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Nature as Dramatist

A few years ago the usual Christmastide increase in the sale of novels, detective stories and other similar literature must have been appreciably lessened by the vast popularity of a small book which Sir James Jeans had written a few weeks before about the mysteries of the universe. And now, again, many a 7s. 6d. that might have gone to the purveyors of fiction will purchase instead a work of science by way of a Christmas offering. This time, however, it is not astronomy but meteorology that provides the counter-attraction. Within a fortnight of its publication Sir Napier Shaw's "The Drama of Weather"* was hailed as "the book of the month" in the United States. Although he writes therein of signs and portents, the author does not himself assume the mantle of a prophet, and it will therefore be strange if his new work is not accorded at least as much honour in his own country as it has already received across the Atlantic.

"The Drama of Weather" may perhaps be succinctly described as a miniature of the "Manual of Meteorology" with all the difficult parts sifted out. This is not to say that anybody who is familiar with the four volumes of the Manual will find nothing further to interest or instruct him in the book under review. On the contrary, the author's lively imagina-

*"The Drama of Weather." By Sir Napier Shaw. Size 8½ in. × 6 in. Pp. xiv + 269. *Illus.* Cambridge University Press. 7s. 6d. net.

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tion has enabled him to take an entirely fresh outlook on his subject, and to present it to his readers in a form as original as it is attractive. The title is no mere catch-phrase. Astronomers have recently suggested that the universe of space and time can only have been devised by a master mathematician: Sir Napier prefers to regard the weather as "the work of an accomplished dramatic artist," and from that germ of thought, given expression on the first page of the preface, the book grows logically to an organic whole. "If we would make out the forces acting upon the atmosphere," he writes, "we must ascertain the motion of its parts, an enterprise which implies nothing less and nothing more than realising the drama and forming a pageant to represent it. It is a task that has never been achieved, and weather will never be understood until it has been; but many separate parts of the stage have been scrutinised, and the information used for practical purposes." As further justification for his mode of treatment Sir Napier adds, in another place, "Every phase of the behaviour of the atmosphere recalls some characteristic of personality either of a man or a woman, sometimes of both."

Here, then, we have the underlying scheme of the work. As a spectator of the drama, the reader is led first of all to inspect the scenery and "effects"; a prologue, headed "Pageantry in the sky," describes or illustrates for him such things as the forms of clouds, atmospheric disorder and quietude, electrical discharge, the trickery of light and colour, visibility, mirage. Thence he proceeds, in Chapter I, to consider "Ideas of the drama ancient and modern," wherein is set forth an historical review of weather study from the earliest times, with sub-sections on matters ranging from agricultural meteorology, astrology and weather lore to the modern stress of public service. Chapter II ("The watchers: what they see and what they say"), and Chapter III ("The score") deal, in the main, with observations visual and instrumental, their use, presentation and interpretation. Herein are exhibited and explained the barometer, thermometer, rain gauge, and other tools of the meteorologist, together with the knowledge that he has acquired from them, as exemplified in maps of the distribution of pressure, temperature and rainfall over the globe, charts of the upper air, and such like. Chapter IV is entitled "The chorus. Rhythmic aspects of the records," and concerns itself chiefly with the various types of seasonal change in the climatic elements. In Chapter V—"The weather map presents the play"—we meet the protagonists in the drama, and learn how they enact their parts. This section of the book consists of three sub-divisions, devoted respectively to cyclones and anticyclones, with their nature, travel and weather associations, to synoptic charts, with their meaning and use, and to the "Norwegian duet for polar and tropical air with cyclonic accompaniment—fronts and frontiers." Lastly, a three-page Epilogue—"spoken behind the scenes," having peered into the future and visualised for us the vertical cross-sections of the ideal weather map yet to come, sums up the whole drama and our present comprehension of it in a few suggestive paragraphs.

The book is characterised throughout by the same effortless lucidity and literary grace that differentiates all Sir Napier Shaw's later writings from so many other expositions of matters scientific. While the more abstruse conceptions of modern meteorology are naturally omitted, the harmless, necessary difficulties are nowhere shunned; but so deftly are they handled that the non-technical reader will find himself understanding them without being aware that his intelligence has been exercised. A good example of this is on pp. 104 and 105, where tables of an aspect rather forbidding to the uninitiated set out such important but supposedly perplexing details as the relationships of temperature with pressure and density of water-vapour and long-wave radiation from a black body. A footnote explains these with a graphic simplicity which must make their meaning clear to the most unambitious mind.

There is in these pages none of that despondency which has of late been rife amongst meteorologists of the younger school in regard to the future of weather forecasting. Such pessimism is doubtless but a temporary counterblast to the premature optimism of half a century ago, recalled by Sir Napier. The only use of any word like "melancholy" in the book occurs in reference to the paucity of our information as to rainfall over the oceans. On p. 77 the author has a gentle tilt at a vulnerable point in official procedure. As one concerned with the application of meteorology to agriculture, he would have the annual volume of the *Weekly Weather Report* begin with nature's phenological year early in November, instead of with March, as at present. But for how many subscribers to that publication did its chief appeal vanish when it ceased to appear week by week?

The stores of information which pack this work from cover to cover are plentifully leavened with both humour and literary allusion. Homer, Hesiod, Herodotus, Aristophanes, Aristotle, Theophrastus, the Books of Job and Enoch, the New Testament, Shakespeare, Shelley and Ruskin are only a few of the sources drawn upon. Sir Napier's innate modesty prevents him from allowing casual readers to suspect the extent of his own contributions towards the advance of the science. In one place is a reference to "*a* recent 'Manual of Meteorology'"; elsewhere there is reproduced from the first edition of "Forecasting Weather" the well-known sketch diagram for the distribution of wind, temperature and rain about the centre of a depression, without any hint that this, and what it stood for, were pre-war signposts to the later revision of ideas by the Norwegian school.

Incidentally, we are reminded by the author that Norway is not the only Scandinavian country to which meteorology owes much; Sweden, we are told, gave us isallobars and the nephoscope, in addition to the centigrade thermometric scale.

A popular section of the book should be that which accounts for the action of various "weather toys," such as the familiar "Jacky and Jenny" hygrometric chalet, the Old Dutch weather-glass, the chloride-of-cobalt butterflies and flowers which deck seaside shop windows in summer, and the new-fangled "humidor." We miss, however, an explanation of the so-called "storm-glass"—that sealed phial of camphor-in-alcohol, which is said to have been an accidental discovery of the old alchemists, and which, in spite of a prevalent belief to the contrary, is not dependent solely on temperature changes for its diverse forms of crystallisation. Perhaps Sir Napier will throw his searchlight on this mysterious instrument in a later edition of his work.

There seems to be a surprising lack of unanimity as to the world's recorded extremes of low temperature. For the absolute surface minimum at Verkhoiansk −90° F. is given on p. 184 of the volume under review, but −94° F. or −93·6° F. in the "Meteorological Glossary" and other official publications. The absolute upper-air minimum, over Java, is said by Sir Napier to be −135° F. at 16 Km., by McAdie to be −133° F. at 17 Km., and by the "Meteorological Glossary" to be −131·6° F. at 16½ Km. As to the Verkhoiansk reading, Sir Napier's figure appears to be confirmed by a recent communiqué from the Soviet Meteorological Service relating to the establishment of a valley climatological station at an altitude of 2,000 ft. above M.S.L. in the Oimekon district of Siberia. This region, it is said, will probably prove to be the world's "cold pole"; a minimum of −85° F. registered there in the "comparatively mild" winter of 1929-30 was noted as being "only 5° F. higher than the Verkhoiansk extreme," and this "record" of half-a-century's standing is thought likely to be broken before long.

It remains only to add that, like its astronomical precursor in rivalry with works of fiction as a Christmas attraction, "The Drama of Weather" has been admirably produced by the Cambridge University Press. Its price is no higher than that of the average novel; yet style, binding, paper, type, illustrations, are all excellent, the reproduction of the many cloud photographs, in particular, coming near to perfection. For the success of this book all meteorologists will echo the expression that Sir Napier himself employs on p. 101, in his advocacy of the Kelvin kilograd temperature scale,—Prosit!

E. L. Hawke.

[−93·6° F. is given as the absolute minimum temperature at Verkhoiansk for February, 1892, in *Annalen des Physikalitchen Central-Observatoriums*, St. Petersburg, 1892, Teil 2.—Ed., *M.M.*]

Notes on the Upper Air Observations at Reykjavik during the Polar Year.

A Dutch expedition established by Dr. Cannegieter obtained a valuable series of observations from aeroplanes at Reykjavik, in western Iceland, between September, 1932, and August, 1933. The complete discussion of these observations must await the publication of the full data for the Polar Year, when sounding balloon observations at a number of places will also be available. There must also have been many interesting points which can only be dealt with by a meteorologist who was on the spot. Some preliminary discussion is nevertheless worth while. The present note deals with the temperature, pressure and lapse rate at 4 kilometres, and with the differences between Reykjavik and Duxford.

Many of the aeroplane observations were broadcast by wireless and appear in the *Upper Air Supplement of the Daily Weather Report* between October 24th and August 31st. (Nearly all the broadcast observations were on separate days, but on six occasions there were morning and evening observations.) Owing to an initial misunderstanding of the code used for transmitting the observations a few of the earlier observations in the *Daily Weather Report* require correction. At the height of 3 to 5 kilometres, 1 Km. (3,280 feet) should be added to the published figures for October 24th, 25th, January 3rd, May 1st, and 1 Km. should be substracted on November 22nd, 23rd, December 15th, January 18th. With the data so far available in England, it is impossible to treat each season separately, but the middle of April is a convenient division between the winter period and the spring and summer period. On April 12th the upper air temperature was the lowest of the series, but when observations were renewed after Easter, temperature had risen decidedly and never became really low again.

A Statistical Summary of observations in *Daily Weather Report.*

(a) Winter period, 56 observations.

Sea level pressure	mean	1004mb.	standard	deviation	17·5mb.
Pressure at 4 Km.	,,	596mb.	,,	,,	12·1mb.
Temperature at 4 Km.	,,	—8·8°F.	,,	,,	9·4°F.
Fall of temperature from 3 to 4 Km.	,,	10·2°F.	,,	,,	3·6°F.
,, ,, ,, ,, 4 to 5 Km.	,,	11·4°F.	,,	,,	3·2°F.

Correlation co-efficient between temperature and pressure at 4 Km. 0·64
,, ,, ,, ,, at 4 Km. and sea level pressure 0·36

(b) Spring and summer period, 85 observations.

Sea level pressure	mean	1010mb.	standard	deviation	9·0mb.
Pressure at 4 Km.	,,	612mb.	,,	,,	6·3mb.
Temperature at 4 Km.	,,	12·3°F	,,	,,	6·7°F.
Fall of temperature from 3 to 4 Km.	,,	9·5°F.	,,	,,	2·2°F.
,, ,, ,, ,, 4 to 5 Km.	,,	10·4°F.	,,	,,	2·1°F.
,, ,, ,, ,, 5 to 6 Km.*	,,	10·5°F.	,,	,,	2·0°F.

Correlation co-efficient between temperature and pressure at 4 Km. 0·54
,, ,, ,, ,, at 4 Km. and sea level pressure 0·07

* 42 observations only.

It is interesting to compare these figures with those given by W. H. Dines* for England. The correlation co-efficients are lower in Iceland than in England. The standard deviations at 4 Km. are much the same, the figures for Iceland temperature being a trifle lower than for England. An interesting point is that the standard deviation of pressure falls off with height in Iceland, whereas in England it remains practically the same. Thus the effect of the lowest four kilometres is larger in Iceland. The mean lapse-rate at the heights considered is much the same as in England.

Individual Cases.—A study of the observations in conjunction with synoptic charts reveals the same general features as one would expect in similar situations in England. The lowest temperatures occurred in Arctic currents, the extreme at 4 Km. being −27° F. at 18h. on April 12th. A lower figure has occasionally been observed in England. High upper air temperatures were observed in most anticyclones and in currents originating well to southward. (Genuine tropical air is rare in Iceland.) The extreme at 4 Km. was 27° F. at 18h. on June 27th, and also at 10h. on July 8th, the latter being a good example of a warm current in a depression. Inversions with dry air above them were common in anticyclones.

The most notable observation was at 15h. on January 3rd, when sea-level pressure was as low as 942 mb., probably the lowest for any upper air ascent yet made. Temperature at 4 Km. was −13° F., an appreciably higher figure than that usually found in Arctic currents. Pressure at 4 Km. was 558 mb., or 38 mb., below the winter normal, whereas sea-level pressure was 62 mb. below normal. At the top of the troposphere the deviation was presumably less than at 4 Km. This example supports the conclusion I obtained for extremes of low or high pressure over England,† namely that in such cases the deviations at the top of the troposphere are about half those at sea level. Since the density is a function of both pressure and temperature, the result implies that the troposphere is normally cold in a deep depression and warm in a pronounced anticyclone, but that too large deviations of temperature in this sense are incompatible with extremes of sea-level pressure.

Comparison with Duxford.—Nearly simultaneously observations (within 3 or 4 hours) at Reykjavik and Duxford are available on 127 occasions. Interpolation is necessary to make a comparison either at fixed heights or fixed pressures, but errors due to this cause can only be small. The mean temperature difference for the whole year at 4 Km. was 11·0° F., with a standard deviation 11·4°F. For the winter period the mean difference was 16·1° F., with standard deviation 13·1° F., and for the summer period the mean was 7·3° F., with

* *London, Meteorological Office. Geophs. Publ.* No. 13.

† *London, Mem. R. Meteor. Soc.* Vol. 3, No. 29, p. 164.

standard deviation 9·9° F. Thus there are large fluctuations in the difference, and in fact it is often warmer over Reykjavik than over Duxford. The difference maintained a high average when a series of depressions moved over or to southward of Iceland, and for the period November 1st to February 9th the average was as high as 26·5° F. The extremes were 44° F. on February 4th and 40° F. on February 1st, and it can readily be seen from the charts that the air masses at the two stations were of widely different origin. (At a fixed pressure of 600 mb., the two extreme differences were 41° F. and 36° F.). The largest summer difference at 4 Km. was 29° F. on August 28th. The mean difference for July and August was 12·2° F., compared with only 3·4° F. for the period from April 15th to June 30th.

Temperature at 4 Km. was higher at Reykjavik than at Duxford on 22 out of 127 cases, or 17 per cent. On 19 occasions pressure at 4 Km. was higher at Reykjavik, and in another four cases it was the same to the nearest 1 mb. In 20 cases out of these 23 cases temperature at 4 Km. was higher at Reykjavik, so that pressure at 8 or 9 Km. was probably higher (or at least as high) over Reykjavik. A higher pressure over Iceland might involve either northerly or easterly upper winds between Iceland and England. Nephoscope observations of high or medium clouds in the British Isles north of Duxford showed north-east or east upper currents on nine of the occasions under consideration, and on another three occasions when there were no nephoscope observations, the upper current probably had an east component. Thus it is probable that the normal westerly upper current is reversed over a wide range of latitude on not much less than 10 per cent. of all days. At single stations in the British Isles the percentage of easterly upper currents is somewhat larger. It should be remembered that we are dealing with a region where the normal temperature gradient is below the average for the latitude.

Two cases of temperature reversals may be considered in greater detail. On February 9th temperature at 5 Km was 33° F. lower at Reykjavik than at Duxford. By next day an incursion of polar air had caused a large fall of temperature over Duxford, while at Reykjavik there had been an equally large rise in the rear of a wedge of high pressure, so that temperature at 5 Km. was 7° F. higher than over Duxford. (3 and 4 Km. readings missing, but as the 2½ Km. reading is also higher over Reykjavik, there is no doubt as to the reality of the change).

The other example is of special interest in view of the great snowstorm over the British Isles on February 23rd-24th, 1933. On February 21st temperature at 4 Km. was 1° F. higher at Reykjavik, and on February 23rd it was no less than 21° F. higher, and pressure was 13 mb. higher. At Duxford at 13h. 30m. temperature was $-20{\cdot}5°$ F. at 4 Km., an abnormally low reading. From surface conditions it is clear that the isotherms and isobars in the upper air must have been orientated more or less north to south, and that the gradients must have been steep where the depression formed off west Ireland. By 7h. on the 24th pressure was down to 986 mb. at Pembroke, and a cold air mass was quickly sweeping round the west side of the centre. Pressure and temperature at Reykjavik at 4 Km. were even higher than on the previous day, and it is obvious that the powerful easterly current on the north side of the depression must have extended to high levels. The sea-level gradient wind (*i.e.*, the approximate wind at 2,000 feet) was distinctly stronger on the north side of the depression than on the south side, and the slow westward drift of the depression after occlusion may be attributed to this fact, and to the fact that the easterly current was not merely superficial. Occluded depressions normally behave like vortices in a general current (when there is a general current), and drift slowly in the direction of their strongest winds, especially depressions intense enough to produce a fairly uniform temperature in their interior regions. The fact that the depression on February 24th moved westward instead of moving up the Channel or over southern England was of immense importance to British weather.

During the periods when pressure at 4 Km. over Reykjavik was as high as or higher than over Duxford, there was a complete absence of depressions moving east or north-east between the two stations. As a rule this was obvious beforehand from surface conditions, but nevertheless there is no doubt that upper air observations from Iceland would be very useful for forecasting on some occasions. A network of stations would be required for any large advance.

C. K. M. DOUGLAS.

Discussions at the Meteorological Office

The subject for discussion for the next meeting will be :—

January 15th, 1934.—*Observation of temperature in climatology (instruments, methods).* By L. Besson (Paris, A. Inst. Hydr. Climat., 7, 1932, Fasc. 4, No. 26) (in French). *Opener.*—E. V. Newnham, B.Sc.

Royal Meteorological Society

The opening meeting of this Society for the present session was held on Wednesday, November 15th, at 49, Cromwell Road, South Kensington, Prof. S. Chapman, F.R.S., President, in the Chair.

Preceding the Ordinary Meeting a Special General Meeting was held, and revisions of the by-laws were adopted whereby the annual subscription became two guineas instead of three guineas, which amount had been payable since 1921. The compounding fees for Life Fellowship were also reduced.

The Council of the Royal Meteorological Society has awarded the Symons Gold Medal for 1934 to Sir Gilbert T. Walker, C.S.I., F.R.S. The medal is awarded biennially for distinguished work in connexion with meteorological science, and will be presented at the Annual General Meeting of the Society on January 17th, 1934.

At the Ordinary Meeting Mr. C. J. P. Cave showed a few lantern slides of photographs of clouds taken during the past summer; Sir Gilbert Walker, F.R.S., also exhibited lantern slides giving further evidence of the existence of cells.

J. Edmund Clark, I. D. Margary and C. J. P. Cave.—Report on the Phenological Observations in the British Isles. December, 1931, *to November*, 1932.

Exceptional warmth again prevailed until February, which was also excessively dry. But the year was most notable for its wetness and dullness, above all, April, May and July. These gave half as much rain again as usual and only three-quarters of the sunshine average. June and early autumn largely saved the situation for field and garden crops, and gave a fine floral display from August on.

Plant events after April to early July, were late by ten days or more in England and Wales, but a bare week for the British Isles as a whole, since Scotland and Ireland fared much better. Worst were England south-east, south-west and Midlands. The floral isakairs (equal divergences from the average) show this well, with areas in the former over a fortnight late for all plants against ten days early in the latter.

Scarcity and lateness of three butterflies were the response to the wet cold of late April and May. The same cause accounted for no bird in the main migrant table being early. Due presumably to food shortage the 7 insect-feeders up to May 9th averaged 4 days later than the other 8 birds in the same period. The Spring migrant isophenes (equal appearance dates) lay much further south than usual, the reverse occurring in autumn, when the genial weather favoured lingering.

The additional notes received from many proved as usual of great value and form an important part of the letterpress.

Tables present the dates of the separate plants in each of the 11 districts, with averages for England and Wales and for the British Isles, also corresponding averages for 35 years, which are confirmed after 40 years. In an appendix are now tabulated the results decade by decade, with comparisons and ranges. These tables summarise a presentation of our results from an aspect not previously attempted.

V. V. Sohoni and M. M. Paranjpe.—Fog and Relative Humidity in India.

In this paper the authors showed that the association of fogs with unsaturated air was fairly common in India. Further, that although thick fogs are predominantly associated with relative humidities of over 90 per cent., thin fogs are equally prevalent with humidities of from 90 to 70 per cent.

Correspondence

To the Editor, *The Meteorological Magazine.*

Where is the Rainbow?

The elementary theory of the rainbow explains how the phenomenon is produced by reflection and refraction of the sun's rays falling on raindrops, and that the bright coloured arch that we see is actually a multitude of drops which are momentarily in the right position to transmit the refracted and reflected light into the eyes of the observer. This is all quite simple and straightforward, but if we pursue the matter a little further we arrive at a curious and paradoxical result.

Suppose we attempt to locate the position of the rainbow in space by using one of the ordinary methods depending on parallax. We might, for example, use a range-finder, or take the bearings of a point on the bow, *e.g.*, the apex, from two points at the ends of a measured base line. If that be done, the distance so determined is not the distance of the raindrops but "infinity," for the simple reason that it is impossible to observe the same rainbow from two different positions. When the observer moves from one position to the other, the rainbow moves too. The bearings measured from the two ends of the base line will be identical. It does not matter whether the bow is formed by a shower a mile away or by the spray from a garden hose-pipe a few yards away, the result must always be the same.

Now our own normal optical equipment consists of a pair of eyes which enable us to judge distances and to see things in their proper spatial relationship by observing simultaneously from two view points, about two and a-half inches apart. Speaking for myself, I feel positive that when I look at a rainbow formed by the spray of a garden hose, I judge it to be close at hand among the falling drops. The theory given in the preceding paragraph indicates, however, that I should judge it to be far behind the drops, at an infinite distance (or to be more accurate, at the distance of the sun). Possibly the explanation is that the parallax due to binocular vision is only one of the factors entering into our judgment of distance, other factors being brightness, contrast and apparent relative position. In the case of the rainbow the eyes see a bright translucent object associated with the water drops, and interfering with the visibility of objects beyond the spray. The illusory evidence arising from binocular vision is rejected and the brain judges the bow to be where it really is—among the water drops.

Has anyone ever taken a stereoscopic photograph of the rainbow formed in spray a few yards from the camera? It would be very interesting to see what it looks like in the stereoscope.

E. G. BILHAM.

The Hot Summer and the Scottish Snowbeds

Since my note in your last issue I have ascertained beyond any doubt that the snowbed in the Observatory Gully of Ben Nevis had also completely disappeared by September 23rd last. This information was furnished, among others, by five Scottish climbers who were climbing from the Hut at the foot of the Observatory Gully from September 23rd-25th.

The snowbed under Aonach Beag also disappeared on or about September 30th, so that for a week or ten days there could not have been any snow in all Scotland for the first time in memory, unless, which seems improbable, there is some undiscovered cleft in which snow accumulates in still greater depth than it does under (1) Ben Nevis, (2) Aonach Beag, and (3) Braeriach of the Cairngorms.

R. P. DANSEY.

Kentchurch Rectory, Hereford. November 28th, 1933.

The Summer of 1933

While acknowledging the abundant sunshine of the past summer here in Lancashire at least the rainfall compares unfavourably with that of 1932; there were bad storms in June, especially on the 20th, and the rainfall in August was also greater than last year. The total rainfall (June to August inclusive) this year 8·35 inches was approximately 2 inches more than in 1932 which, in spite of the wet July was a really dry summer.

H. NOWELL FFARINGTON.

Worden Hall, Leyland, Lancashire. November 29th, 1933.

A Brilliant Lunar Corona and Rain from an Apparently Cloudless Sky

The following phenomena were observed at this station on October 31st and November 5th respectively, and I send details in the hope that they may be of interest.

At 21h. 54m. G.M.T. on October 31st a very fine and beautifully coloured lunar corona was observed here. The sequence of colours when first observed was reddish-brown (on outside of ring), green, and blue (inside). At 22h. no less than three distinct rings could be seen, the colour sequence now being reddish-brown (outside), green (very distinct), blue, reddish-brown, green, red, and finally whitish nearest the moon. After 22h. the corona quickly faded. The cloud in which it was seen was alto-cumulus with patches of smooth alto-stratus and was moving rapidly from north-west by north.

On November 5th at 8h. 35m. G.M.T., a few small drops of rain were observed to be falling from an apparently cloudless sky overhead. There was only 3/10ths of cloud which consisted of a little cirro-stratus to the north-west with cirrus and cirro-cumulus, strato-cumulus and cumulus low down on the south and south-east horizons. The greatest amount of cloud was situated to the north. No cloud occurred in the zenith and very little above about a quarter of the whole sky. All three types of cloud were moving from some point of north-east, the cirriform cloud having a more northerly drift than the two lower types. The sun was shining strongly at the time but no rainbow was seen. The surface wind was northerly, moderate and the screen temperature was 39°. No rain was seen to be falling from the patches of strato-cumulus. About 11h. a very slight shower of drizzle occurred, but by this time the cloud had increased and had become more or less cumuliform. Only on one other occasion have I observed rain to fall from an apparently cloudless sky during the past six years.

A. E. MOON.

39, *Clive Avenue, Clive Vale, Hastings. November 6th*, 1933.

Sunspots and Sunshine

I am much obliged to Mr. Hawke for his contribution in your November issue, to the serious discussion of my article on the above subject. I gather from his own article that there is support for the 3½- to 4-year periodicity in the occurrence of fine summers, which it was the main purpose of my own article in your October issue to prove, but that he disagrees with my statement that the exceptionally fine summers occur at the times of minimum sunspot activity. My statement and figures on this point were based upon an article which was published in the *Daily Mail* under his signature, on June 6th of the present year, in which he stated " that as far back as reliable meteorological observations are known to extend, at least one notably fine and hot season has invariably marked the approach of each minimum of the sunspot cycle. . . . Last winter there was a rather surprising recrudescence of solar activity for a couple of months, but this subsided during the spring and there can be little doubt that the minimum of a cycle associated in its approach with the maximum tendency towards dry summer weather in this country is now at hand."

I am quite open to correction, however, on the point that the years of minimum sunspot activity are not exactly coincident with the years of maximum sunshine in this country, and to accept Mr. Hawke's figures of 1901, 1913 and 1923 as the correct years of sunspot minima during the present century. Only ten years separated, however, the last two periods of minimum, and it is still possible that 1933 may prove to be another year of minimum solar activity, as indicated by Mr. Hawke in the last paragraph quoted above.

JOHN B. C. KERSHAW.

Oaklands, Conway Road, Colwyn Bay. November 25th, 1933.

Pollen in a Cloud

Recently, whilst flying over the Tochi Valley in Waziristan (with the object of taking dry and wet bulb temperature readings in and near cumulus cloud), my pilot and I had a rather unpleasant but interesting experience.

We entered a patch of cumulus, which was about 100 ft. thick, at approximately 6,900 ft. above the ground, the time being 10h. 30m. I.S.T. Immediately, I noticed a smell of hay and felt a tickling sensation in my nose. My eyes began to water, and I sneezed frequently until we emerged from the cloud. On landing shortly afterwards I saw that my pilot had also been affected. His eyes and nose were still in a lachrymose condition! He, too, stated that he could "smell" the cloud.

We had both observed that on the hillside below the patch of cumulus there was a party of villagers busily winnowing, and there appears to be little doubt that fine particles of chaff and pollen had been lifted into the cloud by convection currents. We did not experience any bumpiness just below the cloud, but from 3,000 ft. down to the ground the air was very turbulent.

The dry and wet bulb readings taken on the way down from 6,000 ft. were as follows:—

Height.	*Dry.*	*Wet.*
Ground level	91	80
1,000 ft.	84	74
2,000 ,,	78	69
3.000 ,.	72	64
4,000 ,,	69	61
5,000 ,.	65	58
6,000 ,,	61	54

It will be observed that the lapse-rate was super-adiabatic from ground-level to 3,000 ft., hence the ascending currents and consequent turbulence. The temperature readings just below, in, and outside the cloud have not been given, as they will be included in a set of similar observations to be published at a later date. I may add that I, personally, am subject to catarrh, but that my pilot had never experienced "hay-fever" before!

R. G. VERYARD.

No. 1 *(Indian) Group Headquarters, R.A.F., Peshawar. October* 21*st*, 1933.

Degree of Accuracy in Estimating Tenths

Using my wet and dry bulb observations for May, 1932, to October, 1933, I calculated the percentage frequency with which each of the figures 0 to 9 occurred in the decimal place. These are as follows:—

Figure		0	1	2	3	4	5	6	7	8	9
Percentage Frequency	Wet Bulb	28·5	12·2	11·8	6·3	4·3	2·7	5·5	6·9	10·8	11·0
	Dry Bulb	33·7	8·1	14·9	5·8	2·1	3·7	3·3	5·8	13·3	9·3

These figures, together with those of Dr. D. N. Harrison* seem to indicate that the ordinary observer is inclined to underestimate the decimal place, if the value is less than ½ and to overestimate, if greater than ½.

It seems to me that if observers calculated the percentage frequency from their own observations, as done above, they would then be able to make better estimates of the decimal places in their future observations, as they would then know where their errors lay.

R. H. DAW.

Trerose. St. Mary's Avenue, Northwood, Middlesex. November 6th, 1933.

Referring to the note on this subject in the *Meteorological Magazine* for October, surely the writer would not suggest that the figures quoted in his paragraph (2) are any criterion of what can be accomplished with a millimetre scale estimating to tenths.

The following are from Lerwick Tabulations (3,124 readings). No special virtue is claimed for them, the readings having been made in the ordinary course of the day's work. They are again hourly values as in Dr. Harrison's example:—

Figure	0	1	2	3	4	5	6	7	8	8
Percentage Frequency	8	8½	8½	10½	12½	10	13½	11	9½	9

The tendency seems to have been to over-estimate values below ·5 and under-estimate those above ·5. This is in contradiction to the Japan figures.† The partiality for sixes, however may be a human failing. Was it not suggested by the Japan experiment, where "·66 was a much greater stumbling block than ·24"?

Objection might be made to the choice of these Lerwick figures for this purpose, on the grounds that they represent readings

* See *Meteorological Magazine*, 68, 1933, p. 213.
† See *Meteorological Magazine*, 68, 1933, p. 191.

made by one individual and checked by a second. They may, however, be defended as follows:—

(*a*) Reader and checker seldom differed by more than ·1, in which case the reader's figure was unaltered.

(*b*) Occasionally differences of ·2 occurred, in which event the difference was divided. In these cases it is not too much to assume that the final figure was *in general* more nearly correct than the reader's.

(*c*) Very occasionally differences of ·3 or more occurred, but they invariably yielded to arbitration.

The net result would be that the reader's preferences as exhibited in (*a*) would be but slightly smoothed in the final result by the few cases occurring in (*b*).

Any favouritism which shows up in the final result, however, is not necessarily present in the reader alone. The checker might have similar tastes. That such a similarity does occur is shown by the following table covering another 3,308 observations, where the readings were made by one of three tabulators in turn, and checked by a second. There is a distinct similarity between this and the previous table:—

Figure	0	1	2	3	4	5	6	7	8	9
Percentage Frequency	10½	7½	9	9½	11	10½	13	11	9½	8

This similar favouritism may be the function of the trace and may depend on its quality and on its thickness relative to the divisions on the scale.

Returning to the example quoted by Dr. Harrison, the suggestion of reading to the nearest half-millimetre would not have availed much. Presumably the tabulator would still have concentrated on the whole number, making 82 per cent. of readings end in 0·0 in the first case and 83 per cent. in the second.

J. C. CUMMING.

Lerwick Observatory. November 6th, 1933.

NOTES AND QUERIES

The "Gustiness" Shown on Pressure Tube Anemograms with Half-inch and One-inch Pressure and Suction Pipes

In May, 1930, the Dines anemograph with ½-inch pressure and suction pipes at Lympne was replaced by one having 1-inch pipes, and it was immediately noticed that the character of the records had changed, in that the trace showed not only a very much increased range of gustiness, but occasional notably low lulls. Accordingly, it was thought worth while by Mr. R. A. Watson, the officer in charge, to extract the figures given in Tables I and II below with a view to obtaining a quantitative value of the change of gustiness.

A measure of the gustiness was obtained as follows: The hour with the highest mean wind was taken out each day and the highest gust and lowest lull in the hour noted. The mean value of these highest gusts divided by the mean wind in the hours in which they occurred was then deduced as a measure of the magnitude of the gusts. This is given under A in the tables below. Similarly, the mean of the lulls divided by the mean wind is given under B.

TABLE I.—Lympne, Anemograph with ½-inch pipes.

1929.	*A.*	*B.*
January	1·39	·62
February	1·39	·66
March	1·31	·63
April	1·39	·61
May	1·38	·57
June	1·42	·52
July	1·48	·55
August	1·41	·54
September	1·38	·58
October	1·49	·53
November	1·45	·56
December	1·48	·57
Mean	1·41	·58

TABLE II.—Lympne, Anemograph with 1-inch pipes.

1930.	*A.*	*B.*
June	1·54	·25
July	1·69	·19
August	1·65	·26
September	1·60	·30
October	1·69	·17
Mean	1·63	·23

The very marked effect of the change from ½-inch to 1-inch pipes on the lulls is at once noticeable from these figures.

In order to ascertain to what extent the lulls at Lympne were abnormal, similar figures were then got out in the Meteorological Office for other stations, particularly those where anemometers with ½-inch pipes had been replaced by instruments with 1-inch pipes. The results are shown in Table III. The length of connecting pipes is about 30-35 feet in all cases except at Croydon and Lympne, where the pipes are 70 feet in length. The length is of some importance as the damping effect of long pipes will be more marked than that of short pipes, particularly in the case of ½-inch pipes.

Table III shows, as would be expected, that the substitution of 1-inch connecting pipes for ½-inch pipes leads in all cases to an increase in the gustiness of the record, the gusts being raised and the lulls lowered. It also shows that while at

TABLE III.

Station.	*Diameter of Pipes.*	*A.*	*B.*
Science Museum, London, S.W.7.	1 inch	2·39	·013
Croydon	1 ,,	1·67	·42
Lympne	1 ,,	1·63	·23
Lympne	½ ,,	1·41	·58
Pendennis	1 ,,	1·48	·52
Pendennis	½ ,,	1·35	·63
Scilly (Telegraph) ...	1 ,,	1·42	·58
Scilly (Garrison) ...	½ ,,	1·34	·65
Holyhead	1 ,,	1·52	·53
Holyhead	½ ,,	1·34	·62
Bell Rock	1 ,,	1·28	·70
Lerwick	1 ,,	1·47	·58
Lerwick	½ ,,	1·37	·68

Lympne the effect on the gusts was not dissimilar to that at other stations, the effect on the lulls was decidedly abnormal. This is brought out even more clearly in the following table where the ratios of A_1 to $A_{\frac{1}{2}}$ and of B_1 to $B_{\frac{1}{2}}$ are set out. The suffixes refer to the diameter of the pipes.

TABLE IV.

	$\frac{A_1}{A_{\frac{1}{2}}}$	$\frac{B_1}{B_{\frac{1}{2}}}$
Scilly	1·06	0·89
Lerwick	1·07	0·85
Pendennis	1·10	0·83
Holyhead	1·13	0·85
Lympne	1·16	0·40

The fact that the connecting pipes are of greater length at Lympne than at the other stations in this table would readily explain the slightly larger figure 1·16 for gusts. It would not however be sufficient to account for the abnormally low figure for the lulls. The figure 0·40 for the ratio B_1 to $B_{\frac{1}{2}}$ at Lympne seems to be indicative of some peculiar system of eddies which give marked lulls of such short period that they are to a very considerable extent damped out on the records of a pressure tube recorder with ½-inch pipes though they are recorded satisfactorily on one with 1-inch pipes.

Turning again to Table III, in general the difference between A and B is less at the coastal stations than at the inland stations and this difference forms a measure of the turbulence of the wind. Placing the stations in order of increasing turbulence, we obtain Table V. The figures relate to anemometers fitted with

1-inch pipes in each case. The exceptional turbulence recorded

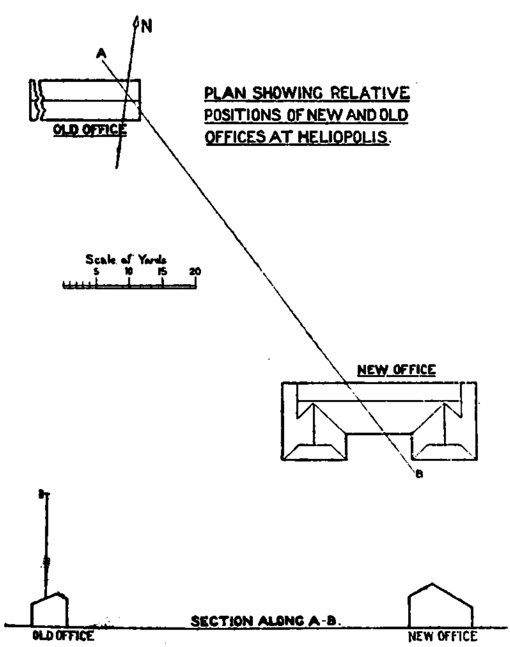
TABLE V.

	Difference A—B.
Bell Rock	0·58
Scilly	0·84
Lerwick	0·89
Pendennis	0·96
Holyhead	0·99
Croydon	1·25
Lympne	1·40
Science Museum, London, S.W.7 ...	2·26

by the anemometer on the roof of the Science Museum in the heart of London is well shown. J. S. DINES.

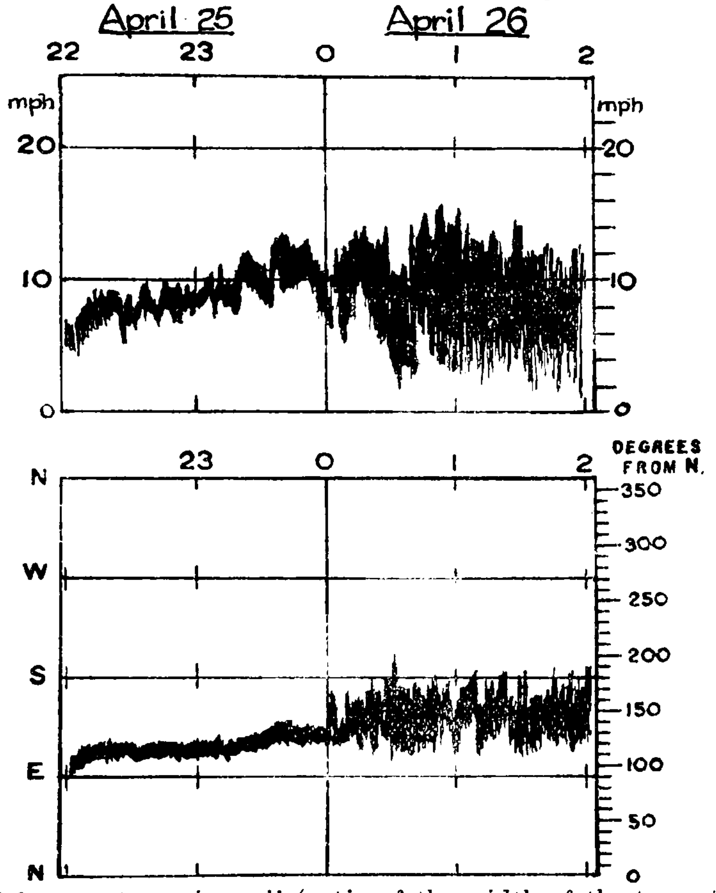
The Effect of a Building on the Gustiness of the Wind

The meteorological station at Heliopolis, north-east of Cairo, lies in fairly level country with a general slope from south to north, bounded between south-east and south-west by comparatively high ground, which rises to 1,000 feet at a distance of 12 miles to the south-east. This high ground causes a well-defined katabatic wind from a south-easterly direction on many nights.



Winds are measured by a pressure-tube anemometer erected above the old Meteorological Office building, 26 feet above the apex of the roof and 40 feet above the ground. Mr. J. Durward remarks that before the erection of the new office, the katabatic winds from between E. and S. all showed very little gustiness.

The new office building (see Fig. 1) is to the south-east of the anemometer mast. The furthest corner is 180 feet distant and the nearest corner about 135 feet. The height of the new building is 14 feet to the eaves, about 19 feet to the apex of the roof, and its length is 88 feet. Fig. 2, representing a portion of the anemometer trace at Heliopolis on April 25th and 26th, 1933, shows the effect of the introduction of this building. During the first part of the trace, the wind did not pass over the new building on its way to the anemometer, and the gustiness is small,



the "factor of gustiness" (ratio of the width of the trace to the mean velocity) being only about 0·6 or 0·7. After the wind veered beyond about 130° however, so that the new building lay in the path of the wind to the anemometer, the width of the trace became very much greater and the factor of gustiness increased to about 2·0, while the mean wind speed was reduced by 1-2 miles per hour. This trace is of considerable interest in connexion with the problem of anemometer exposure.

Books Received

Deutsches Meteorologisches Jahrbuch, 1931. Freie Hansestadt Bremen. Edited by Dr. A. Mey. Jahrgang 42, Bremen. 1932.

In addition to the usual very complete presentation of this year's data, this volume contains two interesting notes, one on "A comparison of temperature within and without the town of Bremen," by A. Mey, and the other on "A contribution to the Climatology of the North Sea coast," by P. Lühe and W. Feld.

The electric field of overhead thunderclouds. By S. K. Banerji, D.Sc. London: Phil. Trans. Roy. Soc., series A, vol. 231, pp. 1-27.

Obituary

LUIGI PALAZZO, *Socio nazionale della Reale Accademia Nazionale dei Lincei Grand' Ufficiale della Corona d'Italia, Commendatore della Corona di Prussia, e dell'Aquila Rossa.*—On June 13th of this year Luigi Palazzo died in Florence; his wife, Maria Giuseppina, after a union of forty-four years, had previously died in Rome on April 9th, to the great grief of himself and his family.

Palazzo had been associated with the meteorological and geophysical service of Italy for forty-three years and director for thirty-one of them. He had retired from the directorate of the Office in the Collegio Romano, on reaching the age limit, on October 31st, 1931. His services were forthwith commemorated by the *Premio Palazzo*, a prize founded by subscription to be awarded every four years by the Accademia dei Regi Lincei for contributions to meteorology or geophysics within the eight years previous to the award.

Palazzo's career is set out by Professor G. B. Rizzo of Naples in the July-August number of *Meteorologia Pratica*, the organ of the Società Meteorologica Italiana, of which Palazzo was for many years vice-president. He was also President of the International Seismological Association and Vice-President of the Italian Committee for Geodesy and Geophysics, and held many other appointments and distinctions. A list of papers includes 8 on experimental physics with hygiene, 40 on meteorology and aerology, 61 on terrestrial magnetism, 13 on seismology, 34 biographical notices, addresses or books.

The development of the Government service with which he was so long associated is set out by P. D. Bernardo M. Paoloni, O.S.B., in the correspondence number of the same journal in 1931.

He was born in Turin on January 18th, 1861, was at school at the Liceo "Cavour" in that city, and entered the University in November, 1880, graduated in physics in July, 1884, with a special taste for experiment, spent two years at Rome in the Ufficio Centrale di Meteorologia and in the Instituto Fisico dell' Università there, devoting himself mainly to terrestrial magnetism. Then two years in German universities, first at Würzburg and then at Berlin and the Prussian Meteorological Institute, again with special devotion to terrestrial magnetism.

In 1887 he was called to succeed Chistoni as Physical Assistant in the Ufficio Centrale at Rome, and from that time was in charge of terrestrial magnetism for Italy, a branch of science which he developed with scrupulous care and attention throughout his life. His magnetic charts of Italy and her colonies are a permanent memorial.

In September, 1899, when Prof. Tacchini retired from the direction of the Italian Office, Palazzo was nominated Reggente la Direzione dell'Ufficio, and in August, 1901, Director. So the responsibility for meteorology was included in his *carica* with that for magnetism.

In 1900 in the midst of a very embarrassing political situation he and I were present together at an open meteorological conference at Paris in connexion with the International Exhibition of that year. On September 15th at the end of the Conference in a small room at the top of the Eiffel Tower an irregular meeting of the International Meteorological Committee was held under the Chairmanship of E. Mascart, Director of the Bureau Central Météorologique, Professor of Physics in the Collège de France, and afterwards President of the Academy of Sciences. At that meeting Palazzo and I were elected members of the Committee in succession to Ciro Tacchini and Robert Henry Scott, and thereafter I had many opportunities of renewing our friendship, including two visits to Rome on my part and at least two visits to England on his.

As a member of the Committee and of many of the special commissions he was a regular attendant at the international meetings. German was ordinarily his second language, and terrestrial magnetism was evidently his own subject; but he missed no opportunity of meteorological investigation and combined it with his visits of magnetic exploration, as in his expedition to Zanzibar in July, 1908, and to the Indian Ocean with *ballons-sondes* for use at sea in December, 1909.

He was in every way a "good companion," and like many good companions he developed a deafness which interfered to some extent with social amenities. When an international commission, meeting in London, went to spend a week-end at Ditcham Park with Mr. Cave, he was discovered on the platform at the station with no luggage, not having heard the whole of the invitation; but he got there all right as usual, and at dinner he astonished ladies on either side of him, specially invited to talk to him in Italian, by responding to their carefully elaborated Italian in French. However, the chief feature of that notable assembly was the consternation when one of the guests, who had never shaved himself, found himself five miles away from the nearest tonsorial artist. That was not Palazzo; he wore a beard.

Palazzo continued as a member of the International Committee until the month of his retirement from Office, and on October 5th, 1931, he attended the meeting at Locarno and took affectionate farewell with many friendly reminiscences of what certainly could claim to be the most fraternal assembly in the world of the representatives of diverse nationalities.

NAPIER SHAW.

News in Brief

The 1934 annual meeting of the British Association will be held at Aberdeen from September 5th to 12th under the presidency of Sir William Hardy, F.R.S. Col. Sir Henry Lyons, F.R.S., has been appointed President of the Conference of Delegates of Corresponding Societies.

At the anniversary meeting of the Royal Society on November 30th, 1933, the Royal Medal, 1933, was presented to Prof. G. I. Taylor for wide researches including among other subjects turbulence and the formation of fog, and the Hughes Medal, 1933, to Prof. E. V. Appleton for researches on the ionosphere.

The Buys Ballot Medal, 1933, has been awarded by the Koninklijk Akademie van Wetenschappen te Amsterdam to Prof. V. Bjerknes. The medal is awarded every ten years, the recipient in 1923 being Sir Napier Shaw.

We learn from *Nature* that the Oxford Congregation has voted an additional grant of £50 to the School of Rural Economy for an expedition to a district of the southern Sudan with the view of investigating extreme conditions of drought and rainfall in their bearing on agricultural development.

Admiral Byrd is on his way to the Bay of Whales in the Antarctic with a surveying expedition of two ships, one of which carries an aeroplane and an autogyro. The expedition hopes to reach Admiral Byrd's former encampment on Christmas Day. The collection of meteorological observations is one of the objects of the expedition.

Errata

October, 1933, p. 213, last line but one, *for* " ended in 0·9, 0·0 or 0·1 " *read* " ended in ·9, ·0 or ·1," and p. 214, line 4, for " end in 0·0 or 0·5 " *read* " end in ·0 or ·5."

November, 1933, p. 240, last line but one, after " By Charles H. Brown " *add* " 7th edition. Size 8½ in. × 5½ in., pp. ix + 234. *Illus.* Glasgow: Brown, Son & Ferguson Ltd., 1933, 7s. 6d. net."

The Weather of November, 1933

Pressure was above normal over western North America, Spitsbergen, Iceland, northern Europe and eastern North Atlantic, the greatest excesses being 7·7 mb. at 50° N. 120° W. and 7·5 mb. at Lerwick. Pressure was below normal over most of eastern North America, western North Atlantic and central and southern Europe and the Mediterranean, the greatest deficits being 6·2 mb. at Zurich and 4·8 mb. at 60° N. 60° W. Temperature was above normal at Spitsbergen and northern Norway, but below normal generally elsewhere in western Europe. Rainfall was in excess in the north but deficient in central Europe and most of Sweden; in north-west Gothaland there was only 10 per cent. of the normal.

The chief feature of the weather of November over the British Isles was the deficiency of rain except along the east coast. At Ross-on-Wye and Stornoway the monthly totals were only 22 per cent. and 30 per cent. of the normal, while at Tynemouth, the total of 4·41 in. was more than twice the normal. Sunshine was generally above the normal in the western districts and the mean temperature mainly below normal in the south but above normal in the north. There was a marked absence of south-westerly winds. Squally winds from NW. veering N. persisted generally until the 3rd, in the rear of a depression moving east over the North Sea and reached gale force locally, while the weather was showery with snow on the hills in Scotland and hail at a few places, even in the south. Sunshine records were good during this time, over 8 hrs. at several places. After the 3rd an anticyclone spread in from the Atlantic, mainly fair to cloudy weather with slight showers prevailed and the winds moderated though continuing from the north. The air, however, was coming from the south round the anticyclone and on the 6th gave high temperature in the north, when 62° F. was recorded at Leuchars and 61° F. at Dundee, and on the 7th in the south as well. Much mist and fog prevailed from the 5th to 9th. On the 8th the winds backed to W. and SW. and the weather again became cold and unsettled though with sunny intervals. The 11th was a markedly cold day generally, at Renfrew the maximum temperature did not rise above 37° F. On the 14th a depression passed south-south-east across the country giving strong winds or gales at times in Scotland and Ireland and heavy rain locally, 1·75 in. fell at Donaghadee (Co. Down), and 1·60 in. at Borrowdale (Cumberland) on the 14th and 1·04 in. at Talyllyn (Merioneth) on the 15th. From then until the 18th the winds were easterly and the weather cloudy with scattered showers, but after the 18th the winds veered to SE. and S. and the temperature rose. During the following brief mild spell a maximum of 60° F. was recorded at Croydon on the 20th and conditions were generally quiet with much fog over most of England until the 23rd, though brighter weather occurred in the west and north. On the 24th the winds freshened somewhat from NE. or N. causing a drop in temperature as the anticyclone to the north spread over the country. Showers of sleet and snow were experienced along the east coast on the 25th, while on the 26th persistent fog at Renfrew was associated with a maximum temperature of 26° F. The greater part of the country remained under the influence of this anticyclone until the end of the month, the weather being generally cold and dry with little sun and much mist or fog. Meanwhile a depression approached from the Atlantic on the 27th giving south-easterly winds with milder fairer weather along the western seaboard. This was maintained until the 30th when the winds in the north and west freshened from S. or SE. with gales locally, and heavy rain fell in south-west Ireland, 1·70 in. at Valentia, Co. Kerry. The distribution of bright sunshine for the month was as follows:—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway	51	+ 8	Liverpool	55	— 4
Aberdeen	47	— 8	Ross-on-Wye	71	+ 8
Dublin	59	—12	Falmouth	63	—13
Birr Castle	68	+ 4	Gorleston	44	—18
Valentia	80	+15	Kew	48	— 4

The special message from Brazil states that the rainfall was generally scarce with averages 0·12 in. above normal and 0·83 in. and 1·10 in. below normal in the northern, central and southern regions respectively. Five anticyclones crossed the country. The crops were generally in good condition except in the north-east where the cane was affected by the unfavourable weather and in the south on account of the locusts. At Rio de Janeiro the mean pressure was 0·4 mb. above normal and mean temperature 0·9° F. below normal.

Miscellaneous notes on weather abroad culled from various sources It was reported on the 6th that the snow in Switzerland was 1 ft. deep at the 3,600 ft. level and 6 ft. deep above the 6,000 ft. line, and on the 18th that snow had fallen in Turin and over Piedmont. On the 20th Stugsund was free of ice, but at most of the other ports in the Gulfs of Bothnia and Finland thin ice had formed though navigation was not hindered. Falls of from 12 in. to 18 in. of snow occurred on the 28th over most of Switzerland and snow fell during the 26th and 27th in Alsace, the fall being especially heavy in the Vosges. A severe storm occurred along the Turkish Black Sea coast at the end of the month and 17 people were drowned. (*The Times*, November 7th-December 2nd.)

On the 9th, it was recorded that the drought in South Africa had broken as good soaking rains had fallen in many districts of the Cape during the previous 48 hours, and also in scattered districts of south-west Africa. In the Free State, Transvaal and Natal rains had started a few days before that. Good rains also fell in Kenya during the week ending the 21st. A series of dust storms occurred in the Orange Free State towards the end of the month, culminating on the 29th in a storm which did much damage to the southern districts of Rouxville, Bethulie and Smithfield. (*The Times*, November 10th-December 1st.)

A severe hailstorm is reported on the 17th to have demolished the houses at Namyang 27 miles from Hsipaw in the Shan States, Burma, killing three people and making 300 more homeless. The storm uprooted great trees and ruined the crops, the hailstones being of a large size unprecedented in the Shan States. (*The Times*, November 18th.)

On the 18th it was stated that useful rains varying from ½ in. to 1 in. had fallen over Victoria; on the 20th the severe drought in the north-eastern pastoral country of South Australia was broken, and after this, extensive and timely rains occurred over the whole State, amounting to as much as 3·5 in. in two days in some places. Towards the end of the month, however, serious floods followed torrential rains and large areas of wheat and other crops were damaged and three lives lost. The weather had moderated at the end of the month. (*The Times*, November 20th-December 2nd.)

Abnormally cold weather occurred in Ontario about the 16th. and a snowstorm was raging over the Great Lakes from the 9th to 16th. From the 21st navigation was difficult in the St. Lawrence River owing to the ice conditions. On the 28th close packed ice also occurred from Quebec to Murray Bay beyond which there was open water. Temperature in the eastern United States was above normal at the beginning of the month, but by the second week the cold spell in the west was extending also to the east. This was followed by a warm spell which extended south-east only at first and did not reach the north-eastern States until towards the close of the month. Precipitation was generally below normal. (*The Times*, November 16th-30th, and *Washington, D.C., U.S. Dept. Agric., Weekly Weather and Crop Bulletin.*)

Severe gales were experienced at times on the North Atlantic.

General Rainfall for November, 1933

England and Wales ...	59	per cent of the average 1881-1915.
Scotland	67	
Ireland	49	
British Isles	59	

Rainfall: November, 1933: England and Wales.

Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per-cent. of Av.
Lond .	Camden Square	·88	39	*Leics.* .	Thornton Reservoir ...	1·72	76
Kent .	Tenterden, Ashenden...	1·48	49	,, .	Belvoir Castle...........	1·94	87
,, .	Folkestone, Boro. San .	2·16	...	*Rut* .	Ridlington	2·00	87
,, .	St. Peter's, Hildersham	...	...	*Lincs* .	Boston, Skirbeck	2·29	115
,, .	Eden'bdg., Falconhurst	1·01	28	,,	Cranwell Aerodrome ...	2·15	115
,, .	Sevenoaks, Speldhurst	1·25	...	,, .	Skegness, Marine Gdns	1·94	90
Sus .	Compton, Compton Ho.	·90	24	,, .	Louth, Westgate	1·87	72
,, .	Patching Farm	1·23	35	,, .	Brigg, Wrawby St. ...	1·63	...
,, .	Eastbourne, Wil. Sq.	1·24	35	*Notts* .	Worksop, Hodsock ...	1·93	98
,, .	Heathfield, Barklye ...	1·63	44	*Derby* .	Derby, L. M. & S. Rly.	1·04	48
Hants.	Ventnor, Roy. Nat. Hos.	1·00	31	,, .	Buxton, Terr. Slopes	2·50	53
,, .	Fordingbridge, Oaklnds	1·01	30	*Ches* .	Runcorn, Weston Pt...	1·78	64
,, .	Ovington Rectory	·80	24	*Lancs*.	Manchester, Whit Pk.	1·14	43
,, .	Sherborne St. John ...	·46	16	,, .	Stonyhurst College ...	1·91	42
Herts .	Welwyn Garden City...	1·33	56	,, .	Southport, Hesketh Pk	1·56	50
Bucks.	Slough, Upton	·99	45	,, .	Lancaster, Greg Obsy.	1·81	45
,, .	H. Wycombe, Flackwell	·92	45	*Yorks*.	Wath-upon-Dearne ...	1·70	83
Oxf .	Oxford, Mag. College...	1·00	45	,, .	Wakefield, Clarence Pk.	2·04	96
Nor .	Pitsford, Sedgebrook...	..	...	,, .	Oughtershaw Hall......	4·33	...
,, .	Oundle....................	1·76	...	,, .	Wetherby, Ribston H.	3·15	135
Beds .	Woburn, Exptl. Farm..	1·52	68	,, .	Hull, Pearson Park ...	2·89	132
Cam .	Cambridge, Bot. Gdns.	1·25	65	,, .	Holme-on-Spalding ...	2·10	96
Essex .	Chelmsford, CountyLab	1·19	53	,, .	West Witton, Ivy Ho.	3·43	99
,, .	Lexden Hill House ...	1·08	...	,, .	Felixkirk, Mt. St. John	4·07	166
Suff .	Haughley House.........	1·43	...	,, .	York, Museum Gdns.	2·70	129
,, .	Campsea Ashe...........	3·54	160	,, .	Pickering, Hungate ...	3·06	123
,, .	Lowestoft Sec. School	3·49	148	,, .	Scarborough	2·11	86
,, .	Bury St.Ed ,WestleyH.	1·71	74	,, .	Middlesbrough	3·24	153
Norf .	Wells, Holkham Hall	2·07	96	,, .	Baldersdale, Hury Res.	2·70	73
Wilts.	Devizes, Highclere......	·73	27	*Durh* .	Ushaw College	4·40	173
,, .	Calne, Castleway	·67	27	*Nor* .	Newcastle, Town Moor	3·32	137
Dor .	Evershot, Melbury Ho.	1·07	25	,, .	Bellingham, Highgreen	2·69	78
,, .	Weymouth, Westham .	·68	22	,, .	Lilburn Tower Gdns...	4·46	133
,, .	Shaftesbury, Abbey Ho.	·69	21	*Cumb* .	Carlisle, Scaleby Hall	·85	28
Devon.	Plymouth, The Hoe ...	1·50	41	,, .	Borrowdale, Seathwaite	3·00	23
,, .	Holne, Church Pk. Cott.	1·63	30	,, .	Borrowdale, Moraine...	3·72	36
,, .	Teignmouth, Den Gdns.	·96	31	,, .	Keswick, High Hill...	1·86	33
,, .	Cullompton..............	·89	26	*West* .	Appleby, Castle Bank	1·99	60
,, .	Sidmouth, Sidmount...	1·19	38	*Mon* .	Abergavenny, Larchf'd	1·12	29
,, .	Barnstaple, N. Dev. Ath	1·33	34	*Glam* .	Ystalyfera, Wern Ho.	1·64	25
,, .	Dartm'r, Cranmere Pool	2·50	...	,, .	Cardiff, Ely P. Stn. ...	·93	22
,, .	Okehampton, Uplands	1·70	32	,, .	Treherbert, Tynywaun	2·44	...
Corn .	Redruth, Trewirgie ...	2·18	45	*Carm*.	Carmarthen Friary ...	·80	16
,, .	Penzance, Morrab Gdn.	1·76	38	*Pemb* .	Haverfordwest, School	1·81	36
,, .	St. Austell, Trevarna...	2·17	44	*Card* .	Aberystwyth	1·02	...
Soms .	Chewton Mendip	·68	16	*Rad* .	BirmW.W.Tyrmynydd	1·86	28
,, .	Long Ashton	·57	18	*Mont* .	Lake Vyrnwy...........	1·62	29
,, .	Street, Millfield.........	·68	25	*Flint* .	Sealand Aerodrome ...	1·37	57
Glos .	Blockley	1·38	...	*Mer* .	Dolgelley, Bontddu ...	2·18	35
,, .	Cirencester, Gwynfa ...	1·12	38	*Carn* .	Llandudno	1·41	49
Here .	Ross, Birchlea............	·67	26	,, .	Snowdon, L. Llydaw 9	5·19	...
Salop .	Church Stretton.........	·85	29	*Ang* .	Holyhead, Salt Island	1·81	44
,, .	Shifnal, Hatton Grange	1·17	45	,, .	Lligwy....................	2·25	...
Staffs .	MarketDrayt'n,Old Sp.	1·32	50	*Isle of Man*			
Worc .	Ombersley, Holt Lock	·77	34		Douglas, Boro' Cem. ...	2·40	50
War .	Alcester, Ragley Hall..	·96	42	*Guernsey*			
,, .	Birminghm, Edgbaston	·93	39		St. PeterP't. Grange Rd	3·22	77

Rainfall: November, 1933: Scotland and Ireland.

Co.	Station	In.	Per cent. of Av.	Co.	Station	In.	Per cent. of Av.
Wig .	Pt. William, Monreith	2·49	58	*Suth* .	Melvich	2·95	74
,, .	New Luce School	3·22	63	,, .	Loch More, Achfary	6·28	73
Kirk .	Dalry, Glendarroch	2·55	43	*Caith* .	Wick	2·94	94
,, .	Carsphairn, Shiel	3·53	45	*Ork* .	Deerness	2·79	71
Dumf .	Dumfries, Crichton, R.I	2·04	59	*Shet* .	Lerwick	2·91	68
,, .	Eskdalemuir Obs.	2·07	36	*Cork* .	Caheragh Rectory	2·77	...
Roxb .	Branxholm	1·69	51	,, .	Dunmanway Rectory	2·99	48
Selk .	Ettrick Manse	2·34	43	,, .	Cork, University Coll.	2·72	68
Peeb .	West Linton	1·62	...	,, .	Ballinacurra	2·63	66
Berw .	Marchmont House	2·50	83	*Kerry* .	Valentia Obsy	3·67	67
E.Lot .	North Berwick Res.	1·44	64	,, .	Gearhameen	4·70	48
Midl .	Edinburgh, Roy. Obs.	1·44	64	,, .	Darrynane Abbey	3·59	70
Lan .	Auchtyfardle	1·36	...	*Wat* .	Waterford, Gortmore	1·55	42
Ayr .	Kilmarnock, Kay Pk.	1·89	...	*Tip* .	Nenagh, Cas. Lough	1·12	28
,, .	Girvan, Pinmore	2·54	48	,, .	Roscrea, Timoney Park	1·21	...
Renf .	Glasgow, Queen's Pk.	1·79	48	,, .	Cashel, Ballinamona	·81	23
,, .	Greenock, Prospect H.	3·35	52	*Lim* .	Foynes, Coolnanes	1·31	33
Bute .	Rothesay, Ardencraig.	3·81	...	,, .	Castleconnel Rec.	·91	...
,, .	Dougarie Lodge	2·80	...	*Clare* .	Inagh, Mount Callan	2·30	...
Arg .	Ardgour House	3·86	...	,, .	Broadford, Hurdlest'n.	1·17	...
,, .	Glen Etive	...	...	*Wexf* .	Gorey, Courtown Ho.	·79	23
,, .	Oban	2·51	...	*Wick* .	Rathnew, Clonmannon	1·53	...
,, .	Poltalloch	4·03	72	*Carl* .	Hacketstown Rectory	1·84	47
,, .	Inveraray Castle	4·99	59	*Leix* .	Blandsfort House	2·10	63
,, .	Islay, Eallabus	3·13	58	,, .	Mountmellick	1·79	...
,, .	Mull, Benmore	...	...	*Offaly* .	Birr Castle	1·15	37
,, .	Tiree	3·61	75	*Dublin*	Dublin, FitzWm. Sq.	·96	36
Kinr .	Loch Leven Sluice	1·58	44	,, .	Balbriggan, Ardgillan.	1·35	47
Perth .	Loch Dhu	...	...	*Meath*.	Beauparc, St. Cloud	1·54	...
,, .	Balquhidder, Stronvar	...	...	,, .	Kells, Headfort	2·10	62
,, .	Crieff, Strathearn Hyd.	2·90	67	*W.M* .	Moate, Coolatore	1·43	...
,, .	Blair Castle Gardens	3·29	94	,, .	Mullingar, Belvedere	1·28	38
Angus.	Kettins School	3·00	97	*Long* .	Castle Forbes Gdns.	1·27	35
,, .	Pearsie House	4·02	...	*Gal* .	Galway, Grammar Sch.	1·58	...
,, .	Montrose, Sunnyside	2·82	106	,, .	Ballynahinch Castle	3·04	51
Aber .	Braemar, Bank	3·85	100	,, .	Ahascragh, Clonbrock.	1·95	48
,, .	Logie Coldstone Sch.	3·63	118	*Mayo* .	Blacksod Point	3·03	58
,, .	Aberdeen, King's Coll.	3·24	110	,, .	Mallaranny	3·41	...
,, .	Fyvie Castle	4·21	122	,, .	Westport House	2·37	48
Moray	Gordon Castle	1·69	59	,, .	Delphi Lodge	4·54	44
,, .	Grantown-on-Spey	...	...	*Sligo* .	Markree Obsy	2·53	60
Nairn.	Nairn	·87	37	*Cavan*.	Crossdoney, Kevit Cas.	1·64	...
Inv's .	Ben Alder Lodge	2·10	...	*Ferm* .	Enniskillen, Portora	1·03	...
,, .	Kingussie, The Birches	1·43	...	*Arm* .	Armagh Obsy	·94	33
,, .	Inverness, Culduthel R.	·59	...	*Down*.	Fofanny Reservoir	2·46	...
,, .	Loch Quoich, Loan	5·60	...	,, .	Seaforde	1·57	41
,, .	Glenquoich	3·50	29	,, .	Donaghadee, C. Stn.	3·11	102
,, .	Arisaig, Faire-na-Sguir	3·36	...	,, .	Banbridge, Milltown	1·08	39
,, .	Fort William, Glasdrum	3·42	...	*Antr* .	Belfast, Cavehill Rd.	1·42	...
,, .	Skye, Dunvegan	2·93	...	,, .	Aldergrove Aerodrome	1·60	49
,, .	Barra, Skallary	2·35	...	,, .	Ballymena, Harryville	2·48	61
R & C .	Alness, Ardross Castle	3·30	82	*Lon* .	Garvagh, Moneydig	2·03	...
,, .	Ullapool	3·56	67	,, .	Londonderry, Creggan	2·28	56
,, .	Achnashellach	4·89	54	*Tyr* .	Omagh, Edenfel	1·40	37
,, .	Stornoway	1·78	31	*Don* .	Malin Head	2·11	...
Suth .	Lairg	2·41	60	,, .	Milford, The Manse	2·38	55
,, .	Tongue	3·00	65	,, .	Killybegs, Rockmount	·33	...

Climatological Table for the British Empire, June, 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.	1011·7	− 5·0	85	45	70·9	52·7	61·8	+ 2·6	54·0	74	4·3	1·93	− 0·22	10	8·6	52
Gibraltar	1014.7	− 2·6	87	57	80·3	61·4	70·9	+ 0·4	60·2	81	2·3	0·00	− 0·54	0	..	..
Malta	1013·3	− 1·9	88	59	74·8	64·5	69·7	− 3·0	63·6	73	3·6	0·50	+ 0·41	5	10·9	70
St. Helena	1016·1	+ 0·3	65	54	62·4	56·5	59·5	− 1·0	57·1	90	9·1	2·66	..	20	..	..
Freetown, Sierra Leone	1013·9	+ 1·9	89	66	85·1	72·0	78·5	− 1·8	75·3	87	7·0	30·01	+ 9·97	29	..	..
Lagos, Nigeria	1012·6	+ 0·2	86	71	83·4	75·0	79·2	− 0·3	75·6	90	9·4	14·86	− 3·62	25	2·5	20
Kaduna, Nigeria	1013·5	− 0·3	90	65	86·3	69·4	77·9	+ 1·4	72·1	83	8·1	6·65	− 0·44	17	6·5	51
Zomba, Nyasaland	1015·6	− 1·9	90	50	76·8	55·2	66·0	+ 3·1	58·8	67	3·8	1·11	+ 0·63	5	..	..
Salisbury, Rhodesia	1019·5	− 1·2	77	38	70·8	46·3	58·5	+ 1·6	51·5	61	2·3	0·19	+ 0·14	2	8·0	72
Cape Town	1018·6	− 1·5	69	37	60·8	47·1	53·9	− 1·8	47·9	92	6·1	4·71	+ 0·21	16	..	..
Johannesburg	1021·7	− 1·0	67	28	58·1	39·3	48·7	− 2·0	39·4	50	1·9	0·21	+ 0·07	1	9·1	87
Mauritius	1018·8	− 0·2	81	55	76·5	63·9	70·2	+ 0·8	67·1	74	5·5	2·93	+ 0·13	17	6·5	60
Calcutta, Alipore Obsy.	998·4	− 1·3	97	75	91·0	79·5	85·3	+ 0·2	80·2	87	8·3	15·71	+ 3·80	19*	..	..
Bombay	1003·8	− 0·2	93	76	88·6	78·9	83·7	− 0·3	78·6	83	7·4	10·29	− 9·58	17*	..	..
Madras	1004·3	+ 0·5	102	75	98·8	81·6	90·2	+ 0·2	76·1	60	7·4	0·75	− 1·22	2*	..	..
Colombo, Ceylon	1010·0	+ 1·4	86	72	84·7	76·5	80·6	− 1·0	77·4	80	7·6	10·12	+ 2·80	25	5·2	42
Singapore	1008·8	− 0·1	92	70	89·0	75·6	82·3	+ 0·8	78·3	78	5·6	10·07	+ 3·20	15	6·6	54
Hongkong	1004·7	− 1·1	91	74	87·0	79·4	83·2	+ 1·8	78·6	81	8·8	16·44	+ 0·74	28	5·1	38
Sandakan	1009·1	..	91	71	89·2	75·2	82·2	+ 0·5	76·9	81	6·5	3·95	− 3·55	8	..	..
Sydney, N.S.W.	1019·8	+ 1·9	72	37	63·4	48·5	55·9	+ 1·2	50·5	79	6·1	1·89	− 2·85	14	5·3	54
Melbourne	1020·4	+ 1·9	66	35	58·7	44·2	51·5	+ 1·1	46·6	82	7·0	1·49	− 0·57	18	3·5	36
Adelaide	1020·6	+ 1·5	73	39	62·9	47·6	55·3	+ 1·8	49·1	70	6·0	1·33	− 1·77	16	5·0	52
Perth, W. Australia	1016·8	− 1·2	71	43	65·8	53·3	59·5	+ 2·7	54·8	76	6·1	6·52	− 0·42	22	4·8	48
Coolgardie	1019·1	+ 0·2	75	39	63·4	47·5	55·5	+ 2·7	48·7	74	5·1	0·59	− 0·67	6	..	..
Brisbane	1019·1	+ 0·8	74	38	69·7	51·0	60·3	+ 0·1	53·9	71	4·1	1·37	− 1·42	7	7·6	73
Hobart, Tasmania	1017·9	+ 3·6	63	33	53·0	42·0	47·5	+ 0·5	43·3	80	6·8	1·39	− 0·84	17	3·5	38
Wellington, N.Z.	1017·6	+ 2·7	57	35	50·5	42·0	46·3	− 3·2	44·4	83	8·0	2·75	− 2·02	17	2·6	28
Suva, Fiji	1014·3	+ 0·7	87	67	80·0	70·9	75·5	+ 0·8	70·8	81	6·8	7·79	+ 1·08	16	3·5	32
Apia, Samoa	1011·7	+ 0·1	87	68	85·2	73·7	79·5	+ 1·7	75·7	74	3·8	1·93	− 3·42	13	8·6	76
Kingston, Jamaica	1012·1	− 1·7	91	70	87·3	73·5	80·4	− 0·9	74·1	83	5·5	11·83	+ 7·73	14	7·9	60
Grenada, W.I.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Toronto	1013·3	− 1·4	92	43	78·2	56·8	67·5	+ 3·7	60·7	64	3·8	1·84	− 0·82	8	9·8	64
Winnipeg	1011·3	− 0·5	97	35	79·7	56·2	67·9	+ 5·6	57·0	74	5·8	0·97	− 2·14	8	..	..
St. John, N.B.	1011·6	− 1·9	80	40	65·4	49·1	57·3	+ 0·8	52·7	78	7·0	5·06	+ 1·79	16	7·3	47
Victoria, B.C.	1016·5	− 0·3	80	41	63·4	48·0	55·7	− 1·3	52·0	75	5·8	1·15	+ 0·31	10	8·9	56

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