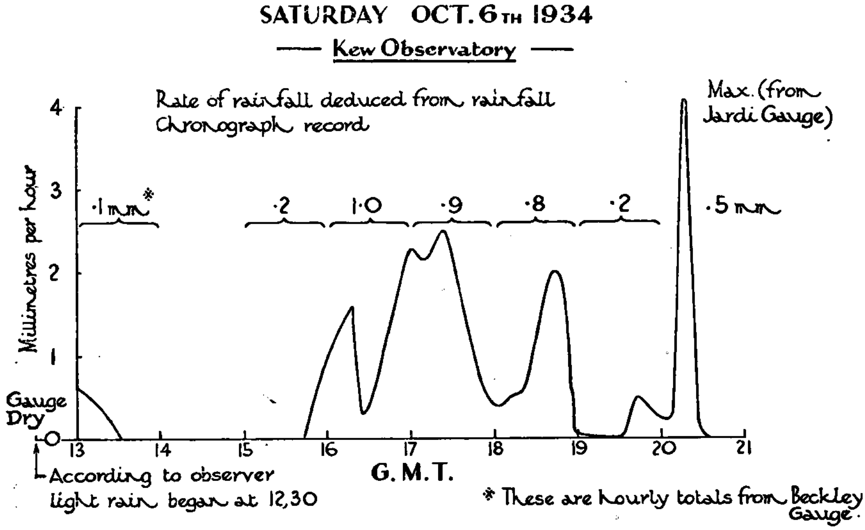
To the Editor, *Meteorological Magazine*

Rain in Advance of True "Warm-front" Rain

The weather of Saturday, October 6th, is very interesting to a student of synoptic meteorology. A deep depression with its centre in about Latitude 54°N. Longitude 25°W. was moving north-east. It had a well-marked warm front which ran south-east from the centre passing nearly through Valentia and Brest at 7h. G.M.T. The rain in advance of the warm front had by that time reached Plymouth.

In the course of the morning the rain extended eastwards, and at Golders Green a few drops fell between 12h. 15m. and 12h. 30m. G.M.T. There was then a short interval with no rain, and rain began again between 12h. 30m. and 13h. This rain, which was slight or moderate in intensity, continued until about 13h. 30m., after which it practically ceased for about two hours. About 15h. 30m. drizzle began, and turned to rain which continued for three or four hours.

The course of weather as observed at Golders Green was practically confirmed by the chronograph record from Kew Observatory. According to that, recordable rain began just before 13h. G.M.T.* This rain continued, at first at an intensity of about ½ mm. per hour, gradually diminishing in intensity until by 13h. 30m. it had practically ceased. No more rain was recorded by the chronograph until between 15h. 20m. and 15h. 30m., when there were



two isolated marks on the record—indicating very slight rain about that time. Rain began to be recorded about 15h. 40m. and increased in intensity to about 1½ mm. per hour at 16h. 20m., and then diminished in intensity to about 0·3 mm. per hour by 16h. 30m., and afterwards increased again to over 2 mm. per hour. This rain continued, with further substantial variations in intensity, until about 20h. 30m.

The point which, to my mind, is of most outstanding interest is the preliminary period of rain extending over nearly an hour, followed by an interval of more than two hours with practically no rain, before what one may call the true warm-front rain began.

* The observer at Kew observed light rain beginning about 12h. 30m.

It is not unusual for there to be a few drops of rain some time in advance of the commencement of the true warm-front rain, and on Saturday, October 6th, I thought the few drops which fell between 12h. 15m. and 12h. 30m. were these preliminary drops, and that when the rain began again about 12h. 45m. that this was the real warm-front rain. I had therefore anticipated that this rain would continue during the afternoon, and I was much surprised when it ceased, or practically ceased, for so long an interval.

I do not know what the explanation of this advance rain lasting nearly an hour is, nor if it has been previously noted in the literature of frontal variations of weather. It deserves investigation.

The diagram (Fig. I) kindly supplied by Dr. Whipple shows the course of the rain at Kew Observatory during the period in question.

E. GOLD.

October 9th, 1934

Lowest Pressure in a Tropical Cyclone

On the morning of September 21st, 1934, a terrible typhoon struck Osaka and neighbourhood, and caused a great deal of damage to life and property. The typhoon was first traced in our weather chart to the south-west of the Island of Saipan, the Carolines, on September 13th. Moving toward the north-west the cyclonic centre approached the Okinawa islands on the morning of the 20th, where it recurved north-east. Then the typhoon-centre passed over Cape Muroto on the south-east corner of Shiko-ku. At the Muroto Meteorological Station (33° 15′N., 134° 11′E., 186 m.) the barometer fell to 684·0 mm. (911·9 mb.) at 5h. 10 m. on the 21st. At the same time a wind velocity of 45 m./s. was observed, the direction being west. It is the mean velocity for the 20 minutes. This is much lower than 687·8 mm. (917·1 mb.) observed at False Point, India, at 6h. 30 m. on September 22nd, 1885, the record of the lowest depth of a cyclonic centre. The barometric reading at Muroto referred to is the reading of the mercurial barometer of the Fortin type, reduced to standard gravity and to sea-level, according to the formula given in " International Meteorological Tables ". The instrument was carefully tested by the Central Meteorological Observatory, Tokyo, before it was brought to the station.

T. OKADA.

Central Meteorological Observatory, Tokyo, September 27th, 1934.

[An even lower reading is that of 665·2 mm. (886·8 mb.) on August 18th, 1927 on the Dutch steamship *Sapœrœa* in the Pacific, 460 miles east of Luzon (Philippines). This reading was quoted in *Nature*, August 18th, 1928, p. 251, and in the *Meteorological Magazine* 68, 1933, p. 18 Ed. *M.M.*]

Gusty Winds at Wellington

The photograph reproduced as the frontispiece of this number of the magazine shows one of the balloons used to carry "radio-sondes" by Mr. J. Holmboe, the Norwegian meteorologist attached to the Lincoln Ellsworth Antarctic Expedition. The sondes were provided by the International Polar Year Commission and this is one of a number launched at Wellington, New Zealand.

The distortion of the balloon in the wind is rather surprising. The northerly wind at Wellington is extremely gusty. This was only a light one but even so the balloon was at one stage forced below the level of Mr. Holmboe, who is holding it in the picture. Nevertheless, in a lull it came back overhead and was released without difficulty.

EDWARD KIDSON.

Meteorological Office, Wellington, New Zealand, August 28th, 1934.

Peculiar Squall Cloud

Following a sharp squall at 17h. 10m. on October 4th, the peculiar cloud formation shewn in the sketch on the opposite page was observed in the east.

The squall cloud had the usual stratified base and cumuliform top, but at 17h. 20m. the curious protuberance in the centre appeared. The rapid formation of the phenomenon indicated that the currents in the cloud producing it must have been fairly violent, the whole appearing in a few seconds, looked like the blast of steam from a locomotive when starting from rest. After about five minutes, the mushroom shaped top suddenly spread out horizontally, forming an "anvil" of cirrus, such as is usually associated with thunder clouds, but no thunder or lightning was observed.

The cloud while passing overhead from the west, was accompanied by a sharp squall of about force 6 and 10 minutes of very heavy rainfall. The wind veered slightly from SW. to WSW. at the time and shade temperature, which had reached 60°F. before the squall, had fallen to 58°F. immediately after its passing.

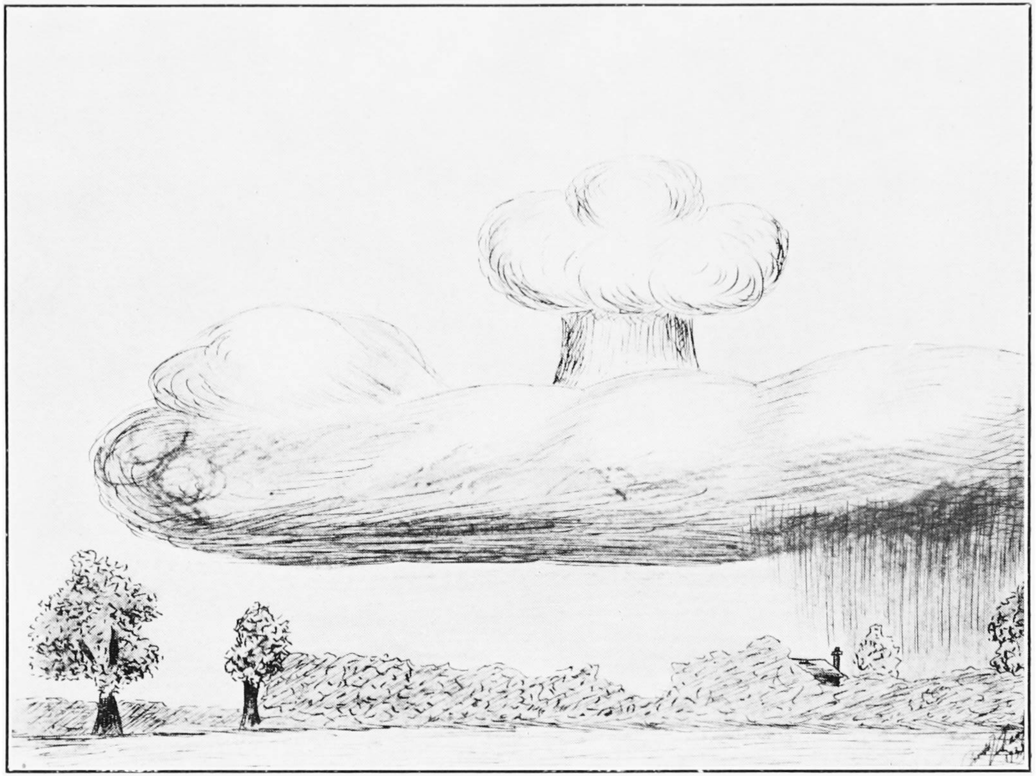
DONALD L. CHAMPION.

7, *Robinson Avenue, Goff's Oak, Waltham Cross, Herts, October 8th,* 1934.

Unusual Rainbow

An unusual rainbow was seen at 15h. 15m. (local time) on September 13th, 1934, at the base of a nimbus cloud which hung over the sea about six miles to the eastward of Bermuda; the appearance of the rainbow was as if it had just risen above the top of the horizon. The top arc was only about 5° in elevation above the sea and the inner colours of the bow were actually in contact with the sea. The rainbow seemed to be resting on a false horizon, slightly below the true horizon, probably caused by a line of heavy rain on the calm and rather glassy sea.

(facing p. 238)

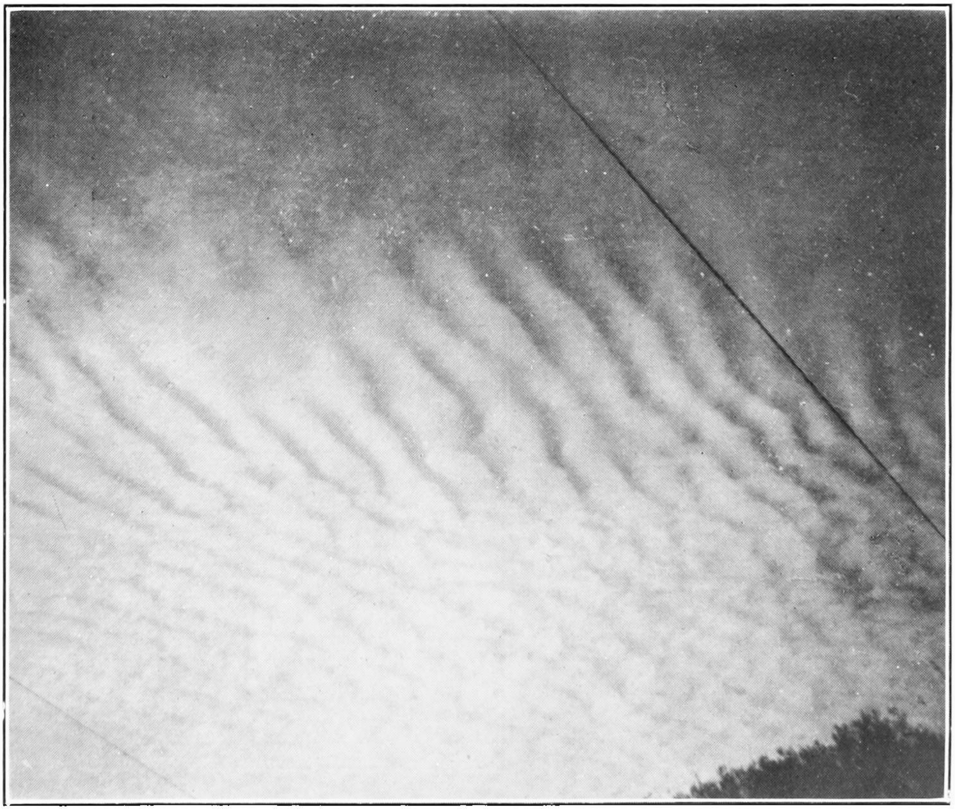


SQUALL CLOUD, OCTOBER 4TH, 1934

(reproduced by the courtesy of Mr. D. L. Champion)

(facing p. 239)

LUMINOUS NIGHT CLOUDS, AUGUST 11TH, 1934
(reproduced by the courtesy of Mr. S. N. Plummer)



WAVED ALTO-CUMULUS, AUGUST 18TH, 1934
(reproduced by the courtesy of Mr. R. M. Poulter)

This aspect continued for from ten to fifteen minutes, after which the rainbow gradually rose out of the sea, the top of the bow eventually subtending an angle of about 15° from the horizontal.

Throughout this time the sky was clear to the westward except for a few fine weather cumulus and there was no cloud in the vicinity of the sun. The colours of the rainbow at first though all present were rather subordinated to the orange and red which rather gave the appearance of a ball of fire resting just below the horizon.

H. B. MOORHEAD.

Meteorological Station, St. Georges, Bermuda, October 2nd, 1934.

Luminous Night Clouds

As reported in a letter published in *Nature* for August 11th, 1934, p. 219, Prof. Carl Störmer observed large masses of luminous night clouds over southern Norway on the night of June 30th–July 1st. Mr. S. N. Plummer observed similar clouds at Holyhead on the nights of July 1st–2nd and 2nd–3rd. On the first of these nights Mr. Plummer succeeded in obtaining a photograph, reproduced on the opposite page, using a Miniature camera, Selochrome film, with an exposure of 5 minutes at f.3·5. The photograph was taken at 0h. 30m., G.M.T., on July 2nd.

Waved Alto-Cumulus

The photograph of waved alto-cumulus against blue sky, on the opposite page, was taken at 6h. 40m. G.M.T., August 18th, 1934, at North Harrow (Middlesex) with the camera pointing south-east by east, elevation 25°, and reference wires running north-north-west to south-south-east. The table below shows conditions in the upper air over south and east England that morning.

CROYDON, 6H. G.M.T.			DUXFORD, 6H. G.M.T.		
	Wind.			*Temperature.*	*Humidity.*
Ft.	°	m.p.h.	Ft.	°F.	%
Surf.	—	0	100	56·6	99
1,000	—	0	1,100	58·5	86
2,000	285	7	2,020	56·8	88
3,000	265	9	3,500	52·5	79
4,000	285	8	—	—	—
5,000	285	9	5,090	49·0	76
6,000	270	14	6,700	46·2	71
8,000	310	15	8,480	41·5	64
10,000	300	15	10,300	36·6	34
12,000	290	12	12,280	32·0	61
Nephoscope Observation.			14,380	25·2	65
10h. G.M.T.			16,650	16·5	—
alto-cumulus 310° 21 m.p.h.			19,080	7·7	—

From the above table it seems that the cloud was from 8,000 to 10,000 ft.

R. M. POULTER.

29, Pinner Park Avenue, Headstone Lane, Harrow, September 17th, 1934.

Atmospheric Refraction and the Moon's Globularity

At night when the moon's disc is yellow we see it more or less flat, but during the daylight hours when it is white the spherical curvature of the moon is sometimes discernible. The best time to observe this is on a very clear morning when the moon is on the wane between full and last quarter. I noticed a striking case of this phenomenon at a scout camp in Sussex one morning last August, and drew the attention of some of the boys to it, who agreed with me that the moon's surface did not look flat but " bulged right out like a ball."

The phenomenon, therefore, cannot be psychological—the moon appearing spherical because we know it is—for the simple reason that it only occasionally strikes the eye. As we cannot suppose that the eye in the ordinary way can distinguish the curvature of a surface nearly a quarter of a million miles away we must assume that some refractive effect of the atmosphere is capable of making the moon look what it is, namely a round globe.

Here, then, is another lunar atmospheric problem, like that of the blue moonlit sky, for the consideration of physicists. I need hardly add that I am not referring to the common lunar phenomenon known as " earthshine," when we see darkly part of the surface which is having night.

I may add as bearing on the question that when Peary first saw the sun rise after the long Arctic night in March, 1909, whilst on his 400-mile journey to the North Pole over the sea-ice from Grant Land he described it as " like a football owing to excessive refraction."

L. C. W. BONACINA.

35, Parliament Hill, London, N.W.3. March 3rd, 1934.

NOTES AND QUERIES

The Deepening of Depressions

The note* by C. S. Durst and R. M. Stanhope brings out the absence of any appreciable diurnal variation of barometric tendencies. There remains the possibility that there may be some diurnal variation at cyclonic centres, at least in extreme cases, although on theoretical ground it seems unlikely. My previous note† referred only to unusually marked deepening in the winter half year for the period 1922–30, and the need for caution was mentioned. The result was purely empirical and against expectation. I have now examined the charts from 1931 onwards. The extreme cases of deepening close to or over the British Isles occurred on the nights

* *Meteorological Magazine* 69, 1934, p. 184.

† *Meteorological Magazine* 66, 1931, p. 39.

preceding February 28th, 1931, February 24th and March 17th, 1933, and September 8th, 1934. (On February 24th, 1933, the 7h. pressure at Pembroke was 986 mb.; the message was delayed by the snowstorm.) It is quite possibly a pure coincidence that all four cases were at night. I have also tried to pick out cases on the eastern Atlantic when the deepening at the centre averaged fully 1 mb. per hour for at least a half-day period. Though it is easy to establish marked deepening, it is impossible to obtain an exact quantitative measurement, since there is seldom a ship very near the centre, and an active new depression may entirely elude the network of ships' observations. I still think that the empirical evidence favours a slight diurnal effect, though it is impossible to prove it at present. I can think of no satisfactory explanation, as even on land the diurnal variation of temperature is very small during precipitation, especially in winter.

In view of the general interest of the problem of deepening, I give a list of dates when there was undoubtedly very marked deepening.

(*a*) Nine cases on nights preceding following dates:—February 28th, November 13th, 1931; September 18th, October 8th and 19th, 1932; January 17th, February 24th, March 17th, 1933; September 8th, 1934.

(*b*) Three day cases:—November 7th, 1931; December 30th, 1932; August 19th, 1934.

(*c*) Eight cases of prolonged deepening for periods exceeding 24 hours (ranging up to 35 mb. in amount) about following dates:—October 1st, November 3rd and 18th, 1931; January 6th, 1932; January 5th to 7th (2 cases), 14th and 17th, 1934.

If the charts for these 20 cases are examined, it can be seen that on only two occasions (October 1st, 1931, and January 5th to 6th, 1934) was there anticyclonic development to east or south of the deepening depression. A phrase used by Durst and Stanhope, namely " a transfer of air from the low pressure areas to the high " requires great care in its interpretation, and there is certainly no relation between large rising tendencies and deepening depressions. It is only over a very large area that the mean pressure remains constant. The chief rise of pressure is behind an active depression, and an anticyclone occasionally develops there, though there is usually no definite anticyclonic development within 2,000 miles of a rapidly deepening depression. I have discussed the question of air transfer and associated problems in a paper not yet published. It is a complex question, involving various layers of the atmosphere. If we consider the air motion relative to the centre of the depression, by super-posing at all points a motion equal and opposite to that of the centre, it is clear that the mean motion of the polar air in the lower troposphere is directed towards the rear. It is true that the cold front, and then the occlusion, sweeps far round an intense depression, but this is due to the rotation of the system. A depression in its final stage has the nature of a vortex drifting in the general current, if any. While it is still active, perhaps for a time after occlusion, there is usually no genuine vortex centre, but there is rotation round a centre moving forward relative to the air mass, and some convergence into a region just ahead of the centre. The mean relative motion of the air is towards the rear of the depression, and this may be of some importance, in view of the facts mentioned above. Nearly one-third of the entire atmosphere lies below 10,000 feet.

The upper layers must also be taken into account. At cirrus levels a depression apparently develops, and certainly exists, over the subsiding polar air behind the low-level centre, and during the deepening of the latter the high-level system is sheared forward till there is a more or less vertical axis. There is a corresponding development of a wedge of high pressure at cirrus levels where the rising warm air spreads out up above. This moves forward relative to the depression, but its effect on sea level pressure depends on the air movements and other changes in the layers underneath, which may neutralise or reverse its influence. Such high-level wedges are very common, and may be necessary for the development of pronounced anticyclones, but the subsidence of cold air is also necessary, and is probably the primary factor in most cases. It is only occasionally that all the factors required for the development of an anticyclone over western Europe and of a deep depression on the Atlantic are present simultaneously. Sometimes an anticyclone greatly intensifies when a depression to westward is filling up, as on November 11th to 13th, 1932.

C. K. M. Douglas.

Exceptionally High Maximum Temperatures at Bridgwater, July 7th-10th, 1934

The unusual warmth of July, 1934, has already been fully described in the *Monthly Weather Report* of the Meteorological Office for July and it was referred to again by Mr. L. C. W. Bonacina in a letter in the October number of the *Meteorological Magazine*. It seems worth while, however, to put on record some further information recently received from Major A. C. F. Luttrell, Edington, Bridgwater. He says that on four consecutive days, July 7th to 10th inclusive, the maximum temperature at his station reached or slightly exceeded 90° F. The actual readings were 90° F. on the 7th, 91° F. on the 8th, 90° F. on the 9th and 91° F. on the 10th. The instrument recording these temperatures was a Kew tested thermometer and it was housed in a regulation Stevenson Screen. These figures are very remarkable. The writer has examined figures at Kew, Greenwich and the Radcliffe Observatory, Oxford, during the notable warm spells of July, 1900; July, 1901; August to September, 1906; July and August, 1911; July, 1921; July, 1923; August, 1930; August, 1932, and July and August, 1933, and only on one occasion was there a run of four consecutive days with a maximum of 90° F. or above. This was at Greenwich from August 31st to September 3rd, 1906, and the readings were 94·3° F., 91·9° F., 93·5° F. and 91·0° F., respectively. The thermometer at Greenwich is, however, on a Glaisher stand and there is a tendency for the temperature to be higher than in a Stevenson screen. There have been a few cases of three consecutive days with readings of 90° F. or above ; for example, July 11th–13th, 1923, and August 18th–20th, 1932, at Greenwich, and August 31st–September 2nd, 1906, at Oxford and Kew. Cases of two consecutive days are much less rare. L. F. LEWIS.

REVIEWS

Naturbeobachtungen. By Arthur Döring. Deutsches Meteorologisches Jahrbuch für 1931, Freistaat Sachsen, Appendix. Dresden, 1933.

This paper discusses life reaction to altitude as the *Phenological Reports of the Royal Meteorological Society* do to latitude tempered by oceanic influence, which is practically negligible in Saxony. There, two selected stations, Böhlitz Ehrenberg near Leipzig at 100 metres and Eibenstock, Erzgebirge, 600 to 700 metres, lie between 51° and 50° N, or roughly the latitude of England south of the Thames. Herr Döring discusses the 462 records observed between 1901–14, the observations being taken at Böhlitz Ehrenberg from 1901–6 and at Eibenstock, Erzgebirge from 1907–14. As the mean meteorological conditions at both stations were practically identical for the two periods phenological comparisons are satisfactory.

Twenty-two of the 34 quarto pages are tables. These give for each plant or animal event the mean dates and extremes with years ; also snowfall, thunderstorms, etc., with monthly mean temperatures from adjoining weather stations. The results are here briefly tabulated :—

Quarters and Year.	1st	2nd	3rd	4th	Year.
Mean temp., °C., at 100 metres ...	1·8	13·0	16·6	4·5	9·0
Mean temp., °C., at 650 metres ...	– 1·2	9·1	12·6	2·7	5·8
Difference	3·0	3·9	4·0	1·8	3·2
Difference in days, animals... ...	12·4	10·6	– 0·2	–4·0	4·7
Difference in days, per 100 metres...	2·2	1·9	0·0	–1·0	0·6
Difference in days, plants	23·2	16·4	17·4	–5·3	13·8
Difference in days, per 100 metres	4·2	3·0	3·2	–1·0	2·4

Mean annual rainfalls, 436 and 955 mm. ; Late frosts, May 1st and June 5th ; Last snow, April 20th and May 3rd.

Fourteen plants, 14 birds and the frog appear also in the Royal Meteorological Society's lists. They are nearly all earlier south of the Thames, save for departures ; house martin and swallow 25 and 13 days later here. The martin precedes the swallow ten days instead of rather after ; our swift a day later. Missel and Song thrush first arrive in early and middle March. The dog rose, R. canina, averages here half a month before white acacia, which there flowers first. Croaking and mating of frogs are a full month later; the ten flowerings 13 days and migrants 4 days. As in the table and with us bird divergences are small compared with plants.

Space precludes further comments on results over a range double that possible here. Yet even so an examination of contiguous high and low stations would be well worth while, based on data in our annual reports from 1891.

J. EDMUND CLARK.

Praktische Orkankunde mit Anweisungen zum Manövrieren in Stürmen. By Kapitän L. Schubart. Size $10\frac{1}{2} \times 7\frac{1}{2}$ in., pp. 143, *Illus.* Berlin, 1934.

The word "Orkan"—hurricane—is interpreted in its double sense of meaning either a wind of Beaufort force 12 or more, or a tropical revolving storm. Parts of the introductory section are concerned with the occurrence of winds of force 8 and above, and the last part, 3, deals with the navigation of ships in relation to the barometric depressions of middle latitudes; the remainder of the introductory chapter and the whole of Parts 1 and 2 are devoted to tropical revolving storms, the relation of these to navigation being the principal object of the book. This is essentially one for practical use, and the author has rightly avoided purely theoretical considerations, which would be out of place in such a treatise. He has, however, brought out very clearly the underlying uniformity in all tropical cyclones. This is in fact a theme which is sustained *sotto voce* throughout the work, and welds it into a pleasantly cohesive whole. In particular it is shown how the conditions in which tropical cyclones are formed are similar in all regions where they occur; the variations that are observed in their seasonal frequency and tracks arise from differences in the atmospheric environment, not from peculiarities in the cyclones themselves.

Part 1 (38 pages) is concerned with the explanation and description of hurricanes, the wind and weather associated with them, their tracks and regions of occurrence, etc. In Part 2 (63 pages) the emphasis is on the navigational aspect; section 1 gives rules for the recognition of the approach of a tropical cyclone at sea, and how to avoid it; section 2 deals with the navigation of a ship when under the influence of a cyclone. Among the usual indications of a distant cyclone, considerable space is devoted to the difference between the actual mean pressure for the day as estimated, and the true normal pressure. For this (and other) purposes, tables for barometer correction and conversion tables for temperature and pressure are included; it is shown how to make allowance for the semi-diurnal oscillation in estimating the mean pressure; and eight charts of normal pressures are reproduced covering the principal months and regions of cyclones. Whether the barometer is below or above normal is far from being an infallible test for the approach of a cyclone, and has to be considered in conjunction with all other available signs, but it is worthy of mention here as an illustration of the thoroughness which on the whole is maintained throughout the book.

The author accepts Meldrum's statement* that a large number of the cyclones of the South Indian Ocean are stationary, but this view has not found much favour with recent writers, and there is no apparent reason why these particular cyclones should be exceptional as a class. In this connexion he quotes a statement by R. A. Watson,† who gives the average life of a cyclone as 4½ days, but this appears to be a misunderstanding, for Watson's figure refers only to the existence of cyclones within certain limits, viz., between the equator and lat. 30° S., and long. 50° E. and 70° E., and therefore does not include the whole duration of many of those which pass through this region.

Apart from a few minor slips, the book is well produced and amply supplied with charts and diagrams. There is no index, but this defect is balanced by a full list of contents, while in the text the sectional headings are conspicuous and cross-refer ences abound. As the book contains what every navigator should know about tropical cyclones, it ought soon to find a place on every ship—but it needs translating first. A. F. CROSSLEY.

Meteorological Observations for 1932. Prepared in the Meteorological Office, Wellington. E. Kidson, D.Sc., Director, Wellington, N.Z. 1933.

The volume of New Zealand Meteorological Observations for 1932 contains much interesting material. In addition to the monthly tables of pressure, bright sunshine, wind velocity and earth temperatures at various stations, there are full climatological summaries for 54 places, including not only New Zealand but such outlying districts as the Cook Islands, Niue Island and Danger Island. Robinson cup anemometers are in use at 13 stations, and Campbell-Stokes sunshine recorders at 27. The last part of the report gives for Wellington for each month the average diurnal variation of pressure, temperature, rainfall and sunshine, and a number of measurements of solar radiation. The introduction includes a summary of the weather, from which we learn that the year 1932 was among the driest experienced in New Zealand during the last 70 years or more. The temperatures were generally below the average, and this is attributed to the canopy of volcanic ash from the Chilian volcanoes which was observed over New Zealand in the winter months.

---

* On a Periodicity in the Frequency of Cyclones in the Indian Ocean south of the Equator. *London Rep. Brit. Ass. II*, 1872, *p.* 56.

† The cyclone season 1928–1929 at Mauritius. *Misc. Pub., Royal Alfred Observatory, Mauritius, No.* 10.

BOOKS RECEIVED

Summary of the Meteorological Observations made at the Meteorological Stations in the Netherlands West Indies during the Years, 1932 *and* 1933, compiled by the Royal Dutch Meteor. Inst., The Hague, 1933 and 1934.

OBITUARY

Professor Thomas Agius.—We regret to learn of the death on October 19th of Prof. Thomas Agius, M.A., M.D., M.R.M.S., at the age of 63. Prof. Agius was keenly interested in the meteorology of Malta, and in 1902 he was appointed Professor of Physics in the University of Malta and Director of the University Observatory. He regularly prepared the climatological summaries which are published in the annual Colonial Reports for Malta; 200 reprints of these summaries are sent each year to the Air Ministry and are grouped with similar reprints from other Colonies in sets which are distributed to a number of meteorological institutions and libraries in all parts of the world. Until the establishment of a branch of the British Meteorological Office at Malta these reports were almost our only source of information about the climate and weather of the island of Malta. Prof. Agius also did much to popularise meteorology in Malta by lectures and articles, among which was an interesting account of the Gregale, and he wrote the chapter on the Climate of Malta in the book on "Malta and Gibraltar" published by Macmillan in 1915. He was Rector of the University from 1926 until he retired in March, 1933.

NEWS IN BRIEF

H.M. the King of Denmark and Iceland has nominated Dr. H. G. Cannegieter, Assistant Director of the Royal Meteorological Institute of Holland, a Great-Knight in the Order of the Icelandic Falcon as a recognition for the work done in Iceland during the Polar Year.

The Weather of October, 1934

Pressure was below normal over most of Alaska, the extreme north of Canada, northern Greenland, Spitsbergen, Iceland, Scandinavia and north Russia, and also over the southern North Atlantic, most of the eastern and central United States and California, the greatest deficits being 10·4 mb. at Thorshavn and 6·1 mb. at Barrow. Pressure was above normal in a band covering the Rocky Mountains, most of Canada and the Great Lakes, south Greenland, the Azores, south and central Europe and Asia Minor, the greatest excess being 4·6 mb. at Bayonne. Temperature and rainfall were both above normal in Sweden.

The main features of the weather of October over the British Isles were the deficiency of sunshine, the deficiency of rain in the south and the excess of rain in the north, and the high temperatures which prevailed except for a short period near the middle of the month and after the 28th. From the 1st to 8th depressions and associated secondaries crossed the British Isles, giving unsettled weather with bright intervals. Strong south-westerly winds veering to west and reaching gale force in places prevailed in the south on the 4th, and gales also occurred in north-west Scotland on the 6th and 7th and in the Shetlands on the 8th. Thunderstorms sometimes accompanied by hail or heavy rain were experienced fairly generally over the whole country on the 4th and 5th, but the heaviest rain fell on the 6th, 3·18 in. at Snowdon and 1·93 in. at Brecon. Temperature was high during this time, reaching 71° F. at Norwich and 70° F. at Gorleston on the 7th; the 5th was generally the sunniest day with 9·4 hrs. bright sunshine at Lowestoft and 9·2 hrs. at the Scilly Isles. From the 9th to 13th depressions moving eastwards caused unsettled conditions with rain and bright intervals in the north while the south came under the influence of the anticyclone extending from the Azores. Sunshine records were best on the 9th, when Edinburgh and Berwick-on-Tweed both recorded 10·0 hrs. bright sunshine and Scarborough 9·9 hrs. Westerly gales occurred in the Shetlands on the 10th and 12th. By the 14th the anticyclone over the Azores had spread northwards to Greenland in the rear of the depression which was moving south-east to the Baltic, and strong cold north-westerly winds veering north swept across the country. Gales were experienced at many exposed places and gusts of 79 m.p.h. were recorded at Fleetwood on the 14th and of 76 m.p.h. at Holyhead on the 15th. Temperature fell considerably but much sun was experienced on the 15th and 16th, 9·5 hrs. at Penzance on the 16th. Rain occurred at times over most of the country with hail and sleet at many places and snow in parts of Scotland. By the 18th the winds had backed between NW. and W. and the weather became mild again until the 28th; 68° F. was recorded at Aberdeen on the 20th and 66° F. at Cambridge and Tottenham on the 25th. During the 19th the wind backed to SW. and from then to the 28th depressions passed north-eastwards across the country, giving cloudy unsettled weather with heavy rain in the north and west at times and slight rain elsewhere; 3·81 in. fell at Aasleagh (Co. Mayo) on the 24th, 3·33 in. at Valentia (Co. Kerry) on the 24th (a record for 24 hrs. at this station), 2·11 in. at Snowdon on the 20th and 1·82 in. at Borrowdale on the 26th. Strong winds were experienced frequently and gales occurred in south-west England on the 25th and in various parts of Scotland on the 21st, 22nd, 25–28th. From the 29th to 31st pressure was high over the Atlantic and low over Scandinavia so that the British Isles came under the influence of polar air and wintry conditions spread even to south England by the 31st. Snow and sleet occurred generally in Scotland on the 30th and in England as well on the 31st, while rainfall was heavy locally on the 29th and 30th; 1·64 in. was measured at Ilderton (Northumberland) on the 30th. Widespread fog occurred in south-east England on the morning of the 31st and temperature did not reach 40° F. in most parts on that day. The distribution of bright sunshine for the month was as follows :—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway ...	71	− 8	Liverpool ...	64	−29
Aberdeen ...	112	+16	Ross-on-Wye ...	84	−16
Dublin	94	− 3	Falmouth ...	91	−22
Birr Castle ...	84	− 7	Gorleston ...	99	−18
Valentia... ...	64	−28	Kew	80	−13

Miscellaneous notes on weather abroad culled from various sources.

A sudden drop in temperature occurred in Switzerland on the 15th and snow fell over most of the country, to the level of Berne, and reached a depth of 1 ft. at the 3,000 ft. level ; a temperature of 11° F. was recorded at 4,000 ft. A hurricane swept across Cyprus on the 17th, killing 3 children and doing much damage to buildings. A severe storm passed across western Greece about the 18th, 2 people were killed at Agrinion and nearly all the houses in Astako were wrecked. (*The Times*, October 17th–19th.)

Sixty people were killed in typhoons which swept the coast of Indo-China on two successive days about the 5th. It was reported from India that the monsoon had withdrawn by the 10th. A typhoon struck Manila (Philippines) at 1 a.m. on the 16th, 4 people were killed and much damage done to property ; the main street was submerged by 3 ft. of water and several ships were driven ashore. Gales were were still raging between Manila and Hong Kong on the 17th. A typhoon was encountered on the 23rd 900 miles east of the Philippines and a typhoon also swept the district (186 miles in length) between Vinh and Bonge in Indo-China during the last week of the month—250 people were reported killed and 5,000 houses wrecked. (*The Times*, October 6th–November 3rd.)

A hurricane struck the Wairarapa district of New Zealand on the 1st, doing much material damage. Light to moderate rains fell in parts of Victoria and New South Wales early in the month, followed by good general rains before the 17th. An unexpected frost in north-eastern Victoria and the south Riverina in New South Wales about the 7th destroyed about £500,000 worth of fruit. Five years' drought in the northern part of central Australia was broken about the 10th and there were heavy falls of rain of over an inch in some places. Towards the end of the month further heavy rains occurred in Victoria and New South Wales, causing floods and the washing away of the railway line in places, and excellent rains also relieved the serious position in South Australia. (*The Times*, October 2nd–27th.)

After the snow at the beginning of the month high temperatures were experienced in Manitoba, Saskatchewan, Ontario and southern Quebec about the 13th, but east of Quebec City a winter snowstorm was raging on that day. Temperature was above normal in the

Western and Middle States for the first three weeks and variable in the north and east, while the rainfall was irregular in distribution but mainly deficient. A violent thunderstorm occurred in southern California on the 17th, accompanied by torrential rain, hail and a waterspout; 6 people were killed and many injured or rendered homeless. An earth tremor occurred at the same time. (*The Times*, October 13th–19th, and *Washington D.C., U.S. Dept. Agric., Weekly Weather and Crop Bulletins.*)

Daily Readings at Kew Observatory, October, 1934

Date	Pressure, M.S.L. 13h.	Wind, Dir., Force 13h.	Temp. Min.	Temp. Max.	Rel. Hum. 13h.	Rain.	Sun.	REMARKS. (see p. 1).
	mb.		°F.	°F.	%	in.	hrs.	
1	1014·4	SW.4	56	66	63	0·02	0·4	r 8h. 25m.–50m. [22h.
2	1007·4	NW.2	54	58	81	0·17	0·0	r_0r 5h.–17h., d 21h.–
3	997·7	SSW.4	49	61	73	0·05	0·3	pr_0 10h. rr_0 17h.–18h.
4	985·4	SW.5	51	61	64	0·06	6·4	r_0r 4h.–6h. & 17h.
5	1005·2	WSW.3	46	59	56	trace	5·0	pr_0 8h. & 16h. pr 18h.
6	1023·9	SSW.3	44	57	78	0·15	0·2	r_0r 12h. 30m.–20h.
7	1025·9	SW.4	54	65	87	0·03	0·1	r_0r 19h.–24h.
8	1029·2	NNE.2	56	61	64	0·12	1·7	rr_0 0h.–5h. r_0 7h.20m.
9	1025·7	NNW.3	43	58	51	—	4·7	
10	1029·0	WSW.3	48	63	67	trace	3·8	r_0 20h. & 21h. 15m.–
11	1029·7	W.3	56	64	64	—	7·0	[30m.
12	1028·1	WSW.3	47	61	64	—	5·1	f till 9h.
13	1029·3	WSW.2	52	63	73	trace	0·1	$r_0$7h., 18h. 30m. & 20h.
14	1016·1	W.4	56	61	51	trace	0·2	r_0 22h., 23h. & 24h.
15	1005·6	NW.4	44	49	52	0·01	4·6	r 2h.15m.–25m.
16	1021·6	NNW.5	37	51	60	trace	4·1	pr_0 7h., 15h. & 17h.
17	1014·4	WNW.3	41	50	86	0·12	0·0	rr_0 3h.–9h. & 15h.–17h.
18	1017·3	W.2	45	57	77	trace	0·1	d_0d 1h. 40m.–5h. 35m.
19	1019·1	NNW.2	51	59	60	—	3·2	
20	1018·1	SW.3	53	59	85	0·02	0·0	r_0r 6h. 25m.–8h.
21	1015·2	SSW.4	53	59	75	trace	0·3	d_0 9h. & 10h.–12h.
22	1008·5	WSW.4	56	60	48	trace	5·3	d 6h. 20m.
23	1012·7	W.2	45	57	58	—	7·5	z 18h.
24	1014·4	SSW.4	42	60	65	—	2·0	
25	1006·6	S.4	52	64	73	0·03	1·7	r_0r 18h.–19h. 45m.
26	1016·7	WSW.4	49	58	57	—	5·5	
27	1012·5	SW.5	49	57	65	trace	1·0	d_0 20h.
28	1012·2	W.4	51	55	54	trace	1·9	pr_0 7h. & 9h. 30m.
29	1012·1	WNW.3	38	51	53	—	7·2	x early.
30	1005·6	SW.2	34	47	73	trace	0·4	x m early, r_0 18h. [19h.
31	1007·2	NW.3	29	40	83	0·07	0·0	x F m ; d_0rs_0 13h.–
*	1015·1		48	58	66	0·85	2·6	* Means or totals.

General Rainfall for October, 1934

England and Wales ...	79	per cent of the average 1881-1915.
Scotland	155	
Ireland	127	
British Isles	107	

Rainfall : October, 1934 : England and Wales

Co.	Station.	In.	Per cent of Av.
Lond .	Camden Square	1·09	41
Sur .	Reigate, Wray Pk. Rd.	2·46	74
Kent .	Tenterden, Ashenden	2·32	66
,, .	Folkestone, Boro. San.	1·86	...
,, .	Eden'bdg., Falconhurst	2·64	73
,, .	Sevenoaks, Speldhurst.	1·74	...
Sus .	Compton, Compton Ho.	2·34	51
,, .	Patching Farm	2·16	55
,, .	Eastbourne, Wil. Sq.	2·96	71
,, .	Heathfield, Barklye	2·34	56
Hants.	Ventnor, Roy.Nat.Hos.	2·26	58
,, .	Fordingbridge, Oaklnds	1·81	44
,, .	Ovington Rectory	1·74	43
,, .	Sherborne St. John	1·29	37
Herts .	Welwyn Garden City	1·42	51
Bucks.	Slough, Upton	1·58	56
,, .	H. Wycombe, Flackwell	1·67	51
Oxf .	Oxford, Mag. College	1·36	49
Nor .	Pitsford, Sedgebrook	1·39	52
,, .	Oundle	·81	...
Beds .	Woburn, Exptl. Farm	1·67	63
Cam .	Cambridge, Bot. Gdns.	1·78	75
Essex .	Chelmsford, County Lab	1·41	68
,, .	Lexden Hill House	2·01	...
Suff .	Haughley House	1·08	...
,, .	Campsea Ashe	1·39	53
,, .	Lowestoft Sec. School	1·49	53
,, .	Bury St. Ed., WestleyH.	1·39	51
Norf. .	Wells, Holkham Hall	1·51	54
Wilts .	Calne, Castleway	2·08	65
,, .	Porton, W.D. Exp'l. Stn	1·17	37
Dor .	Evershot, Melbury Ho.	3·01	65
,, .	Weymouth, Westham.	1·85	51
,, .	Shaftesbury, Abbey Ho.	1·81	46
Devon.	Plymouth, The Hoe	3·02	76
,, .	Holne, Church Pk. Cott.	6·60	100
,, .	Teignmouth, Den Gdns.	2·41	63
,, .	Cullompton	2·93	71
,, .	Sidmouth, U.D.C.	2·32	...
,, .	Barnstaple, N. Dev.Ath	3·77	83
,, .	Dartm'r, Cranmere Pool	8·40	...
,, .	Okehampton, Uplands.	5·73	95
Corn .	Redruth, Trewirgie	3·91	74
,, .	Penzance, Morrab Gdn.	3·08	60
,, .	St. Austell, Trevarna	4·76	90
Soms .	Chewton Mendip	3·37	70
,, .	Long Ashton	2·21	58
,, .	Street, Millfield	2·42	74
Glos .	Blockley	1·35	...
,, .	Cirencester, Gwynfa	2·05	62
Here .	Ross, Birchlea	1·34	41
Salop .	Church Stretton	2·96	82
,, .	Shifnal, Hatton Grange	2·51	89
Staffs .	Market Drayt'n, Old Sp.	3·04	99
Worc .	Ombersley, Holt Lock.	1·06	40
War .	Alcester, Ragley Hall	1·21	44
,, .	Birminghm, Edgbaston	1·65	59
Leics .	Thornton Reservoir	1·81	64
,, .	Belvoir Castle	1·07	40
Rut .	Ridlington	1·27	45
Lincs .	Boston, Skirbeck	1·17	43
,, .	Cranwell Aerodrome	·98	34
,, .	Skegness, Marine Gdns.	1·18	43
,, .	Louth, Westgate	1·36	42
,, .	Brigg, Wrawby St.	1·21	...
Notts .	Worksop, Hodsock	1·28	49
Derby.	Derby, L. M. & S. Rly.	1·54	59
,, .	Buxton, Terr. Slopes	5·89	120
Ches .	Runcorn, Weston Pt.	3·89	113
Lancs.	Manchester, Whit. Pk.	4·58	139
,, .	Stonyhurst College	8·08	180
,, .	Southport, Bedford Pk.	4·37	123
,, .	Lancaster, Greg Obsy.	6·40	156
Yorks.	Wath-upon-Dearne	1·45	52
,, .	Wakefield, Clarence Pk.	1·62	56
,, .	Oughtershaw Hall	10·96	...
,, .	Wetherby, Ribston H.	2·07	69
,, .	Hull, Pearson Park	1·56	52
,, .	Holme-on-Spalding	1·80	60
,, .	West Witton, Ivy Ho.	4·88	131
,, .	Felixkirk, Mt. St. John.	2·77	96
,, .	York, Museum Gdns.	1·35	50
,, .	Pickering, Hungate	2·12	70
,, .	Scarborough	2·29	73
,, .	Middlesbrough	2·65	88
,, .	Baldersdale, Hury Res.	5·89	148
Durh .	Ushaw College	3·50	102
Nor .	Newcastle, Town Moor.	3·39	106
,, .	Bellingham, Highgreen	5·98	153
,, .	Lilburn Tower Gdns.	5·31	143
Cumb.	Carlisle, Scaleby Hall	4·65	139
,, .	Borrowdale, Seathwaite	21·00	184
,, .	Borrowdale, Moraine	16·94	187
,, .	Keswick, High Hill	8·66	155
West .	Appleby, Castle Bank	6·00	172
Mon .	Abergavenny, Larchf'd	2·90	69
Glam .	Ystalyfera, Wern Ho.	6·65	97
,, .	Cardiff, Ely P. Stn.	3·30	69
,, .	Treherbert, Tynywaun.	10·19	...
Carm .	Carmarthen, Priory St.	5·01	88
Pemb .	Haverfordwest, School.	...	...
Card .	Aberystwyth	4·72	...
Rad .	BirmW.W.Tyrmynydd	6·64	100
Mont .	Lake Vyrnwy	7·35	129
Flint .	Sealand Aerodrome	2·82	93
Mer .	Dolgelley, Bontddu	10·92	180
Carn .	Llandudno	3·94	117
,, .	Snowdon, L. Llydaw 9.	25·73	...
Ang .	Holyhead, Salt Island	4·79	120
,, .	Lligwy	5·84	...
Isle of Man			
	Douglas, Boro' Cem.	6·00	130
Guernsey			
	St. PeterP't.Grange Rd.	3·31	74

Rainfall: October, 1934: Scotland and Ireland

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Wig .	Pt. William, Monreith.	6·01	152	*Suth* .	Melvich	7·38	201
,, .	New Luce School	8·05	172	,, .	Loch More, Achfary	17·52	225
Kirk .	Dalry, Glendarroch	7·93	151	*Caith* .	Wick	4·89	165
,, .	Carsphairn, Shiel	12·81	181	*Ork* .	Deerness	5·90	156
Dumf.	Dumfries, Crichton, R.I.	4·87	131	*Shet* .	Lerwick	6·03	153
,, .	Eskdalemuir Obs.	9·76	181	*Cork* .	Caheragh Rectory	5·36	...
Roxb .	Branxholm	6·11	188	,, .	Dunmanway Rectory	6·22	104
Selk .	Ettrick Manse	9·15	166	,, .	Cork, University Coll.	3·50	90
Peeb .	West Linton	6·50	...	,, .	Ballinacurra	2·76	68
Berw .	Marchmont House	4·22	110	,, .	Mallow, Longueville	4·26	118
E.Lot .	North Berwick Res.	2·46	83	*Kerry*.	Valentia Obsy	7·03	126
Midl .	Edinburgh, Roy. Obs.	3·27	119	,, .	Gearhameen	12·10	133
Lan .	Auchtyfardle	6·72	...	,, .	Darrynane Abbey	4·50	89
Ayr .	Kilmarnock, Kay Pk.	6·95	...	*Wat* .	Waterford, Gortmore	3·29	84
,, .	Girvan, Pinmore	6·54	131	*Tip* .	Nenagh, Cas. Lough	4·68	138
Renf .	Glasgow, Queen's Pk.	6·35	195	,, .	Roscrea, Timoney Park	3·60	...
,, .	Greenock, Prospect H.	9·23	172	,, .	Cashel, Ballinamona	3·27	91
Bute .	Rothesay, Ardencraig	9·66	...	*Lim* .	Foynes, Coolnanes	4·05	109
,, .	Dougarie Lodge	8·05	...	,, .	Castleconnel Rec.	4·16	...
Arg .	Ardgour House	16·77	...	*Clare* .	Inagh, Mount Callan	8·35	...
,, .	Glen Etive	18·62	230	,, .	Broadford, Hurdlest'n.	3·70	...
,, .	Oban	9·40	...	*Wexf* .	Gorey, Courtown Ho.	4·19	118
,, .	Poltalloch	10·73	217	*Wick* .	Rathnew, Clonmannon.	3·28	...
,, .	Inveraray Castle	13·59	193	*Carl* .	Hacketstown Rectory	3·16	83
,, .	Islay, Eallabus	9·88	207	*Leix* .	Blandsfort House	3·29	93
,, .	Mull, Benmore	...	...	,, .	Mountmellick	3·79	...
,, .	Tiree	...	...	*Offaly*.	Birr Castle	3·47	119
Kinr .	Loch Leven Sluice	4·17	121	*Dublin*	Dublin, FitzWm. Sq.	1·87	70
Perth .	Loch Dhu	13·40	187	,, .	Balbriggan, Ardgillan	2·77	103
,, .	Balquhidder, Stronvar.	8·45	...	*Meath*.	Beauparc, St. Cloud	2·74	...
,, .	Crieff, Strathearn Hyd.	5·40	137	,, .	Kells, Headfort	3·39	101
,, .	Blair Castle Gardens	5·63	182	*W.M* .	Moate, Coolatore	4·49	...
Angus.	Kettins School	3·21	101	,, .	Mullingar, Belvedere	4·48	144
,, .	Pearsie House	4·17	...	*Long* .	Castle Forbes Gdns	5·30	163
,, .	Montrose, Sunnyside	3·16	114	*Gal* .	Galway, Grammar Sch.	4·81	...
Aber .	Braemar, Bank	4·41	117	,, .	Ballynahinch Castle	9·16	153
,, .	Logie Coldstone Sch.	3·33	103	,, .	Ahascragh, Clonbrock.	5·29	145
,, .	Aberdeen, King's Coll.	3·48	116	*Mayo*.	Blacksod Point	7·87	158
,, .	Fyvie Castle	4·18	109	,, .	Mallaranny	9·66	...
Moray	Gordon Castle	3·92	124	,, .	Westport House	7·51	167
,, .	Grantown-on-Spey	4·80	162	,, .	Delphi Lodge	15·93	168
Nairn.	Nairn	2·52	107	*Sligo* .	Markree Obsy	6·22	153
Inv's .	Ben Alder Lodge	7·13	...	*Cavan*.	Crossdoney, Kevit Cas.	5·09	...
,, .	Kingussie, The Birches.	5·03	...	*Ferm* .	Enniskillen, Portora	4·63	...
,, .	Inverness, Culduthel R.	3·28	...	*Arm* .	Armagh Obsy	4·50	165
,, .	Loch Quoich, Loan	...	...	*Down*.	Fofanny Reservoir	9·25	...
,, .	Glenquoich	20·63	206	,, .	Seaforde	5·32	149
,, .	Arisaig, Faire-na-Sguir.	7·81	...	,, .	Donaghadee, C. Stn.	4·31	149
,, .	Fort William, Glasdrum	11·89	...	,, .	Banbridge, Milltown	3·74	135
,, .	Skye, Dunvegan	8·88	...	*Antr* .	Belfast, Cavehill Rd.	4·92	...
,, .	Barra, Skallary	6·61	...	,, .	Aldergrove Aerodrome.	3·93	131
R&C .	Alness, Ardross Castle.	6·16	160	,, .	Ballymena, Harryville.	5·53	150
,, .	Ullapool	8·37	173	*Lon* .	Garvagh, Moneydig	5·74	...
,, .	Achnashellach	13·72	171	,, .	Londonderry, Creggan.	7·53	204
,, .	Stornoway	6·65	128	*Tyr* .	Omagh, Edenfel	5·73	156
Suth .	Lairg	7·70	206	*Don* .	Malin Head	6·61	...
,, .	Tongue	6·30	150	,, .	Killybegs, Rockmount.	...	...

Climatological Table for the British Empire, May, 1934

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	1019·3	+ 3·4	79	37	63·9	46·2	55·1	+ 1·7	47·6	76	7·0	0·44	− 1·28	8	6·49	42
Gibraltar	1016·4	+ 0·3	83	50	73·1	58·2	65·7	+ 0·2	56·7	79	4·0	0·13	− 1·44	3	...	...
Malta	1015·0	+ 0·5	80	57	71·9	61·4	66·7	+ 0·8	61·3	74	4·6	0·47	+ 0·06	4	9·68	69
St. Helena	1013·2	+ 0·1	72	57	66·7	60·0	63·3	+ 0·2	60·5	91	8·8	2·19	...	14	...	...
Freetown, Sierra Leone	1012·3	+ 1·1	91	63	88·3	69·8	79·1	− 2·4	79·0	87	7·7	2·64	− 8·83	3	...	...
Lagos, Nigeria	1010·3	− 0·3	92	71	86·6	76·1	81·3	− 0·5	76·9	84	7·3	5·38	− 5·37	15	6·2	50
Kaduna, Nigeria	1006·3	...	98	68	90·8	72·0	81·4	+ 2·0	73·2	79	8·6	6·26	+ 0·56	14	6·4	51
Zomba, Nyasaland	1014·7	− 0·4	81	51	78·3	57·7	68·0	+ 2·2	64·2	72	4·6	0·09	− 0·95	3	...	...
Salisbury, Rhodesia	1016·6	− 0·8	81	45	75·9	49·9	62·9	+ 2·3	55·6	58	1·5	0·09	− 0·39	3	8·7	77
Cape Town	1015·8	− 2·3	82	44	69·1	52·3	60·7	+ 1·8	54·5	93	6·4	4·40	+ 0·65	12	...	...
Johannesburg	1018·3	0·0	78	34	66·6	46·6	56·6	+ 2·2	47·6	61	2·8	1·94	+ 1·18	7	8·4	77
Mauritius	1017·6	+ 1·2	82	63	78·6	67·6	73·1	+ 0·5	70·3	80	7·0	11·65	+ 8·62	27	5·6	50
Calcutta, Alipore Obsy.	1003·2	− 0·3	105	69	96·9	79·6	88·3	+ 2·2	81·3	85	5·2	2·55	− 3·01	4*	...	...
Bombay	1008·3	+ 0·9	93	77	91·6	79·5	85·5	− 0·3	77·3	73	2·7	0·00	− 0·55	0*	...	...
Madras	1005·6	+ 0·2	110	77	97·8	81·7	89·7	− 0·1	78·6	65	5·2	0·00	− 1·84	0*	...	...
Colombo, Ceylon	1010·0	+ 1·6	88	71	86·4	77·9	82·1	− 0·7	78·6	79	6·6	8·61	− 2·33	18	7·9	64
Singapore	1009·0	+ 0·3	90	71	87·9	75·9	81·9	− 0·1	78·3	80	8·1	12·12	+ 5·48	14	7·4	61
Hongkong	1008·8	− 0·3	90	66	81·3	73·8	77·5	+ 0·1	72·7	78	8·5	8·73	− 3·34	12	4·5	34
Sandakan	1010·1	...	92	74	90·0	75·2	82·6	+ 0·1	77·9	82	5·2	3·98	− 2·35	11	...	...
Sydney, N.S.W.	1023·9	+ 5·3	77	48	67·9	52·9	60·4	+ 1·6	55·3	82	5·0	5·11	− 0·07	15	5·8	56
Melbourne	1025·7	+ 6·5	76	37	65·0	46·2	55·6	+ 1·5	49·6	82	6·5	0·14	− 2·02	3	5·9	58
Adelaide	1025·0	+ 5·0	81	43	72·6	49·8	61·2	+ 3·3	52·1	52	5·0	0·10	− 2·68	3	6·6	65
Perth, W. Australia	1017·9	− 0·5	84	42	73·3	56·3	64·8	+ 4·1	57·0	67	4·7	4·88	− 0·09	13	5·9	57
Coolgardie	1018·7	− 0·7	83	41	76·0	51·6	63·8	+ 6·1	56·8	63	3·4	0·10	− 1·23	2	...	...
Brisbane	1021·1	− 2·5	78	48	72·3	56·0	64·1	− 0·5	58·7	74	5·0	2·39	− 0·42	13	6·1	57
Hobart, Tasmania	1022·8	+ 7·5	71	37	60·8	47·2	54·0	+ 3·5	48·0	70	5·9	0·28	− 1·62	7	4·6	47
Wellington, N.Z.	1018·5	+ 2·9	67	35	55·5	45·0	50·3	− 2·5	47·5	77	6·9	4·53	− 0·15	12	3·7	37
Suva, Fiji	1012·9	− 0·2	88	69	80·0	72·0	76·0	− 0·5	72·5	85	8·4	20·92	+ 10·85	25	2·3	20
Apia, Samoa	1010·8	− 0·3	87	73	84·8	74·7	79·7	+ 1·3	76·4	81	6·7	6·09	+ 0·02	17	...	...
Kingston, Jamaica	1012·9	− 0·2	87	69	86·1	72·5	79·3	− 0·4	72·9	77	7·9	1·93	− 2·46	4	7·0	54
Grenada, W.I.	1010·5	− 2·1	88	71	85	72	78·5	− 1·2	72·0	70	6	8·09	+ 3·90	21	...	...
Toronto	1015·6	+ 0·7	86	34	69·4	46·0	57·7	+ 3·9	48·6	54	3·4	0·47	− 2·32	4	10·3	70
Winnipeg	1012·6	− 1·2	99	18	69·6	42·9	56·3	+ 4·3	43·5	67	5·0	0·63	− 1·37	6	...	...
St. John, N.B.	1013·9	0·0	78	33	58·5	41·6	50·1	+ 2·4	45·6	73	6·1	2·16	− 1·55	12	6·4	43
Victoria, B.C.	1016·2	− 0·5	75	41	61·5	48·1	54·8	+ 1·8	51·0	79	5·6	1·22	+ 0·09	12	8·1	53

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

(23246) Wt.25/32 1,000 11/34 Hw. G.377/6