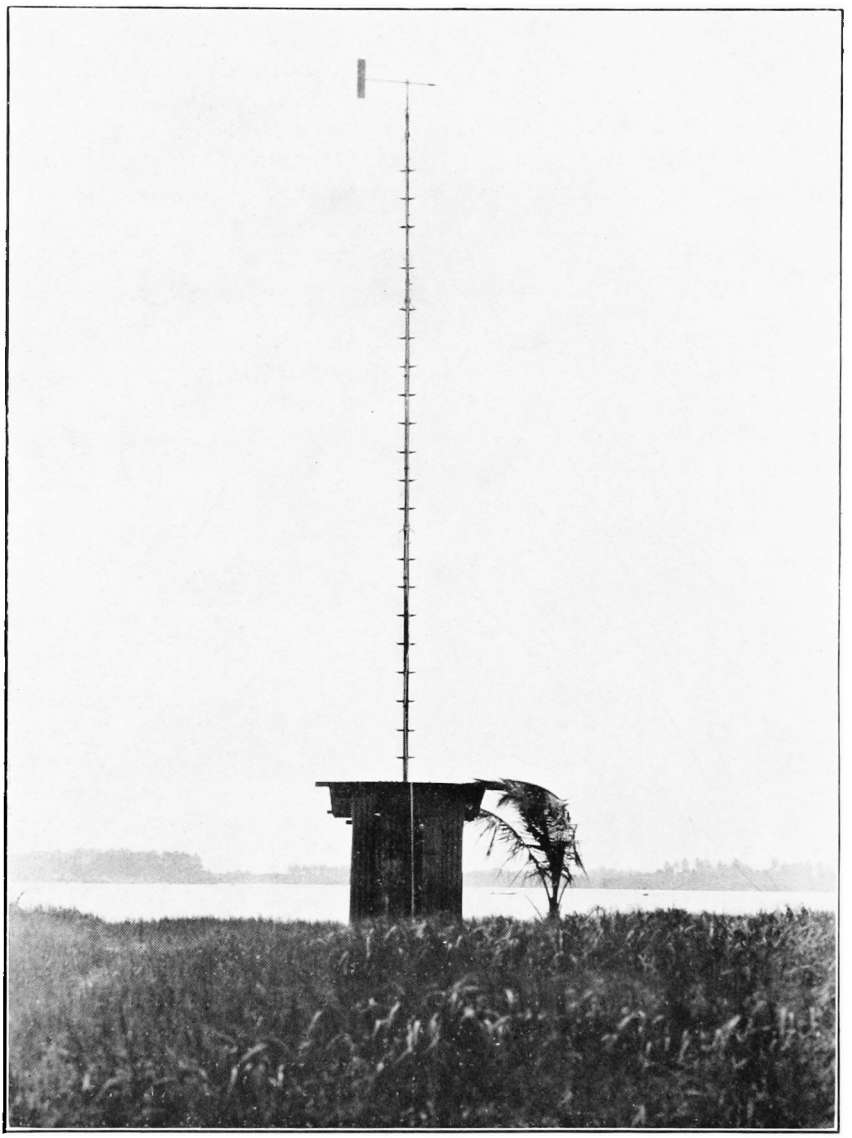

DINES ANEMOBIAGRAPH, MAGAZINE POINT, LAGOS, NIGERIA.

M.O. 340.

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Erection of Dines Anemobiagraph at Magazine Point, Lagos, Nigeria

By D. E. SMITH, M.A.

The completion of the installation of a 45 ft. Dines Anemobiagraph at Magazine Point, Lagos, on June 15th marked an epoch in the meteorological history of Nigeria if not of west Africa. The meteorological service in Nigeria is under the Survey Department, and a site for the instrument was fixed about $\frac{1}{4}$ mile from the Survey Office with an exposure which if not almost unique is certainly rather unusual. Lagos is situated on an island and is connected to the mainland by Carter Bridge and Denton Bridge, which is the highway to the north. As shown in the sketch map six creeks converge on the anemobiagraph site. These are Ebute Metta Creek, Badagri Creek, Porto-Novo Creek, Light-house Creek, Five Cowrie Creek, and the main channel to the Bight of Benin. To the reader who is unacquainted with the topography of Lagos and its environs it would appear that the site chosen was the worst possible. Wind would blow up these channels and give wind direction and force at Magazine Point which, if not entirely erroneous, would certainly tend to give a false idea of the true wind. Unfortunately, however, Lagos might be appropriately called the " city of creeks," and only on the north side of town would there have been a site entirely free from the

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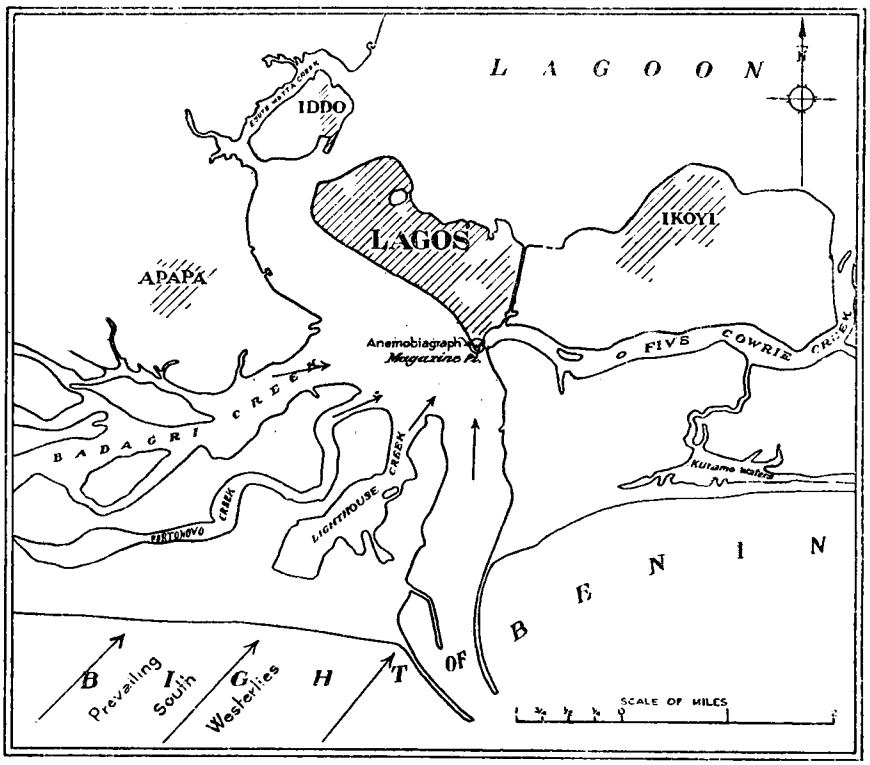
influence of creek wind currents, and then the site would have been inconveniently distant from the Survey Offices.

It appears to me in view of the recent anemograms that the present site is really quite a good one. It seemed at first that the velocity recorded by the instrument was rather lower than it ought to have been. This was deduced from the rather rough consideration of the various Beaufort numbers and the equivalent speeds in m.p.h. as given in the Observers' Handbook. It was thought that a better idea of the wind velocity could be got from pilot balloon observations. The velocity of the wind at 500ft. was found to be practically identical with the mean



speed recorded by the anemometer. That is to say if one stood at ground level there appeared from consideration of Beaufort Scale to be a wind velocity of say 20 m.p.h., but the anemobiagraph and pilot balloon observation agreed in giving the velocity as 12 m.p.h. The apparent gustiness at ground level, I deduce, must be due either to semi-vertical currents or to another reason which I am inclined to think is nearer the truth. The height of the ground level both at Lagos and on the surrounding islands is approximately 10ft. to 15ft. On the various small peninsulas which border the creeks I have mentioned above, there are mangrove trees of say 20ft. in height. My theory is that the south-

westerly wind (the prevailing wind at this time of the year) comes off the Bight of Benin and gets concentrated into the various channels south-west of Lagos, but this concentration is active only in the first 30ft. layer of the atmosphere, and thereafter the wind adopts its true direction and force. It will be interesting to get the opinion of other observers at stations with anemobiagraphs in similar environment.

A critical reader may say that the low velocity recorded by the anemobiagraph is due to faulty tubing between the head of the instrument and the base, but the tubing has been carefully examined and found to be in apparently good condition.

Some Recent Studies of the Upper Air

(1) *Reports of the Greenland Expeditions of the University of Michigan* (1926-31). William Herbert Hobbs, Director. Part I. Aërology. Expeditions of 1926 and 1927-29. S. P. Fergusson, Editor. Size $10\frac{3}{4} \times 8$, pp. x + 259, *Illus.* Ann Arbor, University of Michigan Press, 1931.

(2) *India Meteorological Department. Scientific Notes*, Vol. 1, No. 7, Normal monthly upper winds over eight stations in India. Vol. 1, No. 8, Monthly normal isobars and wind-roses at 0·5, 1, 2 and 3 Km. above sea-level over India and neighbourhood. Vol. 3, No. 21, Upper air circulation over India and its neighbourhood up to the cirrus level during the winter and the monsoon. By H. C. Banerjee and K. R. Ramanathan. Calcutta, 1930-1.

(3) *Miscellaneous publications of the Royal Alfred Observatory*, No. 9. Pilot balloon observations at Mauritius from July, 1927—June, 1928. By N. R. McCurdy, pp. 6, *Illus.* Mauritius, 1931.

(1) Professor W. H. Hobbs regards the Greenland ice sheet as the northern wind pole of the earth, and accordingly as a vital factor in the weather of the North Atlantic Ocean. To study the meteorological conditions of this important region he has led three expeditions to Greenland between 1926 and 1929, well equipped for upper air as well as surface investigations. In the present volume he contributes a long introduction of 37 pages, in which he shows how the upper air results confirm the theory of a "glacial anticyclone" over Greenland, with outflowing winds near the surface changing to inflowing winds at a higher level. The observations were obtained not only on the west coast, but also at several points on the ice itself; but the most favourable site found was on Mount Evans, in latitude 66° 51′N. on a rounded summit at an altitude of 1,294 feet, and only 25 miles from the western margin of the inland ice. At this station practically all the strong winds (sometimes reach-

ing 120 miles per hour) " come from the south-easterly quarters and blow down off the inland ice lying to the eastward . . . The domination by the glacial anticyclone is most marked for the winter season and shows greatest variation in the month of May." The surface winds and those at a height of 393 metres above the station (750m. above tide) are shown in a series of seasonal wind roses; the latter height was selected to show the lowermost winds free of local irregularities due to topography.

The changes of wind direction with height are shown in another series of diagrams month by month. In summer the winds are south-west only between 2,000 and 4,000 metres and north-westerly above 4,000 metres. In September and October the winds remain south-easterly at all heights, while from November throughout the winter they become south-westerly at a small height and remain almost entirely in that quadrant to the highest levels reached. The general change from south-easterly winds to winds with a component from west shows that the air-flow from the ice is supplied by in-blowing winds at a moderate elevation. The outbreaks of air from the glacial anticyclone are regarded as " strophic," and an interesting table displays the connexion between individual strophs or bursts of air and the subsequent development of depressions in the North Atlantic. The stroph of January 14th, 1928, with a south-east wind of 120 miles per hour, followed four days later by some of the worst weather ever experienced by Atlantic liners, is especially interesting.

The observations on the western margin of the ice-sheet were supplemented by a series of ascents carried out by the Norwegian Meteorological Institute at Mackenzie Bay on the east coast of Greenland from June 18th to August 10th, 1927. Apart from a very shallow and weak current from south-east, reaching only to 500 metres, these show prevailing winds from north-west extending from 1,000 to 9,000 metres, above which they become south-westerly. An in-blowing south-easterly wind is frequently found, most often near 4,000 metres, but the height is so variable that this wind does not appear on the graph of resultant winds. The reviewer thinks however that the importance of this easterly component is somewhat over-estimated, for it occurs in only 13 of the 26 ascents which reached 5 Km., and in some of these it is only a few hundred metres thick and is overlain as well as underlain by westerly winds. It does not compare in volume with the westerly in-blowing winds of the west coast, and it seems probable that the actual circulation at high levels is a combination of the in-blowing winds required to maintain the glacial anticyclone with the westerly winds of the general atmospheric circulation appropriate to these latitudes.

The greater part of the volume consists of diagrams and tables presenting the results of the individual ascents (including

two sounding balloons with meteorographs), and the observations of clouds, published for synoptic purposes. There is also a very fine atlas of cloud forms. The whole volume is profusely illustrated, while the printing and general appearance are excellent.

(2) These three publications of the India Meteorological Department form a valuable addition to our knowledge of the upper winds over India. No. 7 gives the resultant direction and velocity in each month, in tabular and diagrammatic form, for periods ending 1925 at nine stations (of which Bombay and Poona are grouped together) ranging from Lahore in 31° 34′N. to Bangalore in 12° 58′N. The results were obtained by the tail method, generally in the morning, when turbulence is slight but katabatic effects may occur.

In No. 8 the results of upper air observations from a number of stations in India and surrounding districts (including Iraq and Kamaran Is. in the Red Sea) are plotted month by month in the form of wind roses at levels of 0·5, 1, 2 and 3 Km. On the same charts are plotted isobars constructed from monthly normals of pressure and temperature at surface stations, employing a lapse-rate of temperature with height of 11°F. per Km., except from June to October over the sea, when higher lapse rates were assumed for the first half kilometre. In general the wind roses fit the calculated isobars with remarkable fidelity, which is rather surprising considering the uncertainties of this form of extrapolation.

The changes in the pressure distribution with height are most rapid in winter, when the thermal gradient from south to north is steepest. In January there is an almost complete reversal between the surface, with high pressure in the north and low in the south, and 3 Km., with low pressure in the north-west and high in the south. The insertion of a closed high over Arabia seems rather problematical, however, considering the paucity of data for that region. In July, on the other hand, while the intense low over north-west India weakens in intensity and shifts to the northern Arabian Sea between the surface and 3 Km., the high pressure south of India retains its position. Thus, there is a marked reversal of the prevailing wind direction at 3 Km. from east in winter to west in summer. This painstaking publication should thoroughly fulfil the purpose of assisting aviation in India.

No. 21 extends the results described in the preceding paper up to a height of 10 Km. Wind roses are drawn for 13 stations at heights of 4, 6, 8 and 10 Km. for the two periods December-January and July-August. The winds are classified into seven groups according to force, ranging from below 5 to above 60 m./s., and approximate isobars have been sketched in, based on pressures and temperatures over Agra obtained from sounding

balloon ascents and pressure gradients calculated from the monthly mean winds. In addition, charts of the cirrus movement are shown with stream lines but no isobars.

The charts at 4 Km. are of especial interest for comparison with those constructed by Teisserenc de Bort from surface observations only. In January the latter shows a very weak gradient from south to north over India (only 4mb. between 18° and 30°N.), and a small closed high pressure isobar of 474mm. (632mb.) over the west coast in 14°N. The new Indian charts show a much steeper gradient (nearly 7mb. in the same distance), the isobars being crowded together owing to the effect of the Himalayas, which still persists at this level, while the greater part of peninsular India is occupied by a broad belt of pressure above 628mb. extending from west to east. Teisserenc de Bort's chart for July bears very little relation to the Indian chart at 4 Km. for July and August, which shows a closed low pressure area over the Peninsula. The paper ends with two charts showing the approximate limiting heights of winds with a westerly component in winter and summer.

(3) The series of pilot balloon observations from Mauritius is a continuation of those for 1925-6 previously published. The individual ascents are tabulated and illustrated graphically, and in addition wind roses are given for the two half-years May to October and November to April, and vector means for shorter periods. The results show that the surface layer of light to moderate east to south-east winds is overlain by very light southerly or variable winds extending from 1,500 metres to 3 Km. in winter and 5 Km. in summer. Above this is a layer of moderate to strong westerly winds.

It will be seen that the various publications mentioned above provide the means for confirmation or rectification of the existing charts of isobars in the upper air in three widely separated regions. Teisserenc de Bort made his calculations in 1893, when our observational knowledge of the upper air was rudimentary, and on the whole they have stood the test of time remarkably well. The period is approaching, however, when the accumulation of data from ascents of pilot balloons and sounding balloons will demand a re-examination of the whole problem of the atmospheric circulation in three dimensions. An important contribution to this end has recently been made by A. Wagner,* but this summary, admirable as it is, remains a summary, and contains very little attempt at generalisation. Incidentally, so fast does our knowledge grow nowadays that neither the Greenland nor the Indian results described above appear in Wagner's collection.

* Handbuch der Klimatologie, Bd. I, Teil F. Klimatologie der freien Atmosphäre, von A. Wagner, Berlin, 1931.

Barometric Characteristic in the Tropics

Flight-Lieutenant Batty, in a recent paper,* discusses the possibility of using the barometric characteristic and tendency for forecast purposes in the tropics. The barograph used was a small one with a weekly clock recording in natural scale of inches of mercury.

A barograph has been in use in Salisbury for two and a-half years, with a time scale of 1·5 centimetres to the hour and a magnification of five times the mercury scale. This instrument was specially made by Messrs. Negretti & Zambra and has proved very sensitive and accurate in use. The instrument is very sensitive to minor changes of pressure and responds to gusts during high winds; it was, therefore, necessary to adopt an arbitrary criterion to discriminate between the characteristics. The characteristic classes were taken from the Meteorological Office large pocket register, form 2003—page 23. Unsteady motion was defined as irregularities extending at least 0·005 (mercury) inches on either side of the mean line and curved traces show a curvature of at least 0·01 inches deviation from the straight line. The characteristic was determined for the three hours before the morning observation—8.30 a.m., South African Standard time, which is four minutes slow by local time. The results were as follows:—

Characteristic	0 Rising then falling	1 Rising then steady	2 Unsteady	3 Steady or rising	4 Falling or steady then rising
Per cent.—Salisbury ...	4	18	20	52	6
(Batty) Quetta	—	—	25	46	29

The occurrence of 0 and 1 is obviously due to the hours selected and the period 4 to 7 a.m. was, therefore, tried:—

Characteristic	0 Rising then falling	1 Rising then steady	2 Unsteady	3 Steady or rising	4 Falling or steady then rising
Per cent.—Salisbury ...	—	—	25	42	33
(Batty) Quetta	—	—	25	46	29

The agreement is remarkably close.

Batty found that the "unsteady" characteristic preceded 50 per cent. of the days of unsettled weather, and that 80 per cent. of the occurrences of this characteristic were followed by unsettled weather. In Salisbury the respective figures were 45 per cent. and 55 per cent. These figures are not strictly comparable as the weather is not so closely observed in Salisbury and rain days only have been taken. Since October, 1930, more detailed observations have been made, and for the six months—October to March—the percentages were 57 and 78 respectively.

*India Meteor. Dept., Sci. Notes, Calcutta, Vol. III, No. 24.

It appears, therefore, that very similar conditions apply in Southern Rhodesia.

Weather forecasting in Southern Rhodesia, in the absence of cyclonic disturbances, is based on the general pressure fluctuations from day to day and the deviation from normal pressure. The latter maps have been classified into types by Mr. C. L. Robertson and, with the aid of past experience, fair general forecasts for 24 and 48 hours are issued. The method is quite empirical, and several noteworthy failures have proved that the weather is not entirely dependent on the general pressure distribution.

Investigations have, therefore, been extended to other factors, and it is found that absolute humidity plays a notable part. Quite half the rainfall, however, is associated with travelling disturbances, which can be readily traced on maps showing the hour at which rain commenced at about 200 stations. Autographic instruments at Salisbury show these disturbances very well. The general appearance on the weather map is in accord with that of cold fronts except that the winds converge from both sides, in entire disregard of the isobars, and wind swings of 90° to 180° are usual.

During periods of unsettled weather, the normal barograph trace at Salisbury is disturbed by irregular humps and hollows which last for several hours, and are of the order of a millibar on the average. That these disturbances are associated with rain is shown by an examination of the weather maps between December 14th, 1930, and March 31st, 1931. In 108 days, there were 71 rain days (rain days are taken as days when 10 per cent. or more of the stations reported rain). On 47 days irregularities were noted on the Salisbury barograph, and 40 of these coincided with rain days; five of the remaining seven were on days when isolated showers were reported. The present distribution of barometers, 10 in an area about 7° square, is quite inadequate to show these irregularities, and the great differences in altitude between the barometers—3,000ft.—and the absence of reliable levels makes the problem exceedingly difficult. The fact that these irregularities are associated with rain and frontal phenomena invites the conclusion that they are "secondaries," and it is hoped that a suitable distribution of barometric stations will show them on the weather map.

There is a slight connexion between the occurrence of the unsteady characteristic and the irregularities in the barograms. In 108 days, 41 recorded the unsteady characteristic; 47, irregularities, and on 31 occasions the latter preceded or fell on the same day as the former. This connexion is not close enough to associate the characteristic with the irregularities, and some other explanation of the former must be sought.

NOEL P. SELLICK.

Discussions at the Meteorological Office

November 30th, 1931.—*Contribution to the aerology of the Indian monsoon.* By A. Wagner. (Beitr. Geophysik, Leipzig, 30, 1931, pp. 196-238) (in German). *Opener*—Mr. S. P. Peters, B.Sc.

December 14th, 1931.—(1) *Discussion of the results of sounding balloon ascents at Agra during the period July*, 1925, *to March*, 1928, *and some allied questions.* By K. R. Ramanathan (Ind. Meteor. Mem., Calcutta, 1930, pp. 163-193); and (2) *Distribution of temperature in the lower stratosphere.* By P. R. Krishna Ras (Ind. Meteor. Dept., Sci. Notes, Calcutta I, No. 10, 1930). *Opener*—Mr. L. H. G. Dines, M.A.

Correspondence

To the Editor, *The Meteorological Magazine.*

Electric Storm at Clunes

About 2 p.m. on October 2nd there was a sudden electric storm here accompanied by heavy rain. The electricity fused all the telephones in the place, including the Post Office.

At my keeper's and forester's houses, where they have the telephone, exactly the same thing happened. Two or three shots went off at the door like gun shots, to be followed a second or two later by a flash of lightning and a clap of thunder. Two or three trees were struck in the old forest, but all was apparently done by the rainstorm. The telephone instruments all fused. My electric light cables were also affected, although protected by an overhead lightning wire. Two fuses went, one in the castle and the other in the butler's house, although the dynamo was not working at the time. (I have no batteries and run direct.) My forester was mending one of the telephone wires at the time and got a shock though he hastily dropped the wire. The curious thing is that this storm seems to have preceded and not to have been simultaneous with the flash of lightning. Exactly the same thing occurred again at 4 p.m., though the damage seems to have been all done at 2 p.m.

I was at Spean Bridge at 2 p.m. and heard two peals of thunder away in this direction. At 4 p.m. I was in Fort William and have no recollection of hearing any thunder at all, though of course there was heavy rain. So it must have been very local. In fact, I can hear of no thunder or lightning anywhere else in this district, though most people heard the thunder in this direction.

It took a man a day and a half to put the telephones right, and I believe the Post Office wires were affected right up to Inverness and in all other directions.

D. W. Cameron of Lochiel.

Clunes, Spean Bridge, Inverness. October 19th, 1931.

Atmospheric Pollution

The following extract from a letter dated October 27th, 1931, to the Director of the Meteorological Office from Colonel, The Master of Sempill will be of general interest:—"I thought you might possibly be interested to know of certain things that I have noticed during the past week while this anticyclone has been over the country.

Yesterday I noticed that the smoke over Manchester, Sheffield, Huddersfield, Leeds and suchlike places went up at least to 6,000 feet, and in some cases slightly higher, about 8,500 feet.

On Sunday, October 18th, I had to fly from Liverpool to Southampton, and on account of the smoke kept well to the west, in fact passed down at about 2,000 feet above the tops of the Welsh hills. When I came to the lee side of Birmingham (there was a north-easterly wind on that day), I ran into very thick weather caused by smoke from Birmingham and district, and the visibility dropped to a few hundred yards and maintained itself in this condition for some ten to fifteen miles. I experienced slight rain, and when I came out of this smoke bank, although still 2,000 feet over the top of the Welsh mountains, the machine was absolutely filthy, and it was necessary to wipe the soot-laden moisture off the windscreen to get normal visibility.

On the night of Friday, the 23rd, the machine was out in the open in the extreme south of Cornwall, and the wind was then from the NE. During the late afternoon and evening there was slight rain, and in the morning the whole machine was found to be covered with soot."

Steaming Water

Steaming water is seen in the lanes between ice floes and over rivers and lakes on mornings after a night of radiation. The vapours which give rise to it are attributed to the mixing of warmer moist air with colder air above. The air is therefore essentially unstable in a layer near the water surface.

I have often seen wisps and swirls in these vapours which appeared to be an attempt at the formation of such a pattern as would be expected in an unstable fluid.* One morning recently, however, while crossing a bridge over the river Ouse I saw a quite definite pattern of convectional streaks such as have been produced in a laboratory by Terada.† The streaks of vapour were about one or two feet apart, and it was quite obvious from the drift of vapour that there was a current of air flowing in the direction of their length.

C. S. DURST.

*See *Meteorological Magazine*, 60, 1925, p. 1.

†Some experiments of periodic columnar forms of vortices caused by convection, *Tokyo, Rep. Aeron. Res. Inst., Vol. III*, No. I, 1928.

Parhelion in "False Cirrus"

A parhelion was observed yesterday, October 7th, in an anvil of "false cirrus" at 14h. 25m. on the eastern side of the sun. There was no trace of the halo of 22° visible. The phenomenon became obscured at 14h. 35m. by lower cloud, and had by this time become much fainter owing to a thicker portion of the anvil having spread upwards into the vicinity of the parhelion. The parhelion was brightly coloured at 14h. 30m. Although "false cirrus" was frequently in the vicinity of the sun during other parts of the day, I did not observe any other optical phenomena. Apparently a thin layer of this cloud is the ideal for the production of halo phenomena, since the above was only observed in such.

Weather conditions were of a showery type and thunder occurred about 12h. 15m. The wind was westerly and very strong about midday and early afternoon.

A. E. MOON.

39. *Clive Avenue, Hastings. October 8th*, 1931.

Corona in Cirrus Cloud

This unusual phenomenon was observed at this station at 14h. 20m. on October 14th.

The corona was some 5° in diameter, well defined in very fine cirrus cloud and had the usual sequence of colours.

The sky at the time was 7/10ths clouded, consisting of 2/10ths strato-cumulus cumulo-genitus and the remainder being the afore-mentioned fine cirrus. The corona perisisted for some time and later small patches of cirro-cumulus were observed approaching from northwards.

This phenomenon is probably such an occurrence as is mentioned in the notes on clouds in the Meteorological Glossary, p. 43.

W. I. JONES.

Salt Island, Holyhead. October 15th, 1931.

NOTES AND QUERIES

Train Struck by Tornado

We learn from the *Monthly Weather Review* for May, 1931, that a tornado struck the express train "Empire Builder" when it was travelling at nearly 60 miles per hour east of Moorhead, Minn. The engine and tender remained on the rails intact, but five coaches were torn loose from the engine and lifted bodily from the rails, one being hurled 80 feet away. The remaining eight coaches were probably pulled from the rails. Fortunately the heavy steel coaches were strong enough to resist the crash and only one passenger was killed, but 57 were injured. One other life was lost, a farm youth being

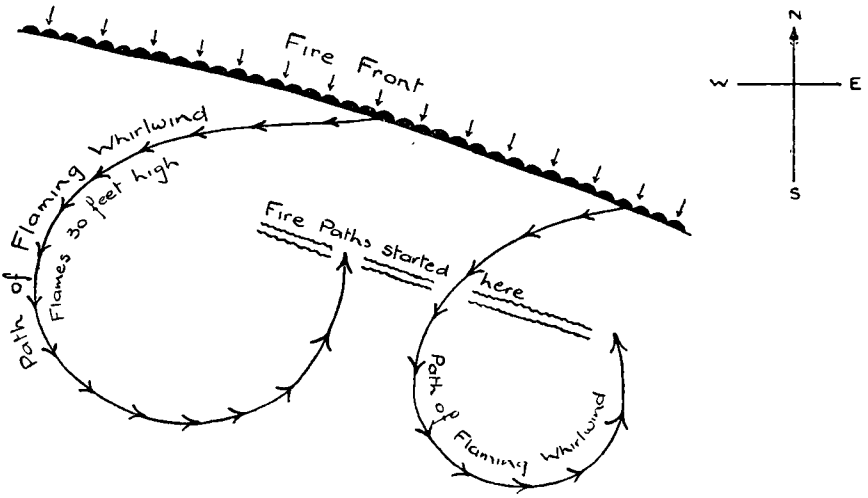
crushed beneath the ruins of a house. At one point on the storm's path the roof of a barn was carried through the air for 200 yards.

Bush Fires and Whirlwinds

The following observations in connexion with bush and grass fires, and whirlwinds, were made some time ago and may be of interest.

The first case happened in Southern Rhodesia, in the bush country located between Bulawayo and a small village to the north called the Lonely Mine, during August, 1929. A big bush fire was raging at the time and there was a NNE. wind blowing at about 25 m.p.h. The farmers in the district went out with their natives to points a couple of miles ahead of the fire and started to burn fire-paths, keeping the fires they had made well under control to windward.

It was at this time that the strange effect of whirlwinds was observed.

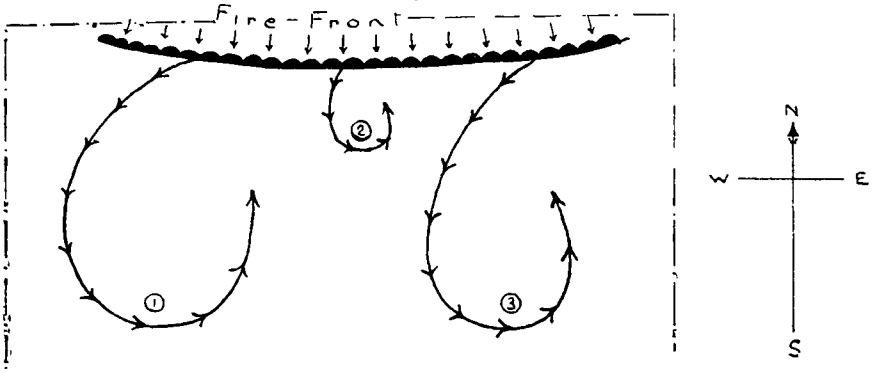


RHODESIAN BUSH FIRE.

A whirlwind would start up and carry a column of fire and smoke, first across wind, then do a left-hand circuit and make straight back towards the advancing fire, against wind. The flames were about 30 feet high, but smoke and burnt grass were carried upwards to over 2,000 feet.

The second case in point and in which exactly the same observations were made took place at the South African Air Force Aerodrome, Pretoria, during June last year. The machine-gun target is located on the north side of the aerodrome, and on this particular day tracer bullets set fire to the grass, and as there was a strong breeze blowing from the north the fire soon spread

across the whole field. Every available man was turned out to try and stop the fire spreading across the whole area, and this could have been done had it not been for the strange behaviour of a lot of small whirlwinds, which, in several instances carried the fire right round the fire-fighters, in a circle, and naturally



AERODROME FIRE CAUSED BY TRACER BULLETS.

the men had to run for their lives as the flames were four to six feet high. The debris in this case was carried up about 150 to 200 feet.

It was noticed that in each case the whirlwind went first towards the west, that was cross-wind, then right round south and back towards the fire, actually against the strong prevailing wind.

F. C. ELLIOT WILSON.

Course of Training for Observers

A course of training for meteorological observers was held at the Meteorological Office, South Kensington, on October 6th and 7th, 1931. Sixteen observers attended. Of these, eight were from health resorts and eight from crop weather stations.

A short discussion of British climatology was given on the morning of the second day, illustrated by specially prepared slides, and in the afternoon a visit was paid to Kew Observatory.

Meteorology and Agriculture

The annual paper-reading Conference organised by the Agricultural Meteorological Committee was held at the Meteorological Office on October 8th and 9th under the chairmanship of Sir Napier Shaw, F.R.S. Following an account on the first morning by Mr. E. G. Bilham, B.Sc., of some recent instrumental and statistical developments in the Meteorological Office, nine papers were read dealing with the influence of weather on soil

and on plant parasites and the action of light on disease organisms in plants and in milk. Dr. E. M. Crowther, who spoke about soil, made interesting observations on the differences of outlook in regard to soil classification in Russia and this country. In Russia a broad outlook is induced by the fact that there are vast climatic zones with strong contrasts and equally vast soil formations. Soil science in such a field of study would naturally develop on very different lines from those likely to be followed in the British Isles, where the whole range of geological formation from the oldest igneous rocks in the west to the latest deposits in the eastern lowlands are crowded together, with moderate climatic contrasts distributed to a great extent selectively so that the older formations tend to have the wetter and more oceanic climate and the recent deposits the maximum degree of dryness and continentality which such a small land area can furnish. The lecturer held that these considerations were mainly responsible for the difficulty at first experienced in this country of assimilating Russian ideas. He then went on to consider among other matters the action of weather on the chemical constituents of various types of soil. The paper may be regarded as an extension of Dr. Ogg's " Soils and Weather," which introduced the subject to the Conference in 1930. Of the remaining papers, each of obvious importance and interest, that by Mr. A. Beaumont on the relation of weather to the appearance and progress of potato blight may be noticed particularly for the very definite meteorological relationship established. The element of prime importance in this case is humidity. Wet weather was found to vary in its effects in accordance with the type of synoptic weather chart with which it was associated, even very wet spells being comparatively unfavourable for development of the trouble when associated with fast morning depressions giving rise to intervals of strong sunshine and dry wind when passing away to the east or north-east.

Mr. L. Iorwerth Jones, when studying crop yields under climatic contrasts furnished by neighbouring localities at very different heights above sea level near Aberystwyth, obtained surprising results when interchanging samples of soil between the different stations. In one case grass would not even germinate when the soil that suited it well at a low level was transferred to a high level.

The only other paper that calls for special mention because of its meteorological interest was by Dr. T. Wallace, who described how, at Long Ashton, heavy rain had been shown to wash various substances from the leaves of fruit trees, the result in some species being obvious symptoms of lack of nitrogen and even subsequent frost damage. The application of water in the laboratory in accordance with a fixed routine to the leaves of

various fruit trees was carried out in order to determine which species were most liable to loss from this source.

As a whole, papers read at this Conference tended to emphasise the especial importance of relative humidity in agricultural meteorology, as was pointed out by the Chairman in his concluding remarks.

E. V. NEWNHAM.

Toy Balloon Race

Mr. R. Parker Smith sends word of a toy balloon race which was held at the Perse School, Cambridge, on June 25th, 1931. The recovered balloons were all found at places lying to the south-west of Cambridge—amongst others three were found near Hitchin, three near Hemel Hempstead, two near Amersham, one near Stratfield Turgis, and one, the furthest, near Southampton, a distance of 110 miles. The tracks followed by the recovered balloons were thus in general accordance with the results of pilot balloon observations made in east and south-east England that afternoon, the wind up to 5,000ft. being north-easterly or east-north-easterly towards the south coast and usually not exceeding 15 m.p.h.

Reviews

The Climate of Japan. By T. Okada. Size 12 × 9in., pp. 4 + 328 + 10, *Illus.* Tokyo, Central Meteorological Observatory, 1931.

Japan is meteorologically one of the most interesting countries in the world, with alternating monsoons, a long chain of islands extending from sub-arctic to sub-tropical latitudes, a high mountain range in Japan proper giving a remarkable contrast of seasons on opposite coasts, and an eternal conflict between the continental power of Siberia and the oceanic influence of the Pacific. Thanks to the large number of observatories which have been erected since 1893, when the late Dr. K. Nakamura's "Climate of Japan" appeared, abundant material is now available for the study of these questions, and Dr. Okada has presented us with a work which is magnificently complete in every detail.

The book is divided into four parts, climatography, climatology, tables and charts. Climatography is descriptive; after a general introduction we have brief climatic sketches of 17 regions, from Sakhalin to Formosa and the Bonin Islands to Korea. These contain a number of small tables giving monthly temperature, precipitation and sometimes humidity and sunshine for representative stations, the positions of which are in most cases shown on small inset maps—a very useful feature.

Climatology includes the scientific study of the distribution of the various elements over the Japanese islands and Korea; for example, under the heading "air temperature," not only is the distribution and the diurnal and annual variation described but formulæ are given showing the relation of daily range and of mean January and July temperatures to latitude, longitude, "continentality" and cloudiness. Continentality is calculated as the percentage of land in a circle of 20 Km. radius round the station. Other chapters deal with the absolute and relative humidity, pressure, wind direction and velocity, cloudiness, clear and cloudy days, sunshine, first and last hoar frost, first ice, evaporation, rainfall and snowfall. The thorough nature of the discussion may be illustrated by the chapter on wind direction; the average hourly directions and velocities are converted into vectors which are then analysed harmonically into diurnal, semi-diurnal and tri-diurnal ellipses. The results are summed up as follows: "Consulting with the topographical maps we find that the major axis of the diurnal wind ellipse coincides with the general trend of the valley in which the observing station lies."

The "Climatic tables" are very complete, including 162 stations; they embrace monthly tables for all customary elements as well as some which are not usual, such as mean daily variability of temperature, maximum wind velocity, minimum relative humidity, maximum precipitation in one hour, evaporation, and dates of first and last ice, the latter from observations in the evaporation gauges. There are also, for a selection of stations, tables of five-day means for pressure, temperature, vapour pressure, relative humidity, rainfall and wind direction, and hourly means for each month of these elements as well as cloud amount and sunshine. The data are shown also in the form of diagrams and an excellent series of coloured charts.

The text is written in English, which though occasionally quaint is remarkably good considering that it is for the author a foreign language. Misprints are rare, and the majority are corrected in an erratum slip, though a reference to the National Physical Laboratory at "Tedenton" has escaped the proof-reader. The whole work is most neatly and tastefully produced.

C. E. P. BROOKS.

The Flood Rains of 11th March, 1924, in Hawke's Bay. By Dr. E. Kidson. (Wellington, N.Z., J. Sci. Tech. xii, No. 1, 1930, pp. 53-60).

The rains of March 11th, 1924, in Hawke's Bay, are worthy of comment because of the severity "which has probably never been equalled in any part of New Zealand since the advent of the white man." Hawke's Bay is on the east coast of North Island and the heavy rain fell over an area where the average

annual rainfall is about 45 inches a year (*i.e.*, equal to that of Falmouth). At Rissington, some 8 miles inland (altitude 420ft.), 20.14in. fell in 10 hours between 7.30 a.m. and 5.30 p.m. on the 11th. At 9 a.m. on the 11th 2.99in. was recorded, and at 11.45 a.m. " we thought we had better ease the gauge a bit, so took 9in. out of the bottle!" So far as can be ascertained from the rainfall records 10in. fell over 450 sq. miles; 15in. over 175 sq. miles and 20 in. over 30 sq. miles. The bulk of the rain fell in 14 hours between 4 a.m. and 6 p.m. on the 11th. This is far more striking than any heavy rain which has occurred in the British Isles. Perhaps the most remarkable storms of this country are those of August 26th-27th, 1912, in East Anglia and of June 28th, 1917, near Bruton in Somersetshire, but these only gave from 6 to 8 inches in 20 hours over 550 sq. miles and more than 9 inches in 16 hours over 2 sq. miles respectively.

The rains of March 11th, 1924, were associated with the passage of a deep cyclonic depression across the Auckland Peninsula. The reports of continuous thunder lasting many hours suggests that the air was in an unusually unstable condition. A large mass of warm air from the north was apparently trapped in Hawke's Bay between the sea and the mountains, which rise to over 3,000ft., and became surrounded finally by cold air, including cold air brought up the western sides of the mountains.

This illustrates an important difference in the climates of New Zealand and the British Isles. While the rainfall of New Zealand is generally heavier than that of the British Isles, the number of rain-days is on the whole appreciably fewer. Thus, the average number of rain-days near Hawke's Bay is about 140 compared with 200 at Falmouth.

J. GLASSPOOLE.

Books Received

Deutsches Meteorologisches Jahrbuch für 1928. Freistaat Sachsen. Edited by Prof. Dr. E. Alt, Jahrgang, xlvi, Dresden, 1930.

In addition to the usual very complete presentation of the year's data in tables and charts, this volume contains an interesting dissertation by Karl Knopf, entitled " Das Erzgebirge als Klimafaktor," well illustrated by charts.

Den Genomträngande Kosmiska Strälningen. By F. Lindholm. (Reprinted from Sv. Fysikersam. publ. Kosmos band 8, 1930, pp. 97-135.)

Die atmosphärische Trübungsdichte aus Sonnenstrahlungsmessungen in einzelnen kurzwelligen Spektralbereichen. By F. Lindholm. (Reprinted from Strahlentherapie, Berlin and Vienna, 39, 1931, pp. 369-75.)

Obituary

Dr. Alfred Wolfer.—We regret to record the death at Zurich on October 8th, 1931, of Alfred Wolfer, well known to all meteorologists for his work in the measurement and recording of sunspots. Wolfer was born on January 27th, 1854, at Schönenberg near Zurich. In 1894 he was appointed Director of Zurich Astronomical Observatory in succession to R. Wolf, and he continued to occupy that post until he retired in 1926. In 1901 he was awarded the degree of Doctor of Philosophy at Basel.

Most of Wolfer's work appeared in the long series of *Astronomische Mitteilungen*, which he edited, and in the quarterly tables of sunspot relative numbers which appeared in the *Meteorologische Zeitschrift* and later also in *Terrestrial Magnetism*. The latter also contained in 1925 a revision of the table of relative numbers from 1749 onwards first compiled by Wolf. These basic data have played a very large part in studies of the relation between solar conditions and the phenomena of meteorology and terrestrial magnetism, so that Wolfer, though not himself a meteorologist, has contributed greatly to meteorological knowledge.

News in Brief

Mr. E. P. Burd, of Okehampton, sends the following note taken from the Corporation records: "4th July, 1675. From this tyme to the beginning of October following we had little or no rain: for that the like hath not been knowne by any one living here."

Dr. Victor F. Hess, professor of experimental physics at Graz University has been chosen Chief of the newly established station for the investigation of penetrating radiation on the Hafelekar near Innsbruck.

The retirement of Professor A. McAdie.—We learn that after sabbatical leave for the first semester of the coming academic year, Alexander McAdie, Abbot Laurence Rotch Professor of meteorology, Harvard University and Director of Blue Hill Observatory, will become Professor Emeritus.

We learn that Prof. E. Mathias has retired from the posts of Director of the Puy de Dôme Observatory and Professor in the Faculty of Science at Clermont-Ferrand.

Mr. C. A. Bracey retired from the staff of the Meteorological Office on November 2nd after just over 52 years' service. At a well-attended meeting the Director, on behalf of the Staff Council, presented him with Groves' Dictionary of Music and a pair of binoculars, in appreciation of his services.

Mr. Bracey joined the Office in 1879 and was posted to the autographic records section, where he was for some time engaged in the production of the engraved plates published in the *Quarterly Weather Report*. In 1884 he was transferred to the Land Branch, which subsequently became the British Climatology Division, where he was the clerk in charge of the section responsible for the production of the *Monthly Weather Report*. Figures seemed to fascinate him and he was responsible for preparing several labour-saving tables which are still in daily use. These were largely produced during his long daily train journey to and from the Office. He prepared a list of the greatest daily falls of rain at some 116 stations in the British Isles from the date of commencement of the station up to 1915. These statistics are preserved in two volumes in the Library of the Office. He also compiled a detailed summary of the daily rainfall observations at Brixton from 1871-1910.

On the social side he was chairman of the Office Cycling Club for many years, right up to his retirement. He was always the first to help a less fortunate colleague.

The Weather for October, 1931

Pressure was above normal over northern Africa, southern and central Europe to southern Scandinavia, the British Isles and the Faroes, and also over southern Greenland, the greatest excess being 9·6mb. at Scilly Isles. Pressure was below normal over Russia, northern Scandinavia, Spitsbergen, Iceland, and the greater part of the northern North Atlantic, the greatest deficit being 10·8mb. at Vardo. Temperature was above normal in Spitsbergen and northern Scandinavia and below normal in southern Scandinavia and central and southern Europe, while rainfall was deficient over nearly the whole of Europe; in north-west Norrland (Sweden), however, it was 50 per cent. above normal.

The weather of October in the British Isles was dry. The first fortnight of the month was mild, but from the 20th onwards the weather was cold with severe night frosts. Sunshine was considerably above normal in a belt extending roughly from Dublin to Lincolnshire and Essex. For the first 12 days the weather was unsettled and mild, with depressions moving east or north-east across Iceland giving S-SW. winds generally over the British Isles—these reached gale force at times in the north. Some heavy rain fell locally in the west and north, among the biggest measurements being 2·02in. at Oakley (Merioneth) on the 1st, 1·0in. at Blacksod Point (co. Mayo) on the 5th, and 2·26in. at Rosthwaite (Cumberland) on the 9th. In the south and east the amounts measured were small and the rainfall less frequent than in the north and west. On the 3rd a wedge of high pressure crossed the British Isles between two depressions

giving a sunny day; much sunshine was also reported on the 10th and 11th, 9·7hrs. at Portsmouth on the 3rd, 10·4hrs. at Rhayader on the 10th, and 9·7hrs. at Cardiff on the 11th, were among the larger amounts. Thunderstorms occurred in the Orkneys on the 2nd, and locally in England on the 7th. There was much mist and fog locally on the 11th and 12th. On the 13th an anticyclone moved north-east over the British Isles from the Azores. Day temperature fell somewhat and night temperatures considerably, but sunshine records were good generally on the 15th and 16th and locally on the 17th. 9·8hrs. were recorded at Cockle Park on the 15th, 9·3hrs. at Dundee on the 16th. Mist and fog were again experienced locally on the 15th and 19th. A change to much colder weather occurred about the 20th, when a depression over northern Norway extended southwards and northerly winds swept across the British Isles. From then onwards a succession of anticyclones passed across the kingdom and cold sunny weather prevailed. On several days maxima were generally below 50°F.; 40°F. was the maximum at Inverness, Fort Augustus and Nairn on the 29th, and at Edinburgh on the 30th, while screen minima fell to 15°F. at Rhayader on the 26th and to 16°F. at Dalwhinnie on the 25th, and grass minima to 7°F. at Rhayader on the 25th and 26th, and to 10°F. at Greenwich on the 28th. At Ross-on-Wye the minimum temperatures for the 27th were the lowest on record for October for at least 70 years. Snow was reported from numerous places in north Scotland on the 20th, 21st, 24th, 25th and 30th, and also at a few places in north England on the 24th. A trough of low pressure moved across the British Isles and gave rain generally on the 29th, 1·35in. fell at Festiniog (Merioneth), and 1·07in. at Stonyhurst. This was followed by a ridge of high pressure in the rear of which south-westerly winds brought warmer weather to the country for the last day. The total rainfall for the month was below normal over the whole country and was as little as 10 per cent. of the normal at Brighton. Absolute droughts (a period of at least 15 consecutive days, to none of which is credited ·01in. of rain or more) were recorded at many places in southern England, the southern Midlands and southern Wales. At Street, Somerset, the absolute drought ended on the 27th. The distribution of bright sunshine was as follows:—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway	69	— 17	Liverpool	126	+40
Aberdeen	104	+ 9	Ross-on-Wye	109	+17
Dublin	123	+ 19	Falmouth	123	+ 7
Birr Castle	101	+ 3	Gorleston	127	+18
Valentia	102	+ 1	Kew	90	— 2

The special message from Brazil states that the rainfall in the northern and central regions was irregular with 0·04in. and 0·59in. above normal respectively and in the southern regions generally scarce with 0·59in. below normal. Sugar and cotton crops were in good condition in the north-east but in the centre and south the coffee blossoms were affected by the strong winds during the last ten days. Seven anticyclones passed across the country. At Rio de Janeiro, pressure was 1·4mb. above normal and temperature 0·2°F. above normal.

Miscellaneous notes on weather abroad culled from various sources.

Three inches of rain fell in Funchal, Madeira, on the 2nd and many streets were flooded for a short time. Severe weather was experienced in south-east Europe early in the month. Basements of houses fronting the Neva in Leningrad were flooded early on the 20th, when the river level rose suddenly owing to a storm over the Baltic. After a long drought during which the use of water was severely restricted in Madrid, rain fell in Spain about the 22nd (*The Times*, October 5th-23rd, 1931).

The monsoon lasted longer than usual this year in Bombay, where the rainfall was considerably above the average. A typhoon swept along the Pacific coasts of Japan on the night of the 12th. As a result of heavy rains which flooded the Vizagapatam district, a number of heavy boulders, displaced by the rains, fell on the Ghat road between Itikwalasa and Jeypore, and crushed to death 30 people. Other landslips have completely blocked communications in many districts (*The Times*, October 13th-21st, 1931).

Great damage was done by frost to some of the best vineyards in South Australia during the first part of the month. Useful rains fell in the northern and central districts of Queensland on the 24th and 25th (*The Times*, October 13th-26th, 1931).

Stormy weather on the Atlantic interfered with shipping towards the end of the month (*The Times*, October 27th, 1931).

Temperature in the United States was much above the normal during the early and last parts of the month but about normal in the middle, while rainfall was mainly below normal during the month (*Washington, D.C., U.S. Dept. Agric. Weekly Weather and Crop Bulletin*). October, 1931, in Maine was one of the clearest and sunniest months in many years. A heavy rainstorm on the 16th and a thunderstorm accompanied by torrential rain and hail on the 25th, however, brought the rain fall total above the normal (E. C. Austin, Auburn, Maine).

Rainfall, October, 1931—General Distribution

England and Wales	32	per cent of the average 1881-1915.
Scotland	82	
Ireland	56	
British Isles	49	

Rainfall: October, 1931: England and Wales

Co.	Station	In.	Per-cent of Av.	Co.	Station	In.	Per-cent. of Av.
Lond .	Camden Square.....	·66	25	*Leics* .	Belvoir Castle.....	·54	20
Sur .	Reigate, Alvington.....	·62	19	*Rut* .	Ridlington.....	·63	22
Kent .	Tenterden, Ashenden...	·63	18	*Linc* .	Boston, Skirbeck.....	·65	24
,, .	Folkestone, Boro. San..	1·03	...	,, .	Cranwell Aerodrome...	·54	19
,, .	Margate, Cliftonville...	·53	18	,, .	Skegness, Marine Gdns	·94	34
,, .	Sevenoaks, Speldhurst	·80	...	,, .	Louth, Westgate.....	·82	25
Sus .	Patching Farm.....	·55	14	,, .	Brigg, Wrawby St.....	1·12	...
,, .	Brighton, Old Steyne..	·37	10	*Notts* .	Worksop, Hodsock.....	·70	27
,, .	Heathfield, Barklye....	·92	22	*Derby*.	Derby, L. M. & S. Rly.	·61	23
Hants.	Ventnor, Roy. Nat. Hos.	·76	19	,, .	Buxton, Devon Hos....	2·27	46
,, .	Fordingbridge, Oaklnds	·76	18	*Ches* .	Runcorn, Weston Pt...	1·60	47
,, .	Ovington Rectory.....	·75	19	,, .	Nantwich, Dorfold Hall	1·10	...
,, .	Sherborne St. John.....	·77	22	*Lancs* .	Manchester, Whit. Pk.	1·66	50
Berks .	Wellington College.....	·53	16	,, .	Stonyhurst College.....	3·45	77
,, .	Newbury, Greenham...	·49	14	,, .	Southport, Hesketh Pk	2·41	68
Herts .	Welwyn Garden City...	·65	...	,, .	Lancaster, Strathspey	3·65	...
Bucks.	H. Wycombe, Flackwell	·81	...	*Yorks*.	Wath-upon-Dearne.....	·69	25
Oxf . .	Oxford, Mag. College..	·71	25	,, .	Bradford, Lister Pk....	1·26	36
Nor .	Pitsford, Sedgebrook...	·48	18	,, .	Oughtershaw Hall.....	4·04	...
,, .	Oundle.....	·47	...	,, .	Wetherby, Ribston H.	1·04	35
Beds .	Woburn, Crawley Mill	·64	24	,, .	Hull, Pearson Park.....	1·22	41
Cam .	Cambridge, Bot. Gdns.	·49	21	,, .	Holme-on-Spalding.....	1·41	...
Essex .	Chelmsford, County Lab	·61	25	,, .	West Witton, Ivy Ho.	1·53	41
,, .	Lexden Hill House....	·62	...	,, .	Felixkirk, Mt. St. John	1·25	43
Suff .	Hawkedon Rectory.....	·85	31	,, .	Pickering, Hungate....	1·43	47
,, .	Haughley House.....	·62	...	,, .	Scarborough.....	2·02	65
Norf .	Norwich, Eaton.....	1·03	33	,, .	Middlesbrough.....	1·21	40
,, .	Wells, Holkham Hall	1·11	40	,, .	Baldersdale, Hury Res.	1·78	...
,, .	Little Dunham.....	1·61	52	*Durh* .	Ushaw College.....	1·30	38
Wilts.	Devizes, Highclere.....	1·08	35	*Nor* .	Newcastle, Town Moor	1·09	34
,, .	Bishops Cannings.....	·73	22	,, .	Bellingham. Highgreen	2·02	51
Dor .	Evershot, Melbury Ho.	·69	15	,, .	Lilburn Tower Gdns....	1·06	29
,, .	Creech Grange.....	·88	17	*Cumb* .	Geltsdale.....	3·57	...
,, .	Shaftesbury, Abbey Ho.	·53	14	,, .	Carlisle, Scaleby Hall	2·96	89
Devon.	Plymouth, The Hoe....	·67	17	,, .	Borrowdale, Seathwaite	9·75	81
,, .	Polapit Tamar.....	...	...	,, .	Borrowdale, Rosthwaite	9·32	...
,, .	Holne, Church Pk. Cott.	1·26	19	,, .	Keswick, High Hill.....	3·60	...
,, .	Cullompton	·62	15	*West* .	Appleby, Castle Bank..	2·78	80
,, .	Sidmouth, Sidmount...	·48	13	*Glam* .	Cardiff, Ely P. Stn.....	·68	14
,, .	Filleigh, Castle Hill....	1·17	...	,, .	Treherbert, Tynywaun	3·33	...
,, .	Barnstaple. N. Dev. Ath	1·03	23	*Carm* .	Carmarthen Friary.....	2·14	37
,, .	Dartm'r, Cranmere Pool	2·20	...	*Pemb* .	Haverfordwest, School	2·25	42
Corn .	Redruth, Trewirgie.....	1·20	23	*Card* .	Aberystwyth.....	...	...
,, .	Penzance. Morrab Gdn.	1·07	23	,, .	Cardigan, County Sch.	1·81	...
,, .	St. Austell, Trevarna...	1·15	22	*Brec* .	Crickhowell. Talymaes	1·40	...
Soms .	Chewton Mendip.....	1·73	36	*Rad* .	Birm W. W. Tymynydd	2·24	34
,, .	Long Ashton.....	1·12	30	*Mont* .	Lake Vyrnwy.....	1·96	34
,, .	Street, Millfield	·47	14	*Denb* .	Llangynhafal.....	1·43	38
Glos.	Cirencester, Gwynfa....	·66	20	*Mer* .	Dolgelly, Bryntirion...	4·46	73
Here .	Ross, Birchlea.....	·61	18	*Carn* .	Llandudno.....	1·86	52
,, .	Ledbury, Underdown..	·67	22	,, .	Snowdon, L. Llydaw	9 12·05	...
Salop .	Church Stretton.....	·99	27	*Ang* .	Holyhead, Salt Island	1·97	49
,, .	Shifnal, Hatton Grange	·98	35	,, .	Lligwy.....	2·51	62
Worc .	Ombersley, Holt Lock	·65	24	*Isle of Man*			
,, .	Blockley.....	·87	...		Douglas, Boro' Cem....	2·59	57
War .	Birminghm, Edgbaston	·91	33	*Guernsey*			
Leics .	Thornton Reservoir....	·80	28		St. Peter P't. Grange Rd.	·58	13

Rainfall: October, 1931: Scotland and Ireland

Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per cent. of Av.
Wigt .	Pt. William, Monreith	2·97	75	*Suth* .	Melvich	3·88	...
,, .	New Luce School	3·37	72	,, .	Loch More, Achfary	7·64	98
Kirk .	Carsphairn, Shiel	5·51	78	*Caith* .	Wick	2·93	99
Dumf .	Dumfries, Crichton, R.I	2·32	...	*Ork* .	Pomona, Deerness	...	...
,, .	Eskdalemuir Obs.	5·33	99	*Shet* .	Lerwick	4·12	104
Roxb .	Branxholm	2·89	89	*Cork* .	Caheragh Rectory	2·08	...
Selk .	Ettrick Manse	4·03	73	,, .	Dunmany Rectory	2·13	35
Peeb .	West Linton	2·82	...	,, .	Ballinacurra	1·23	31
Berk .	Marchmont House	1·43	37	,, .	Glanmire, Lota Lo	1·36	33
Hadd .	North Berwick Res.	1·81	61	*Kerry* .	Valentia Obsy	2·47	44
Midl .	Edinburgh, Roy. Obs.	1·41	54	,, .	Gearahameen	4·60	...
Lan .	Auchtyfardle	3·21	...	,, .	Killarney Asylum	2·30	43
Ayr .	Kilmarnock, Agric. C.	...	...	,, .	Darrynane Abbey	2·23	44
,, .	Girvan, Pinmore	3·97	79	*Wat* .	Waterford, Brook Lo	...	...
Renf .	Glasgow, Queen's Pk.	3·08	95	*Tip* .	Nenagh, Cas. Lough	2·61	77
,, .	Greenock, Prospect H.	6·78	126	,, .	Roscrea, Timoney Park	1·37	...
Bute .	Rothesay, Ardencraig	5·72	130	,, .	Cashel, Ballinamona	1·67	46
,, .	Dougarie Lodge	4·06	..	*Lim* .	Foynes, Coolnanes	1·92	51
Arg .	Ardgour House	11·00	...	,, .	Castleconnel Rec	2·32	...
,, .	Manse of Glenorchy	...	...	*Clare* .	Inagh, Mount Callan	4·39	...
,, .	Oban	5·50	119	,, .	Broadford, Hurdlest'n.	2·56	...
,, .	Poltalloch	4·99	101	*Wexf* .	Gorey, Courtown Ho	1·25	35
,, .	Inveraray Castle	9·12	129	*Kilk* .	Kilkenny Castle	1·56	49
,, .	Islay, Eallabus	5·48	115	*Wic* .	Rathnew, Clonmannon	·98	...
,, .	Mull, Benmore	...	..	*Carl* .	Hacketstown Rectory	2·05	54
,, .	Tiree	3·93	...	*Leix* .	Blandsfort House	1·90	54
Kinr .	Loch Leven Sluice	2·00	58	,, .	Mountmellick	1·98	...
Perth .	Loch Dhu	7·20	101	*Off'ly* .	Birr Castle	1·97	33
,, .	Balquhidder, Stronvar	5·56	...	*Kild'r.*	Monasterevin	...	...
,, .	Crieff, Strathearn Hyd.	1·75	45	*Dubl* .	Dublin, Fitz Wm. Sq.	·67	25
,, .	Blair Castle Gardens	2·29	74	,, .	Balbriggan, Ardgillan.	1·20	44
Angus.	Kettins School	1·23	43	*Me'th* .	Beauparc, St. Cloud	1·73	...
,, .	Dundee, E. Necropolis	1·21	46	,, .	Kells, Headfort	1·87	56
,, .	Pearsie House	1·21	...	*W.M* .	Moate, Coolatore	1·42	...
,, .	Montrose, Sunnyside	·83	30	,, .	Mullingar, Belvedere	2·38	76
Aber .	Braemar, Bank	2·38	63	*Long* .	Castle Forbes Gdns	2·27	70
,, .	Logie Coldstone Sch.	1·81	56	*Gal* .	Ballynahinch Castle	2·93	49
,, .	Aberdeen, King's Coll.	1·53	51	,, .	Galway, Grammar Sch.	2·92	...
,, .	Fyvie Castle	1·79	47	*Mayo* .	Mallaranny	4·70	...
Moray.	Gordon Castle	2·67	85	,, .	Westport House	2·78	62
,, .	Grantown-on-Spey	...	...	,, .	Delphi Lodge	5·88	62
Nairn.	Nairn, Delnies	2·06	88	*Sligo* .	Markree Obsy	3·24	79
Invs .	Ben Alder Lodge	4·37	...	*Cav'n* .	Belturbet, Cloverhill	2·07	71
,, .	Kingussie, The Birches	2·99	...	*Ferm* .	Enniskillen, Portora	2·71	...
,, .	Loch Quoich, Loan	19·50	...	*Arm* .	Armagh Obsy	1·98	73
,, .	Glenquoich	13·72	137	*Down* .	Fofanny Reservoir	3·05	...
,, .	Inverness, Culduthel R.	1·85	...	,, .	Seaforde	1·97	55
,, .	Arisaig, Faire-na-Squir	5·56	...	,, .	Donaghadee, C. Stn.	2·06	71
,, .	Fort William	9·51	...	,, .	Banbridge, Milltown	1·75	...
,, .	Skye, Dunvegan	5·67	...	*Antr* .	Belfast, Cavehill Rd	2·51	...
R & C .	Alness, Ardross Cas.	2·67	69	,, .	Glenarm Castle	2·96	...
,, .	Ullapool	4·37	90	,, .	Ballymena, Harryville	3·02	82
,, .	Torridon, Bendamph	...	...	*Lon* .	Londonderry, Creggan	3·37	92
,, .	Achnashellach	7·54	..	*Tyr* .	Omagh, Edenfel	2·89	79
,, .	Stornoway	4·99	...	*D.n* .	Malin Head	4·18	...
Suth .	Lairg	4·00	107	,, .	Dunfanaghy	3·19	...
,, .	Tongue	3·61	86	,, .	Killybegs. Rockmount	3·80	68

Climatological Table for the British Empire, May, 1931.

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	in.	in.			
London, Kew Obsy. ..	1011·9	— 4·0	74	48	62·1	46·9	54·5	+ 1·1	49·0	81	6·9	2·48	+ 0·76	15	5·1	33
Gibraltar.....	1016·0	— 0·1	82	51	74·5	56·8	65·7	+ 0·2	56·2	81	4·4	0·36	— 1·37	4	..	..
Malta	1015·2	+ 0·7	82	54	71·9	60·2	66·1	+ 0·2	60·6	75	4·4	0·92	+ 0·51	6	9·8	70
St. Helena	1014·9	+ 0·9	69	57	67·2	59·6	63·4	+ 0·3	60·5	92	7·9	1·19	..	7	..	..
Sierra Leone	1012·7	+ 1·5	91	67	87·6	72·1	79·9	— 1·6	78·3	84	5·4	10·21	— 1·26	21	..	..
Lagos, Nigeria	1011·3	+ 0·3	91	72	86·9	76·2	81·5	— 0·3	77·2	79	8·9	8·87	— 1·60	17	..	..
Kaduna, Nigeria	1011·8	— 0·9	97	—	90·8	—	—	—	74·3	79	7·1	10·08	+ 4·14	13	..	..
Zomba, Nyasaland ..	1014·8	— 0·3	83	54	75·9	59·5	67·7	+ 1·9	..	76	7·1	0·60	— 0·44	3	..	..
Salisbury, Rhodesia ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cape Town.....	1018·7	+ 0·6	84	40	65·2	51·7	58·5	— 0·4	52·7	87	6·5	2·03	— 1·72	14	..	..
Johannesburg	1017·8	+ 1·0	77	45	70·4	50·6	60·5	+ 6·1	47·6	41	1·3	0·00	— 0·76	0	9·9	91
Mauritius	1017·6	+ 1·2	82	59	79·0	66·7	72·9	+ 0·3	69·6	73	4·6	5·00	+ 1·97	20	7·8	70
Calcutta, Alipore Obsy.	1003·2	— 0·3	101	70	94·4	79·0	86·7	+ 0·6	79·8	81	6·0	7·68	+ 2·12	9*	..	..
Bombay	1007·4	0·0	94	77	92·4	80·7	86·5	+ 0·7	78·1	73	3·4	0·00	— 0·55	0*	..	..
Madras	1005·0	— 0·4	106	71	98·3	81·3	89·8	0·0	79·5	71	5·3	1·77	— 0·07	1*	..	..
Colombo, Ceylon	1009·3	+ 0·9	90	72	87·3	77·2	82·3	— 0·5	79·1	82	8·5	11·81	+ 0·87	27	5·5	44
Singapore	1009·2	+ 0·5	94	72	88·8	76·5	82·7	+ 0·6	78·9	82	6·9	6·96	+ 0·31	15	6·2	51
Hongkong	1008·5	— 0·8	89	68	80·7	73·8	77·3	— 0·1	73·9	86	9·0	12·00	+ 0·02	19	3·6	27
Sandakan	..	..	92	74	89·4	76·1	82·7	+ 0·2	78·5	81	..	5·08	— 1·25	9	..	..
Sydney, N.S.W.	1019·1	+ 0·5	81	41	68·3	54·3	61·3	+ 2·5	55·2	78	5·6	3·50	— 1·68	13	5·5	53
Melbourne	1018·5	— 0·7	73	37	63·3	49·5	56·4	+ 2·3	52·8	81	6·9	2·66	+ 0·50	18	4·3	42
Adelaide.....	1019·3	— 0·7	77	44	65·7	52·1	58·9	+ 1·0	53·3	75	8·2	2·99	+ 0·21	24	3·6	35
Perth, W. Australia ..	1019·9	+ 1·5	76	40	65·7	49·5	57·6	— 3·1	52·2	73	4·7	6·29	+ 1·32	13	6·5	62
Coolgardie	1020·0	+ 0·6	79	36	63·7	44·7	54·2	— 3·5	49·5	67	5·6	1·27	— 0·06	7	..	..
Brisbane.....	1020·3	+ 1·7	81	48	74·0	58·8	66·4	+ 1·8	61·2	77	5·8	2·19	— 0·62	12	5·7	53
Hobart, Tasmania....	1012·6	— 2·7	70	37	59·2	47·2	53·2	+ 2·7	47·8	74	7·1	2·24	+ 0·34	18	3·8	39
Wellington, N.Z.	1023·0	+ 7·4	60	37	55·0	46·1	50·5	— 2·3	47·6	77	6·7	2·56	— 2·12	16	4·5	45
Suva, Fiji	1013·6	+ 0·9	90	67	81·9	72·1	77·0	+ 0·5	72·6	80	7·7	7·88	— 2·19	22	4·1	36
Apia, Samoa	1011·1	0·0	89	71	85·3	74·6	79·9	+ 1·5	76·9	81	6·5	13·86	+ 7·79	16	5·2	45
Kingston, Jamaica ..	1011·7	— 1·4	93	70	88·7	74·0	81·3	+ 1·6	73·5	76	5·7	3·76	— 0·63	9	7·4	57
Grenada, W.I.	1013·8	+ 1·2	91	71	87·4	73·9	80·7	+ 1·0	73·9	76	4·9	2·71	— 1·48	14	..	..
Toronto	1012·5	— 2·4	84	30	65·9	45·9	55·9	+ 2·1	49·4	70	4·7	1·89	— 0·90	11	7·4	50
Winnipeg	1013·6	— 0·2	90	16	61·0	39·0	50·0	— 2·0	..	..	4·0	2·43	+ 0·43	7	..	..
St. John, N.B.	1014·2	+ 0·3	75	32	56·6	41·6	49·1	+ 1·4	44·7	74	7·0	4·26	+ 0·55	14	5·9	40
Victoria, B.C.	1018·2	+ 1·5	78	43	62·9	48·0	55·5	+ 2·5	50·7	70	5·2	1·48	+ 0·35	8	10·0	66

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