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## International Days\*

The regular issue of the "blaue Hefte," which carried the results of the international days for the Commission for the Exploration of the Upper Air under the presidency of Hugo Hergesell, Director of the Meteorological Institute of Strassburg, was interrupted by the war.

After the war Professor V. Bjerknes became president, and at a meeting at Bergen in 1921 international enterprise was resumed and questions of units and other technical matters were discussed. Shortly afterwards I learned by post that I had been elected president; and in 1925, with the material for 1923 in hand, a meeting was held in London to settle details of form.

With the generous assistance of a grant from the meteorological section of the Union Géodésique et Géophysique Internationale, the printed volume in four parts was presented at a meeting at Leipzig in 1927. It included a list of stations and data, synoptic pressure charts of the world for the international days, 36 in all; tables of data in the prescribed form, with units

*\*Ergebnisse der aerologischen Messungen 1925. Internationale Kommission für die Erforschung der freien Atmosphäre, Berlin 1930-1. 784 pp. Herausgegeben von dem Präsidenten Geh. Rat. Prof. Dr. H. Hergesell.*

*Comptes Rendus des jours internationaux 1924. Commission internationale de la haute atmosphère, London, 1932. Première partie 161 pp. Tableaux des sondages réussis. Cartes synoptiques. Deuxième partie 24 pp. Folio de téphigrammes.*

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strongly reminiscent of "Dynamic Meteorology and Hydrography"; and reproductions of entropy-temperature diagrams of the soundings by balloon, which then received the name of tephigrams. The volume was placed on sale at £2 per copy.

The Leipzig meeting authorised an appeal for promises of subscription to repeat the effort for the international days of 1924 at a price not exceeding £3 per copy. Dr. Hergesell was reappointed president. The arrangements for 1925 and beyond were entrusted to his charge.

The material for 1924 was made ready during 1928, but had to wait for an arrangement about costs which was finally achieved as the result of a resolution of a meeting of the Commission at Madrid in 1931 and facilitated by the adoption of a method of reproduction of typescript by photography, which is specially economical when observations have to be expressed in complicated tables of figures in irregular rows and columns.

In the meantime the President approached the problem from a similar standpoint and commenced the issue of "blaue Hefte" for the international days of 1925. During 1929, '30 and '31, he issued 784 pages of material in 18 parts, of which one, namely, that for January 24th, 1925, represents the data for a special inquiry, arranged by telegraph, into the features of a notable anticyclone. The others are for April 14th-16th, August 17th-22nd, and December 1st-31st, representing the "international month" for that year. Economy of space is secured by a long table of 29 symbols, a table of *Generalia* for the stations grouped into districts giving geographical co-ordinates and time of ascent, conditions of weather at the surface, particulars of the instruments and apparatus employed, of the greatest height reached and the mode of reaching it. Then a table of geopotential, or geodynamic height, temperature and relative humidity for isobaric surfaces in 100 mb. steps from 1,000 mb., followed by a table of pressure, temperature and humidity for steps of geodynamic height 500, 1,000, 2,000 geodynamic metres, and so on; then a repetition of the same for geometric heights of the same figure, and a table of an indefinite number of steps of height with corresponding pressure, temperature and humidity.

When there are pilot balloons, direction and velocity of the wind are given for heights variously chosen. The method of indicating cloud observations and those at mountain stations need not be particularised.

The issue for 1925, priced at £3, has been followed by a corresponding issue for 1926, covering 1,054 pages in the same style with the same price. The data are entirely numerical; meanwhile the volume for 1924 has appeared priced at £2 5s. per copy: 144 pages of tables in the same form as 1923 with 12 pages of pressure-charts for the 38 international days of that

year. Also with the aid of a special grant from the International Meteorological Organisation there is a separate part of tephigrams for the *ballon-sonde* ascents. Superposed thereon, when the information is available, are diagrams of the components of the horizontal velocity of the balloons in their flight.

There is some difference of opinion in the highest meteorological circles about the relative merits of diagrams and numerical data for representing the achievements of international effort. Some are of opinion that scientific reality can only be expressed in numbers; and with reduction to numbers the original graphs should be understood to make their bow to international curiosity. Others, on the contrary, if they wished to see how things were going in the upper air, would sooner turn over twenty pages of diagrams than a hundred pages of numbers, which a poet once called mournful. A word may be added in favour of that view, because the numerical results for each country are generally given in detail in the publications of the several institutes; and the great advantage of collecting the world's observations in one volume is that it emphasises the geographical aspect of the exploration and makes it possible to bring meteorology, geography and chronology on the stage together within sight of the curious student of weather.

Sometime it must be realised that after sixty years of synoptic maps, ostensibly for sea level, some vertical sections, particularly along meridians, are necessary for making an effective picture of the atmospheric structure. The volumes of international days give the material at present available for that ideal; and perhaps the suggestion which they whisper is that as a sounding balloon works quite creditably with a meteorograph, failing only for lack of ventilation, a meteorograph might be carried also by an aeroplane; and then the daily aeroplane from Dakar to Oran, from Oran to Paris, from Paris to London, from London to Iceland, from Iceland to Greenland, from Greenland to Toronto, and from Toronto to Washington, and back, would give us some interesting information which would be a useful frame for the isolated data of the international days. And then, with the motor car suggested by the Italian Ufficio Presagi as a mobile observatory, ascents of *ballon-sondes* might be arranged at selected points along the air routes for obtaining sections, instead of at fixed stations. The meteorological millennium would become visible in the background of the view.

NAPIER SHAW.

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## The Areas with Light and Heavy Rainfalls

Three years ago we prepared revised figures\* of the average annual rainfall of each five-degree zone of the earth's surface.

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\* The zonal distribution of rainfall over the earth. *London, Mem. R. Meteor. Soc.*, 3, No. 28, 1930.

Subsequently, figures were required, for another purpose, of the zonal areas with rainfall below 10 inches a year, and this information was readily derived from the working sheets for the earlier investigation. It seemed desirable to put these results on record, with similar figures for the areas with rainfall between various limits. The figures for the land and sea were computed separately. For most of the land areas the figures are reasonably trustworthy, being derived from good rainfall charts, while much of the area for which satisfactory charts are not available is desert and may be assumed to have a rainfall below 10 inches. For the oceans the charts are far less reliable, and in places are not far removed from guess-work, hence the results for the oceans are given in skeleton form only.

TABLE I.—PERCENTAGE AREAS WITH ANNUAL RAINFALL BETWEEN SPECIFIED LIMITS.

	0—10in.	10—20in.	20—40in.	40—60in.	60—100in.	<i>Above</i> 100in.
<b>Land</b>						
70°—60°N	48	41	9	2	0	0
60°—50°N	4	62	31	2	1	0
50°—40°N	30	31	32	5	2	0
40°—30°N	34	31	21	11	3	0
30°—20°N	58	6	9	15	11	1
20°—10°N	29	15	28	11	12	5
10°N—0°	1	8	14	27	37	13
0°—10°S	1	2	13	23	43	18
10°—20°S	4	9	35	31	20	1
20°—30°S	35	23	23	9	10	0
30°—40°S	26	29	31	11	3	0
40°—50°S	44	9	17	9	16	5
50°—60°S	7	34	22	15	17	5
70°N—60°S	26	25	22	13	11	3
<b>Ocean</b>						
70°—40°N	5	8	29	27	25	6
40°—10°N	8	17	27	19	25	4
10°N—10°S	3	26	11	10	30	20
10°S—40°S	8	15	32	20	24	1
70°N—40°S	6	18	25	18	26	7

Table I shows the percentage areas between certain limits for each 10-degree zone of the continents and for the north-temperate, sub-tropical and equatorial zones over the oceans. The figures for the land bring out some interesting points, notably the extremely large proportion of the land between 30° and 20°N. which has a rainfall below ten inches and the general heaviness of the rainfall in the equatorial region between 10°N. and 10°S. The storm belt between 50° and 60°N. has a generally moderate rainfall, while between 60° and 70°N. 89 per cent. of the area receives less than 20 inches a year. South of 20°S. the percentage areas with low rainfalls again increase, but beyond 40°S. the land areas are small and the 44 per cent. below ten inches in 40-50°S. lies almost entirely in Patagonia. The data for the oceans are less reliable but serve to bring out

the general moderateness of the amounts, except near the equator.

The figures for the land areas as a whole show that more than a quarter of the whole land surface has a rainfall below ten inches, and more than one-half has a rainfall below 20 inches, while only one-thirtieth exceeds 100 inches. On the other hand less than one-quarter of the sea surface receives less than 20 inches,, and as much as one-fourteenth exceeds 100 inches, though the latter figure especially is very doubtful. The average annual depths of rain over the land and sea have been computed as 25.9 inches and 43.6 inches respectively.

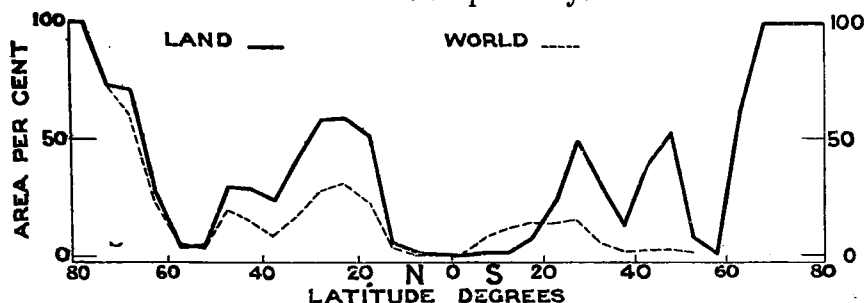


FIG. 1. PERCENTAGE AREAS WITH RAINFALL BELOW 10 INCHES.

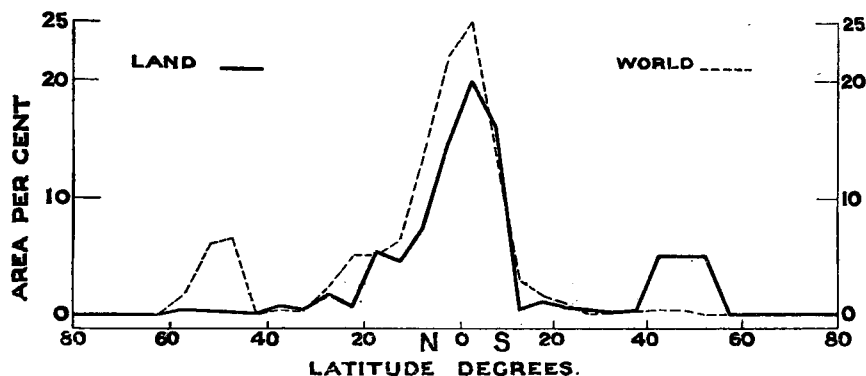


FIG. 2. PERCENTAGE AREAS WITH RAINFALL ABOVE 100 INCHES.

The incidence of rainfall below ten inches in different latitudes is shown graphically in Fig. 1, the full line representing the percentage of land areas and the broken line that of the world as a whole. Apart from the polar regions which probably everywhere receive less than ten inches, there are two main zones of light rainfall, over the land between  $15^{\circ}$  and  $30^{\circ}$ N. and between  $20^{\circ}$  and  $35^{\circ}$ S. The second maximum in the southern hemisphere, between  $40^{\circ}$  and  $50^{\circ}$ S., represents only the narrow dry area of Patagonia previously referred to. The broken line, representing percentage areas over the world as a whole, shows essentially the same features, except that the Patagonian maximum almost entirely disappears and the southern dry area is

shown to extend mainly from  $10^{\circ}$  to  $30^{\circ}\text{S.}$ , almost symmetrical with that in the northern hemisphere. The secondary maximum in  $40^{\circ}$ - $50^{\circ}\text{N.}$  represents mainly the great deserts of Mongolia and Turkestan, while the dip in  $35^{\circ}$ - $40^{\circ}\text{N.}$  is due largely to the monsoon rains of Asia.

Fig. 2 shows the percentage areas with rainfall above 100 inches, and is chiefly remarkable for the great equatorial maximum on both curves. In  $0^{\circ}$ - $5^{\circ}\text{S.}$  the areas reach 20 per cent. for the land and 25 per cent. for the whole world. The secondary maximum about  $50^{\circ}\text{N.}$  is due to the heavy rainfall in the North Atlantic in this stormy latitude, while the secondary maximum in land areas about  $50^{\circ}\text{S.}$  results mainly from the heavy rainfall along the coastal ranges of Chile.

During the process of calculation figures were obtained for the average rainfall of the British Isles in each degree of latitude, which have some interest, and these are given in table II. The most noteworthy points shown by this table are the pronounced maximum between  $56^{\circ}$  and  $57^{\circ}\text{N.}$ , which include most of the Scottish Highlands, and the minimum between  $52^{\circ}$  and  $53^{\circ}\text{N.}$ , which covers the widest and flattest part of England and Wales.

TABLE II.—AVERAGE RAINFALL OF THE BRITISH ISLES IN EACH DEGREE OF LATITUDE.

	$59^{\circ}$ - $58^{\circ}$	$58^{\circ}$ - $57^{\circ}$	$57^{\circ}$ - $56^{\circ}$	$56^{\circ}$ - $55^{\circ}$	$55^{\circ}$ - $54^{\circ}$	$54^{\circ}$ - $53^{\circ}$	$53^{\circ}$ - $52^{\circ}$	$52^{\circ}$ - $51^{\circ}$	$51^{\circ}$ - $50^{\circ}$
	in.	in.	in.	in.	in.	in.	in.	in.	in.
Great Britain	47.6	55.5	61.4	43.8	43.5	34.7	32.8	34.1	40.2
Ireland				45.5	44.3	40.7	43.0	62.0	

C. E. P. BROOKS.

THERESA M. HUNT.

## OFFICIAL PUBLICATIONS

The following publications have recently been issued:—

GEOPHYSICAL MEMOIRS No. 56. *Some upper-air observations over Lower Egypt.* By S. P. Peters, B.Sc., A.Inst.P.

Owing to the increasing importance of lower Egypt as a centre of convergence of air routes traversing the continents of Europe, Asia and Africa, any addition to our limited knowledge of meteorological conditions in the upper air of this region is to be regarded as welcome. An important contribution to the subject is to be found in this *Memoir*, which records and discusses a notable series of observations made in 1925 and 1926 by means of aeroplane ascents from the Royal Air Force aerodrome at Abu Sueir. The unique feature of the investigation is the fact that as many as five ascents per day were made on about thirty days, to a height of 10,000 feet, as a result of which considerable insight into variations of temperature in

the upper air during the course of a day is provided. It appears that above a height of about 3,000 feet there is normally very little diurnal change of temperature, though at the surface the temperature may not uncommonly range through as much as 30°F. in the course of 12 hours.

The *Memoir*, though mainly concerned with temperature conditions, also includes references to allied aspects of the aerology of lower Egypt, as, for example, the diurnal variation of winds in the free air, haziness and bumpiness. It should be of interest to all aviators and meteorologists who are concerned with this region.

GEOPHYSICAL MEMOIRS No. 57. *Observations of smoke particles and condensation nuclei at Kew Observatory.* By H. L. Wright, M.A.

Since the beginning of 1928 observations have been made at Kew Observatory of the number of smoke particles and the number of condensation nuclei which are present in the air. In this publication the observations for three years are discussed with special reference to their variations with changes in the meteorological elements. In the winter months the average number of smoke particles in a cubic centimetre of air is 1,367, while in summer the average is only 180. In the case of condensation nuclei the contrast is less marked, there being 38,000 per cubic centimetre in winter and 20,000 in summer. Easterly winds from London bring smoke particles to Kew Observatory in great numbers, and light winds from any direction lead to excessive concentrations. While easterly winds are also associated with large numbers of nuclei, the distinction with wind direction is not so marked as in the case of smoke particles. Smoke particles are produced by the combustion of coal in industrial furnaces and by the domestic fire, the latter apparently being the most fruitful source, while nuclei originate in the combustion of coal and of gas.

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## Discussions at the Meteorological Office

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

February 27th, 1933.—(a) *The relationship of climatic and geological factors to the position of soil clay and the distribution of soil types.* By E. M. Crowther (London, Proc. R. Soc. B. 107, 1930, pp. 1-30). (b) *Analyses of agricultural yield, Part IV: Water-table movements on a farm in Egypt.* By W. L. Balls (London, Phil. Trans. R. Soc. B. 221, 1932, pp. 335-75). *Opener*—Dr. B. A. Keen.\*

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\*The discussion of these papers has been postponed from January 16th owing to the illness of Dr. Keen.

## Royal Meteorological Society

The Annual General Meeting of this Society was held on Wednesday, January 18th, in the Society's House, 49, Cromwell Road, S. Kensington, Mr. R. G. K. Lempfert, C.B.E., M.A., Vice-President, in the Chair.

The Report of the Council for 1932 was read and adopted, and the Council for 1933 duly elected, Prof. S. Chapman, F.R.S., being re-elected President.

The Buchan Prize, which is awarded biennially for the most important original papers contributed to the Society during the previous five years, was presented to Mr. D. Brunt, M.A.

In the absence of the President through illness, his Address was postponed and the following papers were read:—

*E. G. Bilham, B.Sc.—Variations in the climate of York during the 60 years, 1871 to 1930, and comparison with Oxford.*

The paper is mainly devoted to a comparison of the climatological data for York (The Yorkshire Museum) during the two periods of 30 years, 1871-1900 and 1901-1930. It has commonly been asserted that since the turn of the century winters have become less "wintry" and summers wetter and less sunny. The data show that in the latter period mean temperature has risen in most months, the increase amounting to from 1° to 1.5°F. in January, March, May, October and December. Sunshine increased by approximately 30 per cent in November and decreased by approximately 15 per cent in February, March and May. Rainfall was on the average 7 per cent less in the latter period, the months showing the biggest changes being January (plus 12 per cent), February (minus 15 per cent), June (minus 15 per cent), July (minus 12 per cent), September (minus 28 per cent), October (minus 17 per cent) and December (plus 14 per cent). The results support the popular belief that winters have become milder, but there is no support for the supposition that summers have, on the whole, deteriorated since 1900. The season showing the most marked change is autumn, with 17 per cent less rainfall and 9 per cent more sunshine.

A similar investigation shows that at Oxford (Radcliffe Observatory) corresponding changes of temperature have occurred. Oxford has, however, experienced an increase of rainfall amounting to 22 per cent in spring and 14 per cent in winter, though winter sunshine has increased by 12 per cent.

Analysis of the data in 5-year and 10-year periods shows that the changes of sunshine and rainfall are not progressive, but arise merely from the "casual" variations of those elements. In the case of temperature there is some evidence of systematic change, which may or may not be due to a long-period cycle.

*J. E. Clark, B.Sc.—The York rainfall, 1831-1930; also 1811-24; and for the 114 years.*

The paper deals with the variations in the decadal means of



monthly and annual rainfall and in the number of rain-days as recorded at York. While some of the changes brought out in this paper are also apparent from the tables and diagrams included in Mr. Bilham's paper, the present paper considers a much longer rainfall record than the previous paper.

*L. H. G. Dines, M.A.—Mean values of the relative humidity at different heights in the atmosphere over England.*

Tables are given of mean values of the relative humidity in the troposphere over England up to a height of 8 kilometres. The figures have been derived from observations made with hair hygrometers, and their limitations are stated. An examination of records obtained within the stratosphere leads to the conclusion that the relative humidity in that region varies considerably as between different days, and that its mean value is of the order of 70 per cent with respect to ice.

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## Correspondence

To the Editor, *The Meteorological Magazine*.

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### The Colour of Moonlight

Mr. Bilham's physiological explanation of the apparent blue colour of the night sky, as a contrast with the yellow colour of artificial light, in the *Meteorological Magazine* for December, no doubt accounts for part of the phenomena, but it does not seem to me to be complete. I think selective scattering must also play some part, as in the blue of the day sky.

The streets of London contain a large number of powerful artificial lights. On my nightly journey through London I have at a few points, such as Balham, an elevated view across the housetops, but I cannot actually see any powerful lights. On hazy nights the air above these points appears to have a bluish tinge which I think is partly real, and which can be accounted for on physical grounds.

Artificial lights in a street of tall houses have some resemblance to lights in a reflector; the main course of the light is upwards. The light shining upward into the haze is partly reflected, partly scattered and partly allowed to pass. Except in the case of a fog or dense low cloud, however, the particles are small, and the amount of light directly reflected is comparatively small. On the other hand, the proportion of scattering is large, but the important point is that the scattering is greater in the shorter wave-lengths—that is, the blue end of the spectrum—than in the longer wave-lengths—the red end of the spectrum. Hence the haze, looked at horizontally, appears bluish, but the blue of the haze is not the pure blue of the sky, because the haze particles are larger than the air molecules to which the sky blue is attributed, and so the scattering of the different wave-lengths is less unequal than in clean dry air.

The night sky of London in fact reproduces in crude form a beautiful experiment by Tyndall, in which a beam of electric light was passed the length of a tube containing a cloud of fine particles. Viewed from the side, the tube shone with a blue light, which was purer the smaller the particles.

If it were not for this selective scattering, the hazy night air would obviously appear of the same colour as the artificial illumination, *i.e.*, yellowish. This may explain why a dense London night fog, which reflects or scatters the whole of the artificial light, appears yellow. I do not think the fog particles themselves have a noticeable yellow tinge.

C. E. P. BROOKS.

*January 30th, 1933.*

In reply to Mr. Bilham, I wish to state that I observed the blue sky on Hampstead Heath about 9.30 p.m. on October 17th, an hour which at that period of the year should be too late for any effects of lingering daylight. Moreover, the entire night was very bright and windy, and I have little doubt that the blue tint persisted right through the night. In contrast, the sky on the following evening, as observed in the same locality at the same time, was normal, the weather being just as fine and the moon having risen only 25 minutes later.

In the letter to *The Times*, as quoted by Dr. Simpson, I implied, or meant to imply, in saying that the night sky is ordinarily without colour, that it is without conspicuous colour. As a matter of fact, the normal moonlit sky appears to be a very dark blue rather than black. I recently questioned a boy scout who happened to be walking with me late one evening what he considered the colour of the moonlit sky to be, and he replied "Oh! a kind of bluey black."

Cases of conspicuous blueness like that of October 17th occur at infrequent intervals and are obviously connected with meteorological conditions. I have not studied the optics of the question sufficiently to be able to advance any explanation, but it does not appear to me very remarkable that the night sky should vary in hue and brightness. After all the daylight blue sky is never two days alike in quality or intensity! It is greatly to be desired that persons who live deep in the country away from the disturbance of artificial lights should make observations on the colour of the night sky.

L. C. W. BONACINA.

35, *Parliament Hill, Hampstead, N.W.3.* December 31st. 1932.

### A "Perfect" Lunar Halo

On the evening of February 1st, when leaving the house soon after seven, my attention was at once attracted by a striking lunar halo. The moon, nearing the half stage, stood out sharply, although rather dim, from a circle of uniform and marked

darkness ringed in by a brilliant white halo, under  $2^\circ$  in width. The inner edge was exceedingly sharp, but after  $\frac{1}{2}^\circ$  it shaded off gradually, ending to the east by Aldebaran.

The whole sky seemed hazy and yet the film must have been thin and presumably very homogeneous. For Vega, although so low just west of north shone little less dimly than Aldebaran. Light fleecy clouds obscured the stars here and there. There had been little change by 7.30, but on coming away at 8.45 the film had gone and stars were bright in rifts between stretches of fleecy clouds. These moved only slowly, suggesting high altitude.

J. EDMUND CLARK.

*Street, Somerset. February 3rd, 1933.*

### Conical Hailstones

During a shower of soft hail which occurred in the evening of January 17th between 21h. 45m. and 22h., I observed the hail to be of a peculiar conical shape with round base, which I consider to be rather unusual. Many of the smaller granules were round in shape as commonly observed. The conical ones were fully a quarter of an inch in length and breadth and were opaque, white and relatively soft on the outside, becoming more solid inside. On the morning of the 18th the soft hail was still lying, but had become quite solid. The air temperature (in Stevenson screen) at the time of the shower was 33 degrees. The surface wind was easterly, 2 m.p.h., while the cloud from which the hail fell was moving from the WSW. In addition to the above, other unusual features for this time of year were the mountainous banks of cumulus and cumulo-nimbus clouds which occurred during the morning; some well-developed "anvils" of "false cirrus" were also observed, while thunder and lightning occurred to the south-west at 10h. and again at 19h. 09m. to the south-east. At 19h. 09m. the lightning was very vivid. Hail of the ordinary transparent form (small in size), sleet, and snow also occurred during the day, with frost morning and evening, that in the morning being sharp on the grass. The wind was light, and variable in direction all day and frequently falling calm.

A. E. MOON.

*39, Clive Avenue, Clive Vale, Hastings. January 19th, 1933.*

### NOTES AND QUERIES

#### The Colour of Moonlight

Referring to the correspondence on this subject in the *Meteorological Magazine*, Prof. A. Schmauss, Director of the Bayer. Landeswetterwarte, Munich, has called attention to a recent paper by W. M. Cohn,\* who suggests that the blue of the sky

\*Elektronenbombardement als Faktor bei atmosphärischen Erscheinungen. *Beitr. Geophysik. Leipzig*, 37, 1932, pp. 198-223.

may be partly due to the bombardment of the upper atmosphere by cathode rays from the sun. The fluorescent blue light produced by cathode rays in nearly exhausted tubes is well known, and Cohn argues that the same phenomenon occurs in the highest air at pressures of about one ten-thousandth of a millimetre. He considers that this light is excited by electrons emitted from the sun, which strike all parts of the atmosphere, some of them following curved paths which bring them into the night hemisphere, though the majority fall on the side of the earth turned towards the sun. He even regards the fluorescence excited by these rays as forming an appreciable part of the blue of the day sky, on the grounds (1) that the spectrum of the fluorescence is identical with that of the sky; (2) that the maximum polarisation of the sky light is only about 70 per cent, while Rayleigh's well-known theory of scattering by air molecules requires complete polarisation at a point 90 degrees from the sun; and (3) that polarisation decreases with increasing altitude, indicating that at high levels the proportion of unpolarised fluorescent light increases.

Cohn also states that the colour of the night sky, especially within the tropics, may be a deep blue; he does not state whether this remark applies when the moon is not shining, but he definitely attributes a large part of this illumination to fluorescence excited by electrons emitted from the sun and reaching the earth along curved paths.

The theory of electronic bombardment put forward by W. M. Cohn is open to a number of objections. Here it is sufficient to remark that the measured light of the moonless night sky, though about three times as strong as can be accounted for by the diffusion of starlight, is far below the threshold of colour vision, and is not blue but yellowish. Lord Rayleigh\* describes it as nearly the colour of a piece of paper illuminated by a half-watt lamp at normal incandescence, while J. Dufay† found it to have a spectrum similar to that of sunlight with the addition of the green "auroral" line.

### **The Journey of a Toy Balloon : Evidence for very strong upper Winds**

The following is an abstract of letters received from Mr. J. Bevan, Secretary of Pim Bros., Dublin :—

"On Monday afternoon, November 14th, about 400 balloons were released from the roof of the building of Messrs. Pim Bros., Dublin, in connection with an advertisement of the opening of the Christmas show in the toy department. When blown up the balloons were about 18in. by about 12in.-14in.

\*Some recent work on the light of the night sky. *Nature*, 122, 1928, p. 315.

†Spectre, couleur et polarisation de la lumière du ciel nocturne. *J. Phys. Radium*, (6), 10, 1929, pp. 219-40.

diameter, and were filled with hydrogen. On being released they were borne away in a south-westerly direction and continued to rise until out of sight. Up to December 7th eleven had been returned: two from Dublin, two from County Limerick, two from France and five from England; a few more were found later.

One in particular was stated to have been found that night at 7.30 p.m. near Ashford, Kent, and was posted to us on the Tuesday, being delivered here on Wednesday morning. This appears to us to be almost phenomenal—that a balloon should travel first in a south-westerly direction and be found four hours later at a point some 300 miles south-east of its starting point. Is there any record of a similar occurrence?

On the next day at about 11 a.m. another balloon was found near Ashford; one was found near Caen, Normandy, at 9.30 a.m., another on the sea 10 Km. north of Dieppe by a trawler captain. Other balloons were found as follows:—

Bunwell, Norwich, 11 a.m. Tuesday, November 15th;

Southminster Marshes, Essex, 10.30 a.m. Tuesday, 15th;

Felsham, Bury St. Edmunds, Saturday, 26th.

The various directions are no doubt accounted for by varying directions of winds at various heights—the day was very dull, there being heavy clouds, but it was not raining.”

Mr. J. Strover, of Forge Row, Westwell, near Ashford, has been so good as to confirm the report that it was at 7 or 7.30 on Monday night that he found the balloon mentioned in Mr. Bevan's letter. Mr. Strover says that the balloon was still filled with gas. Moreover, Mr. Bevan assures me that there was no possibility of any of the balloons being released earlier than the Monday afternoon, as the hydrogen cylinder was not obtained until the Monday morning.

On November 14th the gentle current from NE. in the lower atmosphere was general over Ireland. There is practically no meteorological evidence with regard to movements at higher levels. It is remarkable that just the one balloon should have ascended so far as to get into the powerful NW. wind which, it would appear, must have been blowing at about 100 m.p.h.

F. J. W. WHIPPLE.

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### **Meteorological Conditions during the World's Altitude Record Flight for heavier-than-air Aircraft**

On September 16th, 1932, the record height of 43,976 feet was attained by a Vickers' "Vespa" aeroplane fitted with a Bristol "Pegasus" S.III engine, and piloted by Flight-Lieut. C. F. Uwins, Chief Test Pilot of the Bristol Aeroplane Company. The aeroplane had been specially adjusted for the flight and several preliminary tests were made before the actual record was established.

During the test climbs and on the record flight the stratosphere was penetrated and the notes made by the pilot regarding weather conditions and the temperatures recorded offer several points of interest. Air temperatures were obtained from a strut thermometer (nitrogen filled) reading to  $-65^{\circ}\text{C}$ . The following notes and table of observations are extracted from the report supplied by the Bristol Aeroplane Company:—

“The weather during all the flights was fairly clear, but on the last flight the sky was covered by broken cloud at 2,000 feet. The following observations were made:—

*Temperature.*—Air temperature generally fell until a minimum was reached in the neighbourhood of 35,000 feet. On the actual record climb the temperature at this height was  $-50^{\circ}\text{C}$ ., while the temperature at 44,000 feet was  $-56^{\circ}\text{C}$ . The temperature between these heights was steady at  $-55^{\circ}\text{C}$ .

On one climb a temperature of  $-58^{\circ}\text{C}$ . was recorded at 38,000 feet, while the lowest temperature recorded in all the climbs was  $-63^{\circ}\text{C}$ .

It is of interest to observe that a slight reversal of temperature was recorded on three occasions at a height of 40,000-42,000 feet.

On the test climb made on September 7th, 1932, the minimum temperature recorded was  $-52^{\circ}\text{C}$ . at 35,000 feet, above which a steady rise in temperature occurred until at 41,500 feet it stood at  $-46^{\circ}\text{C}$ . This reversal was verified during the descent.

*Clouds.*—Clouds were experienced up to 35,000 feet.

*Bumps.*—Bumps were experienced at various heights. The most noticeable were on the final test when fairly rough air was encountered at 44,000 feet.

*General.*—Conditions at height were generally good. Visibility was excellent, and the only discomfort was experienced when climbing towards the sun. This was extremely bright and made all instruments very difficult to read.

Coloured glasses or some form of eye-shade should prove helpful when flying at these heights.”

<i>Height</i> Feet		<i>Time</i>		<i>Air Temperature</i> $^{\circ}\text{C}$ .
		Min.	Sec.	
O.G.	...	—	—	18
10,000	...	9	00	9
15,000	...	—	—	—
20,000	...	24	45	-14
25,000	...	35	00	-26
30,000	...	45	00	-38
35,000	...	57	00	-50
40,000	...	72	00	-55
43,500	...	96	00	-55
43,500	...	103	00	-56

The flight was made when a belt of high pressure extended

across the British Isles connecting anticyclones centred over southern Germany and the eastern Atlantic. The wind circulation over the British Isles was associated essentially with the former of these two anticyclones, the surface wind in southern England being mainly light, easterly and veering with height to between S. and SE. at 10,000 feet with little change of speed. In the upper air the temperatures at all levels were above the September normal, the excess decreasing from 9°C. at 10,000 feet to 5°C. at 20,000 feet and to 2°C. at 30,000 feet. Observations made at Duxford on September 16th and the two preceding days indicated that the air was slowly descending, as shown by the rise of temperature and decrease of relative humidity in the middle levels.

The report of clouds up to 35,000 feet is of interest, in that synoptic reporting stations near to Bristol make no reference to cirrus clouds on this day. This may be accidental owing to the cloud not being observed at the time of observation or because of the cloud being too thin to be observed through the haze layer.

The bumpiness at 44,000 feet is rather remarkable in view of the notes regarding the constancy of air temperature between 35,000 feet and the maximum height reached. On another occasion a local, very bumpy patch was encountered at about 43,000 feet. This patch was above a big cloud of the cumulonimbus type. After passing through this patch, the air was again quite steady. This may form a small piece of evidence in support of the view that convection and cloud formation are possible in the stratosphere.

R. S. R.

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### Recent Meteorological Work in India

The arrival of a batch of thirteen numbers in the *Scientific Notes* of the India Meteorological Department provides striking evidence of the activity of the staff, an activity that has in the last four years produced 47 of these Notes and 7 of the larger series of Memoirs, as well as several papers in the *Philosophical Transactions of the Royal Society* and in the *Beiträge zur Physik der freien Atmosphäre*.

The Indian department was started in 1875, so that the number of those who remember H. F. Blandford, its able founder, is extremely small. But of the tireless energy and heroic devotion to duty of his successor Eliot the reviewer has vivid recollections. Eliot worked twelve hours or more every day of the week, and spent the greater part of his last years of office in organising and checking the calculation of normals, himself correcting the proofs, in order that when he handed over his duties, the knowledge of the history of the 180 observatories, which he alone possessed, should be utilised to the full. He would sometimes speak with longing of the future years when

the Director would have a trained scientific staff and facilities for research; and material extension along these lines was obtained by him shortly before his retirement.

The first of the present group of papers (Vol. III, No. 18), by K. R. Ramanathan and A. A. Narayana Iyer, is a study of a tropical storm and finds in it a warm front in some respects similar to that found in European depressions. But the fall of pressure was slight and the sea data scanty. In the second (III, 19), by V. N. Ghosh, are given the monthly distributions of air density at M.S.L. over India; and in the third (III, 27), by B. N. Desai, we have a classification of the conditions that produced thunderstorms at Poona in 1930.

It is particularly pleasing to the reviewer to see two papers (III, 29, and IV, 38), by V. Doraiswamy Iyer, who in his earlier years of routine work in the department had little chance of research. His first paper is a study of the very destructive Bengal cyclone of September, 1919, and in the second it is shown that the monsoon rainfall of Siam, excluding a portion of the Malay peninsula, varies in close relationship with the monsoon rainfall of north-west India and can be forecast with a correlation coefficient of 0.81. The parallelism with north-west India is curious, for Burma has a marked negative relationship with the southern oscillation and China is independent of it.

In addition to the joint paper (III, 18) already noticed, K. R. Ramanathan contributes a paper (III, 30) on the structure of the sea breeze which sets in at Poona on many evenings between February and May; he uses special observations with pilot balloons. He also has a second joint paper (IV, 34) with H. C. Banerjee, in which pre-monsoon storms in the Bay of Bengal are compared with winter storms in the Bay; in the former warm dry land air ascends over cooler, damper sea air, while in the latter the moister air is the warmer. These investigations into storms are much needed in view of the present difficulty in foreseeing at certain times whether a storm will move north-west or north-east. In Note IV, 31, S. K. Pramanik, in collaboration with S. C. Chatterjee and P. P. Joshi, continues his examination of lunar atmospheric tides, showing that at Kodaikanal at 7,688 feet above sea level the mean amplitude is the same as at Periyakulam, at 944 feet.

The next paper (IV, 32), by S. Atmanathan, deals statistically with the inferences for daily weather forecasting that can be derived from the temperature difference between Simla at 2,204 m. and Ambala on the plains 135 Km. distant at 272 m. above M.S.L. This difference had long been used, and Ramanathan had studied the sounding-balloon ascents at Agra for the effects of variations in the vertical temperature gradient; but the data of hill stations afford only a rough indication of the



temperature in the free air, and it was desirable to ascertain how far the ordinary daily observations at Simla and Ambala could be relied upon in forecasting. The verdict is definite and satisfactory.

V. V. Sohoni provides in IV, 33, an interesting application of Normand's wet-bulb theory to show that the Calcutta thunderstorms, usually nor'westers, are not due merely to heat, for the wet bulb falls very nearly as much as the dry, and in 95 per cent of the storms there is a decrease of absolute humidity; they are due to the over-running of warm, moist air from the Bay by cold, dry air from north India. The next paper, IV, 35, is by G. Chatterjee, who was trained by Field to take charge of upper-air work at Agra. It gives an improved method of sounding with an ingenious self-deflating balloon that is turned upside down at 3 Km. and empties the hydrogen from its open mouth; the meteorograph has a double temperature-grid with a more open scale than the Dines instrument. In association with P. M. Neogi, Chatterjee describes in IV, 36, two ingenious contrivances for lifting the pens off the recording plate of the meteorograph before it reaches the ground so as to avoid the blurring of the lower portion of the trace.

The last paper (IV, 37), by S. R. Savur, examines the reviewer's method of seasonal forecasting. His original formula of 1908 was for India as a whole, and in 1924 he developed a more ambitious scheme of foreshadowing the winter precipitation of north-west India and the rainfall of the Peninsula and of north-west India, both for June to September and for August and September. For the monsoon rainfall of north-east India little success was claimed, and inasmuch as subsequent theory has shown that a forecast with a 4 : 1 chance of success could only have been made for this region once in six years, its formula may be definitely set aside. The inclusion of between six and ten more years and the use of a statistical expression worked out by Fisher in 1928 has enabled Savur to apply an effective criticism. In his verdict he says:—"It is not a little surprising that only seven out of 28 factors have been found by this stringent test likely to become insignificant in the long run"; and it may be noted that for the monsoon forecasts of the Peninsula and north-west India the corresponding statement would be three out of 32.

The general impression left by these *Scientific Notes* is one of satisfaction due to their objective character. In the early days both of some departments and some individuals, there is a tendency towards an overdue use of intuition and a consequent lack of fibre; an over-hasty rushing into print is not unknown. But here a series of problems covering a wide range have been studied and the department is to be congratulated on the definiteness of the results that have been reached.

G. T. WALKER.

### The lowest recorded Barometric Pressures at mean sea level

On January 3rd, 1933, during the passage of a deep depression from south to north across Iceland, the pressure at Reykjavik at 7h. fell to 927.2 mb., and earlier in the morning the reading was probably still lower. This is among the lowest barometer readings recorded at sea level in temperate regions. Other records are:—

925.5 mb. at Ochtertyre, Perthshire, January 26th, 1884.

925.5 mb. on H.M.S. *Tarifa* in the Atlantic, 51°3'N., 23°59'W. on February 5th, 1870.

927.2 mb. at Belfast on December 8th, 1886.

927.9 mb. on s.s. *Westpool* in the Atlantic, on December 4th, 1929.

Much lower pressures have been recorded from time to time in tropical cyclones. By far the lowest known is a reading of 886.8 mb. (26.185 in.) on August 18th, 1927, on the Dutch steamship *Saparaea* in the Pacific, 460 miles east of Luzon (Philippines). This phenomenal reading was quoted in *Nature* for August 18th, 1928, p. 251. A barograph was on board, but the pen passed off the chart, and readings were made with a mercurial barometer; the lowest reading was checked by several persons. Other low readings are 915.7 mb. on board a ship near Grand Turk Island on September 27th, 1880, and 918.9 mb. at False Point Lighthouse, Orissa, Bengal, on September 22nd, 1885.

It is possible that still lower pressures exist in the funnel clouds of tornadoes, though no actual records exist. As is well known, when a tornado passes over a building, the difference between the pressure of the air inside the rooms and that outside sometimes causes the walls to be burst outward or the roof to be lifted off, but the forces which would be set up by a sudden drop of pressure by even 100 mb. would probably be more than sufficient to account for all the observed damage of this nature.

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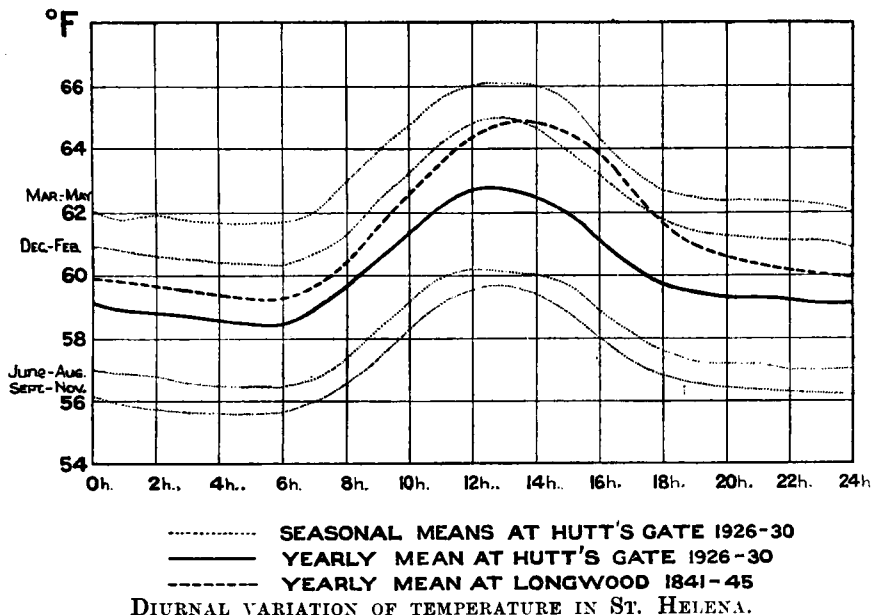
### The diurnal Variation of Temperature in St. Helena

The island of St. Helena occupies a position in the South Atlantic Ocean which from a meteorological point of view is of great importance and interest. Its length is only about eleven miles and its width approximately seven miles, so that the climate is almost purely oceanic, and it lies in the path of the south-east trade winds.

The station is at Hutt's Gate, near St. Matthew's vicarage, in the centre of the island, at a height of about 1,900 feet above M.S.L. In 1926 a bimetallic thermograph was installed and was working intermittently until September, 1930. Despite many breaks in the records there are sufficient observations in that period to warrant an attempt to exhibit the diurnal varia-

tion of temperature at this station.

The values from which the curves in the accompanying diagram are constructed were read from the autographic curves and corrected by eye observations taken at 6h. 30m. It will be seen that the maximum temperatures occur at the end of the southern summer and the minima at the conclusion of the southern winter.



Another noticeable feature of the diagram is the flatness of the curves around the time of the minima, which is characteristic of an oceanic position. There is no definite rainy season at St. Helena, but it may be noted, for purposes of comparison, that the rainfall is greatest in autumn (March to May) and least in spring (September to November). The curves are drawn for G.M.T., local time being 22 minutes behind this.

An interesting comparison may be made with the results of a series of eye observations taken by a detachment of the Royal Artillery in the years 1840-5 at Longwood, which is situated on an elevated plain about a mile distant from St. Matthew's vicarage and 135 feet lower. From September, 1840, to August, 1842, the observations were two-hourly, and from September, 1842, to December, 1845, they were hourly. It will be seen that the mean curve for these early observations is from about 1°F. to 3°F. higher than that for 1926-30. This may be accounted for partly by the difference in position and height, and partly by the fact that at Longwood "the thermometers were fixed to horizontal battens, the bulbs being quite free. They were placed in front of a window (through which they were read)

under a deep verandah on the south side of the observatory, and were screened by the form of the building from all but a south-eastern aspect.”\*

TABLE I. HOURLY MEANS OF TEMPERATURE IN ST. HELENA (HUTT’S GATE), 1926-30.

	1	2	3	4	5	6	7	8	9	10	11	12
Sept.-Nov.	55.9	55.8	55.7	55.7	55.6	55.7	56.0	56.6	57.4	58.4	59.1	59.6
Dec.-Feb.	60.8	60.6	60.6	60.5	60.4	60.3	60.7	61.3	62.4	63.2	64.2	64.8
Mar.-May	61.8	61.9	61.8	61.7	61.7	61.7	62.0	63.0	63.9	64.7	65.6	66.0
June-Aug.	56.9	56.8	56.6	56.5	56.5	56.5	56.7	57.4	58.3	59.2	59.9	60.2
Year -	58.9	58.8	58.7	58.6	58.5	58.5	58.9	59.6	60.5	61.4	62.2	62.7

	13	14	15	16	17	18	19	20	21	22	23	24	Day
Sept.-Nov.	59.7	59.4	58.8	58.0	57.3	56.8	56.6	56.5	56.4	56.3	56.2	56.2	57.1
Dec.-Feb.	65.0	64.7	63.9	63.2	62.4	61.8	61.4	61.3	61.2	61.1	61.1	60.9	62.0
Mar.-May	66.1	66.0	65.5	64.4	63.4	62.7	62.5	62.4	62.4	62.3	62.2	62.1	63.2
June-Aug.	60.1	60.0	59.7	58.9	58.2	57.6	57.3	57.2	57.2	57.0	57.0	57.0	57.9
Year -	62.7	62.5	62.0	61.1	60.3	59.7	59.5	59.3	59.3	59.2	59.1	59.1	60.1

The hourly means for Hutt’s Gate for the four seasons and the year are given in Table I.

L. H. POWERS.

Black Snow at Eskdalemuir in 1897

Mr. Richard Bell, of Castle O’er, in his “ My strange Pets and Other Memories of Country Life ” (Blackwood, 1905), describes a fall of black snow in the parish of Eskdalemuir, and an account of it may prove of interest.

Mr. Bell tells us that a fall of black snow took place on the evening of January 30th, 1897. On the following morning, whilst taking a walk in his avenue, he noticed that the marks made by his footsteps “ were pure white below the coloured surface of the snow, which was of quite a dark colour in comparison.” On investigating the peculiarity, he found that the surface of the unbroken snow to the depth of about a quarter of an inch was deeply coloured as if mixed with soot. The author goes on to say—and I cannot do better than to quote the actual words of this careful observer—“ Having gone further afield during the day I found the whole of the snow on the road and hillsides was of the same black colour; and on looking across the valley the hills

\*Climatological Tables for St. Helena. By J. S. Dines, London, Meteor. Office (M.O. 203), 1910.

appeared as if they were bathed in the lights and shadows, as seen during bright sunshine. As the day was dull, sunshine could not account for this peculiar appearance; and it was evident that it was caused by the wind during the time the snow fell. The wind swept the more salient parts of the hill and deposited the fall of coloured snow in the hollows, thus giving the country the appearance of light and shadow. The area over which the snow fell was, to my own knowledge, four miles long by about a mile and a half wide."

It appears that soot from the chimneys of some manufacturing town must have been responsible for the discoloration of the snow, but as the prevailing winds were of a light order, it is impossible to say whether an English or Scottish town caused the phenomenon.

G. B. KINGSTON JAMES.

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## Reviews

*Periodicity in solar variation.* By C. G. Abbot and Gladys T. Bond. *Smiths. Misc. Coll.* Vol. 87, No. 9, pp. 1-14, *Illus.* 1932.

In this paper Dr. Abbot continues his studies of the relations between solar variations and terrestrial weather. Analysing the variations of the solar constant from 1920 to 1931 he finds periodicities of 7, 8, 11, 21, 25, 45 and 68 months, all of which are fractions either of the sunspot cycle of 135 months or the Brückner cycle of three times this length. Analysis of temperature variations at three places in the United States shows these periodicities, as well as several others which are presumed to be of terrestrial origin, but the total amplitude of the solar periods is about twice that of the terrestrial, showing that the control of weather is mainly solar. These results are employed to calculate the temperatures for the years 1916 to 1918, but for various reasons the agreement between observed and calculated figures is not very good and the method requires to be improved.

*Regenval in Nederlandsch-Indië.* By Dr. J. Boerema. *Kon. Magn. Meteor. Obs., Batavia. Verh.* No. 24. Part I. Vol. 1, size 11 × 7 in., pp. viii + 244, and Vol. 2, size 24 × 20 in., pp. 15.

In this series the meteorology of the Netherlands Indies is considered separately for two main areas (a) Java and Madoera, and (b) the remainder of the Archipelago, including Sumatra, Borneo and Celebes, and referred to as the "Buitengewesten." Vol. 1 is statistical and gives tables showing for each station (a) the mean annual and monthly rainfall in mm., (b) the mean annual and monthly number of rain-days, (c) the mean maximum daily

rainfall in mm. for each month and for the year, and (d) the absolute daily maximum. For stations in the Buitengewesten, which are shown in a separate table, the period of observation is given as well as the number of years for which records are available, and the altitude of the station. The results of the rainfall observations made at 2,715 stations during the period 1879 to 1922, were published in 1925 in Verh. No. 14, which was accompanied by an atlas containing maps of the annual and monthly rainfall in Java and Madoera. Verh. No. 24, Vol. 1, contains statistics for 3,293 stations with at least five years' record during the period 1879 to 1928. Alphabetical lists of the stations are given separately for the two main areas, together with numbers, which can be used to identify the stations in the other tables and on the maps. Vol. 2 gives maps of the mean annual and monthly rainfall in Sumatra, together with a map showing the positions of the rainfall stations. All the maps are on a scale of 1 : 3,000,000 (48 miles to 1 in.). An atlas of Borneo and Celebes is being prepared.

The maps show that the average annual rainfall exceeds 1,000 mm. (39.4 in.) over practically the whole of Sumatra. About this amount occurs in the extreme north and over small inland regions in the northern half. More than 7,000 mm. (276 in.) occurs locally in a mountainous region, about the middle of the south-west coast near Padang. The range is shown by the monthly averages set out below, as taken from Vol. 1 (but converted to inches) for the two stations at Kroeëngraja and Indaroeng:—

<i>Jan.</i>	<i>Feb.</i>	<i>Mar.</i>	<i>Apr.</i>	<i>May</i>	<i>June</i>	<i>July</i>	<i>Aug.</i>	<i>Sept.</i>	<i>Oct.</i>	<i>Nov.</i>	<i>Dec.</i>	<i>Year</i>
in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
6.2	3.3	4.5	4.3	2.6	0.9	1.1	0.8	3.1	3.0	5.1	8.4	43.3
20.0	15.1	21.3	21.6	18.6	14.2	13.7	17.3	22.3	26.2	29.2	24.3	243.8

The variations of the annual totals from place to place and their distribution throughout the year depend on a large number of factors. These factors are discussed in some detail in Verh. No. 18.

Some of the largest numbers of rain-days occur in Java, where thunderstorm rains occur most afternoons, especially at the change from one monsoon to the other. The largest mean number of rain-days is 284 for Goenoeng Pangrango, in Java, but this station is also at an altitude of 3,023 metres.

Practically every one of the 3,293 stations in Vol. 1 has recorded 4 inches in a day, while most stations received that amount at least once every year. The largest amounts reported for the rainfall day are 23.6 in. at Tjendana in Semarang (Java), and 24.6 in. at Tahorre (Molukken). These heavy rains, caused by the passage of monsoon winds over mountainous regions near the coasts, are generally prolonged and often give large monthly totals.

J. GLASSPOOLE.

## News in Brief

Mr. E. J. L. Joss, the meteorological observer at the Crichton Royal Institution, Dumfries, retired on pension on January 31st, 1933. Mr. Joss has for over 21 years forwarded regularly climatological returns for both the *Weekly Weather Report* and the *Monthly Weather Report*. His monthly climatological returns were consistently of a high standard, being amongst the best received in Scotland.

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### Erratum

*Meteorological Magazine* for January, 1933, p. 285, line 13, and also in the Index, p. vi, for "L. A. HARWOOD" read "W. A. HARWOOD."

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## The Weather of January, 1933

Pressure was above normal over western Asia, the whole of Europe except the extreme south-west, central North Atlantic, Newfoundland, and the south-western United States, the greatest excess being 19·1mb. at Vaigatsch, Arctic Russia; the excess in eastern Sweden was 8 to 9mb. Pressure was below normal over Alaska, Canada, central, northern and eastern United States, Greenland, Iceland and Spitsbergen, southern North Atlantic, the Iberian Peninsula, south Italy and northern Africa, the greatest deficit being 16·3mb. at Isafjord. Temperature was above normal over northern Europe, 23·7°F. above normal being recorded at Spitsbergen and 7°–9°F. above in Norrland. Rain-fall was mainly above normal, with 26mm. excess at Zurich. Over the British Isles, however, and parts of Scandinavia precipitation was less than normal, Kew having a deficit of 11mm. and Vardo of 43mm.

During the first week of the month an exceptionally deep depression passing across Iceland caused stormy and mild weather over the British Isles; a gust of 71 m.p.h. was recorded at Holyhead on the 2nd. Rain occurred most days in all districts although the 6th was generally fine in the east; there were heavy falls on the 2nd, notably 3·10in. at Borrowdale, 2·55in. at Holne, S. Devon, and 2·57in. at Llyn Fawr Reservoir, Glamorgan. Thunderstorms occurred at Stornoway, Dumfries, Valentia and The Lizard on the 4th and at Ventnor on the 5th. Temperature was high during this week, especially on the 2nd when maxima of 55°F. and over were recorded; it fell, however, on the 7th when there were rather low minima. By the 9th the country came under the influence of an extension of the Azores anti-cyclone, and the weather was mild and sunny. It became colder in England and Scotland on the 10th and a minimum of 22°F. was recorded in the screen at Marlborough and Rhayader. During the next few days a series of troughs of low pressure

crossing the country caused rain and sleet in the north and occasional rain in the south; there were gales in the north, force 9 being reported at Lerwick on the 14th. From the 15th to the 17th there was snow in many parts of England and Scotland. On the 20th an anticyclone over Russia extended over the British Isles and a period of easterly winds set in with cold, dry weather. At many places maximum temperatures did not rise much above the freezing point, there was, however, a good deal of sunshine. This weather continued into the fourth week when some low maximum temperatures were recorded, notably, 29°F. at Bristol on the 24th and 28°F. at Renfrew on the 24th and 25th. A night minimum of 15°F. occurred at Durham and Rhayader on the 23rd and at Dumfries on the 25th. The Valentia night minimum of 23°F. on the 25th was the lowest in January since 1907. Outdoor skating became general for the first time since the cold spell of February-March, 1929, and lasted until the 29th. After the 25th the cold air from Russia was diverted and temperature gradually rose, although Renfrew reported a maximum of 26°F. on the 28th. There was a good deal of sunshine during this week—in the south on the 22nd (7·8 hrs. at Guernsey) and generally in England on the 26th, 27th and 28th, many places recording more than 7 hrs. on some of these days. Disturbances from the Bay of Biscay and the Atlantic brought unsettled weather after the 29th with gales on the 31st. Very heavy rain was recorded in the north of England and in Scotland during the night of the 31st, 2·60in. fell at Eskdalemuir, 2·54in. at Falstone Rectory, Northumberland, and, in the Lake District, 5·50in. at Borrowdale (Watendlath Farm) and 5·83in. at Haweswater (Burn Banks). The distribution of bright sunshine for the month was as follows:—

	Total	Diff. from		Total	Diff. from
	(hrs.)	normal		(hrs.)	normal
	(hrs.)	(hrs.)		(hrs.)	(hrs.)
Stornoway	38	+10	Liverpool	67	+12
Aberdeen	53	+ 5	Ross-on-Wye	91	+45
Dublin	84	+27	Falmouth	84	+26
Birr Castle	77	+28	Gorleston	72	+13
Valentia	66	+18	Kew	39	— 4

The special message from Brazil states that the rainfall was irregular in the north and centre with averages ·55in. and ·79in. above normal respectively, and scarce in the south with an average of 1·81in. below normal. The circulation was active; four anticyclones passed across the country and vigorous depressions accompanied by much wind. The crops were in good condition except the corn in the south. At Rio de Janeiro pressure was 0·1mb. above normal and temperature 1·1°F. below normal.



*Miscellaneous notes on weather abroad culled from various sources.*

A violent storm at the beginning of the month on the west coast of Norway caused damage to shipping estimated at £50,000. The first part of the month was unusually mild and dry in Switzerland with very little snow, especially in the Bernese Oberland. Snow, however, fell on the 16th in the low country as well as on the mountains. A snowstorm which swept eastern Switzerland on the 21st caused the lower passes to be blocked. From the 22nd for about 6 or 7 days intense cold prevailed generally over the Continent, on the 23rd the temperature at 1 p.m. was below freezing point from the south of France to Scandinavia and eastwards to Siberia, the temperature becoming progressively lower to the east. For two or three days a gale blew over the Alps, temperature fell below 0°F. in the mountains, Jungfrauoch recording -15°F. The frost was severe in Germany, ice breakers were required on the Oder and the Elbe, and on the 25th traffic on the Rhine was suspended, the ice block extending for 25 miles from Coblenz to Kaub. In Berlin the temperature fell almost to 0°F. and -13°F. was recorded in eastern Prussia. It was very cold in parts of Spain, -11°F. being recorded at Teruel; snow fell on the 25th at Valencia and Castellon for the first time this century. During the last few days of the month conditions were less severe and in many parts a thaw set in. In the latter part of the month the weather in northern Algeria was stormy and there was thick snow on the mountains. (*The Times*, January 4th-31st.)

During the first few days of the month heavy weather in the North Atlantic delayed liners making for New York, which were in some cases as much as three days late. Weather was generally mild and fair at the beginning of the month in the United States, towards the middle of the month cold waves of short duration crossed the country, but subsequently temperature became again generally above normal. From 17th-20th a depression of considerable energy moved north-eastwards from the extreme south-west, it was accompanied by widespread precipitation in the central and northern States. On the 26th-28th gales and flood tides caused extensive damage along the New England and Nova Scotian coasts, houses were washed out to sea and roads were destroyed. (*The Times*, January 4th, 30th and 31st, and *Washington, D.C., U.S. Dept. Agric. Weekly Weather and Crop Bulletin*.)

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### General Rainfall for January, 1933

England and Wales	...	93	} per cent of the average 1881-1915.
Scotland	...	103	
Ireland	...	90	
British Isles	...	<u>95</u>	

**Rainfall: January, 1933: England and Wales.**

Co.	STATION	In.	Per- cent. of Av.	Co.	STATION	In.	Per- cent. of Av.
<i>Lond.</i>	Camden Square .....	1'34	72	<i>Leics.</i>	Thornton Reservoir ...	1'85	93
<i>Kent.</i>	Tenterden, Ashenden...	2'16	100	„	Belvoir Castle.....	1'81	102
„	Folkestone, Boro. San.	2'97	...	<i>Rut.</i>	Ridlington .....	1'23	66
„	St. Peter's, Hildersham	'56	32	<i>Lincs.</i>	Boston, Skirbeck .....	1'48	91
„	Eden'bdg., Falconhurst	2'20	90	„	Cranwell Aerodrome ...	1'46	85
„	Sevenoaks, Speldhurst	1'60	...	„	Skegness, Marine Gdns	1'20	69
<i>Sus.</i>	Compton, Compton Ho.	2'81	88	„	Louth, Westgate .....	1'61	74
„	Patching Farm .....	2'55	98	„	Brigg, Wrawby St. ...	1'65	...
„	Eastbourne, Wil. Sq.	2'34	89	<i>Notts.</i>	Worksop, Hodsock ...	1'68	95
„	Heathfield, Barklye ...	2'70	100	<i>Derby.</i>	Derby, L. M. & S. Rly.	1'56	78
<i>Hants.</i>	Ventnor, Roy. Nat. Hos.	2'60	101	„	Buxton, Terr. Slopes	2'85	64
„	Fordingbridge, Oaklands	2'54	92	<i>Ches.</i>	Runcorn, Weston Pt...	1'38	58
„	Ovington Rectory .....	3'06	113	<i>Lancs.</i>	Manchester, Whit Pk.	2'01	80
„	Sherborne St. John ...	2'45	105	„	Stonyhurst College ...	3'69	86
<i>Herts.</i>	Welwyn Garden City...	1'73	...	„	Southport, Hesketh Pk	2'30	90
<i>Bucks.</i>	Slough, Upton .....	1'78	96	„	Lancaster, Greg Obsy.	3'57	102
„	H. Wycombe, Flackwell	2'09	...	<i>Yorks.</i>	Wakefield, Dearne ...	1'68	87
<i>Oxf.</i>	Oxford, Mag. College...	1'60	93	„	Wakefield, Clarence Pk.	1'88	98
<i>Nor.</i>	Pitsford, Sedgebrook...	1'45	78	„	Oughtershaw Hall.....	5'62	...
„	Oundle.....	1'09	...	„	Wetherby, Ribston H.	2'24	109
<i>Beds.</i>	Woburn, Crawley Mill	1'40	82	„	Hull, Pearson Park ...	1'12	62
<i>Cam.</i>	Cambridge, Bot. Gdns.	'98	65	„	Holme-on-Spalding ...	1'86	...
<i>Essex.</i>	Chelmsford, County Lab	1'20	78	„	West Witton, Ivy Ho.	3'31	104
„	Lexden Hill House ...	1'33	...	„	Felixkirk, Mt. St. John	1'98	99
<i>Suff.</i>	Haughley House.....	'78	...	„	York, Museum Gdns.	1'83	103
„	Campsea Ashe.....	'95	52	„	Pickering, Hungate ...	1'79	86
„	Lowestoft Sec. School	'89	53	„	Scarborough .....	1'32	66
„	Bury St. Ed. Westley H.	1'42	79	„	Middlesbrough .....	2'39	149
<i>Norfol.</i>	Wells, Holkham Hall	1'08	74	„	Balderdale, Hury Res.	2'71	83
<i>Wilts.</i>	Devizes, Highclere.....	2'53	116	<i>Durh.</i>	Ushaw College .....	1'78	87
„	Calne, Castleway .....	2'20	96	<i>Nor.</i>	Newcastle, Town Moor	1'32	65
<i>Dor.</i>	Evershot, Melbury Ho.	5'07	146	„	Bellingham, Highgreen	2'39	84
„	Weymouth, Westham.	1'96	81	„	Lilburn Tower Gdns...	1'37	66
„	Shaftesbury, Abbey Ho	2'41	93	<i>Cumb.</i>	Carlisle, Scaleby Hall	2'63	106
<i>Devon.</i>	Plymouth, The Hoe...	2'47	74	„	Borrowdale, Seathwaite	16'50	131
„	Holne, Church Pk. Cott.	6'93	112	„	Borrowdale, Moraine...	13'90	...
„	Teignmouth, Den Gdns.	2'44	84	„	Keswick, High Hill...	9'04	179
„	Cullompton.....	1'90	59	<i>West.</i>	Appleby, Castle Bank	4'28	132
„	Sidmouth, Sidmount...	2'20	77	<i>Mon.</i>	Abergavenny, Larch...	3'56	105
„	Barnstaple, N. Dev. Ath	2'60	80	<i>Glam.</i>	Ystalyfera, Wern Ho.	7'13	113
„	Dartm'r, Cranmere Pool	7'20	...	„	Cardiff, Ely P. Stn. ...	2'62	69
„	Okehampton, Uplands	5'02	98	„	Treherbert, Tynywaun	9'91	...
<i>Corn.</i>	Redruth, Trewirgie ...	3'92	93	<i>Carm.</i>	Carmarthen Friary ...	4'63	106
„	Penzance, Morrab Gdn.	3'18	84	<i>Pemb.</i>	Haverfordwest, School	5'06	110
„	St. Austell, Trevarna...	3'22	75	<i>Card.</i>	Aberystwyth .....	4'05	...
<i>Soms.</i>	Chewton Mendip .....	3'63	94	<i>Rad.</i>	Birm W.W. Tyrmynydd	6'00	95
„	Long Ashton .....	3'56	129	<i>Mont.</i>	Lake Vyrnwy.....	5'67	100
„	Street, Millfield.....	2'25	93	<i>Flint.</i>	Sealand Aerodrome ...	1'33	67
<i>Glos.</i>	Blockley .....	2'43	...	<i>Mer.</i>	Dolgelley, Bontddu ...	7'65	134
„	Cirencester, Gwynfa ...	2'29	91	<i>Carn.</i>	Llandudno .....	3'18	123
<i>Here.</i>	Ross, Birchlea.....	2'55	105	„	Snowdon, L. Llydaw	9'19	20
„	Ledbury, Underdown..	1'92	87	<i>Ang.</i>	Holyhead, Salt Island	3'93	135
<i>Salop.</i>	Church Stretton.....	2'47	97	„	Lligwy.....	5'00	...
„	Shifnal, Hatton Grange	1'77	91	<i>Isle of Man</i>			
<i>Staffs.</i>	Market Drayt'n, Old Sp.	1'49	68		Douglas, Boro' Cem. ...	3'98	117
<i>Worc.</i>	Ombersley, Holt Lock	1'72	90	<i>Guernsey</i>			
<i>War.</i>	Birmingham, Edgbaston	1'92	95		St. Peter P't. Grange Rd	3'22	110

**Rainfall: January, 1933: Scotland and Ireland.**

Co.	STATION	In.	Per- cent of Av.	Co.	STATION	In.	Per- cent of Av.
<i>Wigt.</i>	Pt. William, Monreith	3.65	112	<i>Suth.</i>	Melvich	2.07	63
"	New Luce School	2.96	73	"	Loch More, Achfary	8.23	113
<i>Kirk.</i>	Dalry, Glendarroch	5.13	92	<i>Caith.</i>	Wick	1.76	72
"	Carsphairn, Shiel	10.12	153	<i>Ork.</i>	Pomona, Deerness	2.19	63
<i>Dumf.</i>	Dumfries, Orichton, R.I.	5.33	174	<i>Shet.</i>	Lerwick	3.97	51
"	Eskdalemuir Obs.	7.75	144	<i>Cork.</i>	Caheragh Rectory	4.86	...
<i>Roxb.</i>	Bransholm	4.90	179	"	Dunmanway Rectory	6.32	78
<i>Selk.</i>	Ettrick Manse	10.18	215	"	Cork, University Coll.	3.58	89
<i>Peeb.</i>	West Linton	4.10	...	"	Ballinacurra	3.43	86
<i>Berw.</i>	Marchmont House	1.32	59	<i>Kerry.</i>	Valentia Obsy	5.69	104
<i>E.Lot.</i>	North Berwick Res.	1.24	72	"	Gearahameen	...	...
<i>Midl.</i>	Edinburgh, Roy. Obs.	2.59	147	"	Killarney Asylum	8.83	149
<i>Lan.</i>	Auchtyfardle	4.73	...	"	Darrynane Abbey	3.94	78
<i>Ayr.</i>	Kilmarnock, Kay Pk.	...	...	<i>Wat.</i>	Waterford, Gortmore	3.71	102
"	Girvan, Piumore	4.35	92	<i>Tip.</i>	Nenagh, Cas. Lough	4.51	114
<i>Renf.</i>	Glasgow, Queen's Pk.	4.05	121	"	Roscrea, Timoney Park	2.19	...
"	Greenock, Prospect H.	8.64	126	"	Cashel, Ballinamona	2.30	58
<i>Bute.</i>	Rothsay, Ardencraig	5.34	...	<i>Lim.</i>	Foynes, Coolnanes	3.89	105
"	Dougarie Lodge	4.22	...	"	Castleconnel Rec.	2.81	...
<i>Arg.</i>	Ardgour House	12.50	...	<i>Clare.</i>	Inagh, Mount Callan	...	...
"	Glen Etive	11.33	108	"	Broadford, Hurdlest'n.	4.21	...
"	Oban	6.27	115	<i>Wexf.</i>	Gorey, Courtown Ho.	2.90	93
"	Poltalloch	5.51	110	<i>Kilk.</i>	Kilkenny Castle	2.17	68
"	Inveraray Castle	9.59	116	<i>Wick.</i>	Rathnew, Clonmannon	2.06	...
"	Islay, Eallabus	4.21	90	<i>Carl.</i>	Hacketstown Rectory	2.44	69
"	Mull, Benmore	9.80	...	<i>Leix.</i>	Blandsfort House	2.59	79
"	Tiree	4.24	100	"	Mountmellick	3.49	...
<i>Kinr.</i>	Loch Leven Sluice	3.43	109	<i>Offaly.</i>	Birr Castle	2.86	101
<i>Perth.</i>	Loch Dhu	10.20	112	<i>Kildr.</i>	Monasterevin	...	...
"	Balquhidder, Stronvar	4.34	...	<i>Dublin</i>	Dublin, FitzWm. Sq.	1.34	59
"	Crieff, Strathearn Hyd.	4.53	112	"	Balbriggan, Ardgillan	1.68	73
"	Blair Castle Gardens	4.46	134	<i>Meath.</i>	Beauparc, St. Cloud	2.46	...
<i>Angus.</i>	Kettins School	2.08	79	"	Kells, Headfort	3.24	103
"	Pearsie House	3.31	...	<i>W.M.</i>	Moate, Coolatore	3.03	...
"	Montrose, Sunnyside	2.01	101	"	Mullingar, Belvedere	3.09	96
<i>Aber.</i>	Braemar, Baik	4.51	141	<i>Long.</i>	Castle Forbes Gdns.	3.93	118
"	Logie Coldstone Sch.	1.63	74	<i>Gal.</i>	Ballynahinch Castle	6.19	99
"	Aberdeen, King's Coll.	1.82	83	"	Galway, Grammar Sch.	...	...
"	Fyvie Castle	1.68	71	<i>Mayo.</i>	Mallaranny	7.78	...
<i>Moray.</i>	Gordon Castle	.99	49	"	Westport House	4.47	96
"	Grantown-on-Spey	1.64	68	"	Delphi Lodge	11.63	117
<i>Nairn.</i>	Nairn	1.31	66	<i>Sligo.</i>	Markree Obsy	4.14	106
<i>Inw's.</i>	Ben Alder Lodge	8.16	...	<i>Cavan.</i>	Belturbet, Cloverhill	...	...
"	Kingussie, The Birches	4.13	...	<i>Ferm.</i>	Enniskillen, Portora	3.12	...
"	Loch Quoich, Loan	15.30	...	<i>Arm.</i>	Armagh Obsy	2.13	85
"	Glenquoich	15.48	112	<i>Down.</i>	Fofanny Reservoir	4.74	...
"	Inverness, Culduthel R.	2.78	...	"	Seaforde	2.51	80
"	Arisaig, Faire-na-Squir	4.64	...	"	Donaghadee, C. Stn.	2.01	79
"	Fort William, Glasdrum	11.41	...	"	Banbridge, Milltown	1.90	85
"	Skye, Dunvegan	7.61	...	<i>Antr.</i>	Belfast, Cavehill Rd.	2.39	...
"	Barra, Skallary	5.09	...	"	Aldergrove Aerodrome	1.77	65
<i>R &amp; C.</i>	Alness, Ardross Castle	3.18	84	"	Ballymena, Harryville	2.58	70
"	Ullapool	6.47	141	<i>Lon.</i>	Londonderry, Creggan	4.17	116
"	Achnashellach	9.94	103	<i>Tyr.</i>	Omagh, Edenfel	3.80	107
"	Stornoway	5.67	110	<i>Don.</i>	Malin Head	3.81	...
<i>Suth.</i>	Lairg	2.19	67	"	Milford, The Manse	4.01	107
"	Tongue	3.11	79	"	Killybegs, Rockmount	3.87	69

## Climatological Table for the British Empire, August, 1932

STATIONS	PRESSURE		TEMPERATURE							Rela- tive Humid- ity	Mean Cloud Am't	PRECIPITATION		BRIGHT SUNSHINE		
	Mean of Day M.S.L.	Diff. from Normal	Absolute		Mean Values				Am't			Diff. from Normal	Days	Hours per day	Per- cent- age of possible	
			Max.	Min.	Max.	Min.	1/2 and min.	Diff. from Normal								Wet Bulb
London, Kew Obsy. . . . .	1018.9	+ 3.6	92	52	75.2	57.9	66.5	+ 4.9	59.0	86	7.5	1.16	7	6.3	44	
Gibraltar . . . . .	1016.5	+ 0.2	91	63	82.8	66.7	74.7	+ 1.3	65.1	82	3.4	0.00	0	12.1	89	
Malta . . . . .	1017.4	+ 2.6	92	68	83.6	72.1	77.9	+ 1.2	71.3	72	1.3	0.00	0			
St. Helena . . . . .	1016.7	+ 0.1	62	52	59.9	53.6	56.7	+ 0.7	54.2	93	8.8	1.08	7			
Sierra Leone . . . . .	1015.1	+ 2.4	85	68	80.9	72.6	76.7	+ 1.2	74.2	89	3.8	16.06	23			
Lagos, Nigeria . . . . .	1013.7	+ 0.7	83	68	80.8	72.8	76.8	+ 1.1	72.5	85	9.3	3.02	8	4.7	38	
Kaduna, Nigeria . . . . .	1014.1	+ 1.0	87	53	81.4	64.1	72.7	+ 1.2	69.8	87	8.8	10.03	17	4.0	32	
Zomba, Nyasaland . . . . .	1016.6	+ 0.2	83	47	74.4	52.3	63.3	+ 1.6		64	4.8	0.31	2			
Salisbury, Rhodesia . . . . .	1020.5	+ 0.1	78	38	70.5	45.2	57.9	+ 2.3	49.5	49	1.7	1.78	4	8.5	74	
Cape Town . . . . .	1020.8	+ 0.5	86	41	65.6	48.7	57.1	+ 1.5	50.4	89	5.6	2.81	12			
Johannesburg . . . . .	1020.4	+ 1.2	77	36	67.8	45.7	56.7	+ 2.3	41.5	25	0.2	0.00	0	10.5	94	
Mauritius . . . . .	1020.3	+ 0.2	78	54	75.7	62.8	69.3	+ 0.8	65.7	70	5.6	1.06	21	7.7	69	
Calcutta, Alipore Obsy. . . . .	1002.7	+ 1.7	93	76	88.4	79.0	83.7	+ 0.5	79.5	91	8.1	8.83	18*			
Bombay . . . . .	1006.0	+ 0.1	90	75	86.2	77.2	81.7	+ 0.9	77.3	87	8.0	6.96	17*			
Madras . . . . .	1005.8	+ 0.3	98	73	91.4	78.1	84.7	+ 1.3	77.5	77	6.9	1.98	6*			
Colombo, Ceylon . . . . .	1008.7	+ 0.6	86	71	84.8	75.8	80.3	+ 0.9	76.8	82	7.5	15.99	25	5.0	41	
Singapore . . . . .	1009.1	+ 0.4	90	72	86.5	74.9	80.7	+ 0.4	76.9	83	6.6	3.54	19	6.0	50	
Hongkong . . . . .	1005.6	+ 0.8	91	74	86.5	79.0	82.7	+ 0.6	78.4	85	7.3	20.89	22	6.3	49	
Sandakan . . . . .		..	90	72	87.2	75.0	81.1	+ 0.7	77.9	86	6.1	6.11	16			
Sydney, N.S.W. . . . .	1018.7	+ 0.5	80	41	65.4	47.3	56.3	+ 1.3	50.4	71	4.3	2.31	13	6.8	62	
Melbourne . . . . .	1018.2	+ 0.2	67	33	57.9	42.5	50.2	+ 0.8	46.0	78	7.1	3.26	21	3.8	36	
Adelaide . . . . .	1018.6	+ 0.7	76	38	61.0	45.8	53.4	+ 0.5	48.9	71	7.0	2.89	19	4.3	40	
Perth, W. Australia . . . . .	1018.7	+ 0.2	77	41	61.4	47.3	54.3	+ 1.7	49.4	73	6.2	6.18	21	5.6	51	
Coogardie . . . . .	1019.0	+ 0.3	72	35	61.4	41.1	51.2	+ 2.4	45.7	69	9.3	2.92	11			
Brisbane . . . . .	1020.7	+ 1.5	80	41	70.7	49.7	60.2	+ 0.2	53.5	63	3.3	0.37	3	8.5	76	
Hobart, Tasmania . . . . .	1014.9	+ 1.5	64	32	54.8	41.6	48.2	+ 0.2	44.0	73	7.0	4.59	17	4.0	38	
Wellington, N.Z. . . . .	1022.0	+ 6.9	59	32	50.5	39.8	45.1	+ 3.5	43.0	77	6.3	6.67	16	4.7	45	
Suva, Fiji . . . . .	1015.2	+ 1.0	63	65	78.0	69.0	73.5	+ 0.1	69.8	82	7.4	9.23	19	3.7	32	
Apia, Samoa . . . . .	1011.9	+ 0.4	87	68	84.9	73.4	79.1	+ 1.3	75.5	77	3.7	5.99	13	8.3	71	
Kingston, Jamaica . . . . .	1012.4	+ 1.1	92	70	89.0	73.8	81.4	+ 0.1	72.9	81	4.0	2.94	11	8.3	65	
Grenada, W.I. . . . .		..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Toronto . . . . .	1014.6	+ 0.8	95	51	79.3	59.9	69.6	+ 2.4	63.4	78	3.2	4.17	13	8.9	64	
Winnipeg . . . . .	1013.7	+ 0.5	91	40	79.6	55.1	67.3	+ 3.5	55.4	89	4.4	1.53	8	9.5	66	
St. John, N.B. . . . .	1014.9	+ 0.4	77	52	70.0	56.2	63.1	+ 2.5	59.8	90	6.6	3.56	17	6.8	48	
Victoria, B.C. . . . .	1015.9	+ 1.0	83	50	65.9	52.4	59.1	+ 0.6	55.3	80	5.3	0.90	6	8.8	62	