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Meteorological Records at Kew Observatory

The suggestion having been put forward by a reader that it would add to the value of the *Meteorological Magazine* if it contained a record of the weather day by day at a representative station, it has been arranged that an abstract of the observations at Kew Observatory shall be reproduced each month. The first table is to be found in the present number (p. 25). The following elements are included: pressure and the strength and direction of the wind in the middle of the day (at 13h.); the extremes of temperature (night minimum and day maximum) and, for comparison with this maximum temperature the relative humidity at 13h.; rainfall for the calendar day and the duration of bright sunshine. Short notes on the weather of the day are also set out, some of the letters of the Beaufort weather code being used for brevity. The following Beaufort letters are the ones employed:—d, drizzle; f, fog; h, hail; i, intermittent; l, lightning; p, shower; q, squall; r, rain; s, snow; t, thunder; x, hoar frost. A capital letter is used to denote intensity and a suffix o to indicate slight.

The observations utilised are all made under standard conditions with the exception of the temperature readings. It is the usual practice of the Meteorological Office to publish the readings of thermometers exposed at a height of 4 ft. above the ground in a Stevenson screen. The accepted figures for Kew

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Observatory refer however to thermometers in a large screen on the north side of the building at a height of 17 ft. above the natural level of the ground. There have been long series of comparisons between the readings in the North Wall screen and the Stevenson screen—the large Stevenson screen and two or three experimental screens can be seen in the aerial photograph in the frontispiece—and it is known that on the average the maximum temperature in the North Wall screen is slightly the lower (by about 0·4° F.), whilst the minimum temperature in that screen is the higher, the discrepancy being about 2° F. The question whether it would not be better to bring the observatory practice into line with that at other stations has been discussed from time to time, and the decision has been that consistency from year to year is in this case more important than consistency from place to place.

A view of Kew Observatory from the air is reproduced as frontispiece to this number of the *Meteorological Magazine.* The Observatory is in the Old Deer Park on level ground within a bend of the River Thames. Outside the Observatory enclosure, which contains about six acres, the surrounding part of the Park is occupied by the links of the Mid-Surrey Golf Club. The village of Isleworth is on the other side of the river. Conspicuous within the enclosure, in addition to the main observatory building and several out-buildings, is the roof of the underground laboratory which is used for observations on atmospheric electricity. The tall masts on the other side of the enclosure are for experiments designed to determine the electric charge in the atmosphere.

It is well known that the observatory was not originally called Kew Observatory. It was the King's observatory at Richmond, and it seems that the name Kew Observatory was not used before the negotiations which led to the lease of the building to the British Association in 1842. Possibly the old style, the King's observatory, was felt incongruous when the Crown passed to Queen Victoria. At that time the observatory already had a long though not from a scientific point of view a very eventful history. When the King's observatory was built for King George III by William Chambers, the versatile architect who designed Somerset House but also the Pagoda in Kew Gardens, the park was by no means the extensive open space which we know. The immediate neighbour was Sheen Priory, once a great Carthusian House, but then a group of private houses. The observatory was built in 1769 and about 1771 these were swept away as well as a number of other buildings, including Richmond Lodge, the palace of George II.

The observatory was inaugurated by the famous Transit of Venus, which was duly observed by the King and a party of his friends. Subsequently the principal astronomical observations were those required for regulating the clocks. The observatory might well have had one of the longest meteorological records in the world. There is no mention of meteorological observations in any old account of the observatory, and it was with much surprise that I learned from my brother in 1926 that there were three volumes of a meteorological register in the library of King's College, London. These three volumes include observations made between 1773 and 1840. It was a great disappointment to find that the record was too fragmentary to have any statistical value. There are but few months for which the daily entries are complete and moreover there is a gap of more than 20 years, from May, 1783, to December, 1803, apparently because one volume of the register has been lost.

It is most unfortunate that the rainfall record is quite unreliable. The rain was collected in a funnel on the roof and measured below presumably by a tilting bucket. The amounts are recorded in cubic inches, suggesting that the capacity of the bucket was one cubic inch. It is surmised that the area of the funnel was one square foot so that the entries in the register are to be regarded as inches and 144ths. The apparatus was allowed to remain out of order for considerable periods, but there are 33 years altogether for which annual totals are available. Comparison with other London records reveals, however, great inconsistency in the Richmond figures. This may be attributed in part to the very bad exposure of the gauge on the roof of an isolated building.

Considering the rarity of meteorological observations in the eighteenth century and early part of the nineteenth century it must be regarded as a notable coincidence that one of the best records was that kept by the Steward to the Duke of Northumberland at Syon House just across the river and in sight of the observatory.

The history of the observatory as the object of the care of a public body begins with the lease to the British Association in 1842. Amongst the objects set out in the memorandum which stimulated the Association to this enterprise was the construction of "a universal meteorograph, which will accurately record half-hourly indications of various meteorological instruments, dispensing entirely with the attendance of an observer; an apparatus for recording the direction and intensity of the wind simultaneously at various heights above the earth's surface; an apparatus for telegraphing the indications of meteorological instruments carried up in balloons or by kites, to an observer at the earth's surface."

A year later it was reported that an ordinary meteorological record with standard instruments was being made by Mr. Galloway, under the superintendence of Professor Wheatstone.

This series of observations extended from 1843 to 1851, and was regarded as incidental to the work in atmospheric electricity. At the beginning of 1854 a meteorological journal was commenced, and regular observations have proceeded from that date without a break. No provision was made, however, for publication by the British Association. It was not until the organisation of a network of observatories by the Meteorological Office that adequate use was made of the Kew records. From that date, 1869, the observatory has had a conspicuous place in all meteorological statistics.

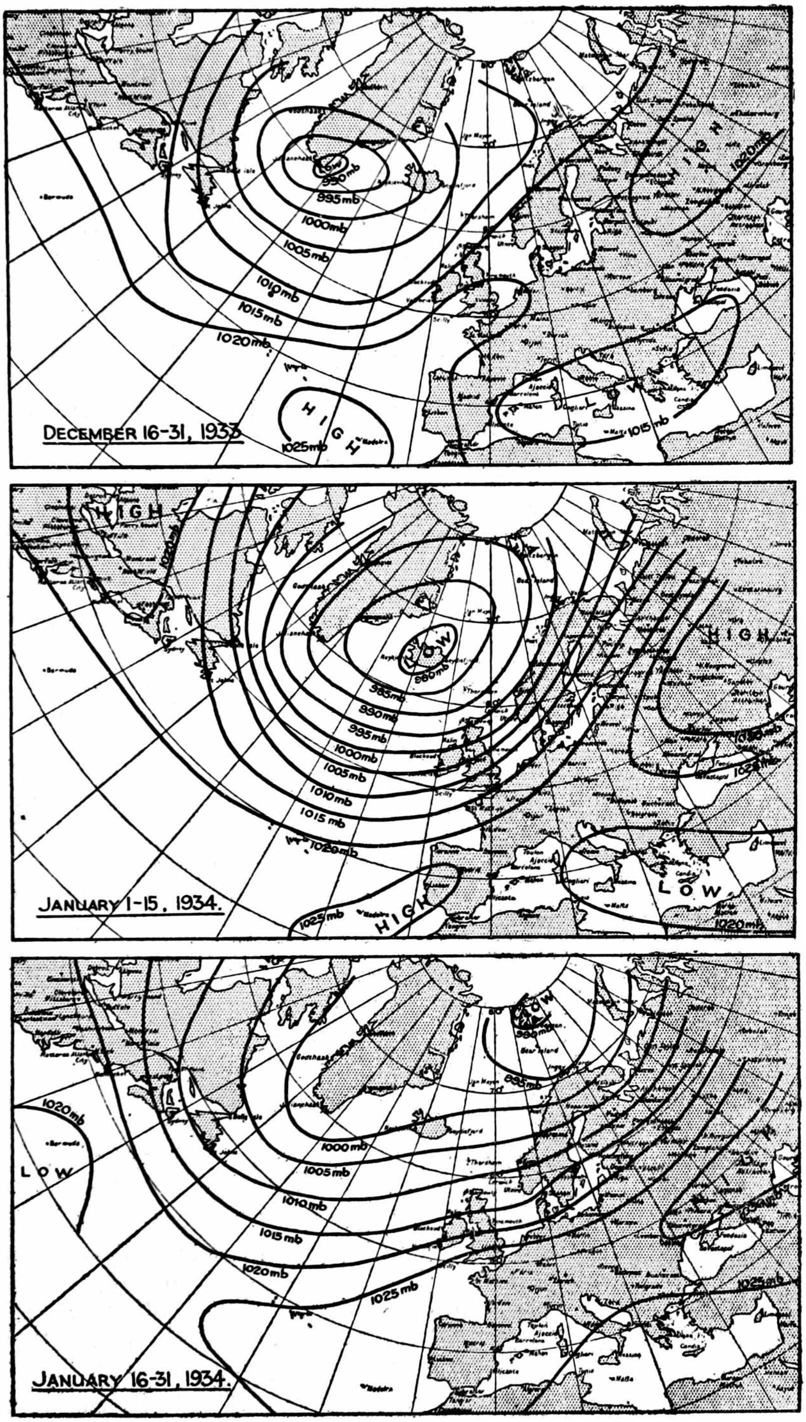
F. J. W. WHIPPLE.

Pressure Distribution during December, 1933, and January, 1934

The *Meteorological Magazine* for January contained on p. 280 a chart of the distribution of average pressure during the first half of December, 1933. The principal features of this chart are an intense anticyclone extending from the Faroes across Scotland and Denmark to northern Germany, and a depression, with average pressure below 1000 mb., centred south-west of Greenland. Another, relatively shallow, depression lies over the Pyrenees. The changes in the general pressure distribution during the succeeding six weeks show a well-marked progression, which is illustrated in the three charts opposite.

The uppermost chart shows the average pressure distribution during the period December 16th-31st. The anticyclone, which from the 11th to 15th had been centred over the Atlantic, gradually retreated eastwards across Europe, while at the same time the Azores anticyclone increased in intensity and the Pyrenees low spread eastwards and occupied the whole Mediterranean. The most remarkable development was shown by the Greenland depression, which deepened considerably and moved in an east-north-east direction to a position just east of the southern extremity of Greenland. Conditions during the second half of December were however not especially abnormal.

The second chart shows the distribution during the first half of January, 1934. The depression has moved still further towards the east-north-east to a position over Iceland, and has become very intense. At Reykjavik the average pressure for the 15 days was only 978 mb., which would be fairly low for a single reading and may be unparalleled for a 15-day average. At the same time the anticyclone over Russia has become intense, the average pressure at Moscow being 1,033 mb. The pressure difference between Iceland and Moscow was as much as 55 mb. in 2,000 miles. The Azores high has also increased in intensity and moved north-eastwards, the highest pressure, 1,027 mb.,



AVERAGE PRESSURE DISTRIBUTION.

being found at Lisbon. The Azores and Russian anticyclones already show a tendency to unite in a belt of high pressure along the axis of Europe. The Mediterranean depression has also moved eastwards and has become weaker.

The whole period was one of great storminess over north-west Europe. On the 4th, pressure fell below 964 mb. south-east of Iceland and gales were widespread. On the 6th a still deeper depression crossed Iceland and pressure at Seydisfjord fell to 951 mb. From the 7th to the 10th conditions were less violent, but on the 11th and 12th a new disturbance with pressure below 960 mb. passed slowly south-east of Iceland. On the 14th a deep secondary to this depression crossed the British Isles and gave a reading of 971 mb. at Manchester at 7h. Another disturbance passed just north of Scotland on the 17th and 18th, giving a pressure of 959 mb. at Lerwick at 1h. on the 18th. After the 18th the distribution changed rapidly. An offshoot from the Azores anticyclone moved north-east across the British Isles to Europe and the main focus of low pressure shifted towards Spitsbergen. From the 28th to 31st conditions were definitely anticyclonic over the British Isles.

The average pressure during January 16th to 31st is shown in the lowermost chart. The lowest pressure is found over Spitsbergen, and a well-marked anticyclonic belt extends from the Azores and Madeira across Spain and central Europe to southern Russia.

The whole series of four charts, including that in the December issue, forms a definite series, in which the focus of low pressure travels 2,500 miles from south-west of Greenland to Spitsbergen without losing its identity, while another focus travels from the Pyrenees the whole length of the Mediterranean. The last three charts show in addition the gradual building up of a long anticyclonic ridge, which from the data available extended continuously at least from northern California to the Aral Sea. The area of average low pressure which travelled continuously on a curved path from south-west of Greenland to Spitsbergen with an average speed of about 400 miles a week, is to be regarded rather as a focus of cyclonic activity than as an actual individual depression. Especially from January 1st-15th, and to some extent throughout the whole period of two months, depressions were continually originating to the west, passing through the focus, where they generally reached their greatest intensity, and moving away to the east or north-east. The charts represent the net result of these activities. The focus is therefore in some respects an abstraction, but it is difficult to believe that an abstraction could persist so definitely for two months without some underlying (or overlying ?) reality.

C. E. P. Brooks.

The West African Tornado

By D. E. Smith, M.A.

That the West African tornado has some very interesting features is revealed by the study of the various storms which passed over Lagos Observatory during the 13-month period of the Polar Year. Anemobiagrams, barograms, hygrograms, and thermograms were available for the complete period and have made a close and comprehensive study possible.

It is fairly apparent that these storms are due to the interaction of the dry north-easterly and warm, moist, south-westerly winds. As in most tropical countries there are two distinct seasons in west Africa, the rainy season lasting from May till October, and the dry or harmattan season from November till April. During the rainy season the coast is swept by the moist south-westerly, and in the dry season the north-easterly descends from the arid regions of north Africa and drives the monsoon coastwards. This north-easterly or harmattan very rarely establishes a complete ascendancy over the south-westerly at the coast, but in the central and northern provinces reigns supreme during its season. The west African tornado most frequently occurs in the months of March to May and September to early November. These are the two periods when the south-westerly and the north-easterly are fighting for supremacy and the proximity of the two air currents is sufficient to produce the storm energy.

One naturally expects that the west African tornado, caused apparently by the proximity of two air currents of different origins, would bear some resemblance to the squalls and discontinuities associated with the polar front in more northern latitudes and a glance at corresponding autograph charts is sufficient to convince us that the resemblance is more than superficial. Each tornado has its squall line with a discontinuity of wind direction and speed. Corresponding to each squall line there is a definite drop of temperature which during the Polar Year amounted to anything up to 15°.

The variations of barometric pressure associated with these storms were registered on a "Tycos" microbarograph manufactured by Messrs. Short and Mason. This barograph has a daily chart and is delicate enough to enable the reading of variations of the order of 0·005 in. In spite of the intensity of some of these storms (the instantaneous gust at the passage of the squall line must in some cases be about 70 or 80 m.p.h.) the charts show but little indication of either the approach or departure of these storms. In view of the proximity of Lagos to the equator (6° 28′ N.) it is not to be expected that the variations would be very large. The geostrophic component of the pressure gradient is naturally small but apparently the cyclostrophic component is also minute, which would indicate that the radius of curvature of these storms is rather large. I append a table showing the variations in the 3 hours preceding and in the 3 hours following the passage of the squall lines of half a dozen of the most intensive storms passing over Lagos during the Polar Year. In order that the fluctuations might

Date	Wind speed m.p.h.	Temperature drop.	Pressure variation preceding 3 hours.			Pressure variation 3 hours after.			Rain-fall.
			1	2	3	4	5	6	
		°F.	in.	in.	in.	in.	in.	in.	in.
Nov. 3rd, 1932	48	11	—0·013	0·000	+0·008	+0·041	—0·020	—0·033	0·45
Feb. 4th, 1933	30	11	—0·012	+0·007	—0·002	+0·032	0·000	0·000	1·26
Apr. 5th, 1933	35	15	—0·012	+0·013	—0·005	+0·037	—0·046	—0.012	0·28
Apr. 29th, 1933	44	13	—0·001	+0·026	+0·019	+0·045	+0·008	+0·004	0·92
May 5th, 1933	55	12	—0·011	+0·011	0·000	+0·022	—0·019	—0·009	1·45
May 16th, 1933	44	10	—0·002	+0·019	+0·073	—0·038	—0·009	—0·016	0·67

not be dwarfed by the diurnal wave I have made appropriate corrections to each of the hourly values. I have also tabulated the wind speed, temperature drop and rainfall. It will be seen that although there is a distinct indication of the passage of the storms as shown in the fourth column there is little or no indication of their approach as shown in the first three. Little then can be said for the microbarograph as a means of weather forecasting on the west coast of Africa. A weather chart might be more helpful; unfortunately our mercury barometers have not been standardised against each other for a considerable number of years and the isobars bear as a rule little or no relation to the atmospheric circulation.

The wind discontinuities at the passage of the front are quite instructive and in some ways rather perplexing. A study of the Lagos anemobiagrams and of the eye observations from all over Nigeria shows that in 99 per cent. of cases the squall breaks from the east-north-east or from within a point or two of that direction. This in itself is not very remarkable The cold wedge of the north-easterly current undermines the moist south-westerly current in the same way as the polar westerly or north-westerly undermines the warm south-westerly in more northerly latitudes. I think it is interesting, however, that in the case of the west African storm the south-westerly may veer or back towards the east-north-east on the passage of the squall line. In most of the cases I have studied, the veering or backing is not a gradual process but usually coincides instantaneously with the sudden increase of wind speed associated with the squall. In some cases indeed the veering or backing is a slow process and is in the nature of a storm warning, but usually the transition is quite sharp. In terms of cyclonic disturbances the explanation is simple enough. In the case of the veering wind the centre of the eastwards moving cyclone is north of the station; in the case of the backing wind the centre is south of the station. In terms of frontal theory the explanation becomes a little more difficult, and I shall be glad if any of your readers can offer an adequate explanation.

Air Currents in the Bay of Gibraltar

It is a common experience that a person seeking shelter from a high wind may be more rudely buffeted by the eddies in lee of a sizeable obstruction than he has been in the free wind before taking cover; and it is only logical to realise that similar conditions must affect larger objects in larger scale surroundings. A notable instance of this might be expected in the case of aeroplanes alighting in lee of that great upstanding obstruction the Rock of Gibraltar, shown in the photograph; and flying practice in Gbraltar Bay has shown that the turbulence in the wind shadow of the Rock is in fact of an extremely violent nature. It was there that in February 1929, the fatal accident occurred to the Fairey III D aeroplane in the act of alighting, and the present survey* of air currents was undertaken very shortly after the loss of that machine.

For the purpose of the survey a model of the Rock was made and exposed in a wind tunnel at the National Physical Laboratory, and measurement observations were then taken of the behaviour in pitch and yaw, and in eddy motion, of some 800 short silk-fibre indicators uniformly distributed in lee of the model to cover 14 sq. miles of the area of the Bay, and to reach in serried ranks up to 7,000 feet above sea. It was then found that a tunnel wind that was perfectly steady and quiescent upstream of the model, became in its lee a veritable "Witches' Cauldron" of eddies, vortices and mutually battling gusts: that these conditions prevailed for more than two miles to the west of the ridge of the Rock (as far, in fact, as the spot where Fairey III D was lost), and that they were embedded as detail in a system of wild but large-scaled turbulence which, with cyclic repetition, carried the ends of some long exploring fibres from heights of 4,000 feet downwards to lick the sea and up again. It seemed in fact, as far as model evidence showed, that all the conditions for flying accidents were present in easterly winds of any considerable strength.

By skewing the model in the tunnel the measurements were

***London, Meteor. Office, Geophysical Memoirs, No.* 59. A survey of the air currents in the Bay of Gibraltar: 1929-30. By J. H. Field, C.S.I., M.A., and R. Warden, Ph.D. (M.O. 356b).

taken for each of seven wind directions between NE. and SE., 45° and 135°, and the interesting further point was then found that while a due east wind, 90°, resulted in two main vortices, each about half a mile in diameter and with its axis curving over from a horizontal attitude at the ridge level to bury its nose vertically in the sea, any shift of the prevailing free wind towards north or south of east progressively augmented one vortex at the expense of its fellow until at angles 60° and 120° only one vortex was left, but with its whole axis turned up into the horizontal plane and extending now the full length of Gibraltar Bay.

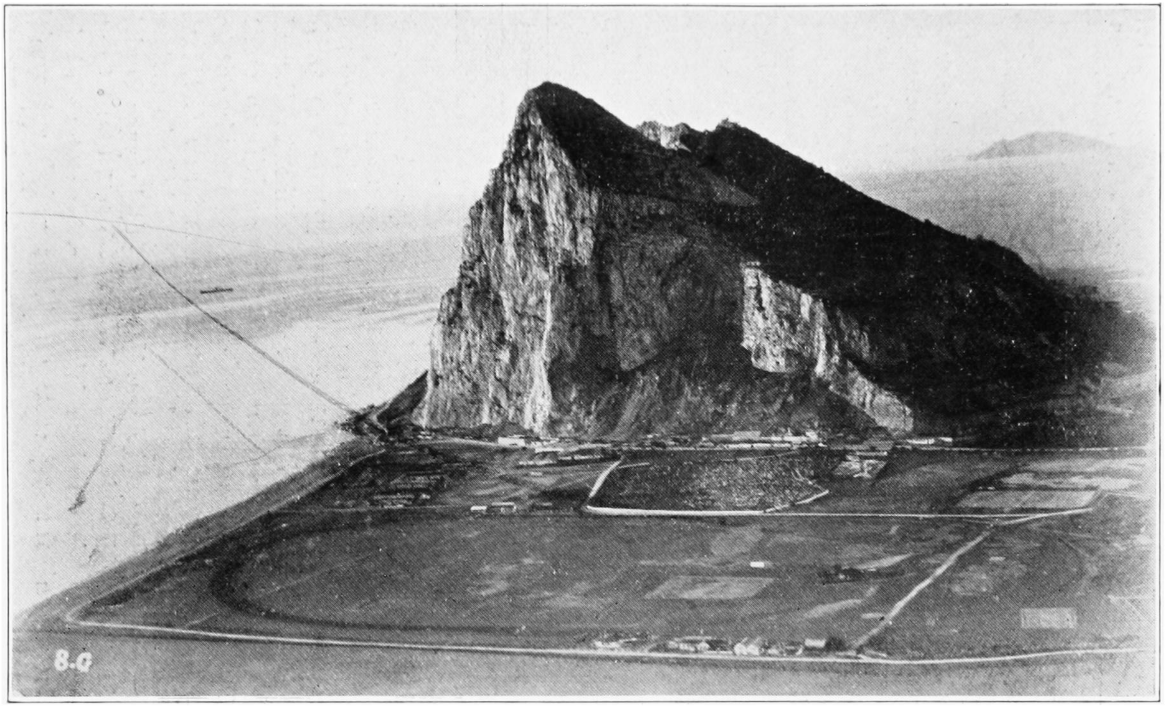
This condition is shown in fig. 2, which is a reproduction on a reduced scale of Plates XVIII C and D of the Memoir. The model is placed aslant in the tunnel to represent a wind from 60°, or a little north of ENE. The streamers shown by the fine wavy lines terminating in ellipses represent 12,000 feet on the full scale; they start just up-wind of the model and their position has been so adjusted that the vortex position occurs at the end of the streamer.

Armed with these preliminary views of what might be found on the actual spot, a party of observers sent up in Gibraltar between November, 1929, and the following March a series of 138 balloons, of known rate of rise in still air, and plotted their courses and rise rates as determined from theodolite observations taken at the two ends of a base line. An intensive examination was made of the results, and a comparison with the model behaviour at corresponding points in the Bay showed a strong measure of agreement.

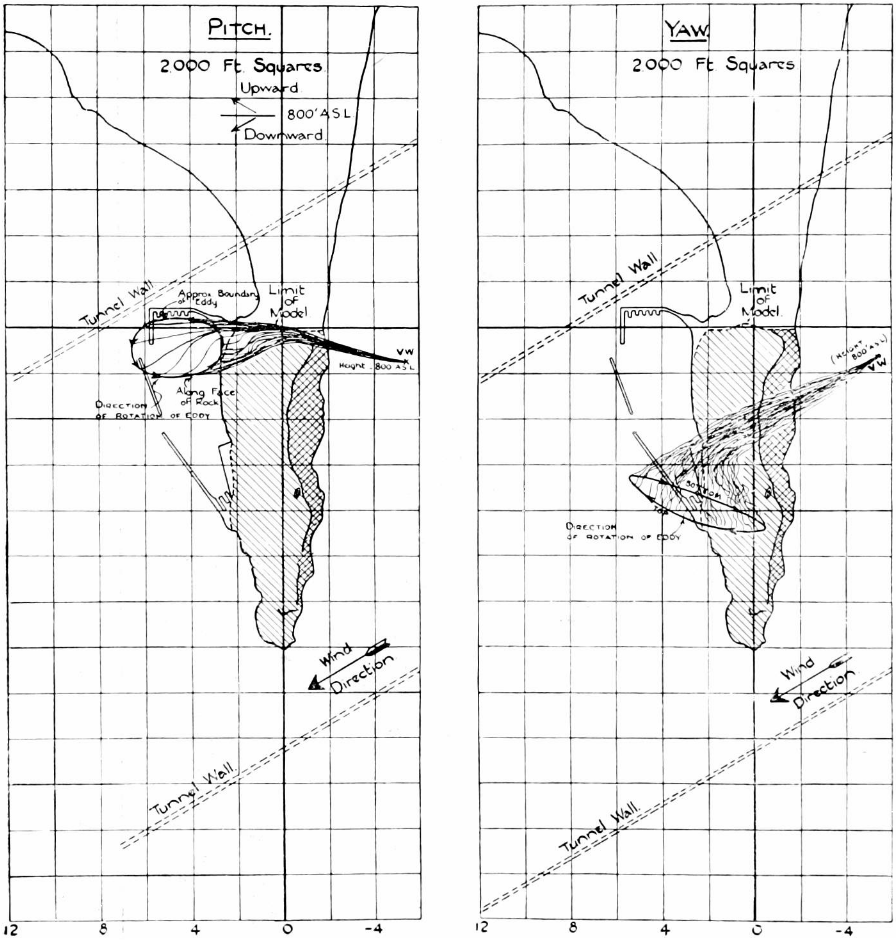
It was true that over a considerable area of the field a liberal amount of choice in balloon motion was offered by the model results, both in pitch and yaw, but out of a total of 360 plottings of balloon points there were only 24 instances of discordances and many of these were slight. The conclusion followed from the available evidence as a whole that the model observations, though on the very small scale ratio 1/5000, gave a definite picture of vortex and eddy distribution which proved to be consistent with the results found later on the full scale. In regard, however, to the two features of wind detail, actual strength and quickness of change in strength and direction, measurements with small models will not readily give a forecast, and these matters had accordingly to be left for examination on the spot at Gibraltar. It was there found that vertical currents over the sea in lee of the Rock would reach strengths as great as 1,500 feet per minute, up or down, even on days of good flying weather; that they were often exceedingly local, and that down currents were more violent than up currents and considerably more frequent.

A point of much interest arose when watching the behaviour

facing p. 10



GIBRALTAR : FROM THE AIR OVER NEUTRAL TERRITORY TO ITS NORTH.



Eddies as shown by streamers of great length in the Bay of Gibraltar at 800 ft. Wind 60°.

of clouds over Gibraltar Bay. When a humid wind blows past a great obstruction such as a hill top or mountain peak, there is frequently to be observed a "banner cloud" trailing downwind as a stationary feature anchored on the apex, the free wind of the day blowing along and through its body, yet leaving it unmoved. We know of celebrated instances in the "plume" of Mt. Everest and the "table-cloth" of Table Mountain, and at Gibraltar, to correspond with these, there occurs the "Levanter cloud." On a day of strong east wind from the damp Mediterranean, this banner cloud will spring from Gibraltar's ridge and stretch westwards for several miles, with the free wind rushing through it in its onward course over the Bay. At regular intervals of a few minutes a terminal part of the banner will break off and travel away downwind, to be succeeded in formation and break-off by similar cloudlets in due time order. This is entirely in accordance with the known behaviour of a bluff obstruction in a wind tunnel, for eddies form in its lee and break away at time intervals which can be calculated from the scale of the obstruction. In the case of Gibraltar, Mr. Relf, of the National Physical Laboratory, had already calculated that the time interval would be about three minutes, and it was interesting to find that not only was evidence of these break-away eddies offered visually by the activity at the tip of the Levanter cloud, but that the period of recurrence agreed closely with his forecast.

On the general question of determining the characters of movement in turbulent air, it must be recognised that the method of using balloons and theododites has strong limitations, and the Gibraltar observers spent a good deal of trouble in making and using a kite instrument of new design, which should give a continuous record of pitch, yaw and velocity of wind, with sufficient quickness of response to prove satisfactory when dealing with eddies. In the case of the present work at Gibraltar, the available time in the sanctioned tour of duty proved too short for this instrument to be effectively used there, but the observers concluded that in other cases where a proposed site for an aerodrome should come under preliminary trial, the best course to pursue would be to use first a model of the site and its surrounding country in a wind tunnel, and then on the site itself a kite or kite-balloon carrying this new instrument, but with a standby provision of pilot balloons and theodolites to fall back upon in case of unexpected difficulty with the new method.

Royal Meteorological Society

The Annual General Meeting of this Society was held on Wednesday, January 17th, at 49, Cromwell Road, South Kensington, Prof. S. Chapman, F.R.S., President, being in the Chair.

The Report of the Council for 1933 was read and adopted, and the Council for 1934 duly elected, the new President being Lt.-Col. E. Gold, D.S.O., F.R.S.

The Symons Gold Medal, which is awarded biennially for distinguished work done in connexion with meteorological science, was presented to Sir Gilbert T. Walker, C.S.I., F.R.S.

Prof. Chapman's Presidential Address was on

The Gases of the Atmosphere.

The permanent gases of the atmosphere (mainly nitrogen and oxygen) are known, from direct measurements in the stratosphere, to be in constant proportions up to the greatest heights yet attained by Piccard and his successors in stratospheric flight. Other constituents vary in their concentration, because of processes tending to produce and destroy or transfer them in the atmosphere; among such constituents are water, ozone, and the newly discovered positrons, which enter the atmosphere from outside as cosmic rays. Experiments are suggested to determine the rate of large-scale transfer of such gases by turbulence, using some easily detectable gas, artificially introduced, as an "indicator." Such experiments might also be made using ozone as the indicator, which would throw light on the distribution of ozone, as recently estimated by Dobson, Gotz and Meetham. The possibility of removing the atmospheric ozone above a certain ground area is also considered. The absorption of solar radiation by oxygen and ozone is discussed in the light of new experimental data, and in relation to the composition and temperature of the upper atmosphere.

Discussions at the Meteorological Office

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

February 26th, 1934.—*Kinematical and dynamical properties of the field of pressure with application to weather forecasting.* By S. Pettersen (Geofys. Publ., Oslo, Vol. 10, No. 2, 1933). *Opener.*—Mr. R. C. Sutcliffe, Ph.D.

March 12th, 1934.—Subject to be announced later.

Correspondence

To the Editor, *The Meteorological Magazine.*

Solar Coronæ

In your January issue Mr. L. W. C. Bonacina expresses the view that coronæ round the sun are relatively rare, and that one should look for them especially in December. May I direct his attention to our yearly volume, *Onweders, Optische Verschijnselen enz.*, which usually is mentioned also in this magazine.

In the 1929 volume he will find 109 observations of sun's coronæ by one observer at Aerdenhout near Haarlem, incidentally not a single one in December, all of them with accurate estimation of the coloured rings—and in 1933 this observer has developed even more zeal, and recorded 292 sun's coronæ on 257 days. Of course this is only possible by using coloured spectacles or a black mirror in order to get rid of diffuse sunlight, but certainly the sun's corona is not a rare phenomenon.

E. VAN EVERDINGEN.

K. Ned. Meteorologisch Instituut, De Bilt, Holland. January 30th, 1934.

A Lunar Corona

On January 27th, 1934, at about 18h. 30m. (G.M.T.), I observed a magnificent lunar corona. The central part next the moon was white and surrounded by a circle (diameter about 6°) of a very dark brown, almost, in fact, of the hue of a lunar eclipse. Surrounding this, was a splendid circle, green and blue, very bright and luminous and, at its rim, a delicate purplish ring (outer diameter approximately 16°). The green and blue zone was almost dazzling and attracted the notice of many people in streets and open spaces. I do not remember ever seeing so beautiful a lunar corona. In a few minutes, unhappily, this splendid phenomenon passed away.

M. MOYE.

12 *rue Boutonnet, Montpellier, France. February 1st,* 1934.

Rainbows and Sky Illumination

On the afternoon of Sunday, October 15th, about 4.15 p.m., there occurred here a heavy rain squall from south-west. It lasted about half an hour, and when the sky began to clear from west-south-west, there developed a rainbow of unusually brilliant hues. At the stage of greatest intensity, it was accompanied by a complete secondary bow, while the primary bow was so brilliant that the colours appeared to glow and give forth light on their own account. The spectacle was one of great beauty, and, curious to see how it would photograph, I got my camera and took three photographs (not reproduced). These clearly show the greater illumination of the sky inside the bow than outside, and I would like to know whether this feature, which is common to the whole three photographs, and is shown even more clearly in the negatives, has been remarked before. I may say that I have never observed it in looking at a rainbow directly.

W. D. LAING.

Holmwood, Nairn. November 20th, 1933.

[It appears that the greater illumination of the sky inside the primary bow can be perceived at times by the naked eye. For the reason why the difference shows up so clearly in photographs (there is a striking example of this given in "Clouds," by G. A. Clarke, plate 35B), I suggest the following explanation. In accordance with the accepted theory, the light which reaches the eye after one internal reflection in the raindrops comes out in all directions lying within about 42° from the central line passing through the sun and the observer's head. This reflected light is most intense near the limit, which corresponds with the path of minimum deviation of the ray, and the rainbow is seen at this angle. Of the light which undergoes two internal reflections, none which reaches the observer makes an angle of less than 50° with the central line. The space between the inner and outer bows therefore appears darker than the space within the inner or beyond the outer bow. Moreover the part of the cloud within the primary bow is seen partly by regularly refracted and reflected light, whereas the cloud between the two bows is seen only by scattered light. The light of shortest wave-lengths would be less scattered than the light of longer wave-lengths, hence from this part of the cloud there would be a deficiency of these wave-lengths (violet and ultra-violet) which affect the camera but which are less appreciated by the eye.—A. F. Crossley.]

Parhelic Circle

In his letter with the above title in the January issue of the *Meteorological Magazine* (p. 287), Mr. Treloar asks whether the statement in Wood's "Physical Optics" that "the white horizontal circle, mock moons and other halo phenomena except the two halos of 22° and 46° require still air for their production" is generally accepted.

Pernter and Exner (pp. 440-2) seem to indicate that wind does not prejudice the production of halo phenomena but may affect the symmetry of certain forms, such as contact arches, and the parhelic circle. They quote an instance when the upper arc of contact was displaced 5° or 6° to the left and the parhelic circle instead of going through the sun passed 1° or 2° below. (Met. Zs., 1915, 552). The observer Saring attributed this to an unusually strong south-west current.

The ring-shaped halos such as 22° and 46° are not affected by wind.

Cicely M. Botley.

Guildables, 17, *Holmesdale Gardens, Hastings.* *January* 23*rd*, 1934.

The Droughts of 1868 and 1933

The chance turning up of a record has solved for me the problem why the land in the 1868 drought left the landscape far more impressively burnt up than in 1933 in Somerset. For the first four months of 1868 only 5·54 inches fell; February 0·41; May to July only just reached 3 inches. May 0·76, July 0·85 inches. On the day the drought broke, about August 10th, as I reached home from a walking tour in drenching rain from the Quantocks for 12 miles into Bridgwater and then by train, our fine landmark of Tor Hill was brown as any new railway embankment in all its 500 feet.* The rain continued all night, over two inches in all being measured, and for the month 5·91 inches.

That was only a beginning. Against 8·54 in. for 7 months the last five yielded 18·83 in., closing with 5·14 in. in December. 1869 had therefore a fine start for water supply. Only yesterday I found the upper turf moor rhines, below Ashcot, perfectly dry. Usually they are full to overflowing, even before receiving the last drop of February fill-dyke. Their present dryness appears to be a record.

J. EDMUND CLARK.

Portway, Street, Somerset. January 13th, 1934.

Malayan Rainfall

As an instance of the distribution of rainfall in the tropics, the annual report on the Rural Board, Province Wellesley, Straits Settlements, cites the case of a rainstorm in the southern portion of the Province when 17·44 inches of rain were recorded between 6 p.m. and midnight, while in the north of the Province on the same day the rainfall was less than one inch.

THE MALAYAN INFORMATION AGENCY.

57, Charing Cross Road, London, S.W.1.

Cyclonic Formation, November 13th, 1933

An interesting phenomenon was observed in the Palk Strait on November 13th. The Sub-Collector of Customs, Kankesanturai, had noticed about sunrise what he believed to be the copious smoke of a steamer some miles out at sea off the north coast. The smoke was static, rising into the air and disappearing in a cloud. As daylight broadened the phenomenon faded until about 9 a.m., when a heavy thunder-cloud gathered in the north-western quarter of the sky. I was driving along the north coast road at that time, and while passing Kankesanturai observed a cyclonic formation over the sea to the north-west. This formation took the shape of a cylinder extending from the centre of the thunder-cloud down a considerable length of sky until, as it approached the sea, it lost its outline and was dissipated into a mist. The cylinder was altogether detached from the clouds behind and was distinctly defined against them. It was perfectly shaped as a pencil, coned

*In about four days it was again green.

at neither end. Had a camera been to hand, a most definite picture could have been obtained. I stopped my car and went down to the beach. The cylinder was moving against the background of clouds, and it became apparent after a minute's observation that it was moving rapidly towards the coast. The sea beneath the mist was considerably agitated. The formation passed to the south-east on the far side of a catamaran which was some miles out from the coast, and continued its journey until it was between the fishing fleet and the shore. The disturbance on the sea, which was impressively marked by the white spray thrown into the air, was narrowly localised, and appeared to be confined to an area of a hundred yards' diameter or so, possibly smaller. After three or four minutes the cylinder was no longer straight but was blown into a curve, and seemed to lose power, in that it lost its clarity of outline at a greater elevation from the sea. Very soon the cylinder disappeared altogether, but the agitated area on the sea continued to move rapidly towards Mayiliddi, until it, too, sank away about one mile from the coast. A small crowd of villagers were watching from the shore, and they stated that they had never seen such a thing previously. A strong wind sprang up from the north-west, and brought a heavy but brief local shower. From the distance, about five miles, travelled by the formation within a time of about five minutes, a speed of sixty miles an hour may be deduced, subject to a wide margin of error owing to the absence of better landmarks than a few fishing sails.

R. J. WILKINSON.

The Kachcheri, Jaffna, Ceylon. November 13th, 1933.

Travel of Thunderstorms

My attention has recently been drawn to what is stated to be a well-known peculiarity in the travel of thunderstorms in three different districts. I refer to the influence of rivers in controlling their movements. To the north of Lowestoft and again at Felixstowe it is said, on good authority, that thunderstorms tend to miss the locality, appearing to prefer a track either to the north or to the south, and it is in both cases suggested that the rivers have a controlling influence. At Wellingborough, Northamptonshire, it is also firmly believed that thunderstorms rarely cross the river.

In spite of the apparent authenticity of the statements I find it difficult to believe that a river, a few hundreds of feet in width, can, in the absence of marked relief, have any important influence on the motion of a storm system which may be anything up to 30,000 feet in height and of comparable horizontal dimensions. It is, moreover, not difficult to find a reasonable explanation for these beliefs as due to illusions of perspective when it is remembered that thunderstorms usually become noticeable at distances up to fifty miles so that far more storms will appear to approach any station than will actually pass overhead.

It must, however, be admitted that such an explanation does not easily satisfy the observer and it would be interesting to know whether any of your readers have come across similar beliefs in other parts of the country.

R. C. SUTCLIFFE.

De Freville, Brook Lane, Felixstowe. January 1st, 1934.

Buxton Weather Bulletin

Mr. H. Everard sends us the following copy of a weather bulletin which was displayed in a shop window at Buxton. In explanation of the remark about pressure it must be remembered that Buxton is at a height of 1,000 ft. above M.S.L.

Temperature.—Keeps up a good average.
Pressure.—Finds effort of climbing too much for it.
Rainfall.—Fairly frequent visitor.
Wind.—Speaks with a soft southern accent.
Current noting.—Ridge of high pressure giving way.
Further outlook.—Good, bad and indifferent in turn.
Propitious features.—Rest from their toils.
Ominous symptoms.—Collecting a representative array.

To-day's local weather handicap.

Pressure—drooping once more.
Distant influences—still quarrelsome.
Inferences—Bashful sunshine.
Arrogant clouds.
General dampness.
Fair periods.
Fairly mild.

Extreme December Minimum in Relation to Extreme June Maximum Temperatures: An Interesting Anomaly

Although it is sometimes said that the month of December hardly justifies its traditional reputation for hard frost the allegation is only true in regard to the frequency of south-westerly winds in the British Isles with the accompanying heavy Atlantic gales which keep frost at bay. But frost in December is always biding its chance in these latitudes, and our thermometric records show quite clearly that the potentialities of this month for intense cold are equal to those of any later winter month—if, indeed, they are not greater. Thus the absolute screen minimum on record for these islands of $-23°$ F. at Blackadder in Berwickshire occurred in December, 1879, a month which in Scotland was truly Arctic, and on the Continent was of almost incomparable rigour seeing that in Paris the mean day and night temperature for the entire month was as low as 18° F. In the south of England December, 1890, was colder than 1879, and at Cambridge the mean of 28·0° and the absolute minimum of 0° have not been equalled in any month of any name since records began in 1876. In London the means at Greenwich and Kew for December, 1890, of respectively 29·3° and 29·4° are just 0·3° and 0·2° higher than those for February, 1895.

If now we turn from dark December to the corresponding summer month, namely "flaming" June, which no doubt derives this epithet from the fierce sun-heats of the summer solstice, we find that the maximum air temperatures on record are notably less conspicuous in relation to the later summer months than are the December minima in relation to the later winter months. Thus at Greenwich the hottest June, which occurred as far back as 1846, had a mean of 67·7° as compared with cases of over 69° both in July and August, and nearly, if not actually, all maxima in the screen exceeding 95° recorded anywhere in England have happened in July and August.

The explanation of the anomaly which seems too definite to be accidental is probably this: at the summer solstice the upper air is still relatively cold and the intense surface heating tends to give rise to convectional instability so that the warm air does not keep down; at the winter solstice, on the other hand, when the upper air is still relatively warm the stratification is stable and surface freezing during the long nights can go on unchecked. That this explanation is correct seems to be supported by the fact that whereas very high maximum temperatures sometimes occur as late as September when a comparatively warm upper atmosphere tends to keep heated surface air down, very low minimum temperatures sometimes occur as early as November, as in the remarkable contrasts of 1919.

L. C. W. BONACINA.

*35, Parliament Hill, London. N. W.*3. *January 27th*, 1934.

NOTES AND QUERIES

Recent Calm Winters on the Lancashire Coast

In the course of a recent investigation it was necessary to tabulate the frequency of occurrences, during the past 11 years, of hours of wind with a mean velocity exceeding 24 miles per hour. An interesting fact revealed by these tabulations, which were confined to the four months November to February, was that the winters of 1931-2 and 1932-3 showed a remarkable deficiency of strong winds at Southport. The tabulations were, therefore, extended backwards to include the whole period for which analyses of wind velocity are available and similar tabulations were made for Holyhead and Spurn Head. The results for the four winter months are shown on Table I. At all three stations the conditions of measurement have remained practically unaltered throughout the whole period.

It will be seen that at Southport the winter of 1931-2 yielded only 43 per cent., and 1932-3 only 52 per cent. of the usual frequency of strong winds. At Holyhead both winters gave less than the average frequency, but the deficiency was in neither case so marked as at Southport. At Spurn Head 1931-2 was

TABLE I.—FREQUENCY OF STRONG WINDS (MEAN VELOCITY EXCEEDING 24 M.P.H.); TOTAL NUMBER OF HOURS IN THE FOUR MONTHS NOVEMBER TO FEBRUARY.

Winter	Southport		Holyhead		Fleetwood		Spurn Head	
	Hours	Per cent. of Average	Hours	Per cent. of Average	Hours	Per cent. of Average	Hours	Per cent. of Average
1913-14	758	147	811	110	...	...	381	71
1914-15	616	119	1,027	140	...	...	..	...
1915-16	801	155	1,047	142	...	...	678	127
1916-17	404	78	745	101	...	...	...	...
1917-18	753	146	924	126	...	...	...	...
1918-19	385	75	532	73	...	...	...	...
1919-20	829	160	936	127	...	...	...	...
1920-21	418	81	533	72	...	...	...	...
1921-22	597	116	831	113	...	...	728	136
1922-23	666	129	748	102	...	...	609	114
1923-24	498	96	655	89	176	63	652	122
1924-25	528	103	623	85	407	146	481	90
1925-26	401	77	615	83	272	97	419	79
1926-27	399	77	517	70	281	100	325	61
1927-28	512	99	779	106	472	169	831	156
1928-29	316	61	547	74	249	89	468	88
1929-30	421	81	773	105	300	117	542	102
1930-31	541	105	802	109	298	117	491	92
1931-32	222	43	588	80	146	52	318	60
1932-33	268	52	675	92	193	69	535	100
Average	517	...	735	...	279	...	533	...

the calmest winter of the whole series, but 1932-3 was normal.

The nearest station to Southport from which the records of a pressure tube anemometer are regularly received in the Meteorological Office is Fleetwood. Records from this station are available back to 1923 and the tabulations of strong winds have been added to Table I. They do not show as much parallelism with the Southport figures as might, perhaps, be expected, but they confirm the relative calmness of the winters of 1931-2 and 1932-3.

Analyses for a number of other stations gave the results shown in Table II. The averages refer to the past eleven winters. The winter of 1931-2 gave a high frequency of strong winds at Kew, but was relatively calm at Scilly and Aberdeen. 1932-3 gave an excess of strong winds at Scilly and Valentia and a deficiency at Lympne and Kew. The remarkable calmness of both winters

TABLE II.—FREQUENCY OF WINDS WITH MEAN VELOCITY EXCEEDING 24 M.P.H. IN WINTER MONTHS NOVEMBER TO FEBRUARY.

	Lympne	Kew	Scilly	Valentia	Aberdeen
	%	%	%	%	%
1931-32	105	203	85	95	62
1932-33	79	87	114	114	99

appears, therefore, to have been confined to the small area represented by the observations at Southport and Fleetwood. At Southport the deficiency of strong winds is continuing also during the present winter.

In his Annual Report for the year 1932, Mr. J. Baxendell, Meteorologist to the Southport Corporation, makes the following comment :—

" The general calmness of the year, coupled with the scarcity of even moderate gales, was astonishing. North-easterly and easterly winds, the latter in particular, were abnormally prevalent; during February they were of more than three times their customary frequency; so also were currents from the north in May and from the east in August. Not a single ' whole gale ' was experienced at any time."

Broadcast Weather Noises

Now that weather noises " off " form such a usual—and vivid —accompaniment of many broadcast plays, meteorologists may be interested in the methods which are used in the studio for reproducing these realistic effects. Mr. J. E. Cowper has kindly supplied the following notes on the subject :—

Wind.—This is done on a cylinder 2 ft. in diameter and 6 in. deep, set in a wooden frame 3 ft. high with a length of canvas stretched over the top. A handle is fixed to this, and by rotating at a normal rate one gets a steady wind, and with a quick motion gusts. It is a most realistic noise, and usually comes over very well.

Rain.—A rose on a water tap is usually used for this, which is turned on fully into a large wooden tank.

Thunder.—This is produced by suspending from the ceiling a huge piece of sheet iron, with a wooden shaft at the bottom where two handles are fixed for the hands. This, when shaken in an intelligent way, produces excellent thunder.

Sea.—A one-sided drum with lead shot inside shaken from side to side and round and round produces waves breaking on the shore, and is quite one of the best noises " off."

May I add that in nearly all cases we use gramophone records of these sounds, and these records will, I think, gradually efface the instruments I have tried to explain to you.

Review

The Wairarapa Floods of August, 1932. By Dr. E. Kidson, Wellington N.Z. Meteor. Office Note No. 13 extracted from New Zealand, J. Sci. Tech., Vol. XIV, No. 4, pp. 220-7, 1933.

The note deals with the meteorological conditions associated with the record flooding experienced to the east of Wellington, in the south of North Island, New Zealand, towards the end of August, 1932. A number of stations in that area recorded more than 6 inches for August 27th to 30th, the largest total being 14·58 in. at Putara, west of Eketahuna, where 8·00 in. fell on the 28th. Maps are given showing the pressure distribution, " cold fronts " and " warm fronts " over Australia and New Zealand for each of these days. The storm is of special interest because of the rapid change from strong north-westerly winds to southerly winds over North Island.

J. GLASSPOOLE.

Obituary

Mr. Stillman Call.—The death of Mr. Call, which we regret to announce occurred on February 6th, severs one of the last remaining links of the Meteorological Office with its earliest history as an independent Government Department. In 1867, Armagh Observatory, then under the charge of Dr. T. R. Robinson (of anemometer fame) was selected as one of seven first-class meteorological stations, and in May, 1868, Mr. Call, a native of Armagh, was appointed as assistant to carry on this section of the work of the observatory. At the close of 1883 the meteorological work at Armagh on behalf of the Meteorological Council was discontinued, and Mr. Call transferred to the office at Westminster, where he remained until his retirement in October, 1907, after 39 years' service. Although of a retiring disposition, Mr. Call had many friends among the older section of the staff. At the time of his decease had reached his 90th year. An enduring record of his work is contained in remarkably beautiful caligraphy amongst the various early manuscript records of the Office.

A. T. BENCH.

Erratum

December, 1933, p. 259, line 30, *for* " The total rainfall (June to August inclusive) this year 8·35 inches." *read* " The total rainfall (June to August inclusive) this year 8·95 inches."

News in Brief

Miss E. M. Edge, of Strelley Hall, Nottingham, wishes to sell the following books, and would be glad to receive offers for them:—

Meteorological Magazine (cloth), 1880-1930 inclusive.
British Rainfall (cloth), 1865-1929 inclusive.
Royal Meteorological Society, Quarterly Journal (paper covers), 1906-26 (a few numbers missing).

The thirteenth annual dinner of the staff of the Meteorological Office, Shoeburyness, was held at the Queen's Hotel, Westcliff, on Saturday, February 3rd, 1934. There was an excellent attendance, including a number of former members of the staff now serving at other stations.

The Weather of December, 1933

Pressure was below normal over Alaska, most of Canada, central United States, Greenland, Iceland, Scotland, Norway, northern Sweden, the extreme north of Russia and Spitsbergen, the greatest deficits being 17·0 mb. at Spitsbergen and 6·9 mb. at Kodiak. Pressure was above normal over western and eastern United States, Newfoundland, most of the North Atlantic, including the Bermudas and Azores, north Africa and Europe south of a line from Londonderry through Hernosand to Obdorsk, the greatest excesses being 8·9 mb. at Astrakhan and 7·6 mb. at Madrid. Temperature was above normal over Spitsbergen and western and central Europe, being as much as 16° F. above normal in central Lapland (the highest on record since observations began in 1861). Rainfall was below normal at Spitsbergen, northern Norway and eastern Gothaland, but about normal elsewhere in Sweden.

The weather over the British Isles during January was generally mild, unsettled and rather stormy in Scotland and Ireland, and colder and quieter with much fog or mist in England especially in the south-east. There was generally an excess of sunshine. Widespread fog or mist was experienced in most parts of England during the first three days, but depressions moving north-eastwards across Iceland gave unsettled weather in the west and north with gales in the extreme north and local heavy rain; 2·00 in. fell at Borrowdale (Cumberland) on the 2nd, and 2·15 in. on the 3rd. Good sunshine records, however, were obtained in south Scotland on the 2nd. From then until the 10th pressure was low to the north and west and high to the south, and the mild unsettled weather continued with local rain but sunny intervals. The 5th was a sunny day generally and the 8th in England and Ireland, 7·0 hrs. bright sunshine being recorded at Eastbourne on the 5th and 6·6 hrs. at Dublin on the 8th. The rainfall was slight in the south and east but moderate elsewhere, while day temperature rose above 50° F. on the 4th, 6th, 7th and 10th mainly in north England, south Scotland and Ireland, being colder elsewhere. Fog or mist was again general in England on the 9th. From the 11th to 18th the depressions centred to the north-west moved on a more southerly course right over the British Isles giving stormy weather with frequent gales and much rain at times, 2·31 in. fell at Tynywaun (Glamorgan) on the 11th, 1·79 in. at Brecon on the 13th and 2·68 in. at Borrowdale on the 16th. Slight snow or sleet occurred locally in the north. A gust of 84 m.p.h. was recorded at Abbotsinch (Glasgow) and at Kirkwall (Orkneys) on the 17th and of 82 m.p.h. at Scilly and 77 m.p.h. at Lympne on the 14th. On the 17th there was a general rise of temperature, 50° F. being exceeded at most places both on that day and the 18th, while 58° F. was reached at Sidmouth on the 17th. Thunderstorms were experienced at Fort Augustus on the 8th, Oban and Mallarany on the 11th and Falmouth on the 14th. On the 19th the winds veered to north and the temperature fell somewhat as an anticyclone spread across the country from the south-west. Quiet sunny weather was maintained over most of England until the 24th with good sunshine records except when affected by fog or mist; 8·0 hrs. at Penzance on the 24th and 7·8 hrs. at Guernsey on the 20th. Sharp night frosts occurred during this period, at Greenwich temperature on the grass fell to 10° F. on the 22nd. Meanwhile the Atlantic depressions had caused a renewal of unsettled weather by the 21st in the west and north where the wind reached gale force locally from the 21st to 25th. A trough of low pressure moved across the country on the 26th accompanied by slight general rain. On the 27th an anticyclone spread in from the the west over the whole country and sunshine records were good everywhere not affected by fog. Penzance and Ilfracombe recorded 8·0 hrs. sunshine on the 28th, but at Manchester temperature did not exceed 30° F. on the 28th or 29th owing to dense fog. Secondary troughs of low pressure moved southwards across the country on the 30th and 31st and gave slight rain, mostly in the east. The distribution of bright sunshine for the month was as follows :—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway	28	0	Liverpool	73	+18
Aberdeen	55	+ 7	Ross-on-Wye	56	+10
Dublin	71	+14	Falmouth	62	+ 4
Birr Castle	57	+ 8	Gorleston	70	+14
Valentia	51	+ 3	Kew	45	+ 2

Mr. Alfredo Salgado, of Ceará, Brazil, has sent us the following notes :—222 mm. (8·74 in.) of rain fell at Ceará on

January 5th between 2.45 a.m. and 2 p.m. There was a serious drought in Ceará during 1932 and a poor rainy season in 1933.

The special message from Brazil states that the rainfall in the northern and central regions was generally scarce with 0·95 in. and 3·46 in. below normal respectively and in the southern regions irregular with 0·43 in. above normal. Four anticyclones passed across the country. The crops were generally in good condition. At Rio de Janeiro pressure was 1·5 mb. above normal and temperature 0·4° F. above normal.

Miscellaneous notes on weather abroad culled from various sources. Navigation closed at Viipuri (Finland) and outer ports on the 2nd. On the 5th and 6th temperature was mild in Switzerland and rainfall was recorded even at the 2,000 ft. level, but on the 7th there was a change to frosty sunny conditions, excellent for ski-ing. The temperature again rose rapidly under the influence of a mild Föhn wind on the 12th and on the 15th a SW. gale brought heavy rain over the lower parts of Switzerland and much snow in the mountains, but there was a change back to colder conditions on the 19th. A short mild spell, however, was experienced again between the 25th and 27th. Owing to the hard frosts in several districts of Franconia (Bavaria) from Christmas to the 9th the water supply was interrupted. Floods were reported from Yugoslavia about the 9th as the result of rain and thaw. Dense fog occurred over the river Scheldt on the 9th, but on the 10th navigation re-opened. Navigation was still held up by ice at Braila (Roumania) on the 10th (*The Times*, January 3rd-30th).

By the 5th the Orange River swollen by heavy rains in the Free State and reinforced by floodwaters of the Vaal River was devastating the northern part of Cape Province, though six weeks previously the river had been dry at Upington. Unusually heavy rain continued during the month throughout the Union, and for hundreds of miles in South-West Africa the railway was repeatedly washed away. A cyclone of moderate intensity passed over Mauritius on the 28th and 29th and three people were klled (*The Times*, January 5th-31st).

From about the 13th to 31st unusually cold weather prevailed in Bombay Province causing much damage to the cotton and seed crops. For the third time during the last 100 years the temperature at Colaba Observatory fell below 54° F. being 53·7° F. on the 13th and 53·2° F. on the 31st (*The Times*, January 15th-February 2nd).

On the 10th heavy general rains were reported in New South Wales and Victoria causing floods and damage to crops. Widespread thunderstorms from Queensland towards the end of the month (*The Times*, January 10th-31st).

Temperature was low at the beginning of the month in the eastern and northern United States, but throughout most of the month temperature was above normal especially in the western States. A cold spell however occurred in the east during the last week-end. Precipitation was generally below normal except in parts of the Gulf States. High winds and excessive rains caused severe floods throughout British Guiana. As the result of severe floods caused by a sudden thaw many deaths from drowning occurred in Mendoza, Argentina, and the trans-Andean traffic stopped about the 10th (*The Times*, January 11th-13th, and *Washington, D.C., U.S. Dept. Agric., Weekly Weather and Crop Bulletin*).

Daily Readings at Kew Observatory, January, 1934

Date.	Pressure, M.S.L. 13h	Wind, Dir., Force 13h	Temp. Min.	Temp. Max.	Rel. Hum. 13h.	Rain	Sun	REMARKS (see p. 1)
	mb.		°F	°F	%	in.	hrs.	
1	1029·1	Calm	29	32	100	—	0·0	F all day
2	1023·0	SSW.1	28	41	97	0·08	0·0	r 15h. 30m.-18h.
3	1019·9	WSW.1	39	41	87	0·01	0·0	r_0 early. f 21h.
4	1012·5	SW.4	35	50	89	0·07	0·0	r 20h.-23h.
5	1022·0	WNW.3	36	44	67	—	5·4	x early
6	1027·1	SW.5	31	47	77	trace	1·2	Breezy all day
7	1021·6	SSW.5	45	46	88	—	0·0	Breezy all day
8	1022·9	SW.3	39	41	86	0·03	1·6	f_0 early. x 18h.
9	1027·8	Calm	28	33	96	trace	0·0	F all day
10	1022·6	S.4	29	43	94	—	0·0	r_0 13h.
11	1005·0	S.4	39	48	90	0·11	0·7	Breezy. rs 12h.
12	993·6	SW.3	47	47	81	0·17	0·7	r-r_0 0h.-11h.
13	1006·3	SW.4	40	48	76	0·04	0·3	r 23h.-24h.
14	983·3	WSW.5	45	48	70	0·21	0·0	r early. Breezy
15	995·3	WSW.3	38	45	84	0·08	1·4	Breezy
16	1015·1	W.4	37	43	59	0·10	4·9	r 19h.-24h.
17	1001·7	SW.5	39	56	90	0·01	0·2	Breezy
18	1001·0	SW.5	49	55	77	0·08	0·1	Breezy all day
19	1013·5	NW.3	40	47	60	0·02	4·6	r 1h.-1h.30m.
20	1037·8	N.3	32	43	55	—	5·7	F at night
21	1040·1	W.1	24	40	82	—	4·0	F till 10h.
22	1035·1	SSW.2	22	36	94	—	1·8	F till 10h.
23	1038·9	S.2	25	40	72	—	6·3	F early & late
24	1033·6	Calm	22	31	98	—	0·0	F & x all day
25	1024·5	S.3	26	39	85	0·06	0·0	r 23h.-24h.
26	1020·0	SW.3	38	48	86	0·06	2·3	r 8h.30m.-9h.
27	1023·8	WNW3	37	47	79	0·01	2·6	pr_0 7h. ;7h.15m.&12h.
28	1032·4	N.3	36	43	69	—	0·0	Dull
29	1035·9	NNE.3	40	40	66	—	0·0	F & x 21h.
30	1035·2	W.2	31	41	82	0·04	0·0	r-r_0 22h.-24h.
31	1038·5	N.3	39	45	67	0·01	0·9	r 1h.-2h.

General Rainfall for January, 1934

England and Wales ...	105	per cent of the average 1881-1915.
Scotland	117	
Ireland	124	
British Isles	112	

Rainfall : January, 1934 : England and Wales.

Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per-cent. of Av.
Lond .	Camden Square	1·35	73	*Leics.* .	Thornton Reservoir ...	2·53	128
Sur .	Reigate, Wray Pk. Rd.	2·37	99	,, .	Belvoir Castle...........	2·03	115
Kent .	Tenterden, Ashenden...	2·63	122	*Rut* .	Ridlington	1·58	85
,, .	Folkestone, Boro. San .	3·03	...	*Lincs* .	Boston, Skirbeck	1·60	99
,, .	Eden'bdg., Falconhurst	3·01	123	,,	Cranwell Aerodrome ...	1·64	95
,, .	Sevenoaks, Speldhurst	1·76	...	,, .	Skegness, Marine Gdns	1·25	72
Sus .	Compton, Compton Ho.	2·68	84	,, .	Louth, Westgate	1·76	81
,, .	Patching Farm	2·05	79	,, .	Brigg, Wrawby St. ...	1·92	...
,, .	Eastbourne, Wil. Sq.	3·12	119	*Notts* .	Worksop, Hodsock ...	1·47	83
,, .	Heathfield, Barklye ...	3·71	137	*Derby* .	Derby, L. M. & S. Rly.	2·41	120
Hants.	Ventnor, Roy. Nat. Hos.	2·81	109	,, .	Buxton, Terr. Slopes	5·24	117
,, .	Fordingbridge, Oaklnds	2·89	105	*Ches* .	Runcorn, Weston Pt...	1·91	81
,, .	Ovington Rectory	3·71	137	*Lancs*.	Manchester, Whit Pk.	2·10	84
,, .	Sherborne St. John ...	2·34	100	,, .	Stonyhurst College ...	4·37	102
Herts .	Welwyn Garden City...	2·11	115	,, .	Southport, Hesketh Pk	2·41	94
Bucks.	Slough, Upton	1·47	79	,, .	Lancaster, Greg Obsy.	5·07	145
,, .	H. Wycombe, Flackwell	1·86	86	*Yorks*.	Wath-upon-Dearne ...	1·39	72
Oxf .	Oxford, Mag. College...	1·62	94	,, .	Wakefield, Clarence Pk.	1·39	72
Nor .	Pitsford, Sedgebrook...	...	...	,, .	Oughtershaw Hall......	7·98	...
,, .	Oundle..................	·80	...	,, .	Wetherby, Ribston H.	2·00	97
Beds .	Woburn, Exptl. Farm..	1·09	64	,, .	Hull, Pearson Park ...	1·41	78
Cam .	Cambridge, Bot. Gdns.	·83	55	,, .	Holme-on-Spalding ...	1·79	95
Essex .	Chelmsford, County Lab	1·36	89	,, .	West Witton, Ivy Ho.	2·76	87
,, .	Lexden Hill House ...	1·29	...	,, .	Felixkirk, Mt. St. John	1·84	92
Suff .	Haughley House.........	1·31	...	,, .	York, Museum Gdns.	1·66	94
,, .	Campsea Ashe...........	1·48	81	,, .	Pickering, Hungate ...	1·46	70
,, .	Lowestoft Sec. School	1·28	77	,, .	Scarborough	1·26	63
,, .	Bury St.Ed., Westley H.	1·42	79	,, .	Middlesbrough	·83	52
Norf .	Wells, Holkham Hall	1·82	126	,, .	Baldersdale, Hury Res.	3·77	116
Wilts.	Calne, Castleway	2·12	93	*Durh* .	Ushaw College	1·83	89
,, .	Porton, W.D. Exp'l. Stn	2·37	103	*Nor* .	Newcastle, Town Moor	1·52	74
Dor .	Evershot, Melbury Ho.	4·40	127	,, .	Bellingham, Highgreen	3·81	133
,, .	Weymouth, Westham .	2·51	103	,, .	Lilburn Tower Gdns...	1·68	81
,, .	Shaftesbury, Abbey Ho.	2·15	83	*Cumb* .	Carlisle, Scaleby Hall	4·15	167
Devon.	Plymouth, The Hoe ...	3·29	99	,, .	Borrowdale. Seathwaite	20·50	163
,, .	Holne, Church Pk. Cott.	9·08	147	,, .	Borrowdale, Moraine...	21·00	200
,, .	Teignmouth, Den Gdns.	2·89	99	,, .	Keswick, High Hill...	9·56	189
,, .	Cullompton..............	2·62	81	*West* .	Appleby, Castle Bank	4·62	144
,, .	Sidmouth, Sidmount...	2·38	83	*Mon* .	Abergavenny, Larchf'd	4·77	141
,, .	Barnstaple, N. Dev. Ath	3·79	116	*Glam* .	Ystalyfera, Wern Ho.	9·36	148
,, .	Dartm'r, Cranmere Pool	9·40	...	,, .	Cardiff, Ely P. Stn. ...	3·43	91
,, .	Okehampton, Uplands	6·82	134	,, .	Treherbert, Tynywaun	14·23	...
Corn .	Redruth, Trewirgie ...	4·54	107	*Carm* .	Carmarthen	...	...
,, .	Penzance, Morrab Gdn.	4·66	123	*Pemb* .	Haverfordwest, School	5·87	127
,, .	St. Austell, Trevarna...	4·56	106	*Card* .	Aberystwyth	3·31	...
Soms .	Chewton Mendip	3·28	85	*Rad* .	Birm W.W. Tyrmynydd	7·09	112
,, .	Long Ashton	2·16	76	*Mont* .	Lake Vyrnwy...........	7·96	141
,, .	Street, Millfield.........	2·00	82	*Flint* .	Sealand Aerodrome ...	1·28	65
Glos .	Blockley	2·31	...	*Mer* .	Dolgelley, Bontddu ...	5·73	101
,, .	Cirencester, Gwynfa ...	2·92	116	*Carn* .	Llandudno	2·54	105
Here .	Ross, Birchlea...........	2·91	120	,, .	Snowdon, L. Llydaw 9	20·49	...
Salop .	Church Stretton.........	4·41	174	*Ang* .	Holyhead, Salt Island	3·53	121
,, .	Shifnal, Hatton Grange	2·32	120	,, .	Lligwy....................	4·16	...
Staffs .	Market Drayt'n, Old Sp.	2·11	96	*Isle of Man*			
Worc .	Ombersley, Holt Lock	2·37	123		Douglas, Boro' Cem. ...	4·92	145
War .	Alcester, Ragley Hall..	1·83	95	*Guernsey*			
,, .	Birminghm, Edgbaston	3·13	155		St. Peter P't. Grange Rd	3·57	122

Rainfall: January, 1934: Scotland and Ireland.

Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per cent. of Av.
Wig .	Pt. William, Monreith	4·30	131	*Suth* .	Melvich	2·65	80
,, .	New Luce School	...	...	,, .	Loch More, Achfary	7·41	102
Kirk .	Dalry, Glendarroch	8·50	152	*Caith* .	Wick	1·84	75
,, .	Carsphairn, Shiel	14·24	195	*Ork* .	Deerness	3·36	97
Dumf.	Dumfries, Crichton, R.I	4·72	156	*Shet* .	Lerwick	4·36	102
,, .	Eskdalemuir Obs.	11·33	210	*Cork* .	Caheragh Rectory	6·39	...
Roxb .	Branxholm	4·15	152	,, .	Dunmanway Rectory	7·63	122
Selk .	Ettrick Manse	10·22	216	,, .	Cork, University Coll.	4·67	115
Peeb .	West Linton	4·26	...	,, .	Ballinacurra	3·30	83
Berw .	Marchmont House	1·52	68	*Kerry*.	Valentia Obsy.	6·74	123
E.Lot.	North Berwick Res.	1·27	74	,, .	Gearhameen	15·60	154
Midl .	Edinburgh, Roy. Obs.	1·96	111	,, .	Darrynane Abbey	4·88	97
Lan .	Auchtyfardle	5·40	...	*Wat* .	Waterford, Gortmore	3·52	97
Ayr .	Kilmarnock, Kay Pk.	4·86	...	*Tip* .	Nenagh, Cas. Lough	5·71	144
,, .	Girvan, Pinmore	6·30	133	,, .	Roscrea, Timoney Park	3·71	...
Renf .	Glasgow, Queen's Pk.	5·05	151	,, .	Cashel, Ballinamona	4·19	110
,, .	Greenock, Prospect H.	10·20	149	*Lim* .	Foynes, Coolnanes	5·03	133
Bute .	Rothesay, Ardencraig.	6·39	...	,, .	Castleconnel Rec.	4·86	...
,, .	Dougarie Lodge	4·31	...	*Clare* .	Inagh, Mount Callan	8·21	...
Arg .	Ardgour House	17·24	...	,, .	Broadford, Hurdlest'n.	6·67	...
,, .	Glen Etive	17·41	165	*Wexf*.	Gorey, Courtown Ho.	3·71	119
,, .	Oban	8·53	...	*Wick* .	Rathnew, Clonmannon	3·29	...
,, .	Poltalloch	6·96	139	*Carl* .	Hacketstown Rectory	2·97	84
,, .	Inveraray Castle	...	...	*Leix* .	Blandsfort House	3·22	98
,, .	Islay, Eallabus	6·01	128	,, .	Mountmellick	5·00	...
,, .	Mull, Benmore	9·60	71	*Offaly*.	Birr Castle	4·44	157
,, .	Tiree	4·62	109	*Dublin*	Dublin, FitzWm. Sq.	1·54	67
Kinr .	Loch Leven Sluice	3·48	110	,, .	Balbriggan, Ardgillan.	3·05	133
Perth .	Loch Dhu	15·20	167	*Meath*.	Beauparc, St. Cloud	3·60	...
,, .	Balquhidder, Stronvar	12·20	...	,, .	Kells, Headfort	3·90	124
,, .	Crieff, Strathearn Hyd.	5·66	140	*W.M* .	Moate, Coolatore	3·87	...
,, .	Blair Castle Gardens	4·44	133	,, .	Mullingar, Belvedere	4·61	144
Angus.	Kettins School	2·21	85	*Long* .	Castle Forbes Gdns.	5·43	163
,, .	Pearsie House	2·91	...	*Gal* .	Galway, Grammar Sch.	4·95	...
,, .	Montrose, Sunnyside	1·33	67	,, .	Ballynahinch Castle	8·29	133
Aber .	Braemar, Bank	3·80	119	,, .	Ahascragh, Clonbrock.	5·46	141
,, .	Logie Coldstone Sch.	·95	43	*Mayo* .	Blacksod Point	7·31	144
,, .	Aberdeen, King's Coll.	1·72	79	,, .	Mallaranny	7·13	...
,, .	Fyvie Castle	1·74	73	,, .	Westport House	6·78	146
Moray	Gordon Castle	·99	49	,, .	Delphi Lodge	13·48	136
,, .	Grantown-on-Spey	2·48	102	*Sligo* .	Markree Obsy.	4·63	119
Nairn.	Nairn	1·76	88	*Cavan*.	Crossdoney, Kevit Cas.	4·65	...
Inv's .	Ben Alder Lodge	9·88	...	*Ferm* .	Enniskillen, Portora	3·37	...
,, .	Kingussie, The Birches	4·90	...	*Arm* .	Armagh Obsy.	2·90	115
,, .	Inverness, Culduthel R.	2·72	...	*Down*.	Fofanny Reservoir	8·43	...
,, .	Loch Quoich, Loan	14·40	...	,, .	Seaforde	3·40	108
,, .	Glenquoich	21·27	155	,, .	Donaghadee, C. Stn.	2·76	109
,, .	Arisaig, Faire-na-Sguir	5·80	...	,, .	Banbridge, Milltown	2·37	106
,, .	Fort William, Glasdrum	13·79	...	*Antr* .	Belfast, Cavehill Rd.	2·88	...
,, .	Skye, Dunvegan	8·24	...	,, .	Aldergrove Aerodrome	2·72	99
,, .	Barra, Skallary	4·70	...	,, .	Ballymena, Harryville	3·83	103
R & C.	Alness, Ardross Castle	3·79	100	*Lon* .	Garvagh, Moneydig	3·77	...
,, .	Ullapool	7·02	152	,, .	Londonderry, Creggan	4·77	132
,, .	Achnashellach	10·73	112	*Tyr* .	Omagh, Edenfel	5·14	145
,, .	Stornoway	6·40	124	*Don* .	Malin Head	4·01	...
Suth .	Lairg	3·74	114	,, .	Milford, The Manse	4·41	118
,, .	Tongue	3·17	80	,, .	Killybegs, Rockmount.	3·56	...

Climatological Table for the British Empire, August, 1933

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.	1018·0	+ 2·7	89	48	76·1	56·8	66·5	+ 4·9	57·5	82	5·5	0·50	— 1·74	4	8·1	56
Gibraltar	1016·3	— 0·2	96	67	85·2	71·5	78·3	+ 2·3	69·1	81	3·8	0·00	— 0·12	0	..	..
Malta	1016·0	+ 1·2	92	62	83·3	70·9	77·1	— 2·0	69·8	71	1·7	0·78	+ 0·64	2	11·9	88
St. Helena	1017·2	+ 0·7	65	52	60·1	54·5	57·3	— 0·1	55·4	95	9·5	1·64	..	16	..	..
Freetown, Sierra Leone	1015·4	+ 2·7	86	64	81·0	69·9	73·9	— 4·0	74·2	91	8·2	37·45	+ 0·88	31	..	..
Lagos, Nigeria	1014·3	+ 1·3	84	72	82·1	74·8	78·5	+ 0·6	74·1	86	9·4	1·51	— 1·13	14	3·4	28
Kaduna, Nigeria	1014·4	— 0·7	87	65	81·6	68·2	74·9	+ 1·0	70·5	90	9·1	8·61	— 3·71	24	4·2	34
Zomba, Nyasaland	1016·9	+ 0·1	83	49	75·5	52·4	63·9	— 1·0	56·4	58	3·9	0·04	— 0·33	2	..	..
Salisbury, Rhodesia	1019·3	— 0·4	82	34	74·8	45·1	59·9	— 0·3	49·8	49	0·3	0·00	— 0·06	0	9·9	86
Cape Town	1021·6	+ 1·3	75	39	62·9	46·5	54·7	— 0·9	47·4	87	4·7	2·80	— 0·57	13	..	..
Johannesburg	1020·4	+ 0·2	74	28	65·5	42·6	54·1	— 0·3	43·0	53	1·8	0·01	— 0·50	1	9·5	85
Mauritius	1020·2	— 0·3	79	54	74·8	60·3	67·6	— 0·9	64·0	71	5·8	1·35	— 1·00	14	6·6	58
Calcutta, Alipore Obsy.	1003·2	+ 2·2	94	74	88·3	78·3	83·3	+ 0·1	79·2	90	9·3	14·70	+ 1·32	20*	..	..
Bombay	1006·0	+ 0·1	88	74	84·9	76·6	80·7	— 0·1	76·8	87	8·2	18·81	+ 4·36	15*	..	..
Madras	1005·9	+ 0·4	100	73	92·7	78·8	85·7	— 0·3	77·2	75	7·3	3·00	— 1·54	4*	..	..
Colombo, Ceylon	1009·8	+ 0·5	85	71	83·2	75·3	79·3	— 1·9	76·4	82	7·2	14·64	+ 11·40	19	5·1	41
Singapore	1009·4	— 0·1	93	71	88·0	75·5	81·7	+ 0·6	77·5	82	5·6	5·92	— 2·03	14	6·9	57
Hongkong	1007·8	+ 3·0	93	76	89·5	80·1	84·8	+ 2·7	78·4	76	5·5	1·73	— 12·67	8	9·7	75
Sandakan	1009·7	..	91	73	88·8	76·0	82·4	+ 0·6	77·5	81	5·8	3·92	— 3·97	11	..	..
Sydney, N.S.W.	1021·3	+ 3·1	73	39	62·2	44·1	53·1	— 1·9	47·3	70	3·8	0·25	— 2·72	4	7·8	72
Melbourne	1021·2	+ 3·2	71	33	57·6	41·4	49·5	— 1·5	44·9	75	6·7	2·05	+ 0·18	17	4·3	40
Adelaide	1022·0	+ 2·7	70	38	60·3	45·4	52·9	— 1·0	47·6	69	6·7	3·36	+ 0·83	19	4·8	44
Perth, W. Australia	1019·9	+ 1·0	71	39	63·4	47·8	55·6	— 0·4	49·8	71	6·3	5·67	+ 0·02	15	6·1	56
Coolgardie	1021·3	+ 2·0	73	34	62·2	43·5	52·9	— 0·7	45·8	68	5·3	2·36	+ 1·37	9	..	..
Brisbane	1022·5	+ 3·3	75	41	68·6	48·4	58·5	— 1·9	52·3	68	4·6	0·90	— 1·11	5	7·1	64
Hobart, Tasmania	1016·7	+ 3·3	60	34	53·8	39·4	46·6	— 1·4	41·6	67	6·2	0·99	— 0·84	14	5·0	48
Wellington, N.Z.	1018·3	+ 3·2	61	34	52·5	41·8	47·1	— 1·5	45·4	82	7·0	4·43	— 0·06	17	4·3	41
Suva, Fiji	1016·4	+ 2·2	88	65	79·3	68·6	73·9	+ 0·3	69·7	80	7·0	2·94	— 5·35	17	4·9	43
Apia, Samoa	1013·6	+ 1·3	87	68	84·8	72·7	78·7	+ 0·9	74·7	71	4·6	1·75	— 1·88	11	9·1	78
Kingston, Jamaica	1012·6	— 0·9	91	70	87·9	73·2	80·5	— 1·0	73·3	84	5·3	13·50	+ 9·95	11	6·9	54
Grenada, W.I.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Toronto	1015·6	+ 0·2	94	53	78·9	59·3	69·1	+ 1·9	62·2	71	3·6	2·41	— 0·38	8	9·3	66
Winnipeg	1014·7	+ 1·5	93	38	79·2	54·3	66·7	+ 2·9	54·6	82	9·8	3·63	+ 1·47	10	10·0	69
St. John, N.B.	1016·3	+ 1·0	79	50	70·7	54·9	62·8	+ 2·2	60·2	91	6·4	7·05	+ 3·19	16	6·2	44
Victoria, B.C.	1015·2	— 1·7	91	50	70·5	53·8	62·1	+ 2·4	56·9	74	3·5	0·35	— 0·29	17	10·5	73

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