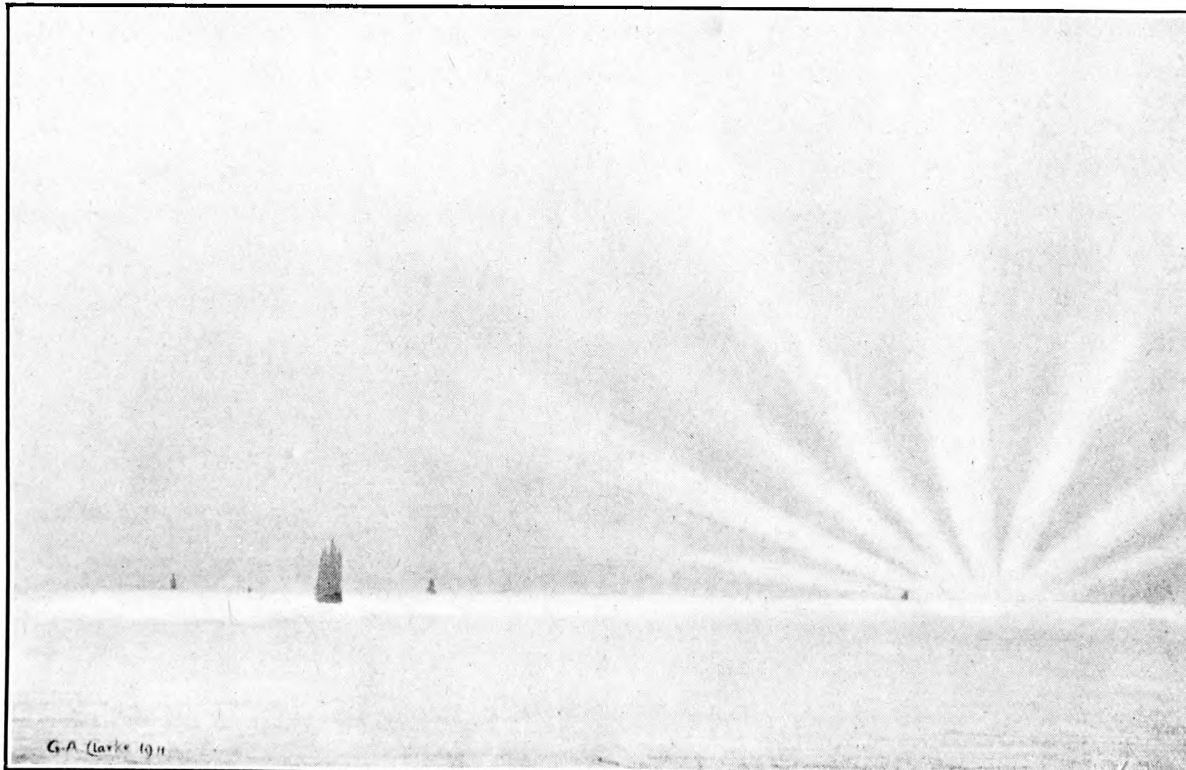

ANTI-SOLAR RAYS.

OBSERVED AT ABERDEEN, JULY 5TH, 1911.

The Meteorological Magazine

Vol. 58

(Fourth of the New Series)

1923

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ERRATA

Page 144, bottom line. *For* " 15°F." *read* " 43°F."
,, 204, footnote. *For* " July " *read* " Sept."
See also page 142.

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The Meteorological Magazine

Air Ministry :: Meteorological Office

Vol. 58

Feb. 1923

No. 685

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EDITORIAL

IN the introductory article to the first issue of *Symons's Monthly Meteorological Magazine*, for February, 1866, Symons wrote: "I hope to give in future numbers . . . above all, the latest rainfall intelligence. . . ." A short note in the same number explained the arrangement of the rainfall table for January, 1866, which included records for 50 stations in all parts of the country, giving the total fall, the difference from the average, the maximum daily fall and date, and the number of days with rain. On the opposite page were printed selections from the observer's notes on the weather during the month. In January, 1867, there were added to the table the maximum and minimum shade temperature, with dates and the number of days of frost.

The publication of tables and notes on these lines, as a matter of fact, preceded the magazine, for since 1863 Symons had printed *Rainfall Circulars* on similar lines, as supplements to *British Rainfall*, giving records and "remarks" for 20 stations. It is interesting that throughout the sixty years which have elapsed since its inception, this rainfall table has appeared each month in substantially the same form. It was commonly referred to by the Editor as the "regular" table.

In July, 1874, at the request of several readers, a short supplementary table, giving the total rainfall only, at 15 additional stations, was added. This was subsequently increased in size till it comprised about 100 records.

In 1907 the columns of temperature were dropped, it being

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felt that the publication of more comprehensive and more closely scrutinized records in the *Monthly Weather Report* of the Meteorological Office rendered their retention unnecessary.

The observers' notes on the weather remained a feature of the magazine until July, 1914, when they were incorporated in a single article on the weather of the month, compiled with the assistance of the *Daily Weather Report* of the Meteorological Office. This section has since January, 1920, been considerably enlarged and has been supplemented by notes on the weather in other parts of the world, more particularly in western Europe.

In February, 1908, appeared for the first time a map showing the distribution of rainfall in the previous month in the Thames Valley and surrounding districts. This map was printed in colour and showed the configuration of the land by means of tints, thus enabling the correlation between the rainfall and the land contour to be studied conveniently.

Since 1919, the amount of information as to the rainfall of the British Isles which has been published at the end of each month has been increased by the inclusion of a supplementary rainfall table in the *Monthly Weather Report* of the Meteorological Office. This table, compiled from the records sent to the British Rainfall Organization, contains about 200 records, the data being confined to the monthly totals. Most of the records in the table in question appear in this magazine also. The publication of the table is discontinued after December, 1922.

With the present issue the two rainfall tables are being incorporated, the number of records being increased to 228. Practically all the stations formerly in the supplementary table of the *Monthly Weather Report* are included. The number of stations for which average values are available is now much larger than formerly and the percentage of the average can be added in 170 cases. In order to make space for the new records the maximum daily fall and number of rain-days are omitted.

The article on the weather of the month has been reduced in length. For fuller detail, readers will be able to refer, however, to the *Monthly Weather Report*. The notes on the distribution of rainfall during the month no longer appear to be necessary, the extended table giving much fuller information. It is proposed, however, to publish notes on exceptional phenomena.

Lastly, the map showing the distribution of rainfall over the Thames Valley is dropped. The preparation of this map in time for publication has always presented considerable difficulty and in many cases records received too late for incorporation have shown it to have been in error. The publication of a rainfall map of the whole country in the *Monthly Weather Report* will, however, be continued.

Anti-Solar Rays

THE sketch reproduced as the frontispiece to this volume was made some years ago by Mr. G. A. Clarke. Enquiries concerning anti-solar rays and allied phenomena have lately been received at the Meteorological Office, and the publication of this sketch is therefore appropriate. Mr. Clarke has kindly contributed a note to accompany it.

Anti-Solar Rays and Cloud Shadows.

By G. A. Clarke.

On certain occasions, just about the time of sunset, a rather curious phenomenon may be observed in the eastern sky. If the observer looks toward the point on the eastern horizon diametrically opposite to that where the sun is setting, he may see a series of converging rays of light which convey the impression that a source of light is about to rise in the east. An example of such an observation is shown in the frontispiece, and is from a drawing made at Aberdeen on July 5th, 1911. The note made at the time of the observation was as follows :—

> " At about 20h. 55m. the sun was setting behind a very low belt of cumulus cloud along the north-west horizon ; and no optical effect was to be seen in the neighbourhood of the sun, except a bright silvery sheen. No rays whatever were visible where the sun had just disappeared behind the cloud, but on looking towards the south-east horizon, diametrically opposite the sun's position, several very distinct rays of light were quite plainly seen, all converging towards one point on the south-east horizon. They gave the impression that the sun was either setting or rising in the south-east. They were not visible for more than about 20° (estimated) above the horizon, and were brighter at the horizon, fading gradually upwards. There was no cloud whatever in the sky save the cumulus bank above referred to."

It is rather curious that during the course of the same day a very unusual green sky-colouring was seen and noted as follows :—

> " On Wednesday, July 5th, from 10h. to 16h., the sky along the whole western horizon appeared to be of a very light emerald green colour, from the horizon to an altitude of about 10 or 12 degrees (measured with theodolite). The green tint was most distinctly noticeable and was much lighter in tone than the tint of blue usually to be seen in that region. In fact there seemed almost to be a luminosity inherent in the colour. The green tint faded rather sharply into the blue of the sky, which otherwise was of the blue ordinarily seen there."

This phenomenon of the convergent rays of the sun has been seen on several occasions at Aberdeen, but is nevertheless very uncommon. On another occasion, March 3rd, 1912, there were seen at 18h. three of these rays stretching from a little to the west of the zenith down towards the eastern horizon (which was not reached by the rays) ; the vanishing point of the rays would have been about east-by-north. On this occasion the rays were pure rose pink in colour. In the first mentioned case their colour was white.

If we take into consideration the colours of the rays in both cases, and also the region of green sky-colouring in the first case, it appears likely that the phenomenon is produced by dust in the higher regions of the atmosphere. If the western horizon were perfectly level, and if there were no clouds present, this dust at very great altitudes would simply be the cause of a general brightening or tinting of the sky ; but, if the passage of the sun's last rays is interrupted by cloud or by irregularities on the western horizon, the effect produced will then be a series of bands as shown in the picture. The bands are of course parallel, the appearance of convergence is only the effect of perspective. A confirmation of the hypothesis that dust in the higher regions of the atmosphere is a favourable condition for the observation of converging rays is, perhaps, to be found in the fact that, in the case of the rays seen in March, 1912, the rose colour was identical with that of the " purple light " when the latter is best displayed.

One rather curious variation of this phenomenon was once seen at Aberdeen, but the actual date of its occurrence is uncertain. The sun was just setting, and had just appeared below the western edge of a widespread sheet of high alto-stratus. The whole atmosphere below the cloud sheet was suffused with pale orange light, and overhead, near the zenith, a long line of small detached cumulus clouds stretched from south to north. Each of these clouds cast a long dark band of shadow towards the eastern horizon, so that there appeared to be a series of converging dark bands across the eastern part of the sky, each band proceeding from a small cumulus cloud.

A letter from Mr. Karl Durston, of Bude, Cornwall, records the observation of a single broad anti-solar beam.

Mr. Durston writes :—

> " At 18h. 25m. G.M.T. to-day (August 31st, 1922), the sky was about three-quarters covered with ragged cumulo-nimbus clouds but was fairly clear in the zenith. The sun was hidden behind some clouds but was throwing out five beams on the water. Exactly opposite the sun were

similar ragged cumulo-nimbus clouds through which showed a dark, almost black, purple sky, and from the horizon a beam of light, the width of any two of the beams from the sun shot up to the same level as the sun on the other side. It remained for about ten minutes."

An example of the shadow of a cirrus plume, observed by Mr. Frank Edwards, of Manchester, is described as follows :—

"At 18h. 45m. G.M.T. on August 20th, 1922, the greater part of the sky was covered with cirrus or cirro-stratus. In the west was a long streak of cirrus-uncinus rising out of a complex of interlaced cirrus to about 60° above the horizon. The sun was behind this complex and from the plume end of the streak a dark shadow bar extended to the east-south-east. It was noticeable down to the horizon and persisted for about 10 minutes, when it faded out. The sky in which the shadow was projected was cloud free. In appearance it much resembled the shadow occasionally seen above a large cumulus crossing the sun when the luminary is low in the sky."

OFFICIAL NOTICES

A Course of Training for Observers

IT is proposed to inaugurate a course of training for meteorological observers and deputy-observers, more especially for those at Health Resorts. The course will be held at Kew Observatory in April, 1923, beginning on a Monday afternoon and finishing on the following Saturday morning. Particulars may be had on application to *The Director, Meteorological Office, Air Ministry, Kingsway, W.C. 2.*

Staff News

The degree of D.Sc. has been conferred on W. A. Harwood by the University of Manchester for a thesis on *Upper Air Work in India* which will shortly be published by the Indian Meteorological Department.

The University of London has conferred the degree of M.Sc. on Messrs. S. N. Sen and J. Glasspoole, the former for a thesis entitled *On the Distribution of Air Density over the Globe* and the latter for work on the rainfall of the British Isles, including two papers, namely, *The Drought of 1921, Section A* (Q.J.R.Met. Soc. Vol. XLVIII., pp. 139-157), and *The Fluctuations of Annual Rainfall* (since published in British Rainfall, 1921).

Messrs. R. G. Veryard and B. A. Copping have graduated as B.Sc. of the University of London.

G. ff. H. Lloyd, R.D., in charge of the Port Meteorological Office, Liverpool, is promoted from Lieutenant-Commander to Commander of the Royal Naval Reserve.

Shoeburyness. On Thursday evening, January 25th, a Meteorological Office Staff Dinner was held at the Queen's Hotel, Westcliff. The chair was occupied by Mr. C. E. Britton and there were 11 present, the guest of the evening being Captain D. Brunt, the Superintendent of Army Services.

Meteorological Office Soirée. The staff of the Meteorological Office held their Fourth Annual Soirée on February 9th, 1923, at the Holborn Hall, W.C. The soirée took the form of a dance, with musical items interspersed. About 250, members of the staff and their friends, were present, Dr. G. C. Simpson and Mrs. Simpson being among the number.

Official Publications

The Fernley Observatory, Southport. Report and Results of Observations for the year 1921. By Joseph Baxendell.

The year 1921 marks the jubilee of the Fernley Observatory so that this volume of the report appropriately contains a brief history of the Observatory and its founders.

The usual detailed account of the year's weather is supplemented by an appendix and by further details of the investigation of meteorological periodicities, carried out in this year by Mr. Charles Baxendell. Among other periodicities discussed may be mentioned that of 2·2 years. Strong evidence for this period, first discussed by Mr. C. E. P. Brooks, has been found by examination of the Southport records of rainfall and barometric pressure. There is a suggestion that this period coincides with an infantile mortality period, caused largely by measles.

The appendix consists of an analysis of the amount and duration of rainfall at Southport under different wind directions for the 10 years 1912-1921 and a comparison of the wind and rainfall of the west and east coasts of northern England, as exemplified by Southport and Sunderland.

The differences between the two stations are striking. At Southport, the wettest winds are south, south-west and then south-east, the driest being north-west and north, while at Sunderland north, east and north-east are the wet winds and west and south-west the dry.

Discussions at the Meteorological Office

January 22nd, 1923. *Meteorological Conditions for the Formation of Rain* and *Life Cycle of Cyclones and the Polar Front Theory of Atmospheric Circulation.* By J. Bjerknes and H. Solberg (Geofysiske Publikationer, Vol. II., 1922, No. 3 and Vol. III., 1922, No. 1).

Opener—Lieutenant-Colonel E. Gold, D.S.O., F.R.S.

In summing up his account of these two papers Colonel Gold declared that they were remarkable not only for the youth of their authors and for the freshness of the ideas which were set out but for the clearness with which the ideas were expressed, a triumph for men writing in a foreign language.

The first paper, which has been summarized already in *The Meteorological Magazine**, shows the progress that has been made in Norway in recognizing the different circumstances in which rainfall occurs. How far the generalizations are applicable to other parts of the globe and especially to our own section of the western seaboard of Europe is a question to which an answer cannot yet be given. The configuration of the land is of paramount importance in Norway. Even with the modest height of our own hill country the control of the weather by configuration is manifest.

In introducing the second paper Colonel Gold asked his audience to think of the air of the northern regions as contained in a great flat bag. The air inside the bag is cold, and warm air approaching it from the south rises over the bag without breaking it. Cyclones are represented by crinkles which develop in the sides of the bag. The special feature of the paper under review is the propounding of the rule that cyclones occur in families, the founder of the family passing through the stages of its life in high latitudes, the children of the first and following generations coming further south. After the passage of the last of the family the northerly air has a through channel to the trade wind zone or, to revert to Colonel Gold's analogy, the bag bursts and cold air escapes. Colonel Gold suggested that the "bag" would have to be replenished by the warm air on top of it cooling and finding its way in. The authors picture the northern hemisphere with four or five families of cyclones and the intervening anti-cyclones all circulating round the pole. This picture does not seem consistent with the idea that the families are continually dying out, in any case it does not make sufficient allowance for the circumstances of a hemisphere with large land masses. As Sir Napier Shaw remarked in the discussion, it recalls Lockyer's theory of the circulation in the

* August, 1922, p. 192.

southern hemisphere where there is a closer approach to uniformity. Whatever view may be taken of this outgrowth of the theory, there can be no doubt but that the " polar front " is proving a great stimulus to research in meteorology. Of that the vigorous debate on this occasion was sufficient evidence.

February 5th, 1923. *On Cloud Formation.* (*Nuclei of condensation, haziness, dimensions of cloud-particles*). By Dr. C. Braak. (K.Magn. en Met. Obs. Verh., No. 10, Batavia, 1922).

Opener—Dr. J. S. Owens.

The Aitken " dust-counter " serves, it will be remembered, for counting the number of nuclei of condensation in the atmosphere. The apparatus was invented some thirty years ago, but there are few accounts of systematic observations made with it. In Dr. Braak's tables are found details of observations on the East Indian Seas and at various stations on land, mostly in Java. As the author points out, the large number of condensation-nuclei found at most of the land stations is to be attributed to pollution of the air by smoke. The lowest readings were found for the open sea and for the mountain stations. In the open sea under humid conditions the number of nuclei was found to be as low as 120 per cubic centimetre.

In another series of observations the diameters of the drops of mountain clouds are placed on record ; the determinations were made, some directly by the microscope, others by the measurement of the diameters of " glories," etc. The remarkable generalization is reached that the predominating size of droplets has a tendency to retain its value for 24 hours or more.

On the more theoretical side there is discussion of the part played by hygroscopic nuclei in producing atmospheric obscurity on the one hand and cloud and rain on the other. A brief summary is not practicable. Dr. Owens took the opportunity to exhibit lantern slides shewing the various forms of matter collected from the air ; crystals of common salt predominate on many of the slides. The relation between the crystals and the Aitken nuclei remains to be worked out.

The subject for discussion on Monday, February 19th, 1923, will be a paper by F. A. Lindemann and G. M. B. Dobson on *A theory of meteors and the density and temperature of the outer air to which it leads.* (Proc. Roy. Soc. A. Vol. 102, 1922, pp. 411-437). *Opener*—Captain N. K. Johnson.

On March 5th, Sir David Wilson Barker will open a discussion on *The pilot charts of the South Atlantic and South Pacific* (U.S. Hydrographic Office).

Royal Meteorological Society

THE Annual General Meeting of this Society was held on Wednesday, the 17th ult., at 49, Cromwell Road, S. Kensington, Dr. C. Chree, F.R.S., President, in the Chair. The Report of the Council for 1922 was read and adopted, and the Council for 1923 was duly elected.

The Presidential Address. Aurora and Allied Phenomena.

Dr. Chree's presidential address was characteristic. His audience enjoyed his dry humour and admired his grasp of the complicated phenomena with which he had to deal. In his opening remarks Dr. Chree spoke with toleration of those scientists who could not carry out researches vigorously without the stimulus of a theory, but he warned them against the temptation to over-emphasize the facts that suited their theories and to suppress others. In particular the need for caution in the advocacy of the rival theories that aurora is the product of the bombardment of the atmosphere by Alpha rays (helium atoms carrying positive charges of electricity) or Beta rays (electrons carrying negative electricity) was emphasized.

Amongst the minor questions which were raised was that of the audibility of aurora. Dr. Chree referred to Mr. Delday's comparison* of the sound sometimes heard on the nights when aurora is present to " the sound made when sifting meal in skin sieves " and quoted Sir Edgeworth David's account† of Amundsen's experience at Framheim : " Amundsen distinctly heard a very faint rhythmically repeated rustling noise in the air. After a time he discovered that this was due to the rapid freezing of the moisture from his breath, and the tiny tinkle made by the minute crystals as they slowly descended under gravity close to his face, sufficiently close for the ear just to catch the faint sound. He said there was no doubt about it that the rustling noises exactly coincided with the periods when he exhaled air from his lungs. He said that he was now confident that this was the true explanation of what the poets call the ' Crackling of the Northern Lights.' "

That Amundsen's explanation will not account for all the reports of audible aurora is evident since many refer to occasions when the breath could not possibly freeze. In fact, in our present state of ignorance, each individual record of sounds accompanying aurora should be discussed on its merits.

The publication of Dr. Chree's address will be awaited with interest.

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* *The Met. Mag.* Oct. 1922, p. 255.

† See *Audibility of the Aurora.* By J. G. Griffin. *J. R. Astro. Soc. Canada.* Vol. XVI. No. 7, 1922, p. 255.

Correspondence

To the Editors, *The Meteorological Magazine*

Simple Weather Forecasting

As I have been held up to ridicule by your correspondent "H.," the following forecast, sent away on December 12th last and published in several papers, may not only interest your readers, but prove that what was dubbed mere "guess-work" is based on some sound principles :—

"December 12th, 1922. For the next 7 to 8 days mainly very unsettled weather, with strong winds and gales, rain or snow in north being general. Then about 24th to 28th, a spell of finer, brighter, and colder weather is probable just previous to next change (December 28th to 30th). From 18th to 25th if wind works north when heavy winds are blowing, snow may be very much in evidence in the north of England.

When earthquakes occur weather is always very uncertain, and sudden barometric and temperature changes, as recently, may be expected from time to time."

Over six weeks before this I stated in letters to correspondents that December 15th to 23rd would probably have very bad weather with heavy winds, and that gales would be remarkable for thunderstorm disturbances, and sudden changes of temperature.

A long forecast issued on August 31st gave the gales to start about October 18th to 21st, and easterly gales started in the English Channel on the evening of the 17th, reaching forces 7 to 8 between that date and the 20th. The same forecast gave the fogs which, starting on November 13th, prevailed as expected until the middle of December, and yet your correspondent called my system guess-work.

W. M. Robertson.

15, *Edgar Road, Winchester, January*, 1923.

A Kaleidoscopic Sun

A very remarkable coronal (?) display was seen here on January the 9th, about 1.30 p.m. local mean time. During the entire forenoon an almost clear sky and sunshine prevailed and up to 1 p.m., when a slight snow-shower fell, clearing again a little later. A friend shouting to me to hurry out, I saw the sun behaving in a most unusual fashion; now surrounded by bright red, flashing rays in all directions, then changing to yellow in which the body of the sun, though more clearly visible, appeared to dance and shift about here and there in a radius of about 5° ; again, changing to green, the rays flashing as in the red—all these changes taking place in less time that it takes to write.

Could this have been caused by a cloud of snow particles crossing the sun in otherwise clear air ?

Of all the beauties seen I should think the quickly changing mock suns the most beautiful as they flashed here and there faster than it was possible to count them. The colours were so brilliant and dazzling, that even after I had come indoors anything I looked at appeared a mixture of all the colours seen.

The only thing which I can compare it is Venus " boiling " in the telescope on a hazy windy evening, on a very large scale ; but no description is able to convey what was seen in these ten or twelve minutes.

JOSEPH MINTERN.

Kilmurry, Passage West, Co. Cork, January 13th, 1923.

Meteorology and Folklore: Thunder and Lightning

THE manifestations of electrical energy, commonly described as thunder and lightning are so awe-inspiring and frequent that it is no wonder that they should have given rise to an abundant crop of fancies, both sublime and grotesque.

Primitive man, watching the on-coming storm, compared the masses of black menacing clouds to a mighty bird, and in the thunder heard the beating of its pinions. Indeed Lewis Spence suggests that all thunder deities were originally bird-like in form ; *e.g.*, the great Aztec lightning and war god Uitzilopochtli bears a name which shows he was once a " humming-bird " pure and simple. The tribes of the Andes place the abode of the thunder on the cloud-enshrouded mountains, and say that through the rifts in the cloud-veil may be seen the red limbs of the storm-spirits.

Carlyle in the *Hero as Divinity* has summarized for us the thunder myth of Norse folklore

> " Thunder was not then mere Electricity, vitreous or resinous ; it was the God Donner (Thunder) or Thor,—God also of beneficent Summer heat. The thunder was his wrath, the gathering of the black clouds is the drawing down of Thor's angry brows ; the fire-bolt bursting out of Heaven is the all-rending Hammer flung from the hand of Thor ; he urges his loud chariot over the mountain-tops ;—that is the peal ; wrathful he ' blows in his red beard,'—that is the rustling storm-blast before the thunder begins."

Thor was also the patron of agriculture. Thunder gods seem to preside over both war and husbandry, probably the first function is suggested by the clamour of the storm, and the second by the rains which accompany thunder.

It is rather curious to find an American thunder god who causes the noise by beating a sheet of metal in a manner reminiscent of civilised "stage-thunder." Thunder gods frequently have a spear or an arrow, the connection of which with the lightning is very obvious. The bolts of Zeus, forged by the Cyclops beneath Mount Etna, are the type, but there are as well the Mexican deity Mixcoatl, the Egyptian Neith, and half a dozen other American gods who have the same attributes. Often the lightning flash is symbolised by the serpent as in the case of "Mixcoatl" which means "Cloudserpent."

The Romans walled round and kept sacred all spots struck by lightning. The augurs, too, paid great attention to lightning, and often when it was considered desirable to postpone any awkward political assembly all the augurs had to do was to announce that lightning had been seen on that day.

CICELY M. BOTLEY.

16, *Wellington Road, Hastings, January 3rd,* 1923.

NOTES AND QUERIES

Surging Mirage

The *John O'Groat Journal*, January 26th, 1923, contains an interesting article by a lighthouseman, Mr. Kenneth Sinclair, dealing with his experience of mirage and abnormal refraction. We learn that in the Pentland Firth the superior mirage is sometimes referred to by the name of "Margaret, the Orkney Witch," a name which is faintly reminiscent of the Fata Morgana. (Is there good authority for the statement of the text-books that the Fata Morgana refers to Morgan, sister of King Arthur ?).

The most striking mirage in Mr. Sinclair's experience was observed from Fair Isle during April, 1919. He writes :—

> "Coming from the east toward the station about 8 a.m. I observed peculiar shades flittering at about an altitude of 22 to 30 degrees in the western sky. The sun was very bright and the sea carried a deep roll, so to speak, with a glassy surface, both of which, I consider, played an important part in this phenomenon. By the eye alone I could form no conception, so resorted to the telescope. By its aid, to my great surprise, I could see spread out a panorama wonderful to behold. The islands of North Ronaldshay, Sanday and Westray were stretched out, mapped and clothed in their natural beauty, against the curve of the western sky. But this most astonishing phenomenon increased in interest when I observed a reversed view, equally as clear, of North Ronaldshay and part of Sanday only, immediately under, as if growing from one base ; and, as sure as the timely rise and fall of the fountain ball, so did this strange sight rise

and fall as if governed by the movement of some sighing bosom. Each movement downwards seemed to separate each object at its base, and growing more distorted on the upward movement things gradually assumed their natural aspect, when I could make out many of the houses on North Ronaldshay, Star Point Lighthouse and farms on Sanday, also Noup Head, Westray. Noup Head Lighthouse is difficult to pick up with a good telescope in the clearest of weather from an altitude of 400 feet, but on this occasion it was clearly seen. This phenomenon kept clear for about an hour and, as it disappeared slowly, it seemed to sink down behind the horizon, leaving the high objects a little longer time to do their farewell bow.

" In September of the same year I saw a similar mirage, with the exception of no reverse view, and no part of Westray; and yet another difference—no rise and fall. On this occasion the sea was smooth, the sun bright and farther south, the hour being 9.30 a.m.

" One thing I noted about these phenomena struck me as strange. The April mirage could be seen from different parts near the station, and the one of September was limited to a few yards. . . . . .

" Mirages are rarely seen because their observation is limited from small areas."

According to theory a double superior mirage is occasioned by an inversion of temperature, the rise of temperature above the " deck " extending through a considerable height. The surging of the mirage implies that the " deck " was heaving. Such direct evidence for Helmholtz waves in the transition layer between a warm current and the cold air beneath it is valuable.

It is not obvious why the sight of a superior mirage should be confined to a small area; is the experience general?

An Unusual Sky Effect

On the evening of December 5th, 1922, Mr. T. H. Applegate observed a curious phenomenon from the meteorological station at Biggin Hill Aerodrome. At 20h. 30m. a squally west wind was blowing at a speed varying between 20 and 30 miles per hour. Light cloud of the strato-cumulus type, with frequent rifts, was moving from the west so that the sky was mainly covered with detached cloud but varied from clear to overcast. The cloud height was estimated to range from 2,500 ft. to 5,000 ft.

Near the west, at a point about 15° above the horizon, a white elliptical ring of light was clearly visible. The ring was complete except at its lowest extremity and appeared to move in the same direction as the cloud but with a somewhat less speed. The interior of the ring seemed to be clear in spite of the passage of clouds which were seen to enter and leave it. Only a few stars, however, were actually visible within the ring and these only at occasional intervals.

As the ring approached it increased in size and became a true circle with a diameter of about 60° just before it was centered overhead. The lowest segment remained broken throughout. After passing the zenith the ring broke up and disappeared. For the whole period of its visibility the plane of the ring seemed to be inclined at an angle of 25° to the vertical, the upper segment being the nearer.

The moon was at an altitude of 27° and situated nearly due east. It was covered with thin cloud throughout the duration of the ring.

The phenomenon resembled a great smoke-ring. It has been suggested that it was the result of "sky-writing," but the time and other circumstances do not seem to render this probable. Information would be welcome from anyone who saw anything unusual on December 5th in the region of south-east England, or from those who have seen similar phenomena, unconnected with sky-writing, on previous occasions.

A Solitary Gust

A CHART from the anemograph maintained at Balmakewan, Kincardineshire, by Mr. W. Low is reproduced on page 15.

It shows a remarkable isolated gust of 60 miles per hour which occurred at 13h. 10m. on November 29th, 1922, the mean speed of the wind being under 20 miles per hour. The direction trace shows a veer from west to north at the time.

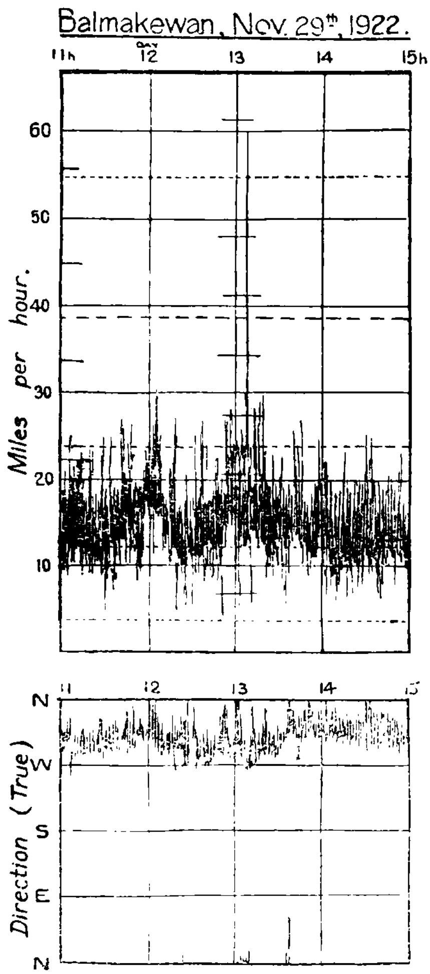
The gust seems to have been purely local, as no noteworthy gusts were reported from other stations.

Mr. Low writes :—

> ". . . the damage done here was not great, quite a number of suppressed and damaged branches from hard wood trees in the avenue were blown down and an isolated specimen Douglas fir lost a number of large lower branches. This tree often suffers as the branches are heavy and seem to be fairly brittle. It may be that the bad gale two years ago* [Dec. 3rd, 1920] carried away all the trees which are exposed to north. I find it is a prolonged gale that makes big gaps, as one tree falls on another and the wind is helped by the weight of the reclining tree ; then a gust brings it further down and the roots of the second tree thus begin to go. The damage grows on the compound interest principle."

The occurrence of an isolated gust with a wind-speed more than three times that of the general air-flow provides valuable confirmation for the highest gust on record in the British Isles. It will be remembered that this gust occurred at Quilty on the coast of Clare on January 27th, 1920. The pen passed beyond the edge of the chart of the Dines anemograph, so that the gust

* *See* this Magazine, Vol. 55, 1920, p. 286.



appears to have exceeded 108 miles per hour though the prevailing wind averaged only 50 miles per hour.

In a recent issue* of the *Meteorologische Zeitschrift* there is an article by Dr. H. Ficker on a remarkable barogram which illustrates the changes of pressure accompanying a hailstorm at Vienna on July 23rd, 1905, and shows an upward excursion of 4 millibars about the beginning of the storm ; the rise and fall of the trace are indistinguishable.

It is well known that irregularities of pressure are shown by a barogram in windy weather owing to the differences in pressure between the upwind and downwind sides of the building in which the instrument is placed. With a very sudden squall an isolated rise of pressure is to be expected. The static pressure due to a wind of 60 miles an hour would be nearly 4 millibars, so that the Balmakewan and Vienna records seem to imply gusts of about the same strength.

A New Observatory for the Canary Islands

THE establishment of a meteorological observatory at Santa Cruz de Tenerife was sanctioned by Royal Decree in July, 1921. It is now announced in the local press that the building has been started and will, it is hoped, be completed shortly. The Island of Teneriffe already has a first-class observatory at Izana, situated 2,307 metres above sea level, which was founded in 1916. Teneriffe is on the direct route from Lisbon to Rio de Janeiro, so that these two observatories will be of great service to Trans-Atlantic aerial navigation. A hydroplane station is also to be established on the island.

* November, 1922, p. 353.

Paradoxical Philosophy

A RECENT paper* by Professor V. Bjerknes, in which he gives the history of the developments in forecasting which have followed the recognition of the importance of surfaces of discontinuity in the atmosphere, demands attention by the way in which the author " grouses " at the inadequacy of the international telegrams. It appears that, in the absence of the details they require, the Norwegian meteorologists deduce from their own weather of to-day in Norway what weather must have prevailed in Scotland yesterday and use such deductions in constructing their own forecasts for to-morrow. In replying to the discussion on his paper, Bjerknes propounded the paradox that the forecaster should not aim to get 100 per cent. of his forecasts successful but rather 50 per cent. The interpretation of this dark saying is that much more detail should be attempted than has been customary in the past. 'Tis better to have plunged and lost than ever to have hedged at all!

The Key to Weather Forecasting

FROM the same paper we learn of the latest development in the Norwegian system of forecasting. The surfaces of discontinuity are discovered and from their rate of displacement the probable changes of position of the moving masses of air are estimated. Due allowance is made for the possibility that some of the masses will only progress by gliding over others. It is found that these estimates can be made with sufficient accuracy for the general course of the air currents to be predicted some days in advance.

The Supply of Forecasts to the Public

THE Meteorological Office has, since February 1st, 1923, issued three forecasts daily for London, that is, for the area within 10 miles of Charing Cross. Hitherto, London has been included in the forecast for southeast England, but the advances in forecasting have now made it possible to differentiate between the anticipated weather of London and that of the south-eastern coasts and counties. The forecasts are issued at 10h., 15h. 30m. and 20h. 30m. G.M.T., and are thus available for the early and late editions of evening papers and for morning papers respectively.

Another advance in the supply of information to the public was made by the introduction of radio-telephonic broadcasting of the official forecasts, which began in this country on November 14th, 1922. The provisional programme started then is now established, and two messages issued by the Meteorological Office are sent out by the British Broadcasting Company from London, Birmingham, Manchester and Newcastle, at about 6h. 30m. and 21h. 30m. each day.

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* *Wettevorhersage.* A paper read at the Hundertjahrfeier Deutscher Naturforscher und Ärzte; see *Phys. Zs.* XXIII., 1922, p. 481.

The Study of Meteors

It is announced that on March 21st, 1923, Major G. M. B. Dobson will deliver a lecture before the Royal Meteorological Society on meteors, with special reference to the investigation of the condition of the upper atmosphere.

Tickets for the lecture may be obtained on application to the Assistant Secretary of the Royal Meteorological Society.

According to recent work* of Professor Lindemann and Major Dobson the temperature of the atmosphere 50 miles up is about the same as that near the earth's surface. In a letter published in *Nature*, February 9th, 1923, Mr. F. J. W. Whipple points out that the hypothesis that the upper atmosphere has a comparatively high temperature provides a possible explanation of the occurrence of zones of audibility at considerable distances from explosions.

The Temperature of Meteors

The temperature of a meteor before entry into the earth's atmosphere is the subject of a recent article† by Prof. Arthur Taber Jones, of Smith College, Northampton, Mass. Professor Jones finds that, on the assumption that the meteorite may be regarded as a black body absorbing all the heat it receives from the sun and then radiating this heat into space, its temperature will be 9° C. or 282 *a*. It is of interest to compare this result with Hann's value‡ for the mean temperature of the atmosphere near the ground, viz., 14.3° C. or 287.3 *a*. The circumstances of a meteorite for which temperature is kept more or less uniform by conduction are different from those of the earth's surface where the horizontal transfer of heat is mostly by air currents, but it would appear that the greenhouse or blanketing effect of the atmosphere only raises the average surface temperature of the earth by about 5.3° C., say 10° F.

The Study of "Atmospherics"

Experiments which are in progress at the Radio Research Board Station at Aldershot are yielding definite information as to the character of the electric waves known as atmospherics. It has been found possible to determine the wave-form and the duration of the disturbance.

* *A theory of meteors and the density and temperature of the outer atmosphere to which it leads.* By F. A. Lindemann, F.R.S., and G. M. B. Dobson, M.A. *Proc.Roy.Soc.* A. Vol. 102, 1922, pp. 411-437.

† *Science.* August, 1922.

‡ *Lehrbuch der Meteorologie.* 2nd Edition, 1913, p. 143.

A New "Weather and Wireless" Magazine

THE first number of *Quarterly Notes and General Forecasts of the British Weather Bureau Association* has been issued, bearing the date January, 1923. The primary object of this little paper, which is edited by Mr. D. W. Horner, appears to be the circulation of the forecasts made by Mr. W. M. Robertson, but it is intended to include general matter of interest to meteorologists. The annual subscription to the British Weather Bureau Association is 1s. 6d. Subscribers are entitled to the four quarterly issues of the Notes. The Association appears to have no officers at present beyond the editor of the Notes.

Upper Air Results in South Africa

The magazine of the *South African Irrigation Department* for January, 1923, contains an interesting article by Mr. G. W. Cox on upper air research.

The note, after giving a brief resumé of the history of the investigation of the upper air in other countries, continues with a description of the initiation of upper air research in South Africa. The first pilot balloon ascent in that country took place on June 18th, 1918, since when no less than 400 ascents have been made. The observations are taken with two "de Quervain" theodolites fitted with J. S. Dines's self-recording attachment.* The average results for ascents at Pretoria in December and January are given in diagrammatic form and show a rapid variation of wind-direction with height near the surface, a northerly wind at the surface backing to a southerly wind within 8,000 feet (2.4 km.). The average velocity at all heights up to 30,000 feet (9.1 km.) is less than 10 miles per hour but above that level the wind increases rapidly with height up to 40,000 feet, the greatest height shown.

Observations with sounding balloons have only recently been initiated and average values are not yet available. A graph of an ascent on May 18th, 1922, is, however, reproduced and shows that the stratosphere was reached on that occasion at 35,000 feet (10.7 km.) with a temperature of $-55°$ F. (225*a*). The latitude of Pretoria is 25° 45′ S. and the height of the tropopause is therefore considerably lower than observations in the Northern Hemisphere in similar latitudes would lead us to expect. It will be of interest to see if this result is borne out by subsequent observations. The values which, with the exception of some ascents by Dr. Griffith-Taylor in Australia, are the first for the middle latitudes of the Southern Hemisphere, form a valuable addition to our knowledge of the upper air.

* See *Technical Report of the Advisory Committee for Aeronautics for the Year 1910-11*, page 81.

Thomas Barker—The Diarist

THE latest number of *The Selborne Magazine* (Vol. XXIX., No. 350) contains a note to the effect that Thomas Barker, the author of the eighteenth century meteorological diary described by Mr. Britton in the November number of this Magazine, was the brother-in-law of Gilbert White, of Selborne. The note continues :—

"It is interesting to recall the following quotation made by Mr. Rashleigh Holte White (*Life and Letters of Gilbert White*) from one of Barker's diaries :

"'1736, March 31st—A flock of wild geese flew N.—G.W.'

"'1736, April 6th—The Cuckoo heard.—G.W.'

"There is little doubt but that the initials are those of Gilbert White, then fifteen years old, who was probably staying with his uncle and aunt at Whitwell Rectory, near Lyndon, where Mr. Barker lived."

The "Big Bang" of 1711.

THE same number of *The Selborne Magazine* gives an account of a note by Gilbert White which, as it is labelled page 285, was, no doubt, intended as an addendum to the *Natural History of Selborne*. The note is especially interesting just now as it deals with the audibility of the explosion of the gunboat *Edgar* at Spithead on October 15th, 1711. The crash was heard and the concussion felt more than thirty miles away, so that "a team at plow" ran away "with fury and amazement so as to tear the share out of the ground and drive it through the body of one of the horses."

Early Records of Notable Weather

MR. RICHARD COOKE, of Detling, near Maidstone, sends some weather notes which he has extracted from Parish Registers. The following are from *An Inventory of Parish Records and Registers of the Diocese of Canterbury*. By Rev. E. Eveleigh Woodruff (Canterbury : Gibbs and Co., 1922).

Ashford. (p. 6). Record of great rain in 1703 and later in the year a storm that raged by land and sea ; in consequence of the storm a fast was proclaimed by the Queen throughout the whole kingdom January 19th following.

Dymchurch. (p. 72). Memorandum that upon the 20th day of January, 1683, the sea at Dymchurch Wall was frozen about three miles from high water mark.—Basil Kenneth, Rector.

Goodnestone next Faversham. (p. 84). 1690, high tide with north west wind Oct. 12th, about 2 of the clock in the morning.

On Tuesday December 9th following, about 3 in the morning, a much more serious hightide doing worse and much more extended damage.

Seasalter. (p. 169). The summer of the year 1725 was the most dreadful for continued rains, cold and tempests that ever any history mentions. Not a day from May to October without rain. The fruits of the earth spoiled, and according to their different Religions some grumbled, some swore, and some few prayed.

Whitstable. (p. 203). Sept. 8th day, 1692. An Earth Quake pretty much witness the inhabitants of the whole parish.—Thos. Willard, Parish Clerk.

Great Chart. (p. 52). 1612, Dec. 28th. Christopher Reynolds of Wy, (Slaine in a fearful tempest happening in our church in the forenoon of the 27th day of this month, all the congregation being gathered together, and the Minister in his Sermon) buried.

Croydon. (p. 62). 1607, Dec. The greatest frost began the IX day of this month ended on Candlemass Eve's Eve.

John Keble's Parishes, by Charlotte Yonge. (Macmillan, 1898) (p. 37) contains the following extracts from the Hursley Parish Registers. The great divine spent the greater part of his life at Hursley, but these are the only entries relating to the weather :

1582. A great hail storm happened at Hursley, Baddesley, and in the neighbourhood this year. The hail stones measured nine inches in circumference.

1629. A great fall of snow in October. It was nearly half a foot deep, and remained on the ground three or four days.

Obituary

Mr. W. W. Bryant.—It is with extreme regret that we record the death of Mr. W. W. Bryant which occurred on January 31st after a brief illness. Mr. Bryant, who had graduated from Pembroke College, Cambridge, joined the staff of the Royal Observatory, Greenwich, in 1892, and from 1904 was in charge of the Meteorological and Magnetic Department. From that date the supervision of the meteorological observations made at the Observatory and their preparation for publication was his care. Though primarily an astronomer, Bryant entered on his meteorological work with great keenness and frequently astonished his meteorological friends by his intimate acquaintance with the Greenwich records. He seemed to carry the whole mass of figures in his head and could quote from memory the remarkable temperatures, heavy rainfall or other particulars appropriate to almost any meteorological discussion. He was a regular attendant at the meetings of the Royal Meteorological Society and at the Monday afternoon discussions held at the Meteorological Office. Almost always he took part in the debates, and his presence will be greatly missed. From 1916 to 1920 he was one of the Honorary Secretaries of the Royal Meteorological Society. In his younger days he was a keen hockey player and though compelled latterly to take a less active part in the game he continued to show his interest by refereeing in games in which the Observatory team took part. He acted in that capacity only a fortnight before his death.

The Weather of January, 1923

JANUARY was characterised by mild sunny weather in the south of the British Isles and by frequent gales in the north. The first few days, when depressions from the Atlantic were passing across the Islands, were unsettled with somewhat heavy rain at times but considerable bright intervals; but from the 11th onwards conditions in the south were anti-cyclonic. Gales occurred on the coasts on the 2nd and again on the 9th and 10th when a deep depression passed across northern Scotland to Scandinavia. In its rear came northerly winds associated in Scotland with showers of hail, sleet and snow. Although temperature on the whole was above normal, some cold days were experienced, for instance on the 17th, when a small centre of high pressure was over London, frost and fog prevailed in many parts, the maximum temperature at Kew Observatory being only 29° F. Sunshine was also well above normal in the south and south-east. The third week in particular was notable for sunny days, records of six or seven hours of bright sunshine occurring at many places, and on the 23rd, as much as eight hours was registered at Pendennis Castle, Falmouth. The total amount of sunshine recorded at Great Yarmouth (Gorleston) was double that recorded in January, 1922.

The general rainfall in the British Isles, expressed as a percentage of the average, was :—England and Wales, 82; Scotland, 123; Ireland, 90; British Isles, 98.

The month was remarkable for floods and heavy rain or snow falls in various countries. On the 1st, floods were reported in the Seine and in the lower valley of the Loire and Sèvre, Nantes being flooded. On the 3rd the Rhine reached an unusually high level, and on the 12th the Seine was again high. Snow fell very heavily in Central France from the 22nd to the 24th. In Switzerland the snowfall during the month was heavy, causing avalanches in which lives were lost.

Unusually heavy rainfall was experienced in Ceylon, and on the 14th the district round the ruined city of Anuradhapura was badly flooded. The floods were increased by the bursting of an old reservoir and led to serious railway accidents.

As the result of a "cloudburst" at Devil's Kantur a railway bridge has been washed away. At Pietersburg four and a half inches (about 114 mm.) of rain fell in two hours.

In Brazil the rainfall was below normal in the north and centre, the general deficit being 13 mm. and 50 mm. respectively. The scarcity was more felt in Ceara. In the south, rain was plentiful, averaging 44 mm. above normal. During the last fortnight there was a very hot spell over the south and centre. The atmospheric circulation was characterized by small and inactive "highs," with a preponderance of continental depressions. The condition of the coffee crop is excellent.

Rainfall Table for January, 1923

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent. of Av.
Lond.	Camden Square	1·28	32	69	*Leics*	Leicester Town Hall	1·14	29	...
Sur .	Reigate, Hartswood	1·59	40	...	,, .	Belvoir Castle	1·19	30	67
Kent.	Tenterden, View Tower	1·42	36	66	*Rut* .	Ridlington	1·25	32	...
,, .	Folkestone, Boro. San.	...	...	...	*Linc.*	Boston, Skirbeck	1·44	37	89
,, .	Broadstairs	1·30	33	75	,, .	Lincoln, Sessions House	1·71	43	102
,, .	Sevenoaks, Speldhurst.	1·65	42	...	,, .	Skegness, Estate Office.	1·25	32	72
Sus .	Patching Farm	1·77	45	68	,, .	Louth, Westgate	1·70	43	78
,, .	Eastbourne, Wilm. Sq.	1.41	36	54	,, .	Brigg	1·67	42	93
,, .	Tottingworth Park	1·62	41	...	*Notts.*	Worksop, Hodsock	·93	24	53
Hants	Totland Bay, Aston	1·29	33	56	*Derby*	Mickleover, Clyde Ho.	1·44	37	72
,, .	Fordingbridge, Oaklnds	1·66	42	60	,, .	Buxton, Devon. Hos.	6·10	155	136
,, .	Portsmouth, Vic. Park.	1·52	39	64	*Ches.*	Runcorn, Weston Pt.	1·86	47	78
,, .	Ovington Rectory	2·10	53	78	,, .	Nantwich, Dorfold Hall	2·30	58	...
,, .	Grayshott	2·13	54	79	*S.L* .	Bolton, Queen's Park .	5·06	129	...
Berks	Wellington College	1·70	43	86	*C.L* .	Stonyhurst College	7·05	179	165
,, .	Newbury, Greenham	1·77	45	77	,, .	Southport, Hesketh	2·26	57	89
Herts.	Bennington House	1·65	42	91	*N.L* .	Lancaster, Strathspey.	4·07	103	...
Bucks	High Wycombe	1·68	43	80	*WRY*	Sedbergh, Akay	7·34	186	134
Oxf. .	Oxford, Mag. College	1·52	39	88	,, .	Wath-upon-Dearne	·84	21	44
Nor .	Pitsford, Sedgebrook	1·11	28	60	,, .	Bradford, Lister Pk.	2·14	54	74
Beds.	Woburn, Crawley Mill.	1·28	33	75	,, .	Oughtershaw Hall	8·26	210	...
Cam.	Cambridge, Bot. Gdns.	1·35	34	90	,, .	Wetherby, Ribston H.	1·21	31	59
,, .	March	...	...	...	*ERY*	Hull, Pearson Park	1·32	33	66
Essex	Chelmsford, CountyLab	1·27	32	...	,, .	Holme-on-Spalding	1·52	39	...
,, .	Lexden, Hill House	1·28	33	...	,, .	Lowthorpe, The Elms.	1·42	36	69
Suff .	Hawkedon Rectory	1·66	42	95	*NRY*	West Witton, Ivy Ho.	2·36	60	...
,, .	Haughley House	1·22	31	...	,, .	Pickering, Hungate	1·65	42	...
Norf.	Beccles, Geldeston	1·26	32	76	,, .	Middlesbrough	1·18	30	74
,, .	Norwich, Eaton	1·85	47	94	,, .	Baldersdale, Hury Res.	...	...	...
,, .	Blakeney	1·96	50	114	*Durh.*	Ushaw College	1·07	27	52
,, .	Swaffham	1·77	45	96	*Nor* .	Newcastle, Town Moor.	1·25	32	61
Wilts.	Calne, High Street	...	...	...	,, .	Bellingham Manor	2·19	56	...
Dor .	Evershot, Melbury Ho.	2·41	61	69	,, .	Lilburn Tower Gdns.	1·97	50	104
,, .	Weymouth, Westham.	1·44	37	59	*Cumb*	Penrith, Newton Rigg.	2·49	63	48
S.D .	Shaftesbury, Abbey Ho.	1·38	35	53	,, .	Carlisle, Scaleby Hall .	...	...	...
,, .	Plymouth, The Hoe	2·21	56	67	,, .	Seathwaite	13·50	343	102
,, .	Polapit Tamar	3·34	85	90	*Glam.*	Cardiff, Ely P. Stn.	2·82	72	75
,, .	Ashburton, Druid Ho.	2·81	72	55	,, .	Treherbert, Tynywaun	7·73	196	...
,, .	Cullompton	2·51	64	77	*Carm*	Carmarthen Friary	3·54	90	81
,, .	Sidmouth, Sidmount	1·92	49	67	,, .	Llanwrda, Dolaucothy.	4·68	119	88
N.D.	Filleigh, Castle Hill	4·31	109	...	*Pemb*	Haverfordwest, Portf'd	2·61	66	57
,, .	Hartland Abbey	2·02	51	...	*Card.*	Gogerddan	5·53	141	135
Corn.	Redruth, Trewirgie	3·24	82	77	,, .	Cardigan, County Sch.	3·10	79	...
,, .	Penzance, Morrab Gdn.	2·75	70	73	*Brec.*	Glasbury, Gwernyfed.	...	...	...
,, .	St. Austell, Trevarna	3·74	95	87	*Rad* .	Birm.W.W.Tyrmynydd	6·38	162	101
Som	Street, Hind Hayes	1·48	38	...	*Mont.*	Lake Vyrnwy	4·80	122	...
Glos. .	Clifton College	2·02	51	71	*Denb.*	Llangynhafal	2·30	58	...
,, .	Cirencester	2·38	61	92	*Mer* .	Dolgelly, Bryntirion	9·57	243	168
Here.	Ross, County Obsy.	1·03	26	43	*Carn.*	Llandudno	1·98	50	77
,, .	Ledbury, Underdown.	1·11	28	52	,, .	Snowdon, L. Llydawll.	14·29	363	...
Salop	Church Stretton	1·80	46	71	*Ang* .	Holyhead, Salt Island.	...	...	...
,, .	Shifnal, Hatton Grange	1·86	47	96	,, .	Lligwy	3·18	81	...
Staff.	Tean, The Heath Ho.	2·61	66	102	*Man.*	Douglas, Boro' Cem.	...	...	...
Worc.	Ombersley, Holt Lock.	1·24	31	65	*Guer.*	St. Peter Port, Grange.	2·30	59	79
,, .	Blockley, Upton Wold.	2·19	56	93	*Wigt.*	Stoneykirk, Ardwell Ho	2·91	74	99
War	Farnborough	1·67	42	78	,, .	Pt. William, Monreith .	3·57	91	...
,, .	Birminghm, Edgbaston	1·81	46	90	*Kirk.*	Carsphairn, Shiel.	8·18	208	...

Rainfall Table for January, 1923—*continued*

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm	Per-cent. of Av.
Kirk.	Dumfries, Cargen	2·92	74	73	*Caith*	Loch More, Achfary	14·68	373	202
Dum	Drumlanrig	3·33	85	81	,,	Wick	3·97	101	161
Roxb	Branxholme	2·12	54	77	*Ork.*	Pomona, Deerness	5·31	135	154
Selk.	Ettrick Manse	5·90	150	...	*Shet.*	Lerwick	5·38	137	126
Berk.	Marchmont House	1·67	42	74	*Cork.*	Caheragh Rectory	4·38	111	...
Hadd	North Berwick Res.	·94	24	55	,,	Dunmanway Rectory	3·65	93	58
Midl	Edinburgh, Roy. Obs.	1·55	39	88	,,	Ballinacurra	1·53	39	38
Lan.	Biggar	3·07	78	115	,,	Glanmire, Lota Lo.	2·13	54	49
Ayr.	Kilmarnock, Agric. C.	4·21	107	123	*Kerry*	Valencia Obsy.	2·56	65	47
,,	Girvan, Pinmore	5·14	131	109	,,	Gearahameen	7·30	185	...
Renf.	Glasgow, Queen's Pk.	3·79	96	113	,,	Killarney Asylum	3·55	90	60
,,	Greenock, Prospect H.	8·28	210	121	,,	Darrynane Abbey	2·71	69	54
Bute.	Rothesay, Ardencr'g.	6·86	174	152	*Wat.*	Waterford, Brook Lo.	1·73	44	47
,,	Dougarie Lodge	4·72	120	...	*Tip.*	Nenagh, Cas. Lough	3·62	92	91
Arg.	Glen Etive	...	...	...	,,	Tipperary	3·09	79	...
,,	Oban	7·72	196	...	,,	Cashel, Ballinamona	2·81	71	74
,,	Poltalloch	8·82	224	176	*Lim.*	Foynes, Coolnanes	3·71	94	98
,,	Inveraray Castle	12·26	311	149	,,	Castleconnell Rec.	4·64	118	...
,,	Islay, Eallabus	6·38	162	136	*Clare*	Inagh, Mount Callan	7·17	182	...
,,	Mull, Benmore	15·20	386	...	,,	Broadford, Hurdlest'n.	4·04	103	...
,,	Mull, Quinish	8·03	204	143	*Wex*	Gorey, Courtown Ho.	1·36	35	44
,,	Loch Leven Sluice	2·40	61	76	*Kil.*	Kilkenny Castle	1·85	47	58
Perth	Loch Dhu	11·00	279	121	*Wic.*	Rathnew, Clonmannon	1·29	33	...
,,	Balquhidder, Stronvar.	8·38	213	99	*Car.*	Hacketstown Rectory	2·36	60	66
,,	Crieff, Strathearn Hyd.	3·81	97	95	*QCo.*	Blandsfort House	2·60	66	79
,,	Blair Atholl	3·88	99	118	,,	Mountmellick	3·02	77	...
,,	Coupar Angus School	2·03	52	86	*KCo.*	Birr Castle	2·93	74	104
Forf.	Dundee, E. Necropolis	1·57	40	81	*Dub.*	Dublin, FitzWm. Sq.	1·71	43	75
,,	Pearsie House	3·16	80	...	,,	Balbriggan, Ardgillan	1·90	48	83
,,	Montrose, Sunnyside	1·74	44	87	*W.M*	Athlone, Twyford	...	...	...
Aber.	Braemar Bank	4·45	113	145	,,	Mullingar, Belvedere	3·42	87	107
,,	Logie Coldstone Sch.	3·18	81	144	*Long*	Castle Forbes Gdns.	3·52	89	106
,,	Aberdeen, Cranford Ho	2·89	73	121	*Gal.*	Galway, Waterdale	3·68	93	...
,,	Fyvie Castle	3·19	81	...	,,	Ballynahinch Castle	...	...	...
Mor.	Gordon Castle	2·85	72	141	,,	Woodlawn	...	...	...
,,	Grantown-on-Spey	3·55	90	147	*Mayo*	Crossmolina, Enniscoe	...	...	...
Na.	Nairn, Delnies	2·47	63	124	,,	Blacksod Point	...	...	...
Inv.	Ben Alder Lodge	10·35	263	...	,,	Westport House	6·80	173	...
,,	Kingussie, The Birches	5·14	331	...	,,	Delphi Lodge	12·48	317	...
,,	Fort Augustus	8·23	209	152	*Sligo*	Markree Obsy.	5·15	131	132
,,	Loch Quoich, Loan	27·00	686	...	*Ferm*	Enniskillen, Portora	4·04	103	...
,,	Glenquoich	24·21	615	176	*Arm.*	Armagh Obsy.	2·56	65	102
,,	Inverness, High Sch.	4·48	114	181	*Down*	Warrenpoint	2·25	57	...
,,	Arisaig, Faire-na Squir	7·81	198	...	,,	Seaforde	3·49	89	111
,,	Fort William	12·64	321	132	,,	Donaghadee	2·19	56	87
,,	Skye, Dungevan	9·37	238	...	,,	Banbridge, Milltown	1·95	49	87
,,	Barra, Castlebay	...	...	...	*Ant.*	Belfast, Queen's Univ.	...	...	...
R&C	Alness, Ardross Cas.	5·92	150	155	,,	Glenarm Castle	4·73	120	...
,,	Ullapool	8·46	215	...	,,	Ballymena, Harryville	4·47	113	120
,,	Torridon, Bendamph.	14·16	360	151	*Lon.*	Londonderry, Creggan	5·15	131	143
,,	L. Carron, Plockton	9·22	234	...	*Tyr.*	Donaghmore	3·97	101	...
,,	Stornoway	6·60	168	128	,,	Omagh, Edenfel	5·47	139	155
Suth.	Dunrobin Castle	...	...	...	*Don.*	Malin Head	3·91	99	150
,,	Lairg	7·33	186	...	,,	Letterkenny Hos	5·22	133	125
,,	Forsinard	...	...	...	,,	Dunfanaghy	4·14	105	102
,,	Tongue Manse	4·44	113	113	,,	Narin, Kiltoorish	4·76	121	...
,,	Melvich School	4·38	111	133	,,	Killybegs, Rockmount	10·35	263	185

Climatological Table for the British Empire, August, 1922

STATIONS	PRESSURE		TEMPERATURE							Rela-tive Humi-dity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb.			Am'nt	Diff. from Normal	Days	Hours per day	Per-cent-age of possi-ble.
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1014·4	− 0·6	73	43	66·0	51·0	58·5	− 3·1	55·6	74	7·4	53	− 4	16	4·2	29
Gibraltar	1015·1	− 0·1	95	61	82·4	68·6	75·5	− 0·6	68·0	71	3·5	0	− 4	0	...	...
Malta	1015·1	+ 0·7	93	71	85·7	75·0	80·3	+ 2·0	72·5	66	1·0	0	− 3	0	10·8	80
Sierra Leone	1013·6	+ 0·3	86	70	81·5	72·3	76·9	− 1·3	72·9	81	8·7	833	− 69	27	...	...
Lagos, Nigeria	1012·7	− 0·9	87	67	82·0	72·7	77·3	+ 0·2	73·6	78	8·4	146	+ 78	10	...	...
Kaduna, Nigeria	1012·8	− 1·0	90	...	79·0	...	...	...	66·7	75	...	256	− 40	15	...	...
Zomba, Nyasaland	1013·7	− 2·5	88	53	81·6	58·9	70·3	+ 5·6	...	71	2·9	3	− 5	1	...	...
Salisbury, Rhodesia	1013·6	− 5·5	86	43	79·5	50·5	65·0	+ 5·1	52·6	45	0·8	0	− 2	0	...	...
Cape Town	1018·2	− 2·0	69	39	60·2	46·5	53·3	− 1·9	51·0	81	6·1	94	+ 7	14	...	...
Johannesburg	1018·2	− 2·5	75	28	65·0	44·7	54·9	+ 1·0	43·3	58	1·7	34	+ 25	3	9·3	84
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	80	23	68·2	38·2	53·2	+ 1·0	41·2	60	2·8	4	− 8	3	...	...
Calcutta, Alipore Obsy.	999·3	− 1·7	92	76	88·1	78·9	83·5	+ 0·5	80·5	79	8·8	460	+151	*20	...	...
Bombay	1005·2	− 0·5	85	75	83·7	77·0	80·3	− 0·4	76·1	81	8·6	131	−229	*29	...	...
Madras	1004·3	− 1·2	101	73	96·2	78·0	87·1	+ 1·4	76·6	64	7·1	97	− 28	*21	...	...
Colombo, Ceylon	1009·3	+ 0·4	87	74	85·5	77·0	81·3	− 0·2	77·0	73	8·8	28	− 57	10	...	...
Hong Kong	1002·2	− 3·0	93	75	87·3	78·8	83·1	+ 1·0	78·3	82	7·8	445	+ 80	25	5·8	45
Sandakan	...	...	90	73	88·1	74·6	81·3	− 0·6	...	...	...	252	+ 47	14	...	...
Sydney	1016·1	− 2·1	74	42	63·9	46·8	55·3	+ 0·3	50·0	61	3·5	46	− 32	9	7·2	66
Melbourne	1016·6	− 1·5	64	33	56·7	42·1	49·4	− 1·7	46·9	75	6·3	63	+ 17	19	...	...
Adelaide	1018·5	− 0·7	69	37	60·8	45·8	53·3	− 0·6	48·7	70	5·3	65	+ 1	16	5·3	49
Perth, W. Australia	1019·3	+ 0·5	76	37	64·6	49·2	56·9	+ 0·9	54·2	74	5·6	132	− 11	22	5·6	51
Coolgardie	1019·7	+ 0·4	80	35	65·4	43·0	54·2	+ 0·6	50·3	53	4·7	61	+ 35	7	...	...
Brisbane	1017·3	− 1·7	79	39	70·9	47·9	59·4	− 1·2	54·0	57	2·2	4	− 52	4	...	...
Hobart, Tasmania	1012·1	− 1·5	62	35	55·4	41·2	48·3	+ 0·3	44·2	72	6·5	52	+ 5	14	5·0	48
Wellington, N.Z.	1015·0	+ 0·3	61	31	56·8	43·5	50·1	+ 1·6	46·4	75	5·9	58	− 58	12	5·3	51
Suva, Fiji	1013·1	− 1·2	86	66	80·9	69·5	75·2	+ 1·5	72·6	87	7·8	268	+ 59	19	...	...
Kingston, Jamaica	1013·3	− 0·4	92	70	89·2	73·2	81·2	− 0·3	...	77	5·5	55	− 38	12	...	...
Grenada, W.I.	1012·8	+ 0·2	88	71	84·7	75·0	79·9	+ 0·4	75·3	75	4·3	225	− 14	22	...	...
Toronto	1015 3	− 0·1	93	48	80·1	57·9	69·0	+ 2·4	61·5	74	3·4	37	− 33	8	...	...
Winnipeg	1013·0	− 0·9	90	44	79·7	55·2	67·5	+ 4·5	62·8	83	3·9	34	− 26	7	...	...
St. John, N.B.	1014·9	− 0·5	78	47	66·9	54·1	60·5	− 0·1	57·6	88	6·8	265	+167	14	...	...
Victoria, B.C.	1015·9	− 1·3	82	48	66·5	52·1	59·3	− 0·8	54·8	85	4·6	18	+ 1	10	...	...

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

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Solar Radiation and the 27-day Interval

By Dr. C. CHREE, F.R.S.

AS various attempts have been made to correlate with meteorological results the daily measures of solar radiation obtained by Dr. Abbot and his collaborators, the significance of these measures is of interest to meteorologists. The difficulties in the observations and their reduction are considerable. The attitude of physicists varies from that of the man willing to accept the third place of decimals in every daily measure, to that of the man sceptical as to any sensible variation from one day to the next. But, accepting the figures provisionally as absolutely exact, there are various possible explanations. They might signify variations in absorption due to some unknown cause but common to the whole of the earth's atmosphere, or the varying presence of some absorptive medium external to both earth and sun. They might arise from varying absorption in the solar atmosphere, or from a difference in the radiation of the sun in different directions. Owing to the solar rotation, the face presented to the earth is constantly varying, so that if different zones differed in their emission—even if the total radiation were constant—we should anticipate variation in the radiation received by the earth. There is strong evidence that different zones do exhibit such a difference in the case of the ionic radiation, supposed responsible for magnetic disturbances on the earth. It is now, I think, generally believed that there is a decided tendency in magnetic conditions on the earth, whether quiet or disturbed, to show a 27-day interval, and the

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most natural explanation is a difference in the radiation from different solar zones, which possesses a similar degree of persistence to that exhibited by sunspots. It thus appeared desirable to find out whether a 27-day interval was recognizable in the Abbot figures. An opportunity for doing this is afforded by the appearance in the *Meteorologische Zeitschrift* for November, 1922, of daily measures* of the solar radiation for 1919 and 1920, which are supposed to be comparable amongst themselves.

Following the same procedure as for magnetic disturbance, I selected for each month the five days of largest, and the five days of lowest radiation. There being no data for 1921, December 1920 was omitted, leaving 115 days representative of high, and 115 days representative of low radiation. The radiation figures for the 115 days of high radiation were entered in a column headed n. There were similarly entered in columns headed $n + 26$, $n + 27$ and $n + 28$, the radiation figures from the associated days which were respectively 26, 27 and 28 days subsequent to the selected days of high radiation. A similar procedure was followed for the 115 selected days of low radiation and the subsequent days associated with them. There were no radiation data for a good many days, so that the associated day results available in the several columns fell considerably short of 115, varying indeed from 87 to 95. Mean results were obtained, as a matter of fact, for each individual month, but in several months only one or two associated days were available. As the radiation figures showed no marked annual variation, a mean which assigned equal weight to each day seemed preferable to one which assigned equal weight to each month. The mean radiation values thus obtained were as follows :—

	n	$n+26$	$n+27$	$n+28$
Days of high radiation and associated days ...	1.969	1.949	1.945	1.946
Days of low radiation and associated days ...	1.923	1.952	1.948	1.950

The mean value of solar radiation for the 24 months was 1.948. When equal weight was allotted, not to each day but to each month, the figures obtained were nearly identical with the above. In 1919 the associations of low radiation with *high* radiation on the 26th day thereafter were decidedly above expectation. But the phenomenon did not repeat itself in 1920, so it is presumably accidental. At any rate there is no suggestion of any tendency

* The entries in the table in question appear to be the mean values for the day of the estimates of the "Solar Constant" made at Calama, Chile. The figures are taken from the *U.S. Monthly Weather Review*, Feb. 1919, *et seq.*, and Aug. 1921.—Ed.M.M.

for high or low radiative values to repeat themselves after a 27-day interval. In the case of magnetic disturbance, it may be added, the 27-day interval showed its presence in 1919 and 1920 to a normal extent, so that the years presumably were not abnormal.

It remains to call attention to a rather remarkable difference between 1919 and 1920. The mean values of solar radiation from all the observations, allowing equal weight to each month, were almost identical, being 1.947 for 1919 and 1.948 for 1920. But the mean values from the 60 selected days of high radiation and from the 60 selected days of low radiation were respectively 1.965 and 1.929 for 1920, as against 1.973 and 1.918 for 1919. There was thus apparently a very large reduction in the variability of radiation in the later year. Assuming this not to be due to any reduction in the uncertainties of observation, it suggests a greater uniformity in solar radiation as we approach sunspot minimum.

Solar Radiation at South Kensington: 1913-1920

By L. C. W. Bonacina

THE inauguration of solar radiation observations by means of such instruments as the Callendar radiograph and the Ångstrom pyrheliometer has marked the beginning of the scientific study of an important climatological element, namely, the intensity of radiation received at a place from the sun. Clearly, ordinary sunshine records tell one nothing of the quality and intensity of the sunshine, while " temperatures in the sun " merely indicate the temperature of the thermometer exposed to insolation and ought not to be quoted in climatology.

Having had occasion, recently, to study the Callendar Recorder observations at South Kensington for the octad 1913-1920 as published in the annual volumes of the *Geophysical Journal* I have compiled the following tables for the various months. Table A gives the means for the eight years of the total daily amounts of radiation received by a horizontal surface expressed in joules per square centimetre and Table B gives the means of the daily maximum " intensities " expressed in milliwatts per square centimetre. The joules and milliwatts are given to the nearest whole number.

The months are put in the order of the mean values, a space being left to separate the solstitial from the equinoctial periods.

A Joules per cm². 1913-1920 (8 years).			B Milliwatts per cm². 1913-1920 (8 years).	
June ...	1553	Summer.	June	75
May	1487		July	70
July	1306		May	69
August ...	1193		August	66
April ...	986	Equinox.	April	58
September ...	909		September ...	53
March ...	591		March	40
October ...	485		October	35
February ...	325	Winter.	February ...	24
November ...	227		November ...	19
January ...	164		January	15
December ...	130		December ...	12

It will be seen that with the single exception of the interchange* between May and July in Table A the months are arranged in the exact order of their astronomical positions according to length of day and altitude of the sun at noon.

In a climate like England where the meteorological "sunniness" or percentage of the possible duration varies in the same sense as the astronomical "sunniness" or amount possible, *i.e.* the length of the day, the actual amount of sunshine must necessarily be very much greater round the summer solstice than round the winter solstice; and if the above tables had been based on a long period, say 30 years, one could have foreseen that the months would be arranged exactly according to length of day. But the fact that, with the single exception noted above, the same arrangement holds for so short a period as eight years is quite remarkable, showing that in this climate the variable meteorological factors affecting the monthly transparency or diathermancy of the atmosphere are small in comparison with the dominating geometrical factors which make the amount of radiation received horizontally from a high sun greater than that from a low sun.

Of the individual months of the whole 96, June, 1914, heads the list both for A and B values, with 1706 and 78 respectively, a fact which substantiates a vivid impression I received that year to the effect that the sun-heats of that month were excep-

* This anomaly between May and July also appears in the 5-year period 1914-1918 which I first examined. The addition of three more years to the record has greatly accentuated this, evidently because the Mays of 1913, 1919 and 1920 were all characterized by brilliant weather, while the Julys were all meteorologically dull. It will be most interesting to see whether the anomaly vanishes ultimately as the record lengthens.

tionally intense even for June—often, too, on days when the air temperature was relatively low. At the bottom of the list comes the cold and gloomy December of 1916, with 109 joules and 11 milliwatts. One wonders how this would compare with the appalling December of 1890 !

In order to see how the June of 1914 compares with the extremely brilliant period May-July, 1921, the corresponding figures for these three months, which are just available, were examined with the following interesting result :—

	A Values.	B Values.
June, 1914	1706	78
May, 1921	1483	79
June, 1921	1728	80
July, 1921	1656	78

It is thus seen that the June of 1914 was beaten by the June of 1921, but not by July, 1921—a month with a rather higher total duration of sunshine and a much higher mean temperature. Evidently the month of June, by reason of its position at the high solstice, is very difficult to oust from its premier position for intense sun-heats.

I have also examined for Kew the Angström radiograph results for the five years 1914-1918, but means cannot be given owing to the fact that daily observations were not taken. Nevertheless the maximum intensities expressed in milliwatts per square centimetre, relatively few as they are, bear out exactly what one would expect, namely, that the relation to the solstices and equinoxes with an instrument that received the radiation perpendicularly is much less close than is the case with the Callendar instrument, and also that the differences between the summer and winter values are smaller. In this case, too, at a different place, the highest figure, 86 milliwatts, is shown for June, 1914 ; but if daily observations had been taken the superiority of this month might have stood out still more clearly. Of the three factors which affect the intensity of radiation received upon a horizontal surface, namely—(1) angle of incidence, (2) thickness of atmosphere traversed, (3) transparency or diathermancy of the atmosphere, the first is eliminated with the Angström instrument so that the influence of factor (3) is more obtrusive. Obviously one June can only differ from another June in virtue of factor (3) if one assumes that the "solar constant" really is constant in the two cases.

For general climatological purposes it is, of course, the results for horizontal surfaces that ought to be studied.

The significance of the remark made above that the apparent power of the sun in June, 1914, was very great, even on cool days, is that the apparent power of the sun to human sensation is influenced to a large extent by the temperature of the air, which consequently ought to be allowed for in making comparative estimates by physiological means. But if one takes a day in June with 80° F. air-temperature and one in September with the same temperature, then, provided both days have the same amount of wind and humidity and are equally transparent to the sun's rays, the sun on the June day must necessarily feel hotter to any one in the open. Similarly a hot day of 90° F. is a fiercer affair, say, in Italy than an equally hot day as judged merely by the air temperature in England.

The moral, therefore, is to remember that the full thermal aspects of climate involve something more than temperatures; and that in making comparisons between temperatures in different latitudes, at different altitudes and at different times of the year, regard ought to be paid to the direct income of solar heat for which a scientific method of study has now been found. It should be remembered, however, that the Callendar radiograph does not register the dark rays to which the glass bulb is not transparent.

[It should be noted that the measurements quoted in this Article may require correction owing to changes in the calibration of the instruments. The Kew results are discussed in a paper to be published shortly as a *Geophysical Memoir*—ED.*M.M.*]

Toy Balloon "Races" from Brighton

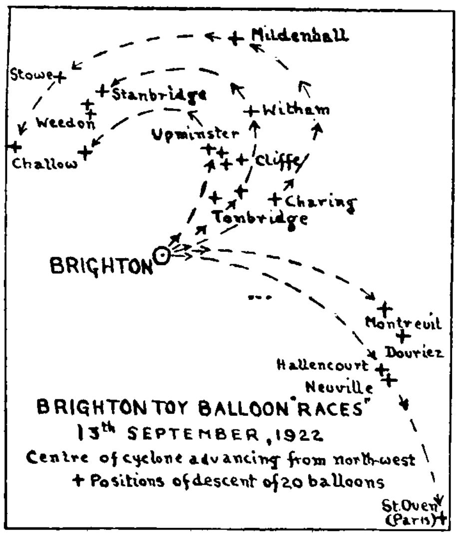
By Hy. Harries

In the November number of this magazine (p. 281) mention was made of toy balloon races organized by Major MacLulich, at Brighton, during last summer. At first the venture was regarded merely as a mild form of sport, the longest distance flown being the only consideration in awarding the prizes, so that no account was taken of the time at which a balloon left Brighton. Many travelled into Germany and Denmark, the distance "made good" exceeding 400 miles in several instances, in one case reaching 465 miles.

On August 23rd (hour not stated) a young man and his fiancée each selected a balloon, and these were liberated simultaneously. Both were picked up at St. Marcel par Vitrey, Haute Saône, on the 24th, by the same person, one at 6h., the other "in the morning," so that the two had travelled in company 295 miles in a direction S 51° E.

Early in September I suggested to Major MacLulich to give the date and hour of departure on the cards; and on the 9th of the month, under well-marked anticyclonic north wind conditions numerous balloons were liberated, and as many as 43 cards were returned, all from the north of France, north of the 48th parallel, and between longitudes 1° E and 1° W. The wind must have been very steady in direction, for nearly all the balloons followed a course between S 2° E and S 5° E.

Ten of the balloons were picked up in the afternoon of the day of their departure from Brighton, one within 2½ hours, having travelled 108 miles, or at a rate exceeding 43 miles per hour, and one within four hours, covering 143 miles. The balloons had thus attained an altitude where the wind was of gale velocity.



BRIGHTON TOY BALLOON "RACES"
13th SEPTEMBER, 1922
Centre of cyclone advancing from north-west
+ Positions of descent of 20 balloons

Of more interest were the flights of balloons despatched on September 13th. On this day a well-defined cyclonic system was advancings south-eastward across the midland counties, directly towards Brighton.

Many balloons were liberated, and the cards of 20 of them were returned. Projected on a map, showing the time of ascent and the destination of each, the results are curious as well as interesting, because, while 15 balloons were drawn into the cyclonic whirl, five were carried outside, into north-eastern France.

Two sent off at 11h. 30m. reached Essex (Grays and Witham) ; three at 11h. 40m. reached Essex (Brentwood), Suffolk (Mildenhall), and away round to Berks (Challow) ; three at 11h. 45m. reached Essex (Upminster) and Bucks (Stanbridge and Weedon) ; six at noon reached Pas de Calais (Montreuil sur Mer and Douriez), Kent (Charing and Maidstone), Bucks (Waddesdon), and Berks (Twyford) ; one at 12h. 30m. and another at 13h. reached Kent (Tonbridge and Cliffe at Hoo) ; three at 15h. passed to Paris (St. Ouen), the Somme (Neuville aux Bois), and Bucks (Stowe) ; and an untimed one crossed over to the Somme (Hallencourt).

The International Section of the *Daily Weather Report*, No. 22,211, contains no observations showing the upper wind over our south midland counties, but we can picture the routes followed by the balloons, which, after passing over East Anglia curved round in the northern side of the cyclone, four descending in north Bucks, and two continuing south-westward, crossing the Thames into Berks.

There is in the *Daily Weather Report* information affording an explanation of the travel of the five balloons which crossed over to France. From south-west on the Sussex coast, the surface wind veered to west at Dungeness, and at Amiens the upper winds were west, 13 miles per hour at 1,640 feet, west-north-west, 18 miles per hour, at 3,280 feet, and north-west, 22 miles per hour, at 4,000 feet, so that four balloons appear to have ascended into the west-north-west current, the one which descended at Montreuil sur Mer having been picked up four hours after its ascent, having made 76 miles, direction S 74 E, or 19 miles per hour, an excellent agreement with the Amiens observation. The balloon which dropped at St. Ouen must have ascended into the north-westerly wind, making 148 miles S 40° E. The Montreuil balloon was the only one picked up on the same day as the ascent, so that 19 cases afford no clue to the rate of travel.

It will be noticed that of the three balloons despatched at 15h. one descended in Thatcham Park, Stowe, Bucks, and another at St. Ouen, the positions being 226 miles apart, from north-west to south-east.

During the second half of the month the holiday season waned, so that subscribers to the races decreased, and from the flights after that of the 13th only about two dozen cards were returned. Of these six had travelled the short distance to the Somme and Pas de Calais on the 16th.

A similar experience to that of August 23rd occurred on September 21st. The evening air was so calm that two balloons liberated at the same instant made, in company, a perpendicular ascent until lost to sight in a thin misty cloud at an estimated altitude of about 2,000 feet. Their cards showed that within 12 hours of their despatch both were picked up in the streets of Cassel, Germany, on the 22nd, one at 6h. 30m. the other at 7h., having made 365 miles N 85° E, or 30 miles an hour. Another balloon sent off about a quarter of an hour earlier drifted very slowly eastward across the West Pier and descended at Littlestone-on-Sea, Dungeness.

As an interesting parallel to [the two cases cited by Mr. Hy. Harries of balloons liberated together falling in the same town or village, it may be mentioned that in 1914 two registering balloons sent up from Benson on consecutive days were both picked up in the little parish of Lode, Cambridgeshire (see *Geophysical Journal*, February, 1914). It is equally difficult to explain such coincidences and to accept them as merely accidental.

Discussions at the Meteorological Office

February 19th, 1923. *A theory of meteors, and the density and temperature of the outer atmosphere to which it leads.* By F. A. Lindemann, F.R.S., and G. M. B. Dobson, M.A. (Proc. Roy. Soc. A. Vol. 102, 1922, pp. 411-437.)

Opener—Captain N. K. Johnson.

It has long been a reproach to meteorologists that they have hardly taken cognizance of the phenomena from which their science derives its name. It seems to have been left to Professor Lindemann and Major Dobson to point out that the density of an atmosphere which can heat up a meteor charging into it with an assigned velocity until it volatalizes should be determinable with considerable accuracy. The authors have not only set the problem, but solved it. The results are of great interest. The data on which their investigation is based may be summarized as follows (they refer to a typical meteor):—

Height of first luminosity	100 *km.*
Height of disappearance	80 *km.*
Length of path	60 *km.*
Speed	40 *km. per second.*
Apparent luminosity at 150 *km. from the observer*	*First magnitude star.*

On the assumption that practically all the energy sent out from the star is luminous, it follows that:—

The rate of emission of energy = 3·3 *kilowatts.*

Moreover, if this energy, emitted at the rate of 3·3 kilowatts for $1\frac{1}{2}$ seconds, represents the kinetic energy of a body moving at 40 km. per second, the mass of the body must be very small, in fact:—

The mass of the typical meteor = 6 *milligrams;*

and

The diameter is therefore of the order ... 1 *millimetre.*

The temperature of the volatalizing meteor is estimated at about 2,000 *a* (*say,* 3,000° *F.*).

The meteor is enabled to reach this temperature of volatalization owing to the concussion with the molecules of the atmospheric gases. It is the merit of the paper that, by showing how the accumulation of heat during this process is associated with the mass of atmosphere which is passed through, it provides a means of computing the density of the atmosphere. There are three lines of attack. All lead to the result that the upper atmosphere is much denser than has been supposed hitherto. At 150 kilometres it is 1,000 times as dense as had been computed on the assumption of a uniform temperature of 220 *a* (−63·4° F.) from 10 kilometres upwards.

It follows that this assumption must be seriously in error, and we learn to our surprise that the true temperature of the outer atmosphere from 50 to 150 km. is about 300 *a* (say, 80° F.), *i.e.*, comparable with that of the earth's surface. A tentative explanation of the paradox is forthcoming, namely that the atmosphere at the levels in question is rich in ozone. Ozone absorbs the ultra violet light from the sun, and this absorption, which is responsible for the poor development in the ultra violet in our sunlight, is thought to suffice to warm the outer shell.

Captain Johnson pointed out a few weaknesses in the mathematical development of the subject, but Professor Lindemann, who took part in the discussion, laid stress on the fact that, whereas modifications in the argument might lead to estimates of density differing by 100 per cent., the discrepancy between the new results and the assumption of a uniform temperature of 220 *a* amounts to at least 10,000 per cent.

March 5th, 1923. *The pilot charts of the South Atlantic and South Pacific* (U.S. Hydrographic Office).

Opener—Sir David Wilson Barker.

The many naval men who were present at this discussion bore witness to the value of these charts. There was, however, a concensus of opinion in favour of an atlas of charts rather than the periodical issue of charts for separate months on flimsy paper. It was announced that there is a likelihood of the British charts being published in such an atlas. As to the detail, a preference for our own methods of shewing winds and sea currents was expressed.

On March 19th, 1923, Captain C. J. P. Cave will open a discussion on M. Louis Besson's *Classification détaillée des nuages à l'Observatoire de Montsouris* (Ann. des Services Techniques d'Hygiene de la ville de Paris, 1921). This will be the last discussion of the session. The Director of the Meteorological Office wishes it to be known that visitors are welcomed at these discussions. Those who would like to receive notices of the meetings next session should make application now.

News in Brief.—From the Aerological Observatory at Pavlowsk, which is now under the directorship of M. P. A. Moltchanoff, the first number of a new monthly publication (in Russian), entitled *Results of daily investigations of the free atmosphere*, has been received. The results of observations taken by means of kites, pilot balloons or aeroplanes, are given for each day of January, 1923. The heights attained are not generally great, but the regularity with which the ascents are carried out and the prompt circulation of the observations are noteworthy. It is interesting to see that the Gregorian Calendar is now adopted, at least for meteorological purposes, in Russia.

Royal Meteorological Society

THE monthly meeting of the society was held on Wednesday, February 21st, at 49, Cromwell Road, South Kensington, Dr. C. Chree, F.R.S., President, in the chair.

The reform of the calendar.

A discussion on the reform of the calendar, with special reference to recent proposals by Dr. C. F. Marvin, Chief of the Weather Bureau of the United States, was opened by Lieut.-Col. E. Gold, F.R.S. Colonel Gold devoted some time to the historical aspect of the question before considering the specific scheme put forward by Dr. Marvin. This scheme involves the division of the year into 13 months of 28 days each and Colonel Gold pointed out that the substitution of the prime number 13 for the many factored number 12 would be most inconvenient, as the grouping of the monthly figures to give statistics for the halves or quarters of the year would no longer be practicable. A further objection, that the traditional characters of the months would be seriously altered if any were shifted by as much as two weeks towards the beginning or end of the year, was raised by Mr. Bonacina. The proposal to take one day from August and add one day to February and so restore the symmetry destroyed by the vanity of the Emperor Augustus is understood to be within the sphere of practical politics and this proposal met with the approval of the speakers. For Dr. Marvin's plan there was no encouragement.

Dr. S. Fujiwhara—On the growth and decay of vortical systems and *On the mechanism of extratropical cyclones.*

Captain D. Brunt gave an account of the contents of these two papers. In the first Dr. Fujiwhara describes experiments which indicate that, in water, vortices with the same sense of rotation attract whilst vortices rotating in opposite senses repel each other. He traces the growth of vortices by amalgamation as a kind of animate growth, and adduces evidence to show that cyclones and anticyclones can be regarded as following similar laws.

In the second paper an equation devised by Hesselberg and Friedmann for the determination of the rate of change of the vorticity of horizontal motion in the earth's absorption is discussed, and it is shown that the most important source of energy of a cyclone is to be found in the vorticity of the surrounding fluid. The production of cyclones along the polar front is shown to be capable of explanation as the absorption by a larger whirl of the horizontal whirl which forms at the surface.

These papers are by no means easy to follow but those who had devoted most time to their consideration were the most enthusiastic in their admiration for the ideas embodied in them.

Correspondence

To the Editors, *The Meteorological Magazine*

A Lunar Rainbow

At 10 p.m. on February 22nd a beautiful lunar rainbow was seen here spanning the Downs. The bow, perfectly formed against a background of stormy cloud, stood north and south, each end terminating in the sea. Beneath the pallid, mysterious arch was the Pier, vague and shadowy, and the dim shapes and lights of vessels out in the Channel. The moon, in a patch of clear sky, rested peacefully " upon her back " in the west, while a gusty wind from a southerly direction carried a heavy rain-squall rapidly seaward.

The arch was visible for a few minutes and then began to fade, rifts appeared in the gloomy cloud curtain, stars shone in the wind-swept spaces, and the Goodwin and Calais lights once more flashed over the heaving waters. It was an arresting and striking phenomenon, and may have heralded the thunderstorm that followed later in the night.

Arthur Butcher.

31, *Beach Street, Deal, February 24th,* 1923.

[In another account of this rainbow it is referred to as " quite white, like two powerful searchlights side by side." The fact that the eye does not perceive the colour of faint lights is well known ; the luminosity of the rainbow is but a small fraction of that of the moon itself.—Ed. *M.M.*]

The Fata Morgana

In the " Notes and Queries " of the February issue of this magazine (page 12) I notice a reference to the Fata Morgana with a query respecting the connection of the name with King Arthur's sister. The following quotation from *Ancient Man in Britain*, by Donald A. Mackenzie (Blackie, 1922) page 161, may throw some light on the matter, as well on the Scottish name " Margaret the Orkney Witch " :—

> " In Greece the pearl was called margaritoe, a name which survives in Margaret, anciently the name of a goddess. The old Persian name is margan. It is possible that this is the original meaning of the name of Morgan le Fay [Morgan the Fairy] who is remembered as the sister of King Arthur, and of the Irish goddess Morrigan " [probably both are the same deity]. . . ." In Italian we meet with Fata Morgana."

The writer is referring to the wide-spread use of pearls as charms. Morgana is a prominent figure in the Charlemagne romances, and in one tale uses her mirage to deceive the paladin Orlando. The subject is well worth investigation.

Cicely M. Botley.

10, *Wellington Road, Hastings, February 26th,* 1923.

The Design of Rain-Gauges

I WAS pleased to see Mr. Mace's letter correcting the misprint in his letter published in the December magazine, as the mis-statement puzzled me considerably. I had continued observations with a low-rim gauge, after setting up beside it one of the Snowdon pattern, for the years 1914-1921, and my experience was similar to his, viz., that a higher rainfall and more rain days were recorded by the former. The figures for the two gauges were published each year in *British Rainfall.* I also contributed a note to this magazine in 1919 with regard to some summer showers not giving sufficient water in the gauge to be measured, in which I suggested, as Mr. Mace does, that the surface of the funnel to be wetted influences the amount of rain recorded.

A. E. SWINTON.

Swinton House, Duns, Berwickshire, January 1923.

[This correspondence raises the question whether it is the object of the rain-gauge to accumulate dew. Remembering that there is no reason to suppose that the amount of dew which is deposited on vegetation is the same as that deposited on a rain-gauge covering an equal area (indeed, much of the " dew " on vegetation is exuded from the plant itself), it seems better to exclude dew as far as possible from our measurements and to regard the collection of a certain amount as merely a necessary evil. That being so, the gauge with the protecting cylinder has the advantage in that dew is mostly deposited on the outside of the cylinder, comparatively little dew will be derived from the pocket of stagnant air inside the cylinder, and a good deal of that evaporates in the morning and never reaches the container.

As to the loss by evaporation of the rain-drops which fail to run down the funnel before it is thoroughly wetted, it must be admitted that the shallow gauge has the advantage. This is a small matter, however, in comparison with the serious defects of such a gauge, its incapacity to retain snow and hail and its almost complete failure in windy situations.—ED. *M.M.*]

Low Barometer Readings

ON Monday, February 26th, a very deep depression, accompanied by a strong south-westerly gale, and a good deal of rain, passed over southern Ireland. My barometer (reduced to sea level) registered 28·10 in. This is the lowest I have ever recorded since I commenced observations in 1902. During these 21 years I have only registered less than 28·25 in. on three other occasions, and it is remarkable that two of them occurred within a week of this date! The dates were February 20th, 1910 (28·24 in.), February 22nd, 1914 (28·14 in.), and January 1st, 1915 (28·14 in.).

The storm continued for 48 hours and some damage was done; the daily rainfall readings were ·65 in. and ·63 in. respectively, and the floods on the River Suir were very high on the 27th and 28th. At Queenstown, Co. Cork, the barometer fell to 28·09 in., which is the lowest for 24 years.

E. W. MONTAGU MURPHY.

Ballinamona, Cashel, Co. Tipperary, March 1st, 1923.

[The *Daily Weather Report* gives the reading at 18 h. on February 6th at Birr Castle as 951 mb. (28·08 in.).—ED. *M.M.*]

Weather of recent years

THREE facts of importance have forced themselves upon my attention in late years, but they do not appear to have been much commented on. Possibly these facts have been more strongly evidenced in this part of the country than in others.

Since the cold winter of 1894-5 we have only experienced one really severe season, and that was in 1916-7, when the cold weather may be said to have endured from November to April.

The rainfall of September during the last 17 years, 1906-22, has been exceedingly short of the average. Notwithstanding the record fall in September, 1918, of 10·41 in., the average fall has been only 2·49 in., whereas Dr. Burder's average for the 37 years, 1853 to 1889, is 3·24 in.

The rainfall of December has, however, been very excessive for the last 17 years, the mean fall of the month having been 4·59 in., whereas the average is 2·88 in.

These departures from normal experience are perhaps only irregularities in our climate, though they have been extended beyond ordinary limits, and naturally call for special remark.

W. F. DENNING.

44, *Egerton Road, Bristol, February 19th,* 1923.

A Warm, Wet February

FEBRUARY, 1923 was remarkable for its warmth and wet. I have taken readings at Totland Bay for the past 37 years. This has been the warmest February and the wettest but one. The days of the month were five weeks in advance of their time, while the nights were even more forward, being as those of the last week of April, or ten weeks too warm. The sea usually reaches its coolest point about the middle of February. This year it has not been colder than 44·8° F., on February 22nd. Only once have I known more rain in February, that was with a rainfall of 5·07 in. in February 1900. This year raspberry canes were in full leaf at the middle of the month, and gooseberry bushes in full leaf before the end. There has been an abundance of spring flowers, while the common field cowslip was in full bloom every day of the month.

The following is the summarized table for the average and the two wettest and warmest Februaries here :—

February	Max.	Min.	Rainfall	Rain Days
	° F.	° F.	in.	
1923	49·4	41·8	4·70	23
1914	48·6	41·4	3·84	18
1900	43·3	34·6	5·07	21
Average	45·2	36·6	2·11	14

JOHN DOVER.

Aston House, Totland Bay, I.O.W., March 3rd, 1923.

NOTES AND QUERIES

A Line Squall at Ross-on-Wye

MR. F. J. PARSONS reports that a line squall, accompanied by thunder and lightning, passed over Ross-on-Wye in the afternoon of February 26th, 1923. The lightning was very vivid, and the thunder heavy both before and after the passage of the squall, abating temporarily when the squall-cloud was overhead and precipitation began. The wind throughout was south-south-west, and reached force 8 or 9 (40 to 50 miles per hour) before the rain and hail started. Some damage was done both by the wind and the lightning. The squall was followed by a brilliant rainbow.

An Account of Rain Making in America

THE following despatch from the New York correspondent of *The Times* is dated February 12th, 1923 :—

> " Fogs, even ' London partiklers,' need be no more, and, given only clouds, rain can be had wherever it may be wanted, according to an announcement made last night by experimenters in the Army Air Service at Dayton, Ohio. Under the direction of Professor Bancroft, of Cornell University, and a fellow-scientist, Mr. Francis Warren, they have been making rain with sand electrically charged and dropped from aeroplanes into clouds. The results are described by observers as ' absolutely uncanny.'

The experiments have been made over a period of several months, with the primary object of dissipating fogs over flying fields. An aeroplane, moving one hundred miles an hour, 500 ft. over the tops of clouds, scattered with the propeller particles of sand charged with ten thousand volts, or about six ten-thousandths of an electric static unit, per grain. The time required to precipitate the moisture and destroy the clouds rarely exceeded ten minutes.

The clouds varied from several thousand feet to several miles in length and breadth, and the thickness from 500 ft. to 1,500 ft., and the experiments were invariably successful, though in the case of very thin clouds the moisture disappeared by evaporation before reaching the ground. According to Mr. Warren, the electric charge diminishes the surface tension of the drops of moisture, and this facilitates coalescence and condensation."

A Record Gust at Valencia Observatory

A STRONG south-easterly gale was experienced at Valencia Observatory, Cahirciveen, in the early hours of February 7th, lasting from 3 h. 30 m. to 6 h. 30 m. The average wind during that period was between 50 and 60 miles an hour, but between 4 h. 30 m. and 5 h. 30 m. many gusts of storm force (65 miles an hour and over) occurred, the maximum being 95 miles per hour at 4 h. 45 m. This is the highest gust recorded at Valencia Observatory since 1917, when the pressure tube anemometer was first installed. Between midnight and 4 h. 30 m. pressure fell 25 mb., from 980 mbs. to 955 mbs., and by 7 h. it had risen again to 962 mbs.

The gale caused considerable damage in the neighbourhood of the Observatory; all the telegraph lines were down and the wireless station out of action for an indefinite time. The Observatory itself suffered, the roof and woodwork being damaged and the greenhouse demolished.

The Conquest of the Air

DURING February several new flying "records" were established. A record climb of 20,000 feet in 12 min. 24 sec. by Flight-Lieutenant Haig at Martlesham Heath was announced in *The Times* of February 6th. The speed at ground level was 189 miles per hour.

On February 15th M. Sadi Lecointe broke the world's record for speed over a four kilometre course, at Marseilles: his average speed for the four kilometres was $234\frac{2}{8}$ miles per hour, beating the previous record by over 10 miles per hour. A few days later, on February 26th, another French airman, M. Maneyrol, established a record, making a motorless flight of 10 kilometres (horizontal distance) during a strong south-westerly wind near Cherbourg.

Three notable flights are also announced to take place this year. On March 15th an expedition of five French aeroplanes is to start on a world tour, probably lasting two years, with the purpose of the advancement of French aviation ; and towards the end of the year an American crew will fly from Berlin to Chicago in the large Zeppelin air-cruiser now being constructed for the American Government. The third is the flight across the Pole ; the latest communication from Amundsen states that he and Lieutenant Omdal intend to attempt the flight at the end of June. Successful trials have been made, and they expect to cover the 2,250 miles, Point Barrow, Alaska, to Spitzbergen, in 26 hours.

Cleaner Air for London

THE Public Control Committee of the London County Council has been considering the questions (1) how far fog in London is the result of atmospheric pollution due to preventable causes ; and (2) how far the atmosphere may be improved by the larger use of electricity for power and other purposes.

The Committee has also inquired whether further powers are required to deal with the emission of smoke. It is now announced that detailed reports have been prepared and are under discussion by the Council.

Review

A DICTIONARY OF APPLIED PHYSICS. Edited by Sir Richard Glazebrook, K.C.B., D.Sc., F.R.S. Vol. III. *Meteorology, Metrology, and Measuring Apparatus.* 8°, 9 × 6, pp. viii. + 840. *Illus.* Macmillan and Co. 1923. £3 3*s. net.*

Sir Richard Glazebrook retired from the position of Director of the National Physical Laboratory in 1919, but he has not been content with a life of leisure. In addition to his work as Professor of Aeronautical Science at the Imperial College of Science, he has found time for other activities, not the least important of which has been the editing of the *Dictionary of Applied Physics.* The distinctive rôle of this Dictionary is to set out the technique of the National Physical Laboratory at the end of Sir Richard's directorship, but articles on other aspects of applied physics are contributed by authors who do not hail from the Laboratory.

The Dictionary is being published in five volumes. The third, which is devoted to Meteorology and Metrology, has recently been issued. With Metrology in general this magazine is not concerned, since the nicety of precise measurement is not of practical importance to the meteorologist. With the barometer, however, we do attempt to measure pressure to one part in 10,000, and appropriately enough this instrument is dealt with by the Metrology Department of the National Physical Laboratory. The article in the Dictionary on *Barometers and Manometers* is written by Mr. F. A. Gould from the Laboratory standpoint. It is useful to have his account of such details as the difference between the corrections to be applied to the readings of barometers of different types. That the corrections for the Kew pattern barometer should not be identical with those for the Fortin was not recognised until the development of the millibar scale directed attention to such matters, and the mathematical development of the subject has not been accessible hitherto.

The principal contributors of articles on meteorological subjects are W. H. Dines (*The Investigation of the Upper Air and Radiation*), D. Brunt (*Physics of the Atmosphere*), Sir Napier Shaw (*Thermo-dynamics of the Atmosphere*), R. Corless (*Meteorological Instruments*), C. T. R. Wilson (*Atmospheric Electricity*), F. J. W. Whipple (*Meteorological Optics*) and S. Skinner (*Humidity*). Allied sciences are represented by articles by D. J. Matthews (*Oceanography*), W. W. Coblentz (*Measurement of Solar Radiation*), E. A. Griffiths (*Radiant Heat and its Spectrum Distribution*), the late C. G. Knott (*Earthquakes and Earthquake Waves*), A. Crichton Mitchell and J. N. Shaw (*Seismometry*), and H. L. P Jolly (*Combination of Observations*).

An adequate review of a book with such a wide scope is not practicable in the space at our disposal. It may be mentioned, however, that Sir Napier Shaw's article is conspicuous as containing much new and important work not published hitherto. As is inevitable with articles from so many pens, there is a certain amount of overlapping. On the other hand there are a good many gaps, and as a mere index of meteorological terminology the *Meteorological Glossary* is to be preferred to the new Dictionary. As a summary of our present knowledge of certain aspects of meteorology, the work is of great value. It will perhaps be regarded in future as a milestone showing the stage reached by the science at the end of the great war.

Obituary

Mr. John Henry James.—John Henry James was born on April 27th, 1877. He was the son of Mr. W. G. James, who joined the Meteorological Office in 1879, and is now on pension after 40 years service in the Marine Division. Mr. J. H. James accepted an appointment in the Observatories Branch in 1908. The Office was then in Victoria Street, Westminster, and after the removal to Kensington a workshop was installed for experimental work upon meteorological instruments, and Mr. J. H. James, whose mechanical ability was of a high standard, was placed in charge. In connection with the provision of special instruments and apparatus for the fighting services during the war, he was specially exempted from military service. From 1920 to his death, which occurred on February 20th, 1923, at the age of 45 years, he held the rank of Principal Assistant. Mr. James was a "Jack-of-all-trades," if that epithet may be used in a complimentary sense; he was not only a skilful worker, but he shewed deep insight into scientific principles. Of the various instruments for the construction of which he was responsible, perhaps the twin-lever wind-direction recorder is the best illustration of his skill.

News in Brief

Two new features were introduced into the monthly flysheet (*Supplement to the Daily Weather Report*) with the issue for January, 1923. The first is a diagram shewing the daily rainfall (9h.—9h.) at Kew, the second is a summary of the observations on the state of the ground at 13h., which have, since November, 1922, been published in the *Daily Weather Report*. (See *The Met. Mag.*, Nov., 1922, p. 267).

Mr. Henry Mellish has circulated in pamphlet form an account of *The Weather of 1922 at Hodsock Priory, Worksop*. An interesting feature is the reproduction of the autographic record of the rainfall of August 6th—8th. It shows over 5 inches in a continuous fall of nearly 28 hrs., and 2 inches in 3 hrs.

The City of Nottingham issues an annual bulletin, *The Meteorology of Nottingham*, which contains, in addition to statistics, a large diagram illustrating the variation from day to day of mortality from various causes and of the principal meteorological conditions. The issue for 1922 contains, as well, a chart of the rainfall recorded at Trent Lane Pumping Station on August 6th, nearly 3·5 inches in a continuous fall of 24 hours, and 1·2 inches in 3 hours. (*Cf.* Rainfall at Hodsock Priory noted above.)

Mr. R. C. Mossman reports that on January 20th, 1923, in Buenos Aires the maximum temperature in the shade was 104° F., the highest on record for that city.

On Friday, March 2nd, Dr. G. C. Simpson, C.B.E., F.R.S., delivered a lecture at the Royal Institution on *The Water in the Atmosphere.*

Mr. A. Watters, 14, Park Avenue North, Hornsey, N. 8, has complete copies of *Symons's Monthly Meteorological Magazine* from 1906-1912, 1915, and some odd numbers, which he would be glad to sell or to exchange for volumes prior to 1903.

Meteorological Office—Staff News.—On Tuesday, March 6th, a team representing the Meteorological Office defeated a team representing the Directorate of Equipment in the first round of the " Air Ministry Inter-departmental Football Cup."

The Weather of February, 1923

THE maps of the *Daily Weather Report* for February show very little variation, a deep depression to the westward of the British Isles persisting throughout the month.

The weather generally was mild and wet. During the first four days temperature was remarkably high for the time of year. At Kew Observatory, for example, a minimum of 51° F. was recorded on three successive nights. The character of the month is well shown by the statistics of the state of the ground (see page 43). The ground was muddy for more than half the month at most places, and at Valencia, Benson and London was "wet" or "muddy" on every day. Thunder was heard in London on the 21st, and elsewhere locally on a few other occasions. Strong gales, mainly southerly, were prevalent—especially so in the north-east of Scotland ; gale force was reported from Wick on no less than seventeen days. The most notable gales occurred about the 6th and 7th, and again on the 26th and 27th.

The total rainfall was in excess of the average everywhere except in the north-west of Scotland. In nearly all southern districts more than twice the average fell, and this was also the case in the east of Scotland, whilst a large area extending from the north of Cornwall to Staffordshire, and parts of the east of Scotland had more than three times their normal fall. In many places, especially in the districts last mentioned, the rainfall of the month was the highest ever known to have occurred in February, this being the case in records covering 105 years at Ross-on-Wye, 80 years at Cirencester, 70 years at Bristol and 59 years at Wolstaston, in Shropshire. The conditions appear to have been similar to those in February, 1915, when more than three times the average occurred in western Aberdeenshire and more than twice the average fell over the greater part of the south of England and Wales. There is no doubt that February, 1923, was the wetter month of the two.

The general rainfall in the British Isles, expressed as a percentage of the average, was: England and Wales, **245**; Scotland, **160**; Ireland, **205**; British Isles, **211**.

During the month abnormally warm weather was experienced in Central Europe. The heavy falls of snow reported in the Alps during January continued until the 3rd, and the warm weather set great masses of snow in motion, causing avalanches in which several lives were lost. On the 6th there was a great landslide into the Davoser See. The melting of the snow caused heavy floods in the Danube; parts of Linz were flooded on the 3rd, and the floods reached Vienna on the 5th and Buda Pesth on the 14th, the waterworks at the latter city being flooded. In southern France, on the other hand, the beginning of the month was marked by a drought, and at Montpellier prayers for rain were offered on the 4th.

In North America the month was severe and stormy. On the 6th temperature fell to $-51°$ F. in north-west Ontario—the lowest temperature on record in that region. There was a great ice-jam on the St. Lawrence, and from the 7th to 9th, following the passage of a deep depression, a cold wave spread over the greater part of the United States. From the 14th to 16th a severe storm crossed the northern States, doing much damage and causing wrecks on the Pacific and Atlantic coasts. Very low temperatures were recorded.

An unusually heavy rainstorm visited Aden on the 14th, giving a valuable supply of water. About the same time heavy rains visited the Orange Free State, and up to the 14th the total fall for 1923 already exceeded the rainfall of the whole of 1922. There has been damage to railways and roads, but this was more than compensated by the benefit to agriculture. On the 24th heavy rains were reported from south-west Africa, flooding the Fish and Orange Rivers. On the 25th the Zambesi was in flood, interrupting railway communication.

In Brazil rainfall was heavy in the north, including the dry north-eastern region, averaging 85 mm. above normal. In central Brazil the fall averaged 36 mm. above normal, and in the south, exclusive of Rio Grande, 26 mm. above. The latter State had a deficit amounting to 42 mm. The only unusual feature of the "circulation" was the continual absence of intense high pressure systems. The coffee crop is in excellent condition. At Rio de Janeiro pressure was 2·4 mb. above normal, and temperature 0·3° F. below normal.

Rainfall Table for February, 1923

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent. of Av.
Lond.	Camden Square	3·04	77	182	*Leics*	Leicester Town Hall	3·21	81	...
Sur .	Reigate, Hartswood	3·95	100	...	,,	Belvoir Castle	3·37	85	202
Kent.	Tenterden, View Tower	3·90	99	198	*Rut* .	Ridlington	3·59	91	...
,,	Folkestone, Boro. San.	...	...	...	*Linc.*	Boston, Skirbeck	3·16	80	216
,,	Broadstairs	...	...	...	,,	Lincoln, Sessions House	3·74	95	258
,,	Sevenoaks, Speldhurst.	3·92	100	...	,,	Skegness, Estate Office.	3·37	86	...
Sus .	Patching Farm	5·03	128	228	,,	Louth, Westgate	4·27	109	222
,,	Eastbourne, Wilm. Sq.	4·11	104	...	,,	Brigg	3·40	86	198
,,	Tottingworth Park	4·53	115	...	*Notts.*	Worksop, Hodsock	4·09	104	266
Hants	Totland Bay, Aston	4·70	119	232	*Derby*	Mickleover, Clyde Ho.	4·13	105	250
,,	Fordingbridge, Oaklnds	6·89	175	276	,,	Buxton, Devon. Hos.	7·04	179	188
,,	Portsmouth, Vic. Park.	4·88	124	240	*Ches.*	Runcorn, Weston Pt.	4·76	121	256
,,	Ovington Rectory	7·36	187	283	,,	Nantwich, Dorfold Hall	4·55	116	...
,,	Grayshott	6·53	166	255	*Lancs*	Bolton, Queen's Park	6·27	159	...
Berks	Wellington College	4·15	105	221	,,	Stonyhurst College	5·47	139	163
,,	Newbury, Greenham	4·68	119	213	,,	Southport, Hesketh	3·80	97	...
Herts.	Bennington House	3·68	94	...	,,	Lancaster, Strathspey.	5·15	131	...
Bucks	High Wycombe	4·12	105	223	*Yorks*	Sedbergh, Akay	7·76	197	175
Oxf.	Oxford, Mag. College	3·35	85	212	,,	Wath-upon-Dearne	4·55	116	277
Nor	Pitsford, Sedgebrook	4·23	107	253	,,	Bradford, Lister Pk.	6·09	155	260
,,	Eye, Northolm	2·59	66	...	,,	Oughtershaw Hall	11·42	290	...
Beds.	Woburn, Crawley Mill.	3·04	77	208	,,	Wetherby, Ribston H.	4·79	122	277
Cam.	Cambridge, Bot. Gdns.	2·13	54	...	*ERY*	Hull, Pearson Park	4·15	105	250
Essex	Chelmsford, CountyLab	2·92	74	...	,,	Holme-on-Spalding	3·69	94	...
,,	Lexden, Hill House	3·18	81	...	,,	Lowthorpe, The Elms.	4·00	102	221
Suff.	Hawkedon Rectory	2·85	72	187	*NRY*	West Witton, Ivy Ho.	6·37	162	...
,,	Haughley House	2·89	73	...	,,	Pickering, Hungate	4·38	111	...
Norf.	Beccles, Geldeston	3·38	86	247	,,	Middlesbrough	2·04	52	157
,,	Norwich, Eaton	3·54	90	216	,,	Baldersdale, Hury Res.	5·29	134	171
,,	Blakeney	2·71	69	183	*Durh.*	Ushaw College	4·12	105	258
,,	Swaffham	3·78	96	241	*Nor* .	Newcastle, Town Moor.	3·47	88	219
Wilts.	Devizes, Highclere	5·25	133	...	,,	Bellingham Manor	4·37	111	...
Dor	Evershot, Melbury Ho.	9·10	231	290	,,	Lilburn Tower Gdns.	4·80	122	271
,,	Weymouth, Westham.	5·55	141	...	*Cumb*	Penrith, Newton Rigg.	...	...	...
,,	Shaftesbury, Abbey Ho.	5·90	150	255	,,	Carlisle, Scaleby Hall.	3·39	86	...
Devon	Plymouth, The Hoe	6·90	175	238	,,	Seathwaite	18·10	460	152
,,	Polapit Tamar	10·11	257	315	*Glam.*	Cardiff, Ely P. Stn.	8·79	223	293
,,	Ashburton, Druid Ho.	12·12	308	256	,,	Treherbert, Tynywaun	20·75	527	...
,,	Cullompton	8·61	219	308	*Carm*	Carmarthen Friary	8·84	225	239
,,	Sidmouth, Sidmount	5·89	150	236	,,	Llanwrda, Dolaucothy.	11·64	296	267
,,	Filleigh, Castle Hill	9·40	239	...	*Pemb*	Haverfordwest, Portf'd	...	...	...
,,	Hartland Abbey	7·54	191	...	*Card.*	Gogerddan	8·40	213	265
Corn.	Redruth, Trewirgie	9·17	233	242	,,	Cardigan, County Sch.	10·08	256	...
,,	Penzance, Morrab Gdn.	7·55	192	226	*Brec.*	Crickhowell, Talymaes	11·25	286	...
,,	St. Austell, Trevarna	9·35	237	243	*Rad.*	Birm. W.W. Tyrmynydd	13·93	354	266
Som	Street, Hind Hayes	5·98	152	...	*Mont.*	Lake Vyrnwy	12·24	311	...
Glos.	Clifton College	8·53	217	361	*Denb.*	Llangynhafal	3·76	95	...
,,	Cirencester	6·09	155	262	*Mer.*	Dolgelly, Bryntirion	13·22	336	297
Here	Ross, County Obsy.	6·69	170	333	*Carn.*	Llandudno	4·54	115	218
,,	Ledbury, Underdown.	5·66	144	...	,,	Snowdon, L. Llydaw 9	22·40	569	...
Salop	Church Stretton	7·07	180	321	*Ang.*	Holyhead, Salt Island.	4·83	123	198
,,	Shifnal, Hatton Grange	4·88	124	301	,,	Lligwy	4·94	125	...
Staff.	Tean, The Heath Ho.	5·41	137	269	*Man.*	Douglas, Boro' Cem.	4·71	120	144
Worc.	Ombersley, Holt Lock.	4·92	125	300	*Guer.*	St. Peter Port, Grange.	6·47	164	263
,,	Blockley, Upton Wold.	5·96	151	263	*Wigt.*	Stoneykirk, Ardwell Ho	5·87	149	224
War	Farnborough	4·95	126	240	,,	Pt. William, Monreith.	5·82	148	...
,,	Birminghm, Edgbaston	5·88	149	348	*Kirk.*	Carsphairn, Shiel.	9·11	231	...

Rainfall Table for February, 1923—*continued*

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent. of Av.
Kirk.	Dumfries, Cargen	6·56	167	169	*Caith*	Loch More, Achfary	4·58	116	69
Dum	Drumlanrig	6·25	159	164	,,	Wick	2·44	62	107
Roxb	Branxholme	5·37	136	204	*Ork.*	Pomona, Deerness	3·65	93	121
Selk.	Ettrick Manse	7·15	182	...	*Shet.*	Lerwick	4·51	115	143
Berk.	Marchmont House	4·23	107	203	*Cork.*	Caheragh Rectory	13·83	351	...
Hadd	North Berwick Res.	2·83	72	181	,,	Dunmanway Rectory	12·28	312	210
Midl	Edinburgh, Roy. Obs.	2·33	59	149	,,	Ballinacurra	6·87	175	184
Lan.	Biggar	3.88	99	162	,,	Glanmire, Lota Lo.	9·18	233	232
Ayr.	Kilmarnock, Agric. C.	3·71	94	129	*Kerry*	Valencia Obsy.	...	...	...
,,	Girvan, Pinmore	7·23	184	169	,,	Gearahameen	18·80	477	...
Renf.	Glasgow, Queen's Pk.	3·82	97	130	,,	Killarney Asylum	...	...	...
,,	Greenock, Prospect H.	7·24	184	129	,,	Darrynane Abbey	8·56	217	185
Bute.	Rothesay, Ardencr'g.	5·95	151	149	*Wat.*	Waterford, Brook Lo.	7·12	181	218
,,	Dougarie Lodge	7·06	179	...	*Tip.*	Nenagh, Cas. Lough	5·86	149	188
Arg.	Glen Etive	...	...	...	,,	Tipperary	7·11	181	...
,,	Oban	5·19	132	...	,,	Cashel, Ballinamona	6·10	155	191
,,	Poltalloch	5·91	150	141	*Lim.*	Foynes, Coolnanes	6·16	156	193
,,	Inveraray Castle	8·08	205	119	,,	Castleconnell Rec.	6·17	157	...
,,	Islay, Eallabus	7·19	183	172	*Clare*	Inagh, Mount Callan	10·65	271	...
,,	Mull, Benmore	8·60	218	...	,,	Broadford, Hurdlest'n.	6·30	160	...
,,	Mull, Quinish	...	...	...	*Wexf*	Gorey, Courtown Ho.	6·33	161	225
Kinc.	Loch Leven Sluice	4·61	117	163	*Kilk.*	Kilkenny Castle	6·02	153	...
Perth	Loch Dhu	10·10	257	136	*Wic.*	Rathnew, Clonmannon	7.23	184	...
,,	Balquhidder, Stronvar.	9·70	246	136	*Cars.*	Hacketstown Rectory	7·06	179	235
,,	Crieff, Strathearn Hyd.	5·25	133	149	*QCo.*	Blandsfort House	5·96	151	222
,,	Blair Atholl	6·89	175	250	,,	Mountmellick	5·63	143	...
,,	Coupar Angus School	6·43	163	303	*KCo.*	Birr Castle	4·78	121	...
Forf.	Dundee, E. Necropolis	4·85	123	258	*Dubl.*	Dublin, FitzWm. Sq.	5·78	147	306
,,	Pearsie House	...	...	...	,,	Balbriggan, Ardgillan	5·57	141	284
,,	Montrose, Sunnyside	4·94	125	268	*W.M*	Athlone, Twyford	...	...	...
Aber.	Braemar Bank	9·82	249	360	,,	Mullingar, Belvedere	5·68	144	204
,,	Logie Coldstone Sch.	5·94	151	286	*Long*	Castle Forbes Gdns.	5·71	145	201
,,	Aberdeen, Cranford Ho	6·35	161	274	*Gal.*	Galway, Waterdale	5·85	149	...
,,	Fyvie Castle	7·70	196	...	,,	Ballynahinch Castle	...	...	...
Mor.	Gordon Castle	4·07	103	212	,,	Woodlawn	...	...	...
,,	Grantown-on-Spey	2·29	58	108	*Mayo*	Crossmolina, Enniscoe	...	...	...
Na.	Nairn, Delnies	1·41	36	78	,,	Blacksod Point	...	...	...
Inv.	Ben Alder Lodge	8·72	221	...	,,	Westport House	9·60	244	243
,,	Kingussie, The Birches	3·25	83	...	,,	Delphi Lodge	15·81	402	...
,,	Fort Augustus	3·54	90	85	*Sligo*	Markree Obsy.	5·03	128	147
,,	Loch Quoich, Loan	8·11	206	...	*Ferm*	Enniskillen, Portora	5·25	133	...
,,	Glenquoich	7·44	189	72	*Arm.*	Armagh Obsy.	5·42	138	...
,,	Inverness, Culduthel R.	1·40	36	...	*Down*	Warrenpoint	...	...	...
,,	Arisaig, Faire-na-Squir	2·87	73	...	,,	Seaforde	7·95	202	261
,,	Fort William	6·33	161	85	,,	Donaghadee	5·72	145	249
,,	Skye, Dunvegan	3·60	91	...	,,	Banbridge, Milltown	4·38	111	211
,,	Barra, Castlebay	2·36	60	...	*Antr.*	Belfast, Cavehill Rd.	5·27	134	...
R&C	Alness, Ardross Cas.	3·95	100	120	,,	Glenarm Castle	8·90	226	...
,,	Ullapool	3·22	82	...	,,	Ballymena, Harryville	4·73	120	146
,,	Torridon, Bendamph	5·17	131	65	*Lon.*	Londonderry, Creggan	3·57	91	112
,,	L. Carron, Plockton	2·60	66	...	*Tyr.*	Donaghmore	5·20	132	...
,,	Stornoway	4·12	105	92	,,	Omagh, Edenfel	7·84	199	263
Suth.	Dunrobin Castle	...	...	...	*Don.*	Malin Head	4·17	106	173
,,	Lairg	4·87	124	...	,,	Letterkenny Hos	5·16	131	139
,,	Forsinard	...	...	...	,,	Dunfanaghy	...	...	...
,,	Tongue Manse	2·59	66	74	,,	Narin, Kiltoorish	4·58	116	...
,,	Melvich School	3·24	82	108	,,	Killybegs, Rockmount	5·80	147	116

Climatological Table for the British Empire, September, 1922

STATIONS	PRESSURE: Mean of Day M.S.L.	PRESSURE: Diff. from Normal	TEMPERATURE: Absolute Max.	TEMPERATURE: Absolute Min.	TEMPERATURE: Mean Values Max.	TEMPERATURE: Mean Values Min.	TEMPERATURE: Mean Values ½ max. and min.	TEMPERATURE: Mean Values Diff. from Normal	TEMPERATURE: Mean Wet Bulb.	Relative Humidity	Mean Cloud Am'nt	PRECIPITATION: Am'nt	PRECIPITATION: Diff. from Normal	PRECIPITATION: Days	BRIGHT SUNSHINE: Hours per day	BRIGHT SUNSHINE: Percentage of possible.
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1015·5	− 1·3	71	39	62·0	47·3	54·7	− 2·4	52·8	79	6·8	40	− 8	12	3·6	28
Gibraltar	1017·3	+ 1·5	81	57	75·2	63·7	69·5	− 2·9	63·9	75	3·9	43	+ 7	3	...	...
Malta	1015·6	− 0·1	90	66	80·5	71·1	75·8	+ 0·5	69·4	73	3·7	2	− 28	2	8·0	64
Sierra Leone	1012·8	+ 0·2	89	70	83·3	72·7	78·0	− 1·2	73·7	83	8·7	975	+250	28	...	...
Lagos, Nigeria	1011·6	− 1·2	86	72	83·4	74·4	78·9	+ 0·8	75·3	81	8·3	288	+158	24	...	...
Kaduna, Nigeria	1012·3	− 0·5	88	...	82·3	...	...	...	68·6	77	...	272	+ 12	20	...	...
Zomba, Nyasaland	1014·1	+ 0·3	90	52	81·8	59·5	70·7	+ 1·6	...	75	4·5	6	− 3	2	...	...
Salisbury, Rhodesia	1012·9	− 1·8	93	43	84·6	52·5	68·5	+ 2·3	54·4	41	1·5	1	− 7	1	...	...
Cape Town	1019·3	+ 0·2	77	42	66·2	50·2	58·2	+ 0·3	55·5	77	4·8	22	− 35	5	...	...
Johannesburg	1018·3	+ 1·1	81	35	72·0	48·5	60·3	+ 1·0	48·6	56	2·3	15	− 9	6	9·2	77
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Calcutta, Alipore Obsy.	1003·3	− 1·2	92	75	87·2	78·1	82·7	− 0·3	†78·9	†90	†8·6	544	+ 281	*17	...	...
Bombay	1007·1	− 0·9	87	74	84·1	76·4	80·3	− 0·4	76·0	80	6·7	189	− 86	*24	...	...
Madras	1005·4	− 1·1	99	74	95·2	78·1	86·7	+ 1·6	†76·6	†66	†4·5	48	− 83	*7	6·8	...
Colombo, Ceylon	1010·2	+ 0·6	88	74	85·6	76·7	81·1	− 0·3	76·6	70	9·0	35	− 91	13	...	...
Hong Kong	1006·5	− 1·8	91	70	85·7	76·5	81·1	+ 0·1	75·3	78	6·0	252	+ 6	15	6·8	56
Sandakan	...	...	91	72	88·3	74·5	81·4	− 0·3	...	...	...	364	+125	12	...	...
Sydney	1017·1	+ 1·1	81	46	67·2	52·1	59·7	+ 0·7	55·1	67	5·6	107	+ 33	15	6·1	51
Melbourne	1017·3	+ 1·5	76	35	61·5	44·1	52·8	− 1·3	50·3	70	5·7	64	+ 3	14	...	...
Adelaide	1017·5	0·0	84	38	66·1	47·5	56·8	− 0·2	50·3	60	4·9	41	− 9	8	5·8	49
Perth, W. Australia	1017·4	− 0·5	79	43	66·4	49·0	57·7	− 0·4	54·8	71	5·0	56	− 29	18	7·0	59
Coolgardie	1016·4	− 0·7	87	37	70·9	46·1	58·5	− 0·1	52·5	47	4·1	14	− 1	3	...	...
Brisbane	1016·5	− 0·6	82	48	73·8	54·8	64·3	− 1·0	60·5	68	3·7	85	+ 33	11	...	...
Hobart, Tasmania	1016·7	+ 6·0	67	35	58·8	43·8	51·3	+ 0·5	47·0	67	6·2	18	− 36	15	6·4	54
Wellington, N.Z.	1021·3	+ 7·8	67	33	59·0	44·8	51·9	+ 0·4	47·7	73	5·4	64	− 35	11	6·2	53
Suva, Fiji	1013·2	− 1·1	87	64	83·2	67·8	75·5	+ 1·0	74·4	83	7·5	322	+145	17	...	...
Kingston, Jamaica	1012·4	− 0·2	93	71	90·5	73·3	81·9	+ 0·4	...	78	6·3	18	− 86	7	...	...
Grenada, W.I.	1012·3	+ 0·5	88	72	85·5	75·3	80·4	+ 0·2	75·9	79	4·3	191	− 14	22	...	...
Toronto	1019·2	+ 1·4	93	35	73·6	53·4	63·5	+ 4·3	56·5	78	3·8	76	− 5	9	...	...
Winnipeg	1015·7	+ 0·9	85	32	68·1	47·1	57·6	+ 4·2	54·7	78	5·9	76	+ 26	10	...	...
St. John, N.B.	1018·6	+ 1·1	75	32	61·4	47·8	54·6	− 1·3	51·1	84	5·0	40	− 55	5	...	...
Victoria, B.C.	1016·2	− 0·3	79	46	63·9	50·3	57·1	+ 1·5	53·0	88	5·0	45	− 6	11	...	...

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen. † Observations taken at 8 *h.* from September, 1922.

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The Nature of Atmospherics

BY F. J. W. WHIPPLE, M.A.

THE nature of atmospherics, the electrical disturbances which interfere at times with the reception of "wireless" messages, is a subject of interest to meteorologists as well as to the electricians whose aim it is to eliminate the effects of the disturbances in the practice of telegraphy. Some atmospherics are no doubt due to distant thunderstorms, but whether they can originate in the atmosphere without the occurrence of lightning, and whether they have sometimes an extra-terrestrial source are open questions. Hitherto, the principal difficulty in coming to close grips with the subject has lain in our ignorance of the nature of the electric waves. In a paper which has just been published*, Messrs. Watt and Appleton record their success in overcoming this difficulty, success which is in part to be attributed to the use of a new type of cathode ray oscillograph made by the Western Electric Company.

To analyse electric waves of extremely short duration, such oscillographs as are used for ascertaining the wave-form in the alternating currents made by dynamos and which depend on the movement of a galvanometer mirror are obviously unsuitable. In the cathode ray oscillograph there is a jet of electrons which plays on a fluorescent surface. This jet can be deflected by the application of transverse electric forces, and the variation of these forces is shewn by the movements of a bright spot on the fluorescent surface. The apparatus is connected up in such a

* *Proc. Roy. Soc.* A. April, 1923, pp. 84-102.

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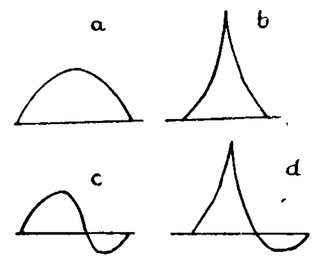
way that regular oscillations of known periods move the spot right and left whilst the electric force to be investigated moves the spot up and down. Owing to the persistence of vision the path of the spot is seen as a bright curve.

In the researches under review, which were conducted by Watt and Appleton at the Radio Research Board Station at Aldershot, the atmospherics were caught by an aerial 500 metres long and 15 metres above ground. The characteristic wave-forms which were observed are shewn in the accompanying figure.



It will be seen that there are various types; the waves are either aperiodic, the disturbance rising to a maximum and then falling rather more slowly, or quasi-periodic, the disturbance rising to a maximum, falling to zero and changing sign. In either case the disturbance can be positive or negative, driving positive electricity downwards from aerial to earth or *vice versa*, and again the wave form may be peaked or rounded. Of the aperiodic waves the negative types are by far the more frequent ; the numbers of quasi-periodic and aperiodic atmospherics are about equal. The rounded waves in either of these forms are nearly 2½ times as frequent as the peaked. The crest of the wave corresponds most frequently with a vertical gradient of about 4 volts per 100 metres ; the highest voltage recorded was 80 volts per 100 metres. Peaked waves give higher voltages than rounded waves, the ratio being a little higher than 2 to 1.

The duration of the atmospherics is found to be of the order of two-thousandths of a second. The lengths of the waves in space must therefore be comparable with 600 kilometres. The fluctuations in voltage involved in atmospherics are quite modest when compared with the persistent gradient of electric force in the atmosphere, though enormous in comparison with the fluctuations produced by radiotelegraphic signals. The normal vertical gradient of electric potential is of the order 20,000 volts per 100 metres, so that in one sense the atmospheric represents a mere ripple. On the other hand, the gradients produced by transatlantic radio signals are of the order of ·0005 volt per 100 metres, and very strong signals run to ·1 volt per 100 metres. In comparison with these signals the atmospheric is a tidal wave.

It will be seen that a wide field of investigation has been opened up. Considering that the new and improved cathode ray oscillograph of the Western Electric Company was exhibited in this country for the first time only in November last, it is remarkable that such far-reaching results should have been obtained with it already.

The improvement in question by which the cathode rays are made to give a small bright spot on the fluorescent screen is very pretty; but that is another story.†

Winter Thunderstorms.

By Captain C. K. M. Douglas, M.A.

RECENT discussion of the causes of winter thunderstorms has centered on the relative importance of the vertical and horizontal temperature gradients. The two factors may clearly operate together, and it will probably prove difficult to estimate their precise influence without some knowledge of the lapse-rate of temperature. Since actual observations of upper air temperature are not as a rule available, it would be valuable if more detailed information of cloud forms could be obtained. The winter thunderstorms are often accompanied by large cumulo-nimbus clouds with "anvil" tops similar to those of summer, which are visible for a considerable distance, and are seldom limited to one locality. I have fairly frequently flown near or through the tops of "anvils" in winter, occasionally on days when thunder occurred in the neighbourhood, and found that the tops usually reached the 4-kilometre level and often exceeded it, though of course the average height was less than in summer. The lapse-rate of temperature up to the 4-kilometre level on these occasions was always fully up to the saturated adiabatic rate, which in winter implies a lapse-rate considerably above normal. Though a horizontal temperature difference may well cause violent convection in the lower air, and consequent thunder, it seems hardly possible that the strong upward current could reach 4 kilometres unless the lapse-rate were sufficiently high. The vertical currents which produce large cumulo-nimbus clouds are of course quite different from the mass movements up surfaces of discontinuity.

At Eskdalemuir Observatory in the winter 1921-22, a careful watch was kept for the large cumulo-nimbus form, and it was seen on the great majority of the days when thunder was reported at Scottish stations within 100 miles. Observations of upper air temperature at Leuchars or Baldonnell were available on

† *Physical Society, Proc.*, 35 (2) p. 122, *Feb.* 1923.

only five of the days when thunder occurred at any Scottish station reporting to the Meteorological Office, and it is noteworthy that on every occasion the lapse-rate was high to the limit of the ascent. On the other hand there were several days when surface temperature over Scotland was uniform and rather low and thunder occurred locally, and on three occasions (Dec. 20th, 1921, Feb. 27th and 28th, 1922) at a considerable number of places. The only other equally widespread storm during the winter in Scotland was of true line-squall type, on the evening of Feb. 26th. On the whole, the facts support the conclusion of Mr. E. V. Newnham* that for the majority of the storms the primary factor is a high lapse-rate of temperature, caused by a cold current passing over a warm sea. The fact that individual storms may develop some of the characteristics of line-squalls is quite consistent with this conclusion.

Captain Cave† has shown that during the first three months of the four years which he investigated, storms occurred on as many as 41 per cent. of the days. It is obviously unlikely that the lapse-rate of temperature was high up to 4 kilometres on all these days, but it may easily have been high on most of them, for the upper air temperature fluctuates so rapidly in stormy weather that it might be low at the time of a thunderstorm, but not for a 24-hour period. Strong evidence in favour of a predominance of high lapse-rates near the surface off our west coasts in winter is provided by the observations of air and sea temperature plotted in the *Daily Synoptic Charts of the North Atlantic* published by the Deutsche Seewarte and the Danish Meteorological Institute. Taking for example the first three months of 1910, we find that out of 864 observations between the parallels of 45° N and 60° N and the meridians of 10° W and 40° W, the air temperature at deck level (read to nearest degree C.) was lower than the sea temperature (read to nearest tenth) on 658 occasions, and that on 533 occasions, or 62 per cent. of the total, the air temperature was as much as a degree lower. The predominance of cases with the air colder than the sea was particularly well marked during stormy periods in January and February when thunderstorms were frequent in the west. For example during the period February 13th to 22nd the proportion rose to 90 per cent., and on the average of all observations in that period the air was as much as 4° C. (7° F.) colder than the sea.

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* *Professional Notes No.* 29, M.O. 245 i.

† *Q. J. R. Met. Soc.*, xlix, No. 205, p. 43.

OFFICIAL NOTICE

Summer Time

"SUMMER TIME" will begin this year on April 22nd and will continue until September 16th. Observers are reminded that it is important to state explicitly the standard of time on all communications with regard to natural phenomena observed during the summer months.

Discussions at the Meteorological Office

March 19th, 1923. *Classification détailée des nuages à l'Observatoire de Montsouris.* By Louis Besson (Ann. des Services Techniques d'Hygiène de la Ville de Paris, 1921).

Opener—Captain C. J. P. Cave.

The types of cloud merge so gradually into each other that there is no limit to the number of forms that can be distinguished by the ingenious. The impression left by reading through the list adopted by the Montsouris Observatory is that few observers can hope to master it so as to use it with confidence. There may be advantages, however, in having such a system. If it is used systematically for a considerable period, information as to the frequency with which cirrus, for example, assumes different forms will be gained and deductions as to the importance of certain physical processes may follow. M. Besson has deliberately adopted the rule of not providing photographs to illustrate the classification; the observer has to judge by the written specification. As a guiding principle, words ending in "us" are used to subdivide the broad classes of the international system, whilst words with the termination "um" indicate associated features. As an example we may cite "alto-cumulus globosus; velum." The first term is defined thus: "*Alto-cumulus globosus*, ou ronds, composés de balles sphéroïdales, à contour plus tranché en haut, un peu déchiré en bas. C'est la forme typique et en quelque sorte classique;" for "velum" we have "Voile discontinu *absolument invisible* inférieur à une nappe d'a-cu. serrés, dont il éclipse momentanément les interstices. Lorsqu'on suit à la herse néphoscopique le déplacement d'un bord blanc d'a.-cu., on assiste parfois à la disparition subite de cet objet, qui reparaît généralement une demi-minute ou une minute après. Nous avons été plus d'une fois témoin de ce phénomène, sans avoir jamais pu apercevoir le voile nuageux qui le produit en s'interposant entre l'œil et la nappe moutonnée."

It may be remembered that Mr. R. F. Granger referred to the frequent occurrence of a veil of this type in his paper on *The physical structure of cloud-form in the lower atmosphere**. The convenience of a technical name for such an interesting phenomenon must be admitted. The view taken by Captain Cave and the other speakers who took part in the discussion was, however, that they would have little use for the elaborate nomenclature adopted by M. Besson. It was felt that the first duty of an observatory associated with a weather service was to determine the heights of the clouds, their thickness and their density. For the close study of the distribution of cloud over the country, reports showing the bearing of the clouds from which maps for different heights could be constructed would be of great interest. For such purposes determinations of cloud height at numerous places are desirable.

The opinion was also expressed that such assumptions as are involved in the use of the name alto-cumulus are to be deprecated. If cirro-cumulus, alto-cumulus and strato-cumulus are essentially of the same character and differ only in height it is misleading to use three names. The Commission appointed by the International Meteorological Committee to revise the definitions of clouds will no doubt take such points into consideration. Such work as M. Besson's should prove of great service to the Commission.

Royal Meteorological Society

THE meeting on March 21st at 49, Cromwell Road, South Kensington, was devoted to the customary March lecture, Dr. C. Chree, President, in the chair.

G. M. B. Dobson, M.A.—Characteristics of the atmosphere up to 200 kilometres as obtained from observations of meteors.

The principle theme of Mr. Dobson's lecture was the advance made in our knowledge of the constitution of the upper atmosphere by the discussion of the circumstances in which the kinetic energy of meteors is converted into light. A short account of the method was given in the last issue of *The Meteorological Magazine.*

Two new lines of attack were mentioned in the lecture. One was the separation of the observations of meteors into summer and winter groups. One of the most curious features of these observations is that few meteors vanish in the region between 50 and 60 kilometres above the earth's surface, though a con-

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* *Q. J. R. Met. Soc.*, Vol. xlvii., 1921, p. 271.

siderable proportion of the total get lower than the 50-kilometre level. This characteristic is now found to be especially well marked in the summer, from which fact it may be deduced that the contrast in temperature between the stratosphere and the warmer atmosphere above it (which Mr. Richardson wishes to call the empyrean) is greater in summer than in winter.

The other new development is the application of photography to the determination of meteor tracks. By the exposure of photographic plates for long periods at two stations a few miles apart an occasional meteor may be recorded on both. Moreover the use of a rapidly revolving shutter in one of the cameras provides time marks on the corresponding trail and the speed of the meteor can therefore be obtained with a high order of accuracy. Since eye observations of meteors leave much to be desired in this respect the probable error of the estimate of the time of passage of a meteor, about a second, being of the order of 50 per cent., the application of photography marks a great advance. Mr. Dobson showed an excellent pair of photographs to illustrate his success.

It should be added that the lecture was notable for the skill with which such a technical subject was explained.

Correspondence

To the Editors, *The Meteorological Magazine.*

Black Rain on the Comeragh Mountains

On yesterday morning, March 23rd, I measured 7·7 mm. of seemingly sooty water from our rain-gauge. There is no chimney near it and the direction of the nearest chimney, 100 yards, is south-south-west. The wind was, and had been, north-easterly, hence it was blowing from the gauge to the chimney, which is only a domestic one ; there are no manufactories about. Thursday and Friday were unusually dark and gloomy, the atmosphere at times seemed like that of Manchester or Leeds. I venture to suggest that smoke laden rain-clouds from the Lancashire neighbourhood were precipitated here on Thursday. We had had nine rainless days ; rain began about 8 a.m. on Thursday and continued as mist or rain all day. The rain measuring glass always contains clear pellucid water. I never remember previously seeing it sooty, and regret that at the moment it did not occur to me to preserve it for examination. Since the 14th of March the wind has been mostly from easterly points.

J. Ernest Grubb.

Seskin, Carrick-on-Suir, March 24th, 1923.

Meteorology and Folklore: More about the Wind

To primitive man one of the most surprising facts in Nature was that air, one of the gentlest and most impalpable of natural objects, could also be one of the strongest and most destructive. So we have the tale of the Maruts, or "crushers," who rage over the tree-tops in their fury, with the rain for their garments, but, when their work is done, assume the form of new-born babes. The weird shrieks of the wind have given rise to many a wild tale. The peasants of mediæval England heard the wailing of unbaptized children in the wind, and the Tyrolese tell of the "poor souls" in the autumn storms. Throughout the Teutonic world there is the tale of the "Wild Hunt" of spirits rushing howling through the air on stormy nights. Since the XVIIth century, at least, it has been associated with Christmas in Germany, and in Iceland it is called the Yule host. Often the old Teutonic wind-god Woden is the leader of the Wild Hunt, and in Norway it was once believed that the old Norse gods made war on Christians on Christmas Eve, coming down from the mountains with wild shrieks and great blasts of wind, and carrying off any unsuspecting mortal.

An old writer gives an interesting account of a magic stone in the Fladda Chuan Island, which was regarded as a wind-charm:—

> "There is a chapel in the isle dedicated to St. Columba. It has an altar in the east end and therein a blue stone of a round form on it, which is always moist. It is an ordinary custom, when any of the fishermen are detained in the isle by contrary winds, to wash the blue stone with water all round expecting thereby to procure a favourable wind . . . . And so great is the regard they have for this stone, that they swear decisive oaths upon it."

The Scottish winter-hag was called Cailleach, or "old-wife." She lived on Ben Nevis, where she kept imprisoned a beautiful maiden who was loved by her son. When he eloped with the prisoner, his mother raised storms to keep them apart and prevent the grass from growing. These storms are named in the Gaelic Calendar as the "Pecker," the "Whistle," the "Sweeper," the "Complaint," etc. In the end the son pursued his mother on horseback and she transformed herself into a moist grey stone. (Mackenzie, *Ancient Man in Britain.*)

The classic hierarchy of wind-gods is very familiar. In the Odyssey, Aeolus, their King, dwells upon an island, and when he is visited by Ulysses gives the hero the contrary winds tied up in a bag. The tale is well known how the greedy sailors unfastened the bag to their own undoing. Virgil pictures the winds imprisoned in a cave, from which on one occasion they were released by Juno's malice to vex the pious Aeneas.

CICELY M. BOTLEY.

10, *Wellington Road, Hastings, February 26th*, 1923.

Anti-Solar Rays

THIS phenomenon,* which has been called by Abercromby and several other meteorologists "anti-crepuscular rays," is one of several (including, for example, the will-o'-the-wisp) which figured much more extensively in the older literature of meteorology than they do in the books of to-day. There is a voluminous literature on the subject, dating back to the middle of the 18th century. A partial abstract of this literature will be found in the Article *Les Deux Soleils*, by Henri de Parville, published in *La Nature*, Paris, 1901, deuxième semestre, pp. 419-420. There are cases on record in which rays of this character have been seen extending entirely across the sky.

C. F. TALMAN.

Weather Bureau, Washington, D.C. March 9th, 1923.

NOTES AND QUERIES

Upper Air Reports from Lindenberg

THE monthly report of upper air data published by the Prussian Aeronautical Observatory at Lindenberg, to which reference was made in *The Meteorological Magazine*, December, 1922, is now supplemented by a graphical representation of conditions in the first four kilometres above the surface. Copies for November and December, 1922, have been received in the Meteorological Office.

The variation throughout the month of the height above Lindenberg of surfaces of equal potential temperature is represented on a framework in which abscissæ represent time and ordinates height. The isopleths of potential temperature refer to a standard pressure of 750 mm., and are drawn for intervals of 2° C. Surfaces described as "sliding surfaces" are similarly represented on the same framework. Arrows differentiate those inclined surfaces at which air is moving upwards from those where it is sinking.

The diagrams show the passage past Lindenberg of "warm fronts," "cold fronts" and "occlusions," and a prominent feature is the pronounced dip in the lines of potential temperature during the passage of a "warm sector." They also show that a "sliding surface" of one form or other was practically always to be found in the first four kilometres above Lindenberg. For the purpose of interpreting fully the distribution of potential temperature a knowledge of the distribution of water in the air is required: it would therefore be an improvement if cloud layers and vapour pressure could be indicated on the charts.

* See *The Met. Mag.*, Feb. 1923, pp. 3-5.

The charts are printed rather crudely on indifferent paper, and, as the diagrams run close up to the left-hand edge of the paper, they are not convenient for filing and binding. But in spite of these minor defects the series represents a welcome addition to the synoptic representation of meteorological conditions.

A Detonating Meteor (?)

MYSTERIOUS sounds were heard in the neighbourhood of Seskin, Carrick-on-Suir, on February 1st, 1923, between 16 h. and 17 h., and again at 22 h. Mr. J. Ernest Grubb has collected several reports of this "great noise in the mountains."

The noise is likened to "thunder" and to "lakes overflowing," and to "motor cars or a threshing engine passing along or like a winnowing machine." Another observer agreed that the noise was "like machinery," but says "It was not like thunder." In one case the noise was described as a "great roaring . . . like a storm gathering in the mountains," while another observer, who said the noise was like "the explosion of bombs or thunder," "thought that a battle was going on in Co. Waterford."

The mountains referred to in the different reports are the Comeraghs and Peaks, about eight miles south-west of Seskin, 2,600 feet high.

Mr. Grubb says: "It was *quite* calm here when the noises were heard, 4-5 p.m. There had been a strong breeze or high south-west wind in the forenoon and we had the same south-west wind later up to 9 p.m. or so."

It was thought that military operations in the neighbourhood might have caused these noises, but three armed Republicans, questioned by Mr. Grubb, stated that no battle was taking place on that date, and that they themselves had heard the noises from the mountains. Mr. Grubb adds that the people in Seskin are only too familiar with the sound of the various weapons in use, and that "none of them, or no combination of them, could have created these sounds, besides, they came right out of the mountains where there are neither roads or tracks or men."

Mr. Denning, to whom Mr. Grubb's account has been submitted, accepts the suggestion that the detonation of meteors may have produced the noises,* although there is as yet no more direct evidence.

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* Cf. this magazine for April 1922, p. 269.

Agriculture and Climatology in the Tropics

THE importance of the study of climatology in connection with tropical agriculture is emphasized by two recent publications.

The first of these, *The Forest Officers' Handbook of the Gold Coast,** has been prepared by Major T. F. Chipp, who has lately returned to this country as Assistant Director of Kew Gardens. It contains in Chapter V. a valuable discussion of the climate of the Gold Coast and its relation to forest distribution. The country is divided into four regions, according to the vegetation, namely, Evergreen Forest, Deciduous Forest, Inland Savannah and Coast Savannah, and it is found that, while there is good evidence of a relationship between the annual rainfall and the distribution of the type of vegetation, the number of rain days is also of importance. A heavy annual rainfall falling on comparatively few days is of equal value with a lighter rainfall spread over a larger number of days. This relationship is shown on a diagram in which rainfall is plotted against rain days. A brief calculation shows that the product, *rainfall in inches* × *rain days* is :—Evergreen Forest, greater than 6,500 ; Deciduous Forest, 6,500 to 4,500 ; Inland Savannah, 4,500 to 2,250 ; Coast Savannah, less than 2,250. But owing, presumably, to changes in the rainfall since the forests were established, the limits of the vegetation and rainfall districts do not quite coincide. This is a point of great importance in questions of re-afforestation where the forest has recently been destroyed.

The most marked influence of the forests is in maintaining the relative humidity, and their destruction has the effect of lowering the average humidity, especially during the dry season. As the successful growth of the cocoa, kola and oil-palm crops requires a constantly high humidity, it appears that the almost complete clearing of the country would involve the disappearance of these crops. The duty of the Government is, therefore, to maintain the forested area at such a level as will give to the crops sufficient protection against desiccation, while providing as large an area as possible for agriculture.

The purpose of the second, a paper on *Cane Sugar and Irrigation,*† is to show that the sugar cane crop in Natal would be benefited if the rainfall were supplemented by irrigation, and it includes a valuable discussion of the climatic requirements of this plant. In regions where irrigation is not practised, the rainfall exceeds 42 in. a year, of which the bigger proportion,

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* *The Forest Officers' Handbook of the Gold Coast, Ashanti and the Northern Territories.* By T. F. CHIPP. 9¾ × 6¼. Pp. 150. *Illus.* Published for the Government of the Gold Coast by the Crown Agents for the Colonies. 1922.

† *Cane Sugar and Irrigation.* South African Irrigation Department Magazine. Vol. 1. 1922. Pp. 209-216.

generally more than two-thirds, falls in the warmer half of the year. During this period it is fairly evenly divided and averages more than 4.75 in. per month in all areas. The harvesting and milling must be done in a relatively dry period, otherwise the sugar deteriorates. As regards temperature, the chief limiting factor is frost, and except under special conditions, the crop is limited to the belt between 32° N and 32° S. Within these limits sugar cane is grown at all latitudes, but it is desirable that there should be some seasonal variation in temperature. For this reason the best results are obtained in places such as Cuba and the Hawaiian Islands, which are as far as 20-23° from the Equator.

The paper is accompanied by a valuable table showing the monthly rainfall and the times of planting and harvest in sixteen sugar-growing countries.

The Frost Service of Southern California

A GOOD deal of scepticism has been exhibited in this country as to the practicability of warding off frost by local heating. The question is regarded seriously in the United States and we learn with interest* that as a result of the experience of last year, when half the crop of lemons and oranges in California was cut off by a frost in January, hundreds of thousands of new orchard heaters have been installed in the orange and lemon groves and that "flying squadrons" are being organised to aid the "orchardists" to fire the heaters. There are eight Weather Bureau employees engaged in the work of forecasting frost in Southern California. At 137 of the 204 special temperature stations thermographs are in operation. We do not know how far fruit growers in this country are adopting similar measures to ward off the dreaded spring frosts.

The Meteorological Station on New Year Island

WE learn from Mr. R. C. Mossman that the meteorological and magnetic station which has existed for nineteen years on New Year Island is to be closed. The station, which is near Cape Horn, in 54°39'S was maintained in connection with the lighthouse, and we gather that since the opening of the Panama Canal the traffic round Cape Horn has fallen off so much that the cost of maintaining the light is no longer thought to be justified. The loss of one of the most southerly stations in the world will be regretted by meteorologists. It is deplorable at a time when navigators are learning to appreciate the advantages of obtaining wireless messages from the shore with details

*See the *Bulletin of the American Meteorological Society*, February, 1923.

of the meteorological situation. Data for New Year Island for the years 1902 to 1905 were published by Mr. Mossman in the *Quarterly Journal of the Royal Meteorological Society*, 1920, p. 90 and summaries for 1914 and 1915 are included in the *Réseau Mondial*.

Smoke Abatement Legislation

On Friday, March 23rd, a deputation waited on the Earl of Onslow, Parliamentary Secretary to the Ministry of Health, to discuss the proposed new legislation to prevent excessive pollution of the air by smoke from factory chimneys. The principal spokesman was Professor Bone of the Imperial College of Science. He stated that industry as a whole realised fully the importance of obtaining abatement of smoke nuisance. It should be realised, however, by those who were responsible for the introduction of legislation that they would, unless the very greatest care was taken, imperil the industry of this country and absolutely ruin the commercial efficiency of trade. This could not be the wish of His Majesty's Government, and therefore he urged that legislation should be dropped. He had no wish that attempts to modify and abate the nuisance should also drop, but there were methods by which this could be tackled which would help to the desired result without endangering either the commercial stability of industry or impairing the efficiency of manufacture, and therefore the federation strongly suggested the desirability of going into a much more thorough survey of the problem, not by a new enquiry, but by research and practical examination of the whole of the factors affecting fuel utilization in specific trades.

The Earl of Onslow, in reply, stated that the Government did not desire to produce legislation which imperilled industry, and he would welcome suggestions which might be incorporated in the new Bill for the purpose of giving adequate protection to industry.

Widespread Atmospheric Pollution

On Friday, March 23rd, the most popular steeplechase of the year, the Grand National, was run at Aintree, near Liverpool, in dense haze, which prevented the spectators in the stands from seeing half the race. The dirt-laden air extended over a large area in the north of England and over the Irish Sea, hiding the horizon at the North Wales watering places and, as the letter from Mr. J. E. Grubb, on p. 55 shows, the rain brought down a sooty deposit at Seskin on the far side of Waterford.

Soaring Flight

IN *The Meteorological Magazine* for March, 1921, some account was given of Dr. Hankin's observations of the soaring flight of birds, dragon-flies and flying-fish.

Dr. Hankin had been led to the conclusion that the generally-accepted view that soaring flight depended on the use of ascending currents of air was untenable and that a new force produced by the action of sunlight must be invoked.

Dr. Hankin's views are criticised by Dr. G. T. Walker in a paper published recently* in the *Proceedings of the Cambridge Philosophical Society*. Dr. Walker describes his observations at Simla and in other parts of India. He discusses the variability of wind as shewn by a Dines anemometer and comes to the conclusion that the accelerations of the air are sufficient to provide the requisite forces on the wings of soaring birds. (The argument is open to criticism, however, in that the anemometer shews the variation of the wind at a fixed point not the variation of a point moving with the wind, and, moreover, the vertical movements which are complementary to the horizontal movements in eddies are ignored). The explanation of gliding in ascending air currents is more straightforward, but that does not diminish the charm of Dr. Walker's descriptions of the behaviour of the great birds. He writes: "I fully share Dr. Hankin's view . . . that birds derive a large amount of pleasure from gliding; I have several times at Simla seen the air suddenly filled with scavenger vultures and kites when the only obvious cause was a sudden change in the weather that made the air very turbulent and gave exceptional facilities for gliding."

It would be of interest to have Dr. Walker's explanation of Hankin's observations of the soaring flight of gulls following a steamer, recorded in the same number of the *Proceedings of the Cambridge Philosophical Society*. It appears that the region of "soarability" is not in the rising air immediately behind the boat but in the air further astern. Can it be that the birds prefer to float in the region where the air is travelling horizontally as it moves forward to feed the updraft close to the boat? The birds may be able to take advantage of the fact that this horizontal flow is not only faster near the water than higher up, but also faster than the motion of the boat.

However this may be, we note with interest that Dr. Hankin does not postulate a new force to explain the phenomenon.

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* *Vol. XXI. Part IV,* 1923.

Forecasting of Night Minimum Temperatures from the Temperature and Humidity of the Preceding Afternoon

THE working rule that the lowest air-temperature of the night under a cloudless sky differs but little from the dew-point of the preceding afternoon is familiar. Various attempts to improve on it have been made from time to time. Amongst these may be mentioned that embodied in the formula given in the *U.S. Monthly Weather Review*, August, 1917, p. 407, as representing the experience of Mr. C. A. Donnel at Boise, Idaho, viz. :—

$$T = D - \tfrac{1}{5}(H - 45).$$

In this formula T = expected minimum [Fahrenheit].
D = dew-point at 20h.
H = relative humidity at 20h.

To meet the conditions at the R.A.F. Station at Cranwell, where forecasts have to be made in the early afternoon in connection with the protection of aerodrome equipment, Captain W. H. Pick has modified Donnel's formula, and writes—

$$T = D - \tfrac{1}{4}(H - 63),$$

H and D referring to 15h. This new formula is found to give good results.

In connection with the same investigation Captain Pick has also examined the relation between the temperature recorded by a "grass minimum" thermometer at night and the dew-point of the previous afternoon.

His results are in close accordance with the formula—

$$G = \tfrac{1}{2}(D + 17)$$

where G is the morning reading of the "grass minimum" thermometer, and D is the dew-point the previous afternoon. This formula is appropriate for nights with little cloud and for values of D from 32° F. to 50° F.

Solitary Gusts

MR. R. P. BATTY, who has made an examination of the records from the anemobiagraph at Larkhill, on Salisbury Plain, from January 1st, 1920, reports that only two isolated gusts have been registered during that period.

The first occurred at 11 h. 55 m. on December 22nd, 1921, and was similar to that at Balmakewan described in the February number of this magazine. The gust, which reached 59 miles per hour, rose from a mean wind of 23 miles per hour, the direction veering from SSW to SW by W. Temperature fell 2·5° F., while the barometer, which was previously falling slowly, rose rather less than 1 mb.

The other example, on March 8th, 1922, at 4 h. 55 m., was of a gust of 68 miles per hour, rising from a mean wind of 30 miles per hour. It was preceded, however, by an increased wind speed for about 20 minutes. The wind veered from S to SW by S, and the temperature fell about 2° F. Previous to the gust, pressure was falling at the rate of 5 to 6 mb. per hour, but at the time of the gust it rose slightly before continuing its rapid fall. It should be noted that the barograph is situated about a mile from the anemometer.

Rain from a Clear Sky

An interesting example of the rare phenomenon, rain from a clear sky, was observed by Mr. H. L. Pace, of the Meteorological Office, Cranwell, at Carlton Scroop, near Grantham, at about 20h. on Wednesday, March 21st, 1923. The shower was very slight and lasted only for a minute, but the drops were so large as to be distinctly audible falling on the ground. The sky was quite clear above, the only cloud visible being some strato-cumulus on the horizon. There was no fog, the visibility being fair, and there was hardly any surface wind.

Mr. Pace saw the rain upon coming out of his house and is unable to say whether there had been any cloud shortly before his observation was made. Enquiries have failed to elicit any answer concerning previous cloud from other observers, although there were several such.

There is some doubt as to whether rain can be produced without the previous existence of clouds. Hellmann* believes that many if not all apparent cases are falls from clouds that have passed out of sight. Some books, *e.g.*, Marriott's *Hints*, and the *Meteorological Glossary* state that the term "serein" is to be used for rain without clouds†. Hellmann makes it clear, however, that this is to perpetuate the misapprehension amongst French meteorologists of the older school as to the nature of dew. Serein (derived from the Latin "serum"—late in the day) was the old name for evening dew in contrast to rosée, morning dew.

**Classification of the Hydrometeors*; trans. in *U.S. Monthly Weather Review*, July 1916 and Jan. 1917.

†The *New English Dictionary* quotes from Tyndall's *Heat*, 1870, §. 495. Reference to the original shows that in opposition to authors quoted by Melloni as attributing the "fine rain which sometimes falls in a clear sky after sunset" to radiation of the air, Tyndall attributes it to radiation from "the body itself, whose condensation produces the serein" *i.e.*, presumably from water-vapour or incipient drops.

Radiation from the Sky

RADIATION MEASURED AT BENSON, OXON, 1923.

Unit: one gramme calorie per square centimetre per day.

ATMOSPHERIC RADIATION only (dark heat rays).

Averages for Readings about time of Sunset.

		Jan.	Feb.	Mar.
Cloudless days:				
Number of readings	n	14	6	5
Radiation from sky in zenith ...	πI	429	429	448
Total radiation from sky ...	J	461	488	481
Total radiation from horizontal black surface on earth ...	X	639	680	684
Net radiation from earth ...	X—J	178	192	203

DIFFUSE SOLAR RADIATION (luminous rays).

Averages for Readings between 9 h. and 15 h. G.M.T.

		Jan.	Feb.	Mar.
Cloudless days:—				
Number of readings	n_0	8	5	2
Radiation from sky in zenith ...	πI_0	17	22	29
Total radiation from sky ...	J_0	26	34	40
Cloudy days:—				
Number of readings	n_1	6	6	7
Radiation from sky in zenith ...	πI_1	41	54	89
Total radiation from sky ...	J_1	35	50	72

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

Underground Water Levels for 1922 in the North and South Downs

ATTENTION was drawn in *The Meteorological Magazine* for September, 1922, to the low underground water level then prevailing in the neighbourhood of the North Downs, north of Maidstone. Further investigation by Mr. Spencer Russell shows that the water was maintained at an extremely low level throughout the year. Naylor's Well, Detling, was dry from August to December, and the well at the Croft, Detling, also failed in December. The average depth in these two wells during 1922 was respectively 0·3 ft. and 0·6 ft., the average of the previous 10 years being 11·3 ft. and 17·7 ft. Other wells under observation in the North Downs were still falling in January, 1923. In the South Downs, the wells at Chilgrove and Compton were, however, rising steadily at the end of the year, the rise being maintained during January, 1923.

There is little difference between the rainfalls for October to December of the North and South Downs, the totals at Detling and Chilgrove being 7·16 in. and 7·93 in. The difference in underground water level is probably due to the freer percolation in the Upper Chalk Zone of the South Downs as compared with that in the Middle Chalk of the North Downs.

The International Air Congress, London, 1923

THE meetings of the International Air Congress will take place on June 25th to June 30th at the Institution of Civil Engineers, Great George Street, S.W. 1. A programme of the Congress, containing a form of application for membership is now issued and is to be obtained from *The General Secretary, International Air Congress, London,* 1923, *7, Albemarle Street, W.*1. Papers of interest to meteorologists will be read in Group C, Air Transport and Navigation, which is to discuss such subjects as meteorology and communication, warnings, thunderstorms, instruments and wireless organization for meterological information, and flying in fog.

Review

BRITISH (TERRA NOVA) ANTARTIC EXPEDITION, 1910—1913. *Observations on the Aurora.* By C. S. WRIGHT, 4°, 12 x 9, pp. viii. + 46, *illus.*

Determinations of Gravity. By C. S. WRIGHT. 4°, 12 x 9, pp. 106, *illus.*

Harrison and Sons *for* The Committee of the Captain Scott Antarctic Fund, 1921. *Each* 7s. 6d. *net.*

Mr. C. S. Wright, who co-operated with Dr. Simpson in the meteorological and magnetic observations of Captain Scott's last expedition, has prepared a valuable report on the auroral observations made at Cape Evans, the winter quarters of the expedition, and at Cape Adare.

Cape Evans is comparatively close to the South Magnetic Pole and well inside the belt of greatest frequency of auroræ. Cape Adare is more favourably placed and the phenomenon was more brilliant there as well as more frequent. The daily variation in the position of the aurora is similar at the two stations. The typical sequence is for the aurora to appear as a glow to the ENE and to climb gradually. The arch reaches the zenith soon after midnight and passes over to the NW or SW sectors a little later. Whilst the greatest frequency of auroræ is in the early morning hours the brightest examples and especially those associated with magnetic storms are best seen in the evening. The paper includes a brief discussion of the bearing of the observations on theories of the aurora.

A second paper by the same author is devoted to the determinations of gravity at Cape Evans and at Wellington, Melbourne and Christchurch.

Two matters are of interest to meteorologists. Difficulties were met with in the manipulation of the pendulum apparatus in the ice cave which was utilised the first year. The temperature of the cave varied from $-22°$ F. to $-4°$ F. (243*a* to 253*a*), and the presence of the observer was bound to produce much disturbance of the thermal equilibrium. Hoar-frost in the instrument case seems to have been eliminated after drying the air with calcium chloride for two weeks. In the second year the observations were made in the dark room of the living hut.

The final result of the observations at Cape Evans is that the local value of g was 983·003 cm./sec.^{2} The value assumed in meteorological tables for the latitude in question, 77°38′S, is $980{\cdot}617 \times 1{\cdot}00236$ or 982·93 cm./sec.^{2} *i.e.*, the actual value is the higher by ·01 per cent. and pressures recorded by the mercury barometer and reduced by the ordinary tables must be increased by 0·1 mb. It is hardly necessary to point out that in view of the inevitable uncertainties of barometric observations such a correction is of no importance.

News in Brief

The second triennial meeting of the Pan-Pacific Science Congress is to be held this year in Australia from August 13th to September 3rd. The provisional programme of subjects to be discussed includes "weather cycles and weather forecasting," "tropical diseases and geodesy," and "hygiene and climatology."

It is announced that Scott's ship, the *Discovery*, has been purchased by the Crown Agents for the Colonies on behalf of the government of the Falkland Isles. It will be employed chiefly in research on whaling, but opportunity will also be afforded for scientific work in other directions, particularly in oceanography, meteorology and magnetism.

Two important books have recently been published by the Cambridge University Press, the *Collected Scientific Papers of John Aitken, LL.D., F.R.S.*, edited by the late Dr. C. G. Knott; and *The Air and its Ways*, by Sir Napier Shaw, Sc.D., F.R.S., which takes its title from the Rede Lecture of 1921 and includes, also, other contributions to meteorology for schools and colleges.

It is announced by Royal Decree that as from March 1st, 1923, the Gregorian Calendar will be in use in Greece instead of the Julian. The National Observatory at Athens has been using the Gregorian Calendar for published weather statistics.

Captain C. J. P. Cave, of Stoner Hill, Petersfield, who is collecting reports of winter thunderstorms*, would be glad to receive any accounts of the storm which occurred on the night of Monday, March 26th. He particularly wishes information from Sussex and Surrey.

On March 7th, 1923, Mr. M. de Carle S. Salter delivered a lecture on *Rain* at the North London Collegiate School.

Meteorological Office—Staff News. On Tuesday, March 27th a team representing the Meteorological Office defeated a team representing the Directorate of Research in the second round of the "Air Ministry Inter-departmental Football Cup."

The Weather of March, 1923

MARCH may be roughly divided into three periods, a mild, unsettled week, two weeks of easterly winds and rather cold weather, and a warm week with southerly breezes.

From the 1st to the 7th south-westerly winds were predominant and the weather generally unsettled, although rain was seldom heavy and some days had a fair amount of sunshine.

On the 7th a depression crossed England and an anticyclone developed in its rear, near the Faröes. This "high" moved eastwards and joined the anticyclone over northern Europe. A somewhat cold, "easterly" type of weather prevailed on the whole until the 20th, although on the 13th a trough of low pressure passed rapidly down the Channel, accompanied by heavy rains in London and the south. Towards the end of the month the continental "high" spread further southward, and light, warm, southerly winds and comparatively clear skies were experienced. Unusually high day temperatures were registered about the 27th. At Kew Observatory, Richmond, a maximum of 68° F. occurred on that date. Such a temperature has only once before been recorded there in March during the past 50 years Thunderstorms occurred locally in various parts of England between the 26th and the 29th.

The rainfall of the month was above the average in parts of the south of the British Isles but less than half the average fall in the northern half of Scotland.

*See *The Meteorological Magazine* for January, 1922.

The general rainfall in the British Isles, expressed as a percentage of the average was : England and Wales, 82 ; Scotland, 49 ; Ireland, 85 ; British Isles, 73.

Early in the month stormy weather with much rain and violent thunderstorms occurred in France, and heavy floods were reported on the Seine, parts of Paris being flooded, and on many other rivers from the 1st to about the 8th. There was some loss of life. The drought still continued in Perpignan, where prayers for rain were ordered on the 16th. On the 8th there was an unusual fall of rain at Luxor in Egypt. Very severe floods in Macedonia, southern Serbia and Thessaly from the 15th to 18th were due to heavy rains and to warm winds melting the snow. The River Vardar was especially affected, and there was great loss of life and damage to property.

On the 23rd the Tigris was reported as rising to an unprecedented height in consequence of heavy rains and the melting of snow in Kurdistan ; a day or two later it burst its banks, flooding three hundred square miles of desert and isolating Baghdad.

In North America the month was stormy. A disturbance which developed over the southern Rocky Mountains on the 5th moved eastward deepening rapidly, and caused gales on the coast on the 6th and 7th, with a blizzard in New York. Another storm of exceptional severity moved up the Mississippi valley on the 12th doing widespread damage, with a death-roll of 46. A storm swept the lower Mississippi valley on the 16th, causing 16 deaths, and again on the 19th a severe storm moving north-east caused blizzards and heavy snowfall in the western and central States, Chicago being isolated.

In Buenos Aires the unusually high March temperature of 94° F. recorded on the 12th, was followed by a fall of 36° F. in twelve hours. Pressure rose 5 mb. almost instantaneously. Near the South Orkneys there appears to be much ice.

Heavy rains in Nyasaland in the middle of March did great damage to the tobacco crop, and caused destructive floods on the Zambesi on the 19th and 20th, which interrupted railway communications. On the 26th the floods were subsiding. In Queensland (Australia) the month was one of drought.

The special message from Brazil states that in the north the rainfall averaged 53 mm. below normal. In the centre the distribution was irregular ; in the south the fall averaged 100 mm. above normal, the excess being greatest in the extreme south. Prospects of the coffee crop are good ; cotton is fair but is suffering from a deficiency of rain. There is still an absence of intense anticyclones and the general circulation presents no unusual features . At Rio de Janeiro pressure was 0·5 mb. and temperature 2·9° above normal.

Rainfall Table for March, 1923

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent. of Av.
Lond.	Camden Square	2·39	61	131	*Leics*	Leicester Town Hall	1·40	36	...
Sur .	Reigate, Hartswood	1·97	50	...	,, .	Belvoir Castle	1·19	30	66
Kent.	Tenterden, View Tower	2·16	55	101	*Rut* .	Ridlington	1·63	41	...
,, .	Folkestone, Boro. San.	...	...	...	*Linc*.	Boston, Skirbeck	1·71	43	110
,, .	Broadstairs	...	...	...	,, .	Lincoln, Sessions House	1·49	38	96
,, .	Sevenoaks, Speldhurst.	2·52	64	...	,, .	Skegness, Estate Office.	2·05	52	124
Sus .	Patching Farm	2·66	68	124	,, .	Louth, Westgate	1·79	45	84
,, .	Eastbourne, Wilm. Sq.	2·45	62	108	,, .	Brigg	1·60	41	88
,, .	Tottingworth Park	2·43	62	...	*Notts*.	Worksop, Hodsock	1·77	45	105
Hants	Totland Bay, Aston	1·73	44	83	*Derby*	Mickleover, Clyde Ho.	1·45	37	81
,, .	Fordingbridge, Oaklnds	2·08	53	89	,, .	Buxton, Devon. Hos.	2·29	58	55
,, .	Portsmouth, Vic. Park.	1·67	43	84	*Ches*.	Runcorn, Weston Pt.	1·50	38	74
,, .	Ovington Rectory	2·34	59	90	,, . .	Nantwich, Dorfold Hall	1·53	39	...
,, .	Grayshott	2·61	66	102	*Lancs*	Bolton, Queen's Park .	2·06	52	...
Berks	Wellington College	2·94	75	149	,, . .	Stonyhurst College	1·44	37	39
,, .	Newbury, Greenham	2·50	63	110	,, . .	Southport, Hesketh	1·35	34	60
Herts.	Bennington House	...	...	...	,, . .	Lancaster, Strathspey.	1·19	30	...
Bucks	High Wycombe	2·89	73	148	*Yorks*	Sedbergh, Akay	2·10	53	46
Oxf. .	Oxford, Mag. College	2·66	68	174	,, .	Wath-upon-Dearne	1·59	40	91
Nor .	Pitsford, Sedgebrook	1·89	48	107	,, .	Bradford, Lister Pk.	1·66	42	68
,, .	Eye, Northolm	1·82	46	...	,, .	Oughtershaw Hall	3·20	81	...
Beds.	Woburn, Crawley Mill.	...	...	...	,, .	Wetherby, Ribston H.	2·09	53	107
Cam.	Cambridge, Bot. Gdns.	1·69	43	115	*ERY*	Hull, Pearson Park	1·53	39	84
Essex	Chelmsford, CountyLab	...	...	...	,, .	Holme-on-Spalding	1·67	42	...
,, .	Lexden, Hill House	1·37	35	...	,, .	Lowthorpe, The Elms.	1·32	33	66
Suff .	Hawkedon Rectory	1·39	35	73	*NRY*	West Witton, Ivy Ho.	1·48	38	...
,, .	Haughley House	1·10	28	...	,, .	Pickering, Hungate	1·67	42	...
Norf.	Beccles, Geldeston	1·38	35	80	,, .	Middlesbrough	1·28	33	82
,, .	Norwich, Eaton	1·58	40	83	,, .	Baldersdale, Hury Res.	1·91	49	63
,, .	Blakeney	1·50	38	91	*Durh*.	Ushaw College	1·76	45	80
,, .	Swaffham	1·46	37	82	*Nor* .	Newcastle, Town Moor.	1·89	48	90
Wilts.	Devizes, Highclere	2·13	54	...	,, .	Bellingham Manor	1·46	37	...
Dor .	Evershot, Melbury Ho.	1·59	40	53	,, .	Lilburn Tower Gdns.	1·85	47	77
,, .	Weymouth, Westham.	1·28	33	77	*Cumb*	Penrith, Newton Rigg.	...	...	...
,, .	Shaftesbury, Abbey Ho.	2·00	51	85	,, .	Carlisle, Scaleby Hall .	·80	20	33
Devon	Plymouth, The Hoe	2·13	54	74	,, .	Seathwaite	5·10	129	46
,, .	Polapit Tamar	1·89	48	63	*Glam*.	Cardiff, Ely P. Stn.	2·10	43	65
,, .	Ashburton, Druid Ho.	2·39	61	54	,, .	Treherbert, Tynywaun	3·50	89	...
,, .	Cullompton	1·50	38	55	*Carm*	Carmarthen Friary	2·29	58	60
,, .	Sidmouth, Sidmount	1·44	37	59	,, .	Llanwrda, Dolaucothy.	3·01	77	65
,, .	Filleigh, Castle Hill	1·78	45	...	*Pemb*	Haverfordwest, Portf'd	...	...	...
,, .	Hartland Abbey	1·25	32	...	*Card*.	Gogerddan	...	...	...
Corn.	Redruth, Trewirgie	2·78	70	77	,, .	Cardigan, County Sch. .	1·75	44	...
,, .	Penzance, Morrab Gdn.	2·22	56	69	*Brec*.	Crickhowell, Talymaes	3·00	76	...
,, .	St. Austell, Trevarna	2·60	66	76	*Rad* .	Birm. W. W. Tyrmynydd	3·31	84	62
Som	Street, Hind Hayes	1·54	39	...	*Mont*.	Lake Vyrnwy	2·81	71	66
Glos.	Clifton College	1·53	39	61	*Denb*.	Llangynhafal	·99	25	...
,, .	Cirencester	2·36	60	100	*Mer* .	Dolgelly, Bryntirion	2·25	57	46
Here.	Ross, County Obsy.	...	...	...	*Carn*.	Llandudno	·76	19	35
,, .	Ledbury, Underdown.	1·31	33	69	,, .	Snowdon, L. Llydaw 9	5·00	127	...
Salop	Church Stretton	1·75	44	74	*Ang* .	Holyhead, Salt Island.	1·12	28	43
,, .	Shifnal, Hatton Grange	1·57	40	85	,, .	Lligwy	1·23	31	...
Staff.	Tean, The Heath Ho.	2·26	57	96	*Man*.	Douglas, Boro' Cem.	1·69	43	57
Worc.	Ombersley, Holt Lock.	1·39	35	82	*Guer*.	St. Peter Port, Grange.	2·39	61	97
,, .	Blockley, Upton Wold.	2·25	57	105	*Wigt*.	Stoneykirk, Ardwell Ho	1·45	37	56
War	Farnborough	1·95	49	92	,, .	Pt. William, Monreith .	1·49	38	...
,, .	Birminghm, Edgbaston	...	...	...	*Kirk*.	Carsphairn, Shiel.	4·21	107	...

Rainfall Table for March, 1923—*continued*

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm	Per-cent. of Av.
Kirk.	Dumfries, Cargen	1·96	50	54	*Caith*	Loch More, Achfary	1·09	28	17
Dum	Drumlanrig	2·31	59	62	,, ..	Wick	·72	18	32
Roxb	Branxholme	1·19	30	41	*Ork* .	Pomona, Deerness	·52	13	19
Selk .	Ettrick Manse	2·98	76	...	*Shet* .	Lerwick	·94	24	30
Berk.	Marchmont House	1·03	26	39	*Cork*.	Caheragh Rectory	4·92	125	...
Hadd	North Berwick Res.	·57	15	30	,, ..	Dunmanway Rectory.	4·31	109	88
Midl	Edinburgh, Roy. Obs.	·78	20	44	,, ..	Ballinacurra	3·61	92	127
Lan .	Biggar	1·14	29	46	,, ..	Glanmire, Lota Lo.	4·06	103	131
Ayr .	Kilmarnock, Agric. C.	1·94	49	67	*Kerry*	Valencia Obsy.	...	...	...
,, .	Girvan, Pinmore	2·41	61	64	,, .	Gearahameen	6·30	160	...
Renf.	Glasgow, Queen's Pk.	1·63	41	62	,, .	Killarney Asylum	...	...	...
,, .	Greenock, Prospect H.	3·31	84	69	,, .	Darrynane Abbey	4·13	105	101
Bute.	Rothesay, Ardencr'g.	2·90	74	81	*Wat* .	Waterford, Brook Lo.	...	...	...
,, .	Dougarie Lodge	2·32	59	...	*Tip* .	Nenagh, Cas. Lough	2·87	73	93
Arg .	Glen Etive	...	...	...	,, .	Tipperary	2·61	66	...
,, .	Oban	2·24	57	...	,, .	Cashel, Ballinamona	...	...	...
,, .	Poltalloch	3·10	79	81	*Lim* .	Foynes, Coolnanes	3·15	80	107
,, .	Inveraray Castle	2·92	74	46	,, .	Castleconnell Rec.	3·17	81	...
,, .	Islay, Eallabus	3·13	80	82	*Clare*	Inagh, Mount Callan	4·49	114	...
,, .	Mull, Benmore	2·40	61	...	,, .	Broadford, Hurdlest'n.	3·38	86	...
,, .	Mull, Quinish	1·95	49	44	*Wexf*	Gorey, Courtown Ho.	2·86	73	124
Kinr.	Loch Leven Sluice	1·69	43	57	*Kilk*.	Kilkenny Castle	2·22	56	97
Perth	Loch Dhu	4·30	109	65	*Wic* .	Rathnew, Clonmannon	2·48	63	...
,, ..	Balquhidder, Stronvar.	3·70	94	60	*Cars*.	Hacketstown Rectory.	2·55	65	91
,, ..	Crieff, Strathearn Hyd.	2·31	59	72	*QCo*..	Blandsfort House	...	...	...
,, ..	Blair Atholl	1·71	43	66	,,	Mountmellick	2·62	67	...
,, .	Coupar Angus School	1·49	38	68	*KCo*.	Birr Castle	2·36	60	98
Forf.	Dundee, E. Necropolis.	1·45	37	70	*Dubl*.	Dublin, FitzWm. Sq.	1·14	29	59
,, .	Pearsie House	...	...	...	,, .	Balbriggan, Ardgillan.	1·33	34	66
,, .	Montrose, Sunnyside	1·55	39	75	*W.M*	Athlone, Twyford	...	...	...
Aber.	Braemar Bank	1·27	32	43	,, .	Mullingar, Belvedere.	...	...	...
,, .	Logie Coldstone Sch.	1·07	27	41	*Long*	Castle Forbes Gdns.	1·87	47	63
,, .	Aberdeen, Cranford Ho	1·74	46	67	*Gal* .	Galway, Waterdale	2·41	61	...
,, .	Fyvie Castle	·87	22	...	,, .	Ballynahinch Castle	...	...	...
Mor	Gordon Castle	·59	15	25	,, .	Woodlawn	...	...	...
,,	Grantown-on-Spey	·98	25	37	*Mayo*	Crossmolina, Enniscoe	...	...	...
Na .	Nairn, Delnies	·58	15	31	,, .	Blacksod Point	...	...	...
Inv..	Ben Alder Lodge	3·08	78	...	,, .	Westport House	3·15	80	81
,, .	Kingussie, The Birches	·55	14	...	,, .	Delphi Lodge	6·03	153	...
,, .	Fort Augustus	·90	23	25	*Sligo*	Markree Obsy.	2·85	72	84
,, .	Loch Quoich, Loan	5·20	132	...	*Ferm*	Enniskillen, Portora	2·17	55	...
,, .	Glenquoich	3·55	90	37	*Arm*.	Armagh Obsy.	1·48	37	63
,, .	Inverness, Culduthel R.	...	...	...	*Down*	Warrenpoint	3·09	79	...
,, .	Arisaig, Faire-na-Squir	2·03	52	...	,, .	Seaforde	3·14	80	108
,, .	Fort William	2·67	68	40	,, .	Donaghadee	1·32	33	60
,, .	Skye, Dunvegan	2·72	69	...	,, .	Banbridge, Milltown.	1·23	31	56
,, .	Barra, Castlebay	1·27	32	...	*Antr*.	Belfast, Cavehill Rd.	2·53	64	...
R&C	Alness, Ardross Cas.	1·08	27	33	,, .	Glenarm Castle	2·09	53	...
,, .	Ullapool	·81	21	...	,, .	Ballymena, Harryville	2·31	59	73
,, .	Torridon, Bendamph.	3·16	80	42	*Lon* .	Londonderry, Creggan	1·87	47	58
,, .	L. Carron, Plockton	1·66	42	...	*Tyr* .	Donaghmore	2·05	52	...
,, .	Stornoway	1·27	32	31	,, .	Omagh, Edenfel	3·14	80	100
Suth.	Dunrobin Castle	...	...	...	*Don* .	Malin Head	1·36	35	59
,, .	Lairg	·60	15	...	,, .	Letterkenny Hos	2·52	64	66
,, .	Forsinard	...	...	...	,, .	Dunfanaghy	...	...	...
,, .	Tongue Manse	·93	24	28	,, .	Narin, Kiltoorish	2·96	75	...
,, .	Melvich School	·61	15	21	,, .	Killybegs, Rockmount.	3·80	97	75

Climatological Table for the British Empire, October, 1922

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
	Mean of Day M.S.L.	Diff. from Normal	Absolute Max.	Absolute Min.	Mean Values Max.	Mean Values Min.	Mean Values ½ max. and min.	Mean Values Diff. from Normal	Mean Wet Bulb.			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1017·7	+ 4·0	65	28	54·5	41·9	48·2	− 1·7	45·6	76	5·7	19	− 50	9	3·8	35
Gibraltar	1013·5	− 1·7	82	52	72·9	60·6	66·7	+ 0·2	61·2	75	5·1	149	+ 65	13	...	...
Malta	1014·5	− 1·2	85	61	75·4	67·1	71·3	+ 1·3	66·3	80	4·8	21	− 47	3	6·2	55
Sierra Leone	1012·0	0·0	88	69	85·5	72·5	79·0	− 1·2	74·6	78	7·5	309	− 12	24	...	...
Lagos, Nigeria	1010·4	− 1·3	87	71	84·9	73·7	79·3	+ 0·2	76·1	80	8·2	391	+195	20	...	...
Kaduna, Nigeria	1011·8	− 0·5	90	...	84·8	...	...	...	69·7	76	...	104	+ 44	14	...	...
Zomba, Nyasaland	1010·1	− 0·4	94	55	87·1	63·5	75·3	+ 1·2	...	85	3·5	51	+ 13	7	...	...
Salisbury, Rhodesia	1010·0	− 1·0	94	51	83·7	57·2	70·5	− 0·3	60·5	53	3·4	47	+ 17	13	...	...
Cape Town	1018·3	+ 0·9	93	44	71·0	52·2	61·6	+ 0·6	57·8	64	5·0	38	− 6	12	...	...
Johannesburg	1014·2	+ 0·2	84	36	72·8	50·8	61·8	− 0·8	52·3	61	3·4	80	+ 19	12	8·6	68
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Calcutta, Alipore Obsy.	1010·7	+ 1·3	92	65	86·2	72·8	79·5	− 1·2	74·0	83	3·7	57	− 42	*5	...	...
Bombay	1010·3	+ 0·6	92	74	89·4	76·7	83·1	+ 0·8	†75·3	†80	†2·8	15	− 32	*2	...	...
Madras	1009·8	+ 0·9	97	69	87·4	75·0	81·2	− 0·9	75·8	80	7·2	449	+163	*11	4·3	...
Colombo, Ceylon	1010·3	+ 0·5	88	70	86·4	74·0	80·2	− 0·3	76·4	70	8·4	277	− 80	21	...	...
Hong Kong	1014·2	+ 0·6	84	66	80·5	72·1	76·3	− 0·6	69·8	74	5·6	51	− 74	10	7·2	62
Sandakan	...	...	90	73	87·3	75·1	81·2	− 0·3	76·9	80	...	251	− 3	15	...	...
Sydney	1013·7	− 1·2	95	47	74·3	56·5	65·4	+ 1·9	59·1	56	3·6	82	+ 7	6	8·1	63
Melbourne	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Adelaide	1015·8	− 0·3	103	40	72·7	51·8	62·3	+ 0·4	53·6	51	4·4	43	− 1	11	8·1	65
Perth, W. Australia	1017·3	+ 0·4	95	42	70·8	53·2	62·0	+ 1·1	57·0	62	4·6	30	− 24	12	8·5	66
Coolgardie	1015·1	− 0·1	98	37	79·7	50·3	65·0	+ 1·4	55·1	34	2·9	2	− 17	3	...	...
Brisbane	1015·8	− 0·3	87	54	80·3	61·6	70·9	+ 1·0	65·8	65	3·5	53	− 14	7	...	...
Hobart, Tasmania	1007·6	− 3·0	91	40	63·5	47·0	55·3	+ 1·3	49·1	62	6·7	79	+ 22	23	6·2	47
Wellington, N.Z.	1014·9	+ 2·6	71	37	64·0	50·1	57·1	+ 2·8	52·1	71	5·8	59	− 48	13	7·1	54
Suva, Fiji	1013·6	+ 0·4	88	57	81·5	63·7	72·6	− 3·4	72·9	78	6·7	213	+ 15	13	...	...
Kingston, Jamaica	1011·3	− 0·6	92	69	88·5	72·3	80·4	− 0·1	...	74	4·9	105	− 85	9	...	...
Grenada, W.I.	1011·4	+ 0·4	90	71	85·0	74·3	79·7	− 0·4	75·0	78	3·8	140	− 46	19	...	...
Toronto	1015·6	− 2·4	83	25	58·5	41·1	49·8	+ 2·9	43·7	80	4·0	24	− 38	8	...	...
Winnipeg	1014·5	− 0·8	86	18	53·5	33·6	43·5	+ 2·7	38·2	86	5·5	13	− 25	10	...	...
St. John, N.B.	1011·5	− 5·0	72	25	52·1	38·9	45·5	+ 0·2	42·9	83	6·7	129	+ 14	13	...	...
Victoria, B.C.	1016·2	− 1·4	67	39	56·9	46·5	51·7	+ 1·3	48·8	90	6·5	79	+ 14	15	...	...

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen. † Observations taken at 8 *h.* from October, 1922.

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EDINBURGH ; or from THE METEOROLOGICAL OFFICE, SOUTH KENSINGTON, LONDON, S.W.7.

Light in the Sea.

By M. T. Spence, B.Sc.

During the past few years the scattering and absorption of light in gases and liquids has attracted a good deal of consideration and discussion. At one time it was thought that the scattering of light in the atmosphere was due only to the presence of dust particles, but the somewhat deeper blueness of the sky as seen from a mountain top in comparison with the colour as seen from lower altitudes contradicts this theory. The attenuation of light in the sea has also been ascribed to the presence of extraneous matter in suspension. It is within comparatively recent years that theory and experiment have shown adequately that the molecules of air and the molecules of water do themselves diffuse and absorb light to an extent which goes to explain the greater part of the observed phenomena.

Many years ago the late Lord Rayleigh* showed from theoretical considerations that in a direction at right angles to an incident beam of light the ratio of the intensity of the light scattered by molecules or particles, small compared with the wave length of light, is inversely proportional to the 4th power of the wave length. This result was arrived at from the theory of dimensions and did not depend on any particular theory regarding the nature of the molecules or the nature of light. (It appears doubtful whether these considerations still conform to the conceptions of modern physicists). In a later paper† he showed that, in the absence of dust, " the light scattered from the molecules (of air) would suffice to give us a blue sky not so very

* *Phil. Mag.* 41, 1871, p. 107.
† *Phil. Mag.* 47, 1899, p. 375.

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greatly darker than that actually enjoyed." The theory has been amply confirmed by the laboratory experiments of the present Lord Rayleigh,* who has shown that the magnitude of the scattering by dust-free gases is in agreement with the theory. During the past few years the values of atmospheric transmission co-efficients obtained at Mount Wilson Observatory go to prove that the amount of light scattered in the atmosphere is not greater than would be expected from Lord Rayleigh's consideration of molecular scattering. It appears, therefore, that the blueness of the sky is due to scattering by air molecules rather than by dust. It is also to be expected from Lord Rayleigh's considerations that the light scattered by water should belong essentially to the blue end of the spectrum. Professor Raman† has carried out an experimental investigation of molecular diffraction by water, using distilled water and tap water after repeated filtrations, and has found that "the track of the beam (of light passing through the water) viewed transversely was a blue colour, and it was judged that the greater part of the observed luminosity was probably due to the water itself." The quantitative results of the experiments agreed very closely with what was expected from the theory, and showed that water scattered light nearly 160 times as strongly as dust-free air. Professor Raman points out that the blueness of the sea is to be accounted for by the molecular diffusion of the water and is not due to reflected sky light, as was at one time believed, nor to the presence of particles in suspension.

It is evident, since light is scattered by the molecules of water in all directions that the intensity of light which emerges after passing through a layer of water will be a fraction of the incident light. For any wave length the intensity of illumination decreases with depth in accordance with the exponential law (ignoring the repeated diffraction of the light).

So far the only mode of decrease of intensity of illumination with depth to be considered, is that due to molecular scattering, but there is another factor of equal importance, absorption.

Absorption is the process whereby the energy of light vibration is transformed into heat energy. It has been established by experiment that the absorption of light by water is almost entirely confined to wave lengths longer than the green, and that the amount of absorption increases with increased wave length, *i.e.*, increases from the green towards the red. Green light would therefore suffer least decrease in intensity in penetrating the sea, whereas both red and blue light would be diminished relatively quickly, the red almost entirely by absorption, and the blue entirely by scattering.

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* *Proc. R. Soc.* 94, 1918, pp. 453-458.

† *Proc. R. Soc.* 101, 1922, pp. 64-80.

In order to determine as accurately as possible the intensity of light at various depths in the ocean, Knudsen* designed an apparatus whereby photographs could be obtained simultaneously by two spectro-photometers at different depths. The quantitative comparison of the photographs is based on the principle that if, for any part of the spectrum, the amount of darkening shown on both plates is the same, then the intensities of illumination are inversely proportional to the widths of the slits used in the spectro-photometers.

Knudsen's results show that with increasing depth in the ocean the intensity of illumination decreases comparatively rapidly at the ends of the visible spectrum (*i.e.*, in the red and violet), and that the rate of decrease is least in the green portion of the spectrum. The number of observations discussed in the publication is too small to provide conclusive data, but the following table based on them is instructive :—

Wave length in Ångström units.	6500	6000	5500	5000	4500	4000
Depth in metres at which light is 1000 times weaker than on the surface	18	25	38	37	23	14
Fraction to which the intensity is reduced in passing through a layer of 10 metres	$\frac{1}{45}$	$\frac{1}{16}$	$\frac{1}{7}$	$\frac{1}{7}$	$\frac{1}{20}$	$\frac{1}{148}$

Knudsen does not state whether, in computing these results, he made any allowance for the time of day at which the photographs were taken. The instruments used were direct vision spectro-photometers, which renders the interpretation of the results difficult. In discussing the results, Knudsen writes : "The material is not large enough to warrant closer consideration here of the causes of absorption. It must suffice to note that it may be due partly to the presence of solid particles of varying size, partly to colouring matter in solution."

In view of the conclusions arrived at from the theoretical considerations and the experimental investigation of the extinction of light in passing through water, it appears probable that the attenuation observed by Knudsen is due mainly to scattering and absorption by the water molecules, and not to solid particles, nor to colouring matter in solution. Professor Raman states that the presence of organic matter would exercise a selective absorption in the blue region of the spectrum : this fact may account for the very rapid decrease in intensity found by Knudsen for 4000 A°. The presence of organic matter must be a factor of considerable importance. Sir John Murray, in "Depths of the Ocean," writes : "The enormous quantities of small plankton organisms inhabiting the upper layers may also render the water

* *Conseil Permanent International pour l'Exploration de la Mer. Publications de Circonstance.* No. 76.

relatively opaque." In discussing the extinction of light in the sea, Sir John Murray considers only the selective absorption of light, and deduces that the red light disappears much sooner than the blue, and that there must be many blue rays though hardly any red ones to a depth of 500 metres.

It has been pointed out that the blueness of the sea and the attenuation of light with increasing depth at the blue end of the spectrum are mainly due to molecular scattering. With reference to the scattering by solid particles and its effects, Professor Raman writes :—

> "(A) A very small quantity of finely dispersed matter would not appreciably alter either the colour or intensity ; (B) a larger quantity of such matter would cause some increase in intensity, accompanied by a decrease in the saturation of the hue. Suspended matter not very finely dispersed would operate in a different way. The first effect of increasing size of the particles would be the breaking down of the λ^{-4} law* as regards the intensity of the light scattered in any given direction. With a collection of particles of different sizes the colour of the light scattered would be practically the same as the colour of the light incident on the particles in any given layer."

The blueness of the sea has been referred to, but no mention has been made of the greenness which the sea so frequently exhibits, particularly in shallow waters. Taking into consideration Professor Raman's deduction of what would happen with a collection of particles of different sizes, it appears evident that since the light incident at a depth of a few metres is predominant in the green, and since the light scattered upwards by the particles is again selectively absorbed and scattered, the greenness of the sea is to be ascribed to light scattered upwards by particles at the bottom or in suspension. This explanation of the greenness of the sea would lead one to anticipate that in deep waters the sea is nearly always blue, and that in shallow waters, which are not otherwise coloured by particles in suspension, the nature of the bottom might be determined by the blue or blue-greenness of the water, *e.g.*, with a bottom in parts dark rock and in parts white sand it should be possible to distinguish between the rock and sand by the blueness of the water over the former in contradistinction to the blue-greenness over the latter. Perhaps some reader will, from experience, confirm or contradict this deduction.

It is to be hoped that the Conseil Permanent International pour l'Exploration de la Mer will provide for systematic observations of the penetration of light into the sea. A knowledge of the variation with the seasons, as well as the variation from

* The law referred to is Lord Rayleigh's law that scattering varies inversely as the fourth power of the wave length.

place to place, would undoubtedly help to solve problems for biologists and for meteorologists. The life of the sea must be dependent to a large extent on the quantity of light reaching it. The amount of heat received from the sun by each layer in the ocean is a fundamental climatic factor.

The Line Squall of February 21st, 1923

By E. G. Bilham, B.Sc.

On February 21st a line squall of considerable violence passed across south-east England. The following notes were made by Mr. D. F. Bowering, the Observer at Biggin Hill, near Bromley, Kent :—

12h. 10m.	Anvil extension in WNW.
12h. 15m.	Slight shower with distant thunder.
12h. 35m.	Storm approaching from WNW ; vivid lightning over Croydon.
12h. 45m.	Squall front running NE to SW, approaching from WNW.
12h. 50m.	Storm broke overhead with heavy thunder and some vivid lightning ; hail, soft hail and heavy rain with slight sleet.
12h. 55m.	Mammamto-Cumulus forming in SE.
13h. 5m.	Wind veered to WNW and fell to 2 m.p.h., but increased suddenly to a squall of 35 to 40 m.p.h. just before front was overhead.
13h. 20m.	Precipitation ceased. Storm passing to east.
13h. 45m.	Hail shower and rainbow.

The sequence of events described by Mr. Bowering presents a number of interesting features. At first sight it might appear that the phenomena observed were simply those characteristic of the passage of a " cold front " similar to that described in the January number of the *Meteorological Magazine*. Actually, a much more complex series of changes occurred, the net result of which was to replace, temporarily, a cold south-easterly wind by a rather milder westerly current.

Before considering the details of the disturbance on February 21st it is necessary to recall the general conclusions regarding the thermal structure of cyclones which have been adopted at Bergen, chiefly as the result of investigations by J. Bjerknes and H. Solberg.* In its early stages a cyclone is found to consist of a wedge-shaped protusion, or sector, of warm " equatorial " air into a cold " polar " current. Usually the equatorial current flows from a south-westerly point, and the apex of the warm

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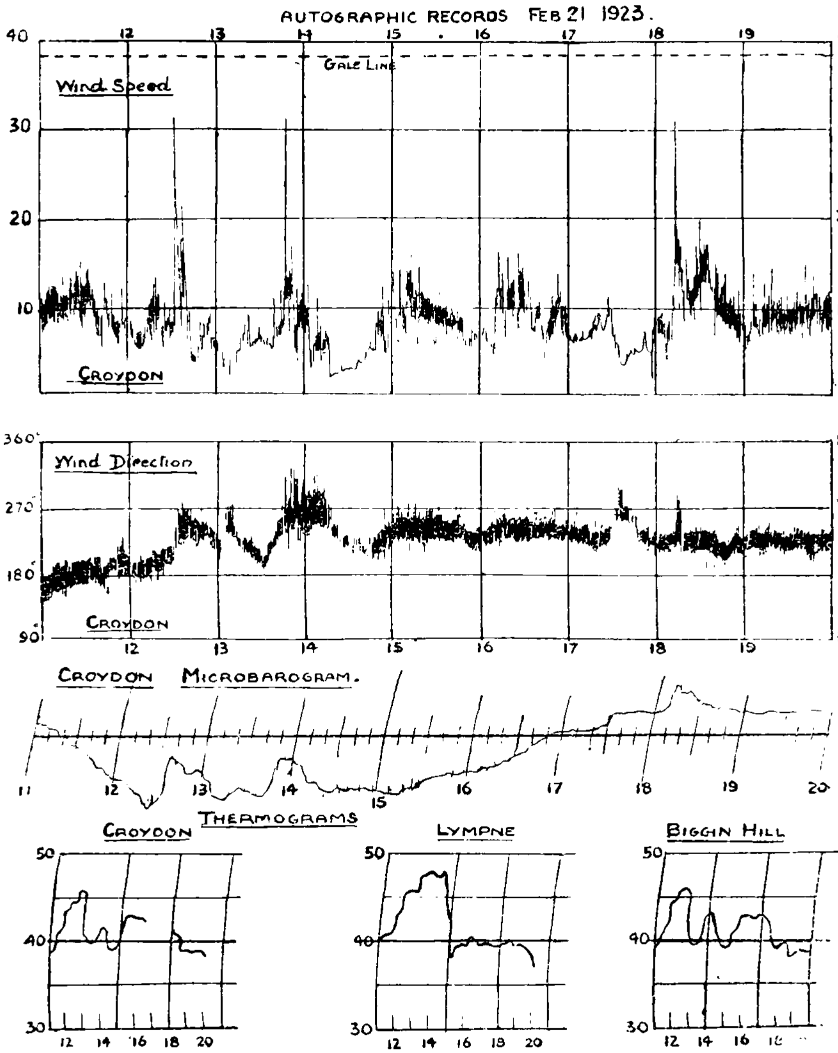
* "Life Cycle of Cyclones and the Polar Front Theory of Atmospheric Circulation." *Geof. Publ. Krist.*, Vol. III., No. 1.

sector coincides with the centre of the depression. The direction of the polar current in front of the warm sector is normally south-easterly, while the current which follows in the rear of the warm air is from a point somewhere between west and north. Within a short period, often only a day or two, of the "birth" of the cyclone, the warm air near the centre gets cut off, or "secluded," as a result of the rapid advance of cold air from the rear. A further advance from the rear causes the secluded mass of warm air to rise, and very soon the warm sector entirely disappears from the chart. At this stage the cyclone is said to be "occluded," pressure begins to rise at the centre, and the cyclone "dies."

The latter half of February provided numerous opportunities of watching this process. A number of deep disturbances developed off our south-west coasts and moved across the British Isles. In each case they were initiated by a burst of warm air from the south-west, which very soon got cut off by polar air from the west. In most cases the disturbance died over the North Sea. The situation was controlled by two important factors: (A) a large stationary depression in the north-east Atlantic, which maintained a cold westerly current originating in high northern latitudes, and (B) an anticyclone covering Scandinavia and the Baltic, which maintained a strong south-easterly current over the North Sea and eastern England.

We now may turn to the actual position on the evening previous to February 21st. The 18h. chart showed the British Isles lying under a cold current mainly from the south-east, the temperature being below 40° F., except in the south-west corner where Scilly reported 46° F., with a south wind. A flow of warm air from south-west was shown at the Azores, where temperature had risen to 64° F. during the day. This warm air had reached Corunna, where rain was falling and the temperature was 55° F. The most striking feature of the chart was, however, a deep depression in the Atlantic centred about latitude 56°N, longitude 26° W. A Scandinavian ship near the centre reported a barometer reading of 951 mb. and wind west-south-west, force 9. The "Minnedosa," about 500 miles south of the centre, was experiencing a west wind of force 11, with heavy hail showers and a temperature of 46° F. (2° below the sea temperature). In these conditions the development of a secondary depression off our south-west coasts was to be expected, and the barometer was, in fact, falling briskly in that region. This secondary disturbance moved eastward across southern England during the day, but never developed closed isobars, and became occluded soon after it formed.



Records of Wind, pressure and temperature in South-east England, February 21st, 1923.

The phenomena at Biggin Hill were thus really incidents in the replacement of a south-east polar current in which the surface temperature was about 38° F. by a westerly polar current with a surface temperature of about 44° F. The rise to 46° F., which is shown on the thermograph trace at 12h. 30m., represents the last vestiges of the equatorial air. At a few points on the south coast the temperature in the tongue of equatorial air exceeded 50° F.* The thunderstorms which occurred at Biggin Hill and other places were most probably due to the convergence of the two polar currents. Winter thunderstorms have been shown by E. V. Newnham† to be most frequently associated with a westerly polar current, and the observations on February 21st show that the storms occurred simultaneously with the arrival of such a current.

The most difficult phenomena to fit into the scheme are the alternations of temperature between 12h. 30m. and 16h. The sudden falls of temperature at about 12h. 50m. and 14h. are presumably to be attributed to the hail showers which occurred near those hours, but it is surprising that in each case it should have taken more than an hour for the temperature to recover the value characteristic of the general air current.

[* The warm air reached Shoeburyness, where the maximum for the day was 49° F., but not Clacton, where the maximum was 42° F.—Ed. *M.M.*]

Two Unusual Pilot Balloon Trajectories.

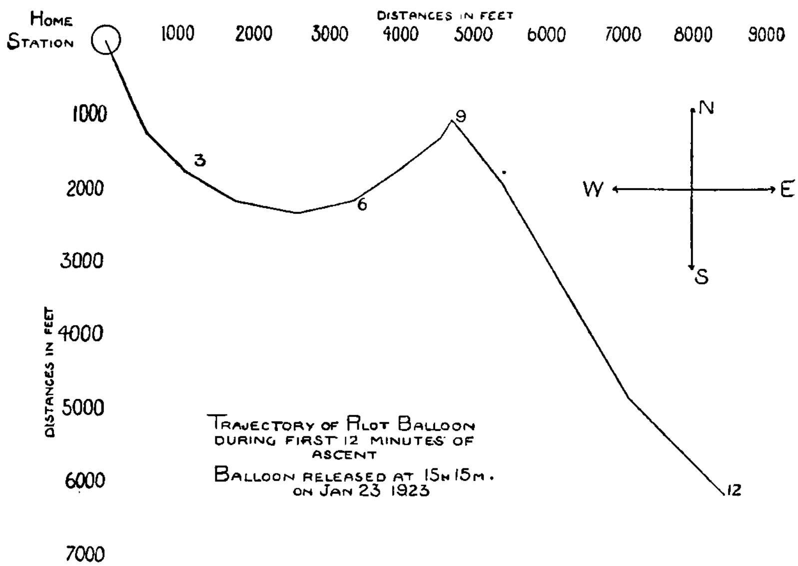
By Capt. D. Brunt, M.A., B.Sc.

In the course of tests made at Shoeburyness of two large theodolites, using special 150-inch pilot balloons, several very interesting ascents have been made and of these the two cases described below stand out on account of the rapid changes of wind noted in each case.

A pilot balloon was released at 15h. 15m. on January 23rd, 1923. An anticyclone was centred about 300 miles west of the mouth of the English Channel, with a depression centred north of Iceland. On the 7h. chart there was a fairly distinct line of discontinuity of surface temperature running down the west coast of Scotland, and across England to the Isle of Wight. The southernmost portion of this line was ill-defined on the 13h. chart. The interesting point concerning the pilot balloon ascent on this date is that it appears to have passed through a surface of discontinuity. A portion of the horizontal trajectory is reproduced in figure 1. The balloon started off in a south-easterly direction, and then swept round almost a complete semi-circle about the outstation, the wind backing to about south-west. During the eighth and ninth minutes the wind decreased without any considerable change of direction, then almost immediately after the ninth minute readings had been taken the balloon began to move very rapidly towards south-east, at about 24 miles per hour. No further marked change of wind velocity or direction was noted, though the balloon was

† *Meteorological Office Professional Notes*, No. 29.

followed to 20,000 feet. The balloon was found at a point about 230 miles south of Shoeburyness, having apparently followed the course of the isobars during the major portion of its journey. It was followed with two theodolites for 25 minutes, and afterwards with one theodolite for a further 17 minutes.



It is obvious that pilot balloon ascents near a surface of discontinuity require unusual watchfulness on the part of the observer. In this case the observer was watching the balloon at the instant when the sudden change of direction took place. Had the change taken place while the observer was reading the scales of the theodolite, it is practically certain that he could not have picked it up again. I suggest that this is possibly the cause of loss of many pilot balloons reported " burst." The decrease of the south-westerly wind occurs in a layer of the order of 1,000 feet in thickness, so that the term " surface," as applied to this change, requires a liberal interpretation. The extreme irregularity of the rate of ascent of the balloon is remarkable. The initial rate was well over 550 feet per minute. In the neighbourhood of the discontinuity it was only 450 feet per minute. In the 16th minute the balloon rose 800 feet, but in the 18th only 70 feet. The two-theodolite method affords two separate determinations of the height of the balloon, and so the computed heights can be accepted as being of a high order of accuracy.

The second pilot balloon ascent was made on March 12th, 1923, at 10h. 30m. The balloon revealed a south wind in the first 6,000 feet, then in the next 6,000 feet a wind from about south-east. At the 23rd minute, at a height of 12,300 feet, the balloon changed its direction of motion, moving back towards south-east, showing a north-westerly wind. At about 15,000 feet the wind veered to north, and the remainder of the ascent shows a steady current from north up to 23,000 feet, at which height the balloon was lost.

A number of observations made on the same day confirm these results. Two balloons released at Shoeburyness at 11h. 50m. and at 14h. were picked up at distances of 150 miles and 24 miles respectively south of the station, and a balloon released at Lympne at 11h. was found at a point 240 miles south of that station. On the same day Croydon and Kew reported Cirrus moving rapidly from north, the former estimating a velocity of about 40 miles per hour. It thus appears that the northerly current may have persisted from a height of 12,000 feet up to the Cirrus level. A balloon released at Shoeburyness at 15h. 10m., and lost in cloud at 15,000 feet, showed a steady current from about south-south-west up to that height. On the same day an ascent at Calshot at 7h. showed a calm from 6,000 feet to 8,000 feet and a wind from north-north-west at 10,000 feet. The level of wind reversal appears therefore to have been lower further west.

The 7h. synoptic chart for March 12th shows a depression centred off the north-west of Scotland, with a fairly strong gradient for south-south-westerly winds over the greater part of the British Isles. There was a depression centred just south of Italy, and between this and an anticyclone centred over northern Russia there was a pronounced gradient for east-south-east winds. From the anticyclone a tongue of high pressure extended across the North Sea and south-east England, down to the north coast of Spain. Over south-east England winds were light and rather variable in consequence of the tongue of high pressure. The gradient of pressure between the Atlantic depression and the Russian anticyclone was fairly steep, the isobars running from south-south-west to north-north-east. By the next day the depression had moved away in a north-easterly direction, but the 7h. chart shows a secondary centred over the Isle of Wight. The temperature distribution shewn by the 7h. chart on the 12th consisted of a trough of low temperature extending in a north-south direction across England. This was apparently a local variation of the main distribution of temperature which indicated a decrease from west to east. A number of upper air temperatures were recorded, and they all show a transition from cold air at the surface to relatively warm air above, with a practically isothermal distribution from about 3,000 to 8,000 feet. These presumably give a transition from the relatively still air over the east of England to the southerly current in front of the Atlantic depression. An ascent at Grain at 11h. 16m. shewed an adiabatic lapse rate from the surface to about 3,000 feet, then practically isothermal conditions up to 8,000 feet, after which the normal lapse rate for cyclones was followed up to about 15,000 feet. The measurements available apparently do not extend into the upper northerly current. The general distribution of decrease of temperature from west to east at the ground would tend to decrease the gradient of pressure at heights above the ground, and if the same general distribution of temperature held in the upper, would reverse the gradient at great heights.

No definite suggestion is here offered as to the origin of the northerly current, but the writer would emphasise the state of things, represented by this pilot balloon ascent, namely, a poleward circulation in the lower layers, with a circulation towards the equator in upper levels probably reaching into the stratosphere. It would have been of great interest to draw isobars for a height of 20,000 feet, had temperature observations been available in sufficient number to permit it. It will require the analysis of a large number of pilot balloon ascents to determine how far the state of things represented by the ascent of March 12th represents the normal interchange of air between equator and pole.

OFFICIAL NOTICE

The Circulation of Forecasts by Telephone

ARRANGEMENTS have been made by the Post Office, in conjunction with the Air Ministry, to communicate daily weather forecasts to the telephone exchanges throughout the country. For this purpose England, Scotland and Wales have been divided into some forty districts, so that each exchange may have available for subscribers information that will be appropriate to the area in which the exchange is situated. It is only necessary for telephone subscribers to ring up the operator at the local exchange at or after 5 p.m. to obtain the forecast for the following night and day.

No charge will be made beyond the local call fee (1¼d.), and in the case of rural "party-lines" no fee is payable. The forecast may be obtained also by ringing up from public call offices upon payment of the ordinary local call office fee.

The service, which was started on May 1st, is primarily intended for the use of farmers. The arrangements are provisional, and are to be reconsidered at the end of the Summer.

Royal Meteorological Society

THE monthly meeting of the Society was held on Wednesday, April 18th, at 49, Cromwell Road, South Kensington, Dr. C. Chree, F.R.S., President, in the chair.

W. H. Dines, F.R.S., and L. H. G. Dines, M.A.—An examination of British upper air data in the light of the Norwegian theory of the structure of the cyclone.

The theories of the Norwegian school of meteorologists, which have occupied so much attention during the last few years, were formulated without much reference to upper air observations, and the desirability of a scrutiny of such observations as are available is manifest. Such a scrutiny has been made by the authors of this paper, and the results are disappointing.

The first method adopted was to select from the occasions on which *ballon sonde* records were available, those on which the synoptic charts indicated that it was likely that the balloon had passed through the polar front. Graphs showing the relation of temperature to height were drawn for these occasions, and compared with graphs for other occasions selected more or less at random. It was found that there were no striking differences between the two groups, inversions of temperature occurring with about the same frequency.

A second problem, the relation between humidity and temperature, was attacked by utilising the kite ascents made at Pyrton Hill. It was found that an inversion of temperature was nearly always associated with a decrease in the humidity, whereas the Norwegian theory requires an increase.

The conclusion reached is that the observational evidence fails to support the hypothesis that the superposition of equatorial over polar air is a characteristic feature of the structure of a cyclone. The speakers who took part in the discussion showed great reluctance to accept this conclusion. Further examination of the material is evidently desirable.

Professor T. Kobayasi (Imperial University of Tokio).—On the mechanism of cyclones and anticyclones.

In this paper the structure of the lower layers of a cyclone is considered, and on certain simple assumptions the stream lines along which the air flows are plotted. The diagrams in which these are shown are very clear and suggestive. It is pointed out that in certain parts of the cyclone, currents flowing from quite different regions are brought into juxtaposition and overlap. If it happens that the upper current is much colder than the lower one the phenomenon characteristic of the line-squall will appear. The treatment of the anticyclone is very slight. The discussion brought out the fact that the treatment of the cyclone is kinematical not dynamical, it does not provide any explanation for the fundamental phenomena which are described, but, in so far as the paper helps us to obtain a clear mental picture of the movements in three dimensions which characterize the cyclone, it will be a useful aid to the formulation of more comprehensive theories.

Capt. E. C. Shankland, R.N.R.—Notes on the fluctuations of mean sea-level in relation to change of atmospheric pressure.

The effect of meteorological conditions on the height of the tide is a matter of practical importance to harbour masters, and has received attention from many investigators. There are two factors to consider: the driving of the water before the wind causing high levels on the coast towards which the wind blows; and the direct effect of the pressure of the atmosphere to which the ocean responds like the mercury in a barometer. Capt. Shankland has selected observations made at Liverpool when the wind was slight, and has correlated with the atmospheric pressure the defect of high water below that predicted in the tide tables.

His conclusion is that the series of observations supports the hypothesis that the defect in the tide is about 20 times the excess above normal of the height of the mercury in the barometer.

In the discussion Mr. Durst pointed out that in the computation of the tides it was tacitly assumed that the average wind would blow. Now the average wind at Liverpool is onshore and tends to raise the tidal level, and, therefore, on a windless day the actual tide should be lower than the predicted tide. Mr. Durst thought it was better to take the depression of the sea level owing to atmospheric pressure as 13·6 times the rise of the barometer in accordance with hydrostatic theory, and to make separate allowance for the wind.

Correspondence

To the Editors, *The Meteorological Magazine*

Observations on "Atmospherics" at Cranwell

In view of the work now being done upon atmospherics and their meteorological causes by Mr. R. A. Watson Watt, Capt. Cave and others, the following observations notified to me by Flight-Lieut. I. Rodney, R.A.F., Officer in charge of the Wireless Telegraphy Station at Cranwell, may not be without interest.

Flight-Lieut. Rodney states that, on the 29th of March, he was at 15h. 55m. receiving on 450 metres wave length, and that then the atmospherics were of medium strength of the sort that give occasional crackles in the telephone receivers. At 16h. a faint hiss was audible, which gradually increased in strength until it became a positive roar in the receivers. The roar continued for an interval of approximately 15 minutes, when it gradually diminished in strength to a fairly strong hiss, only to return within a very few minutes to another roar, this second phase lasting to 16h. 25m. roughly, when it gradually diminished, until at 16h. 30m. all was silent except for the well-known occasional crackles. The roar increased with increase of wave length up to 1,000 metres, remaining of the same intensity from thence up to 2,500 metres.

The interest of the observation is that several similar to it occurred last summer, and that from a wide experience Flight-Lieut. Rodney states that he has only heard it at Cranwell, and he is emphatic that the atmospherics experienced are peculiar. The meteorological conditions prevailing at the times of occurrence of this rare phenomenon have been noted by me, and in every case the outstanding feature is the presence of well-marked Cumulo-Nimbus clouds passing across, with or without rain or thunder phenomena, at the receiving station. Whilst this is all in accord with the belief enunciated by Mr. Watson Watt that atmospherics are very closely connected with convective processes in the atmosphere, it would be interesting to know whether this peculiar type is as peculiar as it is thought to be here, or whether Mr. Watson Watt or any other observers have noticed it, and, if so, as to whether it is, as it were, the wireless manifestation of the passage across of well-marked Cumulo-Nimbus clouds.

W. H. PICK.

R.A.F. (Cadet) College, Cranwell, Lincs., April 4th, 1923.

THE phenomenon described in Captain Pick's letter is not of infrequent occurrence, and is, as he infers from his observations, generally associated with the passage of Cumulo-Nimbus cloud. It is caused by the flow of a fluctuating but more or less unidirectional current along the receiving antenna, under the very strong fields produced by the cloud charges. In the classification of atmospherics laid down by British Association Committee for radio-telegraphic investigations, this discharge is classed as "sizzle," and defined as "a buzzing or frying noise, often heard during a white squall." With an antenna insulated from earth by a small air gap, a stream of sparks several millimetres in length may often be produced across the gap in the conditions described. I have frequently observed similar discharges under a cloud sheet, which I am unable to classify, but which I should describe as a heavy sheet of a dull brown-grey tone with a characteristically "choppy" under-surface.

The Cranwell phenomena recall to my mind a very marked instance of exposed conductors under Cumulo-Nimbus cloud, which I described in a letter to *Nature* (1916, vol. xcvii., p. 161). Here sparks passed between the finger of the observer and a

Campbell-Stokes sunshine recorder on a concrete wall. The sparks increased in length and frequency as a Cumulo-Nimbus cloud reached the zenith, decreased and finally became indistinguishable as it receded, then reappeared with the approach of a second Cumulo-Nimbus, in close analogy with the Cranwell case.

The variation of loudness with wave-length, observed at Cranwell, is probably peculiar to the receiving circuits used. I should hazard a guess that tuning up to 1,000 metres had principally been effected by increasing inductance, which would give a greater variation of potential difference across the grid circuit, while tuning from 1,000 to 2,500 metres was carried out by adding capacity in parallel, which would not affect the potential differences produced by the comparatively slow fluctuations of aerial current.

R. A. WATSON WATT.

Radio Research Board Station, Aldershot, April 10th, 1923.

Meteorology and Folklore: The Aurora Polaris

"ONE wonders" wrote Captain R. F. Scott in his diary, "why history does not tell us of 'aurora' worshippers, so easily could the phenomenon be considered the manifestation of 'god' or 'demon'." The answer is not far to seek, for, unlike the other beautiful or terrifying phenomena of the atmosphere, the aurora is of limited range. In the southern hemisphere there is very little inhabited land in high latitudes; in the northern hemisphere the ancient lands around the Mediterranean enjoy a frequency of one in ten years. However, further north, legend has sprung up around the "Northern Lights."

To the American Indians, as Longfellow has recorded in "Hiawatha," they were:

> "The Death-Dance of the Spirits,
> Warriors with their plumes and war-clubs,
> Flaring far way to northward
> In the frosty nights of Winter;"

while on the other side of the Atlantic they are still called by the Scots "Na Fir Chlis," or the "nimble men." Another idea, especially as regards red auroræ, is that they are the reflection of bloodshed in a far country. Thus, in County Cork in 1854, a red aurora was said by the peasantry to be the blood shed at Balaclava; in 1868 it was remarked "I wonder can that be the blood of the Americans?"; while in 1870 a vivid manifestation was the "blood of the Frenchmen." According to the *Scottish Chronicle*, in the summer of A.D. 660 "the sky was seen to burn." This is probably a reference to a red aurora, probably of the kind which possibly inspired the poet of the Prose Edda, when he described the Twilight of the Gods:

"The fire-reek rageth
Around Time's nurse,
And flickering flames
With heaven itself playeth."

Auroræ have actually been mistaken for terrestrial fires. Under Tiberius the legions ran to Ostia to extinguish a fire which only existed in the heavens, while during the recent war an aurora which appeared during an air raid, led the inhabitants of Dover to think that Canterbury was in flames. The aurora is believed to be the same as a rare appearance called "Buddha's lights" by the Cingalese. This is said by the priests to be a sign of Buddha's anger with sinners, and to appear over the "wihare" where the offenders last worshipped.

Truly the aurora is a lovely enigma. It appears in regions where Nature is not over-lavish with her beauties. Its exact cause is still doubtful, and is still a challenge to the intellect. It is a fitting manifestation of that most elusive force, electricity and its ally magnetism, and, as Captain Scott said, "a golden writing which we have not the key to decipher."

CICELY M. BOTLEY.

10, *Wellington Road, Hastings, April* 21*st*, 1923.

[Authentic observations of red auroræ, at any rate as far south as the British Isles, are rare. The inexperienced observer is apt to report the red glow when the sun is beyond the northern horizon in the middle of a summer night as "Northern Lights" or "aurora."—ED. *M.M.*]

Peculiar Solar Phenomenon

AT 19h. 8m. on Thursday, March 19th, I observed the sun's disc taking a rather peculiar shape while setting in the west. As it sank behind a layer of alto-stratus cloud its lower limb, which projected beneath the cloud, appeared flattened out and enlarged, whilst the upper limb took the form of a cone, with the result that for a few seconds the sun appeared like a burnished triangle with the cloud intercepting the upper from the lower limb.

The sky at the time was practically overcast (9) with alto-cumulus and alto-stratus clouds and a slight east-north-east breeze (force 2) prevailed, the atmosphere being hazy and the air cold. I am of the opinion that the distortion of the sun's disc in this case was caused by refracted light owing to the density of the air surrounding the alto-stratus cloud layer.

CHARLES F. PRIESTLEY.

49, *Brisbane Street, Greenock, April* 30*th*, 1923.

[The theory of such phenomena given by Wegener in *Annal. d. Physik*. iv. Folge, Bd. 57, 1918, is discussed by Exner in the second edition of the *Meteorologicische Optik*, p. 158.—ED. *M.M.*]

NOTES AND QUERIES

Monthly Weather Report, 1923

CONSIDERABLE changes have been made in the form of the Monthly Weather Report commencing with the January issue of this year. The principal differences are in the table (Table IV.) devoted to the summary of observations at fixed hours, and tend to facilitate the study of the daily variation in weather conditions. Thus, in the case of pressure, we now have the mean pressure at each of the specified hours instead of the mean for the 24 hours (incidentally the practice of putting pressure at station level as well as at sea level has been dropped except in the case of a few stations at considerable heights). The frequency with which various fractions of the sky are cloud-covered is now given for each hour of observation, a plan which it is thought will be much more useful than the old one of stating the frequency with which the average cloudiness at two or three hours falls within certain limits.

A new departure is the inclusion of a summary of the observations of visibility in the table. These observations have become of great interest in recent years, not only in connection with aviation but because of their bearing on the study of atmospheric pollution and of atmospheric electricity, and having them set out in permanent tables should facilitate comparisons between different parts of the country.

The increase in the amount of space allotted to each station has unfortunately necessitated a reduction in the number included in Table IV. It is hoped, however, that in some cases statistics on the same lines will be computed and published locally.

The notes on the tables, now set out on a single page, should facilitate the use of the Report.

A Floating Weather Bureau

MR. E. H. BOWIE, of the United States, Weather Bureau, paid a short visit to the Meteorological Office at the beginning of March. He had interesting news to give us. He had come from America in the French vessel *Jacques Cartier*, which sails between Antwerp and New Orleans touching at a French port en route. The vessel is one of about 20,000 tons and is used as a training ship for cadets of the French Mercantile Marine. It carries a cargo to help pay for the cost of using so large a vessel as a moving training ship.

The cadets are taught ordinary climatology and methods of meteorological observation as cadets for the Mercantile Marine have been in the past, but, in addition to this, an endeavour is being made to instruct them in the methods and utility of synoptic meteorology under the varying conditions which they experience in voyaging between France and New Orleans.

During his voyage on the *Jacques Cartier* Mr. Bowie collected reports by wireless telegraphy from many ships in the Atlantic and from shore stations, drew synoptic charts from the observations, and issued forecasts for the information of the ships which had co-operated. The *Jacques Cartier* was in the words of the *Philadelphia Public Ledger* " a floating weather bureau."

Even before the war scientific meteorologists were aware of the possibility of extending synoptic meteorology to ships at sea owing to the development of radio-telegraphy. A beginning had even been made. Reports were being collected from ships and issued to ships. Experience during the war showed that an extension of this was not merely a possibility but practically a necessity; and all meteorologists will welcome the enterprise which the French Mercantile Marine has shown in securing the co-operation of the French Meteorological Office in this useful work, and, what is perhaps more important, in securing for their cadets, at an age when they are most open to impression, contact with expert meteorologists and an opportunity of learning the use of a weather map during a voyage at sea.

A Solarphysics Observatory for Central Australia

NEARLY twenty years ago a movement was started for establishing an astronomical observatory in the dry clear atmosphere of central Australia, and in 1908 a committee was appointed by the British Association for this purpose. The Commonwealth Government supported the scheme, and, during the British Association meeting in Australia in 1914, the Prime Minister of the Commonwealth consented to receive a deputation of overseas astronomers on the solar work to be undertaken in Australia. The expedition sent out by the Lick Observatory to observe the solar eclipse on September 21st, 1922, in central Australia, has also given an impetus to the scheme.

The suggested site is Alice Springs, where the average cloudiness at night is two-tenths and the visibility exceptionally good. The Australian Government Astronomer (Mr. G. F Dodwell), who is strongly in favour of the idea, reports that from Moorilyanna he could see with binoculars Mount Ferdinand, 64 miles distant. Another report from the same district states that a smoke column from a train 45 miles away was seen through the theodolite telescope, and by the movement of the smoke the shunting of the train could be observed. At Cordillo Downs, where they used large instruments lent from America, they noted the perfect definition of the sun, moon and corona.

Mr. Dodwell is appealing both to Governments and to private enterprise for endowments and instruments for the proposed astronomical observatory in central Australia. He reminds us that the Observatories of Europe and America are indebted to private munificence as well as to Government aid.

Meteorological Course at Kew Observatory

THE meteorological course referred to on p. 5 of the February issue was held at Kew Observatory during the week April 23rd—28th. Nine observers from municipal stations at Health Resorts and one private observer were present. The instructor was Captain E. W. Barlow, of the Climatology Division, Meteorological Office. A number of special visits were arranged, the party being shown over Kew Observatory, the Offices at Kingsway and South Kensington and Croydon Aerodrome.

A Prayer for Rain

A PAPER on *The Alps of Chinese Tibet* was read by Prof. J. W. Gregory before the Royal Geographical Society on December 11th, 1922. In the discussion which followed, the President, Sir Francis Younghusband, revealed his experience of floods in Western China some years ago*. "On this occasion," he said, "the gates at Chung-King were closed, not in order to keep out the evil spirits who brought the flood, but in order to keep out the evil spirits who prevented the flood from rising, because the country had been suffering from drought. The magistrate of the city was ordered to repair to the various temples and to pray for rain. He prayed in one of the temples on August 5th in the year 1906 and he prayed with prodigious effect. It began to rain, and a waterspout within twelve hours burst a little higher up the river. The result was disastrous. The river at Chung-King rose to the almost unprecedented height of 108 feet. Houses, coffins, corpses, and live freight on various forms of support were seen racing down the river and were watched in their mad career by the inhabitants on the city wall."

News in Brief

We learn with regret of the death, on May 3rd, of Captain Carl Ryder, Director of the Danish Meteorological Institute.

The discourse entitled "The Water in the Atmosphere," delivered by Dr. G. C. Simpson, C.B.E., F.R.S., at the Royal Institution on March 2nd, was published as a supplement to *Nature* for April 14th.

* See *The Geographical Journal*, March, 1923, *p.* 178.

It is announced that Dr. Charles Niven, F.R.S., for many years Professor of Natural Philosophy in the University of Aberdeen, died on May 11th, 1923.

Meteorological Office—Staff News. On Monday, April 30th, a team representing the Meteorological Office defeated, by 3 goals to 2, a team representing the Aeronautical Inspection Department in the final round for the Air Ministry Football Cup. At the close of the match Dr. Simpson presented the Cup to the Office team on behalf of the Air Ministry, and expressed his great pleasure that the Office had done so well.

The Weather of April, 1923

DURING the first few days of the month pressure was high over Scandinavia and low over the Atlantic and the Bay of Biscay, so that a general southerly wind current prevailed over the British Isles and the temperature rose to 60° F. or slightly higher in the midland and southern counties. 60° F. was also exceeded in the same districts on the 11th and 12th, when the pressure distribution was somewhat similar. Thunder was heard generally about this time. Between these two warm periods the Scandinavian high spread westwards towards Iceland causing easterly winds to prevail over the whole of central Europe and the British Isles. These winds were strong in force along the east coast of England on the 8th and 9th and were accompanied by slight showers of snow in London and many other places.

An easterly type of weather prevailed from the middle of the month until about the 25th, when there was a change to a warmer south-westerly type, and gales occurred in parts of the English Channel on the 25th. High winds and gales were also reported from the Shetland Isles about this period, and snow or sleet fell in various parts of Scotland between the 23rd and 27th. During the latter part of the month ground frost occurred repeatedly, and in a few instances frost was also recorded by instruments in the screen, *e.g.*, 24° F. was reported from Eskdalemuir on the night of the 27th—28th. Sunshine was generally rather poor, and in some instances only amounted to about three-quarters of the average ; at Aberdeen the total was as low as 90 hours.

The general rainfall in the British Isles, expressed as a percentage of the average, was : England and Wales, 126 ; Scotland, 126 ; Ireland, 139 ; British Isles, 128.

Weather Abroad, April, 1923

THE month was marked by several spells of severe weather in western Europe. On the 10th unusual cold was reported in Andalusia, with snow in Granada, and fog at Seville. On the

18th the vineyards in the Palatinate (south-west Germany) suffered severely from frost, and about the same date there were heavy falls of snow in the Swiss Alps. Towards the close of the month heavy snow fell in the Belgian Ardennes. In the North Atlantic the ice conditions were severe, and the *Blutha* was caught in drift ice and abandoned in 41 N, 47 W, far outside the usual ice limits.

In North America on the night of April 4th to 5th there were tornadoes in Lousiana, North Carolina and Texas, with heavy rain and hail storms in various places, associated with a depression which moved south-eastward from the Pacific coast to northern Texas and thence north-eastward. After that the weather in the eastern States was mainly dry, and towards the close of the month forest fires occurred. In Canada there was still much ice on the rivers.

On the 14th a telegram from Cairo stated that while the level of the Mountain Nile was abnormally low, heavy rains in north-west Abyssinia had caused considerable rises in the level of the Sabat River and the Upper Blue Nile. These should restore the main river to its normal level for the time of year, and irrigation prospects are promising.

On the 21st heavy rains were reported in Western Australia, and on the 23rd light rains fell in parts of Victoria and the Riverina district, but there was no general break up of the weather in the east.

The end of March and the beginning of April were marked by a severe storm in the Cordoba district (Argentine), in which over 130 mm. of rain fell in about thirty-six hours. The rivers overflowed and rendered many people homeless. On the night of April 8th Bahia Blanca was flooded by a heavy sea swell, which partially destroyed the sea wall. The weather was fine and calm at the time.

The special message from Brazil states that the rainfall has been very irregular all over the country, but on the average was in excess of the normal. There has been a very active circulation of small highs in the south and centre with temperature well above the normal. Coffee and cotton prospects are excellent. At Rio de Janeiro pressure was 3·9 mb. above normal, and temperature 2·3° F. above normal.

Rainfall Table for April, 1923

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent. of Av.
Lond.	Camden Square	1·37	35	89	*Leics*	Leicester Town Hall	1·59	40	...
Sur .	Reigate, Hartswood	2·36	60	...	,, .	Belvoir Castle	1·70	43	111
Kent.	Tenterden, View Tower	2·06	52	127	*Rut* .	Ridlington	1·82	46	...
,,	Folkestone, Boro. San.	...	...	...	*Linc*.	Boston, Skirbeck	·85	22	63
,, .	Broadstairs	...	...	...	,, .	Lincoln, Sessions House	·93	24	67
,, .	Sevenoaks, Speldhurst.	2·46	63	...	,, .	Skegness, Estate Office.	·86	22	64
Sus .	Patching Farm	3·88	99	222	,, .	Louth, Westgate	1·20	31	72
,, .	Eastbourne, Wilm. Sq.	2·14	54	118	,, .	Brigg	1·54	39	98
,, .	Tottingworth Park	3·54	90	...	*Notts*.	Worksop, Hodsock	1·71	43	116
Hants	Totland Bay, Aston	3·39	86	207	*Derby*	Mickleover, Clyde Ho.	2·08	53	120
,, .	Fordingbridge, Oaklnds	3·76	95	205	,, .	Buxton, Devon. Hos.	3·93	100	134
,, .	Portsmouth, Vic. Park.	3·19	81	203	*Ches*.	Runcorn, Weston Pt.	2·70	69	156
,, .	Ovington Rectory	3·60	91	190	,, ..	Nantwich, Dorfold Hall	1·93	49	...
,, .	Grayshott	3·51	89	179	*Lancs*	Bolton, Queen's Park .	3·67	93	...
Berks	Wellington College	2·60	66	161	,, ..	Stonyhurst College	3·63	92	134
,, .	Newbury, Greenham	3·03	77	166	,, ..	Southport, Hesketh	...	...	...
Herts.	Bennington House	1·57	40	103	,, ..	Lancaster, Strathspey.	3·13	79	...
Bucks	High Wycombe	2·70	69	172	*Yorks*	Sedbergh, Akay	5·49	139	169
Oxf..	Oxford, Mag. College	2·19	56	142	,, .	Wath-upon-Dearne	2·10	53	133
Nor .	Pitsford, Sedgebrook	1·64	42	107	,, .	Bradford, Lister Pk.	2·31	59	115
,, .	Eye, Northolm	·94	24	...	,, .	Oughtershaw Hall	5·92	150	...
Beds.	Woburn, Crawley Mill.	1·75	45	117	,, .	Wetherby, Ribston H.	1·80	46	102
Cam.	Cambridge, Bot. Gdns.	1·16	29	85	*ERY*	Hull, Pearson Park	1·53	39	98
Essex	Chelmsford, CountyLab	1·85	47	...	,, .	Holme-on-Spalding	1·44	37	...
,, .	Lexden, Hill House	1·06	27	...	,, .	Lowthorpe, The Elms.	1·53	39	92
Suff .	Hawkedon Rectory	1·33	34	86	*NRY*	West Witton, Ivy Ho.	3·25	83	...
,, .	Haughley House	·79	20	...	,, .	Pickering, Hungate	1·61	41	...
Norf.	Beccles, Geldeston	·55	14	37	,, .	Middlesbrough	1·31	33	96
,, .	Norwich, Eaton	1·09	28	64	,, .	Baldersdale, Hury Res.	2·80	71	119
,, .	Blakeney	1·09	28	85	*Durh*.	Ushaw College	1·70	43	90
,, .	Swaffham	·94	24	64	*Nor* .	Newcastle, Town Moor.	2·04	52	124
Wilts.	Devizes, Highclere	2·36	60	...	,, .	Bellingham Manor	2·23	57	...
Dor .	Evershot, Melbury Ho.	2·46	63	104	,, .	Lilburn Tower Gdns.	2·15	55	119
,, .	Weymouth, Westham	3·00	76	181	*Cumb*	Penrith, Newton Rigg.	3·04	77	145
,, .	Shaftesbury, Abbey Ho.	2·88	73	135	,, .	Carlisle, Scaleby Hall .	1·01	25	52
Devon	Plymouth, The Hoe	3·04	77	138	,, .	Seathwaite	8·10	206	109
,, .	Polapit Tamar	3·14	80	134	*Glam*.	Cardiff, Ely P. Stn.	3·68	93	145
,, .	Ashburton, Druid Ho.	5·50	140	180	,, .	Treherbert, Tynywaun	6·20	157	...
,, .	Cullompton	2·72	69	120	*Carm*	Carmarthen Friary	2·97	75	108
,, .	Sidmouth, Sidmount	2·56	65	120	,, .	Llanwrda, Dolaucothy.	4·38	111	133
,, .	Filleigh, Castle Hill	2·89	73	...	*Pemb*	Haverfordwest, Portf'd	3·29	84	126
,, .	Hartland Abbey	2·12	54	...	*Card*.	Gogerddan	3·77	96	144
Corn.	Redruth, Trewirgie	4·28	109	149	,, .	Cardigan, County Sch. .	2·64	67	...
,, .	Penzance, Morrab Gdn.	3·62	92	149	*Brec*.	Crickhowell, Talymaes	4·00	102	...
,, .	St. Austell, Trevarna	3·94	100	140	*Rad* .	Birm. W. W. Tyrmynydd	4·46	113	121
Som	Street, Hind Hayes	1·78	45	...	*Mont*.	Lake Vyrnwy	...	...	...
Glos..	Clifton College	2·87	73	133	*Denb*.	Llangynhafal	1·42	36	...
,, .	Cirencester	2·73	69	142	*Mer* .	Dolgelly, Bryntirion	4·61	117	126
Here.	Ross, County Obsy.	2·43	62	129	*Carn*.	Llandudno	1·75	45	97
,, .	Ledbury, Underdown.	2·61	66	...	,, .	Snowdon, L. Llydaw 9	10·95	278	...
Salop	Church Stretton	2·99	76	138	*Ang* .	Holyhead, Salt Island.	2·58	66	124
,, .	Shifnal, Hatton Grange	2·19	56	130	,, .	Lligwy	3·04	77	...
Staff.	Tean, The Heath Ho.	2·65	67	133	*Man*.	Douglas, Boro' Cem.	2·72	69	110
Worc.	Ombersley, Holt Lock.	...	...	...	*Guer*.	St. Peter Port, Grange.	2·73	69	136
,, .	Blockley, Upton Wold.	2·90	74	149	*Wigt*.	Stoneykirk, Ardwell Ho	2·87	73	137
War	Farnborough	2·59	66	132	,, .	Pt. William, Monreith .	2·68	68	...
,, .	Birminghm, Edgbaston	2·49	63	143	*Kirk*.	Carsphairn, Shiel.	3·96	101	...

Rainfall Table for April, 1923—*continued*

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent. of Av.
Kirk.	Dumfries, Cargen.....	5·06	129	190	*Caith*	Loch More, Achfary...	3·65	93	75
Dum	Drumlanrig	4·30	109	175	,, ..	Wick	2·74	70	138
Roxb	Branxholme	2·85	72	151	*Ork* .	Pomona, Deerness	3·19	81	154
Selk .	Ettrick Manse........	4·74	120	...	*Shet* .	Lerwick	1·76	45	77
Berk.	Marchmont House	1·63	41	81	*Cork*.	Caheragh Rectory	6·69	170	...
Hadd	North Berwick Res....	1·98	50	141	,, ..	Dunmanway Rectory.	7·68	195	185
Midl	Edinburgh, Roy. Obs..	1·79	45	131	,, ..	Ballinacurra	4·36	111	168
Lan .	Biggar	3·30	84	191	,, ..	Glanmire, Lota Lo. ...	4·71	120	168
Ayr .	Kilmarnock, Agric. C..	2·80	71	136	*Kerry*	Valencia Obsy........	...	...	...
,, .	Girvan, Pinmore......	...	...	...	,, .	Gearahameen	8·60	218	...
Renf.	Glasgow, Queen's Pk..	3·21	81	163	,, .	Killarney Asylum.....	5·06	129	153
,, .	Greenock, Prospect H..	4·75	121	130	,, .	Darrynane Abbey	3·48	88	101
Bute.	Rothesay, Ardencr'g..	3·92	100	132	*Wat* .	Waterford, Brook Lo..	4·00	102	157
,, .	Dougarie Lodge	3·81	97	...	*Tip* .	Nenagh, Cas. Lough...	3·30	84	131
Arg .	Glen Etive...........	...	...	...	,, .	Tipperary	3·51	89	...
,, .	Oban	3·47	88	...	,, .	Cashel, Ballinamona ..	3·24	82	130
,, .	Poltalloch	3·63	92	124	*Lim* .	Foynes, Coolnanes	4·11	104	168
,, .	Inveraray Castle......	3·50	89	76	,, .	Castleconnell Rec.	3·61	92	...
,, .	Islay, Eallabus.......	3·29	84	115	*Clare*	Inagh, Mount Callan ..	6·02	153	...
,, .	Mull, Benmore	2·30	58	...	,, .	Broadford, Hurdlest'n.	3·76	95	...
,, .	Mull, Quinish	...	...	...	,, .	Newtownbarry	4·30	109	...
Kinr.	Loch Leven Sluice	3·45	88	180	*Wexf*	Gorey, Courtown Ho...	3·50	89	160
Perth	Loch Dhu	6·10	155	129	*Kilk*.	Kilkenny Castle	3·45	87	158
,, ..	Balquhidder, Stronvar.	3·87	98	87	*Wic* .	Rathnew, Clonmannon	3·55	90	...
,, ..	Crieff, Strathearn Hyd.	3·59	91	164	*Cars*.	Hacketstown Rectory .	3·01	77	114
,, ..	Blair Atholl..........	3·16	80	152	*QCo*..	Blandsfort House.....	3·16	80	121
,, .	Coupar Angus School..	2·54	65	153	,,	Mountmellick	3·17	81	...
Forf.	Dundee, E. Necropolis.	2·61	66	154	*KCo*.	Birr Castle...........	2·91	74	135
,, .	Pearsie House........	3·95	100	...	*Dubl*.	Dublin, FitzWm. Sq...	3·13	79	165
,, .	Montrose, Sunnyside..	2·31	59	127	,, .	Balbriggan, Ardgillan .	3·56	90	180
Aber.	Braemar Bank	2·23	57	97	*W.M*	Athlone, Twyford.....	...	...	...
,, .	Logie Coldstone Sch. ..	2·39	61	119	,, .	Mullingar, Belvedere .	...	...	...
,, .	Aberdeen, Cranford Ho	2·26	57	110	*Long*	Castle Forbes Gdns....	2·38	61	100
,, .	Fyvie Castle	2·57	65	...	*Gal* .	Galway, Waterdale ...	2·59	66	...
Mor .	Gordon Castle........	1·73	44	99	,, .	Woodlawn	...	...	...
,,	Grantown-on-Spey....	2·19	56	111	*Mayo*	Crossmolina, Enniscoe	4·47	113	142*
Na .	Nairn, Delnies........	1·92	49	128	,, .	Mallaranny..........	4·09	104	...
Inv..	Ben Alder Lodge	2·73	69	...	,, .	Westport House......	2·46	63	91
,, .	Kingussie, The Birches	1·99	51	...	,, .	Delphi Lodge	7·76	197	...
,, .	Fort Augustus	2·19	56	86	*Sligo*	Markree Obsy.	3·05	77	116
,, .	Loch Quoich, Loan....	4·50	114	...	*Ferm*	Enniskillen, Portora ..	3·13	79	...
,, .	Glenquoich	3·72	95	57	*Arm*.	Armagh Obsy.	3·16	80	150
,, .	Inverness, Culduthel R.	...	...	...	*Down*	Warrenpoint	4·71	120	...
,, .	Arisaig, Faire-na-Squir	...	...	...	,, .	Seaforde	4·63	118	177
,, .	Fort William.........	3·85	98	87	,, .	Donaghadee	3·04	77	152
,, .	Skye, Dunvegan......	2·91	74	...	,, .	Banbridge, Milltown .	2·93	74	143
,, .	Barra, Castlebay	2·64	67	...	*Antr*.	Belfast, Cavehill Rd. ..	3·74	95	...
R&C	Alness, Ardross Cas. ..	3·99	101	165	,, .	Glenarm Castle.......	3·69	94	...
,, .	Ullapool............	2·66	68	...	,, .	Ballymena, Harryville	3·37	86	128
,, .	Torridon, Bendamph..	3·93	100	75	*Lon* .	Londonderry, Creggan	2·85	72	111
,, .	L. Carron, Plockton...	3·29	84	...	*Tyr* .	Donaghmore	4·13	105	...
,, .	Stornoway	2·99	76	99	,, .	Omagh, Edenfel	4·17	106	159
Suth.	Dunrobin Castle......	...	...	...	*Don* .	Malin Head	2·58	66	131
,, .	Lairg	3·23	82	...	,, .	Letterkenny Hos	3·47	88	124
,, .	Forsinard	...	...	...	,, .	Dunfanaghy	2·68	68	99
,, .	Tongue Manse........	4·22	107	161	,, .	Narin, Kiltoorish	2·73	69	...
,, .	Melvich School.......	2·20	56	95	,, .	Killybegs, Rockmount.	3·60	91	100

* Enniscoe for Jan. 6·50 in., Feb. 8·65 in., March 4·23 in.

Climatological Table for the British Empire, November, 1922

STATIONS	PRESSURE: Mean of Day M.S.L.	PRESSURE: Diff. from Normal	TEMPERATURE: Absolute Max.	TEMPERATURE: Absolute Min.	TEMPERATURE: Mean Values Max.	TEMPERATURE: Mean Values Min.	TEMPERATURE: Mean Values ½ max. and min.	TEMPERATURE: Mean Values Diff. from Normal	TEMPERATURE: Mean Wet Bulb.	Relative Humidity	Mean Cloud Am'nt	PRECIPITATION: Am'nt	PRECIPITATION: Diff. from Normal	PRECIPITATION: Days	BRIGHT SUNSHINE: Hours per day	BRIGHT SUNSHINE: Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1023·3	+ 8·8	55	29	48·0	36·9	42·5	− 1·5	41·3	84	7·5	36	− 20	8	1·3	15
Gibraltar	1019·9	+ 3·4	72	47	65·6	57·5	61·5	+ 1·6	57·1	76	5·4	102	− 59	8	...	...
Malta	1016·6	+ 0·9	76	45	64·0	57·6	60·8	− 2·3	56·0	77	6·2	48	− 33	12	4·1	40
Sierra Leone	1011·5	+ 0·7	91	71	87·2	73·7	80·5	− 0·7	75·5	76	6·5	181	+ 47	21	...	...
Lagos, Nigeria	1010·0	− 0·8	89	71	87·2	75·2	81·2	− 0·1	78·2	76	7·9	89	+ 23	9	...	...
Kaduna, Nigeria	1010·3	− 1·0	95	67	90·4	72·0	81·2	+ 6·2	68·0	49	...	0	− 1	0	...	...
Zomba, Nyasaland	1008·2	− 0·8	99	60	89·8	67·4	78·6	+ 3·5	...	88	4·5	90	− 52	16	...	...
Salisbury, Rhodesia	1007·7	− 2·3	92	56	84·9	61·1	73·0	+ 2·1	64·4	58	5·4	165	+ 73	14	...	...
Cape Town	1015·2	− 0·5	93	48	74·6	56·0	65·3	+ 2·2	61·5	65	5·2	11	− 16	7	...	...
Johannesburg	1011·3	− 1·0	81	45	73·5	52·6	63·1	− 0·3	55·2	67	4·2	133	+ 25	16	8·4	63
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Calcutta, Alipore Obsy.	1013·1	− 0·2	86	56	83·0	64·4	73·7	+ 0·6	64·6	74	3·1	2	− 12	*0	...	...
Bombay	1010·6	− 1·3	92	68	88·6	75·2	81·9	+ 1·6	71·6	71	2·6	0	− 10	*0	...	...
Madras	1010·2	− 1·1	88	65	83·7	73·7	78·7	0·0	75·1	85	7·6	834	+509	*19	...	...
Colombo, Ceylon	1010·3	+ 0·2	88	69	84·8	73·5	79·1	− 1·2	75·8	74	7·4	545	+238	21	...	...
Hong Kong	1018·3	+ 0·7	83	44	74·1	63·4	68·7	− 1·0	60.3	59	5·0	14	− 22	4	6·6	60
Sandakan	...	...	89	73	87·0	75·3	81·1	− 0·1	76·8	77	...	337	− 36	14	...	...
Sydney	1011·7	− 2·0	99	52	77·7	59.5	68·6	+ 1·6	61·3	55	4·4	9	− 64	5	8·2	60
Melbourne	1012·7	− 1·5	96	39	71·6	50·2	60·9	− 0·4	55·3	54	5·1	27	− 29	11	8·3	59
Adelaide	1014·1	− 1·0	109	44	82·4	56·4	69·4	+ 2·5	56·4	38	3·9	2	− 27	2	10·0	72
Perth, W. Australia	1014·3	− 1·0	97	47	75·8	56·9	66·3	+ 0·5	59·8	58	4·5	30	+ 10	9	8·3	61
Coolgardie	1011·6	− 1·5	102	46	88·8	58·0	73·4	+ 2·6	59·9	30	3·9	6	− 11	1	...	...
Brisbane	1013·2	− 1·1	93	60	83·8	65·7	74·7	+ 1·1	68·1	67	3·6	90	− 2	5	...	...
Hobart, Tasmania	1007·3	− 2·1	89	39	65·6	47·2	56·4	− 0·8	49·7	59	5·9	21	− 43	14	8·8	60
Wellington, N.Z.	1008·1	− 3·5	72	41	63·8	51·9	57·9	+ 1·0	53·3	74	6·7	138	+ 46	16	5·5	35
Suva, Fiji	1009·6	− 1·5	85	55	82·1	66·5	74·3	− 2·9	73·2	79	6·9	336	+ 94	13	...	...
Kingston, Jamaica	1013·0	+ 0·3	92	66	88·2	70·4	79·3	0·0	...	75	5·6	13	− 67	3	...	...
Grenada, W.I.	1011·0	+ 0·4	90	72	84·5	74·1	79·3	0·0	74·7	76	4·6	164	− 44	22	...	...
Toronto	1017·3	+ 0·5	61	21	46·7	34·8	40·7	+ 4·4	36·6	81	7·5	38	− 37	18	...	...
Winnipeg	1017·5	+ 0·8	54	6	38·4	26·1	32·3	+11·5	29·3	78	7·3	61	+ 37	10	...	...
St. John, N.B.	1011·9	− 2·0	49	19	39·5	28·9	34·2	− 2·5	31·5	80	6·7	63	− 49	11	...	...
Victoria, B.C.	1020·8	+ 5·3	56	36	48·5	39·7	44·1	− 0·3	41·1	90	6·3	49	−115	11	...	...

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

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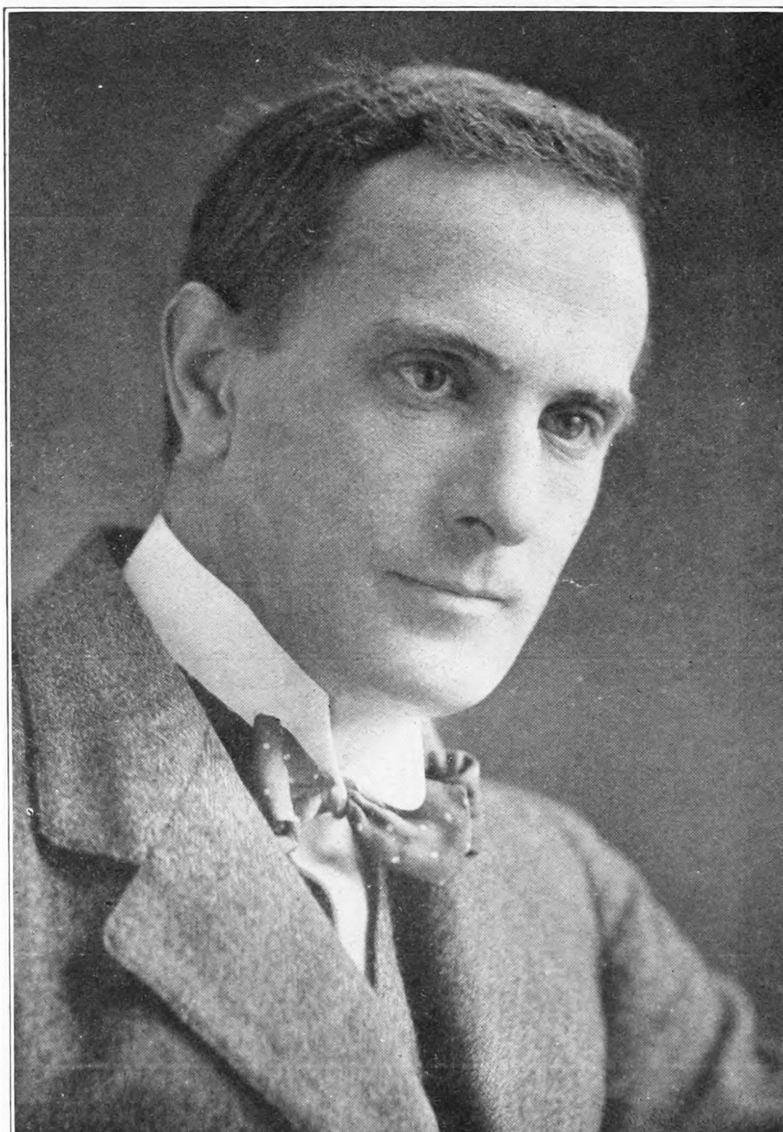

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MORTYN DE CARLE S. SALTER, 1880-1923.

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Mortyn de Carle Sowerby Salter, 1880-1923

THE Meteorological Office has suffered a sad blow by the sudden death of Mr. M. de Carle S. Salter. Mr. Salter's personality made him a very popular member of the staff, and many of us feel a real personal loss quite irrespective of our official relationships. It is very fitting that Dr. Mill, who has worked so intimately with Mr. Salter and been largely responsible for giving him his sound knowledge of rainfall matters, should write an account of his life and work for this Magazine, but I cannot refrain from recording here on behalf of the staff of the Meteorological Office our deep sense of loss and our sincere sympathy with his family in their great bereavement.

G. C. SIMPSON.

READERS of this Magazine will learn with a sense of personal loss that Mr. Carle Salter died after a very short illness on May 21st. For nearly a quarter of a century no issue of the *Meteorological Magazine* appeared without his collaboration in its production, and latterly it was upon him that the difficult task devolved of adapting the old traditions which had been growing up for sixty years to the new conditions of the post-war world.

Mr. Salter was the son of Mr. M. J. Salter, who was well known as a scientific chemist in London, and his ancestors included several whose names remain familiar in the scientific world, notable amongst them the famous botanist, Dr. Sowerby. After an education at Bancroft's School, Mr. Salter joined the

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staff of the British Rainfall Organization, at 62, Camden Square, in 1897, and thus had for three years the advantage of working under Mr. G. J. Symons, F.R.S., the founder of the voluntary system of rainfall observing in this country. When I joined Mr. Sowerby Wallis as joint-director of the British Rainfall Organization, on the first day of the present century, I found Mr. Salter very competent in the handling of statistics, and later when I had the sole responsibility his eagerness to co-operate in the new style of discussion and calculation based on cartometry was extremely helpful to me in gradually introducing more rigidly scientific methods. He was in many ways an ideal assistant, quick in his intelligent grasp of new ideas, unflagging in his patient mastery of depressing routine and always a student of the scientific principles underlying the operations he was carrying out. He soon became my principal assistant, and year by year I delegated to him more and more of the statistical work required for the annual volumes of *British Rainfall*. From 1912 he became personally responsible for the great General Table of Rainfall, and he took a substantial share in the various discussions.

An important part of the work at Camden Square was the preparation of reports on the rainfall of gathering grounds for projected water-works, which had to be prepared often from scanty data and supported by evidence before Parliamentary Committees. In the inspection of the ground and rain gauges and the testing of the value of particular rainfall records and computing average values, he developed his natural aptitude by diligent and unremitting study. Latterly we adopted the system of working out the probable rainfall of an area, separately, from the same data, one trying to establish the highest, the other the lowest possible value consistent with the data, and then arguing the matter out until by mutual criticism we arrived at the most probable figure. By this means when it came to giving evidence one was prepared for the cross-examination of the most pertinacious counsel.

Thus also I acquired that confidence in his judgment and skill which enabled me, when the time arrived, to hand over to him the work I was not destined to carry on, with perfect confidence in his powers ; and hence to me his death was a double sorrow.

On the breakdown of my health, in 1913, Mr. Salter became joint-director of the British Rainfall Organization, and in effect joint-editor of this Magazine also. When the trained assistants left to take part in the War Mr. Salter remained at his post, only because the state of his health was such that no medical board would pass him for active service. Thus it was that the work of the Rainfall Organization was held together and the publications kept going by the temporary assistants whom he trained. This involved a very heavy strain on Mr. Salter which he could never have stood but for the constant care with which his wife—a daughter of the late Dr. E. F. Willoughby—watched over his health. The close of the War, unfortunately, brought no relief, as the period of transition immediately preceding and following my retirement, in 1919, involved an even heavier tax on his strength ; but he lived to see the great body of 5,000 voluntary observers of rainfall transferred in full working order without loss or discontinuity from the informal conditions of a private institution to the less flexible if more dignified control of a Government Department.

Considering the close and continuous application to routine work which his position entailed it would have been no discredit to Mr. Salter if he had failed to find time for independent work ; but he was able to contribute many important papers to the Royal Meteorological Society, on the Council of which he served for many years, and to the Institution of Water Engineers. In these he materially advanced our knowledge of the relation of rainfall to the configuration of the land and also of the fluctuations of general rainfall from year to year. In " The Rainfall of the British Isles " he gave a clear and interesting summary of up-to-date material which should be studied by every rainfall observer. This book shows how thoroughly Mr. Salter had mastered the facts of rainfall distribution, and gave promise of works of wider usefulness in a future which, alas, he was never to see.

Mr. Salter's personal qualities won for him many friends, and he was always a cheerful and entertaining companion and a most loyal colleague. The sympathy of a large number will turn to the widow and only son who formed with him a family circle of rare devotion and affection.

H. R. MILL.

I see by an announcement in to-day's *Times*, the death of the Superintendent of the Rainfall Organization, Mr. Salter, age 42. I realise a loss, a great loss. I feel personally a friend has gone, although I never met him, but his communication has been so pleasant and genial. He was without a doubt an enthusiast and a genius for this work. I express my sincere sympathy with you and the meteorological world at his loss ; his memory will be held in high regard.

HENRY A. ROGERS.

3, *Victoria Square, Cotham, Bristol, May 23rd*, 1923.

Many other expressions of appreciation and sympathy have been received.

Sea Temperature, Pressure Distribution and Weather of May, 1923

By C. E. P. Brooks, M.Sc.

THE abnormally cold and showery weather of May, 1923, in the British Isles, was due to persistent north-westerly winds, associated with a steep pressure gradient between an anticyclone over the North Atlantic and a depression over southern Norway. The mean pressure for the region 50-55° N., 20-30° W., based on 33 wireless reports, was 1,025 mb., or more than 10 mb. above normal, while the mean for Skudesnaes was 1,006·3 mb., or 8·4 mb. below normal. The gradient for northerly winds was actually four times the normal May gradient for westerly winds between the Azores and Iceland.

When we attempt any explanation of unusual weather, it is generally necessary to start a long way back. In this case we appear still to be experiencing the consequences of the abnormal summer of 1921. That summer was marked by open stormy conditions in the Arctic Ocean (1) which set free large quantities of polar ice. This ice, drifting with the east Greenland current, reached the neighbourhood of Iceland in the spring of 1922. In the succeeding months it lowered the temperature of the ocean near Iceland ; in consequence pressure rose there and the tracks of depressions were driven southward causing the unfavourable British summer of 1922 ; a similar action in earlier years has been shown by Brennecke (2). Meanwhile the bulk of the ice rounded Cape Farewell, made the circuit of Davis Strait, and towards the close of 1922 passed into the Labrador Current. The volume, speed and ice-load of the Labrador Current were also increased by the northerly winds westward of Greenland, associated with an intense development of the barometric minimum in the far north-eastern Atlantic during the winter of 1922-23, which will be referred to later. Early in 1923 the Labrador Current carried large quantities of ice into the North Atlantic off Newfoundland (3) ; this and the accompanying cold water helped to lower the temperature of the Gulf Stream.

There was also another reason why the temperature of the Gulf Stream off Newfoundland should be falling about this time. The North-East Trade Wind off the west Coast of Africa drives the surface waters before it as the Trade Wind Drift.

1. Brooks, C. E. P. and Glasspoole, J. *The Drought of 1921. London. Q. J. R. Met. Soc.*, Vol. XLVIII., 1922, p. 139.
2. Brennecke, W. *Beziehungen Zwischen der Luftdruckverteilung und den Eisverhältnissen des Ostgrönlandischen Meeres. Ann. Hydrogr., Berlin*, 32, 1904, p. 49.
3. Brooks, Charles F. *The extraordinary meteorological situation in the North Atlantic Region. Worcester, Mass., Bull. American Met. Soc.*, 4, 1923, p. 49.

This turns westward as the North Atlantic Equatorial Current, which is deflected northward by the Coast of America and ultimately forms the Gulf Stream. The average time occupied in the circuit from the Trade Wind region to the north of Scotland is about a year. If the strength of the Trade Wind is temporarily increased, the warm surface waters will be driven forward more rapidly, and as the late Commander Hepworth showed (4), the increase will be followed about a year later by high sea temperatures off the British Isles. Behind this mass of warm water however there will be an area from which the warm surface waters have been driven off and colder underlying waters brought to the surface; hence the initial rise will be followed a few months later by a fall.

Now we find that from December, 1921, to March, 1922, pressure at Horta (Azores) averaged 5 mb. above normal; this corresponds with a decided increase in the strength of the Trade Winds, and accordingly we should expect high sea temperatures north of Scotland in the winter of 1922-23. That this was probably the case is indicated by the fact that from December, 1922, to February, 1923, pressure was abnormally low between Iceland, Norway and the British Isles, since the effect of warm sea is to cause a fall of barometric pressure, while cold sea causes a rise of pressure. In the western Atlantic, behind this area of warm water, the temperature of the Gulf Stream was relatively low, and this combined with the influence of the Labrador Current to produce a mass of cold water off Newfoundland, and to cause an abnormally cold spring in the United States (3). We must first follow the consequences of the high temperature and low pressure north of Scotland. There is a general tendency, illustrated for instance by the Réseau Mondial charts, for areas of abnormally high or low monthly pressure to drift slowly eastwards, with their accompanying weather. Thus Hildebrandsson finds a high correlation between the rainfall of Thorshavn in January to March, and that of Berlin in the following April to September. As the influence of the warm water in the far north-eastern Atlantic penetrates into Europe we may expect pressure there to be below normal, and the low pressure over southern Scandinavia during May is perhaps the beginning of such a process. In the meantime the cold water off Newfoundland, following the course of the Gulf Stream, travelled in an east-north-east direction at about twelve miles a

4. London, Meteorological Office. *The Trade Winds of the Atlantic Ocean.* 1910.
London, Meteorological Office. *Geophysical Memoirs Nos.* 1 *and* 10, *The effect of the Labrador Current upon the surface temperature of the North Atlantic, and of the latter upon air temperature and pressure over the British Isles, Parts I., II. By M. W. Campbell Hepworth,* 1912, 1914.

day and gradually spread its influence over the North Atlantic. In the area 50-55° N, 20-30° W. the mean sea temperature for May was about 2·5° F. below normal, but this point is rather south of the main course of the Gulf Stream, while it is the northern half that would be mainly affected by the Labrador Current. Further north observations are very scarce, but the deficiency of temperature appears to have been greater. The relatively low temperature must have been at least partially the cause of the high pressure over the central Atlantic during May. Some part of the excess may be due to a northward extension of the Azores anticyclone in consequence of the Icelandic minimum being displaced far to the east.

Thus both factors in the cold north-westerly winds of May—the Atlantic anticyclone and the minimum near Scandinavia, appear to be connected with irregularities in the circulation of the Arctic and north Atlantic waters, which first became apparent more than a year ago.

Royal Meteorological Society

THE monthly meeting of the Society was held on Wednesday, May 16th, at 49, Cromwell Road, South Kensington, Dr. C. Chree, F.R.S., President, in the chair.

M. de Carle S. Salter, Superintendent, British Rainfall Organization, and J. Glasspoole, M.Sc., A.I.C.—The Fluctuations of Annual Rainfall in the British Isles considered cartographically.

In the absence of Mr. Salter, who was then seriously ill, Mr. Glasspoole read the paper. He paid a tribute to Mr. Salter's knowledge and long experience of the subject of rainfall.

The paper deals with a series of 54 rainfall maps for the period 1868-1921, each map showing for one year the ratio of the actual rainfall to the average of the 35 years, 1881-1915. The maps are classified into 3 types, indicating respectively (A) excess of orographical rain, (B) deficiency of orographical rain, and (C) excess of cyclonic rain, the typical years of each of these types being (A) 1874, (B) 1919 and (C) 1912. In the earlier portion of the series, years of type (B) or (C) predominate, while towards the end, years of type (A) are slightly more frequent. In the earlier years the maxima are found to be generally in the east; in the middle of the period, in the west; and in the later years, in the south. In every year of the series, some part of the country had more than its average rainfall, and in all but three years, some part had less than the average.

The general rainfall, *i.e.*, the mean percentage for the whole of the British Isles, varied from 137 in 1872 to 77 in 1887, the

Table showing the Annual Rainfall for each year, 1868 to 1921, expressed as a percentage of the average of the 35 years 1881 to 1915

Year	England and Wales	Scotland	Ireland	British Isles	Year	England and Wales	Scotland	Ireland	British Isles
1868	99	113	104	104	1895	96	95	96	95
1869	105	100	98	102	1896	93	99	94	95
1870	82	80	95	84	1897	101	95	114	103
1871	97	92	98	96	1898	87	109	98	95
1872	144	134	128	137	1899	94	106	102	99
1873	89	105	94	94	1900	109	119	115	113
1874	95	108	98	99	1901	88	94	96	92
1875	114	99	99	107	1902	84	86	92	87
1876	117	114	104	113	1903	128	129	124	127
1877	126	131	123	127	1904	89	93	101	93
1878	110	92	96	102	1905	86	97	89	89
1879	109	91	96	100	1906	101	111	93	101
1880	113	86	95	102	1907	99	104	99	100
1881	109	95	100	103	1908	91	99	96	94
1882	127	113	113	120	1909	105	101	93	101
1883	107	106	110	108	1910	113	105	109	110
1884	88	104	98	94	1911	94	99	96	96
1885	101	91	92	96	1912	125	108	108	116
1886	117	94	109	110	1913	98	93	106	99
1887	74	80	77	77	1914	108	103	108	107
1888	98	93	98	97	1915	110	96	102	105
1889	94	85	93	92	1916	114	117	114	115
1890	90	103	97	95	1917	98	97	99	97
1891	111	100	98	105	1918	107	106	111	108
1892	94	96	98	95	1919	105	93	91	98
1893	83	97	82	86	1920	109	105	111	109
1894	108	102	104	105	1921	70	99	88	82

deviation from 100 exceeding 20 in only 5 years, and averaging 8. The sequence of oscillations in the general rainfall is remarkable. From 1868 to 1882 maxima occur at intervals of 5 years, from 1889 to 1909 of 3 years, and from 1910 to 1921 of 2 years. There is also evidence of a long-period fluctuation with two maxima about 40 years apart.

Values for the rainfall expressed as a percentage of the average of 1881-1915 for each year are given in the accompanying table* for England and Wales, Scotland, Ireland and the British Isles. These values were prepared by Mr. Glasspoole, by taking a series of 120 points equally distributed over the British Isles, tabulating the figures from the map for each year and taking

* The Table is not incorporated in the paper presented to the Royal Meteorological Society. The statistics are represented graphically in the paper.

the means. In a few cases in areas of few rainfall records, it was necessary to estimate values from the maps. These general values are probably more accurate than any previously published, since the data available were more homogeneous and since the average referred to is constant.

Annual pressure maps of North West Europe show three main types of variation :—(i) a shift of the south-west wind-drift to the north or south, corresponding with a rise or fall of pressure over the British Isles as a whole ; (ii) a change in the gradient, corresponding with a variation in the pressure difference between north and south ; (iii) local deflections of the isobars. On correlating the general pressure for each year with the general rainfall, the authors find as the correlation coefficient —0·83, so that variations of type (i) appear to be the principal factor in determining the amount of the general rainfall ; the lower the pressure, the higher the rainfall and *vice versa*. As to the variations of type (ii) a measure of the change in the gradient is obtained by taking the difference between the pressure at Dungeness and at Stornoway. This pressure difference is correlated with a certain measure of the comparative wetness of the western and eastern districts, and a correlation coefficient +0·69 is found, indicating that, in years of high pressure gradient, rainfall is comparatively heavy in the west and comparatively light in the east.

The paper deals with the question of the fluctuations of annual rainfall in a much more elaborate manner than has hitherto been possible.

A. W. Clayden, M.A.—(a) An improved Actinograph ; (b) Note on the influence of a glass shade.

The first actinograph designed by Mr. Clayden was constructed with two bimetallic coils mounted on a horizontal axis ; one coil was blackened, the other bright ; the movements of a pen were controlled by the two coils in such a way that the heating of one coil moved the pen up the record sheet, the heating of the other moved it down. On exposure to sunshine the blackened coil was heated more than the other, and the curve traced by the pen therefore gave a record of the duration and intensity of sunshine. In the improved form of the instrument the axis of the coils is not horizontal but parallel to the earth's axis. Moreover, the coils are longer and, therefore, a more open scale is obtained.

The instrument is not adapted for the accurate measurement of the intensity of solar radiation, but the records which Mr. Clayden displayed show that it gives an excellent idea of the sequence of changes in the amount of sunshine, so that for many purposes it is to be preferred to the ordinary sunshine recorder.

Capt. E. E. Benest.—Notes on the Sumatras of the Malacca Straits.

An account of this paper was given by Capt. Sir David Wilson-Barker. "Sumatras" appear to be a special form of the ordinary arch squall of the East Indies. These squalls usually blow from the south-west, and are more frequent between the months of April and October. A greater number is experienced between Malacca and Pulo Penang than between Malacca and Singapore; but occasionally the latter place is visited and vessels have been driven ashore there owing to a disregard of local warnings. "Sumatras" always occur at night, and are generally accompanied by thunder, lightning and torrential rain. The strength of the wind is estimated as lying between 40 and 55 miles per hour. A characteristic cloud formation is always observed, exhibiting a heavy arch or bank of cumulo-nimbus, which rises to an estimated height of upwards of 7,000 ft. and rapidly spreads over the whole heavens. The duration of these "Sumatras" seldom exceeds two hours.

Correspondence

To the Editor, *The Meteorological Magazine*

Anti-Solar Rays

With reference to the illustration of the anti-solar rays and the description by Mr. G. A. Clarke, which was published in the February number of the *Meteorological Magazine*, this phenomenon has been long seen and commented upon by residents in the Bechuanaland Protectorate. It is a common sight north of latitude 25° in South Africa. It is sometimes seen quite clearly much south of this, even as far south as Kimberley, latitude 29°. For years past I have observed the rays at sunset; I was first of the opinion that they were the converging shadows of cirrus clouds, but on many occasions these rays have been observed quite clearly when there were no clouds in the sky whatever. I came to the conclusion that they were a contra-reflection of the rays of the setting sun inside the atmosphere, such as might be observed if seen from the inside of a crystal sphere. They would probably become visible under such circumstances if there were a certain amount of atmospheric dust.

Miss Giles of Mahalapye, in Bechuanaland Protectorate, latitude approximately 23° south, has kindly written me a description of the rays as follows :—

"During February and March these rays were seen almost every evening immediately after sunset, sometimes mere rays of light somewhat like searchlights but of a pinkish hue, sometimes deep rosy pink and at other times paler and almost yellowy white with a background of blue grey evening sky. When the rays were a deep pink the sky would be of a deep blue, and other times of a pale grey colour. We have on two occasions seen the eastern rays and the rays of the setting sun meeting in the zenith. On one occasion these rays seemed like one continuous arch of lights from east to west. Where they met at the zenith the rays were of a pale colour with a pinkish yellowish tinge."

I may mention that these rays are such a common sight that residents in the Protectorate rarely call attention to the phenomenon.

A. H. WALLIS, C.E.

21, *Egerton Road, Kimberley, South Africa, 30th April*, 1923.

[The possibility of mountains rather than clouds being responsible for the shadow bands has to be remembered. If the phenomenon is observed on consecutive evenings and the rays are in the same apparent positions, the obstructions must be fixed ones.—ED. *M.M.*]

May Weather in 1867 and 1923

IT was stated at the time that the maximum of 81° F. at Kensington on May 4th ultimo was the highest recorded so early in May for 50 years. May I be allowed to draw attention to the really wonderfully close parallel between May, 1923, and May, 1867?

I was then at Cambridge, and remember well the extraordinary burst of heat at the beginning of the month, after a hitherto backward spring. The trees rushed into leaf, the horse chestnuts especially into leaf and flower in a few days. The *Meteorological Magazine* for June, 1867, has abundant detail about this heat spell; as has also *British Rainfall* for that year on pages 58 and 59. Camden Town and Wisbech reported 84° on the 6th, Linton Park 85° on the 7th, and there were many very high maxima on the 8th. But as in the May just ended the early spell of heat was violently and completely reversed, so it was then. In 1923 a terrible thunderstorm and hurricane ravaged north-west France on the 9th, and on the 10th a strong and terribly cold north wind was sweeping over Great Britain. In 1867, on the 10th came an unusually severe series of thunderstorms, from which hardly any part of Great Britain and Ireland escaped. At Cambridge there was a short sharp storm at about 11 a.m., a rapid clearance, and in the late evening a very terrible storm with more than an inch of rain, making a considerable flood in the river Cam. I remember well hurrying to my rooms, while red lightning appeared to be darting across the streets, thankful to be under cover before the rain began.

And then came a fortnight of most bitter weather—frequent showers of hail, sleet and snow, even heavy snowfalls in places, and several destructive frosts, especially from the 21st to the 25th, and even as far south as Bournemouth! But the last few days of that May were mild. This time the bitter Polar winds, whether from west, north or east, have continued without a break to the very end.

It won't do to argue from the later months of 1867 to the months now coming, for the only rule that I have been able to discover about weather parallels is that as soon as attention is called to them they promptly cease!

H. A. Boys, F.R.Met.Soc.

Spring Hill, S. Mary Bourne, Hants, June 1st, 1923.

NOTES AND QUERIES

The Halley Lecture

The Halley Lecture was delivered at Oxford on May 17th by Dr. G. C. Simpson, C.B.E., F.R.S., Director of the Meteorological Office, who took for his subject "The Meteorology of Scott's Last March."

The story of the Polar Party which left Hut Point on November 3rd, 1911, reached the South Pole, 900 miles away, on January 17th, 1912, and perished on the return march, was used as a connecting thread for an account of the meteorological conditions met with on the Ross Barrier and on the Polar Plateau.

Attention was drawn to the existence on the Barrier during November of an enormous daily variation of temperature which frequently exceeded a difference of 20 degrees F. between the mid-day and midnight temperatures, although the sun did not then set but circulated from 10 degrees above the southern horizon at midnight to about 30 degrees above the northern horizon at mid-day.

The effect of blizzards on the men and ponies was described and an explanation of the cause of blizzards was given. Dr. Simpson described the effect on the spirits of the party of the discovery that Amundsen had reached the Pole before them, but came to the conclusion that the chief cause of the disaster was the abnormal weather experienced on the return journey.

Just before the party reached the Barrier in the descent from the Plateau, the temperature commenced to fall very rapidly. For 39 days unexpectedly low temperatures were met with owing to an unusual absence of wind which allowed the temperature to fall extremely low. If a blizzard had occurred at this time it would have displaced the cold air, removed the coating of ice crystals from the surface which made sledging very hard and made it possible to run a sail on the sledge. The low temperatures and heavy pulling overtaxed the strength of the men and was one of the deciding factors in causing the disaster.

The final factor was a blizzard which commenced on March 20th and continued for more than ten days. At this time the party was within eleven miles of a depôt where there was plenty of food and fuel, but they could not leave their tent on account of the high wind and thick drift snow. In consequence they used up their remaining food and by the time the blizzard was over they had all passed away.

The Barometer

A TEN minutes' talk on the Barometer by Lieut-Col. Gold, D.S.O., F.R.S., assistant director of the Meteorological Office, was broadcasted from the London station of the British Broadcasting Company on Thursday evening, May 31st, at 8 p.m. Col. Gold explained briefly the meaning of the millibar and the reasons that induced meteorologists to accept it as the unit of pressure in preference to the pound per square inch when they decided to discontinue giving pressure in units of length, inches or millimetres. He emphasized the practical importance of the fact that pressure at or near sea level is always in the neighbourhood of 1,000 millibars. It is hoped that listeners-in will understand in future what has mystified many of them in the past. In order to enable listeners-in who possess barometers to reduce their observations to Mean Sea Level for comparison with the barometer readings broadcasted each evening, corrections for altitude and temperature which could be easily applied were given. The use of the barometer in determining the pressure distribution over a country and the fundamental importance of the latter in weather forecasting was emphasised. The transmission was satisfactory and listeners-in in the greater London area report that they heard every word distinctly.

It is understood that two further talks will be given in the course of the summer describing the way in which forecasts are made and explaining some recent developments in the art of forecasting weather.

Pilot Balloon Observations in Northern Canada

THE International Meteorological Committee in 1919 recommended that as far as possible, special international investigation of the upper air should be made in co-operation with Roald Amundsen's expedition during the years 1919-1924. Sir R. F. Stupart, in a letter to the Committee, states, that as part of her share in this scheme, Canada sent a specially trained observer in the early summer of 1921 to Fort Good Hope in northern Canada, near the point where the Mackenzie River crosses the

Arctic Circle. With the assistance of two priests he took pilot balloon observations whenever possible throughout the year, and when he left the post in June, 1922, the priests were quite able to continue the balloon work during the coming year. This they agreed to do, so that pilot balloon observations are now being taken regularly at Fort Good Hope.

Transfer of Coastguard Stations to the Board of Trade

IMPORTANT changes have recently been made in the organisation of the former Coastguard Service. There has been for many years a close connection between the work of the Meteorological Office and the Coastguards: they furnished telegraphic reports to the Forecast Division from some of the most important stations round the coast, formerly three times and latterly four times per day, a fourth report at 1 a.m. in the morning having been introduced during the war: they co-operated with the Office in the work of warning seamen of impending gales by hoisting the warning cone when the Forecast Division issued the notification and they contributed readings of the temperature of the sea around the British coasts which were published for many years in the Weekly Weather Report.

On April 1st, 1923, the Coast Guard Service, which has been under the control of the Admiralty since 1856, was suspended and the familiar figure of the Coastguards disappears from our coasts.

The Service has now been divided into three distinct forces:

(1) The Naval Signalling Section.

(2) The Coast Watching Force.

(3) The Coast Preventive Force.

The majority of the former Coastguard Stations have been taken over by the Coast Watching Force which will be under the control of the Marine Department of the Board of Trade. The Naval *personnel* at these stations have been pensioned and in most cases retained as civilian Coast Watchers—the complement at each station, however, having been considerably reduced.

The Board of Trade have undertaken to continue the meteorological observations and returns formerly furnished by the Coastguard. The exhibition of gale warning signals is also being continued, but the re-organisation has led to the closing of certain stations at which gale warning signals were formerly exhibited. In such cases arrangements are being made for the exhibition of signals in neighbouring situations with a view to filling, as far as possible, any gaps which have arisen in the system of warning stations.

The International Symbols ← and ⍏

A Code of symbols for international use was adopted by the International Meteorological Congress of 1873 at Vienna. The meanings attached to some of the symbols in the reports of the Congress in different languages were not quite consistent, however, and ambiguities still persist.

The symbol ← is a case in point. The French (1) and German (2) texts of the resolution of 1873 interpret the symbol as "Aiguilles de glace" and "Eisnadeln," while the English version (3) gives "Ice-crystals." The latter term appears in all the instructions for observers issued by the Meteorological Office; thus, in *The Observer's Handbook* (4), we find "Ice-crystals ←. Small crystals of ice occasionally fall in winter. They may be distinguished from hail or snow by their shape and size." The practice in America differs however; thus Talman (5), in his list of international symbols, adopts the literal translation "Ice-needles." "Ice needles sometimes seen floating or slowly falling in the air in clear cold weather."

The formation of ice-crystals in the lower layers of the atmosphere under a cloudless sky is not an uncommon phenomenon, and in the polar regions it is frequent. Early explorers were familiar with these floating crystals, and the picturesque term "diamond dust" was in use as early as 1671 (6). In his *Classification of Hydrometeors*, Hellmann (7) calls the phenomenon "snow without clouds," and says that the term "Eisnadeln" was given because large numbers of the crystals are needles, although the presence of other forms has been shown by photo-micrographs. It does not appear that the difference of names here connoted a real difference of practice; the German or French observers appear to have reported all cases of ice-crystals (which were not snow or hail) by the symbol ← in spite of the apparent restrictive character of the names used.

Evidently there is no call for a change in the English practice.

1. Bericht über die Verhandlungen des Internationalen Meteorologen Congresses zu Wien [1873]. Wien, 1873.

2. Rapport sur les Travaux du Congrès international des Météorologistes réunis à Vienne du 2 au 16 Septembre 1873. Vienne 1874.

3. Report of the proceedings of the Meteorological Congress at Vienna [1873]. London 1874.

4. *Observer's Handbook*, 1908 (1st) Edition to 1921 (Current) Edition.

5. Talman, Meteorological Symbols. Monthly Weather Review, 1916, p. 268. This paper contains a valuable summary of the usage in different countries. It is unfortunate, however, that in many cases the forms of the principal International Symbols given without qualification (in Table I.) are not in accordance with the official reports of the International Meteorological Congress at Vienna, at which the symbols were adopted. The original forms are shewn under the heading "Principal Variants."

6. Hellmann, Classification of the Hydrometeors, Monthly Weather Review, 1917, p. 13 (translated by C. Abbe Jr.).

The Director of the Meteorological Office, to whom the question has been referred, wishes it to be known that in future the definition in *The Observer's Handbook* will be amplified as follows :

> ↔ *Ice crystals in the air :* these crystals float separately in the air and are usually observed in cold clear weather, when, under suitable conditions, they give rise to halo phenomena.

Another symbol whose meaning is ambiguous is ⇸. According to the three reports the resolution of 1873 defined the symbol as " Snow drift," " Schneegestober," " Bourrasque de neige." The International Meteorological Committee of 1885 at Paris declared the equivalents of the following terms in English, French and German :—

Snowdrift	=	Chasse de neige	=	Schneetreiben
Snowstorm	=	Tourments de neige	=	Schneegestober

without stating which of these was to be represented by the symbol. The Conference at Munich in 1891 decided to change the English equivalent of " Schneetreiben, Chasse de neige " to " drifting snow " on the ground that " snow-drift " denoted the result and not the act of drifting. But the question what ⇸ represented was still left unanswered. *The Observer's Handbook* interprets the symbol as "snowdrift" ; in fact it must be admitted that the resolutions of 1885 and 1891 have so far been ignored.

To meet the difficulty it is proposed to incorporate in future instructions to observers the following definitions :—

> ⇸ *Drift-Snow.* Drift snow is snow which travels with the wind without settling when it reaches the ground. It may occur with or without new snow falling.
>
> If drift snow occurs without new snow falling the symbol is to be used alone.
>
> If drift snow occurs whilst new snow is falling the two symbols ✳ ⇸ are to be used together.

International Photographic Survey of the Sky

It has been proposed that an endeavour should be made to obtain a synoptic survey of the skies of north-western Europe, by simultaneous photographs in all parts of the area. The seven days of the week, beginning September 17th, 1923, are indicated as days to be selected for a trial of the enterprise. At least three photographs are wanted for each day, as nearly as possible at the hours of the telegraphic observations, 7h., 13h. and 18h., but it would be preferable if the photographs were repeated each hour.

Observers who are willing to join in this scheme should communicate in the first instance with Sir Napier Shaw (School of Meteorology, Meteorological Office, South Kensington), President of the International Commission for the Study of Clouds.

Review

A DICTIONARY OF APPLIED PHYSICS. Edited by Sir Richard Glazebrook, K.C.B., D.Sc., F.R.S. Vol. IV. *Light-Sound-Radiology.* 8vo, 9×6, pp. viii. + 914. *Illus.* Macmillan and Co. 1923. £3 3*s. net.*

The fourth volume of the *Dictionary of Applied Physics* deals mostly with matters which are not the concern of meteorologists as such. In looking for the meteorology we are led to study interesting articles on a wide range of subjects, from the Quantum Theory to the Mechanism of Moving Pictures. Within our own range we find the articles by Lord Rayleigh on the Scattering of Light by Gases, and by Dr. A. V. Hill on the Mirror Position Finder. There is also a good deal of meteorology in the account of sound-ranging by Professor W. L. Bragg and in the general article on sound by Professor E. H. Barton.

Lord Rayleigh gives an excellent popular account of his father's work and his own, and reproduces some striking photographs. It is interesting to learn that the scattering of light by dust-free air was established independently by three workers—by Cabannes in 1915, by Schmoluchowski in 1916, and by the present Lord Rayleigh in 1918; it was as early as 1899 that the elder Lord Rayleigh showed theoretically that the blue of the sky could be explained by molecular scattering.

Hill's article on the Mirror Position Finder contains many practical details, and serves as a useful reminder of the advantages of this apparatus as an aid to the determination of the movements in the atmosphere. It is fascinating to watch experts using the mirrors to determine cloud height, and there is evidently wide scope for such methods in the study of the transformations of the clouds.

That the practice of sound-ranging, *i.e.*, of locating the position of guns by the measurement of the differences between the times taken by the sound of the discharge to reach various stations, would be affected by meteorological conditions was to be expected. "It was found impossible to make locations when the wind was blowing from our side of the line towards the enemy; the reports of the guns never reached the microphones or were drowned by other noises on our side of the line. On the other hand, when the wind was blowing from the batteries towards the recording stations, the reports were heard clearly and had a sharply marked commencement." The theoretical allowance for wind and temperature is rather troublesome to compute even when it is assumed that the distribution of these elements is known. It was found better to obtain empirical corrections by experiments made day by day at a safe distance from the firing line, but it is stated that empirical relationships were formulated which could be used when the special installation was not in action. (This is one of the cases where a reference to the place where further details are published would be useful. The Dictionary gives ample references in some articles but none at all in others.)

In Professor Barton's article on Sound, the paragraph (§23) devoted to Long-Range Transit of Sound is based on the work of Tyndall and the late Lord Rayleigh, and perhaps it does not sufficiently take account of the work of meteorologists. Attention should be called moreover to one detail of mathematical interest. In the discussion of the effects of Temperature Gradient it is stated, with reference to an atmosphere with a uniform gradient (such as occurs when the air is in adiabatic equilibrium), "when this state of things prevails it has been shown by the late Lord Rayleigh that the path of a ray of sound through the air is a catenary with vertex downwards." This statement will perpetuate an unfortunate slip of Lord Rayleigh's. Reference to the Theory of Sound* shows that Rayleigh gave the catenary only as an approximation to the path in question. As a matter of fact, the catenary is not even so good an approximation as a circle. The actual curve is a cycloid, as may be seen by examining Rayleigh's equations. The characteristic property of a cycloid is that it is more sharply curved the further from the vertex, whilst the catenary is less sharply curved. Tyndall's theory of "acoustic clouds" is quoted by Professor Barton as the explanation of the bad transmission of sound on certain occasions. It is curious that there is no reference to these "acoustic clouds" in the article on sound-ranging. There is evidently scope for investigation of the relation between audibility and the homogeneity of the atmosphere as regards temperature and humidity. The investigation of Zones of Silence occupies such a large place in meteorological literature that it is disappointing to find only a short paragraph devoted to the subject (and no references). We can not pass the statement that "the difficulties in settling what has been the cause of such phenomena on any particular occasion usually lies in the absence of qualified observers expecting an explosion and listening for it." The real difficulty on the observational side has been to obtain sufficiently detailed information as to the distribution of wind and temperature aloft. Since Fujiwhara has shown how it is to be done, the application of this information in a specific instance should not be difficult.

There is to be one more volume of the great Dictionary, Vol. V., *Metallurgy and Aeronautics.*

F.J.W.W.

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* *2nd Edition, London* 1896, Vol. II., p. 132.

Obituary

Captain Carl Hartvig Ryder: died May 3, 1923.—The International Meteorological Committee has lost one of its most active members. Those who took part in its meetings in September, 1921, will remember Captain Ryder's solicitude for the welfare of the international meteorological organisation as developed in the years before the war.

Before his appointment as Director of the Danish Meteorological Service in succession to Paulsen in 1907 Ryder was a naval officer. His personal experiences in meteorology were specially in relation to Greenland and the Arctic. Throughout his tenure of office he maintained his interest in the Arctic and devoted much attention to the annual issue of monthly charts of the polar ice for which the meteorological world is much indebted to the Danish Office. The telegraphic communication with Iceland is another standing memorial of the Danish interest in meteorology. The daily charts of the Atlantic Ocean which were published jointly from 1881 by the Deutsche Seewarte and the Danish Office are a fitting reminder of the previous services in that province by Captain Hoffmeyer, Paulsen's predecessor. We may express the hope that Captain Ryder's death will not impair the intention to bring them up to date. For some years past Captain Ryder suffered from rheumatism and latterly he felt the burden of the administration of the Office in face of the increasing demands of the Danish public and the economic situation. His short final illness was, however attributed to cancer. His death is much regretted by all his colleagues on the International Committee which he joined in 1910 and by many other friends in this country where he was on several occasions a welcome guest.

NAPIER SHAW.

News in Brief

Two new storm signal stations have just been erected in the Thames Estuary, to warn shipping making use of the Thames and the Port of London, of the approach of bad weather. These stations are situated at Cherry Garden Pier, Rotherhithe, and on the lower pierhead at Tilbury.

A wireless station is to be erected on Novaya Zemlya Island by the Russian Authorities according to *The Times* of May 29th. The station will be situated by Matochkin Strait and will be in communication with north Russian and Siberian stations. The *personnel* will include, in addition to the wireless experts and meteorologists, a geologist and a zoologist.

In connection with Mr. Brooks's article on "Sea temperature, pressure distribution and weather of May, 1923," it is interesting to note that according to the officers of the White Star liner "Megantic," the ice conditions in the North Atlantic are at present worse and more dangerous to navigation than they have been for more than twenty years. *The Times* states that after starting from Montreal on May 18th they met with ice of various kinds, close packed, loose and scattered. Two days out after passing Cape Race they sighted one big iceberg. Ice in this region is most unusual after the end of March.

The *Daily Mail* states that during the experiments recently carried out in the laboratory of the General Electrical Company at Pittsfield, Massachusetts, flashes of artificial lightning representing a pressure of 2,000,000 volts jumped a gap 15 feet wide. When the artificial lightning struck some wooden blocks, part of the wood disappeared indicating in the opinion of the engineers the possibility that it had been transformed into a gaseous element.

The Weather of May, 1923

FOR the first week of the month pressure was high over Central Europe and the southern part of the British Isles, so that warm sunny weather with light winds prevailed over England, Ireland, and the greater part of Scotland. Temperature rose locally in the south to between 75° F. and 80° F. and even touched 82° F. on the 4th in London (Camden Square). Following on these conditions there was a drop of about 10 to 20 degrees within a day or two as a low pressure system became established near Scandinavia and a large anticyclone over the Atlantic. Cold northerly winds, often strong in force, swept across the British Isles for the rest of the month, and these were associated with showers of rain, hail, sleet and even snow at times. On the 16th snow was recorded as lying an inch deep at Buxton. There were during this period occasions when temperature remained below 50° F. throughout the day, *e.g.*, the maximum was 49° F. at Kew Observatory on the 12th, 45° F. at Cranwell on the 23rd and 42° F. at Aberdeen and Eskdalemuir on the 11th. Ground frosts occurred repeatedly. Taking however, the, mean values for the month, it is seen that May, 1923, was not exceptional as regards temperature. Sunshine records were poor, the total sunshine at Nottingham for the month being 60 hours below the average, and at London, Falmouth and Aberdeen, 35 to 40 hours below. Some heavy falls of rain occurred locally at various times during the month, 38 mm. being measured in the 24 hours at Snowdon (Llyn Llydaw) and 27 mm. at Aberdeen. Thunderstorms were experienced on two or three days and were fairly general in London and south east England on the 12th and 16th.

[*Continued on p.* 120.

Rainfall Table for May, 1923

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent. of Av.
Lond.	Camden Square	2·28	58	130	*Leics*	Leicester Town Hall	1·29	33	...
Sur .	Reigate, Hartswood	3·05	77	...	,, .	Belvoir Castle	1·94	49	92
Kent.	Tenterden, Ashenden	3·72	95	...	*Rut* .	Ridlington	1·19	30	...
,, .	Folkestone, Boro. San.	...	...	...	*Linc.*	Boston, Skirbeck	1·84	47	105
,, .	Broadstairs	2·55	65	154	,, .	Lincoln, Sessions House	2·89	73	155
,, .	Sevenoaks, Speldhurst.	3·03	77	...	,, .	Skegness, Estate Office.	...	...	...
Sus .	Patching Farm	2·85	72	154	,, .	Louth, Westgate	2·34	59	115
,, .	Eastbourne, Wilm. Sq.	2·84	72	171	,, .	Brigg	3·27	83	175
,, .	Tottingworth Park	4·39	111	...	*Notts.*	Worksop, Hodsock	3·13	79	157
Hants	Totland Bay, Aston	2·87	73	166	*Derby*	Mickleover, Clyde Ho.	2·59	66	131
,, .	Fordingbridge, Oaklnds	1·48	38	71	,, .	Buxton, Devon. Hos.	4·85	123	156
,, .	Portsmouth, Vic. Park.	2·89	73	172	*Ches.*	Runcorn, Weston Pt.	4·27	109	185
,, .	Ovington Rectory	2·25	57	96	,, .	Nantwich, Dorfold Hall	3·83	97	...
,, .	Grayshott	3·11	79	145	*Lancs*	Bolton, Queen's Park .	4·31	109	...
Berks	Wellington College	2·91	74	156	,, .	Stonyhurst College	4·40	112	154
,, .	Newbury, Greenham	1·78	45	95	,, .	Southport, Hesketh	2·44	62	117
Herts.	Bennington House	1·12	28	59	,, .	Lancaster, Strathspey.	2·79	71	...
Bucks	High Wycombe	2·43	62	138	*Yorks*	Sedbergh, Akay	4·59	117	143
Oxf.	Oxford, Mag. College	1·26	32	70	,, .	Wath-upon-Dearne	2·55	65	126
Nor .	Pitsford, Sedgebrook	·93	24	49	,, .	Bradford, Lister Pk.	3·39	86	162
,, .	Eye, Northolm	·81	21	...	,, .	Oughtershaw Hall	6·39	162	...
Beds.	Woburn, Crawley Mill.	1·63	41	85	,, .	Wetherby, Ribston H.	3·43	87	166
Cam.	Cambridge, Bot. Gdns.	1·18	30	67	*ERY*	Hull, Pearson Park	3·68	93	191
Essex	Chelmsford, CountyLab	1·38	35	...	,, .	Holme-on-Spalding	2·98	76	...
,, .	Lexden, Hill House	1·19	30	...	,, .	Lowthorpe, The Elms.	3·30	84	169
Suff.	Hawkedon Rectory	1·40	36	76	*NRY*	West Witton, Ivy Ho.	2·44	62	...
,, .	Haughley House	1·28	33	...	,, .	Pickering, Hungate	2·52	64	...
Norf.	Beccles, Geldeston	1·29	33	73	,, .	Middlesbrough	2·40	61	125
,, .	Norwich, Eaton	1·28	33	66	,, .	Baldersdale, Hury Res.	...	..	...
,, .	Blakeney	2·15	55	136	*Durh.*	Ushaw College	2·20	56	102
,, .	Swaffham	1·56	40	89	*Nor* .	Newcastle, Town Moor.	2·76	70	136
Wilts.	Devizes, Highclere	1·31	33	...	,, .	Bellingham Manor	1·92	49	...
Dor .	Evershot, Melbury Ho.	1·72	44	84	,, .	Lilburn Tower Gdns.	2·80	71	...
,, .	Weymouth, Westham	1·48	37	91	*Cumb*	Penrith, Newton Rigg.	3·28	83	136
,, .	Shaftesbury, Abbey Ho.	2·09	53	99	,, .	Carlisle, Scaleby Hall .	1·53	39	64
Devon	Plymouth, The Hoe	2·44	62	118	,, .	Seathwaite	9·33	237	127
,, .	Polapit Tamar	2·87	73	142	*Glam.*	Cardiff, Ely P. Stn.	2·58	65	103
,, .	Ashburton, Druid Ho.	2·57	65	93	,, .	Treherbert, Tynywaun	4·97	126	...
,, .	Cullompton	1·41	36	65	*Carm*	Carmarthen Friary	2·99	76	108
,, .	Sidmouth, Sidmount	1·50	38	77	,, .	Llanwrda, Dolaucothy.	5·59	142	165
,, .	Filleigh, Castle Hill	2·43	62	...	*Pemb*	Haverfordwest, Portf'd	...	...	...
,, .	Hartland Abbey	1·62	41	...	*Card.*	Gogerddan	5·05	128	191
Corn.	Redruth, Trewirgie	3·24	82	140	,, .	Cardigan, County Sch. .	2·46	63	...
,, .	Penzance, Morrab Gdn.	3·17	81	143	*Brec.*	Crickhowell, Talymaes	3·25	83	...
,, .	St. Austell, Trevarna	3·59	91	148	*Rad* .	Birm.W.W.Tyrmynydd	5·06	129	147
Som	Street, Hind Hayes	1·12	28	...	*Mont.*	Lake Vyrnwy	5·42	138	...
Glos.	Clifton College	1·99	50	95	*Denb.*	Llangynhafal	4·48	114	...
,, .	Cirencester	1·37	35	65	*Mer* .	Dolgelly, Bryntirion	6·48	165	196
Here.	Ross, County Obsy.	1·63	41	77	*Carn.*	Llandudno	2·64	67	139
,, .	Ledbury, Underdown.	1·50	38	...	,, .	Snowdon, L. Llydaw 9	11·30	287	...
Salop	Church Stretton	2·30	58	89	*Ang* .	Holyhead, Salt Island.	1·23	31	63
,, .	Shifnal, Hatton Grange	2·33	59	113	,, .	Lligwy	1·79	45	...
Staff.	Tean, The Heath Ho.	3·47	88	161	*Man.*	Douglas, Boro' Cem.	2·30	58	91
Worc.	Ombersley, Holt Lock.	1·52	39	74	*Guer.*	St. Peter Port, Grange.	4·37	111	257
,, .	Blockley, Upton Wold.	2·26	57	105	*Wigt.*	Stoneykirk, Ardwell Ho	1·94	49	77
War	Farnborough	1·54	39	69	,, .	Pt. William, Monreith .	1·71	43	...
,, .	Birminghm, Edgbaston	1·66	42	78	*Kirk.*	Carsphairn, Shiel.	4·78	121	...

Rainfall Table for May, 1923—*continued*

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm	Per-cent. of Av.
Kirk.	Dumfries, Cargen	2·33	59	77	*Caith*	Loch More, Achfary	11·11	282	253
Dum	Drumlanrig	...	...	...	,,	Wick	3·63	92	175
Roxb	Branxholme	1·85	47	82	*Ork*	Pomona, Deerness	3·97	101	199
Selk	Ettrick Manse	...	...	...	*Shet*	Lerwick	4·09	104	196
Berk.	Marchmont House	2·16	55	87	*Cork*	Caheragh Rectory	1·19	30	...
Hadd	North Berwick Res.	1·59	40	80	,,	Dunmanway Rectory	1·31	33	39
Midl	Edinburgh, Roy. Obs.	1·54	39	88	,,	Ballinacurra	·81	21	34
Lan	Biggar	2·68	68	133	,,	Glanmire, Lota Lo.	1·34	34	55
Ayr	Kilmarnock, Agric. C.	1·71	43	74	*Kerry*	Valencia Obsy.	...	...	...
,,	Girvan, Pinmore	3·47	88	116	,,	Gearahameen	5·40	137	...
Renf.	Glasgow, Queen's Pk.	2·23	57	91	,,	Killarney Asylum	3·28	83	107
,,	Greenock, Prospect H.	3·03	77	88	,,	Darrynane Abbey	1·73	44	58
Bute	Rothesay, Ardencr'g.	2·94	75	97	*Wat*	Waterford, Brook Lo.	1·31	33	56
,,	Dougarie Lodge	2·83	72	...	*Tip*	Nenagh, Cas. Lough	1·47	37	60
Arg	Glen Etive	4·70	119	...	,,	Tipperary	1·69	43	...
,,	Oban	2·91	74	...	,,	Cashel, Ballinamona	1·19	30	50
,,	Poltalloch	3·11	79	108	*Lim*	Foynes, Coolnanes	1·90	49	82
,,	Inveraray Castle	3·47	88	88	,,	Castleconnell Rec.	1·72	44	...
,,	Islay, Eallabus	3·41	87	129	*Clare*	Inagh, Mount Callan	2·55	65	...
,,	Mull, Benmore	7·20	183	...	,,	Broadford, Hurdlest'n.	1·89	48	...
,,	Mull, Quinish	3·00	76	98	,,	Newtownbarry	1·79	45	...
Kinr.	Loch Leven Sluice	1·68	43	69	*Wexf*	Gorey, Courtown Ho.	...	...	...
Perth	Loch Dhu	2·85	72	63	*Kilk.*	Kilkenny Castle	1·48	37	67
,,	Balquhidder, Stronvar.	2·60	66	64	*Wic*	Rathnew, Clonmannon	·94	24	...
,,	Crieff, Strathearn Hyd.	·92	23	37	*Cars.*	Hacketstown Rectory	1·82	46	70
,,	Blair Atholl	1·78	45	89	*QCo.*	Blandsfort House	...	...	...
,,	Coupar Angus School	1·22	31	50	,,	Mountmellick	1·55	39	...
Forf.	Dundee, E. Necropolis	2·16	55	103	*KCo.*	Birr Castle	1·33	34	60
,,	Pearsie House	...	...	...	*Dubl.*	Dublin, FitzWm. Sq.	1·78	45	87
,,	Montrose, Sunnyside	2·20	56	108	,,	Balbriggan, Ardgillan	1·65	42	79
Aber.	Braemar Bank	4·55	116	190	*W.M*	Athlone, Twyford	...	...	...
,,	Logie Coldstone Sch.	5·33	135	214	,,	Mullingar, Belvedere	1·57	40	64
,,	Aberdeen, Cranford Ho	5·18	132	209	*Long*	Castle Forbes Gdns.	1·63	41	63
,,	Fyvie Castle	6·14	156	...	*Gal*	Galway, Grammar Sch.	1·39	35	...
Mor	Gordon Castle	4·69	119	221	,,	Woodlawn	...	...	...
,,	Grantown-on-Spey	7·15	182	307	*Mayo*	Crossmolina, Enniscoe	3·38	86	104
Na	Nairn, Delnies	2·40	61	133	,,	Mallaranny	2·98	76	...
Inv.	Ben Alder Lodge	4·28	109	...	,,	Westport House	2·55	65	89
,,	Kingussie, The Birches	4·25	108	...	,,	Delphi Lodge	4·99	127	...
,,	Fort Augustus	3·69	94	155	*Sligo*	Markree Obsy.	2·76	70	101
,,	Loch Quoich, Loan	7·90	201	...	*Ferm*	Enniskillen, Portora	1·86	47	...
,,	Glenquoich	6·83	173	125	*Arm.*	Armagh Obsy.	1·43	36	60
,,	Inverness, Culduthel R.	2·79	71	...	*Down*	Warrenpoint	1·52	39	...
,,	Arisaig, Faire-na-Squir	3·43	87	...	,,	Seaforde	1·60	41	61
,,	Fort William	4·19	106	109	,,	Donaghadee	1·11	28	49
,,	Skye, Dunvegan	3·60	91	...	,,	Banbridge, Milltown	1·67	42	74
,,	Barra, Castlebay	1·97	50	...	*Antr.*	Belfast, Cavehill Rd.	2·16	55	...
R&C	Alness, Ardross Cas.	4·46	113	171	,,	Glenarm Castle	2·21	56	...
,,	Ullapool	5·16	131	...	,,	Ballymena, Harryville	2·67	68	93
,,	Torridon, Bendamph.	7·80	198	171	*Lon*	Londonderry, Creggan	3·19	81	122
,,	L. Carron, Plockton	3·55	90	...	*Tyr*	Donaghmore	1·70	43	...
,,	Stornoway	3·21	82	125	,,	Omagh, Edenfel	3·04	77	117
Suth.	Dunrobin Castle	...	...	...	*Don*	Malin Head	1·58	40	80
,,	Lairg	3·75	95	...	,,	Letterkenny Hos	3·05	77	109
,,	Forsinard	...	...	...	,,	Dunfanaghy	2·34	59	90
,,	Tongue Manse	5·56	141	234	,,	Narin, Kiltoorish	2·60	66	...
,,	Melvich School	3·95	100	193	,,	Killybegs, Rockmount	4·88	124	136

Climatological Table for the British Empire, December, 1922

STATIONS	PRESSURE Mean of Day M.S.L.	PRESSURE Diff. from Normal	TEMPERATURE Absolute Max.	Absolute Min.	Mean Values Max.	Mean Values Min.	Mean Values ½ max. and min.	Mean Values Diff. from Normal	Mean Wet Bulb.	Relative Humidity	Mean Cloud Am'nt	PRECIPITATION Am'nt	PRECIPITATION Diff. from Normal	PRECIPITATION Days	BRIGHT SUNSHINE Hours per day	BRIGHT SUNSHINE Percentage of possible.
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1011·0	− 2·9	52	29	47·3	39·6	43·5	+ 3·2	41·7	84	7·5	72	+ 14	17	1·4	18
Gibraltar	1022·2	+ 2·6	70	44	62·3	51·5	56·9	+ 0·5	52·3	75	4·3	124	− 16	8	...	...
Malta	1017·8	+ 1·9	63	46	58·3	51·8	55·1	− 2·1	51·5	83	5·4	90	+ 4	14	4·5	46
Sierra Leone	1011·9	+ 0·7	91	65	87·1	73·8	80·5	− 1·0	74·8	73	5·7	41	+ 4	5	...	...
Lagos, Nigeria	1010·2	− 0·3	89	69	88·0	74·7	81·3	0·0	77·4	75	6·7	22	+ 1	3	...	...
Kaduna, Nigeria	1011·4	− 1·4	93	51	88·9	57·4	73·1	+ 0·7	56·2	35	0·9	0	− 3	0	...	...
Zomba, Nyasaland	1010·0	+ 1·4	94	58	83·5	64·8	74·1	+ 1·4	...	85	5·1	277	− 14	18	...	...
Salisbury, Rhodesia	1009·4	− 0·5	93	52	83·0	59·5	71·3	+ 1·4	64·4	61	5·0	175	+ 29	15	...	...
Cape Town	1016·0	+ 1·7	94	47	78·5	59·3	68·9	+ 1·3	64·3	63	4·3	4	− 18	3	...	...
Johannesburg	1012·4	+ 1·5	86	50	77·3	54·9	66·1	+ 1·0	57·1	63	4·8	126	+ 3	20	8·2	60
Mauritius	1014·8	+ 0·8	92	66	84·7	70·0	77·4	− 0·9	71·2	70	4·7	14	−106	13	10·3	77
Bloemfontein	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Calcutta, Alipore Obsy.	1015·1	− 0·6	83	52	77·2	57·2	67·2	+ 0·7	58·2	81	1·3	0	− 5	*0	...	...
Bombay	1013·7	+ 0·4	89	63	84·6	69·6	77·1	− 0·2	66·1	71	1·2	4	+ 2	*1	...	...
Madras	1013·8	+ 0·3	84	62	82·8	66·8	74·8	− 1·7	70·0	79	2·9	9	−149	*1	...	...
Colombo, Ceylon	1011·7	+ 1·9	88	65	85·7	70·2	77·9	− 1·8	73·0	63	3·7	90	− 50	7	...	...
Hong Kong	1020·0	+ 0·1	74	47	66·8	57·4	62·1	− 0·8	55·2	64	6·2	19	− 12	5	5·1	48
Sandakan	...	...	90	73	86·9	74·6	80·7	+ 0·6	76·6	80	...	357	− 92	17	...	...
Sydney	1007·5	− 4·4	104	58	80·6	64·6	72·6	+ 2·6	65·5	59	4·6	37	− 30	11	8·1	56
Melbourne	1007·2	− 5·3	97	49	76·5	55·3	65·9	+ 1·6	59·2	56	6·4	51	− 8	10	6·5	43
Adelaide	1008·6	− 4·6	103	50	79·6	59·2	69·4	− 1·8	58·8	50	4·9	75	+ 51	10	8·4	58
Perth, W. Australia	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Coolgardie	1008·5	− 2·7	100	48	86·2	56·8	71·5	− 4·3	59·7	35	2·8	3	− 15	2	...	...
Brisbane	1009·0	− 2·9	97	65	86·3	69·2	77·7	+ 1·3	72·3	68	5·3	117	− 8	10	...	...
Hobart, Tasmania	1004·0	− 5·7	88	44	67·7	52·1	59·9	− 0·5	53·7	64	7·7	133	+ 83	20	5·5	36
Wellington, N.Z.	1008·2	− 3·9	77	42	68·6	55·7	62·1	+ 1·6	56·6	70	7·0	19	− 63	9	6·0	40
Suva, Fiji	1008·0	− 0·6	91	62	85·5	71·4	78·5	− 0·4	77·2	83	6·9	408	+100	21	...	...
Kingston, Jamaica	1015·2	+ 1·0	92	66	87·6	69·4	78·5	+ 0·8	...	68	5·9	2	− 39	2	...	...
Grenada, W.I.	1013·8	+ 1·9	85	71	82·4	72·6	77·5	− 0·6	72·1	73	4·1	140	− 48	19	...	...
Toronto	1019·2	+ 1·8	60	6	34·9	21·9	28·4	+ 2·2	25·0	60	6·8	44	− 28	13	...	...
Winnipeg	1017·8	− 0·1	36	−26	9·6	− 4·4	2·6	− 3·1	1·6	...	5·7	35	+ 11	15	...	...
St. John, N.B.	1018·4	+ 4·2	45	−13	29·0	11·6	20·3	− 4·1	18·5	67	7·0	128	+ 22	17	...	...
Victoria, B.C.	1013·6	− 3·2	55	21	40·2	33·8	37·0	− 4·5	35·4	91	8·4	182	+ 32	24	...	...

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

Climatological Table for the British Empire for the Year 1922

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 mm.	PRECIPITATION Diff. from Normal mm.	PRECIPITATION Days	BRIGHT SUNSHINE Hours per day	BRIGHT SUNSHINE Percentage of possible.
London, Kew Obsy.	1014·5	− 0·7	87	26	55·9	42·6	49·3	− 0·4	46·6	75	6·7	569	− 37	163	4·0	31
Gibraltar	1018·2	+ 1·7	95	42	70·5	57·9	64·2	+ 0·1	58·7	75	3·9	657	− 253	72	...	...
Malta	1016·0	+ 1·2	93	41	70·5	61·5	66·0	+ 0·8	60·3	74	4·1	300	− 161	70	7·5	60
Sierra Leone	1012·3	+ 0·5	95	65	86·6	73·7	80·2	− 0·7	74·4	73	5·6	3909	− 8	185	...	...
Lagos, Nigeria	1010·9	− 0·5	92	67	86·2	75·1	80·6	+ 0·4	†75·9	†82	†9·2	2145	+ 325	135	...	...
Kaduna, Nigeria	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Zomba, Nyasaland	1012·1	0·0	99	48	81·0	61·0	71·0	+ 1·9	...	80	4·4	687	− 724	98	...	...
Salisbury, Rhodesia	1011·5	− 2·6	96	32	81·4	52·9	67·1	+ 1·8	58·4	54	...	605	− 203	70	...	...
Cape Town	1017·2	+ 0·2	102	34	71·5	53·5	62·5	+ 0·4	58·0	68	4·6	483	− 166	102	...	...
Johannesburg	1016·2	+ 0·1	86	23	70·9	49·8	60·4	+ 0·9	50·3	62	3·4	706	− 94	112	8·8	74
Mauritius	1015·9	− 0·2	92	55	79·8	66·7	73·3	− 0·7	68·1	76	5·2	1689	+ 428	220	7·8	65
Bloemfontein	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Calcutta, Alipore Obsy.	1007·0	− 0·5	103	51	88·0	71·0	79·5	+ 0·8	...	...	...	2106	+ 538	*84	...	...
Bombay	1008·6	− 0·5	94	60	86·7	75·3	81·0	+ 0·5	...	...	...	1802	− 24	*110	...	...
Madras	1008·2	− 0·6	110	61	91·5	74·9	83·2	+ 0·3	...	...	...	1669	+ 414	*97	...	...
Colombo, Ceylon	1010·2	+ 0·8	95	65	86·8	74·6	80·7	− 0·5	76·5	69	7·0	2230	+ 74	169	...	...
Hong Kong	1011·8	− 0·8	93	44	77·1	68·8	72·9	+ 0·6	67·8	77	7·1	1763	− 350	154	5·5	45
Sandakan	...	...	92	72	87·2	75·1	81·1	− 0·2	...	...	...	3863	+ 815	162	...	...
Sydney	1014·4	− 1·5	104	39	72·6	56·4	64·5	+ 1·5	59·1	64	4·5	1000	− 224	136	6·8	56
‡Melbourne	1014·8	− 1·5	105	32	67·6	49·5	58·6	+ 0·2	...	66	5·8	...	...	...	...	...
Adelaide	1015·7	− 1·4	109	37	72·6	53·2	62·9	− 0·1	54·4	56	4·9	587	+ 55	117	7·0	57
‡Perth, W. Australia	1016·1	− 0·3	106	37	73·1	54·6	63·8	− 0·2	...	...	...	...	...	...	...	...
Coolgardie	1015·0	− 1·0	112	32	77·7	51·8	64·8	+ 0·3	56·1	44	3·8	273	+ 15	48	...	...
Brisbane	1014·4	− 1·3	99	39	78·5	60·2	69·3	+ 0·4	64·2	66	4·0	908	− 249	109	...	...
Hobart, Tasmania	1012·1	− 0·5	97	31	62·3	47·1	54·7	+ 0·4	49·6	68	6·4	718	+ 116	190	6·0	50
Wellington, N.Z.	1015·2	+ 1·1	82	31	62·6	49·2	55·9	+ 0·5	...	74	6·3	741	− 491	150	5·5	45
Suva, Fiji	1010·8	− 0·6	91	55	83·8	68·7	76·3	− 0·7	74·3	83	6·5	4016	+1162	201	...	...
Kingston, Jamaica	1014·1	+ 0·2	93	65	88·2	70·9	79·5	+ 0·2	...	73	5·3	278	− 583	59	...	...
Grenada, W.I.	1013·6	+ 1·2	90	68	83·7	73·6	78·7	0·0	73·8	75	4·6	1685	− 242	250	...	...
Toronto	1017·5	+ 1·1	93	− 7	56·8	39·3	48·1	+ 3·7	42·3	69	5·1	740	− 110	143	...	...
Winnipeg	1016·1	− 0·1	96	−38	48·7	28·6	38·7	+ 4·4	35·3	...	4·9	543	+ 26	109	...	...
St. John, N.B.	1015·5	+ 0·8	78	−14	48·3	33·5	40·9	− 0·3	37·8	77	6·1	1179	− 41	145	...	...
Victoria, B.C.	1017·4	+ 1·0	87	21	54·4	42·5	48·5	− 1·0	44·6	83	5·6	557	− 270	140	...	...

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen. † Mean of observations at 9h. only.
‡ Missing values for one month interpolated.

Continued from p. 115.]

The weather of the past month, as indicated in telegrams to "The Times," is marked by numerous records of heavy rains and floods. In western Europe the weather was cold and rainy, with hail in northern France on the 10th and snow following heavy rain in the Gex region (Haute Savoie) on the 13th. In Italy, after intense heat in the early days of May, cold winds carried the temperature much below normal, and there were fresh falls of snow in the Alps. Floods were reported from the Volga Valley during the month. On the 25th and 26th there were several floods on the Tigris and Euphrates, and on the 29th unusually heavy rain was reported at Sheikh Othman, in the Aden hinterland, causing floods at Lahej, which has not happened for twelve years. In Kenya Colony there have been exceptionally heavy rains during the past two months, and all the rivers are in flood. Near Colombo the " Okara " foundered in a cyclone, about the 7th.

There has been much ice in the St. Lawrence Estuary and in the North Atlantic off Newfoundland, causing accidents to several vessels. Other accidents have been due to fog. In New Brunswick there were very heavy floods at the beginning of the month. On the 9th a storm swept the North Central United States, bringing snow as far west as North Dakota and as far south as Kentucky. It was followed by a heavy frost. On the same day San Bernardino, California, experienced the record May temperature of 101° F. and the first thunderstorm of the year was experienced in New York. On the 14th a tornado in Colorado City, Texas, caused damage and loss of life. It was accompanied by a "cloudburst."

There were good rains in eastern and southern Australia early in the month, which partly broke up the drought. At the same time heavy rains in South Island, New Zealand, caused disastrous floods.

The special message from Brazil states that in the north of the country rainfall averaged about 80 mm. below normal while in the centre and south the distribution was irregular. The month was characterised by an extremely active atmospheric circulation with numerous rapidly-moving high pressure areas and secondaries. A bad storm was experienced at Rio de Janeiro on the 27th. Temperature was generally above normal except in the extreme south. Crops are in good condition. At Rio de Janeiro pressure was 2·1 mb. above normal and temperature 1·6° F. above.

Rainfall. May, 1923; General Distribution

England and Wales ...	121	per cent. of the average 1881-1915.
Scotland	130	,, ,, ,,
Ireland	77	,, ,, ,,
British Isles	115	,, ,, ,,

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Variability of Tropical Climates

By STEPHEN S. VISHER, Ph.D. (Chicago).

Introduction.

IN the standard texts of meteorology and climatology it is commonly stated that tropical climates are extremely uniform. They indeed have comparatively slight seasonal variations in temperature and in the length of day and night, and large areas have rather steady winds, much of the time. But in my opinion this continual emphasis upon uniformity is misleading because there are important variations in temperature and wind, while the rainfall of the lower latitudes appears to be more variable, on the average, than the rainfall of higher latitudes. There likewise appears to be more variation in storminess and in rapid change of air pressure than in higher latitudes.

Tropical Ranges in Temperature.

Although the average seasonal range in temperature is indeed small in low latitudes as compared with middle latitudes, there is, in latitudes more than 10° or 15° from the equator, an appreciable seasonal contrast. Indeed some few cities near the tropics have about as great a seasonal range of temperature as certain especially uniform parts of higher latitudes. This is illustrated when the average differences in mean temperature between the three warmest months and the three coolest, of the following pairs of seaport cities are compared. New Orleans is not within the tropics according to the narrowest limitation of that zone, but is within the belt dominated by the trades during

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most of the year, which is the belt commonly considered as the tropical.

SEASONAL RANGE OF TEMPERATURE.

Table 1.

Hongkong	range	20° F. v.	Glasgow	range	12° F.;	22° N v. 56° N
Brisbane	,,	17° F. v.	Hobart, Tas.	,,	15° F.;	27° S v. 43° S
New Orleans	,,	26° F. v.	Vancouver	,,	22° F.;	30° N v. 49° N

Even in regard to extremes of temperatures, some cities in fairly low latitudes have ranges which approach (or equal in a few cases) those of the less variable parts of relatively high latitudes. This is illustrated by the following table showing the difference between the highest and lowest temperatures ever officially recorded at certain pairs of seaport cities up to a recent year.

EXTREME RANGE OF TEMPERATURE.

Table 2.

Calcutta	range	64° F. v.	Dublin	range	74° F.;	22° N v. 53° N
Rio de Janeiro	,,	52° F. v.	Wellington	,,	58° F.;	23° S v. 42° S
Durban	,,	71° F. v.	Dunedin, N.Z.	,,	71° F.;	29° S v. 46° S
New Orleans	,,	95° F. v.	Sitka	,,	90° F.;	30° N v. 57° N

That there are appreciable seasonal contrasts in temperature in lower latitudes is not surprising when the seasonal variation in insolation is considered. In spite of the fact that the sun shines vertically somewhere between the two tropics every day in the year, there is a great change in the angle of incidence. Few people realise that when the sun is vertically over the northern tropic (Cancer), it shines upon the southern tropic (Capricorn) less nearly vertically by 4 degrees than upon the Arctic Circle. The latitude of Switzerland receives much more heat from the sun on June 21st than does the equator, for not only is the sun as nearly vertical in latitude 47° N as at the equator, but the days are almost four hours longer.

Although, on the average, tropical regions show less seasonal change of temperature than do middle latitudes, the reverse is true in respect to daily range. The night has been called the winter of the tropics. The daily range is considerable in all lower latitudes although it is far less in the more humid regions, such as occur along the equator, than in the more arid. On the average it is distinctly greater than the normal range in higher latitudes. This is due to two chief influences. Day and night are more nearly equal in length and hence there is a closer balance between heating and cooling than occurs in higher latitudes, where the nights are too short in summer for marked cooling and the days are too short in winter for effective heating. The other great cause is the higher average temperature, since the escape of heat varies as the 4th power of the absolute temperature. This means that normally there is much greater cooling per nocturnal hour wherever the daytime temperature is high than where it is low. A third reason why the diurnal range is greater in low latitudes (below 30°) is that a larger proportion of the area is arid or semi-arid than is the case in middle latitudes. In the tropics the nights often become so cool that considerable discomfort results. Even in an insular climate like that of Suva, Fiji (latitude 18° S), in spite of the wind blowing off the sea, and a rainfall of over 100 inches fairly evenly distributed throughout the year, it commonly becomes so cool at night that the sensitive residents wear wraps if they walk out late in the evening. Indeed even the heavy army overcoats are frequently worn with comfort at night and in the early morning during the cooler season. In drier parts of the tropics, the nights become much cooler than in a humid locality like Suva. On the dry western sides of the Fiji Islands, for example, temperatures below 40° F. have been recorded near latitude 16° S, close to sea level, and in dry continental areas frost is not unknown near sea level, as for example within 20° from the equator in Australia and Africa.

Another type of marked cooling in the tropics is the sudden drop, often as much as 6° F. or 8° F., which occurs in thunderstorms, which are very frequent in many parts of the tropics, and are far commoner here on the average than in higher latitudes. Sometimes, as when hail falls in quantity, the temperature-drop is much greater. Hail storms are not very rare in some tropical localities. For example, ten hail storms were reported in ten years in latitudes 13° S to 16° S, near sea level, in the northern Territory of Australia. Three hail storms occurred in Panama (latitude 9° N) in a twelve year period.

Cold snaps of still other types occur within the tropics. For instance, cold winds sometimes sweep down from higher latitudes and bring low temperatures surprisingly near the equator. Zero temperatures have been officially recorded in subtropical northern Florida (latitude 30° N), and a temperature of only 10° above zero F. has occurred on the Gulf Coast of Mexico in latitude 25·5° N. Central coastal Queensland is subject to "severe frosts" during four months of the year, within 21° of the equator, while freezing temperatures have occurred even in the daytime in south-eastern Asia in latitude 22° N at sea level. Still farther south, on the China Sea, near Manila, latitude 15° N, northerly gales in winter occasionally make overcoats welcome even in daytime. Similar cold snaps occur in the cooler months in other tropical localities such as the Hawaiian Islands, Jamaica and Fiji. Indeed, the Weather Bureau reports a snow flurry practically at sea level at Mahukona, Hawaii (latitude 20° 11′ N) lasting ten minutes on December 29th, 1921. Perhaps even more surprising is the great cooling reported as not rare in winter on the coast of Venezuela, when in latitude 10° N gales from the north, off the sea, occasionally bring day temperatures of 45° F. or even less.

Because of the sensitiveness of the residents of the tropics to low temperatures, chills and colds often develop and sometimes pneumonia. Many observers have been impressed by the abundance of coughs and catarrh in the tropics: they may be more common there than in Canada. Indeed there is considerable truth in the saying that "cold causes more suffering in the tropics than in polar or subpolar regions."

Variations in respect to the Winds.

Now as to the winds: Five chief sorts of variation within the tropics merit attention. (1) Even when the direction is fairly constant, there is a marked diurnal variation in velocity. Calm nights are the rule in trade wind deserts, and nearly calm nights are common elsewhere on the land except upon exposed elevations. Likewise at sea, while the diurnal range is less than on land, it is notable. For example, Tetens reports a diurnal range of over 50 per cent. in the velocity of the wind at Samoa. In higher latitudes, while the wind frequently dies down at nightfall and normally weakens, windy nights are by no means uncommon and very frequently the wind is stronger by night than by day. In the tropics windy nights occur on lowlands only during the passage of rather rare severe cyclonic storms. Moreover, disturbances of an intensity which would give strong nocturnal winds in middle and high latitudes cause only moderate winds at night at low elevations in the tropics. This is due to the influence of the comparatively great decrease in vertical convection at night in low latitudes, caused by the greater cooling of the surface air than of the overlying free air. It is for this reason also that even relatively steep barometric gradients in monsoonal regions permit a marked dying down of the surface winds at night.

(2) Seasonal as well as diurnal variations in the velocity of the trades are common. "Half gales" are characteristic of Fiji, the New Hebrides, and many other South Pacific groups in their spring months, and even "whole gales" are frequent during the north-east "monsoons" in the China Sea during winter. On the other hand, in other months, calms or light breezes are the rule when the doldrums migrate past, as they do twice each year with the seasonal change in the altitude of the sun. Along the margins of the tropics, calms likewise occur when the extra-tropical belt of high pressure migrates equatorward in the cooler season.

(3) There is a radical seasonal change in the direction of the trades when they cross the equator; those crossing from the north change from east-north-east winds to north-west, owing

to the deflective effect of the earth's rotation. Consequently many places near the equator have easterly winds much of the year ; calms while the doldrums are migrating past and westerly winds when the doldrums are situated in higher latitudes on their side of the equator. Then as the sun returns equator-ward, calms and easterlies recur.

(4) Another evidence of tropical variability is that land and sea breezes are more characteristic of the lower latitudes than of the higher. This is because the contrast in the temperature of land and water averages greatest in low latitudes. Indeed, while in middle and high latitudes sea breezes are rare except during the hottest weeks, in many parts of the lower latitudes they occur almost every day in the year and give a wind regime which is very different from the constant easterly trades supposedly characteristic of the tropics. The monsoons are a special type of land and sea breezes, since they blow towards the land for many consecutive weeks during summer and in the opposite direction in winter. While produced by temperature contrasts of extra-tropical regions, the monsoons are most strongly felt in tropical latitudes (below 30°) and give large and important regions a sharp seasonal contrast in wind directions. Between the winter and the summer monsoons, there commonly is a spell, several weeks in length, when the winds are irregular and often light. After they become steady in direction, they often fluctuate notably in velocity from day to day as well as between day and night.

(5) Although winds due to cyclonic disturbances do not occur so frequently within the tropics as in higher latitudes, they are significant. The "boxing of the compass," during which the wind comes from every direction in turn, occurs many times a year in most parts of the tropics, while occasionally cyclonic gales or even violent hurricanes occur. Official Japanese daily weather maps and annual summaries of storm tracks show an average of over fifty tropical cyclonic disturbances a year in east longitudes 115°—145°, while a study of the Australian daily weather maps for 20 years shows an average of over 30 a year in similar longitudes south of the equator. Thus in less than one-seventh of the circumference of the earth there are over 80 cyclonic disturbances in an average year. This is, however, the stormiest sector.

Mention should also be made of thunder squalls which are more violent in low latitudes than in higher latitudes on the average, and more frequent. In addition, several regions in subtropical latitudes experience tornadoes or similar storms. Thus it is evident that there is considerable variation in respect to winds in the tropics. (*To be continued*).

Royal Meteorological Society

THE monthly meeting of the Society was held on Wednesday, June 20th, at 49, Cromwell Road, South Kensington, Dr. C. Chree, F.R.S., President, in the chair.

Messrs. J. E. Clark and I. D. Margary. Report on the Phenological Observations in the British Isles for the year 1922.

In this, the 32nd report (New Series), the authors had to deal with an exceptionally cool and sunless summer (after mid-June) with much rain in July and August. The mild winter of 1921-22 was followed by a cold early spring, making the fruit blossom late and giving an expectation of excellent crops. The heat and sunshine of the latter part of May and of early June resulted, however, in a rapidity of flower and insect development rarely experienced in our island, and, with the accompanying drought, injured the hay crop, spring oats, &c. The harvest generally was late, especially in the north, the oat harvest in north Scotland only ending with November.

The isophene flower chart and the migrant records show that the divergence from the 30-year average was, however, not very large, so great was the acceleration due to May and June. As a consequence of the previous very favourable summer and still more favourable October for wood ripening there was a remarkable display of blossom and fruit. But, as Mr. Hooker pointed out in the discussion, what was more striking was the abundance of fruit which had remained on during the winter, so that this year hawthorns were in flower and fruit at the same time. It was a contradiction of the old proverb that the abundance of fruit foretells a hard winter.

Dr. T. G. Longstaff.—Meteorological Notes from the Mt. Everest Expedition of 1922.

In this paper Dr. Longstaff explained that they were able to make few meteorological observations on the expedition, but that a more or less systematic record of temperature was kept on the outward march, at the base camp at 16,500 ft. and at the various climbing camps. The day temperatures were taken with sling thermometers, and the night ones with minimum thermometers exposed to the sky on wooden boxes about one foot above the ground. The lowest reading recorded was —12° F. on May 27th at Camp III., at a height of 21,000 ft. Dr. Longstaff pointed out that his notes referred only to April, May and part of June, and on the northern side of the main Himalayan range. Totally different conditions prevail on the southern side, and the change from one to the other is extraordinarily abrupt. On the north of Mt. Everest the snow level is put at 20,000 ft., and above 25,000 ft. sublimation takes place. Even at 16,000 ft. a covering of snow four inches deep disappeared in an hour or two.

Probably the constant high winds assist this. During the discussion, Dr. Simpson pointed out that many of the phenomena observed were familiar to him in the Antarctic. The existence of glaciers indicated that sublimation did not keep pace with the snowfall. The antisolar rays which had been pictured by Dr. Longstaff were to be seen in all parts of the world, and not only at high altitudes.

Correspondence

To the Editor, *The Meteorological Magazine*

A Brilliant Halo: June 30th

At 7 a.m. (G.M.T.), at Purley, a faint but nearly complete halo was noted. At 10.30, in the City, it was seen as an exceptionally fine circle, the bright inner (red) margin sharply cut and contrasting strongly with the blue purple of the uniformly darker interior sky, which continued to within 7° or 8° of the sun. The outer margin of the halo was also well marked, as the blue of the ring was very clear.

Watching it again at Purley at 11.15 the ring was not quite so sharply defined and the contrast of interior darkness was less marked. The halo haze layer seemed rather denser, and detached heavier cloud forms began to obscure the halo at times, but at 11.20 it was clearer, and then it was noticed that on either side the lower quadrants were double, bulging arcs lying outside the halo circle proper. On the right this was perfect, from rather above the sun level to nearly below it. The interspace, at about 45° with the vertical between the inner (red) edges, was 1° to 1½°. To the left the outer arc was only partly developed, from contact just below the horizontal to the same 1° or 1½° at 45°, disappearing a little lower. The halo below, between these two arcs, was fairly sharp, and the semicircle above very well defined. By noon (G.M.T.) the lower clouds obscured the higher levels.

J. Edmund Clark.

41, *Downscourt Road, Purley, 30th June,* 1923.

[The observation does not seem to be entirely consistent with any phenomenon described in works on meteorological optics. With the elevation of the sun about 60° the upper and lower "tangent arcs" of the 22° halo join and form a single curve, approximately an ellipse. According to Pernter's computations the separation of this circumscribed halo from the circular halo is about 2° where the radius is 45° from vertical and about 3° where the radius is horizontal. Mr. Clark's "bulging arc" agrees in the separation at 45°, but it makes "contact just below the horizontal."—Ed. *M.M.*]

The Exposure of Raingauges

In an article on the exposure of raingauges in the *Meteorological Magazine* for October, 1922, Lieut.-Colonel E. Gold refers to an experiment carried out at Valencia Observatory by Mr. L. H. G. Dines, in which a raingauge was exposed in a conical hole in such a manner that its rim was on a level with the surrounding ground. He gives the result obtained: That during a period when the ordinary gauge caught 335 mm. the gauge in the hole caught 387 mm., an excess of about 15 per cent. There is, however, a factor which appears to have been overlooked in this connection. Lieut.-Colonel Gold's remarks indicate that the comparison was a simple one of the measured rainfalls from the two gauges. The magnitude of the excess, together with a knowledge of the sites made me suspect that this direct comparison was not sufficient, and that a difference between the catches of the two gauges might be found even when both were exposed in the ordinary manner, that is to say, each with its rim one foot above the ground. Fortunately data were available for testing this suspicion, as the experimental gauge had been exposed at the same spot in the ordinary manner for a year previous to its being placed in a hollow.

I have taken out the monthly totals for the two gauges for the year February, 1921, to January, 1922, both inclusive, during which time they were both exposed on their present sites with the rim in each case one foot above the surrounding surface. The results show that my suspicion was well founded, as during the twelve months the ordinary gauge caught 1,238 mm. while the experimental gauge caught 1,288 mm., an excess of 4 per cent. A very brief examination of the monthly totals was sufficient to show that the difference was for the most part a winter phenomenon. I give therefore the data divided into two portions, the first including the months April to September inclusive, the second, the remaining six months.

	Control Gauge.	Experimental Gauge.	Excess.
April—September ...	408 mm.	417 mm.	2 per cent.
October—March ...	830 mm.	871 mm.	5 per cent.
Total... ...	1,238 mm.	1,288 mm.	4 per cent.

These figures give a measure of the preliminary allowance which must be made for "site" before considering the difference between the readings of the two gauges when one is placed in a hollow. It is fortunate, therefore, that in effect we are able to compare the catches of one gauge in the different circumstances at the same time.

The results for the twelve months February, 1922, to January, 1923, both inclusive, when the experimental gauge was in a hollow, are as follows ; the readings from the 1st to the 5th of February being omitted for both gauges, owing to some uncertainty as to their true values.

	Control Gauge.	Experimental Gauge in Hollow.	Excess.
April—September ...	594 mm.	642 mm.	8 per cent.
October—March ...	614 mm.	704 mm.	15 per cent.
Total... ...	1,208 mm.	1,346 mm.	11½ per cent.

Thus, after allowing for "site difference" the excess becomes about 6 per cent. for the summer months and 10 per cent. for the winter months with a mean excess for the twelve months of about 7½ per cent. The division of the year gives roughly the half characterised by light winds and that characterised by strong winds ; and the figures show experimentally the effect which Lieut.-Colonel Gold pointed out as following from theoretical considerations, namely, that in-splashing will increase with increasing wind.

The results given above show that the excess of 15 per cent. quoted in Lieut.-Colonel Gold's article is much too high ; being at least double the average excess which might be expected if the sites were similarly exposed, which is only 7 to 8 per cent. If the invitation to amateur rainfall observers to undertake investigations into the matter of gauge exposures results in such investigations being undertaken, it will be well for the observers to understand the uncertainties which may arise in comparisons between two independent raingauges. It is proposed now to make a further test for twelve months with the sides of the hole cut vertically instead of in the form of a cone.

C. D. STEWART.

Valencia Observatory, Cahirciveen, Kerry, February 5th, 1923.

1921 and 1923 compared with 1865 and 1867

MR. BROOKS looks* to the hot summer of 1921 for an explanation of the ice in the Atlantic in May, 1923, and to that ice to account for the long spell of cold weather that we have lately experienced.

It may, therefore, be of interest to carry the parallel between 1923 and 1867 a little further, for 1865 had also a fine hot summer, and more particularly it had an exceptionally hot brilliant September, with no rain at all at very many stations. I cannot quote figures, for I had not then begun to keep records. The first number of this Magazine did not appear till February, 1866. Also in the Preface to *British Rainfall,* of 1866, Mr. Symons speaks of it as the 7th volume that he had produced, and that volume is the earliest which I possess. But in *British Rainfall*

* *Met. Mag.*, vol. 58, June, 1923, p. 100.

for 1891, on page 22, Mr. Symons couples September, 1865, with February, 1891, these two being at many stations rainless months, but he is not in that passage concerned with its temperature. Some references to its heat are found in *British Rainfall*, 1898. The Septembers of 1895 and of 1898 were also very fine and very hot, but they did not come up to that of 1865.

I remember well the succession of glorious days, the abnormal heat, the bright sunshine and the cloudless skies. But in those days people could enjoy its splendour in blissful ignorance of the consequence that a fleet of icebergs would invade the Atlantic in May, 1867, and cause ruinous frosts in England.

Yet, per contra, it must not be forgotten that after the exceptionally hot and dry summers of 1868, 1893 and 1911, no such results followed, for the late spring and also the summer both of 1870 and of 1895 were hot and dry, and 1913 was a quite respectable year.

H. A. BOYS, F.R.Met.Soc.

Spring Hill, St. Mary Bourne, June 29th, 1923.

[Reference to *British Rainfall*, 1865, shews that May, July and August, were all wet months. The stations with no rain in September were scattered over a large area in the south of England ; they were numerous in Devon and Somerset and also in Norfolk.—ED. *M.M.*]

May Weather

THE article in the June number of the *Meteorological Magazine* by Mr. Brooks on the causes of the cool spring and summer (so far) of the present year, raises one or two points. The recent weather conditions are held to be a result of the abnormal summer of 1921. Ten years earlier the British Isles experienced an even more abnormal summer—the wonderful summer of 1911 (said to be the warmest on record), but two years later, in 1913, we did not experience a cold spring or a cool summer. My recollection is that the summer of 1913 was a fine warm season. Then again, if an abnormal summer tends to produce a cool season two years afterwards, how are we to account for the occurrence in the past of two or three consecutive years with warm seasons, *e.g.*, 1857, 1858 and 1859 ? An explanation of these singular occurrences would be welcomed by many.

FREDERICK J. PARSONS.

County Observatory, Ross-on-Wye, June 27th, 1923.

Mr. Parsons's letter brings out the necessity for taking a very wide view of the sequence of weather. The conditions of May, 1923, were traced back to two causes—the abnormally low pressure in the Arctic Ocean during the summer of 1921 and the abnormally high pressure in the Azores anticyclone during the winter of

1921-22. The term " abnormal summer of 1921 " was applied to the general pressure distribution from Spitzbergen to the Azores, incidentally including the British Isles, and it is the general distribution that counts. A fine British summer is not necessarily associated with low Arctic pressure, and in 1911, the first instance cited by Mr. Parsons, Arctic pressure was rather high. Moreover the winter of 1911-12 was characterised by an abnormally low barometer at the Azores, not high as in 1921-22. Thus in May, 1913, we should expect to find a general pressure distribution the reverse of that found in May, 1923, *i.e.*, low over the Atlantic and high over northern Europe, and this is in fact what happened.

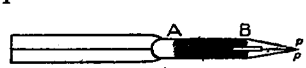
During the drought of May to October, 1887, pressure was generally low over the Arctic Ocean, and the early months of 1889 were marked by high pressure in the North Atlantic. On the other hand in the winter of 1887-88 pressure was rather low instead of high over the Azores, and the barometric minimum between Iceland and Norway was not developed in the spring of 1889. Thus each month or season presents a separate problem, which cannot be solved by analogy with a past month or season over a limited area. In fact the article indicates that the weather of any particular time is a function of preceding conditions not only over a long interval of time, but also over a large part of the earth's surface. The pressure data at hand are insufficient for a discussion of 1857, 1858 and 1859.

C. E. P. Brooks.

Anemometer Pens

There is frequently trouble in getting a new pen to write with certainty when first inserted in the holder of the Pressure Tube Anemometer. Some pens are worse than others, and nearly all settle down after a few days, but meanwhile the record is sometimes lost.

A method which is often useful is to temper the nibs in the part near the slot, leaving the actual points hard as before; then press the nibs down on a hard surface, as in the act of writing, until they separate rather widely. On examining the pen it will be found that the two halves have separated by a very minute amount, leaving a very fine crack through which light can be seen. One or two trials may be necessary before this is achieved, and it is important that the crack should be exceedingly narrow, in fact at the extreme point the two halves ought practically to touch. Such a pen will then generally give a good trace from the start, provided that it is set square with the paper. In the figure the tempered part is shown between A and



B, and should be heated over a very small flame until the blue colour reaches B; then cool it to prevent softening of the writing points *pp*. The operation requires a little practice at first as the crack may be made too wide, but, if so, it may be reduced by pressing the nibs as before, but upside down. They should also be in perfect alignment with each other when the pen is looked at from the side.

L. H. G. Dines.

Benson Observatory, Wallingford, April 28th, 1923.

Meteorology and Folklore

Dawn and Sunset Colours, Cloud Shadows, etc.

Dawn and sunset have had such a strong influence upon the active life of primitive man that their importance must have been early recognised. They are accompanied too with such lovely colour effects that it is no wonder that Homer spoke of "rosy-fingered" Eos, and that some beautiful Vedic hymns are addressed to Ushas, young, immortal, born afresh each day, with ruddy steeds yoked to her shining car. Less satisfactory have been the attempts to interpret other legends as "dawn-myths," since in mythology, as elsewhere, theories are good servants but bad masters.

The inhabitants of the Sandwich Islands say that once upon a time the Sun-God Ra, was very irregular in his rising and setting to the inconvenience of humanity. So the great hero Maui determined to set things right. He plaited six stout ropes of cocoanut fibre and laid them in the Sun's way. The Sun fell into the traps, and became so tangled up that he was glad to purchase his liberty by promising to become more regular in his habits. Maui let him go, but as a reminder the ropes were left hanging round him. "These ropes may still be seen hanging from the sun at dawn and when he descends into the ocean at night. By the assistance of the ropes he is gently let down into Avaiki (the land of shades) and in the morning raised up out of the shades: while the islanders still say when they see rays of light diverging from the sun 'Tena te Taura a Maui' ('Behold the ropes of Maui')." In England these cloud-shadows are known as "the sun drawing water," or as the Danes say "Locke (Loki) is drawing water."

. . . .

It is not in the least extraordinary that water-spouts, which combine a strange appearance with very real danger, should have given rise to a crop of legends. They form the basis of Arab tales of "tinnin" or sea-monsters, which are the same as the Hebrew "Tannin" (E.V. "whale," "dragon") which in Ps. CXLVIII, 7, might in the context be appropriately rendered "water-spouts." African natives have a tale that "God" draws up bad whales to heaven with a water-spout.

. . . .

St. Paul sailed for Italy in a boat whose sign was Castor and Pollux. The ancients identified the twins with St. Elmo's fire and believed that the appearance of two "flames" in a storm was a good omen for they indicated the presence of the brothers and the safety of the ship.

"Safe comes the ship to harbour
Through billows and through gales,
If once the great Twin Brethren
Sit shining on her sails."

One light was called "Helen" and regarded as of ill omen. With the advent of Christianity the Mediterranean seamen transferred the phenomenon to the guardianship of their patron saint St. Erasmus, whose name has been corrupted into St. Elmo. Hence also the English name "corposants" (corpo santo). Perhaps it was in this form that, in the "Tempest," Ariel "boarded the king's ship"

"Sometime I'd divide
And burn in many places; on the topmast,
The yards, the borespit, would I flame distinctly
Then meet and join."

CICELY M. BOTLEY.

10, *Wellington Road, Hastings, May 24th,* 1923.

NOTES AND QUERIES

Meteorological Exhibit at the Royal Agricultural Show, Newcastle, July 3rd to 7th, 1923

As in previous shows, the Agricultural Education Exhibition arranged in connection with the Royal Agricultural Society's Show, at Newcastle, included an exhibit by the Meteorological Office. The space, under cover, allotted for the purpose permitted an adequate display of apparatus, diagrams, and publications, as well as a demonstration of local forecasting from data picked up by wireless telegraphy. In the open, a complete climatological observing station was set up and observations were made regularly. In its general features the display was therefore similar to that given last year at Cambridge.

The issue of forecasts on the spot was only made possible by local co-operation in arranging for the wireless reception. These arrangements were kindly undertaken by Mr. G. Littlefield, of Armstrong College, under the general supervision of Prof. W. M. Thornton.

The assistance of three other gentlemen, Messrs. Bird, Waring and Scrimshaw, who acted as operators, must also be gratefully acknowledged. The receiving apparatus was most adequate, and on only one occasion, when the Air Ministry synoptic message was badly jammed by a neighbouring station, was it necessary to obtain supplementary information from London. The weather charts for each morning and afternoon were reproduced on a large blackboard, similar to that at the Air Ministry. Forecasts and readings taken on the Show-ground were written up alongside.

The Show afforded an opportunity of making the general public acquainted with the existing facilities for obtaining forecasts by wire, telephone and radio-telephony. Although the forecasts distributed by telephone already run to many thousands per month the great majority of the public still seem to be ignorant of this new facility.

H.R.H. the Prince of Wales, with the Duke of Northumberland, inspected the exhibit on Wednesday, July 4th, and expressed his interest in what he saw. The general public attended the Show in immense numbers; if only one visitor out of two found his way into the Agricultural Education Building the exhibit must have been seen by a hundred thousand people. E.G.B.

The International Meteorological Conference

THE sixth International Conference of the Directors of Meteorological Institutes and Observatories will be held at Utrecht, by the invitation of Professor E. van Everdingen, Director of the Dutch Meteorological Institute, during the week September 7th to 13th, 1923. Among the subjects for discussion by the Conference are "The reduction of Atmospheric Pressure to Mean Sea Level," brought forward by Dr. Hesselburg; "Discipline of wireless operations to obviate jamming," brought forward by Mr. T. F. Claxton; and "Daily Synoptic Charts for the Southern Hemisphere (South Atlantic)," and "Verification of Daily Weather Forecasts," brought forward by Dr. M. Sampaio Ferraz.

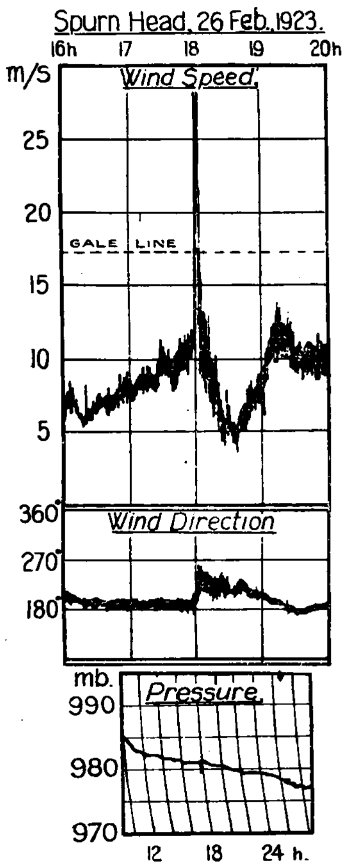
Meetings of several of the International Commissions have been arranged for the preceding week.

The Commission for Agricultural Meteorology	Sept. 3rd to 6th.
The Commission for Solar Radiation ...	Sept. 4th to 6th.
The Commission for Terrestrial Magnetism and Atmospheric Electricity	Sept. 6th.
Joint Meeting of the Commissions for Weather Telegraphy, and for Maritime Meteorology	Sept. 5th to 6th.

Members of the Commissions for the Investigation of the Upper Air and for the study of Clouds who have taken part in the Conference of Directors are asked to meet at Utrecht on September 14th and 15th to discuss the questions referred to them by the Conference.

Effect of Wind Suction in Lighthouses

It has long been realised that the pressure indicated by a barometer placed in a lighthouse tower is not representative of the pressure in its neighbourhood. The pressures reported from such meteorological stations as Dungeness and Spurn Head are frequently lower than those from stations where the barometers are in buildings less exposed to the wind. As a general rule the differences are not conspicuous on the daily weather maps, but in drawing a map illustrating the average distribution of pressure for a month the meteorologist has to make allowance for the irregularity. Other local differences are "smoothed" out in the process of averaging, but this effect is persistent and becomes more marked the longer the series of observations. It is estimated that the mean pressure computed from observations made in the Dungeness lighthouse is too low by about 0·5 millibar in January, by about 0·4 millibar in July.



The effect in question is to be attributed to the eddying of the wind round the lighthouse. It is well known that in pressure-tube anemometers, suction is produced by the wind as it blows over holes perforated through the walls of a vertical tube. Experiments in the laboratory have shown that the air pressure is high on the windward side of such a tube, and low in the eddies on the leeward side: the low pressure occurs on more than half the circumference of the tube, and, as will be realised by anyone who watches the eddies forming in water as it flows past a bridge pier, the lowest pressure is on the flanks. On the average there is a deficiency of pressure, *i.e.*, the pressure is lower inside the tube than in the free air. The lighthouse tower acts as such a suction-tube, the crannies, for example those round the windows, serving for the transmission of pressure. The opening of windows complicates matters; if the open window is on the windward side pressure will be raised, if it is on the lee side suction will be more in evidence, but the most interesting point is that with all windows closed suction is to be expected.

It is not only in the readings of the mercury barometer that the effect in question is to be detected ; the curves produced by barographs show unmistakably the rapid variations of pressure under the influence of the wind. An example in which the magnitude of the disturbance could be determined with unusual precision occurred at Spurn Head on February 26th. At 18h. G.M.T. on that day a line squall passed the lighthouse. The squall lasted but a few minutes ; the wind as recorded by the Dines anemometer rose from 25 miles per hour to 63. The record from the barograph indicates that pressure fell by 2 millibars and rose immediately by the same amount, fall and rise being indistinguishable on the chart. There is some doubt whether the door in the base of the tower, which faces north-west, was open at the time of the squall. If so, the suction produced by the wind, which blew from south or south-west, would have operated under favourable conditions. If the door was not open at the time, the suction must have taken effect through the lantern or other openings into the tower. Though such exact agreement is no doubt fortuitous, it is curious that this measurement of 2 millibars is in precise accordance* with the formula given by experiment for the suction produced in the head of the Dines anemometer.

Experiments are being made by the Meteorological Office with a barometer house designed so as to overcome the effect of eddies in exposed situations.

Yankee Enterprise

"*Tycos*," the quarterly house-journal of the Taylor Instrument Companies of Rochester, New York, is largely devoted to popular meteorology, and serves the excellent purpose of keeping dealers in scientific instruments in touch with the subject.

The April number contains a dozen articles of interest to meteorologists. The leading article is the most exciting. It is entitled "Where the Bottom Fell Out of the Sky," and is reprinted from *Popular Science Monthly*. It is stated that the deluge in question "occurred a few months ago over a region of four square miles, within the watershed of Sand Canyon, a gorge descending from the Sierra Nevada Mountains in southern California. Within the space of half-an-hour it is estimated that 240 inches of rain fell on this small area." We were not surprised to learn from a well-known American meteorologist that the Weather Bureau was unable to confirm this estimate.

* The formula is $S=\frac{1}{2}\rho v^2$, where S is the suction, v is the velocity of the current, and ρ is the density of the air. (Corless : *Dictionary of Applied Physics*, Vol. III., p. 504). Using C.G.S. units we have $\rho = \cdot 0012$ grms/cm^3, $v = 1100$ cm/sec before the gust, 2800 cm/sec in the gust and the change in S is 2000 dynes per square centimetre, *i.e.*, 2 millibars.

An Epic of the South East Trades

THE voyage of the crew of the *Trevissa* in two small lifeboats across the Indian Ocean is one of the most remarkable that has been made for many years. As will be remembered, the *Trevissa* foundered in a SSW gale at midnight on June 3rd, in Long. 85° 42′ E. and Lat. 28° 45′ S, more than 1,200 miles from the nearest land. Being not far from the south-east trade wind area the Captain decided to take advantage of these winds to make Mauritius. From the 5th to the 9th the boats steered west-north-west, but strong winds and high seas compelled them to lay to for several hours at a time, and on the night of the 9th, when rain was falling very heavily, the two boats were unable to keep each other in sight. On the 10th the Captain's boat reached the trade wind area, and for the first time they had a favourable wind, but this was followed by four days' calm. Then bad weather with high seas and strong squally south-east trade winds prevailed and the boat was driven too far north. Eventually they worked back and landed at Rodriguez. The second boat, in charge of the First Officer, passed wide of Rodriguez owing to the bad weather, and reached southern Mauritius 250 miles further on, having covered a distance of about 2,000 miles. In his account of his adventure, the First Officer says: "The south-east trade winds were baffling, being inconstant in direction and strong enough at times to force us to reef our small sail, and the boat's compass was put out of action almost as soon as the boat was lowered."

A Bird's Song in Relation to Light

COLONEL H. S. RAWSON, whose experiments on the effect of light on plant growth are well known, has recently* recorded some remarkable observations illustrating the response of the thrush to early morning light.

The intensity of the light was standardised in a curious way. Colonel Rawson observed in a prism the image of a window-frame, and noted when his eyes could distinguish coloured fringes bordering the framework. He found in 25 cases out of 26 that the song of the thrush commenced within a minute of the fringes becoming visible. Sometimes the interval was only a few seconds. Such a striking agreement in the sensitiveness of the human eye and the bird's merits further investigation.

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* Transactions of the Hertfordshire Natural History Society, etc., vol. xvii., part 4, 1923.

† It is not quite clear whether the window-frame was observed or the trunks of the trees. The optical phenomenon is surely to be explained by the unequal refrangibility of light of different colours, not as the author suggests, by diffraction.

The Reform of the Calendar

THE Editor of the *Bulletin of the American Meteorological Society* has been so good as to devote two pages of his April number to an account of the *Meteorological Magazine*. One paragraph in this article deals with the summary published in the magazine of a discussion on the Reform of the Calendar.

> "The 13-month new calendar, which has received such support from American meteorologists, under the leadership of Professor C. F. Marvin, was adversely criticized at a meeting of the Royal Meteorological Society. The arguments directed against the American proposal were (1) that the year could no longer be conveniently quartered and halved; (2) that the traditional characters of the months would be seriously altered. Neither of these objections will appeal to Americans, for (1) the year could easily be quartered and halved for meteorological purposes by taking units of 13 weeks each. The preparation of quarterly or semi-annual summaries would come at times when the preparation of monthly values was not on deck; (2) American traditions have not yet become very firmly rooted to particular weather for particular months. A move of a few hundred miles makes more of a change in the weather usually than does two weeks of the season's progress. England is noted for its "unseasonable" weather, so why should a shift of a month to a fortnight earlier or later be noticeable even there?"

These answers to the objections do not seem to us to be adequate. In the experience of the Meteorological Office there is always useful work awaiting computers when the preparation of monthly values is not "on deck." In the study of climate, and especially of rainfall, statistics for individual weeks are only computed for comparatively few stations; the month is the usual unit; to ordain that values for the summer and winter half years are only to be obtained by reference to figures for the weeks is to add untold unnecessary labour.

As to our unseasonable weather, does not the very word indicate that we have our ideas as to what is seasonable?

The frequency of Solar Halos

IN the *Annales des Services Techniques d'Hygiène* for 1922, M. Louis Besson gives the results of twenty years observations on halos at Paris (Montsouris). Halos occur much more frequently than would be supposed by the uninitiated, an average of 129 halos of 22° being observed each year between the hours of 7h. 30m. and 19h. 30m., *i.e.*, one every third day. The largest number occur in the early summer, an average of 15 per month being recorded in April and of 14 per month in May and June, while the least number are seen in January and November. The halo of 46° is a much less general phenomenon, being recorded at Paris on an average 8 times a year.

The only station in the British Isles at which observations of halo phenomena are made with assiduity comparable with that shewn at Montsouris, is the Radcliffe Observatory, Oxford. The summary of observations for this Observatory for 1922 (Q. J. R. Met. Soc., Vol. XLIX, No. 206, p. 135), shows that halos of 22° were seen on 147 days during the year (parhelia being present on 25 days) and halos of 46° twice.

Climatological Stations in Scotland

IT was recently noted* that three of the oldest and most important of the Scottish voluntary climatological stations (ARBROATH, GLENCARRON and INVERNESS) had come to an end, and that it had been found possible to replace each of these stations by another under public or municipal control. Now another break has occurred with the termination of the valuable series of observations made at FORT WILLIAM by Mr. W. T. Kilgour. A great enthusiast, Mr. Kilgour became a resident of Fort William in the early days of the Ben Nevis Observatories, and frequently acted as a voluntary observer on the summit of the mountain. His handbook, "Twenty Years on Ben Nevis," is an admirable record of a great achievement. Shortly after the observatories were closed in 1904, Mr. Kilgour offered his services as a voluntary observer at Fort William, and his work has been throughout of the highest quality. Recently he indicated that he could not continue to act, and the familiar name of Fort William will now disappear from the Monthly and Weekly Weather Reports, for, unfortunately, the municipality do not see their way to accept the view that the maintenance of a meteorological station is a public obligation.

With the co-operation of The Forestry Commission (Scotland) a new station has been established at Inchree near ONICH. This station is situated only 8 miles from Fort William, and will adequately replace the latter as a "District Value" station. Following a now well-established custom, the observer attended a course of instruction at King's College Observatory, Aberdeen. It may be noted that it was found impossible to arrange at Onich for observations at the traditional hours of 9h. and 21h. Observations will be made at 9h. and 17h., as at the health resorts, from which reports are received daily by telegraph at the Meteorological Office.

*Met. Mag., vol. 57, September, 1922, p. 213.

The first Samples of Dust from the Upper Air

It will be remembered that at the Meeting* of the International Union for Geodesy and Geophysics at Rome in May, 1922, funds were provided *inter alia* for the purchase of "jet-instruments" of the type devised by Dr. J. S. Owens for obtaining deposits of atmospheric dust. These instruments were for presentation to countries willing to make observations and forward them to the Bureau of the Union. As the firstfruits of this enterprise, observations are now being reported from Washington, where Professor Kimball is responsible for the observations.

The following details refer to samples of air taken in aeroplane flights on April 6th and April 28th.

	Location.	Dust particles per c.c.		Location.	Dust particles per c.c.
April 6th, 1923 14.30 to 15.45	Ground	500	April 28th, 1923. 12.0 to 13.30	Ground	680
	3,000 ft.	700		3,000 ft.	1,750
	6,000 ft.	750		6,000 ft.	160
	9,000 ft.	1,700		Monument (500 ft.)	110
	12,000 ft.	1,350			

On the former occasion there were no clouds, the range of visibility was estimated as 10 (miles ?) on the ground and 20 aloft. By eye observations the haze appeared densest between 6,000 and 8,000 ft. Pilot balloon observations showed a great increase in the strength of the west wind from 15 m.p.h. at 6,000 ft. to 40 m.p.h. at 14,000 ft. It will be seen that the stronger wind held by far the greater number of dust particles in suspension.

On April 28th the sky was overcast, and the flight reached the base of the clouds. There was some rain before the landing. The wind at 6,000 ft. was estimated to be about 60 miles per hour from between south and south-west. In spite of the heavy wind "the flight was extremely smooth on account of no wind shift." It will be noticed that on this occasion the aeroplane passed well above the layer containing the most dust.

The Paulin Aneroid Barometer.

An interesting pamphlet has been issued by the firm Svenska Aktiebolaget Navigator of Stockholm, to advertise the merits of aneroid barometers, constructed on the system invented by Mr. G. Paulin. It is well known that ordinary aneroid barometers suffer from various defects, mostly due to the imperfect elasticity of the capsule, the expansion and contraction of which determine the movements of the hand on the dial. In the new aneroid the pressure to be measured acts on a membrane, to which is attached a spiral spring. This spring can be tightened

* *Met. Mag.*, June, 1922, p. 122.

or slackened by the turning of a screw, and in using the instrument the observer turns this screw until an index connected with the membrane is brought to its zero position. The reading of the instrument is a measure of the force exerted by the spiral spring.

It is claimed that these instruments can be adjusted with great precision and that they are free from all the faults of ordinary aneroids. From a report by Dr. Sandström it appears that Paulin aneroids are to be supplied to all the telegraphic reporting stations in Sweden.

Early Records from Ballons Sondes

IN amplification of his remarks in *The Free Atmosphere in the Region of the British Isles*, page 29, Mr. W. H. Dines, in reply to an enquiry, has provided the following note :—

"I remember that the trace for the Manchester ascent of August 31st, 1906, was not readable, and I think the same remark applies to that of July 1st, 1907. The 1907 observations are certainly not reliable enough for giving extreme values or standard deviations although they will do for forming mean values. ' Alexander's ascents (1901 and 1903) would not fall in the same category, although no doubt the continental accuracy improved with time. Some cynical person, I have forgotten whom, remarked how scarce gradients exceeding the adiabatic were becoming compared with the number of instances published in early years. Since I got the traces on the same metal plate as the calibration marks, I have never had an instance of such a gradient. In nearly all the tabulations or correlation work I have done, I have cut out 1907 and sometimes 1908."

The details of the first ascent in which Mr. P. V. Alexander sent up a paper balloon carrying one of Teisserene de Bort's instruments (to which Mr. Dines's adjective "continental" would apply) were published in the *Aeronautical Journal*, Vol. V., 1901, page 15, This ascent and the ascents of 1903 were included in the *International Kite and Balloon Ascents*.

Seasonal Variation of Air Temperature at Great Heights

IT is an obvious suggestion that the methods which Lindemann and Dobson have elaborated for making estimates of air temperature from the observations of meteors, should be serviceable in the discussion of the seasonal variation of temperature. From a note published by these authors (Proc. Roy. Soc., A. Vol. 103, p. 339) we learn, however, that at present only one line of attack has led to a definite result ; in this case "the curves seem to indicate that the temperature difference in the upper regions between summer and winter materially exceeds that in the stratosphere."

British Association for the Advancement of Science

THE meeting of the British Association will be held this year at Liverpool, September 12th to 19th, and the programme is to contain a number of papers and demonstrations on meteorological and allied subjects. The official demonstration of weather forecasting from data received locally by wireless telegraphy is to be given again, and there is to be an exhibition of meteorological instruments and diagrams. It is hoped to arrange for the release of a ballon sonde during the meeting. The meteorological luncheon will be held as usual, probably on Friday, September 14th.

Radiation from the Sky

RADIATION MEASURED AT BENSON, OXON, 1923.

Unit: one gramme calorie per square centimetre per day.

ATMOSPHERIC RADIATION only (dark heat rays).

Averages for Readings about time of Sunset.

		April	May	June
Cloudless days:				
Number of readings	n	6	8	7
Radiation from sky in zenith ...	π I	463	528	529
Total radiation from sky ...	J	500	563	558
Total radiation from horizontal black surface on earth ...	X	684	728	728
Net radiation from earth ...	X—J	184	165	170

DIFFUSE SOLAR RADIATION (luminous rays).

Averages for Readings between 9 h. and 15 h. G.M.T.

		April	May	June
Cloudless days:—				
Number of readings	n_0	2	2	2
Radiation from sky in zenith ...	πI_0	36	40	71
Total radiation from sky ...	J_0	47	33	62
Cloudy days:—				
Number of readings	n_1	5	5	8
Radiation from sky in zenith ...	πI_1	129	94	118
Total radiation from sky ...	J_1	88	82	107

Unit for I = gramme calorie per day per steradian per square centimetre.
Unit for J and X = gramme calorie per day per square centimetre.

For description of instrument and methods of observation, see *The Meteorological Magazine*, October, 1920, and May, 1921.

Erratum

April, 1923, p. 65, *for* "433" the value of J for February *read* "488."

Meteorology and Gunnery

On Monday, 25th June, 1923, the claim of Lieut. Colonel E. Gold and Captain E. M. Wedderburn in respect of the introduction of tables of "Weighting Factors" for enabling the varying winds and temperatures at different heights to be reduced to a single wind and a single temperature (directly applicable by the gunner to his shooting) was considered by the Royal Commission on Awards to Inventors. The case for the claimants was submitted by Mr. James Whitehead, K.C.. Mr. Trevor Watson, who appeared for the Crown, contended that the method did not constitute an invention, design, drawing or process within the meaning of the Royal Warrant of March, 1919, instituting the Commission; and that the said alleged invention, while not within the scope of the applicants' duties, was intimately connected therewith. After argument by Counsel and examination and cross-examination of the claimants, Mr. Trevor Watson admitted the uses and utility of the said alleged invention, so that Mr. Whitehead had no need to call the witnesses who were ready to give evidence supporting the claim.

The Court reserved its decision.

We learn as we go to Press that the Commission is recommending to H.M. Treasury an award of £2,500. We hasten to offer our congratulations.

News in Brief

Dr. Stephen S. Visher, Professor of Geography at the Indiana University, Bloomington, who contributes our leading article, is to be congratulated on the good use he made of the travelling studentship which was awarded to him by the Yale and Indiana Universities and by the Bishop Museum of Honolulu, to enable him to carry out "field investigations" on tropical disturbances and their effects.

After the great disappointment felt when Capt. Roald Amundsen had to abandon his flight across the North Pole, owing to the breakdown of his machine on its trial flight, it is interesting to learn from the Paris *Journal* that a French officer who was preparing an expedition to the Pole by air, and who withdrew when Capt. Amundsen announced his plans, has now decided to carry on with his preparations.

A thunderstorm of exceptional violence visited London in the early morning of the 10th; 50 mm. (2 in.) of rain fell over a large area.

We are informed that Dr. D. la Cour has been appointed Director of the Danish Meteorological Institute in succession to the late Capt. Carl Ryder.

According to *The Times* three toy balloons, liberated at a hospital fête at Gerrard's Cross, are reported to have come down in France, one in Puys de Dôme, five hundred miles from Gerrard's Cross, Bucks.

The Weather of June, 1923

DURING the first week of the month pressure remained high from Iceland to the Azores and low over Scandinavia, so that as in the latter part of May, cool cloudy weather with northerly winds prevailed generally over the British Isles. After this a series of depressions passed eastwards towards Scandinavia with a consequent backing of the winds towards the south-west and an increase in temperature, though in the rear of these depressions the anticyclone off the south-west of Ireland spread repeatedly northwards. Finally, during the last days of the month, the anticyclone moved eastwards over the British Isles and fine warm weather set in. The 23rd, 28th and 29th stand out conspicuously as the three comparatively warm days of the month, 80° F. being reached at London (Camden Square) on the 23rd, and 78° F. at Scarborough and Clacton, while 78° F. occurred at Crieff on the 28th and in the Valley of the Thames on the 29th. At other times in the month the average was seldom reached. Ground frost occurred once or twice in most districts, 20° F. being recorded by the grass minimum thermometer at Balmoral on the 15th, and 23° F. at Eskdalemuir on the 17th. Sunshine records were again very poor, the total for the month being 80 hours or more below the average at several stations. This general lack of sunshine and warmth was accompanied by a shortage of rainfall in England and Ireland. The total for the month (6 mm.) at Kew Observatory has only twice during the last fifty years, in 1895 and 1921, been so low for June. At Calshot the total was 7 mm. Gales and high winds from between south-west and north-west occurred generally in the west and north on the 10th and 13th, while thick fog was experienced at the mouth of the English Channel on the 9th and 15th.

Cold, stormy weather was experienced in Switzerland and northern Italy at the middle of the month. On the 16th a violent thunderstorm damaged the crops, and snow fell in many places, the Senlis Observatory, which was entirely free from snow on June 16th last year, reporting a fall of over 3 feet. Within the next few days falls of a foot and under were reported as low as 2,400 feet. The night temperature at Geneva on the 18th was only 15° F. Abundant snow fell in northern Italy, temperatures were unusually low and rainstorms accompanied by cold winds were frequent. On the 22nd a heavy fall of snow in Asturias delayed trains, and low temperatures were reported from Teruel, but in south-western Spain the weather was very hot.

Storms and floods were again a marked feature of the month in Canada and the United States and the financial loss was very great. The rivers rose with alarming rapidity in western Canada and much damage was done to roads and property. By the 5th the floods had receded considerably, but these rains have done great service to the farmers. At the same time, much damage was done by bush and forest fires in northern Ontario and Quebec. On the 27th a summer cyclone passed over Toronto, lives were lost, and orchards and farm buildings suffered.

A "heat-wave" visited the north-eastern States in the first week of June and many deaths occurred. On the 6th a severe storm swept over New York City causing many casualties and much damage to property. On the 27th the heat wave was broken by a similar storm which raged with great violence in some parts of the city, but left others untouched. About the second week, the lowlands of Kansas, Oklahoma and Texas were flooded after three days of torrential rain ; Trinity River, Texas, rose at the rate of 7 in. per hour.

Reports from India state that the monsoon started badly and was still weak at the end of the month. It reached Bombay on the 12th, and steady but moderate rain set in. A very hot spell was experienced in Calcutta at the middle of the month. On the 13th the temperature was 110° F., the highest recorded during 55 years of observation.

Good rains fell early in the month in all the agricultural and pastoral districts of western Australia, and news from Adelaide on the 14th stated that heavy rains have entirely dispelled the drought conditions there.

The special message from Brazil states that in the north of the country the rainfall was scarce, averaging about 24 mm. below normal, while in the south the average was 23 mm. above normal. In the centre the distribution was irregular. Prospects of the coffee crop continue good. Temperature was generally a little above normal but slight frosts occurred in the south.

Rainfall. June, 1923; General Distribution

England and Wales ...	31	per cent. of the average		1881-1915.
Scotland	88	,,	,,	,,
Ireland	44	,,	,,	,,
British Isles	51	,,	,,	,,

Rainfall Table for June, 1923

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent. of Av.
Lond.	Camden Square	·42	11	21	*Leics*	Leicester Town Hall	·39	10	...
Sur .	Reigate, Hartswood	·30	8	...	,, .	Belvoir Castle	·69	18	36
Kent.	Tenterden, Ashenden	·66	17	...	*Rut* .	Ridlington	·69	17	...
,, .	Folkestone, Boro. San.	...	..	...	*Linc*.	Boston, Skirbeck	·50	13	27
,, .	Broadstairs	...	..	...	,, .	Lincoln, Sessions House	1·19	30	59
,, .	Sevenoaks, Speldhurst.	·68	17	...	,, .	Skegness, Estate Office.	·51	13	28
Sus .	Patching Farm	·57	15	28	,, .	Louth, Westgate	·77	20	36
,, .	Eastbourne, Wilm. Sq.	·65	17	35	,, .	Brigg	·71	18	34
,, .	Tottingworth Park	·51	13	...	*Notts*.	Worksop, Hodsock	...	..	...
Hants	Totland Bay, Aston	·44	11	24	*Derby*	Mickleover, Clyde Ho.	·63	16	26
,, .	Fordingbridge, Oaklnds	·54	14	29	,, .	Buxton, Devon. Hos.	...	..	...
,, .	Portsmouth, Vic. Park.	·32	8	18	*Ches*.	Runcorn, Weston Pt.	·68	17	26
,, .	Ovington Rectory	·42	11	18	,, .	Nantwich, Dorfold Hall	·67	17	...
,, .	Grayshott	·40	10	18	*Lancs*	Bolton, Queen's Park	1·45	37	...
Berks	Wellington College	·67	17	31	,, .	Stonyhurst College	1·53	39	50
,, .	Newbury, Greenham	·37	9	17	,, .	Southport, Hesketh	·56	14	26
Herts.	Bennington House	...	..	...	,, .	Lancaster, Strathspey.	·75	19	...
Bucks	High Wycombe	·50	13	26	*Yorks*	Sedbergh, Akay	1·31	33	39
Oxf.	Oxford, Mag. College	·39	10	18	,, .	Wath-upon-Dearne	·72	18	32
Nor .	Pitsford, Sedgebrook	·62	16	32	,, .	Bradford, Lister Pk.	1·00	25	43
,, .	Eye, Northolm	·64	16	...	,, .	Oughtershaw Hall	2·78	71	...
Beds.	Woburn, Crawley Mill.	·52	13	26	,, .	Wetherby, Ribston H.	1·34	34	64
Cam.	Cambridge, Bot. Gdns.	...	..	...	*ERY*	Hull, Pearson Park	·50	13	24
Essex	Chelmsford, CountyLab	·74	19	...	,, .	Holme-on-Spalding	·74	19	...
,, .	Lexden, Hill House	·84	21	...	,, .	Lowthorpe, The Elms.	·64	16	35
Suff.	Hawkedon Rectory	·67	17	32	*NRY*	West Witton, Ivy Ho.	·67	17	...
,, .	Haughley House	·40	10	...	,, .	Pickering, Hungate	·75	19	...
Norf.	Beccles, Geldeston	·68	17	38	,, .	Middlesbrough	·74	19	39
,, .	Norwich, Eaton	·83	21	43	,, .	Baldersdale, Hury Res.	·99	25	...
,, .	Blakeney	·74	19	40	*Durh*.	Ushaw College	1·11	28	51
,, .	Swaffham	·63	16	29	*Nor* .	Newcastle, Town Moor.	1·05	27	48
Wilts.	Devizes, Highclere	·49	12	...	,, .	Bellingham Manor	1·48	37	...
Dor .	Evershot, Melbury Ho.	·41	10	18	,, .	Lilburn Tower Gdns.	1·01	26	...
,, .	Weymouth, Westham	·54	14	30	*Cumb*	Penrith, Newton Rigg.	·71	18	33
,, .	Shaftesbury, Abbey Ho.	·59	15	25	,, .	Carlisle, Scaleby Hall.	·71	18	28
Devon	Plymouth, The Hoe	·36	9	17	,, .	Seathwaite	5·00	127	77
,, .	Polapit Tamar	·85	22	40	*Glam*.	Cardiff, Ely P. Stn.	·87	22	35
,, .	Ashburton, Druid Ho.	...	..	...	,, .	Treherbert, Tynywaun	2·25	57	...
,, .	Cullompton	·51	13	24	*Carm*	Carmarthen Friary	1·19	30	41
,, .	Sidmouth, Sidmount	·41	11	20	,, .	Llanwrda, Dolaucothy.	1·73	44	51
,, .	Filleigh, Castle Hill	1·11	28	...	*Pemb*	Haverfordwest, Portf'd	1·19	30	44
,, .	Hartland Abbey	1·03	26	...	*Card*.	Gogerddan	...	..	...
Corn.	Redruth, Trewirgie	·63	16	25	,, .	Cardigan, County Sch.	·86	22	...
,, .	Penzance, Morrab Gdn.	·41	11	18	*Brec*.	Crickhowell, Talymaes	1·50	38	...
,, .	St. Austell, Trevarna	·51	13	20	*Rad* .	Birm.W.W.Tyrmynydd	·76	19	23
Som	Street, Hind Hayes	·45	11	...	*Mont*.	Lake Vyrnwy	1·65	42	...
Glos.	Clifton College	·53	14	21	*Denb*.	Llangynhafal	·95	24	...
,, .	Cirencester	·44	11	18	*Mer* .	Dolgelly, Bryntirion	2·66	68	76
Here.	Ross, County Obsy.	·42	11	20	*Carn*.	Llandudno	·69	17	34
,, .	Ledbury, Underdown.	·39	10	17	,, .	Snowdon, L. Llydaw 9	8·75	222	...
Salop	Church Stretton	·45	11	19	*Ang* .	Holyhead, Salt Island.	·70	18	33
,, .	Shifnal, Hatton Grange	·73	19	33	,, .	Lligwy	·85	22	...
Staff.	Tean, The Heath Ho.	·63	16	24	*Man*.	Douglas, Boro' Cem.	...	..	...
Worc.	Ombersley, Holt Lock.	·30	8	...	*Guer*.	St. Peter Port, Grange.	·49	13	26
,, .	Blockley, Upton Wold.	·38	10	14	*Wigt*.	Stoneykirk, Ardwell Ho	1·29	33	53
War	Farnborough	·54	14	23	,, .	Pt. William, Monreith.	1·37	35	...
,, .	Birminghm, Edgbaston	·45	11	19	*Kirk*.	Carsphairn, Shiel.	3·44	87	...

Rainfall Table for June, 1923—*continued*

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm	Per-cent. of Av.
Kirk.	Dumfries, Cargen	1·12	28	40	*Caith*	Loch More, Achfary	11·48	292	310
Dum	Drumlanrig	1·43	36	58	,,	Wick	2·26	57	126
Roxb	Branxholme	1·14	29	51	*Ork.*	Pomona, Deerness	2·11	54	115
Selk.	Ettrick Manse	1·87	47	...	*Shet.*	Lerwick	2·22	56	125
Berk.	Marchmont House	1·10	28	48	*Cork.*	Caheragh Rectory	·64	16	...
Hadd	North Berwick Res.	·96	24	58	,,	Dunmanway Rectory	·65	17	19
Midl	Edinburgh, Roy. Obs.	1·06	27	55	,,	Ballinacurra	·09	2	3
Lan.	Biggar	1·59	40	77	,,	Glanmire, Lota Lo.	·14	4	5
Ayr.	Kilmarnock, Agric. C.	1·49	38	68	*Kerry*	Valencia Obsy.	...	..	...
,,	Girvan, Pinmore	2·28	58	79	,,	Gearahameen	2·10	53	...
Renf.	Glasgow, Queen's Pk.	1·82	46	79	,,	Killarney Asylum	·75	19	26
,,	Greenock, Prospect H.	1·86	47	56	,,	Darrynane Abbey	·70	18	22
Bute.	Rothesay, Ardencr'g.	2·62	67	85	*Wat.*	Waterford, Brook Lo.	·42	11	16
,,	Dougarie Lodge	2·48	63	...	*Tip.*	Nenagh, Cas. Lough	1·11	28	45
Arg.	Glen Etive	...	..	...	,,	Tipperary	1·05	27	...
,,	Oban	3·37	86	...	,,	Cashel, Ballinamona	·60	15	26
,,	Poltalloch	4·06	103	136	*Lim.*	Foynes, Coolnanes	1·29	33	50
,,	Inveraray Castle	4·32	110	109	,,	Castleconnell Rec.	1·50	38	...
,,	Islay, Eallabus	3·27	83	125	*Clare*	Inagh, Mount Callan	...	..	...
,,	Mull, Benmore	16·50	419	...	,,	Broadford, Hurdlest'n.	...	..	...
,,	Mull, Quinish	3·51	89	118	*Wexf*	Newtownbarry	1·01	26	...
Kinr.	Loch Leven Sluice	1·24	31	57	,,	Gorey, Courtown Ho.	·96	24	40
Perth	Loch Dhu	2·20	56	53	*Kilk.*	Kilkenny Castle	·65	17	27
,,	Balquhidder, Stronvar.	1·30	33	34	*Wic.*	Rathnew, Clonmannon	·90	23	...
,,	Crieff, Strathearn Hyd.	·81	21	31	*Cars.*	Hacketstown Rectory	1·77	45	63
,,	Blair, Castle Gardens	·80	20	...	*QCo.*	Blandsfort House	1·06	27	41
,,	Coupar Angus School	·60	15	32	,,	Mountmellick	1·18	30	...
Forf.	Dundee, E. Necropolis	·86	22	48	*KCo.*	Birr Castle	·94	24	41
,,	Pearsie House	·91	23	...	*Dubl.*	Dublin, FitzWm. Sq.	·98	25	50
,,	Montrose, Sunnyside	·74	19	45	,,	Balbriggan, Ardgillan	1·05	27	52
Aber.	Braemar Bank	1·23	31	64	*W.M*	Athlone, Twyford	...	..	...
,,	Logie Coldstone Sch.	·94	24	48	,,	Mullingar, Belvedere	1·67	42	64
,,	Aberdeen, Cranford Ho	1·05	27	58	*Long*	Castle Forbes Gdns.	1·67	42	65
,,	Fyvie Castle	1·26	32	...	*Gal.*	Galway, Waterdale	1·45	37	...
Mor.	Gordon Castle	1·53	39	75	,,	Woodlawn	...	..	...
,,	Grantown-on-Spey	1·65	42	73	*Mayo*	Crossmolina, Enniscoe	2·04	52	68
Na.	Nairn, Delnies	·88	22	50	,,	Mallaranny	3·38	86	...
Inv.	Ben Alder Lodge	2·65	67	...	,,	Westport House	·64	16	24
,,	Kingussie, The Birches	1·10	28	...	,,	Delphi Lodge	4·16	106	...
,,	Fort Augustus	2·10	53	103	*Sligo*	Markree Obsy.	2·30	58	...
,,	Loch Quoich, Loan	9·50	241	...	*Ferm*	Enniskillen, Portora	·90	23	...
,,	Glenquoich	9·33	237	190	*Arm.*	Armagh Obsy.	1·06	27	42
,,	Inverness, Culduthel R.	·72	18	...	*Down*	Warrenpoint	1·11	28	...
,,	Arisaig, Faire-na-Squir	4·20	107	...	,,	Seaforde	1·04	26	38
,,	Fort William	3·96	101	113	,,	Donaghadee	·83	21	36
,,	Skye, Dunvegan	2·64	67	...	,,	Banbridge, Milltown	1·33	34	52
,,	Barra, Castlebay	1·18	30	...	*Antr.*	Belfast, Cavehill Rd.	1·23	31	...
R&C	Alness, Ardross Cas.	·96	24	42	,,	Glenarm Castle	1·32	33	...
,,	Ullapool	3·47	88	...	,,	Ballymena, Harryville	1·90	48	65
,,	Torridon, Bendamph	7·32	186	179	*Lon.*	Londonderry, Creggan	2·90	74	103
,,	L. Carron, Plockton	4·47	113	...	*Tyr.*	Donaghmore	·68	17	...
,,	Stornoway	2·64	67	114	,,	Omagh, Edenfel	1·83	47	65
Suth.	Dunrobin Castle	...	..	...	*Don.*	Malin Head	1·40	35	65
,,	Lairg	1·36	35	...	,,	Letterkenny Hos	1·19	30	41
,,	Forsinard	...	..	...	,,	Dunfanaghy	...	..	...
,,	Tongue Manse	2·84	72	139	,,	Narin, Kiltoorish	2·30	58	...
,,	Melvich School	3·13	79	161	,,	Killybegs, Rockmount	2·20	56	58

Correction—Donaghadee, May, *for* "1·11 \| 28 \| 49," *read* "1·18 \| 30 \| 51."

Climatological Table for the British Empire, January, 1923

STATIONS	PRESSURE: Mean of Day M.S.L.	PRESSURE: Diff. from Normal	TEMPERATURE: Absolute Max.	TEMPERATURE: Absolute Min.	TEMPERATURE: Mean Values Max.	TEMPERATURE: Mean Values Min.	TEMPERATURE: Mean Values ½ max. and min.	TEMPERATURE: Mean Values Diff. from Normal	TEMPERATURE: Mean Wet Bulb.	Relative Humidity	Mean Cloud Am'nt	PRECIPITATION: Am'nt	PRECIPITATION: Diff. from Normal	PRECIPITATION: Days	BRIGHT SUNSHINE: Hours per day	BRIGHT SUNSHINE: Percentage of possible.
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1022·8	+ 5·2	54	25	47·1	35·7	41·4	+ 2·5	40·1	85	6·9	33	— 12	13	1·6	19
Gibraltar	1024·4	+ 4·9	66	41	58·9	47·1	53·0	— 2·4	48·3	72	3·2	58	— 72	11	...	...
Malta	1015·6	— 0·6	59	43	55·6	49·3	52·5	— 2·1	49·1	83	6·6	103	+ 28	19	3·8	38
Sierra Leone	1010·3	— 0·9	95	69	89·5	74·0	81·7	+ 0·2	73·5	62	4·9	0	— 11	0	...	...
Lagos, Nigeria	1009·4	— 0·5	90	71	87·8	75·3	81·5	+ 0·5	77·5	77	6·7	23	— 5	4	...	...
Kaduna, Nigeria	1011·8	+ 0·2	95	57	91·0	60·4	75·7	+ 1·4	58·7	38	0·6	0	0	0	...	...
Zomba, Nyasaland	1008·2	+ 0·3	89	63	83·9	65·4	74·7	+ 2·3	...	88	6·7	183	—102	21	...	...
Salisbury, Rhodesia	1007·1	— 2·2	96	56	82·0	59·9	70·9	+ 1·4	65·5	72	5·8	146	— 55	21	...	...
Cape Town	1013·4	0·0	91	54	79·7	59·9	69·8	0·0	65·5	66	2·5	13	— 4	4	...	...
Johannesburg	1009·6	— 1·2	85	49	74·5	56·0	65·3	— 0·9	58·7	76	6·1	189	+ 30	17	6·3	46
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Calcutta, Alipore Obsy.	1015·6	+ 0·4	85	47	78·0	54·7	66·3	— 0·1	55·2	80	1·7	0·3	— 10	*0	...	...
Bombay	1012·7	— 0·5	89	65	84·4	68·9	76·7	+ 1·5	65·0	68	1·7	0	— 2	*0	...	...
Madras	1013·7	— 0·4	84	64	81·6	68·7	75·1	— 1·0	70·6	84	4·6	113	+ 90	*6	...	...
Colombo, Ceylon	1010·4	— 0·4	91	70	86·3	72·4	79·3	— 0·5	74·9	73	6·2	177	+ 86	17	...	...
Hong Kong	1029·7	+ 1·3	74	46	65·4	56·1	60·7	+ 0·4	53·9	64	5·4	3	— 34	1	6·7	61
Sandakan	...	...	87	71	84·5	74·0	79·3	— 0·6	75·9	86	...	884	+415	24	...	...
Sydney	1013·4	+ 0·9	103	59	79·9	64·1	72·0	+ 0·4	64·2	62	5·1	46	— 45	7	7·5	56
Melbourne	1008·5	— 4·4	101	49	77·8	56·1	66·9	— 0·6	59·1	54	5·2	25	— 22	10	7·8	54
Adelaide	1010·5	— 2·5	107	51	83·0	60·7	71·9	— 2·2	59·5	44	4·7	18	0	10	9·1	65
Perth, W. Australia	1011·6	— 0·9	99	51	81·2	60·3	70·7	— 3·1	63·5	55	3·3	26	+ 17	3	8·4	64
Coolgardie	1009·2	— 2·2	104	53	92·2	62·1	77·1	— 0·3	64·9	38	3·0	25	+ 13	4	...	...
Brisbane	1008·6	— 2·7	97	64	87·1	70·3	78·7	+ 1·5	72·8	66	4·5	71	— 92	6	9·1	67
Hobart, Tasmania	1003·7	— 6·6	84	45	68·1	53·5	60·8	— 1·5	53·2	60	6·7	57	+ 12	18	7·2	48
Wellington, N.Z.	1009·8	— 3·0	77	48	70·9	57·3	64·1	+ 1·4	58·9	71	7·1	147	+ 61	18	5·5	36
Suva, Fiji	1006·5	— 1·2	91	72	86·6	74·1	80·3	+ 0·4	77·6	84	6·5	190	— 82	22	...	...
Kingston, Jamaica	1015·5	+ 0·2	92	63	87·8	67·5	77·7	+ 0·9	...	67	5·9	8	— 16	2	...	...
Grenada, W.I.	1014·3	+ 1·5	86	69	81·8	71·2	76·5	— 0·5	70·7	71	4·4	78	— 35	21	...	...
Toronto	1018·2	+ 0·8	43	—12	29·8	13·9	21·9	— 0·2	19·3	61	7·7	81	+ 8	21	...	...
Winnipeg	1018·3	— 1·5	42	—35	11·6	— 7·5	2·1	+ 6·5	1·5	...	4·0	42	+ 23	7	...	...
St. John, N.B.	1014·3	— 1·4	43	—15	22·1	7·6	14·9	— 4·3	13·4	65	6·0	141	+ 19	13	...	...
Victoria, B.C.	1014·0	— 1·3	53	24	43·0	36·4	39·7	— 0·4	37·7	88	7·0	163	+ 48	21	...	...

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

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The Thunderstorms of July, 1923

The Genesis of the Storms

THE widespread thunderstorms which occurred during the warm weather of the first half of last month followed a period singularly free from disturbances of this kind. The abnormal June of this year, the weather of which was dominated by the persistence of high pressure off the western coasts, was practically thunderless, and of the stations in the long list in the *Monthly Weather Report*, only three—Oxford, Whitby and St. Aubin's, Jersey—have any entry of thunderstorms,* and these only one each.

The warm spell commenced on Thursday, July 5th, with the simultaneous filling up of a deep depression near Iceland and the growth of an anticyclone over the Continent, and by the next day a south-easterly current was flowing over the whole kingdom, carrying warm air to the extreme west and north-west coasts, Oban, for example, recording the noteworthy maximum of 80° F. This condition was, however, only transitory, and was followed by the development of a depression west of Ireland and the gradual spreading of south-westerly winds back again over the British Isles, during Saturday, July 7th and Sunday, July 8th. The first outburst of thunderstorms accompanied this change of air supply, the 1h. chart of July 7th showing their simultaneous occurrence down the western coasts at Stornoway,

*Actually there was a *pukka* thunderstorm at St. Aubin's on the 1st. "Thunder heard" was reported at Whitby on the 27th. As to Oxford, no details are available.

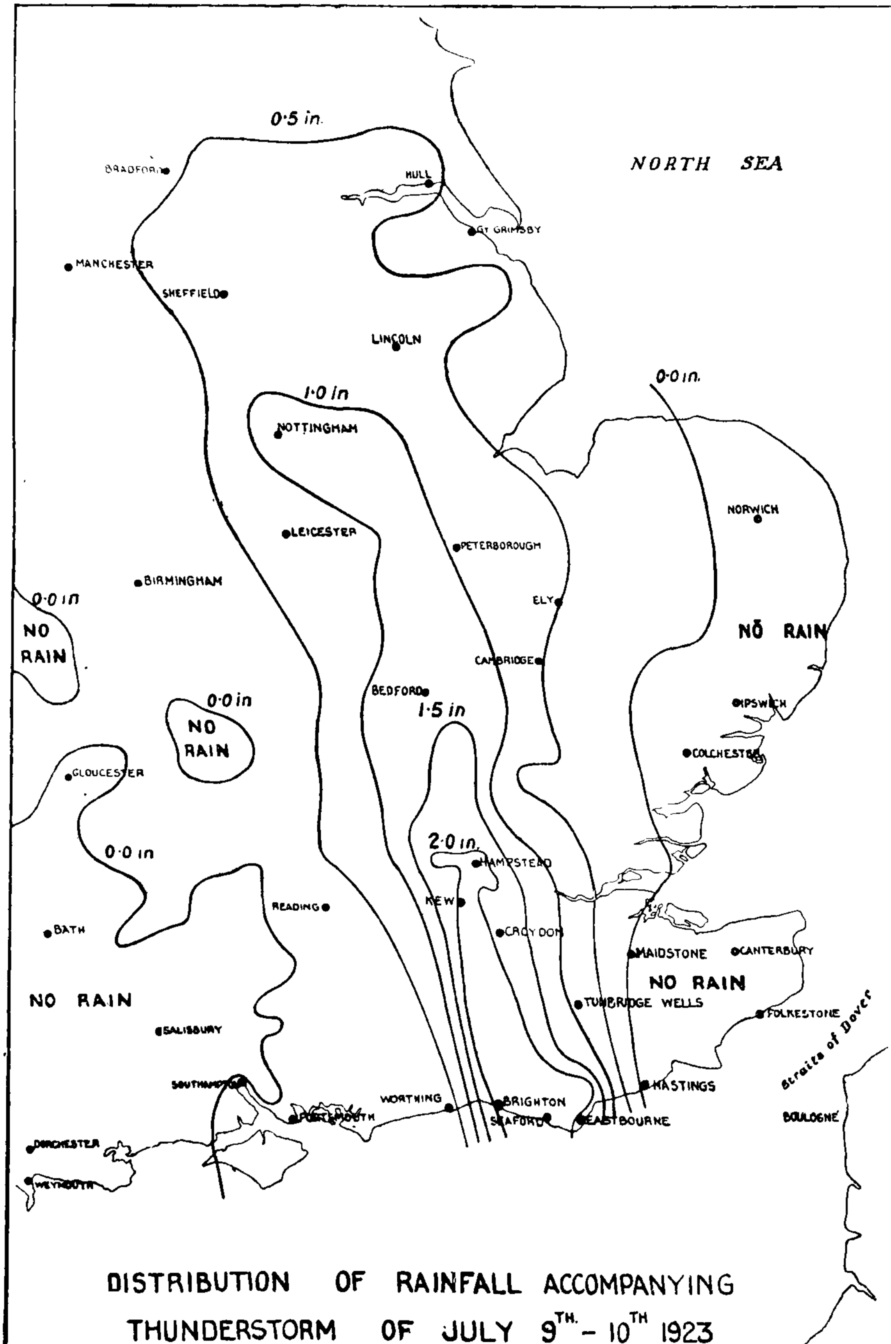
Wt 69—P 1 1000 8/23 M & C

Pembroke, Scilly and the Channel Islands. The line of storms progressed eastwards over the whole kingdom, but the greatest intensity was reached in the north of England and Scotland, where some serious damage was done. In the Carrbridge district of Inverness-shire, on the afternoon of the 8th, flood-water resulting from what is popularly known as a " cloudburst " swept away bridges and caused considerable damage to railway embankments. Yorkshire, too, suffered from very severe storms, and in the Holmfirth district a labourer was killed by lightning on the evening of the 7th.

A second series of storms occurred during the period from the evening of the 9th to the morning of the 11th. This time the theatre of operations was the eastern portion of England and of Scotland, and the series opened late on the 9th with a memorable all-night storm which affected London, and of which some details are given below. Of the remaining storms during this phase, those which occurred in the area round London on Tuesday evening, July 10th, deserve mention. Unlike the storm of the previous night these were preceded by a violent squall of wind. Mr. A. Latchmore, writing from Hitchin, states that his anemometer recorded an increase of wind from calm to gale force in the course of 5 mins. and his barograph at the same time showed an almost instantaneous rise of about 3 mb., followed quickly by a fall of 1·5 mb. At Croydon a wind speed of 53 miles per hour was reached in a gust, and reports of squalls were received from a number of other places. The storm, though only lasting about 2 hours, was very violent in the Windsor area, and the Lower Chapel of Eton College was struck. The depression off the west of Ireland reached its greatest intensity on Monday, July 9th, when the general drift of air over the British Isles was from a southerly point, at any rate a few thousand feet above the surface. The next two days saw the northward movement of this depression and the formation, by the Wednesday afternoon, of a ridge of relatively high pressure across these Islands, linking up the Continental anticyclone with one near the Azores.

Under these conditions there was a temporary freedom from thunderstorms, but by the evening of Thursday, July 12th, a shallow depression had moved up from France to the Channel, and a third series of storms commenced, chiefly affecting the south-west of England and the west Midlands, where some violent storms occurred. A death due to lightning was reported from Totnes.

The end of the warm spell and of the thundery conditions came on Sunday, July 15th, when a general change set in which resulted in the establishment of a " westerly type " over the British Isles.



DISTRIBUTION OF RAINFALL ACCOMPANYING THUNDERSTORM OF JULY 9TH. – 10TH 1923

An account of the London storm based on data available at the time was published in *Nature* of July 21st. It was there mentioned that the chief rainfall was confined to a narrow belt of the country running from SSE to NNW across London, and the rainfall map now published, based on about 200 returns received up to the time of writing, illustrates this. Further returns will no doubt necessitate some modification of the isohyetals, but they certainly represent the main features of the distribution.

Several outstanding falls were reported from places lying within the 2 in. isohyetal. Mr. J. Nicholas recorded a fall of 2·96 in. at an altitude of about 200 feet on the Downs behind Brighton, while a fall of 2·94 in. was measured at Crawley, Sussex, by Mr. N. Longley, following a partial drought lasting 40 days with a total rainfall of only 0·32 in. The largest fall, however, was, as far as reports go at present, 3·21 in. at Seaford, registered by Mr. T. Davys Manning. Other notable falls were 2·80 in. at Burgh Heath, Surrey, reported by Mr. E. M. Taylor, and 2·56 in. at the Hampstead Observatory, the largest fall measured in London.

The storm apparently developed over the Channel and rain is reported as having commenced about 20h. 30m. (Greenwich time) at Seaford, after which it spread NNW at a speed of about 25 miles per hour, a direction and speed in close agreement with the upper wind current between 6,000 and 18,000 feet shown by pilot-balloon ascents on the evening of the 9th. Rain was continuous in the south for something over six hours and at one stage must have been falling simultaneously over most of the strip shown in the accompanying diagram.

M. A. GIBLETT.

The Great Storm in London

THE thunderstorm of July 9th—10th was probably the severest recorded in the London area since that of May 31st, 1911. Both storms occurred under very similar pressure distributions, a narrow neck of relatively low pressure lying over southern England between anticyclonic systems to the north-east and south-west. Sheet lightning was first seen at Chelsea at 22h.* in an ESE direction, thunder being first heard at 22h. 13m. The storm rose to a maximum intensity between 23h. 30m. and 24h. with a most spectacular display of lightning to the south and thunder overhead. A second phase of intensity occurred between 3h. and 4h. on the 10th with the active development of

* All times are G.M.T.

a centre in the NE. Thunder was last heard at 4h. 54m. The brontometer record gave the following number and rate of flashes :—

Time.	Number of Flashes.	Average per Minute.	Max. number in one Minute.
22h.—23h.	600.	10	17
23h.—24h.	1,540	26	47
24h.— 1h.	1,327	22	33
1h.— 2h.	1,129	19	30
2h.— 3h.	1,008	17	28
3h.— 4h.	1,320	22	37
6 Hours	6,924	19	47

(On August 22nd, 1917, at 20h. 30m., during a short storm, a flash rate of 50 per minute was obtained; during the past 14 years, in south-east England, over a large number of storms, the average flash rate is 12 per minute).

The storm apparently occurred at a high altitude, and a very marked feature was the predominance of cloud to cloud discharges. The cloud forms were alto-stratus, alto-cumulus and false cirrus. I was unable definitely to identify cumulo-nimbus before 3h. 30m., and at that hour it was not well developed. Rain commenced at 22h. 48m., the period of heaviest rainfall lying between 23h. 30m. and 4h.

Further storms occurred on the 10th from 7h. 25m. to 7h. 45m., and from 17h. 45m. to 18h. 50m. During the latter, on the sudden commencement of rain at 18h. 30m., a very rapid disintegration of cumulo-nimbus to a degraded form of mammato-cumulus was observed.

SPENCER RUSSELL.

Cycling through the Thunderstorm

My experiences in the thunderstorms of Saturday, July 7th, might prove of some interest.

At about 5.40 p.m. on July 7th I was cycling southwards towards Whitchurch. I could see a thunderstorm in progress ahead of me and eventually ran into it at a point about 2 miles north of Whitchurch. Some of the lightning flashes struck me as being very close, and after several in quick succession there came one which I felt rather than saw. Coincident with its arrival were the following: a loud report like a pistol shot close to my right ear; a violent but momentary convulsion of my arms and shoulders; and a "burnt-metallic" taste on my tongue.

As I rode on and thought over the matter I was about to come to the conclusion that the sensations were the outcome of nerves and imagination when, about a quarter of a mile further on, the same thing happened, every sensation being as before except that the explosive sound seemed to be in my head. By this time I had reached the rain area of the storm and, dismounting, took shelter under a hedge; but though the storm continued with considerable violence in the immediate vicinity and, I understand, did much damage, I did not again experience any physical tremors, nor did I hear any reports coincident with the flashes.

I have come to the conclusion that I suffered a minor shock which was minimised by the insulation afforded by the pneumatic tyres. Incidentally, there were no lasting physical ill-effects.

F. W. JUDE.

Civil Aerodrome, Chorlton-cum-Hardy, Manchester, July 13th 1923.

Variability of Tropical Climates—II.

By STEPHEN S. VISHER, Ph.D. (Chicago).

Variation in the Rainfall.

VARIATIONS in rainfall have perhaps even greater significance than variations in temperature or wind. The indications are that in respect to dependability of precipitation, the lower latitudes are notably less fortunate than are middle latitudes. In order to compare the variability of rainfall in the tropical half of the globe with that of higher latitudes, I have inspected the official records for many cities in both zones. The selection was impartial, being determined solely by whether or not the data were readily available. The comparison is between the greatest and least annual precipitation officially recorded before a recent year. The length of the record varies, but in general it is shorter in low than in higher latitudes, and hence tends to lessen the apparent range in lower latitudes. Tables 3 and 4 give the figures to the nearest one-tenth inch for a few of the stations examined. It will be noticed that the maximum amount of rainfall received in a year was less than twice the minimum for Chicago and Paris, and only a trifle more than twice the minimum in the case of London and Wellington, N.Z. Very few middle or high latitude cities appear to have experienced three times as much precipitation in their wettest year as in their driest. Madrid, Washington, D.C., and Vladivostok are exceptions, as are some cities in southern Europe, while Buenos Aires, Rome and San Francisco are notable for having received about four times as much. However, many geographers class Rome, San Francisco and Buenos Aires as sub-tropical. Furthermore, Madrid and Vladivostok have an average rainfall of less than 20 in., and thus are more subject to large percentage changes than is the case where the normal rainfall is heavier.

TABLE 3.—EXTREME ANNUAL RANGE IN RAINFALL IN MID-LATITUDES.

City.	Latitude.	Average Rainfall. in.	Driest Year. in.	Wettest Year. in.
Buenos Aires ...	35 S	36·8	21·5	80·7
Chicago	42 N	33·5	24·5	45·9
London	51 N	24·0	18·2	38·2
Madrid	40 N	16·2	9·1	27·5
Paris	49 N	21·9	16·4	29·6
Rome...	42 N	32·6	12·7	57·9
San Francisco ...	38 N	22·8	9.3	38·8
Vladivostok	43 N	19·5	9·4	33·6
Washington	39 N	43·8	18·8	61·0
Wellington, N.Z. ...	42 S	49·7	30·0	67·7

Turning now to the lower latitudes: among scattered cities having 30 in. of rainfall or more, on the average, in no case was the officially recorded rainfall of the wettest year less than twice that of the driest. Only in Calcutta and Caracas did the ratio fall as low as 2·25. In Johannesburg it was 2·5; in Hongkong 2·75; in Colombo and Honolulu about 3; in Manila about 3·5; in Madras 4·5; in Singapore 5; and in Rio de Janeiro 13·4. All these cities have an average rainfall of 30 in. or over and the mean for the group of cities is 58·7 in. in contrast with a mean of 30·1 in. for the cities of Table 3. Since percentage fluctuations tend to become smaller as the total rainfall increases, the great fluctuations experienced by these tropical cities are all the more notable.

TABLE 4.—EXTREME ANNUAL RANGE IN RAINFALL IN LOW LATITUDES.

City.	Latitude.	Average Rainfall. in.	Driest Year. in.	Wettest Year. in.
Calcutta	22 N	62·0	39·4	89·3
Caracas	11 N	30·0	23·7	47·4
Colombo	7 N	83·8	51·6	139·7
Hongkong	22 N	84·1	45·8	119·7
Honolulu	21 N	31·3	14·6	45·0
Johannesburg ...	26 S	31·6	21·7	50·0
Madras	13 N	49·0	18·5	88·4
Manila	15 N	76·3	35·7	117·0
Rio de Janeiro ...	23 S	46·8	4·7	63·5
Singapore	1 N	92·0	32·7	158·7

If tropical and sub-tropical cities having an average rainfall of less than 20 in. are included in the comparison, even more violent ranges are disclosed. For example, Cairo and San Diego each received about 6·3 times as much rainfall in their wettest year as in their driest; Athens 7 times; Helwan 18 times and Onslow 47 times. None of the cities of Table 4, except Singapore, happen to be close to the equator. However, extreme fluctuations occur almost under the equator even on oceanic islands.

At Malden Island (lat. 4° 1′ S, long. 154° 58′ W) for example, the annual totals of rainfall have varied from 3·95 in. in 1908 to 63·41 in. in 1905. At Ocean Island (lat. 0° 52′ S, long. 169° 35′ E), nearly 2,000 miles west of Malden Island and within a degree of the equator, the range has been between 19·15 in. in 1909 and 158·93 in. in 1905 (141·02 in. in 1911). There was likewise a range of from 74 rainy days in 1910 to 232 in 1911.

The great variability illustrated by these two mid-Pacific islands is the more notable because insular climates are commonly thought to be exceptionally uniform, particularly if near the equator and not dominated by nearby continental masses, nor within hurricane regions. Neither of these two is in a hurricane region, both are far from land and close to the equator.

So many other regions in low latitudes experience an unreliable rainfall that it seems unnecessary to do more than mention the famines produced by droughts in India and in southern China or the destructive floods in the same countries. Tropical Australia has perhaps even worse droughts and floods, and is saved from terrible famines only by the sparseness of the population and the skill used in reducing losses to a minimum. The annual range at Onslow in tropical West Australia, for instance, was from 0·57 in. in 1912 to 26·96 in. in 1900 and the average yearly deviation from normal in that region has been about 50 per cent. of the average rainfall.

Excessive falls in short periods afford other illustrations of the uncertainty of rainfall. In tropical Australia, on more than 400 days in a 25 year period more than 10 in. of rain fell in 24 hours according to the official rainfall records, while in temperate Australia there have been very few recorded instances of such heavy rainfalls—none in Victoria or South Australia and only two in Tasmania (max. of 18·1 in. in three days). In tropical Australia, more than 30 in. has been officially recorded as falling in 24 hours on 4 different days. The maximum was 35·71 in. at Crohamhurst, Queensland, Feb. 2, 1893. However, 60 in. fell in three consecutive days at Mt. Molloy, Queensland. At Suva, Fiji, it frequently happens that more than 10 in. of rain fall within 24 hours; there were 4 cases in the 7 years 1906-12. The maximum has been 26·5 in. in less than 4 hours on Aug. 8, 1906. What is believed to be the world's record for officially measured rainfall in 24 consecutive hours occurred near Manila on Feb. 14-15, 1911 (1,168 mm., 46 in.). The other stations at which this maximum has been approached are also in low latitudes, namely, Cherrapunji, India, June 14, 1876, 40·8 in.; Funkiko, Formosa, 40·7 in. Aug. 31, 1911 and Hononu, Hawaii, 31·9 in., Feb. 20, 1918.

With such sharp annual and daily extremes as these, it is reasonable to expect great monthly extremes. At Malden

Island, mentioned above, for example, the range in officially recorded rainfall from 1890 to 1918 was as follows :—

TABLE 5.—MONTHLY VARIATION IN RAINFALL AT MALDEN ISLAND.

Jan.	from 0·00 in.	to	19·48 in.		July	from 0·59 in.	to	10·10 in.
Feb.	„ 0·00 „	„	9·27 „		Aug.	„ 0·18 „	„	5·56 „
Mar.	„ 0·15 „	„	25·65 „		Sept.	„ 0·05 „	„	3·03 „
Apr.	„ 0·47 „	„	12·34 „		Oct.	„ 0·00 „	„	5·27 „
May	„ 0·29 „	„	12·30 „		Nov.	„ 0·00 „	„	8·72 „
June	„ 0·00 „	„	12·49 „		Dec.	„ 0·00 „	„	8·20 „

The four months November, 1891, to February, 1892, received a total of only 0·72 in. while the four months January to April, 1915, received over 60 in. The number of rainy days per year varied from 30 to 144. The Philippines show scarcely less violent extremes. In the 16 year period 1903-18, 42 of the 70 stations had a total of about 160 months with no rainfall, while at the other extreme, the wettest months at about half the 70 stations exceeded 40 in. of rain and had less than 20 in. in the case of only 8 stations. This variation is only partly seasonal, for a month which is very dry one year may be excessively wet another. Severe and wide-spread droughts, with over 100 days without rain, are contrasted with destructive floods caused by rainfalls of more than 20 in. in a day or two. Even at Hilo, on the wet side of Hawaii, where the rainfall averages 139·4 in. a year and is relatively reliable, a 13 year period shows that the monthly amounts have varied widely, *e.g.*, January from 0·5 in. to 38·6 in., February from 1·9 in. to 32·5 in.

That the great variation from year to year in rainfall discussed in the foregoing pages is not local is suggested by various data. For example, the mean rainfall of the entire Hawaiian group (150 stations) was more than twice as great in 1919 as in 1918 (112·9 in. *v.* 54·5 in.). Likewise in the Philippines during the droughts such as that referred to in a preceding paragraph, nearly all of the 70 stations are affected similarly.

Another sort of variation in rainfall which is prominent in the tropics is the seasonal type. Very few tropical localities receive their rainfall as evenly distributed throughout the year as is common in many parts of middle latitudes. Distinct wet and dry seasons are the rule. The rainy summers and dry winters of India and China are well known. Most of tropical Australia also receives almost no rain for six months and from 15 in. to 50 in. or more in the other six months. Hawaii, and many other places near the margins of the tropics receive much of their rainfall in winter, while still other parts of the tropics have two wet and two dry seasons.

In order to compare the monthly variability of rainfall in low and middle latitudes, a planimeter measurement was made of Supan's Map of Percentage Range of Mean Monthly Rainfall in Bartholomew's *Atlas of Meteorology*. This map shows four types of regions: (1) where the wettest month is less than 10 per cent. rainier than the driest month; (2) where the wettest month is from 10-20 per cent. rainier than the driest; (3) where the range is from 20-30 per cent.; and (4) where it is over 30 per cent. Tables 6 and 7 show the approximate area and the percentage of each type, by continents. Table 6 concerns middle latitudes (30° to 60°); Table 7 concerns low latitudes (30° N to 30° S.)

TABLE 6.—PERCENTAGE RANGE OF MEAN MONTHLY RAINFALL, LATITUDES 30° TO 60°.

	Range under 10 %		Range 10—20 %		Range 20—30 %		Range over 30 %	
	Sq. Mi. ×10⁶	%	Sq. Mi. ×10⁶	%	Sq. Mi. ×10⁶	%	Sq. Mi. ×10⁶	%
Europe ...	1·77	65	·88	34	·03	1	0	0
N. America ...	2·06	43	2·62	54	·14	3	0	0
S. America ...	·23	26	·55	60	·13	14	0	0
Asia	·22	3	2·65	34	3·75	49	1·13	14
Africa ...	·05	15	·23	44	·47	41	0	0
Australia ...	·36	47	·40	52	·005	1	0	0
Total & Means	4·69	26	7·33	42	4·53	25	1·13	7

TABLE 7.—PERCENTAGE RANGE OF MEAN MONTHLY RAINFALL, LATITUDES 30° N TO 30° S.

	Range under 10 %		Range 10—20 %		Range 20—30 %		Range over 30 %	
	Sq. Mi. ×10⁶	%	Sq. Mi. ×10⁶	%	Sq. Mi. ×10⁶	%	Sq. Mi. ×10⁶	%
N. America ...	0	0	·46	39	·70	61	0	0
S. America ...	·12	2	4·91	76	1·31	21	·04	1
Asia	·10	2	·96	23	2·56	60	·63	15
Africa ...	0	0	2·28	20	8·86	78	·21	2
Australia ...	·16	7	·63	28	1·32	59	·13	6
E. Indies ...	·43	36	·72	63	·01	1	0	0
Total & Means	·81	3	9·96	38	14·76	55	1·01	4

It will be seen that low altitudes have over three times as large an area possessing a monthly variability of over 20 per cent. as is the case in mid-latitudes and twice as large a percentage of their total area has this range. The one large area in mid-latitudes mapped as in the fourth, the most extreme type of rainfall variability is the little known Tibetan Plateau, which has little agricultural value because of its great altitude. Furthermore, the month of least precipitation in mid-latitudes commonly is in the winter, when plants require little moisture, while the wettest month usually is in summer. On the other hand, the driest month of the tropics is also a hot month, with active evaporation. This unfortunate combination is very hard on plants and is the reason for the lack of forests in many places having a large annual rainfall. For instance, parts of tropical

Australia having over 80 in. of rain in a year possess no real forest because several months are extremely dry and hot. In respect to the more uniform rainfall type, where the range between the driest and wettest months is less than 10 per cent., mid-latitudes have nearly six times as large an area as low latitudes. This type comprises about 26 per cent. of the total land area of mid-latitudes, while it makes up only 3 per cent. of low latitudes. Other interesting comparisons come out on further study of these tables.

Such irregular rainfall distribution as has been mentioned in the foregoing pages is decidedly unfavourable to most kinds of land life, as well as to roads, buildings and many other works of man. But the foregoing aspects of tropical rainfall are not the only unfavourable ones. Another, although perhaps less important contrast between the rainfall régime of low and middle latitudes, is the rate of fall. While not strictly an illustration of undependability, nevertheless its effects are similar, for the beneficial results of rain vary sharply with the rate of fall. In general, in low latitudes much of the precipitation occurs during local thunderstorms and heavy falls occur suddenly. A few minutes after a downpour, the sun often shines hotly. In middle latitudes, on the other hand, a much larger proportion of the precipitation occurs in general rains, when for several hours or occasionally for several days, a gentle fall occurs. Therefore a larger percentage of the fall has time to soak into the ground in mid-latitudes than in low latitudes, and there is correspondingly less run-off and soil erosion. Hence in middle latitudes a larger share of the rainfall normally is available for the plants than in the tropics. Likewise, because of slower evaporation, less moisture is required.

(To be concluded)

Official Publications

The following publications have recently been issued :—

PROFESSIONAL NOTES—

No. 31. *The relation between the height reached by a pilot balloon and its ascending velocity.* By J. Wadsworth, M.A.

No. 32. *A note on the upper air observations taken in North Russia in* 1919. By W. H. Pick, B.Sc.

ADVISORY COMMITTEE ON ATMOSPHERIC POLLUTION. Eighth Annual Report; for the year ending March 31st, 1922.

Correspondence

To the Editor, *The Meteorological Magazine*

Symbols for Driftsnow

I AGREE entirely in the amplified definition of "Ice crystals in the air" given on page 111 of *The Meteorological Magazine* for June, 1923.

As to the meaning and use of the symbol −*→, I beg leave to express a different opinion, as this symbol in Sweden is used exclusively when snow is really falling, and days with −*→ are consequently reckoned amongst those with precipitation.

Westman introduced in his Observations at Treurenberg Bay, Spitzbergen, in 1899-1900, the symbol −A→ for driftsnow when no precipitation occurs, and this symbol was afterwards adopted by the Observatories at Vassijaure, 1905 to 1912, and Abisko since 1913. In Swedish we have different names for the two phenomena, viz.: *Snöyra*, precipitation, and *Yrsnö*, without precipitation, and thus the introduction of a new symbol has seemed quite natural to us.

I am aware that it is not always easy in Arctic regions to distinguish whether precipitation is produced or not, but when mountains are in the neighbourhood one has generally the possibility at moments to realize if there is −*→, or −A→ extending to several hundreds of metres upwards.

I should thus suggest, that −*→ be exclusively used when precipitation occurs, and −A→ introduced, or else this last phenomenon not be noted at all. BRUNO ROLF.

Meteorological Bureau, Stockholm 2, July 5th, 1923.

Something like a Rainfall

The *Report of the Saõ Paulo Railway* (Brazil) for 1922, tells of damage done to the Serra (or "mountain") section of the railway by abnormal rainfall in March of that year. During the period March 1st to 10th, the rainfall at the Alto da Serra was no less than 35·9 in., which constituted a record so far as the Railway Company's observations go. During the first three days of the period no less than 24·5 in. of rain fell.

Railway traffic was not interrupted during the first two days, and there was only a partial interruption on the third day. On the fifth day, however, a large slip took place above the Upper Inclines, and as a result some 4,000 tons of boulder and earth came down, which completely blocked the upper line. Various slips took place later on, necessitating somewhat extensive work in the construction of drains and retaining walls. The total cost directly and indirectly of these slips may be set down as approximately £25,000. JOHN MOORE.

40, *Fitz William Square, Dublin, August 4th*, 1923.

Vertical Visibility, Wind and Dust.

IN the July, 1923, issue of the *Meteorological Magazine* it is stated under the heading "The first Samples of Dust from the Upper Air," that "it will be seen that the stronger wind held by far the greater number of dust particles in suspension."

This confirms admirably a result very recently obtained by the present writers in an investigation on "The Vertical Visibility at Cranwell, Lincolnshire, from February, 1922, to June, 1923," described in a paper which it is hoped will be published shortly.

The result in question was obtained by comparing the wind velocity at a height of 2,000 feet with the vertical visibility prevailing and will be seen in the following table :—

Vertical Visibility and Wind Velocity at 2,000 feet.

Wind Velocity 2,000 ft.	No. of Cases.	Vertical Visibility (Percentages).				
		Excellent.	Good.	Fair.	Indifferent.	Bad.
Below 12 m.p.h. ...	31	20%	55%	16%	3%	6%
12—24 m.p.h. ...	70	24%	42%	27%	3%	4%
Above 24 m.p.h. ...	63	12%	38%	33%	5%	12%

The table shows that there is a progressive decrease in the sum of "excellent" and "good" vertical visibility from the low velocities to the high.

W. H. PICK.
S. P. PETERS.

R.A.F. (Cadet) College, Cranwell, Lincs., July 21st, 1923.

Hail at Nottingham

AFTER a very warm day (max. temp. 88° F.) a sudden sharp thunderstorm at 19h. G.M.T. on the 7th produced 0·49 in. of rain here in eight minutes. It was accompanied by hailstones, mostly flattened, half an inch in diameter and a quarter of an inch in thickness ; the largest I have seen here since September 3rd, 1916, when stones an inch in diameter fell. The thunderstorm in the early hours of July 10th was not so violent, but was of much greater duration, lasting five hours. Rain fell to a depth of 1·12 in.

ARNOLD B. TINN.

107, *Burford Road, Nottingham, July 31st,* 1923.

Pilot Balloons, Lightning and Oxides of Nitrogen.

It will be remembered that through the enterprise of Major J. M. MacLulich and Mr. H. Harries, advantage has been taken of the despatch of balloons from Brighton in connection with a local advertising scheme, and information of scientific interest has been obtained from time to time.

Recently Mr. Harries sent to the Meteorological Office a collapsed balloon with the following report:—

"At 10.45 a.m. on June 1st, 1923, balloons were sent off, under the impression that they would reach the north-west and west of France, but all the cards thus far returned show that they dropped in Sussex, Hants and Devon. Amongst them E.596, which descended at Braishfield, near Romsey, Hants, and was picked up at 5 p.m. on the 5th, the finder enclosing the card and the envelope to Major MacLulich by post, but making no statement as to the condition of the envelope. What is left of the latter is enclosed herewith for examination.

"You will see that while the neck of the balloon remains uninjured, it is still quite fresh, the whole of the rest of the rubber has perished; it is in a rotten state and crumbles between the fingers. Submitted to ordinary fire the edges of the rubber would have curled up, but that is not so in this case. Major MacLulich thinks the collapse was due to lightning, an electric discharge bursting it and imparting to it the burnt appearance. It looks like over-vulcanised rubber."

Principal Skinner of the Chelsea Polytechnic, who has been so good as to interest himself in the matter, writes as follows:—

"I gave the fragments of the rubber ballon that you sent to a student, Mr. A. S. Houghton, B.Sc., suggesting to him that the effect might be due to ozone. He found that the unchanged portion of the rubber round the neck was not bleached by ozone; and then he tried the action of the brown oxides of nitrogen produced from dilute nitric acid and a fragment of copper. He found the oxides of nitrogen bleached the rubber and made it brittle like the attacked part of the balloon. The rubber is rendered brittle, transparent and scaly. Assuming that the effect took place before the balloon reached the earth, it would appear that oxides of nitrogen could have produced the effect. Such oxides of nitrogen may have been formed in the air by electric discharges, as is well known."

It is somewhat unfortunate that the history of the balloon in question is not more definitely known; four days elapsed from the time it was despatched to the time it was picked up. It would be of interest to learn of any instances in which balloons are definitely known to have come down perished.

Meteorology on the Cairo to Baghdad Aerial Route.

A CHAIN of Royal Air Force Meteorological Stations extends from Aboukir, on the Mediterranean littoral, near Alexandria, to Baghdad, with the exception of a distance of 469 miles between Amman, situated 2,600 ft. above mean sea level, on the hills east of the Jordan Valley, and Ramadi on the Euphrates, there being no occupied aerodromes in this desert area. (Once a day at about 6 a.m. G.M.T. weather reports for Beirut, Damascus, Deir ez Zor, and Palmyra are received at Baghdad from the French Meteorological Service in Syria, which has arranged for their transmission by W/T from Beirut.)

The Royal Air Force stations are manned by personnel who carry on their normal flying and wireless duties in addition to meteorological work, and who have been locally trained by the Officers who took the meteorological course in England in 1920. Observations are taken three times a day at most stations, and pilot balloon ascents are made early each morning and also during the day when the aeroplanes are *en route*. A synoptic weather and upper wind report containing the observations from all R.A.F. stations in the area is broadcasted daily from Headquarters, Middle East, at 6h. 30m. G.M.T., and other supplementary reports are issued during the morning. In the evening the 18h. observations are broadcasted at about 18h. 45m. from the stations of the aerial route, and the collective message is passed by the station at Amman to 'Iraq. Whenever fog or storm conditions occur at any aerodrome all the other stations are immediately informed. Such warnings are followed by an "all clear" message as soon as the conditions referred to are passed.

The meteorological messages are passed from station to station by means of wireless, and continuous wireless touch is also maintained with all machines in the air so that pilots are kept constantly informed of the weather and upper wind conditions in the districts towards which they are flying. Delay in transmission of weather information is certain to lead to increased petrol consumption—for the most economical height is very variable—and delay under certain conditions may lead to loss of life in the districts towards which they are flying.

In going east from Cairo the machines follow a north-easterly course along the fringe of the Delta cultivation, cross the Suez Canal and from there strike a course for Ramleh, which is situated between Jerusalem and Jaffa. From Ismailia to Ramleh the route is never far from the sea coast. The distance between Cairo and Ramleh is only 266 miles, and at no point does the height above mean sea level exceed 270 ft.; yet the variation in the weather conditions in most months is great, *e.g.*, in January, 1922, 6mm. of rain fell at Heliopolis, 197 mm. at Ramleh. Such variation in rainfall and in corresponding cloud amount emphasises the importance to pilots of accurate and punctual weather reports. From Ramleh the machines proceed inland to Amman and thence across the desert to Baghdad. At Ramadi, the first station on the route in 'Iraq, information is provided in the form of ground signals.

In the 'Iraq area the "Shamal" blows during the summer months and precipitation in measurable quantities is unusual. In the winter, on the other hand, the weather is unsettled with considerable precipitation, and the ground winds variable, though the upper winds are definitely westerly, indeed of many hundreds of upper air observations near the Baghdad end of the route practically no single wind was observed at 10,000 ft. having an easterly component.

Thunderstorms occur occasionally in the winter season in lower Egypt, and heavy thunderstorms are not uncommon in 'Iraq during the spring transition period, 3 or 4 being the monthly average for both April and May.

An Open Scale Meteorograph

A METEOROGRAPH with very open scales has been constructed recently at Benson Observatory, primarily for use in determining the height of fogs. The record is made in ink on a drum turning once an hour. Three pens show, respectively, height above ground, relative humidity and temperature. The height recording pen is actuated by a battery of three aneroid boxes and multiplying levers; humidity is recorded by the centre pen, the hygrometer hairs being set fan-wise to ensure quick response to changes, and the temperature pen is controlled by a bi-metallic spiral of very thin metal. The hygrograph and thermograph are not intended to work to any great degree of accuracy but the altigraph is made as accurate as possible; the chart can be read to within 100 ft. or less to an upper limit of about 3,000 ft.

A photograph of the instrument is reproduced on the plate facing page 166. The method of operation is to sling freely by means of a piece of elastic several yards long, fastened at one end to the cross bar of the instrument and at its upper end to the neck of a small captive balloon. The oval wire guard is provided to prevent damage or disturbance to the working parts. A balloon of about 5 feet in diameter is required, and the procedure recommended is to send the balloon conveying the meteorograph up to a considerable height as quickly as possible and to haul it in slowly.

Dr. T. Royds has been appointed Director of the Kodaikanal and Madras Observatories in succession to Mr. J. Evershed, who retired on February 25th, 1923, after thirteen years service.

The Calibration of the Dines Balloon Meteorograph

THE standard method of calibration of the Balloon Meteorograph designed by Mr. W. H. Dines is described in the *Computers' Handbook*, Section II., Sub-section 2, 1916. The meteorograph is placed in a cylinder half filled with petrol, the temperature of which can be controlled ; when the pressure inside this cylinder is appropriate a jerk is given to the instrument by means of a small hammer actuated by an electro-magnet placed below the floor of the cylinder. The drawback to this method is that the mark made by the scratching point on the electroplated sheet is rather fuzzy.

An improvement has recently been devised by Mr. L. H. G. Dines. In building the meteorograph he fixes an arm about 1¼ inches long at right angles to, and near the bottom of, the invar rod, which is one element of the bimetallic thermometer. When the instrument is to be calibrated a special light armature is hung from this arm. It takes the form of a thin strip of sheet iron which hangs horizontally about 1mm. above the floor of the cylinder. It is backed with a piece of cork such that the whole floats in petrol in neutral equilibrium, and therefore normally puts no strain on any part of the meteorograph.

When the magnet beneath the floor is "energised" the arm is pulled and the couple set up in the invar rod bends it slightly. The result is a very small relative motion between the rod and the german silver strip, and a corresponding movement of the scratching point. The mark made on the plate is sharp, and the record is more accurately deciphered than under the old system.

The Distribution of Forecasts by Telephone

As was mentioned in the *Meteorological Magazine* for May, 1923, *p.* 83, new facilities for the distribution of forecasts by telephone have been provided by the Post Office since May 1st. It is only necessary for telephone subscribers to ring up the operator at the local exchange at or after 5 p.m. to obtain the forecast for the following night and day. No charge is made beyond the local call fee.

We are informed that the number of calls for forecasts during May, the first month in which the system was in force, was approximately 10,350. So far as comparison can be drawn, the facility, in accordance with its purpose, has been utilised more freely by the subscribers in the rural areas than by those in areas which are primarily industrial. The advantages to the farmer of a forecast at such an hour as 5 p.m. are manifest especially at times when there is a risk of frost, and it is anticipated that as the system becomes better known its use will become general.

The Production by Lightning of a Shadow-Picture on Bare Boards

DURING the storm of July 9th—10th a remarkable "photograph" of a waste-paper basket was made by lightning on the floor of a Mincing Lane office, that of Messrs. Thompson Bros. & Co.

The impression had made on bare, unpolished, ordinary flooring boards, and consists of a bleached image of the basket, which was apparently lying across the boards with its open end roughly towards south. The direction of the length of the boards is about perpendicular to Mincing Lane and Mark Lane.

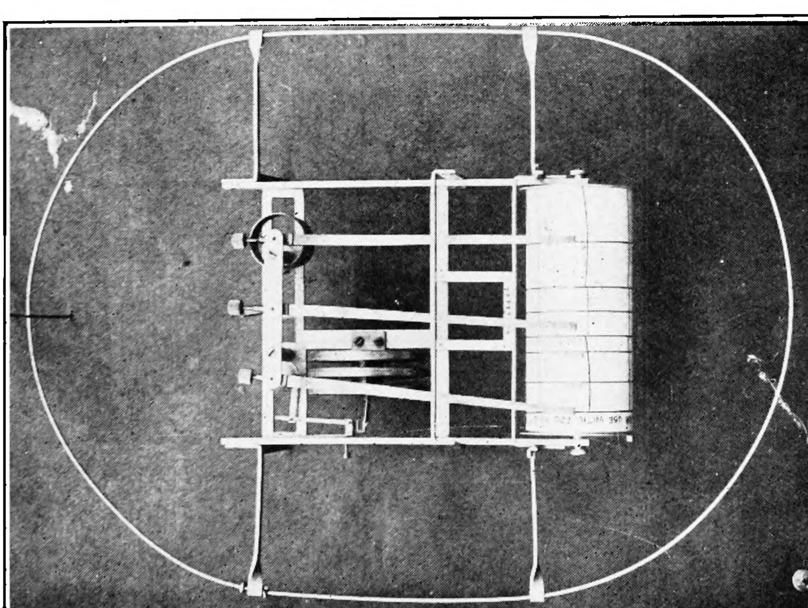
The discovery was made next morning by the staff as they entered the door of the office. The cleaners had been in previously and had disturbed everything but had apparently not noticed the impression. They could not recollect anything definite about the position of the basket when they first entered the office. So far as could be seen, no other similar image was obtained of any other object. The waste-paper basket is of the ordinary wicker type, very old and begrimed, otherwise calling for no remark.

The roof is of clear glass, some 14 or 15 feet high. On each side running parallel to Mark Lane and Mincing Lane are very tall blocks of buildings, and the room in which the impression was made is on the ground floor, in fact, it is merely part of the space between the buildings roofed over. The firm being rice merchants and samples being handled continually, no doubt much rice is trampled on the floor.

The impression had the appearance of a photographic print of the waste-paper basket lying on its side on a piece of photographic paper, as might be obtained by means of a point source of light nearly directly overhead, but perhaps slightly towards the south. It was so clear and unblurred that it is not likely that the same effect would be obtained if the "printing" were repeated, unless the source of light were in substantially the same position every time. The boards carrying the "photograph" have been cut out and are now in the Science Museum. Unfortunately the image seems to be fading. Our illustration is from a photograph taken at the Museum and reproduced by the courtesy of the Director. Photographs taken *in situ* show the image rather more distinctly but with exaggerated perspective. As will be noticed in the illustration opposite images of the ribs (apparently the ribs nearest the ground) can be seen as well as the complete images of the rim, the girdle and the bottom of the basket.

The image is seen most distinctly with oblique lighting. It can not be detected, however, when the wood is examined at close quarters with a lens.

A SHADOW-PICTURE PRODUCED BY LIGHTNING.



AN OPEN SCALE METEOROGRAPH.

It should also be placed on record that the spot where the image appeared was such a centre of traffic that the possibility of the picture being work that an idle hand could have done seems to be excluded. The principals of Messrs. Thompson Bros. are convinced of the genuineness of the phenomenon.

Brazilian Meteorological Service, 1921-1923

A REPORT which has recently been issued by Dr. Sempaio Ferraz, Director of the Brazilian Meteorological Service, shows the rapid progress which has been made in the development of the service since its reorganisation in June, 1921. Previous to that date, there were 97 second and third order climatological stations, and 57 rainfall and co-operative stations. These numbers have now been increased to 152 and 237, respectively. The inspection of stations, which was very seldom done before 1921, is now actively carried out all over the country. Year-books have been published for each of the years 1911-1918, and a book of Normals issued.

The forecast service, which was almost non-existent prior to 1921, is now showing great activity. Daily forecasts for the Southern States, based on synoptic data from 80 stations in Brazil, 18 in the Argentine and 6 in Uruguay, are distributed from Rio de Janeiro and St. Paulo. Two additional distributive centres are to be established this year in St. Catherina and Parana. A storm signal service is in operation along the coast, and every four hours the coastal radio stations, 12 in number, broadcast the weather at the time. In the large towns, flags are used to indicate the anticipated weather changes. Upper air work is carried out at 7 pilot balloon stations, and 2 kite stations are being constructed. The work, however, is much hampered by the difficulty of transporting hydrogen to the aerological stations. A flood service for the Parahyba River has been inaugurated and a similar service is being arranged for the Amazon, where floods occasion considerable destruction amongst cattle. All the leading newspapers now publish a ten-days bulletin, giving the condition of the most important crops and pasture lands and how they have been affected by the weather. Our readers will also remember the special telegram from Brazil, which is published each month in this magazine, at the end of the notes on the weather.

Exposure of Thermometers in India

THE results of an investigation of the merits of different thermometer screens, conducted by Mr. J. H. Field, at Agra, are summarised in a memoir "on exposures of thermometers in India," recently published by the Indian Meteorological Department. It is announced that "it has now been decided to replace as opportunity offers the expensive open shed, which has so long been the standard in this country, by some form of Stevenson screen, and thus to secure truer records, immunity from the effects of changing environment and all the advantages of economy."

News in Brief

The *Philosophical Magazine* for July, 1923, contains a paper by Dr. Harold Jeffreys on *The effect of a steady wind on the sea-level near a straight shore.* The way in which high tides occur after persistent on-shore or along-shore wind is a subject of great interest to meteorologists, and it is a matter for congratulation that mathematical analysis has now been applied to the problem.

Mr. L. G. H. Lee, headmaster of Park Street Council School, Raunds, Wellingborough, has received an appointment as one of His Majesty's Inspectors of Schools. Mr. Lee, who has maintained a meteorological station at Raunds since 1904 and served in the Meteorological Section of the Royal Engineers from 1915 to 1919, has introduced weather study into the curriculum of the older boys with great success.

The Weather of July, 1923

WESTERLY winds with mainly overcast skies and a temperature slightly below normal prevailed during the first few days of the month, but after the 4th the continental anticyclone spread north-westwards and the weather over the British Isles became fine and sunny with high day temperatures and warm nights. Maxima of 90° F. and over were recorded locally in south and east England and in the Midlands on the 6th, 7th and 11th, but were more general on the 12th and 13th when some records were broken, *e.g.*, 85° F. on the 12th was the highest maximum ever registered at Falmouth Observatory; actually the highest temperature recorded during the month was 96° F. at Camden Square, London. The nights also were remarkably warm during this hot spell, the temperature at Westminster, not falling below 70° F. throughout the night of the 12th to 13th. At Kew Observatory, Lympne, and even at Tavistock on the edge of Dartmoor, 845 ft. above mean sea level the minimum tempera-ture for the same night was 68° F.

Thunderstorms developed in the west and north about the 6th and continued at times throughout the following week. On the 8th, floods associated with a severe thunderstorm caused considerable damage at Carrbridge, Inverness; while on the night of the 9th to 10th the storms lasted throughout the night in London and the neighbouring counties, only passing northwards on the morning of the 10th. Heavy rainfalls were associated with these thunderstorms, some of the heaviest falls being 81 mm. at Seaford, 65 mm. at Hampstead 52 mm. at Kew on the night 9th to 10th and 34 mm. at Ross-on-Wye on the 13th, when there was a rapid drop of temperature of 18° in twenty minutee.

After the middle of the month depressions from the Atlantic spread further south across the British Isles, causing cooler, cloudier weather with much rain at times and occasionally strong westerly winds on exposed parts of the coast.

During the first halt of the month, western Europe was visited by a " heat wave." In Holland, where it lasted nearly a fortnight, 150 deaths from heat occurred, while grass fires, due to the high temperature, were reported from several parts of Italy. Between the 14th and 17th thunderstorms caused much damage to crops in Switzerland, floods occurred in several cantons and some lightning casualties were reported. The wheat harvest in France promises to be very good, and in Greece the yield is reported as excellent, in some parts surpassing that of last year by 130 per cent. The Rumanian crops are also satisfactory.

Plentiful rains are reported from the upper districts of the Yemen, south-western Arabia.

At the beginning of the month much anxiety was felt with regard to the crops in India, for there had been a prolonged break in the monsoon. During the next few days, however, Bombay experienced torrential rains, the greatest fall being 12 inches in 24 hours. By the 18th sufficient rains had fallen in western India and good cotton and rice crops are now expected. The grain crops are late, however, and a satisfactory yield is doubtful. Considerable damage by floods was reported from Mysore on the second week of July.

Rainfall was on the whole above normal in Western Australia, Queensland and Tasmania, and below normal in South Australia, New South Wales and Victoria.

A violent storm visited Uruguay about the middle of the month, five lives were lost and much damage was done in Monte Video. The special message from Brazil states that raintall in the south was 20 mm. above normal but irregular and generally below normal in the north and scanty in the central districts, 22 mm. below normal. Temperature was below normal on the whole and mild frosts were experienced in the South, causing some damage to the coffee crops.

Rainfall July, 1923 : General Distribution

England and Wales	103	per cent.	of the average	1881-1915
Scotland	112	,,	,,	,,
Ireland	92	,,	,,	,,
British Isles	103	,,	,,	,,

Rainfall Table for July, 1923

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent. of Av.
Lond.	Camden Square.......	3·24	82	136	*Leics*	Leicester Town Hall...	3·55	90	...
Sur .	Reigate, Hartswood...	3·19	81	...	,, .	Belvoir Castle........	3·91	99	161
Kent.	Tenterden, View Tower	·56	14	27	*Rut* .	Ridlington...........	3·64	93	...
,, .	Folkestone, Boro. San.	·59	15	...	*Linc*.	Boston, Skirbeck	2·11	54	96
,, .	Broadstairs	...	..	...	,, .	Lincoln, Sessions House	3·97	101	179
,, .	Sevenoaks, Speldhurst.	1·96	50	...	,, .	Skegness, Estate Office.	...	..	...
Sus .	Patching Farm.......	1·58	40	66	,, .	Louth, Westgate	3·81	97	152
,, .	Eastbourne, Wilm. Sq.	3·20	81	146	,, .	Brigg	2·96	75	127
,, .	Tottingworth Park....	2·45	62	98	*Notts*.	Worksop, Hodsock....	3·03	77	...
Hants	Totland Bay, Aston...	1·35	34	70	*Derby*	Mickleover, Clyde Ho..	6·14	156	251
,, .	Fordingbridge, Oaklnds	·80	20	40	,, .	Buxton, Devon. Hos...	...	..	...
,, .	Portsmouth, Vic. Park.	·75	19	37	*Ches*.	Runcorn, Weston Pt...	4·32	110	157
,, .	Ovington Rectory	1·18	30	46	,, ..	Nantwich, Dorfold Hall	3·38	86	...
,, .	Grayshott	1·53	39	63	*Lancs*	Bolton, Queen's Park .	4·87	124	...
Berks	Wellington College...	1·51	38	73	,, ..	Stonyhurst College....	6·10	155	158
,, .	Newbury, Greenham..	1·52	39	68	,, ..	Southport, Hesketh...	2·93	74	102
Herts.	Bennington House....	2·77	70	114	,, ..	Lancaster, Strathspey.	4·48	114	...
Bucks	High Wycombe	2·26	57	115	*Yorks*	Sedbergh, Akay	6·76	172	151
Oxf..	Oxford, Mag. College..	1·36	35	60	,, .	Wath-upon-Dearne ...	3·82	97	152
Nor .	Pitsford, Sedgebrook..	3·44	87	146	,, .	Bradford, Lister Pk...	3·25	83	118
,, .	Eye, Northolm.......	2·89	73	...	,, .	Oughtershaw Hall	6·01	153	...
Beds.	Woburn, Crawley Mill.	3·53	90	150	,, .	Wetherby, Ribston H..	2·95	75	118
Cam.	Cambridge, Bot. Gdns.	2·09	53	97	*ERY*	Hull, Pearson Park ...	2·83	72	121
Essex	Chelmsford, CountyLab	1·01	26	...	,, .	Holme-on-Spalding ...	5·12	130	...
,, .	Lexden, Hill House...	1·72	44	...	,, .	Lowthorpe, The Elms.	2·59	66	113
Suff .	Hawkedon Rectory ...	1·62	41	66	*NRY*	West Witton, Ivy Ho..	2·79	71	...
,, .	Haughley House......	1·81	46	...	,, .	Pickering, Hungate ...	4·56	116	...
Norf.	Beccles, Geldeston....	3·34	85	143	,, .	Middlesbrough	2·29	58	89
,, .	Norwich, Eaton	3·30	84	127	,, .	Baldersdale, Hury Res.	2·76	70	89
,, .	Blakeney	2·66	68	118	*Durh*.	Ushaw College	1·76	45	63
,, .	Swaffham	2·81	71	110	*Nor* .	Newcastle, Town Moor.	2·77	70	105
Wilts.	Devizes, Highclere....	·89	23	...	,, .	Bellingham Manor....	2·59	66	...
Dor .	Evershot, Melbury Ho.	1·13	29	45	,, .	Lilburn Tower Gdns...	1·50	38	...
,, .	Weymouth, Westham..	.86	22	48	*Cumb*	Penrith, Newton Rigg..	2·67	68	93
,, .	Shaftesbury, Abbey Ho.	1·62	41	63	,, .	Carlisle, Scaleby Hall .	2·36	60	72
Devon	Plymouth, The Hoe...	·89	23	32	,, .	Seathwaite	9·20	234	109
,, .	Polapit Tamar	1·60	41	59	*Glam*.	Cardiff, Ely P. Stn.....	2·27	58	73
,, .	Ashburton, Druid Ho..	1·29	33	42	,, .	Treherbert, Tynywaun	5·76	146	...
,, .	Cullompton	1·45	37	54	*Carm*	Carmarthen Friary....	2·82	72	80
,, .	Sidmouth, Sidmount ..	1·03	26	41	,, .	Llanwrda, Dolaucothy.	3·88	99	89
,, .	Filleigh, Castle Hill ...	2·71	69	...	*Pemb*	Haverfordwest, Portf'd	...	..	...
,, .	Hartland Abbey......	3·08	78	...	*Card*.	Gogerddan...........	5·43	138	...
Corn.	Redruth, Trewirgie ...	1·23	31	40	,, .	Cardigan, County Sch. .	2·20	56	...
,, .	Penzance, Morrab Gdn.	1·19	30	44	*Brec* .	Crickhowell, Talymaes	3·00	76	...
,, .	St. Austell, Trevarna..	·94	24	28	*Rad* .	Birm. W. W. Tyrmynydd	4·63	118	113
Som	Street, Hind Hayes ...	1·52	39	...	*Mont*.	Lake Vyrnwy	4·39	111	128
Glos..	Clifton College	3·00	76	106	*Denb*.	Llangynhafal	2·77	70	...
,, .	Cirencester	1·94	49	73	*Mer* .	Dolgelly, Bryntirion..	7·93	201	186
Here.	Ross, County Obsy. ...	2·76	70	123	*Carn*.	Llandudno	2·22	56	93
,, .	Ledbury, Underdown.	4·05	103	179	,, .	Snowdon, L. Llydaw 9	12·95	329	...
Salop	Church Stretton......	2·67	68	109	*Ang* .	Holyhead, Salt Island.	2·95	75	113
,, .	Shifnal, Hatton Grange	4·54	115	202	,, .	Lligwy	3·28	83	...
Staff.	Tean, The Heath Ho...	5·55	141	191	*Man*.	Douglas, Boro' Cem...	...	..	...
Worc.	Ombersley, Holt Lock.	2·22	56	104	*Guer*.	St. Peter Port, Grange.	1·87	48	93
,, .	Blockley, Upton Wold.	2·78	71	114	*Wigt*.	Stoneykirk, Ardwell Ho	3·34	85	115
War	Farnborough.........	2·81	71	110	,, .	Pt. William, Monreith .	3·51	89	...
,, .	Birminghm, Edgbaston	4·30	109	185	*Kirk*.	Carsphairn, Shiel.	6·48	165	...

Rainfall Table for July, 1923—*continued*

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent. of Av.
Kirk.	Dumfries, Cargen	4·38	111	135	*Caith*	Loch More, Achfary	8·20	208	153
Dum	Drumlanrig	5·93	151	173	,,	Wick	2·75	70	105
Roxb	Branxholme	2·09	53	69	*Ork*	Pomona, Deerness	3·11	79	121
Selk	Ettrick Manse	4·66	118	...	*Shet*	Lerwick	1·87	47	82
Berk	Marchmont House	1·80	46	59	*Cork*	Caheragh Rectory	3·22	82	...
Hadd	North Berwick Res.	1·15	29	45	,,	Dunmanway Rectory	2·83	72	73
Midl	Edinburgh, Roy. Obs.	2·85	72	109	,,	Ballinacurra	2·45	62	88
Lan	Biggar	3·96	101	137	,,	Glanmire, Lota Lo.	3·01	77	104
Ayr	Kilmarnock, Agric. C.	3·69	94	119	*Kerry*	Valencia Obsy.	...	..	...
,,	Girvan, Pinmore	5·03	128	138	,,	Gearahameen	4·20	107	...
Renf.	Glasgow, Queen's Pk.	3·70	94	127	,,	Killarney Asylum	2·51	64	76
,,	Greenock, Prospect H.	4·76	121	121	,,	Darrynane Abbey	3·54	90	93
Bute	Rothesay, Ardencraig	5·09	129	129	*Wat*	Waterford, Brook Lo.	2·21	56	68
,,	Dougarie Lodge	3·90	99	...	*Tip*	Nenagh, Cas. Lough	3·58	91	114
Arg	Glen Etive	6·92	176	...	,,	Tipperary	3·33	85	...
,,	Oban	4·60	117	...	,,	Cashel, Ballinamona	2·57	65	89
,,	Poltalloch	6·32	161	155	*Lim*	Foynes, Coolnanes	3·76	96	122
,,	Inveraray Castle	...	..	...	,,	Castleconnell Rec.	5·03	128	...
,,	Islay, Eallabus	5·62	143	165	*Clare*	Inagh, Mount Callan	7·29	185	...
,,	Mull, Benmore	8·20	208	...	,,	Broadford, Hurdlest'n.	5·06	129	...
,,	Mull, Quinish	5·76	146	142	*Wexf*	Newtownbarry	2·41	61	...
Kinr.	Loch Leven Sluice	2·13	54	74	,,	Gorey, Courtown Ho.	2·37	60	81
Perth	Loch Dhu	5·95	151	123	*Kilk.*	Kilkenny Castle	2·06	52	73
,,	Balquhidder, Stronvar	...	..	...	*Wic*	Rathnew, Clonmannon	2·21	56	...
,,	Crieff, Strathearn Hyd.	2·90	74	98	*Cars.*	Hacketstown Rectory	3·39	86	98
,,	Blair, Castle Gardens	2·75	70	...	*QCo.*	Blandsfort House	2·42	61	77
,,	Coupar Angus School	1·89	48	80	,,	Mountmellick	2·24	57	...
Forf.	Dundee, E. Necropolis	3·02	77	110	*KCo.*	Birr Castle	2·87	73	97
,,	Pearsie House	1·90	48	...	*Dubl.*	Dublin, FitzWm. Sq.	2·52	64	98
,,	Montrose, Sunnyside	2·11	54	80	,,	Balbriggan, Ardgillan	2·62	67	97
Aber.	Braemar Bank	2·22	56	87	*W.M*	Athlone, Twyford	...	..	...
,,	Logie Coldstone Sch.	2·01	51	68	,,	Mullingar, Belvedere	3·12	79	98
,,	Aberdeen, Cranford Ho	2·31	59	78	*Long*	Castle Forbes Gdns.	1·77	45	57
,,	Fyvie Castle	2·89	73	...	*Gal*	Galway, Waterdale	4·78	121	...
Mor	Gordon Castle	1·49	38	47	,,	Woodlawn	...	..	...
,,	Grantown-on-Spey	3·09	79	101	*Mayo*	Crossmolina, Enniscoe	4·50	114	124
Na	Nairn, Delnies	2·03	51	76	,,	Mallaranny	5·81	147	...
Inv.	Ben Alder Lodge	4·12	105	...	,,	Westport House	2·21	56	71
,,	Kingussie, The Birches	2·61	66	...	,,	Delphi Lodge	7·80	198	...
,,	Fort Augustus	2·83	72	101	*Sligo*	Markree Obsy.	2·60	66	60
,,	Loch Quoich, Loan	11·00	279	...	*Ferm*	Enniskillen, Portora	1·98	50	...
,,	Glenquoich	9·04	230	141	*Arm.*	Armagh Obsy.	2·22	56	61
,,	Inverness, Culduthel R.	1·81	46	...	*Down*	Warrenpoint	2·24	57	...
,,	Arisaig, Faire-na-Squir	6·13	156	...	,,	Seaforde	2·56	65	80
,,	Fort William	8·63	219	178	,,	Donaghadee	3·19	81	96
,,	Skye, Dunvegan	4·27	109	...	,,	Banbridge, Milltown	2·81	71	86
,,	Barra, Castlebay	2·24	57	...	*Antr.*	Belfast, Cavehill Rd.	2·83	72	...
R&C	Alness, Ardross Cas.	3·50	89	116	,,	Glenarm Castle	2·33	59	...
,,	Ullapool	4·37	111	...	,,	Ballymena, Harryville	3·61	92	105
,,	Torridon, Bendamph	6·71	170	124	*Lon.*	Londonderry, Creggan	3·81	97	104
,,	L. Carron, Plockton	5·32	135	...	*Tyr.*	Donaghmore	2·97	75	...
,,	Stornoway	3·78	96	125	,,	Omagh, Edenfel	3·72	95	109
Suth.	Dunrobin Castle	3·44	87	120	*Don.*	Malin Head	3·79	96	133
,,	Lairg	3·08	78	...	,,	Letterkenny Hos	3·02	77	86
,,	Forsinard	...	..	...	,,	Dunfanaghy	...	..	...
,,	Tongue Manse	3·53	90	115	,,	Narin, Kiltoorish	3·21	81	...
,,	Melvich School	4·26	108	152	,,	Killybegs, Rockmount	5·75	146	131

Climatological Table for the British Empire, February, 1923

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 (mm.)	PRECIPITATION: Diff. from Normal (mm.)	PRECIPITATION: Days	BRIGHT SUNSHINE: Hours per day	BRIGHT SUNSHINE: Percentage of possible
London, Kew Obsy.	1003.1	−12·9	55	27	48·3	38·7	43·5	+3·4	41·9	87	7·5	71	+32	22	1·8	18
Gibraltar	1021·7	+2·9	67	44	62·2	50·9	56·5	0·0	52·1	77	5·2	56	−51	10	...	...
Malta	1013·0	−2·0	62	47	58·3	51·2	54·7	0·0	51·1	85	6·2	96	+45	17	5·2	48
Sierra Leone	1011·3	+0·3	92	72	89·5	74·6	82·1	−0·2	74·2	65	5·1	1	−6	1	...	...
Lagos, Nigeria	1010·0	−0·1	91	73	89·0	76·3	82·7	+0·6	78·3	75	6·7	31	−20	2	...	...
Kaduna, Nigeria	1013·1	+1·1	95	52	89·8	60·4	75·1	−3·1	56·2	32	0·4	0	−5	0	...	...
Zomba, Nyasaland	1007·3	−0·5	87	61	81·0	65·3	73·1	+1·4	...	89	8·4	240	−36	20	...	...
Salisbury, Rhodesia	1007·0	−2·9	85	55	78·6	59·4	69·0	+0·1	63·8	78	7·3	284	+102	20	...	...
Cape Town	1013·3	−0·1	100	49	81·3	59·5	70·4	+0·4	65·3	65	2·8	4	−11	5	...	...
Johannesburg	1011·4	+0·3	86	50	77·0	56·3	66·7	+1·3	58·4	75	5·7	142	+12	11	7·8	60
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Calcutta, Alipore Obsy.	1012·1	−1·2	88	55	80·4	62·4	71·4	+0·4	63·0	84	5·0	93	+64	*7	...	...
Bombay	1011·7	−0·9	90	63	82·6	68·5	75·5	−0·1	65·2	70	2·0	1	0	*0	...	...
Madras	1011·8	−1·1	88	63	85·3	69·7	77·5	−0·2	72·9	82	2·8	0	−8	*0	...	...
Colombo, Ceylon	1010·6	0·0	91	65	87·4	70·4	78·9	−1·7	75·2	63	3·0	0·3	−53	1	...	...
Hong Kong	1016·6	−2·2	79	46	63·8	55·0	59·4	+0·3	54·3	72	7·6	10	−33	8	3·7	32
Sandakan	...	...	88	73	86·3	75·3	80·8	+0·7	76·3	80	...	191	−53	10	...	...
Sydney	1015·8	+1·8	102	59	79·8	65·2	72·5	+1·3	66·0	67	4·8	12	−104	5	7·3	54
Melbourne	1016·7	+2·2	106	50	76·9	56·5	66·7	−0·7	60·2	58	3·7	15	−29	5	9·0	64
Adelaide	1015·6	+1·3	108	54	91·1	63·5	77·3	+3·2	61·1	35	2·8	2	−15	1	10·4	78
Perth, W. Australia	1013·8	+0·7	107	55	86·9	64·4	75·7	+1·7	65·0	53	3·1	0	−12	0	8·0	61
Coolgardie	1012·3	−0·2	110	55	95·6	65·5	80·5	+4·5	65·8	31	4·9	0	−19	0	...	...
Brisbane	1014·5	+2·3	99	62	85·9	68·5	77·2	+0·7	71·5	65	4·0	18	−147	5	9·2	71
Hobart, Tasmania	1014·2	+0·7	83	45	69·8	51·8	60·8	−1·6	53·7	58	5·7	19	−18	11	7·7	55
Wellington, N.Z.	1009·5	−5·8	74	45	68·2	55·3	61·7	−0·7	...	70	5·7	37	−46	14	7·1	52
Suva, Fiji	1007·7	0·0	91	73	85·7	75·5	80·6	+0·1	78·5	89	7·4	403	+146	25	...	...
Kingston, Jamaica	1016·9	+1·2	89	64	86·0	66·9	76·5	0·0	...	69	4·5	5	−10	4	...	...
Grenada, W.I.	1015·8	+2·4	85	67	81·9	71·0	76·5	−0·5	70·9	72	4·9	58	−14	22	...	...
Toronto	1020·2	+2·2	43	−5	26·6	11·0	18·8	−2·9	15·5	54	1·9	27	−39	18	...	...
Winnipeg	1022·7	+0·9	38	−33	10·3	−9·1	0·6	+1·2	−1·0	...	3·8	26	+6	6	...	...
St. John, N.B.	1015·6	+1·5	35	−12	19·4	3·1	11·3	−8·6	9·3	...	4·9	52	−47	8	...	...
Victoria, B.C.	1025·2	+9·3	51	11	42·3	32·9	37·6	−2·7	35·2	85	7·0	31	−59	8	...	...

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

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The East-west Oscillation of the Icelandic Minimum as shewn by Monthly Pressure Charts

By C. E. P. BROOKS, M.Sc.

CHARTS of the normal pressure distribution during any month or for the year show a well-marked minimum in the neighbourhood of Iceland and a maximum south of the Azores. Examination of a series of average charts for separate months shows, however, that both these "action centres" are subject to considerable variations of position from time to time; the Icelandic minimum shows the greatest variation in this respect. Since the position of the Icelandic minimum in any month is of great importance as an indication of the frequency and paths of depressions during that month, its movements have been the subject of several investigations,* especially by W. Meinardus and J. Petersen, who have developed the hypothesis that the position of the minimum is controlled by a "self-regulating mechanism," which in its simplest form may be described as follows. If in any month the Icelandic minimum lies westward of its normal position, say over Davis Strait, the isobars will have a more north-easterly trend than usual and the south-west winds between Iceland and north-west Europe

* MEINARDUS, W. Der Zusammenhang des Winterklimas im Mittel- und Nordwesteuropa mit dem Golfstrom. *Zs. Ges. Erdkunde, Berlin*, 1898, *p.* 195.

PETERSEN, J. Unperiodische Temperaturschwankungen im Golfstrom und deren Beziehung zu der Luftdruckverteilung. *Ann. Hydrogr., Berlin*, 38, 1910, *p.* 397.

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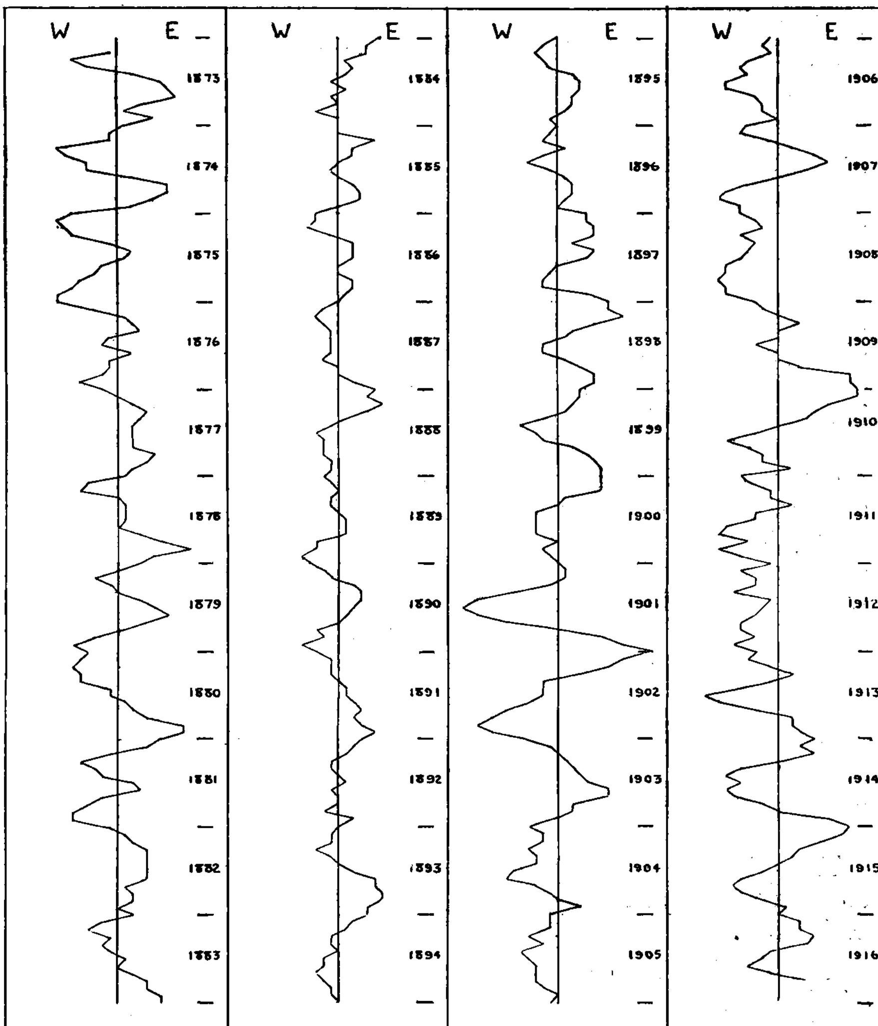
will be frequent and steady. These winds besides being themselves warm, will tend to accelerate the Gulf Drift and will consequently raise the temperature of the surface waters of the north-eastern part of the North Atlantic. This warm water will, after a time, warm the air above it and lower the pressure, drawing the Icelandic minimum eastwards and also causing it to become deeper. This process will still further increase the velocity and temperature of the Gulf Drift, but it will also cause northerly winds to the west of the minimum. These northerly winds will accelerate the cold Labrador current, and after a time will bring large quantities of ice and cold water into the North Atlantic off Newfoundland. These, finding their way into the Gulf Drift, will cool its surface waters somewhat. Carried along by the drift, the cold water will eventually reach the north-eastern Atlantic. Pressure in that region will rise again and the Icelandic minimum will be driven westwards to Davis Strait, when the process will recommence.

The easiest way to test the reality of this cycle is by a study of pressure charts, and the results of such a test are described below. First, however, we must have some estimate of the time required for the cycle to complete itself. This can best be found by considering the velocities of the various ocean currents involved. With the Icelandic minimum over Davis Strait the warming up process in the north-eastern Atlantic will begin almost immediately, and we may assume that it reaches its maximum when the water, initially off the Newfoundland Banks, reaches the Shetland Islands. The distance is about 1,800 nautical miles and the average speed is about 12 miles a day, so that the process normally takes about 150 days or five months. Before the process is completed the Labrador current will already be strengthened, and, as it normally takes less than three months for this current to travel from 69° N to 53° N, it seems probable that with an accelerated speed the influx of cold water and ice into the North Atlantic will commence soon after the time when the Icelandic minimum reaches its most easterly position. The cold water takes about 150 days to reach the north of Scotland and complete the cycle. Thus we find by calculation an average period of ten or eleven months to be required for the changes involved, but, since the wind-driven ocean currents are subject to great variations from time to time, the period may be much shorter or longer in individual cycles.

Since the cycle sought is of the order of a year, and there is already an annual variation in the position of the Icelandic minimum due to seasonal causes, the latter must be eliminated. This is done by employing charts of differences from normal instead of actual pressure values. The most convenient unit is the month. Monthly charts of deviation of pressure from normal over the northern hemisphere for the years 1873 to 1900 have recently been drawn at the Meteorological Office, mainly

FIG. I.



East-West Oscillations of the Icelandic Pressure Minimum.

from the data in the two collections* by Wl. Gorczynski and the U.S. Weather Bureau, and charts for the whole globe for the

* GORCZYNSKI, WL. Pression atmosphérique en Pologne et en Europe. *Warszawa*, 1910.

WASHINGTON U.S. DEPT. AGRIC., WEATHER BUREAU. Report on the barometry of the United States, Canada and the West Indies. *Report* 1900-01, *pt.* 2. *Washington*, 1902.

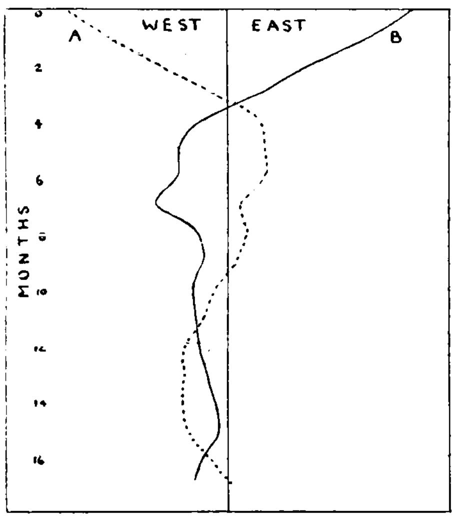
years 1910 to 1916 have been drawn in connection with the *Réseau Mondial.* Monthly charts of the Icelandic region for the years 1901 to 1909 were specially drawn, thus making a series of 44 years, or 528 monthly maps, available for the study. These charts were examined and a number ranging from -4 to $+4$ was assigned to each according to the position and intensity of the Icelandic minimum, -4 indicating that the minimum was well developed and lay over Davis Strait and $+4$ that it was well developed and lay off the coast of Europe. Where the minimum was divided, or there was no evidence of displacement, 0 was entered : in less neutral cases intermediate values were assigned. When these figures were plotted there were some indications of the movement sought, but they were largely masked by irregular fluctuations from month to month. It was evident that the month was too short a unit, so the figures were formed into overlapping sums of four months, giving a scale of -16 to $+16$, and an east-west motion at once became apparent over a large part of the period (Fig. 1). Thus it seems probable that the theoretical cyclical variation in the position of the Icelandic minimum occurs to some extent. In the whole period there are 43 complete oscillations with an average length of 12.1 months, but the individual length varied from 5 to 21 months. Measuring the intervals between successive easterly maxima and successive westerly maxima separately we have 86 values distributed as follows :

Length in months	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Frequency	3	3	1	7	8	8	11	13	7	3	5	4	6	1	2	2	2

There is a well-marked crest at 11 to 12 months and a lesser crest at 15 to 17 months, but the minimum at 14 months may be accidental.

The persistence of an interval of twelve months after the elimination of the annual variation is rather curious. Over the whole period the average values of the individual months in no case exceed 1 on the scale of -16 to $+16$, but when shorter intervals are considered there is a tendency for easterly or westerly maxima to recur at the same season in successive years. Thus from 1873 to 1883 the chief easterly maxima fall mainly between August and December and the westerly maxima between January and April : the same applies to the years 1889 to 1896, though in this period the cycle was much less pronounced. On the other hand the easterly maxima generally occurred in the early months and the westerly maxima in the later months from 1884 to 1888, 1897 to 1902 and 1910 to 1916. Thus there seems to be a more or less regular recurrence of the same phase of the cycle at about the same times in successive years, alternating with occasional almost complete reversals, and it is suggested that this is due to some form of seasonal control, probably to the fact that the Icelandic minimum is poorly developed from May to August and consequently extremes of its easterly or westerly development are least frequent in these months. On the other hand, there is probably no real periodicity underlying the whole series. On the whole, in the first half of the series (up to 1895) the westerly maxima occur in the early months and the easterly maxima in the later months, while in the second half this distribution is reversed. When the Icelandic minimum lies near the European coast we should expect heavier rainfall in the British Isles than when it lies west of Greenland, and this is borne out by the rainfall data:

FIG II.



Average position of Icelandic minimum following maximum displacements to the West (A) and East (B).

Years	1881–85	1886–90	1891–95	1896–1900	1901–05	1906–10	1911–15
Per cent. of normal.							
Jan. to Mar. ...	105	89	86	100	105	100	113
July to Sept. ...	107	101	110	97	103	92	89
Difference ...	−2	−12	−24	+3	+2	+8	+24

A potent cause of variations in the length of the cycle must be variations in the pressure gradient between the Azores anticyclone and the Icelandic minimum. When this gradient is weakened, the Gulf Stream Drift must also be weakened, and the cycle will take longer; when the gradient is strengthened the cycle will complete itself in a shorter interval. Examination of the charts shows that this tends to be the case. If we superpose a number of cycles in order to produce a composite curve, the variation in length spoils the result. In Fig. 2 are shown the variations during the period of 17 months following the 17 chief westerly maxima and the 15 chief easterly maxima. Curve A passes from a maximum westerly position to a maximum easterly position in six months, and returns to a new westerly maximum in 13 to 14 months. Curve B passes from a maximum easterly position to a maximum westerly position in seven months, but fails to show the succeeding easterly maximum.

The results of the investigation seem to confirm the existence of Meinardus and Petersen's self-regulating mechanism and to assign an average period of about twelve months for its operation, but the latter period is so variable that the cycle is useless for forecasting until the causes of the variations have been worked out. At the same time it offers a line of investigation which may produce very useful results for the study of slow changes in the distribution of pressure.

Variability of Tropical Climates—III.

By STEPHEN S. VISHER, Ph.D. (Chicago).

Storm Irregularity.

ANOTHER climatic factor subject to marked changes is storminess. Cyclonic storms are erratic in all parts of the world, but the extremes appear to be greatest in low latitudes. The range in the number of hurricanes damaging Australia, for example, has been from one hurricane in 1907 and 1919 to seven in 1916 and eleven in 1912. In the South Indian Ocean the variation reported by the Mauritius Observatory has been from one storm in 1900 to eight in 1894 (and several other years) and to thirteen in 1913. In the Philippines in a 15-year period the number of very severe typhoons varied from one in 1916 to seven each in 1908 and 1911. In respect to less violent cyclonic storms there appears to be a somewhat similar range. For example, the total number of well-marked tropical cyclones occurring in Queensland, Australia, varied from eight in 1920 to twenty-four in 1916. In respect to the month of occurrence as well as in annual frequency there likewise is marked irregularity. In some years cyclones may be lacking during the months when they normally are most frequent, and occur only in months supposed to be free from dangerous storms. Of thunderstorms also there is marked variation, perhaps more than in higher latitudes. Many stations in Fiji and elsewhere have experienced several times as many in one year as in another. While many hurricanes are accompanied by appalling lightning, other equally severe hurricanes have none.

Variations in Barometric Pressure.

One of the tropical variations which has aroused considerable scientific interest is the persistent double daily change in air pressure, the maxima occurring about 10h. and 22h. and the minima about 4h. and 16h. These minor curves are often evident on barograph records of even the most violent hurricanes with their great fall in pressure, sometimes nearly 2 in. within a few hours. Hence the general absence or imperceptibility of double diurnal waves in higher latitudes can scarcely be ascribed solely to the interference of cyclonic storms there. Seasonal changes in average pressure, while not so great as in certain parts of high latitudes, are commonly as much as 0·5 in. in the tropics.

Changes of the Weather.

Slight changes of weather are almost constantly taking place in the tropics. A rainy spell will be succeeded by a less rainy one or by a few rainless days ; a hot spell by a slightly cooler one ; a spell of fitful breezes by several days of steady winds. Such changes have been noticed by the writer in Jamaica, Hawaii, the Philippines, the East Indies, Queensland and elsewhere, but have been especially studied in Fiji. There, a study of the official records taken at Suva reveals an average of about 20 distinct spells of weather well distributed throughout the year, with about as many less distinct changes.

Conclusion.

In conclusion, when all these types of variation occur, is it desirable to spread the impression that tropical climates are extremely uniform ? But although tropical climates are not so uniform as has been believed, it does not follow that they are better adapted to civilized man than has been supposed. Most of the variability within the tropics is of a highly irregular sort compared with the variability characteristic of the parts of higher latitudes where civilized man mostly lives. Indeed, it appears that tropical climates are unfavourable for a high type of civilization, not alone because of the high temperatures and the general lack of stimulating seasonal changes in temperatures, but also because of the often extreme undependability of the rainfall, the occurrence not infrequently of destructive windstorms and other unfavourable variations. But, nevertheless, highly civilized man can cope with the numerous problems of the tropics far better than can primiti.e peoples. Indeed, the latter, unaided, have made little progress. Hence, fuller utilization of the tropical resources awaits a greater participation by civilized man.

OFFICIAL NOTICES

Lectures at the School of Meteorology 1923-1924

THE following courses of lectures have been arranged in connection with the School of Meteorology of the Imperial College of Science and Technology, for the session 1923-24.

1. *Introductory General Course.* A course of lectures by Sir Napier Shaw, F.R.S., on Fridays at 3 p.m., during the first half session, on the Normal Circulation of the Atmosphere and its Variations, seasonal and temporary.

2. *Discussions of the Incidents of the Weather Reports of the previous week* by Sir Napier Shaw, F.R.S., on Tuesdays at 10.15 during term time.

3. *Short Courses on Technical Subjects.*

   (A) *Meteorological Optics:* a course of five lectures during the spring term, by Mr. F. J. W. Whipple.

   (B) *Radiation:* a course of five lectures during the summer term, by Sir Napier Shaw, F.R.S.

4. *Advanced Meteorology, Dynamical and Physical.* A course of twenty lectures on Mondays at 3.30 during the winter and spring terms by Captain D. Brunt.

Further particulars may be obtained on application to the Secretary, Imperial College of Science and Technology, South Kensington, S.W. 7.

Discussions at the Meteorological Office

THE meetings for the discussion of recent contributions to meteorological literature, especially in foreign and colonial journals, will be resumed at the Meteorological Office during the session 1923-24. The meetings will be held on alternate Mondays at 5 p.m., beginning on Monday, October 15th, 1923, when Sir Napier Shaw, F.R.S., will open the discussion of a paper by V. H. Ryd on "Travelling Cyclones," *Publikationer fra Det Danske Meteorologiske Institut Meddelelser.* Nr. 5, 1923.

The dates for subsequent meetings are as follows :—

October 29th ; November 12th and 26th ; December 10th, 1923 ; January 21st ; February 4th and 18th ; March 3rd, 17th and 31st, 1924.

A Course of Training for Observers

A SECOND course of training for Meteorological Observers will be held at Kew Observatory in April or May, 1924. It is proposed to make this course an annual function. Particulars will be issued later.

International Cloud Week

On account of the International Conference of Directors of Meteorological Institutes and Observatories to be held at Utrecht at the beginning of September, the date of the International Cloud Week* has been changed from September 17th-23rd to September 24th-October 1st, 1923. Further particulars may be obtained from Capt. C. J. P. Cave, Stoner Hill, Petersfield, Hants, or Mr. G. A. Clarke, University Observatory, Aberdeen.

Official Publications

The following publications have recently been issued :—

Geophysical Memoirs—

No. 20. *Variations in the Levels of the Central African Lakes Victoria and Albert.* By C. E. P. Brooks, M.Sc. (M.O. 220j.)

No. 21. *Pyrheliometer Comparisons at Kew Observatory, Richmond, and their bearing on data published in the Geophysical Journal.* By R. E. Watson, B.Sc. (M.O. 254a.)

Professional Notes—

No. 33. *Diurnal and Seasonal Variations of Fog at certain Stations in England.* By F. Entwistle, B.Sc. (M.O.245m.)

Book of Normals of Meteorological Elements for the British Isles for periods ending 1915. *Section* IV.

(*a*) Range of Variations of Temperature and Rainfall.

(*b*) Frequency Tables for Hail, Thunder, Snow, Snow lying and Ground Frost. (M.O. 236.)

The issue of special geophysical supplements to the *Monthly Notices* of the Royal Astronomical Society was inaugurated in March, 1922. Up to the present, three numbers have appeared, containing papers on Seismology (6), Wireless Time Signals (2), The Electric Stability of the Earth, Map Projections, Terrestrial Magnetism and The Variation of Latitude (one each). Non-Fellows of the Society may obtain the Supplements by applying to the Assistant Secretary, Royal Astronomical Society, Burlington House, London, W. 1, at a price just sufficient to cover the cost of publication ; the numbers already issued cost 7s. 6d. in all. A deposit of 10s. should accompany applications ; notice will be sent to subscribers when this deposit is exhausted.

* *Met. Mag.*, vol. 58, June, 1923, p. 111.

Correspondence

To the Editor, *The Meteorological Magazine*

A Brilliant Halo : June 30th

As the halo which I observed* on June 30th is apparently of an exceptional nature I should like to emphasize certain points.

There were no outer arcs of any kind about the upper quadrants. Those below started from near the horizontal, but "lop-sided," *i.e.* from a few degrees above on the right, as much below on the left. The colours were in the same order as the inner, normal, halo. The space may have been more than $1\frac{1}{2}°$, but I think not, and this was at 45° to horizontal. The effect reminded me of the "bulge" stuck on outside the hulls of ships for protection against torpedoes. It remained evident, though not quite continuously, until the upper clouds were obscured.

J. EDMUND CLARK.

41, *Downscourt Road, Purley, Surrey.* 18*th July*, 1923.

Thunderstorms in June, 1923

WITH reference to the footnote on page 149 of the August issue of this Magazine, a communication has now been received from the Radcliffe Observer, Oxford. He states that: "A sharp shower of rain fell at about 20h. 30m. on June 15th, and at the same time the observer noted a single peal only of thunder. There is no note of intensity, hence it is to be inferred that the thunder was neither heavy nor at all distant. No lightning was observed."

It will be recognised that the shower in question was probably of the line-squall type. This hypothesis is supported by the *Daily Weather Report.*

NOTES AND QUERIES

London's Water Supply

IN the *Seventeenth Annual Report* by Sir Alexander Houston, Director of Water Examination for the Metropolitan Water Board, is to be found an interesting popular account of the arrangements for the supply of water to London. To most readers the most novel part of the story is the description of the successful treatment of river water by chlorination.

Before 1916 it was customary to purify Thames water by pumping it into the great storage reservoir at Staines and leaving it there for a month. To save the cost of pumping, the experiment of adding chloride of lime to the water in the aqueduct

* *Met. Mag.*, vol. 58, July, 1923, p. 127.

and passing it almost directly to the filter beds was tried, and it was found that the water supply was actually more free from bacteria than hitherto. The reduction in the coal bill amounts to some £17,500 a year, whilst the cost of the chloride of lime is only £1,500. The principal use of the Staines reservoir now is to maintain the supply of pure water when the Thames is in flood.

Early Records of Notable Weather

MR. RICHARD COOKE, of Detling, near Maidstone, sends some weather notes of the 17th and 18th century. The following are from *Ashford, its Vicars, College and Grammar School*, by the Rev. A. J. Pearman [1888]:—

1673. *Samuel Warren, B.A., Vicar.*

In Mr. Warren's handwriting we have some notes of the weather.

"There fell a great deal of snow on April 22, being Good Friday, 1676 [*sic*]. Hills, meadows, houses all covered with snow: and on May Day following, and on the 4th of May fell much snow, that in some places there were drifts, it was above a yard deep and lay several days on the hills, which we could see several miles off, and all this time very cold weather and so continued about 10 days. It was very wet and cold to the 5th of June.

"In the year 1683 there was a very hard frost, beginning a little before Christmas and lasted 7 weeks. The frost went three feet in the ground, froze all rivers that mills could not grind, the sea about Hithe and Dover was frozen many miles into the sea. The Thames at London so frozen that they built streets upon it, and coaches went commonly upon it. The like frost has not been known in man's memory.

"On 28th July, 1703, being Wednesday, it began to rain between 6 and 7 in the morning and held till 2 o clock in the afternoon pretty moderately, and then it began to rain exceeding hard, with very little intermission, until between 4 and 5 the next morning, which caused a great flood that carried away a great deal of hay out of the meadows down the river: a great loss to many people.

"On Friday and especially on Saturday morning the 26 and 27 days of November, 1703, there were most terrible and dreadful storms of wind with which it pleased Almighty God to afflict the greatest part of this Kingdom. Some of our ships of war and many other ships were destroyed and lost at sea and great numbers of men serving on board the same perished. And many houses barns and other buildings were either wholly thrown down and demolished, or very much damnified and defaced and thereby several persons killed, viz., the Bishop of Bath and Wells, Dr. Kidder, &c. And many stacks of corn and hay thrown down and scattered abroad, to the great damage and impoverishment of many others, especially the poorer sort. And great number of timber and other trees were torn up by the roots, others broke short asunder in the middle; some whole orchards rooted up, others much damnified. Philip Warham of Wye had 220 trees blown down in his orchard. A calamity of this sort, so dreadful and astonishing that the like has not been seen or felt in the memory of any person living in the nation. Hereupon the Queen [Anne] appointed a general fast throughout the Kingdom on Jan. 19 following."

L'Institut de Physique Cosmique de Moscou

THE Meteorological Office has recently received the first bulletin of "l'Institut de Physique Cosmique de Moscou," which now occupies the buildings formerly used by "L'Institut Aerodynamique de Koutchino." The latter institute was founded in 1904 on the initiative of Prof. D. P. Riabouchinsky. Aerodynamical and hydrodynamical experiments and investigations, including upper air observations by means of balloons and kites, were carried out and the results of the work published in occasional bulletins.

The programme which is now being carried out, covers, as the name of the Institute implies, a much wider field than that formerly covered by l'Institut Aerodynamique. With regard to meteorology the most interesting point to be noted among the statutes is that the Institute is to have "tous les locaux qui se trouvent dans la 1-re, 2-me et 3-me anciennes propriétés de Riabouchinsky, et aussi la zone défendue, 200 désiatines de dimensions, pour garder les conditions de climat invariables."

The Institute is under the authority of the Centre Académique du Commissariat de l'Instruction and is affiliated to the Observatoire Physique Central de Petrograd for all its meteorological work.

Rainfall Insurance

WE are glad to see that the form of rainfall insurance policies is under discussion in the United States. Most people in this country have heard of the possibility of insuring against their holidays being spoiled by rain ; it is not generally known however that policies for comparatively large sums of money are taken by the promoters of athletic meetings, flower shows and other fêtes which depend for their success on fine weather. It has become customary in such cases to insure against the occurrence of the tenth of an inch of rain between the hours 9 a.m. and 9 p.m. Incidentally it may be remarked that the policies are often very carelessly drawn up with no provision as to where the rain is to fall or as to who is to measure it. It is left open to doubt whether Summer Time or Greenwich Time is intended. As has been brought out by American experience the criterion is not a satisfactory one, the financial success of an athletic meeting is not affected by a heavy thunderstorm in the late afternoon, whereas light rain earlier in the day may prove ruinous.

Frequently people who might be expected to know better state that insurance is a form of gambling. Of course, sane insurance is the reverse of gambling. The man who fails to insure his house against the risk of fire is the gambler, the man who insures it " hedges " so as to eliminate as far as possible the element of risk. The total value of his assets remains the same if a fire occurs or not. The accusation which can fairly be brought against the present system of insurance against rain is that it is gambling, not hedging. An example which came to our notice recently may be quoted :

The promoters of a large gathering took out a policy for £400, paying a premium of £60. Drizzle commenced about 12 o'clock on the day in question and continued for two hours ; the total fall in that time being about 0.05 inch. The attendance was so seriously affected that the gate money did not equal the prize fund. In the course of the afternoon there was a sharp shower and it was found subsequently that the total fall for the 24 hours 9 a.m. to 9 a.m., as measured in the nearest gauge, was 0.09 inch. It will be noticed that there was no effective insurance against the real cause of loss. Betting on whether the afternoon shower should pass half a mile to the north or to the south of the athletic ground was a mere gamble.

According to the scheme which has found support in America, there should be insurance against the occurrence of the hundredth of an inch of rain in any or each of certain hours. We commend this scheme to the notice of underwriters in this country, pointing out, however, that the installation of a special open scale recording raingauge at an agreed spot and under expert control would be necessary in each instance.

F. J. W. WHIPPLE.

The History of the Fahrenheit Thermometer

OUR works of reference usually explain that the scale of Fahrenheit's earlier thermometers was such that the zero was the temperature of the mixture—ice, water and sea-salt, whilst 24° was blood temperature, that Fahrenheit subsequently used the more open scale with 0° and 96° for these two temperatures, and that this is very nearly the scale to which his name is now given. From a recent article by Prof. E. Lagrange in *Ciel et Terre*,* or rather from a translation by Dr. C. F. Brooks in *Tycos*,† we learn that the researches of Mme. K. Meyer have shown that credit for the earlier of these scales should be given to the Danish physicist Öle Roemer, from whom Fahrenheit must have adopted it. The evidence seems satisfactory.

A word of caution may not be out of place : Roemer is not to be confused with Réaumur, whose name is given to the thermometer scale with the zero at the freezing point and 80° at the boiling point of water.

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* Nov.-Dec. 1922, pp. 357-363.

† Vol. xiii. July, 1923, No. 3, p. 16.

Theories of the Anti-Solar Light

THE anti-solar light (*Gegenschein* or *Counterglow*) is a faintly luminous patch which can be observed at night under favourable conditions in the prolongation of the line joining the centres of sun and earth. In a note published in the May number of *Ciel et Terre* over the initials of M. Max Hauptmann, the theories of Gyldèn and Moreux, both depending on the existence of the neutral point at which the gravitational attractions of the sun and earth balance centrifugal force, are explained. The older theory, Gyldèn's, assumes that meteoric matter would be concentrated at the neutral point, whilst Moreux (*Scientifica et Revue du Ciel*, April, 1923) supposes that the atmospheric gases driven off by light pressure would be attracted in the same way. Hauptmann points out, however, that if light pressure is the moving cause there is no reason to suppose that there would be any concentration at a neutral point (the gas would be driven past that point), and he makes the suggestion that the diffuse stream of gas should itself be visible in the sunlight. In fact, the earth is a comet, and the observer of the anti-solar light is looking from the comet down its tail. This suggestion brings this phenomenon within the range of meteorology. The weak side of it is the neglect of the characteristic feature of comet's tails, their inclination to the radius from comet to sun.

We must confess, however, to a prejudice against this frittering away of the earth's atmosphere. Hauptmann does not refer to the theory that the earth's atmosphere acts like a lens giving a badly focussed image of the sun. This image is at no great distance from the earth, and it is not impossible that there may be sufficient matter at that distance to act as the screen on which the image is projected and made visible.

Thermometer Exposure

FROM time to time attention has been called to the difficulty introduced into comparisons of air temperatures by the effect of exposure upon the values recorded. There is no international agreement as to the standard form of exposure. In the United States the temperatures utilised for the daily weather service are mostly recorded at stations on high roofs in the centres of the larger towns.* In this country the general rule is to utilise only the observations of thermometers exposed in Stevenson screens in open sites and 4 ft. above ground. In India the thermometers have been set up hitherto in open sheds of a special design, but a thorough investigation by Dr. Field has led to the adoption of the Stevenson screen as the standard of that country.

No doubt the practice in other tropical countries where the Indian shelter is in use will be brought into line.

An anomaly in our own organization has been the use of the North Wall screens at certain observatories either instead of or in addition to the Stevenson screen. The North Wall screen offers the advantage that it is convenient for the installation of autographic instruments but it is well known that it gives a smaller daily range of temperature than the Stevenson screen. At Kew Observatory a series of comparisons have been made during recent months between the readings of thermometers in the North Wall screen, in a Stevenson screen on the lawn and on a Glaisher stand (this stand being the one formerly in use at Camden Square, the old headquarters of the British Rainfall Organization). It was found that the study of the differences between the temperatures recorded in the screens on the lawn and on the north wall was complicated by the fact that the difference in height had to be allowed for as well as the difference in exposure. To obviate this difficulty, a Stevenson screen has been set up on a wooden structure so that the thermometer bulbs in this screen are 17 ft. above the grass plot and level with the bulbs of the thermometers in the North Wall screen. The new high screen came into use in the middle of February.

An indication of the types of result that are being obtained may be given. The following figures all refer to the month of May, 1923:—

Maximum Temperature for the interval 7h.—18h., G.M.T.

Mean Excess: Glaisher stand, compared with normal Stevenson screen ... ... 2·0°F.

Mean Excess: Normal Stevenson screen compared with Stevenson screen at 17 ft. ... ... 1·3°F.

Mean Excess: North Wall screen compared with Stevenson screen at 17 ft. ... ... 0·5°F.

Maximum Temperature for the interval 18h.—7h., G.M.T.

Mean Excess: North Wall screen compared with either Stevenson screen or with the Glaisher stand 2·0°F.

It is remarkable that in the short May nights there was no appreciable difference between the minima at 17 ft. and at 4 ft. so that all the lawn exposures can be grouped together.

*In the U.S. *Monthly Weather Review*, April, 1923, p. 190, Meisinger discusses the merits of temperature observations at aerodromes (*e.g.*, Groesbeck, Tex., thermometers 11 ft. above ground) and at normal Weather Bureau stations (*e.g.*, Palestine, Tex., thermometers 64 ft. above ground) in estimating the temperature aloft with a view to the construction of pressure maps for such heights as 1 km. and 2 km. above sea level. He decides (*l.c.*, p. 197) in favour of eliminating the aerological stations from the network and using only regular Weather Bureau stations.

The Cruickshank Lectureship in Astronomy and Meteorology

THE University of Aberdeen intends in the autumn of this year to inaugurate the Lectureship in Astronomy and Meteorology which has been contemplated for some time past, and for which two funds have been accumulating for many years. One of the funds originated under the Will of the late Miss Anne Hamilton Cruickshank, daughter of the late Dr. John Cruickshank, who was appointed Professor of Mathematics in the Marischal College and University, Aberdeen, in June, 1807, and held office until the union of Marischal and King's Colleges in 1860. By a trust disposition, dated 1898, Miss Cruickshank directed her Trustees to apply a portion of her money for the endowment of a Lectureship in Astronomy, including Navigation and Meteorology, in the University, on account of the great interest her father had taken in these three subjects, and the increasing need for instruction in them.

The other fund came from the University Observatory Fund, which originated from an unexpended balance of the sum of £800 paid in the end of the 18th century by the War Office to the University of Aberdeen by way of compensation for the old Astronomical Observatory on the Castle Hill of Aberdeen.

The lecturer will be expected to devote himself to research in Astronomy and Meteorology, and will be required to deliver only a limited number of lectures. All names of applicants should be lodged with the Secretary to the University of Aberdeen before November 1st, 1923, from whom all particulars may be obtained.

International Congress of Navigation

THE 13th International Congress of Navigation met in London in July, 1923. A paper which had been prepared by the late M. de C. S. Salter was discussed on July 5th by a sectional meeting devoted to the consideration of the relation of water supply to inland navigation.

Mr. Salter's paper, *The Volumetric Determination of Rainfall*, is illustrated by a set of maps showing rainfall over the catchment area of the River Don. These maps represent the rainfall on particular days, days with thunderstorm rain, cyclonic rain and orographical rain respectively. Another map represents the average annual rainfall. The likeness of this map to that showing orographical rain is striking, and supports the generalization that thunderstorm rain and cyclonic rain are of comparatively little importance in the hilly parts of the British Isles.

A paper by Mr. H. A. Reed, Chief Engineer Manchester Ship Canal Co.—*Some Notes on the relation between Rainfall and the*

Discharge of the River Mersey in the year 1921—may also be mentioned. The discharge of the Upper Mersey, which drains an area where there is much industrial use of water, amounted to 55 per cent. of the rainfall. The stabilising effect of the use of reservoirs for various purposes is noted.

Autographic Record of Soil Temperature at Kew Observatory

With a view to obtaining continuous records of underground temperatures at given depths a new type of distance thermograph, designed by Messrs. Negretti and Zambra, has been installed recently at Kew Observatory. The thermograph has two pens, actuated by " mercury in steel " thermometers, the bulbs of which are connected to the recording mechanism by means of flexible capillary tubes about 10 feet in length. The capillary tubing is made of a special kind of steel which has no affinity for mercury, and rusting on the outside is prevented by means of a coating of lead. The bulbs are buried in the ground at depths of 4 and 12 inches.

In addition to the recording thermometer, four " mercury in glass " thermometers have been installed in close proximity to it. The stems of these thermometers are bent at right angles so that the upper portion lies horizontally on the ground. The bulbs are placed at depths of 4, 6, 8 and 12 inches ; the readings at 4 and 8 inches are of importance in connection with the crop weather scheme of the Ministry of Agriculture and Fisheries.

Review

A Dictionary of Applied Physics. Edited by Sir Richard Glazebrook, K.C.B., D.Sc., F.R.S. Vol. V. *Aeronautics-Metallurgy-General Index.* 8vo., 9×6, pp. vii.+592. *Illus.* Macmillan and Co. 1923. £3 3*s. net.*

The professional work of meteorologists tends to bring them into close touch with the practical side of aeronautics, the actual conditions under which flight is being carried on. A nodding acquaintance with the more theoretical side is desirable however. Such an acquaintance and a good deal more can be achieved by the study of the latest (and last) volume of the *Dictionary of Physics.*

As to matters with which we are directly concerned, we notice that there is still considerable doubt as to the conventions to be adopted in the graduation of altimeters and as to the allowances to be made for temperature and pressure in judging the performance of engines and aircraft. Pressure and temperature are mainly effective in aerodynamics in so far as they determine together the density of the air. The resistance which has to be overcome as an aeroplane moves through the air at a particular speed is proportional to density and to a first approximation at any rate so is the amount of air which is sucked in through the induction-pipe of the engine. For this reason, as Prof. Bairstow states in the article on Performances of Aircraft, " it has been usual in the reduction of British performance results to assume that the horse-power of an engine is a function of density only. This approximation was justifiable in view of the state of knowledge existing in 1918, and, although there is now evidence to show that a distinct temperature effect exists, it is also clear that the changes introduced by the new knowledge are of a secondary order. The calculations which convert an observed performance into performance in a standard atmosphere are greatly simplified by the neglect of a temperature effect, for both the aerodynamics and engine power then depend only on the single atmospheric characteristic, density. The observed speed and rate of climb need only be ascribed to a height in the standard atmosphere where the density is that recorded in observation, for the necessary reduction to be made."

Reference to the article on the Effect of Altitude on the Running and Performance of Engines for Aircraft, by G. H. Norman, reminds us, however, that there are reasons why the horse-power should depend on atmospheric pressure rather than on density. The induction-pipe of the engine is generally heated in one way or another so that its temperature does not depend at all closely on that of the atmosphere. If the temperature of the induction-pipe is strictly constant, the weight of air taken in by the engine at each stroke will be proportional to pressure. Some experiments have been consistent with this dictum, but the most reliable results suggest a compromise, the power generated is proportional to $pt^{-\cdot 4}$, p being the pressure and t the absolute temperature of the air. It is worth noting that the fact that an aeroplane engine develops the greatest power when it is nearest to the ground is a positive advantage.

Another question in which meteorologists may be interested is the effect of sunlight on textile materials* such as the wings of aircraft. " Varnished doped fabric proved, however, to be no better than the unvarnished in respect of permanence of strength on exposure to sunlight. Ramsbottom showed that by the introducton of very finely-ground opaque pigments into the varnish the deterioration of the fabric by sunlight could be effectively avoided. The pigments were at first introduced in order to render machines less visible from above, but the advantages to be obtained in this direction were found to be far exceeded by the gain in permanence : for example, a doped fabric which lost 49 per cent. of its strength in 28 weeks, lost, when suitably

*See Article on *Doping of Aeroplane Wings*, by Guy Barr, p. 45.

protected, only 4 per cent. over the same period. The pigment finally selected was of a dark khaki colour, made by mixing yellow ochre, Prussian blue, and carbon black." In such bright sunshine as occurs in Egypt the absorption of solar radiation by dark-coloured varnishes had disadvantages, however, and it was found necessary to superimpose a coating of varnish containing aluminium powder.

From the short article by Wing-Commander T. R. Cave-Browne-Cave on the protection of airships and kite balloons from atmospheric electricity, we learn that during the war kite balloons were frequently struck. "Observation showed that in the case of many balloons destruction was due to a discharge which was either induced by a lightning stroke in the neighbourhood or more frequently was associated with no visible flash at all. Destruction by a direct flash to the balloon itself was very rare." The remedy adopted was to fit "discharger bands" with sharp discharger points with good metallic connections leading down to the wire rigging. On the other hand the danger to an airship is said to be small. "A rigid airship secured by the bow to a steel mast rode out a lightning storm of quite exceptional intensity with vivid flashes of lightning quite close to the ship. A non-rigid airship flying on the outskirts of the same storm was destroyed by fire in circumstances which were not of course explained, but were very possibly of electric origin."

The division of the subject matter of this last volume of the *Dictionary of Physics* into two Parts (devoted to Aeronautics and Metallurgy respectively) is an improvement. It is also to be noted that a General Index to the whole Dictionary is printed at the end of this volume.

F.J.W.W.

News in Brief

The London County Council's programme of lectures and classes for teachers for 1923-24 includes a course of six lectures on *British Weather* to be delivered by Sir Napier Shaw.

A daylight saving bill has recently been passed in Montevideo. It states that "The legal time throughout the Republic is the mean meridian time of the National Institute of Meteorology of Montevideo, put forward forty-four minutes fifty-one seconds from the 30th September to the 31st March, and fourteen minutes fifty-one seconds during the remainder of the year."

According to *The Times*, Professor Helland Hansen, the Norwegian scientist, has left Bergen with an expedition aboard the Bergen Museum vessel, the *Armauer Hansen*, on an oceanographic investigation about 124 miles from Aalesund, where it is intended to measure the speed of the Gulf Stream at various depths.

A new feature was introduced in the monthly "flysheet" (*Supplement to the Daily Weather Report*) with the issue for July, 1923. For three stations—Stornoway, Valencia Observatory and Kew Observatory—means of pressure and temperature with differences from normal are given, and also wind-roses. The table of surface visibility, an equivalent of which has been incorporated in Table IV. of the *Monthly Weather Report* since the beginning of the year, is now omitted from the flysheet.

Capt. Roald Amundsen states that he will try again next year to fly across the Pole from Spitzbergen.

The Weather of August, 1923

FINE sunny weather marked the first day of the month, but on the second and third a deep depression passed across Ireland and Scotland, causing heavy rain in these countries, with high winds generally over the British Isles and gales in Ireland and Wales—gusts of between 60 and 70 miles per hour were recorded at several stations, *e.g.*, Holyhead, Quilty and Cahirciveen. After the passage of this disturbance further depressions from the Atlantic took a more northerly course, maintaining unsettled conditions only in the west and north, while in the south-east the weather became fine and warm as the anticyclone centred over France spread northwards. These conditions lasted nearly a fortnight. During this period 80° F. was exceeded on several occasions in the south-east, and also 90° F. in parts of London on the 9th. At the same time the sunshine records were large, *e.g.*, Margate had 83 per cent. of the possible duration of sunshine during the week August 5th to 11th, and Worthing 79 per cent.

On the 14th this spell of fine weather was broken. A shallow depression developed over England and caused thunderstorms and heavy rain locally at night as it moved east to the continent. Local thunderstorms also occurred in south-east England on the 18th, but were more general about the 22nd to 24th and again on the 27th.

During the latter part of the month the depressions from the Atlantic again took a more southerly course, so that unsettled conditions prevailed over the whole country with frequent high winds or gales on the coasts. On the 29th to 30th strong gales occurred also at some inland stations, while force 10 (averaging 59 miles per hour) was experienced in the Scilly Islands and at Spurn Head. Mist or fog occurred frequently in the English Channel during the earlier part of the month.

In the early days of August unclouded skies and brilliant sunshine prevailed in most parts of France. Some very high temperatures were recorded: on August 8th, 111° F. was experienced at Toulouse: this was reported in the press as the highest reading ever recorded in France. Serious forest fires, due to the heat and dryness occurred in many places and lasted for many days. A violent gale on the 18th aggravated the fires, and on the 21st they were still raging; much damage and loss resulted. The worst fires occurred in the Midi and in the forests of Var and the Côte d'Azur. During the last week heavy rain and hail storms broke the drought at Montpelier and Beziers, vineyards were damaged and buildings struck by lightning.

The heat wave was experienced in Italy and Switzerland also, and forest fires were serious near Corbeyrier and Leysin. During the week ended the 13th violent thunderstorms and torrential rains visited many parts of Italy, and in Switzerland the storms were accompanied by a hurricane. Heavy rain storms occurred again in Italy towards the end of the month. During the early part of the month continual rains caused much damage to crops in Russia, and at Tashkent (Turkestan) violent gales destroyed crops and buildings.

Rainfall in India was normal in Upper Burma and Bengal, scanty in Hyderabad and Mysore, and excessive in Lower Burma and the Punjab. Heavy floods occurred in Burma early in the month, many people were rendered homeless, and the rice crops were almost entirely destroyed. Floods occurred on the Jumna and Ganges and lasted for a considerable time. In Bihar the floods were the highest ever recorded there. A small but intense tornado visited Moulmein (Burma) at the beginning of the month and caused great havoc.

Hong-Kong was devastated by a typhoon on the 18th and much shipping was lost; another, but less serious, typhoon occurred on the 21st.

Disastrous tidal waves swept the north-west coast of Korea at the middle of the month, causing heavy loss of life and property.

Very heavy rains again fell in South Australia; since the beginning of May rain has fallen on about five days a week, making the highest aggregate of the past 84 years.

The special message from Brazil states that rainfall was abundant in the central districts, being 37 mm. above normal, but scarce in the north and south, where it was 36 mm. and 24 mm. below normal respectively. Temperature was slightly above normal. The prospects of the coffee and sugar cane crops continue good.

Rainfall August, 1923: General Distribution

England and Wales	103	per cent. of the average 1881-1915
Scotland	159	,, ,, ,,
Ireland	149	,, ,, ,,
British Isles	128	,, ,, ,,

Rainfall Table for August, 1923

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent. of Av.
Lond.	Camden Square	2·01	51	91	*Leics*	Leicester Town Hall	2·09	53	...
Sur .	Reigate, Hartswood	2·14	54	...	,, .	Belvoir Castle	2·21	56	84
Kent.	Tenterden, View Tower	1·77	45	77	*Rut* .	Ridlington	2·11	54	...
,, .	Folkestone, Boro. San.	1·49	38	...	*Linc*.	Boston, Skirbeck	2·37	60	99
,, .	Broadstairs	...	..	...	,, .	Lincoln, Sessions House	2·79	71	113
,, .	Sevenoaks, Speldhurst.	2·13	54	...	,, .	Skegness, Estate Office.	2·55	65	105
Sus .	Patching Farm	2·50	63	99	,, .	Louth, Westgate	2·73	69	97
,, .	Eastbourne, Wilm. Sq.	2·24	57	90	,, .	Brigg	2·36	60	85
,, .	Tottingworth Park	2·50	63	93	*Notts*.	Worksop, Hodsock	2·29	58	93
Hants	Totland Bay, Aston	1·86	47	...	*Derby*	Mickleover, Clyde Ho.	2·56	65	94
,, .	Fordingbridge, Oaklnds	2·25	57	86	,, .	Buxton, Devon. Hos.	5·26	134	120
,, .	Portsmouth, Vic. Park.	1·88	48	84	*Ches*.	Runcorn, Weston Pt.	3·84	97	107
,, .	Ovington Rectory	2·89	73	107	,, ..	Nantwich, Dorfold Hall	3·10	79	...
,, .	Grayshott	2·93	74	105	*Lancs*	Bolton, Queen's Park .	6·04	153	...
Berks	Wellington College	2·42	61	104	,, ..	Stonyhurst College	7·66	195	151
,, .	Newbury, Greenham	2·36	60	90	,, ..	Southport, Hesketh	4·67	119	134
Herts.	Bennington House	2·12	54	88	,, ..	Lancaster, Strathspey.	5·89	150	...
Bucks	High Wycombe	2·75	70	119	*Yorks*	Sedbergh, Akay	9·01	229	161
Oxf. .	Oxford, Mag. College	3·10	79	138	,, .	Wath-upon-Dearne	2·14	54	89
Nor .	Pitsford, Sedgebrook	1·64	42	68	,, .	Bradford, Lister Pk.	3·75	95	138
,, .	Eye, Northolm	1·76	45	...	,, .	Oughtershaw Hall	...	..	...
Beds.	Woburn, Crawley Mill.	3·02	77	...	,, .	Wetherby, Ribston H.	3·42	87	125
Cam.	Cambridge, Bot. Gdns.	2·91	74	124	*ERY*	Hull, Pearson Park	2·73	69	94
Essex	Chelmsford, CountyLab	2.46	63	...	,, .	Holme-on-Spalding	2·88	73	...
,, .	Lexden, Hill House	1·61	41	...	,, .	Lowthorpe, The Elms.	3·30	84	120
Suff .	Hawkedon Rectory	2·73	69	105	*NRY*	West Witton, Ivy Ho.	4·30	109	...
,, .	Haughley House	2·41	61	...	,, .	Pickering, Hungate	3·99	101	...
Norf.	Beccles, Geldeston	2·58	66	119	,, .	Middlesbrough	2·67	68	97
,, .	Norwich, Eaton	2·32	59	98	,, .	Baldersdale, Hury Res.	4·95	126	141
,, .	Blakeney	1·70	43	75	*Durh*.	Ushaw College	3·59	91	123
,, .	Swaffham	2·56	65	99	*Nor* .	Newcastle, Town Moor.	4·18	106	143
Wilts.	Devizes, Highclere	3·32	84	...	,, .	Bellingham Manor	6·05	153	..
Dor .	Evershot, Melbury Ho.	3·00	76	95	,, .	Lilburn Tower Gdns.	4·20	107	...
,, .	Weymouth, Westham	1·25	32	58	*Cumb*	Penrith, Newton Rigg.	...	..	...
,, .	Shaftesbury, Abbey Ho.	2·15	55	74	,, .	Carlisle, Scaleby Hall .	8·24	209	200
Devon	Plymouth, The Hoe	2·29	58	77	,, .	Seathwaite	21·00	533	181
,, .	Polapit Tamar	3·26	83	103	*Glam*.	Cardiff, Ely P. Stn.	4·61	117	107
,, .	Ashburton, Druid Ho.	4·20	107	112	,, .	Treherbert, Tynywaun	10·37	263	...
,, .	Cullompton	2·85	72	93	*Carm*	Carmarthen Friary	5·16	131	111
,, .	Sidmouth, Sidmount	1·80	46	64	,, .	Llanwrda, Dolaucothy.	6·00	152	109
,, .	Filleigh, Castle Hill	4·12	105	...	*Pemb*	Haverfordwest, Portf'd	...	..	...
,, .	Hartland Abbey	3·01	77	...	*Card*.	Gogerddan	3·60	91	74
Corn.	Redruth, Trewirgie	2·88	73	84	,, .	Cardigan, County Sch. .	2·90	74	...
,, .	Penzance, Morrab Gdn.	2·29	58	72	*Brec*.	Crickhowell, Talymaes	2·00	51	...
,, .	St. Austell, Trevarna	2·73	69	75	*Rad* .	Birm.W.W.Tyrmynydd	5·79	147	107
Som	Street, Hind Hayes	2·61	66	...	*Mont*.	Lake Vyrnwy	7·61	193	147
Glos..	Clifton College	4·72	120	135	*Denb*.	Llangynhafal	3·14	80	...
,, .	Cirencester	2·30	58	75	*Mer* .	Dolgelly, Bryntirion	7·01	178	125
Here.	Ross, County Obsy.	2·14	54	83	*Carn*.	Llandudno	2·49	63	82
,, .	Ledbury, Underdown.	1·81	46	69	,, .	Snowdon, L. Llydaw 9	18·30	465	..
Salop	Church Stretton	3·11	79	96	*Ang* .	Holyhead, Salt Island.	4·47	113	141
,, .	Shifnal, Hatton Grange	2·40	61	85	,, .	Lligwy	4·14	105	...
Staff.	Tean, The Heath Ho.	3·84	97	111	*Man*.	Douglas, Boro' Cem.	6·85	174	176
Worc.	Ombersley, Holt Lock.	2·01	51	75	*Guer*.	St. Peter Port, Grange.	2·15	55	91
,, .	Blockley, Upton Wold.	2·18	55	74	*Wigt*.	Stoneykirk, Ardwell Ho	7·15	182	191
War	Farnborough	2·24	57	82	,, .	Pt. William, Monreith .	7·74	197	...
,, .	Birminghm, Edgbaston	2·50	63	92	*Kirk*.	Carsphairn, Shiel.	12·63	321	...

Rainfall Table for August, 1923—*continued*

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent. of Av.
Kirk.	Dumfries, Cargen	10·35	263	235	*Caith*	Loch More, Achfary	8·09	205	139
Dum	Drumlanrig	...	..	...	,,	Wick	3·60	91	131
Roxb	Branxholme	5·50	140	171	*Ork*	Pomona, Deerness	4·61	117	161
Selk	Ettrick Manse	7·96	202	...	*Shet*	Lerwick	4·21	107	140
Berk.	Marchmont House	4·54	115	137	*Cork*	Caheragh Rectory	7·09	180	...
Hadd	North Berwick Res.	4·17	106	132	,,	Dunmanway Rectory	7·29	185	155
Midl	Edinburgh, Roy. Obs.	4·31	109	148	,,	Ballinacurra	5·27	134	154
Lan	Biggar	5·76	146	173	,,	Glanmire, Lota Lo.	5·99	152	164
Ayr	Kilmarnock, Agric. C.	7·05	179	180	*Kerry*	Valencia Obsy.	7·62	193	159
,,	Girvan, Pinmore	8·30	211	186	,,	Gearahameen	11·50	292	...
Renf.	Glasgow, Queen's Pk.	4·93	125	139	,,	Killarney Asylum	5·74	146	130
,,	Greenock, Prospect H.	7·59	193	140	,,	Darrynane Abbey	5·88	149	135
Bute.	Rothesay, Ardencraig	8·42	214	173	*Wat.*	Waterford, Brook Lo.	5·17	131	135
,,	Dougarie Lodge	6·71	170	...	*Tip*	Nenagh, Cas. Lough	...	..	...
Arg	Glen Etive	...	..	...	,,	Tipperary	4·99	127	...
,,	Oban	5·10	129	...	,,	Cashel, Ballinamona	5·35	136	151
,,	Poltalloch	7·01	178	143	*Lim*	Foynes, Coolnanes	5·21	132	135
,,	Inveraray Castle	9·94	253	151	,,	Castleconnell Rec.	5·95	151	...
,,	Islay, Eallabus	6·69	170	153	*Clare*	Inagh, Mount Callan	10·65	271	...
,,	Mull, Benmore	15·60	396	...	,,	Broadford, Hurdlest'n.	6·96	177	...
,,	Mull, Quinish	...	..	...	*Wexf*	Newtownbarry	5·41	137	...
Kinr.	Loch Leven Sluice	5·17	131	135	,,	Gorey, Courtown Ho.	4·54	115	136
Perth	Loch Dhu	9·15	232	136	*Kilk.*	Kilkenny Castle	4·83	123	139
,,	Balquhidder, Stronvar.	6·86	174	113	*Wic*	Rathnew, Clonmannon	4·75	121	...
,,	Crieff, Strathearn Hyd.	6·74	171	160	*Cars.*	Hacketstown Rectory	5·49	139	136
,,	Blair Castle Gardens	5·35	136	...	*QCo.*	Blandsfort House	5·39	137	136
,,	Coupar Angus School	4·69	119	142	,,	Mountmellick	5·62	143	...
Forf.	Dundee, E. Necropolis	4·84	123	143	*KCo.*	Birr Castle	5·37	136	141
,,	Pearsie House	6·24	159	...	*Dubl.*	Dublin, FitzWm. Sq.	4·16	106	137
,,	Montrose, Sunnyside	5·24	133	188	,,	Balbriggan, Ardgillan	5·46	139	160
Aber.	Braemar Bank	4·80	122	143	*W.M*	Athlone, Twyford	...	..	...
,,	Logie Coldstone Sch.	5·45	138	172	,,	Mullingar, Belvedere	5·74	146	138
,,	Aberdeen, Cranford Ho	5·01	127	174	*Long*	Castle Forbes Gdns.	5·82	148	142
,,	Fyvie Castle	4·05	103	...	*Gal*	Galway, Waterdale	7·05	179	...
Mor	Gordon Castle	5·14	131	162	,,	Woodlawn	...	..	...
,,	Grantown-on-Spey	5·62	143	176	*Mayo*	Crossmolina, Enniscoe	8·07	205	179
Na	Nairn, Delnies	4·93	125	205	,,	Mallaranny	10·07	256	...
Inv.	Ben Alder Lodge	6·84	174	...	,,	Westport House	6·36	161	157
,,	Kingussie, The Birches	4·66	118	...	,,	Delphi Lodge	14·10	358	...
,,	Fort Augustus	5·23	133	151	*Sligo*	Markree Obsy.	7·40	188	171
,,	Loch Quoich, Loan	11·50	292	...	*Ferm*	Enniskillen, Portora	...	..	...
,,	Glenquoich	11·20	285	136	*Arm.*	Armagh Obsy.	4·70	119	130
,,	Inverness, Culduthel R.	4·57	116	...	*Down*	Warrenpoint	5·45	138	...
,,	Arisaig, Faire-na-Squir	6·55	166	...	,,	Seaforde	7·00	178	187
,,	Fort William	8·93	227	145	,,	Donaghadee	4·81	122	145
,,	Skye, Dunvegan	5·45	138	...	,,	Banbridge, Milltown	5·24	133	150
,,	Barra, Castlebay	3·60	91	...	*Antr.*	Belfast, Cavehill Rd.	7·14	181	...
R&C	Alness, Ardross Cas.	6·12	155	207	,,	Glenarm Castle	3·73	95	...
,,	Ullapool	5·61	142	...	,,	Ballymena, Harryville	6·21	158	145
,,	Torridon, Bendamph	7·61	193	115	*Lon*	Londonderry, Creggan	6·36	161	137
,,	L. Carron, Plockton	7·54	191	...	*Tyr*	Donaghmore	6·42	163	...
,,	Stornoway	5·32	135	134	,,	Omagh, Edenfel	6·95	177	163
Suth.	Dunrobin Castle	...	..	...	*Don*	Malin Head	6·28	159	178
,,	Lairg	5·48	139	...	,,	Letterkenny Hospital	5·70	145	127
,,	Forsinard	...	..	...	,,	Dunfanaghy	...	..	...
,,	Tongue Manse	6·87	175	215	,,	Narin, Kiltoorish	6·46	164	...
,,	Melvich School	5·68	144	191	,,	Killybegs, Rockmount	9·13	232	163

Climatological Table for the British Empire, March, 1923

STATIONS	PRESSURE: Mean of Day M.S.L.	PRESSURE: Diff. from Normal	TEMPERATURE: Absolute Max.	TEMPERATURE: Absolute Min.	TEMPERATURE: Mean Values Max.	TEMPERATURE: Mean Values Min.	TEMPERATURE: Mean Values ½ max. and min.	TEMPERATURE: Mean Values Diff. from Normal	TEMPERATURE: Mean Wet Bulb.	Relative Humidity	Mean Cloud Am'nt	PRECIPITATION: Am'nt	PRECIPITATION: Diff. from Normal	PRECIPITATION: Days	BRIGHT SUNSHINE: Hours per day	BRIGHT SUNSHINE: Percentage of possible.
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1017·4	+ 4·0	68	31	50·8	38·9	44·9	+ 2·5	42·4	84	7·6	53	+ 10	14	2·3	20
Gibraltar	1017·2	+ 1·4	72	47	64·1	52·2	58·1	+ 0·6	54·5	80	5·3	38	− 84	5	...	...
Malta	1015·5	+ 1·6	66	49	59·6	51·9	55·8	− 0·3	51·4	79	5·9	23	− 11	7	5·9	50
Sierra Leone	1010·8	− 0·1	94	73	89·5	75·6	82·5	− 0·2	74·6	67	5·3	16	− 12	3	...	...
Lagos, Nigeria	1008·9	− 0·5	91	71	88·8	76·9	82·9	0·0	78·3	72	6·7	66	− 30	12	...	...
Kaduna, Nigeria	...	...	100	58	95·0	67·7	81·3	− 0·4	67·3	45	0·2	15	+ 5	2	...	...
Zomba, Nyasaland	1009·2	− 0·5	86	62	80·4	64·6	72·5	+ 1·8	...	89	7·8	266	+ 56	25	...	...
Salisbury, Rhodesia	1009·1	− 2·3	81	52	78·2	58·8	68·5	+ 0·4	63·2	78	6·2	291	+184	22	...	...
Cape Town	1014·6	+ 0·1	96	49	79·9	59·5	69·7	+ 1·5	64·8	69	2·5	18	− 6	4	...	...
Johannesburg	1012·9	− 0·1	81	49	76·0	55·0	65·5	+ 2·2	57·2	73	3·7	52	− 55	11	8·5	70
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Calcutta, Alipore Obsy.	1012·2	+ 2·3	97	57	90·3	67·8	79·1	− 1·0	69·1	81	2·2	29	− 3	*1	...	...
Bombay	1011·4	+ 0·7	96	71	88·0	75·0	81·5	+ 2·0	72·8	74	2·0	0	− 1	*0	...	...
Madras	1012·2	+ 1·3	92	69	88·5	73·3	80·9	− 0·1	75·7	77	2·8	16	+ 11	*1	...	...
Colombo, Ceylon	1010·9	+ 0·9	93	70	89·4	72·9	81·1	− 0·9	77·2	64	4·6	83	− 29	13	9·0	74
Hong Kong	1017·4	+ 1·6	82	55	70·3	61·5	65·9	+ 2·6	61·2	78	6·1	17	− 59	7	5·8	48
Sandakan	...	...	89	73	86·0	75·1	80·5	− 0·6	76·0	78	...	186	− 20	14	...	...
Sydney	1015·5	− 0·7	100	60	79·8	64·5	72·1	+ 2·9	65·4	67	5·2	48	− 82	10	6·6	54
Melbourne	1016·9	− 0·1	93	45	73·6	53·8	63·7	− 0·8	57·6	60	4·8	8	− 49	4	6·3	51
Adelaide	1017·6	+ 0·6	93	50	81·7	56·9	69·3	− 0·6	58·6	47	3·2	1	− 25	1	8·6	70
Perth, W. Australia	1014·4	− 1·0	99	52	84·3	63·3	73·8	+ 2·9	63·6	54	3·3	54	+ 36	4	8·5	70
Coolgardie	1014·3	− 0·5	101	51	88·5	61·7	75·1	+ 3·4	65·1	42	4·2	13	− 6	3	...	...
Brisbane	1014·4	+ 0·3	92	62	84·8	67·2	76·0	+ 1·6	70·6	67	4·6	59	− 91	10	8·1	66
Hobart, Tasmania	1012·5	− 1·5	82	44	66·0	49·9	57·9	− 1·5	52·0	62	5·8	81	+ 38	15	6·6	53
Wellington, N.Z.	1015·3	− 1·7	70	42	65·9	53·4	59·7	− 1·0	54·3	70	6·2	51	− 32	8	5·6	45
Suva, Fiji	1005·9	− 2·6	88	71	83·8	75·1	79·5	− 0·6	77·3	89	7·4	351	− 22	28	...	...
Kingston, Jamaica	1015·3	+ 0·3	92	63	87·3	68·6	77·9	+ 0·8	...	67	3·7	16	− 10	5	...	...
Grenada, W.I.	1015·0	+ 2·1	86	69	83·0	71·4	77·2	− 0·5	70·9	69	4·3	40	− 30	17	...	...
Toronto	1016·2	− 0·8	51	3	35·6	18·6	27·1	− 1·8	22·9	53	5·5	79	+ 12	17	...	...
Winnipeg	1019·7	+ 0·9	45	−27	18·4	− 5·3	6·5	− 7·9	3·5	...	3·7	33	+ 6	14	...	...
St. John, N.B.	1012·5	− 1·7	44	− 9	28·9	12·9	20·9	− 7·5	18·8	61	5·7	125	+ 10	16	...	...
Victoria, B.C.	1021·5	+ 5·7	65	31	49·0	37·9	43·5	+ 0·3	40·1	80	5·3	71	+ 6	14	...	...

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

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The Death of Lady Shaw

ALL readers of the *Meteorological Magazine* will have heard with extreme regret of the death of Lady Shaw, and will desire to express to Sir Napier Shaw their sincere sympathy in the loss which has befallen him. Lady Shaw's health had not been satisfactory for some months past, but it was not realised by her friends that the end was so near. She passed away at Manchester after a brief period of serious illness within a few days of Sir Napier's return from Utrecht, where he had presided over the International Meteorological Conference, to which we refer elsewhere.

In Lady Shaw the staff of the Meteorological Office had a sincere friend who was ever willing to help in any enterprise calculated to bring them together and to foster the spirit of *esprit de corps*. Many an individual also has reason to remember, with gratitude, her friendship and sympathy in times of trouble. On such occasions she was ever ready to give unstintingly of her time and energy. But her interest in Meteorologists and their doings extended beyond the range of the Office staff. The social gatherings connected with international and other meetings held in London in recent years owed much of their success to the care with which Lady Shaw thought out the arrangements and to her skill as a hostess. She had thus many friends among the meteorologists of all countries. Many will remember with pleasure the beautiful photographs of clouds and other phenomena which she showed at such gatherings.

We cannot in this magazine dwell on the many other sides of

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Lady Shaw's activities. She was keenly interested in all educational work. The war forced on all thinking people the need for cultivating the sense of citizenship, and in the last few years Lady Shaw threw herself with characteristic energy into the difficult problem of giving practical shape to that ideal. She was Secretary of the Citizenship Committee of the British Association.

A memorial service was held on September 27th at St. Peter's Church, Cranley Gardens, simultaneously with the funeral service at All Saint's Church, Habergham, near Burnley, and was attended by many friends.

Meeting of the International Meteorological Conference at Utrecht.

SINCE the first steps were taken in 1853 towards international co-operation in meteorology the International Meteorological Organization has had a varied career, its meetings sometimes taking the form of congresses of plenipotentiaries appointed by Governments and convened through diplomatic channels and sometimes of conferences of directors of meteorological services and observatories meeting without official aid. Until 1919 the Organization had no written constitution, but at the first Conference held after the war, at Paris, in 1919, "Réglement de l'organisation météorologique internationale" was formally adopted. According to these rules the International Meteorological Organisation comprises: (1) Conferences of Directors; (2) The International Meteorological Committee; (3) Commissions.

The Conferences are to meet every six years and to consist of "all heads of réseaux of stations in each country and the Directors of Meteorological Observatories which are official and independent of one another," to whom are added a number of Directors of private institutes and representatives of Meteorological Societies.

The International Meteorological Committee is appointed by each Conference to act until the meeting of the next Conference, and is to all intents and purposes the executive body of the Conference, for it carries out the decisions of the past Conference and prepares the business of the next. Each member of the Committee must belong to a separate country and must be the Director of an independent meteorological establishment.

Commissions are appointed by the Committee "to advance the study of special questions," and members are appointed simply from the point of view of their personal qualifications to assist the work of the Commission. In this way the assistance of scientists and private gentlemen unassociated with official services is made available and freely used.

When the Conference met in Paris, in 1919, the political state of the world was so abnormal that invitations could not be sent to some countries, and many other countries were not able to be represented. It was therefore felt that another Conference should be called as soon as conditions became more favourable and all countries, without exception, could meet in council. When the International Meteorological Committee met in London, in 1921, it was considered that such a time was rapidly approaching and the invitation of Professor van Everdingen, the Director of the De Bilt Observatory, Holland, for a meeting of the Conference in Utrecht during 1923 was accepted. The return to normal political relationship has not been so rapid as was expected, and the troubles of the early months of 1923 made it look at one time as if the Conference would have to be postponed, but it was finally decided not to cancel the invitations which had been despatched in December, 1922, and this course has been justified by the successful meetings of the Conference, held in Utrecht, from September 7th to 14th.

The meetings of the Conference were preceded and followed by meetings of several Commissions. The Commissions for Agricultural Meteorology, Solar Radiation, Terrestrial Magnetism and Atmospheric Electricity, Weather Telegraphy and Maritime Meteorology, were held before the Conference (September 3rd—6th), and the Commission for the Study of Clouds and the Commission for the Upper Air met after the Conference (September 14th). For the meetings of the Commissions and Conference fifty members were present, from Argentine (1), Austria (1), Belgium (2), Brazil (1), Denmark (1), Spain (2), Finland (1), France (5), Great Britain (5), India (1), Japan (4), Norway (3), Holland (11), Poland (2), Portugal (1), Russia (2), Sweden (3), Switzerland (2), Czecho-Slovakia (2).

At the first meeting of the Conference on Friday, September 7th, Sir Napier Shaw (Great Britain) was elected President and Dr. Hesselberg (Norway) Secretary-General. After the President's address had been delivered and certain business matters disposed of it was decided to remit all reports and resolutions submitted to the Conference to five sub-commissions for preliminary consideration and the preparation of suitable recommendations. This distribution occupied the greater part of the meeting on Friday afternoon, when the Conference adjourned until the following Tuesday to give the commissions time to prepare their reports. When the Conference re-assembled on Tuesday it worked very hard for three days, considering the sixty odd resolutions submitted for its approval.

The great development of the use of wireless telegraphy in the dissemination of meteorological data has necessitated very intricate co-operation between meteorological services all over the world, expecially in Europe. As the information is distributed broadcast for the use of anyone who cares to receive it, it is highly desirable that the messages issued in the various countries should be of the same form and in the same code. As the result of untiring work of the Weather Telegraphy Commission, under the guidance of its energetic President, Lieut-Colonel Gold, the New International Code is used by twenty-two meteorological services. The arrangement of the times of issue of the wireless messages to prevent interference is also a difficult matter and necessitates close co-operation. It is not surprising, therefore, that twenty resolutions were submitted to the Conference by the Weather Telegraphy Commission. These dealt with such questions as the wording and interpretation of the code, times of issue, description of the stations, reduction of pressure to sea level, additional observations and the establishment of sub-commissions to watch the working of the code and to study proposals for improvements. A new departure was the agreement to add a new group of figures to certain messages to allow experiments to be made of a new method of forecasting based on a close study of cloud forms which has recently been developed by the French Meteorological Office. It was very gratifying that it was not found necessary to alter the International Code, for it is extremely difficult to carry through a change when so many services are concerned, and it would jeopardise all the progress made towards the use of a uniform message if changes were made by some and not by others.

The resolutions submitted by the Commission for Maritime Meteorology were less numerous, but they contained references to several remarkable advances towards the extension of synoptic methods to ships at sea. The Commission recommended the adoption of a code to be used for wireless weather messages sent out from ships. The code consists of eight groups of figures, the first four of which are called universal groups and will be the same for all ships in all parts of the world; the second four, called national groups, will be different according to the office which organises the issue and will be designed to meet the different needs of the various services. This proposal, which was accepted by the Conference, marks a great advance in international co-operation in all parts of the world. The Conference also recorded its appreciation of the work performed on board the "Jacques Cartier." This is a French ship which has made experiments during voyages between America and Europe of collecting meteorological information by wireless telegraphy from ships and shore, preparing a meteorological chart of the Atlantic and then broadcasting forecasts for the use of ships. The "Jacques Cartier" carries an officer of the mercantile marine, trained in the French Meteorological Office, who is assisted by a clerk lent by that Office. Further developments along these lines are to be expected.

The power of the method of "correlation" when applied to meteorological data is now generally recognised by meteorologists. The success of Dr. G. T. Walker, who employs this method in his forecasts of the Indian monsoon, is well known. Such work, however, fails unless homogeneous data, extending over a long period, are available. Professor Exner of Vienna brought this matter before the Conference, and a resolution was adopted expressing the opinion that the publication of long and homogeneous data from a number of stations at distances of about 500 or 1,000 kilometres from one another would be of great value. Not content with expressing this opinion the Conference asked Dr. G. T. Walker to supervise the working of the resolution so far as Asia is concerned, and similarly Professor F. M. Exner for Europe, Mr. H. H. Clayton for America and Dr. G. C. Simpson for Africa, Australia and the ocean generally.

The Conference was unable to solve the problem submitted to it by the Commission for the Upper Air regarding the international publication of upper air data. That these data should be collected and published in a uniform manner is highly desirable, but all the efforts of Sir Napier Shaw, the President of the Commission, to find a possible way of doing so have been unavailing. Such an undertaking would be expensive and would require financial aid from all countries concerned. In present circumstances it is not surprising that such aid is not forthcoming and all the Conference could do was to make suggestions for meeting temporarily the pressing need for the rapid circulation of results obtained by means of sounding balloons. The data obtained by the use of aeroplanes and pilot balloons are too numerous to be handled internationally at present, and the Conference therefore recommended that each country should publish its own data.

Many resolutions dealing with Agricultural Meteorology, Terrestrial Magnetism, Atmospheric Electricity, Solar Radiation and the Upper Atmosphere were adopted, but space does not allow of further details here.

One of the most important questions dealt with by the Conference was its relationship to the International Union of Geodesy and Geophysics. The great growth of the official weather services of all civilised countries has provided so many questions of administration and organisation for international consideration that this side of the activities of the International Meteorological Organization has swamped the scientific side. At recent meetings of the Conference and Committee there has been no time for scientific discussion, and therefore little to attract the members of the Organization other than those connected with the great official meteorological services. A resolution was therefore considered to alter the rules in such a way as to limit membership of the Conference to directors of meteorological services. There was practically no opposition and the rule governing the membership of the Conference now reads as follows :

> "The Officers of the Committee shall invite to the
> "Conference all heads of Réseaux of stations in each
> "country which are official (d'état) and independent of one
> "another."

It was generally understood that this would remove from the work of the Organization all questions of pure science and that the science of meteorology would be considered only in so far as it is applied to the needs of the meteorological services. Practically this is no change in the work of the Organization, but it makes a clear distinction between the sphere of the International Union of Geodesy and Geophysics and the sphere of the International Meteorological Organization. There should now be no material overlap between the work of the Union which considers meteorology from the scientific side and the work of the Organization which "studies only those questions which are of interest to all national meteorological services and which necessitate the utilisation of their own network of stations."

At the last meeting of the Conference when the new International Meteorological Committee had been elected and Sir Napier Shaw was about to terminate his long connection with international meteorology, Colonel Delcambre, the head of the French Meteorological Office, rose, and in a short, eloquent speech expressed the regard every member of the Conference felt for Sir Napier Shaw and the debt which meteorology owed to him. He then proposed that Sir Napier should be elected an honorary member of the International Meteorological Committee, an honour never before bestowed. The proposal was accepted with prolonged applause and much feeling, for all felt that this was a happy way of marking their appreciation of the great work done by Sir Napier Shaw for international meteorology.

The newly elected Committee met the next day and appointed Professor van Everdingen, President, and Dr. Hesselberg, Secretary. The office of Vice-President was left vacant for the present.

The general feeling at the end of the meetings, frequently expressed, was that good work had been done and much progress made. Good feeling between members from all countries was very marked throughout.

Meteorology, etc. at the British Association Meeting, Liverpool, 1923.

A SUBJECT to which increasing attention is being devoted is that of the meteorological effects on sea-level and tides. The magnitude of these effects is sufficient to render their prediction a matter of practical importance, and an important paper was contributed to Section A this year by Dr. A. T. Doodson. It appears that the atmospheric pressure distribution may, by its statical effect and by the operation of the resulting wind, affect the sea-level at Liverpool by the amount of three feet or even more. The fluctuations of sea-level at Liverpool have been correlated with the local atmospheric pressure and with its gradients east and north, and a linear relationship has been established representing the greater part of the meteorological effect. The maximum correlation with the atmospheric pressure is obtained when the sea-level is taken three hours earlier than the pressure, but the effect of the east pressure gradient (south wind) is greatest 15 hours later, while maximum correlation with north-gradient (east wind) is given by simultaneous readings of sea-level and pressure gradient. Two other interesting results contained in the paper are that, for a given pressure gradient, winds in the Atlantic are about 50 per cent. more effective than winds in the Irish Sea, in raising sea-level at Liverpool, and that a west wind raises sea-level on the British coasts of the North Sea though this wind is blowing away from the land. The effect is probably due to west winds blowing over a large area north of Scotland.

"The energy of the circulation of the Earth's atmosphere" was the title of a paper contributed by Capt. D. Brunt. This paper, which was unfortunately read only by title, in the absence of the author, contained some interesting particulars. The total kinetic energy of the general circulation of the earth's atmosphere is estimated as of the order of $3 \cdot 10^{27}$ ergs. An estimate of the kinetic energy of a cyclone which developed over the North Sea between July 27th and August 3rd, 1917, has been given by Sir Napier Shaw as $1 \cdot 5 \times 10^{24}$ ergs, and this represents an addition of 50 per cent., over the area covered by the cyclone, to the average kinetic energy of the general circulation, supposed uniformly distributed over the earth's surface. Considerations of the dissipation of kinetic energy by turbulence lead to the following estimates of the average rates per square metre of the earth's surface: layer from ground to 1 km., 3 watts; layer from 1 km. to 10 km., 2 watts; total 5 watts. If this rate of dissipation were maintained the kinetic energy would be used up in twenty-eight hours. To maintain the general circulation, a little over 2 per cent. of the effective incoming energy of solar radiation must be converted into kinetic energy.

Reference was made to the magnetic disturbance of March 24th, 1923, in a paper by the Rev. A. L. Cortie on "Series in Magnetic Disturbances." This is the greatest disturbance since the exceptional storm of May, 1921, and is a member of a series from January 30th to June 13th, at a mean interval of 27·2 days. This series is noteworthy because the sun has been almost entirely free from spots and bright faculæ since the beginning of the year. It is a continuation of a long series with similar interval beginning October 27th, 1921, and has been associated with a small spot in a region of the sun which has been intermittently disturbed for a similar long period. Complete accord has been established between the series of solar and magnetic disturbances, and the conclusion is drawn that a definite region of the sun can affect the earth magnetically even when there are no visible disturbances upon it.

Reports were again presented by the Committee to assist work on Tides and the Committee for Seismological Investigations, and both Committees were re-appointed, the former with a new constitution. The report of the Tide Committee shows that besides the investigation of meteorological effects, important progress has been made in investigating the effects of friction, due mainly to the retarding effect of the sea bottom. An interesting point in the seismological report is that examination of a long series of Italian records has confirmed a period of about 21 m., detected in Jamaica earthquakes and mentioned in last year's report. Three new periods have also come to light—4 years, 15 months and 6 months.

No report was presented by the Committee for the Investigation of the Upper Atmosphere, but the Committee was re-appointed, with the addition to its members of Mr. L. H. G. Dines.

The official demonstration of forecasting was again given on the lines described in the reports in this Magazine of the previous meetings of the Association in Hull and Edinburgh; but this year, instead of forming an isolated exhibit, it was incorporated as part of the "Scientific Exhibition,"* organised for the first time in connection with a British Association Meeting. This was an exhibition of apparatus and diagrams, representative of many branches of science, open for a fortnight both to members of the Association and of the general public, and was an unqualified success. The Meteorological Office exhibit, to which a representative collection of meteorological instruments was added this year, occupied a prominent position in the entrance

* See *Nature*, July 22nd, 1923.

hall of the Central Technical Schools, where the Exhibition was held, and was a very popular feature. Amongst the items which attracted special attention were a record of the recent earthquake in Japan, and the anemogram for the period of the gale of August 29th-30th, both taken at Bidston Observatory, Liverpool, and lent by the Director, Mr. W. E. Plummer. Valuable voluntary assistance in connection with the routine work of the local daily weather service, which formed part of the exhibit, was rendered by three students of the Geography School of the University of Liverpool, Messrs. Fitzgerald, Darbishire and Smith. Some interesting atmospheric pollution diagrams were lent by Dr. J. R. Ashworth of Rochdale.

The "Scientific Exhibition" also contained an exhibit of anemometers by R. W. Munro, Ltd., and a miscellaneous exhibit by Negretti and Zambra, Ltd., but there was no undue duplication of instruments shown by the Meteorological Office. Special mention may be made of a new barograph of special construction shown by Negretti and Zambra, designed for survey work. The instrument has a very open scale, 1 inch of barometric pressure equalling 4 inches on the chart, and it may be reset to any standard barometric reading between 25″ and 31″ of mercury. Compensation for temperature is embodied, and as this is varied when the instrument is set to any different reading, the temperature errors for a change of 40° C. at any pressure are very minute.

Another feature of the Liverpool meeting was a Soirée at the University, on the lines of the Royal Society Soirées. A demonstration of atmospheric dust was contributed by Dr. J. S. Owens, while Mr. L. H. G. Dines demonstrated the working up of meteorograph records of upper air temperature, and the use of the special meteorographs which have been designed for determining the height of ground fogs. An exhibition of meteorological instruments by Casella, Ltd., was also a feature of the Soirée.

On Friday, September 14th, a ballon-sonde was released from the University grounds by Mr. L. H. G. Dines, before a gathering of nearly one hundred people. It was hoped that the meteorograph might be received back in time for the record to be worked up at the University Soirée, but this was, unfortunately, not the case. It has, however, been returned since.

The "Meteorological Luncheon" was again held, the gathering being as is usually the case, a geophysical rather than a meteorological one. The party, which numbered 38, assembled at the North-Western Hotel, Lime Street. Prof. H. H. Turner presided, and after the luncheon there were interesting speeches from Dr. M. Newbiggin, Prof. Proudman, Mr. L. F. Richardson, Prof. Lindemann, Mr. J. J. Shaw, Sir Richard Gregory and Mr. W. E. Plummer. Others present included Mr. W. Andrews, Mr. and Miss Bellamy, Dr. H. Borns, Mr. L. H. G. Dines, Dr. and Mrs. Doodson, Mr. N. Edge, Miss R. M. Fleming, Mr. M. A. Giblett, Maj. A. H. R. Goldie, Mr. W. Hall, Dr. E. P. Harrison, Dr. W. Harwood, Mr. G. R. Hay, Capt. H. F. Jackson, Dr. H. Jeffreys, Mr. and Mrs. Kinvig, Lt.-Com. G. ff. H. Lloyd, R.N.R., Mr. W. G. Mitchell, Mr. H. Montgomery, Dr. J. S. Owens, Sir J. Petavel, Dr. H. C. Plummer, Mrs. Proudman, Rev. J. P. Rowland, Mrs. and Miss Turner and Miss L. Winchester.

M.A.G.

OFFICIAL NOTICE

The following changes are announced as from June 11th, 1923. Mr. F. J. W. Whipple, Superintendent of the Climatology Division, succeeds the late Mr. M. de Carle S. Salter as Superintendent of the British Rainfall Organization. Mr. R. Corless, Superintendent of the Instruments Division, becomes Superintendent of the Climatology Division, while Captain F. Entwistle, Assistant Superintendent of the Local Centres Division, is promoted Superintendent of the Instruments Division. Mr. Whipple becomes sole Editor of the *Meteorological Magazine*.

Correspondence

To the Editor, *The Meteorological Magazine*

The "Prime"

In Bacon's essay " Of Vicissitude of Things " there occurs the following passage :—

> " There is a toy which I have heard, and I would not have it given over but waited upon a little. They say it is observed in the Low Countries (I know not in what part) that every five and thirty years the same kind and suit of years and weathers comes about again, as great frosts, great wet, great droughts, warm winters, summers with little heat, and the like, and they call it the ' Prime.' It is a thing I do the rather mention because, computing backwards, I have found some concurrence."

It is interesting to note that the period of the " Prime " is the same as that of Bruckner's cycle.

CICELY M. BOTLEY.

10, *Wellington Road, Hastings, September 19th*, 1923.

A Halo Complex, August 20th 1923

SOME interesting halo phenomena were observed at Draycott, Staffs., on August 20th, at 16h. 30m., G.M.T. The sky was rapidly being covered with cirrus cloud when two bows of brilliant rainbow colours appeared above the sun. Blue, green, yellow and red were very bright, the red being nearest the sun. No traces of the halos were seen, the upper bow was apparently an arc of upper contact to the halo of 46°, and the lower to that of the halo of 22°. In the latter one end was bent upwards, and the other end downwards. At 16h. 32m. a brilliant mock sun also appeared. The whole phenomena only lasted 10 minutes, rain setting in steadily at 17h.

GRAHAM C. LAWSON.

Mayfield House, Nr. Ashbourne, Derbyshire. August 23rd, 1923.

[At the time in question the elevation of the sun must have been about 23°. With this elevation the upper arc of contact of the 22° halo is curved like a pair of ram's horns. Presumably, Mr. Lawson observed one " horn " and at the same time a small part of the 22° halo itself. The complex is remarkable, as the circumzenithal arc and the mock sun indicate the presence of prisms with vertical axes, whilst the upper arc of contact of the 22° halo implies prisms with horizontal axes in that part of the atmosphere, and an absence there of the random crystals which were responsible for the 22° halo.—ED. *M.M.*]

Obituary

Dr. John Allen Harker, F.R.S., O.B.E.—Dr. J. A. Harker, who died at Highgate on October 10th after a short illness, was a physicist and chemist with a wide range of interests. He came into touch with meteorologists as a young man when, in 1897, he undertook, on behalf of the Kew Observatory Committee, the comparison of the scales of thermometers ; his work, carried out partly at Kew and partly at Sèvres, put platinum thermometry on a sound basis. When Kew Observatory was made the nucleus of the National Physical Laboratory, Dr. Harker became principal assistant in the Physical Department.

Some years later, in 1913, he undertook temporarily the office of Superintendent of Eskdalemuir Observatory. Since the war, in which his scientific knowledge and experience were largely used by the Government, Dr. Harker had established a successful practice as a consultant, and was engaged on such work as the utilization of the power available at the great Nile barrage. The country can ill afford the loss of men of such ability and initiative.

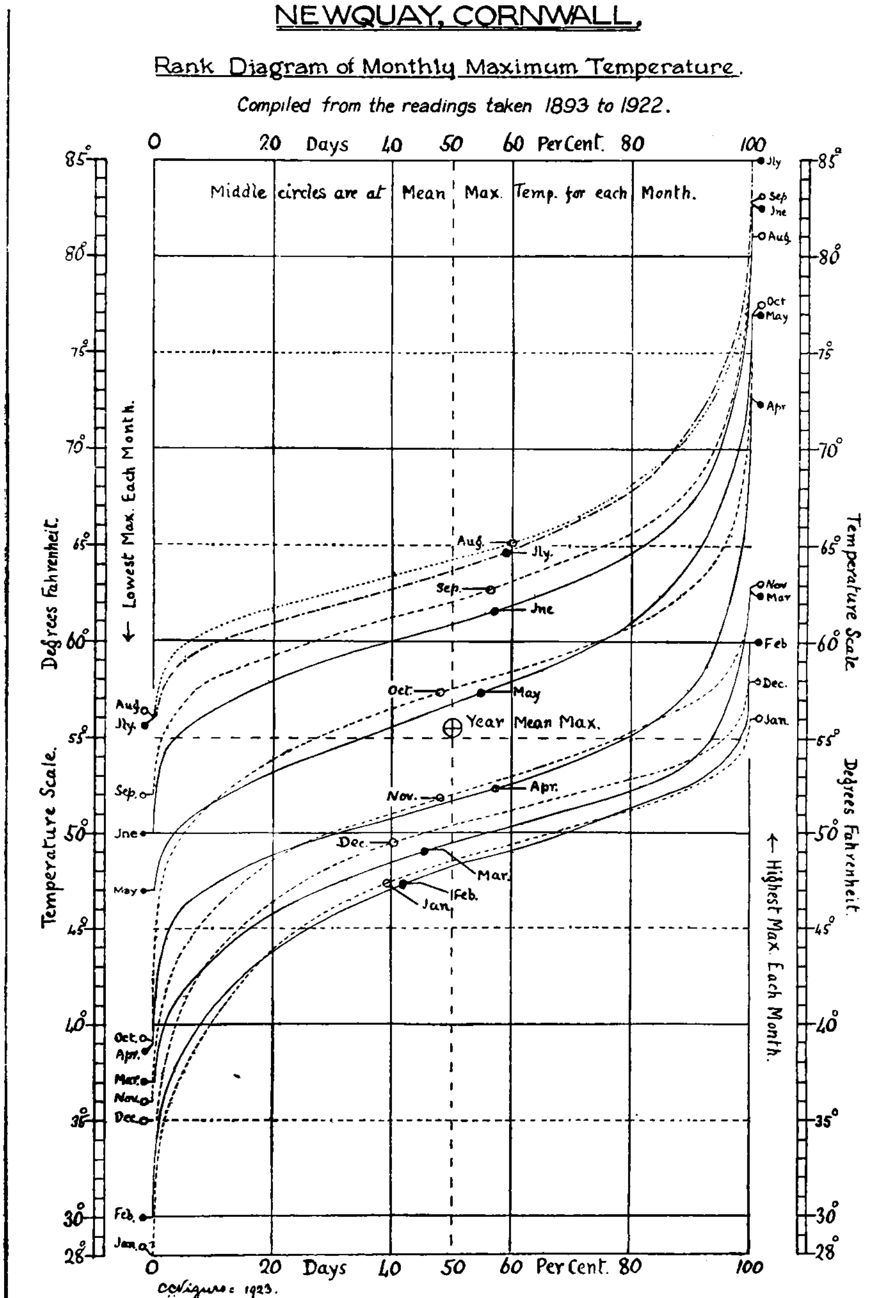
NOTES AND QUERIES

The Distribution of Maximum Temperatures at Newquay

It is a commonplace amongst students of weather that " normal " or " average " weather is very rare, and that the right way to obtain a grasp of the subject is to consider the frequency of deviations from the average of various amounts. The reduction of the observations to an appropriate form, though interesting, is somewhat laborious, and it has not been done very extensively. Dr. Vigurs, of Newquay, has studied the distribution of maximum temperatures at that place, and has been so good as to prepare the diagram* which is reproduced here. It is proposed to call such a diagram a " rank-diagram " : the name is suggested by a row of soldiers arranged in order of height, the shortest on the left, the tallest on the right. Here we have represented by the top curve 100 typical August temperatures, the lowest on the left, the highest on the right. It will be seen, for example, that 20 per cent. of August days have maximum temperature below 61·7° F., 40 per cent. below 63·5° F., 60 below 65·0° F., 80 below 68·2° F. The lowest and highest maxima on record for the month are 56° and 81° respectively. The average maximum is 65·0° F., but the median (shown on the 50 per cent. line) is 64·3° F.

The diagram illustrates the characteristics of the ocean climate of Newquay, which lies on the north side of Cornwall, about 38 miles from Land's End. The seasons are very late—August being hotter than July, February colder than January—but a glance at the diagram shows that the very hottest days are in July and the very coldest in January. The ordinary October days are warmer than those of May, but May has some days hotter than any in October, and October some colder than any in May. There is a similar relation between November and April. These characteristics are determined, of course, by the slowness with which the temperature of the ocean changes. They may be summed up roughly by the statement that the ocean temperature governs the upper limit of air temperature

* The method adopted was as follows: The number of days of each maximum temperature for each month were added up, making for 30 years a total of 930 days for each month with 31 days. To April, June, September and November, 30 days were added proportionately to the number of days at the various degrees of temperature, and to February 90 days in a similar manner. The days were then plotted out on squared paper at the various temperatures at a scale of 6·2 ins. = 930 days, and the curves drawn with a minimum amount of smoothing. The 6·2 ins. was then halved for 50 (per cent. or days) and divided into 5 columns of 1·24 ins. for 20, 40, 60, 80 (per cent. or days) thus saving much computation.


NEWQUAY, CORNWALL.
Rank Diagram of Monthly Maximum Temperature.
Compiled from the readings taken 1893 to 1922.
0 20 Days 40 50 60 Per Cent. 80 100
Middle circles are at Mean Max. Temp. for each Month.
Year Mean Max.
← Lowest Max. Each Month.
← Highest Max. Each Month.
Degrees Fahrenheit.
Temperature Scale.
85° 80° 75° 70° 65° 60° 55° 50° 45° 40° 35° 30° 28°
Jly Sep Jne Aug Oct May Apr Nov Mar Feb Dec. Jan.
C. Le Nigrier 1923.

in winter and the lower limit in summer. The average value of the daily maximum temperature for each month is indicated on the diagram. May and October have the same average, but in May the maximum temperature is below the average on 56 days in 100: in October on 48 days in 100. It is significant that the months divide themselves into two groups, February to July, and August to January. In the former group the proportion of days with temperature below the average is higher than in the latter.

Special interest attaches to the highest and lowest temperatures recorded at the station. Dr. Vigurs gives the following particulars:—

The highest temperature on record, 85° F., occurred at Newquay on July 13th, 1921. There was a long spell of hot weather during the month, and on the day in question, the general flow of air across Cornwall was from the south-east, so that the sea influence must have been almost eliminated. The coldest days in the period covered by the Newquay observations were January 4th, 1894, and January 23rd, 1907. The weather maps for those days (reproduced in handy form in the *Weekly Weather Report*) show a remarkable resemblance. In each case there was an anticyclone over Europe, with very low temperatures in Russia, −27° F. being reported at Moscow on the former date, and −22° F. at Riga on the latter. In both instances the cold air reached Newquay from the south-east. There are only eight "ice-days" (maximum temperature below 32° F.) in the series of observations.

An interesting sequence of readings occurred at Newquay in 1895, the maximum temperatures for September 21st to October 1st being 83, 79, 79, 79, 77 and 77. These present a striking contrast to the Falmouth entries,* 68, 70, 69, 60, 67 and 67. The Newquay figures are supported by the reports from the North Devon stations and from Bristol, and appear to be authentic. They are the more remarkable in that only two readings above 78 are credited to August.

Gordon Bennett Balloon Race, September 23rd, 1923.

THE Gordon Bennett Balloon Race, which started this year from Brussels on the afternoon of September 23rd, will be remembered for the tragic destruction by lightning of three of the competing balloons, involving the death of five of the six aeronauts flying

* Hourly Means 1895, Table xii.

in them, and a few notes on the meteorological aspects of the race may be of interest. Extensive meteorological arrangements were made by the Institut Royal Météorologique, Brussels, as a result of which each competitor received during the morning a photographic copy of the weather chart of north-west Europe, and with it charts showing the wind at various levels, constructed from pilot balloon observations made over a wide area in the early morning. A forecast of general weather conditions for the current and succeeding day was also provided, and in the early afternoon a later set of upper wind charts was issued, giving conditions about noon. Arrangements were also made for the issue of later reports by wireless during the evening, both by slow Morse and by telephony, and a number of balloons carried receiving apparatus.

Owing to the control which the aeronaut is able to exercise over the altitude of the balloon, by the ejection of ballast, the meteorological factor is very important, and the meteorological situation is closely studied by most competitors. The balloon which descends on land, at the greatest distance from the starting point, is counted the winning balloon. The duration of the flight is not taken into account, but in planning the flight it is necessary to choose such altitudes as will give as rapid progress as possible on account of progressive loss of ballast and gas. At the same time the distribution of land and sea must be taken into consideration as a descent in the sea, apart from the danger, disqualifies the balloon. These remarks will serve to show how interesting may be the problems which present themselves on such occasions.

The writer was present unofficially this year in Brussels with one of the British competitors, Sq.-Leader Baldwin, pilot of "Banshee III.", and discussed with him the meteorological situation, on the basis of the information supplied by the Belgian Institute and of cables received from the Meteorological Office, London. It was hoped that advantage might be taken of a strong wind current between 3,000 and 6,000 feet for the first twelve hours to Denmark, and that, crossing to Sweden by a short sea route, strong southerly or south-westerly winds might then be found at a greater height, such being suggested by the horizontal temperature distribution. Conditions were unsettled, however, and of the fifteen balloons, all of which left in succession between 3 and 4.30 p.m. (G.M.T.) in showery weather, only two, both Belgian, succeeded in reaching Sweden, the early landing of most of the balloons, apart from those struck by lightning, being accounted for by the sheer weight of rain and snow which fell on them. The winning balloon landed 1,100 kilometres from Brussels after nineteen hours' flight. From accounts in the Belgian press it appears that the early part of the flight was round about 8,000 feet. Higher levels were obtained later, and at 20,000 feet oxygen was taken. The second balloon, which landed 100 kilometres short of the first, seems to have proceeded much on the lines contemplated by Sq.-Leader Baldwin, who, however, was less fortunate, and was beaten down by rain and snow.

It is important to emphasize that the disastrous results of this year's race are not to be attributed to lack of meteorological information or to faulty meteorological advice. The forecast issued by the Belgian Meteorological Institute was received by all competitors, and conveyed a warning of showers and thundery squalls, while conditions were actually showery at the time of the start. The regulations state, however, that the race shall commence at the prearranged time irrespective of weather conditions. Of course, it is open to any competitor to withdraw, but in view of the international and sporting character of the event and the long and careful preparation necessary, the temptation to "chance it" whatever the weather, is necessarily very strong.

A miniature "Gordon-Bennett" was arranged for onlookers, and very large numbers of toy balloons were released with addressed postcards attached for their return if found. It is to be hoped that the Institut Royal Météorologique, Brussels, will be able to obtain and publish the results, which should be of great interest.

M. A. GIBLETT.

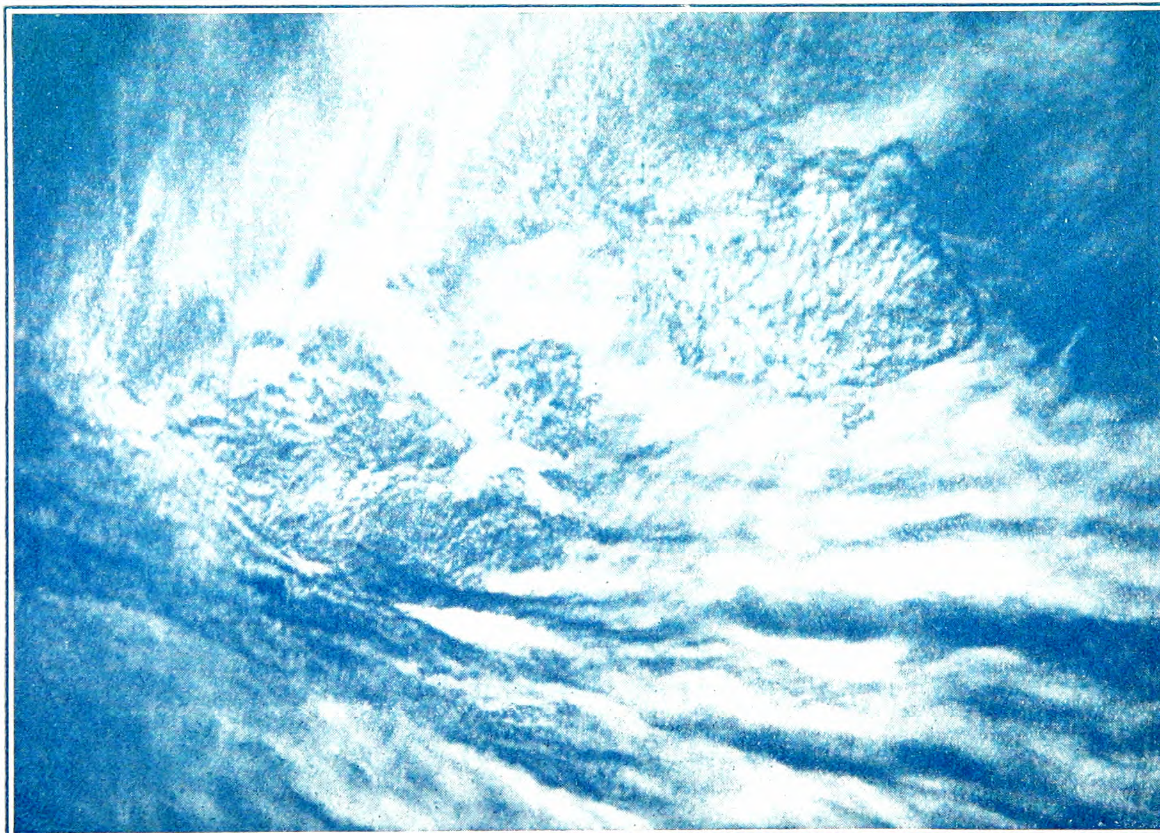
A Cloud Spiral

THE accompanying photograph illustrates an unusual cirrus cloud formation which was observed at Shoreham-by-Sea during the afternoon of July 14th last. It will be seen that the cloud shows a very definite spiral structure about an axis apparently nearly vertical. At the time the picture was taken (14h. 10m. G.M.T.) the cloud was in the south-west, with its base about 15 degrees, and its top about 45 degrees, above the horizon. It occupied this position without much change for an hour or more. Subsequently the cloud spread gradually over the sky towards north-east, apparently as the result of the growth of the low part of the spiral, the whole taking on an appearance like that of a fan with a twist in it.

The photograph suggests a combination of ascensional and anti-clockwise rotatory motion, that is to say, a cyclonic whirl on a small scale. It must be observed, however, that if the cloud were really formed in this way the upward component velocity must have been of the same order of magnitude as the horizontal components in order to give such a steep "pitch" to the screw

Cirrus Spiral, observed at Shoreham-by-Sea, July 14th, 1923.

To face p. 212



Cirro-Cumulus, observed at Aberdeen, November 28th, 1922.

To face p. 213

in the lower part of the picture. No rotatory motion was, however, actually observed.

A reference to the synoptic charts showed that on the day in question the British Isles were in a region of almost uniform pressure between anticyclones over the North Sea and the Azores. There was a tendency for the formation of small shallow depressions, and slight rain or showers fell at many stations. Thunder occurred locally in the Midlands. Surface temperature exceeded 80°F. in the south of England, and at mid-day the dew point was above 60°F. at all the southern stations. It was therefore a day favourable for the exhibition of convectional phenomena. The curious thing about the whirl in the photograph is that it was confined to the cirrus regions. There was no low cloud that could be associated with the phenomenon.

E.G.B.

Note on Cirro-Cumulus Cloud of November 28th, 1922

THE photograph shows a rather curious development that occurred in a sheet of cirro-stratus cloud which was under observation at Aberdeen at 12h. 15m. on November 28th, 1922. The patch of cirro-stratus formed rather rapidly almost in the zenith, and was divided up by several " lanes " of clear sky, which were orientated along the direction of the cloud's movement, which was from west-north-west. The " speed-height-ratio " of the cloud was 2·8 milliradians per second, so that on the assumption of a height of 4 miles for the cloud, the speed must have been about 40 miles per hour. The cloud itself showed much change of form, evaporation and condensation taking place rapidly and simultaneously in different portions of the sheet. At the time the photograph was taken these changes were of an unusual character. Several small areas in the cloud-sheet became separated from the main mass by a narrow clear-cut " boundary line " of blue sky, and, within this boundary, the stratiform character of the cloud was suddenly replaced by fine cirro-cumulus cloudlets which did not retain that form for more than a minute or two, but reverted to the general stratiform appearance. The forming of these turbulent areas appeared to the eye to resemble the " boiling " of eddies in water flowing past a rock where the water is rather deep. It is difficult to offer any suggestion of the causes of the phenomenon.

G.A.C.

Colombo Records for 1922.

FROM the Report on the Colombo Observatory for 1922 we learn that pilot balloon observations, at the rate of "three every third day" have become an important part of the routine of the observatory. The "Tail-method" is used. A survey of the results is to be published shortly. The same Report contains a valuable set of diagrams illustrating the diurnal variation of wind speed at Colombo. The contrast between the monsoonal type of a steady wind fluctuating between 10 miles an hour by night and 15 by day and the sea-breeze type which dies away at night is striking. The monsoon is strongest very soon after noon, but the sea-breeze culminates in the late afternoon. A tentative adaptation of the warm-front theory to explain the circumstances of a tropical rain storm is also interesting.

Radiation from the Sky

RADIATION MEASURED AT BENSON, OXON, 1923.

Unit: one gramme calorie per square centimetre per day.

ATMOSPHERIC RADIATION only (dark heat rays).

Averages for Readings about time of Sunset.

		July	Aug.	Sept.
Cloudless days:				
Number of readings	n	16	23	15
Radiation from sky in zenith ...	πI	626	564	547
Total radiation from sky ...	J	667	600	583
Total radiation from horizontal black surface on earth ...	X	830	763	746
Net radiation from earth ...	X—J	163	163	163

DIFFUSE SOLAR RADIATION (luminous rays).

Averages for Readings between 9 h. and 15 h. G.M.T.

		July	Aug.	Sept.
Cloudless days:—				
Number of readings	n_0	3	0	4
Radiation from sky in zenith ...	πI_0	39	—	22
Total radiation from sky ...	J_0	40	—	25
Cloudy days:—				
Number of readings	n_1	5	3	4
Radiation from sky in zenith ...	πI_1	100	86	53
Total radiation from sky ...	J_1	88	61	50

Unit for I = gramme calorie per day per steradian per square centimetre.
Unit for J and X = gramme calorie per day per square centimetre.

For description of instrument and methods of observation, see *The Meteorological Magazine*, October, 1920, and May, 1921.

The Passing of Benson Observatory

WITH the transfer to Kew Observatory of the important work which has been carried on for many years at Benson, an interesting chapter in the history of the Meteorological Office is closed. The following statement which was issued to the newspapers at the end of September explains the circumstances.

In 1905 the Meteorological Office was for the first time able to assist the regular investigation of the Upper Air over the British Isles, which had previously been carried out by private scientific workers, in some cases with the assistance of the British Association for the Advancement of Science and of the Royal Meteorological Society. Mr. W. H. Dines, F.R.S. had taken a leading part in the practical development of the investigation, and, at the request of the Meteorological Office, he agreed to supervise their work for a nominal fee and provide free of charge the facilities which his residence afforded for work with kites and balloons. After 1910 Mr. Dines removed to Benson, in Oxfordshire, and for the past 12 years he has continued there the upper air work which he had carried out so successfully at Pyrton Hill, on the Chilterns, and at Oxshott, in Surrey, besides contributing meteorological reports daily in connection with the Forecast Service of the Meteorological Office. As a result of these investigations and of the research for which they provided material and in which Mr. Dines has himself taken a leading place, England gained a position in the forefront of the Investigation of the Upper Atmosphere.

At the end of June, 1922, Mr. Dines retired from active supervision of the work, and although he generously continued to give facilities for the investigations to be carried on at Benson, it became necessary to make arrangements for the permanent establishment of Upper Air Investigation. The pressing need for economy made it impossible to erect an observatory in the situation which Mr. Dines's experience had indicated to be the most desirable, viz., open country north-west of Oxford ; it was accordingly arranged to utilise Kew Observatory, where some additional accommodation could be provided at small cost, and where the disadvantage of position would be to some extent compensated by proximity to the Central Office and contact with other branches of meteorological work. The provision of the accommodation is now practically complete and it is anticipated that the transfer will be made early in October. The Observatory at Benson will then be closed. The regular daily reports in connection with forecasting will be made at the Wireless Station at Leafield by the courtesy of the Postmaster-General, while the Upper Air Investigation will be continued at Kew Observatory.

News in Brief

It is announced that Mr. G. M. B. Dobson has been awarded the Johnson Memorial Prize in the University of Oxford for his paper on "Measurements of the Sun's ultra-violet Radiation and its Absorption in the Earth's Atmosphere."* Mr. Dobson has developed a method for recording photographically the strength of such radiation coming from the sun as can pass through a thin film of silver. The fluctuations from day to day are found to be large, and their study opens up a new and important field of investigation for meteorologists.

An account of the International Cloud Week, which was held during the week beginning September 24th, 1923, will be published in the November issue of this magazine.

The Weather of September, 1923

During the early part of the month fair, warm, sunny, weather prevailed generally in the more southerly districts of the British Isles. Maxima of 70° F. and over were recorded at several stations between the 6th and the 13th, 77° F. being reached in London on the 13th, and the sunshine records were above normal. In the north and west, however, the influence of the depressions passing from Iceland towards northern Norway was felt and several rather heavy falls of rain were recorded, *e.g.*, 36 mm. at Onich, 31 mm. at Ford on the 11th, and 33mm. at Stornaway on the 8th.

Towards the end of the second week the track of the depressions was more to the south and conditions became unsettled over the whole country. Strong or high winds were experienced on the western and northern coasts on the 11th and 12th, and then occurred almost daily from the 17th to the 26th on some or other exposed part of the coast, while gale force was reached on the 11th—12th, 17th, 20th—21st and 23rd—25th. Thunderstorms developed locally on the 14th and 15th and again on the 18th, 22nd and 23rd, and heavy rain was recorded from many places ; 63 mm. at Bassett Down, Wilts, on the 14th and 57mm. at Dungeon Ghyll, Cumberland, being among the heaviest falls. The supply of "polar" air brought by northerly winds from the Icelandic region caused a decided drop in temperature on the 15th, and from then to almost the end of the month the weather was cool with maxima about 60° or even lower. Snow was reported for the first time this autumn, on the 20th on several of the mountains in Scotland.

Near the end of the month the anticyclone over France spread northwards and quiet, warm weather occurred generally over the

* Published in the Proc. Roy. Soc. Vol. 104 (series A) 923, p. 252.

British Isles, the highest temperatures of the month being recorded at several stations on the 30th. Much mist and fog prevailed during the last two days along the southern coasts of England and Ireland and resulted in many shipping accidents in the English Channel and St. George's Channel.

The heat and drought in Switzerland, referred to last month, continued through the first half of September, but on the 20th and after, several heavy snowfalls were reported, extending as low as 5,900 feet. In India the rains were generally heavy, especially at Bombay, which was flooded on the 20th and received a further 12 inches of rain in the week ending on the 27th, bringing the total fall during the season up to 77 inches, or 10 inches above normal. In the last week of September the monsoon weakened. In the United States snow and frost were recorded from an extensive area in the north and middle west as early as the 13th, and on the 27th the weakening of a bridge by heavy rainfall, in Wyoming, caused a serious rainfall accident.

Early in the month much fog was recorded, and on the 8th seven American destroyers went ashore in thick fog north of Santa Barbara, on the Pacific coast. The White Star liner "Majestic" was greatly delayed by fog between New York and Southampton.

The special message from Brazil states that in the north the rainfall averaged 23 mm. below normal. In the south the distribution was irregular, though 22 mm. more than normal were recorded, and in the central districts the rainfall was abundant, being 38 mm. above normal. Temperature was slightly above normal. Owing to these conditions the prospects of the coffee and sugar cane crops are not so good.

Mr. R. C. Mossman, Director of the Cordova Observatory, writes that in the Argentine the early days of September saw the termination of a period of unusually cold weather with strong southerly or westerly winds and much rain or snow. In some places in Central Argentine the snow, where not drifted, lay 3 or 4 feet deep, and enormous loss of sheep and cattle is reported; there was also an epidemic of influenza. This inclement weather was associated with an intense anticyclone (1,040 mb.) south of 50°S, with a deep, slow, moving depression south-east of Buenos Aires.

Rainfall September, 1923: General Distribution

England and Wales	126	per cent. of the average 1881-1915		
Scotland	156	,,	,,	,,
Ireland	146	,,	,,	,,
British Isles	138	,,	,,	,,

Rainfall Table for September, 1923

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent. of Av.
Lond.	Camden Square.......	1.29	33	71	*Leics*	Leicester Town Hall...	2·33	59	...
Sur .	Reigate, Hartswood...	1·60	41	...	,, .	Belvoir Castle........	2·76	70	148
Kent.	Tenterden, View Tower	1·85	47	86	*Rut* .	Ridlington...........	2·86	73	...
,, .	Folkestone, Boro. San.	2·02	51	...	*Linc.*	Boston, Skirbeck	2·28	58	130
,, .	Broadstairs	1·59	40	81	,, .	Lincoln, Sessions House	2·37	60	154
,, .	Sevenoaks, Speldhurst.	1·56	40	...	,, .	Skegness, Estate Office.	2·82	72	156
Sus .	Patching Farm........	2·26	57	94	,, .	Louth, Westgate	3·73	95	185
,, .	Eastbourne, Wilm. Sq.	3·38	86	135	,, .	Brigg	2·91	74	172
,, .	Tottingworth Park....	3·27	83	133	*Notts.*	Worksop, Hodsock....	2·21	56	145
Hants	Totland Bay, Aston...	3·15	80	141	*Derby*	Mickleover, Clyde Ho..	2·49	63	139
,, .	Fordingbridge, Oaklnds	2·35	60	109	,, .	Buxton, Devon. Hos...	6·01	153	185
,, .	Portsmouth, Vic. Park.	2·14	54	99	*Ches.*	Runcorn, Weston Pt...	3·60	91	135
,, .	Ovington Rectory	2·60	66	114	,, ..	Nantwich, Dorfold Hall	3·16	80	...
,, .	Grayshott	1·92	49	79	*Lancs*	Bolton, Queen's Park .	5·05	128	...
Berks	Wellington College...	1·74	44	95	,, ..	Stonyhurst College....	7·00	178	183
,, .	Newbury, Greenham..	1·98	50	98	,, ..	Southport, Hesketh...	3·57	91	130
Herts.	Bennington House....	...	..	...	,, ..	Lancaster, Strathspey.	4·07	103	...
Bucks	High Wycombe	2·42	61	128	*Yorks*	Sedbergh, Akay	7·95	202	189
Oxf..	Oxford, Mag. College..	2·00	51	119	,, .	Wath-upon-Dearne ...	1·24	31	78
Nor .	Pitsford, Sedgebrook..	2·60	66	144	,, .	Bradford, Lister Pk...	3·15	80	152
,, .	Eye, Northolm.......	2·60	66	...	,, .	Oughtershaw Hall	8·65	220	...
Beds.	Woburn, Crawley Mill.	2·67	68	140	,, .	Wetherby, Ribston H..	2·68	68	149
Cam.	Cambridge, Bot. Gdns.	1·97	50	122	*ERY*	Hull, Pearson Park ...	3·25	83	189
Essex	Chelmsford, CountyLab	1·84	47	...	,, .	Holme-on-Spalding ...	3·20	81	...
,, .	Lexden, Hill House...	1·28	33	...	,, .	Lowthorpe, The Elms.	2·06	52	119
Suff.	Hawkedon Rectory ...	3·04	77	157	*NRY*	West Witton, Ivy Ho..	2·76	70	...
,, .	Haughley House......	1·64	42	...	,, .	Pickering, Hungate ...	3·01	77	...
Norf.	Beccles, Geldeston....	1·23	31	64	,, .	Middlesbrough	1·56	40	94
,, .	Norwich, Eaton	1·95	49	91	,, .	Baldersdale, Hury Res.	2·76	70	101
,, .	Blakeney	1·43	36	77	*Durh.*	Ushaw College	1·33	34	66
,, .	Swaffham	1·85	47	87	*Nor* .	Newcastle, Town Moor.	1·78	45	87
Wilts.	Devizes, Highclere....	4·23	107	...	,, .	Bellingham Manor....	2·66	68	...
Dor .	Evershot, Melbury Ho.	4·17	106	157	,, .	Lilburn Tower Gdns...	1·91	49	...
,, .	Weymouth,Westham..	3·26	83	155	*Cumb*	Penrith, Newton Rigg..	...	..	...
,, .	Shaftesbury, Abbey Ho.	2·87	73	118	,, .	Carlisle, Scaleby Hall .	3·43	87	127
Devon	Plymouth, The Hoe...	3·00	76	122	,, .	Seathwaite	13·35	339	135
,, .	Polapit Tamar	3·47	88	124	*Glam.*	Cardiff, Ely P. Stn.....	4·02	102	130
,, .	Ashburton, Druid Ho..	4·96	126	159	,, .	Treherbert, Tynywaun	8·48	215	...
,, .	Cullompton	2·96	75	132	*Carm*	Carmarthen Friary....	4·42	112	128
,, .	Sidmouth, Sidmount ..	2·79	71	121	,, .	Llanwrda, Dolaucothy.	6·34	161	156
,, .	Filleigh, Castle Hill ...	4·76	121	...	*Pemb*	Haverfordwest, Portf'd	3·56	90	100
,, .	Hartland Abbey......	3·16	80	...	*Card.*	Gogerddan...........	...	..	...
Corn.	Redruth, Trewirgie ...	3·24	82	104	,, .	Cardigan,County Sch. .	3·44	87	...
,, .	Penzance, Morrab Gdn.	2·80	71	96	*Brec.*	Crickhowell, Talymaes	8·00	203	...
,, .	St. Austell, Trevarna..	3·78	96	119	*Rad* .	Birm.W.W.Tyrmynydd	5·27	134	137
Som	Street, Hind Hayes ...	2·99	76	...	*Mont.*	Lake Vyrnwy	5·62	143	159
Glos..	Clifton College	3·05	77	130	*Denb.*	Llangynhafal	2·93	74	...
,, .	Cirencester	2·83	72	125	*Mer* .	Dolgelly, Bryntirion..	8·48	215	199
Here.	Ross, County Obsy. ...	2·16	55	107	*Carn.*	Llandudno	3·02	77	132
,, .	Ledbury, Underdown.	1·86	47	97	,, .	Snowdon, L. Llydaw 9	18·30	465	...
Salop	Church Stretton......	2·74	70	135	*Ang* .	Holyhead, Salt Island.	3·96	101	148
,, .	Shifnal, Hatton Grange	2·07	53	107	,, .	Lligwy	3·55	90	...
Staff.	Tean, The Heath Ho...	3·82	97	160	*Man.*	Douglas, Boro' Cem...	4·05	103	123
Worc.	Ombersley, Holt Lock.	1·67	42	94	*Guer.*	St. Peter Port, Grange.	3·15	80	121
,, .	Blockley, Upton Wold.	2·49	63	119	*Wigt.*	Stoneykirk, Ardwell Ho	3·95	100	142
War	Farnborough.........	2·73	69	128	,, .	Pt. William, Monreith .	4·04	103	...
,, .	Birminghm, Edgbaston	2·69	69	150	*Kirk.*	Carsphairn, Shiel.	10·63	270	...

Correction—Cardiff, Ely P. Stn., Aug., *for* 4·61 \| 117 \| 107 \| *read* 4·91 \| 125 \| 114

Rainfall Table for September, 1923—*continued*

CO.	STATION.	In.	mm.	Per-cent. of Av	CO.	STATION.	In.	mm	Per-cent. of Av.
Kirk.	Dumfries, Cargen	6·52	166	222	*Caith*	Loch More, Achfary	9·30	236	162
Dum	Drumlanrig	5·85	149	198	,,	Wick	3·34	85	134
Roxb	Branxholme	3·54	90	158	*Ork.*	Pomona, Deerness	5·41	137	187
Selk.	Ettrick Manse	6·79	173	...	*Shet.*	Lerwick	5·84	148	194
Berk.	Marchmont House	1·71	43	71	*Cork.*	Caheragh Rectory	6·33	161	...
Hadd	North Berwick Res.	2·29	58	110	,,	Dunmanway Rectory	5·51	140	134
Midl	Edinburgh, Roy. Obs.	1·60	41	87	,,	Ballinacurra	2·57	65	102
Lan.	Biggar	4·29	109	188	,,	Glanmire, Lota Lo.	3·31	84	118
Ayr.	Kilmarnock, Agric. C.	6·17	157	202	*Kerry*	Valencia Obsy.	5·62	143	136
,,	Girvan, Pinmore	6·87	175	179	,,	Gearahameen	12·00	305	...
Renf.	Glasgow, Queen's Pk.	5·79	147	209	,,	Killarney Asylum	6·76	172	189
,,	Greenock, Prospect H.	11·67	296	246	,,	Darrynane Abbey	4·10	104	115
Bute.	Rothesay, Ardencraig	8·23	209	203	*Wat.*	Waterford, Brook Lo.	3·09	79	112
,,	Dougarie Lodge	7·19	183	...	*Tip.*	Nenagh, Cas. Lough	3·39	86	121
Arg.	Glen Etive	14·83	377	...	,,	Tipperary	3·77	96	...
,,	Oban	8·27	210	...	,,	Cashel, Ballinamona	3·60	91	147
,,	Poltalloch	9·70	246	213	*Lim.*	Foynes, Coolnanes	3·50	89	125
,,	Inveraray Castle	13·44	341	209	,,	Castleconnell Rec.	4·10	104	...
,,	Islay, Eallabus	9·54	242	228	*Clare*	Inagh, Mount Callan	7·76	197	...
,,	Mull, Benmore	24·40	620	...	,,	Broadford, Hurdlest'n.	5·32	135	...
,,	Mull, Quinish	...	..	...	*Wexf*	Newtownbarry	3·27	83	...
Kinr.	Loch Leven Sluice	3·37	86	131	,,	Gorey, Courtown Ho.	2·34	59	95
Perth	Loch Dhu	11·30	287	197	*Kilk.*	Kilkenny Castle	2·26	57	98
,,	Balquhidder, Stronvar	10·12	257	190	*Wic.*	Rathnew, Clonmannon	1·83	47	...
,,	Crieff, Strathearn Hyd.	4·05	103	142	*Cars.*	Hacketstown Rectory	3·39	86	121
,,	Blair Castle Gardens	3·15	80	...	*QCo.*	Blandsfort House	...	..	...
,,	Coupar Angus School	2·78	71	140	,,	Mountmellick	3·49	89	...
Forf.	Dundee, E. Necropolis	2·40	61	115	*KCo.*	Birr Castle	3·35	85	146
,,	Pearsie House	3·65	93	...	,,	Ballycumber, Bellair	3·10	79	...
,,	Montrose, Sunnyside	2·40	61	121	*Dubl.*	Dublin, FitzWm. Sq.	1·83	47	95
Aber.	Braemar Bank	3·43	87	136	,,	Balbriggan, Ardgillan	2·68	68	131
,,	Logie Coldstone Sch.	2·34	59	100	*Me'th*	Drogheda, Mornington	2·88	73	...
,,	Aberdeen, Cranford Ho	3·85	98	165	*W.M*	Mullingar, Belvedere	3·53	90	132
,,	Fyvie Castle	2·02	51	...	*Long*	Castle Forbes Gdns.	4·03	102	140
Mor.	Gordon Castle	3·13	79	125	*Gal.*	Galway, Waterdale	4·13	105	...
,,	Grantown-on-Spey	2·15	55	87	*Mayo*	Crossmolina, Enniscoe	8·15	207	208
Na.	Nairn, Delnies	2·53	64	115	,,	Mallaranny	9·72	247	...
Inv.	Ben Alder Lodge	4·57	116	...	,,	Westport House	6·90	175	194
,,	Kingussie, The Birches	2·59	66	...	,,	Delphi Lodge	14·93	379	...
,,	Fort Augustus	...	..	...	*Sligo*	Markree Obsy.	6·18	157	182
,,	Loch Quoich, Loan	...	..	...	*Ferm*	Enniskillen, Portora	4·96	126	...
,,	Glenquoich	...	..	...	*Arm.*	Armagh Obsy.	3·47	88	141
,,	Inverness, Culduthel R.	1·77	45	...	*Down*	Warrenpoint	3·35	85	...
,,	Arisaig, Faire-na-Squir	10·12	257	...	,,	Seaforde	4·89	124	178
,,	Fort William	10·90	277	174	,,	Donaghadee	3·67	93	154
,,	Skye, Dunvegan	7·72	196	...	,,	Banbridge, Milltown	3·37	86	137
,,	Barra, Castlebay	4·33	110	...	*Antr.*	Belfast, Cavehill Rd.	4·50	114	...
R&C	Alness, Ardross Cas.	2·83	72	97	,,	Glenarm Castle	5·57	141	...
,,	Ullapool	5·42	138	...	,,	Ballymena, Harryville	5·07	129	163
,,	Torridon, Bendamph	8·94	227	129	*Lon.*	Londonderry, Creggan	5·76	146	175
,,	L. Carron, Plockton	6·40	163	...	*Tyr.*	Donaghmore	4·74	120	...
,,	Stornoway	4·94	126	125	,,	Omagh, Edenfel	5·12	130	168
Suth.	Dunrobin Castle	...	..	...	*Don.*	Malin Head	4·60	117	176
,,	Lairg	3·55	90	...	,,	Letterkenny Hospital	6·10	155	179
,,	Forsinard	...	..	...	,,	Dunfanaghy	5·52	140	160
,,	Tongue Manse	3·35	85	106	,,	Narin, Kiltoorish	6·34	161	...
,,	Melvich School	3·96	101	141	,,	Killybegs, Rockmount	9·02	229	196

Climatological Table for the British Empire, April, 1923

STATIONS	PRESSURE Mean of Day M.S.L.	PRESSURE Diff. from Normal	TEMPERATURE Absolute Max.	TEMPERATURE Absolute Min.	TEMPERATURE Mean Values Max.	TEMPERATURE Mean Values Min.	TEMPERATURE Mean Values ½ max. and min.	TEMPERATURE Mean Values Diff. from Normal	TEMPERATURE Mean Wet Bulb.	Relative Humidity	Mean Cloud Am'nt	PRECIPITATION Am'nt	PRECIPITATION Diff. from Normal	PRECIPITATION Days	BRIGHT SUNSHINE Hours per day	BRIGHT SUNSHINE Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1008·0	− 6·4	64	32	54·7	41·1	47·9	+ 0·6	44·2	75	6·8	40	+ 3	12	4·0	29
Gibraltar	1013·6	− 1·7	71	46	64·1	52·0	58·1	− 2·7	54·2	78	5·8	191	+123	18	...	...
Malta	1013·0	+ 0·5	78	49	64·6	55·4	60·0	+ 0·3	55·1	77	5·0	29	+ 9	7	7·1	54
Sierra Leone	1011·0	0·0	93	72	87·8	75·9	81·9	− 0·9	76·1	74	7·1	131	+ 28	12	...	...
Lagos, Nigeria	1009·8	0·0	90	71	87·7	76·0	81·9	− 0·4	78·1	75	6·6	163	+ 14	14	...	...
Kaduna, Nigeria	1011·9	+ 1·2	95	66	90·2	70·8	80·5	− 2·0	70·6	61	0·7	142	+ 74	11	...	...
Zomba, Nyasaland	1012·0	+ 0·1	83	55	78·3	61·2	69·7	+ 0·4	...	87	6·3	57	− 48	15	...	...
Salisbury, Rhodesia	1012·1	− 2·3	88	47	80·2	53·6	66·9	+ 1·0	59·9	69	2·9	35	+ 9	4	...	...
Cape Town	1016·5	+ 0·2	98	46	71·9	55·3	63·6	+ 0·5	58·8	70	5·1	69	+ 18	10	...	...
Johannesburg	1016·6	− 0·3	76	30	69·4	49·7	59·5	− 0·1	50·6	69	3·3	40	− 12	7	8·4	74
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Calcutta, Alipore Obsy.	1004·8	− 1·5	101	68	94·9	77·0	85·9	+ 0·2	76·6	74	4·3	21	− 23	*1	...	...
Bombay	1007·6	− 1·0	93	76	89·9	77·7	83·8	+ 0·7	74·9	72	2·6	1	− 1	*0	...	...
Madras	1006·5	− 1·9	103	72	93·9	77·9	85·9	+ 0·6	78·6	68	3·7	0	− 15	*0	...	...
Colombo, Ceylon	1007·8	− 1·3	92	73	90·0	75·7	82·9	+ 0·2	79·2	66	6·0	190	− 62	13	7·8	63
Hong Kong	1012·0	− 0·6	83	65	76·1	68·6	72·3	+ 1·4	68·5	85	7·7	213	+ 73	13	4·3	34
Sandakan	...	...	89	73	87·0	75·8	81·4	− 0·8	†76·9	†81	...	250	+144	16	...	...
Sydney	1023·3	+ 4·9	77	52	71·1	58·7	64·9	+ 0·3	60·1	74	5·7	240	+102	23	4·6	41
Melbourne	1024·4	+ 5·0	87	39	72·5	49·6	61·1	+ 1·6	55·8	62	3·0	0	− 57	0	6·2	56
Adelaide	1021·7	+ 1·9	91	50	81·3	58·8	70·1	+ 6·3	56·8	39	3·1	1	− 45	1	7·8	70
Perth, W. Australia	1016·4	− 2·0	90	51	78·0	59·8	68·9	+ 2·5	60·8	59	5·0	56	+ 15	8	7·1	63
Coolgardie	1017·7	− 0·8	95	51	77·6	57·6	67·6	+ 2·5	60·9	55	6·9	27	+ 3	9	...	...
Brisbane	1018·1	+ 0·7	85	57	76·1	61·7	68·9	− 1·5	64·8	72	6·3	147	+ 56	19	5·4	47
Hobart, Tasmania	1026·7	+12·2	77	40	63·3	47·9	55·6	+ 0·5	50·9	71	5·8	3	− 45	7	5·5	50
Wellington, N.Z.	1022·8	+ 5·0	71	36	62·8	46·6	54·7	− 2·1	50·0	71	5·6	78	− 21	12	5·9	53
Suva, Fiji	1011·4	+ 0·8	87	70	83·0	73·1	78·1	− 0·6	75·6	88	6·2	161	−126	18	...	...
Kingston, Jamaica	1014·3	0·0	90	66	87·3	69·4	78·3	− 0·1	...	71	4·1	23	− 8	8	...	...
Grenada, W.I.	1014·3	+ 1·7	85	70	83·4	72·5	77·9	− 0·9	72·4	71	5·0	46	− 14	12	...	...
Toronto	1014·0	− 1·5	81	5	51·1	33·9	42·5	+ 1·1	37·0	71	5·1	59	− 2	14	...	...
Winnipeg	1015·3	− 1·7	72	− 9	45·1	23·1	34·1	− 3·7	30·7	71	2·9	19	− 19	6	...	...
St. John, N.B.	1012·2	− 1·4	63	7	42·4	29·2	35·8	− 3·2	33·0	78	6·2	127	+ 38	13	...	...
Victoria, B.C.	1015·1	− 2·2	70	39	55·6	42·6	49·1	+ 1·4	45·1	80	5·6	18	− 26	10	...	...

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen. † Mean of observations at 9h., 15h., 21h., from April, 1923.

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International Cloud Week

THE International Survey of the Sky arranged by the Office National Météorologique de France took place from September 24th to 30th. The hours for taking photographs were 7, 13, and 18. The survey had originally been fixed for a week earlier, but was put off owing to the fact that the Meteorological Conference at Utrecht only ended on the 15th. The effect of this was that the evening hour was worse for photography than it would have been in the previous week. The sun was below the horizon and those who kept strictly to the scheduled hours had a good many blank plates if they exposed them at all at 18h. At Stoner Hill only one evening gave any cloud photographs.

The original propaganda included notices in photographic and scientific journals and many notices in the daily press; circulars were sent to meteorological stations and astronomical observatories; appeals were also kindly made by the British Broadcasting Company on two occasions. About 160 persons wrote to say that they would take part or to ask for further information, but the majority of these did not take any further action. Up to the present time photographs have been received from 56 stations, and 1,519 prints have been sent in.

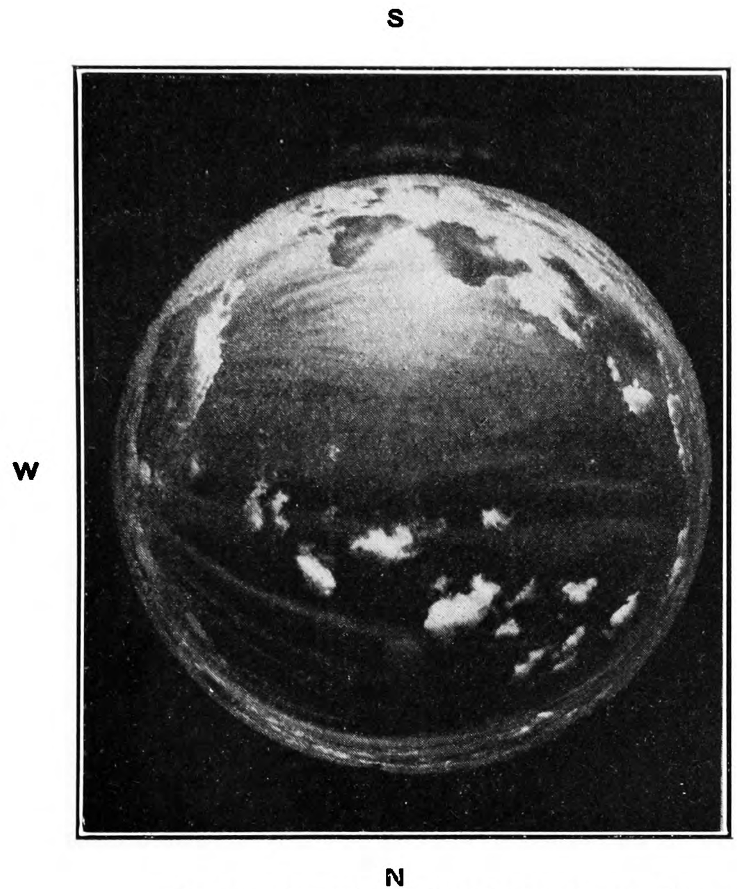
The week was disappointing from a cloud point of view. The most interesting day was the first when there was a great amount of high cloud over a large part of England; at 7h. over the whole of the southern half of England there was much cirrus, which later in the day gave place to cirro cumulus, but on the subse-

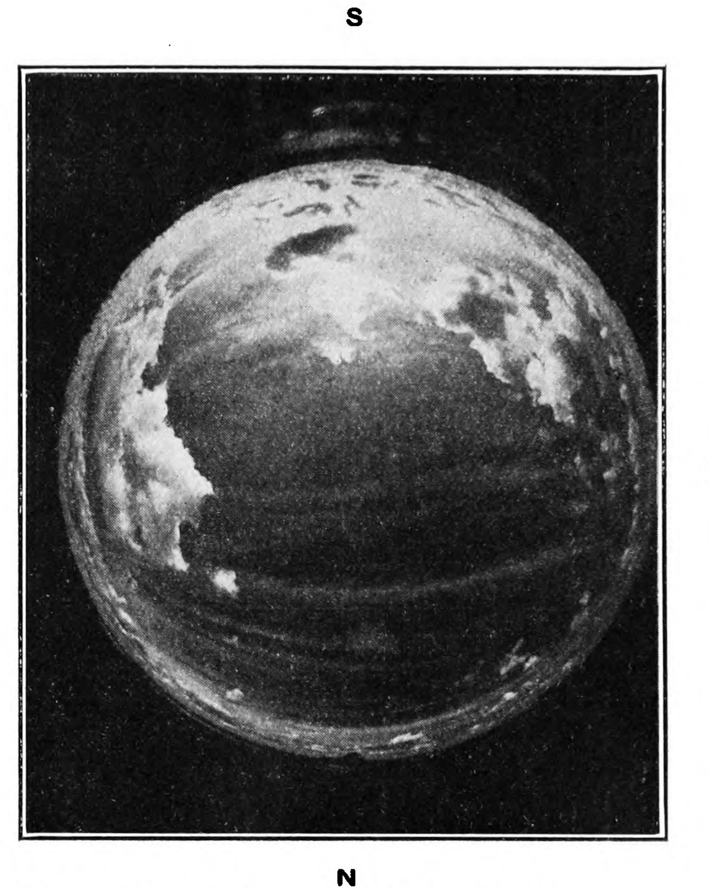
Wt 69—P 1 1000 11/23 M & C

quent days the chief cloud forms were cumulus and strato-cumulus. Very low cloud interfered with photography on several occasions.

On the whole the prints sent in leave a good deal to be desired; those who have not taken up cloud photography find a good deal of difficulty at first in getting the right exposure and development; and even with Mr. G. Aubourne Clarke's excellent instructions, which were forwarded to all volunteers, it was only to be expected that photographers new to the cloud technique should not be very successful. Nevertheless, most of the photographs which failed in this way to make good pictures showed the cloud forms and therefore are useful. There is no doubt that the best photographs were taken by those who used colour filters. Even in the hands of experts, photographs of high clouds taken without filters showed little detail compared with those taken with filters; the best results were obtained with deep yellow or with red screens. One photographer, an expert it is true, had never before used panchromatic plates and colour filters, but in spite of using a process new to him his results were excellent. Some of those who did not use filters got good results in the evening, for when the sunlight passes through a great thickness of the atmosphere the latter in some measure takes the place of a filter.

It was suggested that at each of the hours five photographs should be taken, one each with the camera pointing north, east, south, west, and to the zenith; this, however, was only thrown out as a suggestion to be adopted by those who were so inclined, but it could hardly be expected that many volunteers would use as many as 105 plates in the week. The largest number of prints sent in were 120 from Mr. C. P. Butler, of the Solar Physics Observatory, Cambridge; 105 from the Royal Naval School of Photography, Portsmouth; 86 from Miss A. M. Bulkeley, St. Agnes, Cornwall; 82 from Mr. Alfred Moore, Lyndhurst, Hants.; 81 from Dr. Lockyer, the Norman Lockyer Observatory, Sidmouth; 75 from Mr. G. S. Sansom, Milford, Surrey. Good series were also sent in from the Royal Observatory, Greenwich; Mr. G. A. Clarke, Aberdeen; Mr. C. Leaf, Cambridge; Colonel Arthur Hill, Selham, Sussex; Mr. Wilfrid Hall, Hepplewoodside, Northumberland. Special mention must be made of a series of 37 prints sent by Mr. Robin Hill, of Cambridge, who photographed the whole sky from zenith to horizon on one plate (see Figs. I. & II.). The two photographs reproduced were taken at about 13h. on the 24th, four minutes elapsing between the first and second photograph; they show the bands of cirrus which were the feature of the day. Seven sets of photographs were received from London, five from Hampshire, four each from Hertfordshire and Surrey, three each from Cambridgeshire and Lancashire,





Figs. 1 & 2.—Whole Sky Photographs, Cambridge, Sept. 24th, 1923, about 13h. Interval 4 mins.

two each from Cheshire, Cornwall, Devonshire, Kent, Middlesex, Nottinghamshire, and Sussex, and one each from Bedfordshire, Buckinghamshire, Derbyshire, Dorsetshire, Durham, Northumberland, Somersetshire, Worcestershire, and Yorkshire; three from Scotland, and one each from Wales, Ireland, Malta, and Blue Hill, U.S.A.

The Office National Météorologique will publish a short summary of the Survey, which will be sent to all those who supplied photographs, but this will probably not be ready for some time. The whole work of investigating the prints will take a long time, and it is estimated that it will be quite a year before the full scientific results are worked out.

Recent Researches on the Constituents of the Upper Atmosphere

By M. T. SPENCE, B.Sc.

IN the absence of direct observation, much consideration and discussion have been given to the nature of the gases in the upper strata of the atmosphere, more particularly since the spectrum of the aurora and the systematic observation of luminous meteors have provided indirect evidence on which tentative conclusions have been based. During the past few years notable contributions to the subject have been made by Chapman,* Milne,* Lindemann,† Dobson,† ‡ Rayleigh,§ and Vegard.¶ Chapman and Milne calculated the composition of the atmosphere at various heights and concluded that up to 110 km. nitrogen composed more than half the atmosphere, but that at greater heights nitrogen became less predominant until at about 200 km. helium alone existed. They arrived at these conclusions by assuming—

1. That there is little or no hydrogen in the atmosphere.
2. That large-scale mixing effectively ceases at about 20 km. and that above this height the constitution of the atmosphere is determined solely by molecular diffusion.
3. That above the troposphere the temperature remains approximately constant to great heights (temperature about 220°A).

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* *Q. J. R. Met. Soc.* vol. xlvi, 1920, p. 357.
† *London Proc. R. Soc.* vol. cii., 1923, p. 411.
‡ *Q. J. R. Met. Soc.* vol. xlix, 1923, p. 152.
§ *London Proc. R. Soc.* vol. ci., 1922, p. 114.
¶ *Phil. Mag.* vol. xlvi., 1923, p. 193.

The first assumption was based on experimental determinations of the presence of hydrogen near the earth's surface which showed that it was present only to a very small extent. If the hydrogen present were generated from the earth, it would most probably combine with oxygen through the action of lightning and possibly of sunlight before it had reached any great heights. The second assumption was based on the fact that there is little or no convective motion in the stratosphere. The third assumption was indicated by registering balloons, which have always shown an appreciably constant temperature in the stratosphere up to the greatest heights reached (37 km.).*

Lindemann and Dobson concluded from observations of the heights, paths and velocities of meteors that—

(A) Above 60 km., where there are numerous observations, the air densities, calculated from observations on meteors, are much higher than would be expected from computations based on the theory of molecular diffusion, and the lapse rate indicates a temperature much above 220°A.

(B) "The high temperature in an atmosphere predominantly nitrogen is continued up to about 160 km., above which some rather doubtful observations indicate the presence of a lighter gas."

During the past winter three spectrographs have been in use under the direction of Professor Vegard at the Geophysical Institute of Tromsö, and the wave lengths of the lines shown by auroræ have been carefully determined. One of the instruments used was a quartz spectrograph with fairly large dispersion, which rendered the study of the auroral spectrum into the ultra-violet possible. The wave lengths of 35 lines were measured and 29 of these lines were determined as belonging to the spectrum of nitrogen as produced in the laboratory, and two others are probably associated with the same spectrum. Four lines remain which are not found among the recorded lines of the nitrogen spectrum. One of the four is the green auroral line which Vegard determines as having wave length 5578.2 Angström units. Since the spectra of hydrogen, helium and oxygen are completely absent he concludes that these four lines must also belong to nitrogen, probably under conditions which have not yet been reproduced in the laboratory. With reference to the possible presence of a small proportion of hydrogen and helium, Vegard's

* The height 37 km. published for the ascent at Pavia, Dec. 7th, 1911, is frequently quoted. The validity of the record is very doubtful however. Ascents above 20 km. are rare. (*Vide Meteorological Magazine*, vol. 55, Nov. 1920, p. 226, and vol. 56, June, 1921, p. 121.)

laboratory experiments have shown that the presence of 7 per cent. hydrogen or 30 per cent. helium can readily be detected in the nitrogen spectrum.

Vegard therefore finds it impossible to accept the view that hydrogen or helium is present in the upper strata of the atmosphere for the following reasons—

(A) The green auroral line is predominant at the bottom edge of the auroræ (*i.e.*, at heights of 95-100 km.) where nitrogen is almost certainly the predominant gas, and the same line is observed to the top of auroral streamers.

(B) If hydrogen or helium were present there would be a change shown in the auroral rays when they pass from heights of about 300 km. to 110 km., but no such changes have been noted.

(C) If hydrogen or helium were present in the upper strata of the atmosphere their presence would be indicated by the auroral spectrum.

He also finds that, assuming nitrogen to be the predominant gas to the very limit of the atmosphere, and assuming the auroræ to be produced by cathode rays, the observed brilliancy of auroræ at heights of 400-600 km. cannot be accounted for unless the density at those heights is greater than that to be expected from calculations based on the theory of molecular diffusion. It is shown that if the greater density which the brightness of the aurora demands were to be accounted for by the higher temperatures indicated by the results of Lindemann and Dobson a temperature of 1078°A. would be essential. Vegard considers that such a temperature must be excluded and supposes that the upper strata are electrically charged and that this charge prevents the nitrogen density in the upper strata from diminishing so rapidly with height as would otherwise be the case. The charged shell enveloping the earth and its atmosphere is explained by assuming that the X and γ rays emitted from the sun detach electrons from the gas molecules, and these electrons on account of their small mass and high velocity fly off from the earth's atmosphere, which in consequence is positively charged. It is shown that under these circumstances the molecules of nitrogen would behave as though they were molecules of a much lighter gas, and that in consequence the nitrogen at great heights would, without assuming excessively high temperatures, be of sufficient density to give rise to the observed phenomena. It is suggested by Vegard that molecules of hydrogen and helium, as a result of their apparent reduction in molecular weight, would also fly off from the earth's atmosphere. In this connection it is interesting to note that Milne* has recently applied a rigorous mathematical analysis to the question of the escape of molecules and electrons from an atmosphere. He concludes that owing to the escape of electrons there exists a positively-charged shell round the outer atmosphere, but that the rate of loss of hydrogen and heavier constituents is quite inappreciable. Vegard states in a footnote that since writing his paper later investigations have led him to the view that a highly ionized upper layer cannot exist in the form of a gas, but that the charge is attached to clusters of molecules. He also states that his conclusions respecting the increase in density due to the charged state of the gas require revision.

Vegard's results indicate rather definitely that it is nitrogen alone that forms the uppermost atmosphere. Some ten years ago the presence of hydrogen and of helium was taken for granted and the presence of a gas with a still smaller molecular weight (for which the name "geocoronium" was coined) was invoked to explain the green line in the auroral spectrum. Had the comparatively high densities near the limit of the atmosphere, demanded by the brilliancy of the highest auroral streamers, been observed at that time such observations would no doubt have been regarded as a confirmation of the presence of geocoronium. The newer theory which dispenses with the hypothetical geocoronium as well as with hydrogen and helium may be welcomed as tending to simplify our ideas.

In a later paper† (published since the above was written), Vegard states that more recent investigations have led to some modification of his conclusions regarding the physical state of the uppermost strata. He decides that if nitrogen existed in the gaseous state at heights of 500 to 600 km. the density would be so small (because of the escape of molecules into space as a result of their charged condition) that no visible aurora would be produced. To meet the fact that auroral streamers extending to such heights have been observed he assumes that the nitrogen condenses round ions and exists in the form of minute crystals or fine solid dust. Owing to the earth's magnetic field the dust atmosphere would be most extensive near the plane of the magnetic equator and might be expected to form a "dust-ring" round the earth. He then concludes that the blue of the sky, the twinkling of the stars, the Gegenschein and the Zodiacal light are all caused by this dust atmosphere. It is difficult to take this development of the theory seriously.

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* *Cambridge Trans. Phil. Soc.*, vol. xxii., 1923, p. 483.

† *Phil. Mag.* vol. xlvi., Oct., 1923, p. 577.

Discussions at the Meteorological Office

October 15th, 1923. *Meteorological Problems.* 1. *Travelling Cyclones* by V. H. Ryd. (Kjøbenhavn: Publikationer fra det Danske Meteorologiske Institut, Meddelelser, Nr. 5, 1923.) *Opener*—Sir Napier Shaw.

In the paper which was the subject of this discussion, Dr. Ryd puts before his readers, as a picture of the atmospheric structure of middle latitudes, a certain cyclonic distribution of pressure superposed upon a distribution of isobars representing a uniform current of air. The intensity of the current upon which the circular distribution is superposed, increases upwards, from zero at the surface, as a geostrophic wind, the gradient of which is controlled by a distribution of temperature decreasing uniformly upward and northward.

The hypothetical distribution of pressure is computed to give at the "central" region of the cyclonic column (at the level of about 5·5 km.) a distribution in which the velocity of travel is in accordance with the velocity in the auxiliary field at that level.

From these assumptions he calculates the distribution of pressure, the trajectories of air, the paths with regard to the centre and the instantaneous velocities for the ground, the central region and the intermediate level; he also considers the properties of a region above the central.

He explains that the energy of these systems may be derived from the kinetic energy of the drift or auxiliary current, the velocity of which at great heights exceeds that of the travel of the cyclone. He is satisfied that the conclusions are in reasonable agreement with the observed facts.

Sir Napier Shaw expressed the opinion that the paper deserved careful study, and that the conclusions should be further explored. The theory took no account of penetrative convection, and, although the resilience of the atmosphere made the ascent of air from near the surface to great heights an exceptional phenomenon, it did occur sometimes, and its dynamical results ought to be taken into account.

October 29th, 1923. *Les Systèmes Nuageux*, par Ph. Schereschewsky et Ph. Wehrlé (Memorial de l'office National Météorologique de France, No. 1, 1923). *Opener*—Capt. C. K. M. Douglas.

Capt. Douglas has been so good as to prepare the following notes concerning the memoir which was the subject of this discussion.

This memoir has been issued in three separate parts, consisting of text, charts and photographs, and deals with cloud observations as an aid to weather forecasting. It is concerned chiefly with those cloud systems which are usually associated with precipitation, other types being only briefly referred to. The typical sequence of cloud forms and weather in a moving cyclone was, of course, described by Abercrombie over fifty years ago, and, although since then the use of photography has led to a great advance in our knowledge of cloud structure, most writers have confined themselves to average conditions when dealing with the sequence of events. Recent work in France has aimed at advancing the subject by the detailed study of a large number of individual cases. The weather systems are not very closely related to the isobaric distribution, but rather with the *noyaux de variations* of pressure, or active moving systems, and these are contrasted with centres of action, which are often the main features of the isobaric chart, though the changes are relatively slow. The noyaux are shown up by the use of isallobars, which may form closed systems where the isobaric charts only show an irregularity. It is found that both the noyaux and the cloud systems are carried along in the general current prevailing between 2,000 and 5,000 metres, their respective rates of progress being approximately, but not always exactly, equal.

Since the investigation depends on individual cases, it involves the reproduction of a large number of charts, nearly 400 in all. The area represented includes all central and western Europe up to the North Cape and Iceland on a scale of about 1 inch to 600 miles, so that only large scale phenomena are dealt with. Isobars, isallobars (chiefly for 12-hour periods) and total cloud amounts are shown up by various colours on separate charts, and the charts for a whole series of days appear on the same plate. Amounts of different cloud forms, upper winds and surface temperatures are also published in a few cases.

Two main groups of cloud systems are considered, cyclonic and thundery, and these are divided into various parts, namely, front body, flanks and rear. Full descriptions are given of cloud sequences in the various parts of the systems, both in general and special cases, illustrated by cloud photographs. There are altogether 40 photographs, excellently reproduced, and they are enclosed in coverlets with very full notes on the conditions prevailing. A "cyclonic" system generally sweeps along rapidly on a wide front with a large clearly defined rain area in the middle of the "body," which consists of an extensive mass of alto-stratus type. It may here be mentioned that observations from aeroplanes show that this cloud is several kilometres deep and during rain it usually extends to a fairly low level, often joined to the lower turbulent clouds. The French propose to call this form "nebulum" at lower levels, and "velum" in middle levels.

The "thundery" systems are so-called from their frequent association with thunder, but they include many different types of weather, among others the worst winter snowfalls in France. The distribution of cloud and precipitation indicates irregularity in the vertical movement, and the characteristic features are shown by the clouds at all heights, including the cirrus. The corresponding noyaux are relatively feeble, irregular, and slow moving. The charts of Part II. illustrate the movements and disintegration of various systems, and the change from a cyclonic to a thundery system, but not the origin of systems, as those over western Europe nearly all come in from the Atlantic.

The authors state their views fully on the observational side of the subject, and on the best methods of conveying the requisite information to a central office. Their scheme appears to demand a higher average standard of cloud observing than has yet been attained, and in particular that skies should be watched constantly and not merely for a minute or so at fixed hours of observation. It is the appearance of the sky as a whole and the changes in progress that are important.

The results so far published are purely empirical in character. It may be hoped that the subject may be placed on a physical basis as soon as possible, and it is therefore desirable that photographic surveys of the sky should synchronise as far as possible with the international investigation of the upper air by means of ballons sondes.

During the discussion it was pointed out that the detailed cloud observations advocated in this paper are being carried out by the French and the results published in their Bulletin Quotidien d'Etudes de l'Office National Météorologique de France. The list of symbols used is reproduced below.

Signes Conventionnels de la Nature du Ciel		Signes Conventionnels des Météores passé et présent	
‖	*Ciel d'intervalle.*	●	*Pluie.*
∪	*Ciel de marge.*	✱	*Neige.*
>	*Ciel de front dépressionnaire.*	↯	*Orage.*
•>	*Ciel de front orageux.*	◑	*Averse.*
□	*Ciel de corps dépressionnaire.*	∴	*Grain sans orage.*
⊠	*Ciel de corps d'A.-Cu.*	▲	*Grêle, grésil.*
⊡	*Ciel orageux.*	⊕	*Brouillard.*
<	*Traîne faible.*	—●—	*Bruine.*
≪	*Traîne chargée.*	⊖	*Brume.*

The subject for discussion :—

On Nov. 26th, 1923, will be *The Earth and the Sun. An hypothesis of weather and sunspots,* by Ellsworth Huntington (Yale University Press, New Haven, 1923). *Opener*—Dr. C. Chree, F.R.S.

And on Dec. 10th, 1923, *The Preparation and Significance of free Air Pressure Maps for the central and eastern United States* (Monthly Weather Review, Supplement No. 21, Washington, 1922). *Opener*—Mr. E. G. Bilham, B.Sc.

Royal Meteorological Society

A NEW precedent was established by the Royal Meteorological Society by holding the opening meeting of the session in October, instead of in November. The meeting was devoted to the consideration of a memorandum, prepared by Sir Napier Shaw, Capt. D. Brunt, and Miss E. E. Austin: *Towards a basis of meteorological theory; thirty-nine articles of condition for the middle atmosphere.* In this memorandum knowledge of the properties of the middle atmosphere, the layers between 4 and 8 km., is summarised. Naturally the propositions submitted differ largely in importance; some are straightforward deductions from physical laws, but deductions which have frequently been overlooked by theorists, some are the results of observation and await complete explanation, some are statements of opinion on the part of the authors and challenge criticism. In the last category must be reckoned the declaration "the chief effective cause of the general circulation between the equator and the poles and the correlated circulation round the poles is the cooling of the slopes and plateaux of high land in the polar regions." In the course of the discussion Dr. Simpson expressed the opinion that the cause in question could only account for local disturbance of the general circulation.

The most novel suggestion in the memorandum is with regard to what happens at the transition layer between two air currents. It is pointed out that owing to turbulence the change of wind velocity will be gradual; moreover, the turbulence will tend to produce the adiabatic lapse rate, thereby cooling the air at the top of the lower current and possibly producing cloud.

The discussion failed to bring out any new speakers. Have the meteorologists of the younger generation no definite views on the questions at issue?

Correspondence

To the Editor, *The Meteorological Magazine*

Rainfall Insurance

MAY I be allowed to point out on behalf of the Eagle, Star and British Dominions Insurance Co., Ltd., the originators of rainfall insurance, both in this country and America, that the policies issued by this company are never drawn up in the careless manner suggested in the article on Rainfall Insurance in the September issue of the *Meteorological Magazine*. Every policy states clearly whether the insured times are Greenwich Time or Summer

Time, and specifies the place at which the rainfall record must be taken, and the authority for its measurement. In cases where no official observer is available, a rain gauge is installed at or near the site of the risk, and arrangements made with some disinterested person to take the reading. As an indication of the care which is taken over these details, it may be stated that during the last three years over 40,000 rainfall records have been obtained in connection with policies issued, and the number of occasions on which there has been any failure in the arrangements made has been not more than twenty-five.

Unfortunately, although the Company is probably writing over 95 per cent. of the rainfall policies issued in this country, there are policies which emanate from other sources and which, owing to lack of experience and facilities on the part of the insurers, may be justly characterised as " very carelessly drawn up."

With regard to rain insurance generally, the writer of the article has pointed out the weak spot of such insurances when based on a stipulated measurement of rain. The ideal policy would be based on a combination of the intensity, duration and amount of the rain ; but such a policy, as stated, would necessitate for each risk the provision of a reliable recording rain gauge, which, in view of the average amount of premium per policy, is at present impracticable. Wherever such rain gauges are available, however, " Pluvius " policies can be issued based on the duration of the rain as apart from the measurement. Further, the issue of policies, guaranteeing payment of definite sums in the event of a stipulated measurement of rain, is discouraged as much as possible. It is preferable to cover against a small measurement of rain for a short period during which rain would be most likely to affect the success of the event, and to guarantee that the receipts will not fall below a specified sum. In the example quoted in the article we would have suggested that the rainfall measurement be 0·05 of an inch during a period of 3 hours (say 2 hours prior to the start and 1 hour after), the policy paying the difference between the actual receipts and the sum insured, in which case the assured would have received the amount of loss incurred. In other cases, however, such as cricket matches, a rainfall stipulation, whether of duration or amount, is not satisfactory, as it frequently happens, owing to heavy rain on the previous night, or early morning, that no play is possible on the insured day. In " Pluvius " policies this difficulty is overcome by the provision that the policy will come into force in the event of play being stopped for a specified period as a consequence of rainfall, no measurement or period of rain being stipulated.

With regard to investigations in America, these have been initiated by the Eagle, Star and British Dominions Insurance Company, Ltd., who now form part of what is known as the "Rainfall Association," comprised of all the companies in the United States who are writing rain insurance, and the question of issuing policies on the lines suggested, *i.e.*, against a fall of one-hundreth of an inch in any one or more hours depends entirely on the accumulation of statistics necessary to adequately rate such policies. For this purpose a series of hourly readings for long periods and for a large number of localities is required.

The writer, being in charge of the arrangements for obtaining rainfall records, and for collecting rain statistics, would like to take this opportunity of thanking the officials of the Meteorological Office, the British Rainfall Organization, and the many observers all over the country for their uniform courtesy and help in this work.

In conclusion, it should be noted that the advent of rain insurance on a large scale has created a great interest in the question of rainfall, and has led a number of people, hitherto uninterested, to study the matter, and in many cases to instal rain gauges, all of which must be of ultimate benefit to the science of meteorology.

INIGO R. WILLIAMS, F.R.Met.Soc.

Eagle, Star and British Dominions Insurance Co., Ltd., E.C. 2.

A curious Lunar Rainbow

AT 7h. 30m., on September 22nd, passengers about to embark on a steamer at Bowness, on Lake Windermere, observed a lunar rainbow, the red and violet tints of which were faintly visible. Later, as we steamed southwards towards Lakeside, standing alone on deck, I saw another duller bow appear outside the first bow. The two bows now spanned from earth to earth. Then to my surprise the inner and brighter bow broadened centripetally, losing its colours and extending downwards until it became a white half-disc, like a gigantic half-moon, still fringed by the outer bow. Lastly, I watched both outer bow and luminous half-disc fade away. At no time did I see any colour in the outer bow as it was too faint.

J. C. WALLER.

The Hartley Botanical Laboratories, University of Liverpool, Sept. 27th, 1923.

[The interpretation of Mr. Waller's interesting observation is difficult owing to our unfamiliarity with the physiological side of the question of the visibility of faint luminosity. Many people have never noticed the contrast in tone between the inside of the primary rainbow and the space between the primary and secondary bows, as seen in the day time, but it is conspicuous when once it has been discovered and it shows up well in photographs such as the one* in Clarke's "Clouds." Observers' reports suggest that such a contrast is more striking in the case of lunar rainbows, perhaps because the colours are not readily perceived. Growing appreciation of the contrast would explain Mr. Waller's observation.—ED. *M.M.*]

Weather Parallels

ON November 2nd, 1903, I addressed to this Magazine, from North Cadbury Rectory, in east Somerset, a short letter which appeared in the November number. It ran as follows :—

> "I wish to call attention to the parallel between 1891 and 1903. It is really very close for a great part of the year, and especially for October. The question suggests itself, will there now be a ten days anticyclone as there was then ?"

To this letter was appended the following note by the Editor :—

> "The question propounded above has been answered by the barometer, for the anticyclonic condition which was fully established on November 4th lasted with one slight break until the 13th, when we send this sheet to press.—Ed. *S.M.M.*"

That number was full of letters about the excessive rainfall and storminess of the previous October. It had also plentiful reference to the wet Octobers of 1891 and 1865.

Again the question may be asked is the anticyclone in early November being repeated ? In 1891 there was an anticyclone, with quiet and almost rainless weather from October 27th to November 8th. And now, on October 30th, the barometer rose from its long spell of depression to considerably above normal, and here it has been nearly dead calm, without any measurable rain for three days.

I may add that the rainfall here of the October just finished was 164 mm.

Returns from east Somerset, west Wilts. and north Dorset show a range from 170 mm. to 114 mm., but these figures are somewhat below those of October, 1903, when at North Cadbury, a comparatively dry station, I measured 163 mm.

H. A. BOYS, F.R.Met.Soc.

Spring Hill, S. Mary Bourne, Andover, November 2nd, 1923.

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* Reproduced in the Dictionary of Applied Physics. Vol. iii., p 523.

NOTES AND QUERIES

A remarkable Wind Record—Southport, August 29th-30th, 1923

AUTOGRAPHIC records obtained during the passage of a deep cyclonic depression are always of particular value. The depression which crossed the British Isles on August 29th was, for a summer storm, unusual in its depth and intensity, and records obtained at stations near the path of the centre are therefore of more than ordinary interest. It is not proposed here to consider the disturbance in detail, except in so far as light can be thrown upon the very remarkable records obtained at the Fernley Observatory, Southport, on that occasion.

From the anemograms reproduced in Fig. 1, we may briefly summarise the wind sequence as follows :—

A	29th 9h. to 15h.	Wind SE by S, force 3 to 4, gradually backing to ESE and freshening to force 6.
B	29th 15h. to 20h.	Wind ESE veering to SE and dying away gradually to calm.
C	29th 20h. to 20h. 55m. ...	Dead calm.
D	29th 20h. 55m.	Sudden onset of NW wind increasing within about 10 minu es to force 9.
E	29th 21h. 10m. to 30th 9h....	Wind NW, force 9, backing slowly to W and decreasing to force 8.

From the records of temperature and pressure we learn (1) that the easterly wind of stages A and B was slightly warmer than the northwesterly current of stage E; (2) that the barometer ceased falling and began to rise slowly at 18h.; that is to say three hours earlier than the arrival of the north-west current. The latter event, however, synchronised with a marked increase in the rate of rise.

The synoptic chart for 18h., August 29th, is reproduced in Fig. 2, which also shows the track of the centre as accurately as it could be ascertained from the working charts. It will be seen that there was at that hour a rather abrupt discontinuity of wind direction between Liverpool and Holyhead. The winds at those two stations were in fact representative of the B and E stages in the Southport record. It is not easy, however, to see how it was that Southport enjoyed a dead calm for so long as an hour before the northwesterly gale replaced the easterly current. The anemogram suggests that the centre of the cyclone was passing the station between 20h. and 21h., but the synoptic charts hardly admit of this possibility. If the centre actually moved northward towards Southport after 18h., before resuming its north-eastward movement, there would inevitably have been

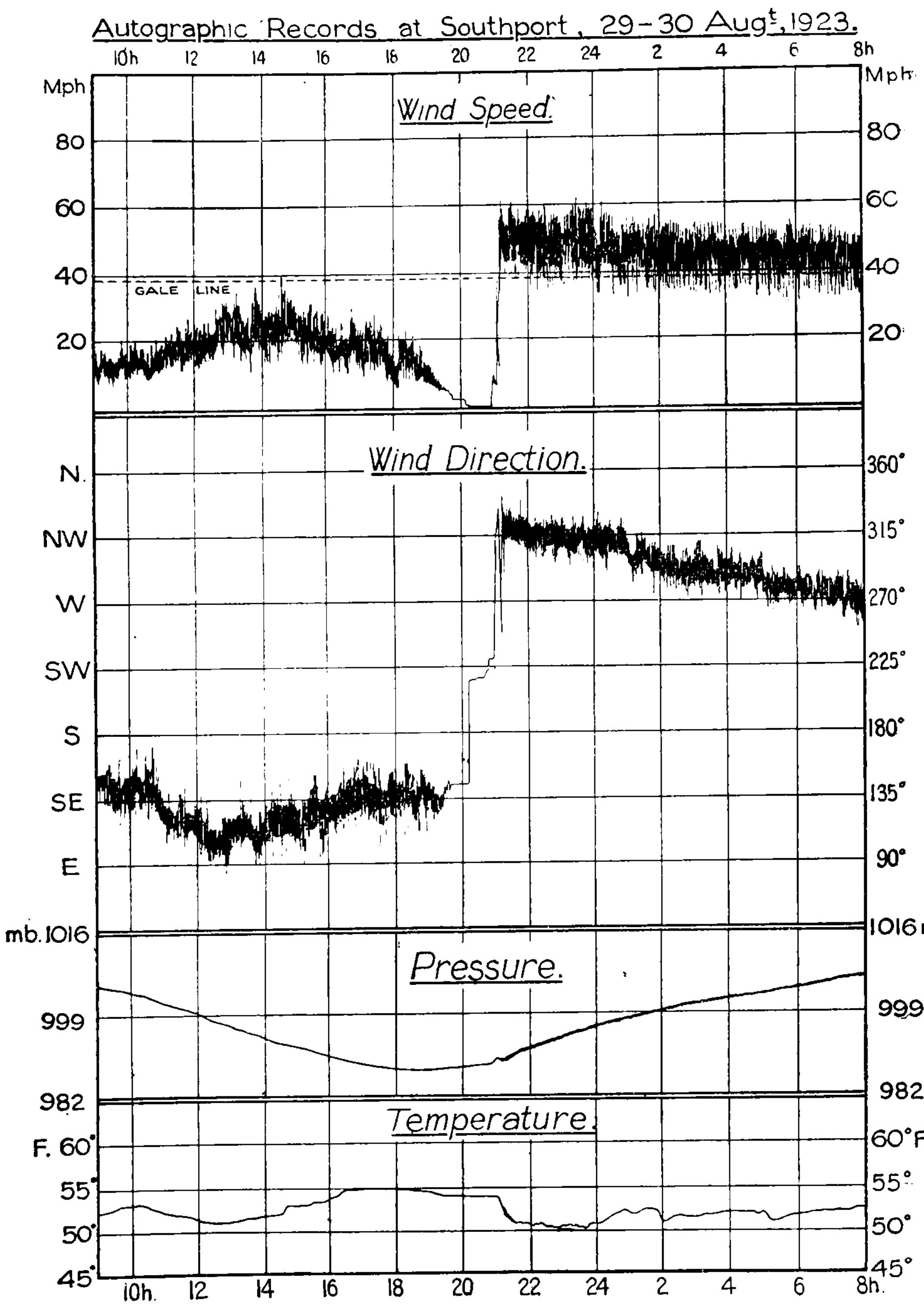
Autographic Records at Southport, 29-30 Augt, 1923.
10h 12 14 16 18 20 22 24 2 4 6 8h
Mph
80
60
40
20
GALE LINE
Wind Speed.
Wind Direction.
N.
NW
W
SW
S
SE
E
360°
315°
270°
225°
180°
135°
90°
Pressure.
mb.1016
999
982
1016 mb.
Temperature.
F. 60°
55°
50°
45°
60°F.
10h. 12 14 16 18 20 22 24 2 4 6 8h.

Fig 1.

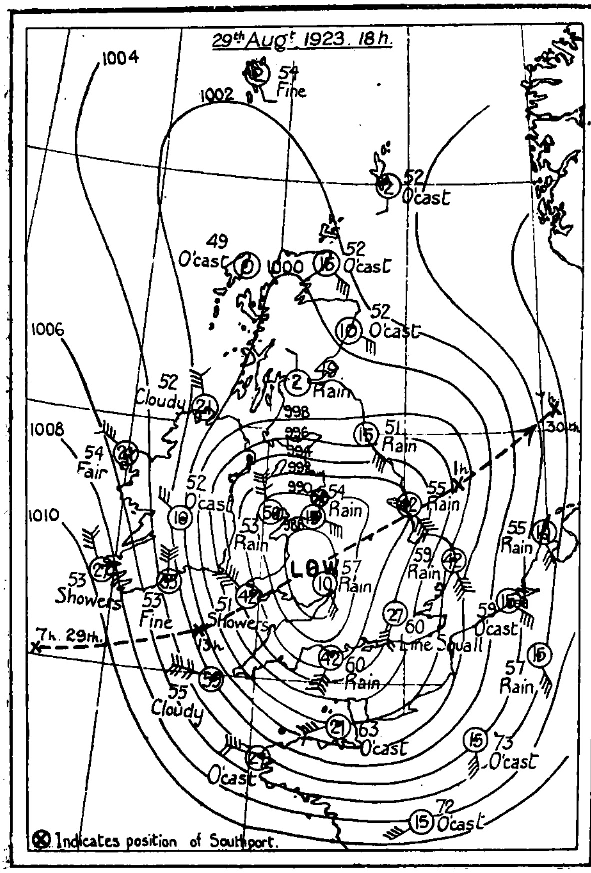

Fig 2

a slight fall of the barometer there, whereas a rise was recorded. The alternative explanation, that there was a subsidiary centre north of that shown on the chart, seems feasible in view of the fact that the isobars indicate quite a number of small irregularities or "secondaries" round the main centre. The 18h. chart, however, shows no trace of a secondary over Lancashire, and we have therefore to consider how the distribution may have changed between 18h. and 20h. in order to produce the required result.

In this endeavour our attention is at once drawn to a marked bulge in the isobars towards Spurn Head, indicating a small secondary centred somewhere near Sheffield. Applying the principle that secondaries travel round the main centre with the speed of the average gradient wind, this secondary would have moved, had the main cyclone remained stationary, to a position near Anglesey by 20h. The main centre was, however, moving towards east-north-east at about 35 miles per hour, and this would bring the secondary just about over Lancashire at 20h. There is nothing in the autographic records* which fails to fit in with this theory, and it is indeed a common habit of small secondaries to produce calms or light winds temporarily in places where there would have been a gale in their absence. It is not often, however, that circumstances adjust themselves so as to produce so remarkable a result as that under consideration.

E. G. Bilham.

* This refeis only to records received in the Meteorological Office. Perhaps reaaers in the north of England who have autographic records will examine them and test this theory.

Light Aeroplane Contests

The series of contests for light aeroplanes organised by the Royal Aero Club, and held at Lympne Aerodrome between October 8th and 13th, proved of great interest. Its success was unbroken until the last day, which was a sad one, for it was marred by the tragic death of M. A. Maneyrol, the French pilot, who last year won the prize at the Itford Gliding Competition. In the morning he had reached a height of 9,400 ft., but went up again in the afternoon in an attempt to make an unbeatable record. It is thought that M. Maneyrol unwittingly put his machine down at too steep an angle when he was about 150 ft. from the ground. However that may be, the wings doubled back and the aeroplane crashed to the ground. The sealed barograph was found, but, unfortunately, was too badly damaged for the record to be read.

The main object of the contests was the development of a low-powered and easily transportable aeroplane. No machine was allowed an engine of over 750 c.c. capacity.

The contests were held over a triangular course, 12½ miles in length, running approximately 3 miles north-east to Postling, 4½ miles north-west parallel to the North Downs to West Brabourne, and, finally, 5 miles south-south-east back to the aerodrome. The aerodrome itself stands at a height of 350 ft. above sea level, on the top of a ridge running east-west. This ridge on its southern side falls somewhat steeply to Romney Marsh, while on the northern side a valley separates the aerodrome from the North Downs, which, at the nearest point, are slightly more than 3 miles away. The land in the district is mainly pasture, and the large fields provide ample facilities for any forced landings which may be made outside the aerodrome. The general contour of the country is such that considerable assistance may be obtained by upward currents with south or south-west winds, but practically throughout the week west or north-west winds prevailed, and thus were blowing almost parallel to the ridge and the North Downs.

Four contests were carried through during the week.

1. The greatest distance covered by the use of one gallon of fuel.
2. The greatest average speed over two laps of the course.
3. The largest number of circuits of the course during the week.
4. The maximum altitude attained.

It was hoped at the end of the week to arrange for a landing and taking-off contest, but weather conditions prevented this being done.

For the first of these contests the best results would be expected in a calm or with light south or south-west winds, where height might be gained in ascending air currents on the south side of the aerodrome or near the Downs, and the engine throttled down when descending to a lower level. For the speed contest a calm was wanted in order to obtain the best figures. Meteorological conditions entered less into the third and fourth contests, and, here, reliability of the machine and endurance on the part of the pilot were of most importance.

Throughout almost the whole period of the contest the district was under the influence of a westerly type of weather, and secondary depressions, with the accompanying strong winds, low clouds, bad visibility, and precipitation, combined to reduce very much the time during which flying was in progress. Only on a few occasions and for short intervals was it possible to make attempts to beat the economy and speed figures, but the reliability of the machines was shown by the consistency with which the pilots added to their total mileage round the course.

Although the weather for much the greater part of the week was most unfavourable for flying, these light aeroplanes made some really wonderful performances. On occasion the conditions caused by low cloud, bad visibility, and rain were such that the high-powered aeroplanes used on the regular cross-Channel services would have been compelled to land and discontinue their flights. Yet even under these circumstances some of the light aeroplanes continued to "lap the course." During the short favourable intervals some splendid performances were recorded, and it is fairly safe to assume that under more favourable conditions the best types would approach 100 miles per gallon, and that a speed of 80 m.p.h. would be exceeded. The safety of most of the types entered was frequently exhibited, for, while a considerable number of forced landings were made, in all but the one tragic case both pilot and machine escaped without so much as a scratch. Further, such engine repairs as were necessary were often done on the spot and the machine then continued its flight around the course. Where this was not possible, the aeroplane could be easily dismantled and wheeled back to the aerodrome along the neighbouring roads. In fact, all machines had to pass a test in which they were dismantled and wheeled along a road for one mile by two persons without the help of any extraneous tackle.

The prize for the greatest height went to Mr. Piercey, who reached 14,400 ft. The greatest distance covered using only one gallon of fuel was 87·5 miles, by Ft.-Lt. W. H. Longton and Mr. James; and the greatest average speed over two laps of the course was 76·1 m.p.h., by Capt. Macmillan, who also in a further test reached 82 m.p.h. before engine trouble caused him to descend halfway round the second lap. Mr. Hinkler succeeded in flying 80 times round the course, or 1,000 miles during the week.

Although the bad weather experienced rendered the flying distinctly less pleasant, it had the advantage of showing that these light aeroplanes are far from being suitable for flying only in fine weather. Machines which are capable of lapping a course such as this in winds reaching gale force, with low clouds descending at times so as to envelop the aerodrome and reducing the visibility to quite low values, and in continuous rain, must have a great future.

R.S.R.

Horse Racing and Weather Insurance

INSURANCE played a large part in the financial arrangements in connection with the much boomed race between Papyrus, the English Derby winner, and Zev, the champion American horse, which took place at Belmont Park, Long Island, on October 20th.

A rain insurance policy was issued to the Westchester Racing Association, the organisers of the race, for $50,000 to be paid in the event of the rainfall between 9 a.m. and 1 p.m. amounting to 0·1 in. Although a considerable amount of rain fell on the previous day, the weather was fine on the day of the race and the underwriters were not called upon to pay.

It is understood that in addition to the rain insurance a policy was issued for $100,000 payable if the race was not run for any reason except rain, and life policies were issued for $250,000 on the life of Papyrus and $50,000 on that of Zev.

News in Brief

We are gratified to learn that the King has approved of the award by the President and Council of the Royal Society of a Royal Medal to Sir Napier Shaw, F.R.S., for his researches in meteorological science. The Copley Medal of the Royal Society has been awarded to Prof. H. Lamb for researches in mathematical physics.

The "Jevons Memorial" Lectures for 1923-4 are being given by Mr. R. H. Hooker at University College, London, on Fridays, November 9th, 16th, 23rd and 30th, at 5.30 p.m. The subject is "The Weather and the Crops." The lectures are open to the public without fee or ticket.

The Times states that at Issy-les-Moulineaux on October 29th M. Sadi Lecointe, the French airman, made an attempt to beat the world's altitude "record" of 34,000 ft., of which he was the holder. A height of 35,273 ft. is said to have been indicated, but the allowances for temperature, &c., will have to be made before the exact height can be stated.

The Government of the Falkland Islands is publishing for its own use a summary of Geophysical Memoirs No. 15, *The Climate* *and Weather of the Falkland Islands and South Georgia*, by C. E. P. Brooks, M.Sc. In this summary British Units are used.

Obituary

Dr. Arthur A. Rambaut, F.R.S., who had been Radcliffe Observer at Oxford since 1897, died on Oct. 14th. His chief work was in connection with stellar parallax and a volume of the Radcliffe observations containing the parallaxes of 2,400 stars was published about a month before his death. Though astronomy was his favourite subject he devoted some time to meteorology, his chief contribution to this science being his studies on earth thermometry.

We also learn with regret of the death on Oct. 3rd of Dr. H. McLeod, F.R.S. Dr. McLeod took a keen interest in meteorology making daily observations at 9 a.m. and 3 p.m. over a period of twenty years at the Royal Indian Engineering College, Cooper's Hill, Egham, where he was professor of experimental science. Summaries of the observations were published in the Monthly Weather Report, etc. He also devised a sunshine recorder. His name is more familiar, however, as the inventor of the McLeod gauge for the measurement of low pressures.

The Weather of October, 1923

THE main features of the pressure distribution of the month were the persistence of the deep depressions off the north-west coasts of the British Isles and the frequent passage of secondaries further south. Unsettled weather with south-westerly winds and a moderate temperature therefore prevailed throughout the greater part of the month though there were also considerable bright periods with the result that some districts experienced an excess of sunshine as well as of rain. The rainfall of the month was greatly in excess of the normal of the period 1881 to 1915. Areas with more than 50 per cent. in excess were widespread, occurring mainly to the west of Great Britain and in the south-east of England. As much as twice the normal occurred in western Argyllshire and in the English Lake District and practically this amount fell to the south of London. The largest value for the month was 35 ins. (889 mm.) at the Stye at the head of Borrowdale in Cumberland. At Kew Observatory rain fell on each day of the month with the exception of the 4th. Over a coastal strip from southern Aberdeenshire to the Wash the total for the month was below the normal, the deficiency being rather more than 50 per cent. in the neighbourhood of Spurn Head. For the British Isles generally the previous five Octobers have been below the normal but in the last twenty years there have been six Octobers with a bigger rainfall than that of the present year. Gales occurred on the 3rd and again from the 9th to the 13th; force 10 (average 59 mph.) being recorded in the Shetland Isles and east Scotland on the 9th. High winds or gales were also experienced on some or other exposed part of the coast from the 18th to 30th. The lowest temperatures of the month occurred in the first and third weeks, the 5th, 14th and 15th being the coldest nights over the country generally. 25° F. was registered by the screen minimum thermometer at Eskdalemuir on the 14th, and 26° F. at Balmoral on the 5th, while grass minima fell to 19° F. at Wisley and Rhayader on the 5th, and to 20° F. at Wisley on the 15th. The 9th and 19th stand out as the two warmest days generally. Thunderstorms occurred in many parts of the country during the latter part of the month and at a number of stations hail was reported.

October was characterised by remarkably wet and stormy weather in many parts of the globe. On the night of the 4th a violent storm swept the English Channel and northern France. The Channel boats were unable to cross and a number of wrecks were reported. Later in the month storms in the Atlantic delayed the liners. About the 2nd a hurricane swept over Newfoundland and the Maritime Provinces, doing great damage to the apple crop. Heavy rain in the valley of the Canadian river caused a flood which inundated Oklahoma on the 16th, and on the 18th a number of passengers in the "Aquitania" were injured in a violent easterly gale off Nantucket. On the 23rd it was reported that owing to heavy rain in the Chagres region during the preceding three days the level of Lake Gatun had risen to such an extent that traffic through the Panama Canal was interrupted for a few days. On the 15th it was reported that good rains were being experienced throughout Victoria (Australia).

The special message from Brazil states that the rainfall was 13 mm. below the normal in the north, plentiful in the central regions where the average was 42 mm. above the normal, and irregular in the south. Temperature was slightly above normal. The cotton crop has been much reduced by boll-weevil but the prospects of the wheat harvest are very good. The coffee picking is almost over. At Rio de Janeiro itself the mean pressure for the month was 2 mbs. above normal and the mean temperature 2° F. above normal.

Rainfall October, 1923: General Distribution

England and Wales	133	per cent. of the average 1881-1915.
Scotland	142	
Ireland	125	
British Isles	134	

Rainfall Table for October, 1923

CO.	STATION.	In.	mm.	Per-cent. of Av	CO.	STATION.	In.	mm.	Per-cent. of Av.
Lond.	Camden Square	5·94	151	226	*Leics*	Leicester Town Hall	2·69	68	...
Sur .	Reigate, Hartswood	8·37	213	...	,, .	Belvoir Castle	2·55	65	94
Kent.	Tenterden, View Tower	6·06	154	174	*Rut* .	Ridlington	3·36	85	...
,, .	Folkestone, Boro. San.	6·27	159	...	*Linc*.	Boston, Skirbeck	2·43	62	89
,, .	Broadstairs	...	...	...	,, .	Lincoln, Sessions House	1·49	38	58
,, .	Sevenoaks, Speldhurst.	6·80	173	...	,, .	Skegness, Estate Office.	1·49	38	54
Sus .	Patching Farm	6·92	176	175	,, .	Louth, Westgate	1·73	44	53
,, .	Eastbourne, Wilm. Sq.	7·10	180	171	,, .	Brigg	1·53	39	51
,, .	Tottingworth Park	7·26	184	175	*Notts*.	Worksop, Hodsock	1·44	37	55
Hants	Totland Bay, Aston	5·74	146	140	*Derby*	Mickleover, Clyde Ho.	2·52	64	94
,, .	Fordingbridge, Oaklnds	5·68	144	137	,, .	Buxton, Devon. Hos.	5·65	144	115
,, .	Portsmouth, Vic. Park.	5·79	147	157	*Ches*.	Runcorn, Weston Pt.	4·34	110	126
,, .	Ovington Rectory	6·65	169	164	,, .	Nantwich, Dorfold Hall	4·23	107	...
,, .	Grayshott	6·84	174	164	*Lancs*	Bolton, Queen's Park .	5·87	149	...
Berks	Wellington College	...	...	...	,, .	Stonyhurst College	6·56	167	146
,, .	Newbury, Greenham	5·59	142	160	,, .	Southport, Hesketh	4·52	115	128
Herts.	Bennington House	4·24	108	156	,, .	Lancaster, Strathspey.	7·33	186	...
Bucks	High Wycombe	5·47	139	175	*Yorks*	Sedbergh, Akay	10·88	276	218
Oxf.	Oxford, Mag. College	3·87	98	139	,, .	Wath-upon-Dearne	1·62	41	58
Nor .	Pitsford, Sedgebrook	3·93	100	147	,, .	Bradford, Lister Pk.	3·07	78	88
,, .	Eye, Northolm	2·67	68	...	,, .	Oughtershaw Hall	12·65	321	...
Beds.	Woburn, Crawley Mill.	3·58	91	132	,, .	Wetherby, Ribston H.	2·77	70	92
Cam.	Cambridge, Bot. Gdns.	3·84	98	163	*ERY*	Hull, Pearson Park	1·37	35	46
Essex	Chelmsford, CountyLab	4·68	120	...	,, .	Holme-on-Spalding	1·45	37	...
,, .	Lexden, Hill House	3·87	98	...	,, .	Lowthorpe, The Elms.	1·64	42	50
Suff.	Hawkedon Rectory	4·26	108	158	*NRY*	West Witton, Ivy Ho.	5·06	129	...
,, .	Haughley House	3·36	85	...	,, .	Pickering, Hungate	2·37	60	...
Norf.	Beccles, Geldeston	2·83	72	100	,, .	Middlesbrough	1·99	51	66
,, .	Norwich, Eaton	3·62	92	116	,, .	Baldersdale, Hury Res.	5·25	133	133
,, .	Blakeney	3·12	79	119	*Durh*.	Ushaw College	1·92	49	56
,, .	Swaffham	3·18	81	110	*Nor* .	Newcastle, Town Moor.	2·21	56	69
Wilts.	Devizes, Highclere	5·46	139	...	,, .	Bellingham Manor	3·34	85	...
Dor .	Evershot, Melbury Ho.	6·71	170	145	,, .	Lilburn Tower Gdns.	2·39	61	...
,, .	Weymouth, Westham	5·05	128	138	*Cumb*	Penrith, Newton Rigg	...	...	...
,, .	Shaftesbury, Abbey Ho.	5·87	149	151	,, .	Carlisle, Scaleby Hall .	5·46	139	163
Devon	Plymouth, The Hoe	5·19	132	132	,, .	Seathwaite	23·00	584	192
,, .	Polapit Tamar	7·91	201	165	*Glam*.	Cardiff, Ely P. Stn.	6·81	173	142
,, .	Ashburton, Druid Ho.	10·54	268	174	,, .	Treherbert, Tynywaun	15·58	396	...
,, .	Cullompton	5·64	143	137	*Carm*	Carmarthen Friary	7·67	195	134
,, .	Sidmouth, Sidmount	4·72	120	127	,, .	Llanwrda, Dolaucothy.	11·02	280	174
,, .	Filleigh, Castle Hill	8·12	206	...	*Pemb*	Haverfordwest, Portf'd	...	...	...
,, .	Hartland Abbey	5·37	136	...	*Card*.	Gogerddan	9·23	234	175
Corn.	Redruth, Trewirgie	6·56	167	125	,, .	Cardigan, County Sch.	8·21	209	...
,, .	Penzance, Morrab Gdn.	5·63	143	121	*Brec*.	Crickhowell, Talymaes	9·25	235	...
,, .	St. Austell, Trevarna	6·94	176	132	*Rad* .	Birm. W. W. Tyrmynydd	9·43	239	143
Som	Street, Hind Hayes	5·14	131	...	*Mont*.	Lake Vyrnwy	11·78	299	207
Glos.	Clifton College	5·32	135	141	*Denb*.	Llangynhafal	5·54	141	...
,, .	Cirencester	5·10	129	150	*Mer* .	Dolgelly, Bryntirion	12·00	305	197
Here.	Ross, County Obsy.	5·49	139	167	*Carn*.	Llandudno	4·40	112	123
,, .	Ledbury, Underdown.	5·17	131	168	,, .	Snowdon, L. Llydaw 9	23·97	609	...
Salop	Church Stretton	6·14	156	170	*Ang* .	Holyhead, Salt Island.	4·61	117	116
,, .	Shifnal, Hatton Grange	3·18	81	112	,, .	Lligwy	6·52	166	...
Staff.	Tean, The Heath Ho.	3·22	82	100	*Man*.	Douglas, Boro' Cem.	6·76	172	146
Worc.	Ombersley, Holt Lock.	3·65	93	137	*Guer*.	St. Peter Port, Grange.	7·70	195	171
,, .	Blockley, Upton Wold.	6·48	165	198	*Wigt*.	Stoneykirk, Ardwell Ho	4·02	102	111
War	Farnborough	5·91	150	187	,, .	Pt. William, Monreith .	5·00	127	...
,, .	Birminghm, Edgbaston	3·50	89	126	*Kirk*.	Carsphairn, Shiel.	11·63	295	...

Rainfall Table for October, 1923—*continued*

CO.	STATION.	In.	mm.	Per-cent. of Av	CO.	STATION.	In.	mm	Per-cent. of Av.
Kirk.	Dumfries, Cargen	7·38	187	169	*Caith*	Loch More, Achfary	12·36	314	159
Dum	Drumlanrig	6·20	157	144	,,	Wick	4·42	112	149
Roxb	Branxholme	4·18	106	129	*Ork.*	Pomona, Deerness	6·42	163	169
Selk.	Ettrick Manse	8·54	217	...	*Shet.*	Lerwick	4·73	120	120
Berk.	Marchmont House	3·54	90	93	*Cork.*	Caheragh Rectory	7·38	187	...
Hadd	North Berwick Res.	1·32	33	45	,,	Dunmanway Rectory	7·55	192	126
Midl	Edinburgh, Roy. Obs.	1·79	46	69	,,	Ballinacurra	3·95	100	97
Lan.	Biggar	3·97	101	132	,,	Glanmire, Lota Lo.	5·74	146	138
Ayr.	Kilmarnock, Agric. C.	6·00	152	171	*Kerry*	Valencia Obsy.	6·92	176	124
,,	Girvan, Pinmore	7·71	196	154	,,	Gearahameen	11·50	292	...
Renf.	Glasgow, Queen's Pk.	4·67	119	144	,,	Killarney Asylum	6·60	168	123
,,	Greenock, Prospect H.	9·37	238	174	,,	Darrynane Abbey	4·25	108	84
Bute.	Rothesay, Ardencraig.	7·59	193	172	*Wat.*	Waterford, Brook Lo.	3·92	100	100
,,	Dougarie Lodge	6·27	159	...	*Tip.*	Nenagh, Cas. Lough	4·63	118	137
Arg.	Glen Etive	14·26	362	...	,,	Tipperary	4·40	112	...
,,	Oban	10·20	259	...	,,	Cashel, Ballinamona	4·33	110	120
,,	Poltalloch	10·12	257	203	*Lim.*	Foynes, Coolnanes	4·55	116	123
,,	Inveraray Castle	14·69	373	209	,,	Castleconnell Rec.	5·97	152	...
,,	Islay, Eallabus	11·25	286	236	*Clare*	Inagh, Mount Callan	7·91	201	...
,,	Mull, Benmore	24·60	625	...	,,	Broadford, Hurdlest'n.	5·89	150	...
,,	Mull, Quinish				*Wexf*	Newtownbarry	4·15	105	...
Kinr.	Loch Leven Sluice	3·17	81	92	,,	Gorey, Courtown Ho.	4·37	111	123
Perth	Loch Dhu	12·10	307	169	*Kilk.*	Kilkenny Castle	3·58	91	114
,,	Balquhidder, Stronvar.	11·89	302	174	*Wic.*	Rathnew, Clonmannon	3·16	80	...
,,	Crieff, Strathearn Hyd.	4·68	119	119	*Cars.*	Hacketstown Rectory	4·44	113	117
,,	Blair Castle Gardens	5·25	133	...	*QCo.*	Blandsfort House	4·14	105	118
,,	Coupar Angus School	2·89	73	101	,,	Mountmellick	4·87	124	...
Forf.	Dundee, E. Necropolis.	2·23	57	84	*KCo.*	Birr Castle	4·49	114	154
,,	Pearsie House	3·86	98	...	,,	Ballycumber, Bellair	4·61	117	...
,,	Montrose, Sunnyside	2·50	63	91	*Dubl.*	Dublin, FitzWm. Sq.	2·05	52	76
Aber.	Braemar Bank	4·06	103	108	,,	Balbriggan, Ardgillan	2·43	62	90
,,	Logie Coldstone Sch.	3·21	81	99	*Me'th*	Drogheda, Mornington	2·04	52	...
,,	Aberdeen, Cranford Ho	3·60	91	111	*W.M*	Mullingar, Belvedere	4·24	108	136
,,	Fyvie Castle	3·31	84	...	*Long*	Castle Forbes Gdns.	4·70	119	...
Mor.	Gordon Castle	3·38	86	107	*Gal.*	Galway, Waterdale	...	...	...
,,	Grantown-on-Spey				*Mayo*	Crossmolina, Enniscoe	7·57	192	146
Na.	Nairn, Delnies	3·35	85	143	,,	Mallaranny	10·83	275	...
Inv.	Ben Alder Lodge	11·41	290	...	,,	Westport House	6·47	164	144
,,	Kingussie, The Birches	4·08	104	...	,,	Delphi Lodge	14·32	364	...
,,	Fort Augustus	7·31	186	185	*Sligo*	Markree Obsy.	5·79	147	143
,,	Loch Quoich, Loan	25·10	637	...	*Ferm*	Enniskillen, Portora	4·33	110	...
,,	Glenquoich	18·82	478	188	*Arm.*	Armagh Obsy.	3·46	88	127
,,	Inverness, Culduthel R.	3·10	79	...	*Down*	Warrenpoint	3·17	81	...
,,	Arisaig, Faire-na-Squir	10·39	264	...	,,	Seaforde	4·28	109	120
,,	Fort William	14·08	358	200	,,	Donaghadee	3·06	78	106
,,	Skye, Dunvegan	10·66	271	...	,,	Banbridge, Milltown	2·95	75	107
,,	Barra, Castlebay	4·33	110	...	*Antr.*	Belfast, Cavehill Rd.	4·72	120	...
R&C	Alness, Ardross Cas.	5·15	131	134	,,	Glenarm Castle	5·47	139	...
,,	Ullapool	7·55	192	...	,,	Ballymena, Harryville	5·31	135	144
,,	Torridon, Bendamph	13·13	333	164	*Lon.*	Londonderry, Creggan	5·07	129	138
,,	L. Carron, Plockton	9·61	244	...	*Tyr.*	Donaghmore	4·16	106	...
,,	Stornoway	7·45	189	144	,,	Omagh, Edenfel	5·03	128	137
Suth.	Dunrobin Castle				*Don.*	Malin Head	4·51	115	153
,,	Lairg	5·43	138	...	,,	Letterkenny Hospital	6·59	167	157
,,	Forsinard				,,	Dunfanaghy	6·23	158	142
,,	Tongue Manse	6·45	164	154	,,	Narin, Kiltoorish	6·44	164	...
,,	Melvich School	5·57	141	152	,,	Killybegs, Rockmount	8·45	215	151

Climatological Table for the British Empire, May, 1923

STATIONS	PRESSURE: Mean of Day M.S.L.	PRESSURE: Diff. from Normal	TEMPERATURE: Absolute Max.	TEMPERATURE: Absolute Min.	TEMPERATURE: Mean Values Max.	TEMPERATURE: Mean Values Min.	TEMPERATURE: Mean Values ½ max. and min.	TEMPERATURE: Mean Values Diff. from Normal	TEMPERATURE: Mean Wet Bulb.	Relative Humidity	Mean Cloud Am'nt	PRECIPITATION: Am'nt	PRECIPITATION: Diff. from Normal	PRECIPITATION: Days	BRIGHT SUNSHINE: Hours per day	BRIGHT SUNSHINE: Percentage of possible.
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1013·7	− 2·2	78	35	59·3	44·0	51·7	− 1·7	47·4	74	7·2	52	+ 8	16	5·3	34
Gibraltar	1017·0	+ 2·1	79	54	71·3	57·9	64·6	− 0·7	59·0	74	4·3	4	− 41	5	...	...
Malta	1015·4	+ 1·7	79	57	71·8	61·7	66·7	+ 1·6	61·7	75	4·3	1	− 9	2	9·6	66
Sierra Leone	1011·0	− 0·7	91	70	88·3	74·7	81·5	− 0·5	76·7	73	6·9	207	− 76	18	...	...
Lagos, Nigeria	1010·2	− 0·8	90	72	87·4	74·9	81·1	− 0·1	77·2	76	7·7	344	+ 81	20	...	...
Kaduna, Nigeria	1012·6	− 0·5	93	60	89·5	68·6	79·1	0·0	71·4	68	1·1	163	− 23	14	...	...
Zomba, Nyasaland	1014·2	− 0·1	82	46	74·0	56·3	65·1	− 0·6	...	83	5·1	54	+ 29	10	...	...
Salisbury, Rhodesia	1015·4	− 2·7	87	39	75·3	46·1	60·7	+ 0·2	55·1	69	2·3	10	− 2	2	...	...
Cape Town	1016·8	− 1·1	81	40	65·5	50·4	57·9	− 0·7	54·7	78	5·6	136	+ 35	13	...	...
Johannesburg	1018·9	− 0·8	72	32	64·7	45·4	55·1	+ 0·7	45·2	62	2·8	4	− 14	3	8·7	81
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Calcutta, Alipore Obsy.	1002·6	− 0·9	106	72	97·1	79·0	88·1	+ 2·1	78·7	72	7·0	26	−120	2*	...	...
Bombay	1007·1	− 0·6	93	79	90·9	80·6	85·7	0·0	76·8	70	4·3	0	− 18	0*	...	...
Madras	1004·8	− 0·6	110	77	99·9	80·0	89·9	0·0	77·6	60	3·4	1	− 26	0*	...	...
Colombo, Ceylon	1008·6	+ 0·4	90	70	88·7	76·3	82·5	− 0·3	78·2	67	6·9	114	−197	15	8·9	72
Hong Kong	1008·9	− 0·5	90	68	82·6	74·2	78·4	+ 1·0	72·9	79	5·8	96	−201	13	7·6	58
Sandakan	...	...	90	74	88·4	75·8	82·1	− 0·5	†77·0	†79	...	140	− 12	9	...	...
Sydney	1012·2	− 6·4	85	45	71·0	54·4	62·7	+ 4·1	54·7	59	4·8	24	−108	5	5·5	53
Melbourne	1009·6	− 9·9	76	37	64·3	49·1	56·7	+ 2·6	51·8	67	6·4	50	− 5	20	4·2	42
Adelaide	1012·2	− 7·9	84	47	68·7	55·0	61·9	+ 4·1	55·7	66	7·4	119	+ 50	21	4·5	44
Perth, W. Australia	1015·2	− 3·6	76	45	69·0	55·4	62·2	+ 1·8	57·5	74	6·8	167	+ 48	23	4·3	41
Coolgardie	1015·2	− 4·6	84	38	70·6	47·3	58·9	+ 1·3	53·3	50	4·2	11	− 24	5	...	...
Brisbane	1015·1	− 3·7	90	51	78·7	56·2	67·5	+ 3·1	62·3	62	2·9	10	− 65	4	8·5	79
Hobart, Tasmania	1001·0	−14·6	69	34	57·4	44·2	50·8	+ 0·4	46·5	72	6·4	115	+ 68	25	4·5	46
Wellington, N.Z.	1009·9	− 5·3	67	37	59·5	48·2	53·9	+ 1·1	50·7	77	6·4	241	+121	21	3·3	33
Suva, Fiji	1011·8	− 1·0	83	66	80·0	70·7	75·3	− 1·2	72·2	84	6·1	189	− 69	17	...	...
Kingston, Jamaica	1012·4	− 0·9	89	67	86·3	73·3	79·8	+ 0·1	...	79	6·4	124	+ 14	11	...	...
Grenada, W.I.	1014·2	+ 1·6	87	72	85·4	74·8	80·1	+ 0·6	74·1	71	3·9	25	− 93	11	...	...
Toronto	1014·6	− 0·2	83	27	61·9	41·3	51·6	− 1·1	46·5	68	3·5	94	+ 18	10	...	...
Winnipeg	1013·6	− 0·7	90	19	67·3	41·5	54·4	+ 2·8	47·3	60	2·4	65	+ 8	7	...	...
St. John, N.B.	1013·2	− 0·8	73	33	55·4	39·7	47·5	− 0·2	43·5	79	6·2	65	− 29	11	...	...
Victoria, B.C.	1016·4	0·0	67	40	58·8	45·9	52·3	− 0·8	48·0	79	6·5	26	− 7	10	...	...

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen. † Mean of observations at 9h., 15h., 21h., from April, 1923.

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Twelve Years' Progress in Weather Forecasting

THE appearance of a second edition of Sir Napier Shaw's *Forecasting Weather* will be cordially welcomed. The first edition has been out of print for some time, and the dozen years which have elapsed since its appearance, in 1911, have been eventful ones in the domain of meteorology as in other departments of human activity. They have all but revolutionised the practice of the daily weather services of European countries. Even those who have been in close touch with each successive development in the method of collecting and presenting the facts for the daily conspectus of weather information represented by the Daily Weather Report of the Meteorological Office will perhaps be astonished at the magnitude of the changes when they have the whole story set out as it is in the opening chapters of this book. We think that the author was well advised in retaining in the new edition the description of the Daily Weather Report of the year 1910, itself a record of rapid changes of form which the report had undergone in the years immediately preceding the appearance of the first edition, and adding to it an account of the changes which have increased the report from one setting out some 2,000 facts about a day's weather in north-west Europe to one in which about 8,000 facts are marshalled for the information of the reader. The contrast will be of absorbing interest to the non-professional reader and should give the professional meteorologist furiously to think on how he can digest and turn to advantage the almost bewildering mass of information presented.

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Other changes which have taken place in the domain of organisation are concerned with the units used for meteorological measurements. In the first editicn the author was clearly much exercised over this question. His aim, which as Director of the British Weather Service and President of the International Meteorological Committee he was in a unique position for futhering, was to bring about the general adoption of a system of units based on the C.G.S. system. The extent to which that ideal has been realised in the intervening years is detailed in the book. It is a record of mixed achievement and failure. The millibar has made substantial progress as the unit for the measurement of pressure and is rapidly gaining ground in all that pertains to the study cf the upper air. Measurements of rainfall are now published in millimetres in the Daily Reports of this country. In other respects there has been little progress, and the author has sorrowfully to admit that the adoption of the tercentesimal scale of temperature in place of the Fahrenheit scale seems further off now than it did a few years ago.

Among the additions to the book we notice with pleasure the chapter on clouds necessitated by the inclusion of type and amount of high and low cloud among the facts which observers are expected to repcrt in their messages. In the main it is an account of the international classification of cloud forms, but it is presented in a manner which cannot fail to impress on the reader the importance of keeping in mind the physical processes involved in the formation of clouds, and the illustrations, though on a small scale, are not only beautiful in themselves but are extraordinarily well selected from that point of view.

The same insistence on physical causes which the author has had so prominently before him in the whole conception of the book, has led him to give considerable space in the new matter now introduced to the question of turbulent motion. The conception has only found its way into meteorological literature, thanks to the researches of G. I. Taylor and others, within the period which has elapsed since the first edition appeared. It has cleared our ideas to a remarkable extent on the processes underlying the formation of fogs and of some forms of clouds, and the reader will find a clear exposition of the principles involved, and some suggestions for their application in the domain of forecasting the occurrence and development of these meteors. Space is also found for consideration of the problems of visibility which have come into prominence in recent years, and for an exposition of the theory of the polar front which we owe to the labours of the Norwegian school of meteorologists and which has already had its influence on the practice of forecasting.

Taken as a whole a comparison of the two editions leaves on the mind the impression of a prodigious advance in the organisation for the collection and distribution of weather information, but that, as the author points out, represents progress in communications rather than in forecasting proper. On the other hand we get a sense of the very real progress which the science of meteorology has made in the last twelve years in the matter of understanding the processes going on in the atmosphere, on which the changes in our weather which we experience from day to day depend. Let the reader go through the book and note the passages which could not have been written twelve years ago, for the reason that our knowledge was not sufficiently far advanced, and he will realise that meteorology is not standing still. A forecaster equipped only with the knowledge available in 1911 would stand but a poor chance of turning to profitable account the additional material now at his disposal, but the application of the new knowledge to the task of forecasting the weather day by day has hardly yet begun, above all the application of methods of numerical computation such as those suggested by L. F. Richardson which are briefly described in the book is still far off.

In conclusion we should like to congratulate Messrs. Constable and Co. on the manner in which they have accomplished the task of presenting the book and its numerous illustrations. We wish they could have seen their way to producing it at a lower cost. The increase from twelve shillings and six pence to thirty six shillings is considerable, but presumably in these days it is truer than ever that if we want a good thing we must be prepared to pay for it.

R.G.K.L.

The Great Earthquake in Japan

How the Meteorologists Fared

By the courtesy of Sir Napier Shaw we are able to give the following extracts from a letter written to him by Dr. Fujiwhara after the great earthquake and fire which occurred in Japan on September 2nd.

> As you know, Tokyo, Yokohama and their vicinity experienced a terrible catastrophe. The area of the destructive motion of the earth was about one degree square (about 10,000 sq. km.). Nearly 120,000 people were killed. . . . . The number of houses burnt in Tokyo was about 320,000 and the number of sufferers about 1,350,000. . . . . . I was making an experiment upon water vortices with an assistant when the first shock was felt at 11h 58m. 44s. The water in the tank was thrown out and I felt vexed at the unexpected disturbance in the experiment. But very soon I recognised the earthquake was heavy, and the circumstance was imminent. I bade my assistant not to go out, but to crouch down on one side of a firm stone stand.

I observed that shocks after shocks continued, and plaster fell off from the wall : the wooden skeleton of the wall appeared, which creaked heavily and strained, and I expected that the upper floor would fall down over us, but fortunately it did not, and after about one minute I recognised the principal danger had passed away. We dashed out of the room, and saw that people were still swaying about in the gallery in air smoky with the powder of fallen walls. . . . . . . The daughter of Professor Okada had given birth to her baby girl on the noon of the preceding day. Of course she was in bed, and the family could not escape without her. All the family then remained still surrounding the bed until Professor Okada and other gentlemen ran back for the rescue. They carried out the bed with her and made a tent there. Mrs. Okada was so brave and calm, and quite composedly gave orders to the nurse and maid how to act. Afterwards when the fire was near she asked Professor Okada not to care for his home, but to take duty at the Observatory, so that not only he, but also other members of the Observatory could fight against the fire. . . . . During this time the wind blew from the south-west, and our Observatory was rather safe. From 8h. in the evening the wind shifted to the west, and then to the north-north-west, and sparks began to arrive. At this time Tokyo was filled with dark smoke and brilliant flame, and many thousands of refugees assembled in the vicinity and prevented our work. Firemen were busy and tired, and could not come to our Observatory. The waterworks had been broken by the first shock and we could not get water, except from the bathing tubs, which I had ordered to be filled up in anticipation. Thus the circumstance was very hard for us. Still there was hope, because our Observatory was standing separately from other buildings, and there was a bank with trees protecting it . . . . Smoke was thick and sparks were furious. One of my comrades got a spark on his back and the cloth took flame. . . . . . . I determined my mind and descended from the roof, plunged into the people and shouted to them to escape through the Imperial gate, which was thought so sacred, that even in this state people did not dare to go in. A few policemen also echoed my words, and the Imperial Guard let the refugees in. I led my family to the old Observatory through another heavy crowd, and went back to the Observatory and continued the work to prevent fire. . . . . . . Our comrades took out important books, etc., from the Observatory, and put them into holes, dug in the ground. . . . . In this way, three spots with flame were prevented, but at last the eaves of the roof caught fire, owing to a spark carried by a current which made a vortex there. It was beyond my power, because the water was used up, and moreover I could not approach there, and, after only one minute, flame caught the ceiling. . . . . . We had a small library in the main building which was wooden. In this library we kept all new books of meteorology and allied subjects. We tried to save them, but unfortunately heavy bookshelves had tumbled down during the earthquake, and there was no means to take the books out before the library was burnt. . . . . . . We succeeded in saving the big library, which was built separately with steel concrete. It was full of meteorological data of Japan and foreign countries, old books, etc. . . . . When flame was curling round the library, Mr. Miara, the assistant observer, found that flame streamed in through the wind holes leading under the floor. He put a wet towel over his head and face and closed the holes. By this brave act the library was saved. . . . . . . I think it would be worth reporting that our brave observers continued the hourly observations during the fire. No single observation was lost. Air temperature rose 6 to 8 degrees Centigrade above the value otherwise expected. . . . . . . Tornadoes were reported to have occurred. It seems to be true. Somebody told me that at Hifukusyo—in Tokyo—where more than 30,000 people were killed, a terrible tornado had happened and even a wagon was sucked up. Pine trees were uprooted, and some were twisted off and thrown down. . . . . At that time my sister who lives at Yokohama and had been compelled to take refuge in the river, observed tornadoes here and there. They were whirling up very near the most brilliant fires. She could not remember if they were turning to the right or left, but it seems certain to her that they moved when their fires decayed and joined to the other fire. . . . . Thus it seems certain that tornadoes can be caused by strong heating of the air. . . . . The task to get food continued some 10 days. We lived only by taking rice balls the first few days. On the other hand this was the typhoon season, and the storm warning was absolutely necessary. I issued a weather forecast for the 3rd, only by taking cloud, wind and barometer at Tokyo into consideration. During a week I lost 2 and got 5 hits. We made all efforts to get weather telegrams, and on the 10th we succeeded by erecting a receiving set of radio telegraphy in our Observatory.

We wish to offer our sympathy to Prof. Okada and his staff for the loss they have sustained, and to congratulate them on their escape.

We understand that steps are being taken to send out from this country sets of books to replace some of those lost by scientific institutes in Japan. The original records which have been destroyed are however irreplaceable.

Discussions at the Meteorological Office

November 12th, 1923. *Klimatische Kontinentalität und Ozeanität.* By Prof. R. Spitaler (Gotha: Petermanns Mitteilungen, Vol. 68, June 1922, p. 113). *Opener*—Mr. L. C. W. Bonacina.

In the maps which were the subject of this discussion the lines of equal continentality are based upon the normal difference of temperature between January and July. The fact that the normal distribution of temperature over the globe at any time of the year is determined in the main by latitude, altitude and continentality is expressed by Spitaler in a certain formula. From this formula the annual range, which there would have been at a point had the parallel of latitude containing it been in the middle of a land hemisphere or water hemisphere, can be computed. Comparison of the actual range with these hypothetical ranges affords a measure of thermal continentality. In consequence of the circulation of the atmosphere, whereby prevailing oceanic winds in one region may transfer oceanity landwards, and continental winds in another may transfer continentality seawards, the thermal or climatic continentality of a place does not always correspond with local geographic continentality as given by the percentage of land around it, but may be overweighted or underweighted with respect thereto. Thus England's climatic continentality is, in consequence of the prevailing Atlantic winds, only 25 per cent., and therefore much lower than its geographic continentality. If geographic continentality be defined, for instance, by the proportion of land in a circle with radius 10°, then for London the value is about 50 per cent.

Mr. Bonacina suggested that continentality should also be studied with reference to diurnal range of temperature, and to the magnitude of irregular deviations from the normal; although these two measures would run roughly parallel with the annual range studied by Spitaler there would be some important discrepancies between the three. He thought that, if some method could be found whereby each locality was assigned a set of continentality co-efficients for the different types of weather, light would be shed on some of the profoundest problems in meteorology.

November 6th, 1923. *The Earth and the Sun. An hypothesis of weather and sunspots.* By Ellsworth Huntington (Yale University Press, New Haven, 1923). *Opener*—Dr. C. Chree, F.R.S.

Professor Huntington has written a book which invites the attention of the general reader looking for the latest teaching on the way that solar changes influence terrestrial weather.

The trend of the discussion suggested that much of the evidence adduced in favor of definite connections between the two would break down under cross-examination. How much of the story of the intrigues of planets and sunspots, radiation and temperature, would survive the cross-examination is not clear. The time is hardly ripe for a judicial summing-up of the case.

The wireless direction-finding apparatus installed at Croydon and Pulham has proved of great service during the recent periods of fog and mist; *e.g.*, the only air express to reach Croydon on November 21st was guided to the aerodrome over the mist and fog in southern England by wireless telephony.

An advertisement of a rain-gauge for sale, second-hand, will be found on page ii. of the cover of this magazine.

Royal Meteorological Society

THE monthly meeting of the society was held on Wednesday, November 21st, at 49, Cromwell Road, South Kensington, Dr. C. Chree, F.R.S., President, in the Chair.

L. F. Richardson, B.A., F.Inst.P.—Attempts to measure air temperature by shooting spheres upward.

Mr. L. F. Richardson is furthering the biblical prophecy*: if he has not literally turned swords into ploughshares he has made guns serve the purposes of the peaceful meteorologist. Mr. Richardson's method of finding the strength of the wind aloft is to fire a spherical projectile upwards, nearly but not quite vertically, and to note what slope must be given to the gun so that the wind may blow the projectile back to the observer's shelter. Incidentally Mr. Richardson noticed that the time of flight of the projectile must depend on the temperature of the air aloft. Considerable refinement in the timing is necessary, but it appears that the average temperature of the air below 300 ft. can be estimated with a probable error of about a degree centigrade. Frequently, and especially in foggy weather, temperature near the ground differs widely from the temperature in the free atmosphere, and a means of determining the latter may prove of great value. We are reminded that the American practice of utilizing for the daily weather service temperatures observed on the roofs of high buildings rather than on the ground has its advantages.

Col. H. G. Lyons, F.R.S.—Exhibit of a replica of an early Korean rain-gauge.

Illustrations of a Korean rain-gauge are to be found in several meteorological works. Col. Lyons has secured for the Science Museum a replica of one of these gauges. The pattern was in use in 1770. It is clear that the importance of a deep gauge and of a good stiff circular rim were appreciated in Korea at that early date. The original might even satisfy such a test as Mr. Heath Robinson would delight to illustrate—gauge on side, observer standing on rim, inspector declaring distortion infinitesimal.

F. J. W. Whipple, M.A., F.Inst.P.—Exhibit of a limit-gauge for rainfall.

Readers of the *Meteorological Magazine* are familiar with the commercial importance of insurance against rainfall. Many insurance policies provide for payment of a claim when the amount of rain recorded is equal to or exceeds 0·10 inch. Mr Whipple showed a measure designed to stand inside an ordinary rain-gauge and to show with precision the limit 0·095, so that falls to be reckoned as 0·10 or more may be easily distinguished from falls to be reckoned as 0·09 or less.

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* *Isaiah* ii. 4; *Micah* iv. 3.

S. N. Sen, M.Sc., A.Inst.P.—On the distribution of air density over the globe.

The distribution of the mass of the atmosphere in height as well as in geographical position is a subject of philosophical and practical importance. Mr. Sen has gone through the lengthy process of computing the density of the air from standard estimates of the temperature and pressure, and has presented his results in a series of instructive charts and diagrams. The outstanding peculiarity of the distribution is the fact that in the lower atmosphere the warmer air is the lighter, whilst at greater heights the warmer air is the heavier. The explanation is simple: the expansion of the lower air increases the mass of air to be accommodated in the upper layers. The transition occurs at about 8 kilometres from the ground. As was mentioned in the discussion it is more than a coincidence that 8 kilometres is the average "height of the homogeneous atmosphere."

Correspondence

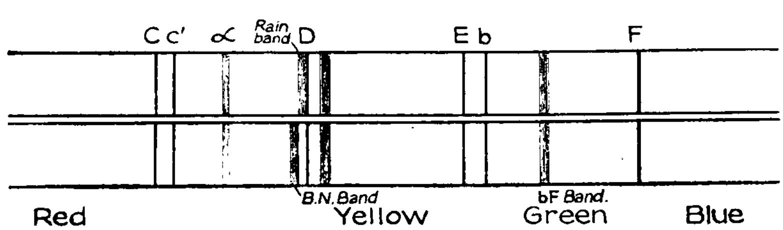
To the Editor, *The Meteorological Magazine*

Telluric Spectroscopy

Professor Piazzi Smyth, Astronomer Royal for Scotland, about the middle of last century was the first to draw the attention of scientists to the absorption of light by the aqueous vapour in our atmosphere as shown in the spectroscope. Particularly he pointed out the importance of the telluric absorption band at and near the sodium line D in the solar spectrum as an index to the amount of aqueous vapour present at any time in the atmosphere around and over the point of observation; and from the variations taking place in the intensity of this band the possibility of predicting fine or rainy weather. When the band was but faintly observed fine weather would probably follow, and when very pronounced rain was sure to follow. This band is what is now known to the meteorologist as the rainband.

In 1882, I was initiated into the making of observations of the rainband by Mr. C. L. Wragge, the pioneer in the meteorological work that resulted in the establishment of the Ben Nevis Observatory. During the whole existence of this institution I was one of the staff, and during the first three years I was always on day duty. In this way I was enabled to make hourly observations from before sunrise till after sunset. I always observed every telluric line or band in my field of view from A to F The lines below C, however, could not be seen except at sunrise and sunset. I kept a record of the varying intensities of the following bands, viz.: C′, alpha, rainband, low-sun band, and another band between *b* and F. (See *Madeira Meteorologica* by Piazzi Smyth). After some time I became familiar with my field of view and could detect the slightest variation in the intensity of any of these bands. All my observations made on Ben Nevis are now in the archives of the Scottish Meteorological Society. Following Dr. H. R. Mill and a number of other British and North American observers, I published in the *Scottish Meteorological Journal* and in *Nature* the results of my observations, showing the forecasting value of the rainband spectroscope. Hitherto I have not written anything about the other lines or bands.

In the course of my observations of the bands I have already mentioned, I by-and-by became aware of another band that occasionally made its appearance immediately to the red side of the rainband. This band I observed at its strongest in the evening, after sunset, and just before cold weather. Not knowing more about it we called it the " Cold Band." Now, however, I always call it the " Ben Nevis Band." After a bit I included this band in the general routine of observation, noting its presence and intensity or its absence as the case might be. It was some years after I had first noted the " Ben Nevis band " that I came to associate it with variations in the rainband. This was on the summit of Ben Nevis ; but as it was not infrequent to observe the rainband diminish in the evening, owing to the damp air falling below the level of the summit, I did not give much weight to the fact that as a rule when the " Ben Nevis band " increased the rainband diminished. At sea-level at Fort William there was always a fair amount of rainband, so I could not there detect the connection.



THE SOLAR SPECTRUM

After the closure of the Ben Nevis Observatories I had the honour to be appointed to the staff of the Meteorological Office of the Argentine Republic, under Director Davis. At first I had a spell down south on the staff of the observatory in the South Orkneys. There I observed the relation between the " Ben Nevis band " and the rainband, just as I had observed it on Ben Nevis. There could have been no sinking of the damp air at the South Orkneys, for observations were made at sea-level, so I was forced to the conclusion that the increase in the "Ben Nevis band" was due to the decrease in the rainband—that the increase in the former was at the expense of the latter.

On settling down here in Buenos Aires, I was surprised to see the "Ben Nevis band" fairly strong at times in this latitude and at sea-level. I have never seen the matter so pronounced, however, as during a recent intense spell of drought. Some evenings the "Ben Nevis band" was as strong as the alpha band, and spectroscopists know what that means; while the D line showed as a very clear, clean but weak line with a trace of the yellow part of the spectrum on its red side. I had never observed the like of this before.

So far, I have never found myself equipped with the means and instruments to enable me to say what the gas or vapour is that causes the "Ben Nevis band." I only know that it appears and behaves in relation to the rainband as I have already described.

ANGUS RANKIN.

Oficina Meteorológica Argentina, Buenos Aires, August 2nd, 1923.

[Mr. Rankin is to be thanked for calling attention to the utility of spectroscopic observations for indicating the changes in amount of vapour in the atmosphere. The pioneer work of Piazzi Smyth has not been followed by the development of a routine in which the personal equation of the observer is eliminated and quantitative results are obtained. Variations in the absorption of the ultra-red rays have been studied at the Solar Physics Observatory on Mount Wilson, and a paper by Fowle shows how the proportion of vapour in the free atmosphere can be estimated and compared with that in the air at the observatory.—ED. *M.M.*]

The Burning of Ferne doth draw downe Rain

IN an old book entitled "Choice Notes from 'Notes and Queries'" there is the following interesting extract, being a letter written by Philip Herbert, third Earl of Pembroke, Lord Chamberlain to the Sheriff of Staffordshire, which illustrates a curious popular belief somewhat akin to the idea that gunfire brings rain.

> "Sr. His Majesty taking notice of an opinion entertained in Staffordshire, that the burning of Ferne doth draw downe rain, and being desirous that the country and himself may enjoy fair weather as long as he remains in those parts, His Majesty hath commanded me to write unto you to cause

all burning of Ferne to bee forborne untill His Majesty be passed the country. Wherein not doubting but the consideration of their own interest as well as of his Majesty's will invite the country to a ready observance of this his Majesty's command, I rest

Your very loving friend,

PEMBROKE AND MONTGOMERY.

Belvoir, 1st August, 1636.

To my very loving friend the High Sheriff of the County of Stafford."

Unfortunately there is no record of the weather during the King's visit.

CICELY M. BOTLEY.

10, Wellington Road, Hastings, October 20th, 1923.

Variability of Climates

MY attention has been called by a member of the Cornwall Rainfall Association to a statement in an article on p. 158 of your August number that the percentage range of mean monthly rainfall is under 10% in 65 per cent. of the area of Europe, and no part has over 30%.

I find on referring to Hellmann's "Untersuchungen über die Schwankungen der Niederschläge" that for the fifty years, 1851—1900, the wettest month throughout Europe generally had nearly three times the rainfall of the driest month in the year, there being very few places where the proportion is as low as twice as much. It would be interesting to know how the figures given in your August number are obtained.

A. PEARSE JENKIN, F.S.I.

Trewirgie, Redruth, October 31st, 1923.

[The interpretation of the statement in question is that in the memoir by Supan on which the map referred to by Dr. Visher is based the normal rainfall of each month is expressed as a percentage of the normal rainfall of the year, and the difference between the falls in the driest and wettest months is likewise expressed as a percentage of the annual fall. For example, at Greenwich :—

The normal for the wettest month has	11·4	per cent. of the annual fall.
The normal for the driest month has	6·0	
The range is	5·4	

Accordingly Greenwich falls in the region with range below 10 per cent.—ED. *M.M.*]

NOTES AND QUERIES

The Norwegian Meteorological Service and Losses in the Arctic

Most meteorologists are aware of the splendid work being done by Norway in obtaining meteorological information from the Arctic by wireless telegraphy so that it is available for the rest of the world to use on daily synoptic charts; but few probably are aware of the grievous losses both in men and ships that this work has cost the Norwegian people. At the International Meteorological Conference at Utrecht in September, Dr. Hesselberg told us that during last year no less than three men of the Norwegian Meteorological Service lost their lives in the course of their duties in the Arctic, and now another tale of danger and of loss of ships and lives has just come to hand.

In the summer of 1922 a Norwegian hunting expedition crossed from Tromsö to Greenland. The Norwegian Meteorological Office equipped the expedition with a telegraphist and radio set. The expedition reached Mygbugten in its ship "Annie" in the autumn of 1922, and commenced that regular series of weather messages from Greenland which has been so useful in our daily weather work.

For some time past the Norwegian Office has maintained a party of meteorologists equipped with wireless on the island of Jan Mayen, and in July 1923, the ship "Conrad Holmboe" was despatched with provisions and new men for the two stations at Jan Mayen and Mygbugten. All went well until, after completing the work at Jan Mayen, the "Conrad Holmboe" tried to reach Mygbugten, but then she was caught in the floes, and seriously damaged by screw-ice. In the meantime the "Annie" left Mygbugten and nothing more was heard from her. In these circumstances it was necessary to send a relief expedition, and the ship "Polarulv" went to the ice off Greenland. She kept in touch by wireless with the "Conrad Holmboe" and succeeded after the lapse of a month in bringing the damaged ship back to Isafjord in Iceland, little more than a wreck, but with the 14 men on board all safe and sound.

The "Polarulv" then went back again towards Greenland to try to find the "Annie," but she, in her turn, was involved in disaster, for, when between Iceland and Greenland, she foundered during a storm. The captain and three men were drowned, but the rest of the crew were saved by a British trawler. It is now too late in the season to send a new relief expedition to the aid of the "Annie," about which ship and its crew no information has been received since she left Mygbugten.

The British have always admired the men who risk their lives in polar regions in the cause of science, and our sympathies—especially as meteorologists—go out to Dr. Hesselberg and his colleagues in the Norwegian Meteorological Service in this their time of great anxiety, and we join with them in their hope that the crew of the "Annie" has succeeded in reaching the coast of Greenland.

G. C. SIMPSON.

The Growth of the Daily Weather Map

IT is interesting to note how the area covered by the daily weather maps of the various countries has been extended during the last few years so that observations from the greater part of the northern hemisphere are now plotted each day.

Sir R. F. Stupart in a letter addressed to the President of the Conference of Directors points out that Canada has started to form a network of wireless meteorological stations in northern Canada. Stations at Dawson and Mayo, Yukon, are to be opened immediately, and next spring stations will be placed at Fort Simpson (Lat. 62°, Long. 121°) and Fort McMurray (Lat. 57°, Long. 111°), where the system will connect with the land telegraph. This will cause a further extension of Canada's daily (10h.) working maps, which are already very comprehensive as they extend from Long. 180° across north America and the northern Atlantic to Central Europe, and include Spitzbergen and Gibraltar.

Charts of the weather of the northern hemisphere, showing observations which reach from the west coast of America across the north Atlantic to the western borders of Russia, are issued each day by the Meteorological Office, London, and our knowledge of the weather conditions is extended still further eastwards by the maps of the Russian daily weather reports, which are among the largest to be reproduced for publication. These maps cover the whole of Europe and stretch across western Asia as far as Long. 90° E. The daily weather charts of the North Pacific Ocean which are now being published by the Imperial Marine Observatory, Kobe, complete the circle of observations round the hemisphere. These charts are published monthly and represent the conditions at noon by Japanese Standard Time (3h. G.M.T.). The observations extend over an area from Lat. 5° N to 65° N. and from China and Siam to the United States. The first two volumes containing the maps for January and February, 1923, are now available.

It would be of interest to know what regions are included in the working charts of the United States and Norway. Publication of the charts of the northern hemisphere issued day by day by the United States during the year 1914 has not been resumed.

Atmospheric Electricity from the Engineer's point of view

Dr. ALEXANDER RUSSELL, President of the Institution of Electrical Engineers, delivered his inaugural address on October 18th, 1923. One section of the address was devoted to a consideration of thunderstorms. The exposition of the physics of the phenomena of a thunderstorm was interesting, but a good many of the statements in it would probably be challenged by other workers in this controversial subject.

Amongst the personal experiences mentioned by Dr. Russell was the watching of a thunderstorm at sea from a small boat on a calm day. Where the lightning seemed to strike the sea a narrow column of spray or more probably steam rose suddenly, the effect being similar to that produced by a gannet when diving. Dr. Russell has also had the good fortune to see globular lightning. He was on the coast of Ayr many years ago when two spheres of a dull reddish colour about 20 or 30 feet up moved slowly in from the sea, each about a foot in diameter. One hit the wall of a building but did no apparent damage, although it made a loud report. The other drifted away.

Ball Lightning

SOME interesting accounts of ball lightning have recently been received. These illustrate the excessive variability of the phenomenon.

In one case, investigated by the Rev. H. D. Dale, Vicar of Hythe, the ball lightning occurred during a very heavy hail shower in the evening of April 26th, 1923. No sign of an approaching thunderstorm was observed, but suddenly at 7h. 30m. a ball of fire, which appeared to be about 6 to 12 ins. in diameter, fell and burst almost instantaneously, penetrating the metal road to a depth of 2 ft. 8 ins., then running along the metal water main. This was followed by a tremendous thunderclap. The road immediately after the explosion appeared filled with sparks followed by smoke. Windows were broken in houses 150 to 300 yds. away, and the electric lighting affected in houses half a mile away, while the wire netting on the palings close by fused, and lines were scored on the bark of trees 2 to 8 yds. from the hole, which was about 1½ ins. in diameter.

Another account of ball lightning comes from Mr. J. Mintern, of Killmurry, Passage West, Co. Cork, who reports that he observed ball lightning during a severe thunderstorm on the evening of May 2nd, 1923. The first ball of fire was seen about 21h. 30m.—it was a clear yellow in colour, and its edges were defined. It was visible for a few seconds and then seemed to drop slowly, in the north apparently, into the river Lee. A few minutes later a vivid flash was seen " like a rope of fire coloured blue, green and yellow." A little later still a second ball of fire was seen to fall more to the eastwards, where the storm was travelling. This ball was not so distinct as the first, and " looked as if seen through a fog." The storm was not associated with heavy rainfall ; only a few moderate showers fell while it was at its height.

On another occasion the ball lightning was seen in a church. The *Daily Express* states that the Rev. T. Peacock, Vicar of Hemingborough, was giving an address at Selby to the Yorkshire Association of Bellringers during a thunderstorm on the afternoon of September 2nd, 1923, when a ball of fire appeared in the church, ran up the aisle and then exploded. The air was pungent with the smell of sulphur. One curious thing about the fireball was that it rolled up the carpet in the aisle.

Nature of Ball Lightning

Dr. Russell's address gave Dr. Simpson the text for an article on "Thunderstorms and Globular Lightning" in *Nature* of November 17th. Dr. Simpson's opinion is that " the only physical phenomenon yet produced in a laboratory at all approaching ball lightning is the active nitrogen studied by Lord Rayleigh." On the other hand Mr. E. Kilburn Scott writes to *Nature*, of November 24th, pointing out that in the manufacture of nitrogen products on a large scale, nitric oxide and nitrogen dioxide are formed in the electric arc, and suggests that ball lightning may consist of these substances in a very concentrated and possibly liquid form.

Minimum Thermometers

The experience of meteorologists with spirit thermometers seems to differ widely from that of other physicists. The meteorologist knows that it happens frequently that a minimum thermometer which obtains a good certificate when first made develops an error in the course of its first year or two of service and reads too low. In many cases the error is temporary, by standing the thermometer so that any spirit on the walls of the tube can drain down to the main body the trouble is cured, but as a general rule it is persistent. This evil which, we understand, is not met with in thermometers used for laboratory purposes, has been explained in various ways ; the favourite theory is that alcohol escapes through minute cracks or holes in the glass ; another suggestion is that the tubes used for spirit thermometers are not annealed with the same care as those for mercury thermometers, and that the bulbs expand when the air above the spirit exerts its pressure at high temperatures. One maker thinks that in certain conditions the glass would absorb spirit to such an extent as to account for the observed errors, but nothing definite is known about this process. In 1921 two defective grass minimum thermometers were sent to the National Physical Laboratory for an exhaustive test, and have been under examination there since then.

One thermometer (No. 1368), which had been certified as correct in 1909, required a correction $+3·4°$ F. in 1921, and in 1923 the correction had increased to $+3·7°$ F. With the second (M.O.17148) the corresponding figures were $+1·1$ and $+1·3$. It will be noticed that in both cases the zero is still falling.

With a view to obtaining some evidence of the flaw in the glass, the thermometers were kept in an evacuated vessel for some days at the temperature of melting ice, but this test does not show any change in the readings of the instrument. Very careful examination of the thermometers shows no evidence of minute flaws which could lead to a slow leak of the contained spirit; this is confirmed by the negative result of the test in vacuo. It has to be admitted that it is not possible at present to offer an adequate explanation of the phenomena. The two thermometers are still under observation at the Meteorological Office.

Organic Bodies in the Air

THE presence of organisms of various kinds floating in the air is regarded amongst medical men as axiomatic. It is therefore remarkable that until recently very few of such organisms had been identified on the microscope slides made with Dr. Owens's jet apparatus. The first report of the regular occurrence of organic structures on the slides was received from Dr. H. Kimball, who stated that at Washington in August opalescent bodies had been found in large numbers both in records taken on the ground and also in those taken on an aeroplane. It was not long before similar observations were made in England. On October 10th, 1923, a record taken at South Kensington by Mr. G. M. Watson was found to contain two large bodies identical in appearance with some of those in the specimen slide from America. Subsequently, the organisms were found to be more prevalent in the country, at Cheam, than in London. They were usually oval, the long diameter varying between about 5 to 12 μ (1 inch equals 25,000 μ), giants compared with the ordinary dust particle on the microscope slides. Acting on the idea that the particles were probably characteristic of the air of a wet and stormy autumn Dr. Owens examined the spores of the mould which forms on dead leaves, and found that they were identical in appearance, size and shape with those got from the air.

Meteorological Charts

It was mentioned in the March number of the *Meteorological Magazine* that a change of policy with regard to the issue by the Meteorological Office of charts of the oceans for the use of sailors was contemplated. This change is now being made. Monthly charts of the North Atlantic and Indian Ocean, in which all information of a more permanent character have been prepared, are being issued in sets so that they may be available for reference in the chart room on board ship. The sets may be purchased through the Admiralty Chart Agents.

The Marine Observer

The backs of the Meteorological Charts have been used hitherto for the circulation of information of interest to seamen. A much more convenient medium for this purpose has now been provided by the publication of a new magazine, *The Marine Observer*. The first number of the magazine was published on December 5th. Copies, price 2s. each, may be obtained from H.M. Stationery Office.

The Marine Superintendent, Commander Brooke Smith, is to be congratulated on this new development in the activity of the senior branch of the meteorological service.

A Defective Sunshine Recorder Ball

On pages 76-77 of the *Book of Normals* the averages of the daily duration of bright sunshine at Broadstairs, Margate and Ramsgate are given as 4·79, 4·34 and 4·79 hours respectively. This seems to show that Margate receives nearly 30 minutes a day, or over 160 hours a year less sunshine than the neighbouring stations. Locally this difference was attributed to the loss of evening record at Margate owing to the sun setting in the haze at the mouth of the Thames, but the difference appeared to be increasing, and during the four years 1919 to 1922 Margate recorded an average of 206 hours a year less than Broadstairs, while on the occasion of the solar eclipse of April 8th, 1921, the gap in the record was greater at Margate than at any other station in the British Isles. Accordingly a second sunshine recorder was sent to Margate in May of this year to test the accuracy of the old instrument, and it was found that during June and July the new recorder, exposed side by side with the old one, registered 64.8 hours more sunshine, equivalent to 1.06 hours a day, and to fourteen per cent. of the total sunshine. Thus it appears, as we should expect from the proximity of the stations, that the differences in the real duration of sunshine are small, but the old instrument at Margate has failed to register sunshine of slight burning power such as occurs near sunrise and sunset. The Meteorological Office inspector reported that the ball of the recorder (which was installed in 1892) is a deep yellow colour, and there is no doubt that, owing to some chemical or physical change, the glass has lost part of its transparency. A similar loss of sunshine, but to a far less extent, had previously been noticed at Lancaster and Hull, and investigation will be necessary to find out if any other stations are affected in this way.

Photography as a Scientific Implement

A "COLLECTIVE WORK" bearing the title *Photography as a Scientific Implement*, has been published by Messrs. Blackie & Son, Limited. The book has been written by thirteen specialists. The chapters vary in interest; some, like the first, on the history of photography, by C. R. Gibson, and the last, on the camera as witness and detective, by W. M. Webb, are easy and amusing, others are highly technical. There seems to be no direct reference to meteorology in the book, but the problems with which it deals are so closely akin to ours that we can say with confidence that it should be included in the equipment of the laboratory of every enterprising meteorological observatory.

Methods of Interpolation

THE needs of the Mathematical Laboratory established by Professor E. T. Whittaker at Edinburgh have already provided a stimulus for the writing of several useful text-books. A new one, "A short course in Interpolation," written by Professor Whittaker and Mr. George Robinson, has been published by Blackie & Son, Limited.

The book provides for much excellent training in arithmetical methods of interpolation, but we regret to notice that the importance of graphical methods is entirely overlooked. This defect stands out in the only question in the book with a direct bearing on meteorology. The heights above sea level corresponding with barometric pressures, 30, 27, 25, 23 and 20 inches are given, and the height corresponding with 29 inches is required. The practical method in such a case would be to plot the data on semilogarithmic paper and draw a more or less smooth curve, the possibility of angles corresponding with irregularities of temperature being borne in mind. The authors propose a method equivalent to using ordinary plotting paper and drawing the best fitting curve of the 4th degree. It is announced that this book is part of a larger work on the Calculus of Observations. We would like to see a chapter on meteorological applications in such a work.

Rime as an Indicator of Air Movements

THE fog which occurred near the end of November was remarkable in some parts of London for the development of rime. There was hardly any hoarfrost on the ground but objects exposed to the wind bore a fine crop of rime. One detail which I have not seen mentioned previously was conspicuous on the railings in various places on Hampstead Heath during the afternoon of Sunday, November 25th.

In the case of a horizontal iron rail one or two inches in diameter there would be a well defined horizontal central line, looking black in contrast with the white deposit above and below it. The central line was almost free from deposit and presumably marked the dead space between the part of the air which was deflected upwards and that which was deflected downwards. This evidence that, on the up-wind side at any rate, the airflow which carries the deposit is along steady stream lines rather than in shifting eddies is valuable. A series of photographs illustrating the formation of rime on various objects would be of great interest.

F.J.W.W.

Reviews

Medical Climatology of England and Wales. By Edgar Hawkins, M.A.(Oxon.), M.D.(Edin.), D.P.H.(Oxford). Demy 8vo., $8\frac{3}{4} \times 5\frac{1}{2}$, pp. xiv. + 302, 149 charts. London : H. K. Lewis & Co., Ltd. 1923. *£1 5s. net.*

In this book the author has succeeded in presenting facts about the Climatology of England and Wales in a manner designed to facilitate easy comparison between different stations and districts, specially for the purpose of the patient or doctor who wishes to discover a suitable climate for the treatment of a given ailment. In this presentation extensive use has been made of coloured diagrams, all of which are drawn on a uniform plan. There are 144 diagrams in the book, and, as everyone of these is purely climatological, it will be appreciated that considerable attention has been paid to the climatological aspect of the subject. There is not, in the whole book, a single full climatological table ; the author clearly prefers the graphical to the statistical method of presentation. The diagrams, which are at once novel and ingenious, and convey a large amount of information in a striking manner, are of three main types.

In the first place there are charts showing by means of coloured block columns annual mean percentage values of temperature, sunshine, rainfall, daily range of temperature, cloud and relative humidity ; showing further, by means of wind roses, the relative frequency of the three most prevalent wind directions, and by block columns the average percentage numbers of days of snow, hail, thunderstorm, fog, gale and rain. Diagrams of this kind are given for each of the seven meteorological districts and also for a number of stations in each district. The block columns are all drawn to a common percentage scale, on which 100 represents* the normal annual value for the whole of England and Wales. It is, therefore, seen at a glance whether a particular element in a given district or at a given station is above or below the normal for the whole country, and what percentage of that normal the departure may be.

In the second place mean monthly values of temperature, daily range of temperature, sunshine, rainfall, rain-days, relative humidity and cloud are shown for the whole country and also for each district. These are line diagrams of the usual kind.

Thirdly, mean monthly values of temperature, daily range of temperature, rainfall and rain-days, expressed as percentages of the general means for England and Wales, are drawn for each district and for each station in each district. These are line diagrams with a common percentage scale, 100 representing the normal value for the month for the whole of England and Wales.

The percentage diagrams, especially the last described, are of a kind which is not generally familiar, and consequently they present unusual features. For example, the seasonal rainfall curve for Geldeston, Norfolk, shows a maximum (10 per cent. below the general mean) in July, and a minimum (about 35 per cent. below the general mean) in January. This does not necessarily mean that the January rainfall at Geldeston is less than the July fall, only that, in comparison with the country as a whole, Geldeston has a rather low rainfall for July and a decidedly low rainfall for January. Yet that is a fact of much importance to a patient seeking relief from wet winters, but compelled to remain in England. On the other hand, at Plymouth the rainfall in June is about equal to the general mean for June (99 per cent.), while in December it is as much as 60 per cent. above the general value for December.

The text contains general remarks on the climatology and soils of the country, with a discussion of their bearing on therapeutics, followed by detailed descriptions of the climatology and soils of various towns and districts with special reference to established health resorts.

We commend the book, not only to the medical man and the invalid, but also to the student of our English climate. It should be used to supplement other sources of information. To extract numerical data with no other book of reference available is not always an easy matter.

R.C.

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* In the case of temperature, 0 is the freezing point and 100 is 48·2 F.

Het Klimaat Van Nederlandsch-Indie. By C. Braak. Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia, Verh. No. 8, Vol. I., Part III. Size 11×8, pp. iv. +73 (Dutch) +39 (English Summary). *Illus.* Batavia, 1923.

THIS publication is the third part of a work on the climate of the Dutch East Indies. Part I. contains three introductory chapters; Part II. deals with wind and pressure; and the present publication, Part III., contains chapter (6) on rain. These three parts are all included in volume I., which is devoted to the general features of the climate of the Archipelago. In volume II. it is proposed to deal with the local climate of the different islands, while volume III. is to be devoted to climatological tables.

The islands are small enough to allow of an effective interchange of air with the surrounding seas, and as they are situated near the equator the rainfall is abundant. The influence of the continents of Asia and Australia renders the Archipelago "the most typical monsoon region of the world."

The amount of rainfall data in these islands is considerable, for Dr. W. Van Bemmelen, in his paper "On the Rainfall of Java,"* published records from 702 stations in Java alone with at least five years' observations in the period 1879 to 1905. The records have largely been maintained by private observers, as in this country. We are told, however, that of the material available "only a very moderate use has been made, the computation of the rain observations, which has already been started at the observatory, being reserved for a separate treatise." Chapter (6) contains no map of the average annual or monthly rainfall, the preparation of new maps being, however, in progress. Maps are given showing (*a*) month of greatest rainfall, (*b*) month of least rainfall, (*c*) number of months with 5 mms., or less in the dry year 1914, (*d*) number of consecutive months in which the average rainfall did not exceed 5, 10, 15, 30 and 50 mm. respectively in Java. Similar data for the rest of the Archipelago are embodied in a table.

With mountains which rise to over 10,000 feet, a feature of rainfall which is not met with in this country is described, namely, the falling off in the amount of rainfall at great heights after a maximum has been reached. Generally the level of the greatest amount of rain lies higher on the more elevated mountains. In the higher regions the rains lose more or less the character of tropical showers, and, in the place of short-lived thunderstorms, mist and drizzle become more frequent. Thus, the intensity of

* Maps of the average rainfall at Java for the year and for the periods December–February, March–April, May–June, July–September, and October–November were subsequently published in 1915.

rain decreases above a certain limit, but the longest duration of rain is found at the top of the mountain.

With this exception the amount of rainfall is found to be roughly proportional to the duration, or, in other words, the showers are of longer duration or more frequent at the stations with large rainfall than at the stations with small rainfall, but their intensity is about the same. A similar state of affairs is found in the British Isles, *e.g.*, the correlation coefficient between rainfall amount and duration for 48 records for the year 1915 is $+0·80$ ($e=0·04$).*

An analysis is made of the mean amount of rain falling in a rain-day at stations with different amounts of average monthly rainfall. The mean daily fall is considerably greater than that at stations in the British Isles with similar amounts of monthly rainfall. Nevertheless, the highest intensity of rain which has been recorded, namely, 3.8 mm. in a minute, is at a rate which has been exceeded in the British Isles on four definite occasions.

The variations from month to month, and also the variations during the day, are more complex, and are dealt with in some detail. The English Summary is sufficient to enable the tables of the Dutch text to be studied, and the whole volume makes interesting reading, as well as being of permanent value for future reference.

J.G.

News in Brief

It is officially reported that Flight Lieut. A. E. Gendle, the principal meteorological officer in the Middle East area was attacked by Arabs when walking near Baghdad with another officer on December 7th, and was killed on the spot. The other officer, Flight Lieut. Pearce, was severely wounded.

The Royal Society has appointed Mr. G. I. Taylor, F.R.S., to one of the first two Yarrow professors. The professorships have been founded through the generous gift made by Sir Arthur Yarrow and the holders are to devote their time to research. Much of Mr. Taylor's work is already regarded by meteorologists as classical and they will join in congratulating him on his appointment.

A joint conference of the Royal Meteorological Society, the Science Masters' Association, and the Geographical Association, will be held under the presidency of Sir Napier Shaw at Birkbeck College, London, on Thursday, January 3rd, at 2 p.m. The conference will discuss the place of meteorological observations in the school course and the teaching of meteorology and climatology in schools from the physical and the geographical standpoint. Visitors are invited.

* See "*British Rainfall,*" 1916. *p.* 37.

We learn with much regret that Sir Arthur Schuster has lost the sight of one of his eyes owing to an accident he met with a short time ago when he was accidentally struck by a golf club while standing near a lady player practising on his lawn. We understand that the doctor is satisfied with the progress he is making towards regaining his normal health.

Starting from January 1st, 1924, a new series of wireless weather reports especially intended for the use of seamen will be issued twice daily at 9h. and 20h. by the Meteorological Office through the Air Ministry wireless station. The code and full particulars may be found in the *Marine Observer*, in the Board of Trade notices to mariners for November, and in Supplement No. I. to the 2nd edition of *Particulars of Meteorological Reports* (M.O. 252), which will be published shortly by H.M. Stationery Office.

An address on recent developments in marine meteorology was delivered by Commander Brooke Smith at the Royal Technical College, Glasgow, on November 21st.

The *Amateur Wireless* states that a Biggleswade farmer has written to the British Broadcasting Co. informing them that he saved the cost of his four-valve set by listening-in to the weather forecasts. Hearing that rain was expected, he arranged to cart his crops one day before he originally intended.

The Weather of November, 1923

DURING the first two or three days of the month there was a continuance of the unsettled mild conditions of October, and maxima above 60° F. were registered, the actual highest reading, 65° F., being recorded at Cromer on the 3rd. Apart from these few days and two or three near the middle of the month, cold weather prevailed throughout November with much frost at night but many sunny days.

Northerly winds were experienced for some days in the rear of the depression, which passed northwards of Scotland towards Scandinavia on the 3rd, and these caused a gradual decrease in temperature until, on the night of the 7th-8th, screen minima as low as 18° F. were recorded at Tenbury, Marlborough and Rhayader. Snow and sleet were experienced in the north early in the month, and much rain or sleet occurred over the country generally as another depression passed southwards across the British Isles from Iceland to France. With the rise of pressure in the north, the easterly winds strengthened to gale force in the Channel on the 10th.

From the 12th to 18th, a series of deep depressions caused heavy rain in all parts of the kingdom, and floods occurred in Lancashire, North Wales, Cheshire and other districts, causing much inconvenience and damage to property. The weather charts during this period followed a sequence which may be regarded as typical of unsettled "westerly" conditions. An anticyclone to westward of the British Isles caused warm air to flow towards Iceland on the 9th. Subsequently the equatorial current spread southward covering the British Isles by 13h. on the 12th, and raising the temperature to above 50° F. at most stations. Meanwhile, a cold northerly current had appeared in Iceland, where temperatures ranged from 19° F. to 25° F. The contrast of temperature was thus very marked, and the early appearance of a deep depression off north-west Ireland was not surprising. The disturbance moved north-eastward across the northern half of the kingdom during the 13th. Another depression followed a similar track on the 15th, and a third depression, pursuing a rather more northerly course, crossed Scotland during the night of the 16th-17th. After reaching the North Sea, the latter disturbance gradually filled up, moving slowly southwards, and a northerly current spreading over the British Isles terminated the series.

Gales and a good deal of rain accompanied all three disturbances. At Southport shortly after 12h on the 15th an unusually violent squall was experienced, the direction of the wind shifting from south-east to west with a force of 82 m.p.h. The rainfall was heaviest on the 12th and 13th, as much as 100 mm. (3·92 ins.) being recorded at Llyn Fawr (Glamorgan) on the 13th, 90 mm. (3·56 ins.) at Oughtershaw (Yorkshire) on the 12th, and 73 mm. (2·88 ins.) at Penrhyn Quarry (Carnarvon) on the 13th, while at Dungeon Ghyll (Westmoreland) the total was 153 mm. (6·02 ins.) for the 48 hours ending 9h on the 14th. The flooding appears to have been caused chiefly by rain falling during that period. According to the Liverpool correspondent of the "*Times*," writing on November 14th, the floods at Sale on the Mersey were the most severe within memory, the water being eleven feet deep at Sale Priory. At Clitheroe, 300 houses were flooded, and at Bury, fire engines had to be requisitioned to pump water out of houses. Rain is said to have fallen continuously for 48 hours at Portmadoc, and the streets were flooded to a depth of two feet.

After the 18th, showers of hail, sleet or snow fell repeatedly in the northern and western districts, and snow or sleet also occurred in London and the south-eastern counties on the 28th. The mean temperature for the last half of the month was well below normal, and the readings of the screen minimum thermometer were exceptionally low, 12° F. being recorded at West Linton on the night of the 29th-30th, and at Rothamsted on the night 26th-27th, while a reading of 8° F. was registered above the surface of the snow by the terrestrial radiation thermometer at Balmoral on the 15th. Reference to Kew Observatory records shows that so prolonged a period of frost as that experienced between the 24th and 27th has not been experienced there in November since 1890. Aeroplane observations at South Farnborough show at 15,000 feet a mean temperature for the month 19° F. below the normal. Thunderstorms occurred at times during the month.

The early part of November was marked by great storminess in western Europe, and on the night of the 4th a very severe gale did much damage in Denmark and Slesvig Holstein. From the 10th to the 14th heavy rain in the south of the Rhone valley caused floods, and from the 22nd to the 28th there was a spell of very cold weather in Belgium, France and Italy, with heavy falls of snow which interfered with railway traffic, and caused a fatal motor omnibus accident in Italy. In the last eight or ten days of the month there was heavy rain in Spain, causing floods in Seville. Heavy rain in Italy, together with the melting of the snow which had fallen during the cold spell, resulted in floods in the valley of the Scalve in the Italian Alps which burst the dam holding up the artificial Gleno Lake. A wall of water, estimated at 90 feet deep, swept down the valley, doing enormous damage, while the loss of lives appears to have exceeded 300. About the 29th there was heavy rain in the hills near Aswân (Egypt), which flooded the Nile Railway and interrupted communications. From India it was reported on the 18th that very heavy rains had caused a breach in the east coast section of the Bengal-Nagpur railway. On the 20th a typhoon swept over the island of Luzon (Philippines), and the Visayas Islands, causing much damage. Manila was partly under water.

The special message from Brazil states that the rainfall in the north was slightly above the normal, in the centre slightly under the normal, and in the south still more scarce, the average being 45 mm. below normal. The weather was generally favourable for the crops except in the case of the sugar cane in the north. At Rio de Janeiro temperature was 25° F. below normal and pressure 4 mbs. above.

Rainfall November, 1923: General Distribution

England and Wales	99	per cent. of the average 1881-1915.
Scotland	110	
Ireland	97	
British Isles	101	

Rainfall Table for November, 1923

CO.	STATION.	In.	mm.	Per-cent. of Av
Lond.	Camden Square	1·46	37	62
Sur.	Reigate, Hartswood	1·76	45	...
Kent.	Tenterden, View Tower	2·34	59	77
,,	Folkestone, Boro. San.	2·13	54	...
,,	Broadstairs	2·27	58	92
,,	Sevenoaks, Speldhurst.	2·17	55	...
Sus	Patching Farm	1·93	49	54
,,	Eastbourne, Wilm. Sq.	2·62	67	75
,,	Tottingworth Park	2·45	62	66
Hants	Totland Bay, Aston	1·36	35	43
,,	Fordingbridge, Oaklnds	2·20	56	64
,,	Portsmouth, Vic. Park.	1·33	34	44
,,	Ovington Rectory	2·39	61	72
,,	Grayshott	2·03	51	60
Berks	Wellington College	1·93	49	75
,,	Newbury, Greenham	2·24	57	80
Herts.	Bennington House	...	...	...
Bucks	High Wycombe	1·76	45	71
Oxf.	Oxford, Mag. College	1·20	31	54
Nor.	Pitsford, Sedgebrook	1·72	44	78
,,	Eye, Northolm	1·28	33	...
Beds.	Woburn, Crawley Mill	1·25	32	55
Cam.	Cambridge, Bot. Gdns.	1·18	30	61
Essex	Chelmsford, CountyLab	2·42	61	...
,,	Lexden, Hill House	2·76	70	...
Suff.	Hawkedon Rectory	2·09	53	92
,,	Haughley House	2·21	56	...
Norf.	Beccles, Geldeston	1·41	36	61
,,	Norwich, Eaton	3·27	83	127
,,	Blakeney	3·18	81	143
,,	Swaffham	2·14	54	88
Wilts.	Devizes, Highclere	1·93	49	...
Dor.	Evershot, Melbury Ho.	2·63	67	62
,,	Weymouth, Westham	...	...	...
,,	Shaftesbury, Abbey Ho.	1·78	45	55
Devon	Plymouth, The Hoe	1·79	45	50
,,	Polapit Tamar	4·91	125	116
,,	Ashburton, Druid Ho.	4·95	126	87
,,	Cullompton	3·02	77	88
,,	Sidmouth, Sidmount	2·05	52	66
,,	Filleigh, Castle Hill	4·46	113	...
,,	Hartland Abbey	4·74	120	...
Corn.	Redruth, Trewirgie	4·82	123	99
,,	Penzance, Morrab Gdn.	4·54	115	99
,,	St. Austell, Trevarna	4·51	115	92
Soms	Chewton Mendip	4·83	123	113
,,	Street, Hind Hayes	2·17	55	...
Glos.	Clifton College	3·20	81	102
,,	Cirencester	2·14	54	70
Here.	Ross, County Obsy.	1·73	44	68
,,	Ledbury, Underdown	1·36	35	56
Salop	Church Stretton	2·47	63	84
,,	Shifnal, Hatton Grange	1·64	42	69
Staff.	Tean, The Heath Ho.	2·47	63	84
Worc.	Ombersley, Holt Lock	1·23	31	54
,,	Blockley, Upton Wold	1·83	47	62
War	Farnborough	2·37	60	86

CO.	STATION.	In.	mm.	Per-cent. of Av.
War	Birminghm, Edgbaston	1·80	46	76
Leics	Leicester Town Hall	1·77	45	...
,,	Belvoir Castle	2·17	55	97
Rut.	Ridlington	2·00	51	...
Linc.	Boston, Skirbeck	2·41	61	121
,,	Lincoln, Sessions House	1·98	50	105
,,	Skegness, Estate Office.	2·43	62	113
,,	Louth, Westgate	3·61	92	140
,,	Brigg	3·28	83	144
Notts.	Worksop, Hodsock	2·30	59	117
Derby	Mickleover, Clyde Ho.	2·47	63	111
,,	Buxton, Devon. Hos.	6·10	155	130
Ches.	Runcorn, Weston Pt.	3·47	88	125
,,	Nantwich, Dorfold Hall	2·02	51	...
Lancs	Bolton, Queen's Park	6·25	159	...
,,	Stonyhurst College	7·99	203	177
,,	Southport, Hesketh	4·79	122	153
,,	Lancaster, Strathspey	6·13	156	...
Yorks	Sedbergh, Akay	10·35	263	199
,,	Wath-upon-Dearne	2·49	63	122
,,	Bradford, Lister Pk.	4·77	121	163
,,	Oughtershaw Hall	10·10	257	...
,,	Wetherby, Ribston H.	2·72	69	116
ERY	Hull, Pearson Park	3·06	78	140
,,	Holme-on-Spalding	2·37	60	...
,,	Lowthorpe, The Elms	3·11	79	127
NRY	West Witton, Ivy Ho.	5·68	144	...
,,	Pickering, Hungate	4·45	113	...
,,	Middlesbrough	3·79	96	179
,,	Baldersdale, Hury Res.	...	...	...
Durh.	Ushaw College	...	...	...
Nor.	Newcastle, Town Moor.	4·31	109	178
,,	Bellingham Manor	4·61	117	...
,,	Lilburn Tower Gdns.	5·05	128	...
Cumb	Penrith, Newton Rigg	...	...	...
,,	Carlisle, Scaleby Hall	4·02	102	134
,,	Seathwaite	19·70	500	145
Glam.	Cardiff, Ely P. Stn.	3·64	93	87
,,	Treherbert, Tynywaun	8·81	224	...
Carm	Carmarthen Friary	5·60	142	112
,,	Llanwrda, Dolaucothy	6·02	153	102
Pemb	Haverfordwest, Portf'd	...	...	...
Card.	Gogerddan	6·83	173	145
,,	Cardigan, County Sch.	5·12	130	...
Brec.	Crickhowell, Talymaes	6·75	171	...
Rad.	Birm. W.W. Tyrmynydd	5·91	150	89
Mont.	Lake Vyrnwy	6·34	161	114
Denb.	Llangynhafal	3·61	92	...
Mer.	Dolgelly, Bryntirion	7·74	197	125
Carn.	Llandudno	4·94	126	160
,,	Snowdon, L. Llydaw 9	21·50	546	...
Ang.	Holyhead, Salt Island	4·74	121	114
,,	Lligwy	7·12	181	...
Man.	Douglas, Boro' Cem.	4·27	108	89
Guer.	St. Peter Port, Grange	5·34	136	127
Wigt.	Stoneykirk, Ardwell Ho	4·43	113	111
,,	Pt. William, Monreith	4·98	127	...

Rainfall Table for November, 1923—*continued*

CO.	STATION.	In.	mm.	Per-cent. of Av
Kirk.	Carsphairn, Shiel	10·12	257	...
,,	Dumfries, Cargen	5·55	141	123
Dum	Drumlanrig	4·90	125	117
Roxb	Branxholme	4·44	113	134
Selk.	Ettrick Manse	6·17	157	...
Berk.	Marchmont House	3·58	91	119
Hadd	North Berwick Res.	2·32	59	104
Midl	Edinburgh, Roy. Obs.	2·25	57	104
Lan.	Biggar	3·70	94	130
Ayr.	Kilmarnock, Agric. C.	3·92	99	104
,,	Girvan, Pinmore	6·96	177	131
Renf.	Glasgow, Queen's Pk.	3·29	84	88
,,	Greenock, Prospect H.	5·42	138	84
Bute.	Rothesay, Ardencraig	5·42	137	107
,,	Dougarie Lodge	4·35	111	...
Arg.	Glen Etive	7·54	191	...
,,	Oban	6·08	154	...
,,	Poltalloch	...	...	...
,,	Inveraray Castle	...	...	...
,,	Islay, Eallabus	7·49	190	139
,,	Mull, Benmore	12·70	323	...
,,	Mull, Quinish	...	...	...
Kinr.	Loch Leven Sluice	2·66	68	74
Perth	Loch Dhu	6·15	156	71
,,	Balquhidder, Stronvar	5·35	136	67
,,	Crieff, Strathearn Hyd.	2·24	57	52
,,	Blair Castle Gardens	3·46	88	...
,,	Coupar Angus School	2·16	55	77
Forf.	Dundee, E. Necropolis	2·24	57	92
,,	Pearsie House	2·68	68	...
,,	Montrose, Sunnyside	3·19	81	120
Aber.	Braemar Bank	3·33	85	86
,,	Logie Coldstone Sch.	3·97	101	129
,,	Aberdeen, Cranford Ho	3·32	84	103
,,	Fyvie Castle	4·92	125	...
Mor.	Gordon Castle	5·23	133	182
,,	Grantown-on-Spey	2·87	73	96
Na.	Nairn, Delnies	2·66	67	113
Inv.	Ben Alder Lodge	3·88	99	...
,,	Kingussie, The Birches	3·20	81	...
,,	Fort Augustus	4·82	122	105
,,	Loch Quoich, Loan	13·00	330	...
,,	Glenquoich	10·16	258	84
,,	Inverness, Culduthel R.	2·51	64	...
,,	Arisaig, Faire-na-Squir	8·02	204	...
,,	Fort William	6·59	167	82
,,	Skye, Dunvegan	7·50	191	...
,,	Barra, Castlebay	3·08	78	...
R&C	Alness, Ardross Cas.	3·74	95	93
,,	Ullapool	6·30	160	...
,,	Torridon, Bendamph.	9·26	235	100
,,	L. Carron, Plockton	4·81	122	...
,,	Stornoway	7·29	185	125
Suth.	Dunrobin Castle	...	...	...
,,	Lairg	4·68	119	...
,,	Tongue Manse	4·67	119	102
,,	Melvich School	5·47	139	137
Caith	Loch More, Achfary	11·59	294	136
,,	Wick	4·37	111	139
Ork.	Pomona, Deerness	6·16	157	157
Shet.	Lerwick	7·43	189	175
Cork.	Caheragh Rectory	5·39	137	...
,,	Dunmanway Rectory	4·40	112	71
,,	Ballinacurra	3·58	91	89
,,	Glanmire, Lota Lo.	3·62	92	84
Kerry	Valencia Obsy.	5·02	127	92
,,	Gearahameen	8·60	218	...
,,	Killarney Asylum	5·73	145	102
,,	Darrynane Abbey	4·88	124	96
Wat.	Waterford, Brook Lo.	2·45	62	65
Tip.	Nenagh, Cas. Lough	3·84	97	96
,,	Tipperary	3·89	99	...
,,	Cashel, Ballinamona	4·17	106	119
Lim.	Foynes, Coolnanes	4·28	109	107
,,	Castleconnell Rec.	4·87	124	...
Clare	Inagh, Mount Callan	7·42	189	...
,,	Broadford, Hurdlest'n.	4·89	124	...
Wexf	Newtownbarry	2·62	67	...
,,	Gorey, Courtown Ho.	2·87	73	82
Kilk.	Kilkenny Castle	2·12	54	69
Wic.	Rathnew, Clonmannon	2·53	64	...
Cars.	Hacketstown Rectory	3·01	77	77
QCo.	Blandsfort House	1·91	49	57
,,	Mountmellick	2·81	71	...
KCo.	Birr Castle	2·96	75	95
,,	Ballycumber, Bellair	2·75	70	...
Dubl.	Dublin, FitzWm. Sq.	1·87	48	70
,,	Balbriggan, Ardgillan	1·83	47	64
Me'th	Drogheda, Mornington	2·14	54	...
W.M	Mullingar, Belvedere	2·54	65	74
Long	Castle Forbes Gdns.	3·32	84	92
Gal.	Galway, Waterdale	3·31	84	...
Mayo	Crossmolina, Enniscoe	6·04	153	103
,,	Mallaranny	8·03	204	...
,,	Westport House	5·30	135	108
,,	Delphi Lodge	11·02	280	...
Sligo	Markree Obsy.	5·08	129	120
Ferm	Enniskillen, Portora	4·66	118	...
Arm.	Armagh Obsy.	3·75	95	132
Down	Warrenpoint	2·86	73	...
,,	Seaforde	3·80	97	100
,,	Donaghadee	2·69	68	88
,,	Banbridge, Milltown	2·62	67	95
Antr.	Belfast, Cavehill Rd.	3·64	93	...
,,	Glenarm Castle	3·63	92	...
,,	Ballymena, Harryville	3·79	96	94
Lon.	Londonderry, Creggan	5·70	145	139
Tyr.	Donaghmore	4·13	105	...
,,	Omagh, Edenfel	5·28	134	139
Don.	Malin Head	4·01	102	122
,,	Letterkenny Hospital	6·06	154	125
,,	Dunfanaghy	4·63	117	98
,,	Narin, Kiltoorish	5·13	130	...
,,	Killybegs, Rockmount	8·02	204	127

Climatological Table for the British Empire, June, 1923

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 (mm.)	Diff. from Normal (mm.)	Days	BRIGHT SUNSHINE: Hours per day	Percentage of possible
London, Kew Obsy.	1021·1	+ 4·4	75	37	62·9	48·8	55·9	− 3·3	51·8	72	8·1	6	− 49	7	3·9	24
Gibraltar	1018·4	+ 2·6	80	54	72·8	60·3	66·5	− 3·8	61·1	74	4·2	33	+ 21	5	...	...
Malta	1015·5	+ 0·9	91	61	75·2	64·8	70·0	− 2·0	63·1	69	4·1	1	− 1	1	...	...
Sierra Leone	1013·4	+ 0·7	89	69	86·7	73·6	80·1	− 0·4	75·9	78	7·2	337	−153	22	...	...
Lagos, Nigeria	1012·5	− 0·4	89	70	85·3	74·4	79·9	+ 1·3	76·3	82	8·3	637	+154	23	...	...
Kaduna, Nigeria	1014·0	+ 0·2	90	62	86·7	67·9	77·3	+ 1·3	71·1	75	...	183	− 42	16	...	...
Zomba, Nyasaland	1017·6	+ 0·2	79	49	74·7	53·5	64·1	+ 1·6	...	81	3·7	2	− 13	2	...	...
Salisbury, Rhodesia	1019·3	− 0·9	85	36	73·1	41·6	57·3	+ 0·9	52·0	65	1·5	0	− 1	0	...	...
Cape Town	1018·0	− 2·3	72	39	61·2	49·7	55·5	− 0·3	53·2	82	6·0	139	+ 26	13	...	...
Johannesburg	1022·9	− 1·5	63	28	59·1	39·7	49·4	− 1·3	39·0	59	2·5	12	+ 9	1	9·1	87
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Calcutta, Alipore Obsy.	997·5	− 2·2	108	75	95·5	80·5	88·0	+ 2·9	80·4	79	8·4	136	−154	*8	...	...
Bombay	1004·9	+ 0·7	94	76	90·7	81·7	86·2	+ 2·3	78·9	77	6·4	183	−286	*7	...	...
Madras	1002·9	− 0·9	110	77	102·6	82·2	92·4	+ 2·5	76·4	52	4·8	50	+ 2	*2	...	...
Colombo, Ceylon	1012·4	+ 4·1	87	73	85·0	77·4	81·2	− 0·7	77·4	77	9·4	202	+ 10	24	4·4	35
Hong Kong	1004·8	− 1·3	91	71	84·6	77·6	81·1	− 0·4	76·6	82	8·2	399	+ 1	24	5·1	38
Sandakan	...	...	91	72	89·2	75·4	82·3	+ 0·6	76·9†	77†	...	341	+156	16	...	...
Sydney	1010·9	− 7·0	80	43	64·9	50·0	57·5	+ 3·1	51·4	65	5·1	96	− 31	6	4·8	48
Melbourne	1010·2	− 8·3	66	37	57·6	47·1	52·3	+ 1·9	49·2	76	7·5	58	+ 5	19	2·7	28
Adelaide	1011·2	− 7·9	70	43	60·3	48·6	54·5	+ 1·1	50·5	76	7·3	147	+ 69	23	2·7	28
Perth, W. Australia	1011·2	− 6·8	69	42	62·4	49·9	56·1	− 0·5	52·1	75	6·7	325	+153	21	4·2	42
Coolgardie	1012·4	− 6·7	67	32	58·7	43·5	51·1	− 1·6	48·7	69	6·7	78	+ 47	19	...	...
Brisbane	1014·5	− 3·5	82	42	70·6	50·8	60·7	+ 0·6	55·8	62	2·6	68	+ 3	3	8·5	81
Hobart, Tasmania	1007·4	− 6·9	60	35	52·8	42·2	47·5	+ 0·7	44·7	80	7·0	89	+ 33	16	3·1	34
Wellington, N.Z.	1004·5	− 9·8	62	32	55·1	41·5	48·3	− 1·4	45·2	79	6·1	86	− 35	12	4·1	45
Suva, Fiji	1013·1	− 0·5	81	60	77·9	66·5	72·2	− 2·7	68·2	84	5·3	207	+ 51	15	...	...
Kingston, Jamaica	1014·1	+ 0·1	93	71	89·4	73·7	81·5	+ 0·2	...	66	4·4	5	−100	4	...	...
Grenada, W.I.	1015·2	+ 1·9	88	72	84·4	74·6	79·5	+ 0·7	74·5	75	6·5	93	−126	22	...	...
Toronto	1012·3	− 2·0	96	44	77·0	56·1	66·5	+ 3·9	60·5	72	4·0	108	+ 38	12	...	...
Winnipeg	1011·3	− 1·2	93	41	80·7	54·5	67·6	+ 5·4	61·3	62	3·0	37	− 46	5	...	...
St. John, N.B.	1008·6	− 5·4	71	43	63·4	46·4	54·9	− 1·6	50·1	76	7·0	50	− 33	10	...	...
Victoria, B.C.	1013·7	− 3·2	86	47	65·0	49·6	57·3	+ 0·3	52·4	77	5·0	10	− 14	5	...	...

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen. † Mean of observations at 9h., 15h., 21h., from April, 1923.

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Weather Lore in the Light of Science

THE correspondence columns of the *Meteorological Magazine* testify to the perennial interest in weather proverbs. Many must have felt that an authoritative discussion of such proverbs and their application to local weather forecasting was wanted. Professor Humphreys, who writes with enthusiasm on meteorological physics and who commands an easy style, is in many ways well qualified for the task.

The first part of his book *Weather Proverbs and Paradoxes* is based on an article published in 1911 in the *Popular Science Monthly*, for May, and is devoted to proverbs.

The weather proverb which is perhaps the most frequently quoted in this country is

> " Red sky at night is the shepherd's delight;
> Red in the morning is the shepherd's warning."

Professor Humphreys points out that this proverb has many variations, and that it is to be found not only in Shakespeare but in the Bible. The words of Jesus, as quoted in the Gospel according to St. Matthew (xvi. 2), are: " When it is evening ye say fair weather, for the heaven is red. And in the morning foul weather to-day, for the heaven is red and lowring." The authorised translation interpolates " it will be " in each half of the saying, but it gains in force by the omission of those words. Professor Humphreys entirely ignores the qualification " and lowring." This is highly significant, for in his discussion it is implied that the red sky to which reference is made is free

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from cloud. He dwells on the contrast between gray cloudy skies and red cloudless skies. This seems to be a fundamental mistake. The red sky which attracts attention is usually more or less covered with clouds at moderate heights and it is the illumination of the under side of such clouds that calls for our admiration. It is certainly true that the appropriate cloud distribution often occurs in this country in the evening in fine settled weather. It may be that at sunrise it is more characteristic of the lowring heaven and the coming storm. No one seems to have made the regular observations which would establish the proposition statistically. Professor Humphreys looks at the question from a different standpoint. He writes: "A red morning sky means . . . . that the atmosphere is rather humid, else the clear sky would have a short wave-length color, such as yellow or green; that, as the sky is not gray, there are no dew, or water, droplets on the dust particles of the lower air; that therefore this dust has been protected from excessive loss of heat by radiation; and, from this in turn, that the upper air contains much moisture, the condition that holds radiation losses down to a minimum. That is, a red morning sky implies that the whole atmosphere, up to considerable elevations, is humid, and rain, therefore probable, later in the day." This statement is hard to follow. It might even be characterised as special pleading. Is the absence of "dew droplets on the dust particles of the lower air," *i.e.*, mist, in itself an indication that there is an excess of moisture aloft? The fact is that the whole question will have to be threshed out on scientific lines before it will be profitable to set out any explanation in a popular form.

The same absence of the statistics which would show how frequently the forecast embodied in the proverb is successful will be found in every instance. This is the more to be regretted as the appropriate information with regard to the weather that follows such phenomena as halos could be worked up without much labour.

Professor Humphreys is not content to take proverbs as he finds them, he invents new ones (a pedant would say new epigrams), such as

Glimpse you e'er the green ray
Count the morrow a fine day.

A summer fog for fair,
A winter fog for rain;
A fact most everywhere
In valley and on plain.

Presumably "most everywhere"* does not include London.

* "Most" for "almost" seems to be accepted in American scientific literature, without even an apologetic apostrophe.

Our winter fogs cannot be regarded as prognostics of rain. With reference to dew, Humphreys chants:

When the morn is dry
The rain is nigh;
When the morn is wet
No rain you get.

The second part of the book is based on an article on meteorological paradoxes in *The Journal of the Washington Academy of Science*, 1920. The paradoxes are arresting.

Air pushed north blows east.
Rain dries the air.
To warm air cool it.
The coldest air covers the warmest earth.
The sun sets after it is down.

The greatest paradox of all and the most controversial is

The hotter the sun, the colder the earth.

The explanations of all the paradoxes are set out very lucidly, and if the book does not fulfil the expectation of the publishers and make every reader weather wise, it should add to the number who wish to carry further their studies in meteorology.

Aitken's Researches

THE Collected Papers of Dr. John Aitken form a valuable and interesting volume, containing an immense amount of information upon a variety of subjects—rigidity, glacier motion, the colour of the sea, ocean circulation, freezing, boiling, condensation, dew, fog, sunsets, atmospheric dust, and in fact almost every physical phenomenon in conspicuous evidence in Nature. The collection includes the famous papers on dust, fogs, clouds and dew, and there is an introductory sketch of the life and scientific work of the author by the late Dr. Cargill G. Knott, F.R.S., to whom the selection of the included papers and the preparation of the volume were entrusted by the Council of the Royal Society of Edinburgh. Aitken's work was carried out primarily as a hobby, undertaken because the handicap of ill-health rendered him unable to follow the chosen profession of engineering.

Since the constituent papers were originally independent communications, generally to the Royal Society of Edinburgh, there is little pretence of continuity in the finished collection, although many of the papers deal with closely allied subjects. It is, however, manifest throughout that Dr. Aitken was a scientist of the first order, a very capable and ingenious experimentalist. He possessed remarkable ability in interpreting the processes and phenomena of Nature, devising experiments to illustrate them, and presenting his explanations in such a manner that they appeared incontrovertible.

There is, however, a suspicion that on encountering fresh problems, preferably difficulties over which others had stumbled, he was apt to form rather hasty conclusions, and it would appear that the points at issue were so clear to him that he did not appreciate the necessity for precision in their expression. His use of words was sometimes unfortunate and inconsistent, so that the volume contains many apparent contradictions which detract from its value as a work of reference, and may lead to confusion. For instance, no less than 170 pages of the book are concerned with observations by means of the famous Aitken's Dust Counter, with page upon page of tables embodying the results of hundreds of skilful observations purporting to give the number of dust particles in the atmosphere (*pp.* 400-455, etc.), yet this instrument does not count dust particles but nuclei of water condensation in the air, and indeed dust in the sense usually understood has no effect upon the instrument. In an early communication dealing with what was later to be the essential principle of the dust counter Aitken said " . . . . " when speaking of the dust produced by combustion, I do not " mean the dust usually spoken of in connection with fires, as it " is comparatively heavy, and soon settles to the ground, nor do " I refer to smoke or soot. The dust I refer to is the invisible " dust, so fine that it scarcely settles out of the air. If we put " air into the experimental receiver and leave it for days . . " we still find it fog-producing . . . ." (*p.* 49). Aitken must then have been aware of what his apparatus was capable of counting, yet at the head of the first paper describing the instrument appears the quotation " The gay motes that people the sunbeams " (*p.* 187), and, in the absence of further definition, again and again is the impression conveyed that what is referred to is dust in the ordinary sense of the word. It is nevertheless realised by Aitken that " particles " could be " produced by the splashing of water " (*p.* 204) and that " fine spray . . . . supplied active centres of condensation."

Had the first unusual definition of dust been adhered to throughout a great deal of confusion would have been avoided. But, in another paper on the " formation of small clear spaces in dusty air," the word " dust " signifies something entirely different, something which could be seen floating in the air by examination in an intense beam of light. Actually, in this instance, artificial chemical fumes were generally used, which settled fairly rapidly by the action of gravity. The " clear spaces " referred to are called " dustless spaces " (*p.* 87, last line). Nevertheless one dark space " would contain the dust of the atmosphere, which, however, is black compared with the brilliancy of the surrounding fog " (*p.* 90). Later it is considered " better . . . . as usual, under the name of dust particles, to include all the solid and liquid products of combustion, of whatever size or colour they may be " (*p.* 284). In a subsequent paper on the formation of figures by the deposition of dust, the word again signifies the larger light-reflecting particles. It may possibly be argued that what applies to the larger particles must be also applicable to all dust, however fine, the only difference being one of degree, but this is uncertain and is not suggested by Aitken. A single molecule of hygroscopic substance might conceivably act as a nucleus of condensation, but it would not settle by gravity.

Equally original is the definition of the term " size " as applied to nuclei of condensation. " When, then we use the word ' size ' " he says, " we mean their condensing power, which does not necessarily mean their relative dimensions, though probably not far from it " (*p.* 549). The latter phrase, as is pointed out, involves the assumption that the surface attraction for water is the same for all kinds of particles ; which is obviously not true.

Nevertheless, when interpreted in the light of subsequent knowledge, the results of the dust counter observations are of far reaching importance ; it was first demonstrated by these experiments that the number of condensation nuclei in the atmosphere, whatever their nature and dimensions, may be of the order of 300 to 400 per cubic centimetre in very clear mountain air, and up to 466,000 per cubic centimetre in the polluted air of a city.

Light is also thrown upon the varied sources of the nuclei of condensation—from the action of the sun's rays upon the wet foreshore to products of the combustion of gas—and upon the hazing effect due to water condensation on the nuclei, even in unsaturated air, which varies according to the relative humidity.

The word " smoke " appears to suffer in a similar manner. Glasgow " smoke " could without doubt travel the twenty miles to Falkirk " as the dust counter showed the air to be always " very impure when the wind blew from densely inhabited areas " (*p.* 285). Yet it is stated later (*p.* 536), after the description of experiments in which the dust counter was not used, that the " greater amount of the smoke " would fall out of the air in its slow passage over 15 miles. In the former case, small condensation nuclei due to combustion would be counted ; these, as already shown, do not settle rapidly, therefore, presumably, in the latter case larger sized particles were implied.

Naturally some of the earlier conclusions are modified and amended by later papers since the work was progressive ; this does not take away from the value of the original experiments and adds to the interest of the book. The experiments described throughout are triumphs of skill and ingenuity, and lead to many striking conclusions, of which the following are examples :—

> The flow of glaciers is not due to simple melting of the ice under pressure, followed by regelation, but rather to the special structure of glacier ice.
>
> Water in a freezing lake is cooled below the temperature of maximum density through a vertical interchange due to action of the wind, although in the case of the open sea different conditions obtain, and a similar interchange does not take place. It is of note that the latter conclusion was formed as a result of experiments carried out in a small trough.
>
> The blue colour of the Mediterranean Sea is not due to the scattering of light by finely divided suspended matter, but to selective absorption in the water itself ; in other words the sea appears blue because it actually is blue.
>
> "Dew drops" on blades of grass are not composed of dew, but are sap exuded from the grass itself, and although genuine dew condenses from the air it is actually derived in the first place from the ground.

As is mentioned in the preface, "Dr. Aitken wrote very much as he thought and spoke," and consequently for the purposes of reference the information is somewhat scattered and diluted, and it is dangerous to select facts from any passage without careful reference to the whole of the paper of which it is a part. This is well illustrated in the paper "The Sun as a Fog Producer," where, following the description of the results of experiments carried out in glass flasks, it is shown that the conditions are here not the same as those obtained in Nature, owing to the absorption of certain of the sun's rays in passing through the glass walls, and that the results were different when flasks of clear silica were employed as containing vessels.

Taken as a whole, the Collected Papers make a book of absorbing interest. They will repay study by all who are alive to the importance of the physical side of meteorology.

G. M. WATSON.

Discussions at the Meteorological Office

December 10th, 1923. *The Preparation and Significance of Free-air Pressure Maps for the central and eastern United States.* By C. LeRoy Meisinger. (Monthly Weather Review, Supplement No. 21, Washington, 1922). *Opener*—Mr. E. G. Bilham, B.Sc.

Part I. of the paper is devoted to a historical summary of the attempts made by various meteorologists, from Guyot to Bigelow, to prepare satisfactory tables for the reduction of barometer readings in the United States to mean sea level. The problem is complicated by the existence of the great plateau at an average height of 3,500 ft. covering most of the western States. It is not surprising to learn that no satisfactory method of overcoming the difficulties surrounding this problem has yet been devised. The author, consequently, puts forward as one of his main reasons for preparing upper air pressure charts that their use may lead to an improvement in the barometry of the plateau region.

In Part II. a useful summary of previous work on the construction of upper air pressure charts is given, but none of the methods adopted by previous investigators are considered suitable for use in the United States. Part III. is devoted to the consideration of various factors observable at the surface, the variations of which might be expected to give a measure of the variations in the mean temperature of the air column up to one or two kilometres. The wind direction is finally selected for the purpose, the justification of the choice being that the free-air temperature in the States depends more on the origin of the air supply than on anything else. The remainder of the paper consists of a detailed description of the method of procedure, and a discussion of certain specimen charts representing the pressure distribution at 1 and 2 kilometres.

The method of procedure is briefly as follows. From the kite observations at seven stations tables were prepared showing for each of eight wind directions and for each month of the year the average difference between the surface temperature and the mean temperature up to 1 km. and 2 km. These values were then plotted on maps and the corresponding values, read off from the charts for each of 32 " reduction stations " selected as having good anemometer exposures and giving a good geographical distribution over the central and eastern United States, were tabulated. From the tables so prepared the temperature argument in the reduction of the surface pressure readings to a height of 1 km. or 2 km. on any given occasion could be obtained if the wind direction and surface temperature were known. The actual pressure reductions were carried out by a nomographic method due to H. G. Schwerdt and W. W. Loebe. *

The author asserts that the movements of depressions and the distribution of rainfall, &c., are more directly associated with the pressure features at 1 km. and 2 km. than with those at mean sea level, and some examples are given in support of this view.

THE subjects for discussion for the next two meetings will be:

January 21st, 1924. *The auroral spectrum and the upper strata of the atmosphere*, and *The constitution of the upper strata of the atmosphere*, by L. Vegard (Phil. Mag. XLVI., 1923). *Opener*—C. E. Britton, B.Sc.

February 4th, 1924. *A statistical study of surface and upper air conditions in cyclones and anti-cyclones passing over Davenport, Iowa*, by A. D. Udden (Monthly Weather Review, February, 1923). *Opener*—Capt. J. Durward, M.A.

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* *Met. Zs. Wien*, vol. xxxviii., May, 1921, pp. 139-142.

Royal Meteorological Society

THE monthly meeting of the society was held on Wednesday, December 19th, at 49, Cromwell Road, South Kensington, Dr. C. Chree, F.R.S., President, in the Chair.

The President announced that the Symons Medal had been awarded to Professor Okada, the head of the Japanese Meteorological Service, in recognition of his services to meteorology.

W. H. Pick, B.Sc. and S. P. Peters, B.Sc.—A note on the vertical visibility (estimated looking downwards) at Cranwell, Lincolnshire, during the period February, 1922, to June, 1923.

Ever since aviation became general it has been recognised that the visibility aloft was an element of great importance, but there has been difficulty in organizing regular observations. At the Royal Air Force College, at Cranwell, arrangements have been made during the last two years for the flying instructors to report visibility; an analysis of the observations has been prepared by the authors of this paper. The outstanding feature of the results is that visibility depends principally on wind direction. At Cranwell visibility is good when the wind blows off the North Sea and bad when the air is fouled by the smoke from the Midlands. Horizontal visibility near the ground is affected by mist and fog as well as by smoke haze, so that it is not very surprising that the correlation between visibility on the ground and aloft is slight. At the height, 2,000 ft., at which the Cranwell observations were made, visibility is adversely affected by strong wind, but it was mentioned by Captain Douglas in the discussion that in his experience as an observer for the artillery during the war, mostly at greater heights, the seeing was better when the air currents were vigorous, presumably because the air in its more rapid passage across the industrial areas had picked up less smoke. It is clear that the forecasting of visibility at aerodromes must depend on the careful study of local conditions, and especially of the bearing of the centres of atmospheric pollution. Aviators should be enthusiastic supporters of the Smoke Abatement Society.

Harold Jeffreys, M.A., D.Sc.—The cause of cyclones.

In this paper Dr. Jeffreys classifies the principal theories which have been put forward in explanation of cyclones. He points out that the distribution of temperature suffices to explain the existence of large areas of high or low pressure, such as are associated with the monsoons, and that local convection would account for the minor disturbances whose dimensions are of the same order as the "height of the homogeneous atmosphere." No adequate theory which would account for tropical storms or for the cyclones of higher latitudes has been established on a numerical basis.

The work of Ryd,* who claims to have laid the foundation of such a theory, was not mentioned in the paper but was referred to in the discussion. Sir Napier Shaw urged that theorising was premature until we had before us the results of a complete set of observations at all heights for some particular cyclone. The organisation of such observations is clearly the most pressing duty of the authorities responsible for upper air research.

A. W. Lee, M.Sc., A.Inst.P.—The relation of the circulation in the upper air to a circumpolar vortex.

In the absence of Mr. Lee, Sir Napier Shaw gave an account of this paper. The method adopted by the author is to estimate the strength of the wind at specified heights by studying the distribution of pressure. He finds that to a first approximation the average movement of the air north of the horse-latitudes is the same as that of so many concentric rigid shells. In July the shell 4 kilometers above ground rotates in the same sense as the globe, and 2·6 per cent. faster; the corresponding estimates for the shells at 6 kilometers and 8 kilometers are 3·0 per cent. and 4·3 per cent. The actual movements of the air are of course very complicated, but this simple standard of reference will prove of great aid to clear thinking about the circulation of the atmosphere.

Correspondence

To the Editor, *The Meteorological Magazine*

Logarithmic Paper

YOUR readers may be interested to know that I have made arrangements for a supply of logarithmic paper, double-ruled, with different scales of ruling horizontally and vertically, for the special purpose of plotting the observed pressures and corresponding temperatures in the upper air.

The space occupied by the ruling goes comfortably into the quarto page of official publications so that diagrams reproduced full size would bind up conveniently. The logarithmic ruling one way is for pressure; it is on the common scale of logarithmic paper—that of the 10-inch or 25 cm. slide rule: within its 25 cm. it ranges from 1 to 10 and is the counterpart of 100 mb. to 1,000 mb. The ruling for temperature is at right angles on a scale two and a half times as great as that for pressure; enough of the range is ruled to plot temperatures from 170t to 330t

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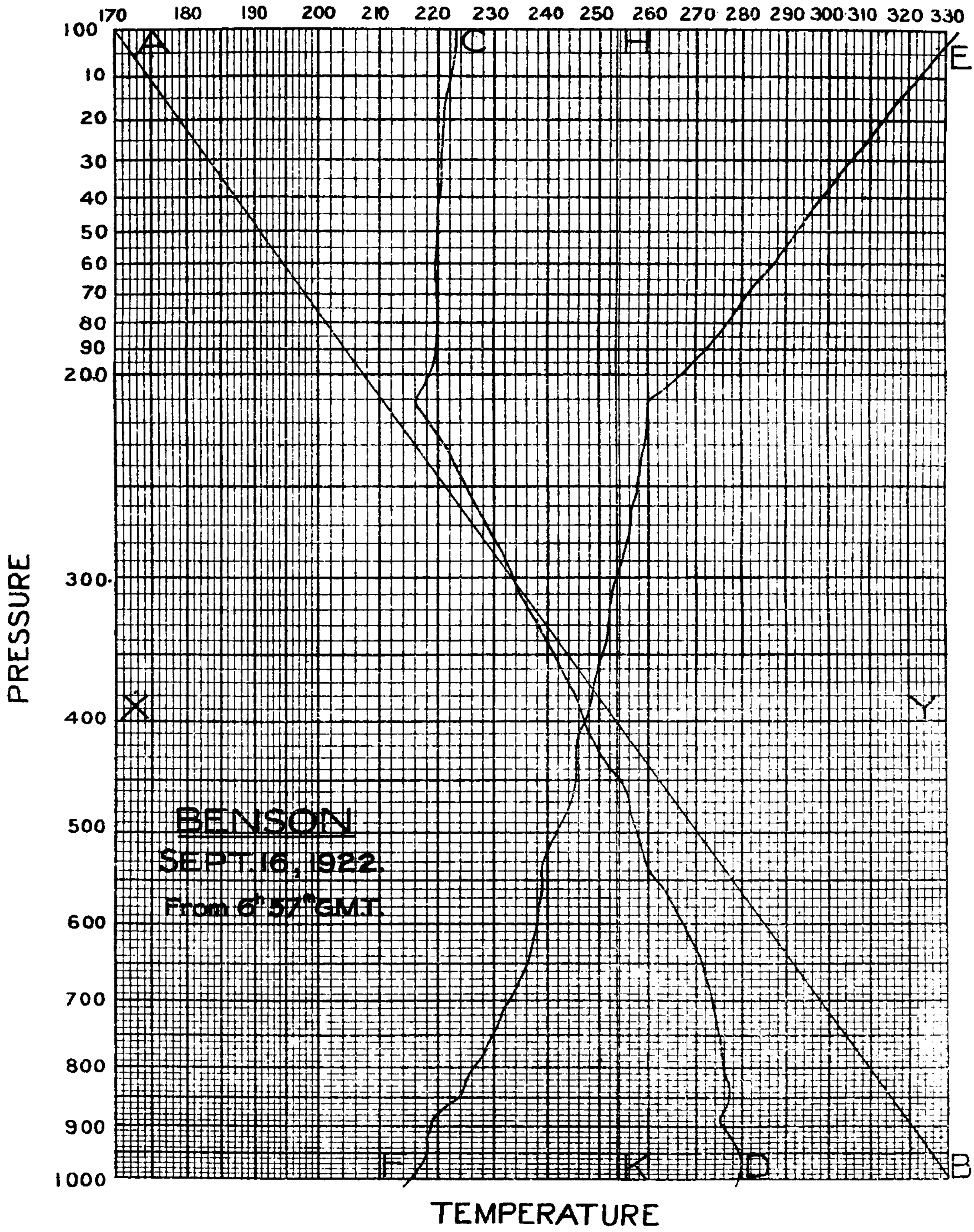
* Vide *Meteorological Magazine*, Vol. 58, Nov., 1923, p. 227.

Pressure – Temperature Logarithmic Paper



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within 18 cm. The limits mentioned correspond with the limits of observation of atmospheric pressures and temperatures: hence the whole available range in either direction may be filled. With ordinary double-ruled logarithm paper the temperatures are all crowded within a narrow strip and two-thirds of the paper is necessarily unoccupied.

The great advantage of plotting pressures on the logarithmic paper is that, while the reality of pressure as a variable is preserved, the height can always be read on the vertical scale approximately, because equal intervals along it represent nearly equal steps of height. In the case of temperature the advantage is that the line of the dry adiabatics is straight so that potential temperatures can be read with the aid of a set square. There are other advantages of a more recondite character. The ranges of pressure and temperature shewn on the paper are such that the dry adiabatics, which give the potential temperature of any point by the reading of temperature at the point where they cut the base line, are lines parallel to one diagonal of the frame.

The paper is on sale by Messrs. W. F. Stanley & Co., Ltd., at 4s. 6d. per quire of 24 sheets.

There are doubtless many other applications of logarithmic paper, ruled differently in the two directions, and it is rather remarkable that the demand has not been anticipated.

NAPIER SHAW.

School of Meteorology, Imperial College of Science and Technology.

[To illustrate Sir Napier Shaw's letter a diagram drawn on the logarithmic paper has been reproduced half-size. The curve CD represents the relation between pressure and temperature as observed over Benson on September 16th, 1922. The curve EF is derived from CD, the horizontal intervals between the curve EF and the straight line HK being equal to those between the curve CD and the straight line AB. EF represents the relation between pressure and potential temperature, the potential temperature being defined for this purpose as the temperature obtained by adiabatic expansion or compression to the pressure 400 millibars.]

Minimum Thermometers

THE progressive increase of the correction of certain minimum thermometers which you describe in your December number has likewise been observed in France. I have recently talked the matter over with M. Tonnelot, a skilful maker of thermometers. According to him the phenomenon only takes place when methyl alcohol is employed. He recalls a variation amounting to some 5° C. in five years in some minimum thermometers which a workman had inadvertently filled with methyl alcohol. An experimental test would be easy. If it confirmed M. Tonnelot's observation, it would have to be admitted that methyl alcohol was subject to contraction, doubtlessly by partial polymerisation at the ordinary temperature. It is moreover likely that in many thermometers ethyl alcohol is mixed with methyl alcohol, which is less expensive. This would explain the frequently observed small variations.

LOUIS BESSON.

Observatoire de Montsouris, Paris, December 27th, 1923.

NOTES AND QUERIES

Meteorology and Geography

Two meetings of interest to meteorologists took place at the Birkbeck College on January 3rd.

In the morning Sir Richard Gregory, the Editor of "Nature," gave his Presidential Address to the Geographical Association, his subject being "British Climate in Historic Times." The collection of the information on which the address was based must have involved much research and the examination of all kinds of literature. Sir Richard Gregory appears to have overlooked the work which is most frequently consulted in the Meteorological Office when questions are raised as to the weather of particular years—Lowe's "Chronology of the Seasons." There is scope, however, for more exhaustive examination of the subject, and it is to be hoped that the suggestion that this should be by co-operative effort will bear fruit. The general conclusion that our climate has not changed appreciably in the Christian era is not likely to be affected.

The afternoon meeting was devoted to the Conference on Meteorology in Education. Sir Napier Shaw presided. Mr. Dobson, who contributed the first paper, a valuable account of "Progress of Meteorology in the last Quarter of a Century," was kept away by illness, and the paper was read by Mr. Whipple. Mr. L. B. Cundall discussed some difficulties in the teaching of meteorology in schools, and Mr. W. G. W. Mitchell explained how wireless telegraphy gave opportunities for "Local Forecast Centres in Secondary Schools." The general discussion showed that there were wide differences of opinion as to the amount of meteorology which could find a place in school courses. A report of the Conference is to be published by Messrs. G. Philip & Sons, 32, Fleet Street, London, E.C. 4, from whom copies will be purchasable at 1s. 6d. each.

Wind and Weather

A LITTLE book, "Wind and Weather," by Professor Alexander McAdie, has been published by the Macmillan Company, of New York, as one of a series of "Outing Books." The book contains reproductions of the bas-reliefs in the library of the Blue Hill Observatory, allegorical figures of the winds copied from the Frieze of the Tower of the Winds at Athens.

Professor McAdie's comments are helpful. He points out the empty waterpot carried by Notos—the south wind—who has just discharged the rain, and the inverted fire basket from which Skiron—the north-west wind—"spills a generous stream of hot air on all below." To which last is added the jest: "his dusky Highness might not inappropriately adorn legislative halls and editorial sanctums." If the fire-basket is really a fire-basket (only an archæologist could say), we must suppose that the North-wester at Athens has often Foehn characteristics.

Professor McAdie quarrels with what he regards as the ordinary explanation of sea-breezes, and would substitute the following: "The sea-breeze is probably caused by a slow descent of dry, warm air, on an incline sloping from north-east to south-west. As it reaches the surface it . . . . . becomes an east wind. It carries inland with it some of the air over the ocean which is much cooler and heavily saturated." It seems hardly fair for the Professor of Meteorology at Harvard University to put such an unsupported and heretical theory before the unsuspecting general reader without more reservation than is implied by the word "probably."

Wind Suction in Lighthouses

EXPERIMENTS recently made at Inchkeith lighthouse have yielded results of interest in connection with the well-known effect discussed in an article in the July number of the *Meteorological Magazine* (p. 135). When observations were begun at Inchkeith the barometer was installed at the foot of the lighthouse tower, and it soon became evident that the barometer tended to read low, especially in strong winds. In attempting to find a better site a spare barometer was installed in a store near the tower, where it was hoped that the "lighthouse" effect would be negligible. As a result of observations made twice a day for three weeks, it was found that the lighthouse barometer registered a pressure lower on the average by about 0·4 mb. than that in the store, when both readings were corrected and reduced to mean sea level. The barometers were interchanged and a further set of readings taken, giving satisfactory confirmation. It was found moreover that the differences increased progressively with the wind force, the average for winds of force 6 or above being 0·83 mb. in one series and 0·88 mb. in the other. Individual differences exceeded a millibar in several instances.

These observations serve to emphasise the importance of avoiding, as a site for a barometer, the base of a tower of any kind.

Observations at Stations of the First and Second Order, 1921

In the recently issued Introduction to "Observations at Stations of the First and Second Order" for the year 1921, it is announced that the publication of observations in this form is being discontinued. The volume is accordingly the last of a series, which commenced with the year 1873. It is pointed out in the Introduction that the data which have been published in the 49 volumes provides adequate material for such researches as require daily readings at single stations. A list of the stations in the British Isles for which daily readings have been published in this or similar forms is given in the Introduction.

The Barometer at Sea

A paper on the effect of the rolling of a ship on the readings of a marine mercury barometer is contributed by Mr. M. A. Giblett to the October number of the *Philosophical Magazine*. Mr. Giblett made comparisons between the readings of a mercury barometer and an aneroid whilst on a trawler on the North Sea, and found that on the average there was a discrepancy of about half a millibar which was not explained by existing theories. The mercury barometer read lower than the aneroid. In the paper Mr. Giblett shows how the phenomenon may be explained. Owing to the rolling of the boat the point of support of the barometer oscillates from side to side, and the barometer swings in sympathy instead of remaining vertical. Imagine a simple pendulum of such a length that it will swing in time with the ship. The point of support of this imaginary pendulum is over the point of support of the actual barometer; the bob of the imaginary pendulum is an imaginary barometer, the axis of which is in line with the string of the pendulum. To a close approximation the actual barometer on the ship will move in the same way as this imaginary barometer. There is a difference in the vertical movement, but it turns out that this affects the "pumping" only, not the mean position of the mercury. On account of the oscillation the mercury is driven down by centrifugal force, and, on the other hand, on account of tipping, the mercury tends to rise. As it happens, the former effect is twice as great as the latter, and therefore a depression of the mercury is to be expected. The amount of this depression is $\frac{1}{4}\,\frac{b}{L^2}\,h$, $2b$ being the distance through which the point of support of the barometer moves horizontally, L the length of the imaginary pendulum and h the barometric height. With oscillations of 4 feet, to and fro, and a period of 6 seconds, the length of the pendulum is 30 feet and the depression is a millibar: as Mr. Giblett found half a millibar as the average for occasions with and without appreciable rolling of the ship, there is satisfactory agreement with the observations. The moral is that to get the best readings of a barometer at sea it must be mounted below deck as near as possible to the axis of rolling of the ship. In this position the swing of the barometer will be reduced to a minimum.

Observations in Esthonia

THE first volume of a new series of year books, incorporating the meteorological observations made in Esthonia, has been issued. This volume includes the observations for 1921 at the Observatory of the University of Dorpat, as well as at the stations of the second and third order. It represents the 56th volume of the observatory reports and the 3rd of the reports for the second and the third order stations; data for earlier years are to be found for the latter stations in publications of the Russian Meteorological Service. The notes in the new publication are given in Esthonian, together with a German translation.

Computed Heights of Pilot Balloons

IT is generally recognised that the best way of determining the movements of a pilot balloon is by the use of two theodolites. The advantage of the method is that there are four instrumental readings to determine the position of the balloon, two readings for each theodolite. These readings act as a check on each other. The height of the balloon can be computed in two different ways, and if the two results are in agreement there is a guarantee that no errors have been made in observation or computation. We have received, however, a memorandum from Mr. C. E. Britton, in which he points out that this guarantee is not always valid: in fact it fails entirely when the balloon, as seen from one of the stations, lies near to the place at right angles to the line joining the two stations. In that case an error made in reading the azimuth at the former station cannot be detected by the comparison of computed heights.

Mr. Britton writes: "To take a concrete and very possible case, let the base line AB be 4,000 feet and the azimuths at A and B, 83° and 87° respectively. Let the elevations of the balloon at the two stations be 25° and 25°8′. The heights computed from these figures will agree exactly. If, however, the observer at A inadvertently records an azimuth of 84°, the difference* between the computed heights will only be 20 feet, a quantity well within the errors of experiment. There will, of course, be an error in the actual height of the balloon as deduced from these figures, and the existence of vertical currents in the atmosphere would be suggested erroneously. It follows that, in a double theodolite ascent, any pair of heights which, although agreeing in themselves, seem to be at variance with those they precede and follow, should be regarded with caution. Evidence of a bad observation should be sought for by examining the series of parallaxes or by differencing the azimuth observations before the abnormal result is accepted as indicative of a true vertical current in the atmosphere.

The Rainfall of 1923

THE months of greatest and least rainfall during the year were February and June. For the British Isles as a whole the rainfall of February amounted to about twice the average; it was the wettest February for at least twenty years. In June, on the other hand, the fall was about half the average for this month. March and June were the only months with a considerable deficiency over the British Isles generally. In the months of January, July, November and December the fall closely approximated to the average, but the fall was considerably above the average in April, May, August, September and October.

The main features of interest of the year as a whole were (1) that nearly everywhere over the British Isles the rainfall was above the average (the deficiency nowhere exceeding 10 per cent.), and (2) that generally the largest excesses occurred to the west. It is unusual for either of these features to be so highly developed in the rainfall of a year.

In England and Wales only isolated areas received less than the average, the largest being along the north-east coast from Middlesbrough to Berwick, others occurred in the neighbourhood of Sidmouth, Southampton, Bishop Stortford, Peterborough and Margate. Falls of more than 20 per cent. in excess were

*The correct height is 10,720 feet, the two computed heights are 11,910 and 11,930 feet. In another example worked out by Mr. Britton for the same base line, the azimuths at A and B are 89°30′ and 80°30′ the elevations 25° and 24°42′ and the observer at A inadvertently records an azimuth at 90°30′. The computed heights agree exactly, though they are in error by 170 feet. Correct height 10,590 feet. Computed heights 11,760 feet, 11,760 feet.]

confined mainly to the Devon-Cornwall peninsula, the north-western half of Wales and to the north-west of England. In these last two areas falls of as much as 40 per cent. in excess occurred. At Bryntirion, near Dolgelly, in Merionethshire, the fall amounted to 90·13 inches or 153 per cent. of the average. This being the largest amount registered in the locality, at any rate since 1868.

In Scotland less than the average was recorded only in the south-east corner. Falls exceeding 20 per cent. above the average were widespread, occupying the greater part of the western half of Scotland and also the counties of Aberdeen, Banff and Kincardine. At Eallabus in Islay the fall amounted to 75·82 in., or 155 per cent. of the average, and was the largest total since the record began in 1866.

In Ireland areas with deficient rainfall were confined to a coastal strip in the south and to an isolated area in the neighbourhood of Cavan. Falls of more than 20 per cent. in excess occurred in an area to the north-west stretching from the Connemara Mountains to Londonderry, and in this area there were excesses of as much as 30 per cent., an unusual occurrence there.

At London, Camden Square, the annual total was 27·03 in., or 110 per cent. of the average. At Edinburgh, Royal Observatory, 24·21 in., or 99 per cent., and at Dublin, Fitz-William Square, 28·49 in., or 104 per cent.

The general rainfall of the countries has been provisionally computed :—

England and Wales	113	per cent. of the average 1881-1915.
Scotland	118	
Ireland	110	
British Isles	113	

Atmospheric Pollution

THE Secretary of the Atmospheric Pollution Committee reports that deposit gauges have recently been brought into use by local authorities at the following places: Stoke-on-Trent, Blackburn, Rochdale, Salford and Huddersfield, as well as by Messrs. Cadbury, at Bournville, near Birmingham. The new gauges at Blackburn and Rochdale are in addition to older ones. Observations with an automatic filter have been started at Stoke-on-Trent.

According to the *Chicago Tribune* a terrific blizzard was raging over the northern part of the United States on January 6th. Several people have been frozen to death, and the transportation of foodstuffs is held up in several States. Temperature in Chicago is said to be the lowest recorded since 1904.

Obituary

Flight-Lieutenant A. E. Gendle.—Flight-Lieut. Gendle, whose tragic death in Mesopotamia was reported in the last number of the *Meteorological Magazine*, was, before the War, on the staff of the Meteorological Office. He had been at Kew Observatory as a boy, and was one of the two assistants sent from Kew Observatory to Eskdalemuir, when that observatory was opened in 1908. After serving five years there he was transferred to South Kensington. On the outbreak of war he was mobilised as a trooper in the Middlesex Yeomanry. This regiment was quartered in the neighbourhood of London up to the middle of 1915, when Gendle tiring of inaction made an effort to join the Naval Air Force. It happened that he got into touch with the Officer responsible for the Naval Meteorological Service and was offered a commission as a meteorologist. At this time the use of small airships for patrolling home waters necessitated the establishment of meteorological stations at coast aerodromes. The first of these was established at Capel, near Folkestone, under Gendle's supervision. He was later at the Admiralty, and was transferred to the Royal Air Force on the formation of that branch as a separate unit. He took a prominent part in its Meteorological Service, which, while working in close co-operation with the Meteorological Office, became responsible for the issue of forecasts and reports to airships and aeroplanes operating in and around the British Isles. At the end of the War, Gendle accepted a permanent commission in the R.A.F. He was sent to 'Iraq on meteorological duty, and at the time of his death was in charge of the arrangements for the supply of information to pilots on the overland air-route from Egypt to Palestine and Bagdad.

M. Alexandre Gustave Eiffel.—The death has occurred in Paris of M. Gustave Eiffel, designer of the tower which bears his name. M. Eiffel was born at Dijon, in 1832, and was educated as an engineer. His earlier work was concerned mainly with bridge building, so that he was well equipped for his great enterprise, the design and erection of the Eiffel Tower. For the construction of the tower, which was completed in 1889, meteorologists are doubly indebted to him. In 1900 he took up meteorological research, and for some years published an annual "Atlas Météorologique." From 1907 onwards his chief study was aero-dynamics.

M. R. P. Marc Dechevrons, S.J.—M. Marc Dechevrons, whose death occurred on December 6th, 1923, had been Director of the St. Louis Observatory, Jersey, since 1894. Before this he was Director of the Zi-Ka-Wei Observatory (China), between 1875 and 1887, and it was during this period that he published his main meteorological work which dealt with the typhoons of the China Sea. He also devoted much energy to the study of atmospheric electricity and of the Zodiacal light.

News in Brief

We regret to announce the death of *Dr. Fusakichi Omori*, Professor of Seismology, and President of the Imperial Earthquake Investigation Committee, which took place at Tokio on November 8th, 1923.

By invitation of His Majesty the King of Egypt, an International Geographical Congress will meet at Cairo in 1925, this being the 50th anniversary of the foundation of the Royal Geographical Society of Egypt. Meteorology is to be included in the programme.

On the programme of the Annual Meeting of the American Meteorological Society, held in conjunction with the American Association for the Advancement of Science on December 29th, was a proposal for a World Meteorological Foundation.

The gold medal of the Royal Scottish Geographical Society has been awarded to Dr. Hugh Robert Mill in recognition of his distinguished service in geographical research.

A good example of a Lunar Cross was observed by Miss Penny at Delnies, Nairn, on October 25th. As the moon rose a beam exactly like that from a searchlight was seen on the sky, and when the moon was a little higher " it appeared to have a clear ray of light perpendicularly through it and a slight ray across."

The Weather of December, 1923

THE weather conditions during the beginning of December were somewhat less severe than those which were so prevalent in November, but " snow lying " was still reported from many parts of the country, and the mean temperature for the first week was below the normal except in the extreme north. Screen minima as low as 15° F. and 22° F. were recorded at Balmoral on the morning of the 4th, and at Durham on the 5th respectively.

Mist and fog were also general during this time. After the 9th, on which day maxima under 40° F. were experienced, the British Isles came under the influence of a more southerly current of air from the Atlantic, and temperature rose to 50° F. generally, and to 55° F. at a few stations in Scotland, e.g., Onich (Inverness) and Ford (Argyle). In the north and west this milder weather was accompanied by much rain, though the readings for any one day were not so large as those recorded at a few places on the 1st and 2nd when 62 mm. fell at Llyn Fawr (Glamorganshire), and 57 mm. at Treherbert (Glamorganshire) on the 1st, and 55mm. at Trecastle (Breconshire) on the 2nd.

Between the 19th and the 22nd, cold northerly winds swept the country and snow fell generally. From then onwards to the end of the month there were alternating milder and cold periods in the easterly parts of the kingdom. Snow occurred in the London area on the 19th, 21st and 26th. In the west the conditions were somewhat milder, though during the last ten days of the month severe ground frosts were recorded in all parts of the country, the readings of the thermometer exposed on the snow falling below 10° F. at a few places. The lowest screen minima for the month were also recorded at many stations during this period, the actual lowest reading being 13° F. at Eskdalemuir on the 25th, and at Renfrew on the 29th. High southerly winds and gales were experienced on the coasts about the 2nd and 7th, and the westerly and northerly winds were frequently rough during the latter part of the month.

The record of the month in Europe has been one of rain and snow. In Italy the heavy rain, which in conjunction with a thaw caused the bursting of the great dam of Lake Gleno on the 1st, continued for another week, and the Tiber, Arno and other rivers were all in flood. On the 23rd it was reported that a heavy gale was blowing down the Adriatic, and very low temperatures were recorded over the whole of Italy, with snow in the south ; a heavy fall of snow occurred in Rome in the night of the 30th. Snow is rare in southern Italy. In Austria there were heavy snowfalls from the 21st to the 27th, and railway traffic was interrupted. Switzerland has suffered an alternation of thaw and frost—very mild until the 20th, followed by two days of heavy snow and low temperatures, some of which are stated to be "records" for the time of year. On the 23rd there was a decided thaw, followed by frost and very heavy snow from the 24th to the 26th. On the latter date a gale set in, followed by a thaw and heavy rain up to 3,000 feet. In many mountain valleys ten feet of snow fell between the 23rd and the 27th. On the 28th, with a westerly gale, the rain and thaw extended to a height of 4,800 feet, and it was not until the 31st that the normal fine cold weather of winter was established. Under these conditions avalanches have been exceptionally frequent, causing some loss of life, much damage to buildings and interruption of train services.

Over N.E. France the month was very wet, as were the first two days of January, 1924. The following rainfall figures represent something short of the total amounts for the periods indicated :—

Period	Paris	Romilly	Nancy	Belfort	Dijon
	mm.	mm.	mm.	mm.	mm.
Dec. 1-31 ..	114	119	67	74	87
Dec. 22-31 ..	60	76	52	41	57
Jan. 1-2 ..	14	15	7	28	17

The normal rainfall at Paris during the whole winter is about 100 mm. It is not surprising that floods occurred, for the two previous months were also wet. From the 25th to the 31st the Seine rose steadily. At the end of the month it was 18½ feet above its normal level at Paris, and a further rise was feared, so that the disaster of 1910 may be repeated. Towards the end of the month the Rhine also began to rise, and parts of Cologne were flooded. In Denmark Christmas was stormy and snowy.

In eastern Australia drought was experienced until the 26th, when good general rains fell in northern and western New South Wales, and more scattered rain in central and western Queensland. A violent hailstorm swept over Pretoria on the 25th, and it is stated that many of the hailstones weighed more than 16 ounces. Much damage was done.

The special message from Brazil states that the rainfall was much below the normal in all districts, and principally in the centre, where the deficit amounted on the average to 100 mm. Temperature was generally one or two degrees above the normal, and the cane and sugar crops have suffered from the hot dry weather. At Rio de Janeiro pressure was 2·5 mm. and temperature 2° C. above the normal.

Mr. R. C. Mossman writes that a cold wave was experienced in the Argentine on the 7th and 8th, associated with a rise of pressure of 28 mb. in two days at Cordoba. The shade minima fell to 28° F. at Chubut on the 7th, and 39° F. at Cordoba on the 8th, these being 20° to 25° F. below the normal for the time of year.

Rainfall December, 1923: General Distribution

England and Wales	102	per cent. of the average 1881-1915.
Scotland	101	
Ireland	89	
British Isles	99	

Rainfall Table for December, 1923

CO.	STATION.	In.	mm.	Per-cent. of Av	CO.	STATION.	In.	mm.	Per-cent. of Av.
Lond.	Camden Square	2·31	59	97	*War*	Birminghm, Edgbaston	3·11	79	116
Sur.	Reigate, Hartswood	2·82	72	...	*Leics*	Leicester Town Hall	2·66	68	...
Kent.	Tenterden, View Tower	2·84	72	91	,,	Belvoir Castle	2·71	69	110
,,	Folkestone, Boro. San.	2·76	70	...	*Rut*	Ridlington	2·48	63	...
,,	Broadstairs	2·17	55	91	*Linc.*	Boston, Skirbeck	3·03	77	141
,,	Sevenoaks, Speldhurst.	3·11	79	...	,,	Lincoln, Sessions House	2·44	62	111
Sus.	Patching Farm	3·38	86	101	,,	Skegness, Estate Office.	2·74	70	125
,,	Eastbourne, Wilm. Sq.	3·71	94	106	,,	Louth, Westgate	2·70	69	97
,,	Tottingworth Park	4·20	107	88	,,	Brigg	2·76	70	113
Hants	Totland Bay, Aston	2·82	71	87	*Notts.*	Worksop, Hodsock	2·59	66	110
,,	Fordingbridge, Oaklnds	4·32	110	109	*Derby*	Mickleover, Clyde Ho.	3·51	89	133
,,	Portsmouth, Vic. Park.	3·18	81	102	,,	Buxton, Devon. Hos.	6·13	156	108
,,	Ovington Rectory	3·96	101	100	*Ches.*	Runcorn, Weston Pt.	4·49	114	142
,,	Grayshott	3·54	90	93	,,	Nantwich, Dorfold Hall	4·51	115	...
Berks	Wellington College	2·69	68	93	*Lancs*	Bolton, Queen's Park	6·08	154	...
,,	Newbury, Greenham	3·44	87	108	,,	Stonyhurst College	5·05	128	104
Herts.	Bennington House	2·51	64	101	,,	Southport, Hesketh	4·89	124	151
Bucks	High Wycombe	3·62	92	124	,,	Lancaster, Strathspey.	4·66	118	...
Oxf.	Oxford, Mag. College	2·34	59	101	*Yorks*	Sedbergh, Akay	6·59	167	112
Nor.	Pitsford, Sedgebrook	2·91	74	120	,,	Wath-upon-Dearne	2·35	60	99
,,	Eye, Northolm	2·15	55	...	,,	Bradford, Lister Pk.	3·43	87	103
Beds.	Woburn, Crawley Mill.	2·36	60	100	,,	Oughtershaw Hall	5·44	138	...
Cam.	Cambridge, Bot. Gdns.	1·94	49	101	,,	Wetherby, Ribston H.	3·43	87	140
Essex	Chelmsford, CountyLab	1·96	50	...	*ERY*	Hull, Pearson Park	3·10	79	129
,,	Lexden, Hill House	2·27	58	...	,,	Holme-on-Spalding	3·15	80	...
Suff.	Hawkedon Rectory	2·73	69	113	,,	Lowthorpe, The Elms.	3·22	82	120
,,	Haughley House	2·50	63	...	*NRY*	West Witton, Ivy Ho.	2·86	73	...
Norf.	Beccles, Geldeston	2·87	73	125	,,	Pickering, Hungate	3·52	89	...
,,	Norwich, Eaton	3·11	79	119	,,	Middlesbrough	2·11	54	109
,,	Blakeney	2·86	73	129	,,	Baldersdale, Hury Res.	2·53	64	62
,,	Swaffham	3·77	96	158	*Durh.*	Ushaw College	1·87	48	75
Wilts.	Devizes, Highclere	3·67	93	...	*Nor.*	Newcastle, Town Moor.	2·34	59	97
Dor.	Evershot, Melbury Ho.	3·67	93	71	,,	Bellingham Manor	2·50	63	...
,,	Weymouth, Westham	3·53	90	101	,,	Lilburn Tower Gdns.	3·71	94	...
,,	Shaftesbury, Abbey Ho.	2·90	73	80	*Cumb*	Penrith, Newton Rigg.	3·53	90	82
Devon	Plymouth, The Hoe	3·54	90	71	,,	Carlisle, Scaleby Hall	2·95	75	92
,,	Polapit Tamar	5·84	148	114	,,	Seathwaite	10·20	259	62
,,	Ashburton, Druid Ho.	5·59	142	74	*Glam.*	Cardiff, Ely P. Stn.	4·16	106	81
,,	Cullompton	3·68	94	84	,,	Treherbert, Tynywaun	10·47	266	...
,,	Sidmouth, Sidmount	3·29	84	84	*Carm*	Carmarthen Friary	5·33	135	93
,,	Filleigh, Castle Hill	6·41	163	...	,,	Llanwrda, Dolaucothy.	7·12	181	102
,,	Hartland Abbey	4·64	118	...	*Pemb*	Haverfordwest, Portf'd	5·31	135	93
Corn.	Redruth, Trewirgie	5·07	129	81	*Card.*	Gogerddan	4·62	117	92
,,	Penzance, Morrab Gdn.	4·59	117	81	,,	Cardigan, County Sch.	3 59	91	...
,,	St. Austell, Trevarna	5·63	143	92	*Brec.*	Crickhowell, Talymaes	3·50	89	...
Soms	Chewton Mendip	4·82	122	90	*Rad.*	Birm.W.W.Tyrmynydd	6·39	162	78
,,	Street, Hind Hayes	2·71	69	...	*Mont.*	Lake Vyrnwy	5·71	145	83
Glos.	Clifton College	3·13	79	82	*Denb.*	Llangynhafal	4·50	114	...
,,	Cirencester	3·73	95	108	*Mer.*	Dolgelly, Bryntirion	8·18	208	119
Here.	Ross, County Obsy.	1·99	51	67	*Carn.*	Llandudno	3·18	81	103
,,	Ledbury, Underdown.	1·98	50	71	,,	Snowdon, L. Llydaw 9	20·73	527	...
Salop	Church Stretton	3·42	87	102	*Ang.*	Holyhead, Salt Island.	3·32	84	80
,,	Shifnal, Hatton Grange	2·86	73	111	,,	Lligwy	3·26	83	...
Staff.	Tean, The Heath Ho.	4·92	125	151	*Man.*	Douglas, Boro' Cem.	5·78	147	115
Worc.	Ombersley, Holt Lock.	2·48	63	95	*Guer.*	St. Peter Port, Grange.	3·67	93	90
,,	Blockley, Upton Wold.	3·50	89	108	*Wigt.*	Stoneykirk, Ardwell Ho	8·00	203	195
War	Farnborough	3·32	84	113	,,	Pt. William, Monreith	6·41	163	...

Errata November—Beccles, Geldeston, should read | 2·68 | 68

Lligwy ... ... ,, ,, | 6 92 | 176

Rainfall Table for December, 1923—*continued*

CO.	STATION.	In.	mm.	Per-cent. of Av	CO.	STATION.	In.	mm	Per-cent. of Av.
Kirk.	Carsphairn, Shiel	10·66	271	...	*Caith*	Loch More, Achfary	12·09	307	131
,,	Dumfries, Cargen	4·42	112	82	,,	Wick	4·35	110	141
Dum	Drumlanrig	4·53	115	86	*Ork*	Pomona, Deerness	4·35	110	104
Roxb	Branxholme	2·44	62	67	*Shet*	Lerwick	5·22	133	109
Selk	Ettrick Manse	4·92	125	...	*Cork*	Caheragh Rectory	4·90	125	...
Berk	Marchmont House	3·13	79	111	,,	Dunmanway Rectory	4·42	112	55
Hadd	North Berwick Res.	2·66	68	124	,,	Ballinacurra	1·96	50	38
Midl	Edinburgh, Roy. Obs.	2·35	60	109	,,	Glanmire, Lota Lo.	2·79	71	51
Lan	Biggar	2·84	72	84	*Kerry*	Valencia Obsy.	5·35	136	81
Ayr	Kilmarnock, Agric. C.	4·68	119	110	,,	Gearahameen	12·00	305	...
,,	Girvan, Pinmore	7·31	186	122	,,	Killarney Asylum	4·62	117	63
Renf.	Glasgow, Queen's Pk.	2·87	73	68	,,	Darrynane Abbey	3·11	79	53
,,	Greenock, Prospect H.	5·81	148	74	*Wat*	Waterford, Brook Lo.	2·71	69	58
Bute	Rothesay, Ardencraig	6·47	164	119	*Tip*	Nenagh, Cas. Lough	4·15	105	90
,,	Dougarie Lodge	6·75	171	...	,,	Tipperary	3·20	81	...
Arg	Glen Etive	7·41	188	...	,,	Cashel, Ballinamona	3·43	87	79
,,	Oban	6·41	163	...	*Lim*	Foynes, Coolnanes	4·71	120	100
,,	Poltalloch	7·12	181	112	,,	Castleconnell Rec.	5·34	136	...
,,	Inveraray Castle	8·14	207	82	*Clare*	Inagh, Mount Callan	8·28	210	...
,,	Islay, Eallabus	8·56	217	144	,,	Broadford, Hurdlest'n.	5·07	129	...
,,	Mull, Benmore	21·40	544	...	*Wexf*	Newtownbarry	2·91	74	...
,,	Mull, Quinish	...	...	...	,,	Gorey, Courtown Ho.	2·90	74	76
Kinr.	Loch Leven Sluice	2·72	69	69	*Kilk.*	Kilkenny Castle	2·60	66	75
Perth	Loch Dhu	6·10	155	61	*Wic*	Rathnew, Clonmannon	2·27	58	...
,,	Balquhidder, Stronvar	3·67	93	38	*Cars.*	Hacketstown Rectory	2·98	76	73
,,	Crieff, Strathearn Hyd.	2·94	75	66	*QCo.*	Blandsfort House	...	...	...
,,	Blair Castle Gardens	2·56	65	...	,,	Mountmellick	4·13	105	...
,,	Coupar Angus School	2·79	71	93	*KCo.*	Birr Castle	3·19	81	97
Forf.	Dundee, E. Necropolis	2·85	72	107	,,	Ballycumber, Bellair	...	...	...
,,	Pearsie House	4·16	106	...	*Dubl.*	Dublin, FitzWm. Sq.	1·54	39	62
,,	Montrose, Sunnyside	3·39	86	122	,,	Balbriggan, Ardgillan	2·76	70	96
Aber.	Braemar Bank	3·47	88	97	*Me'th*	Drogheda, Mornington	2·48	63	...
,,	Logie Coldstone Sch.	3·17	81	113	*W.M*	Mullingar, Belvedere	3·29	84	89
,,	Aberdeen, Cranford Ho	4·93	125	142	*Long*	Castle Forbes Gdns.	2·89	73	73
,,	Fyvie Castle	4·45	113	...	*Gal*	Galway, Waterdale	3·76	95	...
Mor	Gordon Castle	3·25	83	121	*Mayo*	Crossmolina, Enniscoe	4·99	127	76
,,	Grantown-on-Spey	3·57	91	132	,,	Mallaranny	7·94	202	...
Na	Nairn, Delnies	2·07	53	93	,,	Westport House	4·42	112	77
Inv.	Ben Alder Lodge	5·38	137	...	,,	Delphi Lodge	13·20	335	...
,,	Kingussie, The Birches	2·53	64	...	*Sligo*	Markree Obsy.	4·79	122	100
,,	Fort Augustus	3·02	77	52	*Ferm*	Enniskillen, Portora	4·28	109	...
,,	Loch Quoich, Loan	11·30	287	...	*Arm.*	Armagh Obsy.	2·94	75	94
,,	Glenquoich	11·07	281	76	*Down*	Warrenpoint	3·20	81	...
,,	Inverness, Culduthel R.	1·90	48	...	,,	Seaforde	4·84	123	117
,,	Arisaig, Faire-na-Squir	7·21	183	...	,,	Donaghadee	4·37	111	138
,,	Fort William	6·86	174	68	,,	Banbridge, Milltown	2·83	72	98
,,	Skye, Dunvegan	8·46	215	...	*Antr.*	Belfast, Cavehill Rd.	5·20	132	...
,,	Barra, Castlebay	3·83	97	...	,,	Glenarm Castle	5·53	141	...
R&C	Alness, Ardross Cas.	3·54	90	86	,,	Ballymena, Harryville	6·04	153	136
,,	Ullapool	5·96	151	...	*Lon*	Londonderry, Creggan	5·50	140	126
,,	Torridon, Bendamph	11·43	290	112	*Tyr*	Donaghmore	4·41	112	...
,,	L. Carron, Plockton	5·82	173	...	,,	Omagh, Edenfel	4·56	116	108
,,	Stornoway	5·79	147	93	*Don*	Malin Head	4·76	121	142
Suth.	Dunrobin Castle	...	...	...	,,	Letterkenny Hospital	4·99	127	93
,,	Lairg	3·90	99	...	,,	Dunfanaghy	4·78	121	92
,,	Tongue Manse	4·92	125	99	,,	Narin, Kiltoorish	5·75	146	...
,,	Melvich School	4·83	123	112	,,	Killybegs, Rockmount	9·12	232	125

Climatological Table for the British Empire, July, 1923

STATIONS	PRESSURE		TEMPERATURE										PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb.	Relative Humidity	Mean Cloud Am'nt	Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1016·2	+ 0·4	90	49	75·7	57·7	66·7	+ 4·0	60·5	69	5·8	83	+ 28	11	7·5	47
Gibraltar	1016·7	+ 1·4	90	60	82·5	67·2	74·8	+ 0·1	67·2	69	1·9	0	— 1	0	...	...
Malta	1016·4	+ 2·4	99	63	84·7	72·5	78·6	+ 1·1	71·0	69	1·0	0	— 1	0	...	...
Sierra Leone	1014·1	+ 0·7	88	70	83·0	72·3	77·7	— 1·3	73·4	84	8·5	883	+ 7	30	...	...
Lagos, Nigeria	1013·5	— 0·3	85	71	81·1	73·4	77·2	— 0·1	74·4	84	9·1	265	— 4	22	...	...
Kaduna, Nigeria	1016·4	+ 2·4	86	62	81·9	65·8	73·9	— 0·7	69·1	85	1·6	187	— 45	22	...	...
Zomba, Nyasaland	1017·4	— 0·5	80	46	74·1	53·7	63·9	+ 2·2	...	87	2·5	11	+ 4	4	...	...
Salisbury, Rhodesia	1019·9	— 1·0	77	31	72·9	39·9	56·4	+ 0·3	50·0	64	1·4	0	— 1	0	...	...
Cape Town	1021·2	— 0·1	76	37	62·0	47·8	54·9	0·0	52·5	83	5·7	95	+ 5	16	...	...
Johannesburg	1023·5	— 2·1	65	29	58·6	40·0	49·3	— 1·3	38·7	59	3·0	26	+ 20	4	8·9	84
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Calcutta, Alipore Obsy.	998·1	— 1·1	94	77	88·6	78·8	83·7	+ 0·2	78·9	87	8·9	415	+ 88	17*	...	...
Bombay	1002·4	— 1·3	88	74	83·8	77·4	80·6	— 0·5	77·2	87	9·6	1099	+460	26*	...	...
Madras	1004·0	— 0·5	104	74	98·9	79·9	89·4	+ 2·1	74·9	58	8·1	42	— 62	4*	...	...
Colombo, Ceylon	1009·5	+ 1·4	86	72	84·7	75·7	80·2	— 1·1	76·9	77	9·1	316	+186	24	5·7	46
Hong Kong	1003·9	— 1·0	91	74	86·1	78·8	82·5	0·0	77·5	81	7·9	471	+152	18	6·5	49
Sandakan	...	...	90	74	87·6	74·8	81·2	— 0·7	76·4†	78†	...	269	+103	11	...	...
Sydney	1016·1	— 2·4	68	41	61·3	46·8	54·1	+ 1·7	48·7	68	4·7	207	+ 84	14	5·6	55
Melbourne	1016·2	— 2·9	65	37	55·2	44·4	49·8	+ 1·2	47·5	80	7·1	72	+ 26	18	2·6	27
Adelaide	1019·3	— 1·1	68	41	59·2	47·0	53·1	+ 1·5	49·4	76	7·7	127	+ 60	22	2·8	28
Perth, W. Australia	1020·6	+ 1·5	69	40	63·1	48·5	55·8	+ 0·7	51·4	73	5·9	116	— 50	18	4·6	45
Coolgardie	1021·9	+ 2·0	67	33	61·3	41·4	51·3	+ 0·1	48·1	61	4·1	18	— 5	9	...	...
Brisbane	1017·3	— 1·0	75	43	68·4	49·3	58·9	+ 0·6	53·6	61	3·1	52	— 4	6	8·2	78
Hobart, Tasmania	1012·0	— 1·8	63	35	54·0	41·7	47·9	+ 2·5	44·6	77	6·6	34	— 20	15	3·8	41
Wellington, N.Z.	1015·5	+ 2·6	59	35	51·9	42·7	47·3	— 0·2	44·3	79	7·7	96	— 48	19	3·1	33
Suva, Fiji	1012·6	— 1·6	85	63	78·3	67·8	73·1	— 0·5	70·2	88	6·1	186	+ 69	14	...	...
Kingston, Jamaica	1014·4	— 0·3	95	71	91·2	73·3	82·3	+ 0·6	...	64	4·5	12	— 30	2	...	...
Grenada, W.I.	1014·9	+ 1·6	86	72	84·0	74·2	79·1	+ 0·2	74·9	77	5·6	215	— 34	26	...	...
Toronto	1016·0	+ 1·9	92	51	78·8	59·1	68·9	+ 0·7	62·5	69	4·6	44	— 33	10	...	...
Winnipeg	1013·6	+ 0·9	96	45	83·2	59·7	71·5	+ 5·3	64·5	68	3·5	90	+ 13	15	...	...
St. John, N.B.	1014·8	+ 1·1	85	47	68·3	46·5	57·4	— 3·0	54·4	79	6·6	53	— 39	12	...	...
Victoria, B.C.	1016·1	— 0·6	82	48	67·4	52·3	59·9	— 0·4	54·9	78	3·6	24	+ 15	6	...	...

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen. † Mean of observations at 9h., 15h., 21h., from April, 19[illegible].