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The Design of Raingauges

By E. G. BILHAM, B.Sc., D.I.C.

To ensure satisfactory service over a long period of years it is important that a raingauge should be soundly constructed of good material. The existing Meteorological Office specification provides for the use of sheet copper of adequate weight and also states that all joints are to be water-tight and carefully soldered. However well made a joint may be, it constitutes, nevertheless, a weak point. The development of a leak at a seam is the commonest source of uncertainty in rainfall observations, and the elimination of soldered joints may now be regarded as the most pressing problem in the design of gauges.

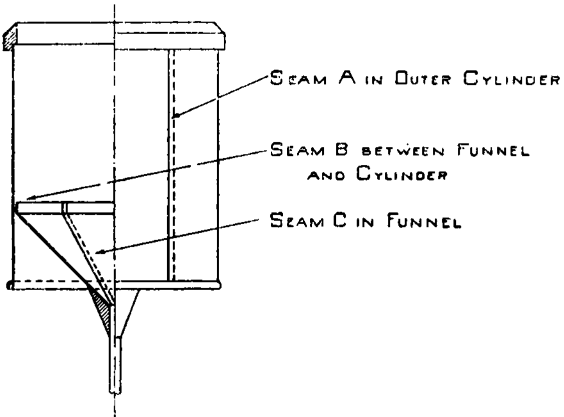
The ordinary raingauge of the Snowdon or Meteorological Office pattern is provided with a funnel of the pattern illustrated diagrammatically in Fig. 1. There are three important seams, a vertical seam, A, where the edges of the cylinder are brought together, a horizontal seam, B, where the sloping funnel is attached to the inside of the cylinder, and a seam, C, in the sloping funnel. A leak in A may let in rain striking the outside of the cylinder. A large proportion of the rain entering by this means would undoubtedly find its way into the receiving can, thus adding to the measured amount of rain. A leak in B could not increase the measured fall, but would diminish it, because some of the rain entering the funnel would run straight down the inside of the cylinder into the outer vessel instead of being

Wt 69—P 1 1000 6.27 M & C

collected. A leak in C might conceivably cause some slight loss if it occurred near the top.

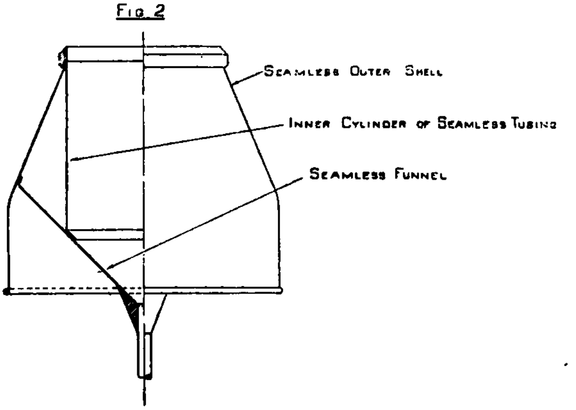
Other parts of the gauge in which leaks have to be watched for are the collecting can and the outer vessel. A leak in the can is easily detected; a leak in the outer vessel, though of less consequence should be remedied at the first opportunity. Leaks in the funnel are much more difficult to detect and the measured amounts of rainfall may be seriously affected before the need for repairs is realised. It follows, therefore, that the funnel should be the first part of the gauge to receive the attention of the designer.

FIG. 1



In the course of designing, in the Instruments Division of the Meteorological Office, a mountain gauge of large capacity the form of construction of the funnel illustrated in Fig. 2 was devised. Here there are three separate continuous pieces of metal and the only joints are the soldered annular contacts where the separate pieces meet. It will be seen that these joints are so arranged that even if leakage develops at any point the catch of rain cannot possibly be affected. While making a funnel of this type, Mr. W. A. Rollason, of 52, Hatton Garden, E.C. 1, was led to suggest the simplified form shown in Fig. 3. Here the number of pieces is reduced to two, with a single annular joint at the rim, where it is well protected by the brass ring. Each piece is "spun" into the form shown and has no vertical seam.

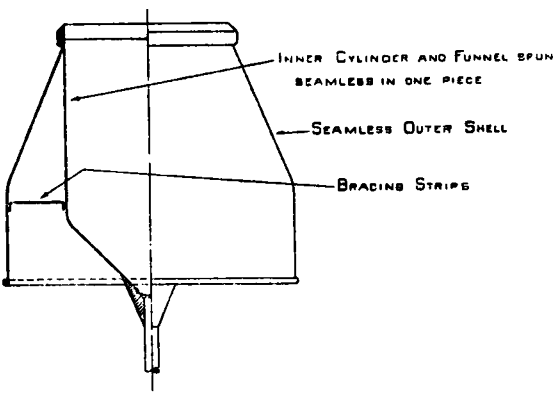
FIG. 2



Mr. Rollason's form has the advantage that it can readily be adapted to suit a gauge of the ordinary form for daily measurements. This is merely a matter of reducing the diameter of the outer cone, at the base, till it is very nearly the same as that of the inner funnel portion. The resulting "funnel" is then of nearly the same outward appearance as the ordinary funnel illustrated in Fig. 1, but is seamless and double-walled. Gauges constructed in this manner have been put under test at certain stations.

Experiments are also being made in the use of seamless copper tubing for the construction of rain-gauges. By this means, all vertical seams can be avoided, not only in the funnel, but in the outer vessel and the inner can. There would remain, however, the seam B in Fig. 1, although the seam C could be eliminated by spinning the funnel itself. Moreover, if copper tubing is used for the outer vessel, the splayed form of base, which is a valuable feature of the Meteorological Office pattern, could not be retained. Nevertheless, the use of this material offers very marked advantages, especially for the construction of mountain gauges of the Bradford pattern, in which the depth of the collected rainfall is determined by means of a dip rod. Copper tubing can be made to a high degree of uniformity in the area of cross section, and, in consequence, the volume of water in a vessel made of such tubing is accurately proportional to the depth, if the bottom is flat.

FIG. 3



The Marine Barometer

The specification for the marine type of Kew pattern barometer has recently been under consideration. Three matters to receive attention were :—

(A) The limits between which the "falling time" should be measured.

(B) The value of the falling time, and

(C) The amount of latitude which should be allowed to the manufacturer in realising the specified value of the falling time.

The old specification, dating from 1854, stated that the falling time between 1·5 inches and 0·5 inch above the steady height of the barometer should lie between 3 and 6 minutes. The inch has now been replaced by the millibar as the official unit of pressure, and consequently it is desirable to express the values of the limits as round numbers of millibars. At first sight it might appear that the best course would be to convert 1·5 inches and 0·5 inch to millibars and round off to the nearest millibar, giving the values 51 and 17 millibars. There is, however, another point to take into consideration. The " falling time " is related to the " lagging time," the latter term being defined as the interval by which the barometric indications lag behind the changes actually occurring. It can be shown that if the damping is caused by non-turbulent flow through a capillary tube the fall of the mercury will follow a logarithmic law. Further, provided the fall is logarithmic, if the upper limit is made *e* times the lower limit—*e* being the base of Napierian logarithms, 2·718—the " falling time " will be equal to the " lagging time." It is clearly advantageous to secure this equality since it enables us to say precisely that the barometric pressure had the value shown by the reading at a time, *t*, before the time of reading, *t* being the falling time. Fortunately, this advantage can be secured with very little modification of past practice. The value 50 millibars suggests itself naturally as the upper limit, and the lower limit then becomes $50/e$ or 18 millibars, and these values have accordingly been adopted as the limits.

Under head (B) the old standard value of the falling time was $4\frac{1}{2}$ minutes and this was retained unchanged. Owing, however, to the slight narrowing of the limits under head (A) a slight lengthening of the time has virtually been made.

With regard to (C) it was decided that barometers would be accepted if the actual falling time did not differ from the specified value by more than $\frac{1}{2}$ minute. In order to ensure that the fall of the mercury should follow a logarithmic law, it was specified that the damping should be produced by the use of capillary tubing in the barometer tube and not by means of a constriction. Experience has shown that makers can work, without inconvenience, within narrower limits than those of the old specification and there was reason to believe that a falling time of 3 minutes was too short. Expressed in terms of the old limits, the new barometers have falling times between $4\frac{1}{2}$ and $5\frac{1}{2}$ minutes approximately.

Twelve barometers made by Messrs. S. & A. Calderara in accordance with this specification have recently been examined at the National Physical Laboratory, and the results obtained offer striking evidence of the accuracy with which a barometer maker can work to a definite specification at the present day.

In no case did the falling time actually realised differ from the specified mean value of 4½ minutes by more than 15 seconds, while four of the barometers had falling times differing only 5 seconds from 4½ minutes. The mean value for the 12 barometers was 4 minutes 39 seconds.

It should perhaps be emphasised that the new specification is merely a provisional one. It is hoped that before long some further experimental evidence will be available for guidance in coming to a decision as to whether the falling time should be increased. E.G.B.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, May 18th, at 49, Cromwell Road, South Kensington, Sir Gilbert Walker, C.S.I., F.R.S., President, in the Chair.

Harold Jeffreys, D.Sc., F.R.S.—Cyclones and the General Circulation.

It appears that if there were no variation of temperature with latitude the atmosphere could rotate with the earth like a rigid body, and this would be a stable state. But increase of temperature towards the equator implies that the velocity from the west must increase with height, and in these conditions it appears that frictional interaction between different layers of the air and between the lowest layer and the ground would suffice to destroy any motion symmetrical about the earth's axis. Irregular horizontal interchange of air must therefore be developed, and it seems that this implies a system of cyclones resembling in their main features those we know. One effect of the interchange would be that the normal winds at the surface must be on the whole as much easterly as westerly, and reasons are suggested to explain why the easterly prevailing winds are near the equator and the westerly ones in higher latitudes. It seems probable that this mechanism would give slow anticyclonic circulations near the poles, apart from possible local conditions tending to reverse or intensify such circulations.

George M. Meyer, B.A., Assoc.M.Inst.C.E.—Early Water-mills in relation to Changes in the Rainfall of East Kent.

Records of water-mills in Doomsday and in mediæval law-suits show that the streams of the district were of greater volume at the end of the eleventh century than to-day, and that the decrease was rapid about 1275. Early in the fourteenth century silt was carried down by the Gestling or North Stream, whereas now practically none is brought down by that stream nor by the Stour near its mouth. In the second part of the paper detailed reasons are given for considering that in this district the varying discharge of the streams represents approximately the changes in the rainfall. These variations had a profound effect upon the silting up of local harbours, a point which may well affect the choice of site for a new harbour if expected industrial developments in Kent materialize.

S. Morris Bower,—Report on Winter Thunderstorms in the British Islands from January 1st to March 31st, 1926.

The report contains charts and tables showing the distribution and frequency of thunderstorms during the above period, based on the records of about fifteen hundred observers. Further maps showing the areas affected by certain storms, and a chart of the tracks of associated depressions are included. The widespread thunderstorms about February 16th, 1926, which appear to have accompanied the passage of five squall lines, are specially treated, and maps indicating by isochronous lines the movements of the various storms are given. Figures showing the diurnal variation in the frequency of winter thunderstorms in 1925 and 1926 are included and discussed.

Correspondence

To the Editor, *The Meteorological Magazine*

Remarkably Long-lived Lunar Rainbow

I can easily go one better than Mr. Rowswell as regards the above. I extract the following from my meteorological journal: "December 11th, 1900. Another remarkable lunar rainbow, very bright, colours were seen in the primary bow, which lasted continuously from 10.55 p.m. to 12.40 a.m. on the 12th and perhaps longer; a most unusual duration; faint traces only of the secondary bow." The word "another" refers to a double lunar rainbow seen on October 4th, 1900, of which a description was inserted in the *Meteorological Magazine*, vol. 35 (1900), p. 138.

CHARLES L. BROOK.

Harewood Lodge, Meltham, Yorks., February 21st, 1927.

Lightning Discharges

The work done by F. W. Peek, Jr., of the General Electric Company at the High Tension Laboratory of this Company at Pittsfield, Massachusetts, on "Lightning and other High Voltage Phenomena," is of such direct value in connexion with the study of thunderstorms that I have with his consent made the following abstract of the results of the experiments.

These experiments were undertaken to determine fundamental principles from the standpoint of pure research, and at the same time to better the insulation of apparatus and the protection of high voltage transmission lines. Briefly, artificial lightning was produced by a lightning generator supplying 2,000,000 volts above ground. The discharge produces a loud sharp explosive report, and the power is of the order of millions of kilowatts for a few millionths of a second. Currents as high as 10,000 ampères have been obtained. The voltages increase at the rate of millions of volts per second.

A model was made to scale representing cloud and transmission line. It was found that when a flash occurred from this model cloud, 1 per cent. of its voltage was induced on the model line. It is known that the voltage induced on an actual line under similar conditions is sometimes of the order of 1,000,000. Hence the voltage of an actual flash of lighning may be 100,000,000, which means 330 kv/m (kilo-volts per metre) as the gradient in the most dense part of the electric field, or where the flash occurs ; and a gradient of less than a third of this a short distance away. It is estimated from voltage, size and height of clouds, that the current is of the order of 80,000 ampères and the energy 13,500 kilowatt seconds or 3·8 kw. hours.

"This energy," Dr. Peek says, "is sufficient to operate an automobile about 5 miles or an electric toaster for a day. Since this energy is dissipated in a very short time the power may be several thousand million kilowatts."

"A study was made using models built to scale to determine the protective value of lightning rods. . . . . . Tests show that lightning from a cloud overhead does not always strike the highest object."

When the discharge point of the cloud is moving, the area protected by a rod 1·85 per cent. of cloud height is as follows. When the cloud is directly above the rod, 84 per cent. of the strokes hit the rod and 16 per cent. hit the ground. Within a radius four times the rod height, there were no ground hits. As the discharge point of the cloud moves away, the number of ground hits increases rapidly and is 100 per cent. at twelve times the rod height.

What then are the chances of being struck ? If the cloud is overhead and distant about 300 metres, a man will be hit 15 times out of every hundred strokes. This refers to vertical strokes and it must be remembered that a majority of strokes are horizontal, that is from cloud to cloud. A man flat on the ground would be struck about once in every hundred strokes. This, however, does not mean that we should lie flat under trees ; nor do the ratios given above apply when the location is near a wire fence or under a tree.

An edifice five metres high would be struck 84 times out of a hundred vertical flashes ; but if the cloud moved one hundred metres, there would be no stroke.

Full details of Dr. Peek's experiments can be found in

Smithsonian Report, 1927, p. 169-198, and in the *Journal of Franklin Institute,* February, 1925.

ALEXANDER MCADIE.

Harvard University, Blue Hill Observatory, Readville, Mass.
February 8th, 1927.

The Frost of April 30th

Not having seen any notice of this in your pages and thinking that such a severe frost ought not to go unrecorded I beg to send a few remarks on its effect in South Herefordshire. During 40 years observations I have never known such a severe visitation so late in the season. The exposed thermometer 4 ft. above ground sank to 16°F. Although it was a " dry " frost the damage done was immense. Sycamore leaves were crumpled up on hedges and on some trees ; laburnum leaves and blossoms were frizzled up. My walnut tree this last week of May is as bare as in January. Perhaps the most remarkable sight is the oaks ; on very low ground the young buds were completely frizzled ; on ground perhaps 50 ft. higher some trees are now, at the end of May like huge mushrooms and afford a remarkable illustration of the weight and density of cold air, the lower two-thirds of the trees being a mass of shrivelled-up foliage and quite bare, while the upper one-third, above the severest frost, is a bower of green ; altogether they are a remarkable sight, the tallest oaks show the effect most and are just like huge mushrooms or umbrellas.

Needless to say the promise of a magnificent fruit crop has been completely nullified, at any rate on low ground.

R. P. DANSEY.

Kentchurch Rectory, Hereford. May 23rd, 1927.

Severe Winters

In regard to the discussion on this subject, my impression is that it is not being viewed in quite the right perspective.

The decade 1885-1895 was an outstandingly cold and snowy one in the nineteenth century, and since then we seem simply to have reverted to the normal standard of our temperate English climate. I do not think Mr. Horner's statement, that we have had no winter " worthy the name " since that of 1894-95, except 1916-17, is quite happy. There have been, if not many severe winters, at any rate many very severe spells and months this century, and I would particularly like to draw Mr. Horner's attention to the following seasons :—

1899-1900. A spell of general frost and snow in mid-December, followed in the first half of February by an extremely heavy snowfall with severe cold, in every corner of the British Isles.

The snowfall of February, 1900, was referred to in "British Rainfall, 1900," as probably "unprecedented" for the British Isles as a whole.

1900-1901. January, February and March were months of moderate frost and, especially the last two, were snowy generally. About March 20th the amount of snow lying on Dartmoor was said to be not far short of that after the famous blizzard in March, 1891. At the end of March the north of England had a terrible snowstorm.

1901-1902. In mid-December a paralyzing snowstorm affected northern England, followed by some skating. February, 1902, was a month of widespread and severe frost with general skating. The late Canon Rawnsley gave a fine poetical description of the skating on Derwentwater.*

1906-07. Widespread snowstorms of great severity in Christmas week, with disastrous blizzards in east of Scotland. A good deal of frost between mid-January and mid-February.

1908-09. A winter marked by spells of acute cold. The first just after Christmas was most intense in the south-east of England. Late in January came a week's intense fog-frost with very copious deposits of rime. Finally in late February and early March came a snow-spell with hard frosts of a character reminiscent of February, 1900. This is one of the snowiest spells in our annals taking the British Isles as a whole.

1909-10. Mild in England, but both November and January had intense skating frosts in Scotland.

1915-16. This winter was noteworthy for the very cold November, very warm January and the accentuated snowspell of February and March recalling that of 1909 without the intense cold. The mountain snowfall of March was enormous, it being estimated than an aggregate of 10 feet fell in the Black Mountains of South Wales and in parts of the Pennines.

1916-17. The well remembered series of cold snowy months extended from December to April. The frost in early February was intense with skating in every corner of England. The terrific Irish snowstorms in January and April, especially April, bear comparison with such blizzards as those of January, 1881, in southern England; March, 1891, in south-western England; and March, 1886 and March, 1888, in northern England and Scotland.

1917-18. December was generally cold, having the lowest mean temperature in London of any December since 1890, whilst early in January a very intense frost prevailed in the north, Loch Lomond being frozen over, said to be the first time since 1895.

1918-19. General skating in February, which in Scotland was more severe than February, 1917.

* *Meteorological Magazine* 37 (1902), p. 19.

1923-24. Severe frost in November, and all through the winter there were frequent falls of snow.

1925-26. Widespread frost and heavy snowfalls through November, December, and a bit of January. In the south of England the frost before Christmas was of a more faltering character, but in the north it was the real thing with a long spell of skating. If there ever was an "old-fashioned Christmas" in Scotland it was surely that of 1925.

The above list does not, of course, include every spell of frost and snow, because these occur every year, but only the more prominent.

It seems to me that the picture it gives is about what should be expected in a country where, after all, rainy south-westerly winds off a warm ocean being normal, frosts must necessarily, as a rule, be of short duration.

In addition, I would draw attention to the relatively large number of skating frosts which November has provided in the first quarter of this century, to wit 1904, 1910, 1915, 1919, 1921, 1923, and 1925 in many parts of England, if not in London. In Scotland the frost in the first half of November, 1919 was extraordinarily intense, not only for the first half of that month, but for any time of the year.

Finally in bleak springs I think this century has been very liberal when one recalls the furious snowstorms in the following Aprils, 1903, 1908, 1911, 1917 and 1919, not to mention the Marches which are too much the rule.

L. C. W. Bonacina.

27, Tanza Road, Hampstead, N.W 3. *March 22nd,* 1927.

NOTES AND QUERIES

Ground Frosts

At stations which report in connexion with the daily weather service the grass minimum thermometer is read at 7h. and the number of ground frosts in the climatological summaries from these stations is based upon the 7h. observations.

Questions have been raised from time to time as to the number of ground frosts which are not recorded on this basis but which would have been recorded had the thermometers been read at 9h. or some later hour. A summary has accordingly been prepared for the year 1926 based upon readings of the grass minimum thermometer made both at 7h. and 9h. at four observatories, Kew, Aberdeen, Valentia, and Eskdalemuir.

The following table shows the number of ground frosts actually recorded from the observatories at 7h. and the additional number which would have been recorded if the observations had been made at 9h. The second part of the table shows the number of occasions on which the readings at 7h. and 9h. were identical, the number of occasions on which they differed by less than 1° F, between 1° F and 2° F, and so on. It will be seen from the table that observations at 9h. would have given only one more ground frost than observations at 7h. except at Aberdeen where there would have been two more. The readings at 7h. and 9h. are identical in more than 90 per cent. of the days. The readings of the grass minimum thermometer at 7h. may therefore be regarded as satisfactory for the computation of the number of ground frosts.

	Number of Ground Frosts at 7h.	Additional Ground Frosts at 9h.	Number of occasions of differences between 7h. and 9h. readings.				
			0·0°	0·1°–1·0°	1·1°–2·0°	2·1°–3·0°	3·1° or more
Aberdeen ...	84	2	346	12	3	3	1
Kew	82	1	333	14	8	7	3
Valentia ...	16	1	341	11	8	4	1
Eskdalemuir...	104	1	336	13	12	2	2

Stands for Stevenson Screens

The particulars published by the Meteorological Office in the past relating to the construction of the Stevenson screen specify that the stand should be made of oak. This material is not, however, suitable for use in the tropics, and attention has been given recently to the development of an all-metal stand suitable for general adoption. Before a change could be made it was necessary to make certain that the substitution of steel for wood did not affect the records of temperature in the Stevenson screen. A trial was, therefore, made at Kew Observatory, a comparison over several months being made between the readings of thermometers in screens supported on oak and steel stands respectively. The results showed no differences which could be attributed to the stands. It may be mentioned incidentally that the thermal capacity of a steel stand may be made very much less than that of the ordinary oak stand. Had any difference been found, therefore, it might have been expected that the readings in a screen on a steel stand would agree more closely with the actual conditions than those in a screen on a wooden stand.

Apart from the question of durability a steel stand has many advantages over a wooden one. Its bulk is much less and it is easier to assemble. It is not likely to warp and disturb the adjustment of the screen after erection and it can, if desired, be easily bedded in concrete. Stands for large and ordinary size screens can be made of similar design, the only difference required being in the lengths of the cross pieces which connect the two ends.

A number of steel stands have now been obtained for use with the large Stevenson screen. They consist simply of four uprights of 1¼ inch by $\frac{3}{16}$ inch angle iron connected by cross pieces of similar material at the top and bottom. Diagonal rods of mild steel strip, 1 inch by ⅛ inch, are provided on the sides and ends for stiffening purposes, and square foot-plates are attached to each leg to give a firm base in the ground. The ends are supplied as complete units rivetted together, the front cross piece and tie rods being supplied loose with the necessary bolts and screws for assembling at the station. The stands will be painted white and will certainly not be less attractive in appearance than the ordinary form of oak stand.

Radiation from the Sky

RADIATION MEASURED AT BENSON, OXON, 1927.

Unit: one gramme calorie per square centimetre per day.

ATMOSPHERIC RADIATION only (dark heat rays) Averages for Readings		Jan.	Feb.	Mar.
Cloudless days :—				
Number of readings	n	7	8	3
Radiation from sky in zenith ...	π I	390	390	452
Total radiation from sky ...	J	410	419	488
Total radiation from horizontal black surface on earth ...	X	607	652	742
Net radiation from earth ...	X—J	197	233	254
DIFFUSE SOLAR RADIATION (luminous rays). Averages for Readings between 9 h. and 15 h. G.M.T.				
Cloudless days :—				
Number of readings	n_0	0	3	3
Radiation from sky in zenith ...	πI_0	..	17	37
Total radiation from sky ...	J_0	..	28	59
Cloudy days :—				
Number of readings	n_1	0	2	2
Radiation from sky in zenith ...	πI_1	..	35	40
Total radiation from sky ...	J_1	..	29	37

Unit for I = gramme calorie per day per steradian per square centimetre.
Unit for J and X = gramme calorie per day per square centimetre.
For description of instrument and methods of observation, see *The Meteorological Magazine*, October, 1920, and May, 1921.

The Autumnal Land Breeze

The Meteorological Office circular, No. 42 (December, 1919), contains a paragraph headed "The Autumnal Land Breeze," in which it is shown that clear indications of the prevalence of a flow of air towards the Irish Sea were to be found in the *Weekly Weather Reports* for October of that year. It was explained that in addition to the absence of a general circulation a necessary condition for the development of a continuous land breeze is that the temperature of the sea water should be higher than the maximum reached by the air over the land during the day.

A week in which the necessary conditions were well developed was the week ending October 23rd, 1926, when the mean temperature over the British Isles was 9° F. below the normal for the week, the mean maximum for the week did not reach 50° F. in any district except the Channel Islands, and mainly anticyclonic conditions prevailed.

The following are the frequencies of the components of wind direction and the mean value of the velocities at Holyhead, Kingstown (near Dublin) and Valentia, based on the anemometer records at 3h, 9h, 15h and 21h, each day of the week.

Component	Holyhead.		Kingstown.		Valentia.	
	Frequency.	Mean Value mi/hr.	Frequency.	Mean Value mi/hr.	Frequency.	Mean Value mi/hr.
South	13	4	6	3	2	2
North	8	11	17	6	22	4
West	3	8	20	7	3	5
East	21	9	7	10	24	9

The prevalence of the west component in the wind direction at Kingstown compared with the other two stations is very marked. Isobars based on the mean pressure for the week at telegraphic stations show an average gradient for easterly winds across the Irish Sea.

The same phenomenon is to be found in other cold weeks in the autumn since 1919, *e.g.*

Week ending November 12th, 1921, mean temperature over the British Isles 7° F. below normal.

		Holyhead.	Kingstown.	Valentia.
Frequency of	West Component ..	9	18	4
	East Component ..	13	3	20

Week ending November 24th, 1923, mean temperature over the British Isles 6° F. below normal.

		Holyhead.	Kingstown.	Valentia.
Frequency of	West Component ..	13	26	6
	East Component ..	8	0	16

Week ending November 21st, 1925, mean temperature over the British Isles 5° F. below normal.

	Holyhead.	Kingstown.	Valentia.
Frequency of West Component ..	0	5	0
East Component ..	26	12	14

As a contrast to these conditions may be cited the week ending July 17th, 1926, when the mean temperature over the British Isles was 6° F. above normal, the mean minimum for England northwest (including North Wales) 59·8°F., for the South of Ireland 59·5°F., and the mean temperature of the Irish Sea for July 58° F.

	Holyhead.	Kingstown.	Valentia.
Frequency of West Component ..	15	5	6
East Component ..	8	21	14

M. T. SPENCE.

Geophysical Work in Greenland

On May 25th an expedition of the Topographical Section of the Danish General Staff left for Greenland under the leadership of Captain F. C. Jörgensen. The main purpose of the expedition is to survey Greenland, and its headquarters will be at Disko Island, but a wireless station is to be erected at Scoresby Sound in latitude 70° N. on the east coast, where seismological and meteorological observations will be carried on. This will be a valuable addition to the network of Arctic reporting stations.

New Geophysical Magazine

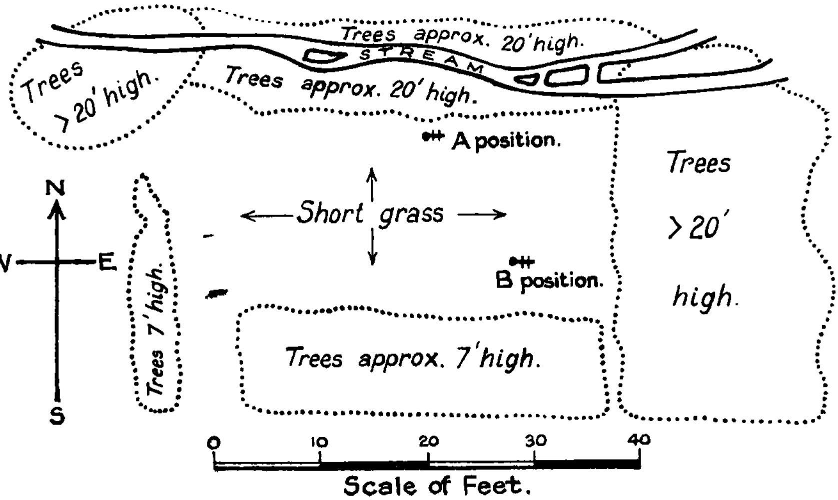
The Central Meteorological Observatory of Japan has recently issued the first two numbers of a new journal entitled the *Geophysical Magazine*, which is to be devoted to geophysics, including meteorology, terrestrial magnetism and atmospheric electricity.

In the preface to the first number Prof. T. Okada gives as the reason for adding another to the series of journals issued by the Central Meteorological Observatory, that hitherto most of the papers published by the members of the Japanese weather service, although of much interest to European meteorologists, have been unnoticed simply because they are written in a language not easily intelligible to western people. To remedy this defect and so help towards a better understanding between European and Japanese meteorologists this magazine will contain short notes and abstracts in English, French or German, of the papers published by the members of the Japanese weather service. Longer memoirs will continue to be printed in the *Bulletin of the Central Meteorological Observatory* and other publications.

The first number of the magazine contains four papers, none of which are of direct meteorological interest, but the second number includes a paper by T. Utumi, giving a "Statistical proof of Okada's law on the behaviour of cyclones and anticyclones."

Erratum

We regret that the following diagram illustrating the article on "Comparison of Grass Minimum Thermometer Readings at South Farnborough," on page 93 of the May magazine, was omitted.



Reviews

Solar activity and long-period weather changes. By Henry Helm Clayton. Washington, D.C., Smiths. Inst. Misc. Coll. Vol. 78, No. 4. 1926.

In this paper Mr. Clayton returns to the subject of the connexion between variations of the solar constant, as observed at the Smithsonian Astrophysical Observatories, and terrestrial weather, dealing now with monthly averages instead of with the individual daily observations. The first method adopted to demonstrate a relationship is briefly as follows: The monthly means of solar radiation for the years 1918 to 1924 are classed as low (1·911—1·930), medium, and high (1·951—1·960). For a number of stations in North America the average deviations of temperature from normal were calculated for the months of low solar radiation, for one and two months before low solar radiation, and for one to twelve months after low solar radiation. To eliminate secular and long-period variations each of these fifteen values was expressed as a deviation from the mean of the whole set of fifteen. The same procedure was then followed for the months of high solar radiation. The values of temperature deviation for the months of low radiation and for one to four months following are then correlated with the corresponding values accompanying and following high radiation ; this gives high negative coefficients. It is claimed that these sets of figures are " entirely independent of each other and there is no obvious reason why they should be correlated with each other except through their relation to solar values."

It is difficult to assign any meaning to correlation coefficients obtained from only five average values in this way, but apart from that, the statement that the figures are independent does not seem to be justified. The total number of observations used is not stated, but is presumably 84. Of these 27 are classed as low and 17 as high. Consider the following procedure : 84 numbers are taken at random and their average value found. Of these 84 numbers, 27 are selected, again at random, and their mean expressed as a deviation from the mean of the whole 84 ; call this set A. From the remaining 57 numbers, set B, of 17 numbers, is selected, again at random, and its mean expressed as a deviation from the average of the whole 84. If most of the high numbers happen to be included in set A, so that its deviation is positive, the chances are that the deviation of set B will be negative and *vice versa*. If the whole procedure is repeated several times, the deviations of the A's would have a negative correlation with the deviations of the B's, which would probably be ·3 or ·4. The coefficients obtained by Mr. Clayton are much higher than this, indicating that there is probably some relationship, but the method of correlation does not seem to be the best way to express it.

From this part of the work Mr. Clayton concludes that " there are two pulses accompanying and following each high and low solar value, (1) a rise or a depression of temperature accompanying the high or low solar value, and (2) a similar departure about three months later."

Deviations from normal are next calculated for pressure, temperature and rainfall, winter and summer being considered separately, for the months of low and high solar radiation, and the differences high—low were obtained, data from 47 American stations being utilised. It is believed that there is a relation between sunspot numbers and solar radiation, and in order to check the results obtained from the latter, the deviations from normal of pressure, temperature and rainfall accompanying low, medium and high sunspot numbers since 1856 are obtained for the same stations, together with the differences, high—low. These two similar investigations gave for winter and for summer, for each element, some 47 pairs of differences, one of each pair referring to extreme values of solar radiation, the other to extreme values of sunspots for a much longer period. For each half-year and element, the two sets of differences are then correlated, giving the following coefficients :—

pressure ..	winter + ·56	summer + ·45
temperature..	winter + ·62	summer + ·50

The correlation coefficients for the rainfall differences are not given, but the results for pressure and temperature do seem to be significant, and to bear the interpretation which Mr. Clayton puts upon them, namely, " that higher solar-radiation values prevail at times of numerous sunspots, and that definite geographically located weather changes attend changes in the solar activity, whichever measure of it we employ."

The remainder of the paper is devoted to the further discussion of the geographical aspect, to the annual variation of the relationships, and to answering various objections which have been raised against previous work on the subject.

C. E. P. B.

Om Isforholdene i Danske Farvande, Aarene 1861-1906. By C. I. H. Speerschneider. Size 10×7, pp. 83, Copenhagen. Publikationer fra Det. Danske Meteorologiske Institut, Meddelelser Nr. 6.

This paper contains a summary of ice conditions in the western Baltic and the waters east of Denmark from the year 1861 to 1906 as well as a table giving the ice conditions in the Sound from 1861 to 1926. This summary is also generalised under the different geographical localities and the formation of ice in the different channels is discussed. The author points out an interesting process of ice formation, namely, " Subsurface " ice. In the Kattegat after prolonged frost the salt water becomes very cold, but does not freeze on account of its high salinity. If, however, fresher water from the Baltic flows over this cold salt water, the under side of the fresher water is cooled down below freezing point, ice needles are formed out and rise from below to the surface, or under favourable conditions pancake ice may even be generated. The importance of this process is that owing to the rising of the ice, there is never any protecting sheet between the fresh and salt water, with the result that under the right conditions freezing is very extensive and rapid and may be even of considerable danger to small craft.

C.S.D.

Books Received

Apia Observatory, Samoa. Report for 1923, Wellington, 1926.

India Weather Review, annual summary for 1924.

Report on the Administration of the Meteorological Department of the Governm nt of India in 1925-26, and a note on the long established Observatories of Madras and Bombay.

Report on Rainfall Registration in Mysore for 1925. By C. Seshachar, M.A., Bangalore, Govt. Press, 1926.

Meteorology in Mysore for 1925, being the results of observations at Bangalore, Mysore, Hassan and Chitaldrug. Thirty-third annual report. By C. Seshachar, M.A., Bangalore, 1926.

Obituary

Professor Edouard Brückner.—We regret to learn of the death of Professor Edouard Brückner, on May 21st, at the age of 64 years. Professor Brückner is well-known to all meteorologists from the weather cycle of about 35 years which bears his name, and which is probably the best-founded of all meteorological periodicities. It is stated that he discovered this cycle in 1887; apparently it was known several centuries before, for it is mentioned by Sir Francis Bacon, but until Brückner published in 1890 his noteworthy compilation "Klimaschwankungen seit 1700" it had never been scientifically demonstrated. Among his other meteorological publications may be mentioned his "Berichten über den Fortschritt der geographischen Meteorologie" (1891, 1894, 1899); "Einfluss der Schneedecke auf das Klima der Alpen" (1893) and "Klimaschwankungen 1813—1912 in Vorderindien" (1918).

E. Brückner was born at Jena on July 29th, 1862, his father being Alexander Brückner the historian, which perhaps accounts for his able treatment of historical sources in "Klimaschwankungen." He received the degree of Ph.D. at Munich in 1885, and from 1886 to 1888 he was assistant editor of the *Meteorologische Zeitschrift.* His work was not mainly meteorological however, for in 1891 he became Professor of Geography at Bern, and in 1906 Professor of Geography at Vienna, which post he held until his death, and he did a great deal to explore the boundary science of geology and meteorology which is known as palæoclimatology. He collaborated with A. Penck in studying the Quaternary history of the Alps, a fortunate association which produced "Die Alpen im Eiszeitalter," three large volumes published between 1901 and 1909, providing at once the first sure proof of the succession of glacial advances and retreats, a nomenclature which is firmly rooted in the literature of glaciology, and a model of painstaking exploration, critical comparison and lucid exposition.

The Weather of May, 1927

The weather of May was in general fair and cool in the north, rather warmer in the south. On the morning of the 1st severe frost was experienced in most places, the temperature falling to 18° F. in the screen at Eskdalemuir, and to 14° F. on the grass there and at Greenwich, but this was followed later in the week by a change to fairer conditions with a marked rise in temperature in England and Ireland. Day temperatures between 70° and 80° F. occurred in many parts; 81° F. was recorded at Tottenham on the 7th, and 87° F. at Ford (Argyllshire) on the 8th. In the extreme northwest of Scotland, however, there was no rise, and day temperatures did not exceed 55°F. during this period. Thunderstorms occurred locally on several days and among the larger rainfall measurements were 66 mm. (2·58 in.) at Aasleagh (Mayo) on the 1st, and 31 mm. (1·22 in.) at Edinburgh on the 4th. After the 9th, the winds became temporarily more northerly, temperature dropped considerably and some sleet was experienced on the northeast coasts on the morning of the 13th. By the 14th, however, the approach of a depression off the Hebrides caused southwesterly winds and warmer generally unsettled weather. On the 16th, a thunderstorm at Rothesay was reported to be the most severe experienced at that station for over twenty years. A belt of high pressure subsequently extended across the British Isles giving a few days fine, sunny weather, with temperature rising to nearly 70° F. in some cases, but there was a renewal of unsettled conditions with rain locally by the 20th. Heavy rain again occurred on the 23rd when 41 mm. (1·61 in.) were measured at Ford (Argyllshire) and 38 mm. (1·50 in.) at Dungeon Ghyll (Westmoreland) on the 23rd. After this the weather was mainly fair until the end of the month, with local showers and cool northerly winds, except in the south, where the temperature varied a good deal, some high maxima being experienced on a few days, *e.g.*, 77° F. at London on the 24th, 74° at Southampton on the 25th, and 71° F. at London and South Farnborough on the 30th. The total sunshine was well below the average in the north but somewhat above it in the south.

Pressure was above normal in a belt extending from Greenland across the British Isles to the western Mediterranean, the greatest excess being 5·1 mb. at Seydisfjord. Pressure was below normal over the North Atlantic from Newfoundland to Portugal and also over eastern Scandinavia. Temperature was above normal, except in Scotland and Scandinavia, and rainfall below normal, except in southern Sweden and Spitsbergen.

Heavy rain and thunderstorms about the 13th caused much damage in central Switzerland where several rivers overflowed their banks, and in consequence of the warm weather the road over the Simplon Pass was open much earlier than usual. Abnormally cold frosts at night damaged vineyards and orchards in Hungary about the middle of the month, and at the same time forest fires, fanned by high winds, were raging along the River Khilok (Siberia). On the 23rd, a severe storm occurred on the Adriatic, and on the same day heavy rain on the Serra da Estrella

(*Continued on p.* 124.)

Rainfall: May, 1927: England and Wales

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Lond.	Camden Square	1·29	33	73	*War.*	Birminghm, Edgbaston	1·96	50	92
Sur .	Reigate, The Knowle ..	1·14	29	67	*Leics*	Thornton Reservoir ..	1·34	34	67
Kent.	Tenterden, Ashenden. .	·60	15	38	,, .	Belvoir Castle........	·79	20	37
,, .	Folkestone, Boro. San.	...	..	...	*Rut .*	Ridlington...........	·88	22	...
,, .	Margate, Cliftonville . .	·47	12	30	*Linc.*	Boston, Skirbeck	1·06	27	60
,, .	Sevenoaks, Speldhurst.	1·28	33	...	,, .	Lincoln, Sessions House	1·00	25	53
Sus .	Patching Farm.......	1·10	28	59	,, .	Skegness, Marine Gdns.	·78	20	46
,, .	Brighton, Old Steyne .	·99	25	61	,, .	Louth, Westgate	1·02	26	50
,, .	Tottingworth Park....	·73	19	41	,, .	Brigg	·93	24	50
Hants	Ventnor, Roy. Nat. Hos.	·62	16	36	*Notts.*	Worksop, Hodsock....	1·10	28	55
,, .	Fordingbridge, Oaklnds	·80	20	38	*Derby*	Mickleover, Clyde Ho. .	1·92	49	97
,, .	Ovington Rectory	1·13	29	52	,, .	Buxton, Devon. Hos...	1·59	41	51
,, .	Sherborne St. John...	1·71	43	88	*Ches.*	Runcorn, Weston Pt...	1·34	34	58
Berks	Wellington College...	1·12	28	60	,, ..	Nantwich, Dorfold Hall	1·52	39	...
,, .	Newbury, Greenham..	1·57	40	84	*Lancs*	Manchester, Whit. Pk.	1·41	36	67
Herts.	Benington House	·96	25	51	,, ..	Stonyhurst College....	1·24	31	44
Bucks	High Wycombe	1·41	36	80	,, ..	Southport, Hesketh Pk	1·18	30	56
Oxf..	Oxford, Mag. College ..	·86	22	48	,, ..	Lancaster, Strathspey .	1·91	49	...
Nor .	Pitsford, Sedgebrook..	·94	24	49	*Yorks*	Wath-upon-Dearne ...	·97	25	48
,, .	Oundle..............	·63	16	...	,, .	Bradford, Lister Pk...	1 38	35	66
Beds.	Woburn, Crawley Mill.	·70	18	36	,, .	Oughtershaw Hall....	2·55	65	...
Cam.	Cambridge, Bot. Gdns.	...	..	...	,, .	Wetherby, Ribston H..	1·72	44	83
Essex	Chelmsford, CountyLab	·95	24	66	,, .	Hull, Pearson Park ...	·85	22	44
,, .	Lexden, Hill House...	·70	18	...	,, .	Holme-on-Spalding ...	1·16	29	...
Suff .	Hawkedon Rectory ...	·49	12	26	,, .	West Witton, Ivy Ho..	2·05	52	...
,, .	Haughley House......	·53	13	...	,, .	Felixkirk, Mt. St. John	1·77	45	94
Norf.	Beccles, Geldeston....	·42	11	24	,, .	Pickering, Hungate ...	1·07	27	...
,, .	Norwich, Eaton	·63	16	33	,, .	Scarborough.........	·94	24	49
,, .	Blakeney	·74	19	47	,, .	Middlesbrough	1·66	42	86
,, .	Little Dunham	·76	19	39	,, .	Baldersdale, Hury Res.	1·92	49	...
Wilts.	Devizes, Highclere....	·92	23	51	*Durh.*	Ushaw College	1·67	42	77
,, .	Bishops Cannings	1·09	28	56	*Nor .*	Newcastle, Town Moor.	1·52	39	75
Dor .	Evershot, Melbury Ho.	1·39	35	68	,, .	Bellingham, Highgreen	2·10	53	...
,, .	Creech Grange	1·31	33	...	,, .	Lilburn Tower Gdns...	1·89	48	...
,, .	Shaftesbury, Abbey Ho.	1·59	41	75	*Cumb*	Geltsdale............	2·66	68	...
Devon	Plymouth, The Hoe...	·38	10	18	,, .	Carlisle, Scaleby Hall .	1·98	50	83
,, .	Polapit Tamar	·83	21	41	,, .	Seathwaite M.	...	..	...
,, .	Ashburton, Druid Ho..	·68	17	25	*Glam.*	Cardiff, Ely P. Stn.....	1·66	42	66
,, .	Cullompton	·60	15	28	,, .	Treherbert, Tynywaun	3·83	97	...
,, .	Sidmouth, Sidmount ..	·76	19	39	*Carm*	Carmarthen Friary....	2·05	52	74
,, .	Filleigh, Castle Hill ...	1·26	32	...	,, .	Llanwrda, Dolaucothy.	2·16	55	64
,, .	Barnstaple, N.Dev.Ath.	·99	25	48	*Pemb*	Haverfordwest, School	1 44	37	58
Corn.	Redruth, Trewirgie ...	1·02	26	44	*Card.*	Gogerddan..........	2·34	59	89
,, .	Penzance, Morrab Gdn.	·99	25	45	,, .	Cardigan, County Sch. .	2·03	52	...
,, .	St. Austell, Trevarna..	·76	19	31	*Brec.*	Crickhowell, Talymaes	2·00	51	...
Soms	Chewton Mendip	1·40	36	51	*Rad .*	Birm. W. W. Tyrmynydd	2·11	54	62
,, .	Street, Hind Hayes ...	1·68	43	...	*Mont.*	Lake Vyrnwy	2·32	59	74
Glos..	Clifton College	1·04	32	50	*Denb.*	Llangynhafal	1·74	44	...
,, .	Cirencester, Gwynfa..	1·10	28	53	*Mer .*	Dolgelly, Bryntirion..	2·69	68	81
Here.	Ross, Birchlea	1·04	26	49	*Carn.*	Llandudno	1·26	32	66
,, .	Ledbury, Underdown.	·98	25	48	,, .	Snowdon, L. Llydaw 9	4 97	126	...
Salop	Church Stretton	1·28	33	50	*Ang .*	Holyhead, Salt Island.	1·13	29	58
,, .	Shifnal, Hatton Grange	1·40	36	68	,, .	Lligwy	·81	21	...
Staff.	Tean, The Heath Ho...	...	..	...	*Isle of Man*				
Worc.	Ombersley, Holt Lock.	1·43	36	70		Douglas, Boro' Cem...	...	..	...
.. .	Blockley, Upton Wold.	1·43	36	66	*Guernsey*				
War.	Farnborough	1·04	26	46		St. Peter P't. Grange Rd	·81	21	48

Rainfall: May, 1927: Scotland and Ireland

CO.	STATION	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Wigt.	Stoneykirk, Ardwell Ho	1·55	39	62	*Suth.*	Loch More, Achfary...	5·42	138	123
,,	Pt. William, Monreith.	2·71	69	...	*Caith*	Wick	2·07	53	100
Kirk.	Carsphairn, Shiel.	4·28	109	...	*Ork.*	Pomona, Deerness	1·83	46	92
,,	Dumfries, Cargen.....	2·65	67	88	*Shet.*	Lerwick	1·84	47	88
Roxb	Branxholme	1·30	33	58		———			
Selk.	Ettrick Manse.........	3·73	95	...	*Cork.*	Caheragh Rectory	1·84	47	...
Berk.	Marchmont House	2·78	71	113	,,	Dunmanway Rectory.	3·01	76	89
Hadd	North Berwick Res....	1·57	40	79	,,	Ballinacurra	2·04	52	86
Midl	Edinburgh, Roy. Obs..	2·10	53	112	,,	Glanmire, Lota Lo. ...	2·29	58	94
Lan.	Biggar	...	..	...	*Kerry*	Valentia Obsy.	2·34	59	74
,,	Leadhills	...	..	...	,,	Killarney Asylum.....	1·63	41	53
Ayr.	Kilmarnock, Agric. C..	1·96	50	85	,,	Darrynane Abbey	2·58	66	87
,,	Girvan, Pinmore......	2·83	72	95	*Wat.*	Waterford, Brook Lo..	1·87	47	81
Renf.	Glasgow, Queen's Pk..	2·26	57	93	*Tip.*	Nenagh, Cas. Lough...	1·62	41	66
,,	Greenock, Prospect H..	4·23	107	123	,,	Roscrea, Timoney Park	1·13	29	...
Bute.	Rothesay, Ardencraig.	4·20	107	139	,,	Cashel, Ballinamona ..	1·05	27	44
,,	Dougarie Lodge	3·31	84	...	*Lim.*	Foynes, Coolnanes	1·64	42	70
Arg.	Ardgour House	4·50	114	...	,,	Castleconnell Rec.	1·48	38	...
,,	Manse of Glenorchy..	4·62	117	...	*Clare*	Inagh, Mount Callan ..	2·95	75	...
,,	Oban	2·74	70	...	,,	Broadford, Hurdlest'n.	1·27	32	...
,,	Poltalloch	3·65	93	126	*Wexf*	Newtownbarry	1·54	39	...
,,	Inveraray Castle......	4·96	126	126	,,	Gorey, Courtown Ho...	1·52	39	68
,,	Islay, Eallabus.......	3·19	81	120	*Kilk.*	Kilkenny Castle	1·41	36	64
,,	Mull, Benmore	7·90	201	...	*Wic.*	Rathnew, Clonmannon	1·21	31	...
Kinr.	Loch Leven Sluice	2·32	59	95	*Carl.*	Hacketstown Rectory.	1·64	42	63
Perth	Loch Dhu	3·60	91	80	*QCo.*	Blandsfort House.....	1·45	37	60
,,	Balquhidder, Stronvar.	2·57	65	...	,,	Mountmellick	1·13	29	...
,,	Crieff, Strathearn Hyd.	2·03	52	82	*KCo.*	Birr Castle..........	·79	20	35
,,	Blair Castle Gardens ..	2·41	61	119	*Dubl.*	Dublin, FitzWm. Sq...	·77	20	38
Forf.	Kettins School.......	2·51	64	103	,,	Balbriggan, Ardgillan .	1·09	28	52
,,	Dundee, E. Necropolis.	2·39	61	114	*Me'th*	Beauparc, St. Cloud ..	1·77	45	...
,,	Pearsie House........	2·37	60	...	,,	Kells, Headfort......	1·57	40	58
,,	Montrose, Sunnyside..	...	..	...	*W.M*	Moate, Coolatore.....	1·38	35	...
Aber.	Braemar, Bank	1·64	42	69	,,	Mullingar, Belvedere .	1·32	34	54
,,	Logie Coldstone Sch. ..	2·00	51	80	*Long*	Castle Forbes Gdns....	1·55	39	60
,,	Aberdeen, King's Coll..	2·58	66	111	*Gal.*	Ballynahinch Castle ..	2·40	61	67
,,	Fyvie Castle	3·51	89	...	,,	Galway, Grammar Sch.	1·73	44	...
Mor.	Gordon Castle........	2·44	62	115	*Mayo*	Mallaranny..........	2·03	52	...
,,	Grantown-on-Spey....	4·11	104	176	,,	Westport House......	2·15	55	75
Na.	Nairn, Delnies........	2·30	58	72	,,	Delphi Lodge	4·17	106	...
Inv.	Ben Alder Lodge	...	..	...	*Sligo*	Markree Obsy.	2·02	51	72
,,	Kingussie, The Birches	2·37	60	...	*Cav'n*	Belturbet, Cloverhill..	1·49	38	60
,,	Loch Quoich, Loan....	5·00	127	...	*Ferm*	Enniskillen, Portora ..	1·53	39	...
,,	Glenquoich	4·89	124	90	*Arm.*	Armagh Obsy.	1·54	39	65
,,	Inverness, Culduthel R.	1·93	49	...	*Down*	Fofanny Reservoir ...	3·63	92	...
,,	Arisaig, Faire-na-Squir	...	..	...	,,	Seaforde	1·69	43	64
,,	Fort William.........	3·11	79	78	,,	Donaghadee, C. Stn...	1·51	38	67
,,	Skye, Dunvegan......	2·97	75	...	,,	Banbridge, Milltown .	1·38	35	61
,,	Barra, Castlebay	...	..	...	*Antr.*	Belfast, Cavehill Rd. .	1·73	44	...
R&C	Alness, Ardross Cas. ..	2·37	60	91	,,	Glenarm Castle.......	2·74	70	...
,,	Ullapool.............	2·00	51	...	,,	Ballymena, Harryville	1·95	50	68
,,	Torridon, Bendamph..	4·64	118	162	*Lon.*	Londonderry, Creggan	1·45	37	55
,,	Achnashellach	3·98	101	...	*Tyr.*	Donaghmore	2·06	52	...
,,	Stornoway	1·81	46	71	,,	Omagh, Edenfel	1·46	37	56
Suth.	Lairg	1·91	49	...	*Don.*	Malin Head	1·74	44	88
,,	Tongue Manse........	2·10	53	88	,,	Dunfanaghy	1·25	32	48
,,	Melvich School.......	2·62	67	128	,,	Killybegs, Rockmount.	1·96	50	54

Climatological Table for the British Empire, December, 1926

STATIONS	PRESSURE Mean of Day M.S.L.	PRESSURE Diff. from Normal	TEMPERATURE Absolute Max.	TEMPERATURE Absolute Min.	TEMPERATURE Mean Values Max.	TEMPERATURE Mean Values Min.	TEMPERATURE Mean Values ½ max. and min.	TEMPERATURE Mean Values Diff. from Normal	TEMPERATURE Mean Wet Bulb	Relative Humidity	Mean Cloud Am'nt	PRECIPITATION Am'nt	PRECIPITATION Diff. from Normal	PRECIPITATION Days	BRIGHT SUNSHINE Hours per day	BRIGHT SUNSHINE Percentage of possible
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1026·5	+12·8	50	29	44·1	35·8	39·9	− 0·4	37·7	86	6·7	6	− 52	5	1·7	22
Gibraltar	1020·4	+ 0·3	68	36	59·9	49·9	54·9	− 1·1	48·8	78	5·3	9	−133	2	...	...
Malta	1015·0	− 1·6	68	48	61·0	53·9	57·5	− 0·4	53·5	82	6·2	51	− 43	10	4·9	51
St. Helena	1012·2	+ 1·4	69	55	62·7	56·1	59·4	− 2·8	57·5	92	4·0	47	− 3	17	...	...
Sierra Leone	1010·8	− 0·1	90	70	87·5	74·4	80·9	− 0·5	76·4	80	2·8	11	− 25	2	...	...
Lagos, Nigeria	1008·1	− 2·4	91	70	87·9	74·2	81·1	− 0·4	75·8	83	7·5	2	− 18	1	...	...
Kaduna, Nigeria	1015·1	+ 2·3	95	52	88·8	57·7	73·3	0·0	58·6	37	2·0	0	0	0	...	...
Zomba, Nyasaland	1014·5	+ 0·4	92	48	81·8	51·4	66·6	− 6·5	...	82	9·1	395	+123	26	...	...
Salisbury, Rhodesia	1007·6	− 1·6	91	55	79·0	60·5	69·7	+ 0·1	63·8	71	6·6	211	+ 64	20	4·8	36
Cape Town	1014·2	− 0·1	90	47	77·6	58·7	68·1	+ 0·2	61·0	67	2·5	2	− 19	1	...	...
Johannesburg	1010·4	− 0·1	86	51	77·5	56·8	67·1	+ 2·0	58·0	66	4·0	115	− 23	16	8·3	61
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	96	48	87·8	58·9	73·3	+ 1·5	62·5	57	4·0	51	− 11	9	...	...
Calcutta, Alipore Obsy.	1014·2	− 1·5	83	55	77·8	58·8	68·3	+ 1·8	58·9	81	3·4	18	+ 13	2*	...	...
Bombay	1011·9	− 1·6	87	65	84·7	69·2	76·9	− 0·6	65·3	71	0·7	0	− 1	0*	...	...
Madras	1012·3	− 1·2	87	58	84·8	67·4	76·1	− 0·6	71·0	81	5·2	27	−121	3*	...	...
Colombo, Ceylon	1009·3	− 1·4	90	69	86·9	72·8	79·9	+ 0·9	75·4	73	4·9	142	+ 10	12	8·2	70
Hongkong	1019·8	+ 0·1	77	43	67·1	59·0	63·1	+ 0·1	57·6	72	7·1	12	− 17	3	4·5	42
Sandakan	...	...	88	73	85·4	74·8	80·1	0·0	76·5	86	...	1116	+667	25	...	...
Sydney	1012·4	+ 0·5	104	57	74·7	61·2	67·9	− 2·2	63·2	63	6·7	188	+114	16	6·4	44
Melbourne	1012·4	− 0·1	98	46	77·6	55·3	66·5	+ 2·2	58·6	54	6·2	32	− 27	9	6·7	51
Adelaide	1012·8	− 0·4	103	50	80·1	57·8	68·9	− 2·2	57·6	42	6·4	35	+ 10	6	8·9	62
Perth, W. Australia	1013·5	+ 0·3	102	50	83·5	60·4	71·9	+ 1·2	61·5	45	2·8	1	− 14	2	11·3	79
Coolgardie	1012·5	+ 1·3	104	45	87·3	58·2	72·7	− 3·1	57·4	34	2·3	11	− 7	4	...	...
Brisbane	1011·4	− 0·6	93	63	83·1	66·8	74·9	− 1·5	68·2	66	6·0	241	+118	18	7·1	52
Hobart, Tasmania	1010·5	+ 0·8	81	41	68·7	51·1	59·9	− 0·5	54·5	62	6·6	34	− 16	15	8·5	56
Wellington, N.Z.	1014·4	+ 2·2	75	41	65·3	52·0	58·7	− 1·7	55·8	70	6·1	96	+ 14	12	6·8	45
Suva, Fiji	1010·5	+ 1·9	91	68	85·7	73·7	79·7	+ 0·8	74·3	73	6·8	119	−189	17	6·4	48
Apia, Samoa	1009·8	+ 1·4	89	73	84·8	74·9	79·9	+ 0·6	77·4	80	6·7	555	+209	22	5·6	44
Kingston, Jamaica	1014·0	0·0	88	66	85·3	68·0	76·7	− 1·0	66·6	88	2·2	21	− 20	2	9·6	86
Grenada, W.I.	1012·2	+ 0·7	88	72	84·9	73·7	79·3	+ 1·2	73·7	77	4·6	50	−135	14	...	...
Toronto	1019·2	+ 1·8	43	− 3	30·1	17·8	23·9	− 2·3	21·4	79	8·0	37	− 35	14	2·1	23
Winnipeg	1017·5	− 0·4	35	−28	10·9	− 3·7	3·6	− 2·1	2·0	77	7·0	0	− 25	0	2·9	35
St. John, N.B.	1014·0	− 0·2	43	− 4	28·3	13·9	21·1	− 3·3	17·7	76	5·7	107	+ 1	17	3·7	42
Victoria, B.C.	1017·5	+ 0·7	55	19	45·2	37·7	41·5	0·0	39·5	87	8·9	99	− 51	20	1·2	14

*For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

Climatological Table for the British Empire for the Year 1926

STATIONS	PRESSURE: Mean of Day M.S.L.	PRESSURE: Diff. from Normal	TEMPERATURE Absolute: Max.	TEMPERATURE Absolute: Min.	TEMPERATURE Mean Values: Max	TEMPERATURE Mean Values: Min.	TEMPERATURE Mean Values: ½ max. and min.	TEMPERATURE Mean Values: Diff. from Normal	TEMPERATURE Mean: Wet Bulb.	Relative Humidity	Mean Cloud Am'nt	PRECIPITATION: Am'nt	PRECIPITATION: Diff. from Normal	PRECIPITATION: Days	BRIGHT SUNSHINE: Hours per day	BRIGHT SUNSHINE: Percentage of possible.
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1014·8	− 0·6	85	18	57·4	44·5	50·9	+ 1·2	46·2	87	7·2	603	− 3	162	3·6	30
Gibraltar	1017·7	− 0·2	90	36	70·7	59·0	64·9	+ 0·6	57·8	80	5·1	664	−245	77	...	...
Malta	1016·0	+ 0·1	89	45	70·6	61·6	66·1	0·0	61·9	83	4·6	354	−150	58	8·0	66
St. Helena	1014·2	+ 2·8	76	50	63·8	57·1	60·4	− 1·6	58·5	91	3·9	745	−273	219	...	...
Sierra Leone	1012·1	+ 0·7	95	69	87·5	74·0	80·7	0·0	75·4	81	5·5	3285	−708	170	...	...
Lagos, Nigeria	1009·7	− 1·7	93	68	86·6	75·4	81·0	+ 0·5	76·4	83	7·8	1931	+111	128	...	...
Kaduna, Nigeria	1013·7	+ 1·3	103	...	88·7	...	...	...	65·7	54	2·5	1771	+521	121	...	...
Zomba, Nyasaland	1019·1	+ 0·8	95	46	79·8	58·7	69·3	− 0·1	...	76	6·2	1985	+628	138	...	...
Salisbury, Rhodesia	1012·7	− 0·7	92	35	78·0	53·9	66·0	+ 0·7	58·0	60	3·7	889	+ 77	96	7·9	66
Cape Town	1018·1	+ 1·1	98	35	71·4	53·2	62·3	0·0	55·4	79	4·3	505	−139	88	...	...
Johannesburg	1016·6	+ 0·5	88	21	71·5	49·9	60·7	+ 1·2	51·0	58	2·4	699	−145	88	8·9	74
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	101	12	76·2	46·2	61·2	− 0·2	51·2	63	2·9	510	− 85	57	...	...
Calcutta, Alipore Obsy.	1007·7	+ 0·1	107	49	87·6	71·1	79·4	+ 0·7	71·9	84	5·4	1934	+345	89*	...	...
Bombay	1008·9	− 0·3	94	63	86·7	75·7	81·2	+ 0·7	73·3	77	4·1	1845	+ 12	83*	...	...
Madras	1009·0	+ 0·2	110	58	92·1	75·3	83·7	+ 0·7	75·8	76	5·7	798	−491	45*	...	...
Colombo, Ceylon	1009·6	− 0·4	93	66	87·5	75·1	81·3	+ 0·6	77·3	75	6·7	2667	+561	204	6·8	56
Hong Kong	1013·1	+ 0·5	93	43	76·0	68·2	72·1	− 0·2	67·6	79	7·6	2560	+428	139	5·0	41
Sandakan	...	...	93	71	87·7	75·5	81·6	+ 0·3	76·7	81	...	3798	+758	149	...	...
Sydney	1015·1	− 0·8	108	42	72·5	56·4	64·4	+ 1·2	58·5	65	4·9	943	−273	127	7·0	58
Melbourne	1015·4	− 0·9	104	32	68·4	50·8	59·6	+ 1·2	53·4	67	6·3	521	−126	149	5·7	47
Adelaide	1016·4	− 0·6	104	37	72·9	53·3	63·1	+ 0·1	54·2	54	5·7	562	+ 23	116	7·4	60
Perth, W. Australia	1015·9	− 0·5	106	39	72·8	55·7	64·2	0·0	57·8	63	5·6	1250	+389	167	7·0	56
Coolgardie	1015·5	− 0·5	110	31	77·5	52 3	64·9	+ 0·4	53·8	49	3·0	241	− 17	57	...	...
Brisbane	1016·0	+ 0·2	97	41	79·1	60·4	69·8	+ 0·9	62·7	65	4·2	783	−350	106	8·2	68
Hobart, Tasmania	1011·5	− 1·1	91	31	62·6	47·4	55·0	+ 0·7	49·0	66	6·8	656	+ 54	187	6·2	50
Wellington, N.Z.	1013·9	− 0·8	81	32	61·5	49·2	55·4	+ 0·1	52·1	74	6·3	1076	−146	172	5·5	46
Suva, Fiji	1012·0	+ 0·6	91	62	81·6	71·6	76·6	− 0·4	72·9	82	7·2	2651	−203	219	4·9	41
Apia, Samoa	1010·6	+ 0·3	91	66	85·4	74·7	80·0	+ 1·5	76·9	78	5·9	2629	− 85	176	6·7	56
Kingston, Jamaica	1013·4	− 0·3	95	64	87·8	71·5	79·6	+ 0·3	70·4	83	3·5	500	−361	67	...	...
Grenada, W.I.	1013·6	+ 1·4	92	70	85·1	74·6	79·8	+ 1·0	75·2	78	5·5	1508	−426	199	...	...
Toronto	1014·9	− 1·5	91	− 5	51·5	36·1	43·8	− 0·6	38·7	74	6·1	961	+111	163	5·3	41
Winnipeg	1015·6	− 0·6	98	−29	46·0	27·0	36·5	+ 2·2	...	...	5·7	441	− 93	91	5·6	43
St. John, N.B.	1012·5	− 2·2	83	−13	47·1	32·6	39·8	− 1·4	36·3	77	5·9	1345	+125	165	5·3	43
Victoria, B.C.	1016·8	+ 0·4	85	19	58·0	46·1	52·1	+ 2·6	48·3	81	6·6	535	−292	139	6·1	46

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

(*Continued from p.* 119.)
(Portugal) caused the mountain torrents to overflow and destroy many bridges and houses.

A sudden severe frost occurring unusually late in the year did much damage to the mulberry crops in central Japan about the 13th, and in India a gale lasting four hours severed communications and wrecked many buildings at Mussooree, United Provinces, on the 31st. A steamer plying between the islands of the Philippines was sunk during a typhoon on the 28th and 108 people were drowned.

Flood waters on the Assiniboine river swept away temporary dykes at Brandon, Manitoba, on the 3rd, the water rising 18 ins. in 24 hours. From then until the 16th, the Seine, Red, and Assiniboine rivers continued to rise and the floods extended, but by the 20th the water was gradually retreating and the weather had improved. Between the 20th and 24th, however, continuous heavy rain again occurred in most of the Prairie Provinces, causing much anxiety. The floods in the Mississippi basin continued throughout the month. Heavy rains occurred fairly frequently in this area and were probably partly responsible for the rises in the river which took place, according to the river stages table, even after the flood crest, which was just below Arkansas City on the 1st, had passed. Fresh breaches in the levees occurred almost every day ; the levees at Bayou des Glaises were broken on the 13th, those at Melville on the 17th, and those at McCrea on the 24th, so that practically the whole of the " Sugar Bowl " area was inundated owing to these breaches on both sides of the Atchafalanga river. By the 23rd, the dreaded flood crest had disappeared from the Mississippi river and conditions were improving, but heavy rain in Ohio, Missouri, and the Upper Mississippi valleys, brought a second flood crest to the river and a new tide, though of smaller proportions than that of May, was sweeping southwards past Helena, Arkansas, on June 1st, and inundating thousands of acres again. On May 7th-9th, tornadoes swept across Arkansas, Missouri, Texas, and Illinois, and about 150 people were killed. After a long spell of dry weather light rain fell at Buenos Aires on the 23rd.

The special message from Brazil states that the rainfall was scarce over the whole country, being 60 mm., 41 mm. and 49 mm. below normal in the northern, central and southern districts respectively. The first frosts of the year occurred in the middle of the month. The crops were generally in good condition in spite of the lack of rain. Pressure at Rio de Janeiro was 0·7 mb. above normal and temperature normal.

Rainfall, May, 1927—General Distribution

England and Wales ..	56	per cent. of the average 1881-1915.
Scotland	100	
Ireland	65	
British Isles	69	