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The Loss of the Airship N.S. 3.

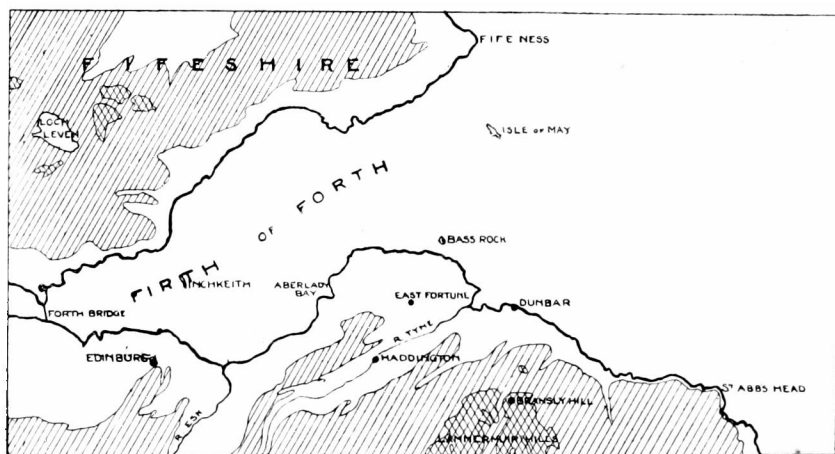
THE airship N.S. 3, on patrol from East Fortune, was wrecked at sea off Dunbar in the early morning of June 22nd, 1918. The occurrence subsequently became of considerable meteorological interest on account of the suggestion that a "wind barrage" of a more or less permanent nature exists over the mouth of the Firth of Forth during south-westerly winds.

Evidence bearing on this supposed wind barrage was referred for investigation to the Meteorology Sub-Committee of the Advisory Committee for Aeronautics. The papers discussed by the Sub-Committee have been used in the preparation of the following notes by permission of the Aeronautical Research Committee.

At 0 h. 40 m. (summer time) on June 22nd, 1918, the N.S. 3 was 7 miles south-east of the Bell Rock. The wind was estimated to be 35 miles per hour, rising to 45 miles per hour in gusts, and was increasing, and course was laid at full speed for East Fortune. At 3 h. 15 m., when the airship was passing south-east of May Island, the wind was 45 miles per hour, with violent bumps. Three attempts were made to cross the coast near Dunbar, but the first two were defeated by violent gusts which drove the airship outwards from the coast. The third attempt was successful, but, owing to the violence of the gusts and to up-currents throwing the ship up to 1500 feet, no further headway could be made. The ship therefore re-crossed the coast seawards in order to try to work home up the Firth, but before she could be turned into the wind she

was rapidly driven down into the water, in spite of a large elevation of the bows.

The area over which the supposed wind barrage is operative has a triangular shape with apex at the island of Inchkeith, the north and south coasts of the Firth as the sides, and a line drawn from Fifeness to St. Abb's Head as the base. The evidence of wind abnormality may be summarised as follows:



THE FIRTH OF FORTH.

The lighter shading indicates ground above 250 feet, the heavier that above 1000 feet.

The existence of regions of high and irregular winds when the general wind was westerly or south-westerly had been recognised by pilots for some time. According to a memorandum prepared at East Fortune, it frequently happens that, whilst the wind experienced in the triangular area at the usual patrol height, 500 to 1000 feet, is between north-west and south-west, the wind at a similar height over the waters beyond Fifeness is from a different direction, between north-west and north-east, and that off the coast south of St. Abb's is between south and south-east. Severe bumpiness is experienced off St. Abb's Head and along the southern coast of the Firth on these occasions, the disturbances being most pronounced in the region of Belhaven Sands and Dunbar. The gusts vary rapidly in velocity and direction, and are accompanied by violent "updrafts." The district west of Bass Rock, particularly over Aberlady Bay, is relatively free from these unpleasant conditions. A year's general experience of pilots has shown that up to a height of 1500 to 2000 feet the wind velocity is about 10 miles per hour greater at the mouth of the Forth than over East Fortune. The suggestion was put forward that during westerly winds the valley of

the Forth forms a funnel through which the wind at a height of 500 feet and upwards has increased velocity. The valley of the small River Tyne near Dunbar might have a similar effect.

The synoptic chart for 1 h. (G.M.T.) on June 22nd showed that the geostrophic wind in the East Fortune region was about 42 miles per hour from west-north-west, but the wind shown by the 40-foot anemometer at East Fortune was 15 miles per hour from west-south-west at that hour, and at Blackford Hill, Edinburgh, the anemometer reading was 21 miles per hour from west-south-west. At Glasgow the wind was estimated to be 21 miles per hour from the same direction. There had been a gust of 39 miles per hour at midnight from west at Blackford Hill, and the microbarographs there and at Eskdalemuir also gave indication of disturbed conditions.

As regards the funnel effect it is not at present possible to say definitely what result river-valley configuration has upon the winds on the slopes or summits, and the theory that the wind in such circumstances is substantially increased is not readily verified. It is often supported by reference to strong winds which sweep down gulleys on to the sea, but these are characteristic of long mountain valleys and are attributable to thermal causes. It is unlikely that an effect of this kind would have been produced on a windy night in either of the valleys under consideration.

The ordinary result of the wind passing over a hilly region is a very considerable eddy-effect which reduces the velocity at, say, 30 feet above the surface to about half that in the free air, the reduction being greatest in the valleys and least on the hill tops. This eddy-motion, which is the direct result of an arrest of momentum at the ground, may be regarded as the superposition upon the mean wind of motion in confused and imperfect eddies, and takes the form of transient upward or downward motion, forward or backward, to one side or the other. The superposed velocities in all six directions probably have about equal ranges.

Records from anemometers show that the effect of eddy-velocity in a region such as that near Dunbar is to make the actual wind at, say, 30 feet from the ground fluctuate between the limits of 0.5 and 1.5 times the mean velocity, *i.e.*, approximately 10 to 40 miles per hour for a geostrophic wind of 50 miles per hour. Over trees the range tends to be somewhat greater. Very little is known about the vigour of eddies at a height of 500 feet, but it can be assumed that with a strong westerly wind in this neighbourhood the air

would have a good deal of its energy of motion in the form of irregular eddies. In any case a ship in a strongly eddying current could not keep trim and would be very likely to lose headway and become unmanageable; it would catch the wind at a variety of angles and, if driving at full speed, would meet a succession of blows of perhaps nearly double the full speed resistance in still air. The effect of turbulence due to hilly ground would extend for a considerable distance to leeward of the hills.

The temperature difference of sea and land tends to complicate ordinary eddy-motion at the coast. The air coming off the land with the westerly wind on the night of the loss of N.S. 3 was relatively cold, but the temperature difference does not seem to have been sufficient to cause much additional disturbance of the air.

There is a further coastal effect which may be operative in windy weather, when the local temperature gradient is not very marked. This is the dynamical effect upon the stream of air produced by the sudden transition from a hilly land-surface, with a comparatively high coefficient of eddy viscosity, to the sea-surface, with a comparatively low one. This change must probably be represented by a sudden transition of pressure in the surface layers which produces a "refraction of the isobars" at the coast.

There was nothing in the ordinary meteorological conditions to suggest a cause for the violent up-current experienced by the N.S. 3. The largest rising current that has been measured by a two-theodolite pilot balloon ascent in this country was one of 12 miles per hour (J. Durward, *Meteor. Mag.*, Vol. 56, p. 97). J. S. Dines (*ibid.*, p. 96) has measured one of 11 miles per hour, and had four of over 7 miles per hour in 66 ascents. The largest downward current at a considerable height appears to have been one of 5 miles per hour deduced by G. A. Clarke (*Q.J.*, *Roy. Met. Soc.*, XLVII., p. 117) from a single-theodolite ascent at Aberdeen. The experience of N.S. 3 suggests something considerably more violent, but the conditions were generally the same as in Clarke's case, the wind eddying downwards between the hills and the sea.

Bransly Hill, the spur of the Lammermuirs to the south of Dunbar, is 1300 feet high and 5 miles from the coast, and the airship coming landwards would probably have met increasing turbulence up to a maximum at the front of the hill eddy.

On consideration of all the evidence, the Meteorology Sub-Committee were satisfied that a sufficient explanation of the experiences of N.S. 3 was to be found in the eddy-motion of the atmosphere, which would in all probability be

especially prominent in the district under consideration and in all hilly regions near the coast line. There seems to be no evidence of any funnelling effect in the Forth Valley such as would justify the use of the word "barrage". Certain elements of the turbulence, notably the Bransly Hill eddy, are probably permanent in winds of similar strength and direction. One feature of general interest which emerged during the inquiry is the not infrequent existence of a sharp maximum velocity at about 1000 feet which is not necessarily confined to the coast but is certainly prominent there. This is likely to be of importance for airships navigating at that level.

In connection with the inquiry, research on the effect of eddies on the drag experienced by an airship model was initiated at the National Physical Laboratory. A report by Messrs. Relf and Lavender has been published.* A model airship 3 feet long was set up in a wind channel and artificial eddies were produced by passing the air through nets of thick cord. It was found that the eddies produced by the cords died out rather quickly; their effect was halved when the network was moved from close up to the nose of the model to a distance of 3 feet, and almost eliminated at 6 feet. The greatest drag exceeded double that in a free channel. It was found that the eddies from a gridiron arrangement of cords running one way were more persistent than those from a network, and that the eddies made by a thick cord carried further than those from a thin one, but no obstacle comparable with a hill was included in the tests.

The moral of the investigation appears to be that when meeting an eddying wind an airship loses a great deal of the advantage of the streamline shape.

Official Publications.

The Observer's Handbook, 1921. Price 7s. 6d. net.

THE new edition of the *Observer's Handbook* differs only slightly from its predecessors. Attention may be drawn to the code for mist and fog, based on the range of visibility, which is described on pages 53 and 54. The visibility code in its relation to this fog and mist code is given in the May issue of this Magazine.

An illustrated description of the Assmann Psychrometer is a new feature of Part III., while Part IV. contains an additional

* *Advisory Committee for Aeronautics Reports and Memoranda No. 597.*

table for computing the velocity-height-ratio of clouds in milliradians per second from Fineman Nephoscope readings. The newer type of instrument designed at the Meteorological Office and known as Mark II., is described on page 48. The diagram formerly reproduced in the Handbook to illustrate the method of computing the velocity-height-ratios is no longer shown. According to this diagram the tip of the pointer is adjusted until it is in the same straight line as the cloud-image and the central point of the mirror, whereas in actual practice it is the *image* of the tip that is adjusted to the straight line. Both methods are described in Fineman's paper *Spegelnefoskopet*, Stockholm, 1889.

Professional Notes.—No. 22. *A Comparison of Minimum Temperatures for the periods 17 h. to 9 h. and 17 h. to 17 h.*
By M. A. Giblett, M.Sc. Price 1s. 3d. net.

THE investigation recorded in this note was undertaken in connection with a suggested revision of the scheme of observations at Health Resorts. The revision of the terminal hours for maximum and minimum temperatures took place in March and April of this year and an account of the change was published in this Magazine, April 1921, page 75.

Mr. Giblett's work shows that the average night-minimum (17 h.—9 h.) differs in winter from the average 24-hour minimum by about 0.4° F. whilst the difference is negligible in summer.

The minimum for the longer period is found to occur after 9 h. about 20 times a year, mostly in winter.

Professional Notes.—No. 24. *The Variation of Wind with Place.*
By Captain J. Durward, M.A. Price 6d. net.

THIS note gives an account of an investigation undertaken in 1918 to test the accuracy of "Meteor" reports to artillery. A preliminary inquiry into results from two stations in north-east France, 50 miles apart, showed that between the heights of 2,000 and 10,000 feet, 70 per cent. of the winds agreed to within 5 ft./sec. and 90 per cent. to within 10 ft./sec. A more detailed investigation was then made from observations from seven stations along the British Front. One station was taken as the standard, and the winds at the other six stations were resolved first along the wind—the "following component"—and then at right angles to the wind—the "cross component."

It was found that, between 2,000 and 6,000 feet, in the case of the following component the 50 per cent. zone of agree-

ment within 5 ft./sec. had a radius of 55 miles, and in the case of the "cross component" the 55 per cent. zone had the same radius. The agreement at 10,000 feet was found to be somewhat better than this. It was considered that, on the average, errors arising from neglect of the variation with place are comparable with those arising from other causes.

Meteorology in Edinburgh, September 1921.

THE meeting of the British Association in Edinburgh, from September 7th to September 14th, was characterised by a marked revival of meteorological activity, and this, together with the meeting of the Royal Meteorological Society in the same city on September 7th, combined to make the occasion a memorable one for those meteorologists who were able to be present.

The claims of meteorology to a place in the programme of Section A of the British Association have again been recognised by the reappointment of a meteorological secretary to that section, an office vacant since the retirement of Lieut.-Col. E. Gold, F.R.S., in the early days of the war. Of the papers read a number were of geophysical interest. Dr. A. Crichton Mitchell described the new Geophysical Observatory in the Shetlands established by the Meteorological Office for research on aurora and magnetic and electrical phenomena. Terrestrial magnetism was represented by two papers, "The Magnetic Storms of the Present Solar Cycle," by the Rev. A. L. Cortie, and "The Magnetic Anomaly in the District of Kursk, Russia," by Prof. Kriloff. The various theories of cyclones were reviewed by Dr. H. Jeffreys in a paper "On the Cause of Cyclones," while Capt. C. K. M. Douglas contributed "Some Remarks on Bjerknes' Theories of Cyclones and Anti-cyclones." The outstanding difficulty in the "radiation" theory of the stratosphere, viz., "The Discontinuity of Temperature at the Top of the Troposphere," formed the subject of a paper by Mr. W. H. Dines, F.R.S. "The Dry Period of 1921 in England and Wales" was described by Mr. M. de Carle S. Salter, and compared with those of 1887, 1893, and 1911. In an address on "Internal Movements in the Sea," Dr. Hans Pettersson described in a delightful way, and illustrated experimentally, how, under favourable conditions, dense sea water freshly saturated with oxygen enters the Baltic, and, sinking into the deepest hollows, renews the supply of oxygen there and renders them habitable by marine fauna. The Report of the Seismological Committee was delivered by Prof. H. H. Turner, F.R.S., and contained, amongst other things,

a brief account of further research by Mr. J. J. Shaw on the travel of microseisms, preliminary work on which was described in the report last year. The Report of the Committee on Tides was drawn up by Dr. A. T. Doodson, and it is interesting to note that one of the subjects of reference for future investigation is the effect of meteorological conditions on the degree of accuracy obtainable in the analysis and prediction of tides.

In Section B, recent work for the Advisory Committee on Atmospheric Pollution was described by Dr. J. S. Owens in a paper on "Suspended Impurities in City Air."

The occasion was a particularly suitable one for the meeting of the Royal Meteorological Society in view of its amalgamation early this year with the Scottish Meteorological Society. The meeting was held in the Natural Philosophy Department of the University, the building devoted to Section A of the British Association, and there were present some 50 or 60 Fellows and visitors from both sides of the Border. Proceedings opened with an address by the President, Mr. R. H. Hooker, on "The Functions of a Scientific Society with special reference to Meteorology." Dr. Angus Macdonald then read a paper on "Meteorology in Medicine," which was followed by "Some Notes on Meteorology in War Time" by Mr. C. J. P. Cave, and a paper "On the Diurnal Variation of Atmospheric Pressure at Castle O'er and Eskdalemuir Observatory, Dumfriesshire," by Dr. A. Crichton Mitchell. The meeting closed with a paper by Dr S. Fujiwhara of the Central Meteorological Observatory, Tokyo, on "The Natural Tendency towards Symmetry of Motion and its Application as a Principle to Meteorology."

A joint Exhibition of Meteorological Diagrams and Photographs was arranged in two rooms of the Natural Philosophy Department and remained open to Fellows of the Society and Members of the Association from Wednesday, September 7th, until the end of the week. One room was devoted to autographic records from Eskdalemuir Observatory, and, of these, a number showing pulsations of the Earth's vertical magnetic force, were of outstanding interest. Prominent in the other room were cloud photographs by Mr. G. A. Clarke and Capt. C. K. M. Douglas and photographs illustrating waves in water, sand, snow and air, by Dr. Vaughan Cornish, while diagrams illustrative of Mr. Salter's paper on the "drought" and others by Dr. J. S. Owens showing the diurnal variation of suspended impurity in city air and by Dr. E. M. Wedderburn showing temperature variations in Loch Earn, attracted much attention.

As announced in the *Meteorological Magazine* of last August, a temporary branch of the Meteorological Office was

opened in the Natural Philosophy Department, and a wireless receiving set was installed there by the Communications Department of the Air Ministry, for the reception of the synoptic messages issued several times daily by this and other countries. The data received were exhibited in the Entrance Hall in the form of a synoptic chart on a large blackboard covering an area from Spitzbergen to Algiers and from Iceland to the Russian frontier. In this way it was shown effectively how much weather information is distributed day by day through the "æther," a great deal of it available to the amateur equipped with a not very expensive receiving set. Numerous practical demonstrations were given of reception by wireless and of the subsequent decoding and charting of information. In addition a "Local Daily Weather Report" was prepared and duplicated, and forecasts were issued to the Press and to private inquirers. The Daily Weather Report was issued soon after 10 h. G.M.T. and contained, in addition to the 7 h. synoptic chart, tabulated details of surface and upper air conditions over the British Isles and a "General Inference" and local forecast for Edinburgh. Copies were exhibited not only in the buildings occupied by the British Association but in many public places in Edinburgh.

Two functions of a less serious nature were an excursion of Fellows of the Royal Meteorological Society to Eskdalemuir by motor char-a-banc on Tuesday, September 6th, and the "Meteorological Luncheon." The party of about 25 who joined the excursion spent a very enjoyable day and were shown over the Observatory by the Superintendent, Dr. A. Crichton Mitchell, afterwards being entertained to tea by Mrs. Crichton Mitchell. They were favoured with delightful weather. For many years the "Meteorological Luncheon," as before it the "Meteorological Breakfast," has afforded an opportunity for the gathering together of geophysicists attending the British Association meeting. This year the party, augmented by Fellows of the Royal Meteorological Society and their friends, numbered 45, and a very successful luncheon was held in the Advocates' Dining Hall, Parliament House, on Tuesday, September 8th. Dr. H. R. Mill, who presided, delivered a very entertaining speech in which the history of the function was traced from its earliest days. Subsequently speeches were delivered by Prof. R. A. Sampson, F.R.S., Astronomer Royal of Scotland, and by Mr. R. H. Hooker, President of the Royal Meteorological Society. An interesting feature of the luncheon was the reproduction, on the back of the menu, of the synoptic weather chart of 7 h. the same morning.

Correspondence.

To the Editors, "*Meteorological Magazine*."

Visibility.

THE letter of Mr. C. F. Priestley in the September number of this Magazine on "Visibility on the Firth of Clyde" is interesting and suggests comparisons with other west-coast stations. I do not think that visibilities such as he describes are at all uncommon.

There being no distant mountains suitable for observation in the neighbourhood of Valencia Observatory, resource has been had to clouds low down on the horizon over the Atlantic and the results of a few such observations may be of interest.

The most suitable conditions occur with a sky thinly dotted with fracto-cumulus cloud; with unusually good visibility the outlines of such clouds can sometimes be seen distinctly right down to the water-horizon. The heights of the bases of clouds of this type are generally pretty definite and can be estimated with very fair accuracy in the case of those near at hand by comparison with the neighbouring mountains. Such clouds are seldom seen at Valencia Observatory below about 2,000 ft.

In computing distances the effect of refraction is considerable and should not be ignored. Calculation shows that in the case of tangential rays of light the radius of curvature is normally about 5·3 times the radius of the earth. It may readily be determined that the effect of refraction in such case is to increase all horizon distances by 11 per cent. If then an observer at height h ft. above sea level observe on the water-horizon another object at H ft., the distance in miles between them, after allowing for refraction, will be $1\cdot36 (\sqrt{H} + \sqrt{h})$.

On August 28th last in the afternoon the visibility was not quite good enough to be classed as "v," the sky was dotted with fracto-cumulus and a light westerly wind was blowing. The outlines of the clouds could be traced down to about 05° above the Atlantic horizon by an observer standing about 50 ft. above sea level, and the height of the bases of similar neighbouring clouds was at least 2,000 ft. If we take 2,000 ft. as the height of the part of the clouds seen, and allow for the 05° elevation the distance works out as 65 miles.

On the next day in the afternoon the sky was again dotted with fracto-cumulus, the wind-force 4 from north-west, and the visibility classed as "v." The bases of local fracto-cumulus clouds were at from 2,500 to 3,000 ft., while

the outlines of distant ones could be made out to within about 1° of the horizon, viewed from a point 82 ft. above sea level. If 2,700 ft. be taken as the height of the clouds the distance works out as 75 miles.

The best observation of all was obtained in the evening of the same day after sunset, when the outlines of fracto-cumulus clouds could be seen with perfect distinctness against a light background of sky, right down to the Atlantic horizon. Local clouds in this case had bases about 2,000 ft. high, so that a distance of 73 miles is indicated.

Somewhat similar observations have been made before at Valencia, though not with such precision as in this case, and I think that the result justifies the conclusion that the conditions indicated by Beaufort letter "v" at Valencia represent a visibility of at least 60 to 70 miles, and sometimes more. Roughly speaking, Beaufort letter "v" has been noted during recent years on about 15 to 20 days per annum.

L. H. G. DINES.

Valencia Observatory, Cahirciveen, September 26th, 1921.

I HAVE read with interest the article on p. 224 of this Magazine on "Visibility on the Firth of Clyde," and it has occurred to me that some account of a view from Blackpool Tower on a day when visibility was very great may be considered worth publishing.

As an old mountaineer who has seen many views, I considered this view, in the amount of detail visible over a wide area, to be unique in my experience. A tower has the advantage over a mountain that it has no skirts or outliers to obstruct the view.

The counties included in the view under consideration would be Cumberland, Westmorland, Yorkshire, Lancashire, Cheshire, Flint, Denbigh, Carnarvon, and the Isle of Man.

September 3rd, 1921, was a day of exceptional clearness. The view from the summit of the Tower at Blackpool (about 500 feet high) was remarkable, not only from the extent of country covered but also from the immense amount of visible detail at great distances. It was exceptional, too, in that the view was equally clear in every direction.

The Isle of Man, visible from the promenade only as a series of detached islets, stood high out of the water 70 miles away and dark blue. The hills of Wales, 60 to 70 miles away, were equally clear. In this connection it may be of interest to note that some years ago I was on Snowdon with the Rev. R. P. Dansey, and he made out the top of Blackpool

Tower (70 miles away) with glasses, showing through a gap in the ridge of Glyder Fawr.

To the east the view is more restricted, but to the north the hills of the Lake District were visible in great detail ; every mark and gully on Black Combe, 33 miles away, could be seen with the naked eye, and Saddleback, 57 miles away, was clearly distinguishable through the gap of Dunmail Raise. Further east the Howgill Fells, which rise to the north of Sedbergh in Yorkshire could be made out.

To mention smaller details, Great Orme's Head, above Llandudno, 48 miles away, could be recognised, and the white wall of the lighthouse enclosure on its north-west point could be made out with glasses ; with the same aid the colours of fields and woods on the nearer Welsh coast, 40 miles away, could be distinguished ; the buildings in Liverpool and the top of the transporter bridge over the Mersey at Runcorn, 35 miles away, were also visible.

Northwards, even from the ground level, the colours of cornfields, pastures, and woods on the nearer hills some 27 miles away beyond Morecambe Bay, and the purple of the heather above, could be made out with the naked eye.

From the tower with glasses I could clearly recognise the tower on Eller Horn, a hill to the north-east of Grange-over-sands 29 miles away, and could see the houses in Grange itself.

A little to the west of Black Combe an isolated islet rose dark blue from the sea. This I took at the time to be a hilltop in Scotland, but the map showed it to be the top of St. Bee's Head, the most westerly point of Cumberland, 52 miles distant.

I have only mentioned some of the more distant features ; a view which included a great deal of detail in nine different counties and the whole of the coast line from Llandudno round to Barrow is so exceptional that it seems worth recording. Probably visibility was at its maximum, and everything which the sphericity of the earth allowed to be seen was distinguishable.

VICTOR H. GATTY.

Whiteholme, near Preston, October 2nd, 1921.

Are Upper Air Temperatures better Evidence for Horizontal or for Vertical Movements ?

THERE have been several allusions lately by various writers in the *Meteorological Magazine* to the effect of wind direction upon temperature in the upper air, possibly as echoes from the theory of the polar front, but there is another cause of temperature variation that is apt to be overlooked.

It can be simply and readily proved that a mass of air has to move with an inclination of only $3'$ to the horizon, which is a slope of 1 in 1160, to produce on itself a change of temperature equal to that due to the change of latitude produced by a south or north wind, and further that it will require a very thick current of air and very rapid motion before fully saturated air moving at so small an angle to the horizontal can produce perceptible rain.*

Since rain is common, air currents at much greater inclinations than $3'$ must be common also, neither is there any reason to suppose all inclined air currents to consist of rising saturated air; they may be dry or wet, rising or falling. In these currents we have a powerful source of change of temperature, and it is not safe to ascribe an anomaly of temperature to some other cause without first proving that this is ruled out. Thus, suppose at some definite height and place an anomaly of $+10^{\circ}$ F. is found, if the air has run down an incline of $30'$ for 100 miles with sufficient speed to have escaped change by radiation, the $+10^{\circ}$ is explained. It does not follow that this is the cause, but it quite certainly may be, and very likely is. We are accustomed to ascribe rain to such causes, why not also changes of temperature some of which are admitted by all to be the primary cause of rain? W. H. DINES.

Weather Lore.

I WAS interested in letters on this subject which appeared in the January and March numbers of your Magazine, concerning red sky at sunset. I have observed that with a rosy afterglow fine weather follows, but with a dark red inevitably rain comes next day, as to morning red, I can only conclude

* $\sin 3' = 1/1160 = 250 \text{ metres}/290 \text{ kilometres}$.

If air rises 250 m. adiabatically it falls $2^{\circ} \cdot 5$ C. and the average fall of temperature for 250 m. in height is $1^{\circ} \cdot 5$ C.; thus the air which has risen 250 m. is 1° C. below the air at its new level.

From the *Book of Normals* (M.O. 236), Section III., the fall of temperature towards the north over England is about 1° F. per 100 miles = 1° C. per 180 miles, and 180 miles = 290 kilometres, hence the two causes exactly balance.

From a table given by Hann (*Lehrbuch der Meteorologie* 1906, p. 162), it appears that 1 cu. metre of saturated air at 0° C. condenses $\cdot 33$ grammes of water vapour on cooling 1° C., and, therefore, $\cdot 83$ g. on cooling $2^{\circ} \cdot 5$ C. Consider a current 1 m. wide and 1,000 m. deep running up a slope of $3'$ with a velocity of 50 miles or 80 km. per hour. Suppose for the moment that all the water is given off at the last metre the amount per hour is $\cdot 83 \times 1,000 \times 80,000$ g. But it rains equally fast all up the 290 km. slope, or this is distributed over $290 \times 1,000 \times 10,000$ sq. cms.

The rate is $8 \cdot 3 \times 8 \times 10^6/29 \times 10^8$ cm. per hour
 $= 2 \cdot 29 \times 10^{-2}$ cm. per hour,
 $= \cdot 01$ in. per hour nearly.

The rate would be less than this because the latent heat set free would not allow a cooling of $2^{\circ} \cdot 5$ C. W. H. D.

the same results. This month of September I have specially noted sunrises and I give the following as recorded from my observations:

12th. Dark red and yellow sunrise, with falling barometer and backing wind, rain at night, strong wind morning and noon. Rain on 13th and 14th but not heavy, barometer rising.

15th. A vast expanse of red rosy sky at sunrise, wind veering—a fine day followed.

16th. Rosy sunrise, rising barometer, veering wind—a fine day followed.

17th. Sunrise not so rosy or so full in volume with steady barometer and wind—fine morning followed but with strong wind from NE. Cloudy sky overcast at times, a shower followed at 13 h. 30 m. and rain at 15 h. G.M.T. Wind variable, E, NE, ENE. Barometer, slight fall of 0.02 in. and rise of 0.04 in. from morning observation to noon.

These signs of colour can be taken into consideration with some assistance from the observation of wind changes, barometer movements, and variation of temperature as aids to forecasting local weather.

It is, I think, a subject worth the consideration of our professors.

HENRY A. ROGERS.

3, Victoria Square, Bristol, Sept. 21st, 1921.

A Cyclist's Experience of Rime in September.

On the morning of Wednesday, September 28th I was cycling from Newbury to Reading. I left Newbury at 8 h. 50 m. G.M.T. and happened to note that the air temperature was 43° F. A thick clammy mist was prevailing, but occasionally the sun's position was visible, the inference being that the sky was cloudless. After a mile or so towards Woolhampton my jacket became white with frost crystals, although grass around and the meadows were wet with dew (the hoar-frost on them having already melted away). C. W. HEINEMANN.

Kensal Green, October 1921.

[It is to be presumed that the fog at Woolhampton was much colder than that in the town of Newbury and that it contained super-cooled water drops which would be deposited as rime. Perhaps this cold fog had drifted into the valley after the melting of any hoar-frost there may have been during the night.

The observations at Bucklebury Place, 2 miles north of Woolhampton, at 8 h. G.M.T. were:—Dry bulb temperature, 42°·5 F.; minimum temperature, 37°·2 F.; grass minimum, 30° F.; weather, foggy.—ED. M.M.]

Units for Meteorological Work.

MAY I point out one or two further aspects of the present discussion? Whilst every scientific meteorologist will acknowledge the desirability, and in many cases the necessity, of using absolute C.G.S. units in physical problems involving calculation, it does seem rather unnecessary to have effected so drastic a revolution in the ordinary tabular matter which is periodically published. And remember it is not the ordinary reader on whom the burden of the change has fallen most heavily, but the writer of books desirous of appealing to as many classes of readers as possible. Imagine the plight nowadays in which such an author finds himself. If he is to court favour with the select scientific few he must rigidly adhere to absolute C.G.S. units, but thereby numbers of readers in the wider world will be "put off" the book. If he uses one set of units in one section of the work, another in another, as seems most fitting in accordance with general usage he is sure to be denounced for inconsistency. If, again, in every figure he quotes he gives the equivalent in brackets he must sacrifice literary smoothness, or if he refers his readers to a table of equivalents in an appendix many will resent the trouble, although the last seems to be the best solution of the difficulty.

It is to be hoped therefore that the difficulties of authors in this matter will be sympathized with.

As many correspondents have pointed out, the actual advantages are by no means entirely with C.G.S. units. Personally, for ordinary climatological descriptive or comparative purposes, I much prefer the small Fahrenheit degree because one can disregard fractions in many instances where it would not be justifiable to do so with Centigrade degrees.

L. C. W. BONACINA.

27, Tanza Road, Hampstead, September 25th, 1921.

The Word "Drought."

THE writer of the article entitled "The Deficient Rainfall" in the August number of this magazine draws a distinction between the "popular" and "technical" meanings of the word "drought." The question arises as to whether any such distinction exists.

Mr. G. J. Symons, in 1887, drew up definitions of the terms "absolute drought," "partial drought" and "engineers' drought" for purposes of discussing spells of rain shortage in *British Rainfall*, and, so far as I am aware, no one objects to the use of these terms for the special purposes of that and similar publications. There appears to me, however, to be a very real objection to restricting the meaning of

the single word "drought" to cover only the three types of rain shortage to which those definitions refer. "Drought" is an extremely ancient word, meaning, among other things, "lack of rain" (*New English Dictionary*), and surely Symons's definitions need not prevent anyone using the word in that sense without regard to special limitations.

In a recent newspaper interview a meteorologist complained of the loose and inaccurate use of the word "drought" in the press. The implication is that it is incorrect to describe as a drought a spell of dry weather which does not conform to Symons's definitions. The right of anyone to so clip and limit the meaning of a common English word is surely very questionable, and in this instance, at any rate, there is no reason to believe that any such general limitation was intended when the above definitions were introduced.

E. G. BILHAM.

August 29th, 1921.

[Mr. Bilham's criticism would appear to be directed rather towards the anonymous meteorologist mentioned in the last paragraph (who will, we hope, duly note it) than to the writer of the article entitled "The Deficient Rainfall." The article does not appear to demand any restriction in the use of the word "drought," but quite properly avoids any misunderstanding by defining the sense in which the word is being employed. Scientific terminology must narrow the application of words, if it is to be scientific at all, for exactness is the soul of science. Probably the real crime, if crime there be, was Symons's preference for an old English word rather than some artificial new one the restriction of which no one would dispute.—Ed. M.M.]

An Observation of the 22° Halo with an Infralateral Arc of Contact.

AT 16 h. G.M.T. on Monday, August 8th, while at New Pitsligo, a village some 30 miles north of Aberdeen, I saw a very fine example of a solar halo.

The halo of 22° was complete and very bright; there was in addition an upper arc of contact to this halo. On both sides of the sun and just without the halo were extremely brilliant parhelia, and below the right-hand parhelion, at about 45° from it, there was seen another arc of contact to the 22° halo.

G. M. RATTRAY.

Aberdeen Observatory, August 18th, 1921.

[Mr. G. A. Clarke reports that at Aberdeen, on the same date, at 18 h., a very strongly coloured and very bright right-hand parhelion was seen, but no trace of halo or arcs was visible.]

NOTES AND QUERIES.

A Comparison between the Double Theodolite and Tail Methods of Obtaining the Height of Pilot Balloons.

A SERIES of ascents has recently been made at Larkhill to determine what degree of accuracy can be got by the use of the tail method. The method consisted of following each balloon with two theodolites, the home station observer taking readings of the micrometer as well as of the azimuth and altitude scales. In all, 25 ascents have been made, though in some cases readings have not been obtained every minute.

The balloons were followed chiefly by means of a Mark C theodolite—the micrometer of which has a scale value of 5,900 units to a radian. A few were followed by the Dines recording theodolite, of which the micrometer scale value is 3,570, and naturally the results obtained by the latter are not so good as by the former. In both instruments the movable cross-wires were only roughly fixed with Gloy, and were liable to shift. The correction was determined before and after each ascent.

Some of the pendants consisted of a circular piece of paper cut along a spiral nearly to the centre. This spins, but it is not very easy to see after 6 or 7 minutes on account of the small extent of surface. A sheet of foolscap gummed along the shorter edges and cut upwards for an inch or two at the bottom, with the corners turned outwards, makes a more suitable form of pendant. This spins well and can be followed for a longer interval.

Attempts were made to colour the pendants, with red or black ink, water colours or pastels. But nothing is gained by so doing; the white foolscap shows up very clearly against blue sky; and even when clouds are present it shows up as dark as a coloured pendant does. Still, coloured pendants made of paper having a highly polished surface would doubtless prove very satisfactory.

On one occasion a small balloon was used as a pendant, but this proved to be quite useless, as the tail oscillated about 45° from the vertical at times, and it was impossible to get readings with any accuracy.

In all cases the pendant was attached to the balloon by a length of ordinary cotton thread, the length from the centre of the balloon to the centre of the pendant being 30 feet.

To allow of a reading being taken at the first minute a piece of tissue paper was hung 15 feet from the balloon; this, however, was not altogether satisfactory, as it seemed to cause the thread to sag a little.

When the azimuth and altitude of the balloon are altering quickly, it is better to take a reading of the micrometer at the half minute and a reading of the other scales at the minute. But when the balloon is fairly steady it is possible to take the three readings at the minute with fair accuracy. Most of the heights given in the table below were calculated from readings taken at the minute, but some, especially in the first five minutes of an ascent, have been interpolated from the heights calculated from the half-minute values.

Results—In Table I. the average heights in feet at successive minutes are given. The heights attained by the tail method are calculated from the actual micrometer reading and are not smoothed.

TABLE I.—HEIGHTS OF BALLOONS AT SUCCESSIVE MINUTES.

Minutes - -	1	2	3	4	5	6	7
Heights by two-theodolite method.	503	949	1,224	1,613	2,104	2,568	2,895
Height by tail method -	516	903	1,231	1,644	2,034	2,379	2,728
Height from formula - -	500	1,000	1,500	2,000	2,500	3,000	3,500
Percentage error in tail method.	2·6	5·1	0·6	1·9	3·3	7·3	5·8
Number of observations	10	22	23	20	21	22	18

Minutes - -	8	9	10	11	12	13
Heights by two-theodolite method.	3,275	3,802	4,071	4,566	4,631	5,093
Height by tail method - -	3,096	3,662	3,841	4,321	4,343	4,858
Height from formula - -	4,000	4,500	5,000	5,500	6,000	6,500
Percentage error in tail method.	5·5	3·7	5·6	5·4	6·2	4·8
Number of observations	16	16	11	10	7	7

The heights given by the tail method agree on the average with the heights calculated by the double theodolite method to within about 5 per cent. The method is therefore very useful for the determination of winds in the lowest layers of the atmosphere; in particular the irregularities of wind velocity which appear in an ascent calculated by the single theodolite method disappear. For example, on June 28th, 1921, at 13 h. 45 m. G.M.T., the single theodolite method gave the 2,000 feet wind as 82 feet-seconds from 73°; actually it was 25 feet-seconds from 73°. If the first few minutes of an ascent

are all that are required, it would be sufficient to make the tail about 15 feet long, and readings could then usually be obtained at the first minute.

It will be observed that the heights obtained by the tail method are on the average lower than those got by the double theodolite method after the 4th minute. This is rather strange, seeing that if the tail swings the micrometer readings will be low and the heights too great. Most, though not all, of the balloons have been observed personally, and the heights almost invariably work out too low. It is probable that the error is due to the lengthening of the tail caused by the thread unravelling. Further experiments are being made to test this theory.

With regard to the measurement of heights greater than those generally obtained during the first thirteen minutes of an ascent—measurements usually obtained when the sky is blue and a white pendant is used—the micrometer readings usually need smoothing, as an error of 0·1 in the reading may mean an error of 300 feet in the height when the micrometer reading is in the neighbourhood of 5. A few heights obtained in various ascents are given below:—

TABLE II.

Time.	Height (Tail method).	Height (Double Theodolite method).
Minutes.	Feet.	Feet.
59	28,700	28,450
21	10,100	9,600
18	5,460	5,500
30	13,980	13,500
21	8,580	8,550
19	8,260	8,780
35	16,350	17,000

It appears then that the tail method gives quite a useful check on the altitude at any time on days of blue sky when balloons can be observed to considerable heights.

J. DURWARD.

Cessation of Summer Time.

SUMMER Time in this country came to an end on October 3rd at 2 a.m. In New York it ceased at 2 a.m. on September 25th, and in Belgium at midnight on the same day, while France will not revert to the normal time until October 25th.

Effect of Salt Spray on the ordinary Wet-Bulb Thermometer at Valencia Observatory.

It is known that the effect of salt water on a wet-bulb thermometer is to cause it to read too high. In an experiment carried out at Valencia Observatory some time ago, two wet-bulb thermometers were mounted in the standard manner with their reservoirs alongside containing fresh water. The muslin of one of the thermometers was thoroughly moistened at intervals with sea water, and as a result was found invariably to read higher than the other one, the difference for humidities, about the value 70 per cent., being as much as $1\cdot3^{\circ}$ F., and the effect a permanent one.* At this Observatory the Stevenson screen, in which the dry-bulb and wet-bulb thermometers are mounted, stands about 200 yards from a narrow estuary to the west, and about three miles from the open sea, so that the wet-bulb thermometer would be exposed to the effects of invisible spray carried by the wind off the sea, though visible spray has seldom been seen to fall on the thermometer screen, perhaps on three occasions in six years.

The probability of the ordinary wet-bulb thermometer being affected in a manner similar to that described in the experiment mentioned above is, of course, apparent, and it was with the object of investigating to what extent this occurs that the present inquiry was undertaken. A wet-bulb thermometer was fitted with a syphon wick and a muslin cap was lightly tied round the bulb of the thermometer, and then a few cotton threads were loosely twisted round the cap. The thermometer was set up in the Stevenson screen, so that whilst one end of the bundle of threads dipped into the ordinary reservoir, the other end passed through a tube and was attached to a small plummet about the level of the bottom of the screen. By means of capillary attraction water passed continually over the bulb and carried away any salt that may have fallen on it. Once a fortnight the muslin and threads of the wet-bulb thermometer used for the routine observations at the Observatory were removed, washed in rain water, and replaced, but the syphon wet-bulb thermometer was left untouched.

Simultaneous readings of the two thermometers were taken at one or more of the hours 7 h., 10 h., 13 h., 16 h., 18 h., and 21 h. on most days over a period of approximately a year, in all 683 observations. These were arranged in two classes :—

- (1) Readings taken during a week prior to the washing of the threads and muslin ;

* *Meteorological Office Circular*, No. 5, p. 4.

- (2) Readings taken during a week subsequent to the washing of the threads and muslin.

In each of these classes individual observations were grouped according to the readings of the ordinary wet-bulb thermometer, and the corresponding mean difference between the two thermometers was calculated. The two thermometers had been calibrated together, and the difference of their index errors had been estimated to $\cdot 01^{\circ}$ F., so that suitable corrections could be applied to the readings. No systematic relation between the wet-bulb temperatures and the differences in question could be traced.

The result of the investigation may briefly be summarised thus :—

Let A be the temperature of the ordinary wet-bulb thermometer with clean muslin and wick, say, three days old ; B, the corresponding temperature with muslin and wick 10 days old ; S, the temperature of the syphon wet-bulb thermometer. Then on the average

$$S - A = 0\cdot 021^{\circ} \text{ F.}$$

$$S - B = 0\cdot 013^{\circ} \text{ F.}$$

Little importance is to be attached to the actual figures. The interesting point is the practically negligible difference between them. This is in marked contrast with the behaviour of the Richard hair hygograph which is housed in a larger Stevenson screen adjoining the thermometer screen. This instrument has been found to be immediately affected by salt on the incidence of a westerly wind of force 5 or over, the error being as much as from 8 to 10 points with a humidity of 82 per cent.

Hence we see that with fortnightly washing of the muslin and threads of the wet bulb thermometer the effect of the salt in an impalpably fine condition in the air is negligible. On the other hand, salt which falls in visible spray has a deleterious effect, and the recommendation that muslin and wick should be washed or changed after the fall of such spray has occurred appears to be well justified.

Large Hailstones in New Zealand.

MR. C. MAHONEY of Ruatoki, New Zealand, reports that on Sunday, May 8th, he witnessed a thunderstorm at Raukokore. Torrents of rain were falling when there was a sudden vivid flash of lightning, and immediately from amidst the swaying, splashing shower there fell at intervals of a few feet extraordinary large hailstones. One of these stones was measured and found to be $1\frac{2}{3}$ inch long, $1\frac{1}{8}$ inch wide, and $\frac{3}{4}$ inch thick.

It was a mass of rugged, glittering ice. In the centre there was a white nucleus, softer than the outside and uncrystalline.

It is noted that the stones "pattered" on the roof of a verandah and did no serious damage. A possible explanation is that the hailstones were caught in a violent ascending current just before reaching the ground, and, therefore, fell with comparatively low velocity. Experience does not support a suggestion made by Mr. Mahoney that the hailstones were formed near the ground. They could only be formed in the cold upper portion of the squall cloud.

Radiation from the Sky.

RADIATION MEASURED AT BENSON, OXON, 1921.

Unit : one gramme calorie per square centimetre per day.

ATMOSPHERIC RADIATION only (dark heat rays).						
Averages for Readings about time of Sunset.						
		June.	July.	Aug.	Sept.	
Cloudless days :—						
Number of readings - - -	n	..	..	..	7	
Radiation from sky in zenith - -	πI	..	647	545	558	
Total radiation from sky - - -	J	..	684	610	635	
Total radiation from horizontal black surface on earth.	X	..	860	776	775	
Net radiation from earth - - -	$X-J$	..	186	166	140	
DIFFUSE SOLAR RADIATION (luminous rays).						
Averages for Readings between 9 h. and 15 h. G.M.T.						
Cloudless days :—						
Number of readings - - -	n_0	..	..	..	7	
Radiation from sky in zenith -	πI_0	65	72	65	45	
Total radiation from sky	J_0	58	70	60	48	
Cloudy days :—						
Number of readings - - -	n_1	..	..	..	20	
Radiation from sky in zenith -	πI_1	296	196	248	171	
Total radiation from sky - - -	J_1	250	160	216	151	

Very few observations with a cloudless sky could be obtained in August and hence the means are not reliable.

Variation of Wind with Height at Ballybunion.

It was reported in the *Meteorological Office Circular*, No. 5,* that a series of observations of wind velocity at different heights on towers at the wireless station, Ballybunion, on the coast of County Kerry, had been made by Mr. S. P. Wing in 1915. An account of the experiments appeared in *The Electrician* of July 1st, 1921. Three Robinson anemometers were mounted at heights of 492 feet, 300 feet, and 15 feet. The determination of the wind velocity from the records appears to be reliable. The observations were compared with each other and with the geostrophic wind. The influence of the direction of the wind on the ratio of the velocity of the observed wind to that of the geostrophic wind is well marked, the ratio being greatest at all heights for northerly and easterly winds and least for southerly winds. This is somewhat surprising, as the south side appears to have had the best exposure. The ratio is, however, very variable, as is usual in such comparisons. The general conclusion is, that on an average the wind velocity increases with height and at a height of 500 feet is about 1·4 times that at 15 feet. The average ratio of the wind velocity at 500 feet to the geostrophic velocity is about 88 per cent.

The experiments were carried out with a view to designing wireless towers 750 feet in height in such a way as to prevent destruction by gales. It may be mentioned in this connection that the ground wind is a smaller fraction of the upper wind at inland stations than at coast stations; consequently in inferring the maximum wind force at a considerable height from the ground wind, a larger factor will be necessary than at Ballybunion.

Plant Diseases and Climatic Conditions.

The Report on the Occurrence of Insect and Fungus Pests on Plants in England and Wales for the year 1919, issued by the Ministry of Agriculture and Fisheries, contains a series of diagrams illustrating Temperature, Rainfall, and Sunshine. The first figure shows values of these elements for the four seasons Autumn 1918 to Summer 1919 at the six districts into which England and Wales are divided for the purpose. A diagram for each district follows, in which weekly values for January to December 1919 are shown. The series of diagrams forms a useful supplement to the Weekly Weather Report of the Meteorological Office.

* See also Sir Napier Shaw's *Manual of Meteorology*, Part IV, Page 12.

It is interesting to note which attacks of, or periods of immunity from, disease are considered to be due to climatic conditions. The year 1918-19 was characterised by high rainfall in Autumn, Winter, and Spring—July also was very wet in many places—and by a dry warm spell from May to mid-June.

The dry spell is held responsible for extensive damage to root crops by flea-beetles and to potatoes by scab-fungus, but, on the other hand, the slightness of the attacks of black mould on wheat, American mildew on gooseberries, and wart disease on potatoes are also attributed to it.

The wet season, especially in December and January, caused great havoc among the potato clamps, causing excessive heating and decay.

The year 1919 was noteworthy for the small amount of blight on potatoes, except in the south-west of England and North Wales. Freedom from blight is usually attributed to a dry summer, but although July 1919 was very wet, East Anglia was almost free from attack. On the other hand, rainfall in Devon and Cornwall was very low but the blight very severe. It is suggested that the intensity of attack in these counties and in North Wales was due to the high atmospheric humidity.

The Unprecedented Drought—the Salisbury Plain Figures.

Mr. F. J. WARDALE, writing from Shrewton, Wilts, points out that the low rainfall of the last year at that place is unprecedented in his series of observations extending over 20 years, and that smaller totals have only been recorded at Chitterne, 5 miles distant, once in the long series of observations at that place. The figures are :—

12 months :—

Shrewton, August 1920—July 1921, 17·37 in.

Chitterne, November 1858—October 1859, 17·32 in.

13 months :—

Shrewton, August 1920—August 1921, 18·58 in.

Chitterne, November 1858—November 1859, 18·78 in.

The Chitterne gauge is 4 ft. above ground, and has no tube to the receiver, and Mr. Wardale writes :—

“ . . . if we add 4 per cent. for the former and a substantial amount for evaporation in such a dry spell on account of the latter defect, I think the record character of the recent drought will be fairly established as far as this district is concerned.”

The Measurement of Snow.

CONSIDERABLE diversity of practice appears to exist among rainfall observers in the method of measuring unmelted snow which has accumulated in the funnel of the rain gauge. In some specially constructed gauges a hot water chamber is provided, but this is not common. When subjected to heat snow rapidly evaporates, and the longer the time occupied in the process of melting the greater is the loss on this account. The method most commonly employed is to carry the funnel containing the unmelted snow into the house and to stand it near a fire. This method is open to the objection already mentioned, and it has the further disadvantage that if snow or rain is still in progress whilst the gauge funnel is not in position, some of it is not recorded. Another method is to pour a measured quantity of hot water into the funnel in order to melt the snow, making an appropriate allowance when taking the reading. This involves a considerable risk of cracking the measuring glass by subjecting it to extremes of temperature, and also the occasional risk of forgetting to allow for the added water.

A method which is open to neither of these objections is to wrap a cloth which has been dipped into hot water round the funnel of the gauge whilst the funnel is still *in situ*: this melts the snow rapidly and effectively. The only precaution necessary is to see that no water drips from the cloth into the funnel.

The same method can be used in melting ice which has formed in the receiver of the gauge. In this case the receiver is removed and the hot cloth applied directly to it.

Meetings for the Discussion of Geophysical Subjects.

MEETINGS for the discussion of geophysical subjects will take place at the rooms of the Royal Astronomical Society, Burlington House, W.1, on the first Fridays in November, December, February, March, and May next. In each case the meeting will commence at 5 p.m. Tea will be provided at 4.30.

The November discussion will deal with the Eötvös Gravity Balance, and will be opened by Col. H. G. Lyons. In December, Dr. H. Jeffreys will open a discussion on the geological effects of the cooling of the Earth. Full particulars of these and other discussions will appear in *Nature*. They may also be obtained on application to the Assistant Secretary of the Royal Astronomical Society.

Exceptional Weather in October.

DURING both the day and the night very high temperature readings were recorded at the beginning of October at several London stations. At Kew, 80° F. and over was recorded several times, the highest reading being 83° F. (north-wall screen) on October 6th. The previous record during 50 years was 77° F. on October 4th, 1886. Minimum temperatures of 60° F. and over occurred on several nights. The highest was 62° F. (north wall screen) on the 3rd. The significance of this may be gathered when it is considered that the mean absolute maxima for October at Kew is 66° F.

The Quest.

SIR ERNEST Shackleton's ship the *Quest* left London for a voyage of exploration in the Southern Ocean on September 17th, 1921. In addition to the usual meteorological instruments the *Quest* was furnished by the Meteorological Office with equipment for the observations of pilot balloons by day and by night, and with Marvin meteorographs for the recording of upper air temperatures: the meteorographs are to be carried by kites.

Audibility of the Oppau Explosion in England.

A NOTICE has been inserted in the Press asking for particulars from persons who believe they heard the explosion at Oppau, near Mannheim, on September 21st. Many letters have been received in reply to this request, and further particulars will appear in the next number of the *Meteorological Magazine*.

Smoke-Rings formed by an Aeroplane.

ON the evening of September 3rd, the attention of many people in North London was drawn to a curious appearance in the sky of luminous rings. One correspondent refers to them as "oblong hoops of light, cloudy mist," with a "bright silvery" appearance; another speaks of "bright streaks" and "circles of light." It was not realised by many that these "rings" were formed by an aeroplane, as the machine itself was not visible from some places. The air on the night in question was very still, so that the smoke-rings persisted for some time.

Meteorological Stations.

Woking.—With the exception of the record of rainfall, the climatological observations made at Knapp Hill, Woking, since 1908 have, unfortunately, to be discontinued. Captain E. R. Taylor established a station in 1895 at Pirbright Camp and transferred it to Knapp Hill in 1908. Mr. G. C. H. Simmonds has been the observer for the whole period. The observations have been utilised in the *Monthly Weather Report* since 1911.

Obituary.

George Walker Walker, A.R.C.Sc., M.A., F.R.S., formerly Superintendent of Eskdalemuir Observatory, died in University College Hospital on September 6th, 1921, at the age of 47, after a short illness.

After a brilliant academic career Walker was elected Fellow of Trinity College, Cambridge, in 1900, and appointed lecturer in Physics at Glasgow University. While holding that appointment he suffered from nervous breakdown and had to give up work for a time. In 1908 he was invited to accept the post of Superintendent of the new observatory then being built at Eskdalemuir for the National Physical Laboratory.

Walker was an enthusiastic and original worker and, in the four years during which he held the appointment, the scope of the Observatory developed rapidly, the transfer of the observatory to the administration of the Meteorological Office occurring in the middle of the period. Unfortunately, his health again became precarious at the end of 1912 and he had to resign his post. His most notable subsequent work was the magnetic re-survey of the British Isles, for the Royal Society. At the time of his death he was chief Scientist to the Royal Naval Training School, Portsmouth.

Walker's published work includes numerous papers on magnetics and on molecular physics. His book, *Modern Seismology*, published in 1913, which expresses his experience at Eskdalemuir, contains the standard account of seismological instruments.

Dr. Francis Edward Carey of Villa Carey, Guernsey, who died on October 1st at the great age of 86, was a remarkable figure among the many quietly unobtrusive meteorological observers who have made the standard of voluntary recording in this country so high. Dr. Carey came from a distinguished Guernsey family, and would undoubtedly have made a great name as a medical man but for his devotion to the island of his birth which he could never be brought to leave for any length of time. He commenced meteorological observations in St. Peter Port in 1880, and for more than 40 years maintained a daily register of sunshine, temperature and rainfall, taking the readings personally to the last in spite of his great age.

Review.

Bibliotheca Chemico-Mathematica: catalogue of works in many tongues on exact and applied science, with a subject index. Compiled and annotated by H.Z. and H.C.S. 2 vols. 127 pl. London: Sotheran & Co., 1921. Price, 3l. 3s.

THERE are few pleasanter ways of passing a spare half-hour than in turning over the pages of old scientific books, picking out the curious illustrations, and noting the development of ideas. Such pleasures are given in full measure by the catalogue of the scientific literature on their shelves which has been issued by Messrs. Sotheran in two handsome volumes. Looking at the catalogue as a price list from the meteorologist's point of view, it is of interest to notice that a set of the *Daily Weather Report* covering 22 years from 1872 is offered for 16 guineas; the publications of the *Royal Meteorological Society* for 46 years are offered for 15l.; and 30 volumes of *Symons's Meteorological Magazine* for 2 guineas. Amongst the illustrations are found pictures from very rare books; we may cite that of the first idea of a parachute, described by Veranzio, a Hungarian bishop, in a work published in 1595, and that of the first electric telegraph set up in 1816 by Sir Francis Ronalds, afterwards the first Superintendent of Kew Observatory for the British Association. The original picture of the wheel-barometer, invented by Robert Hooke, is reproduced from his work *Micrographia*, dated 1665.

From sundry bibliographical notes we learn that Turnor's *Astra Castra—Experiments and Adventures in the Atmosphere*, contains the best account of ballooning between 1783 and 1848, with the meteorological observations during the ascents, that the properties of the black bulb thermometer were discovered by Richard Watson in the middle of the 18th century, and that the first discovery of a freezing mixture was described by John Bate in *The Mysteryes of Nature and Art* in 1634, though credit for the invention is usually given to Robert Boyle, whose experiments were 33 years later.

Amongst Robert Boyle's own works one of the most inviting titles is *A Sceptical Dialogue about the Positive or Privative Nature of Cold*. Surely the invention of an absolute scale of temperature must have been foreshadowed.

In the index we find about 50 entries under *Meteorology*, but there are also about 30 for *Early Works on Meteorology*, three for *History of Meteorology* as well as cross references to *Air*, *Barometry*, *Climatology*, *Clouds*, &c., &c. Following up the cross reference to *Dew, Theory of*, we find six works. Of these the most important is Wells's *Essay on Dew* which

is to be had in the first edition for 2 guineas, but the others include Hamilton's *Essays* of 1772, about which the note runs: "Interesting for containing the Author's theory of dew and evaporation 'proceeding on a principle very different from any that has hitherto been used on this occasion, whereby I shall avoid those objections which later writers have made to the former accounts that have been given us of these Phænomena.'—Preface. It was unknown to G. J. Symons, F.R.S." Of Pictet's *Essay on Fire*, 1791, it is stated "The author found in the above work an explanation of the formation of dew by which he was able to explain a dew maximum on clear nights. His theory was completed in 1811 by Dr. W. C. Wells." Another of the references is to Prévost's *Du Calorique Rayonnant*, famous for the author's Theory of Exchanges and valuable "as having to some extent anticipated the theories of Dr. Wells."

Credit for the preparation of the *Bibliotheca Chemico-Mathematica* is given by his fellow compiler Mr. H. C. Sotheran to Heinrich Zeitlinger "an equal well-wisher of learning and of England." Both are to be thanked for a notable service to Science.

F. J. W. W.

News in Brief.

THE death on October 1st, 1921, is announced of *Dr. Julius von Hann*, of Vienna, in his 83rd year. The news will be received by meteorologists with deep regret.

The Report of morning observations at Health Resorts, which has been issued daily during the past summer, was discontinued after September 30th.

On September 27th, the "Further Outlook" of the *Daily Weather Report* included a forecast of fine weather for seven or ten days ahead, and on the 28th it was stated that the break-up of the conditions ensuring the fine spell was unlikely to occur within a fortnight. This is the longest range on record for an official forecast in this country.

A report from Dayton, Ohio, states that on September 28th Lieutenant John Macready broke the world's record for high flying. The reading of his altimeter reached 40,800 feet when his engine gave out and forced him to descend. Ice formed on the oxygen tank at 39,000 feet. Further details of this ascent are awaited with interest.

The Weather of September, 1921.

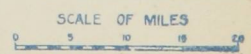
THROUGHOUT the greater part of September pressure was high over the British Isles and Southern Europe so that the month was, in the main, fine, warm and dry. At the end of August there was a depression off the west of Ireland, and as this depression moved towards the Baltic there were heavy local rains with some thunderstorms in northern districts. On the 4th a fresh depression appeared off Iceland and a shallow "low" covered Central Europe.

The southern districts, however, experienced fine weather from the 4th of the month; high day temperatures were recorded, 80° F. being general over south and south-east England, France and Spain. In England there was morning mist and the nights were often cold, ground frost occurred locally on the 4th and at inland stations the daily range at times exceeded 40° F.

The anticyclone over these southern districts began slowly to withdraw eastwards, from the 7th, while the Icelandic depression deepened and spread southwards. On the 9th, the temperature again exceeded 80° F. generally in England, France, Germany and Holland and local thunderstorms were experienced. In south and south-east England the night of the 9th-10th was unusually warm, temperature remaining over 60° F. generally, but the following day there was a very marked drop in temperature amounting to 15° or 18°. The northerly current did not reach as far as France or Germany, however, and in those countries temperature remained high on this day.

On the 11th a very deep secondary appeared to the south of Ireland. It passed rapidly up the Channel causing heavy gales and severe thunderstorms over a large area. London received 50 mm. of rain, Belfast 70 mm. and Berne 60 mm. This was the only occasion during the month when there was heavy precipitation in the British Isles outside the more northerly districts. From the 12th to the 17th a series of depressions occurred. One off the west of Ireland brought further rain to that country and gales again in the Channel. Another was in the neighbourhood of the Azores on the 14th and yielded heavy rain—80 mm. being reported from Madeira and 60 mm. from Ponta Delgada; while on the 16th and 17th a shallow depression moving northwards from Spain caused strong easterly gales in the Channel and a thunderstorm at Jersey with 22 mm. of rain.

THAMES VALLEY RAINFALL — SEPTEMBER, 1921.



Watershed of River Thames above Taddington, and River Lea above Taddington.

Isohyets.

On the morning of the 18th pressure rose to 1040 mb. over the Skagerrak and by the 20th the conditions over England and Europe generally were anticyclonic, the area of high pressure being very large and stretching from Russia to beyond the west coast of Ireland. Occasional depressions in the neighbourhood of Iceland passed to the north of the British Isles but fair, quiet weather prevailed until the end of the month. Morning mist and fog were prevalent, especially in south and south-east England, and on the 19th a dense low gloom was experienced over a wide area, in London continuing nearly all day, while on the 22nd thick fog was experienced all day at Scilly and Pembroke. Otherwise, the days were warm and sunny, the nights cold and sometimes frosty. In England ground frosts were reported locally towards the end of the month, and in Scandinavia the night of the 20th was characterised by a sharp frost.

Very heavy rain fell during the 17th to 19th over the Department of Corrèze, France. Severe floods resulted, and the Murat viaduct was swept away.

The olive harvest in the districts of Languedoc and Provence was the finest for many years as a result of the hot summer and subsequent rainfall.

A thunderstorm of exceptional violence broke over Rome on the evening of the 22nd and on the next day a violent storm visited Sicily doing considerable damage, especially at Syracuse and Palermo, both to vessels and on shore. These storms were associated with a very irregular distribution of the isobars to the east of, and between, a region of low pressure over Southern Spain and Northern Africa, and a region of high pressure over Southern England and Northern France.

In South Africa the worst blizzard for many years was experienced between the 8th and the 10th. Railway and other services were disorganized.

The Indian monsoon was weak at the beginning of the month, but a message dispatched from Simla on the 21st stated that owing to recent rain all anxiety as regards the monsoon in Bombay and the Deccan had been removed.

Heavy rain and snow stopped all harvesting operations in Saskatchewan early in the month, and Manitoba also had heavy rain but without frost. On the last day of the month a very severe storm passed over Ontario and Quebec with much resulting damage to property.

There has been excellent rain throughout the settled areas of South Australia and many districts anticipate a record harvest.

(Continued on p. 276.)

Rainfall Table for September 1921.

STATION.	COUNTY.	Aver. 1881— 1915.	1921.		Per cent. of Av.	Max. in 24 hrs.		No. of Rain Days.
			in.	mm.		in.	Date.	
Camden Square.....	London	1·82	2·50	63	137	1·95	11	6
Tenterden (View Tower)....	Kent	2·14	·62	16	29	·47	11	
Arundel (Patching Farm) ..	Sussex	2·40	·72	18	30	·66	11	4
Fordingbridge (Oaklands) ..	Hampshire ..	2·15	·91	23	42	·72	11	8
Oxford (Magdalen College) ..	Oxfordshire ..	1·68	1·67	42	99	1·09	11	8
Wellingborough (Swanspool)	Northampton	1·80	1·03	26	57	·55	11	5
Hawkedon Rectory	Suffolk	1·93	1·45	37	75	·97	11	4
Norwich (Eaton)	Norfolk	2·14	1·31	33	61	·68	11	8
Launceston (Polapit Tamar)	Devon	2·80	1·37	35	49	·41	17	9
Sidmouth (Sidmount)	"	2·30	·61	15	..	·51	11	5
Ross (County Observatory) ..	Herefordshire	2·02	1·60	41	79	1·04	11	7
Church Stretton (Wolstaston)	Shropshire ..	2·03	·84	21	41	·34	12	7
Boston (Black Sluice)	Lincoln	1·76	·68	17	39	·37	12	7
Worksop (Hodsock Priory) ..	Nottingham ..	1·52	·61	16	40	·22	12	6
Mickleover Manor	Derbyshire ..	1·79	1·17	30	65	·58	12	6
Southport (Hesketh Park) ..	Lancashire ..	2·75	1·83	47	67	·43	13	9
Harrogate (Harlow Moor Ob.)	York, W. R. ..	1·92	·92	23	48	·38	13	9
Hull (Pearson Park)	" E. R.	1·72	·61	15	35	·30	13	5
Newcastle (Town Moor) ..	Northland ..	2·04	1·17	30	57	·80	13	8
Borrowdale (Seathwaite) ..	Cumberland ..	9·92	3·25	83	33	..	..	..
Cardiff (Ely Pumping Stn.) ..	Glamorgan ..	3·10	3·60	89	113	1·22	11	9
Haverfordwest (Gram. Sch.) ..	Pembroke ..	3·55	1·82	46	51	1·05	12	6
Aberystwyth (Gogerddan) ..	Cardigan ..	3·64	1·74	44	48	·72	11	5
Llandudno	Carnarvon ..	2·28	1·89	48	83	·90	11	8
Dumfries (Cargen)	Kirkcudbrt. ..	2·94	2·25	57	77	1·11	13	10
Marchmont House	Berwick	2·41	·48	12	20	·21	1	5
Girvan (Pinmore)	Ayr	3·83	2·74	70	72	·92	13	16
Glasgow (Queen's Park)	Renfrew	2·77	2·06	52	74	·67	13	11
Islay (Eallabus)	Argyll	4·18	2·54	65	61	·49	10	18
Mull (Quinish)	"	4·79	3·47	88	72	·42	13	23
Loch Dhu	Perth	5·73	4·70	119	82	1·70	10	11
Dundee (Eastern Necropolis)	Forfar	2·08	1·71	43	82	·86	13	13
Braemar (Bank)	Aberdeen ..	2·52	1·18	30	47	·45	13	9
Aberdeen (Cranford)	"	2·34	1·09	28	47	·40	13	13
Gordon Castle	Moray	2·50	1·18	30	47	·15	12*	14
Fort William (Atholl Bank) ..	Inverness ..	6·28	5·49	139	87	·95	10	22
Alness (Ardross Castle)	Ross	2·92	1·65	42	54	·31	1	19
Loch Torridon (Bendamph) ..	"	6·95	5·38	137	77	1·01	10	19
Stornoway	"	3·95	4·64	118	117	1·22	3	22
Loch More (Achfary)	Sutherland ..	5·75	8·66	220	151	3·32	3	24
Wick	Caitness	2·50	3·18	81	127	·89	15	21
Glanmire (Lota Lodge)	Cork	2·80	1·20	31	43	·43	9	8
Killarney (District Asylum)	Kerry	3·58	1·88	48	52	·52	11	13
Waterford (Brook Lodge) ..	Waterford ..	2·77	1·26	32	45	·53	9	7
Nenagh (Castle Lough)	Tipperary ..	2·81	1·72	44	61	·43	12	13
Ennistymon House	Clare	3·85	2·91	74	76	·72	13	12
Gorey (Courtown House)	Wexford	2·47	1·01	26	41	·40	12	7
Abbey Leix (Blandsfort) ..	Queen's Co. ..	2·72	1·65	42	61	·50	9	8
Dublin (Fitz William Square)	Dublin	1·92	1·33	34	69	·61	12	7
Mullingar (Belvedere)	Westmeath ..	2·67	1·08	27	40	·90	12	7
Woodlawn	Galway	3·10	1·91	49	62	·67	13	16
Crossmolina (Enniscooe)	Mayo	3·92	1·49	38	38	·33	12	15
Collooney (Markree Obsy.) ..	Sligo	3·39	1·42	36	42	·34	19	12
Seaforde	Down	2·75	1·69	43	61	·89	13	6
Ballymena (Harryville)	Antrim	3·11	1·53	39	49	·44	12	16
Omagh (Edenfel)	Tyrone	3·05	1·59	40	52	·52	13	11

* Also 13 and 14.

Supplementary Rainfall, September 1921.

Div.	STATION.	RAIN.		Div.	STATION.	RAIN.	
		in.	mm.			in.	mm.
II.	Ramsgate	·63	16	XII.	Langholm, Drove Rd.	2·32	59
"	Sevenoaks, Speldhurst	1·21	31	XIII.	Ettrick Manse	2·98	76
"	Hailsham Vicarage...	·58	15	"	North Berwick Res. ...	1·39	35
"	Totland Bay, Aston ..	·71	18	"	Edinburgh, Royal Ob.	1·60	41
"	Ashley, Old Manor Ho.	·94	24	XIV.	Biggar.....	1·52	39
"	Grayshott.....	·94	24	"	Leadhills	2·88	73
"	Ufton Nervet.....	2·33	59	"	Maybole, Knockdon ..	..	..
III.	Harrow Weald, Hill Ho.	2·62	67	XV.	Dougarie Lodge.....	2·29	58
"	Pitsford, Sedgebrook'..	1·14	29	"	Inverary Castle.....	6·76	172
"	Chatteris, The Priory.	·78	20	"	Holy Loch, Ardnadam	4·03	102
IV.	Elsenham, Gaunts End	1·84	47	XVI.	Loch Venachar	3·05	77
"	Lexden, Hill House ..	2·69	68	"	Glenquoy Reservoir ...	3·00	76
"	Aylsham, Rippon Hall	·95	24	"	Loch Rannoch, Dall...	2·15	55
"	Swaffham.....	1·14	29	"	Blair Atholl Gardens ..	1·81	46
V.	Devizes, Highclere ...	1·83	47	"	Coupar Angus.....	1·95	49
"	Weymouth.....	·71	18	"	Montrose Asylum	1·24	31
"	Ashburton, Druid Ho.	1·20	30	XVII.	Logie Coldstone, Loanh'd	·97	25
"	Cullompton	·94	24	"	Fyvie Castle.....	1·30	33
"	Hartland Abbey	2·30	58	"	Grantown-on-Spey ...	1·27	32
"	St. Austell, Trevarna .	1·13	29	XVIII.	Cluny Castle	2·65	67
"	North Cadbury Rec. .	1·39	35	"	Loch Quoich, Loan ...	14·40	366
"	Cutcombe, Wheddon Cr.	2·90	74	"	Fortrose	6·7	17
VI.	Clifton, Stoke Bishop.	4·07	103	"	Faire-na Squir.....	5·50	140
"	Ledbury, Underdown.	1·21	31	"	Skye, Dunvegan	3·53	91
"	Shifnal, Hatton Grange	·54	14	"	Glencarron Lodge.....	6·85	174
"	Ashbourne, Mayfield .	1·18	30	"	Dunrobin Castle	1·94	49
"	Barn Green, Upwood	·99	25	XIX.	Tongue Manse	4·59	117
"	Blockley, Upton Wold	1·70	43	"	Melvich Schoolhouse ..	3·98	101
VII.	Grantham, Saltersford	·56	14	XX.	Dunmanway Rectory..	2·74	70
"	Louth, Westgate	·47	12	"	Mitchelstown Castle...	1·94	49
"	Mansfield, West Bank	·89	23	"	Gearahameen	3·90	99
VIII.	Nantwich, Dorfold Hall	·73	19	"	Darrynane Abbey	1·49	38
"	Bolton, Queen's Park.	1·35	34	"	Clonmel, Bruce Villa ..	1·47	37
"	Lancaster, Strathspey.	2·21	56	"	Cashel, Ballinamona...	1·61	41
IX.	Rotherham.....	..	..	"	Roscrea, Timoney Pk..	1·27	32
"	Bradford, Lister Park.	1·13	29	"	Foynes.....	1·74	44
"	West Witton.....	..	..	"	Broadford, Hurdlesto'n	2·09	53
"	Scarborough, Scalby..	1·11	28	XXI.	Kilkenny Castle.....	1·31	33
"	Middlesbro', Albert Pk.	·63	16	"	Rathnew, Clonmannon	1·26	32
"	Mickleton.....	1·40	36	"	Hacketstown Rectory ..	1·44	37
X.	Bellingham	1·88	48	"	Balbriggan, Ardgillan .	1·54	39
"	Ilderton, Lilburn	1·44	37	"	Drogheda	1·44	37
"	Orton.....	2·49	63	"	Athlone, Twyford	1·46	37
XI.	Llanfrechfa Grange ..	2·68	68	XXII.	Castle Forbes Gdns....	1·40	36
"	Treherbert, Tyn-y-waun	4·79	122	"	Ballynahinch Castle...	1·63	41
"	Carmarthen Friary	2·10	53	"	Galway Grammar Sch.	1·99	51
"	Llanwrda, Dolaucothy	2·61	66	XXIII.	Westport House	1·83	47
"	Lampeter, Falcondale	1·86	47	"	Enniskillen, Portora...	1·40	36
"	Cray Station	3·50	89	"	Armagh Observatory ..	1·24	31
"	B'ham W.W., Tyrmyndd	1·80	46	"	Warrenpoint	1·55	39
"	Lake Vyrnwy.....	2·31	59	"	Belfast, Cave Hill Rd..	1·73	45
"	Llangynhafal, P. Drâw	·72	18	"	Glenarm Castle	1·69	43
"	Oakley Quarries	4·43	113	"	Londonderry, Creggan.	1·85	47
"	Dolgelly, Bryntirion..	2·45	62	"	Sion Mills.....	1·42	36
"	Lligwy	1·53	39	"	Milford, The Manse ...	1·73	44
XII.	Stoneykirk, Ardwell Ho.	1·82	46	"	Narin, Kiltorish	1·99	51
"	Carsphairn, Shiel.....	3·73	95	"	Killybegs, Rockmount .	2·47	63

Climatological Table for the

STATIONS	PRESSURE		TEMPERATURE							
	Mean M.S.L.	Diff. from Normal	Absolute				Mean Values			
			Max.	Date	Min.	Date	Max.	Min.	1 st max. and 2 nd min.	Diff. from Normal
	mb.	mb.	° F.		° F.		° F.	° F.	° F.	° F.
London, Kew Observatory	1020.0	+6.1	70	28	32	20	56.8	39.7	48.3	+1.0
Gibraltar	1015.2	-0.1	74	24, 30	48	1, 10	67.1	53.2	60.1	-0.7
Malta	1011.7	-0.8	65	20	51	4, 7	62.9	52.0	57.5	-2.2
Sierra Leone	1011.2	+0.2	94	11	68	2, 7, 11	89.9	71.8	80.9	-1.9
Lagos, Nigeria	1011.2	+1.4	99	16	72	16	84.1	76.9	80.5	-1.8
Kaduna, Nigeria	1012.8	+4.5	102	1	64	24	92.0	71.3	81.7	-0.8
Zomba, Nyasaland	1013.2	+1.3	83	5, 24	53	28	76.7	60.3	68.5	-0.8
Salisbury, Rhodesia	1013.3	-1.1	82	1, 2	46	27	78.1	53.6	65.9	0.0
Cape Town	1016.4	+0.1	94	18	40	27	74.3	53.4	63.9	+0.8
Johannesburg	1017.6	+0.9	74	13	40	24	68.5	49.6	59.1	-0.5
Mauritius .....	..	..	..	..	..	..	..	..	..	..
Bloemfontein .....	..	..	78	18	35	28	71.4	48.4	59.9	-0.9
Calcutta, Alipore Obsy... ..	1007.0	+0.7	101	1	71	22	94.4	76.2	85.3	-0.4
Bombay	1008.3	-0.3	96	29	75	1	90.9	78.9	84.9	+1.8
Madras	1008.4	+0.2	96	22, 23	73	17	92.5	78.2	85.4	+0.1
Colombo, Ceylon	1009.9	+0.8	90	28	73	5	87.9	75.5	81.7	-1.0
Hong Kong	1013.3	+0.7	85	27	61	8	76.4	68.7	72.5	+1.6
Sydney	1018.7	+0.4	84	15	51	11	73.5	58.8	66.1	+1.7
Melbourne	1019.4	+0.3	82	3, 14	41	27	69.4	50.8	60.1	+0.6
Adelaide	1020.5	+0.7	86	29	49	10	74.2	54.6	64.4	+0.6
Perth, Western Australia ..	1020.2	+1.8	87	12	49	20	76.2	57.1	66.7	+0.4
Coolgardie	1019.2	+0.7	96	18	45	21	80.1	53.6	66.9	+1.8
Brisbane	1017.7	+0.4	86	7	57	21	78.0	63.2	70.6	+0.2
Hobart, Tasmania	1015.1	+0.7	76	14	40	6, 9	64.0	47.8	55.9	+0.8
Wellington, N.Z.	1018.5	+0.7	69	9	37	28	62.0	47.1	54.5	-2.3
Suva, Fiji	1012.6	+2.0	89	17	68	16	85.8	71.6	78.7	0.0
Kingston, Jamaica	1014.8	+0.5	91	1	67	28	86.8	69.9	78.3	-0.1
Grenada, W.I.	1013.2	+0.6	87	14	71	Sev.	83.8	72.9	78.3	-0.5
Toronto	1016.4	+0.9	75	5	26	1	58.3	40.3	49.3	+7.9
Winnipeg	1015.3	-1.7	70	18	16	8	47.5	28.8	38.1	+0.3
St. John, N.B.	1018.6	+5.0	75	28	20	7	49.7	34.7	42.2	+3.2
Victoria, B.C.	1018.1	+0.8	66	9	32	3	53.1	40.0	46.5	-1.2

LONDON, KEW OBSERVATORY.—Mean speed of wind 8.0 mi/hr., 3 days with snow, 2 days with hail, 4 days with thunder heard, 5 days with fog.

MALTA.—Prevailing wind direction NW, mean speed 10.7 mi/hr.

GIBRALTAR.—2 days with thunder heard.

SIERRA LEONE.—Prevailing wind direction SW, 5 days with thunder heard.

MAURITIUS :—

November 1920 ..	1015.4	-0.7	86	..	60	..	82.6	66.6	74.6	-0.9
December 1920...	1014.2	+0.2	90	29	64	5	84.6	71.1	77.9	-0.4
Year 1920	1016.2	+0.1	91	Jan.20	52	July28	80.0	66.5	73.2	-0.8

November.—Prevailing wind direction E, mean speed 8.2 mi/hr.

December.—Prevailing wind direction E, mean speed 8.0 mi/hr.

British Empire, April 1921.

TEMPERATURE		Relative Humidity	Mean Cloud Am't	PRECIPITATION				BRIGHT SUNSHINE		STATIONS
Mean	Absolute			Amount		Diff. from Normal	Days	Hours per day	Per-cent- age of possi- ble	
Wet Bulb.	Min. on Grass									
° F.	° F.	%	0-10	in.	mm.	mm.				
45.0	22	69	4.9	1.06	27	- 10	7	6.5	47	London, Kew Observatory.
55.8	45	76	3.5	2.94	75	+ 7	5	..	..	Gibraltar.
..	..	79	5.8	2.41	61	+ 41	5	6.8	52	Malta.
75.9	..	69	4.5	1.45	37	- 68	5	..	..	Sierra Leone.
80.5	63	83	7.5	4.81	122	- 27	13	..	..	Lagos, Nigeria.
74.3	..	80	..	4.05	103	+ 35	5	..	..	Kaduna, Nigeria.
..	..	87	6.1	5.22	133	+ 28	13	..	..	Zomba, Nyasaland.
58.5	42	61	4.6	0.62	16	- 10	6	..	..	Salisbury, Rhodesia.
58.4	..	64	4.2	1.50	38	- 13	6	..	..	Cape Town.
51.4	35	71	4.7	0.72	18	- 34	7	8.3	73	Johannesburg.
..	..	..	..	..	..	..	..	..	..	Mauritius.
53.1	..	78	4.1	2.05	52	- 2	8	..	..	Bloemfontein.
79.1	64	56	2.4	2.85	72	+ 28	8	..	..	Calcutta, Alipore Obsy.
77.6	67	68	1.7	0.00	0	- 2	0	..	..	Bombay.
78.3	..	77	4.5	1.99	51	+ 36	5	..	..	Madras.
78.7	70	71	6.5	8.97	228	- 24	22	..	..	Colombo, Ceylon.
68.0	..	81	8.1	2.82	72	- 68	5	4.2	33	Hong Kong.
62.5	45	75	5.1	5.77	147	+ 8	8	5.5	49	Sydney.
55.8	37	65	5.5	0.60	15	- 43	10	..	..	Melbourne.
56.5	34	55	4.6	0.45	11	- 36	5	6.3	57	Adelaide.
60.7	39	60	3.5	0.83	21	- 20	4	..	..	Perth, Western Australia.
59.7	38	45	3.3	0.16	4	- 20	1	..	..	Coolgardie.
66.5	54	75	4.6	8.06	205	+112	20	..	..	Brisbane.
50.0	34	64	6.1	1.43	36	- 12	13	5.4	50	Hobart, Tasmania.
50.0	27	71	5.6	1.41	36	- 63	7	6.1	56	Wellington, N.Z.
73.2	..	85	..	25.62	651	+364	19	..	..	Suva, Fiji.
..	..	73	6.2	1.71	43	+ 12	9	..	..	Kingston, Jamaica.
73.1	..	71	4.4	1.82	46	- 14	13	..	..	Grenada, W.I.
43.7	23	77	4.8	4.89	124	+ 63	11	..	..	Toronto.
34.2	..	77	4.4	1.86	47	+ 9	8	..	..	Winnipeg.
37.7	19	83	6.3	4.39	112	+ 23	17	..	..	St. John, N.B.
42.1	26	75	6.0	1.13	29	- 15	13	..	..	Victoria, B.C.

MADRAS.—4 days with thunder heard.

COLOMBO, CEYLON.—Prevailing wind direction SW ; mean speed 3.7 mi/hr ; 4 days with thunder heard.

HONG KONG.—Prevailing wind direction E ; mean speed 10.6 mi/hr ; 1 day with thunder heard, 5 days with fog.

GRENADA. — Prevailing wind direction E.

										MAURITIUS :—
..	..	68	5.3	0.41	10	- 30	8	9.5	73	November 1920.
..	60	71	5.9	2.08	53	- 67	18	8.8	66	December 1920.
..	63	75	6.0	50.37	1279	+ 18	228	7.7	64	Year 1920.

Year.—Prevailing wind direction ESE ; mean speed 7.8 mi/hr ; 13 days with thunder heard.

During the middle of the month warm and dry weather prevailed over the cotton belt of the United States, but the crop shows further deterioration. On the 10th a severe flood destroyed a large part of San Antonio, Texas, with heavy loss of life.

A typhoon passed over Western Honshin (Japan) about the 27th with much damage to property and loss of life.

The rainfall of the month was below the average over practically the whole of the British Isles. Less than half the average occurred south of a line from roughly Launceston to Canterbury, and over the greater part of England and Wales north of a line from near Aberystwyth to the Wash. More than the average occurred in the extreme south of Wales and over most of the Thames Valley. In Scotland less than half the average fell along the east coast, while in the extreme north-west more than the average fell. Less than 50 per cent. occurred in Ireland along the north-west and south coasts. The rainfall in Ireland nowhere reached the average, approaching it most closely in the central plain. Areas with less than 25 mm. (1 in.) were confined almost entirely to England, especially along the south and east coasts, and on the Welsh border. In south Midlands more than 50 mm. (2 in.) fell over a broad band from Marlborough to Felixstowe, mainly as a result of the thunderstorm of the 11th when from 25–50 mm. (1–2 in.) fell over practically the whole of the Thames Valley. More than 100 mm. (4 in.) for the month fell locally in the wet districts of Wales, the English Lake District and the mountains of Kerry, but in Scotland the area with 4 in. was considerable, stretching from Dumbarton to Cape Wrath. More than 250 mm. (10 in.) occurred at Loch Quoich. On the 3rd heavy rain fell locally in the north-west of Scotland as much as 84 mm. (3·32 in.) being registered at Loch More (Achfary).

For the eight months February to September a considerable area in the south-east of England has had less than half the average rainfall. At Patching near Arundel only 44 per cent. of the average of this period fell.

The general rainfall for September, expressed as a percentage of the average, was:—England and Wales, 54; Scotland, 81; Ireland, 53; British Isles, 64.

In London (Camden Square) the mean temperature was 60·5° F., or 2·8° F. above the average. This was the thirteenth successive month with mean temperature in excess of the average of the 60 years 1860–1919. Duration of rainfall, 20·0 hours; evaporation, 1·72 inches.