A. Anning, Photographer, Ben Rhydding.

FLOODING AT ESCROFT, NEAR ILKLEY, AFTER THUNDERSTORM LASTING HALF-AN-HOUR, APRIL 25TH, 1930 (see p. 110)

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The Manual of Meteorology* : Volume II—Comparative Meteorology; Volume III—The Physical Processes of Weather

Sir Arthur Schuster once jestingly proposed that meteorological observations should cease for five years, in order that meteorologists might concentrate their energies on the discussion of the results which had already been accumulated. In the "Manual of Meteorology" Sir Napier Shaw has undertaken, with the sole assistance of Miss Austin, the task which Sir Arthur Schuster suggested as suitable for the meteorologists of the world. The first volume, reviewed in the *Meteorological Magazine* for July, 1927, bore the title "Meteorology in History," and traced the development of the science from the beginning up to recent years; it ends with the comment that most of the contributions to meteorological theory described were very ineffective, because each author "first clipped the universe to fit his theory." Accordingly Volume II, under the sub-title "Comparative Meteorology," is concerned with facts. The facts of the whole universe, so far as they concern meteorology, are presented unclipped, in quotations, in tables, in Sir Napier's own pregnant sentences, and, above all, in a wealth of illustrations.

We say "universe" advisedly, for the first chapter is headed

*By Sir Napier Shaw, LL.D., Sc.D., F.R.S., with the assistance of Elaine Austin, M.A., 8vo., 10½ × 7¼, Cambridge University Press; Vol. II, pp. xl. + 445, illus., 1928, 36s. net; Vol. III, pp. xxviii. + 445, illus., 1930, 36s. net.

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"The influence of sun and space," and reflects Sir Napier's often-expressed dictum that the beginning of all weather is radiation, that "it is precisely the part which the atmosphere plays in affecting the incoming and outgoing radiation which is a matter of chief interest for the science of meteorology." Much of the information collected here is not readily available elsewhere in text-book form—but this is a remark which a conscientious reviewer would feel called upon to repeat in connexion with almost every chapter. It certainly applies to the second, dealing with "Land, sea and ice" and other geophysical agencies, four illustrations being devoted to the distribution of sea-ice alone—an index of the importance which is attached to this feature of the earth's surface.

At this stage we are introduced to the series of world charts which make up a notable feature of the volume. These are in pairs, a separate chart for each hemisphere, printed in colour on a background of white and grey, the latter in two shades to distinguish the main oceans from the seas which carry floating ice for part of the year. When it is remarked that there are no fewer than 166 of these charts, it will readily be admitted that not only the authors but the Cambridge University Press also, have been generous to their readers.

The representation of the world in two hemispheres is a logical outcome of Sir Napier's interpretation of meteorology as a dynamic science. He writes: "Furthermore, for adequate conception of the actual behaviour of the atmosphere, the idea of circulation is fundamental, and circulation is related either to the earth's axis, which is permanent, and in that sense meteorologically normal, or to some local axis which is meteorologically speaking transitory. . . . We have, therefore chosen for the ground-plan of the great majority of our maps hemispheres in pairs, Northern and Southern." In these charts the meridians are represented by straight lines, and the tenth parallels of latitude by equidistant circles. This is not a true "projection" in the geographical sense; there is some distortion, especially in low latitudes, which gives the equatorial parts of Africa and America a curiously flattened appearance. Concerning this inequality of scale in different directions, Sir Napier himself remarks that: "An obvious disadvantage of our charts is that the plan of computing the direction and velocity of the geostrophic wind from the separation of consecutive isobars with the aid of a common geostrophic scale is not applicable. . . ." For general purposes they are undoubtedly very convenient, more so, probably, than any of the recognised projections. If one may be permitted a grumble where so much has been given, however, one could wish that the lines of longitude and parallels of latitude had been carried over the continents as well as over the oceans. The location of any specific point in the great land-mass of Asia is a laborious business which involves completing the framework with the aid of a pencil and compasses. The provision in future editions of a complete framework on transparent linen would do much to remedy this defect.

As the ground-work of the charts has been specially drawn for the " Manual," so too have most of the charts themselves. This applies to the monthly charts of temperature, pressure, cloudiness and rainfall, the annual charts of daily range of temperature and the charts of sea temperature for four months, all of which were compiled in the Meteorological Office from the latest data available for each country or ocean. The charts of mean dew-point at sea-level in January and July, which we believe are the work of Miss Austin, are the first attempts ever made towards a world representation of the quantity of water-vapour in the atmosphere. As a whole the charts make up the finest existing climatological atlas of the world.

The charts of mean surface air temperature show the isotherms over the sea quite independently of those over the land. The results are sometimes peculiar, suggesting a sudden jump of 10°F. at the shore line. We suspect that the break is sometimes exaggerated by the observations; in any case the isotherms must actually be continuous, but every sea-side holiday-maker knows that on hot calm days there is a very steep gradient of temperature across the coast, and makes for the " front." Sir Napier's method does bring home this quasi-discontinuity to his readers, in a way which the customary smoothed isotherms fail to do.

Circular maps do not occupy the whole of an octavo page, and the remaining spaces are ingeniously used to present a great variety of information, conversion tables, figures of diurnal and seasonal variation, diagrams and even photographs, related to the subject of the charts.

The charts have been described at some length, partly because many readers will regard them as the most interesting part of the book, and partly because it is possible to give a more or less adequate idea of their contents. Short of making a categorical index of each chapter, the text almost baffles description, ranging as it does from the zodiacal light to earth temperatures, from thunderstorms to correlation coefficients and the structure of barometric depressions. In acordance with the title, everything is treated " comparatively," but where possible it is comparison in three dimensions, and full representation is given to the upper air. Again, there is comparison in time as well as in space, and we have a chapter on " Changes in the general circulation. Resilience or plasticity." To the uninitiate the two ideas embodied in this title seem unrelated; Sir Napier finds the connexion in his idea of the atmospheric circulation as a resilient structure: "It may be disturbed by any temporary exceptional cause such as some peculiarity of the orbits of the sun, moon or planets, a change in the solar energy, or a loss of transparency in the atmosphere on account of dust or carbonic acid gas, an accumulation of ice in the polar regions or a recession of the glaciers of lower latitudes, and so on. When the temporary cause is removed and the conditions are restored to the normal (if that be possible) the circulation will, in virtue of its resilience, recover its normal condition; but it may oscillate about the normal in some period or periods of its own before resuming its normal state." Hence a discussion of periodicities, ending in a list of those ranging from 260 years to one year, which occupies 4½ pages of small print. The volume closes with a somewhat detached appendix containing a list of "forty-five articles expressing the meteorological conditions between the geopotential levels of 400 and 800 geodekametres (approximately 4,000 metres and 8,000 metres in latitude 50°) and their connexions with the layers above and below."

If it is difficult adequately to review Volume II of the "Manual of Meteorology," it is even more difficult to describe Volume III. The sub-title of this volume is "The physical processes of weather"; the introduction records as a suggested alternative *Miscellanea physica.* It is further described as "a reconsideration of the customary meteorological methods of dealing with the atmosphere's reaction to heat," but the first three chapters are concerned with gravity-waves, sound-waves and atmospheric optics. Next of course radiation, its vicissitudes in the atmosphere and the factors which control it. Here we are introduced to the idea of the atmosphere as a heat engine, which dominates the middle half of the book. The most important measure of the state of the air is its entropy, a conception which is not easy to understand, but which governs the stratification of the atmosphere and, in Sir Napier's words, "stiffens the upper layers and protects the empyrean against the ambition of water to make use of its vapour to climb into the Olympian heaven." The word "entropy" slips so easily from his pen that in its various associations it requires 69 references in the index, many of which are illustrated by diagrams. As there are in addition 33 references to the tephigram, representing the relation of entropy to temperature, an understanding of this difficult conception is a necessary preliminary to the study of the physical processes of weather. "Open, entropy!" is the key-word to Sir Napier's cave of treasures.

Even so, one doubts if many meteorologists who start this book at the beginning will succeed in reading solidly through to the end of Chapter VIII. The very multiplicity of topics destroys sustained attention, while the freshness of treatment, by presenting familiar matters in a new light and asking questions which as yet not even the author is competent to answer, makes the mind wander, until one lays down the book to follow a train of thought. So, at least, has the reviewer found it, and so, he thinks, would the author prefer it.

The last two chapters are on a different footing. That on "electrical energy in the atmosphere" is almost equivalent to a history of the study of atmospheric electricity from Maxwell to G. C. Simpson, but the end, we gather, is not yet. The final chapter, "Convexion in the general circulation," though short, is in some ways the most interesting of the whole book. The idea of motion along isentropic surfaces, guided by the distribution of pressure and the earth's rotation, is brought into connexion with the distribution of cloud and rainfall to form three natural regions, advective or "gathering," divective or "strawing," and intermediate. The typical advective region is the "gathering storm," but no obvious relationship is found between the mean monthly isobars or isotherms and the boundaries of these natural regions, and we are left with the demand for synoptic charts of isobars along isentropic surfaces as the ultimate expression of the circulation of the atmosphere.

The science of meteorology has grown up in somewhat haphazard fashion; it is an unruly boy whom Sir Napier has undertaken to school. The process is at times painful. Old lax habits must be given up, old vague terms must be closely defined, a new vocabulary must be learnt. It is not the least part of our debt that Volume II opens with a list of "definitions and explanations of certain technical terms," and Volume III with a "list of words used in special senses or not yet incorporated in the *New English Dictionary* that have been found convenient for the avoidance of misunderstanding or for the sake of brevity." There is also a gallant attempt at the introduction of system into the use of symbols; the suggested list covers five pages and involves upper and lower case, roman and italic, Greek uncial and minuscule, and even so cannot avoid, for example, four meanings of *v*—velocity, specific volume, vapour pressure and voltage. Still, we are spared incursions into Coptic, and the meaning of the symbols in the text is always clear.

In the matter of units, one cannot help wishing at times that logic was not pushed so far. Millibars are old friends now (incidentally it is rather a shock to come across millibars not corrected to standard gravity), and many English meteorologists are almost as familiar as their Continental confrères with rainfall in millimetres. On the other hand, those brought up on gram-calories per square centimetre find it hard to think of radiation in kilowatt-hours, for it is easier to imagine the sun as warming a kettle of water than as lighting an electric lamp. In the world charts of temperature Sir Napier has been kind, and has given us Fahrenheit degrees (with the curious exception of the mean seasonal range of temperature, which is in centigrade degrees), but throughout Volume III we find every figure of temperature followed by the mysterious symbol "tt." He himself made us learn the absolute scale; the tercentesimal, we are told, differs on technical grounds and so requires a different symbol. The practical difference is so small that one regards the two symbols as interchangeable, and makes a mental correction: "for tt read °A."

These are details, however, and matters of opinion at that; beside the solidity of the three volumes of the "Manual" already published they sink into insignificance. At long last Sir Napier Shaw and Miss Austin, with the co-operation of the Cambridge University Press, have removed the reproach that there existed no work in English comparable in scope with Hann's great *Lehrbuch*. More, for while the *Lehrbuch* pretended to be no more than a compilation and summary of pre-existing knowledge, the "Manual" contains new knowledge and new ideas in abundance. In a sense the work is now complete, for the contemplated fourth volume was issued as early as 1919 under the title "Part IV. The relation of the wind to the distribution of barometric pressure." In the interval, however, there have been several interesting developments of dynamic meteorology, and we look forward to Sir Napier's exposition of these, confident that though he may startle us at times he will at least illumine our darkness.

Thunderstorm near Ilkley on April 25th, 1930.

Some details of the thunderstorm at Ben Rhydding, to the east of Ilkley, on April 25th, 1930, have been very kindly supplied by Mr. Terence More, The Cottage, Ben Rhydding.

At The Cottage, 50 yards from Ben Rhydding railway station, thunder was first heard at 15h. 25m.,* and rain began at 15h. 30m., changing to hail at about 15h. 40m. The hail lasted for 5 minutes or a little longer, and rain continued until just before 16h. It is estimated that 1·84in. of rain fell at Ben Rhydding in 30 minutes, but the gauge was not emptied until May 1st, 2·22in. having been collected in seven days. At Ilkley (Spence's Garden) about 2 miles further west, 1·08in. was recorded as falling from 16h. to 16h. 25m. The thunder and lightning were violent. One flash was said to resemble a ball of fire as it passed over The Cottage in a west-east direction, to shatter the chimney of a house 150 yards away. A house 100 yards north of The Cottage was also struck. Some of the hail stones were

*Greenwich Mean Time is used throughout this article. Add one hour to get summer time.

described as being half an inch in diameter. Street lamps at an elevation of 800ft. south of Ben Rhydding, had their glass panes broken presumably by the hail. The wind, which was east in the morning, must have changed during or before the fall of hail, for the stones reached 6 inches up the well in the east-north-east corner of the yard. After the water had subsided from this yard, 7ft. square, it was estimated that a wheelbarrow could still be filled with the hail that was left there.

The general meteorological situation on the morning of April 25th was not unusual, shallow depressions extending from the south of Scotland to the Bay of Biscay. The inference was "weather will remain rather unsettled with some local rain or showers, some bright periods and also a tendency for thunder." The approach of the storm was heralded by a dark cloud first sighted over Alms Cliff Crag and to the east-north-east. It came towards Ben Rhydding skirting Pool and Otley. At Burley it broadened and may have been joined by another storm from the southeast or south. From Burley the storm travelled along both sides of the valley, the rain being somewhat less intense over the middle of the valley than up on the hillsides. The rain appears to have become heavier near Ben Rhydding on the south side and March Gill Reservoir on the north. West of Ilkley the amount of damage was less. The sky cleared first in the east at the end of the storm. The Surveyor and Water Engineer at Ilkley confirms this. "The rainstorm was most concentrated at Ben Rhydding, there being comparatively little rainfall at Hebers Ghyll (to the west of Ilkley) whilst near Burley Wood Head (to the southeast of Ben Rhydding) the rain was exceptionally heavy." There is some evidence of heavy rain to the north of Ben Rhydding on the hills near Middleton on the other side of Wharfedale.

The photograph (taken by Mr. A. Anning, Valley Drive, Ben Rhydding) shows the main road from Ilkley to Otley, at Escroft, about 1½ miles below Ben Rhydding. The photograph is taken looking towards Rumbald's Moor. There is hail on the wooded hillside in the background, but none on the footpath. The River Wharfe, visible through the railings on the right, is no higher than the ordinary winter level.

The caretaker at The Cottage was working in a garden near the moor above Burley on the occasion of the Ilkley flood of July 12th, 1900. In comparing the two storms he says they were similar in respect of the violence of thunder, lightning and hail. The storm was of shorter duration on April 25th, 1930, but was more severe while it lasted than the storm above Burley in 1900. The latter was, of course, much more severe at Ilkley. Also, it moved from south to north, at right angles to Wharfedale, whereas it is probable that the present storm travelled from east to west.

The heavy rain of April 25th, 1930, is striking because of its occurrence early in the year. Mossman found* that only 1·2 per cent. of the heavy rains in short periods during the 46 years, 1868 to 1913 occurred in April, the frequency being greatest in June, July and August.

This heavy rain is also of unusual interest since it fell in the neighbourhood of Ilkley. In the paper on " Intense and Widespread Falls of Rain "† attention was directed to the peculiar grouping over the British Isles of the intense falls on record, and reference was made to three near Ilkley. These occurred at Huddersfield on July 24th, 1904, on Embsay Moor (draining to the Wharfe above Ilkley) on June 3rd, 1908, and at Ilkley on July 12th, 1900. There was in addition a severe storm at Ilkley on June 18th, 1872, although a precise comparison is not available. " The destruction of flood gates, culverts and small bridges on the streams flowing down the sides of these ranges into the Ribble and Wharfe Valley was enormous on this day."‡ The Ilkley flood of July 12th, 1900, one of the most outstanding rain-storms experienced anywhere in the British Isles, was discussed by Dr. H. R. Mill in *British Rainfall*, 1900, pp. 16-22.

J. GLASSPOOLE.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, May 21st, in the Society's rooms, 49, Cromwell Road, South Kensington, Mr. R. G. K. Lempfert, C.B.E., M.A., President, in the Chair.

Sir Napier Shaw, Sc.D., F.R.S., gave an account of Dr. Moltchanoff's method of automatic signalling of the results of sounding of the upper air.

Sir Gilbert T. Walker, C.S.I., F.R.S.—Seasonal foreshadowing.

This paper contains some applications to seasonal foreshadowing of the tables of relationships given in previous studies of world weather. Methods applicable to the monsoon rainfall of north west India and the Peninsula, to the height of the Nile and the river Parana in Brazil, and to the rainfall of Ceará in Brazil had already been published; and as the swayings of the southern oscillation affect the winter temperatures of south west and north west Canada as well as the summer rainfall of South Africa and Australia it was natural to see how far conclusions of practical value could be derived. The rainfall data have not been based on as many stations as is theoretically desirable, but the resulting total correlation coefficients in the

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*See *British Rainfall*, 1913, p. 49.
†*London, Proc Inst. Civ, Engin.*, 1929.
‡See *British Rainfall*, 1872, p. 61.

four cases are ·71, ·72, ·72 and ·79, values which would seem to justify a prediction in general terms in nearly half the years of a long series.

A. C. Best, B.Sc.—Instruments for obtaining dry and wet bulb temperatures.

The efficiency of the Casella-type Assmann psychrometer is discussed, and attention is drawn to the defects of this type. Of these the chief defect is the low rate of aspiration. Experiments are described showing that the rate of aspiration in the above type psychrometer starts at about 1·5 metres per second. A modified form of the Casella-type psychrometer is then described in which the aspiration, effected by a small electric motor, has the value of 5 metres per second. It is shown that this psychrometer will run for about eight minutes in air having a relative humidity of 33 per cent before the wet bulb dries up.. The results of comparing the depressions given by these two psychrometers, two types of sling psychrometers and a Stevenson Screen are given. Two methods of measuring the rate of aspiration were employed. In the first a hot wire anemometer was used. This instrument is described. The second method was by timing a puff of smoke up a glass tube.

Correspondence

To the Editor, *The Meteorological Magazine.*

Experiments with Wet-Bulb Thermometers

In connexion with Dr. Whipple's note in the April number regarding experiments with wet-bulb thermometers, it may be of interest to mention another simple method of avoiding the errors associated with salt deposit. This method was tested at Malta during the past year with satisfactory results, and a report made in February on it is under consideration by the Director of the Meteorological Office.

The method consists simply in raising the water container on a block, so that the muslin and wick are completely immersed inside the container in the interval between observations. A thin desk of cork or cardboard is fixed on the thermometer stem, and roughly closes the mouth of the container when it is raised in the block. The container is lowered to its working position ten minutes before the observation is made.

With this arrangement it is only necessary to renew occasionally the water in the container: the same muslin and wick will last for a long time. Also it is perfectly easy for any observer to adopt it either on board ship or on land.

Meteorological Office, Malta. W. A. Harwood.

Dr. Whipple's article on "Experiments with Wet-Bulb Thermometers " in the April number reminds me of a series of similar experiments which were made at Valentia Observatory 14 years ago. As the results were not published at the time a brief summary of the conclusions reached may be of interest.

First a spare wet bulb adjacent to the standard one was supplied with sea water in the bottle instead of fresh. As might have been expected the bulb so treated read on the average consistently higher than the standard. Secondly, the same bulb supplied with fresh water in the normal manner was on a definite occasion deliberately contaminated by dipping the bulb into sea water. The immediate result was very much the same as when the whole water supply was salt, but the important point is that the effect was permanent, and it was evident that with the usual arrangement of water bottle and wick the salt solution remained on the bulb and did not diffuse back along the wick.

Finally an arrangement similar to that described by Dr. Whipple was used, giving a continuous slow circulation of water over the bulb. At intervals of a few days the bulb was contaminated by means of sea water as before, but whatever the effect may have been immediately afterwards it practically all disappeared in an hour or two.

The conclusions reached were entirely consonant with those which Dr. Whipple has obtained at Kew, and both of them suggest the query. . . . What is the magnitude of the systematic error which is produced in the use of the standard wet bulb on board a ship at sea? That there must be a systematic error is certain, because with breaking waves minute particles of salt water are carried by the air, even though there be no obvious spray. Such particles are caught on the wet bulb and once caught produce a permanent effect till the muslin is next cleaned or changed.

It would be instructive to run two wet bulbs in the same screen on a ship, one of which was supplied with water on Dr. Whipple's plan, and to compare the results over a year's working. A great point in favour of the method of continuous flow is that it entails no trouble beyond a regular replenishment of the water supply, and actually reduces the frequency with which the muslin need be changed.

L. H. G. Dines.

Kew Observatory, Richmond, Surrey. May 23rd, 1930.

Display of Mock Suns

At 6 p.m. on May 1st, while in the southwest district of London, I noticed a display of " mock suns " similar to that witnessed by me at Guildford in October, 1927. On the present occasion the display was not quite so well defined as previously, but the two " suns " were distinctly visible one on either side of the actual sun, horizontally, and intersected by the halo. The weather conditions at the time were fine with a moderate but very cool northeast wind, the sky being almost clear of cloud, except, of course, in the neighbourhood of the sun where appeared the usual cirrus and cirro-nimbus clouds, thickening towards the western horizon. The halo was clearly marked in the lower and more cloudy part of the sky and the portion immediately above the sun could be seen, though less distinctly, even against the blue sky.

On my arrival at Guildford later in the evening, I had another view of the display. The sun had fallen lower in the heavens to a point within about 15° of the horizon and was more enveloped in cloud. The two "mock suns" and also a part of the halo had disappeared, but another "sun" though less bright now, appeared in the remaining part at its apex. This, however, did not last very long, and within a quarter of an hour the whole phenomenon had faded away.

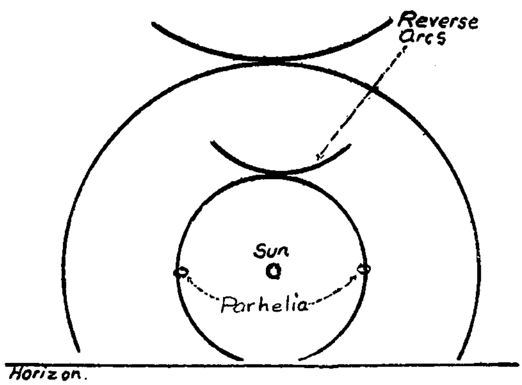
Probably other readers witnessed the display, some perhaps to better advantage.

H. J. WELLER.

Hogs Back, Guildford. May 5th, 1930,

While gardening on the morning of Saturday, May 17th, I observed the following. (British summer time is used throughout.)

Sunrise was clear. At 6h. 15m. cirro-stratus which had arrived from the southwest produced the halo of 22° with parhelia each side of the sun. At 6h. 30m. the parhelion south of the sun was hidden for a few minutes by a patch of alto-cumulus. At 6h. 40m. the halo of 46°, with reverse arcs on zenith of both halos as shown in sketch, appeared very distinctly. Coloration was very bright. All the phenomena remained visible until blotted out by increasing and thickening cirro- and alto-cumuli at 7h. 5m. Visibility was good.



At 7h. I noticed an isolated patch of alto-cumulus approaching from the northwest transversely to the main cloud mass.

F. CLAUDE BANKS.

Horndon-on-the-Hill, Essex. May 19th, 1930.

Delayed Ink Feed For Crowquill Pens

A method has been devised whereby pens of the crowquill type as fitted to pressure-tube anemographs can be loaded to their full capacity, without fear of the recording ink dropping off. The pens, furthermore, have been found to function satisfactorily without any special treatment such as tempering, etc.

The method then, is to insert a piece of wick (as supplied for use with the wet-bulb thermometer) through the entire length of the pen and its elbow joint. This single strand of wick should reach to within two millimetres of the point of pen, and may extend about the same length outside the elbow joint. A few drops of ink can then be placed on this protruding wick, which will readily conduct to the point of pen. It may assist in cases to apply a slight pressure on the pen points in order to open them out a trifle and give the point an initial supply of ink. This may be done with the aid of a penknife. Further ink may now be added; the presence of the wick enables a larger quantity to be held without fear of running off.

A new pen fitted with one strand of wick records very satisfactorily for 48 hours without any attention or the addition of fresh ink.

Trials were made with two and three pieces of wick, and also with wick applied to the " Starr " double pen. In the former cases the ink feed did not last so long, owing to the restricted space for ink, and in the latter case the ink was fed too freely.

Experiments have been made over a reasonable period, incorporating light and strong winds, and every excursion of the pen has been recorded.

P. R. ZEALLEY.

School of Artillery, Larkhill, Salisbury Plain. May 15th, 1930

NOTES AND QUERIES

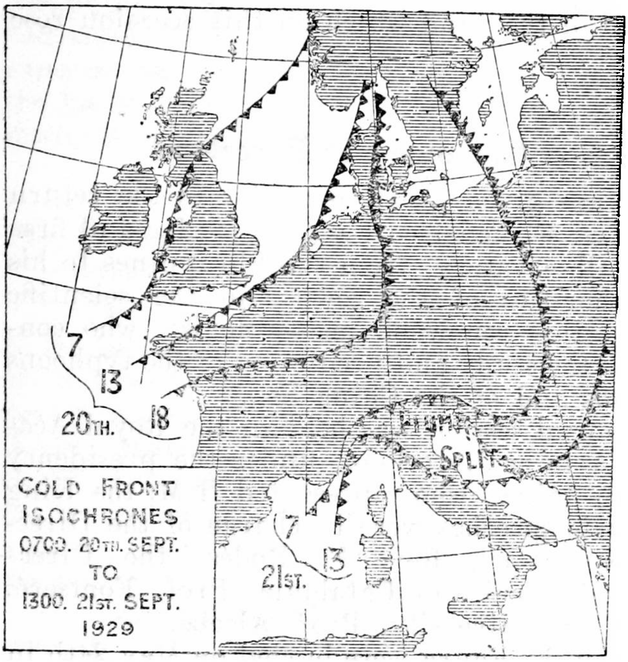
Line-Squall and Bora at Split, Dalmatia, on September 21st, 1929

Attention was drawn to this line-squall and bora by Lt. Moorhead, R.N., of H.M.S. *Eagle*, moored off Split at the time.

The line-squall passed over Split at 12h. 5m. G.M.T. The wind veered very rapidly from SW to NW and rose to force 7-8 during the squall. A line cloud accompanied the squall with heavy rain and some thunder. The *Eagle* thermogram shows an almost instantaneous fall of temperature from 78° to 64° and a further fall to 60° soon after. Later in the day the temperature rose to 66°. The barogram shows a well-marked trough. After the squall the wind fell off to force 4 and then veering rapidly to NE (bora) blew for several hours at force 7-8.

The weather record of H.M.S. *Queen Elizabeth* at Fiume, some 160 miles to the north of Split, shows that the squall passed over there at 9h. This squall was given by a well-marked cold front whose movement between 7h., 20th, and 13h. 21st, is shown in the diagram. The front travelled from the English Channel and eastern North Sea to the central Adriatic in 24 hours. It was associated with a deep depression over Scandinavia.

The forecasting of bora winds in the Adriatic appears to be largely a matter of following cold fronts moving south or south-east over central Europe. Some fronts are held up considerably by the Alps and it is difficult to estimate how much a given front is going to be held up in this way. A cold front which followed the one above described was, in fact, held up for about 24 hours by the Alps. This front was to be seen moving southeast-wards over the British Isles at 7h. on the 21st and reached Austria and the Alps on the following morning, the 22nd. As mentioned above, it was held up on the mountains and the cold air did not come down into the Adriatic until 7h. on the 23rd when Trieste reported wind NE, force 5. The cold air did not reach Split until 23h. 30m. No very definite squall occurred at that time but wind freshened considerably from NE and blew until the 27th, reaching force 7-8. Temperature showed no sudden change but maxima on the 24th and succeeding days were below 70° compared with one of 80° on the 23rd. Both fronts were associated with the same depression over Scandinavia but this had filled considerably in the interval between them and the gradient for the onward movement of the second was smaller. A large anticyclone built up over central Europe behind the second front and gave steady NE winds in the Adriatic.



G. A. BULL.

" Willy-Nilly " in Crete

We owe to Pilot S. J. Stocks, of Imperial Airways, through the agency of Captain J. Durward, a description and photograph of a curious phenomenon which he observed at Mirabella in Crete on January 15th, 1930, and which is termed a " willy-nilly." The photograph, which is not reproduced, shows a lagoon backed by mountains from 2,000 to 4,100 feet high; the usually calm water of the lagoon is much disturbed and the base of the mountains is blurred by a dense mist of spray, which rises to a height of 600 feet on the seaward or foremost edge of the disturbance and has an average height of 400 feet.

The " willy-nilly " did not revolve like a water-spout, but consisted of an irregular belt of violently rising air, about 600 yards long and 200 yards wide. The vertical motion is strong enough to raise the surface of water as spray and sometimes to carry up small pieces of seaweed and light wreckage. It travels with the speed of the wind which on this occasion rose to 60 m.p.h. in gusts.

Commemoration Ceremony at Barcelona

The City of Barcelona has given great solemnity to the return of the remains of the Rev. F. Federico Faura, founder and first Director of the Manila Observatory, from the Philippines to his native land. The authorities of the town and the scientific societies have honoured this renowned meteorologist, who consecrated his whole life to the study and prediction of the typhoons of the Philippine Islands and of the China Sea.

On May 23rd a memorial session was held in the Royal Academy of Sciences and Arts at Barcelona, under the presidency of H.H. the Prince Don Jaime, who represented H.M. the King of Spain. The panegyric speeches were in charge of the Director of the Ebro Observatory, Rev. F. Rodés, the Director of the Meteorological Service of Catalonia, Prof. Fontseré, and the Vice-rector of the University, Prof. Alcobé.

The remains of the Rev. F. Faura were buried on May 24th in the new Church of Artés, a little Catalonian village, where he was born in 1840.

E. Fontseré.

Reviews

Grundzüge des Klimas von Muottas-Muraigl (Oberengadin). Eine meteorologisch-physikalisch-physiologische Studie. By Prof. Dr C. Dorno. Size $8\frac{3}{4} \times 5\frac{3}{4}$in., pp. xi + 177. *Illus.* Brunswick, 1927.

The actual observations at Muottas Muraigl (in the Upper Engadine, height 2,456m.) upon which this book is based were taken on about 40 days between July, 1923 and June, 1924, the five periods ranging in length from two days in June, 1924, to thirteen in October, 1923. It was doubtless this paucity of data which led to the author's choice of title for a book which otherwise suggests thoroughness. During the periods selected at different seasons of the year the observations taken included meteorology, radiation of various kinds, meteorological optics, atmospheric electricity and physiology. Comparisons were made with observations at Davos, 900m. lower than Muottas and several conclusions are drawn as to the rate of change of conditions likely to exist between 1,500m. and 2,500m. compared with that between 500m. and 1,500m. Large increases are indicated not only in ultraviolet radiation from the sun and the cooling properties of the air but also in electric potential and conductivity.

That the section on meteorology should be comparatively short, occupying only about one-fourth or less of the space devoted to radiation and physiology severally, is in accordance with expectations from the pen of Prof. Dorno. The treatment of the latter subjects includes criticism of several instruments and methods of observation. L. D. SAWYER.

The Glacial Conditions and Quaternary History of North-east Land. By K. S. Sandford. London Geogr. J., 74, 1929, pp. 451-70 and 543-52.

North-east Land, the furthest removed of the Spitsbergen group of islands, is about the size of Wales, but presents in miniature nearly all the features of a continental ice-sheet. There are three " domes " of ice, which give rise to their own characteristic blizzards, a zone of " highland ice " in which the contours of the ice surface are determined by the conformation of the ground beneath, and a number of interesting coastal features—small glaciers, ice cliffs and dead ice.

At present the loss by ablation, melting and calving of icebergs is very nearly if not quite balanced by the supply of new snow, so that the ice is either stationary or retreating almost imperceptibly. The moraines and raised beaches show evidence of more violent fluctuations in the past; at one stage, many thousands of years ago, the glaciation was more extensive than it is at present, though there is no means of knowing whether this coincided with the last maximum of glaciation in Europe. During this glacial maximum the island lay more than 200 feet lower than at present; the raised beaches formed during this period sink towards the heads of the fiords, suggesting that the subsequent elevation was due to isostatic compensation after the withdrawal of the thick ice from the coasts. The period of elevation was associated with warmer seas than the present, the deposits including *Mytilus edulis*, a temperate species which cannot live in arctic waters where shore-ice is formed, although the ice-foot now persists throughout the summer.

Over the lower raised beaches there is in some places recent boulder clay, pointing to a sub-recent re-advance of the ice beyond its present limit, and there is some evidence that in the last few decades the ice has retreated locally for a small distance.

Books Received

Jaarboek, Koninklijk Nederlandsch Meteorologisch Instituut, 1927, A. Meteorologie, B. Aard-Magnetisme (No. 97). Utrecht, 1928.

Ergebnisse Aerologischer Beobachtungen, 1927. K. Ned. Meteor. Inst. (No. 106A). Utrecht, 1928.

Onweders, Optische Verschijnselen, enz. in Nederland. Naar Vrijwillige Waarnemingen in 1926. Deel xlvi. K. Ned. Meteor. Inst. (No. 81). Amsterdam, 1928.

Nautisk-Meteorologisk Aarbog, 1928. The Danish Meteorological Institute, Copenhagen, 1929.

Obituary

Dr. Fridtjof Nansen.—With the death of Dr. Nansen on May 13th the world lost a great humanitarian and science lost an intrepid pioneer and explorer. His work on the repatriation of German and Russian prisoners of war, on famine relief in Russia, on the resettlement of Anatolian refugees and in the service of the League of Nations, has been adequately described in *The Times* and elsewhere, but by meteorologists and geographers he will be remembered as the man who first opened to science the frozen centre of the Arctic Ocean.

Nansen was born at Christiania (now Oslo) on October 10th, 1861, and after taking the degree of Doctor of Philosophy at the University of Oslo, he made his first acquaintance with the Arctic in 1882 during a voyage to the east coast of Greenland in the sealer *Viking*. His daring as an explorer was made known to the world by his successful leadership of an expedition across the Greenland ice-sheet in 1888, the first time that great area of inland ice was crossed from coast to coast. The results formed one of the earliest contributions to the problems of the nourishment of an ice-sheet and the "glacial anticyclone."

Nansen's knowledge of oceanography led him to infer the existence of an ocean current crossing the North Polar Basin from east to west, and in 1893 he set out in a ship, the *Fram*, designed especially for the purpose of being frozen-in north of Siberia and drifting in the ice across the neighbourhood of the pole. This daring programme was successfully carried out, the ship became fast in the ice in September, 1893, in 78° 43′ N., and did not emerge until August, 1896, near Spitsbergen, after reaching a latitude of 85° 56′ N. in longitude 66°E. Full bi-hourly meteorological observations were maintained throughout this period of nearly three years, in a region the meteorology of which had previously been entirely unknown; in addition Nansen with one companion left the ship in March, 1895, on a sledge expedition over the ice, and obtained a second series of observations still further north between that date and June, 1896. The meteorological results of the expedition were set out by Prof. Mohn in a volume of 659 pages which has formed the starting point for all subsequent discussions of polar meteorology, and has added more than any other single work to our knowledge of the atmospheric circulation in high latitudes.

After an interval of political and diplomatic service in 1906 Nansen became Professor of Oceanography at the Unversity of Oslo, and took part in several expeditions to investigate the oceanography and marine meteorology of the North Atlantic. The results were published in a number of separate papers and one compilation, written in association with B. Helland-Hansen, well known to meteorologists under the title "Temperature variations in the North Atlantic Ocean and in the Atmosphere." This great work, which was issued by the Smithsonian Institution in 1920, includes a discussion of all the literature on the relation of sunspots to weather published up to 1917. His interest in Arctic problems remained fresh, however, and in the last years of his life he assisted in founding a society known as the "Aeroarctic" for the exploration of the north polar regions from the air. Nansen had arranged to visit this country to explain the programme of "Aeroarctic" in a lecture to a joint meeting of the Royal Aeronautical and Royal Meteorological Societies on March 14th, 1930, and it was a great disappointment to all British meteorologists when his illness made it necessary to cancel the visit. Their sorrow would have been still greater had they known that the opportunity was never to return.

News in Brief

At a meeting of the Senate on March 26th, 1930, it was decided to confer on Sir Gilbert Walker, C.S.I., Sc.D., F.R.S., the title of "Professor of Meteorology in the University of London," with the status and designation of "Appointed Teacher."

All who are interested in meteorology will congratulate Sir Gilbert Walker on the added dignity, which may be taken as marking a definite advance in the status of the science of meteorology in this country.

The honour of a Knighthood has been conferred on Mr. Henry William Watson McAnnally, C.B., J.P., Principal Assistant Secretary in the Air Ministry.

On June 30th Mr. R. A. Watson retires from the directorship of the Royal Alfred Observatory, Mauritius, which he has held for three years. His place will be taken by Mr. McCurdy, while Mr. M. Herchenroder becomes Assistant Director.

Mr. J. Wadsworth has resigned his post in the Meteorological Office in order to take up a new appointment as Director of the Apia Observatory, Samoa, in succession to Mr. Andrew Thomson.

The Weather of May, 1930

The weather of May was characterised by lack of sunshine, except in the extreme north-west; and although in south-east England the month was wet, Kew Observatory experiencing the wettest May since 1886, most districts had less than the average rainfall. The sunny weather of the closing days of April continued on the 1st, many stations recording over 11 hrs. bright sunshine, and Aberdeen 13·8 hrs. There was a general increase of cloud in the next few days, and thunderstorms occurred locally in England on the 3rd, 4th and 5th. Fog occurred in several parts of England in the early morning of the 5th. A depresion from the west of Ireland then spread to the southern part of the country and rain fell over most of England in the early hours of the 6th, while by the 7th northerly winds had spread to all parts of the country and hail showers fell in east Scotland and as far south as Harrogate. Cold showery weather continued for a few days, minimum temperatures of 28° occurring at Kilmarnock and Aspatria on the 8th, 29° at Fort Augustus on the 9th, and 28° at Durham on the 10th. On the 11th a small depression crossed the British Isles, causing rain or showers in most districts and a gale in the English Channel. Variable but mainly unsettled weather with southwesterly winds then set in and conditions became somewhat milder. On the 17th heavy rain fell locally in northern England, Scotland and Ireland, Borrowdale (Cumberland) having 1·70 in., Eskdalemuir 1·18 in., Roches Point 0·87 in., and Fofanny (Co. Down) 1·41 in. On the 18th a deep depression centred north of Scotland moved slowly westward, and strong westerly winds were general, while gales occurred in parts of Scotland. In the midlands and south of England, however, considerable sunshine was experienced and Guernsey had 13·6 hours. Following this depression anticyclonic conditions developed; the weather was mainly cloudy, however, until the 20th; varying amounts of sunshine were recorded, but day temeratures mostly failed to reach 60°. Rain fell locally during this period but amounts were generally not large. Thunderstorms occurred locally in the south-east on the 19th.

Considerable sunshine was experienced in the north on the 21st and 22nd, Douglas having 13·4 hrs. on the 21st and Lerwick 15·3 hrs. on the 22nd; but on the 22nd the midlands and south-east of England were influenced by winds associated with a low pressure area on the Continent, day temperature at Kew Observatory failing to exceed 51°. An improvement occurred on the 23rd, many places having over 13 hrs. of bright sunshine. Rather cloudy weather with local thundery showers prevailed for the next few days. On the 26th falls exceeding one inch were measured at a few places in England, Derby having 1·35 in. Fog persisted off the east coast during most of the 25th and impeded air and sea transport in the English Channel. On the 26th temperature reached 71° at Renfrew, and on the 27th day temperatures generally rose above normal. 74° was recorded at Greenwich on the 29th. On the 28th and 29th good sunshine records were obtained at many places, 14·5 hrs. at Lympne on the 28th, and 14·4 hrs. at Lerwick on the 29th. On the 30th a depression developed in the Bay of Biscay and over western France, and later in the day widespread rain and drizzle occurred over southern England, several stations in Kent receiving about 1 inch. At Gorey (Wexford) also on the 30th 1 inch fell. On the 31st day temperatures again reached normal generally. The distribution of bright sunshine for the month was as follows:—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs).
Stornoway	218	+27	Liverpool	148	—51
Aberdeen	176	—11	Ross-on-Wye	129	—74
Dublin	168	—37	Falmouth	187	—44
Birr Castle	148	—34	Gorleston	168	—57
Valentia	200	— 3	Kew	152	—49

Pressure was below normal in a belt from Newfoundland across Iceland and the British Isles to southern Sweden, the deficit reaching 4·8mb. at Reykjavik. Pressure was above normal over the Mediterranean, Spain and the Azores, the excess reaching 5·0mb. at Corunna, and also in a small area in central Scandinavia. In Scandinavia temperature was above normal everywhere, the excess reaching 5°F. in Norrland while rainfall was deficient in the north but excessive in the south, southern Scania having twice the normal fall. In central Europe temperature was low and rainfall heavy.

The month has been characterised by storms and heavy rains in many parts of the world. In Switzerland and Bavaria heavy rain fell from the 7th to the 14th, and the floods on the 15th were as extensive as any in the past 20 years. The damage has been increased by avalanches, and in the Linth Valley a stream of mud and stones ten feet deep came down from the Kilchenstock Mountain, covering fields and pastures and threatening several farms. The river Isar at Munich reached five feet above flood level. On the 22nd heavy rains caused serious floods in

(*Continued on p. 128*)

Rainfall: May, 1930: England and Wales

Co.	Station	In.	Per-cent of Av.	Co.	Station	In.	Per-cent. of Av.
Lond .	Camden Square.........	2·67	152	*Leics* .	Belvoir Castle...........	2·08	99
Sur .	Reigate, Alvington.....	2·77	152	*Rut* .	Ridlington...............	2·85	...
Kent .	Tenterden, Ashenden...	3·38	215	*Linc* .	Boston, Skirbeck........	2·32	132
,, .	Folkestone, Boro. San..	3·39	...	,, .	Cranwell Aerodrome...	1·78	98
,, .	Margate, Cliftonville...	2·55	161	,, .	Skegness, Marine Gdns	1·83	108
,, .	Sevenoaks, Speldhurst	2·25	...	,, .	Louth, Westgate........	1·59	78
Sus .	Patching Farm.........	1·55	84	,, .	Brigg, Wrawby St.....	1·83	...
,, .	Brighton, Old Steyne..	2·20	136	*Notts* .	Worksop, Hodsock.....	1·22	61
,, .	Heathfield, Barklye....	2·96	165	*Derby* .	Derby, L. M. & S. Rly.	3·03	159
Hants.	Ventnor, Roy. Nat. Hos.	1·85	109	,, .	Buxton, Devon Hos....	2·87	93
,, .	Fordingbridge, Oaklnds	2·70	130	*Ches* .	Runcorn, Weston Pt...	·86	37
,, .	Ovington Rectory.......	2·47	114	,, .	Nantwich, Dorfold Hall	2·50	...
,, .	Sherborne St. John.....	1·75	90	*Lancs* .	Manchester, Whit. Pk.	1·96	92
Berks .	Wellington College.....	1·95	105	,, .	Stonyhurst College.....	2·98	105
,, .	Newbury, Greenham..	1·96	104	,, .	Southport, Hesketh Pk	1·00	48
Herts .	Welwyn Garden City...	2·50	...	,, .	Lancaster, Strathspey	1·09	...
Bucks.	High Wycombe..........	2·89	164	*Yorks*.	Wath-upon-Dearne.....	1·27	63
Oxf . .	Oxford, Mag. College..	2·01	112	,, .	Bradford, Lister Pk....	1·56	75
Nor .	Pitsford, Sedgebrook...	2·70	141	,, .	Oughtershaw Hall......	2·20	...
,, .	Oundle....................	3·31	...	,, .	Wetherby, Ribston H.	2·22	107
Beds .	Woburn, Crawley Mill	2·91	150	,, .	Hull, Pearson Park.....	1·74	90
Cam .	Cambridge, Bot. Gdns.	3·31	188	,, .	Holme-on-Spalding.....	1·32	...
Essex .	Chelmsford, CountyLab	2·05	142	,, .	West Witton, Ivy Ho.	1·14	...
,, .	Lexden Hill House....	1·94	...	,, .	Felixkirk, Mt. St. John	1·34	71
Suff .	Hawkedon Rectory.....	3·03	164	,, .	Pickering, Hungate....	1·03	...
,, .	Haughley House........	2·36	...	,, .	Scarborough.............	1·07	56
Norf .	Norwich, Eaton.........	3·06	159	,, .	Middlesbrough..........	1·12	58
,, .	Wells, Holkham Hall	2·13	132	,, .	Baldersdale, Hury Res.	1·47	...
,, .	Little Dunham..........	3·15	162	*Durh* .	Ushaw College...........	1·27	59
Wilts.	Devizes, Highclere......	1·73	95	*Nor* .	Newcastle, Town Moor	1·29	63
,, .	Bishops Cannings.......	2·23	114	,, .	Bellingham, Highgreen	1·23	...
Dor .	Evershot, Melbury Ho.	2·49	122	,, .	Lilburn Tower Gdns....	1 38	...
,, .	Creech Grange..........	3·30	...	*Cumb* .	Geltsdale.................	1·45	...
,, .	Shaftesbury, Abbey Ho.	2·27	107	,, .	Carlisle, Scaleby Hall	1·15	48
Devon.	Plymouth, The Hoe...	2·01	97	,, .	Borrowdale, Seathwaite	4·20	57
,, .	Polapit Tamar...........	1·87	93	,, .	Borrowdale, Rosthwaite	4·04	...
,, .	Ashburton, Druid Ho.	...	...	,, .	Keswick, High Hill.....	2·16	...
,, .	Cullompton.............	1·86	86	*Glam* .	Cardiff, Ely P. Stn.....	1·54	62
,, .	Sidmouth, Sidmount...	2·19	112	,, .	Treherbert, Tynywaun	3·76	...
,, .	Filleigh, Castle Hill....	3·00	...	*Carm* .	Carmarthen Friary.....	2·35	85
,, .	Barnstaple, N. Dev. Ath.	2·36	114	,, .	Llanwrda..................	2·45	73
Corn .	Redruth, Trewirgie.....	2·04	88	*Pemb* .	Haverfordwest, School	2·27	91
,, .	Penzance, Morrab Gdn.	2·07	94	*Card* .	Aberystwyth............	2·51	...
,, .	St. Austell, Trevarna...	3·12	129	,, .	Cardigan, County Sch.	1·86	...
Soms .	Chewton Mendip........	2·60	94	*Brec* .	Crickhowell, Talymaes	1·70	...
,, .	Long Ashton............	1·45	...	*Rad* .	Birm W. W. Tyrmynydd	...	...
,, .	Street, Millfield	1·57	...	*Mont* .	Lake Vyrnwy...........	...	...
Glos. .	Cirencester, Gwynfa....	1·33	65	*Denb* .	Llangynhafal............	2·31	...
Here .	Ross, Birchlea............	1·55	73	*Mer* .	Dolgelly, Bryntirion...	4·24	128
,, .	Ledbury, Underdown..	2·19	107	*Carn* .	Llandudno................	1·28	67
Salop .	Church Stretton.........	3·27	127	,, .	Snowdon, L. Llydaw 9	8·83	...
,, .	Shifnal, Hatton Grange	2·23	108	*Ang* .	Holyhead, Salt Island	1·26	64
Worc .	Ombersley, Holt Lock	2·96	144	,, .	Lligwy.....................	1·10	...
,, .	Blockley..................	2·23	..	*Isle of Man*			
War .	Farnborough.............	2·44	109		Douglas, Boro' Cem....	1·93	77
,, .	Birminghm, Edgbaston	2·07	97	*Guernsey*			
Leics .	Thornton Reservoir....	3·12	155		St. PeterP't. GrangeRd.	2·07	122

Rainfall: May, 1930: Scotland and Ireland

Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per-cent. of Av.
Wigt .	Stoneykirk, Ardwell Ho	...	...	*Suth* .	Loch More, Achfary...	5·39	122
,, .	Pt. William, Monreith	1·18	...	*Caith* .	Wick....................	1·51	73
Kirk .	Carsphairn, Shiel.......	3·13	...	*Ork* .	Pomona, Deerness......	2·68	135
,, .	Dumfries, Cargen......	...	...	*Shet* .	Lerwick..................	1·52	73
Dumf.	Eskdalemuir Obs.......	3·11	94	*Cork* .	Caheragh Rectory......	2·97	...
Roxb .	Branxholm..............	1·51	67	,, .	Dunmanway Rectory...	2·74	81
Selk .	Ettrick Manse..........	2·30	...	,, .	Ballinacurra.............	1·77	75
Peeb .	West Linton............	1·34	...	,, .	Glanmire, Lota Lo......	2·00	82
Berk .	Marchmont House......	·95	38	*Kerry*.	Valentia Obsy..........	3·07	97
Hadd.	North Berwick Res.....	·86	43	,, .	Gearahameen............	3·60	...
Midl .	Edinburgh, Roy. Obs.	1·22	65	,, .	Killarney Asylum......	1·41	46
Ayr .	Kilmarnock, Agric. C.	1·54	67	,, .	Darrynane Abbey.......	2·78	93
,, .	Girvan, Pinmore........	2·09	70	*Wat* .	Waterford, Brook Lo...	1·99	86
Renf .	Glasgow, Queen's Pk. .	1·64	67	*Tip* .	Nenagh, Cas. Lough...	1·52	61
,, .	Greenock, Prospect H.	2·96	86	,, .	Roscrea, Timoney Park	1·73	...
Bute .	Rothesay, Ardencraig.	2·50	82	,, .	Cashel, Ballinamona...	2·73	114
,, .	Dougarie Lodge.........	2·11	...	*Lim* .	Foynes, Coolnanes......	1·48	64
Arg .	Ardgour House.........	5·49	...	,, .	Castleconnel Rec.......	1·94	...
,, .	Manse of Glenorchy...	4·82	...	*Clare* .	Inagh, Mount Callan...	3·07	...
,, .	Oban.....................	2·73	...	,, .	Broadford, Hurdlest'n.	1·87	...
,, .	Poltalloch...............	2·22	77	*Wexf*.	Newtownbarry	...	...
,, .	Inveraray Castle........	3·94	100	,, .	Gorey, Courtown Ho...	2·81	127
,, .	Islay, Eallabus.........	2·02	76	*Kilk* .	Kilkenny Castle.........	1·69	76
,, .	Mull, Benmore.........	4·50	...	*Wic* .	Rathnew, Clonmannon	2·43	...
,, .	Tiree	...	...	*Carl* .	Hacketstown Rectory..	2·72	105
Kinr .	Loch Leven Sluice......	1·91	78	*Leix* .	Blandsfort House......	2·05	84
Perth .	Loch Dhu................	4·30	96	,, .	Mountmellick...........	2·06	...
,, .	Balquhidder, Stronvar	...	...	*Off'ly* .	Birr Castle..............	...	...
,, .	Crieff, Strathearn Hyd.	1·73	69	*Dubl* .	Dublin, FitzWm. Sq...	2·18	106
,, .	Blair Castle Gardens...	1·55	76	,, .	Balbriggan, Ardgillan.	1·62	78
,, .	Dalnaspidal Lodge.....	...	...	*Me'th* .	Beauparc, St. Cloud...	1·97	...
Angus.	Kettins School.	2·00	82	,, .	Kells, Headfort.........	1·46	54
,, .	Dundee, E. Necropolis	1·58	75	*W.M* .	Moate, Coolatore......	2·03	...
,, .	Pearsie House...........	2·12	...	,, .	Mullingar, Belvedere..	1·84	75
,, .	Montrose, Sunnyside...	...	...	*Long* .	Castle Forbes Gdns......	1·08	42
Aber .	Braemar, Bank..........	1·20	50	*Gal* .	Ballynahinch Castle...	2·65	73
,, .	Logie Coldstone Sch....	1·12	45	,, .	Galway, Grammar Sch.	1·45	...
,, .	Aberdeen, King's Coll.	·99	43	*Mayo* .	Mallaranny..............	1·85	...
,, .	Fyvie Castle.............	1·25	...	,, .	Westport House.........	1·69	59
Moray.	Gordon Castle...........	1·17	55	,, .	Delphi Lodge...........	3·48	...
,, .	Grantown-on-Spey......	·91	39	*Sligo* .	Markree Obsy...........	2·18	78
Nairn.	Nairn, Delnies	1·35	75	*Cav'n* .	Belturbet, Cloverhill...	1·42	57
Inv .	Kingussie, The Birches	1·52	...	*Ferm* .	Enniskillen, Portora...	1·68	...
,, .	Loch Quoich, Loan.....	...	...	*Arm* .	Armagh Obsy...........	1·54	65
,, .	Glenquoich..............	7·31	134	*Down* .	Fofanny Reservoir......	3·84	...
,, .	Inverness, Culduthel R.	1·42	...	,, .	Seaforde..................	1·88	71
,, .	Arisaig, Faire-na-Squir	1·95	...	,, .	Donaghadee, C. Stn...	1·53	67
,, .	Fort William...........	4·11	...	,, .	Banbridge, Milltown...	1·63	...
,, .	Skye, Dunvegan.........	2·67	...	*Antr* .	Belfast, Cavehill Rd...	2·00	...
R & C.	Alness, Ardross Cas ...	2·56	99	,, .	Glenarm Castle.........	2·48	...
,, .	Ullapool.................	2·40	...	,, .	Ballymena, Harryville	1·94	68
,, .	Torridon, Bendamph...	4·11	90	*Lon* .	Londonderry, Creggan	1·65	63
,, .	Achnashellach..........	5·07	...	*Tyr* .	Donaghmore.............	1·66	...
,, .	Stornoway..............	2·48	97	,, .	Omagh, Edenfel.........	2·19	85
Suth .	Lairg....................	1·99	...	*Don* .	Malin Head..............	1·05	...
,, .	Tongue..................	2·12	89	,, .	Dunfanaghy.............	1·06	...
,, .	Melvich..................	3·14	...	,, .	Killybegs, Rockmount.	1·99	55

Climatological Table for the British Empire, December, 1929.

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	in.	in.			
London, Kew Obsy.	1005·6	— 8·1	57	29	48·2	38·9	43·5	+ 3·2	41·4	88	6·7	4·43	+ 2·14	23	2·0	26
Gibraltar	1023·6	+ 3·5	69	43	65·2	51·0	58·1	+ 2·1	51·8	86	5·0	2·46	— 3·15	8	..	..
Malta	1018·1	+ 1·5	68	42	61·0	52·7	56·9	— 1·0	54·2	90	5·3	1·38	— 2·33	10	6·5	67
St. Helena	1012·1	+ 1·1	..	55	..	56·2	..	..	57·0	92	10·0	1·50	— 0·46	18	..	..
Sierra Leone	1011·8	+ 0·9	89	70	86·5	72·9	79·7	— 1·7	74·5	78	3·2	0·10	— 1·32	2	..	..
Lagos, Nigeria	1009·7	— 0·8	90	66	87·0	71·8	79·4	— 2·1	73·2	79	3·8	6·02	+ 5·22	2	..	..
Kaduna, Nigeria	1016·6	+ 3·8	89	..	84·7	..	..	..	64·7	77	1·2	0·00	0·00	0	..	..
Zomba, Nyasaland	1007·4	— 0·9	90	62	81·3	65·5	73·4	+ 0·3	..	73	6·8	10·82	— 0·05	16	..	..
Salisbury, Rhodesia	1007·8	— 1·4	84	53	76·1	59·5	67·8	— 1·8	62·1	71	7·5	6·59	+ 0·81	17	5·1	39
Cape Town	1013·4	— 0·9	95	44	79·2	58·8	69·0	+ 1·1	61·1	69	3·7	1·36	+ 0·55	5	..	..
Johannesburg	1010·3	— 0·5	86	50	75·5	55·4	65·5	+ 0.4	57·6	69	4·6	5·06	— 0·37	17	8·0	58
Mauritius	1011·0	— 3·0	92	69	84·6	72·3	78·4	+ 0·1	74·8	75	8·0	22·03	+ 17·30	24	5·7	43
Bloemfontein	..	..	..	..	..	..	..	..	..	..	..	2·19	— 0·26	..	..	..
Calcutta, Alipore Obsy.	1015·0	— 0·7	84	47	76·9	57·2	67·1	+ 0·6	58·1	86	2·4	0·29	+ 0·09	1*	..	..
Bombay	1012·1	— 1·4	94	55	86·0	67·9	76·9	— 0·6	65·0	69	0·9	0·86	+ 0·81	1*	..	..
Madras	1012·2	— 1·3	85	64	83·9	70·9	77·4	+ 0·7	73·1	84	5·0	5·88	+ 0·07	8*	..	..
Colombo, Ceylon	1010·7	0·0	89	65	85·2	71·2	78·2	— 0·8	74·6	76	5·5	5·01	— 0·36	19	6·9	59
Hongkong	1017·9	— 1·8	78	44	68·8	60·9	64·9	+ 1·9	60·8	76	7·1	0·42	— 0·71	7	4·6	43
Sandakan	..	..	89	72	87·3	74·2	80·7	+ 0·6	76·9	85	..	6·98	— 10·68	9	..	..
Sydney, N.S.W.	1007·4	— 4·5	98	57	79·5	64·1	71·8	+ 1·7	64·3	60	5·9	1·87	— 1.04	12	7·9	55
Melbourne	1009·3	— 3·2	97	44	72·0	53·5	62·7	— 1·6	55·8	62	7·2	2·50	+ 0·16	15	5·2	35
Adelaide	1012·2	— 1·0	102	47	78·0	56·6	67·3	— 3·8	56·4	46	7·5	3·52	+ 2·52	5	7·9	55
Perth, W. Australia	1013·3	+ 0·1	100	52	82·0	60·4	71·2	+ 0·5	61·2	50	4·5	0·38	— 0·20	4	12·2	86
Coolgardie	1011·5	+ 0·3	108	45	91·3	59·1	75·2	— 0·6	58·2	32	2·9	0·00	— 0·70	0	..	..
Brisbane	1009·8	— 2·2	97	59	87·4	67·5	77·5	+ 1·1	68·8	51	4·1	1·90	— 2·94	7	9·5	69
Hobart, Tasmania	1005·0	— 4·7	75	41	63·4	49·7	56·5	— 3·9	51·3	63	8·6	5·36	+ 3·40	19	5.5	36
Wellington, N.Z.	1004·9	— 7·3	69	43	62·7	51·5	57·1	— 3·3	54·4	76	7·5	2·67	— 0·55	16	6·3	42
Suva, Fiji	1005·9	— 2·7	89	70	83.5	74·2	78·9	0·0	74·6	77	6·9	23·91	+ 11·80	22	6·1	46
Apia, Samoa	1006·7	— 1·7	87	71	85·1	75·6	80·3	+ 1·0	77·9	82	5·9	16·84	+ 3·22	22	4·3	33
Kingston, Jamaica	1014·5	+ 0·5	89	65	85·0	68·7	76.9	— 0·8	67·2	87	2·8	1·27	— 0·32	7	7·8	70
Grenada, W.I.	1009·9	— 1·6	89	71	86·4	73·3	79·9	+ 1·8	74·5	77	2·8	3·75	— 3·52	18	..	..
Toronto	1016·9	— 0·5	41	6	30·9	19·7	25·3	— 0·9	22·3	73	9·2	2·29	— 0·54	19	1·0	11
Winnipeg	1020·2	+ 2·3	40	—28	10·6	—2·8	3·9	— 1·8	..	..	6·4	1·45	+ 0·17	12	2·0	24
St. John, N.B.	1016·0	+ 1·8	44	— 1	28·3	15·1	21·7	— 2·7	18·4	77	7·5	3·99	— 0·18	16	2·1	24
Victoria, B.C.	1015·8	— 1·0	52	29	45·2	38·8	42·0	+ 0·5	40·4	93	8·3	4·92	— 0·99	22	1·7	20

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

Climatological Table for the British Empire, Year, 1929.

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	in.	in.			
London, Kew Obsy.	1016·5	+ 1·1	87	13	57·1	42·3	49·7	0·0	43·8	86	6·6	21·39	− 2·41	131	4·7	36
Gibraltar	1017·9	0·0	91	38	71·5	58·3	64·9	+ 0·6	57·2	80	4·8	19·50	− 16·32	73	..	..
Malta	1015·9	0·0	95	39	68·9	59·2	64·0	− 2·1	59·1	77	4·4	17·47	− 2·39	90	8·4	69
St. Helena	1013·5	+ 1·9	..	52	..	56·5	..	..	57·6	94	9·2	29·76	− 10·36	230	..	..
Sierra Leone	1012·2	+ 0·8	93	..	85·5	..	..	..	75·5	83	4·4	155·15	− 2·08	164	..	..
Lagos, Nigeria	1011·4	0·0	91	66	85·7	74·7	80·2	− 0·3	75·6	82	7·7	85·82	+ 14·19	133	..	..
Kaduna, Nigeria	1015·1	+ 2·7	99	..	88·1	..	..	..	67·1	65	..	57·91	+ 8·68	124	..	..
Zomba, Nyasaland	1011·7	− 0·6	94	46	78·6	61·1	69·9	+ 0·5	..	70	5·5	58·18	− 3·64	117	..	..
Salisbury, Rhodesia	1012·2	− 0·3	95	36	76·7	54·1	65·4	+ 0·1	57·1	56	3·7	34·71	+ 2·77	94	8·2	68
Cape Town	1017·5	+ 0·5	102	38	71·3	54·8	63·1	+ 0·8	56·1	79	4·3	19·54	− 5·50	85	..	..
Johannesburg	1016·3	0·0	88	28	70·3	50·6	60·5	+ 1·0	51·2	63	3·6	34·64	+ 1·42	110	8·5	70
Mauritius	1015·8	− 0·3	92	56	79·6	67·5	73·6	− 0·4	70·1	71	5·8	70·96	+ 21·30	252	7·6	63
Bloemfontein	..	..	..	..	..	..	..	..	..	..	.	..	..	..	..	..
Calcutta, Alipore Obsy.	1007·4	− 0·2	103	47	87·9	71·7	79·8	+ 1·1	72·2	85	4·9	59·64	− 2·90	85*	..	..
Bombay	1008·6	− 0·6	97	53	87·9	74·7	81·3	+ 0·8	73·2	77	4·0	59·76	− 12·43	67*	..	..
Madras	1008·2	− 0·6	108	64	91·2	75·5	83·3	+ 0·3	75·1	75	5·2	52·42	+ 1·68	65*	..	..
Colombo, Ceylon	1010·2	+ 0·2	91	63	85·8	74·5	80·1	− 0·6	76·3	77	6·6	90·22	+ 4·97	198	7·0	58
Hongkong	1012·6	0·0	92	44	77·1	69·1	73·1	+ 0·8	68·1	76	6·8	69·82	− 14·00	122	5·9	49
Sandakan	..	..	92	72	87·5	74·7	81·1	− 0·2	77·2	83	..	120·53	+ 0·81	154	..	..
Sydney, N.S.W.	1014·8	− 1·1	106	37	70·5	56·0	63·3	+ 0·1	57·3	68	5·2	57·90	+ 10·00	129	6·9	57
Melbourne	1015·7	− 0·6	101	29	66·6	49·8	58·2	− 0·2	52·1	68	6·6	28·81	+ 3·26	172	5·3	44
Adelaide	1017·1	+ 0·1	104	35	71·8	53·0	62·4	− 0·6	53·1	52	6·1	17·51	− 3·69	119	7·0	57
Perth, W. Australia	1016·6	+ 0·2	104	38	72·6	54·7	63·7	− 0·5	56·0	60	4·9	36·77	+ 2·74	132	8·1	66
Coolgardie	1016·2	+ 0·2	109	30	76·7	50·5	63·6	− 0·9	52·7	51	3·3	10·27	+ 0·11	48	..	..
Brisbane	1015·0	− 0·8	102	40	78·3	59·4	68·9	0·0	61·8	64	4·6	39·77	− 4·89	111	8·1	67
Hobart, Tasmania	1012·0	− 0·6	93	29	61·2	46·5	53·9	− 0·4	48·1	68	7·0	26·55	+ 2·81	194	5·6	46
Wellington, N.Z.	1013·2	− 1·5	75	34	59·0	48·3	53·6	− 1·7	51·0	78	7·0	47·48	− 0·56	169	5·6	46
Suva, Fiji	1010·9	− 0·5	90	60	82·4	72·1	77·3	+ 0·3	73·3	79	6·8	148·77	+ 36·39	236	5·1	42
Apia, Samoa	1009·7	− 0·6	90	68	84·7	74·3	79·5	+ 1·0	76·6	77	4·9	108·33	+ 1·48	191	..	..
Kingston, Jamaica	1013·7	0·0	93	63	86·7	71·0	78·9	− 0·4	69·6	83	4·2	19·96	− 13·63	80	..	..
Grenada, W.I.	1009·8	− 2·4	90	69	86·1	73·3	79·7	+ 0·9	73·9	79	3·9	82·06	+ 5·98	223	..	..
Toronto	1015·9	− 0·5	92	− 3	54·0	38·0	46·0	+ 1·6	39·9	71	6·1	37·00	+ 3·53	158	5·3	43
Winnipeg	1016·5	+ 0·3	100	−30	44·8	25·3	35·0	+ 0·7	..	..	5·1	14·32	− 6·75	99	6·2	50
St. John, N.B.	1014·7	0·0	84	−12	48·9	34·1	41·5	+ 0·3	37·3	76	6·3	43·85	− 4·23	171	5·3	43
Victoria, B.C.	1018·5	+ 2·1	84	14	55·3	43·5	49·4	− 0·1	45·7	81	6·0	17·29	− 15·20	119	6·2	51

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

(*Continued from p. 123*)
Bucharest and several other parts of Roumania, and rains are reported from southern Russia. On the 8th abnormally heavy rains fell in Ceylon, accompanying a severe gale which did much damage; the Kelani River overflowed and burst a protective dam, flooding North Colombo. The water reached the level of the housetops, three feet higher than the previous record of 1913; 15,000 persons were homeless and eleven deaths were reported.

In America, on the 1st, a deep depression travelled south-eastwards north of the Great Lakes, and a series of tornadoes visited the United States. Damage and loss of life occurred in Nebraska, Wisconsin, Minnesota, Kansas and Missouri. At Westby, Wisconsin, nearly every building in Main Street was destroyed. On the same day there were violent thunderstorms around New York. Still more disastrous were the tornadoes which struck several places in Texas on the 6th, resulting in the loss of 66 lives and several million dollars damage to property. During the first half of May the eastern parts of the U.S.A. suffered from drought and high temperature, but in the third week there were widespread rains, which were beneficial throughout the Atlantic States but were too heavy in the Mississippi valley. On the 16th to 18th three days of continuous rain flooded more than 50 square miles in southern Arkansas, Texas, Oklahoma and Louisiana; the Washita River at Camden reached a flood level of 30 feet and the Red River in Arkansas and Texas washed away bridges and flooded roads and railways. At Waco, Texas, 13in. of rain fell in the three days. The last week of the month was cooler, and snow fell in several parts of western Canada.

In the Argentine the first half of the month was generally warm and rainy, the third week was cool and rainy, and the fourth week warm and dry. In Australia abundant rains were reported on the 8th to 12th over the wheat belts of the south and east, including the dry north-west Mallee, to the great benefit of the farmers.

The special message from Brazil states that the rainfall in the northern regions was 1·81 in. below normal, and in the central and southern regions irregular, the averages being 0·39 in. above normal and 0·04 in. below normal respectively. Four anti-cyclones passed across the country and the continental low-pressure area persisted. All the crops except cocoa were still suffering from the lack of rain. At Rio de Janeiro pressure was 1·5mb. above normal and temperature very slightly above normal.

Rainfall, May, 1930.—General Distribution

England and Wales	107	per cent of the average 1881-1915.
Scotland	79	
Ireland	76	
British Isles	94	