M.O. 313.

The Meteorological Magazine

Air Ministry :: Meteorological Office

Vol. 64

June 1929

No. 761

LONDON: PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE

To be purchased directly from H.M. STATIONERY OFFICE at the following addresses: ADASTRAL HOUSE, KINGSWAY, LONDON, W.C.2; 120, GEORGE STREET, EDINBURGH; YORK STREET, MANCHESTER; 1, ST. ANDREW'S CRESCENT, CARDIFF; 15, DONEGALL SQUARE WEST, BELFAST; or through any Bookseller.

Some Perplexities of the Winter of 1928-9

By L. C. W. BONACINA.

Before the winter of 1928-9, duly ticketed and labelled, is consigned to the meteorological archives, one or two anomalies about it, real or apparent, that run the risk of being forgotten, should be noted. The first anomalous feature relates to the snowfall which for its extreme irregularity of distribution is unique, at least among severe winters since 1875. In the supplementary manuscript to my paper "Snowfall in the British Isles" in *British Rainfall*, 1927, I am reluctantly classing 1928-9 as a snowy winter because, especially in Wales, but also in parts of south-western England, northern England and Scotland, the snowfall was actually heavy all through; moreover by English standards every cold winter means such precipitation as there is in the form of snow rather than rain. But in the Scottish Highlands it was relatively slight and in central and eastern England, except possibly on the Kent coast, the frequent falls of dry snow were so trivial that the ground was never once really covered, the total amount which fell being much smaller than in many a mild winter. In 1895 when the snowfall in the west was also much heavier than in the east the disproportionality was less than in 1929, London being well-covered in February 1895.

The result of this insignificant snowfall in 1929 was that, notwithstanding the freezing of the Thames and the Arctic appearance of the Essex tidal creeks, the winter was nothing like so climatically impressive as it might have been, and the result also was that the frost had a tamer ending in March than would have been the case had the anticyclone established itself

(84689) P. S. 1602/81. 1,050 6/29 M. & S. Gp. 303.

over a land everywhere deep in snow. Who could have believed that after a February so cold, with the frost—just because of the lack of snow—deep in the soil, the equinoctial sunshine of March would yet have sufficed to raise the temperature locally nearly to 80°? And that in a bleak northern county like Yorkshire where sleet and snow in spring, when not actually present, seem always lurking round the corner! Our experiences in March, of skating with afternoon temperatures between 50° and 60°, should have brought home to us that under real anticyclonic weather, heat and cold are closely interwoven. But to us in the British Isles, true "children of the mist" as we are, such dry continental conditions are so rare as to become quite astonishing.

Another interesting anomaly that requires looking into relates to the relative duration of deep-water skating in the north-west and south-east of England. I have heard from more than one source that skating was in full swing on the great lakes of Cumberland and Westmorland for many weeks, and that on Derwentwater it lasted, even over a depth of 70 feet, from early in January to mid-March, the ice being 6 inches thick. Around London skating lasted on small shallow ponds for a similar length of time, but not till the onset of the acute cold in February did it begin on the lakes and reservoirs and never at all on the Serpentine (as distinct from the Long Water) which became the haunt of wild fowl of many kinds. The Serpentine, be it remembered, is of trifling depth in comparison with Derwentwater, and though it may have strong currents, one's natural explanation of the fact that the ice did not apparently quite reach regulation thickness was that the duration of the intense cold was much shorter than in the north. Yet on referring to the charts published in the *Monthly Weather Reports* we find that both in January and February the Lake District lay on a higher sea-level isotherm than London, whilst in December, the first month of the frost, there was little difference. Now the explanation of the relative brevity of deep-water skating in the south would seem to be either that the northern reports are exaggerated, or else that the published isotherms are not based on a sufficient number of stations to reveal the apparently intense local cold that led to such prolonged skating in the deep basins of Lakeland with cold air streaming into them from the heavily snow-clad mountains. But the critical factor may be hydrological rather than meteorological, viz., that the Lakes are more susceptible to freezing through being fed by water from cold mountain levels. In this connexion may I point out that although Cumberland lies on a rather milder normal winter isotherm than Middlesex there have been more winters in the last 50 years which have seen crowds of skaters on Windermere and Derwentwater than on the Serpentine in London.

The Means adopted to obtain satisfactory Illumination of our Barometers

By G. A. Clarke, Aberdeen Observatory.

In the summer of 1928 it was decided, as the result of a discussion with Col. Gold, to enclose the Aberdeen barometers in protective casings, in order to shield them from the direct light and heat of the sun, which at certain periods of the year shines through the eastward window of the Observatory, at the sides of which window the barometers are mounted.

Consequent upon this decision the necessity arose for artificial illumination of the cistern level, vernier, and scales of the instruments, and the following is a description of the plan adopted.

The barometers are completely enclosed in box-like cases with glazed doors. In the right-hand rear corner of the casing, small electric bulbs of the type known as "tubular" are fitted, one at the vernier level and the other at the cistern level, and are so arranged as to be switched on simultaneously. No direct light from these bulbs falls on the instrument, but, instead, a system of reflecting and shielding surfaces was evolved and arranged as shown in the drawings which in Figs. 1 and 2 show horizontal cross-sections at the vernier and cistern levels respectively.

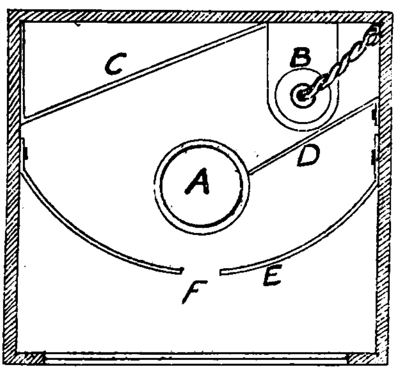


Fig. 1.

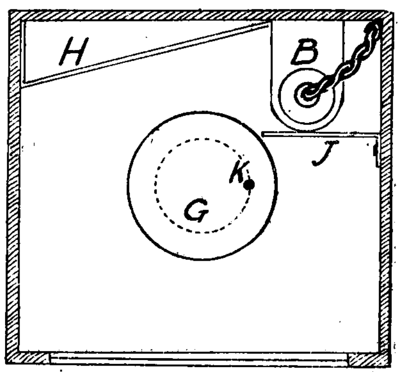


Fig. 2.

In Fig. 1 the circle A represents the cross-section of the barometer tube and scale. At B the tubular bulb is fitted to a brass flange, the bulb hanging vertically. The light from the bulb is reflected from a surface of white Bristol-board C, which is inclined at an angle as shown in the drawing. At D is a blackened Bristol-board shield, covering the bulb and cutting off direct light from the observer's view. In front of the barometer scale, at a suitable distance, and having a suitable curvature, both determined by experiment, is a curved Bristol-board shield E. This shield is white on the inside and blackened on the side towards the observer. In it is cut a slit F, of sufficient length and width to enable only the mercury column and the scale and vernier to be seen conveniently.

When the light is switched on, the observer, looking through the slit F, sees the brilliantly illuminated white card C above the mercury column, and the scale and vernier less brightly illuminated by the reflection of light from the white inner surface of the shield E. When the vernier is brought down to the level of the mercury meniscus, the brighter illumination practically disappears, and only the illuminated scales are visible; they can then be read with ease and precision.

At the cistern level, the cross-section of which is shown in Fig. 2, G indicates the cistern, H is the inclined reflector, and J the dark shield. K shows the position of the fiducial point or index, which, when the light is switched on, shows clearly against the white reflecting background.

The chief advantages of the arrangements described are those of uniformity and effectiveness of illumination. The employment of light reflected from matt white surfaces entirely eliminates the effects of irradiation, while the presence of the shields ensures that only the necessary parts of the instrument are illuminated. The cases enclosing the barometers should obviate any sudden or rapid variations of temperature, the intensity of the illumination is fairly constant, and the readings are taken always under uniform conditions; they should therefore be very consistent and dependable.

Royal Meteorological Society

The usual monthly meeting of this Society was held on Wednesday, the 15th inst., in the Society's Rooms, 49, Cromwell Road, South Kensington, Sir Richard Gregory, D.Sc., President, in the Chair.

Mr. J. E. Clark gave a brief account of the effects of the frost and drought in the early months of 1929 in delaying the appearance of plants.

The following papers were discussed:—

1. *J. Edmund Clark, I. D. Margary, R. Marshall and C. J. P. Cave.—Report on the phenological observations in the British Isles, December,* 1927, *to November,* 1928.

It may surprise many to find on examining the Report, that 1928 considered as a whole differed so slightly from the average for 35 years. We think of the year as sunny, but the dull spring balanced brilliancy in January, July and September; so too the bitter December and chilly June were off-set by the wonderful warmth from January to April, with only occasional slices of cold sandwiched in. The response of flowers, birds and insects, each in their own way has been interesting. December checked the hazel, despite January, making it flower at the average date. But coltsfoot and the next five plants to appear, up to the hawthorn, came early. Still the April cold snap nearly made the horse-chestnut late, so that it only flowered two days instead of six earlier than the hawthorn. In north Scotland it was actually later. Migrants, despite some remarkable premature records of swallow, chiffchaff and cuckoo, averaged only a couple of days early. But this fully suffices to make the lines of equal appearance dates (Isophenes) shift markedly northwards compared with 1927. Interesting are special areas of approach mostly up estuaries, especially the Bristol Channel. A reason for this may be the sea temperatures south and south-east of Ireland. The agreement of the flowers with the average date has produced a " zero " line, unbroken but very sinuous, 2,750 miles long, unprecedented in the previous 37 years. Both farm and garden notes are decidedly on the cheerful side, especially compared with 1927, excepting fruit crops and large areas in north Scotland.

2. *D. Brunt, M.A., B.Sc.—The index of refraction of damp air, and the optical determination of lapse-rate.*

This paper gives the correction to the index of refraction μ, to allow for the presence of water vapour, and shows that variations of humidity give results which cannot be distinguished optically from variations of temperature. It is shown that damp air of temperature T, and virtual temperature T^1 has the same index of refraction as dry air at a temperature $\frac{2}{3}T + \frac{1}{3}T^1$.

3. *J. Reginald Ashworth, D.Sc.—The influence of smoke and hot gases from factory chimneys on rainfall.*

In a manufacturing town such as Rochdale the combustion of large quantities of coal must produce an upward current of hot air which is probably sufficient to influence the rainfall. This effect is not likely to be a large one but it seems to be a real one from these considerations. (1) The average rainfall on week-days over the long period of 30 years is found to be six per cent more than the average on Sundays. At Stonyhurst, where factories do not predominate, the rainfall on Sundays and week-days is more nearly alike than at Rochdale. (2) A continuous record of rainfall hour by hour shows that there are more hours of rain during the working hours of the day on week-days than on Sundays. Also on week-days the rainy hours are more in the daytime than in the night the reverse of which occurs on Sundays, and at Stonyhurst on all days, as is generally the case at western stations. (3) The rate at which rain falls is decidedly greater on week-days than on Sundays. It is small on Sundays and increases until mid-week, after which it slightly diminishes. This variation of the rate at which rain falls agrees very closely with the fluctuation of smoke emission as tested by the average number of soot particles deposited from the air each day of the week. The fact that there is any difference at all points to the influence of human agencies, of which the only reasonable one is the emission of smoke and hot gases in large quantities into the air. The alternative to this that there is a natural 7-day period in rainfall which accidently has its minimum on Sundays is too unlikely to be seriously considered.

A good discussion followed, in which two opposite views were expressed. Some speakers thought that all the effects ascribed to the emission of hot gases could equally well be the result of chance variations; it was pointed out for example that the deficiency in the quantity of rain on Sunday was less marked than the excess on Monday, for which no cause was assigned, and that the deficiency in the number of hours between 6h. and 18h. on Sunday was not uniformly distributed but was almost confined to a few hours at midday. Other speakers, including Sir Napier Shaw, thought that although each separate piece of evidence could be otherwise explained, taken all together their general concordance was a strong argument for the reality of the effect. The general view taken by these speakers was that the increase was probably due to the chemical effect of the hygroscopic nuclei emitted rather than to any mechanical effect caused by the high temperature of the gases emitted.

Correspondence

To the Editor, *The Meteorological Magazine*

Inversions and Grass Minimum Temperatures

In the *Meteorological Magazine* for January, 1929, p. 283, Colonel Gold discusses the difference in the readings of minimum thermometers exposed according to specifications two inches above the ground, where one is over short grass and moss and another over grass with bare earth between blades. The latter gives consistently lower readings. In studies of "Frost Protection" it has been shown that a miniature tropopause exists a few centimeters above the soil, especially noticeable on quiet, clear nights. Thus, if the surface reading is $-2°C.$ the reading at a height of 5 centimeters may be $-4°C.$, above which level the temperature rises slowly, reaching $-2°C.$ at about one meter.

The nature of the cover is important. Contrary to the findings at South Farnborough, thickly matted soils are not always warmer than open, sandy soils. In fact sanding is one of the methods used in cranberry bogs to mitigate low temperatures.

Colonel Gold suggests that radiation is more energetic at the top of the carpet of short grass and moss, and that the layer of air entangled beneath the grass top remains warmer. Minute turbulence follows from the unstable state. With bare ground a more stable condition exists and the air cools progressively. It is largely a question of air drainage and a slow transvection of air, which moving over a bare or sanded surface, leads to mixing and decreases stratification.

In various papers on Frost Fighting, curves of these and other inversions (see Fig. 1, Temperature Inversions in Relations to Frosts) are given.* Inversions on a larger scale are quite common, from the ground up to 200 meters. Thus at Blue Hill

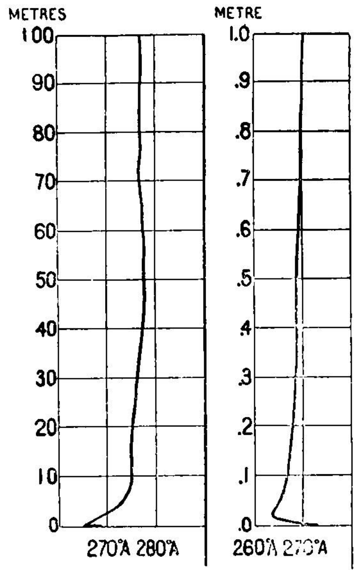


FIG. 1.
(Reproduced from Ann. Astr. Obs. Harvard Coll., LXXIII., 1915.)

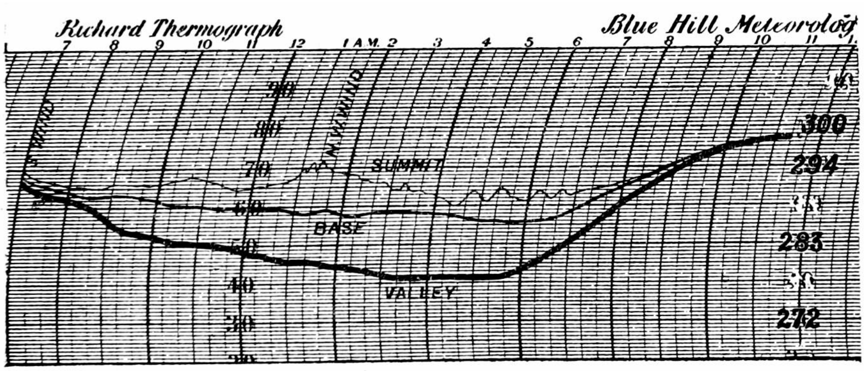


FIG. 2.
(Reproduced from Ann. Astr. Obs. Harvard Coll., LXXIII., 1915.)

an inversion of 11°C. has been recorded; and we are able to check the lapse by intermediate records, the three levels being: summit 200 meters, base 66 meters, and valley 18 meters above sea-level. (Fig. 2, Illustration of Typical Late Spring Frost.) Wind seems to be the effective factor. It is also well known that there are inversions or marked changes in lapse rate just above cumulus clouds. And finally, there is the great discontinuity at the top of the troposphere. If we accept the conclusions of Lindemann and Dobson there is another major inversion

***Ann. Astr. Obs. Harvard Coll.* LXXIII, 1915. Part II. Temperature inversions in relation to Frosts, by A. McAdie.

at 65 kilometers. Not only from the study of meteors and auroras, but from the behaviour of radio signals in, through and possibly beyond, the Kennelly-Heaviside ionized layer, we are now able to explore the upper reaches of air. Meanwhile at the other extreme, under our feet, is a tropopause in miniature.

ALEXANDER MCADIE.

Harvard University, Blue Hill Observatory, Mass. U.S.A. February 4th, 1929.

A further series of comparison readings of grass minimum temperatures on the two instrument sites at South Farnborough have recently been completed, and it is thought that a discussion of the results might prove interesting in view of the suggestions made by Colonel Gold in the *Meteorological Magazine* for January, 1929.

In the first of the present series (November 17th to December 16th, 1928) the average difference for 30 nights was 1°F., the first site (covered with short grass and moss) reading higher than the second, in which bare earth is visible between the blades of grass. In the second set of readings (December 17th, 1928, to January 15th, 1929) with the thermometers interchanged, the average difference was 0.2°F., the first site reading lower. This appeared to indicate a thermometric error of 0.6°F. and led to the conclusion that the real difference between the two sites during the period studied was only of the order of 0.4°F., the first site reading higher. The interesting result is that for 50 nights in late summer and autumn the average difference is 5°F. but that for 60 nights in late autumn and winter it is only 0.4°F. These figures lead to the suggestion that the seasonal change in the vegetation around the first site plays the major part in the divergence.

It is to be noted, however, that the moss-covered site is still reading slightly higher during winter when neighbouring trees, etc., are bare, and at first sight it would appear that this (0.4°F.) is the order of the differences, an explanation of which was suggested by Colonel Gold. Some recent observations of grass minima on the second site have given very different results. A site covered with a carpet of moss was selected as near as possible to the standard site (grass and earth covered). Only nine readings have been obtained to date. Five of these on cloudy nights gave similar readings, the other four on radiation nights gave a lower minima over moss of the order of 2°F. and not a higher reading. It would appear that conduction of heat upwards from the earth beneath does in this case play an important part, and that the minute turbulence is only of a secondary nature. In the case of the moss the heat radiated would not be made good by conduction, the air entangled in the moss acting as a bad conductor.

There is a further complication on the first site in the fact that it is more often permeated with water owing to the proximity of a small stream and to bad drainage. This would increase the conductivity of the soil and moss and with a dry night air lead also to cooling by evaporation. In the case of the first site we have, therefore, to consider four possible effects:—(*a*) surrounding vegetation and the reflection of heat radiated from the ground, (*b*) the moss carpet and its prevention of conduction of heat from the earth, coupled with any difference in the nature, and hence the conductivity, of the soil on the two sites, (*c*) the effect of water in increasing the conductivity of the soil and moss, and (*d*) the effect of evaporation during night in cooling the moss carpet. A measure of the difference in the readings between the two sites is consequently given by an expression of the form $(a)-(b)+(c)-(d)$. Several variations of this expression might occur, *e.g.* (1) during a night with high relative humidity, effect (*d*) would be negligible; (2) after a spell of dry weather, effect (*c*) would be negligible; (3) during wet weather, effects (*b*) and (*c*) would tend to neutralise one another, etc. It is thought that these variations might afford an explanation of the day to day changes in the differences between the two sites as well as to the change in the average differences. From the figures available, effect (*a*) appears to predominate whilst surrounding trees are in leaf; in winter, effects $(a)+(c)$ are in general balanced by effects $(b)+(d)$, so that on the average there is little difference between the sites.

Some such specification as suggested by Colonel Gold certainly appears desirable, but in view of the results obtained at this station it is felt that a specification of the solid angle subtended by surrounding objects should also be included.

W. H. BIGG.

R.A.E., S. Farnborough. January 29th, 1929.

Smoke Cloud

In regard to the letter re the above in the current issue of the *Meteorological Magazine*, may I point out that the blaze on the Fire Hills at Hastings occurred on Monday, March 11th, therefore the smoke seen by Dr. Whipple on the 9th could not have originated at Hastings.

CICELY M. BOTLEY.

Guildables, 17, *Holmesdale Gardens, Hastings. April 22nd*, 1929.

I am much obliged to Miss Botley for pointing out my mistake. The smoke which I saw had the right bearing for Hastings but it must have originated at a nearer place, perhaps in Ashdown Forest. That being so my estimate of the height of the cloud should be considerably reduced.

F. J. W. W.

The Scanty Rainfall of 1929

A search through the rainfall records here extending over 110 years fails to reveal a four-month period of low rainfall such as has been experienced this year. The total fall to April 30th was only 3·06 inches made up as follows:—

	inch.	
January	0·98	(The average fall during this period is 8·35 inches.)
February	1·12	
March	0·18	
April	0·78	
	3·06	

March was the driest on record here.

By selecting a three-month period of drought in various years some extraordinary "coincidences" result:—

1893. March to May: total 2·07 inches.
1898. January to March: total 2·07 inches.
1921. February to April: total 2·07 inches.
1929. February to April: total 2·08 inches.

However, the timely arrival of early May rains has thwarted the beating of yet another record. I refer to the dry season of 1896 when the five-months' rainfall (January to May) amounted to only 3·84 inches—of which May claimed but 0·18 inch. In that very dry year the total rainfall to the end of August (eight months!) had reached only 8·15 inches.

The dryness of the spring of 1929 is well illustrated by the relative humidity values, *e.g.*, during April two values under 30 per cent were registered at 13h. whilst the hygrograph showed one instance under 20 per cent. The *mean* relative humidity during April was well under 60 per cent both at 13h. and 18h. Such a state of things does not normally occur until June or July.

F. J. PARSONS.

The Observatory, Ross-on-Wye. May 6th, 1929.

Approximate Equations for the Determination of Screen Minimum Temperatures during Radiation Nights

In the *Meteorological Magazine* for February, 1928 (p. 20), one of us, in conjunction with Mr. J. Paton, gave approximate equations for the determination at Cranwell of screen minimum temperatures during radiation nights in winter (October to March inclusive) from a consideration of data of the preceding 15h. It has since been thought that a similar piece of work for a seacoast station was called for, for the purposes of comparison. Calshot was the station selected. The period examined stretched from October 1st, 1923, to March 31st, 1928, a

" radiation night " was defined as in the previous note as one in which the mean cloud amount at 18h., 1h., and 7h. G.M.T. was four-tenths or less, and the screen minimum temperature was that measured at the last mentioned 7h.

In determining the equations representing the relationships by the usual graphical methods, a differentiation as before was adopted with regard to wind force during the night, as measured by a Dines anemometer whose head is 43ft. above ground, taking the average of the readings at 18h., 1h., and 7h., as the deciding factor. Two wind groups were taken : (*a*) a mean of 8 miles an hour or less, (*b*) a mean of more than 8 miles an hour. Each of these two groups was further sub-divided according as to whether the relative humidity at 15h. was greater or less than 85.

The equations obtained were as follows, where T = expected night screen minimum; D = dew point at 15h., H = relative humidity at 15h. :—

Mean wind speed	Value of H	Equation	No. of cases available
8 m.p.h. or less	H=or>85	T=1.06D−8.0	9
	H<85	T=0.88D+2.1	59
Greater than 8 m.p.h.	H=or>85	T=0.83D+1.8	32
	H<85	T=0.80D+9.0	143

As in the previous note these equations are only put forward as holding for values of D greater than 32°F. Those given fit the actual results very well, there being no marked divergencies.

W. H. Pick.
D. F. Bowering.

September 24th, 1928.

Moonbeams analogous to Crepuscular Rays

On April 25th at 11 p.m. (B.S.T.) a dim streak of light was seen stretching across the sky, from near the eastern horizon to the zenith. The night was cool and still, and the sky dark, apparently covered by light unbroken clouds. Some of the brighter stars (1st and 2nd Mag.) of high altitude were visible, but near the horizon all were obscured by haze. From a position distant from street lamps, other similar straight streaks were visible. These were about 2° in angular breadth, and in general appearance and visibility resembled lunar halos, except that they were straight. These streaks apparently converged towards the east (and therefore were presumed to be parallel) and were most distinct between about 30° above the horison and a few degrees west of the zenith; they were stationary except for a slow drift southwards. A little after 11 p.m. the moon suddenly appeared, some 8° above the south-south-east horizon, over a dense bank of cloud.

L. G. VEDY.

Downing College, Cambridge. May 4th, 1929.

NOTES AND QUERIES

The early History of the South-west Monsoon

Marco Polo, the Venetian, travelled in Asia between the years 1271 and 1295. On his return journey in 1293, or more probably in 1294, he visited the island of Ceylon. The following notes of what he observed or learned there are taken from the translation published in the magnificent annotated edition of Colonel H. Yule, issued by Murray in 1871. " You must know that the sea here forms a gulf between the Island of Seilan (Ceylon) and the main land . . . . . The pearl-fishers take their vessels, great and small, and proceed into this gulf, where they stop from the beginning of April till the middle of May . . . . . As soon as the middle of May is past no more of those pearl shells are found there." A note by Colonel Yule points out that the fishery in modern times takes place at an earlier season, in March and April. The time appears to be fixed so that the fishery occurs between the cessation of the north-east and the beginning of the south-west monsoons.

The next European traveller to visit Ceylon and to record the date of this fishery seems to have been another Venetian, named Cæsar Frederick, who lived in the East from 1563 to 1581. An account of his travels was published in Hakluyt's Voyages (II.1.224). This narrative, however, gives the same dates for the season of the pearl-fishery as does Colonel Yule for modern times.

The difference between these two early records raises the interesting question whether there was actually a change in the date of arrival of the south-west monsoon between the beginning of the fourteenth and the middle of the sixteenth centuries. An alternative solution is very simple; Marco Polo may have made a mistake. If so it can hardly have been a casual error of dictation, because the statement of the date of the end of the fishing season is repeated.

A change was made in the calendar by Pope Gregory XIII in the year 1582 when ten days were omitted, making that particular year, in Italy, one of only 355 days. The corresponding change in England was not introduced until 1752, the bill to affect this alteration in 1584 having been withdrawn after the second reading. Clearly this fact must be taken into account in estimating the true change in the date of the beginning of the south-west monsoon. Correcting Marco Polo's account for the change in the calendar increases by nearly ten days, the difference between his record and present-day dates of the monsoon. It is doubtful whether Cæsar Frederick used the old style or the new in the story of his travels. If he used the old style then it is possible that the fishery in his day came to an end early in May rather than at the end of April. The change in the date of the monsoon may not have been quite completed by 1580.

Another district, of which Marco Polo gave some account, was called by him Maabar, and this is believed to correspond closely with the modern Coromandel Coast. He describes the climate in the following passage:—"You must know that the heat here is sometimes so great that 'tis something wonderful. And rain falls only for three months in the year, viz., in June, July and August. Indeed, but for the rain that falls in these three months, refreshing the earth and cooling the air, the drought would be so great that no one could exist." Colonel Yule wrote a note on this passage stating his belief that Polo wrongly applied to this coast a description that was true of the districts both to the west and to the east of it. Coromandel, he informs us, gets rain from the north-east monsoon in October. It would be a dangerous matter to contradict such a high authority as Colonel Yule, but the evidence of a change of climate in Eurasia since the Middle Ages, which has been collected in recent years, rouses the suspicion that Marco Polo may have been correct after all. If so an interesting problem is propounded, for some very drastic change in the circulation seems to be indicated, reminiscent of the history of the climate of Central America.

It may well be asked whether there are any other records of climate in the latter part of the thirteenth century which point to the later arrival of summer conditions. There is just one meagre piece of dubious evidence that in England, or rather in the south of England, spring came late in the Middle Ages. It is notoriously difficult to prove a negative. A considerable body of evidence has, however, been collected which points to the conclusion that the cultivated cherry was scarcely grown at all in England between the days of the Romans and the reign of Henry VIII. Now vines were certainly widely cultivated during that period, as was pointed out by Sir Richard Gregory* and many earlier authorities. The cause for this anomaly must be sought in the different climatic requirements of these two fruits. Usually the vine is regarded as a more southern type than the cherry. But even under glass, unless much forced,

*See *Geographical Teacher*, XII, part 4, p. 249.

grapes ripen at a much later season than cherries, and the flowering period in the open will be found to be somewhat later. It seems probable that cherries in the south of England were not a paying crop in the Middle Ages, just as they are not in the north country to-day, because the conditions in April and May did not allow of successful flowering and setting of the fruit. Possibly the vine, in protected situations, may have succeeded in forming its fruit and ripening it later in the year sufficiently to be made into a substitute for decent wine—with the help of those tell-tale blackberries that some of the cottagers were bound to pick for their landlords. The flower of the cherry came too early and met the frost of the last part of the mediæval winter. By the end of the fifteenth century the date of the change to summer conditions had become early enough to allow the cherry to set its fruit in the south of England. Its culture spread very rapidly in Kent in the reign of Henry VIII.

The picture of the mediæval climate of England which is suggested by the strange history of the culture of cherries would seem to approximate to the present climate of Burgos in Spain, which is vividly sketched as *Nueve meses de invierno y tres de infierno*, Nine months winter and three months hell.

Everything in this article must be regarded as tentative and provisional. Confirmation is badly needed of the record of Marco Polo. The true cause of the neglect of cherry culture in earlier times may have been merely the ignorance of the men of those days of the dietetic value of plenty of fruit. The coincidence of the two lines of evidence is left to the consideration of the reader.

G. M. Meyer.

Insplashing into and outsplashing from the funnel of a rain-gauge

The remarkably heavy rainfall in London during Monday evening, October 22nd, provided a particularly good example of insplashing into the funnel of a gauge from the surrounding ground. At Streatham two rain-gauges were in use, one a gauge with a Snowdon funnel with 4-inch vertical sides and its rim 1 foot above short grass, the other a check gauge with a shallow funnel and with its rim only 4 inches above recently dug earth. When the gauges were inspected the next morning splashes of earth were apparent on the outside of the funnel of the check gauge right up to the rim. The observer had also noted that the rain-water in the gauge was very muddy. In the case of the standard gauge and in the case of other gauges inspected that morning in the district, where the same quantity of rain fell, the catch had been clear water even where the surrounding ground seemed very dirty. All these gauges were of the Snowdon pattern with the rims at 1 foot.

It is unfortunate that the check gauge had a shallow funnel. Actually, the check gauge only gave ·72in., compared with ·77in in the Snowdon gauge. Apparently the check gauge with the shallow funnel failed to retain all the heavy rain falling into the funnel.

It appears, therefore, that during this unusually heavy rain—

(1) while there was a material amount of insplashing into the gauge with the rim only 4 inches above the ground, it was negligible in the case of that at 1 foot;

(2) the amount of outsplashing from the gauge with the shallow funnel exceeded the insplashing by about 7 per cent. of the total fall.

J. GLASSPOOLE.

Meteorological Charts of Egypt and the Nile Valley

The Survey of Egypt has recently issued a very fine series of climatological charts, part of a larger atlas. These charts are based on information supplied by the Physical Department, covering the whole Nile Valley from the Mediterranean to latitude 5° south, and represent the longest period of observations available, generally covering 25 years. They show mean temperature, mean daily maximum, and mean daily minimum for the months of January, April, July and October, and absolute maxima and minima of temperature for the year. The highest maximum shown exceeds 52°C. (126°F.) at Wadi Halfa. Then follow isobars, prevailing winds and isohyets for the same four months. The last chart shows annual isohyets and daily weather charts illustrating various weather types, including the Khamsin. These are accompanied by explanatory text, and the whole is preceded by two sheets of text and diagrams, which also illustrate the variations of humidity and cloudiness.

Meteorological Instruments of the late Mr. J. G. Waller

The late Mr. J. G. Waller, who carried on meteorological observations at Plumstead for a number of years, had a good equipment of meteorological instruments including two barometers, sunshine recorder and thermometers, and Mrs. Waller now wishes to dispose of these. Offers to purchase should be made to her at 51, Hinstock Road, Plumstead, London, S.E.18.

Erratum

October, 1928, p. 224. Heading of table *should read* "Climatological Table for the British Empire, April, 1928."

Ten-Day Period Temperatures

An examination of the mean maximum and mean minimum temperatures for ten-day periods at the four stations, Kew, Falmouth, Valentia and Aberdeen for the thirty years, 1871 to 1900 inclusive, obtained from the Meteorological Office publication, *Temperature Tables for the British Isles*, shows a run of temperatures for the periods August 1st to 10th, and August 11th to 20th, which does not appear consistent with a smooth annual variation.

From the table of temperatures appended it will be seen that, before the general fall takes place during August 21st to 30th—

(1) The mean maxima and minima for Falmouth and Kew for August 1st to 10th decrease from the preceding period and increase in the subsequent period.

(2) The mean minima for the four stations show an average increase of 0·45°F. for the period August 11th to 20th after an average decrease of 0·33°F.

(3) Although Aberdeen shows a slight fall of 0·2°F., there is an average increase of 0·27°F. in the case of the mean maxima for the four stations for the period August 11th to 20th.

A point of interest is that Buchan fixed the period August 6th to 11th for a "cold" spell, and the period August 12th to 15th for a "warm" spell. This "cold" spell falls approximately into the first ten-day period in question, and the "warm" spell into the second ten-day period.

MEAN DAILY MAXIMUM TEMPERATURE, 1871—1900				
	July 21st-31st	Aug. 1st-10th	Aug. 11th-20th	Aug. 21st-30th
	°F.	°F.	°F.	°F.
Kew ...	71·0	70·4	71·1	68·4
Falmouth...	66·1	65·7	65·9	64·8
Valentia ...	64·3	64·5	64·9	63·1
Aberdeen ...	61·6	62·1	61·9	60·1
MEAN DAILY MINIMUM TEMPERATURES				
Kew ...	55·1	53·8	54·5	53·0
Falmouth...	55·8	55·5	56·0	54·8
Valentia ...	54·7	55·0	55·1	54·0
Aberdeen ...	50·6	50·6	51·1	49·4

D. F. BOWERING.

Reviews

Die bebenauslösende Wirkung der Sonnenflecken, gezeight an der sogenannten elfjährigen Periode. By Otto Myrbach. Brunswick, Zs. Geophys. 4, 1928, Heft 7/8, pp. 413-416.

In this paper an hypothesis is put forward that solar activity has a direct influence on the generation of earthquakes. The view is that an earthquake is caused when stresses in the earth's crust exceed some critical value, but that by some solar action the rate of growth of the stresses can be accelerated. The author anticipates that increased solar activity will enable earthquakes to occur before the stresses have reached their critical values and, therefore, that disturbances will be more frequent and less violent during sunspot maximum than during sunspot minimum.

The hypothesis is tested by comparing the variation of earthquake frequency with variation of solar activity, but in the absence of reliable information as to the total number of earthquakes occurring all over the world, the author uses data relating to disturbances recorded at one station only (Vienna). Unfortunately the number of distant earthquakes which are registered at one station depends rather on their strength than on the frequency of occurrence, whereas the number of near earthquakes depends mainly on frequency of occurrence. However, the author makes use of this difference and separates the near earthquakes from the distant ones, expecting to find at sunspot maximum a minimum frequency of distant earthquakes and a maximum frequency of near earthquakes. The frequency curve for near shocks, which is reproduced in the paper, can scarcely be considered to bear any close relation to the sunspot curve, while the method of deriving the corresponding curve for distant earthquakes is very unconvincing.

F. J. Scrase.

Climate of New Zealand. By Dr. E. Kidson. Extract from the *New Zealand Official Year-Book*, 1929, pp. 1-18.

This booklet gives in sixteen pages of letterpress and diagrams a considerable amount of information. Eleven pages are devoted to a general description of New Zealand's climate, supplemented by a map of the mean annual rainfall and by tables of normal values for six stations in the North Island and eight in the South Island. For comparison similar tables are given for Kew Observatory and Aberdeen.

The remaining part is devoted to results of observations in 1927. Diagrams are given showing the departures from normal of mean monthly temperature and rainfall at eight stations; areas over which rainfall in 1927 was above the average are shown by a map, a tabular summary is given of the observations at 28 stations distributed over the two islands, and short notes indicate the general character of the weather in the various months. Regarding the year as a whole, it is stated that "the prevailing westerly winds were very much below average strength, a feature most probably associated with the approach of a maximum of solar activity. Rainfall was above normal over most of the North Island, and although there was a deficit in the South Island this was offset by the absence of drying winds. . . . . The year was, on the whole, a cold one."

S. T. A. MIRRLEES.

Obituary

We regret to learn of the death, on April 9th, 1929, at Washington, D.C., of Colonel E. Lester Jones in his 53rd year. Colonel Jones had been Director of the United States Coast and Geodetic Survey since April, 1915.

The Weather of May, 1929

May was again a dry month on the whole, though there were many local variations, some stations in the west, and particularly the south-west, having more than the average rainfall. The first half of the month was rather cool and unsettled, pressure was high to the north-west and south-west of the British Isles, leaving a track for depressions across the country. Some heavy local falls of rain were recorded during this period, notably:—on the 4th, 1·91in. at Festiniog, Merioneth, and 2·23in. at Llyn Fawr Reservoir, Glamorgan; on the 5th, 1·88in. at Holme, S. Devon; and on the 14th, 2·06in. at Borrowdale, in Cumberland. Thunder was reported locally on the 7th, 8th, 14th and 15th. Many good sunshine records were obtained during the first three days of the month, and again from the 8th to the 10th.

On the 16th anticyclonic conditions became established, and practically no rain fell throughout the country until the 21st, when a depression on the Atlantic spread eastwards, causing rain in the west and north. At Fofanny Reservoir, in County Down, 3·52in. fell on the 22nd. In the east of England, however, it remained fine and sunny with rather high temperature until the 24th. On the 24th a shallow trough of low pressure crossed Great Britain causing local thunderstorms; Mr. G. E. Dacey reported a severe storm with damage by lightning at Lewisham, and 1·72in. fell at Cambridge. Further thunderstorms, due to shallow depressions over France and off south-west Ireland, occurred on the 26th and 27th. Temperature continued high locally until the 28th.

During the last few days of the month an anticyclone off the north-west coasts gave north-easterly winds over most of the country and dry, cool weather with a good deal of cloud in the east but bright in the west. In the extreme south-west, however, almost continuous rain was experienced for two days.

Sunshine was well above the normal in many places and some good individual records were obtained, notably:—14·9hrs. at Croydon on the 21st, 15·2hrs. at Harrogate on the 25th, and 16hrs. at Inverness on the 30th. During the week from the 19th-25th Gorleston recorded 93hrs., an average of 13·3hrs. per day; and during the whole month Calshot recorded 270hrs., an average of 8·7hrs. a day and 56 per cent of the duration of daylight. The distribution of sunshine is shown by the following table:—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway	236	+45	Valentia	178	—25
Aberdeen	179	— 8	Liverpool	241	+42
Dublin	240	+35	Falmouth	207	—24
Birr Castle	201	+19	Kew	244	+43

Pressure was slightly below normal over the British Isles and Iceland and slightly above normal over the rest of Europe except southern Italy and Greece; it was well above normal over the Atlantic from the Azores to Bermuda. Temperature was above normal in Sweden and slightly so in eastern England; it was below normal in Spain and Central Europe. Rainfall was below normal in northern Norway, eastern England and Central Europe and above normal at Spitsbergen, in northern and in central Sweden where the excess reached 50 per cent; in southern Sweden the rainfall was normal.

Owing to the severe winter there were icebergs in the Kerch Strait (Sea of Azov) in the middle of May; the shallower part of the sea had frozen right to the bottom, and although the surface layers thawed some time ago, the ice layer at the sea bed was only then thawing and rising to the surface. Ships were forced to alter their courses. In consequence of a sudden drop in temperature snow fell on the Swiss Alps on the 15th as low as 4,500 feet; in some places the fresh snow was 10in. deep. Storms and continuous rain in Yugoslavia caused floods in many districts; on the 17th the main railway line between Belgrade and Nish was cut in two places by floods of the River Morava, and the Simplon Express had to return to Belgrade. A cloud-burst occurred at Valievo destroying many houses.

Widespread floods occurred in Iraq in the early part of May. The Tigris is said to have reached a height unknown for 50 years, and the Euphrates rose 23 feet above its normal summer level at Jerablus, submerging all its islets. Thousands of acres of winter crops ready for harvesting were destroyed.

Rainfall: May, 1929: England and Wales

Co.	Station	In.	Per-cent of Av.	Co.	Station	In.	Per-cent of Av.
Lond .	Camden Square	1·39	79	*Leics* .	Belvoir Castle	1·20	57
Sur .	Reigate, The Knowle	2·45	144	*Rut* .	Ridlington	1·68	...
Kent .	Tenterden, Ashenden	1·58	100	*Linc* .	Boston, Skirbeck	1·15	65
,, .	Folkestone, Boro. San.	1·38	...	,, .	Lincoln	·83	44
,, .	Margate, Cliftonville	·69	44	,, .	Skegness, Marine Gdns	·89	52
,, .	Sevenoaks, Speldhurst	2·05	...	,, .	Louth, Westgate	1·19	59
Sus .	Patching Farm	2·67	144	,, .	Brigg, Wrawby St.	1·08	...
,, .	Brighton, Old Steyne	1·70	105	*Notts* .	Worksop, Hodsock	·73	37
,, .	Heathfield, Barklye*	2·54	141	*Derby* .	Derby, L. M. & S. Rly.	2·31	121
Hants .	Ventnor, Roy. Nat. Hos.	2·73	161	,, .	Buxton, Devon Hos.	3·12	101
,, .	Fordingbridge, Oaklnds	2·42	116	*Ches* .	Runcorn, Weston Pt.	1·87	81
,, .	Ovington Rectory	...	...	,, .	Nantwich, Dorfold Hall	1·74	...
,, .	Sherborne St. John	1·46	75	*Lancs* .	Manchester, Whit. Pk.	2·61	123
Berks .	Wellington College	3·29	177	,, .	Stonyhurst College	3·18	112
,, .	Newbury, Greenham	1·89	100	,, .	Southport, Hesketh Pk	1·96	94
Herts .	Benington House	...	...	,, .	Lancaster, Strathspey	2·23	...
Bucks .	High Wycombe	2·81	159	*Yorks* .	Wath-upon-Dearne	1·10	54
Oxf .	Oxford, Mag. College	·83	46	,, .	Bradford, Lister Pk.	1·57	75
Nor .	Pitsford, Sedgebrook	1·83	96	,, .	Oughtershaw Hall	1·72	...
,, .	Oundle	·83	...	,, .	Wetherby, Ribston H.	1·50	72
Beds .	Woburn, Crawley Mill	1·68	87	,, .	Hull, Pearson Park	1·26	65
Cam .	Cambridge, Bot. Gdns.	2·81	160	,, .	Holme-on-Spalding	1·36	...
Essex .	Chelmsford, County Lab	1·78	124	,, .	West Witton, Ivy Ho.	1·47	...
,, .	Lexden Hill House	1·50	...	,, .	Felixkirk, Mt. St. John	1·66	88
Suff .	Hawkedon Rectory	1·29	70	,, .	Pickering, Hungate	1·18	...
,, .	Haughley House	·94	...	,, .	Scarborough	1·42	74
Norf .	Norwich Eaton	·94	49	,, .	Middlesbrough	1·16	60
,, .	Wells, Holkham Hall	1·26	78	,, .	Baldersdale, Hury Res.	1·53	...
,, .	Little Dunham	1·73	89	*Durh* .	Ushaw College	1·21	56
Wilts .	Devizes, Highclere	1·75	97	*Nor* .	Newcastle, Town Moor	·78	38
,, .	Bishops Cannings	1·99	102	,, .	Bellingham, Highgreen	1·60	...
Dor .	Evershot, Melbury Ho.	3·56	175	,, .	Lilburn Tower Gdns.	1·04	...
,, .	Creech Grange	2·53	...	*Cumb* .	Geltsdale	1·59	...
,, .	Shaftesbury, Abbey Ho.	2·46	116	,, .	Carlisle, Scaleby Hall	1·29	54
Devon .	Plymouth The Hoe	3·18	154	,, .	Borrowdale, Seathwaite	8·50	115
,, .	Polapit Tamar	3·99	198	,, .	Borrowdale, Rosthwaite	6·98	...
,, .	Ashburton, Druid Ho.	4·76	178	,, .	Keswick, High Hill	3·46	...
,, .	Cullompton	2·67	124	*Glam* .	Cardiff, Ely P. Stn.	3·44	137
,, .	Sidmouth, Sidmount	2·34	119	,, .	Treherbert, Tynywaun	7·55	...
,, .	Filleigh, Castle Hill	3·20	...	*Carm* .	Carmarthen Friary	4·41	160
,, .	Barnstaple N. Dev. Ath.	3·18	154	,, .	Llanwrda	4·30	127
Corn .	Redruth, Trewirgie	5·46	236	*Pemb* .	Haverfordwest, School	4·95	...
,, .	Penzance, Morrab Gdn.	4·85	220	*Card* .	Aberystwyth	3·02	...
,, .	St. Austell, Trevarna	4·25	176	,, .	Cardigan, County Sch.	3·48	...
Soms .	Chewton Mendip	2·60	94	*Brec* .	Crickhowell, Talymaes	4·00	...
,, .	Long Ashton	2·48	...	*Rad* .	Birm W. W. Tyrmynydd	4·34	127
,, .	Street, Millfield	1·78	..	*Mont* .	Lake Vyrnwy	3·02	96
Glos. .	Cirencester, Gwynfa	2·95	143	*Denb* .	Llangynhafal	1·61	...
Here .	Ross, Birchlea	2·14	101	*Mer* .	Dolgelly, Bryntirion	3·81	115
,, .	Ledbury, Underdown	1·90	93	*Carn* .	Llandudno	1·77	93
Salop .	Church Stretton	2·62	102	,, .	Snowdon, L. Llydaw 9	4·85	...
,, .	Shifnal, Hatton Grange	1·83	89	*Ang* .	Holyhead, Salt Island	2·59	133
Worc .	Ombersley, Holt Lock	1·75	85	,, .	Lligwy	2·26	...
,, .	Blockley	1·87	...	*Isle of Man*			
War .	Farnborough	1·88	84		Douglas, Boro' Cem.	2·79	112
,, .	Birminghm, Edgbaston	1·80	84	*Guernsey*			
Leics .	Thornton Reservoir	1·81	90		St. Peter P't. Grange Rd.	2·55	150

* Gauge formerly at Tottingworth Park.

Rainfall: May, 1929: Scotland and Ireland

Co.	Station	In.	Per-cent of Av.	Co.	Station	In.	Per-cent. of Av.
Wigt .	Stoneykirk, Ardwell Ho	3.57	142	*Suth* .	Loch More, Achfary ...	2·56	58
,, .	Pt. William, Monreith	...	...	*Caith* .	Wick	1·94	94
Kirk .	Carsphairn, Shiel.	6·38	...	*Ork* .	Pomona, Deerness	1·69	85
,, .	Dumfries, Cargen	..	...	*Shet* .	Lerwick	1·88	90
Dumf.	Eskdalemuir Obs.	4·23	128	*Cork* .	Caheragh Rectory	3·63	...
Roxb .	Branxholm	2·28	101	,, .	Dunmanway Rectory...	4·88	144
Selk .	Ettrick Manse	...	...	,, .	Ballinacurra	3·24	137
Peeb .	West Linton	1·58	...	,, .	Glanmire, Lota Lo. ...	4·13	169
Berk .	Marchmont House......	1·71	69	*Kerry*.	Valentia Obsy.	3·53	112
Hadd.	North Berwick Res. ...	2·05	103	,, .	Gearahameen	6·00	...
Midl .	Edinburgh, Roy. Obs.	1·34	72	,, .	Killarney Asylum	2·79	91
Ayr .	Kilmarnock, Agric. C.	2·92	126	,, .	Darrynane Abbey	2·91	98
,, .	Girvan, Pinmore	4·43	149	*Wat* .	Waterford, Brook Lo...	3·61	156
Renf .	Glasgow, Queen's Pk. .	2·71	111	*Tip* .	Nenagh, Cas. Lough...	2·43	98
,, .	Greenock, Prospect H.	5·25	152	,, .	Roscrea, Timoney Park	1·83	...
Bute .	Rothesay, Ardencraig.	3·68	122	,, .	Cashel, Ballinamona...	2·82	117
,, .	Dougarie Lodge	4·57	...	*Lim* .	Foynes, Coolnanes......	1·74	75
Arg .	Ardgour House	5·99	...	,, .	Castleconnel Rec.	2·08	...
,, .	Manse of Glenorchy ...	4·68	...	*Clare* .	Inagh, Mount Callan...	3·14	...
,, .	Oban	4·44	...	,, .	Broadford, Hurdlest'n.	2·61	...
,, .	Poltalloch	5·20	180	*Wexf*.	Newtownbarry	4·01	...
,, .	Inveraray Castle...	5·07	129	,, .	Gorey, Courtown Ho ..	3·32	150
,, .	Islay, Eallabus	4·24	156	*Kilk* .	Kilkenny Castle.........	2·65	120
,, .	Mull Benmore	9·30	...	*Wic* .	Rathnew, Clonmannon	2·58	...
,, .	Tiree	4·17	...	*Carl* .	Hacketstown Rectory..	2·84	109
Kinr .	Loch Leven Sluice......	2·43	100	*QCo* .	Blandsfort House	2·64	109
Perth .	Loch Dhu	5·60	125	,, .	Mountmellick...........	...	...
,, .	Balquhidder, Stronvar	...	...	*KCo* .	Birr Castle	2·57	115
,, .	Crieff, Strathearn Hyd.	2·70	68	*Dubl* .	Dublin, FitzWm. Sq...	1·26	61
,, .	Blair Castle Gardens ...	2·58	127	,, .	Balbriggan, Ardgillan.	1·76	...
,, .	Dalnaspidal Lodge ...	4·27	118	*Me'th* .	Beauparc, St. Cloud...	1·99	...
Angus.	Kettins School	2·82	116	,, .	Kells, Headfort	2·61	97
,, .	Dundee, E. Necropolis	2·39	114	*W.M* .	Moate, Coolatore	2·20	...
,, .	Pearsie House...........	2·75	...	,, .	Mullingar, Belvedere..	2·70	110
,, .	Montrose, Sunnyside...	1·95	96	*Long* .	Castle Forbes Gdns......	2·08	81
Aber .	Braemar, Bank	2·82	118	*Gal* .	Ballynahinch Castle ...	3·71	103
,, .	Logie Coldstone Sch....	1·49	60	,, .	Galway, Grammar Sch.	1·50	...
,, .	Aberdeen, King's Coll.	2·28	98	*Mayo* .	Mallaranny..............	3·32	...
,, .	Fyvie Castle	1·99	...	,, .	Westport House.........	1·87	66
Mor .	Gordon Castle	1·34	63	,, .	Delphi Lodge	5·81	...
,, .	Grantown-on-Spey ...	2·66	114	*Sligo* .	Markree Obsy............	2·71	97
Na .	Nairn, Delnies	2·62	145	*Cav'n* .	Belturbet, Cloverhill...	2·30	93
Inv .	Kingussie, The Birches	1·56	...	*Ferm* .	Enniskillen, Portora...	2·05	...
,, .	Loch Quoich, Loan ...	7·30	...	*Arm* .	Armagh Obsy............	2·74	115
,, .	Glenquoich..............	5·60	102	*Down* .	Fofanny Reservoir......	7·23	...
,, .	Inverness, Culduthel R.	1·99	...	,, .	Seaforde	2·59	99
,, .	Arisaig, Faire-na-Squir	3·78	...	,, .	Donaghadee, C. Stn ...	2·95	130
,, .	Fort William	5·38	...	,, .	Banbridge, Milltown...	1·97	...
,, .	Skye, Dunvegan	4·03	...	*Antr* .	Belfast, Cavehill Rd ...	2·98	...
R & C.	Alness, Ardross Cas. ...	2·08	80	,, .	Glenarm Castle	3·41	...
,, .	Ullapool	1·59	...	,, .	Ballymena, Harryville	3·38	118
,, .	Torridon, Bendamph...	3·60	79	*Lon* .	Londonderry, Creggan	2·45	94
,, .	Achnashellach	3·52	...	*Tyr* .	Donaghmore	3·04	...
,, .	Stornoway	2·22	87	,, .	Omagh, Edenfel.........	2·41	93
Suth .	Lairg	2·07	...	*Don* .	Malin Head...............	1·92	...
,, .	Tongue	2·34	98	,, .	Dunfanaghy	2·34	...
,, .	Melvich	2·57	125	,, .	Killybegs, Rockmount.	2·34	65

Climatological Table for the British Empire, December, 1928.

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.	1017·7	+ 4·0	54	25	43·5	33·8	38·7	− 1·6	36·5	92	7·3	2·35	+ 0·06	15	1·5	19
Gibraltar	1021·0	+ 0·9	68	44	60·7	49·3	55·0	− 1·0	49·8	82	5·2	3·06	− 2·55	8	..	..
Malta	1016·0	− 0·6	65	44	58·3	50·4	54·3	− 3·6	49·7	72	6·6	4·33	+ 0·62	18	4·6	48
St. Helena	1012·7	+ 1·8	65	54	62·7	56·2	59·5	− 2·7	57·4	96	9·5	1·85	− 0·11	19	..	..
Sierra Leone	1012·0	+ 1·1	90	68	86·8	73·8	80·3	− 1·1	76·1	79	2·1	2·34	+ 0·92	2	..	..
Lagos, Nigeria	1010·3	− 0·2	91	69	88·2	74·9	81·5	0·0	74·6	80	5·1	0·13	− 0·67	2	..	..
Kaduna, Nigeria	1015·6	+ 2·8	97	..	88·9	..	..	..	57·8	31	..	0·00	0·00	0	..	..
Zomba, Nyasaland	1008·4	+ 0·1	89	60	82·5	65·4	73·9	+ 0·8	..	77	7·5	8·90	− 1·97	20	..	..
Salisbury, Rhodesia	1007·2	− 1·4	86	53	78·3	60·5	69·4	− 0·2	63·3	67	6·6	5·24	− 0·54	16	5·8	44
Cape Town	1014·4	+ 0·1	98	50	77·1	59·0	68·1	+ 0·2	61·0	70	4·3	0·98	+ 0·16	4	..	..
Johannesburg	1009·7	− 0·3	89	49	79·0	56·9	67·9	+ 2·8	59·0	66	3·7	3·86	− 1·57	16	9·6	70
Mauritius	1014·1	+ 0·1	87	67	82·8	70·3	76·5	− 1·8	71·4	68	7·8	2·84	− 1·89	20	7·3	55
Bloemfontein	..	..	97	52	87·4	60·2	73·8	+ 2·0	60·9	49	5·0	1·48	− 0·97	7	..	..
Calcutta, Alipore Obsy.	1015·3	− 0·4	84	53	79·4	58·5	68·9	+ 2·4	58·8	83	1·8	0·00	− 0·20	0*	..	..
Bombay	1012·6	− 0·9	93	61	86·9	69·5	78·2	+ 0·7	66·5	71	0·8	0·00	− 0·05	0*	..	..
Madras	1012·0	− 1·5	88	65	84·2	71·6	77·9	+ 1·2	72·0	81	6·4	4·24	− 1·57	8*	..	..
Colombo, Ceylon	1010·2	− 0·5	89	71	85·5	73·2	79·3	+ 0·3	74·9	76	6·4	8·78	+ 3·41	16	7·6	65
Hongkong	1019·4	− 0·3	79	54	70·5	61·9	66·2	+ 3·2	60·5	68	4·9	0·02	− 1·11	1	7·0	65
Sandakan	..	..	90	72	85·9	73·9	79·9	− 0·2	76·8	84	..	34·32	+ 16·66	21	..	..
Sydney	1011·9	0·0	85	59	74·8	63·6	69·2	− 0·9	64·5	66	6·1	0·94	− 1·97	6	7·4	51
Melbourne	1012·4	− 0·1	99	47	77·2	55·9	66·5	+ 2·2	59·0	62	6·6	0·78	− 1·56	7	6·8	46
Adelaide	1012·5	− 0·7	105	49	84·8	60·0	72·4	+ 1·3	59·1	33	4·3	0·24	− 0·76	5	10·9	76
Perth, W. Australia	1011·1	− 2·1	101	53	81·1	61·4	71·3	+ 0·6	62·4	49	3·4	1·12	+ 0·54	8	10·5	74
Coolgardie	1009·5	− 1·7	107	52	90·4	60·0	75·2	− 0·6	60·9	42	2·8	0·70	0·00	6	..	..
Brisbane	1011·7	− 0·3	92	62	83·9	67·4	75·7	− 0·7	68·2	58	6·3	2·56	− 2·28	10	8·7	63
Hobart, Tasmania	1010·2	+ 0·5	83	45	68·4	51·6	60·0	− 0·4	54·1	60	7·0	1·99	+ 0·03	15	8·4	55
Wellington, N.Z.	1013·2	+ 1·0	72	45	63·9	52·3	58·1	− 2.3	56·1	79	7·0	8·19	+ 4·97	15	6·9	46
Suva, Fiji	1009·1	+ 0·5	91	71	86·5	74·7	80·6	+ 1·7	76·4	79	7·5	17·41	+ 5·30	20	5·6	42
Apia, Samoa	1009·3	+ 0·9	89	72	86·6	74·9	80·8	+ 1·5	77·5	75	5·3	10·69	− 2·93	22	7·3	57
Kingston, Jamaica	1014·1	+ 0·1	88	65	85·7	68·6	77·1	− 0·6	66·9	87	2·6	0·08	− 1·51	2	7·1	64
Grenada, W.I.	1009·0	− 2·5	88	70	84·7	72·7	78·7	+ 0·6	74·6	79	3·5	7·17	− 0·10	20	..	..
Toronto	1018·9	+ 1·5	47	13	37·5	28·2	32·9	+ 6·7	29·1	81	7·6	1·25	− 1·58	11	2·4	27
Winnipeg	1017·2	− 0·7	44	−16	24·2	11·1	17·7	+12·0	11·5	78	5·5	0·35	− 0·63	8	2·8	34
St. John, N.B.	1015·7	+ 1·5	52	7	35·8	23·9	29·9	+ 5·5	26·6	75	5·4	4·22	+ 0·05	15	3·9	44
Victoria, B.C.	1018·8	+ 2·0	49	29	44·1	38·2	41·1	− 0·4	39·1	87	7·4	2·63	− 3·28	14	2·0	24

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

July, 1928, p. 152. Sandakan—mean min., ½ (M + m), and differences from normal *should read* 75·0 ; 81·3 ; + 1·5 respectively.

Dec., 1928, p. 276. Sandakan—precipitation, difference from normal *should read* — 2·69.

Climatological Table for the British Empire, Year, 1928.

STATIONS	PRESSURE: Mean of Day M.S.L. (mb.)	PRESSURE: Diff. from Normal (mb.)	TEMPERATURE: Absolute Max. (°F.)	Absolute Min. (°F.)	Mean Values Max. (°F.)	Mean Values Min. (°F.)	Mean Values ½ max. and min. (°F.)	Mean Values Diff. from Normal (°F.)	Mean Wet Bulb (°F.)	Relative Humidity (%)	Mean Cloud Am'nt (0—10)	PRECIPITATION: Am'nt (in.)	Diff. from Normal (in.)	Days	BRIGHT SUNSHINE: Hours per day	Percentage of possible
London, Kew Obsy.	1014·1	− 1·3	87	25	57·7	43·7	50·7	+ 1·0	45·2	86	6·8	23·90	+ 0·10	169	4·5	34
Gibraltar	1018·1	+ 0·2	99	42	70·4	58·1	64·2	− 0·1	57·1	81	4·5	25·39	− 10·43	88	..	..
Malta	1015·9	0·0	95	44	70·6	61·1	65·9	− 0·2	60·7	77	4·7	33·44	+ 13·58	108	8·3	68
St. Helena	1014·0	+ 2·4	73	50	64·6	57·0	60·8	− 1·2	58·2	95	9·0	24·21	− 15·91	195	..	..
Sierra Leone	1012·7	+ 1·3	93	67	85·3	73·0	79·4	− 1·3	74·7	79	5·9	148·54	− 8·69	175	..	..
Lagos, Nigeria	1010·0	− 1·4	92	69	85·4	75·4	80·4	− 0·1	75·7	83	6·9	79·05	+ 7·42	140	..	..
Kaduna, Nigeria	1015·1	+ 2·7	99	..	88·4	..	..	..	..	..	..	50·62	+ 1·39	113	..	..
Zomba, Nyasaland	1012·9	+ 0·6	95	47	79·5	60·8	70·1	+ 0·7	..	69	5·2	40·08	− 14·46	104	..	..
Salisbury, Rhodesia	1012·1	− 0·2	95	34	78·5	53·5	66·0	+ 0·7	57·2	55	3·3	23·27	− 8·67	78	8·8	73
Cape Town	1018·3	+ 1·3	100	34	71·6	54·3	63·0	+ 0·7	55·6	79	4·7	16·66	− 8·64	89	..	..
Johannesburg	1016·9	+ 0·5	89	27	71·0	50·3	60·6	+ 1·1	50·4	57	2·9	29·51	− 3·71	94	8·8	73
Mauritius	1016·4	+ 0·3	92	54	79·8	67·6	73·7	— 0·3	69·8	71	5·7	55·35	+ 5·69	228	8·1	67
Bloemfontein	..	..	97	22	74·6	47·4	61·0	− 0·4	50·0	58	2·9	16·45	− 6·92	64	..	..
Calcutta, Alipore Obsy.	1007·7	+ 0·1	105	49	88·6	71·9	80·3	+ 1·6	72·3	85	5·0	78·57	+ 16·03	111*	..	..
Bombay	1008·9	− 0·3	95	60	87·2	74·6	80·9	+ 0·4	73·2	78	3·9	85·73	+ 13·54	100*	..	..
Madras	1008·3	− 0·5	110	63	92·1	76·3	84·2	+ 1·2	74·9	73	5·2	50·36	− 0·38	90*	..	..
Colombo, Ceylon	1010·2	+ 0·2	92	66	86·3	75·3	80·8	+ 0·1	76·5	76	7·0	98·81	+ 13·56	203	7·2	60
Hongkong	1012·1	− 0·5	93	45	77·1	68·9	73·0	+ 0·7	68·0	77	6·9	71·15	− 12·67	132	5·5	46
Sandakan	..	..	92	71	87·9	74·9	81·4	+ 0·1	77·4	83	..	167·78	+ 48·06	178	..	..
Sydney	1014·9	− 1·0	101	41	72·3	57·2	64·8	+ 1·6	58·6	68	5·1	40·07	− 7·83	130	6·9	57
Melbourne	1015·5	− 0.8	104	32	68·5	50·9	59·7	+ 1·3	53·6	68	6·2	24·09	− 1·46	151	5·9	49
Adelaide	1016·3	− 0·7	109	35	73·2	53·5	63·4	+ 0·4	54·3	53	5·1	19·43	− 1·77	107	7·5	62
Perth, W. Australia	1016·0	− 0·4	101	40	73·3	55·2	64·3	+ 0·1	57·5	61	5·0	44·88	+ 10·85	140	7·8	64
Coolgardie	1015·4	− 0·6	113	31	78·0	50·7	64·4	− 0·1	53·7	51	2.9	6·96	− 3·20	53	..	..
Brisbane	1015·9	+ 0·1	103	40	78·1	60·2	69·1	+ 0·2	62·8	68	4·7	52·64	+ 7·98	139	7·7	64
Hobart, Tasmania	1011·7	− 0·9	101	33	62·7	48·3	55·5	+ 1·2	49·5	67	6·5	30·23	+ 6·49	205	6·0	50
Wellington, N.Z.	1014·7	0·0	79	36	60·7	49·3	55·0	− 0·3	52·3	77	6·6	55·21	+ 7·17	146	5·8	48
Suva, Fiji	1011·6	+ 0·2	94	62	82·8	72·2	77·5	+ 0·5	73·4	79	6·9	113·83	+ 1·45	233	5·6	46
Apia, Samoa	1010·7	+ 0·4	90	68	85·1	75·0	80·1	+ 1·6	77·1	79	4·9	133·27	+ 26·42	207	6·8	56
Kingston, Jamaica	1013·7	0·0	94	64	86·9	71·1	79·0	— 0·3	69·8	84	3·7	28·89	− 4·70	66	..	..
Grenada, W.I.	1009·7	− 2·5	90	60	86·1	73·6	79·9	+ 1·1	75·2	77	4·9	63·77	− 12·31	215	..	..
Toronto	1014·9	− 1·5	90	— 4	54·3	38·8	46·6	+ 2·2	41·0	75	5·5	35·35	+ 1·88	160	5·6	46
Winnipeg	1015·6	— 0·6	96	—25	48·1	29·6	38·9	+ 4·6	..	..	5·1	20·91	— 0·16	97	6·0	49
St. John, N.B.	1014·4	− 0·3	85	—10	50·6	36·1	43·4	+ 2·2	39·7	74	6·3	43·10	− 4·98	172	5·1	42
Victoria, B.C.	1017·7	+ 1·3	90	24	56·0	45·0	50·5	+ 1·0	47·2	81	6·0	19·90	− 12·59	124	6·0	49

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

Note :—Malta—Station moved from from Valletta. 35°53′N, 14°30′E, 185ft. to Pieta, 35°54′N, 14°31′E, 233.6ft. from April 20th, 1928. Differences from normal refer to Valletta throughout.

and about 200 residences were washed away. By the middle of the month the Tigris had subsided but the Euphrates was still rising; the railway from Baghdad to Basra was cut in two places and about a mile of track was washed away. The presence of so much water in the desert made flying very difficult as the mists rising from the surface caused very bad visibility. The Euphrates began to fall at Ramadi on the 21st.

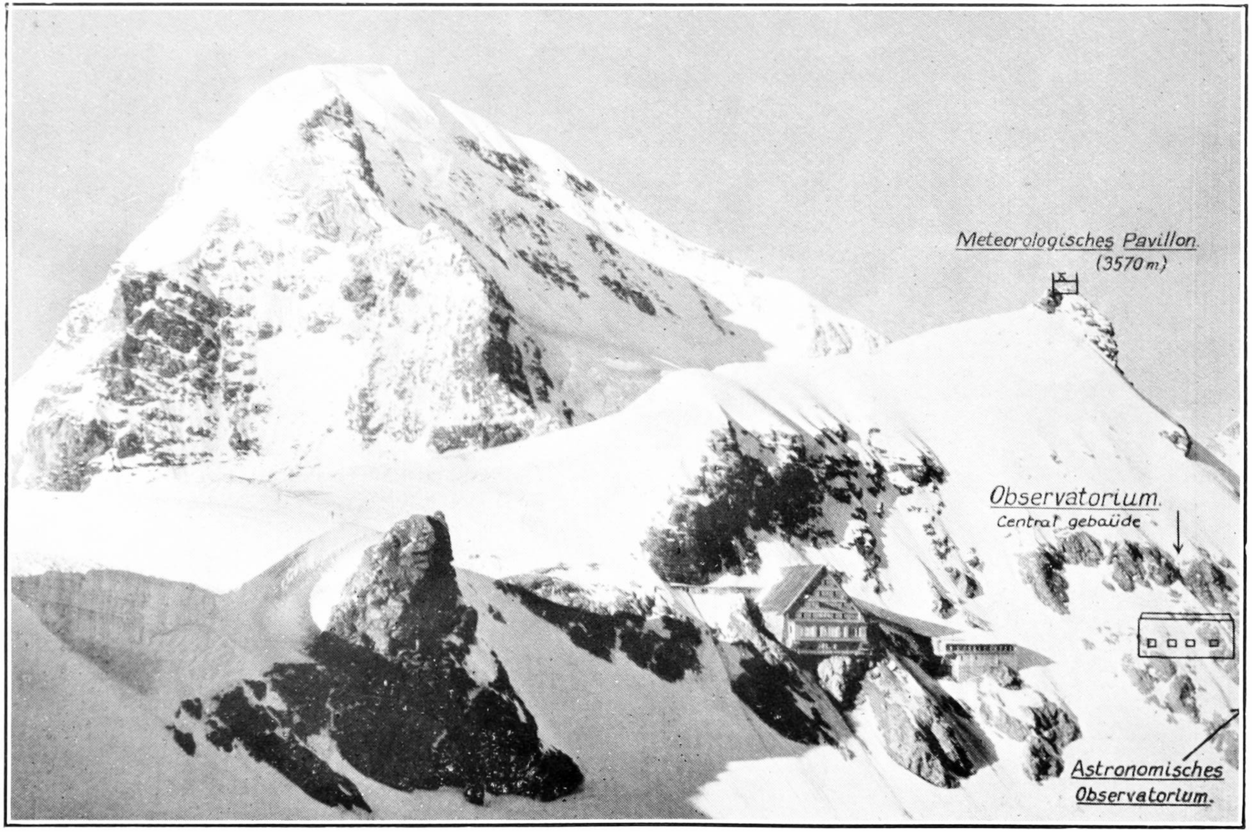
In the evening of the 11th an exceptional hail storm visited the Trichinopoly Cantonment of India. It was preceded by thunder and brilliant lightning in the distance, a high wind, and heavy rain. The hail itself lasted about ¾ hour. At first the hail stones were about ½in. to ¾in. in diameter, but they soon became unusually large; the largest sphere measured was 2in. in diameter, but there were many agglomerations much bigger. One hail stone picked up about 20 minutes after the storm was over measured $4\frac{1}{16}$in. in length, as the temperature of the air was between 75° and 80° it must have been considerably larger when it fell. A great deal of damage was done to roofs of bungalows, the hail stones breaking through four or five layers of tiles. A heavy storm swept Japan on the 23rd, causing considerable damage and some loss of life, 70 per cent of the average rainfall for May fell in 18 hours. On the 24th a typhoon struck the southern part of Manila, 10 persons were reported killed and 33 missing.

During the first half of the month cool and rather rainy weather prevailed in most regions of the United States except the west and south. A tornado was reported to have visited Virginia on the 2nd, demolishing a school and killing 50 persons; in Columbus (Ohio) a prison wall was blown down and 4 prisoners killed. Very hot weather prevailed in New York and the Atlantic coast at the end of the month; Boston recorded a maximum temperature of 96°F. on the 30th. Deaths from heat stroke were reported.

The special message from Brazil states that rainfall in the north was scanty, being 0·28in. below normal; in the centre the distribution was irregular, but the average was 0·63in. above normal; in the south rain was plentiful with an average of 0·99in. above normal. Six anticyclones passed across the country; the weather in the south and the centre was abnormally unsettled for the month. The first frosts of the season occurred in the south, but the crops generally were in good condition. At Rio de Janeiro pressure was 1·2mb. above normal and temperature 2·2°F. below normal.

Rainfall, May, 1929.—General Distribution

England and Wales	103	per cent. of the average 1811-1915.
Scotland	107	
Ireland	109	
British Isles	105	



POSITION OF NEW METEOROLOGICAL OBSERVATORY ON THE JUNGFRAUJOCH
(see p. 140)