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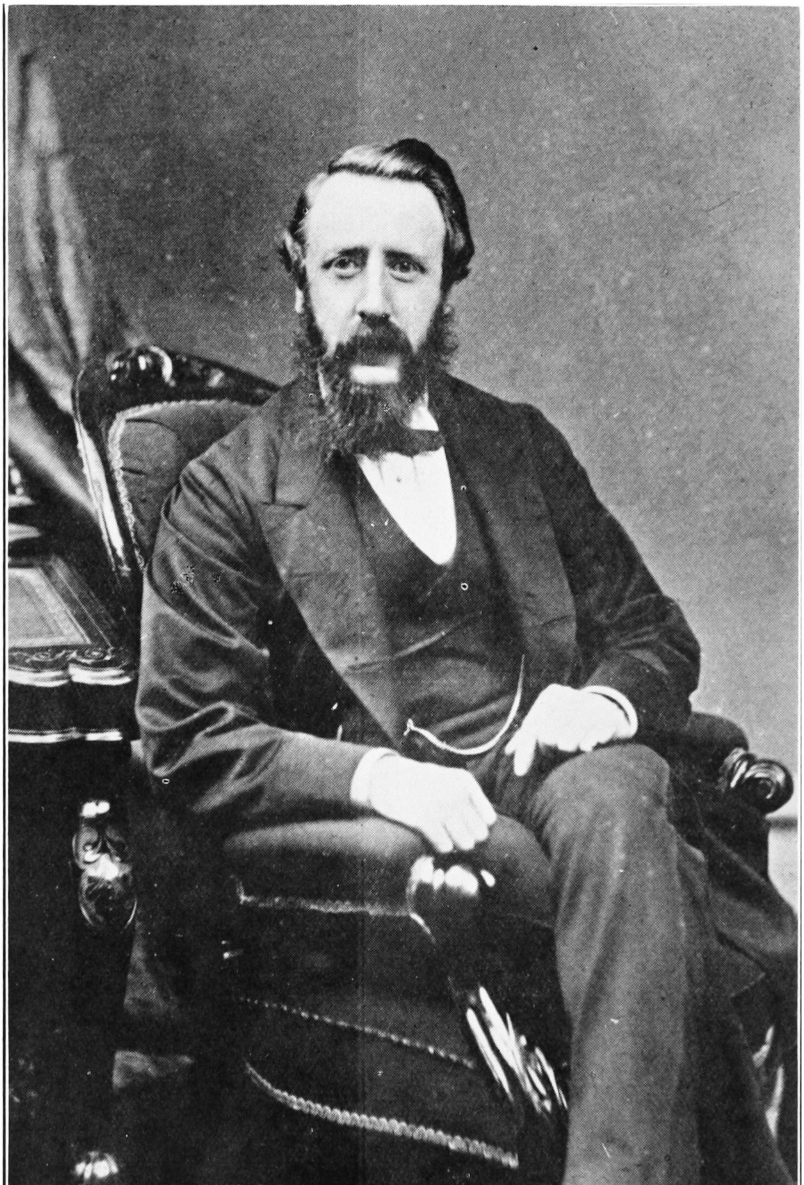

G. J. SYMONS AT THE AGE OF THIRTY-FIVE
(*from a photograph taken at Bradford in 1873*)

M.O. 422.

The Meteorological Magazine

Air Ministry: Meteorological Office

Vol. 73

August, 1938

No. 871

LONDON: PRINTED AND PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE

To be purchased directly from H.M. STATIONERY OFFICE at the following addresses: York House, Kingsway, London, W.C.2; 120 George Street, Edinburgh 2; 26 York Street, Manchester 1; 1 St. Andrew's Crescent, Cardiff; 80 Chichester Street, Belfast; or through any bookseller.

George James Symons, F.R.S.

BORN AUGUST 6, 1838; DIED MARCH 10, 1900.

In this number of the Meteorological Magazine we commemorate the centenary of the birth of the founder of the British Rainfall Organization and of this Magazine. For the article which follows we are indebted to Dr. H. R. Mill, Director of the British Rainfall Organization from 1903 to 1919. The portrait which forms the frontispiece is reproduced from a photograph in the possession of Mr. H. Sowerby Wallis, by whose courtesy it is now published. Readers of the Magazine will share our pleasure in the fact that both Mr. Wallis, who was intimately associated with Symons for a period of twenty-eight years, and Dr. Mill his successor as Director and Editor of the Magazine, are able to join with us on this occasion in doing honour to the memory of our founder.

The Scientific Work of George James Symons, F.R.S.

Symons was born on August 6th, 1838, in the spring of the nineteenth century when the new spirit of research and discovery was stimulating youth to make of the Victorian era from its outset a triumph of effort and optimism.

He grew up along with the growth of all that distinguished his century from those that went before—the strength of steel, the power of steam, the instantaneity of the electric telegraph and the blossoming of all the specialized Societies which promoted science and its practical applications. It was as natural for a quick-witted sympathetic boy finding himself in such a field of intellectual force to feel drawn towards science as for a magnet to swing towards the north. Had he received the discipline of thorough scientific training before he entered on scientific work he might have become one of the greatest men of science of his time. As it was, after a fair education at private schools and a brief course at the School of Mines he joined the recently founded British Meteorological Society at the age of eighteen, took part in the discussions in the following year and read a paper on thunderstorms before he was twenty. I doubt if he ever grasped the value of mathematics or the importance of theoretical reasoning. His mind was objective, guided always by shrewd common sense and impelled by an undying fire of enthusiasm. He was essentially a collector of facts, a keen critic in the cause of accuracy and a faithful chronicler of things as he found them. The results he obtained interested him in their application to practical affairs rather than in their bearing on scientific principles. At the age of twenty-two he attracted the attention of Admiral Fitzroy, famous for his voyage with Darwin in the *Beagle*, and obtained a post under him as a clerk in the Meteorological Department of the Board of Trade, which was the humble chrysalis whence the Meteorological Office of the Air Ministry eventually emerged. Symons found the type of office routine to which the name of Red Tape is applied particularly irksome because it cramped his scope. In the course of his official duties he was struck by the extreme inadequacy of the available observations of rainfall. So he proceeded to make a systematic collection of all those he could find, and appealed to the public for additional observers. This was not considered a suitable subject to occupy official time and, stung by the reproof of his superiors, young Symons resigned from the service of the State. In perfect freedom his genius for classification and organization drove him forward like a discoverer in a new world. His shrewd common sense controlled his enthusiasm and enabled him to devise methods of computation, checking and book-keeping which, while rigidly thorough, were so economical of space and time that he was able as years went on to maintain personal contact with his growing army of observers and to guide them into habits of order and accuracy, without himself neglecting an item of routine. With it all he developed a power of making friends with people of all social grades and of every mental range from the most eminent men of science to the merest dabblers in harmless hobbies.

Unquestionably the greatest contribution which Symons made to Science was the foundation and the building-up of the British Rainfall Organization with its annual publication, *British Rainfall*, and its journal, *Symons' Monthly Meteorological Magazine.*

In *British Rainfall*, 1860–61, there were records of 472 stations using instruments of widely different patterns, set at different heights above the ground, read at various hours and recorded often to different dates. *British Rainfall*, 1899, with the last records he collected gave results from 3,501 stations measured in rain gauges of approved and practically uniform pattern, set with very few exceptions at the uniform height of 1 foot, read in the case of daily gauges, which most of them were, at 9 a.m. and dated for the commencement of the 24 hours preceding the reading.

This close approach to systematic uniformity was the result of continuous research and supervision. Some idea of the vast amount of work done by Symons and those whom he directed may be obtained from "The Development of Rainfall Measurement in the last forty years" in *British Rainfall*, 1900, where references are given to many long series of experiments carried out to determine the best material, form and exposure of rain gauges, together with special studies to provide definitions of terms used in describing rainfall and the investigation of remarkable cases of heavy or continuous rains and of droughts.

Profiting by the lessons of past experience Symons made every issue of *British Rainfall* better than its predecessor and gradually brought his army of helpers to work together and accumulate a vast store of mutually interdependent data.

Much, perhaps most, of Symons's work embodied in these publications escaped cataloguing, but he is credited in the Royal Society's "Catalogue of Scientific Literature" with 46 entries. These deal largely with rainfall matters but they have a much wider range. He made a remarkable collection of books on meteorology dating from the earliest times, which on his death was added to the library of the Royal Meteorological Society and together with the Bibliography of Meteorology, on which he spent much time, is invaluable to the student of the history of weather science. In many other ways he did much to enhance the reputation of the Royal Meteorological Society in which he delighted to serve in every honorary office from Secretary to President. He made collections and catalogues of all varieties of meteorological instruments from the most primitive attempts to modern recording apparatus. He invented the Brontometer for the simultaneous record on a quick-running drum of barometric pressure, temperature, wind and rainfall with means for adding by hand the moment when lightning flashes were seen and thunder heard. Preliminary observations with this instrument were given in a paper to the Royal Society in 1890.

Whirlwinds, which had a peculiar fascination for him, snow-storms and floods formed the subject of many papers, his interest centering in their locality, incidence and effects, rather than in their cause. Except for a map of average rainfall based on a short but singularly representative period Symons made little use of cartographical method, his monthly and annual sketch maps of departures from the average published in *British Rainfall* being mere diagrams.

His almost instinctive genius for the collection and interpretation of instrumental records extended beyond his special sphere of rainfall. For many years he laboured for the Underground Temperature Committee of the British Association collecting records from all parts of the world. His small but valuable monograph on the "Floating Island of Derwent Water" made it clear that the phenomenon was not a mere legend but a huge blister of the felt-like layer of vegetable matter on the bottom of the lake which at times was inflated by decomposition gases until it appeared like a green islet on the surface.

His largest undertaking was the investigation he carried out for the Royal Society of the distribution of the dust from the volcanic outburst of Krakatoa in 1883 which he traced throughout the whole atmosphere all round the world. The report fills a substantial volume of the Transactions of the Royal Society and is a fine example of the large-scale expression of Symons's peculiar genius.

One cannot speak of Symons's work without a word about his attractive personality. His fresh complexion, prematurely white hair and beard, and especially his kindly humorous eyes made him a conspicuous figure at all scientific gatherings. I seem to see him still as I used to see him fifty years ago in the crowded receptions of the British Association passing from group to group of old friends with the button of the Legion of Honour in his coat and a smile of complacent geniality. He had always something pleasant to say and delighted in telling good stories and dropping hints helpful to young observers. He was always ready to act on committees and he always found time to answer letters with the promptitude of a busy man and the clearness natural to a well-stored mind and retentive memory. His loyalty to old friends was a feature of his character, and he gave a fine instance of it in his life-long association with a friend of his boyhood who became a printer and produced every volume of *British Rainfall* and every number of the *Meteorological Magazine* for more than half a century.

Symons had a wide knowledge of human nature and amazing tact in dealing with and getting the best out of people of every kind.

HUGH ROBERT MILL.

Style in Meteorological Literature

BY ELIZABETH KIDNER

Nowadays the pursuit of meteorology does not tend to inspire the highest flights of penmanship. A modern meteorologist is concerned mainly with calculations and in the exposition of these it remains only for him to aim at such austere qualities as brevity, lucidity and undeviating accuracy. When the science was in its infancy, however, it was the pet of philosophers and nature lovers, and the meteorological writings of those times are the result of an intense appreciation of the phenomena on which they treat, which produced a generally high standard of descriptive composition. The following account of a sea-breeze is taken from Dampier's "Discourse on Winds"[1] :—

"It comes in a fine, small, black Curle upon the Water, whenas all the Sea between it, and the shore not yet reach'd by it, is as smooth and even as Glass in Comparison ; in half a Hour's time after it has reached the shore it fans pretty briskly, and so increaseth gradually till 12 a Clock, when it is commonly strongest, and lasts so till 2 or 3 a very brisk gale ; about 12 Noon it also veres off to Sea 2 or 3 Points, or more in very fair Weather. After 3 a Clock it begins to dye away again, and gradually withdraws its force till all is spent, and about 5 a Clock, sooner or later, according as the Weather is, it is lull'd asleep, and comes no more till the next Morning."

Another example may be quoted from the Rev. W. Derham, whose annotated sermons, covering the whole field of natural history, are contained in a volume of " Physico-Theology " [2] :—

" By Reflecting the Light of the heavenly Bodies to us, I mean that Whiteness, or Lightness which is in the Air in Day-time, caused by the Rays of Light Striking upon the Particles of the Atmosphere, as well as upon the Clouds above, and the other Objects beneath upon the Earth. To the same Cause also we owe the Twilight, *viz.*, to the Sun-beams touching the uppermost Particles of our Atmosphere, which they do when the Sun is about Eighteen Degrees beneath the Horizon. And as the Beams reach more and more of the Airy Particles, so Darkness goes off, and Day-light comes on, and encreaseth."

These authors did not disdain to classify and to make laws, but their rulings were based on pictorial and naturalistic considerations which make them very pleasant reading. This is Francis Bacon's primary division of the winds[3] :—

" Windes are either generall or precise, either peculiar, or free. I call them generall which always blow ; precise, those which blow at certaine times : Attendants or Peculiar, those which blow most commonly : Free Windes, those which blow indifferently, or at any time."

This is Robert Boyle's idea of cold[4] :—

" We made three Differences of the Cold, all according to the Places : In our House, in the Woods, and in the open Air."

And here is one of the Shepherd of Banbury's rules[5] :—

" In Summer or Harvest, when the Wind has been South two or three Days and it grows very hot, and you see Clouds rise with great white tops like Towers, as if one were upon the Top of another, and joined together with black on the nether Side, there will be Thunder and Rain suddenly."

Much of the literature of that period is filled with the sense of mystery and portent which for many people even now accompanies the experience of the more violent freaks of the weather. Thus Daniel Defoe in his account of the great storm of November 26th, 1703[6] :—

" The wind by its unusual Violence made such a noise in the Air as had a resemblance to Thunder ; and 'twas observ'd, the roaring had a Voice as much louder than usual, as the Fury of the Wind was greater than was ever known : the Noise had also something in it more formidable ; it sounded aloft, and roar'd not very much unlike remote Thunder" . . . . "In the Countries the Air was seen full of Meteors and vaporous Fires: and in some places both Thundrings and unusual Flashes of Lightning, to the great terror of the Inhabitants."

In contrast to this is the dramatic effect achieved by Gilbert White by totally different means. Though employing the most unpretentious language, and confining himself usually to a statement of observational facts, he nevertheless contrives to hold his reader in a fascinating state of expectation. The following is an extract from his letter to the Hon. Daines Barrington describing the frost of January, 1776[7]:—

"On the fourteenth, the writer was obliged to be much abroad; and thinks he never before, or since, has encountered such rugged Siberian weather. Many of the narrow roads are now filled above the tops of the hedges; through which the snow was driven in most romantic and grotesque shapes, so striking to the imagination, as not to be seen without wonder or pleasure. The poultry dared not to stir out of their roosting places; . . . ."

Gilbert White's letters must rank among the very best of weather records. The simplicity and sincerity with which he writes constitute a very charming and dignified style.

During the nineteenth century meteorological literature gradually assumed a more and more strictly scientific aspect. Ruskin, however, for whom the scenic qualities of meteorology had much attraction, was grateful that his mind was still "capable of imaginative vision and liable to the noble dangers of delusion," and he contributed several papers from which many beautiful passages could be quoted. This is perhaps one of the best[8]:—

"But it (meteorology) is a science of the pure air, and the bright heaven; its thoughts are amidst the loveliness of creation; it leads the mind, as well as the eye, to the morning mist, and the noon-day glory and the twilight cloud,—to the purple peace of the mountain heaven,—to the cloudy repose of the green valley; now expiating in the silence of the stormless aether,—now on the rushing of the wings of the wind. It is indeed a knowledge, which must be felt to be, in its very essence, full of the soul of the beautiful."

Robert Louis Stevenson was the author of a meteorological paper and the following extract illustrates the lucidity with which he propounds his theme[9]:—

"In the first place, then, the mass of foliage may be expected to increase the radiating power of each tree. The upper leaves radiate freely towards the stars and the cold inter-stellar spaces, while the lower ones radiate to those above and receive less heat in return; consequently, during the absence of the sun, each tree cools gradually downward from top to bottom."

From the mass of modern meteorological literature, Mr. G. J. Symons's writings stand out by virtue of the freedom and vigour of his style and his frequent use of comparisons to emphasize his point. For example[10] :—

" Years ago, when the Meteorological Office was shut up from the afternoon of Saturday to the morning of Monday, I urged that it was impossible to avoid one of two alternatives. Either storm warnings were useful, in which case it was as wrong to stop them on Sunday as it would be to extinguish every lighthouse lamp on Saturday night, or they were useless and therefore should be abandoned entirely."

Mr. W. H. Dines wrote in a more conventional manner, with faultless composition and also with great clarity. For instance[11] :—

" Taking the earth's atmosphere as a system by itself, its angular momentum remains practically constant from year to year about the earth's axis : therefore the total couple due to all the forces acting upon it must be zero. The internal forces have no effect upon the system as a whole, and the only external force is that due to friction with the earth's surface ; hence the total moment caused by friction between the air and the earth, that is, the total moment caused by the friction due to wind, is zero."

For still more sedate prose and perfect phrasing we turn to Dr. H. R. Mill[12] :—

" Everywhere the effects of the dry season remained apparent, and more than once extraordinary clouds, the position of which in any classification would have been extremely troublesome, revealed themselves on a nearer approach to be swarms of locusts."

For a maximum of content into a minimum of words we look to Sir George Simpson[13] :—

" . . . very few educated people would have any difficulty in giving an answer to the question—What is the cause of the monsoon ? They would refer to the high temperature over the land compared with that over the surrounding sea, and would speak of ascending currents of air causing an indraft of sea air towards and into the interior of the country."

And for a new light on a well-worn subject we can always rely on Sir Napier Shaw[14] :—

" Two things are unconquerable in the long run, sand and snow, and sand is a sort of snow that never melts."

REFERENCES

[1] William Dampier. " Voyages and Descriptions ", Pt. 3, p. 27. London, James Knapton, 1699.

[2] W. Derham. " Physico-Theology ", footnote, p. 12. London, W. Innys, 1719.

[3] Francis Bacon. " The Natural and Experimentall History of Winds ". Translated from the Latin by G. Gent, p. 1. London, Humphrey Moseley, 1653.

[4] Robert Boyle. " The general history of the air ", p. 167. London, A. and J. Churchill, 1692.

[5] John Claridge. " The Shepherd of Banbury's Rules ", p. 27. London, Thomas, Hurst, Edward Chance & Co., 1827.

[6] Daniel Defoe. " The Storm : a collection of the most Remarkable Casualties and Disasters which happened in the Late Dreadful Tempest both by Sea and Land " , p. 34. London, J. Nutt, 1704.

[7] Gilbert White. "The Natural History of Selbourne", p. 292. London, Harry G. Bohn, 1851.
[8] John Ruskin. "Remarks on the present state of meteorological science". *London, Trans. Meteor. Soc.*, 1839, p. 56.
[9] Robert Louis Stevenson. "On the thermal influence of forests". *Edinburgh, Proc. roy. Soc.*, **8,** 1873, p. 4.
[10] G. J. Symons. "On the present state and future prospects of meteorology". *London, Quart. J.R. Met. Soc.*, **8,** 1882, p. 109.
[11] W. H. Dines. "Circulation and temperature of the atmosphere". *Washington Mon. Wealt. Rev.*, **43,** 1915, p. 552.
[12] H. R. Mill. "South Africa as seen by a meteorologist". *London, Quart. J.R. Met. Soc.*, **32,** 1906, p. 183.
[13] Sir George Simpson. "The south-west monsoon". *London, Quart. J.R. Met. Soc.*, **47,** 1921, p. 151.
[14] Sir Napier Shaw. "The drama of the weather", p. 54. Cambridge University Press, 1933.

Halo Phenomena of May 1938

Unusual halo phenomena were reported on two occasions during

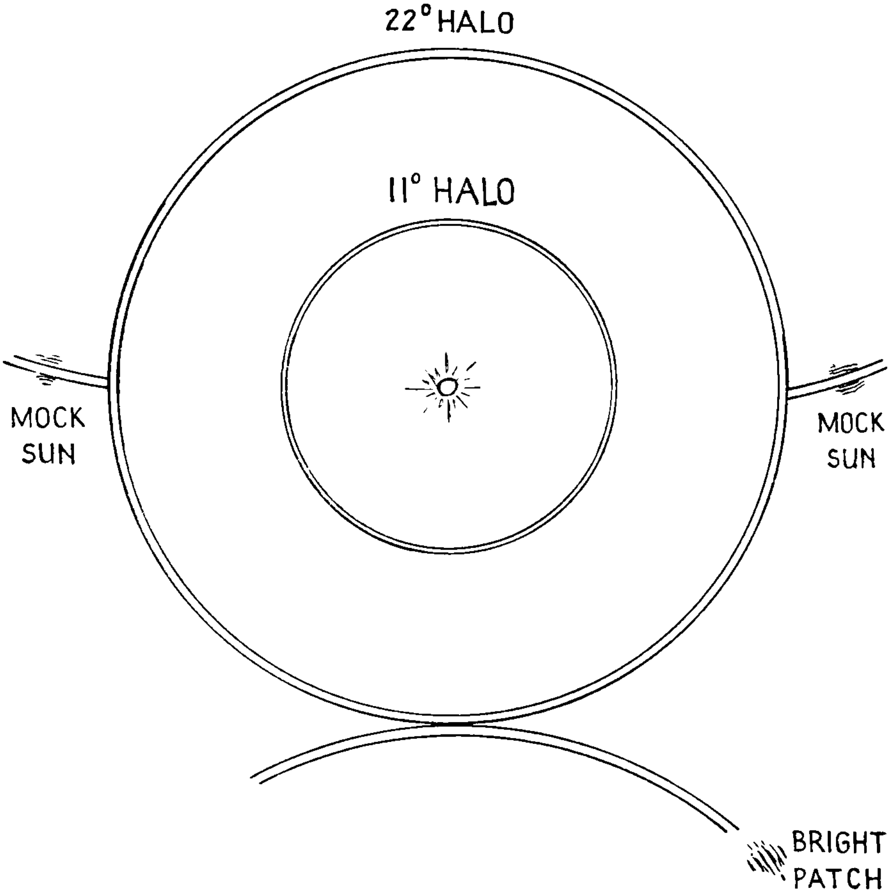

FIG. 1—HALO PHENOMENA, MAY 1ST, 1938, OBSERVED AT ABERDEEN

May. On the 1st Mr. W. F. Watson observed the display shown in fig. 1 at Aberdeen. He writes :—

"At 1220 G.M.T. an unusually brilliantly coloured 22° halo was visible. In this connexion it is interesting to note that with the exception of some cirrus wisps and about two-tenths of cirro-stratus in the eastern section of the sky, no cloud whatsoever could be seen in the vicinity of the halo (the sky being definitely blue). In addition to the 22° halo small portions of the parhelic ring, with colourless parhelia to right and left of the sun, were also visible outside the 22° halo. By 1225 G.M.T. a much smaller ring of approximately 11° radius could be clearly seen within the 22° halo. This small ring showed colours in the sequence—red nearest the sun, then yellow and a faint whitish, precisely as did the larger halo. The phenomenon was still visible at 1300 G.M.T. when the lower arc of contact became plainly visible with a brighter patch at its termination as shown in the accompanying sketch."

"The small ring of 11° radius had disappeared by 1305 G.M.T. but was again seen for a short period at 1340 G.M.T. The 22° halo was visible until approximately 1400 G.M.T. when it too had disappeared. During the course of the afternoon although the halo itself was not seen again, the arc of upper contact with faint colour effects was noted at 1500 G.M.T., and the circumzenithal arc with strong colours was visible at 1700 G.M.T. for some twenty minutes."

"The cirrus cloud noted during the afternoon underwent many changes, at times only the halo or arc indicated the presence of a very thin sheet of cirrus, at other periods typical banded and tufted cirrus with striated cirro-stratus appeared and covered up to six-tenths of the sky."

The display was also observed by Mr. G. A. Clarke who confirmed that the radius of the small halo was about 10° or 11°, and stated that it appeared thinner than the 22° halo and of about half the brightness.

This observation is of very great interest, and may be unique. No record can be found of any observation in which the radius of a halo was found by actual measurement to be between 10° and 11°. The nearest approach is that termed by L. Besson "Van Buijsen's halo," which has been recorded eight times, with estimated radii varying from $7\frac{1}{2}$° to 10° and an average of $8\frac{1}{2}$°. A display somewhat similar to that at Aberdeen was sketched by Mr. S. C. Russell at Epsom in 1907,* but no measurements are given and the figure of 10° given by Besson for the small halo was apparently measured from the sketch. Mr. Clarke estimated the radius of the halo at Aberdeen with the aid of a scale and black mirror, and is most unlikely to have been two degrees out. There is good reason therefore to regard this as a hitherto unknown halo phenomenon, for which the name "Clarke-Watson halo" is suggested.

* *Symons' Met. Mag., London*, 42, 1907, p. 35.

The second display was on May 30th, when Mr. G. A. Clarke achieved the rare if not unique feat of obtaining good photographs of elliptical halo. Mr. Clarke's account of the display follows :—

" A rather remarkable series of optical phenomena in a sheet of cirro-stratus cloud was observed at Aberdeen on the morning of May 30th."

" As early as 7h. G.M.T. a very bright upper arc of contact to the halo of 22° was observed, the halo itself being faint and incomplete. At 8h. a lower arc of contact had also become visible and two parhelia, fairly bright and well extended horizontally, but narrow vertically were seen while the halo itself though still very faint was distinguishable, the appearance being as shown at I in fig. 2. The arcs of contact were very

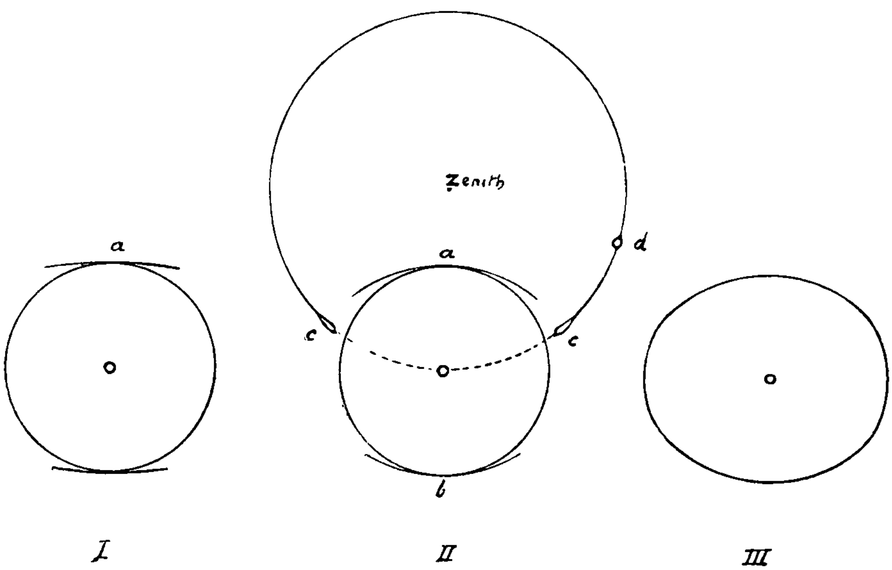

FIG. 2—HALO PHENOMENA, MAY 30TH, 1938, OBSERVED AT ABERDEEN

bright and at first were rather broad and diffuse, but as time went on they became narrower and more sharply defined, as well as even more brilliant in intensity. Colours from the orange-red through green to blue-green were clearly evident, and occasionally a blue-violet was faintly discernible, the background of cirro-stratus cloud being of a greyish rather than of the usual milky tint."

" At 8h. 15m. a faint parhelic (or mock sun) ring was formed, extending from the parhelia round the sky, and for short periods this ring could be very faintly seen within the halo itself.

Fig. 3

Fig. 4

FIGS. 3 AND 4.—ELLIPTICAL HALO, MAY 30TH, 1938, OBSERVED AT ABERDEEN

The parhelic ring then disappeared but formed again later, and after 9h. the general appearance was as shown at II in fig. 2. The contact arcs *a* and *b* had become more concave towards the sun, the parhelia ring *cde* was complete outside the halo of 22° and just barely traceable within it; there was a white (or colourless) parhelion at *d* where the halo of 46° should normally intersect the parhelic circle, though there was no trace whatever of the 46° halo itself. The two parhelia *c* were bright and strongly coloured, and the arc *a* was brilliant and also strongly tinted."

"After some time the parhelic circle finally disappeared and the arcs *a* and *c* gradually extended until they met in the neighbourhood of the parhelia. These latter then disappeared, together with the last traces of the 22° halo, and there was left visible an extremely fine elliptical halo whose upper and lower arcs were intensely brilliant, while the sides were fainter, but quite clear and so easily discernible even to the layman that the phenomenon was noted and commented upon by numbers of the general public (*see* III in fig. 2)."

"The phenomenon was observed by all members of the local staff, and while photographs were being taken by myself, measurements by theodolite were being made by Mr. Inman, and notes of the changes in form and intensity of the various phases by Mr. Watson."

"Measurements by theodolite gave the major axis of the ellipse as 27°, agreeing with my own estimate, and corroborated by the photographs (figs. 3 and 4) accompanying this note. On the chimney is a white cross, this represents the actual position of the sun. If a scale is placed on the photograph it will readily be seen that the distances from the cross to the top of the arc and from the same point to the lower end of the arc are in the ratio of 22 : 27."

"The sheet of cirro-stratus in which these appearances were observed was of a rather peculiar type. The brilliant halos are most often seen (in the writer's experience at all events) in sheets of structureless pale milky-tinted 'cirro-nebula'—as it used to be named—but on this occasion the cloud layer showed a strange curdled or turbulent structure, a little of which may perhaps be seen in the reproduction of the photograph just with the arc near its lower end; the structure is much more clearly shown in other photographs of the series I made."

On the afternoon of the same day another remarkable display was observed at the Bidston Observatory, Birkenhead. Mr. R. H. Corkan writes:—

"The phenomena were first noticed after they were well formed, at about 14h. 20m. G.M.T. and consisted of a complete 22° halo, a complete mock sun ring and two brilliant parhelia just outside the 22° halo. The parhelia and halo were coloured with red towards the sun. At about 14h. 45m. G.M.T. the upper and lower portions of the halo commenced to fade and there formed first the upper portions and later the complete ring of a 17° to 19° halo, also coloured with red towards the sun. The portions of the 22° halo near to the mock sun ring and their associated parhelia remained bright, while between the two halos was formed a diffusion of light, which, at a casual glance, caused the whole to have the appearance of a circle and an ellipse concentric with the sun, the two being tangential at their upper and lower parts. The large separation between the parhelia of the 22° halo and the inner halo was a striking feature of the display."

"Shortly after, there appeared on the mock sun ring, which was still complete, two large white parhelia at 90°. Anthelion was not observed. The whole remained practically unchanged in form until well after 15h. G.M.T. when the halos began to fade. The mock sun ring and the parhelia still remained bright and were visible until about 15h. 40m. G.M.T."

The halo of 17 to 19 degrees, known as Rankin's halo, is extremely rare, probably less than a dozen records of it being known. A very fine example was seen in south-east England on May 16th, 1926, when accurate measurements by C. J. P. Cave gave a radius of 17½° to the inner edge.* It was probably seen in Cumberland on May 8th, 1935,† but no exact measurements were made. It is a remarkable coincidence that two halos, one very rare, the other possibly unique, should be observed in Great Britain in the same month.

OFFICIAL PUBLICATION

British Rainfall 1937. H.M. Stationery Office, 15/- net.

The seventy-fifth volume of British Rainfall follows the general lines of its predecessors and includes the usual detailed discussion of the rainfall of the year in all its aspects. A new feature is an Index of River Basins, which has been added as a supplement to the alphabetical index of counties, and should prove very useful to readers who wish to survey all the rainfall readings available for a given basin. Part IV includes two special articles by Dr. Glasspoole, and one by Miss Lewis. It is a pleasure to record that in the Symons centenary year the volume has been produced at an exceptionally early date.

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* *Nature, London*, 117, 1926, p. 791.

† *Met. Mag., London*, 70, 1935, p. 130.

Correspondence

To the Editor, *Meteorological Magazine*

Divergent Isobars and Winds

In the discussion of this subject[1] the dry periods in 1921 and 1933 have been referred to. The published charts of mean pressure for these dry periods show that in 1921 and 1887[2] a wedge-shaped area of high pressure extended from the Azores area to Southern England, while in 1933[3] a similar wedge extended to France. The effect of curvature in the air motion would be to cause slight convergence on the north side of the wedge, but in practice the divergence due to surface friction might entirely overcome this. The interesting fact so well brought out in Dr. Frith's diagram[1], that with steep gradients the actual wind at 2,000 feet averages much below the geostrophic value, is likely to result partly from a predominance of cyclonic curvature when the gradient is steep and partly from friction. In very turbulent air surface friction affects the wind at 2,000 feet, but over the sea a sufficiently high degree of turbulence is unlikely. Thus Dr. Frith's diagram has probably no application to the conditions in the droughts of 1921 and 1933, where the steep gradients were on the Atlantic, with little curvature in that area.

The daily charts in 1921 and 1933 show periods when anticyclones formed over the British Isles, and divergence was to be expected, and the other fine periods were probably due to previous subsidence in the air mass. A persistent area of high pressure is a complex affair built up of component parts, each of which has a period of development with subsidence. This produces dryness aloft and reduces the lapse rate, and in conjunction with other factors usually causes an inversion or very stable layer which is not readily destroyed, so that eventually the large high pressure area is occupied entirely by stable air which is dry aloft. There may be stratus or strato-cumulus clouds, but these tend to dissolve as the air spreads inland and is heated from below, the amount of cloud being obviously influenced by the strength of the wind, the length of its track over land, and the time of day. Minor fronts between the old and new parts of the anticyclone can produce little or no precipitation in these conditions, apart from drizzle near the coasts.

Many individual cases of fine weather associated with diverging isobars can be explained by the above considerations. The association is by no means invariable, since a wide frontal rain belt not infrequently extends into a region of diverging isobars in the cold air.

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[1] *Met. Mag., London,* 73, 1938, pp. 119–121.

[2] C. E. P. Brooks and J. Glasspoole. "The Drought of 1921". *London, Quart. J.R. Met. Soc.,* 48, 1922, p. 139. (Figs. 19 and 20, p. 158.)

[3] J. Glasspoole and W. L. Andrew. "The Exceptional Summer of 1933". *London, Quart. J.R. Met. Soc.,* 60, 1934, p. 29. (Fig. 16, p. 51.)

Before there can be any serious challenge to the theorist, the empirical case for the fanning of the isobars being a cause of divergence of air needs to be established. To prove or disprove it satisfactorily from pilot balloon data may be impossible, but the calculation of subsidence from observations of upper air temperature and humidity provides a practicable alternative.

C. K. M. DOUGLAS.

Meteorological Office, London, July 28th, 1938.

Thunderstorms at Market Harborough, July 1st, 1938

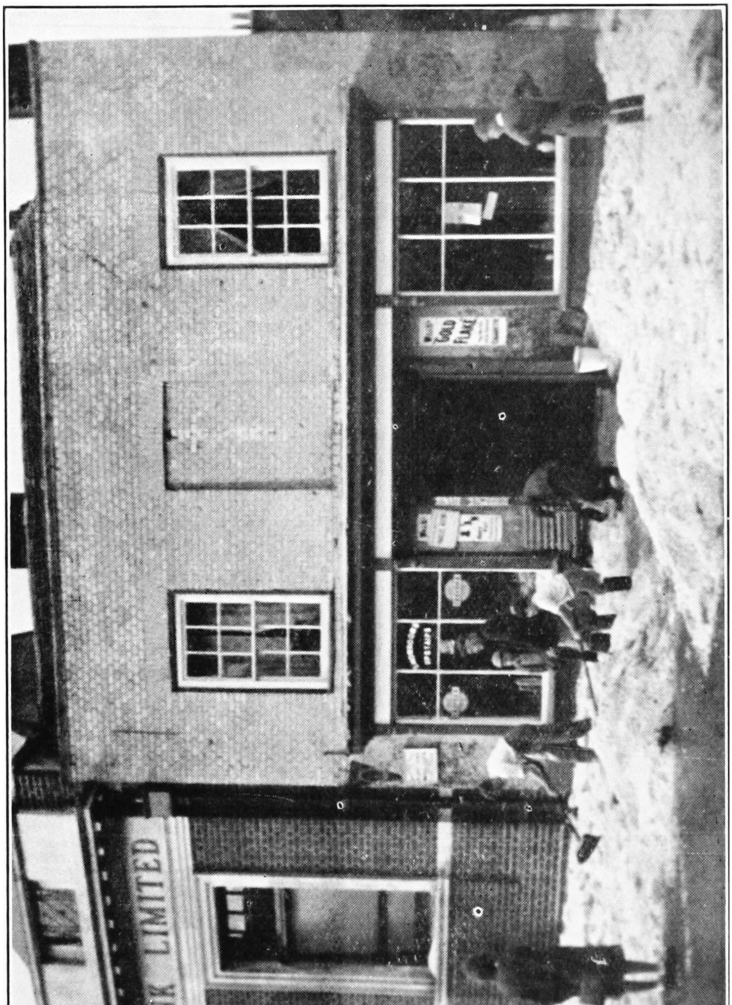
On July 1st, 1938, from 1620 to 1815 G.M.T., two thunderstorms were more or less simultaneously in progress here, accompanied by intense rainfall. One storm, approaching from the S.W., preceded the other, from the E.N.E., by some ten or twelve minutes, and the former was virtually overhead from 1720 to 1725 G.M.T., while the nearest approach of the later storm was about 1 mile away to the E. at about 1755 G.M.T. There was considerable lightning and thunder during the period, but by no means exceptional or severe. The truly remarkable feature was the intense rainfall, reaching maximum downpour about 1720 to 1730 G.M.T. Hailstones of moderate size, diameter 1·0 to 1·5 cm., fell for several minutes during the maximum period. From about 1755 to 1805 G.M.T. the sun shone brightly through breaks in the clouds and a rainbow was noticed. Shortly after the cessation of rain, I measured the amount of rainfall recorded in my 5 in. rain-gauge, standard M.O. pattern, the amount being 1·95 in., the whole falling in approximately two hours.

This morning (July 2nd), my garden shows the force of this heavy rainfall in various ways ; a flat portion of the kitchen-garden has the clear pressed appearance of the sea-beach after the tide has receded ; some rows of potatoes, "moulded up," were washed nearly flat and one potato "set" was lying exposed above the ground ; small seedlings of wallflowers, etc., were washed out of their seed-beds ; and across a sloping portion of the kitchen-garden channels 3 or 4 inches deep and several yards in length were cut by the rushing streams, while the hollows at the edge of a lawn and of grass-paths were choked with several inches of finely-washed sediment.

A remarkable feature of this intense downpour of rain is the fact of the restricted area upon which it fell. My house is on the extreme eastern boundary of the town, on a hillside 356 ft. above sea-level. About three-quarters of a mile westwards, at the offices of the Urban District Council, the rainfall read at 900 G.M.T. this morning was 0·75 in., about half a mile further westward the rainfall reported by Mr. G. C. Wooldridge was 0·52 in., and at the Grammar School, about one and a half miles N.W. from here, the amount was 0·64 in.

P. J. HARRIS.

Hillcroft, Shrewsbury Avenue, Market Harborough, Leicestershire, July 2nd, 1938.



LARGE HAILSTONES AT BISHOPS WALTHAM, JULY 7TH, 1938

Hailstorm at Eastbourne, July 7th, 1938

Distant thunder first heard about 4 p.m. B.S.T. Thunderstorm occurred from 4.55 p.m. to 5.15 p.m. B.S.T. which was accompanied by heavy hail from 5.5 p.m. to 5.12 p.m. B.S.T. The sky cleared immediately after this and the sun came out but at 5.25 p.m. B.S.T. a heavy shower occurred and lasted for 3 or 4 minutes. The total amount measured at 17 hour was 0·465 inch. No precipitation occurred before the commencement of the storm at 4.55 p.m. The hailstones resembled in shape that of a kidney bean or a section of a tangerine orange. They were hard, grooved and round on the inner and outer edges. The average size was that of a sugar lump or moth ball. One I picked up was about $\frac{3}{4}$ inch long and $\frac{1}{2}$ inch wide. Considerable damage was done but this was confined chiefly to gardens. In my own garden the stems of a row of dwarf peas which had not been stuck and were about 12 inches high were cut in half, the pods in other rows were badly scored, the leaves of the sprouts were riddled and the lettuce plants had their outside leaves cut off. The tops of the potatoes, chrysanthemums and the carnation shoots were cut off.

A. H. HOOKHAM.

Avenue House, The Avenue, Eastbourne, July 26th, 1938.

Hailstorm near Winchester, July 7th, 1938

On July 7th, 1938, at about 5.0 p.m. B.S.T. South Hampshire experienced a very severe thunderstorm that did an immense amount of harm to market gardeners and farmers. It was quite unique to residents in the area, and had not been experienced for at least a century.

It was accompanied by hail which was a foot deep in the Square at Bishops Waltham, near Winchester, where the accompanying photograph was taken (facing page 179).

The hailstones were one inch in diameter and the size of napthalene (moth) balls. There was a wind with the storm which blew in gusts of 50 m.p.h. at the height of the disturbance.

NORMAN E. NEVILLE.

83, *West Street, Fareham, July 16th,* 1938.

Great Gale of June 1st, 1938

On Wednesday, June 1st, a squally S.W. wind was blowing over the Isle of Wight, and towards evening this increased rather suddenly. Before darkness set in, a tempest of unprecedented fury was raging, the wind increasing to about 90 m.p.h. in squalls. Next day it was possible to see the havoc caused by this extraordinary June gale. All trees facing windward, that is to say south-west, especially in exposed places, were quite brown and withered, just as if fire had swept over them. On the leeward side, however, the trees retained their usual greenness, so that the effect was most unusual. This blasting of trees, shrubs and flowers, alike, was caused by the salt spray carried far inland by the wind, and for miles this sorry sight was apparent. My father who has lived in the Wight for more than 50 years, says he never remembers such a sight before in mid-summer, though in September, 1935, a violent gale had the same effect on vegetation—but it was autumn then, so the picture was not nearly so incongruous. Another S.W. gale, fortunately not so violently destructive, broke over the Island on June 28th, and this naturally aggravated the situation. It must be many years since June has been so windy in the Wight. We have had extremely dry weather ever since February 1st, and this may have helped to irritate the already parched leaves. The rainfall at Sandown for the first half of 1938, January–June, is only 6·38 in., a 30 year record at least.

J. E. COWPER.

Shanklin, July, 1938.

(*Note.*—The damage to foliage noted by Mr. Cowper occurred over a very wide area. It is not certain that it was occasioned by salt spray ; the fact that it occurred in all cases on the weather side of the trees rather suggests that the browning was due to mechanical damage caused by the buffeting of the wind.—Editor.)

Unusual Records of Temperature and Vapour-Pressure

I think the following abnormal recordings here (height above M.S.L. 105 ft.) may be of interest to your readers.

On July 1st the absolute minimum temperature recorded in a Stevenson Screen was 38° F. The temperature remained below 40° F. for 3 hours.

On July 31st at 18h. G.M.T. the dry bulb thermometer read 69·0° F. and the wet 68·0° F., giving a dew point of 67° F. and a vapour pressure of 22·9 millibars, very unusually high for so low a dry bulb temperature.

J. M. BRIERLEY.

Rodwell, South Petherton, Somerset, August 2nd, 1938.

NOTES AND QUERIES

Note on the trend of temperatures, 1880–1937

Meteorological literature of recent years shows that considerable interest in being taken in the marked upward trend of temperatures as observed in various parts of the world. This movement towards higher temperatures has become especially notable of late years in North Arctic regions[1], and also to a less extent in Europe[2], North America[3], Egypt[4], etc. In the following tables successive 20 year means of temperature, covering the last 55 years, are shown for a few representative stations where the readings are thought to be very reliable. The use of a few 20 year means in this way presents a very simple picture of temperature trend, and avoids the slight distraction caused by the minor fluctuations which are shown by " moving average " curves. The latter are of course preferable for a close study of weather elements.

Table 1 compares the period temperatures of Great Britain as recorded at the observatories of Oxford and Aberdeen with those observed at three stations situated in the countryside several miles from any town. The general agreement of the 20-year means is so good here that it gives real confidence in the accuracy of temperature measurements at the best meteorological stations. Incidently it shows that change of mean temperature at city stations, due to an increase in size of the city, is very small or absent at old established cities such as these.

TABLE 1

SUCCESSIVE 20 YEAR TEMPERATURE DEPARTURES AT CITY AND COUNTRY STATIONS IN GREAT BRITAIN

A = Combined mean at three English country stations (Stonyhurst College, Hodsock Priory and Rothamsted).

Period	1880–1899	1890–1909	1900–1919	1910–1929	1918–1937
	Mean	Departures from mean			
	° C.	° C.	° C.	° C.	2° C.
A	8·70	+·11	+·19	+·32	+·37
Oxford	9·25	+·10	+·19	+·32	+·36
Aberdeen	7·70	+·17	+·19	+·31	+·44

Table 2 shows the temperature trend from six stations between central Europe and the North Cape. As pointed out by Dr. Brooks[1] the later arrival of higher temperatures in the Arctic is very important in the study of the cause of recent variations in the far north.

TABLE 2

SHOWING LATER ARRIVAL OF HIGHER TEMPERATURES IN ARCTIC EUROPE

Period		1880–1899	1890–1909	1900–1919	1910–1929	1918–1937
Station	Lat. N.	Mean ° C.	Departures from mean ° C.	° C.	° C.	° C.
Vienna	48	9·03	+·10	+·23	+·32	+·47
Berlin	52	9·09	+·14	+·34	+·43	+·60
Copenhagen ...	56	7·63	+·09	+·22	+·36	+·58
Helingsfors ...	60	4·42	+·06	+·14	+·31	+·70
Harparanda ...	66	0·71	−·04	−·06	+·27	+·88
Gjesvaer ...	71	1·86	·00	−·07	+·29	+·82

Table 3 gives the same period departures from different parts of the world. The 11 stations shown here appear to have thoroughly reliable records and may be taken as generally representative of the region in which they are situated. On the whole these regions show a marked similarity to the European temperature departures, but as would be expected there are considerable differences in the Tropics and Southern Zone. The west Pacific is a region where short period temperature departures are inclined to be opposed to those of Europe.

TABLE 3

TREND OF TEMPERATURES IN DIFFERENT PARTS OF THE WORLD, 1880–1934

Period	1880–1899	1890–1909	1900–1919	1910–1929	1915–1934
Station	Mean °C.	°C.	Departures from mean °C.	°C.	°C.
North Temperate Zone					
Sulina (Black Sea) ...	10·93	+·09	+·19	+·22	+·23
St. Louis, Mo. ...	13·20	+·19	+·15	+·29	+·60
Tokyo	13·82	−·01	−·05	+·19	+·30
Tropical					
Key West, Flo. ...	24·00	−·27	−·20	+·10	+·27*
Honolulu	23·73	−·22	−·13	+·10	+·15
Batavia	26·02	+·14	+·28	+·41	+·48
Allahabad	25·77	+·16	+·05	+·16	+·25
Lagos, Ni'j.	26·94†	·00	+·10	+·14	+·14
South Temperate Zone					
Cape Town	16·82	−·16	+·12	+·41	+·52
Santiago	13·50	+·26	+·28	+·16	+·25
Adelaide	17·23	−·06	+·01	+·13	+·13

* 1918–1937. † 1892–1909.

Most of the years of the present decade have been much above normal over wide areas ; notably in the Arctic, the whole of North America, most of Europe, South Africa, and the far south Atlantic at South Georgia. Small areas showing distinct negative departures of late are located in Portugal and the south east part of India.

G. S. CALLENDAR.

REFERENCES.

[1] C. E. P. Brooks. *London, Met. Mag.*, 73, 1938, p. 29.
[2] C. E. P. Brooks. *London, Met. Mag.*, 57, 1922, p. 203.
[3] J. B. Kincer. *Washington, Mon. Weath. Rev.*, 61, Sept., 1933.
[4] L. J. Sutton. *London, Quart. J.R. Met. Soc.*, 62, 1936.

REVIEWS

Agricultural Meteorology : The prediction of the minimum temperature on clear days at selected stations in India. By M. Narasimhan and L. A. Ramdas. Reprinted from *The Indian Journal of Agricultural Science*, Vol. VII, Part V, Oct., 1937. Delhi, 1937.

The object of this paper is to forecast the occurrence of frost for the agriculturalist and it seems to be assumed that a prediction of the screen temperature at a height of four feet fulfils that purpose. The paper is in two sections : the first a brief theoretical note on nocturnal cooling and the second a statistical examination of data from 19 stations throughout India. Neither section appears to have any real connexion with the other.

The authors quote Ångström's formula, $S/\sigma T^4 = A - B \times 10^{-\gamma e}$, for the ratio of incoming to outgoing nocturnal radiation with clear skies (e being the vapour-pressure), giving the values of the constants A, B and γ for Poona, although it may be remarked that Brunt's expression, $a + b\sqrt{e}$, for the same ratio gave a correlation coefficient of 0·93 for that station. This formula is then used somewhat naïvely as evidence that nocturnal cooling should be greater the drier the atmosphere. A uniform curve is also given, showing, for a chosen maximum temperature and for 17 stations taken together, a close and nearly linear relationship between the diurnal range of temperature and the vapour-pressure. This, however, is greatly at variance with the formulae evolved for individual stations later in the paper.

The statistical section of the paper proceeds on familiar lines to connect the minimum temperature (N°F.) with a preceding temperature and humidity by means of an empirical formula, the precise variables chosen being maximum temperature (X°F.) and vapour-pressure (V ins. mercury) recorded in the preceding afternoon. The months selected are mainly between November and March and extend over from one to five years so as to provide observations on 100 clear nights at each of the 19 stations. Dot diagrams are drawn between V and N, and between X and N, and the corresponding correlation coefficients are found to be of the order of 0·6 or 0·7. These relationships are finally combined in the regression equation, $N = b_x X + b_v V + \text{constant}$, and the multiple correlations are all found to be above 0·7, the highest being 0·93 at Calcutta.

The 100 individual readings are given for Calcutta, with evidence that the same regression equation holds over several years taken individually. The error in the forecast minimum temperature is rarely greater than 3°F., but the wide range of values of the constants b_x and b_v at different stations raises a strong doubt as to whether the formula has much value in forecasting when the correlation coefficient is below 0·9.

Thus, for Bangalore,

$$N = -29{\cdot}91 + 0{\cdot}9568\,X + 3{\cdot}46\,V,$$

while, for Lahore,

$$N = 4{\cdot}96 + 0{\cdot}3692\,X + 35{\cdot}48\,V.$$

At both places there is a negligible correlation between X and V, so that water-vapour seems to be ten times as effective at the latter as at the former in reducing the fall of temperature. Apart from this inconsistency between most pairs of the 19 stations, such a result obscures any connexion with simple radiational reasoning.

Higher correlation might have been found if the vapour-pressure term had been $10^{-\gamma e}$ or $\sqrt{V}$, according as Ångström's or Brunt's formula is preferred. As it stands the equation is not very different from that deduced by Gold* from the observations of Andrews at

* *Met. Mag., London*, 69, 1934, p. 88.

Larkhill, subsequently written by Flower and Davies* in the form

$$T - M = a\,(T - D) + bT + c,$$

where T = temperature at 15h.,
D = dew-point at 15h.,
M = minimum temperature on the following night

and a, b and c are constants.

Replacing T and M by the X and N of the present paper, the formulæ then only differ appreciably in that D is not exactly proportional to V, a discrepancy that increases with temperature. It is interesting to make approximate transformations from the mean values given in the paper in view of the suggestion put forward by Flower and Davies that a has a universal value of about 0·4 for all parts of the world. The values of a so found range from about 0·3 almost to zero, thus giving some support to Veryard's† conclusion that a decreases as the diurnal temperature range increases.

C. J. Boyden.

Étude pratique des rayonnements solaire, atmosphérique et terrestre (méthodes et résultats). By Ch. Maurain. Size 10 in. × $6\frac{1}{2}$ in., pp. 189. *Illus.* Paris, Gauthier-Villars. 1937.

The study of the radiations from the sun, and their transformations within the atmosphere, has become a highly important branch of meteorological research, with an enormous literature of its own. Prof. Maurain has therefore performed a valuable service for meteorologists by providing a clear, readable and comprehensive account of our present knowledge of the subject.

After a brief chapter on the duration of bright sunshine, the author describes and illustrates the various instruments in general use for measuring the intensity of direct solar radiation, and discusses in detail the method of computing the "solar constant". The next chapter deals with the weakening of the solar radiation during its passage through the atmosphere and gives a great deal of information about the coefficient of transparency and factors of turbidity. In Chapter VI the study of incoming radiation is completed by an account of methods and measurements of radiation from the sky, while the following chapters deal with terrestrial radiation, the theoretical distribution of solar radiation over the globe (in this chapter several pages are devoted to Sir George Simpson's studies of radiation), the inter-relations between direct solar, sky and terrestrial radiation, and the general balance of radiation in the atmosphere and on the surface of the earth. Here it is of interest to find that the balance sheet formulated by W. H. Dines in his well-known paper on "The heat balance of the atmosphere", published in 1917, can hardly be improved upon after the accumulated research of twenty years.

The second half of the book deals with the spectral distribution of energy in solar and sky radiation, and like the earlier chapters

* *Met. Mag., London,* 69, 1934, p. 230. † *Met. Mag., London,* 71, 1936, p. 69.

describes first methods and then results. Several pages are given to the measurement of ultra-violet radiation, but the photographic method is dismissed in a few lines and Dobson's name is not mentioned. In Chapter XIII the author discusses the luminous intensity of solar and sky radiation and the intensity of daylight, and in the final chapter the climatic effects of solar heat and light, for example on the growth of plants. The book is mainly a summary of the work of others, but it is woven into a complete whole, and now and again the author interjects some thoughtful criticisms or considerations of his own. C.E.P.B.

The air and its mysteries. By C. M. Botley, F.R.Met.Soc. Size $7\frac{1}{2} \times 5$ in., pp. xvi + 296. *Illus.* London, G. Bell and Sons, Ltd., 1938. Price 8*s*. 6*d*. net.

As a frequent contributor to our correspondence columns the name of Miss Cicely M. Botley is well known to readers of the *Meteorological Magazine* and it is a pleasure to welcome a book from her pen. " The Air and its Mysteries " belongs to the " popular " class of scientific literature ; it is " an attempt to give those who live in an air-minded age some insight into the new and wonderful realm of which, through the courage of the pioneer and the skill of the scientist, they have been made free." The scope of the book goes far beyond the ordinary confines of meteorology and it contains a surprising amount of information on all sorts of subjects connected directly or indirectly with the air. As might be expected from Miss Botley, many of her 296 pages are enriched with interesting quotations from folk-lore and classical literature. There are numerous illustrations, excellently reproduced. The author has a well-stored mind and a fluent easy style. In a Foreword, Sir Richard Gregory expresses the view that the book is worthy of taking a high place among the many good books on scientific subjects now available to the non-technical reader. A few inaccuracies were noted, but we agree with Sir Richard's opinion and commend the book to the attention of those in search of light reading of a pleasant and informative character.

E. G. B.

BOOKS RECEIVED

County Borough of Eastbourne : Annual Report of the Meteorological Observations for the year 1937. Eastbourne, 1938.

County Borough of Southport : Meteorological Department : Report and Results of Observations for the year 1937. Southport, 1938.

City of Portsmouth : Health Report for the year 1937. (Meteorology, pp. 25–26), Portsmouth, 1938.

Borough of Torquay : Meteorological Report for the year 1937 *with extremes and comparisons with averages of preceding year.* Torquay, 1938.

OBITUARY

We regret to learn of the death of Lt.-Colonel C. H. H. Harold, O.B.E., R.A.M.C. (Retired), Director of Water Examination, Metropolitan Water Board, who died on 18th July, 1938, at the age of 53.

The Weather of July, 1938

Pressure was high (1028 mb.) west of the Azores and low (1003 mb.) over Baffin Bay, the low pressure area extending eastward to Scotland and northern Ireland (1010 mb.). Over most of Europe pressure was uniform, about 1015 mb., decreasing to 1000 mb. over the Red Sea area. In North America pressure was highest in British Columbia (1019 mb.). The differences from normal were generally slight but areas of 5 mb. above normal occurred in western Canada, west of the Azores, Finland and Iraq. The Atlantic west of the Azores and the Sudan were 5 mb. below normal. No figures were received from Russia, India or Australasia.

Temperatures were everywhere above 32° F. The British Isles with means ranging from 55° F. in the north-west to 62° F. in London were slightly below normal as were northern and western France, but Scandinavia with temperatures of about 60° F. was abnormally warm. In south-eastern Europe the temperatures of 70° to 80° F. were also from 3° to 5° F. above normal. In North America temperatures ranged from 35° in Baffin Bay to above 80° F. in the southern States ; Texas was 5° F. above normal but elsewhere the deviations were small.

Rainfall in Europe was generally deficient, but above normal in most of Sweden, Ireland and parts of Britain, southern France and parts of the Balkans. In most of the United States rainfall was abnormally heavy, especially at Mobile (13 inches, nearly twice the normal) and Abilene (8 inches, 6 inches above normal). Central and southern Canada in general had deficient rains.

The weather of July was chiefly notable for the general deficiency of sunshine, and stations in Ireland had about 30 per cent. less than the average. It was wet generally over the British Isles as a whole, and another interesting feature was the large number of days with rain in the west and north. Although wet elsewhere, in south-east England and part of the Midlands July was the sixth successive dry month. Many stations in Ireland had excesses of over 50 per cent. of the average rainfall, while in Cumberland many places had more than twice the average rainfall, totals exceeding 20 inches at several stations and even exceeding 25 inches at one or two stations. Rainfalls of the same amounts were recorded on Snowdon during the month. Deep depressions on the 7th to 8th and from the 27th to 30th resulted in gales in western and southern coastal districts and a squall of 76 m.p.h. was recorded at Calshot during a thunderstorm on the 7th when heavy rain fell in Ireland and much damage was done to crops and trees locally in southern England, where hail accompanied the thunderstorm.

During the first two days of the month pressure was high to the south-west and low to the north-east of the British Isles : thundery conditions prevailed for the first week and thunderstorms and hail were reported on each of the first seven days. Temperatures were below average and continued so for the first half of the month. A depression centred south of Iceland on the morning of the 3rd moved east-south-eastwards reaching the Hebrides on the 4th and the low pressure area covered the North Sea, the British Isles and north-west Atlantic on the 5th. Sunshine totals were poor during this period, although higher totals were recorded in the south-west on the 5th. A depression south-west of Ireland on the 6th took an easterly and then northerly track, deepening as it progressed until it was situated over south Wales on the 8th : there were heavy falls of rain on the 7th, particularly in Ireland and among the highest totals recorded were 3·14 inches and 3·02 inches at Greystones and Roundwood respectively, both these stations being in Co. Wicklow. Stations in southern Scotland and north-western England had no sunshine on the 7th and gales were recorded at some stations on the 8th. The depression moved slowly north-eastwards on the 9th and pressure rose temporarily over the British Isles. From the 10th to 12th a series of depressions moved eastwards across Scotland and sunshine totals were very low, some stations recording no sunshine on one or other of these days. There were general showers on the 10th and 11th in the north and west and fog was reported at several coastal stations during this period.

A ridge of high pressure crossed England on the 13th and was followed by a trough of low pressure which extended from east Scotland to the Scilly Isles on the morning of the 14th and moved slowly north-eastwards becoming an almost stationary area of low pressure over the North Sea on the 16th, which slowly filled up. Temperatures were about or just below average during this period : sunshine totals were very variable and were fairly good at some individual stations although Manchester and Huddersfield recorded no sunshine on the three days, 14th to 16th. A ridge of high pressure moved eastwards over the British Isles on the 17th and a wedge of high pressure crossed on the 18th. Rainfall was very slight generally on these two days but sunshine totals were poor and there was fog at south-western coastal stations early on the 18th.

A depression centred over Iceland on the 19th deepened and a trough of low pressure extending from southern Norway to the Bristol Channel on the 20th moved very slowly eastwards. This was followed by a ridge of high pressure on the 21st and pressure remained high over England until the 24th. Temperatures were high during this period, sunshine totals were much better generally and there was very little rainfall, although there was fog at several stations on these days.

A complex low pressure area over the Atlantic to the west of Ireland on the 25th moved slowly eastwards and a series of secondary depressions moving north-eastwards along the west coasts caused heavy rain in the west and north. Rainfall was particularly heavy on the 29th : 4·37 inches were recorded at Garinish Island, Co. Cork, and many stations had over 2 inches in Ireland, and in the north and west of Great Britain rainfall was also very heavy. Extensive flooding occurred in the English Lake district as a result of the heavy falls on the 29th and 30th : Borrowdale in Cumberland had 5·60 inches on the 29th and 2·56 inches on the 30th, while at a few stations the rainfall of the 29th was the highest daily total in records going back more than 20 years. The deep depression which had become almost stationary north of Ireland on the 29th subsequently decreased in intensity and gave way to a belt of high pressure which stretched across England on the 31st connecting anticyclones over the Baltic and mid-Atlantic. Temperatures rose considerably on the 30th and 31st and a maximum of 85° F. recorded at Tunbridge Wells and Southend on the 31st was the highest recorded this year to date. There was fog at many stations on the 30th and 31st.

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

	Total hrs.	Diff. from average hrs.		Total hrs.	Diff. from average hrs.
Stornoway ..	126	−19	**Chester** ..	142	−31
Aberdeen ..	140	−12	**Ross-on-Wye**	151	−41
Dublin	99	−71	**Falmouth** ..	142	−75
Birr Castle ..	102	−47	**Gorleston** ..	179	−32
Valentia ..	106	−51	**Kew**.. ..	147	−47

Kew temperature, mean, 62·3°F : diff. from average −2·2°F.

Miscellaneous notes on weather abroad from various sources.

Heavy rain in the Carpathian foothills and snow in the High Tatras caused floods in many parts of Galicia in the early part of the month. Villages were evacuated and several lives lost, but little damage was done to the grain harvest, which promises to be above the average of the last five years. A hailstorm which swept over part of the Dauphiné on the 25th caused much damage to crops and shattered many panes of glass. A violent thunderstorm was reported from Torsac, Charante, on the 26th. A wave of heat spread over France on the 30th–31st, temperatures of more than 90° F. being recorded in many places. (*The Times*, July 13th–August 2nd.)

Serious flooding in Kobe was reported on the 5th after two days of abnormally heavy rainfall. Hundreds of people were drowned, many houses demolished and business completely disorganised. The damage is officially estimated at nearly £6,000,000. Osaka and Kyoto Prefectures also experienced extensive floods. The early onset of the monsoon caused the abandonment of the attempt to climb Mt. Masherbrum, in the Karakorum, and delay in the German expedition to Nanga Parbut on the 8th. (*The Times*, July 6th–26th.)

General rain fell in New South Wales during the latter part of the month, improving the pastoral outlook. The drought in the south-west and west areas of Australia was also broken. (*The Times*, July 30th.)

Daily Readings at Kew Observatory, July, 1938

Date	Pressure, M.S.L. 13h.	Wind, Dir., Force 13h.	Temp. Min.	Temp. Max.	Rel. Hum. 13h.	Rain	Sun	Remarks
1	1008·9	E 2	48	67	51	0·01	6·4	t 14h., pr_0 15h. & 16h.
2	13·6	W 2	48	67	49	0·04	6·7	tpR 15h., t 18h.
3	17·4	WSW 2	49	68	60	Trace	3·5	pr_0 18h.
4	06·3	SSW 4	53	67	56	Trace	6·6	tpr_0 14h., pr_0 15h.
5	02·1	NW 2	48	63	74	0·14	6·7	pR 9h., tpr_0 9h.–13h.
6	13·1	SSW 3	49	67	52	Trace	5·7	pr_0 1h. & 13h.–15h.
7	06·6	ESE 4	54	75	61	0·05	1·6	pr 11h.–15h., t 17h.
8	03·1	SSW 5	55	63	68	0·26	0·5	ir_0–r 7h.–16h., pR 19h.
9	17·2	WSW 3	54	64	58	Trace	4·0	pr_0 10h., 14h. & 17h.
10	19·4	SSW 4	52	64	77	Trace	1·4	pr_0 10h. & 24h.
11	09·5	SW 4	59	71	65	—	4·5	
12	08·7	W 2	56	65	63	Trace	0·3	pr_0 11h.
13	17·8	NNW 1	54	74	45	—	9·5	
14	16·4	SW 3	56	67	64	—	0·0	
15	14·6	W 2	58	65	81	0·23	0·1	r 12h., r–r_0 17h.–20h.
16	19·5	WNW 3	52	63	72	Trace	1·8	pr_0 13h., 15h. & 18h.
17	23·2	WSW 3	53	70	49	Trace	8·4	pr_0 18h.
18	22·4	W 3	58	68	70	Trace	0·9	ir_0 14h.–15h.
19	20·7	SW 2	56	72	64	—	8·6	m till 8h.
20	18·1	WSW 2	56	76	65	—	7·1	
21	18·6	N 1	61	75	52	—	3·7	
22	16·8	SE 2	60	72	65	—	0·0	
23	14·5	ENE 2	56	74	52	—	2·6	
24	12·5	S 2	55	78	57	—	5·2	w early.
25	13·0	SSW 3	56	74	54	0·01	6·0	r–r_0 20h.–21h.
26	11·7	WSW 3	59	72	42	—	5·5	
27	16·2	S 5	52	74	41	0·28	8·9	r_0–r 19h.–23h.
28	16·1	WSW 3	53	69	55	—	8·2	
29	17·6	SSW 4	53	72	54	—	3·7	w early.
30	16·8	SSW 4	56	74	58	—	13·6	
31	1021·2	SSW 2	63	82	64	—	4·9	
*	1014·6	—	55	70	59	1·02	4·7	* Means or Totals.

General Rainfall for July, 1938

England and Wales	115	per cent of the average 1881–1915.
Scotland	143	
Ireland	163	
British Isles ...	132	

Rainfall : July, 1938 : England and Wales

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Lond .	Camden Square..........	1·17	49	*Leics* .	Thornton Reservoir ...	3·26	131
Sur .	Reigate, Wray Pk. Rd..	2·09	93	„ .	Belvoir Castle...........	2·71	112
Kent .	Tenterden, Ashenden...	1·76	84	*Rut* .	Ridlington	2·42	96
„ .	Folkestone, Boro. San.	2.18	...	*Lincs* .	Boston, Skirbeck.........	2·19	99
„ .	Margate, Cliftonville....	2·16	109	„ .	Cranwell Aerodrome...	2·83	121
„ .	Eden'bdg., Falconhurst	1·68	73	„ .	Skegness, Marine Gdns.	2·34	107
Sus .	Compton, Compton Ho.	2·48	88	„ .	Louth, Westgate.........	2·43	97
„ .	Patching Farm..........	1·72	72	„ .	Brigg, Wrawby St.......	3·33	...
„ .	Eastbourne, Wil. Sq....	1·84	84	*Notts* .	Mansfield, Carr Bank...	3·95	151
Hants.	Ventnor, Roy.Nat.Hos.	1·54	76	*Derby*.	Derby, The Arboretum	4.28	173
„ .	Southampton,East Park	2·42	106	„ .	Buxton, Terrace Slopes	5·57	142
„ .	Ovington Rectory.......	4·01	155	*Ches* .	Bidston Obsy............	2·71	105
„ .	Sherborne St. John......	1·73	78	*Lancs*.	Manchester, Whit. Pk.	4.48	136
Herts .	Royston, Therfield Rec.	1·45	58	„ .	Stonyhurst College......	4·67	121
Bucks.	Slough, Upton............	1·13	59	„ .	Southport, Bedford Pk.	2·90	101
Oxf .	Oxford, Radcliffe.........	1·18	50	„ .	Ulverston, Poaka Beck	7.04	155
N'hant	Wellingboro, Swanspool	1·65	72	„ .	Lancaster, Greg Obsy.	4·39	125
„ .	Oundle	1·48	...	„ .	Blackpool	3·61	124
Beds .	Woburn, Exptl. Farm...	1·51	68	*Yorks*.	Wath-upon-Dearne......	2·95	118
Cam .	Cambridge, Bot. Gdns.	1·33	62	„ .	Wakefield,Clarence Pk.	3·15	124
„ .	March......................	1·29	54	„ .	Oughtershaw Hall.......	6·62	...
Essex.	Chelmsford,County Gdns	1·00	47	„ .	Wetherby, Ribston H..	3·98	159
„ .	Lexden Hill House......	1·22	...	„ .	Hull, Pearson Park......	3·75	160
Suff .	Haughley House.........	1·49	...	„ .	Holme-on-Spalding......	3·28	127
„ .	Rendlesham Hall........	1·91	82	„ .	Felixkirk, Mt. St. John.	2·84	104
„ .	Lowestoft Sec. School...	1·57	69	„ .	York, Museum Gdns....	2·33	92
„ .	Bury St. Ed., WestleyH.	1·62	65	„ .	Pickering, Houndgate...	2·81	104
Norf. .	Wells, Holkham Hall...	1·36	59	„ .	Scarborough..............	2·19	90
Wilts .	Porton, W.D. Exp'l. Stn	2.25	114	„ .	Middlesbrough...........	2.85	111
„ .	Bishops Cannings........	2·45	98	„ .	Baldersdale, Hury Res.	3·43	107
Dor .	Weymouth, Westham.	1·91	106	*Durh* .	Ushaw College...........	2·51	90
„ .	Beaminster, East St....	3·85	148	*Nor* .	Newcastle, Leazes Pk...	2·29	89
„ .	Shaftesbury,Abbey Ho.	2·33	91	„ .	Bellingham, Highgreen	3·22	98
Devon.	Plymouth, The Hoe....	3·35	121	„ .	Lilburn Tower Gdns....	3·70	150
„ .	Holne, Church Pk. Cott.	5·24	149	*Cumb*.	Carlisle, Scaleby Hall...	5·54	169
„ .	Teignmouth, Den Gdns.	3·06	131	„ .	Borrowdale, Seathwaite	21·00	270
„ .	Cullompton	2·91	108	„ .	Thirlmere, Dale Head H.	11·31	194
„ .	Sidmouth, U.D.C........	3·48	...	„ .	Keswick, High Hill......	6·74	176
„ .	Barnstaple, N. Dev.Ath	2·86	106	„ .	Ravenglass, The Grove	6·16	164
„ .	Dartm'r,Cranmere Pool	6·20	...	*West* .	Appleby, Castle Bank...	4·70	149
„ .	Okehampton, Uplands.	4·32	133	*Mon* .	Abergavenny, Larchf'd	3·29	132
Corn .	Redruth, Trewirgie......	4·60	151	*Glam* .	Ystalyfera, Wern Ho....	6·53	142
„ .	Penzance, Morrab Gdns.	3·94	145	„ .	Treherbert, Tynywaun.	7·77	...
„ .	St. Austell, Trevarna...	3·93	117	„ .	Cardiff, Penylan..........	3·63	118
Soms .	Chewton Mendip.........	3·58	103	*Carm* .	Carmarthen,M. & P. Sch.	...	...
„ .	Long Ashton............	3·94	139	*Pemb* .	Pembroke,Stackpole Ct.	...	...
„ .	Street, Millfield..........	3·45	141	*Card* .	Aberystwyth	5·76	...
Glos .	Blockley	2·69	...	*Rad* .	BirmW.W.Tyrmynydd	5·83	142
„ .	Cirencester, Gwynfa....	2·54	98	*Mont* .	Newtown, Penarth Weir	...	...
Here .	Ross-on-Wye............	2·28	100	„	Lake Vyrnwy	5·15	150
Salop.	Church Stretton.........	2·40	98	*Flint* .	Sealand Aerodrome......	2·61	114
„ .	Shifnal, Hatton Grange	2·94	130	*Mer* .	Blaenau Festiniog	11·32	145
„ .	Cheswardine Hall........	2·83	104	„ .	Dolgelley, Bontddu......	7·87	185
Worc .	Malvern, Free Library...	3·20	140	*Carn* .	Llandudno	2·64	118
„ .	Ombersley, Holt Lock.	2·94	137	„ .	Snowdon, L. Llydaw 9..	22·50	...
War .	Alcester, Ragley Hall...	2·91	122	*Ang* .	Holyhead, Salt Island...	4·11	157
„ .	Birminghm, Edgbaston	3·00	129	„ .	Lligwy	5·35	...

Erratum : Llandudno, June, *for* 3·03/150 *read* 3·03/159

Rainfall : July, 1938 : Scotland and Ireland

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
I. Man	Douglas, Boro' Cem.	5·27	172	*R&C* .	Achnashellach	6·42	125
Guern.	St.Peter P't.Grange Rd.	2·16	107	,, .	Stornoway, C.GuardStn.	2·67	93
Wig .	Pt. William, Monreith.	5·23	186	*Suth* .	Lairg	4·66	149
,, .	New Luce School	5·97	176	,, .	Skerray Borgie	7·38	...
Kirk .	Dalry, Glendarroch	5·88	164	,, .	Melvich	4·93	176
Dumf.	Dumfries, Crichton R.I.	...	...	,, .	Loch More, Achfary	8·13	152
,, .	Eskdalemuir Obs	8.87	216	*Caith* .	Wick	3·46	132
Roxb .	Hawick, Wolfelee	4.92	160	*Ork* .	Deerness	2·85	111
Peeb .	Stobo Castle	...	...	*Shet* .	Lerwick Observatory	2·82	123
Berw .	Marchmont House	3·43	112	*Cork* .	Cork, University Coll.	3·97	147
E.Lot .	North Berwick Res.	3·04	118	,, .	Roches Point, C.G. Stn.	4·78	166
Midl .	Edinburgh, Blackfd. H.	2·43	86	,, .	Mallow, Longueville	3·52	141
Lan .	Auchtyfardle	4·23	...	*Kerry* .	Valentia Observatory	5·89	156
Ayr .	Kilmarnock, Kay Park	4·78	...	,, .	Gearhameen	10·60	184
,, .	Girvan, Pinmore	5·79	159	,, .	Bally McElligott Rec.	5·87	...
,, .	Glen Afton, Ayr San.	6·34	151	,, .	Darrynane Abbey	5·86	154
Renf .	Glasgow, Queen's Park	4·64	159	*Wat* .	Waterford, Gortmore	5·78	182
,, .	Greenock, Prospect H.	4·57	124	*Tip* .	Nenagh, Castle Lough.	6.05	193
Bute .	Rothesay, Ardencraig	4·98	126	,, .	Cashel, Ballinamona	5·02	176
,, .	Dougarie Lodge	4·74	150	*Lim* .	Foynes, Coolnanes	4·57	148
Arg .	Loch Sunart, G'dale	5·86	126	*Clare* .	Inagh, Mount Callan	8·86	...
,, .	Ardgour House	8·80	...	*Wexf* .	Gorey, Courtown Ho.	5·76	196
,, .	Glen Etive	...	...	*Wick* .	Rathnew, Clonmannon.	5·48	...
,, .	Oban	5.80	...	*Carl* .	Bagnalstown, Fenagh H.	5·65	179
,, .	Poltalloch	5·39	131	,, .	Hacketstown Rectory	5·85	170
,, .	Inveraray Castle	8·64	174	*Leix* .	Blandsfort House	6·06	194
,, .	Islay, Eallabus	4·23	124	*Offaly* .	Birr Castle	6·71	227
,, .	Mull, Benmore	...	...	*Kild* .	Straffan House	5·51	195
,, .	Tiree	3·81	105	*Dublin*	Dublin, Phoenix Park	3.89	145
Kinr .	Loch Leven Sluice	3.71	129	*Meath* .	Kells, Headfort	5·37	169
Fife .	Leuchars Aerodrome	3·26	125	*W.M* .	Moate, Coolatore	5·85	...
Perth .	Loch Dhu	5.95	123	,, .	Mullingar, Belvedere	...	...
,, .	Crieff, Strathearn Hyd.	3·77	127	*Long* .	Castle Forbes Gdns	5·65	181
,, .	Blair Castle Gardens	4·73	185	*Gal* .	Galway, Grammar Sch.	4·68	146
Angus.	Kettins School	4·01	155	,, .	Ballynahinch Castle	8·03	194
,, .	Pearsie House	5·55	...	,, .	Ahascragh, Clonbrock.	5·78	166
,, .	Montrose, Sunnyside	3·54	135	*Rosc* .	Strokestown, C'node	5·03	180
Aber .	Balmoral Castle Gdns.	4·72	185	*Mayo* .	Blacksod Point	2·57	82
,, .	Logie Coldstone Sch.	...	...	,, .	Mallaranny	5·20	...
,, .	Aberdeen Observatory.	4·62	164	,, .	Westport House	2·98	96
,, .	New Deer School House	...	...	,, .	Delphi Lodge	9·81	148
Moray	Gordon Castle	4·60	144	*Sligo* .	Markree Castle	3·71	107
,, .	Grantown-on-Spey	4.00	130	*Cavan.*	Crossdoney, Kevit Cas.	5·52	...
Nairn.	Nairn	4.55	170	*Ferm* .	Crom Castle	7·08	203
Inv's .	Ben Alder Lodge	4·10	...	*Arm* .	Armagh Obsy	4.78	165
,, .	Kingussie, The Birches.	3·76	...	*Down.*	Fofanny Reservoir	7·00	...
,, .	Loch Ness, Foyers	4·54	150	,, .	Seaforde	5·82	182
,, .	Inverness, Culduthel R.	4.36	168	,, .	Donaghadee, C. G. Stn.	3·87	139
,, .	Loch Quoich, Loan	7·73	...	*Antr* .	Belfast, Queen's Univ.	4·38	147
,, .	Glenquoich	8·13	127	,, .	Aldergrove Aerodrome	4·29	153
,, .	Arisaig House	6·86	138	,, .	Ballymena, Harryville.	4·62	135
,, .	Glenleven, Corrour	5·29	128	*Lon* .	Garvagh, Moneydig	5·22	...
,, .	Fort William, Glasdrum	8.53	...	,, .	Londonderry, Creggan.	5·31	145
,, .	Skye, Dunvegan	4·83	...	*Tyr* .	Omagh, Edenfel	5·08	149
,, .	Barra, Skallary	3·58	...	*Don* .	Malin Head	3·89	114
R&C.	Tain, Ardlarach	6·59	223	,, .	Dunfanaghy	3·73	127
,, .	Ullapool	4·80	151	,,	Dunkineely	3·67	...

Erratum : Fort William, Glasdrum, June *for* 8·74/*read* 9·24

Climatological Table for the British Empire, February, 1938

STATIONS	PRESSURE: Mean of Day M.S.L. (mb.)	PRESSURE: Diff. from Normal (mb.)	TEMPERATURE: Absolute Max. (°F.)	TEMPERATURE: Absolute Min. (°F.)	TEMPERATURE: Mean Values Max. (°F.)	TEMPERATURE: Mean Values Min. (°F.)	TEMPERATURE: Mean Values ½ Max. and Min. (°F.)	TEMPERATURE: Mean Values Diff. from Normal (°F.)	TEMPERATURE: Mean Wet Bulb (°F.)	Relative Humidity (%)	Mean Cloud Am'nt (0–10)	PRECIPITATION: Am'nt. (in.)	PRECIPITATION: Diff. from Normal (in.)	PRECIPITATION: Days	BRIGHT SUNSHINE: Hours per day	BRIGHT SUNSHINE: Percentage of possible
London, Kew Obsy.	1025·2	+ 9·2	55	28	46·2	37·2	41·7	+ 1·0	37·4	84	7·4	0·31	− 1·23	7	2·5	25
Gibraltar	1022·3	+ 2·3	63	39	56·7	50·2	53·5	− 2·3	48·4	74	6·3	0·69	...	6	...	...
Malta	1018·7	+ 2·6	63	42	56·0	48·1	52·1	− 3·2	47·1	72	6·3	6·37	+ 4·17	10	5·9	55
St. Helena	1015·3	− 0·6	72	59	69·2	61·0	65·1	− 0·1	61·9	92	8·6	2·90	+ 0·22	18	...	...
Freetown, Sierra Leone	1010·5	+ 1·4	91	73	88·1	74·9	81·5	...	75·6	77	3·4	0·00	− 0·30	0	...	...
Lagos, Nigeria	1009·1	− 0·6	92	73	89·5	76·6	83·1	+ 0·6	77·4	89	6·1	3·08	+ 1·18	4	6·7	56
Kaduna, Nigeria	1012·2	...	99	55	93·3	60·3	76·8	− 0·1	55·6	42	2·1	0·00	− 0·02	0	9·7	82
Zomba, Nyasaland	1008·9	+ 0·8	88	59	80·5	64·0	72·3	+ 0·3	70·7	86	5·9	10·30	− 0·35	8	...	...
Salisbury, Rhodesia	1010·3	+ 0·1	87	51	79·8	58·7	69·3	+ 0·5	62·0	72	6·4	1·84	...	5	8·7	69
Cape Town	1013·9	+ 0·5	88	54	79·0	60·4	69·7	− 0·6	61·2	73	4·0	0·25	− 0·33	4	...	...
Johannesburg	1011·3	0·0	81	45	75·5	54·8	65·1	− 0·5	57·1	71	5·8	3·29	− 1·93	10	7·9	61
Mauritius	1009·3	− 1·5	90	69	86·4	73·4	79·9	+ 0·6	75·4	75	5·6	8·79	+ 1·28	15	8·7	67
Calcutta, Alipore Obsy.	1013·4	+ 0·1	89	50	81·8	58·2	70·0	− 1·2	58·8	78	2·0	1·11	+ 0·12	3*	...	...
Bombay	1011·8	− 0·9	94	60	82·9	66·5	74·7	− 1·0	64·0	67	0·7	0·00	− 0·03	0*	...	...
Madras	1011·8	− 1·1	88	67	85·6	72·3	78·9	+ 1·2	73·4	80	5·5	0·54	+ 0·24	2*	...	...
Colombo, Ceylon	1010·5	− 0·3	90	69	86·2	73·9	80·1	− 0·3	76·2	79	5·8	5·97	+ 4·03	13	7·4	62
Singapore	1010·4	+ 0·2	94	72	88·3	75·1	81·7	+ 1·5	77·8	74	6·8	4·72	− 1·90	13	7·1	59
Hongkong	1017·6	− 1·0	78	47	63·3	55·7	59·5	+ 0·4	54·7	73	7·4	4·69	+ 2·86	11	3·7	33
Sandakan	1010·4	...	87	71	84·6	74·1	79·3	− 0·9	76·1	87	8·5	24·02	+ 13·05	13	...	...
Sydney, N.S.W.	1008·6	− 5·3	88	58	79·0	65·0	72·0	+ 0·7	65·2	63	4·8	3·56	− 0·64	8	7·9	59
Melbourne	1008·4	− 6·1	103	49	79·4	57·1	68·3	+ 0·7	59·9	57	6·0	1·87	+ 0·16	8	6·5	48
Adelaide	1009·8	− 4·5	107	53	81·8	61·8	71·8	− 2·2	61·4	49	6·5	2·45	+ 1·73	13	7·0	53
Perth, W. Australia	1011·4	− 1·6	99	50	83·0	61·4	72·2	− 1·9	61·1	48	3·5	0·13	− 0·32	1	11·1	84
Coolgardie	1012·5	+ 0·1	102	47	88·7	61·2	74·9	− 1·3	59·8	49	3·9	0·49	− 0·36	2	...	...
Brisbane	1008·4	− 4·1	97	63	86·9	70·6	78·7	+ 2·2	71·7	69	5·0	5·62	− 0·72	7	8·9	68
Hobart, Tasmania	1006·8	− 6·4	87	41	70·7	54·6	62·7	+ 0·4	56·5	67	6·1	4·26	+ 2·78	17	6·4	46
Wellington, N.Z.	1016·2	+ 0·4	79	54	71·1	59·5	65·3	+ 2·7	62·9	81	7·4	6·32	+ 3·18	12	5·9	43
Suva, Fiji	1006·6	− 1·2	91	72	87·6	76·1	81·9	+ 1·6	77·3	84	6·1	8·45	− 2·27	24	6·5	51
Apia, Samoa	1007·8	− 0·6	89	73	85·3	75·1	80·2	+ 1·2	76·5	80	6·5	13·35	− 1·94	23	5·1	41
Kingston, Jamaica	1015·9	+ 0·6	88	63	84·3	67·0	75·7	− 0·8	64·5	82	2·5	0·20	− 0·40	4	5·6	48
Grenada, W.I.	1011·3	− 2·2	89	71	87	73	80	+ 2·9	75	75	5	2·04	− 0·74	15	...	...
Toronto	1022·6	+ 4·6	51	− 4	33·9	20·5	27·2	+ 6·1	...	...	7·3	3·62	+ 1·24	14	3·0	29
Winnipeg	1025·4	+ 3·6	47	−33	14·3	−5·1	4·6	+ 4·5	...	...	4·6	1·72	+ 0·98	8	4·3	43
St. John, N.B.	1020·7	+ 6·8	40	− 4	27·5	11·1	19·3	− 0·6	15·5	79	6·0	3·60	− 0·30	15	4·0	38
Victoria, B.C.	1011·0	− 5·6	57	31	46·6	36·8	41·7	+ 1·2	39·3	86	7·9	1·81	− 1·45	15	3·3	32

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

(43235) Wt. 21/31 1125 8/38 Hw. G. 377/6.