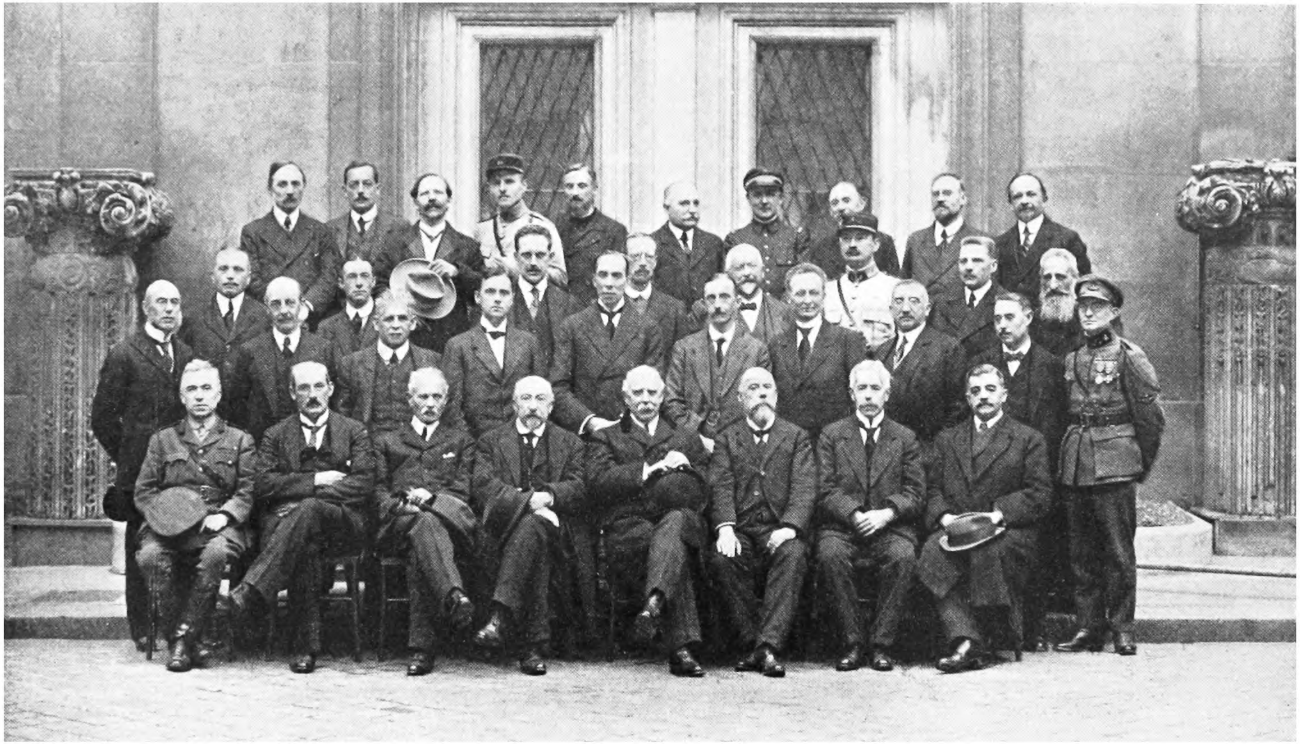
INTERNATIONAL METEOROLOGICAL CONFERENCE. PARIS, OCTOBER, 1919.



Reading from the top.

Goreczynski, Poland. Mercanton, Switzerland. le Quervain, Switzerland. Lt. Bureau, France. Combier, Syria. Dongier, France. Lt. de V. Rouch, France. Mathias, France. Rothé, Alsace. Lasserre, Algeria.

Eginitis, Greece. H. Knox Shaw, Egypt. Krogness, Norway. Capt. A. J. Bamford, Ceylon. Lebeug, France. Capt. Franck, France. Jacobs, Belgium. R. P. Berloty, Syria.

Coculesco, Roumania. G. T. Walker, India. A. Hunt, Australia. Hesselburg, Norway. Lt. H. D. Grant, Great Britain. C. Stewart, South Africa. V. Bjerknes, Norway. J. Galbis, Spain. E. Fontséré, Spain. Capt. Jaumotte, Belgium.

Lt.-Col. D. C. Bates, New Zealand. Wallén, Sweden. Sir F. Stupart, Canada. A. Angot, France. Sir Napier Shaw, Great Britain. L. Palazzo, Italy. Van Everdingen, Holland. Capt. Ryder, Denmark.

The Meteorological Magazine

Vol. 55

(First of the New Series)

1920

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Air Ministry. Meteorological Office.

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1922

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ERRATA.

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7 The Highest Gust on Record, *after* "very" *read* "edge."

41 Meteorological Stations, *for* "Norfolk, Howden" *read* "Yorks, Howden."

49 Winter in Tristan da Cunha, table, *for* "1896" *read* "1816."

67 Formula for Rising Velocity of Pilot Balloons, *for* "September 1919" *read* "September 1918."

91 Thunderstorm Days, *for* "March 6th" *read* "May 6th."

214 Discussion at the Meteorological Office, footnote, *for* "January 24th" *read* "June 24th."

218 For temperature at Woburn *see* p. 258.

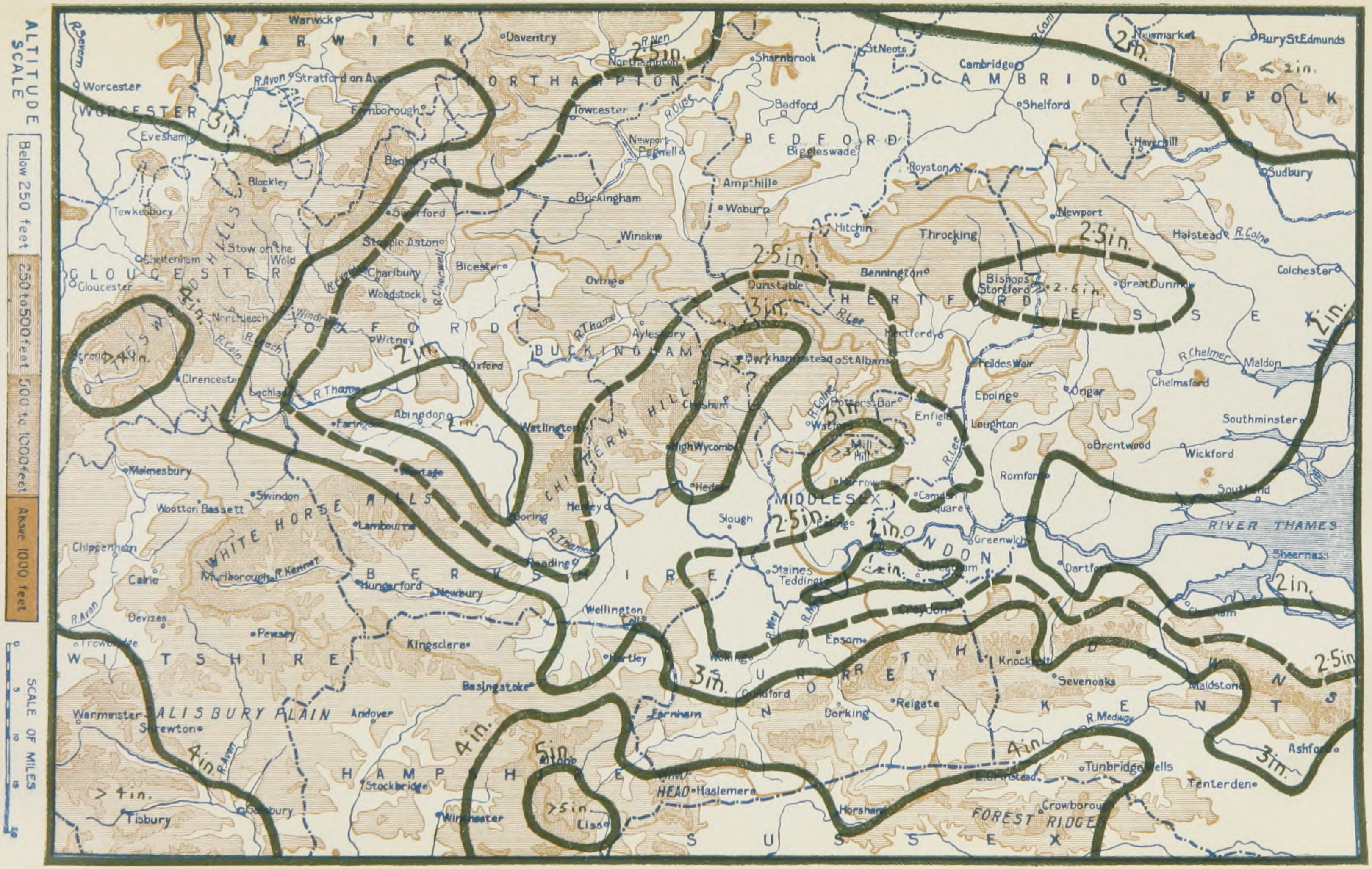
236 Duration of Rainfall at Camden Square, *for* "22·6" *read* "26·5."

276 Line 4, *for* "vertical" *read* "vortical."

277 The Rainfall of 1920, heading, *delete* "Official Publications."

287 Evaporation at Camden Square, *for* "·4 in." *read* "·00 in."

THAMES VALLEY RAINFALL. JANUARY, 1926.



Symons's Meteorological Magazine.

Watershed of River Thames above Teddington, and River Lee above Feildes Weir.

Isohyetals

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Vol. 55

February :: 1920 ::

No. 649

Air Ministry :: Meteorological Office

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Introductory Note.

WITH the first issue of *The Meteorological Magazine* as the official organ of the Meteorological Office, a few words of introduction may be desirable. Since 1916 the Office has issued each month a Circular, which has been found of value for the publication of official information and for the exchange of opinions on current meteorological topics. On the absorption of the British Rainfall Organization, the Office became respoisible for the continuance of *Symons's Meteorological Magazine*, which had been closely associated with that Organization throughout its long history. The continued existence of two separate publications was obviously undesirable, and the *Meteorological Magazine* is to be issued instead. For convenience in reference the serial numbers of *Symons's Meteorological Magazine* are being carried on.

With regard to the *Meteorological Office Circular* it may be noted that a classified index has been prepared. Typed copies of convenient size for binding will be supplied on application to the Office.

Contributions to the *Meteorological Magazine* from Observers and others who take an interest in the weather will be welcomed by the Editors, to whom they should be sent not later than the 5th of the month.

Shackleton's Last Expedition.

A Review by R. C. MOSSMAN, F.R.S.E.

IN this book Sir Ernest Shackleton gives a vivid and soul-stirring account of the adventures on two sides of Antarctica of the British Expedition of 1914-17. The main object of Shackleton's venture, it may be recalled, was the crossing of the Antarctic Continent from the head of Weddell Sea to McMurdo Sound taking the South Pole on the way As Vaksel Bay, the contemplated point of departure, on the Weddell Sea side, was in lat. 78° S., the same latitude as McMurdo Sound, in the Ross Sea area, a distance of at least 1,440 miles had to be crossed, without allowing for relays and unavoidable detours which might easily add an extra 400 miles to the journey. A line of depôts over the Ross Barrier as far as the Beardmore Glacier in lat. 83° S. was necessary, so that the trans-antarctic party might be assured of adequate food supplies towards the end of their long march.

To accomplish this task a subsidiary expedition under Captain Mackintosh, went down to McMurdo Sound in the *Aurora*, which, however, broke adrift from her ice moorings close to the shore, and, after a perilous voyage (if such a term can be applied to a ship, frozen up and a plaything of winds and currents), reached New Zealand, thanks to the fine seamanship of Captain Stenhouse, after a besetment of ten months. The stranded party, deprived of much essential gear, carried out successfully the laying of the depôts, although under conditions of unprecedented difficulty and hardship. Scurvy developed, and one member, Spencer Smith, broke down and died, after having been dragged for forty days on a sledge. Later on, the leader of the party, Captain Mackintosh, and his companion, Hayward, lost their lives through an error of judgment, being overtaken by a blizzard while on sea ice between Hut Point and Cape Evans.

Meanwhile the main expedition on the *Endurance* was having a series of misadventures in Weddell Sea of an even more varied and perilous description, although fortunately unattended by any casualty. The main pack was met with on 11th December, 1914, before the 60th parallel was reached, and for five weeks the vessel made slow progress south. In the middle of January, 1915, a long continued north-east gale packed the ice in the southern bight of Weddell Sea, the temperature fell, and on January 19th, the ship was closely beset in lat. 76° 34′ S., about 80 miles off the desired haven. There was no open water in sight, and no later improvement in the conditions took place owing to the severe cold throughout February, whose mean temperature of 7° F. was 4° lower than the previous Antarctic record for this month at sea level. The *Endurance* continued to drift first to the south-west and then in a zig-zag northerly direction until overwhelmed by ice pressure on October 27th, 1915, nearly 600 miles (as the skua flies) from the point where she was imprisoned. The subsequent adventures of the party and their miraculous deliverance after a drift of five and a half months on floating ice, followed by a miserable existence on a desolate ice-swept island for four months, are graphically described by Sir Ernest Shackleton and Frank Wild to whose almost superhuman courage and resource the party as a whole owe their lives. Shackleton's great 800 mile journey through the sub-antarctic ocean in a 22 foot boat at a season of the year when its mood was at the worst, was a remarkable feat of endurance and skilful navigation, to the success of which Captain Worsley's faculty of snapping positions under almost impossible conditions largely contributed. The first crossing of the South Georgia glaciers in a thirty-six hours' march is also worthy of mention. The account of the four midwinter voyages, in small unprotected vessels, through Cape Horn seas encumbered with ice, to relieve the men on Elephant Island, is modestly told. Only those who have had practical experience of the fearful conditions that prevail when a heavy sea rolls down on the pack edge, with its chaos of jostling ice blocks, can adequately appreciate the frequent desperate situations, so successfully overcome. There is little of a scientific nature in the book, but readers of this magazine will find in the appendices preliminary reports dealing with various aspects of the physical conditions in Weddell Sea, along with an admirable account of South Atlantic whaling, now of such economic importance.

The climatic features of Weddell Sea are described in general terms by Mr. Hussey. Summer was the cloudiest and winter the clearest time. The weather experienced on Elephant Island is described as "appalling," and is evidently much the same as at the South Orkneys. The autographic meteorological records, including traces from a Dines anemometer, went down with the *Endurance*, but the logs containing four-hourly observations of the principal climatic elements have been brought home intact. During the drift on the floe and at Elephant Island, less complete information is available, but the wonder is that so much was effected under such trying circumstances. The meteorological work seems to have been maintained throughout with much care and zeal, and it is fortunate that it will be possible to co-ordinate the data with those for sub-antarctic stations, such as Laurie Island, South Georgia, New Year Island, the Falklands, and for stations on the mainland of the south of South America. The lowest temperature observed was

–35° F., but the outstanding feature seems to have been the remarkable coldness of the summer and early autumn. Towards the end of February, a minimum of —16° F. was recorded, and on March 6th the thermometer fell to —21° F., so that, as in the Ross Sea area, the cold snaps that occur in the "fall" are much more striking than those of winter. It is of interest to note that for the first time in the Weddell Sea area several faint auroras were observed.

No reference is made in the book to any systematic scientific work having been effected by the McMurdo Sound party.

South.—The Story of Shackleton's Last Expedition, 1914-17. By Sir Ernest Shackleton, C.V.O. London: William Heinemann, pp. xxix 376. 82 Illustrations and Map. Price 25s.

Royal Meteorological Society.

THE Annual General Meeting was held on January 21st, in the rooms of the Royal Astronomical Society, Burlington House, W., Sir Napier Shaw, F.R.S., President, in the chair. The report of the Council for 1919 was read and adopted. The increased interest in meteorology is reflected in a continued growth of the Fellowship. During the year, 97 new Fellows were elected and the total number of Fellows now stands at 820. The inadequate accommodation of the present premises has long been recognized, and the transfer of the library and staff to more suitable and commodious premises in Grosvenor Gardens is foreshadowed. The Council for 1920 were duly elected as follows :—*President:* R. H. Hooker, ; *Vice-Presidents:* Joseph Baxendell, Francis Druce, Sir Napier Shaw, D.Sc., LL.D., F.R.S. ; F. J. W. Whipple. *Treasurer:* W. Vaux Graham ; *Secretaries:* W. W. Bryant, J. S. Dines ; *Foreign Secretary:* R. G. K. Lempfert, C.B.E. ; *Councillors:* C. E. P. Brooks, John Brownlee, M.D., D.Sc., Capt. C. J. P. Cave, R.E., J. E. Clark, Richard Corless, O.B.E., Capt. G. M. B. Dobson, James Fairgrieve, Lieut. H. D. Grant, R.N.V.R., Henry Mellish, C.B., D.L., J. E. Petavel, D.Sc., F.R.S., M. de Carle S. Salter, G. I. Taylor, F.R.S. The Symons Gold Medal, awarded to Prof. H. H. Hildebrandsson, of the University, Upsala, was presented to the Swedish Minister, on his behalf, the President taking the opportunity to pay a warm tribute to the attainments and to the personal charm of the Professor.

Sir Napier Shaw delivered an address on "Pioneers in the Science of the Weather," which was preceded by a sketch of the history of the Meteorological Office, in which the year 1919 marked such an important epoch. The address will be printed in the *Quarterly Journal* of the Society.

The following candidates were balloted for and elected Fellows of the Society:—Mr. H. W. Baker, Mr. W. R. Ballinger, Lieut. F. O. Bassett, Mr. J. H. Bassett, Mr. J. E. Belasco, B.Sc., Mr. L. H. G. Dines, M.A., Mr. O. Henrichsen, Mr. J. Leahy, Mr. G. F Morton and Mr. J. S. Samson.

Obituary.

Mr. Thomas W. Baker, late Chief Assistant at Kew Observatory, died at Sheen on January 28th. Mr. Baker, who retired in 1912, after fifty-three years' service, joined the staff of the Observatory as a boy in 1860. He occupied the position of Chief Assistant for a period of thirty-seven years, during which time he was responsible for most of the magnetic observations as well as for the testing of sextants and other optical instruments.

We hear, with deep regret, of the sudden death, on January 24th, of *Mr. R. F. Wallace,* whose retirement from the staff of the Meteorological Office, after thirty-seven years' service, was reported last month. He was taken ill at South Kensington Station, and passed away without recovering consciousness, within a hundred yards of the Instruments Division in Cromwell Road, where he had worked as Principal Assistant during the latter years of his life. His genial and kindly manner had endeared him to a large circle of friends.

Climatological Stations.

Hereford.—Observations at Belmont Priory, which were interrupted in October, 1918, were recommenced in June, 1919. From the beginning of 1920, the publication of temperature and rainfall for Hereford in the *Weekly Weather Report* has been resumed, and the station takes its place again as a District Value station. For the year 1919, the Ross-on-Wye station served for this purpose.

Mallaranny.—The number of reporting stations in the North of Ireland has recently been increased by the addition of Mallaranny in County Mayo. This station now appears in the *Weekly Weather Report.*

Official Publications.

British Meteorological and Magnetic Year Book, 1917, Part III., Sec. 2., Geophysical Journal, 1917.—The annual supplement, which completes this volume has now been issued. This supplement contains the first chronological summary of upper air temperatures observed on aeroplanes to be published in this country. This summary refers to Martlesham, a testing station of the Royal Air Force near Ipswich. Details are given for about 270 ascents.

To the usual diagram showing the variation of water level in the " well " at Kew Observatory has been added a graph of " integrated rainfall." This is of special interest as the year includes the thunderstorm of June 16th (when 120 mm., the " record " for London, was measured at Kensington, and 43 mm. fell at the Observatory) as well as the heavy cyclonic rains of July 29th to August 1st. The water level was hardly affected by the former storm, but the general rain in the latter case produced a rise of 550 mm.

The British Meteorological and Magnetic Year Book, 1916 Part IV.—Hourly Values from Autographic Records.—This volume follows the line of its predecessors. It contains monthly means of hourly values for the usual meteorological elements as recorded at Kew, Valencia and Eskdalemuir Observatories with corresponding data for electrical potential gradient. In the case of Terrestrial Magnetism hourly readings themselves are given for Eskdalemuir and the harmonic analysis of diurnal variation for days of different types is carried out. A special feature of the volume is a discussion by Dr. Chree of the electrical potential gradient at Kew and Eskdalemuir Observatories in the years 1914 to 1916. There was a change of site of the Kew electrograph in 1915, but Dr. Chree finds that if it exerted any influence on the diurnal inequality, that influence was certainly small. A very substantial difference in type is found to exist between the diurnal inequalities at Kew and Eskdalemuir.

Professional Notes No. 9.—An Analysis of Cloud Distribution at Aberdeen during the years 1916-1918, by G. A. Clarke. Price 4d. net. Mr. G. A. Clarke holds a unique position as an observer of clouds. His sketches and photographs are well known for their artistic merit as well as for their scientific value. Nephoscope observations at Aberdeen for which he has been principally responsible, have been published in the *Geophysical*

Journal for some years, and an analysis of this series was published in the supplement to the *Journal* for the year 1916. In the Professional Note which has recently been issued the frequency of different cloud types is discussed. The question is approached from the point of view of aviation and stress is laid on the selection of the characteristic cloud present each day, the rule adopted being that if four tenths of the sky was covered with a lower cloud, that cloud should be taken as characteristic. For example, when a complete layer of strato-cumulus has below it four-tenths of cumulus, the characteristic of cumulus is given. Amongst other results it is found that on 31 per cent. of days there is considerable cloud below 3,000 ft. and on only 15 per cent. is there no " characteristic " cloud below 15,000 ft.

NOTES AND QUERIES.

The Highest Gust on Record.

THE severe gale which was experienced on the west of Ireland during the morning of January 27th last, was remarkable on account of the unprecedented gust of wind, which was recorded by the Dines' anenometer at Quilty, Co. Clare.

During the early hours of the morning a moderate breeze was blowing. After 3 h. the wind increased steadily in force until at 8 h. the mean velocity for the hour was 23 m/s. There were several gusts of 31 m/s. and over, between 7 h. and 8 h., and one of 36 m/s., at 7 h. 45 m. After this the pen did not rise above 31 m/s. until 8 h. 20 m. when it rushed up to the very of the chart. It seems to have caught on the edge of the sheet and spluttered as it came down. The indicated speed of the wind was at least 50 m/s. (over 110 mi/hr.). The duration of the squall cannot have been much more than a minute, and the average strength of the wind afterwards was about the same as before—22 m/s. The highest subsequent gust was one of 31 m/s., at 8h. 25m. The general direction of the wind during the morning was between S. and S.W., but as the anemometer is not provided with a direction-recorder there is no evidence as to the direction of the squall. No report on the incident has yet been received from the Observer.

The strongest gust hitherto recorded in this country was 44·6 m/s. (100 mi/hr.), at Pendennis, on March 14th, 1905;

the highest at Quilty, 41 m/s. (92 mi/hr.), on December 4th, 1914. No doubt greater wind speeds are reached occasionally in the small tornadoes which occur from time to time.

Geostrophic Wind in March for London.

It is now an accepted principle in meteorology that the wind at about 1,000 ft. is in fairly close agreement with the "geostrophic wind," which is thought of as blowing along the isobars and with such strength that the pressure-gradient just balances the tendency of the air-current to bear to the right owing to the rotation of the earth. The best series of actual observations of the wind aloft are comparatively short, and broken by many gaps: it is, therefore, of interest to ascertain the frequency of geostrophic winds from different quarters and of different strengths. The estimation of geostrophic wind each day at London, from 1881 onwards, has been undertaken by Miss D. Figgins. The following table gives a summary of the results for March; the speed is given to the nearest multiple of 5 metres per second.

Geostrophic Wind at London; March 1881—1915.

FREQUENCY OF STRENGTH AND DIRECTION.

Estimates base on the D.W.R. chart (8*h.*, 1881-1908; 7*h.*, 1909-1915).

Direction.	5 m/s. 11 mi/hr.	10 m/s. 22 mi/hr.	15 m/s. 33 mi/hr.	20 m/s. 44 mi/hr.	Over 23 m/s. Over 50 m/hr.	Total Frequency of Direction.
N.	19	26	27	6	9	87
NE.	7	22	30	18	7	84
E.	10	22	28	11	4	75
SE.	11	16	4	4	...	35
S.	10	21	14	13	8	66
SW.	19	42	57	32	23	173
W.	11	46	71	58	39	225
NW.	16	32	46	23	8	125
Total Frequency of Strength	103	227	277	165	98	870

Indeterminate — 215.

The majority, but by no means all of the days in the "indeterminate" class, corresponds with light winds. It will be noticed that geostrophic winds from western quarters preponderate. The low proportion from south-east and the entire absence of gales from that quarter is worth comment.

Rainfall at Havana and in South-west England.

THE rainfall figures from Havana during the rainy season May to October, 1919, have now been received. During this period only 75 per cent. of the average seasonal fall was registered, which suggests that the rainfall in England, south-west, during January to March, 1920, will probably be above the average. For seven successive years, 1913-1919, the rainy seasons at Havana have yielded a fall below the average, and in four out of the six succeeding seasons in this country the rainfall has been in excess of the average. Full particulars of the two seasons, from 1905 to 1918, will be found in *Symons's Meteorological Magazine*, April, 1919, p. 30. A. HAMPTON BROWN.

70, Victoria Street, S.W. 1, 10th January, 1920.

[Cf.—" The Rainfall in Cuba and England S.W." (*Symons's Met. Mag.*, February, 1915), in which communication Mr. Hampton Brown found a correlation coefficient of —·54 between the rainfall at Havana in England S.W. in the seasons mentioned.]

Line Squall of December 4th, 1919.

IT would be interesting to trace the movement of this squall, which was attended by thunder and lightning in many places. Apparently it traversed the southern half of England, reaching this district at about 4.50 p.m. My brother was in Arras on that night, and reports a sharp thunderstorm accompanied by heavy hail passing over from the west at 8 p.m. This seems to have been the same squall which swept over London some three hours earlier. H. HARRISON.

36, Rosemont Road, Richmond Hill, Surrey, 10th December, 1919.

A Correction.

THE kindly and sympathetic notice of my retirement from the Meteorological Office which appeared in the January issue of *Symons's Meteorological Magazine* contained one slight error. I cannot claim the distinction of having served under the administration of Admiral Fitzroy. The Admiral died in April, 1865. It was four years later that I entered the service of the Meteorological Office, which was then, and for many subsequent years, under the control of Mr. Robert H. Scott.

FREDK. J. BRODIE.

30, Loxley Road, Wandsworth Common, 29th January, 1920.

Reviews.

The Book of Normals of Meteorological Elements for the British Isles. Section I. Monthly Normals, 1881-1915 for Temperature, Rainfall and Sunshine. Published by the Authority of the Meteorological Committee. London, 1919. Pp. 94. Size, 9½ × 6. Price, 2s.

METEOROLOGISTS will note with satisfaction the collection into a single compact volume of the climatological normal values for stations reporting to the Meteorological Office (Statistical Division). Such data have for the most part been hitherto available only by reference to Appendix IV. of the *Weekly Weather Report,* 1913. The present work covers the period 1881-1915. The values for shade temperature (mean maximum, mean minimum and mean temperature) are given separately in degrees Fahrenheit and in the Absolute scale, and those for rainfall in inches and millimetres, an extremely useful precaution during the period of gradual transition from the older units to the newer. There are one or two instances in which the choice of records for weighting incomplete rainfall records might have been more felicitous. Thus Aspatria in Cumberland is referred to Cally, in Kirkcudbrightshire, Shrewsbury to Birmingham, and Grayshott (near Hindhead) to Portsmouth. In all these cases numerous more applicable records are available, and in or two instances the monthly régime at the two stations compared is so different that an appreciable error may result. C.S.

News in Brief.

Summer Time in France. In the *Meteorological Office Circular,* No. 44, it was stated that Summer Time was being adopted in France from February 1st, 1920. The notice announcing this date was subsequently cancelled and the change to Summer Time is being made on the night February 14th—15th.

ON SATURDAY, JANUARY 31ST, the staff of the Meteorological Office met together at an unofficial soirée at the Merrick Rooms, Kensington, W. About 160, members of the staff and friends, were present. An attractive programme of music had been arranged, and revealed considerable musical talent. This was followed by a dance which proved very enjoyable. Sir Napier and Lady Shaw, with a majority of the senior officials of the Office, were present.

Weather in the British Isles: January, 1920.

Except for a brief cold spell about the 6th and 7th, weather of an oceanic or south-westerly type prevailed during the greater part of the month. Depressions, which were often of great size and intensity, followed one another in rapid succession and very commonly travelled on a north-easterly course, so that winds from westerly or south-westerly points predominated, with the result that there were many mild days and the mean maximum temperature for the month in some parts of England exceeded the normal for January by about 4° F. Gales were frequent and widespread, and at times the speed of the wind was very great. Snow was infrequent during the month, but there were considerable falls on the 10th and also during the night of the 28th-29th, the fall on the latter date in Derbyshire being the heaviest during the present winter. Between the 14th and 17th, there was much coastal fog and mist, but generally fogs during the month were remarkably rare.

The mean temperature was above the normal in each week of the month; the departures were most striking in the week which ended on the 17th, when the normal was exceeded by 11° F. at Wilton, 10° F. at Raunds (Northants), and at Oxford. Notable high individual readings were 61° F. at Cullompton (Devon), and 60° F. at Dublin on the 17th, 58° F. at Bath, and 57° F. at Fulbeck (Lincoln), on the 18th. The maximum recorded at Cahirciveen on the 12th was 56° F., the highest January value since the Valencia Observatory was moved there in 1892. The minimum at Cahirciveen on the 18th was as high as 52° F., though 34° F. was reported from Eskdalemuir the same morning.

The first serious gale of the month visited Scotland and north-east England on the 8th, much damage was done and there was very heavy rain in Scotland. Gales were general on the 11th and 13th.

At 7 h. on the 27th, the weather map showed a very large and deep depression off the west of Ireland, which during the day travelled rapidly north-eastwards and caused a very severe gale in all parts of the British Isles. This gale was especially severe over Scotland, Ireland and the west of England. At Quilty (Co. Clare), the strength of the wind was quite abnormal, and at 8 h. the anemometer at this station recorded a gust of 110 m.p.h. This gale was also of great violence at Queenstown Harbour, where much damage was done to the quays and wharves, and a gust of 80 m.p.h. was recorded at 8 h. by the anemometer at Weaver Point. On the 30th another depression appeared off the west of Ireland and winds of gale force were again experienced in many parts of the British Isles, and in some of the northern districts the gale was accompanied by a heavy fall of snow.

The rainfall of the month was practically everywhere in excess of the average, reaching twice the average over isolated areas. Amounts less than 2 inches were confined to the extreme east of England and Scotland. Practically the whole of Devon, Cornwall and Wales, and the greater part of the west of Scotland recorded over 5 inches. More than 10 inches occurred over wide areas of the uplands, while over 15 inches was recorded on Dartmoor, the Lake District and over isolated areas in Argyll and Inverness-shire. At Loch Quioch, Loan, over 25 inches fell. Very heavy rain fell locally on the 16th, when 4·22 in. was recorded at Glenelg Manse. In Ireland the fall was less than 4 inches over a small area in the north-east. More than 10 inches was recorded in elevated areas in the west and north, reaching 15 inches in the mountains of Connemara. The general

Continued on p. 16.

Rainfall Table for January, 1920.

STATION.	COUNTY.	Aver. 1875—1909.	1920		Per cent. of Av.	Max. in 24 hours		No. of Days
		in.	in.	mm.		in.	Date	
Camden Square	*London*	1·83	2·58	66	141	·61	10	21
Tenterden	*Kent*	2·14	3·19	81	149	·55	10	21
Arundel (Patching)	*Sussex*	2·59	4·06	103	157	·92	10	20
Fordingbridge (Oaklands) ..	*Hampshire*..	2·67	4·22	107	158	·55	10	27
Oxford (Magdalen College) .	*Oxfordshire* .	1·78	2·02	51	113	·35	10	20
Wellingborough	*Northampt'n*	1·90	2·26	57	119	·45	28	16
March	*Cambridge* ..	1·48	1·94	49	131	·37	9	15
Geldeston [Beccles]	*Norfolk*	1·53	1·81	46	118	·56	28	14
Polapit Tamar[Launceston].	*Devon*	3·59	7·82	199	218	1·32	10	26
Rousdon [Lyme Regis].....	;, ...	2·94	4·60	118	156	·95	9	22
Ross (Birchlea)	*Herefordshire*	2·33	4·25	108	182	1·02	28	19
Church Stretton(Wolstaston)	*Shropshire* .	2·51	4·64	118	185	1·17	28	20
Boston..................	*Lincoln*.....	1·54	1·52	39	99	·40	28	16
Worksop (Hodsock Priory) .	*Nottingham*	1·70	2·49	63	146	1·01	28	20
Mickleover Manor	*Derbyshire* .	1·95	3·07	78	157	·72	28	22
Southport (Hesketh Park) .	*Lancashire* .	2·55	3·46	88	136	·50	10	22
Wetherby (Ribston Hall) ..	*York, W.R.*	1·89	3·38	86	179	·85	10	14
Hull (Pearson Park)	,, *E.R.* .	1·70	2·27	58	133	·62	28	21
Newcastle (Town Moor) ...	*North'land* .	1·90	3·08	78	162	1·03	10	20
Borrowdale (Seathwaite) ...	*Cumberland*	13·44	19·20	488	143	..	..	..
Cardiff (Ely)	*Glamorgan* .	3·65	6·17	175	169	1·15	10	26
Haverfordwest	*Pembroke* ..	4·69	6·60	168	141	1·03	10	26
Birminghamww.Tyrmynydd	*Radnor*	6·24	8·01	204	128	1·16	10	24
Llandudno	*Carnarvon* ..	2·51	3·68	94	147	·51	18	19
Cargen [Dumfries]	*Kirkcudbrt.* .	4·10	7·23	184	176	1·03	23	26
Marchmont House.........	*Berwick*	2·40	2·57	65	107	·55	10	19
Girvan (Pinmore)	*Ayr*........	4·78	7·10	180	148	·71	18	29
Glasgow (Queen's Park) ...	*Renfrew* ..	3·53	5·12	130	145	·48	7	25
Islay (Eallabus)...........	*Argyll*......	4·78	6·64	169	139	·63	29	29
Mull (Quinish)	,, ...	5·55	7·33	186	132	·82	7	29
Loch Dhu	*Perth*	9·20	11·10	282	121	2·20	7	28
Dundee (Eastern Necropolis)	*Forfar*	2·01	2·64	67	131	·46	24	19
Braemar	*Aberdeen* ...	2·92	4·38	111	150	·63	25	17
Aberdeen (Cranford)	,, ...	2·36	1·73	44	73	·52	29	17
Gordon Castle	*Moray*	1·99	1·55	39	78	..	..	..
Drumnadrochit	*Inverness* ..	3·63	5·07	129	140	·98	7	26
Fort William	,, ...	9·20	15·86	403	172	3·71	16	30
Loch Torridon (Bendamph)	*Ross*	9·28	14·81	376	160	2·81	16	28
Stornoway	,, ...	5·10	8·77	223	172	..	..	..
Dunrobin Castle	*Sutherland* .	2·75	2·81	71	102	·54	6	12
Wick	*Caithness* ..	2·48	3·34	85	135	..	..	..
Glanmire (Lota Lodge).....	*Cork*	4·70	6·05	154	129	·97	2	26
Killarney (District Asylum)	*Kerry*	5·94	8·49	216	143	1·17	25	29
Waterford (Brook Lodge) ..	*Waterford* ..	3·78	4·83	123	128	·84	2	25
Nenagh (Castle Lough)	*Tipperary* ..	3·88	5·79	147	149	·72	10	27
Ennistymon House	*Clare*	4·30	6·88	175	160	·75	18	27
Gorey (Courtown House) ..	*Wexford* ...	3·19	4·71	120	148	·67	10	24
Abbey Leix (Blandsfort) ...	*Queen's Co.* .	3·15	5·49	139	174	·75	2	25
Dublin(FitzWilliamSquare)	*Dublin* ...	2·14	4·29	109	200	·70	9	22
Mullingar (Belvedere)	*Westmeath* .	3·10	5·64	143	182	·71	10	25
Woodlawn	*Galway*	3·83	5·60	142	146	·58	9	27
Crossmolina (Enniscoe)	*Mayo*	5·35	7·93	201	148	·90	25	29
Collooney (Markree Obsy.) .	*Sligo*	3·87	6·30	160	163	·95	8	29
Seaforde	*Down*	3·41	4·59	117	135	·59	10	23
Ballymena (Harryville)	*Antrim*	3·73	5·09	129	136	·93	10	27
Omagh (Edenfel)	*Tyrone*	3·46	5·53	140	160	·74	9	28

Supplementary Rainfall, January, 1920.

Div.	STATION.	RAIN. in.	RAIN. mm.	Div.	STATION.	RAIN. in.	RAIN. mm.
II.	Ramsgate	2·16	55	XII.	Langholm, Drove Rd.	7·07	180
,,	Sevenoaks, Speldhurst	3·40	86	XIII.	Selkirk, Hangingshaw	3·60	91
,,	Hailsham	4·40	112	,,	North Berwick Res.	1·78	45
,,	Totland B. Aston Ho.	4·09	104	,,	Edinburgh, Royal Ob.	2·45	62
,,	Ashley, Old Manor Ho.	3·84	98	XIV.	Biggar	4·94	126
,,	Grayshott	4·24	108	,,	Leadhills	13·90	353
,,	Ufton Nervet	3·13	80	,,	Maybole, Knockdon F	5·56	141
III.	Harrow Weald, Hill Ho.	3·37	86	XV.	Rothesay	6·64	169
,,	Pitsford, Sedgebrook	2·52	64	,,	Oban	8·14	207
,,	Chatteris, The Priory	1·69	43	,,	Inveraray Castle	15·42	392
IV.	Elsenham, Gaunts End	2·48	63	,,	Holy Loch, Ardnadam	10·37	263
,,	Lexden, Hill House	2·00	51	XVI.	Loch Venachar	7·50	190
,,	Aylsham, Rippon Hall	2·14	54	,,	Glenquey	7·20	183
,,	Swaffham	1·95	50	,,	Loch Rannoch, Dall.	8·84	224
V.	Devizes, Highclere	3·82	97	,,	Coupar Angus	2·74	70
,,	Weymouth	4·48	114	,,	Montrose Asylum	1·79	46
,,	Ashburton, Druid Ho.	11·74	297	XVII.	Balmoral Castle	3·69	94
,,	Cullompton	5·33	135	,,	Fyvie Castle	2·21	56
,,	Lynmouth, Rock Ho.	7·81	198	,,	Peterhead, Forehill	1·82	46
,,	Hartland Abbey	4·62	117	,,	Grantoun-on-Spey	2·47	63
,,	St. Austell, Trevarna	7·25	184	XVIII.	Cluny Castle	6·65	169
,,	North Cadbury Rec.	4·48	114	,,	Loch Quoich, Loan	25·50	648
VI.	Clifton, Stoke Bishop	4·72	120	,,	Skye, Dunvegan	10·70	272
,,	Ledbury, Underdown	3·45	88	,,	Fortrose	2·35	60
,,	Shifnal, Hatton Grange	3·76	96	,,	Ardross Castle	5·81	148
,,	Mayfield, [Ashbourne]	4·12	105	,,	Glencarron Lodge	12·27	312
,,	Barnt Green	2·44	62	XIX.	Tongue Manse	3·66	93
,,	Blockley, Upton Wold	3·55	90	,,	Melvich	4·80	122
VII.	Grantham, Saltersford	1·98	50	,,	Loch More, Achfary	11·57	294
,,	Louth, Westgate	2·19	56	XX.	Dunmanway Rectory	10·40	264
,,	Mansfield, West Bank	3·04	77	,,	Mitchelstown Castle	6·42	163
VIII.	Nantwich, Dorfold Hall	3·59	91	,,	Gearahameen	16·50	419
,,	Bolton, Queen's Park	4·55	116	,,	Darrynane Abbey	7·18	182
,,	Lancaster, Strathspey	3·90	99	,,	Clonmel, Bruce Villa	6·75	171
IX.	Wath-upon-Dearne	2·79	71	,,	Ballinamona	5·14	131
,,	Bradford, Lister Park	4·62	117	,,	Roscrea, Timoney Pk.	4·36	111
,,	West Witton	4·85	123	,,	Foynes	6·19	157
,,	Scarborough, Scalby	4·17	106	,,	Broadford, Hurdleston	5·80	147
,,	Ingleby Greenhow	4·15	105	XXI.	Kilkenny Castle	5·14	130
,,	Mickleton	4·50	114	,,	Rathnew, Clonmannon	4·61	117
X.	Bellingham	3·83	97	,,	Hacketstown Rectory	5·62	143
,,	Ilderton, Lilburn Co.	2·38	60	,,	Ballycumber, Moorock	4·65	118
,,	Orton	9·55	243	,,	Balbriggan, Ardgillan	4·49	114
XI.	Llanfrechfa Grange	5·87	149	,,	Drogheda	3·76	96
,,	Treherbert, Tyn-y-waun	16·97	431	,,	Athlone, Twyford	5·10	130
,,	Carmarthen Friary	6·46	164	,,	Castle Forbes Gdns.	4·90	124
,,	Fishguard	5·54	141	XXII.	Aasleagh House	13·86	352
,,	Lampeter, Falcondale	6·67	169	,,	Westport House	7·99	203
,,	Abergwngy	9·20	234	XXIII.	Enniskillen, Portora	5·82	148
,,	Crickhowell, Talymaes	5·00	127	,,	Dartrey [Cootehill]	5·07	129
,,	Sennybridge	6·90	175	,,	Armagh Observatory	4·12	105
,,	Garthbibio	13·40	340	,,	Warrenpoint, Manor H	3·84	98
,,	Llangynhafal, PlasD'w.	3·41	87	,,	Belfast, Cave Hill Rd.	5·60	142
,,	Dolgelly, Bryntirion	6·64	169	,,	Glenarm Castle	5·68	144
,,	Lligwy	3·91	99	,,	Londonderry, Creggan	4·57	116
XII.	Stoneykirk, Ardwell Ho.	5·02	128	,,	Sion Mills	6·24	158
,,	Gatehouse, Cally	7·17	182	,,	Milford Manse	5·23	133
,,	Carsphairn, Shiel	11·52	293	,,	Killybegs	8·14	207

Old Style type denotes converted units.

Climatological Table for the

STATIONS Those in italics are South of the Equator	Pressure		TEMPERATURE							
			Absolute				Mean Values			
	Mean M.S.L. mb.	Diff. from Normal mb.	Max. ° F.	Date	Min. ° F.	Date	Max. ° F.	Min. ° F.	½ max. and min. ° F.	Diff. from Normal ° F.
London, Kew Obsy.	1016·5	+2·6	84·	9	45·	28	72·7	54·7	63·7	+2·1
Gibraltar	1018·7	+3·3	97·	6,30	64·	3	85·2	69·1	77·1	+0·8
Malta	1016·0	—0·7	90·5	31	68·5	8	83·4	72·1	77·7	—1·1
Sierra Leone	1015·1	+2·0	100·	31	61·	12, 20	83·3	64·9	74·1	—4·0
Lagos	..	..	87·3	7	69·0	9	81·1	72·5	76·8	—0·4
Kaduna, N. Nigeria	*946·0	..	87·	29	61·	29	81·8	67·4	74·6	..
Cape Town	..	..	77·0	13	39·8	4	63·9	49·1	56·5	+1·3
Johannesburg	..	..	75·2	24	28·2	4	65·4	42·4	53·9	—4·9
Mauritius	1013·8	—6·8	79·2	28	55·4	22	75·4	61·3	68·3	—0·2
Bloemfontein	..	..	80·0	27	22·9	5	67·1	37·9	52·5	+0·9
Calcutta, Alipore Obs.	..	..	91·6	5	76·3	20	87·9	78·9	83·4	+0·8
Bombay	..	..	85·6	10	75·8	30	84·1	77·7	80·9	+0·3
Madras	..	..	101·1	14	74·0	22	96·5	79·0	87·7	+2·2
Colombo, Ceylon	..	..	85·9	31	73·2	19	84·3	76·1	80·2	—1·7
Hong Kong	1001·9	—3·4	92·2	1	74·0	31	87·1	78·5	82·8	+0·7
Sydney	..	..	78·5	12	38·8	6	65·6	46·8	56·2	+1·3
Melbourne	..	..	74·1	31	29·9	4	59·7	42·9	51·3	+0·2
Adelaide	..	..	76·2	5	35·6	21	64·7	47·2	55·9	+2·0
Perth	..	..	73·2	25	39·1	14, 15	63·6	47·4	55·5	—0·5
Coolgardie	..	..	79·5	9	32·2	12	64·0	43·2	53·6	+0·4
Brisbane	..	..	79·1	21	38·4	5	70·9	48·3	59·6	—0·9
Hobart, Tasmania	..	..	63·8	10	32·8	5	55·0	41·9	48·5	+0·6
Wellington, New Zealand	1014·3	+0·3	64·5	31	33·0	9,11	54·9	44·7	49·8	+1·2
Suva, Fiji	1014·0	—1·8	84·8	4	65·8	31	76·3	68·8	72·5	—1·3
Kingston, Jamaica	..	..	97·5	9	71·3	30	91·8	74·5	83·1	+1·6
Grenada	1013·2	+0·5	89·	2, 7	68·	23, 24	85·1	74·1	79·6	+0·3
Toronto	..	..	92·2	7	47·6	29	77·8	57·9	67·9	+0·8
Fredericton	..	..	83·0	13	40·0	10	72·8	51·1	61·9	—1·
St. John, N.B.	..	..	77·5	16	47·0	5	66·2	52·3	59·3	—1·9
Victoria, B.C.	..	..	80·4	18	47·7	9	66·7	51·0	58·9	—1·4

* At Station Level, height of 2088 feet.

SIERRA LEONE.—5·75 in. (146 mm.) rain on 23rd.

Mauritius.—Prevailing wind E.S.E. ; mean speed, 2·7 m./s.

Bloemfontein.—Severe drought.

HONG KONG.—Prevailing wind E.S.E. ; mean speed, 5·1 m./s.

British Empire, August, 1919.

TEMPERATURE				PRECIPITATION				Mean Cloud Am'nt.	Bright Sun-shine	STATIONS Those in italics are South of the Equator
Mean Values				Amount		Diff. from Normal	Days		Hours per day	
Dew Point ° F.	R'tive. Humidity %	Max. in Sun ° F.	Min. on Grass ° F.	in.	mm.	mm.				
53·4	67	144·0	33·8	2·20	56	—1	11	5·2	7·32	London, Kew Observatory.
63·4	65	153·	60·0	·00	0	—4	0	1·8	..	Gibraltar.
..	76	144·	..	·00	0	—4	0	2·3	..	Malta.
72·1	83	..	..	22·78	579	—369	26	5·7	..	Sierra Leone.
70·2	78	156·	57·	·20	5	—50	5	8·1	..	Lagos.
68·5	89	..	..	6·30	160	—136	19	2·5	..	Kaduna, N. Nigeria.
49·4	77	..	..	2·19	56	—31	14	6·0	..	*Cape Town.*
32·4	55	..	25·2	·00	0	—5	0	1·7	9·42	*Johannesburg.*
59·7	75	..	49·5	3·05	77	+13	18	5·7	..	*Mauritius.*
31·4	53	..	..	·11	3	—9	3	1·9	..	*Bloemfontein.*
..	89	..	75·2	23·32	592	+283	23	8·6	..	Calcutta, Alipore Obsy.
75·7	86	125·8	72·1	10·63	270	—90	30	9·0	..	Bombay.
71·7	66	162·0	73·2	3·12	79	—46	8	6·6	..	Madras.
73·6	84	153·9	68·0	4·47	114	+24	18	8·3	..	Colombo, Ceylon.
76·5	82	..	..	19·67	500	+143	24	7·2	5·73	Hong Kong.
43·5	63	122·2	30·1	·75	19	—60	9	3·2	..	*Sydney.*
40·8	64	127·7	21·8	·57	14	—32	11	5·3	..	*Melbourne.*
45·5	67	135·2	26·6	3·07	78	+14	13	5·0	..	*Adelaide.*
47·4	73	137·7	28·2	6·03	153	+10	17	5·4	..	*Perth.*
42·1	62	134·2	28·8	3·56	90	+65	10	4·8	..	*Coolgardie.*
45·9	58	136·8	31·4	·69	18	—39	4	2·0	..	*Brisbane.*
39·5	68	123·4	28·1	·00	0	—46	0	6·5	..	*Hobart, Tasmania.*
43·9	79	127·0	22·0	3·42	87	—29	17	6·6	3·79	*Wellington, New Zealand.*
68·0	88	..	..	4·12	105	—83	16	8·5	..	*Suva, Fiji.*
70·2	74	..	..	·89	23	—70	5	3·8	..	Kingston, Jamaica.
72·9	78	140·	..	15·10	384	+139	28	5·0	..	Grenada.
56·1	75	123·0	42·9	2·17	55	—13	8	4·5	..	Toronto.
55·2	76	..	..	1·95	50	—51	11	5·8	..	Fredericton.
54·1	85	140·4	37·5	3·54	90	—8	14	6·7	..	St. John, N.B.
32·0	78	136·0	38·0	·34	9	—7	4	2·5	..	Victoria, B.C.

Sydney.—Rainfall very deficient.

Wellington.—6 sunless days, 9 days frost.

KINGSTON, JAMAICA.—Drought through the island. Highest temperature ever recorded.

GRENADA.—10 thunderstorms; 3·20 in. (81 m.m.); rain on 22nd.

rainfall expressed as a percentage of the average was as follows :— England and Wales, 150; Scotland, 142; Ireland, 151, and British Isles, 147. This is, therefore, the second consecutive month of rainfall over 40 per cent. in excess of the average over the British Isles as a whole.

In London (Camden Square), the month was dull and mild. The shade temperature reached 56°·2, on the 12th, and the mean temperature was 42°·1, or 3°·6 above the average. Duration of rainfall, 60·6 hours. Evaporation, ·20 in.

Weather Abroad: January, 1920.

THE chief feature of January, 1920, has been its storminess and the exceptionally heavy rainfall in western and central Europe. For the first four days of the month pressure was high in the neighbourhood of Iceland and relatively low over the land area of western Europe. Under these conditions heavy rain fell on the Continent; 35 mm. fell at Marseilles in the 24 hours ending at 7 h. on the 2nd, and as much as 47 mm. was reported at Perpiguian on the morning of the 5th. At Lugano 68 mm. were measured on the 7th. These heavy falls following those of the end of December, 1919, caused serious floods in many regions. The Rhine rose to a higher level than had been recorded for 40 years. Paris suffered considerable damage, the Seine at Pont Royal reaching a level of 24 feet 3 inches above the normal—the highest ever recorded. River traffic was impossible, the bridges being blocked. The Seine began to fall on January 5th, but a state of flood was maintained more or less through the month.

Later in the month (11th to 17th) the Arno, at Florence, was in flood, and at the same time heavy rain and mild weather in the Alps, following on a heavy snow fall, caused destructive avalanches, while on the 17th and 18th the Danube inundated the lower streets of Budapest. Heavy floods were experienced on the rivers of Bohemia and Moravia, and probably also over Germany.

During the greater part of the month there was a strong south-west current of air over the North Sea, and comparatively high temperatures extended as far as the Arctic Circle, the thermometer at Spitzbergen standing at about 36° F. for a few days.

On the opposite side of the Atlantic severe conditions prevailed. The river St. Lawrence " was never so solidly blocked with ice in the history of its navigation," and in New York severe weather was experienced, the minimum temperature having fallen below 10° F. on several occasions, and to 4° F. on the 5th*. The low temperatures were due to a series of depressions appearing over or off the north-east coast of the United States, causing northerly winds.

A curious coincidence, if such it is, is that on December 30th, at the same time as the heavy rains of Europe, a drought which had prevailed in Australia was broken, and useful rains fell throughout the month of January.

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* The mean daily maximum temperature for the month at New York was 29° F., the mean daily minimum was 19° F., and the mean of the two 24° F. This is six degrees below the normal January temperature of 30° F. These figures are based on 27 days figures, four days being absent.

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The International Meteorological Conference. Paris, October, 1919.

THE French edition of the Minutes of the International Meteorological Conference, which met in Paris in October last, has now been issued.*

The last preceding meeting of this body took place at Innsbruck in 1905. But for the war a meeting would have been held in Holland in 1915.

There were present at Paris the Directors of the Meteorological Services and of Observatories belonging to the Allied and Neutral Powers, the number of representatives from British Dominions being 9, from other Allied Powers, 38, and from Neutral Powers, 19.

At the first meeting the members were welcomed by M. Angot, who was subsequently elected Secretary, Sir Napier Shaw being President. As the President pointed out in his opening address the Conference was an important epoch-making occasion in

*Paris, Bureau Central Météorologique, Proces-Verbaux des Seances de la Conférence Météorologique Internationale des Directeurs et du Comité Météorologique International. Réunion de Paris, 1919.

the history of International Meteorology, for the events of the war had brought many new problems into the field of discussion, chief among them being the growing meteorological requirements of aviation, and the re-establishment of the international organization, which the war had either suspended or disorganized.

This question of international organization took the first place on the programme. The scheme adopted was on the same lines as that which was in operation before the war. The organization comprises (1) The Conferences of Directors; (2) The International Meteorological Committee, and (3) Commissions.

The Conferences of Directors are chiefly concerned with administrative questions and work requiring international co-operation, purely theoretical matters being excluded. In addition to the directors of official services, the directors of certain private institutions, and also representatives of Meteorological Societies may be invited to the Conferences. They are to be convened in future every six years instead of at intervals of nine years as laid down hitherto. The International Meteorological Committee is to maintain international intercourse during the intervals between the conferences. The Committee is nominated by a Conference of Directors and its powers cease with the following conference. The members are to belong to different countries and to be directors of independent meteorological establishments. This Committee is to meet every three years as hitherto. The number of members has been increased from seventeen to twenty, but four places are for the time being to remain unfilled.

The Commissions investigate particular branches of meteorological work. They are organized and their Presidents nominated in the first instance by a Conference or the Committee, but they may co-opt members and organize their own work.

The Commissions appointed by this Conference are shown in the following list, the names of the Presidents being in brackets :—

Agricultural Meteorology (M. Angot).

Meteorological Telegraphy (Lieut.-Col. E. Gold).

Maritime Meteorology (M. van Everdingen).

Solar Radiation (M. Maurer).

Application of Meteorology to Aerial Navigation (Lt.-Col Saconney).

Réseau Mondial (Sir Napier Shaw).

Exploration of the Upper Atmosphere (Prof. V. Bjerknes).

Terrestrial Magnetism and Atmospheric Electricity (M. Angot).

Polar (Sir Napier Shaw).

A few of the decisions recorded on practical matters may be referred to.

It was agreed that in view of the requirements of aviation, telegraphic reports four times a day were desirable. The standard hours hitherto have been 7 h. and 18 h. It was decided to have additional readings at 1 h. and 13 h., the hours adopted already in the British Isles, and incorporated in the scheme put forward by the Radiotelegraphic Commission. A proposal to replace the hours 1, 7, 13 and 18 by 3, 9, 15, 21, a series with which we are familar in this country as partially in use at climatological stations, was not accepted by the Conference.

The code for the transmission of the reports was revised, provision being made for the inclusion of information as to the movement of clouds.

On the question of international organization for supplying weather information for flying purposes, it was agreed that for any flight over the territory of several countries it should be possible to obtain :—

(*a.*) The actual weather conditions along the route ;

(*b.*) A detailed forecast for the following six hours, and

(*c.*) A general forecast for the following twenty-four hours.

The provision of handbooks for aeronautical use on the lines of *The Weather of the British Coasts* was recommended.

The suggestion that the estimated probability of their fulfilment should be given with the special forecasts issued to aeronauts was supported. It was stated that in Holland in forecasting rain the conventions adopted are that "probable" indicates a probability of about 60 per cent. and "very probable" a probability of about 80 per cent., "certain" corresponding with 100 per cent.

Some time was devoted to the consideration of a proposal to create a commission to prepare an international meteorological vocabulary, one speaker urging that the scope of such a work should be wide enough to include the Japanese and Chinese languages. As a preliminary it was agreed that each meteorological service should provide the Committee with a translation in the language of its country of the terms appearing in *The Meteorological Glossary* published by our own Office.

A photograph of the members of the Conference is issued with this number of the *Meteorological Magazine*, as frontispiece to the annual volume.

Official Notices.

Summer Time Act.

It is officially announced that "Summer Time" will come into force this year at 2h. G.M.T., on the morning of Sunday, March 28th, and will continue until 2h. G.M.T. on the morning of Monday, September 27th.

After the public clocks have been altered, each hour of observation for the climatological record should remain the same by G.M.T. and should, therefore, be one hour later by Public Time.

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, and also that the times of observations tabulated in the Monthly Weather Report should be checked at the beginning and end of the summer-time period.

Changes in the Monthly Weather Report.

The Monthly Weather Report has been extended by the addition of two extra pages. One of these takes Table V., which gives the rainfall at 196 stations not included in Table III., so that a very large part of the information on which the map of rainfall for the month is based is now published. In this Table V. the rainfall is given in inches and in millimetres and also as a percentage of the normal. In the Report for January the last page is left blank, the form of the Table which is to fill it not having been finally settled.

Attention may be called to a small change which has been made in Table III. of the Report. The terminal hours for maximum and minimum temperature, and for rainfall, are now stated explicitly instead of being indicated by letters. Observers are requested to check the accuracy of the entries against their respective stations both in the January report and also after the advent of summer time.

The following new stations are now being included in Table III., Bexley Heath, Bridlington, East Ham, Luton and Wantage.

Climatological Stations.

Carnforth.—Observations at the station at Carnforth, overlooking Morecambe Bay, had to be discontinued from January 1st, 1920. Mr. W. Farrer, who contributed a series of observations which extends over fourteen years, is transferring the instruments to his house at Witherslack, which is nine miles north-west of Carnforth. The equipment includes an anemobiagraph, the records from which have been utilised in the Monthly Weather Report since June, 1914, but the exposure of the instrument was not entirely satisfactory, tall trees standing to the east of the house on which it was mounted.

Royal Meteorological Society.

THE usual monthly meeting of the Society was held on 18th February, Mr. R. H. Hooker, President, in the Chair. The first paper, by Capt. C. J. P. Cave, was on "The Status of a Meteorological Office."

Mr. W. H. Dines, F.R.S., read a paper entitled "Atmospheric and Terrestrial Radiation," in which the flow of radiant energy through the atmosphere was discussed. It is well known that the air obstructs incoming solar radiation only slightly, but that the non-luminous heat escaping from the earth is to a great extent absorbed by the atmosphere, whilst the atmosphere itself is sending out radiation of a similar character. In this paper, Mr. Dines has computed the flow of such radiant energy, other than solar, both upward and downward across any horizontal plane in the atmosphere. He finds that over Europe the air from the earth's surface up to about eight kilometres is losing heat by radiation, from eight kilometres to twelve it is gaining heat in this way, from twelve kilometres upwards it is losing. The balance in each case must be made up by the direct effects of solar radiation and by the movements of air (and water) in and out of the layers.

Lt.-Col. E. Gold, Sir Napier Shaw and Mr. L. F. Richardson took part in the discussion.

Mr. D. Brunt, M.A., read a paper on "Internal Friction in the Atmosphere." When a steady state of motion is assumed, any portion of the atmosphere is in equilibrium under the action of three forces, the gradient of pressure, the deflecting force at right angles to its motion, and the "frictional force." The first two of these are measurable and so the third can be evaluated. The paper gives a comparison of the "frictional force" defined in this manner with the values derived from a theoretical discussion of turbulent motion. Use was made of observations made at the Eiffel Tower to derive the value of the co-efficient of eddy viscosity.

The paper was discussed by Mr. F. J. W. Whipple and Mr. M. A. Giblett.

Scottish Meteorological Society.

A MEETING of the Society was held on the evening of 30th January, 1920, in the Lecture Room of the Royal Society of Edinburgh. Mr. D. A. Stevenson, M.Inst.C.E., Vice-President, was in the chair, and Dr. C. G. Knott, President, delivered a lecture on "The Colours of the Sky and some Optical Phenomena."

The colours of the sky, in all their varied beauty could be explained in terms of a few fundamental principles of physical optics. There was, first of all, the composite character of sunlight, which Newton showed to be composed of a large number of graded tints of red, orange, yellow, green, blue, indigo and violet. In general, the diversity of colour in natural bodies was due to the selective absorption of certain of these colours, so that the so-called colour of the body was a resultant of the remaining tints which were not so strongly absorbed. Again, light was undulatory, and colours varied with wave length. Rayleigh had shown the blue colour of the sky to be due to the fact that some particles on which white composite light falls scatter by diffraction more of the light of shorter wave-length, that is, more violet than blue, more blue than green, more green than yellow, more yellow than red. Were there no atmosphere the sun would appear a great white or bluish ball in a black sky, but actually the small particles of dust and of the air itself send to the eye scattered light, and this light is mainly blue, whilst the light which comes straight through the atmosphere from the sun is mainly yellow. The colours of the sunrise and sunset were considered, with their endless variety due in part to variations in the number and character of the dust particles and rain drops floating about in the atmosphere. Another principle was physiological rather than physical, and depended on the tendency of the eye to see contrasted or complementary colours. When a red and a white light were arranged so as to throw two shadows of an object on a white screen, the one shadow appeared red (as was to be expected) and the other appeared green, although the part of the screen it occupied was being illuminated by white light. Thus a citron sky behind a range of hills intensified the purple glow of the hills, already themselves bathed in bluish light scattered back from the particles of the air or floating dust. The exquisite beauty of sunrise and sunset colours was no doubt enhanced by this subjective action in the eye; but to what extent, it would be difficult to say. The physiology of vision, especially of colour vision was still but little understood.

The lecture was on popular lines and illustrated by experiments. There was a large attendance.

NOTES AND QUERIES.

Effects of the Diurnal Variations of Temperature in Surveying.

IN a recent paper on Systematic Error in Spirit Levelling, Mr. J. H. Cole* has discussed certain small errors which have been detected in the levelling work of the Survey of Egypt. It is found that when a line of levels is taken across the country and back again by the same route, there is a disagreement. In fact if two bases were at exactly the same height then a leveller, working from the first to the second, would report the latter as the lower and *vice versa*.

The explanation is found to lie in the fact that precise levelling can only be carried on during the two or three hours after sunrise, when the temperature-gradient (or as we should now say the lapse-rate of temperature) is changing rapidly. It was shown by direct experiment with a specially designed thermopile that in Egypt the lapse-rate at sunrise is negative and of the order 1° F. per foot. It vanishes about two hours after sunrise and later becomes positive. Between two observations of level made during the morning at an interval of a few minutes, the effect of refraction is diminishing. It should be explained that in levelling the observer takes up a position about halfway between two staves and compares the heights of marks on them. The one which is nearer the starting-point of the survey is called the backstaff, the other, the forestaff.. In the ordinary routine of surveying the observer looks in succession at the backstaff and the forestaff. Refraction of the light will, therefore, raise the image of the backstaff more than that of the forestaff. The accumulation of such effects leads to the artificial difference in the heights of the bench marks, at the beginning and end of the set of observations.

The success of the investigation suggests that it might be profitable to set up telescopes with the object of measuring the variation of the lapse-rate near the ground as part of the routine of a meteorological observatory. The difficulty in direct measurement of air temperatures is so considerable that an indirect method would be of great service.

Mr. Cole's mathematical investigation of the relation between the lapse-rate and refraction is open to the criticism that it is invalid for rays which are horizontal or nearly so, *i.e.*, for the case which for the surveyor is most important.

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* Cairo : Survey of Egypt : Departmental Paper, No. 35, 1919.

As has been pointed out by Sir Arthur Schuster, a good way to deal with such problems is to consider the movement of an advancing wave front in the beam of light. Suppose a beam proceeding from a point starts with its axis horizontal and that it is observed at a distance x. Further let the speed of the light, which depends on the temperature of the air, be $v\ (1 + ay)$ where y is height above ground. When there is an inversion of temperature so that the air is cold and dense near the ground, the coefficient a is positive. It is easily shown that owing to the greater speed of the light passing along the upper rays of the beam as compared with the lower ones, the wave front is canted through an angle $\frac{1}{2} ax$. This is the correction to be applied to the inclination of the line of sight, and the corresponding correction to the observed height of an object is $\frac{1}{2} ax^2$.

It is shown in the paper that the coefficient a is equal to the centigrade lapse-rate multiplied by $8{\cdot}9 \times 10^{-7}$, so that if for example the lapse-rate is 1° C. per metre and the distance x is 100 metres, the apparent displacement of the object is 4·45 mm.

This effect of a temperature inversion on levelling was discussed in France twenty-five years ago, but the effect of the rapid change in the lapse-rate does not appear to have been noticed previously. To the meteorologist the most interesting point brought out by the investigation is, perhaps, the persistence of the inversion near the ground up to two hours after sunrise.

Corona with a Bright Ring.

On 5th January, at 21 h., a lunar corona was seen here which, though I do not think was very abnormal, yet presented interesting features and was well placed for careful observation.

The sky was covered with a very thin ci-st (*Cirrus Haze*), which would hardly have been evident at all had the moon not been shining. In it showed a faint lunar halo, of 22°, and a plain yellowish corona of 1½° diameter. The interesting point was the existence of a narrow bright ring in this corona, about 0°·8 in diameter, and 0°·1 wide, and appreciably brighter than either the annular space between it and the moon, or the rest of the corona outside it. No colouring could be detected, the whole being composed of different shades of a general yellow tint. The intensity of the corona was maintained with little change to a diameter of 1½°, beyond which it fell off rapidly to that of the surrounding sky.

The phenomenon appeared to be of a permanent nature and was, I think, a real effect and not merely an optical illusion.

Valencia Observatory, Cahirciveen. L. H. G. DINES.

The Highest Aeroplane Ascent.

FROM the newspapers we learn that on February 27th, 1920, Major R. W. Schroeder, Chief Test Pilot at Dayton, Ohio, U.S.A., while attempting to break all previous altitude records in a Le Fère biplane, driven with a 400-h.p. Liberty engine, fainted, while his machine was nearly seven miles above the earth, and fell over five miles in a " sheer nose-dive ."

The machine was fitted with a device which compresses the rarefied atmosphere at high levels to sea-level pressure, and the pilots' clothes were electrically heated. The supply of oxygen having suddenly stopped, Major Schroeder had to raise his ice-coated goggles to examine the oxygen tank. " All at once it seemed as though a terrific explosion had taken place inside his head. His eyes hurt terribly and he could not open them. He seemed to be peeping through a crack. There was a tremendous rush of air and he seemed to be falling." His subconscious sense, however, saved him, for he made a perfect landing from a height of 2,000 feet. The height recorded by the altimeter was 36,000 feet, and the corresponding temperature was 230a.

The height reached by Schroeder is very close to the record claimed by Glaisher and Coxwell, on September 5th, 1862. On this occasion the observer, Glaisher, lost consciousness after taking the barometer reading corresponding with 29,000 ft. At the time of observation the balloon was ascending at about 1,000 feet a minute, and the greatest height reached was estimated as 36,000 or 37,000 feet, by making allowance for the time which elapsed before Coxwell opened the valve for the descent. It is remarkable, however, that the lowest temperature recorded by a minimum thermometer on this occasion was no lower than —12° F. (249 a). This is a higher temperature than any found in the stratosphere in soundings in recent years. The official account of this ascent is given in the *Report of the British Association, 1862*, p. 383. The record of Berson and Süring, who reached 35,400 ft. in a balloon on July 31st, 1901,* is more reliable and is generally accepted as giving the greatest height attained by aeronauts hitherto. It is to be hoped that Schroeder's performance, which follows closely after that of Rohlfs (34,600 ft. on September 18th, 1919), will be authenticated in due course.

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* *Ver. Kön. Preuss. Met. Inst. Ergebnisse der Arbeiten am Aëronautischen Observatorium*, 1900-1901, p. 227.

Atmospheric Pollution.

THE fourth and fifth reports of the Advisory Committee on Atmospheric Pollution contain the results of the observations for the years ending March, 1918, and March, 1919. The gauge at Newcastle-on-Tyne showed the largest mean monthly deposit in both years among the stations for which complete and reliable analyses are available. In the latter year Rochdale had a higher mean monthly deposit, but only nine months' observations are available at this station. As in earlier years, Malvern Wells had the smallest deposit for the year ending in March, 1918, and is representative of uncontaminated country air. No returns were made at Malvern during the last year owing to the observer's absence and the smallest records were given by the gauge at Wandsworth Common. Numerous tables show the classification of the elements of pollution, the seasonal variation compared with previous years, and the comparison of mean monthly deposits during summer and winter. An analysis showing the months of highest and lowest deposits for each element of pollution for London stations is compared with similar results for Glasgow. The fourth report adds : "In all the elements we find the months of maximum and minimum deposits are different for the two groups of stations. If we look at the deposits of total insoluble and soluble matter, we find that in the Glasgow group of stations insoluble matter shows its maximum deposit during the summer months, whereas the total soluble matter shows its maximum during the winter months. There is no sign of such a seasonal variation in the London group. It must, however, be noted that while all the Glasgow gauges are on the ground level, two of the three London gauges are on the roofs of houses, and thus raised above one of the sources of summer deposit, *i.e.*, dusty streets or roads." The most recent analysis reveals a considerable diminution of the deposit in 1918 as compared with 1917 in the majority of stations. There is indication of distinct improvement in the Glasgow air in 1918.

Some notes on the composition of rainfall samples in Georgetown, British Guiana, as representing entirely different conditions from those of the British Isles are included. An account is given of research work relative to the problem of measuring suspended impurity in the air, carried out by Mr. G. M. Watson, under the general direction of the Chemical Sub-Committee. The reports include also a detailed explanation of an automatic air filter, designed by Dr. J. S. Owens, which gives records over a period of twelve hours, and of other experimental apparatus.

Wind in Relation to Tide.

In reply to Dr. Walter's enquiry regarding the Relation of the Wind and the Tides in the Vale of Conway, I beg to make the following remarks :—

This vale runs practically north to south, with the Snowdonian range forming its western slope and along it the tide flows for a distance of about twelve miles. During the passage of western cyclones the direction of the wind on the adjoining heights varies between south-east and south-west, but owing to the trend of the vale the direction there will be south to north.

This occurs without any relation to the direction of the tidal flow. With the veering of the wind towards west, or north-west, which occurs at any state of the tide, the direction in the vale will be quite the reverse, viz., north to south, again following the trend of the valley. The same applies during sea and land breezes with the result that according to tradition, the wind has generally speaking two directions in the Vale of Conway, known locally as "At y Mor" and "At y tir,"—"seawards" and "landwards."

As the direction of the tide changes twice a day and these winds blow during a large proportion of the year, it is quite natural to expect the direction of the wind and the tide sometimes to change simultaneously. In fact, according to the law of average, they ought to do so, but not, in my opinion, on account of any physical relation.

J. R. GETHIN JONES.

Bryn Awel, St. Mary's Road, Llandudno, 28th January, 1920.

Geostrophic Wind at London; April, 1881—1915.

FREQUENCY OF STRENGTH AND DIRECTION.

Estimates based on the D.W.R. charts (8*h.*, 1881-1908; 7*h.*, 1909-1915).

Direction.	5 m/s. 11 mi/hr.	10 m/s. 22 mi/hr.	15 m/s. 33 mi/hr.	20 m/s. 44 mi/hr.	Over 20 m/s. Over 44 m/hr.	Total Frequency of Direction.
N.	27	18	13	10	5	73
NE.	29	49	21	7	4	110
E.	14	60	40	15	4	133
SE.	21	30	6	2	1	60
S.	10	29	17	4	3	63
SW.	18	58	33	13	5	127
W.	25	69	64	26	13	197
NW.	25	37	28	8	3	101
Total Frequency of Strength	169	350	222	85	38	864

Indeterminate — 186.

Tropical Thunderstorms.

THE meteorological potentialities of aeroplane observation become more apparent almost daily, and owe much of their value to the gaining of that second view-point which is so essential in studying all natural phenomena. *The Times* of 20th February prints an extremely interesting account of tropical thunderstorms as seen from mid-air, during the recent great attempt to cross the African continent.

> " Usually in the district lying between Victoria Nyanza and Lake Nyassa the mornings are fine from sunrise until noon ; but after that heavy thunderstorms may be expected to continue until sundown. . . .
>
> " In the air even the worst thunderstorms can be dodged. The average Central African thunderstorm consists of a mighty mass of nimbus rising sometimes to a height of 10,000 feet, pitch dark in the centre, turning to a silver grey at the base, from which the rain falls practically in a solid column to the ground. They move in broad circles at a rate ranging from 12 to 40 miles an hour.
>
> " I have seen as many as a dozen of these storms within an area of 100 square miles, yet, by dodging, we got safely home without feeling a splash of rain. On the ground their approach was heralded by a fierce, cool wind, but in the air one always experienced severe gusts and bumps within a mile of the rain column."

Readers of *British Rainfall* are familiar with the characteristic highly localized rainfall of heavy thunderstorms in this country, generally taking the form of narrow bands of heavy precipitation, sometimes continuous, sometimes interrupted, but nearly always separated by tracts in which no rain falls, or at most only slight showers. The work of Mr. J. Fairgrieve has gone some way towards throwing light on the process of development of these rain-fields, but much still remains to be discovered as to the direction of propagation and to the circumstances which give rise, either simultaneously or progressively, to a number of local columns of violent vertical air currents such as would appear to be necessary for the deposition of tropical rainfall.

February Phenology.

IN February, more fresh flowers have come out than in any of the fifteen years we have lived here, namely, 46 out of the 95 which were in bloom on the 29th. This compares with 25 out of 108 in 1913, our warmest winter. In 1917, our coldest winter, the totals at the end of February were 12 fresh out of 23 in all.

J. EDMUND CLARK.

Aysgarth, Purley, Surrey.

Review.

Meteorology for all : Being some Weather Problems explained. By D. W. Horner, F.R.Met. Soc., M. Aer. Inst. Introduction by M. de C. S. Salter. London : Witherby and Co., 1919. Size, $7\frac{1}{2} \times 5$. Pp. xii., 184. *Illustrations.*

THIS volume is a popular guide to the study of the weather. From the somewhat disproportionate number of chapters dealing with instruments, apparatus and units of measurement, and the excellent way these are presented it is quite evident that the author's tastes are chiefly mechanical. The regional aspect of meteorology, commonly disguised under the name of climatology, is left out altogether; but probably the author realizes that this side of the subject would require a volume to itself. In chapter XII., on "The Cause of Some Meteorological Phenomena," there is evidence of p. 115 that the author is not familiar with the principle of cooling by adiabatic expansion in the production of rainfall. In explaining the origin of thunderstorms on hot afternoons, he says : "As the hot air ascends it mixes with the colder atmosphere of the upper regions, and heavy squall cumulus clouds or 'thunder-heads' are formed." The primary cause of rainfall is the rising of air into regions of diminished pressure by whatever mode this is effected, with consequent expansion and cooling. Rather more than the average amount of credence is given in Chapter XVI., on "Weather Saws and Rules" to popular sayings about the weather, which, in default of a rigid definition of the terms of the argument, may generally be interpreted as one pleases. We must take exception to the author's endorsement of the superficial dictum, generally atrributed to Macaulay, that an English summer merely consists of a spell of three hot days, followed by a thunderstorm. This is more true of Scotland than England, and it is certainly a libel on the climate of the south of England, which during the summer half of the year experiences on the average a very considerable number of hot days.

Throughout the work there occur statements about the weather, for which the authority should be given; whether, for example, they are founded on statistical investigation or upon long personal experience. On pages 100 and 101 appear Abercromby's conventionalized diagrams of cyclone and anticyclone, which now ought to be banished from the text-books as effete. In the pioneer days, when isobaric configurations were first being studied, they served a useful purpose as broadly delineating the weather conditions appropriate to opposed types of atmospheric circulation. But apart from the wide variability in the character of individual depressions Abercromby's idealized cyclone appears faulty in the fuller light of modern knowledge, and should be replaced by Bjerknes's representation. Abercromby's diagram does not even suggest that the most persistent rainfall occurs generally with the easterly winds on the northern side of an ordinary eastward-moving system. L.C.W.B.

Obituary.

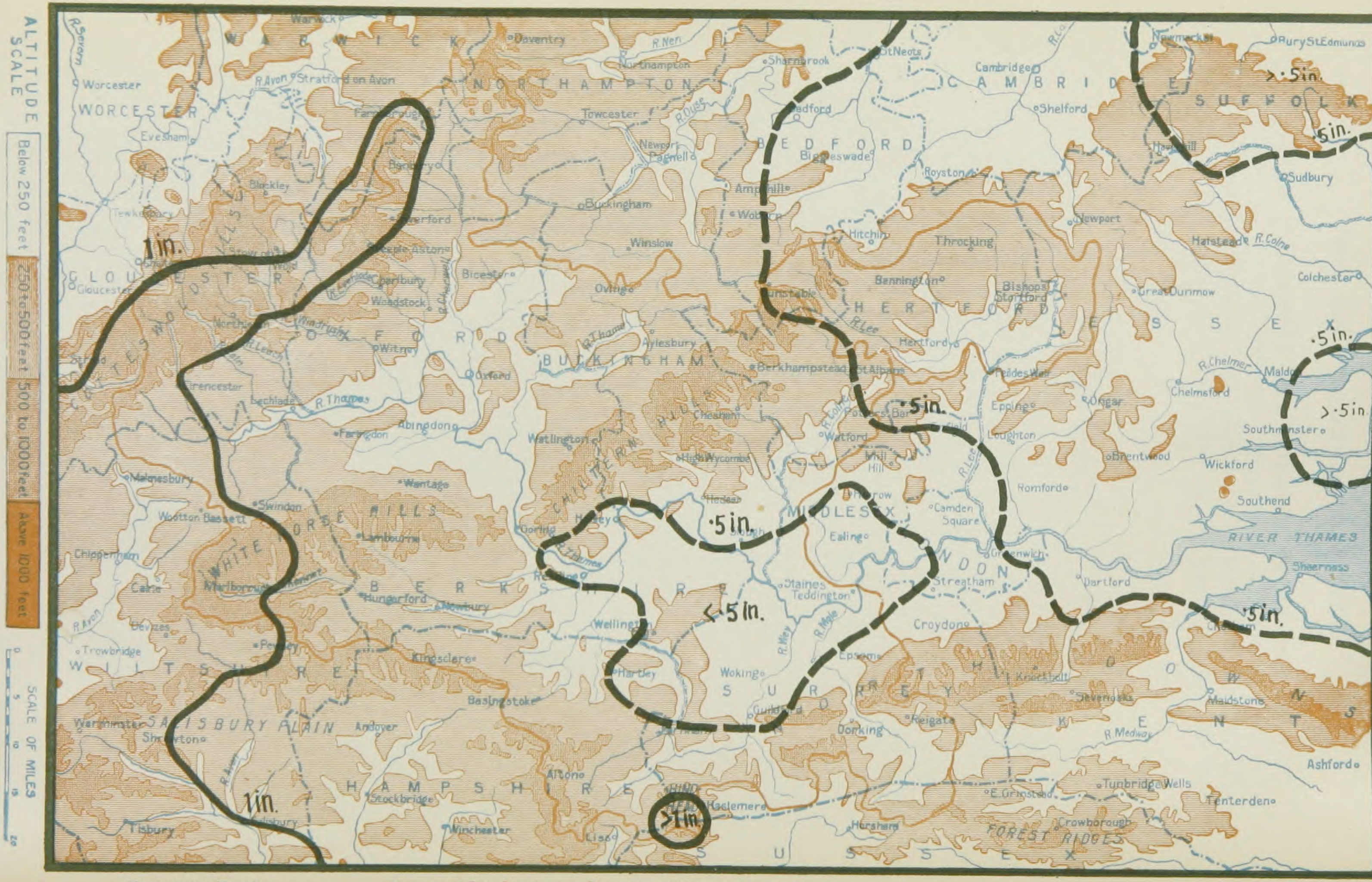
We learn, with deep regret, of the death, after a short illness, of *Mr. John Robert Gethin Jones*, of Llandudno. Mr. Gethin Jones's occasional contributions to scientific literature betray a wide knowledge of general meteorology and a keen insight into weather phenomena among the Welsh hills. His experience as a rainfall Observer was unparalleled, at any rate, in the British Isles. For twelve years he supervised observations at numerous remote spots in the mountains, in the Snowdon district, observations which throw valuable light on the control exercised by the configuration of the land. A still more arduous task was the measurement of the rainfall and stream-flow in the Black Mountains in Breconshire, on which he was engaged for about seven years, during which period daily observations were made over a wide area. His devotion to nature made him an inspiring companion as well as a reliable guide in scientific matters. The letter printed on p. 27 shews how his interest in Meteorology was maintained to the end of his life.

News in Brief.

The Meteorology of the Weddell Sea.—Meteorologists will be interested to know that Mr. R. C. Mossman, F.R.S.E., has undertaken the reduction of the meteorological data collected during the last Shackleton Antarctic Expedition, in co-operation with Mr. L. D. A. Hussey, B.Sc., Meteorologist to the Expedition. It is unfortunate that the autographic records went down with the *Endurance*, as they would have been useful in the investigation of certain characteristics of the diurnal variation of pressure and temperature, which appear to be peculiar to the Antarctic.

Zone Time.—It is announced that "Zone Time," four hours slow on Greenwich, is to be introduced in the Argentine on April 30th. The 24-hour clock is to be used for all official purposes.

THAMES VALLEY RAINFALL. FEBRUARY, 1920



Meteorological Magazine

Watershed of River Thames above Teddington and River Lea above Feildes Weir

Isohyetals

Weather in the British Isles: February, 1920.

FEBRUARY was characterized by a mean temperature decidedly in excess of the normal, a moderate amount of sunshine, and an absence of the boisterous conditions which prevailed in January.

In its deviation from the normal, the mean temperature for the month was remarkably uniform. The excess ranged from 2°·7 F, in Scotland, West, to 3°·6 F. in England, South-east. No district in any week showed a deficit, and except in Scotland West, every district, in one or other of the first three weeks, exceeded the normal by 3°·6 F. Scotland North reached 5° F. in the first week, England North-west, 5°·2 F., and the Midlands 5°·4 F. in the second week. The mild character of the month was shown by the fact, that, with the exception of Cambridge, which was nearly, and Raunds, which was exactly, at the normal in the week ended February 28th, no station contributing to the Weekly Weather Report had temperature below the normal in any of the four weeks. Only once during the past thirty-four years has so mild a February been recorded at Totland Bay. During the first three weeks, there were very few days when the maximum failed to reach 50°. On the 17th, a temperature of 61° in London was followed by a ground frost at night; next day, temperatures of 60° were general, and 62° was reached at Leamington Spa, Bath, and Aberystwyth, and 63° at Rhyl. On the 19th and 20th, a somewhat sudden change occurred in association with the south-easterly passage of a trough of low pressure off our north-western coasts. This caused the warm southerly current to be replaced by cold northerly winds, with a rapid decrease of temperature, and in the Midlands there were falls of snow and sleet. At Kew Observatory the maximum fell 15°, from 58° on the 19th to 43° on the 20th. At Meltham (Yorks.), the highest maximum temperature (61°) for at least forty-three years was followed twenty-six hours later by snow, which, between 16 h. and midnight of the 19th, had fallen to a depth of 7 inches. The Observer at Raunds (Northants.) speaks of passing from "Spring to mid-winter in twenty-four hours."

Sunshine, though mostly below the average during the second week, was in most places slightly above the normal for the month. The difference varied from a deficit of 0·75 hr. per day in Scotland North, and 0·18 hr. per day in Ireland North, to an excess of 0·55 hr. per day in Scotland East and England East, and 0·63 hr. per day in England North-east. During the month there were several occasions on which the day's sunshine amount reached 7·0 hr. Over 8 hrs. was recorded along the south coast, on the 7th (Hastings, 8·5 hrs.), as much as 9·0 hrs. on the 17th (Hastings, 9·3 hrs.), while on the 22nd, Penzance had 10·0 hrs., an amount very little short of the maximum for the time of year. A correspondent mentions the spring-like character of this same day, the 22nd, at Cambridge, when the sun shone from a cloudless sky all day, and the river was full of boats.

For the first few days of the month, there was a strong current of air from W.S.W. across the country, and the wind reached gale force in Scotland. The strength was estimated as Force 10 on the Beaufort Scale at Lerwick, on the 3rd and 4th. Gales also occurred in many parts of the kingdom between the 9th and 11th. Precipitation was abnormally heavy in Scotland, North and West, during these days, 30 mm. being measured at Eskdalemuir and at Glasgow on the 9th, and no less than 103 mm. at Fort William on the 9th and 10th together.

Over the south and east of England there was considerable deficiency of rain, large areas in the Thames Valley having less than ·50 in. More than

Continued on p. 36.

Rainfall Table for February, 1920.

STATION.	COUNTY.	Aver. 1875—1909. in.	1920 in.	1920 mm.	Per cent. of Av.	Max. in 24 hours in.	Max. in 24 hours Date	No. of Days
Camden Square	*London*	1·66	·58	15	35	·24	20	11
Tenterden	*Kent*	1·90	·59	15	31	·18	20	14
Arundel (Patching)	*Sussex*	2·17	·70	18	32	·31	10	9
Fordingbridge (Oaklands)	*Hampshire*	2·34	·89	23	38	·17	10	20
Oxford (Magdalen College)	*Oxfordshire*	1·62	·68	17	42	·34	20	11
Wellingborough	*Northampt'n*	1·70	·82	21	48	·36	20	11
Hawkedon Rectory	*Suffolk*	1·55	·74	19	48	·42	20	14
Norwich (Eaton)	*Norfolk*	1·75	·73	18	42	·29	20	13
Launceston (Polapit Tamar)	*Devon*	2·95	1·06	27	36	·19	10	17
Lyme Regis (Rousdon)	,,	2·50	·50	13	20	·11	20	11
Ross (Birchlea)	*Herefordshire*	2·12	·67	17	32	·23	19	16
Church Stretton (Wolstaston)	*Shropshire*	2·17	2·40	61	111	1·11	19	12
Boston	*Lincoln*	1·53	·83	21	54	·39	20	11
Worksop (Hodsock Priory)	*Nottingham*	1·64	2·12	54	129	1·69	19	17
Mickleover Manor	*Derbyshire*	1·71	2·39	61	140	·88	19	13
Southport (Hesketh Park)	*Lancashire*	2·07	2·12	54	102	·67	19	17
Wetherby (Ribston Hall)	*York, W.R.*	1·71	1·80	46	105	·50	19	8
Hull (Pearson Park)	,, *E.R.*	1·78	1·51	38	85	1·07	19	13
Newcastle (Town Moor)	*North'land*	1·63	·98	25	60	·54	19	9
Borrowdale (Seathwaite)	*Cumberland*	10·96	14·50	368	132	..	..	..
Cardiff (Ely)	*Glamorgan*	3·07	1·62	41	53	·32	9	21
Haverfordwest	*Pembroke*	3·42	2·12	54	62	·64	19	18
Birmingham ww. Tyrmynydd	*Radnor*	5·16	4·18	106	81	1·09	9	18
Llandudno	*Carnarvon*	2·11	2·56	65	121	·91	19	16
Dumfries (Cargen)	*Kirkcudbrt.*	3·42	4·38	111	128	1·04	9	19
Marchmont House	*Berwick*	2·15	2·26	57	105	·56	18	12
Girvan (Pinmore)	*Ayr*	3·87	4·20	107	109	·60	9*	19
Glasgow (Queen's Park)	*Renfrew*	2·70	5·19	132	192	1·52	9	18
Islay (Eallabus)	*Argyll*	3·91	5·16	131	132	·93	9	22
Mull (Quinish)	,,	4·45	6·58	167	148	·71	8	23
Loch Dhu	*Perth*	6·69	15·45	392	231	2·95	9	19
Dundee (Eastern Necropolis)	*Forfar*	1·91	1·81	46	95	·52	18	14
Braemar	*Aberdeen*	2·55	3·14	80	123	·58	12	15
Aberdeen (Cranford)	,,	2·36	1·23	31	52	·35	18	13
Gordon Castle	*Moray*	1·95	1·74	44	89	·79	18	14
Drumnadrochit	*Inverness*	2·89	5·86	149	203	·79	9	23
Fort William	,,	6·85	19·11	485	279	3·20	9	24
Loch Torridon (Bendamph)	*Ross*	7·53	14·07	357	187	1·74	1	23
Stornoway	,,	4·19	7·44	189	178	1·26	17	24
Dunrobin Castle	*Sutherland*	2·58	2·25	57	87	·50	10†	10
Wick	*Caithness*	2·23	2·36	60	106	·28	2	19
Glanmire (Lota Lodge)	*Cork*	3·76	1·76	45	47	·28	16	21
Killarney (District Asylum)	*Kerry*	4·99	3·01	76	60	·61	16	25
Waterford (Brook Lodge)	*Waterford*	3·18	1·86	47	58	·43	25	18
Nenagh (Castle Lough)	*Tipperary*	2·89	3·61	92	125	·96	17	20
Ennistymon House	*Clare*	3·44	4·52	115	131	·75	9	21
Gorey (Courtown House)	*Wexford*	2·75	1·61	41	59	·28	25	17
Abbey Leix (Blandsfort)	*Queen's Co.*	2·55	2·68	68	105	·62	9	18
Dublin (FitzWilliam Square)	*Dublin*	1·93	1·85	47	96	·34	3	15
Mullingar (Belvedere)	*Westmeath*	2·67	2·76	70	103	·50	19	21
Woodlawn	*Galway*	2·80	3·04	77	109	·51	9	19
Crossmolina (Enniscoe)	*Mayo*	4·20	5·92	150	141	1·09	2	23
Collooney (Markree Obsy.)	*Sligo*	3·20	3·17	80	99	·50	9	20
Seaforde	*Down*	2·81	2·15	55	77	·62	18	16
Ballymena (Harryville)	*Antrim*	2·99	2·74	70	92	·42	18	19
Omagh (Edenfel)	*Tyrone*	2·68	3·64	92	136	1·18	9	22

Supplementary Rainfall, February, 1920.

Div.	STATION.	RAIN. in.	RAIN. mm.
II.	Ramsgate	·60	15
,,	Sevenoaks,Speldhurst	·58	15
,,	Hailsham............	·50	13
,,	Totland B. Aston Ho.	·41	10
,,	Ashley, Old Manor Ho.	·92	23
,,	Grayshott	·83	21
,,	Ufton Nervet	·71	18
III.	Harrow Weald, Hill Ho.	·49	12
,,	Pitsford, Sedgebrook .	·51	13
,,	Chatteris, The Priory .	·49	12
IV.	Elsenham, Gaunts End	·47	12
,,	Lexden, Hill House ..	·35	9
,,	Aylsham, Rippon Hall	·73	18
,,	Swaffham	·69	18
V.	Devizes, Highclere ..	·97	25
,,	Weymouth	·44	11
,,	Ashburton, Druid Ho.	1·38	35
,,	Cullompton	·80	20
,,	Lynmouth, Rock Ho.	1·86	47
,,	Hartland Abbey......	1·17	30
,,	St. Austell, Trevarna	1·10	28
,,	North Cadbury Rec. .	1·05	27
VI.	Clifton, Stoke Bishop .	1·86	47
,,	Ledbury, Underdown .	·56	14
,,	Shifnal, HattonGrange	1·53	39
,,	Ashbourne, Mayfield ..	2·89	73
,,	Barnt Green	·63	16
,,	Blockley, Upton Wold	1·20	30
VII.	Grantham, Saltersford	1·22	31
,,	Louth, Westgate	2·09	53
,,	Mansfield, West Bank	2·30	58
VIII.	Nantwich, Dorfold Hall	3·19	81
,,	Bolton, Queen's Park .	3·90	99
,,	Lancaster, Strathspey.	2·78	71
IX.	Wath-upon-Dearne ...	1·89	48
,,	Bradford, Lister Park.	2·88	73
,,	West Witton.........	2·00	51
,,	Scarborough, Scalby	1·35	34
,,	Ingleby Greenhow ...	·91	23
,,	Mickleton	3·40	86
X.	Bellingham	2·53	64
,,	Ilderton, Lilburn	2·02	51
,,	Orton	8·01	204
XI.	Llanfrechfa Grange ...	1·26	32
,,	Treherbert,Tyn-y-waun	6·23	158
,,	Carmarthen, The Friary	2·36	60
,,	Fishguard	1·56	40
,,	Lampeter, Falcondale .	3·22	82
,,	Abergwngy	7·25	184
,,	Crickhowell, Talymaes	2·10	53
,,	Sennybridge	2·30	58
,,	Lake Vyrnwy	8·21	208
,,	Llangynhafal, P.Drâw.	2·67	68
,,	Dolgelly, Bryntirion ..	5·28	134
,,	Lligwy	2·74	70
XII.	Stoneykirk,ArdwellHo.	2·58	66
,,	Gatehouse, Cally	4·21	107
,,	Carsphairn, Shiel ...	7·84	199
XII.	Langholm, Drove Rd.	6·04	153
XIII.	Selkirk, Hangingshaw	2·47	63
,,	North Berwick Res. ..	1·67	42
,,	Edinburgh, Royal Ob.	2·40	61
XIV.	Biggar	3·88	99
,,	Leadhills	7·41	188
,,	Maybole, Knockdon ..	6·20	157
XV.	Rothesay	6·20	157
,,	Oban	8·23	209
,,	Inveraray Castle	14·72	374
,,	Holy Loch, Ardnadam	11·83	300
XVI.	Loch Venachar	10·10	256
,,	Glenqucy	7·10	180
,,	Loch Rannoch, Dall. .	8·08	205
,,	Coupar Angus.........	1·97	50
,,	Montrose Asylum.....	1·27	32
XVII.	Balmoral Castle	2·07	53
,,	Fyvie Castle	·99	25
,,	Peterhead, Forehill ...	..	..
,,	Grantown-on-Spey ...	2·28	58
XVIII.	Cluny Castle	6·87	174
,,	Loch Quoich, Loan ...	29·80	757
,,	Skye, Dunvegan......	11·06	281
,,	Fortrose............	3·11	79
,,	Ardross Castle	4·91	125
,,	Glencarron Lodge ...	15·00	381
XIX.	Tongue Manse	4·68	119
,,	Melvich	3·10	79
,,	Loch More, Achfary .	12·13	308
XX.	Dunmanway Rectory .	3·73	95
,,	Mitchelstown Castle ..	2·63	67
,,	Gearahameen	·58	15
,,	Darrynane Abbey ...	2·82	72
,,	Clonmel, Bruce Villa .	2·15	55
,,	Cashel, Ballinamona ..	2·28	58
,,	Roscrea, Timoney Pk.	2·30	58
,,	Foynes	3·30	84
,,	Broadford,Hurdlesto'n	3·82	97
XXI.	Kilkenny Castle	1·87	48
,,	Rathnew, Clonmannon	1·35	34
,,	Hacketstown Rectory	2·73	69
,,	Ballycumber, Moorock	3·14	80
,,	Balbriggan, Ardgillan	1·80	46
,,	Drogheda	1·68	43
,,	Athlone, Twyford	2·78	71
,,	Castle Forbes Gdns. .	2·56	65
XXII.	Ballynahinch Castle ..	4·78	121
,,	Westport House	3·96	101
XXIII.	Enniskillen, Portora ..	2·95	75
,,	Cootehill, Dartrey	3·06	78
,,	Armagh Observatory .	2·47	63
,,	Warrenpoint,ManorHo.	2·35	60
,,	Belfast, Cave Hill Rd.	2·17	55
,,	Glenarm Castle	4·99	127
,,	Londonderry, Creggan	2·61	66
,,	Sion Mills	2·92	74
,,	Milford Manse	3·10	79
,,	Killybegs	5·06	128

Climatological Table for the

STATIONS Those in italics are South of the Equator	Pressure Mean M.S.L. mb.	Pressure Diff. from Normal mb.	Temperature Absolute Max. °F.	Date	Min. °F.	Date	Mean Values Max. °F.	Min. °F.	½ max. and min. °F.	Diff. from Normal °F.
London, Kew Obsy. ..	1017·0	+0·2	83·	11	31·	30	65·7	48·6	57·2	+0·1
Gibraltar	1015·9	—0·1	87·0	1	56·1	29	77·9	65·2	71·5	—0·8
Malta	1015·7	—2·2	87·8	16	65·5	25	82·0	70·7	76·3	+0·6
Sierra Leone	1013·6	+1·2	90·0	2,13	58·	17	84·0	62·8	73·4	—5·8
Lagos...............	..	..	86·5	21	70·3	19	81·0	73·3	77·1	—1·0
Kaduna, N. Nigeria ..	*944·2	..	94·	29	64·	16	83·8	66·7	75·3	..
Cape Town	..	..	83·0	17	39·2	12	63·7	47·8	55·7	—2·2
Johannesburg	..	..	86·1	28	31·0	14	70·6	46·0	58·3	—0·9
Mauritius	1018·7	—1·4	80·8	29	58·8	2, 9	77·7	63·0	70·3	+0·3
Bloemfontein	..	..	87·7	28	26·0	7	71·9	40·0	55·9	—3·9
Calcutta, Alipore Obs.	..	..	93·5	21	75·4	7	88·6	78·2	83·4	+0·6
Bombay	..	..	89·3	22	76·2	3	86·2	74·4	80·3	—0·3
Madras	..	..	99·0	1, 2	73·3	16	91·8	76·9	84·3	—0·6
Colombo, Ceylon	..	..	86·9	19	71·6	13	84·9	74·7	79·8	—2·1
Hong Kong	1010·6	+2·1	88·0	7,11	72·7	16	84·7	76·8	80·8	—0·9
Sydney.............	..	..	92·3	27	41·4	8	71·7	51·2	61·5	+2·5
Melbourne..........	..	..	85·0	19	36·0	21	65·6	46·5	56·1	+2·1
Adelaide	..	..	83·7	23	39·4	7	66·0	48·0	57·0	0·0
Perth	..	..	72·3	7	40·9	20	64·3	47·7	56·0	—2·2
Coolgardie	..	..	84·2	21	35·2	11	70·5	43·3	56·9	—1·2
Brisbane	..	..	87·3	14	46·5	9	76·3	55·4	65·9	+0·6
Hobart, Tasmania	..	..	74·9	19	35·1	5	60·2	44·3	52·3	+1·5
Wellington, New Zealand	1011·0	—1·8	65·3	26	31·2	9	57·1	43·8	50·5	—0·9
Suva, Fiji	1017·4	+1·8	89·4	6	62·8	7	78·5	68·5	73·5	—1·0
Kingston, Jamaica ...	1011·2	—0·9	92·8	4	70·1	20	89·9	74·0	81·9	+0·4
Grenada	1008·8	—3·1	88·0	2,10	72·0	16†	85·1	75·1	80·1	—0·1
Toronto	..	..	94·7	8	38·7	18	73·9	53·0	63·5	+2·7
Fredericton..........	..	..	78·7	29	32·0	16	66·4	45·7	56·1	+1·
St. John, N.B.	..	..	75·2	2	39·3	16	62·0	49·2	55·6	—1·1
Victoria, B.C.	..	..	81·4	14	48·0	29	64·9	50·4	57·7	+1·0

* At Station Level, height of 2088 feet. † Also 21 and 23.

London, Kew Observatory.—1 thunderstorm, 6 fogs.

Gibraltar.—3 thunderstorms.

Sierra Leone.—1 thunderstorm, 1 gale.

Mauritius.—Prevailing wind ESE ; mean speed, 5·1 mi./hr.

Bloemfontein.—Severest drought experienced.

Colombo, Ceylon.—Prevailing wind SW ; mean speed, 5·0 mi./hr. ; 3 thunderstorms.

British Empire, September, 1919.

TEMPERATURE				PRECIPITATION						
Mean Values				Amount						
Dew Point ° F.	R'tive. Humidity %	Max. in Sun ° F.	Min. on Grass ° F.	in.	mm.	Diff. from Normal mm.	Days	Mean Cloud Am'nt.	Bright Sunshine Hours per day	STATIONS Those in italics are South of the Equator
50·7	76	133·3	19·6	1·5	37	—11	10	5·2	5·10	London, Kew Observatory.
62·0	74	145·	50·	2·61	66	+29	9	4·2	..	Gibraltar.
..	78	142·	..	0·42	11	—23	1	5·3	8·2	Malta.
71·9	82	..	..	20·81	529	—217	25	5·3	..	Sierra Leone.
71·4	81	160·3	59	2·74	70	—60	11	8·0	..	Lagos.
68·3	86	..	..	11·57	294	+34	24	2·6	..	Kaduna, N. Nigeria.
48·5	75	..	..	3·54	90	+33	14	5·4	..	*Cape Town.*
38·7	61	..	30·2	0·25	6	—18	3	2·8	9·37	*Johannesburg.*
61·0	74	..	52·3	3·24	82	+43	13	5·9	..	*Mauritius.*
35·6	46	..	..	0·44	11	—12	4	2·2	..	*Bloemfontein.*
77·2	84	..	69·1	2·58	66	—197	8	6·7	..	Calcutta, Alipore Obsy.
75·9	84	129·6	68·0	8·16	207	—68	19	6·8	..	Bombay.
75·4	80	164·5	72·2	6·72	171	+40	10	4·9	..	Madras.
73·4	84	161·7	68·9	16·74	425	+288	25	8·3	..	Colombo, Ceylon.
70·7	73	..	..	2·65	67	—187	10	4·7	7·78	Hong Kong.
48·7	58	139·2	31·9	3·98	101	+27	11	3·6	..	*Sydney.*
43·2	60	133·9	25·2	1·05	27	—34	14	5·8	..	*Melbourne.*
47·2	67	137·0	30·3	3·05	77	+27	18	5·2	..	*Adelaide.*
47·6	71	137·6	31·0	2·41	61	—24	14	4·6	..	*Perth.*
40·0	47	141·0	26·8	0·48	12	—5	3	2·8	..	*Coolgardie.*
51·5	59	142·1	35·5	0·19	5	—48	3	2·6	..	*Brisbane.*
39·1	57	132·2	28·1	1·19	30	—24	15	6·0	..	*Hobart, Tasmania.*
43·4	77	135·0	23·0	1·96	50	—49	12	6·5	5·65	*Wellington, New Zealand.*
67·7	82	..	..	11·36	289	+119	18	7·2	..	*Suva, Fiji.*
72·2	70	..	..	1·95	50	—54	10	5·6	..	Kingston, Jamaica.
73·6	80	138·0	..	11·05	281	+81	22	4·7	..	Grenada.
52·6	80	128·3	33·7	1·91	49	—23	10	5·1	..	Toronto.
47·9	75	..	..	5·16	131	+41	11	5·9	..	Fredericton.
49·7	82	133·8	31·0	4·81	122	+30	16	6·9	..	St. John, N.B.
52·0	74	131·5	35·0	1·35	34	—9	8	3·5	..	Victoria, B.C.

HONG KONG.—Prevailing wind E by S; mean speed, 9·7 mi./hr.

Sydney.—Highest maximum on record in September.

Melbourne.—Drought severe. Highest maximum on record in September for 63 years.

Brisbane.—Rainfall continuously seriously deficient.

Wellington.—3 sunless days, 1 thunderstorm; snow on hilltops on 2nd.

GRENADA.—4 thunderstorms.

3 inches occurred on the Pennines, and in the west, and also over the whole of Scotland except coast strips in the south and east. Part of the Lake District of the Scottish Highlands had more than 15 inches, a considerable area having more than double the average. In Ireland the fall ranged from rather less than 2 inches along the south and east coasts to 6 inches in the extreme west. The general rainfall expressed as a percentage of the average was :—England and Wales, 77 ; Scotland, 164 ; Ireland, 89 ; British Isles, 112.

In London (Camden Square) the mean temperature was 43°·0, or 3°·3 above the average, it being the third successive month with an excess of more than 3°. Duration of rainfall, 22·5 hours. Evaporation, ·24 in.

Weather Abroad: February, 1920.

In western Europe the rainy and stormy weather of January continued during the month, though with less severity. The heaviest rains occurred in association with a depression which passed from Portugal to the Mediterranean. At Perpignan, on the north side of its path, 25 mm. and 48 mm. of rain were measured for consecutive days, the 19th and 20th. Floods were subsequently reported at many places in the south of France. High temperatures occurred on the Continent, as in the British Isles, on the 17th , when the maximum at Strasbourg was as high as 69° F. Phenomenal rain fell at Madeira on the 25th and 26th, the total fall of 48 hours being 213 mm., or 8·5 in.

In the near East, in S. Russia, Greece and Egypt, and especially in Palestine, cold and stormy conditions prevailed. In Jerusalem no less than 39 inches of snow fell on the 13th, the heaviest snowfall since 1860, and under the influence of a high wind the snow accumulated in drifts, causing much damage. As a record of this event, a photograph shewing soldiers knee-deep in snow, in a street in Jerusalem, has been reproduced by the *Graphic*.

In Australia, the welcome rains continued, and early in the month the serious drought which had been prevalent in South Africa, was broken by copious falls.

The most remarkable conditions of the month were in North America. On the first day of the month a shallow depression appeared off the south of Florida ; this depression passed north-eastwards along the coast, deepening rapidly, and on the 6th, it was off New York. On this day the severe weather experienced in the north-eastern States during January culminated in one of the greatest snow blizzards ever recorded there. The snow fell with a north-easterly gale, which extended far out into the Atlantic. Transport, both passenger and goods, was rendered impossible. The New York summer resorts suffered severely, especially Coney Island, which was almost destroyed. In New York it proved impossible to clear the streets for nearly a fortnight. Boston, Buffalo, and other cities were similarly snow-bound. It must be remarked, however, that the mean temperature of this period was not below the normal for February, which is about 30° F. In the St. Lawrence Gulf, heavy ice-fields still held the steamship *Montcalm*, while in Canada, heavy snows and continuous cold (for twelve weeks no temperature above freezing point had been reported) caused great inconvenience.

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Climates of the British Empire suitable for the Cultivation of Cotton.

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

COTTON is a sub-tropical plant which probably originated in the Eastern Mediterranean, but it has become so thoroughly naturalised in the Southern States of America that they must be considered as having the most suitable climate for the commercial cultivation of the plant. The cotton belt includes the States of Tennessee, Alabama, South Carolina, Louisiana, Texas and Oklahoma. The climatology of these regions has been described in two important papers.*

The essential features of a cotton-growing climate are :—(1) The mean annual temperature should not be below 60° F. (2) The mean temperature of the warmest month should exceed 80° F. or the mean of the three warmest months should exceed 77° F. to get the best results; this condition, however, is not so important as the first. (3) The interval between killing frosts (or droughts) should be at least 200 days. (4) The annual rainfall should not exceed about 60 inches for good crops, though cotton of a poorer quality

* Washington, D.C., U.S. Dept. Agric., Bull. No. 8. Report on the climatology of the cotton plant. By P. H. Mell, 1893.

Stine, O. C., and Baker, O. E. Climate of the cotton belt. Washington, D.C., U.S. Dept. Agric., Monthly Weath. Rev., 47, 1919, p. 487.

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can be grown in much wetter climates. Unless irrigation is possible the annual fall should not be less than 23 inches. (5) There must be plenty of bright sunshine. A dull and humid atmosphere is particularly unfavourable to the cotton plant.

In the cotton belt of the United States the rainfall lies in almost all parts between 23 inches and 60 inches. The mean annual temperature nowhere falls below 60° F., and the warmest month always just exceeds 80° F.

In the British Empire these conditions are found in their entirety in parts of India and in the West Indies, which are already important cotton-producing countries. Other colonies whose annual rainfall lies between the specified limits may be considered in greater detail.

Uganda, represented by Entebbe, lies at an elevation of more than 3,000 feet, and the heat natural to a place on the equator is reduced by this elevation, so that the temperature is rather below the specified temperature for the warmest month, but the remarkable uniformity both in temperature and rainfall throughout the year should counterbalance this and enable cotton crops to be grown with reasonable success.

Nyasaland is represented by Zomba at a height of 3,000 feet. The annual rainfall is 55 inches with a well-marked dry season. The summer temperature is nearly 75°, and cotton has been tried experimentally with some success. On the lower ground near Lake Tanganyika and the Shire River it should do very well, and only lack of transport is against successful commercial cotton production.

Gambia.—Bathurst has a very suitable climate except for the length of the dry season and the excessive rain in August. Cotton should do well, however, as an irrigated crop in the dry season.

The Soudan, as represented by Wau, has a very favourable climate, and cotton should do well. In the drier parts irrigation would be necessary.

Nigeria.—The coastal regions of Nigeria, represented by Lagos, appear to be too moist and rainy for the successful growth of high quality cotton, but further inland, as at Zungeru, conditions appear to be excellent.

Gold Coast.—The rainfall of this colony is very variable, but is less than that of the Nigerian Coast, and cotton should do well.

Rhodesia, represented by Salisbury, has a very similar climate to that of Zomba, and cotton should do well in the low-lying parts of the colony.

British East Africa consists of a low coastal region (*c.f.* Zanzibar) and the high Kenia plateau (Nairobi). The plateau is generally too high, but some cotton can be grown in the coastal belt; generally, however, the rainfall is too heavy for a commercial crop.

The Union of South Africa as a whole has a climate unsuited to the cultivation of cotton, being hardly warm enough and having also sparse and irregular rains. The east coast, however, including Natal, is far more suitable.

Australia.—The Northern Territory is only just too wet, and the coast of Queensland seems suitable. Further south, New South Wales and Victoria, where cotton has been tried and has not been a success commercially, are barely warm enough. The wetter parts of West Australia should be successful with Egyptian cotton, but without irrigation the interior is too dry.

New Guinea.—An untouched source of supply, probably of great value, is to be found in New Guinea, where the climate of the southern coast is very suitable, and where a native cotton of good quality already exists.

The colonies such as *Sierra Leone*, *Borneo*, *Fiji*, *Seychelles*, *British Honduras*, *Ceylon*, *Straits Settlements* and *Guiana* are in general too damp for the commercial production of good quality cotton, though probably some cotton for native use is grown in most of these colonies. On the other hand, Cyprus and Malta have too little and too irregular rains for the successful growth of cotton crops without irrigation. The case of Lower Egypt need not be referred to; in Upper Egypt the air seems to be too dry even with proper irrigation.

Royal Meteorological Society.

ON Wednesday, March 17th, a lecture was delivered before the Royal Meteorological Society by Captain C. K. M. Douglas, at the rooms of the Royal Astronomical Society, on "Clouds as seen from an Aeroplane." Some of Captain Douglas's photographs of cloud, taken whilst observing for the Meteorological Service in the North of France, have already appeared in *Symons's Meteorological Magazine.* Many others were used to illustrate the lecture, and details of the meteorological conditions associated with the various types were discussed.

The lecture will be printed in the *Quarterly Journal* of the Royal Meteorological Society.

The Royal Society.

AT the meeting of the Royal Society on February 26th, Mr. L. F. Richardson read a paper on "Some Measurements of Atmospheric Turbulence."

The movement of small floating particles such as smoke or the parachutes of plant seeds is considered by the author. If the particles start from a fixed point and the standard deviation of their heights after a certain time is estimated, then, as shown by Osborne Reynolds, provided the time is short, the standard deviation is proportional to the time. On the other hand, when the time is large, the standard deviation is proportional to the square root of the time in accordance with the theory of eddy conductivity.

The author's measurements show that the diffusivity (the K of Taylor's theory) increases greatly with height in the first kilometre. Reasons are given for supposing that it is useful to assume in general that the conductivity of air for water vapour is equal to the viscosity, and the fitting methods for measuring each by smoke are contrasted.

Official Publications.

Climatological Diagrams, M.O. 3096. 60 copies, 7s. 6*d.*; post free, 7s. 10*d.*

In response to the demand from observers for a climatological diagram on which daily readings can be displayed graphically, a new form (M.O. 3096) has been prepared. Provision is made for the readings for one week, and it is suggested that the diagrams for the past and current weeks should be exhibited together so that the progress of the weather for at least seven clear days may be seen. The charts have the advantage of a more open scale than can be obtained in the customary monthly charts.

Soundings with Pilot Balloons in the Isles of Scilly, November and December 1911. Geophysical Memoirs, No. 14, M.O. 220d. By Captain C. J. P. Cave, M.A., and J. S. Dines, M.A. Price 1s. 6*d.* net.

The Climate and Weather of the Falkland Isles and South Georgia. Geophysical Memoirs, No. 15, M.O. 220b. By C. E. P. Brooks, M.Sc. Price 3s. 6*d.* net.

The two Memoirs mentioned above have just been published. A short account of the subject matter of each will appear in the next number of the Magazine.

Meteorological Stations.

A LIST of new stations of the Meteorological Office is given below. Three of the stations, namely Croydon, Didsbury, and Biggin Hill, have been established recently. The others were established by the Royal Air Force during the War, and their reports have been utilised continuously in the Daily Weather Service. The normal equipment of these stations includes anemograph, barograph, thermograph, hygrograph and hyetograph, but Beachy Head is not provided with autographic instruments. Biggin Hill is a kite-balloon station.

County.	Station.	Lat.		Long.		Height in feet above M.S.L.	Officer in Charge.
		°	′	°	′		
Dublin -	Baldonnel -	53	18	6	26 W	300	Lieut. J. J. Somerville.
Lancashire -	Didsbury	53	26	2	13 W	99	Capt. G. H. L. Douglas-Lane.
Lincolnshire	Cranwell -	53	2	0	31 W	233	Capt. W. H. Pick.
Norfolk -	Howden -	53	47	0	52 W	19	Lieut. Guy Harris.
Suffolk -	Felixstowe	51	57	1	20 E	15	Lieut. A. Walters.
Kent	Lympne -	51	5	1	1 E	340	Lieut. R. S. Read.
Hampshire-	Calshot -	50	49	1	18 W	12	Capt. H. W. L. Absalom.
Surrey -	Croydon	51	21	0	7 W	242	Capt. G. R. Hay.
Sussex -	Beachy Head.	50	44	0	15 E	525	Chief Officer Coast-Guard.
Kent - -	Biggin Hill	51	19	0	3 E	610	Mr. T. H. Applegate (Observer).

Retirements.

Mr. Henry Harries, who is a native of South Wales, joined the staff of the Meteorological Office in May 1875 as a Temporary Clerk, has been identified with the work of the Marine Division and the preparation of Monthly Meteorological Charts of the Oceans, and also with the work of Weather Forecasting and Storm Warning.

He began his service in the Marine Division under Captain Toynbee, and continued with Marine Meteorology under Captain Hepworth until, on promotion to Principal Assistant in 1903, he was transferred to the Forecast Division. He continued in that division until February 1919, when, on the death of Mr. Allingham, he returned to the Marine Division.

In May of that year he was promoted Assistant Superintendent, a post which he held until his retirement on 31st March 1920.

Mr. Harries has written numerous papers on meteorological subjects, and for many years he acted as correspondent to the *Morning Post.*

Mr. T. Duncan Bell joined the staff in November 1869, at the age of 15, as a Temporary Clerk, and was attached to the Observatory Branch under Mr. Samuel Jeffery. He was shortly after transferred to what was then the general office or correspondence department under Mr. J. S. Harding, the Chief Clerk, whom he assisted in the care of the Library. The entire charge of the Library subsequently devolved upon him, and from 1906, when he was promoted to Principal Assistant in the Statistics and Library Branch, he dealt also with inquiries of all kinds, personal and by letter, under the supervision of the Superintendent of Statistics.

These duties were maintained until April 1914, when he succeeded Mr. J. A. Curtis as Chief Clerk, a position which he held throughout the difficult period of the War until his retirement, 31st March 1920, after 50 years and 5 months of service.

Obituary.

NEWS is received of the death on March 13th of *Mr Thomas William Backhouse*, of West Hendon House, Sunderland, in his 78th year. Like many of the members of the Society of Friends, Mr. Backhouse devoted a very large part of his long life to scientific pursuits and carried on for more than sixty years an elaborate series of meteorological and astronomical observations. A great part of the results of these observations he condensed into a valuable book, published in 1915, containing summaries of records for 50 years. Amongst his original investigations was a discussion of the amount of rain falling with wind blowing from the various points of the compass. The position of Sunderland on the East coast of Great Britain gives a peculiar interest to the work as showing that at a station so situated a high proportion of the rainfall is associated with breezes from the North Sea. Elected a Fellow of the Royal Meteorological Society in 1892, Mr. Backhouse served as Vice-President in 1918 and 1919.

We learn with deep regret of the death on February 20th of *Mr. Maxwell Hall*, Government Meteorologist of Jamaica. Mr. Maxwell Hall was by profession a Barrister-at-Law and Resident Magistrate for the district of Hanover, but his interest in meteorology and astronomy was very keen, and it is entirely owing to his work that our knowledge of the weather of Jamaica is on a better basis than that of any other West Indian island. His efforts in this direction date back to 1878, and after two visits to London, in the course of which the matter came before the Meteorological Council, he succeeded, in 1880, in obtaining the establishment of the Jamaica Weather Service, with a subsidy of £150 per annum, out of which he had to pay £50 to an observer and to meet other expenses. The objects of the Service were to encourage the recording of rainfall and to foretell the approach of hurricanes, in both of which he was eminently successful. It is interesting to note that considerable use was made of spectroscopic observations.

The first monthly weather report was for the month of June 1881, and the series has been continued without interruption until the present day, though the subsidy was discontinued from time to time. In 1891 appeared the first edition of the Rainfall of Jamaica, a foolscap volume with full page monthly maps, based on data at 153 stations. This was reprinted in 1911, when 194 stations were available with records covering at least ten years. The discussion of the data is very complete, and the whole forms a model piece of work. Other publications include a Report on the Barometer in Jamaica (1911), reports on earthquakes and numerous descriptions of various West Indian hurricanes. In 1904 appeared a general description of the Meteorology of Jamaica. It is very greatly to be hoped that this fine record of work will not be interrupted by the death of its originator.

The Study of Atmospheric Physics.

(Extracts from a memorandum by Frank H. Bigelow.)

ATMOSPHERIC Physics divides into several branches, commonly known as Meteorology, Solar Physics, Atmospheric Electricity, Magnetism, Radiation, Electron-dynamics.

There are ten fundamental laws which must be satisfied simultaneously by the data derived from the observations made in all the branches. They are :—

1. The Boyle-Gay Lussac Law in non-adiabatic media.
2. The First Law of Thermodynamics.
3. The gravity balance equation in atmospheres.
4. The kinetics of molecular energy.
5. The Poynting Equation of transformation.
6. The Stefan Law of Radiation.

7. The Maxwell Spectrum Distribution Law.
8. The Wien-Displacement Law.
9. The Maxwell Laws of Electro-magnetism.
10. The Law of Electron-atom-molecular Dynamics.

During 50 years these observational data and these laws have been *disjecta membra*, lacking an organic unity to make them harmonious. The reason for this unsatisfactory state of the Science of the Atmosphere is that there has been no unifying analytic system sufficiently comprehensive and exacting to accomplish this purpose. The empirical processes have unduly received attention and support because of their simplicity and public utility.

During the past ten years my research has gradually built up a successful body of formulæ which now have the power to weld these separated subjects into one harmonious system. Years were spent on statistics, other years on the well-known analytic discussions, but these were never found to fit together. Then a new beginning was made such that the Boyle-Gay Lussac Law should fit exactly in the atmospheric strata that are under observation. From this foundation the structure implied in the ten fundamental laws has been developed step by step. This has involved a radical departure from many of the ideas that have been in circulation for many years, notably from the Abbot value of the solar intensity of radiation, the Planck workungsquantum, the Bohr non-radiating orbits, the Rutherford heavy nucleus, the entire series of observations made by the several national services. On the other hand, we compute the radiation at any point in an atmosphere where the temperature is known, the spectrum distribution (in part), the electric and the magnetic fields, the electron and atomic orbit, &c. The subject is very extensive, complex, difficult to popularise, especially among non-mathematical circles. The possibilities of the new fundamental laws are limitless theoretically and practically.

The pressing question is how to get the world generally on this new procedure. Leagues, unions, societies with brief rare sessions are impractical. What is needed is a small body of experts for a few years to clarify, verify, prepare literature, and gradually reform the entire procedure of atmospheric physics.

January 23rd, 1920, *Pilar, F.C.C.A., Argentina.*

Prof. Bigelow's views are set out more fully in his books (*a*) Treatise on the circulation and radiation in the atmospheres of the Earth and of the Sun. New York, 1915. (*b*) Treatise on the Sun's radiation. New York, 1918.

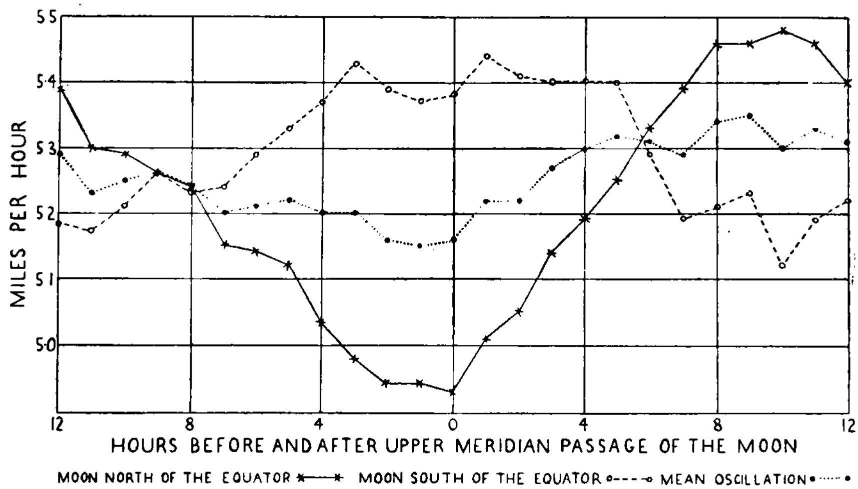
A summary of the latter by Ellsworth Huntington appears in the *Geographical Review,* December 1919, p. 350.

Dr. J. R. Sutton's Researches.

TWO short papers by Dr. J. R. Sutton, appearing in the Transactions of the Royal Society of South Africa,* open up interesting lines of investigation. In the first he looks for a relation between the temperature of June at Kimberley and the rainfall of the last half of May, and finds that the mean daily range of temperature is greater in the Junes following Mays with rainfall below normal than in those which follow Mays with rainfall above normal. The generalization breaks down only once in the fourteen years considered. The difference in daily range between the two sets of Junes averages 2° F. Dr. Sutton attributes the difference to the state of the soil, the greater temperature range corresponding with dry soil, but it would have been interesting to learn how far variations in the cloud amount and the duration of sunshine would account for the varying range of temperature. The largest June range, 32°, occurred in 1916, when there was no rain at all in the 46 days, May 16—June 30, and the smallest, 25·5°, when there was 2·17 in. in the same period.

In the second paper an attempt is made to trace the influence of the moon on wind-speed. Hourly values of wind-speed as recorded at Kimberley were entered according to lunar time and averages covering 180 lunations were worked up.

VARIATIONS OF WIND SPEED AT KIMBERLEY LAT 28° 43′ S LONG 24° 46′ E



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* Vol. VIII., Part 1, 1919. (1) A note on the possibility of long range weather forecasts. (2) A possible lunar influence upon the velocity of the wind at Kimberley.

In our diagram, which has been drawn to represent Dr. Sutton's results, two curves show the variation of wind through the lunar day (*a*) when the moon is south of the equator and (*b*) when it is to the north. It will be seen that in either case there is a single oscillation in the lunar day, but that it is reversed with the lunar declination. With the moon north of the equator, the wind is least when the moon is crossing the meridian, low down in the north, and greatest as it approaches the nadir. With the moon south of the equator there is a smaller range, but the wind is strongest with the moon near the zenith and weakest at lunar midnight. In connexion with the fact that there is no indication of a 12-hour period in the wind, Dr. Sutton remarks that "it is "worth notice that when the moon's declination, north or "south, is greatest, the semi-diurnal lunar atmospheric tide "at Kimberley practically disappears, resolving itself into a "single oscillation, the phase when the moon is north being "nearly the reverse of that when the moon is south," but gives no reference to the publication of the work on which this interesting statement is based.

This reversal of the type of oscillation according to the position of the moon is very striking, and one's first feeling on reading the paper was surprise that the author had not shown more enthusiasm for his discovery, but a closer examination reveals the fact that no allowance has been made for the influence of the sun on the wind, which influence is not eliminated automatically by the method of grouping the observations. As the path of the moon is nearer to the ecliptic than to the equator, it follows that at the Kimberley midsummer the moon when it has south declination is near the sun, so that the Upper Meridian Passage is approximately at noon. Thus for the broken curve the hour indicated by 0 in our diagram corresponds roughly to noon in summer and to midnight in winter, and, as the range of the diurnal variation of wind is greater in summer than in winter, the summer type prevails when the observations for the year are averaged. Similarly, for the unbroken curve the reading at the hour 0 is found by averaging night hours in summer and day hours in winter.

It is doubtful whether this explanation leaves room for any direct influence of the moon on the wind. The result of averaging all the observations is shown by the dotted line, which indicates a variation of only 0·2 mi/hr. in the course of the lunar day.

F. J. W. W.

NOTES AND QUERIES.

The Reform of the Calendar.

IN a letter to *Nature*, Professor Flammarion draws attention to the proposal set out in the *Annuaire Astronomique* for 1920 for the reform of the Calendar. He proposes to divide each quarter of the year into months having 30, 30 and 31 days, respectively, each quarter beginning on a Monday and ending on a Sunday. The 365th day of the year is not to be allotted to any week and the same remark applies to the extra day of leap year. These special days are to come at the beginning or end of the year, and may perhaps be counted with January and December, respectively. The Meteorologist will probably look with some suspicion at a proposal which would lead to such a serious break with the past: otherwise he would certainly welcome the abolition of the short month of 28 days which is so troublesome to allow for in all statistical studies.

International Weather Symbols.

AMONGST the matters dealt with at the International Meteorological Conference in Paris in October 1919 was the introduction of additional weather symbols. The symbol for mirage  suggested by Sir Napier Shaw in the M.O. Circular No. 26, was adopted. For sleet the symbol  which combines the signs for snow and for rain, was accepted. A proposal to modify the symbol **V** for rime which is likely to be confused with the letter *v*, used for exceptional visibility, was not entertained favourably, but the difficulty was met to a certain extent by the adoption of a new symbol  for exceptional visibility.

The "Standard Atmosphere" for Aeronauts.

TABLES for the conversion of barometric pressures into heights have been issued recently by the International Aeronautical Federation.* These tables are to be used for the comparison of the performances of aircraft; it is assumed apparently that the merit of a particular flight is to be judged by the pressure which is reached rather than by the

* *Table De Conversion Des Pressions Barométriques en Altitudes.* Fedération Aéronautique Internationale, Paris.

actual height above ground. Thus the observed pressure being equivalent to 160 mm., the aeronaut is to be credited with the height 11,208 metres given in the table, though the actual height above mean sea level which he has actually attained will have been much less than this if the flight is undertaken under cyclonic conditions in winter, much greater if it is under anti-cyclonic conditions in summer. The system has the great advantage that the single reading of the aneroid barometer suffices to determine the conventional "height," whereas a knowledge of the temperature at every level is required if the true height is to be found. Certainly the height as given in these tables is much closer to the truth than that which would be shown by an altimeter standardised, as is customary, for an atmosphere with the uniform temperature of 50° F.

The tables to which reference has been made are computed from a formula put forward by M. Rodolphe Soreau,* which is based only on the 40 soundings made at European stations in the first six months of 1912; the approximation to the mean values for Western Europe computed by W. H. Dines is only moderately satisfactory. M. Soreau's formula, which it may be noted was intended by its author to be valid when the pressure at sea level was 760 mm. of mercury, is

$$z = (15320 + 8{\cdot}65\,P - 0{\cdot}0055\,P^2)\,\log\,(760/P),$$

where z is the required height in metres and P the pressure in millimetres.

The difference between the F.A.I. table and Mr. Dines's averages as given in the M.O. Glossary, p. 54, amounts to nearly 5 mb. both at 5 km. and at 10 km., the discrepancy in heights at those levels being 140 metres and 70 metres respectively. Meteorologists will hope that the matter will be reconsidered before the system of estimating height becomes stereotyped. A satisfactory agreement as to the relation between the conventional "height" and the pressure would provide a better basis for the graduation of altimeters for aeronautical use.

In so far as the merit of the performance of aircraft is concerned it is to be borne in mind that the efficiency of the engine and the lifting power depend on pressure and temperature; the rate of ascent and the air-speed at given pressure and temperature are the things to be compared for different machines. It would facilitate clear thinking on the subject if this fact were recognised explicitly. It is perhaps more striking to learn that an aeroplane has flown in air at pressure 300 mb., or three tenths of the sea-level pressure, than to be told that it attained a height of 25,500 ft.

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* *Comptes rendus de l'Académie des Sciences*, December 1919, p. 1024.

Winter in Tristan da Cunha.

INFORMATION has been received of the visit of the *Yarmouth* to Tristan da Cunha, which she reached on 31st July last, after battling against westerly winds and gales during the voyage from Cape Town. The winter is reported to have been the most severe and snowy experienced for fourteen years, although the coldest month, September, was yet to come.

The Islands of Tristan da Cunha are a group of three small volcanic islands in the South Atlantic, in 37° 6′ S., 12° 17′ W., about 2,000 miles west of Cape Town. The name of Tristan is generally restricted to the larger and most northerly island, which has an area of about thirty-two square miles. It is surrounded by precipitous cliffs between one and two thousand feet high.

The group is situated on the southern side of the South Atlantic anticyclonic area, and consequently experiences persistent westerly winds with frequent gales, many rain days and much cloud. The volcanic cone of Tristan reaches a height of 7,600 feet, and is snow-clad until late in summer. Meteorological observations are scanty; the best available, which were taken as long ago as 1816, by Lieut. Rich, are published in the "Challenger" report. The following summary may be of interest:—

1896. Date.	Days of Rain.	Days when landing was impossible.	Temperature.	
			Mean. °F.	Min. °F.
August 15–31	14	13	50	42
September 1–30	25	16	55	40
October 1–31	17	17	58	47
November 1–27	16	17	56	43

This gives a total of 72 rain days in 104 days of observation.

Captain Carmichael, who followed Lieut. Rich, did not continue his weather record. He describes, however, the following interesting feature:—

> "The prevailing wind blows from westward and southward. Strong gales are frequent, but rarely continue above twenty-four hours. They never blow quite home to the island, but incline upwards at some distance from the shore, and, striking against the face of the mountains, are beaten back on the lowland in furious whirlwinds."

A mine of information on the island is Parliamentary Paper Cd. 3098, entitled "Further correspondence relating to the Island of Tristan da Cunha," published in 1906.

News in Brief.

International Meteorological Meeting at Venice.—The Italian Meteorological Society announces that during October next, on a date not yet decided, an International Meteorological Meeting will take place at Venice, and an invitation is extended to all interested in the science. Application for membership should be addressed to the Comitato Ordinatore, Osservatorio Servicario Patriarcale, Venice, Italy.

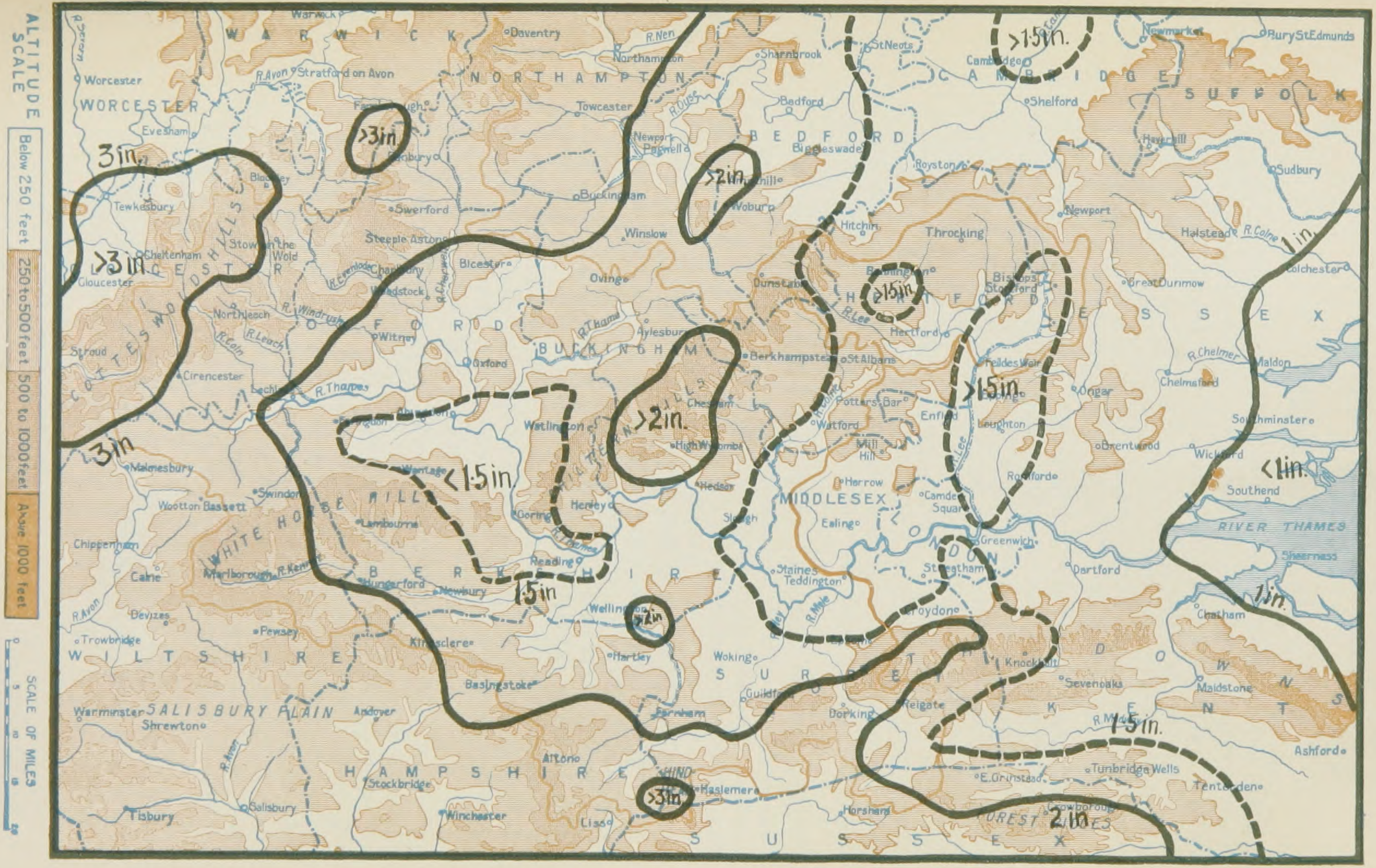
Weather Insurance.—The weather is a very important factor in all outdoor occupations and amusements, and the losses involved when adverse weather conditions are experienced amount annually to very large sums. One has only to consider a few instances, such as a promising hay harvest spoilt by rain, corn crops partially ruined by hail storms, building contracts held up by frost, cricket and football matches, and race meetings abandoned owing to frost, snow or rain, to see that the question of Weather Insurance is of great importance.

In the past a certain amount of insurance has been effected against such risks, but the premiums have often been prohibitive, owing to the fact that they were based on a small volume of business and that no reliable data of the average weather conditions had been collated.

The Eagle, Star and British Dominions Insurance Company, Limited, has now, however, opened a special Department, named the "Pluvius" Department, for operating in Weather Insurance, and various forms of policies have been prepared, covering as far as possible all insurable weather risks, including the provision of compensation to holiday-makers in the event of excessive rainfall during the insured period. It is anticipated that there will be a large and growing demand for th s form of insurance.

War's Delays.—A tabular statement of the magnetic elements at Irkutsk (1908–9), Katharinenburg (1908–12), and Pawlowsk (1908–9–10) reached the Meteorological Office on March 27th, 1920, together with a covering letter from the late Prince B. Galitzine, dated St. Petersburg, July 23rd, 1914. From a note in the *Times* it would appear that this letter had been detained at Dantzig since the declaration of War. The data referred to are being communicated to *Terrestrial Magnetism.* They are also being published in *Hourly Values, 1917.*

Messrs. Negretti and Zambra announce an exhibition of new meteorological instruments at 38, Holborn Viaduct, E.C.1, from March 29th to April 19th.



Meteorological Magazine

Watershed of River Thames above Teddington, and River Lee above Feildes Weir

Isohyetals

Weather in the British Isles: March 1920.

LIKE the three months which preceded it, March was notable for its unusual mildness. Throughout the month the weather was of a very varied character and, in fact, "March many weathers" behaved in accordance with its reputation. There was however a marked absence of cold, drying winds, for during the greater part of the month there was a preponderance of winds from westerly or south-westerly quarters, winds which were, moreover, frequently accompanied by copious precipitation in the form of snow, sleet, hail, and rain. During the first half of the month snow and sleet were fairly general, but during the latter half these forms of precipitation were comparatively rare. Occasionally the precipitation was accompanied by a good deal of electrical disturbance, especially in the western districts and in Ireland, and towards the end of the month thunder was also heard in some south-eastern and midland localities. There were one or two very sunny days, but, generally speaking, the amount of sunshine was moderate.

Commonly air pressure was higher over the southern part of the British Isles than over the northern, and as a result the weather was much finer in the South than in the North, and on most days the temperature at English stations was several degrees warmer than at the majority of Scottish stations. A striking feature of the month was the frequency of the warm days; at Kew Observatory, for instance, the maximum temperature was between 55° F. and 66° F. on sixteen occasions, and fell below the normal on only five days. From the 21st to 23rd there was an unusually fine spell over the greater part of England, and a maximum of 67° F. was recorded at Raunds, Worksop, Salisbury and Westminster. These warm days had a marked effect on the mean temperature for the week which ended on the 27th; at Cromer the mean was 8·3° F. above the normal, at Norwich and Westminster 7·9° F. above, and at Fulbeck 7·5° F. above.

The coldest weather of the month occurred during the week which ended on the 13th, when the mean temperature was below the normal in all districts. On the 8th, 21° F. was recorded at Eskdalemuir and 22° F. at Balmoral, Kilmarnock, Cally, Cheadle, and Stonyhurst, and on the morning of the 9th the reading at Raunds was as low as 20° F.

An outstanding feature of the month's weather was the passage eastwards across England on the 14th and 15th of a deep secondary depression connected with a low pressure area between Iceland and Scotland. In London at 3 h. on the 15th the barometer fell to 967·5 mb. (28·57 in.), after having fallen continuously for 51 hours since midnight of the 12th, and at 7 h, when the depression was centred over the Humber, the barometer reading at Spurn Head was as low as 965·4 mb. (28·51 in.). The passage of this system caused unsettled weather in most parts, and on 14th and 15th showers of snow, sleet, hail, and rain were common, with gales in many places. In parts of Lincoln, Notts, and Northants the snow fell to a depth of 1 ft.

The rainfall of the month was nearly everywhere in excess of the average, reaching twice the average over considerable areas in Wales. Amounts less than 1 inch occurred however in the extreme east of England. More than 5 inches fell on Dartmoor, over considerable areas in the north-east of England, the west of Scotland and Ireland, and over practically the whole of Wales. More than 10 inches was reached in a number of small areas. The general rainfall expressed as a percentage of the average was:—England and Wales, 150; Scotland, 137; Ireland, 129; British Isles, 139.

In London (Camden Square) there was frequent but light rain. The mean temperature was 46·7° F., or 4·6° above the average, being the highest value recorded for March during the 63 years' record. The maximum shade temperature reached or exceeded 60° F. on as many as 10 days, the highest number previously recorded in March being 8 days in 1893. Duration of rainfall, 35·9 hours. Evaporation, ·78 in.

Rainfall Table for March 1920.

STATION.	COUNTY.	Aver. 1875—1909.	1920.		Per cent. of Av.	Max. in 24 hrs.		No. of Rain Days.
		in.	in.	mm.		in.	Date.	
Camden Square	*London*	1·70	1·42	36	84	·28	14	18
Tenterden (View Tower)	*Kent*	1·95	1·14	29	58	·32	14	17
Arundel (Patching)	*Sussex*	1·95	2·33	59	119	·64	14	16
Fordingbridge (Oaklands)	*Hampshire*	2·09	2·44	62	117	·47	13	21
Oxford (Magdalen College)	*Oxfordshire*	1·45	1·56	40	108	·40	14	16
Wellingborough	*Northampton*	1·72	2·08	53	121	·64	14	18
Hawkedon Rectory	*Suffolk*	1·66	1·58	40	95	·30	14	18
Norwich (Eaton)	*Norfolk*	1·80	1·25	32	69	·23	14	17
Launceston (Polapit Tamar)	*Devon*	2·74	4·14	105	151	·58	13	24
Lyme Regis (Rousdon)	„	2·30	3·33	85	145	·54	29	19
Ross (Birchlea)	*Herefordshire*	2·01	3·41	87	170	·52	14	19
Church Stretton (Wolstaston)	*Shropshire*	2·19	4·08	104	186	·90	14	20
Boston (Black Sluice)	*Lincoln*	1·47	2·31	59	157	·77	15	16
Worksop (Hodsock Priory)	*Nottingham*	1·70	2·22	56	131	·69	15	15
Mickleover Manor	*Derbyshire*	1·69	2·13	54	126	·62	14	15
Southport (Hesketh Park)	*Lancashire*	2·11	3·85	98	182	·76	24	22
Wetherby (Ribston Hall)	*York, W. R.*	1·92	2·34	59	122	·55	14	11
Hull (Pearson Park)	„ *E. R.*	1·84	1·75	44	95	·52	14	16
Newcastle (Town Moor)	*North'land*	2·10	3·26	83	155	·67	24	17
Borrowdale (Seathwaite)	*Cumberland*	10·63	16·60	422	156	..	..	..
Cardiff (Ely)	*Glamorgan*	2·89	4·40	112	152	·62	31	25
Haverfordwest	*Pembroke*	3·16	6·87	174	217	·83	26	26
Aberystwyth (Gogerddan)	*Cardigan*	3·04	7·75	197	255	·80	30	20
Llandudno	*Carnarvon*	2·13	5·27	134	247	·74	26	21
Dumfries (Cargen)	*Kirkcudbrt.*	3·33	6·11	155	184	1·78	27	22
Marchmont House	*Berwick*	2·64	3·71	94	141	·79	15	17
Girvan (Pinmore)	*Ayr*	3·62	5·19	132	143	·85	27	24
Glasgow (Queen's Park)	*Renfrew*	2·61	3·64	92	139	·85	27	21
Islay (Eallabus)	*Argyll*	3·68	3·94	100	107	·47	27	27
Mull (Quinish)	„	4·28	7·08	180	165	·82	5	25
Loch Dhu	*Perth*	6·29	8·45	215	134	1·30	27	21
Dundee (Eastern Necropolis)	*Forfar*	2·06	2·11	54	102	·60	30	18
Braemar	*Aberdeen*	2·87	4·43	112	154	1·25	27	16
Aberdeen (Cranford)	„	2·65	2·65	67	100	·51	15	19
Gordon Castle	*Moray*	2·36	2·86	73	121	·53	15	15
Drumnadrochit	*Inverness*	3·09	3·18	81	103	·43	27	26
Fort William	„	6·39	9·84	250	154	1·75	3	27
Loch Torridon (Bendamph)	*Ross*	7·29	10·05	255	138	1·69	2	24
Stornoway	„	3·85	5·01	127	130	·70	2	26
Dunrobin Castle	*Sutherland*	2·64	3·21	82	122	·60	29	13
Wick	*Caithness*	2·24	3·17	81	142	·64	30	22
Glanmire (Lota Lodge)	*Cork*	3·09	4·27	108	138	·67	25	20
Killarney (District Asylum)	*Kerry*	4·51	6·00	152	133	..	..	..
Waterford (Brook Lodge)	*Waterford*	2·64	4·27	108	162	·75	25	17
Nenagh (Castle Lough)	*Tipperary*	2·99	3·28	83	110	·54	25	20
Ennistymon House	*Clare*	3·24	4·72	120	146	·57	27	23
Gorey (Courtown House)	*Wexford*	2·28	3·61	92	158	1·03	26	15
Abbey Leix (Blandsfort)	*Queen's Co.*	2·59	3·85	98	149	·75	27	19
Dublin (FitzWilliam Square)	*Dublin*	1·98	2·05	52	104	·39	1	19
Mullingar (Belvedere)	*Westmeath*	2·64	2·22	56	84	·45	2	15
Woodlawn	*Galway*	3·01	3·38	86	112	·72	27	24
Crossmolina (Enniscoe)	*Mayo*	4·36	5·77	147	132	·88	5	27
Collooney (Markree Obsy.)	*Sligo*	3·33	4·68	119	141	·77	5	23
Seaforde	*Down*	2·84	3·34	85	118	·43	27	19
Ballymena (Harryville)	*Antrim*	3·07	3·75	95	122	·53	27	22
Omagh (Edenfel)	*Tyrone*	2·98	3·74	95	125	·49	27	24

Supplementary Rainfall, March 1920.

Div.	STATION.	RAIN. in.	RAIN. mm.
II.	Ramsgate	·50	13
,,	Sevenoaks, Speldhurst	1·35	34
,,	Hailsham Vicarage	2·20	56
,,	Totland B. Aston Ho.	2·60	66
,,	Ashley, Old Manor Ho.	2·49	63
,,	Grayshott	3·01	76
,,	Ufton Nervet	1·96	50
III.	Harrow Weald, Hill Ho.	1·34	34
,,	Pitsford, Sedgebrook	2·09	53
,,	Chatteris, The Priory	1·43	36
IV.	Elsenham, Gaunts End	1·44	37
,,	Lexden, Hill House	·94	24
,,	Aylsham, Rippon Hall	1·39	35
,,	Swaffham	1·55	39
V.	Devizes, Highclere	2·27	58
,,	Weymouth	2·91	74
,,	Ashburton, Druid Ho.	5·30	135
,,	Cullompton	4·24	108
,,	Lynmouth, Rock Ho.	4·78	121
,,	Hartland Abbey	4·85	123
,,	St. Austell, Trevarna	4·58	116
,,	North Cadbury Rec.	2·19	56
VI.	Clifton, Stoke Bishop	2·77	70
,,	Ledbury, Underdown	2·71	69
,,	Shifnal, Hatton Grange	2·58	66
,,	Ashbourne, Mayfield	1·93	49
,,	Barnt Green, Upwood	2·25	57
,,	Blockley, Upton Wold	3·45	88
VII.	Grantham, Saltersford	2·32	59
,,	Louth, Westgate	2·06	52
,,	Mansfield, West Bank	2·29	58
VIII.	Nantwich, Dorfold Hall	3·14	80
,,	Bolton, Queen's Park	4·09	104
,,	Lancaster, Strathspey	5·14	131
IX.	Wath-upon-Dearne	1·63	41
,,	Bradford, Lister Park	2·73	69
,,	West Witton	4·23	107
,,	Scarborough, Scalby	2·65	67
,,	Ingleby, Greenhow	3·10	79
,,	Mickleton	3·40	86
X.	Bellingham	3·00	76
,,	Ilderton, Lilburn	3·65	93
,,	Orton	7·28	185
XI.	Llanfrechfa Grange	4·45	113
,,	Treherbert, Tyn-y-waun	10·34	263
,,	Carmarthen Friary	7·05	179
,,	Fishguard	6·44	164
,,	Lampeter, Falcondale	8·47	215
,,	Abergwngy	7·40	188
,,	Crickhowell, Talymaes	7·00	178
,,	Sennybridge	7·44	155
,,	Lake Vyrnwy	6·09	132
,,	Llangynbafal, P. Drâw	5·21	231
,,	Dolgelly, Bryntirion	9·11	178
,,	Lligwy	6·49	165
XII.	Stoneykirk, Ardwell Ho.	3·49	89
,,	Gatehouse, Cally	5·53	140
,,	Carsphairn, Shiel	8·33	212
XII.	Langholm, Drove Rd.	5·92	150
XIII.	Selkirk, Hangingshaw	4·52	115
,,	North Berwick Res.	1·88	48
,,	Edinburgh, Royal Ob.	2·18	55
XIV.	Biggar	4·84	123
,,	Leadhills	10·13	752
,,	Maybole, Knockdon	4·44	113
XV.	Rothesay	5·54	141
,,	Oban	..	..
,,	Inveraray Castle	12·23	311
,,	Holy Loch, Ardnadam	7·12	181
XVI.	Loch Venachar	4·95	126
,,	Glenqucy	4·10	104
,,	Loch Rannoch, Dall	5·43	138
,,	Coupar Angus	3·34	85
,,	Montrose Asylum	1·76	45
XVII.	Balmoral Castle	3·61	92
,,	Fyvie Castle	2·20	56
,,	Peterhead, Forehill	3·62	92
,,	Grantown-on-Spey	2·32	59
XVIII.	Cluny Castle	4·32	110
,,	Loch Quoich, Loan	28·90	734
,,	Skye, Dunvegan	7·91	201
,,	Fortrose	2·17	55
,,	Ardross Castle	2·80	71
,,	Glencarron Lodge	10·31	262
XIX.	Tongue Manse	2·41	61
,,	Melvich Schoolhouse	2·40	61
,,	Loch More, Achfary	6·85	174
XX.	Dunmanway Rectory	5·58	142
,,	Mitchelstown Castle	3·76	96
,,	Gearahameen	10·00	254
,,	Darrynane Abbey	6·24	158
,,	Clonmel, Bruce Villa	4·40	112
,,	Cashel, Ballinamona	3·66	93
,,	Roscrea, Timoney Pk.	3·14	80
,,	Foynes	3·52	89
,,	Broadford, Hurdlesto'n	4·03	102
XXI.	Kilkenny Castle	3·71	94
,,	Rathnew, Clonmannon	4·31	110
,,	Hacketstown Rectory	4·08	104
,,	Ballycumber, Moorock	2·64	67
,,	Balbriggan, Ardgillan	2·31	59
,,	Drogheda	2·30	58
,,	Athlone, Twyford	4·09	104
,,	Castle Forbes Gdns.	3·19	81
XXII.	Ballynahinch Castle	4·95	126
,,	Westport House	5·19	132
XXIII.	Enniskillen, Portora	3·13	80
,,	Cootehill, Dartrey	3·59	91
,,	Armagh Observatory	3·20	81
,,	Warrenpoint	3·23	82
,,	Belfast, Cave Hill Rd.	3·28	83
,,	Glenarm Castle	4·70	119
,,	Londonderry, Creggan	3·93	100
,,	Sion Mills	..	..
,,	Milford, The Manse	4·13	105
,,	Killybegs, Rockmount	6·13	156

Climatological Table for the

STATIONS These in italics are South of the Equator	PRESSURE		TEMPERATURE							
			Absolute				Mean Values			
	Mean M.S.L.	Diff. from Normal	Max.	Date	Min.	Date	Max.	Min.	½ max. and min.	Diff. from Normal
	mb.	mb.	° F.		° F.		° F.	° F.	° F.	° F.
London, Kew Observatory	1021·7	+8·0	65	1	28	23	53·6	37·0	45·3	−4·6
Gibraltar	1018·3	+3·0	78	3	48	28, 29	69·5	56·7	63·1	−3·3
Malta	1016·7	−0·7	91·0	14	50·5	24	75·2	64·4	69·8	−0·9
Sierra Leone	1013·1	+1·4	90	17	61	2, 4, 7	86·4	70·4	78·4	−1·8
Lagos	..	..	87	3	70	15	84·0	73·8	78·9	−0·3
Kaduna, N. Nigeria	*944·3	..	91	17	63	8	86·6	66·5	76·5	..
Cape Town	..	..	89·2	10	45·5	3	71·2	52·4	61·8	+0·8
Johannesburg	..	..	86·3	23	43·1	20	78·9	53·0	65·9	+4·9
Mauritius	1018·2	+0·2	84·4	31	57·0	1	79·9	64·0	72·0	−0·6
Bloemfontein	..	..	90·4	12	35·2	14	85·7	51·2	68·5	+3·3
Calcutta, Alipore Obsy.	..	..	92·8	2	56·9	28	89·0	74·3	81·7	+1·3
Bombay	..	..	92·0	30	76·4	21	88·8	77·9	83·3	+1·3
Madras	..	..	96·2	8	73·1	23	89·2	76·3	82·7	+0·7
Colombo, Ceylon	..	..	87·8	23	72·7	27	85·7	76·0	80·9	−0·1
Hong Kong	1014·2	+0·6	84·7	3	59·3	22	78·5	71·0	74·7	−2·1
Sydney	..	..	..	..	..	..	..	..	..	..
Melbourne	..	..	94·4	30	37·0	4	69·1	49·1	59·1	+1·5
Adelaide	..	..	102·8	30	40·6	25	73·5	51·7	62·6	+0·7
Perth	..	..	76·0	21	44·0	11	66·1	51·2	58·7	−2·3
Coolgardie	..	..	94·5	25	36·8	7	74·5	48·9	61·7	−1·8
Brisbane	..	..	92·4	9	54·3	4	79·6	60·2	69·9	+0·2
Hobart, Tasmania	..	..	81·4	30	37·1	3	64·3	47·7	56·0	+2·0
Wellington	1014·3	+2·3	68·8	27	40·7	16	60·4	48·4	54·4	+0·3
Suva, Fiji	1016·3	+1·7	88·4	5	63·4	17	80·3	69·8	75·1	−0·8
Jamaica, Kingston	1012·2	+0·9	92·5	7	69·6	31	88·6	72·6	80·6	+0·1
Grenada	1011·4	+0·3	90·0	2	72·0	10, 27, 28	86·0	74·9	80·5	+0·4
Toronto	..	..	80·0	3	31·8	8	61·5	44·6	53·1	+4·9
Fredericton	..	..	65·0	15	17·0	21	53·4	32·9	43·1	0
St. John, N.B.	..	..	64·4	7	24·3	30	51·5	38·8	45·1	−2·2
Victoria, B.C.	..	..	67·2	6	31·7	25	53·9	42·4	48·1	−3·3

* At Station Level, height of 2088 feet.

LONDON, KEW OBSERVATORY.—9 days of fog.

SIERRA LEONE.—7 thunderstorms, 5 days of gale.

Mauritius.—Prevailing wind ESE ; mean speed, 5·4 mi/hr.

Bloemfontein.—Still experiencing severest drought on record.

HONG KONG.—Prevailing wind ENE ; mean speed, 11·5 mi/hr.

British Empire, October 1919.

TEMPERATURE				PRECIPITATION				Mean Cloud Am'nt	Bright Sunshine	STATIONS
Mean Values		Absolute		Amount		Diff. from Normal	Days		Hours per day	Those in italics are South of the Equator.
Dew Point °F.	R'tive Humidity %	Max. in Sun °F.	Min. on Grass °F.	in.	mm.	mm.				
40·3	79	117·0	20·1	0·6	15	− 54	9	5·2	3·94	London, Kew Observatory.
55·0	76	144	41	6·01	153	+ 66	7	3·1	..	Gibraltar.
..	73	139	..	0·99	25	− 55	4	6·5	6·3	Malta.
73·8	81	..	..	6·50	165	−169	22	5·9	..	Sierra Leone.
74·5	79	161·5	56·5	8·96	228	+ 27	19	7·9	..	Lagos.
70·1	86	..	..	1·49	38	− 22	9	2·6	..	Kaduna, N. Nigeria.
51·2	67	..	..	0·32	8	− 36	2	4·1	..	*Cape Town.*
43·9	52	..	41·3	1·52	39	− 26	10	2·5	9·40	*Johannesburg.*
61·0	70	..	50·5	1·26	32	− 3	10	6·6	..	*Mauritius.*
43·1	41	..	..	0·65	17	− 26	5	3·2	..	*Bloemfontein.*
73·0	77	..	59·0	0·46	12	− 87	1	4·0	..	Calcutta, Alipore Obsy.
74·4	77	140·2	68·1	1·40	36	− 11	4	2·6	..	Bombay.
74·7	82	163·0	67·9	10·80	274	− 12	16	5·7	..	Madras.
73·8	82	164·0	70·6	12·47	317	−171	26	7·7	..	Colombo, Ceylon.
64·8	72	..	..	4·69	119	− 4	9	5·8	5·5	Hong Kong.
..	..	..	..	..	..	..	..	..	..	*Sydney.*
44·6	56	144·2	29·6	1·64	42	− 24	11	6·3	..	*Melbourne.*
46·8	52	155·5	28·4	0·77	20	− 24	10	5·8	..	*Adelaide.*
49·1	70	144·4	34·4	2·18	55	+ 1	14	5·3	..	*Perth.*
42·9	45	152	34·2	0·63	16	− 2	6	3·8	..	*Coolgardie.*
55·9	61	147·6	47·1	0·86	22	− 47	5	3·1	..	*Brisbane.*
43·2	59	137·6	29·2	1·82	46	− 11	15	6·6	..	*Hobart, Tasmania.*
46·9	76	139·0	28·8	1·98	50	− 58	9	5·9	6·87	*Wellington.*
71·0	84	..	..	17·10	434	+235	21	7·5	..	*Suva, Fiji.*
72·2	84	..	..	7·63	194	+ 4	12	6·3	..	Jamaica, Kingston.
72·7	77	141	..	9·10	231	+ 47	19	3·7	..	Grenada.
45·9	85	112·2	27·0	2·98	76	+ 7	18	5·8	..	Toronto.
35·5	75	..	..	4·22	107	+ 4	9	5·5	..	Fredericton.
39·0	72	126·2	18·5	3·86	98	− 7	13	6·0	..	St. John, N.B.
42·0	82	120·0	26·0	1·30	33	− 24	12	5·8	..	Victoria, B.C.

Adelaide.—Absolute maximum highest on record for October.

Wellington.—2 sunless days, 5 days of frost.

Suva, Fiji.—2 thunderstorms.

JAMAICA, KINGSTON.—The rainfall, taking the island as a whole, was below the average.

GRENADA.—3 thunderstorms.

Weather Abroad: March 1920.

In Western Europe March was not so disturbed as February, but in the British Isles and eastward into the Baltic the weather continued unusually warm, and at Helsingfors and Revel the sea was unusually free from ice. Early in the month a gale in the Baltic caused loss of life. In France the warm weather was interrupted for a few days by a cold spell about the 11th. Heavy rainfall occurred in Switzerland and Italy as well as in France; at Lugano 100 mm. fell on the 15th and 16th and 64 mm. on the 30th and 31st. From Madeira 66 mm. was reported on the 2nd.

The cold and stormy conditions of February in the near East continued into March, with an intensity unequalled for many years, culminating about the 9th in a hurricane in the Black Sea, which destroyed an American Red Cross steamer, with the loss of 500 invalided soldiers.

America was visited by several severe storms which crossed the northern part of the United States from west to east. One of these appeared off San Francisco on the 1st and reached New Brunswick with greatly increased intensity on the 7th. In the rear of this storm heavy snowfall and blizzards visited the Middle West and Chicago. All traffic was interrupted for some time and much damage done. The same storm caused a gale estimated at 70 m.p.h. in New York Harbour, seriously damaging the "Cedric" and destroying many light craft.

The next depression appeared on the 13th and developed into a severe storm west of the Lake Region, causing damage especially in Kentucky and in Quebec and the Atlantic Provinces of Canada. Finally on the 28th two destructive tornadoes visited respectively the neighbourhood of Chicago and the borders of Georgia and Alabama. The disturbance near Chicago was very destructive, resulting in 188 deaths and thousands of injured. It appeared first at Elgin, thirty miles west of Chicago, where it wrecked the centre of the town, passing on to the residential suburb of Wilmette, north of Chicago. This tornado is noteworthy as being unusually early in the year. In Georgia the towns of Lagrange and West Point were destroyed, with at least twenty-five deaths.

Geostrophic Wind at London; May, 1881–1915.

FREQUENCY OF STRENGTH AND DIRECTION.

Estimates based on the D.W.R. charts (8*h.*, 1881–1908; 7*h.*, 1909–1915).

Direction.	5 m/s. 11 mi/hr.	10 m/s. 22 mi/hr.	15 m/s. 33 mi/hr.	20 m/s. 44 mi/hr.	Over 20 m/s. Over 44 mi/hr.	Total Frequency of Direction.
N.	29	27	18	5	4	83
NE.	24	72	21	6	—	123
E.	13	30	35	16	3	97
SE.	29	22	10	2	1	64
S.	13	21	9	4	—	47
SW.	23	57	36	16	5	137
W.	22	66	53	19	9	169
NW.	21	30	21	11	2	85
Total Frequency of Strength	174	325	203	79	24	805

Indeterminate—280.

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THE WINTER OF 1919-20.

A Remarkable Season.

By Sir JOHN W. MOORE, M.D., D.Sc., F.R.Met.Soc.

THE long winter of 1919-20 has not yet drawn to a close, if one may judge by the violent S.W. gale which swept over Ireland on Sunday, May 2nd, by the low temperature which has since prevailed, with the exception of a few hours on Thursday, the 6th inst., and by frequent hail showers during the present week.

And yet the winter, if one of the longest, has been one of the mildest on record—a paradox, but a fact. September, 1919, in its first half bore the impress of the fine summer of last year, for the weather was both warm and generally fine and dry. The latter half was less settled and some sharp spells were felt, distinctly autumnal in character and forerunners of winter. October was a dry cool month, with an unusually high mean atmospheric pressure of 30·22 in. (1023·4 mb.) and a great and persistent prevalence of winds from between NW. and NE. November was cold, cloudy, unsettled. The mean temperature was 5·5° below the average for the 35 years 1881–1915, and only 1·8° in excess of the record low temperature for November which occurred in 1878. The precipitation, which was ·34 in. above average, was mainly in the form of hail and snow. Hail fell on ten days and snow on eight. Indeed, snow lay on the ground in the Dublin district from the 12th to the 16th, inclusive—an unusual feature so early in an Irish winter. The wind, while mainly westerly, had still a good deal of northing in it. With the passing of November came a complete change, and December proved to be a very open month of SW. and W. winds, much cloud, and frequent rain. Large and deep atmospheric depressions, or their secondaries, swept in over the British Isles from the Atlantic. In Dublin the mean temperature of the closing month of 1919 was 1·4° above the average (42·0°) and 4·0° above that of November.

The first three months of 1920 resembled December, 1919. The weather of January was almost continuously of the oceanic or south-westerly type. Atmospheric depressions of great size and intensity swept past the western shores of the British Isles in quick succession. Like December and January, February was open, with a preponderance of equatorial or oceanic winds (SW. and W.), much cloud, and a moist atmosphere. March proved to be the fourth consecutive month in which the mean temperature was materially in excess of the average. It was an open month of south-westerly winds, much cloud, and frequent, but not especially heavy, rainfall, 2·06 in. on 19 days.

TABLE OF TEMPERATURE

Showing a comparison of the Season 1919–1920 with that of the Normals for 35 years 1881–1915.

Month.	Normals, 1881-1915.			1919-1920.			Excess.	Defect.
	Max.	Min.	Mean.	Max.	Min.	Mean.		
	° F.	° F.	° F.	° F.	° F.	° F.	° F. +	° F. –
September - -	61·8	50·3	56·1	61·6	49·3	55·5	—	0·6
October -	55·1	44·8	50·0	54·6	43·9	49·3	—	0·7
November -	50·1	40·9	45·5	44·9	35·1	40·0	—	5·5
December -	46·9	38·2	42·6	48·8	39·2	44·0	1·4	—
January -	46·1	37·5	41·8	49·2	38·0	43·6	1·8	—
February - -	47·0	37·6	42·3	50·3	41·0	45·7	3·4	—
March -	49·2	38·1	43·7	50·8	39·8	45·3	1·6	—
April - -	53·7	41·4	47·6	51·7	41·8	46·8	—	0·8
Mean for Eight Months, September-April -	51·2	41·1	46·2	51·5	41·0	46·3	0·1	—

With the coming of April, winter may be said to have returned. Winds from polar points of the compass took the place of the equatorial currents of the winter, and the first complete spring month was cloudy, cold and cheerless, with 27 rain days in Dublin. The mean temperature for the first time since November fell short of the average by, it is true, only 0·8°. But the mean maximum was 2·0° in defect owing to absence of sunshine, whereas the mean minimum was 0·4° above the average in consequence of the clouded state of the night sky.

The mean temperature for the four months December to March inclusive was 2·5° above average.

The highest temperatures in the screen in each of the past eight months have been 71·9° on September 10th, 66·4° on October 6th, 58·0° on November 23rd, 54·9° on December 5th, 60·8° on January 17th, 61·0° on February 29th, 57·2° on March 17th, and 58·8° on April 22nd. The maximal readings in January and February were quite unique for Dublin.

Correspondence.

To the *Editors*, "*Meteorological Magazine*."

The Mild Winter, 1919–20.

THE past winter was so exceptionally mild that I think a few particulars may be of interest.

At Ross-on-Wye the mean temperature for the period December to February (inclusive) was 3·8° F. in excess of the normal.

The actual temperatures for each month are as follows:—

Month.	Mean Temperature, Winter 1919-20.	Average for 35 years, 1881-1915.	Excess over Normal.
	° F.	° F.	° F.
December -	43·2	40·0	3·2
January -	42·9	38·5	4·4
February	43·8	39·9	3·9

Two very warm weeks occurred about mid-winter, viz., the week ending December 27th and the week ending January 17th, the mean temperature being well over 48° in the latter instance. In both weeks the excess warmth amounted to more than 10° F.

Nearly 50 days had a maximum temperature of 50° or over, whilst in February the mean daily maximum was as high as 50·5°.

The persistent mildness of the winter seems to have been less accentuated in the East and South-East of England than in the West, and, contrary to the usual experience, the highest temperatures were recorded inland, although the prevailing winds, off the Atlantic, often blew with considerable force.

Temperatures around 55° were especially common in the West of England and in Wales. The actual highest temperature here for each month was, in December 55°; in January 56°; in February 60°. The last-named reading had not been registered here in February since 1899, and was followed within 48 hours by snow!

Immunity from frost and snow has been a feature of the past winter. The number of nights here with frost in the screen was a dozen or so for the whole three months, the severest frost occurring on January 6th, when the minimum was 22°. This was the coldest day, for in the day-time the thermometer failed to rise above 30°. The next day ended the only really cold spell of the winter, which had begun with the new year. Day temperatures were a little under 40°, though the night readings were seldom below 32°.

In December and February, however, there was not a single instance of a maximum temperature below 40°, the lowest being 41° in the last week of February.

The result of such a mild winter was evidenced by the unusually forward state of vegetation. Many spring flowers were out and many fruit trees were in blossom by the middle of February. FREDERICK J. PARSONS.

Chasedale Observatory, Ross-on-Wye, 7th May, 1920.

THE remarkable mildness which has prevailed since the beginning of December has been so noteworthy that I venture to trouble you with a few remarks upon the results of the thermometrical readings here. Following the coldest November since 1910, the mean temperature of the combined winter months December to February, inclusive, was as high as 41·2°. During the last 30 years it has been as warm, or warmer, on only five occasions, viz., 1897–8, 41·3°; 1898–9, 42·6°; 1902–3, 41·8°; 1912, 41·2°; and 1915–16, 41·7°. But the abnormal mildness of March, following these warm months, was even more remarkable, as the mean temperature of that month was as high as 46·3°, which is the highest recorded by me during the 38 years in which I have kept a register. The result of all this warmth, followed by the forcing rains of April (3·60 in. here) has been a forwardness of vegetation beyond what is usual even in warm springs. The hawthorn (*cratægus oxyacantha*) was in bloom on April 15th, which is the earliest date in my register. I find, however, in the Marsham (Norfolk) records that it was in flower in 1779 as early as April 6th, which appears to hold the record. I cut a good bunch of asparagus on April 3rd, and my early peas were in bloom in the garden before the close of the month.

ARTHUR W. PRESTON.

Christchurch Lodge, Eaton, Norwich, 5th May, 1920.

THE passing winter may long be remembered as the mildest within the recollection of most modern meteorologists. The months have been all out of place, and in advance of their time, so far as their individual temperatures are concerned. Michaelmas Day gave us the first intimation of winter in a most unusually early slight ground frost down to 29·2° F. Apart from the thermometer, Nature gave us some object lessons. The last swallows were seen on October 31st instead of waiting until the middle of November. They seemed to have some secret knowledge of the cold November coming. The Isle of Wight is one of the temperate counties, where the extremes of heat in summer and cold in winter of the Midland district are absent. For the winter we may take, not the six dark months, but rather November to April inclusive. Of these six months the coldest is usually February, but this winter it was November. Sweet peas remained in bloom until November 23rd. Runner beans were gathered as late as November 7th; on this date too fuchsia bushes in the open were in full bloom. On October 27th several apple trees were in blossom again, and remained in full bloom until January 7th the coldest day this winter, with a temperature down to 21·9° F. Of the six winter months, after November had gone, with its mean temperature down to 40·9° F. (5·4° colder than average), all the remaining five winter months were much too warm. December to April was warmer than November. The December minimum in the screen went down to only 31·6° F. January, like December, was on the whole 2° warmer than usual. The real surprise of the winter was the 60-day period of February and March, which worked out at a mean temperature of 45·6°, or exactly 4° warmer than the average The first frost on the screen was on November 11th; there had been no screen frost since April 3rd. The last screen frost was on March 9th. The last frost on the grass was also on March 9th. May 5th tried to give us one more frost, but just failed, the grass thermometer going down only to 32·7° F. But this was sufficient to brown off many of the early hawthorn and elm leaves. During the six months November to April there were only 38 grass frosts and 18 frosts in the air. The absence of any screen frost in February was most remarkable. March 3rd is on the average the coldest night of the winter at Totland; this year on that date the thermometer was down to 32·2°. Swallows were back with us on April 8th. Hawthorn was in full bloom in many places on April 10th; this was three days earlier than my preceding record here on April 13th in 1903. November this winter was colder than any of its predecessors during the past 34 years. While in Yorkshire I noticed elderberry and dog-rose in full leaf in January during a long succession of westerly winds; it appeared somewhat out of place one morning when on a 17-mile walk the Whitby Wolds were covered with snow at noon. The sun did little to warm through February, but clouds managed to do what the sun left undone. The same might be said of April, but during March the sun did help. Both March and April have only once in 34 years been exceeded in warmth. Mushrooms appeared on the Needles Downs in abundance during the third week in April. The sea usually gets to its coldest about the third week of February, but the lowest temperature this winter was 43·2° during the third week of November and the 1st week of January. The sea was unusually warm during February, not going below 44·2°, which is 4° warmer than the usual February temperature.

Totland Bay, Isle of Wight, 7th May, 1920. JOHN DOVER.

THE past winter has been remarkable here for the general high level of the temperature and the absence of any severe frost. The autumn had been a cold one, November exceptionally so, though the extreme minimum, 20·8°, was not remarkable, but the four months December 1919 to March 1920 were all very mild and open, and the mean temperature of the period, 42·2°, was 3·1° above the average and higher than in any of the previous 44 years, a striking contrast to the winter of three years ago, 1916–17, when the mean for the same four months was only 35·3°. The only winter which compares with the past one for warmth was that of 1883–84, when the mean for the four months was 41·8°. The absence of any sharp frosts has also been remarkable, as the lowest temperature in the four months was 23·6°, and a winter in which the thermometer does not fall below 20° is quite uncommon.

The only snowfall of consequence was on the night of February 19th, when a depth of about 7 inches was attained, and as it was wet and heavy it broke the wires down very badly, but most of it melted next day. There was also a heavy fall of snow and sleet on March 14th and 15th, which, though it did not lie here, disorganised the railway traffic south of Nottingham for some days. HENRY MELLISH.

Hodsock Priory, Worksop, May 8th, 1920.

The Prolonged Deficiency of Easterly Winds.

As stepping-stones in the direction of the exploration of the fundamental causes of extended meteorological abnormalities, it is desirable to examine intermediate ones, rather than to confine one's attention to the final consequences (such as surface temperature and rainfall).

The keynote of most of 1919 was a very unusual prevalence of north-westerly and northerly winds, including those from nearly all points from west to north-east. Hence the combination of coolness with serious drought, except in central and eastern England.

But throughout the recent winter, southerly to westerly winds have greatly preponderated, as, indeed, they also did for many months immediately preceding 1919. The results are well known!

However, whether north of west or south of west, in one interesting respect the effect has been the same: *due east has been the chief direction to suffer.* At Southport, the net deficiency of easterly winds for the year 1918 was no less than 201 hours. But to this, 1919 added a further shortage of 271 hours; and the aggregate has been augmented during the first quarter of 1920 by another 129 hours. One cannot possibly expect such a state of things to continue much longer; in all probability, the greater proportion of these 601 hours of easterly* winds lost since the beginning of 1918 will have to be made up during the ensuing year or two. An unusual summer and autumn might, of course, do much in that direction, but 1920–21 winter pressure abnormalities of a "great frost" type could easily do more. And, unhappily (as I hope shortly to show elsewhere), exactly then is due a maximum of cold winds of a periodicity into which every severe winter during the last 80 years falls practically perfectly.

Very evidently, behind the mean monthly or annual slope of the isobar (which determines the wind direction) lies the state of the surrounding system of permanent atmospheric action-centres. That is the *vera causa*, so far as we are at present able to go. But there do not exist the long and accurate pressure records for each of those centres, which we should like to possess for mathematical analysis. Hence good wind direction statistics, at intermediate places, form very useful data. But they should be from continuous or hourly records, if possible, and, in any case, be unspoiled by frequent "calms."

JOSEPH BAXENDELL.

An Unusual April.

LAST year drought in the west of England set in about April 1st; this year, just a week earlier there started an exceptionally wet spell. From March 24th to April 22nd, a period of 30 days, as much as 7·99 in. of rain fell here.

Another fact unparalleled in 35 years' temperature observa-

* Throughout this Note the expressions "east" and "easterly" embrace the 45 degrees centring at 90°.

tions is that no frost was recorded, even by the exposed instruments, after March 22nd, till April 29th, a complete immunity from even ground frost for fully five weeks at a time when such visitations are greatly dreaded by the fruit-grower. However, this was not altogether a blessing; a few dry frosts would not have hurt, but the continuous wet rendered the blossom, especially in the case of peaches, so sodden that it dropped off without setting. Though the mean minimum temperature of April was the highest I have ever recorded (40·1°), the days were by no means warm, owing to absence of sun, and the reading of 64° recorded on March 30th was never again reached throughout April, the maximum being only 62° on two occasions. As evidence of the mildness and small snowfall of the past winter I may state that when spending a week in the Lake District at the end of April and the beginning of May we did not see a single bed of winter snow remaining, and beds usually do not disappear before June and sometimes later. There was a little snow on the tops above 2,800 feet or so from time to time, and drifts of 2 feet or more, but it was all fresh snow which fell at the time of our visit. R. P. Dansey.

Kentchurch Rectory, Hereford, May 6th, 1920.

When a meteorological record has been running for a considerable number of years instances in which the extremes which have been established are exceeded become comparatively uncommon, and it seems therefore worth while calling attention to the very exceptional position of April 1920, in that, though observations have been taken here from 40 to 45 years, these records have been surpassed in each of the different elements of climate.

Thus in the matter of rainfall the total fall, 3·74 in., and the number of rain days, 24, were larger than in any of the previous 45 years, the nearest approach having been 1877 with 3·43 in. The peculiarity of the temperature was the mildness of the nights, which were on a par with what we expect in May; both the mean minimum, 41·2° and the extreme minimum, 31·5°, were higher than we have had before, while the mean daily range, 12·4° was smaller than in any other year and little more than two-thirds of the normal figure. Sunshine values were even more exceptional; the total, 59·3 hours, was close to the normal value for February, it was 77 hours less than the average and 25 hours less than in 1888, which had hitherto been our dullest April. Corresponding with this, the amount of Cloud was the highest I have recorded. Finally, the mean pressure, 29·692 in., was lower than in any of the previous 42 Aprils. Henry Mellish.

Hodsock Priory, Worksop, 7th May, 1920.

Mock Suns observed at Cranwell, March 27th, 1920.

Two mock suns were observed here at 7h. 25m. on the morning of the 27th inst. The sky was clear except for a little Cirro-stratus in which the mock sun seemed to be bedded. The sun's position at the time of observation was azimuth, 113·4°, elevation, 14·3° as measured by a theodolite; and the positions of the two mock suns, which were visible simultaneously, were (*a*) azimuth, 89·0°; elevation, 14·5°, and (*b*) azimuth, 137·1°; elevation, 14·0°.

In each case the mock sun was coloured red on the side nearest the sun; no other colours were distinctly discernible. In each case, too, a pointed white tail extended on the sides remote from the true sun, parallel to the horizon. These streamers extended outward for about 6°. The mock sun (*a*) persisted until 8h., whilst (*b*) disappeared at 7h. 45m. The sky became cloudy at 13h., overcast at 15h., and rain fell at 16h. The barometer rose slightly from 7h. to 8h., and fell slowly, very slowly, thenceforward. W. H. PICK.

Cranwell, Lincs., March 31*st*, 1920.

[It will be remembered that mock suns are explained by the refraction of light through crystals which are hexagonal and flat; as such crystals settle down through the air they keep horizontal. The rays concerned pass with minimum deviation through faces inclined at 60°. The angle between the sun and the mock sun for the elevation 14·3° is given by Pernter as 22·5°.—ED. M.M.]

Formation of Cumulus.

I SHOULD esteem it a favour if any of your readers could throw any light on the formation of cumulus cloud during the prevalence of a strong wind. During the last week when the breeze was often strong from some southerly point, I repeatedly noticed the sky filled with heavy cumulus clouds, and wondered how columns of warm air could exist sufficient to form such clouds with such a general movement of the air. Do these columns move with the surface wind, or are the clouds formed other than true cumulus. The most beautiful forms of cloud are, of course, seen on a still day when both the temperature and the humidity are high and there is a tendency for thunderstorms. I may say that during my stay in Macedonia I never witnessed such grand cloud scenes as one frequently sees in this more interesting climate of ours. From a meteorological point of view, I think the British Isles have no equal in the variety of weather features to be met with. E. HARRISON.

36, *Rosemont Road, Richmond, Surrey, March* 29*th*, 1920.

OFFICIAL NOTICES.

Aeronautical Research and Education.

THE report of a Committee appointed by the Secretary of State for Air to consider future arrangements for Aeronautical Research and Education was recently issued as Command Paper 554. The Committee, which was presided over by Sir Richard Glazebrook, recommended that the present Advisory Committee for Aeronautics should be replaced by an Aeronautical Research Committee in connection with the Air Ministry. Such an Aeronautical Research Committee has now been constituted.

The Chairman of the Committee is Sir Richard Glazebrook, now Zaharoff Professor and Director of the School of Aviation in the Imperial College of Science and Technology, whilst Lieut.-Colonel Gold is appointed by the Controller-General of Civil Aviation, for meteorology. Mr. G. I. Taylor, who also has special knowledge of that subject, is appointed as a representative of science.

Approval has been given for the provision of a grant from public funds towards the cost of the Department of Aeronautics at the Imperial College of Science, and the organisation and staffing of that Department under the direction of Sir Richard Glazebrook is now proceeding. The appointment of Dr. Leonard Bairstow, F.R.S., C.B.E., as Professor of Aerodynamics has been announced. Instruction in meteorology is to be provided for all students of aeronautics at the College.

Circulation of Forecasts by Wireless Telegraphy.

Collective Weather Reports for London and S.E. England.

FROM February 20th, 1920, hourly reports of meteorological information, prepared by the Forecast Service of the Meteorological Office, have been sent out from the wireless station at the Air Ministry. The message is given in a code form, which is practically the same as prescribed in Annex G of the "Convention relating to International Air Navigation," Paris, 1919. The forecasts, which are being issued eight times a day, are based on observations taken about half an hour before the time of issue.

Detailed explanation of the code can be obtained on application at the Office.

Climatological Stations.

Whitby.—Mr. T. Woodhouse Parkinson having left Whitby, Captain D. S. Ramsdale has taken over the charge of the station.

Formula for Rising Velocity of Pilot Balloons.

In computing the rate of ascent of pilot balloons for the one theodolite method, the use of the simple formula $V = q\, L^{\frac{1}{2}}/(W + L)^{\frac{1}{3}}$ is customary. In this formula V is the upward speed of the pilot balloon, L is the net free lift in grammes, W is the dead weight of rubber and attachments, and q is a constant.

In September, 1919 (M.O. Circular No. 27), the following values of the constant were adopted for stations under the Meteorological Office :—

$q = 84$ for V in metres per minute,
$q = 275$ for V in feet per minute.

It is now announced that with balloons having a free lift less than 150 grammes, the same value of q is to be used for night ascents with lantern, as for day ascents without lantern.

Weather Map at the Air Ministry.

During the month of April, 1920, a new device for making the meteorological reports rapidly available to the public has been evolved in the shape of a large Weather Map which is exhibited daily in one of the front windows on the ground floor of Empire House, Kingsway. All the principal reporting stations in the British Isles as well as a few neighbouring Continental ones are marked on the chart, which is on the Mercator Projection and is 10 ft. high and 6 ft. wide. The information on the chart is changed at about 3h., 8h. 30m. and 14h. 30m., G.M.T., the data exhibited referring to observations made at 1h., 7h. and 13h., G.M.T.

Arrows painted black fly with the wind, the speed being shown in miles per hour, violet figures indicate the visibility in miles, red figures denote temperature in degrees Fahrenheit, and the state of the weather is written in black letters ; *e.g.*, Heavy Snow, Thick Drizzle, Dense Fog, Cloudless.

The chart has attracted a great deal of interest since it was first exhibited. Some of the eager enthusiasts do not at first realize that the map represents the reported weather at the time specified, and not the meteorologists' estimate of the weather to be. Such an estimate is indicated separately by the exhibition of the latest *forecasts*.

Official Publications.

Geophysical Memoirs No. 14.—Soundings with Pilot Balloons in the Isles of Scilly. By Capt. C. J. P. Cave, M.A., and J. S. Dines, M.A.

In this Memoir the authors have discussed the results of 41 pilot balloon soundings made at Scilly during the months of November and December, 1911. The object of this series of observations was to study in detail the structure of the free atmosphere uninfluenced by land masses, and the memoir can be regarded as a sequel to Captain Cave's "Structure of the Atmosphere in Clear Weather." Owing to the favourable geographical position of Scilly and the small size of the islands a pilot balloon soon reaches a height where complexities introduced by the presence of the land are negligible, so that the set of observations is probably representative of the normal structure of the free atmosphere over the sea. The authors have compared these results with those obtained at Ditcham Park and discussed in Captain Cave's book already mentioned, and many other points of theoretical interest have been investigated.

The pressure distribution during the winter of 1911 differed very little from that of the normal winter in the region of the British Isles, and the pilot balloon observations at Scilly, which were happily undertaken at a time when winter conditions were becoming established, are therefore of special interest as illustrating the sequence of upper air movements during the transition from Autumn to Winter.

Geophysical Memoirs No. 15.—The climate and weather of Falkland Islands and South Georgia. By C. E. P. Brooks, M.Sc.

The Falkland Islands and South Georgia lie in the South Atlantic Ocean between latitudes 40° and 60° S. and longitudes 20° and 60° W. This region is within the same latitudes in the Southern Hemisphere as the British Isles are in the Northern.

Hitherto the meteorology of these islands has not been studied in detail. The author has collected information from various sources, principally MS. returns, and has presented it with suitable discussion. The Memoir is well illustrated with maps and diagrams. The representative meteorological station for the Falkland Islands is Cape Pembroke; for South Georgia, Grytviken. Meteorological data from other stations are also available, but they are not so full and detailed as those from the two stations already mentioned.

The prevailing ocean currents in this region sweep up a considerable number of icebergs from the Antarctic. The wind, which is generally between W. and N.W., blowing over the ice-laden sea, controls to a great extent the temperature of the Islands. At Cape Pembroke "there is "astonishingly little variation in the mean temperature from "year to year," and the annual range at Grytviken is only 4° F.

Humidity is very high, but the rainfall, although distributed over a large number of days, is not excessive, about 30 inches a year.

A sunshine-recorder has been in operation at Stanley, in the Falkland Islands, since 1906, and it is found that the duration of sunshine averages 3·8 hr. per day throughout the year. This is a little below the normal for Kew Observatory—4·0 hr. per day. The highest proportion of possible sunshine occurs in February, *i.e.*, subsequent to the solstice, whereas in England May is usually the sunniest month.

A set of wind-roses illustrates the difference between the dry warm Föhn wind which reaches Cape Pembroke from the N.W. and the cooler and damper winds from other quarters.

As a contribution to the study of the general movement of the atmosphere the directions of motion of upper clouds are summarised. The distribution differs but little from that of the surface winds, N.W. being the most frequent direction (31 per cent. of the observations) and E. the least frequent (4 per cent.).

Geostrophic Wind over London; June, 1881–1915.

FREQUENCY OF STRENGTH AND DIRECTION.

Estimates based on the D.W.R. charts (8*h.*, 1881–1908; 7*h.*, 1909–1915).

Direction.	5 m/s. 11 mi/hr.	10 m/s. 22 mi/hr.	15 m/s. 33 mi/hr.	20 m/s. 44 mi/hr.	Over 20 m/s. Over 44 mi/hr.	Total Frequency of Direction.
N.	31	24	6	1	2	64
NE.	35	40	26	4	2	107
E.	16	33	21	8	2	80
SE.	11	14	3	—	—	28
S.	18	15	6	2	—	41
SW.	35	51	29	9	—	124
W.	32	87	47	12	4	182
NW.	22	49	31	15	1	118
Total Frequency of strength	200	313	169	51	11	744*

* Indeterminate—306.

Royal Meteorological Society.

THE usual monthly meeting of the Society was held on the 21st March, Mr. R. H. Hooker, President, in the chair.

A description of the Night Sky Recorder recently brought into use at the Royal Observatory, Greenwich, was given by Mr. W. W. Bryant. The object of the instrument is to supplement the daily sunshine record in so far as it gives an indication of the amount of cloud at night. It consists of a small fixed camera pointing to the pole of the heavens. The lens is a single component of a doublet of eight-inch focal length, and 0.4 in. aperture, working at f/20. It is found that this aperture in conjunction with plates of "ordinary" speed will give good star tracks even at full moon. Measurements are made by means of a photographic scale. The camera must only be open when the sun is sufficiently below the horizon, and it was suggested that the opening in the evening could be conveniently carried out by an observer and the shutting by an alarm clock. The precise time for any portion of the trace is obtained by an original adjustment of the plate and checked when the evening is clear at the time of opening. It is found convenient to utilise the trace of a neighbouring star δ *Ursae Minoris* rather than that of the Pole Star, which gives much the smaller arc. The trace examined under the microscope appeared to give a thickness varying more with the relative clearness of the sky than the sunshine recorder trace.

Lieut. N. L. Silvester read a paper entitled "Local Weather Conditions at Mullion, Cornwall," in which he gave a detailed analysis of the local meteorological elements over a period of about twelve months. The ordinary autographic records used were supplemented by a complete series of hourly eye observations. Ratios of gradient to surface wind had been computed and analysed from the results of over four hundred pilot balloon ascents by the one theodolite method. It had been possible to make comparisons between two very different exposures at a small distance apart. These had at least shown unmistakable evidence of the marked friction and turbulence affecting the wind near the surface in the vicinity of large buildings such as air-ship sheds. Much useful information relating to the local occurrence of fogs, subdivided into (1) radiation fog, (2) sea fog, (3) coast mist and drizzle and unusual visibility, had been tabulated. Another feature was the collection in tabular form of local signs of approaching bad weather.

Mr. J. Edmund Clark gave an account of the Surrey hail-storm of July 16th, 1918. This storm differed from other similar British visitations by the fortunate absence of much wind and by coming after midnight. The track of serious damage rarely exceeded a half mile in width and was 16½ miles long, the hail beginning at 1h. 55m., G.M.T., to the west of Holmwood station and ending near North Bromley station at about 2h.30 m., G.M.T. Rain and hail ceased sharply beyond the south-east margin, near which the fall was heaviest. At Purley, 1.37 in. fell in 11 minutes. Vivid, almost incessant lightning accompanied the hail; the noise of the latter, however, rendered the thunder inaudible. About 25 per cent. of the hail consisted of jagged chunks of ice, some up to two or three inches long. Greenhouse roofs and some windows were smashed and crops destroyed, in places reduced to pulp. The total damage amounted to at least ten thousand pounds. The associated thunderstorm over the south-east of England, and the temperature, pressure, wind and upper air conditions were considered in the paper.

The following candidates were elected fellows of the Society:—H. F. Bentley, G. R. Collinson, C. W. Dean, Lieut. S. Fielder, O.B.E., R.N.R., J. Hammond, F. E. Lee, Miss W. A. Quennell, J. R. Roberts and W. C. Waugh.

NOTES AND QUERIES.

Intense Rainfalls in 1919.

FOR more than fifty years an article has appeared annually in *British Rainfall* dealing with the recorded instances of notably intense rainfalls in short periods of time during the year under review. The limits above which any record is regarded as sufficiently noteworthy to be included were defined in 1908, and have been adhered to rigidly since that date. These limits were slightly more stringent than those adopted during the previous forty years. At the same time a means was found for defining those rainfalls which might reasonably be labelled as "remarkable" and "very rare," respectively, and these were specially indicated in the lists.

During the preparation of *British Rainfall*, 1919, the whole of the available information in regard to that year has been collated, and the curious fact has been brought to light that, in spite of the largely increased number of observers, the number of instances of intense rainfalls reaching the limit for quotation is smaller than in any year since 1885, and that the year 1919 was the first since 1869 with no recorded instances of rainfalls reaching the "remarkable" limit. The number of records quoted must naturally depend in some measure upon accidental factors, but so remarkably short a list as that for 1919 must clearly be traceable to the great absence of thunderstorms which was one of the characteristics of the year, a fact borne out by the comments of observers in all parts of the country.

It would be a great satisfaction in putting this unusual phenomenon on record if any observers who have self-recording raingauge records for 1919 would examine the traces with a view of extracting details of any exceptionally intense rainfalls. Any observers who obtained such records by means of ordinary rain gauges and have not yet sent them to Camden Square are particularly requested to do so at an early date.

C. S.

Formation of Mercury Globules in Barometers.

Mr. A. J. Bamford has sent to the Meteorological Office an interesting photograph of a Kew-barometer showing globules of mercury above the main column. The photograph was taken at Puttalam, in Ceylon, by Mr. Evans.

Mr. Bamford writes:—

> "The most visible globules are all on the front, but there are others behind which are partly hidden by the glint on the left of the tube. This is by no means an isolated phenomenon. I have met it more than once, particularly at Puttalam, a station on the west coast north of Colombo, with an average diurnal range of temperature of 12·7° F. The bubbles join up quite rapidly with the main column when the instrument is tilted, but form again before the next inspection, *i.e.*, in a few months. I remember talking to some of the others at the Paris Conference about it, and finding that some of them had met it too, but I do not remember seeing any notes about it in any book. There it no serious change of index error."

Mr. Bamford is seeking for an explanation of the phenomenon.

The tradition of the Meteorological Office is that it occurs only in barometers exposed to the sun. Direct experimental evidence from observers who have noticed it would be welcome.

Exceptional Balloon Ascents.

In the course of experiments on the use of light filters in observing pilot balloons, two exceptional one-theodolite ascents have been obtained at South Farnborough. In one case (November 26th, 1919) the balloon was followed for 152 minutes and the nominal height reached was 25 kilometres, the final distance 95 kilometres. In the other case (January 9th, 1920) the nominal distance was 84 kilometres.

Recourse was had to laboratory experiment for evidence on the probability of the results. A balloon from the same batch was examined for relation between inflated diameter, internal pressure, and rate of leak. It developed a pinhole at the diameter which would normally be attained at a height of 14 kilometres. Computation from normal values of pressure temperature and density in the upper air indicate that, allowing for the leak, this balloon would probably have been at a height of 26·5 kilometres at the end of a 152-minute ascent.

An experimental determination was also made of the angle subtended by an object just capable of detection by the theodolite in the conditions of illumination prevailing during the ascent. It was found that an object subtending 1·7 seconds of arc could be detected. This corresponds to a diameter of 80 cm. at 95 kilometres, and the actual diameter of the balloon at the end of the ascent was probably between 110 and 130 cm. It is to be observed that detection of the brightly illuminated balloon is easier than the resolution of the corresponding angle. The resolving power of the $1\frac{7}{8}$-in. objective used would, on the simple theory of resolving power, be 2·7″, but the empirical rule derived from astronomical experience indicates a better performance, say, 2·4″. A 115-cm. balloon at 95 kilometres would be just on the limit of resolution.

Thus experimental evidence supports the probability that a height of 25 kilometres and a distance of 95 kilometres were attained on November 26th. Examination of the results of the ascent show that the minimum horizontal velocity was found at 10·5 kilometres, *i.e.*, where it would be expected, the boundary of the stratosphere in November being at 10·8 kilometres, and, further, that the angular elevation of the balloon was increasing at the 110th minute, a very improbable circumstance if appreciable leakage had occurred. R. A. W. W.

South Farnborough.

A Correction.

The notice concerning Mr. Harries' retirement in the last issue of the Magazine requires correction. Mr. Harries served in the Marine Division under Lieut. C. W. Baillie, R.N., as well as under Capt. Toynbee and Capt. Campbell Hepworth. From Capt. Hepworth's death on February 25th, 1919, Mr. Harries was in charge of the Marine Division. He was appointed Acting Superintendent on May 1st.

Obituary.

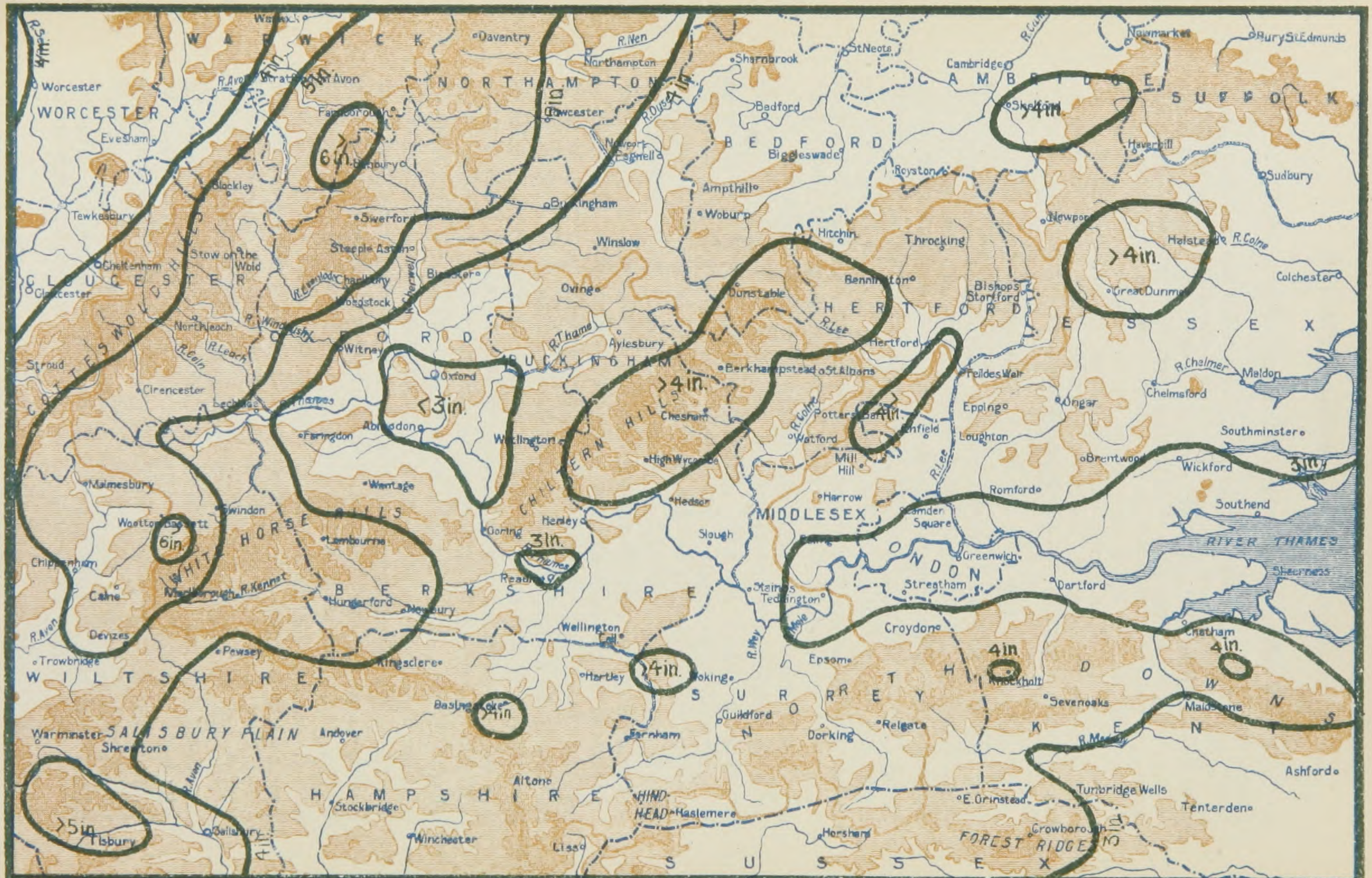
John George Bartholomew, LL.D., F.R.S.E., F.R.G.S. (22nd March, 1860—13th April, 1920).—News of the death of Dr. J. G. Bartholomew, the great cartographer, will be received with universal regret and by his personal friends with deep sorrow. Never a physically strong man, he had been for several years in very indifferent health, but a three months' rest in Portugal appeared to have somewhat strengthened him, and his death at Cintra was as unexpected as it was peaceful.

Dr. Bartholomew possessed the soul of an artist and the mind of a man of science; he followed the course of geographical discovery and research with an exact and eager interest; his invention of the layer system of contouring in orographical maps resulted in work of unsurpassed delicacy and effectiveness; and the award to him in 1905 by the Royal Geographical Society of the Victoria Medal in consideration of "his successful efforts to raise the standard of cartography," was in effect a considered judgment that the work of the Edinburgh Geographical Institute had eclipsed that of the great map-makers of Gotha. The various sets of maps and admirable atlases issued by his firm are familiar to us all, and doubtless most of them were profitable projects; but Dr. Bartholomew's friends were aware that he was never chiefly concerned with the commercial success of any venture, and he laid meteorologists under a lasting obligation by the publication of the great "Atlas of Meteorology" in the preparation of which considerable capital was sunk with no certainty of any return. On the great "*Times* Survey Atlas of the World," now in course of publication, he had been engaged for more than 15 years.

Dr. Bartholomew was primarily the founder of the Royal Scottish Geographical Society; for a time on the Councils of the Royal Society of Edinburgh and of the Scottish Meteorological Society; a consistent supporter of the British Rainfall Organization, for which he specially prepared various working maps, and a member of many foreign scientific societies.

A. W.

THAMES VALLEY RAINFALL APRIL, 1920.



ALTITUDE SCALE

Below 250 feet	250 to 500 feet	500 to 1000 feet	Above 1000 feet

SCALE OF MILES 0 5 10 15 20

Symons's Meteorological Magazine

Watershed of River Thames above Teddington, and River Lea above Feildes Weir

Isohyetals

H.M. Stationery Office Press Kingsway W.C.2.

Ps. 5540/193. 10s. R.35. 1250. 5/20.

Weather in the British Isles: April 1920.

FROM the first day, which was dull and rainy in London and many other parts of Great Britain, to the last, on which hailstorms were widespread, April was unsettled, showery, and inclement. During the greater part of the period the weather over the British Isles was of a cyclonic type, and depressions passing eastwards from the Atlantic kept the air-pressure low, so that at some stations the mean pressure for the month was the lowest on record for April. With these conditions rain fell frequently, and numerous stations had as many as 28 rain-days. On some of the days, however, the sunshine records were good, Cahirciveen, for instance, registering 11·2 hr. on the 4th, Nairn 12·4 hr. on the 20th, and Malin Head 14·0 hr. on the 30th; but commonly these sunny conditions were only temporary and confined to limited areas. In some localities the lack of sunshine was very marked, the mean daily amount at Kew Observatory and Nottingham being only about two hours and a half, and only half the normal duration for April.

This general deficiency of sunshine kept the daytime temperature very low, so that at numerous stations the mean maximum temperature was below the normal. On the other hand, owing to the persistent cloudiness, the nights were unusually warm. At Copdock, Ipswich, the mean minimum for the month (41·7° F.) was the highest April value during 19 years, and at Totland Bay, Isle of Wight, the mean (44·6° F.) was the highest during 34 years. Very generally the 23rd was the warmest day of the month, the highest values being about 65° F.; and the coldest mornings were the 1st, 8th and 30th, minima of 21° F. in the screen and 16° F. on the grass being registered at Eskdalemuir on the last of those dates. On the 10th, when two "lows" were shown on the weather map for 7 h., one over the West and the other over the East of England, the maximum temperatures reported were very remarkable, the reading at Harrogate, for instance, being only 39° F., compared with 62° F. at Raunds (Northants).

Over the British Isles as a whole the rainfall was above the average. Considerable areas in central England and Wales had over twice the average; Scotland had about the average, while Ireland had everywhere above the average, reaching nearly twice the average in Kerry. Less than 2 in. for the month was confined to small areas in the central plain and east coast of Scotland. More than 5 in. fell over considerable areas in England as far east as York, Grantham, Northampton and Marlborough, and over the high land of Scotland and Ireland. Over 10 in. was confined to the uplands of Wales, Cumberland and the south-west of Ireland. At some of the stations the rainfall was very abnormal. At Cheadle (Staffs), where the total for the month was 5·65 in., it was the wettest April for 50 years; Meltham (Yorks) had 7·11 in., the month being the wettest in 40 years; Birmingham 4·63 in., the wettest in 33 years; and Tenbury (Worcester) 4·98 in., the wettest in 26 years. Stations as far apart as Thetford (Norfolk), North Cadbury Rectory (Somerset), Church Stretton (Shropshire), Neston (Cheshire), and Haverfordwest (Pembroke) reported the wettest April for over 20 years. Many stations recorded the greatest number of rain days for April. As a result of heavy rains the Nene and Welland Valleys were in flood during the week which ended on the 10th, and the Teme and the Wye were in flood between the 15th and 17th.

Snow fell infrequently, and was mainly confined to Scotland, the principal falls being those which occurred on the 7th and 10th. Hail was more frequent and often accompanied thunderstorms. On the 9th, there was an especially violent thunderstorm. At Calne "1·78 in. fell from 8 a.m. to 11·15 a.m. (a period of 3¼ hours), causing considerable flooding and damage" in that town; at Lechlade 2·33 in. and Brackley (Northants) 1·46 in., fell on this day. Gales and strong winds were not very widely experienced

(*Continued* on p. 80)

Rainfall Table for April 1920.

STATION.	COUNTY.	Aver. 1875—1909.	1920.		Per cent. of Av.	Max. in 24 hrs.		No. of Rain Days.
		in.	in.	mm.		in.	Date.	
Camden Square	*London*	1·74	3·07	78	176	·37	27	21
Tenterden (View Tower)	*Kent*	1·77	2·48	63	140	·40	14	21
Arundel (Patching)	*Sussex*	1·82	3·11	79	171	·39	19	21
Fordingbridge (Oaklands)	*Hampshire*	1·92	3·11	79	162	·51	14	24
Oxford (Magdalen College)	*Oxfordshire*	1·67	2·81	71	168	·44	8	25
Wellingborough	*Northampton*	1·78	4·10	104	230	·83	9	25
Hawkedon Rectory	*Suffolk*	1·63	3·91	99	240	·59	1	24
Norwich (Eaton)	*Norfolk*	1·77	3·60	91	203	·58	9	25
Launceston (Polapit Tamar)	*Devon*	2·34	4·92	125	210	·73	14	25
Lyme Regis (Rousdon)	„	2·39	3·84	98	161	·65	14	22
Ross (Birchlea)	*Herefordshire*	2·09	4·56	116	218	·91	15	25
Church Stretton (Wolstaston)	*Shropshire*	2·20	6·16	156	280	·66	*8	28
Boston (Black Sluice)	*Lincoln*	1·57	3·67	93	234	·75	9	25
Worksop (Hodsock Priory)	*Nottingham*	1·62	3·74	95	231	·49	8	24
Mickleover Manor	*Derbyshire*	1·77	4·19	106	237	·52	8	24
Southport (Hesketh Park)	*Lancashire*	1·84	4·01	102	218	·57	9	25
Wetherby (Ribston Hall)	*York, W. R.*	1·35	3·67	93	198	·50	9	21
Hull (Pearson Park)	„ *E. R.*	1·69	3·98	101	235	·53	10	27
Newcastle (Town Moor)	*North'land*	1·84	3·29	84	179	·60	10	21
Borrowdale (Seathwaite)	*Cumberland*	6·91	12·10	307	175	..	..	..
Cardiff (Ely)	*Glamorgan*	2·50	4·95	126	198	·70	14	30
Haverfordwest	*Pembroke*	2·82	5·74	146	204	·75	8	25
Aberystwyth (Gogerddan)	*Cardigan*	2·48	7·44	189	300	·76	30	25
Llandudno	*Carnarvon*	1·79	3·28	83	183	·78	9	26
Dumfries (Cargen)	*Kirkcudbrt.*	2·50	3·32	84	133	·47	13	24
Marchmont House	*Berwick*	2·28	2·22	56	97	·48	1	18
Girvan (Pinmore)	*Ayr*	2·81	3·07	78	109	·55	26	20
Glasgow (Queen's Park)	*Renfrew*	1·86	1·91	48	103	·24	28	22
Islay (Eallabus)	*Argyll*	2·64	3·23	82	122	·49	15	22
Mull (Quinish)	„	2·98	2·02	51	68	·36	18	20
Loch Dhu	*Perth*	4·38	3·50	89	80	·30	†6	20
Dundee (Eastern Necropolis)	*Forfar*	1·93	1·76	45	91	·36	19	19
Braemar	*Aberdeen*	2·30	2·80	71	122	·47	25	17
Aberdeen (Cranford)	„	2·23	2·28	58	102	·37	27	17
Gordon Castle	*Moray*	1·74	1·80	46	103	·35	1	21
Drumnadrochit	*Inverness*	1·85	2·42	62	131	·50	28	23
Fort William	„	3·65	3·15	80	86	·51	15	19
Loch Torridon (Bendamph)	*Ross*	4·70	3·47	88	74	·61	27	19
Stornoway	„	2·64	2·96	75	112	·69	27	23
Dunrobin Castle	*Sutherland*	2·02	2·31	59	114	·35	26	21
Wick	*Caithness*	1·89	2·01	51	106	·31	27	22
Glanmire (Lota Lodge)	*Cork*	3·23	5·75	146	178	·87	12	22
Killarney (District Asylum)	*Kerry*	3·46	6·80	173	197	·85	7	26
Waterford (Brook Lodge)	*Waterford*	2·68	4·48	114	167	·75	9	22
Nenagh (Castle Lough)	*Tipperary*	2·54	3·61	92	142	·70	19	25
Ennistymon House	*Clare*	2·81	4·14	105	147	·74	19	24
Gorey (Courtown House)	*Wexford*	2·37	3·34	85	141	·53	30	20
Abbey Leix (Blandsfort)	*Queen's Co.*	2·54	3·67	93	144	·65	9	25
Dublin (FitzWilliam Square)	*Dublin*	2·03	2·83	72	139	·45	9	27
Mullingar (Belvedere)	*Westmeath*	2·37	2·42	62	102	·62	14	21
Woodlawn	*Galway*	2·54	3·49	89	137	·57	13	25
Crossmolina (Enniscoe)	*Mayo*	3·13	4·11	104	131	·42	26	24
Collooney (Markree Obsy.)	*Sligo*	2·52	3·55	90	141	·50	15	23
Seaforde	*Down*	2·76	2·91	74	105	·52	21	21
Ballymena (Harryville)	*Antrim*	2·57	2·77	70	108	·35	25	21
Omagh (Edenfel)	*Tyrone*	2·50	4·39	112	176	1·05	15	25

* Also 15. † Also 13, 14 15, 24.

Supplementary Rainfall, April 1920.

Div.	STATION.	RAIN. in.	RAIN. mm.	Div.	STATION.	RAIN. in.	RAIN. mm.
II.	Ramsgate	2·17	55	XII.	Langholm, Drove Rd.	4·16	106
,,	Sevenoaks, Speldhurst	3·38	86	XIII.	Selkirk, Hangingshaw	2·68	68
,,	Hailsbam Vicarage	2·78	71	,,	North Berwick Res.	1·48	38
,,	Totland B. Aston Ho.	2·55	65	,,	Edinburgh, Royal Ob.	1·58	40
,,	Ashley, Old Manor Ho.	3·79	96	XIV.	Biggar	2·05	52
,,	Grayshott	3·56	90	,,	Leadhills	4·45	113
,,	Ufton Nervet	3·74	95	,,	Maybole, Knockdon	1·89	48
III.	Harrow Weald, Hill Ho.	3·40	86	XV.	Rothesay	3·32	84
,,	Pitsford, Sedgebrook	4·85	123	,,	Oban	2·33	59
,,	Chatteris, The Priory	2·69	68	,,	Inveraray Castle	5·15	131
IV.	Elsenham, Gaunts End	4·02	102	,,	Holy Loch, Ardnadam	3·23	82
,,	Lexden, Hill House	3·17	80	XVI.	Loch Venachar	2·10	53
,,	Aylsham, Rippon Hall	3·50	89	,,	Glenquey	3·00	76
,,	Swaffham	3·13	80	,,	Loch Rannoch, Dall	2·03	52
V.	Devizes, Highclere	5·22	133	,,	Coupar Angus	1·60	41
,,	Weymouth	3·41	86	,,	Montrose Asylum	2·42	62
,,	Ashburton, Druid Ho.	6·26	159	XVII.	Balmoral Castle	2·72	69
,,	Cullompton	4·91	125	,,	Fyvie Castle	2·26	57
,,	Lynmouth, Rock Ho.	5·11	130	,,	Peterhead, Forehill	2·21	56
,,	Hartland Abbey	4·38	111	,,	Grantown-on-Spey	2·48	63
,,	St. Austell, Trevarna	5·34	136	XVIII.	Cluny Castle	2·79	71
,,	North Cadbury Rec.	4·77	121	,,	Loch Quoich, Loan	8·90	226
VI.	Clifton, Stoke Bishop	4·40	112	,,	Skye, Dunvegan	2·85	72
,,	Ledbury, Underdown	4·39	112	,,	Fortrose	1·78	45
,,	Shifnal, Hatton Grange	4·21	107	,,	Ardross Castle	2·80	71
,,	Ashbourne, Mayfield	4·92	125	,,	Glencarron Lodge	5·16	131
,,	Barnt Green, Upwood	3·81	97	XIX.	Tongue Manse	3·10	79
,,	Blockley, Upton Wold	5·25	133	,,	Melvich Schoolhouse	2·34	59
VII.	Grantham, Saltersford	4·68	119	,,	Loch More, Achfary	7·44	189
,,	Louth, Westgate	5·02	128	XX.	Dunmanway Rectory	9·50	241
,,	Mansfield, West Bank	5·30	135	,,	Mitchelstown Castle	5·43	138
VIII.	Nantwich, Dorfold Hall	4·34	110	,,	Gearahameen	12·50	318
,,	Bolton, Queen's Park	5·57	141	,,	Darrynane Abbey	5·07	129
,,	Lancaster, Strathspey	4·24	108	,,	Clonmel, Bruce Villa	4·84	123
IX.	Wath-upon-Dearne	3·84	98	,,	Cashel, Ballinamona	4·08	104
,,	Bradford, Lister Park	4·22	107	,,	Roscrea, Timoney Pk.	3·39	86
,,	West Witton	5·13	130	,,	Foynes	3·44	87
,,	Scarborough, Scalby	4·34	110	,,	Broadford. Hurdlesto'n	3·82	97
,,	Ingleby Greenhow	3·94	100	XXI.	Kilkenny Castle	3·65	93
,,	Mickleton	3·90	99	,,	Rathnew, Clonmannon	3·30	84
X.	Bellingham	3·05	77	,,	Hacketstown Rectory	4·19	106
,,	Ilderton, Lilburn	2·43	62	,,	Ballycumber, Moorock	2·42	62
,,	Orton	5·47	139	,,	Balbriggan, Ardgillan	2·94	75
XI.	Llanfrechfa Grange	6·33	161	,,	Drogheda	2·64	67
,,	Treherbert, Tyn-y-waun	14·00	356	,,	Athlone, Twyford	2·48	63
,,	Carmarthen Friary	7·24	184	,,	Castle Forbes Gdns.	2·89	73
,,	Fishguard	5·42	138	XXII.	Ballynahinch Castle	4·61	117
,,	Lampeter, Falcondale	8·69	221	,,	Westport House	4·03	102
,,	Abergwngy	10·35	263	XXIII.	Enniskillen, Portora	3·99	101
,,	Crickhowell, Talymaes	6·30	160	,,	Cootehill, Dartrey	3·85	98
,,	Sennybridge	9·08	231	,,	Armagh Observatory	2·89	73
,,	Lake Vyrnwy	8·20	208	,,	Warrenpoint	4·02	102
,,	Llangynhafal, P. Drâw	4·07	103	,,	Belfast, Cave Hill Rd.	3·03	77
,,	Dolgelly, Bryntirion	9·08	231	,,	Glenarm Castle	3·66	93
,,	Lligwy	3·60	91	,,	Londonderry, Creggan	3·33	85
XII.	Stoneykirk, Ardwell Ho.	2·95	75	,,	Sion Mills	2·94	75
,,	Gatehouse, Cally	..	..	,,	Milford, The Manse	3·28	83
,,	Carsphairn, Shiel	5·00	127	,,	Killybegs, Rockmount	4·80	122

Climatological Table for the

STATIONS Those in italics are South of the Equator	PRESSURE		TEMPERATURE							
			Absolute				Mean Values			
	Mean M.S.L.	Diff. from Normal	Max.	Date	Min.	Date	Max.	Min.	½ max. and min.	Diff. from Normal
	mb.	mb.	° F.		° F.		° F.	° F.	° F.	° F.
London, Kew Observatory	1008·7	−5·5	57	23	26	27	43·9	34·7	39·3	−4·7
Gibraltar	1016·5	−0·1	69·9	5	46·4	2	64·3	52·9	58·6	−2·0
Malta	1018·5	+0·1	80·2	7	48·0	19	68·0	58·2	63·1	−0·2
Sierra Leone	1012·3	+1·3	99	12	70	5, 6	89·1	73·7	81·4	+0·1
Lagos	..	..	88·2	30	70·3	1	86·4	74·3	80·3	−1·0
Kaduna, N. Nigeria	*944·0	..	90	†6	52	25	87·3	58·7	73·0	..
Cape Town	..	..	86·2	22	49·1	28	74·3	56·4	65·3	+2·2
Johannesburg	..	..	81·9	17	42·8	9	72·2	51·9	62·1	+2·6
Mauritius	1014·8	−1·1	87·8	30	61·0	6	83·8	68·4	76·1	+0·5
Bloemfontein	..	..	92·8	19	40·9	9	79·8	52·8	66·3	−2·1
Calcutta, Alipore Obsy.	..	..	..	..	..	..	..	..	..	..
Bombay	..	..	91·4	5	69·5	25	88·0	75·9	81·9	+1·5
Madras	..	..	90·6	17	70·5	26	86·2	74·4	80·3	+1·7
Colombo, Ceylon	..	..	87·1	25	70·2	18	85·2	74·0	79·6	0·0
Hong Kong	1017·5	−0·1	83·7	6	48·5	25	72·7	64·1	68·4	−1·3
Sydney	..	..	..	..	..	..	..	..	..	..
Melbourne	..	..	94·9	27	45·0	15	73·2	54·6	63·9	+2·6
Adelaide	..	..	104·5	25	46·6	14	81·6	57·2	69·4	+2·5
Perth	..	..	96·4	22	50·2	1	74·6	56·6	65·6	−0·1
Coolgardie	..	..	98·2	30	41·0	1	81·9	55·9	68·9	−2·1
Brisbane	..	..	89·6	19	56·5	8	81·1	64·2	72·7	−0·8
Hobart, Tasmania	..	..	86·0	8, 16	42·9	11, 20	68·6	50·0	59·3	+2·1
Wellington	1009·1	−3·2	65·8	2	35·8	23	60·8	48·6	54·7	−2·2
Suva, Fiji	1014·3	+1·9	86·0	26	66·2	20	82·2	72·0	77·1	−0·3
Jamaica, Kingston	..	..	..	..	..	..	..	..	..	..
Grenada	1010·5	−0·5	89	5, 14	72	‡2	84·9	74·4	79·7	+0·4
Toronto	1018·6	+2·0	64·3	1	16·2	27	45·1	31·2	38·1	+0·7
Fredericton	1018·3	..	58·0	30	2·5	29	41·2	26·1	33·7	+0·4
St. John, N.B.	1017·3	+3·0	52·3	18	14·0	29	42·7	31·3	37·0	+0·3
Victoria, B.C.	1017·9	+3·0	55·3	16	29·7	26	46·7	38·9	42·8	−3·1

* At Station Level, height of 2,088 feet. † Also 10, 12, 15, 16, 30. ‡ Also 9, 22, 25, 26.

GIBRALTAR.—2 thunderstorms, 5 days of gale.

MALTA.—Mean speed of wind, 9·3 mi/hr.

SIERRA LEONE.—8 thunderstorms, 2 days of gale.

LAGOS.—Harmattan appeared on 19th.

Mauritius.—Prevailing wind ESE ; mean speed, 7·0 mi/hr.

COLOMBO.—Prevailing wind W. ; mean speed, 3·9 mi/hr.

British Empire, November 1919.

TEMPERATURE				PRECIPITATION						
Mean Values		Absolute		Amount		Diff. from Normal	Days	Mean Cloud Am'nt	Bright Sunshine	STATIONS
Dew Point	R'tive Humidity	Max. in Sun	Min. on Grass						Hours per day	Those in italics are South of the Equator.
°F.	%	°F.	°F.	in.	mm.	mm.				
35·7	85	86·7	15·6	1·1	27	− 29	19	7·3	1·50	London, Kew Observatory.
51·4	77	142	38	16·44	418	+256	13	5·2	..	Gibraltar.
..	80	124	..	3·66	93	+ 2	5	7·5	5·9	Malta.
73·0	77	..	..	4·51	115	− 25	11	3·1	..	Sierra Leone.
73·1	75	156	57·4	4·66	118	+ 56	5	7·2	..	Lagos.
57·6	60	..	..	0·38	10	+ 9	1	1·2	..	Kaduna, N. Nigeria.
51·6	62	..	..	0·67	17	− 10	5	3·6	..	*Cape Town.*
50·1	73	..	40·1	5·32	135	+ 36	13	6·1	7·85	*Johannesburg.*
64·9	69	..	56·8	1·23	31	− 9	12	5·2	..	*Mauritius.*
47·9	53	..	..	1·95	50	− 8	9	3·9	..	*Bloemfontein.*
..	..	..	..	..	..	..	..	..	..	Calcutta, Alipore Obsy.
71·2	72	136·5	60·5	0·18	5	− 5	2	2·6	..	Bombay.
73·6	84	158·4	67·3	12·83	326	+ 1	14	6·1	..	Madras.
72·6	82	160·5	64·6	8·89	226	− 48	18	7·2	..	Colombo, Ceylon.
62·1	67	..	..	2·89	73	+ 31	8	5·6	5·86	Hong Kong.
..	..	..	..	..	..	..	..	..	..	*Sydney.*
50·1	59	153·8	37·0	1·15	29	− 29	13	6·0	..	*Melbourne.*
49·5	43	166·0	36·4	0·15	4	− 26	6	4·9	..	*Adelaide.*
52·9	62	156·3	46·6	0·29	7	− 13	9	4·9	..	*Perth.*
48·6	45	158·2	37·0	1·45	37	+ 25	9	4·6	..	*Coolgardie.*
60·2	66	147·2	50·7	0·38	10	− 85	3	3·8	..	*Brisbane.*
44·6	55	156·0	31·1	0·35	9	− 56	10	6·0	..	*Hobart, Tasmania.*
46	72	143·0	22·5	2·54	65	− 25	11	6·6	6·36	*Wellington.*
72·7	82	..	..	14·34	364	+124	16	8·0	..	*Suva, Fiji.*
..	..	..	..	..	..	..	..	..	..	Jamaica, Kingston.
72·9	80	143	..	7·96	202	− 1	24	5·5	..	Grenada.
31·3	81	98·0	14·0	1·63	41	− 23	9	7·4	..	Toronto.
28·0	83	..	..	5·51	140	+ 37	8	6·4	..	Fredericton.
32·0	86	102·7	10·2	5·99	152	+ 32	18	6·7	..	St. John, N.B.
39·8	91	107·0	23·0	5·53	140	− 14	22	7·8	..	Victoria, B.C.

HONG KONG.—Prevailing wind ENE; mean speed, 10·4 mi/hr.

Brisbane.—Drought continuing; lowest rainfall on record for November.

Hobart, Tasmania.—With exception of 1868 (0·16 in., 4 mm.) this November has lowest rainfall on record.

Wellington.—3 sunless days, 4 days of frost, 1 thunderstorm, 1 day of hail.

Suva, Fiji.—4 thunderstorms.

GRENADA.—2 thunderstorms.

during the month; the most notable occurring on the 15th and 16th in South-East England on the 20th in Western districts, and on the 21st in Southern England.

The general rainfall expressed as a percentage of the average was:—England and Wales, 204; Scotland, 100; Ireland, 146; British Isles, 153.

The weather throughout the month was very unsettled for flying but visibility was for the most part fair and inland fogs were rare. The thunderstorms at the end of the month were of a local nature and could be easily avoided by aircraft. During the gale of the 15th a wind at 3,000 ft. of no less than 110 m.p.h. was reported from the pilot-balloon station at Lympne.

In London (Camden Square) the mean temperature was 49·3° F., or 1·2° F. above the average. The duration of rainfall, 73·1 hours, was the largest recorded in April since these observations were started in 1881. Evaporation ·85 inch.

Weather Abroad: April 1920.

The distribution of pressure over Western Europe during April was unfavourable to fine weather.

Pressure was high over Iceland and a series of depressions, none of them of great intensity, passed slowly across the British Isles. The most severe occurred at the end of the month and caused gales in the Baltic on the 30th. The result was an unsettled month in Western Europe, cold and snowy in Norway, rainy and not particularly mild further south. The considerable totals for the month, well above the average in most places, appear to have been due rather to a large number of wet days than to heavy individual falls, but on the 18th very heavy rain fell in Switzerland —91 mm. at Berne and 75 mm. in Lugano. (These falls were due to a shallow disturbance lying over the Gulf of Lyons and Geneva). At Biarritz 107 mm. fell in three days ending April 22nd.

In America pressure was persistently low off the mouth of the St. Lawrence and high over Central and Western Canada The advent of spring in the prairie regions was delayed by the cold northerly winds caused by this distribution, causing a great scarcity of fodder. From April 1st to 19th the mean temperature at Edmonton, Alberta, was only 26° F. (mean daily max. 32° F., mean daily min. 20° F.), compared with a normal of 46° F. for the whole of April or of about 38° F. for the first half. Snow was falling as late as mid-April in Alberta. During the first half of the month these low temperatures appear to have extended northwards into the Arctic Ocean, 48 degrees of frost being recorded at Spitsbergen on the 13th, but on the 21st the temperature there rose suddenly to a maximum of 34° F. A tornado was recorded in parts of Mississippi, Alabama and Tennessee on April 20th, damaging several townships and causing a score or more of deaths.

Unusually wet weather appears to have prevailed in New Zealand and in Northern and Eastern Australia. But it happens that this phenomenon is regarded with very different feelings in the two countries. Australia being constitutionally short of rain, any excess above normal is regarded as a blessing, fertilising the soil and ensuring abundant pasture. On the other hand, New Zealand normally has rather more rainfall than its rivers can dispose of satisfactorily, and any excess, as in this case, results in floods, destruction of bridges and heavy damage to roads, buildings and cattle.

On April 23rd a violent cyclone passed over Manikganj, a small town in Bengal, killing 93 persons.

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The Ventilation of Instrument Shelters.

By Rev. W. F. A. ELLISON, M.A., Director, Armagh Observatory.

ONE of the greatest enemies of valuable astronomical and meteorological instruments is moisture, yet, although this is generally recognised, little thought seems to be given by the makers of instruments to their protection from damp. It is an easy matter to design a dome for an equatorial telescope or a hut for the recording portion of an anemograph so as to exclude rain. But to prevent the more insidious form of moisture, that condensed from the air inside the building, from injuring the instruments does not seem to have occurred to the designers of such things. Yet it is not a difficult matter. The solution of the problem is to be found in one word—ventilation.

It is now several years since I set to work to design an observatory with revolving roof to shelter a 5-inch equatorial refractor. In doing so I had before me two main principles—the utmost possible lightness consistent with resisting the weather, and absolutely thorough ventilation. These qualities I obtained in the following way: the upright position of the structure consisted of corrugated galvanised iron roofing, nailed to a light timber frame, and the whole was so supported on dwarf brick piers that the floor was everywhere one foot clear of the ground. A cat could run right through underneath it in any direction, its only contact with the ground being the eight brick supports. Against the possibility of being capsized by wind it was secured by

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driving four long iron spikes deep into the ground and screwing these to the bottom frame. This building proved so dry that dew never formed on the glasses of the telescope, and even in winter, books and papers left there curled up as if before a fire. A box of matches left there in the dampest weather would always strike easily. It was so successful that I afterwards constructed a much larger dome for an 18-inch silvered glass reflector on the same plan. This was transferred to Armagh, when I came here, and re-erected without alteration. Its only difference from the smaller dome is that concrete takes the place of brick in the foundation. Long iron bolts, bedded head down in the concrete, serve for anchorage against wind. The galvanised iron roofing is most useful in such a building, as its corrugations ensure abundant ventilation, and its rigidity adds immensely to the strength of the structure.

When I came to Armagh Observatory I found two valuable instruments suffering seriously from damp. These were the 10-inch Grubb equatorial with its clock, and the recording part of the Robinson-Beckley anemograph. The Grubb dome had eight ventilating apertures below the floor, but these were fitted with cast-iron insets, which so reduced the effective airways that they might as well have been closed altogether. Above, the building had one small window which was not made to open. The effects of damp were only too conspicuous. The fine sidereal clock was falling to pieces; the veneering of its case had nearly all come adrift, the glue having melted, and the steel parts of the movement were badly rusted. The driving clock was in like condition, and the object-glass was partly obscured by rust from its cast-iron cell. My first action was to take a heavy hammer and knock out all the cast-iron gratings from the under floor ventilators. Then I had two more windows inserted in the dome, on opposite sides, and made to open like those of a greenhouse. Neither is ever closed except in the wildest weather, and the improvement in the condition of the instruments is immense.

Next was the anemograph hut. This was even worse than the telescope dome, as it was practically airtight. On the morning after a sharp night the interior was always dripping wet. Every nail and bolt dripped water. In addition to deterioration of the mechanism the accuracy of the records suffered. The paper of the charts when it absorbed moisture increased its dimensions to an extent sometimes of the equivalent of 20 minutes on the time scale and of nearly one unit of the velocity scale. And a still more serious consequence was that the marks of the two pens were often so faint as to be nearly illegible.

All this trouble has now been cured by cutting a row of 2-inch holes with a centre-bit on one side of the hut, where they are protected outside by a sloping board against the entrance of rain. The very first day after this was done the improvement in dryness was most marked. I intend to cut another row of holes on the opposite side, so that a current of air may flow right through. I expect that after that the last trace of dampness will disappear. Even with one row only on one side the charts are now always dry and the trace bold and legible.

In conclusion, might I call the attention of those interested to the material called Rubberoid as a covering for such buildings. It is far cheaper than painted canvas, more waterproof and much more durable, besides being as easily repaired if damaged as a punctured bicycle tyre. It does not require to be painted, and lasts indefinitely.

The Disaster at Louth.

THE attention of the public has recently been focussed on the appallingly sudden and disastrous flood which caused serious loss of life and property in the town of Louth, in North Lincolnshire. Up to the present moment it has not been possible to bring together sufficient information to enable a detailed account of the occurrence to be compiled, but it appears desirable to put upon record such meteorological facts bearing upon the subject as are available.

The last week of May was marked by hot weather in all parts of the country, and numerous thunderstorms developed, more particularly in England. The highest temperatures were reported on May 25th, when 82° F. was reached in the Thames Valley. Thunderstorms, in one case with remarkably heavy rain, took place in Hertfordshire, Essex and Norfolk. At Athlone, in Co. Westmeath, 1·49 in. of rain fell in an hour on the same day. On the 26th, an area of comparatively low barometric pressure lay across England and Ireland, and thunderstorms occurred in parts of the Thames Valley, rainfall being exceptionally heavy in the west of London, particularly at Barnes and Ealing, where over 2 inches fell. At Hammersmith roads were flooded and wood pavements burst up, though at South Kensington, a couple of miles distant, only light showers fell. At Fulham ·86 in. was measured. Isolated thunderstorms again took place on the 27th, on this occasion in the north, ·80 in. of rain falling in 20 minutes at Mosley Hall, near Whaley Bridge, and 1·13 in. at Marchmont, in Berwickshire.

The distribution of atmospheric pressure after this date continued to be irregular; it was lower over the British Isles than in neighbouring countries, and on the evening of the 28th a "low" which appears to have originated over the south of France began to deepen and move northward. The pressure map for 7 h., G.M.T., on the 29th indicates the depression as situated over the Bristol Channel. At 13 h., pressure was below 1012 mb. over the Midlands, and by 18 h. it had fallen to 1009 mb. By the morning of the 30th the centre was over the North Sea, and by the evening of that day, having deepened to 1004 mb., it had moved to the Shetlands.

On the rainfall day of May 29th, ending at 9 h. on 30th, practically no rain fell to the south of a line drawn from Plymouth through Reading to Lowestoft. In the north no rain was observed over the whole of the centre and west of Scotland and in Ulster. A great area in which the rainfall exceeded ·50 in. nearly everywhere occupied England and Wales north of Aberystwyth, Birmingham and Skegness, and extended northward to Edinburgh. Associated with this comparatively wet area, a string of isolated patches lay across the centre of Ireland from the Shannon Estuary to Dublin. More than an inch of rain fell at one or two spots in the Irish strip and North Wales, and also over an extensive area in the north of England occupying the greater part of Lancashire, the West Riding of Yorkshire, Lincolnshire and the east of Nottinghamshire. At Newmarket-on-Fergus, in Co. Clare, 1·02 in. of rain fell in 30 minutes, and at Llandysilio, on the Welsh border, 1·02 in. in 15 minutes, but it was only within the English area that any very exceptional phenomena were reported. The centres of very heavy rainfall appear to have been near Preston and in the centre of Lincolnshire. At Leyland, five miles south of Preston, out of a total rainfall of 3·23 in. in the 24 hours ·60 in. fell in 20 minutes from 16 h. 40 m. to 17 h., G.M.T., and 1·65 in. from 17 h. 55 m. to 18 h. 15 m., the latter a shower of intensity very rarely attained in the British Isles. About ten miles further to the north 1·53 in. was measured at Broughton, whilst there was evidence of much heavier rain in the adjacent hills to the north-west causing an extraordinary rise in the Barton Brook and the River Brock, where flood waters carried away bridges and caused considerable damage to roads.

The Lincolnshire rainfall was even more severe; more than 2 inches fell as far west as Lincoln, but the extremely intense fall appears to have been confined to part of the low hills known as the Lincolnshire Wolds. In Louth itself the fall amounted to only 1·42 in., but at Elkington Hall, 3 miles to the west, 4·69 in. was measured, of which 4·59 in. fell in 3 hours. About 2 miles south of this 4·10 in. fell in 2 hours at Hallington, but the gauge overflowed at this point so that the precise amount of the fall was lost. There is reason to think that it was at least as great as at Elkington. Ten miles further south, at Horncastle, 3·95 in. fell in 3 hours. All the evidence goes to suggest that the fall of rain somewhat further west than the points of observation near Louth was even more remarkable, but in the absence of any direct confirmation this cannot be stated positively. The amount certainly fell off somewhat abruptly towards the north-west, only 1·82 in. falling in the 24 hours at Kirmond, some 11 miles W.N.W. of Louth and only ·61 in. at Market Rasen. It is extremely unfortunate that no records are available in the district between Louth and Horncastle, as it is a matter of interest to enquire whether the enormous rainfall occurred along the whole ridge or only at intervals. The statement of a witness at the inquest that a large part of the rain ran into the River Bain indicates some extension westward, and it appears probable that the area of intense rain was widest at its northern extremity, which one may assume to have been near Welton-le-Wold.

Little definite information is available bearing on the time relations of the storms. It is clear that more than one storm occurred during the day, and that the Louth flood was associated with rainfall which commenced about 13 h., G.M.T., and became heavy at about 14 h. 30 m. At Horncastle rain commenced seriously at 15 h., G.M.T. A reputable witness from Benniworth, in the Bain Valley, 12 miles W.S.W. of Louth, stated that rain suddenly poured so fast at 14 h. 30 m. that house pipes could not carry it, and "in a moment the "fields were at least 8 inches deep in water." He added, "I saw a huge cloud, in the shape of an egg, which kept "twisting round. There were three flashes of lightning, very "vivid and very shocking. One seemed to pierce through "the cloud, and immediately afterwards the cloud seemed to "come earthward." The evidence of the borough surveyor showed that the Lud stream, normally 3 feet wide and 1 foot deep, was swollen to a width of 52 yards and a depth of 50 feet. The mere volume of water flowing down the two streams which converge on the outskirts of Louth would probably have been sufficient to account for the extremely serious nature of the damage inflicted, but it appears from such information as we have been able to obtain that it is probable that the stream was temporarily blocked with débris brought down by the earlier rains, and that the devastating flood which poured through the town was the result of the sudden breaking down of this obstacle, which had been able to hold up a considerable volume of water owing to the comparatively gentle gradient of the valley at that point. The abrupt nature of the flood was possibly augmented by the fact that the centre of heavy rain was moving eastward at the time, as is suggested by such scanty time evidence as is available.

In the present incomplete state of the data in our hands it appears inadvisable to attempt any volumetric estimate of the precipitation. The amount of water entering the town of Louth was variously estimated at 20,000,000 and 9,000,000 tons. It is abundantly clear that whilst the amount of rainfall in three hours was nearly, if not quite, unprecedented, the disaster to the town of Louth must be attributed in an almost equal degree to the accident of its geographical position. A similar rainfall in many districts would have undoubtedly drained away without causing exceptional damage, but the valley of the Lud and its tributary form a veritable bottleneck, and if, as is surmised, the bottle was inadvertently corked by a blockage in the stream the awful suddenness of the disaster may be to some extent explained.

Official Publications.

British Meteorological and Magnetic Yearbook, 1918, Part III., Section 2, Geophysical Journal, 1918.—The 1918 volume of the Geophysical Journal has been issued. The introduction contains a memorandum by Dr. C. Chree, F.R.S. on "Probable errors in absolute observations of magnetic elements." Each of the various magnetic elements, horizontal force, declination, and inclination, is found by somewhat elaborate routine of observation. It is of importance to know how far the figures which are published are to be regarded as significant. For instance, in the case of horizontal force, where the tabular unit is 1γ, the probable error in a single observation by a skilled observer during a "quiet" time is only about 3γ, or one part in 6,000, so far as the mere accuracy of observation is concerned, but the systematic error may be of the order of 5γ. Dr. Chree also gives reasons for the choice of certain hours for the various magnetic observations.

The Annual Supplement for 1918 is longer than any of its predecessors. In addition to the usual geophysical data the monthly sums of wind components at Deerness, Holyhead, Great Yarmouth, and Scilly for the years 1911–18 are set out in convenient tables.

Records of upper air temperatures obtained by aeroplane ascents at Martlesham Heath were incorporated in the Annual Supplement for 1917. Corresponding data for South Farnborough became available for the first time in 1918, and results for both stations appear in the supplement under review. An attempt has also been made to derive the most probable monthly averages for England SE by combining temperature data at given heights for the two stations.

A new feature of the water level diagram for Kew Observatory is the addition of a graph representing the integrated general rainfall of the Thames Valley. The close agreement throughout the year between the rainfall at the Observatory and the general rainfall over the Thames Valley brought out by the diagram is surprising.

Correspondence.

To the *Editors*, "*Meteorological Magazine.*"

Mock Suns.

WITH reference to the letter of Mr. W. H. Pick, the phenomena of parhelia would seem to have been unusually in evidence during the past few weeks. At Glasgow at 7.45 p.m. (summer time) on May 4th I observed a pair of coloured parhelia at similar altitude to the sun. Not having any more elaborate means available, I measured their angular distances from the sun with a walking-stick, and estimated the chord subtended as 6¼ inches at 17 inches distance from the eye. This gives an angle of about 21°, a fair approximation to the theoretical angle of 22°. The southern parhelion fortunately happened, when first seen at 7.45 p.m., to be exactly in line with the street (Kent Road) along which I was walking, and I find from an Ordnance survey map that it trends W. 7° S. Calculation shows that the sun was at azimuth W. 15° N. The total angle was thus 22°. Slight correction is due for the sun's altitude of 9°, but rigorous computation by spherical trigonometry gives a result differing only about ¼°. The weather was fine at the time, but heavy rain followed within a few hours. These same parhelia were also reported as seen from near Bridge of Allan (Stirlingshire). A few days later—the exact date is not stated—similar phenomena were, according to letters in the *Scotsman* of May 25th and 28th, observed from Dunure (Ayrshire) and from Edinburgh.

JOHN J. ROSS, B.A., F.R.A.S.

7, Queen's Terrace, Glasgow, June 5th, 1920.

The Flood of April 9th, 1920, at Calne.

AT 7 h. 45 m. thunder was heard in a south-westerly direction, and a dark cloud was seen to be gathering; by 8 h. rain was coming down in tropical quantities, and continued with unabated intensity until 11 h. 15 m. During these $3\frac{1}{4}$ hours 1·78 in. fell, a quantity which exceeds all records here for such a time for at least 50 years. For a thunderstorm to last so long was doubtless due to the fact that the wind changed during the storm from south-west to north-east, remaining so for considerably over an hour, and then veered back to south-west.

The storm was felt over a wide area, extending from the Pewsey Vale in the south to the neighbourhood of Swindon, a distance of considerably over twenty miles, but in very few places was it more than eight miles in breadth. The centre was in the Calne region, extending from Oliver's Camp at the back of Heddington, over Calstone, Cherhill, Compton, Calne, Cliffansty and Cliff Pypard, and it evidently spent itself in the neighbourhood of Swindon. On the east of the Downs the water drains towards the Kennet and into the Thames, and on the west into the Marden and Avon. Very little of the abnormal rainfall was felt on the east side.

A feature of the storm was the excessive amount of rain falling here and there, whilst intervening districts were less deluged. Heddington evidenced a huge downpour; the water swept down the hill and flooded cottages far from any stream. At Calstone a gorge running down from the hills had the appearance, it is said, of the rapids of a strong river, with considerable depth of water and marked velocity. Other possible channels between here and Cherhill were quite normal in appearance. A large table-land above Cherhill Hill felt the full force of the downpour, so that ordinary ploughed land became in an hour or two a lake overflowing in immense quantities into the London road. This current carried the shallow soil clean away, leaving the bare chalk exposed, so that ultimately the ground presented the appearance of a dried-up river bed. At Compton Bassett water poured down from the hillside in a roaring torrent, sounding like the sea. On the ridge between Woodhill Park and Cliff Pypard the effects of the storm beggar description. Here there are two roads, about a quarter of a mile apart, descending from the hill; one was torn up by the flowing water, which cut away the sides of the track and gouged the chalk out in places to the depth of three feet, though these incisions were only six or eight inches wide. The other road bore no traces of the heavy rain. E. W. BROWN.

Calne, 12th May, 1920.

Snow at Jerusalem.

THE report on page 36 of the February issue of the *Meteorological Magazine*, relating to a fall of 39 inches of snow at Jerusalem on February 13th, is interesting. The most copious snowstorm I ever experienced was that of January 18–19, 1881, when near Basingstoke the undrifted fall was about 18 inches. The storm lasted over, virtually, two days. I handled some of the snow three months after the fall.

The Jerusalem snow was more than twice the above quantity and deposited in about half the time. Can any of your readers tell us: Was the day dark throughout, and for how long did the snow lie? I take it the rain value would be even in excess of four inches.

WILLIAM GODDEN.

20, Richmond Avenue, Willesden, N.W. 10, 30th March, 1920.

Remarkable Audibility.

ON the evening of Sunday, May 16th, at 17h. 30m., G.M.T., I distinctly heard the puffs of the engine of a train starting from Havant Station, which is 7·1 miles distant, bearing S.S.W. A few minutes later the train became visible coming up the line at a point about half a mile to a mile nearer; there can be no doubt but that this was the train I heard, and that it was starting from Havant when I first heard it. The wind was north-east, about Force 4, and gusty, but there was a reversal above, for alto-cumulus was coming from the south, and it was probably the reversal that caused the remarkable audibility. Both on the evening of the 16th and on the previous evening, when wind conditions were similar, there was a continuous low rumble for which I am unable to account; it sounded like thunder at the extreme limit of audibility, but it was too continuous. I have heard the sea, distant 12 miles, under certain conditions, but it would hardly have been the sea on this occasion, for with a north-east wind there would not have been much surf on the East Winnow sand or on Hayling Beach. I have heard similar sounds on other occasions, and it is possible that they are caused by trams which run from Portsmouth to Horndean, where the terminus is only four miles distant, but the volume of sound seems too great for two or three trams, and the sounds may come from trams and other traffic in the streets of Portsmouth, the nearest point of which is under 11·2 miles and the furthest 13·5 miles in a direct line. I am by no means certain that this is the true explanation.

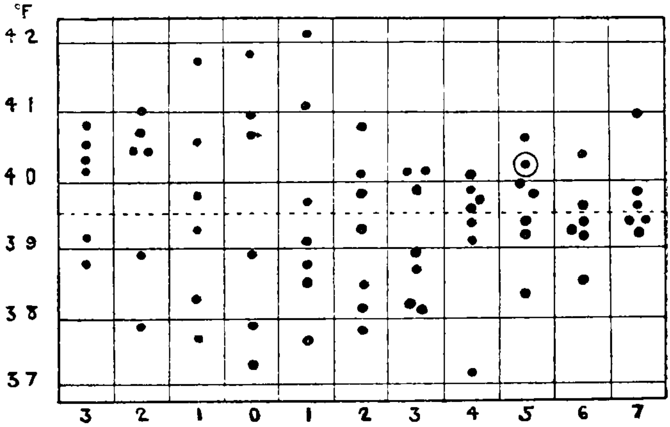
C. J. P. CAVE.

Ditcham Park, Petersfield, 17th May, 1920.

Forecasting Winter Temperatures.

SOME interesting results, I think, are obtained when we treat the Greenwich winters since 1841 in this way.

Smooth the series of mean temperatures of winter in groups of five (42–46, 43–47, &c.), putting down the mean to the middle year. Then represent those means by dots in a series of graduated columns according to the scheme 3.2.1. min. 1.2.3.4.5.6.7, the minimum being that of sunspots.



It then appears that two groups may be distinguished; in one (2.1. min. 1.2) there is wide variation; in the other (3.4.5.6.7.) the range is generally small. In the former, extreme values above or below average (say over 40·4° or under 38·4°) are relatively numerous; in the latter rare. The dots are scattered over a wide space in the former division, while in the latter they seem to draw in towards the average line, clustering near it.

Should these relations persist in future, they might, I believe, be helpful is estimating the character of an approaching winter. ALEX. B. MACDOWALL.

Bellevue, Bridge of Allan, 1st May, 1920.

Phenology of the Past Winter.

THE following table is based on records kept from 1906 of garden flowers and "allowed" wild species in my garden at Asgarth, Riddlesdown Road, Purley, on an open north-east slope from 330 to 400 feet altitude. The numbers give (a) the total of garden varieties actually in bloom at the end of each month, and (b) the number that first flowered during the month. Of bulbs, such as tulips and narcissi, only leading types are included.

Year.	Previous December.		January.		February.		March.		April.	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
1913 -	78	40	83	26	80	25	98	46	113	41
1914 -	83	37	54	6	66	27	81	49	143	88
1915 -	63	19	11	0	23	11	45	22	65	43
1916 -	61	17	26	10	37	13	65	33	98	63
1917 -	49	18	57	22	107	50	144	81	162	90

To illustrate the earliness of the present year, especially at the beginning of April, it may be noted that only three times has the Banksian rose flowered before May, namely, on April 29th in 1913, on April 24th in 1914, and now on the 6th in 1920. Last year's date was May 15th; in 1917, May 17th. Previous to 1920 the year 1913 gave the earliest and 1917 the latest records.

Although the opening three weeks of May were unfavourable, vegetation here showed a tendency to earliness. Fifty-nine fresh flowers had opened by the 21st, including six more roses. Then the burst of summer brought out 112 more (with 55 roses). This made 62 roses in all by the end of May. The year 1914 had previously stood first with 41, out of a total of 278 May flowers, compared with 333 this year. For the whole of December to May 495 flowers have been recorded, with 431 of the fresh season, thus greatly exceeding the 1914 record of 444 with 342 fresh. In 1915 only three roses were in bloom, and eight in 1917.

Purley, 31st May, 1920. J. Edmund Clark.

Thunderstorm Days.

In looking over some old records kept by me before the war, I noticed that thunderstorms seemed to develop between certain dates in the late spring and early summer with a frequency worthy of comment. Perhaps the most pronounced period occurs round about June 1st (May 27th—June 2nd). In the 6 consecutive years, 1908 to 1913, and again in 1917, 1918 and 1919 thunderstorms developed between these two dates, principally over the southern half of England. Another well-marked spell includes March 6th and a day or two on either side, as in 1912 to 1915 and again in 1919. May 19th is a further period of thunder frequency, storms being reported in the years 1910, 1912, 1914 and 1918. Less pronounced dates are June 20th, July 1st, and April 28th to May 2nd. Of course all this may be a matter of coincidence, but anyone interested may have access to other records and so prove or disprove my theory. E. Harrison.

36, Rosemont Road, Richmond Hill, Surrey.

Royal Meteorological Society.

THE usual meeting of the Society was held on 19th May, Mr. R. H. Hooker, President, in the chair.

A paper entitled "Agricultural Climatology of Australia," by Dr. Griffith Taylor, was summarised by the President. In this paper the author points out the extreme importance of the rainfall as the controlling factor in the settlement of the country; the season at which rain falls and the certainty of its occurrence (its "reliability") are as important as the total amount. The greater proportion of the wheat lands lie in regions receiving less than 20 inches of rain per annum, while the crop can be grown with as little as 7 inches, if it falls at the right time. Sugar cane is confined to the east coast, where the rainfall exceeds 40 inches and the temperature 68° F. The hay crop is also important, and it is of interest to note that in dry seasons when the grain fails the unripe cereals are cut and used as hay. Ninety per cent. of the sheep are in the south-eastern third of the continent; a rainfall of at least 10 inches and a temperature below 77° F. is required for them. Cattle are reared more in the north-east. The great variability of the rainfall results in serious droughts, the failure of the cereal crops, and the reduction of flocks and herds. It is hoped that these recurrent losses will become less serious with the progress of irrigation, but Dr. Taylor is not sanguine that irrigation will open up to settlement the enormous areas anticipated by some writers.

A discussion followed in which the value of the paper to prospective settlers was emphasized.

The Report on the Phenological Observations for the year 1919, prepared by him in co-operation with Mr. H. B. Adames, was presented by Mr. J. E. Clark. The year 1919 will be remembered for the uniform cold of the first four months, leading up to the snowstorm at the end of April and a warm May. As a result the four earliest flowers in the phenological list were nine days late, but the last four were decidedly early. The early migrants were late, especially the nightingale. Owing to the war the number of phenological observers had been reduced to about 100, but many promises of new contributions in 1920 had been received, so that the list of observers would be nearly doubled. An appeal was made for more observations from Wales, Ireland SW, and Scotland NW.

An interesting discussion followed, to which Messrs. F. J. W. Whipple and J. H. Pease and the President contributed.

Lieut. J. G. Goodyear, R.A.F., and Prof. B. Melvill Jones, M.A., were elected fellows of the Society.

NOTES AND QUERIES.

Sunlight and the Life of the Sea.

IN a paper by Dr. Benjamin Moore, F.R.S., E. Whitley and T. A. Webster, read before the Royal Society on March 9th, it was shown how the microscopic life of the sea depended on sunlight rather than on temperature. The authors stated that in many years the outburst of diatoms occurred before the temperature of the water had even begun to move from its winter level. The growing diatoms capture the light and utilise it for building carbon and nitrogen into their organic substances. The annual crop of moist plankton corresponds roughly to about 10 tons per acre. The nitrogen fixed by the minute organisms of the sea provides food for the fish, and in various ways serves to furnish fertilizers for the farmers' fields.

Ice in the Arctic.

"THE State of the Ice in the Arctic Seas for 1919," by Commander C. I. H. Speerschneider, has recently been published by the Danish Meteorological Institute. The ice conditions described were about normal, except that the ice in the northern and western portions of the Barents Sea was much further north than the average, whilst in the eastern portion there was considerably more than the average, conditions not approaching the normal until September. In April the ice reached as far south as the northern coast of Iceland, and the belt of ice off the west coast of Spitsbergen was twice as broad as usual. Unusual numbers of icebergs were seen off Cape Farewell in June.

The charts are being reproduced on the back of the Meteorological Chart of the North Atlantic for June, 1920.

New Zealand Daily Weather Report.

LIEUT.-COL. BATES, Director of the Meteorological Office of the Dominion of New Zealand, has forwarded the daily reports of weather of January and February 1920, issued from Wellington. They give observations of Wind Direction and Force (in words), Barometer corrected, Air Temperature, Weather and State of the sea and tide. The map has not yet advanced to the stage of charting the elements recorded, and indeed New Zealand necessarily finds itself somewhat isolated when a weather chart is wanted.

Disturbance of the Normal Atmospheric Circulation in the North Pacific.

THE Monthly Weather Review of the U.S. Weather Bureau for January, 1920, contains allusion to the occurrence of remarkably low pressures in Hawaii and high pressures in Alaska and the Aleutian Islands. On January 17th at Honolulu the reading was 1004 mb., on the same day near Unalaska pressure rose above 1057 mb. The average January pressure is 1016 mb. at Honolulu, an 1005 mb. at Unalaska.

The extremes previously recorded are 998 mb. at Honolulu and 1038 mb. at Unalaska. The reading of 1057 mb. is therefore a remarkable record.

It appears that about January 8th the Asiatic anticyclone spread eastwards across Alaska, and at the same time the usual Aleutian low moved south-eastwards.

Rain Gauges with Rims of Different Shapes.

Two 8-inch rain gauges were compared at Benson from August to December, 1919. Gauge A had the taper to the sharp edge on the outside, so that the inside measurement of the cylinder just below the rim was exactly 8 inches. Gauge B had the taper inside, so that the diameter of the cylinder, outside measurement, was 8 inches. Gauge B was placed in a similar exposure to A, 6 feet north-east of it.

The result has been that gauge A has recorded 1·003 times the amount of gauge B. The difference is trifling, but is probably real, as each month shows an excess for gauge A.

The gauges were read and emptied at 7h. and 18h. each day, and often the amounts were less than 2 mm. Under such conditions the observer would naturally enter the same amount to each gauge, because no appreciable difference could be expected. The result, however, is the same if falls below 2·0 mm. be excluded.

The following comparison includes all falls over 10 mm. :—

A -	18·0	19·8	10·1	10·3	16·3	11·7
B	17·9	19·6	10·1	10·2	16·5	11·7

W. H. DINES.

8th April 1920, *Benson.*

It was anticipated that gauge A would catch the greater quantity of rain as drips hovering on the edge on the windward side would be blown into the gauge, whilst a like effect, on the lee side, would be responsible for loss of rain from gauge B. Assuming in the absence of evidence that the error found by Mr. Dines is equally shared, it follows that the standard gauge of pattern A records too much by about 1 part in a thousand.

The experiment suggests that the ideal rim would have a slope inside as well as outside, the cross-section being like the gable end of a house.—[ED. M.M.]

Reviews.

Photographing Clouds from an Airplane. By Ford A. Carpenter. (Prepared by the Department of Meteorology and Aeronautics, Los Angelos Chamber of Commerce, and published in *The Ace* of January 1920.)

THIS paper gives some interesting descriptions of clouds observed from aeroplanes in South California. Though written primarily for the general reader, the paper contains information of interest to meteorologists. A cloud which is very common on the Pacific Coast in the early morning and late evening in summer is known as the "velo" cloud, and consists of a thin layer of light fog above the surface, but below 1,000 feet, extending about six miles seaward and twelve miles inland. Similar clouds are occasionally met with in favourable conditions on the West coast of Scotland.

The author on several occasions refers to "cirro-cumulus" clouds at heights of about 6,oco to 8,000 feet, using a modified cloud classification which he has published in an earlier work. Thin patches or layers of clouds at those levels which are exactly similar to cirro-cumulus are frequently met with. The author is a meteorologist of long experience, and his views on the importance of the study of clouds are worth recording. His opinion is given as follows:—

> "To the aviator, clouds are a sure guide to the weather in the different air levels, and too much emphasis cannot be laid upon the importance of a thorough knowledge of cloud structure, cloud movement and the resulting weather conditions. To my mind cloud study should comprise as much as one-half of a course in meteorology."

The reviewer is decidedly in agreement with the views expressed above. A pilot flying at 5,000 feet who possesses a knowledge of clouds and has seen a recent synoptic chart is in possession of information which no one on the ground can possibly have, and can always avoid getting into difficulties as the result of weather conditions.

The paper is illustrated by photographs both of clouds and of the ground, taken with a Kodak and apparently with ordinary films. If it is desired to concentrate especially on cloud photography from aeroplanes, slow plates usually give the best results. C. K. M. DOUGLAS.

Chilian Meteorology.—(1) Santiago Instituto Meteorologico y Geofisco de Chile. Carlos Henriquez, Director. Seccion climatologica. Publicación No. 27 Anuario Meteorologico de Chile, 1917. Santiago de Chile, 1919. 8vo, pp. 81. (2) Publicación No. 28. Observaciones Meteorologicas en Algunas Ciudades de Chile (Resúmenes), 1911–1915. Santiago de Chile, 1919. 8vo, pp. 86.

In few parts of South America has meteorology during the past ten years made such great strides as in the Republic of Chile, where a well-organised service was established in 1910, from which a stream of valuable reports continues to flow. The high-water mark of efficiency seems to have been reached in 1915, when there were 46 first or second order stations at work of which only two furnished incomplete reports. In 1916 the respective figures were 43 and 1, and in 1917, 28 and 5, showing an appreciable shrinkage from the previous year. The shrinkage, which is almost entirely due to the suppression of inland and high level stations, is explained by the economic crises induced by the War.

Publicación No. 28 gives averages of the principal climatic elements for the five years 1911–1915, except in two cases, at 20 stations in Chile. Although the period is short the data are of much interest, as the averages are homogeneous, and thus intercomparable. A description of each station, along with particulars of remarkable phenomena observed, is given, but it would have been of advantage if some reference had been made to the combination of hours employed in getting the averages, as the present report will doubtless be extensively circulated amongst those not familiar with the procedure described in the annual reports from which it is compiled. The highest station is El Teniente, in latitude 34° S., height 2,142 metres, but most of the records refer to coastal lighthouses, where observations are continuous since 1899, the year when the old maritime service, discontinued in 1910, was established.

The special interest of this report lies in the fact that the Dirección of the Central Office in Santiago is evidently fully alive to the necessity of publishing averages covering the same period. In too many cases the lack of homogeneous normals constitutes a serious drawback to students of South American climatology, since the only way to obtain the information is laboriously to extract the values from the annual reports, and combine them for a uniform period. It is to be hoped that other South American services, following the example of Chile, may be able to see their way to summarise their results every five or ten years, taking the same period, such as 1911–1915, 1916–1920, 1911–1920, and so on. This would greatly facilitate the preparation of a general climatology which would have some pretentions to be considered a scientific document. This specially applies to rainfall, which varies so much in many districts during different terms of years that at present the discussion of abnormals is rendered difficult and unsatisfactory.

It is unnecessary critically to examine here the summaries for the various stations given in this useful report, but attention may be drawn to the obviously erroneous relative (and absolute) humidity at Punta Galera (latitude 40° S.), where the mean relative humidity is given as 94 per cent. of saturation, with extremes of 91 per cent. in October and 97 per cent. in April and July, suggesting an exceedingly unpleasant climate. At the same station during the six years 1900 to 1905 the mean humidity was 85, the dampest month of the 72 giving a mean no higher than 90.

If mention is made of such little flies in the amber, it is not in a spirit of deprecation, but merely to draw attention to the fact that the system of station inspection leaves some room for improvement, which would doubtless be affected by an increase in the appropriations.

R. C. M.

Practical Exercises on the Weather and Climate of the British Isles and North-West Europe. By W. F. Stacey, Cambridge University Press, 1919. Large Crown 8vo., pp. viii + 64. Price 2s. 6*d.*

As an exercise book on the *Daily Weather Report* of the Meteorological Office this little book could scarcely be improved upon. There are 162 exercises divided into thirteen groups under headings such as Winter cyclone, Summer cyclone, Passage of a depression, Wedge, a V-depression, and Easterly type. In each example all the usual elements are given for 50 stations, so that if a pupil works through these exercises there is little of the formal interpretation of the *Weather Report* that he will not understand. It is a question whether many schools will care to spend so much time on a rather technical subject, for, whatever the title may imply or the preface suggest, very little of the work proposed is either climate or geography, but for the student who wishes to obtain a grasp of the routine and *rationale* of forecasting the book should be of great value. J. F.

Geostrophic Wind over London; July, 1881–1915.

FREQUENCY OF STRENGTH AND DIRECTION.

Estimates based on the D.W.R. charts (*8h.*, 1881–1908; *7h.*, 1909–1915).

Direction.	5 m/s. 11 mi/hr.	10 m/s. 22 mi/hr.	15 m/s. 33 mi/hr.	20 m/s. 44 mi/hr.	Over 20 m/s. Over 44 mi/hr.	Total Frequency of Direction.
N.	42	27	13	5	2	89
NE.	29	8	3	—	1	41
E.	15	30	5	2	—	52
SE.	15	4	—	1	—	20
S.	24	14	1	—	1	40
SW.	65	66	32	6	2	171
W.	51	120	73	11	3	258
NW.	51	66	32	3	5	157
Total Frequency of Strength	292	335	159	28	14	828*

* Indeterminate—257.

News in Brief.

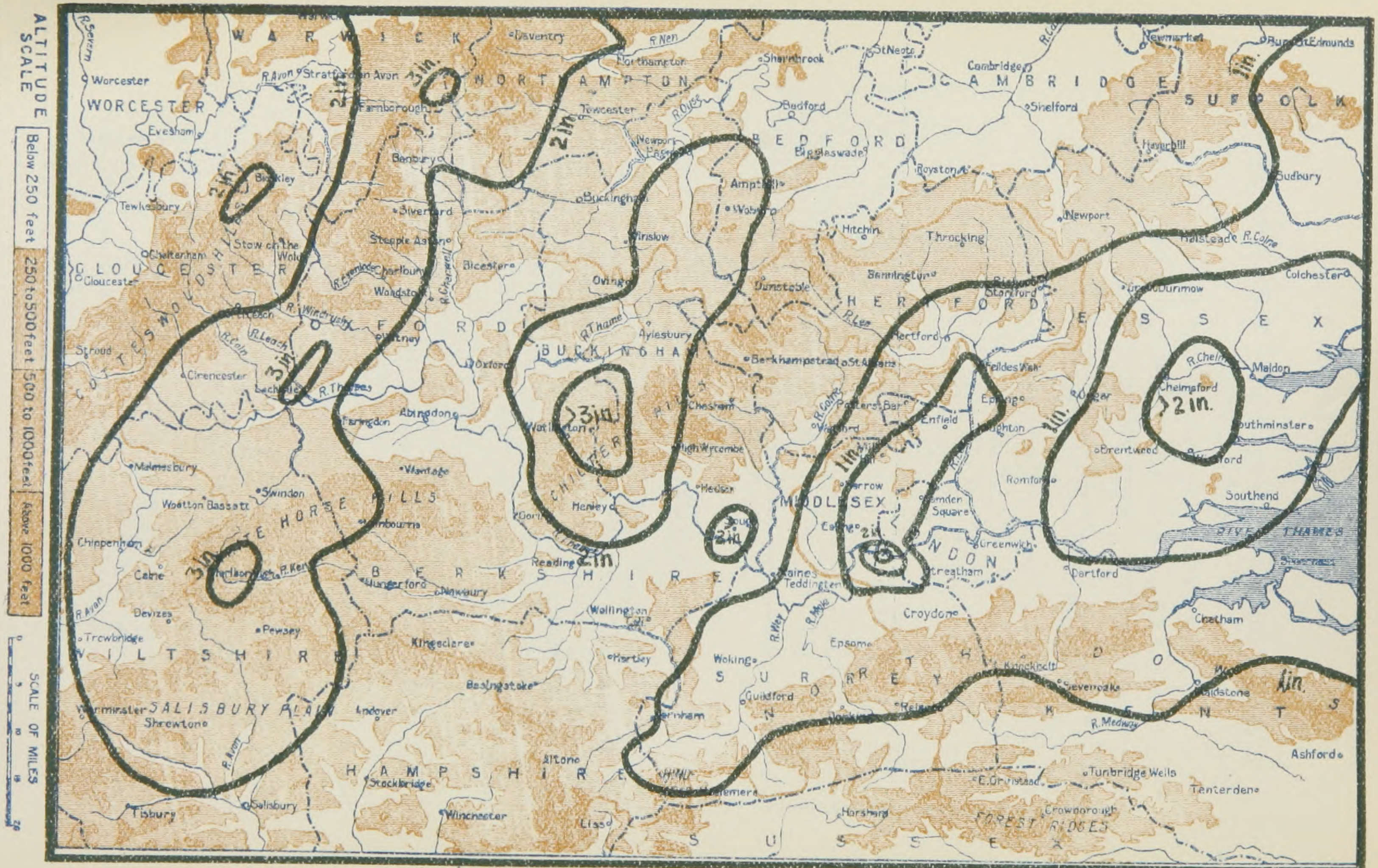
Colonel H. G. Lyons, D.Sc., F.R.S., Ex-President of the Royal Meteorological Society and Acting Director of the Meteorological Office from May 1918 to April 1919, has been appointed Director and Secretary to the Science Museum, in succession to Sir Francis Ogilvie, LL.D., C.B., who has been transferred to the Department of Scientific and Industrial Research.

Captain David Wilson Barker, F.R.S.E., F.R.G.S , a former President of the Royal Meteorological Society, who retired last year from the command of H.M. Training Ship "*Worcester*," received the honour of knighthood on the occasion of the King's birthday.

Professor C. T. R. Wilson, F.R.S., Director of the Solar Physics Observatory, Cambridge, has been awarded the Hopkins Prize of the Cambridge Philosophical Society.

Zone Time.—From April 30th, 1920, official time throughout the Republic of Uruguay will be the 60th meridian time, which has already been adopted in the Argentine, and is the same as the "Atlantic Time" in use in Canada.

THAMES VALLEY RAINFALL. MAY, 1920.



Watershed of River Thames above Teddington and River Lea above Feildes Weir.

H M Stationery Office Press, Kingsway, W.C.2.
Ps 554/194 105 A 35. 1250 6/20

Weather in the British Isles: May 1920.

THE exceptionally severe and widespread thunderstorms at the end of the month will long be remembered, but for the most part the weather, though wet, was cool, there being no thundery hot weather until the 20th. The prevalence of south-westerly and westerly winds, which so notably characterised the past winter, persisted during the month.

During the first eleven days the atmospheric conditions were decidedly chilly, and there was frost both in the screen and in the open at many inland stations. On the 1st, at Eskdalemuir, a shade minimum of 21° F. was recorded, with 13° F. on the ground. Sleet also was reported at some of the southern stations during these early days, but milder conditions gradually prevailed, and after the 11th the thermometer seldom fell below the freezing-point. Throughout the month there was no instance of a primary depression passing directly across the British Isles, with the result that gales were rare. The most notable gale was one which during the opening days of the month was associated with a depression of considerable extent, which advanced north-eastwards from the Azores and caused gales from the east in the northern districts and from the south-west in the western districts. This gale was very severe in the Irish Sea and in the Firth of Clyde, and at Southport on the 3rd gusts of 32 metres per second were recorded; much damage was done to pear and horse-chestnut trees in the neighbourhood of Leyland, Lancs.

Soon after the 20th warm weather became general, and conditions for about a week, especially over southern and eastern England, were very fine, sunny, and warm. On four consecutive days (22nd–25th) Yarmouth had more than 14 hours of sunshine per day, and maximum temperatures between 70° F. and 80° F. were common in many localities. On the 25th a reading of 84° F was registered at Cambridge, 83° F. at Westminster, 82° F. at Benson, and 80° F. at Kew Observatory. Subsequently there was a marked increase in the amount of cloud, and under the influence of shallow depressions the character of the weather deteriorated. On the 26th and 27th a long valley of relatively low pressure was stretched across England and the Netherlands, and within this belt violent thunderstorms occurred. On the 25th and 26th there were local storms in the south of England; on the latter day notably in the western suburbs of London, when 65 mm. fell in 70 minutes at Barnes, 32 mm. at Slough in less than an hour, and 16 mm. at Hampstead, the greater part in half an hour. At Shrewton, Wilts, 12 mm. fell in 10 minutes, and at Nettlebed, Oxon, 44 mm. in 45 minutes. On the 29th a depression which had originated over France moved northwards and occasioned very heavy rain in the north of England, more especially in Lancashire and Lincolnshire, in which counties there were floods which caused loss of life and serious damage to property. Further particulars will be found on pp. 83–86. At Benson, during a thunderstorm on the same day, the tower which carries the anemometer was struck by lightning and damage was done to the lightning recorder. The night of the 29th was unusually warm, and at Kew Observatory the minimum was as high as 59° F., followed by further thunderstorms in the south and east of England on the following day.

The total rainfall during the month was above the average except in the south of England generally, and fell below half the average in the neighbourhood of the Thames estuary. The fall was more than twice the average in parts of the south-west of Scotland, and also in the neighbourhoods affected by the great storms of the 29th in the north of England. The total fell to less than one inch (25 mm.) in parts of the home counties and exceeded 3 inches (75 mm.) only very locally in the south and east of Great Britain, the distribution being extremely irregular in the thunderstorm districts. In parts of County Clare, Yorkshire and Lincolnshire as much as 6 inches (150 mm.) fell, but this amount was otherwise confined

(*Continued* on p. 104)

Rainfall Table for May 1920.

STATION.	COUNTY.	Aver. 1875—1909.	1920.		Per cent. of Av.	Max. in 24 hrs.		No. of Rain Days.
		in.	in.	mm.		in.	Date.	
Camden Square	*London*	1·75	·69	18	39	·14	17	13
Tenterden (View Tower)	*Kent*	1·65	·95	24	58	·27	28	13
Arundel (Patching)	*Sussex*	1·80	1·49	38	83	·39	6	13
Fordingbridge (Oaklands)	*Hampshire*	2·09	1·39	35	67	·32	17	12
Oxford (Magdalen College)	*Oxfordshire*	1·81	1·62	41	90	·37	11	14
Wellingborough	*Northampton*	1·98	1·28	32	65	·24	5	14
Hawkedon Rectory	*Suffolk*	1·85	1·03	26	56	·30	26	14
Norwich (Eaton)	*Norfolk*	1·92	1·78	45	93	·62	26	14
Launceston (Polapit Tamar)	*Devon*	2·08	1·78	45	86	·46	1	14
Lyme Regis (Rousdon)	"	2·02	1·73	44	86	·35	1	12
Ross (Birchlea)	*Herefordshire*	2·10	1·70	43	81	·37	28	16
Church Stretton (Wolstaston)	*Shropshire*	2·64	2·83	72	107	·63	27	17
Boston (Black Sluice)	*Lincoln*	1·80	2·00	51	111	·38	5	15
Worksop (Hodsock Priory)	*Nottingham*	2·08	2·10	53	101	·53	29	16
Mickleover Manor	*Derbyshire*	2·10	2·81	71	134	·72	26	16
Southport (Hesketh Park)	*Lancashire*	2·13	3·54	90	166	·91	29	19
Wetherby (Ribston Hall)	*York, W. R.*	2·09	2·49	63	119	·88	29	..
Hull (Pearson Park)	" *E. R.*	1·98	2·89	73	146	·73	29	18
Newcastle (Town Moor)	*North'land*	2·04	3·60	91	176	·92	29	13
Borrowdale (Seathwaite)	*Cumberland*	7·50	12·45	316	166	..	..	..
Cardiff (Ely)	*Glamorgan*	2·56	3·85	98	150	·87	6	20
Haverfordwest	*Pembroke*	2·62	3·89	99	148	1·28	5	17
Aberystwyth (Gogerddan)	*Cardigan*	2·63	4·28	109	163	·59	9	13
Llandudno	*Carnarvon*	1·86	2·41	61	130	·46	11	17
Dumfries (Cargen)	*Kirkcudbrt.*	2·87	5·62	143	196	1·12	1	23
Marchmont House	*Berwick*	2·53	3·14	80	124	1·13	27	13
Girvan (Pinmore)	*Ayr*	2·98	4·00	102	134	·54	21	21
Glasgow (Queen's Park)	*Renfrew*	2·40	4·60	117	192	·58	26	21
Islay (Eallabus)	*Argyll*	2·58	6·47	164	251	·92	1	26
Mull (Quinish)	"	2·99	6·22	158	208	·72	21	23
Loch Dhu	*Perth*	4·59	10·00	254	218	1·50	1	21
Dundee (Eastern Necropolis)	*Forfar*	2·05	3·17	80	155	1·05	1	16
Braemar	*Aberdeen*	2·33	2·81	71	121	·65	1	13
Aberdeen (Cranford)	"	2·40	3·60	91	150	·63	1	17
Gordon Castle	*Moray*	2·10	2·14	54	102	..	..	..
Drumnadrochit	*Inverness*	2·33	1·98	50	85	·26	11	25
Fort William	"	3·93	6·70	170	170	1·08	21	25
Loch Torridon (Bendamph)	*Ross*	4·54	6·38	162	141	·68	6	20
Stornoway	"	2·55	5·21	132	204	·67	2	25
Dunrobin Castle	*Sutherland*	2·19	2·97	75	136	·43	13	20
Wick	*Caithness*	2·04	2·87	73	141	·37	2	22
Glanmire (Lota Lodge)	*Cork*	2·54	4·13	105	163	1·24	1	22
Killarney (District Asylum)	*Kerry*	3·05	4·04	103	132	·56	5	23
Waterford (Brook Lodge)	*Waterford*	2·33	3·42	87	147	1·00	1, 5	19
Nenagh (Castle Lough)	*Tipperary*	2·51	4·58	116	182	·83	5	24
Ennistymon House	*Clare*	2·70	5·02	128	186	·90	5	24
Gorey (Courtown House)	*Wexford*	2·24	2·97	75	133	1·05	1	16
Abbey Leix (Blandsfort)	*Queen's Co.*	2·43	2·91	74	120	·55	1	21
Dublin (FitzWilliam Square)	*Dublin*	2·07	2·63	67	127	·52	1	19
Mullingar (Belvedere)	*Westmeath*	2·51	3·19	81	127	·60	19	16
Woodlawn	*Galway*	2·86	4·02	102	141	·76	1	25
Crossmolina (Enniscoe)	*Mayo*	3·17	5·40	137	170	·79	18	24
Collooney (Markree Obsy.)	*Sligo*	2·80	3·99	101	143	·62	18	25
Seaforde	*Down*	2·72	3·24	82	119	1·46	1	22
Ballymena (Harryville)	*Antrim*	2·84	3·88	99	137	·62	2	25
Omagh (Edenfel)	*Tyrone*	2·66	4·29	109	161	·70	2	25

Supplementary Rainfall, May 1920.

Div.	STATION.	RAIN. in.	RAIN. mm.
II.	Ramsgate	1·10	28
„	Sevenoaks, Speldhurst	·96	24
„	Hailsham Vicarage	1·15	29
„	Totland B. Aston Ho	1·40	36
„	Ashley, Old Manor Ho.	1·11	28
„	Grayshott	1·16	29
„	Ufton Nervet	1·40	36
III.	Harrow Weald, Hill Ho.	·96	24
„	Pitsford, Sedgebrook	1·64	42
„	Chatteris, The Priory	1·82	46
IV.	Elsenham, Gaunts End	1·04	26
„	Lexden, Hill House	1·02	26
„	Aylsham, Rippon Hall	1·50	38
„	Swaffham	1·74	44
V.	Devizes, Highclere	2·41	61
„	Weymouth	1·51	38
„	Ashburton, Druid Ho.	2·72	69
„	Cullompton	1·86	47
„	Hartland Abbey	2·38	60
„	St. Austell, Trevarna	2·55	65
„	North Cadbury Rec.	1·55	39
„	Cutcombe, Wheddon Cr.	2·78	71
VI.	Clifton, Stoke Bishop	1·91	48
„	Ledbury, Underdown	1·58	40
„	Shifnal, Hatton Grange	4·06	103
„	Ashbourne, Mayfield	3·48	88
„	Barnt Green, Upwood	1·98	50
„	Blockley, Upton Wold	2·50	64
VII.	Grantham, Saltersford	1·32	34
„	Louth, Westgate	3·34	85
„	Mansfield, West Bank	1·96	50
VIII.	Nantwich, Dorfold Hall	3·13	80
„	Bolton, Queen's Park	7·57	192
„	Lancaster, Strathspey	5·15	131
IX.	Wath-upon-Dearne	3·06	78
„	Bradford, Lister Park	3·62	92
„	West Witton	3·46	88
„	Scarborough, Scalby	2·65	67
„	Ingleby Greenhow	1·95	50
„	Mickleton	4·40	112
X.	Bellingham	4·35	111
„	Ilderton, Lilburn	3·31	84
„	Orton	9·57	243
XI.	Llanfrechfa Grange	3·42	87
„	Treherbert, Tyn-y-waun	6·76	172
„	Carmarthen Friary	4·25	108
„	Fishguard	3·44	87
„	Lampeter, Falcondale	6·11	155
„	Abergwngy	5·20	132
„	Crickhowell, Talymaes	4·00	102
„	Sennybridge	2·62	66
„	Lake Vyrnwy	6·73	171
„	Llangynbafal, P. Drâw	1·91	48
„	Dolgelly, Bryntirion	8·15	207
„	Lligwy	4·42	112
XII.	Stoneykirk, Ardwell Ho.	4·32	110
„	Gatehouse, Cally	..	..
„	Carsphairn, Shiel	9·14	232
XII.	Langholm, Drove Rd.	5·35	136
XIII.	Selkirk, Hangingshaw	3·46	88
„	North Berwick Res.	2·86	73
„	Edinburgh, Royal Ob.	2·23	57
XIV.	Biggar	4·11	104
„	Leadhills	6·72	171
„	Maybole, Knockdon	5·78	147
XV.	Rothesay	6·47	164
„	Oban	5·44	138
„	Inveraray Castle	13·76	350
„	Holy Loch, Ardnadam	9·17	233
XVI.	Loch Venachar	6·90	175
„	Glenquey	6·20	158
„	Loch Rannoch, Dall	4·25	108
„	Coupar Angus	2·99	76
„	Montrose Asylum	2·86	73
XVII.	Balmoral Castle	2·57	65
„	Fyvie Castle	3·31	84
„	Peterhead, Forehill	3·71	94
„	Grantown-on-Spey	1·58	40
XVIII.	Cluny Castle	2·73	69
„	Loch Quoich, Glenquoich	11·55	293
„	Skye, Dunvegan	7·49	190
„	Fortrose	1·48	38
„	Ardross Castle	2·92	74
„	Glencarron Lodge	5·72	145
XIX.	Tongue Manse	2·15	55
„	Melvich Schoolhouse	2·97	75
„	Loch More, Achfary	5·56	141
XX.	Dunmanway Rectory	6·75	171
„	Mitchelstown Castle	4·06	103
„	Gearahameen	9·80	249
„	Darrynane Abbey	4·99	127
„	Clonmel, Bruce Villa	3·22	82
„	Cashel, Ballinamona	2·85	72
„	Roscrea, Timoney Pk.	3·57	91
„	Foynes	4·70	119
„	Broadford, Hurdlesto'n	5·54	141
XXI.	Kilkenny Castle	3·68	94
„	Rathnew, Clonmannon	2·81	71
„	Hacketstown Rectory	2·81	71
„	Ballycumber, Moorock	3·18	81
„	Balbriggan, Ardgillan	3·04	77
„	Drogheda	2·63	67
„	Athlone, Twyford	4·67	119
„	Castle Forbes Gdns.	3·71	94
XXII.	Ballynahinch Castle	4·98	126
„	Westport House	6·86	174
XXIII.	Enniskillen, Portora	3·27	83
„	Cootehill, Dartrey	3·36	85
„	Armagh Observatory	2·97	75
„	Warrenpoint	3·44	87
„	Belfast, Cave Hill Rd.	3·83	97
„	Glenarm Castle	4·94	126
„	Londonderry, Creggan	4·14	105
„	Sion Mills	3·88	99
„	Milford, The Manse	4·37	111
„	Killybegs, Rockmount	7·35	187

Climatological Table for the

STATIONS Those in italics are South of the Equator	PRESSURE		TEMPERATURE							
			Absolute				Mean Values			
	Mean M.S.L.	Diff. from Normal	Max.	Date	Min.	Date	Max.	Min.	½ max. and min.	Diff. from Normal
	mb.	mb.	° F.		° F.		° F.	° F.	° F.	° F.
London, Kew Observatory	1010·2	−3·7	54	23	23	9	48·0	37·6	42·8	+2·5
Gibraltar	1023·8	+4·2	66·2	2, 22	38·9	27	60·4	47·6	54·0	−2·3
Malta	1016·0	−0·8	68·5	1	45·0	11	59·7	52·1	55·9	−0·9
Sierra Leone	1011·8	+0·8	91	14	71	23	88·2	75·1	81·7	−0·2
Lagos	1012·2	+1·7	90·2	31	71·0	20	87·3	74·8	81·1	−0·2
Kaduna, N. Nigeria	*944·3	..	91	†11	51	14	87·3	55·7	71·5	..
Cape Town	..	..	95·0	28	51·3	2	78·9	58·3	68·6	+1·0
Johannesburg	..	..	85·9	9	45·5	19	78·9	55·4	67·1	+2·5
Mauritius	1012·7	−1·1	91·6	30	64·9	6	87·6	71·4	79·5	+0·9
Bloemfontein	..	..	96·0	10	46·6	25	86·2	59·6	72·9	+0·1
Calcutta, Alipore Obsy.	1015·3	−2·0	79·6	14	52·1	19	77·2	55·9	66·5	+0·3
Bombay	..	..	89·4	18	61·7	29	84·7	70·5	77·6	+0·4
Madras	..	..	86·3	17	67·4	11	83·4	72·3	77·9	+1·4
Colombo, Ceylon	..	..	90·1	19	70·3	2	85·7	73·2	79·4	+1·4
Hong Kong	1021·3	+1·6	71·9	27	45·5	30	65·8	57·1	61·5	−1·5
Sydney	..	..	..	..	..	..	..	..	..	..
Melbourne	..	..	102·2	21	48·1	18	78·0	57·4	67·7	+3·0
Adelaide	..	..	109·3	10	50·5	29	85·3	60·6	72·9	+1·8
Perth	..	..	99·9	29	51·0	27	77·6	58·5	68·1	−2·6
Coolgardie	..	..	101·2	7, 8	52·5	28	90·5	60·7	75·6	−0·2
Brisbane	..	..	97·5	18	64·4	22	84·5	68·5	76·5	+0·2
Hobart, Tasmania	..	..	92·8	21	44·2	18	72·3	53·2	62·7	+2·4
Wellington	1013·6	+2·4	79·0	30	38·4	4	64·9	51·1	58·0	−2·3
Suva, Fiji	..	..	..	..	..	..	..	..	..	..
Jamaica, Kingston	..	..	88·3	22	66·3	27	85·3	69·9	77·6	−0·1
Grenada	1012·6	+0·6	86	4, 5	70	25	83·7	73·3	78·5	+0·4
Toronto	1019·6	+1·7	48·8	13	− 7·2	17	30·0	15·1	22·5	−5·4
Fredericton	1018·3	..	41·0	13	−26·0	17	23·1	0·4	11·7	−6·5
St. John, N.B.	1016·9	+1·7	45·5	13	−17·2	18	27·3	10·0	18·7	−5·4
Victoria, B.C.	1019·6	+3·0	52·5	24	15·5	11	41·7	34·2	37·9	−4·9
Jamaica. November	..	..	91·8	26	64·8	12	88·1	70·8	79·5	+0·2

* At Station Level, height of 2,088 feet. † Also on 15th and 21st.

LONDON.—2 thunderstorms, 4 days of fog.

GIBRALTAR.—1 thunderstorm, 1 day of gale.

MALTA.—Mean speed of wind, 8·6 mi/hr, prevailing direction NW.

SIERRA LEONE.—1 day of gale, 1 thunderstorm.

Mauritius.—Prevailing wind E.; mean speed, 5·6 mi/hr.

British Empire, December 1919.

TEMPERATURE				PRECIPITATION						
Mean Values		Absolute		Amount		Diff. from Normal	Days	Mean Cloud Am'nt	Bright Sunshine	STATIONS Those in italics are South of the Equator.
Dew Point °F.	R'tive Humidity %	Max. in Sun °F.	Min. on Grass °F.	in.	mm.	mm.			Hours per day	
39·8	86	82·6	18·1	3·7	95	+ 37	24	7·3	0·81	London, Kew Observatory
46·7	76	119	32	1·82	46	−100	5	3·0	..	Gibraltar.
..	81	117·5	..	2·91	74	− 30	10	5·0	4·7	Malta.
72·6	76	..	..	0·27	7	− 30	4	3·4	..	Sierra Leone.
72·2	69	156·3	55·2	1·28	33	+ 12	2	6·9	..	Lagos.
43·8	40	..	..	0·00	0	− 3	0	1·0	..	Kaduna, N. Nigeria.
55·3	63	..	..	0·19	5	− 17	4	3·4	..	*Cape Town.*
53·1	66	..	45·0	3·04	77	− 21	18	4·8	9·42	*Johannesburg.*
68·6	72	..	59·4	2·38	60	− 60	17	5·7	..	*Mauritius.*
64·7	42	..	..	0·50	13	− 49	3	1·7	..	*Bloemfontein.*
55·0	70	..	42·0	0·00	0	− 5	0	2·1	..	Calcutta, Alipore Obsy
64·8	67	133·1	52·0	0·00	0	− 2	0	1·1	..	Bombay.
69·9	80	157·4	64·1	6·24	158	0	13	6·4	..	Madras.
71·2	80	159·3	65·6	9·28	236	+116	12	7·0	..	Colombo, Ceylon.
50·5	66	..	..	0·73	18	− 10	5	5·1	6·40	Hong Kong.
..	..	..	..	..	..	..	..	..	..	*Sydney.*
53·2	59	153·2	38·0	3·69	94	+ 35	12	4·6	..	*Melbourne.*
53·0	46	168·4	41·0	1·14	29	+ 11	3	2·6	..	*Adelaide.*
54·8	62	163·2	44·0	0·83	21	+ 6	4	2·7	..	*Perth.*
50·1	38	164·0	50·2	2·06	52	+ 36	6	2·8	..	*Coolgardie.*
63·7	67	155·0	58·1	1·58	40	− 88	9	5·3	..	*Brisbane.*
46·5	53	150·6	37·1	1·17	30	− 20	10	5·8	..	*Hobart, Tasmania.*
48·7	71	145·0	25·5	2·41	61	− 22	14	6·2	7·76	*Wellington.*
..	..	..	..	..	..	..	..	..	..	*Suva, Fiji.*
68·6	82	..	..	1·89	48	+ 7	6	3·5	..	Jamaica, Kingston.
69·7	75	135	..	5·28	134	− 58	19	3·3	..	Grenada.
9·6	56	69·0	11·0	1·00	25	− 41	13	6·0	..	Toronto.
1·8	81	..	..	2·75	70	− 18	13	4·2	..	Fredericton.
8·4	68	102·7	−18·5	3·55	90	− 12	18	5·3	..	St. John, N.B.
33·5	89	100·0	9·8	4·79	122	− 37	17	6·3	..	Victoria, B.C.
69·2	78	..	..	0·41	10	− 70	5	3·0	..	Jamaica. November.

COLOMBO, CEYLON.—Prevailing wind NNW ; mean speed, 5·0 mi/hr ; 4 thunderstorms.
HONG KONG.—Prevailing wind ENE ; mean speed, 9·3 mi/hr.
Brisbane.—22nd month of deficient rainfall in last 2 years.
Wellington.—1 sunless day, 3 days of frost, 2 days hail, 1 thunderstorm.

to the usually rainy districts of the west. The general rainfall expressed as a percentage of the average was :—England and Wales, 117; Scotland, 164; Ireland, 145; British Isles, 141.

In London (Camden Square) the month was fair to fine, with occasional very light rain and considerable warmth after the 20th. The mean temperature was 57·5° F., or 3·5° F. above the average. The duration of rainfall was 20·5 hours. Evaporation, 2·71 inches.

Weather Abroad: May 1920.

Anticyclonic conditions developed over Southern Europe early in May and persisted throughout the month. Under their influence high day temperatures were recorded at many stations, 90° F. at Clermont and Biarritz on the 11th and at Perpignan on the 27th and 29th, and 94° F. at Clermont on the 28th. Both Madrid and Lisbon recorded 86° F. on the 8th, and on the 21st Rome reached 91° F., a temperature not exceeded in May since 1834. Cairo recorded 99° on the 27th. From about the 23rd to 28th, however, the fine weather was broken by a shallow depression near the Azores, which caused several heavy falls of rain in the Iberian Peninsula, though Italy continued to suffer from disastrous drought and several very hot nights were experienced there, when the temperature did not fall below 70° F.

As in England, fine warm conditions prevailed as a rule in Northern France, but on several days widespread and severe thunderstorms were experienced. On the evening of the 25th a heavy storm with hail and much wind burst over Paris, unroofing houses, breaking windows and destroying crops. In Germany also there were severe thunderstorms and considerable floods.

Heavy falls of rain were experienced in Denmark and the Scandinavian countries, especially on the 19th (39 mm. at Haparanda). Spitzbergen and Iceland, being on the other side of the low pressure belt, experienced strong north-easterly and northerly winds and very low temperatures, the maximum at Spitzbergen not rising above 25° F.

In America the month opened with a severe storm which destroyed the town of Peggs, in Oklahama, causing many deaths. This storm was connected with a shallow depression which lay over the south-western States, but about the 4th a high pressure area spread southward from Canada and fine dry weather prevailed from Canada to the West Indies. In Ontario, May was the driest month for 27 years, and the grain crops were backward, while the hay crops promised to be a partial failure. Forest fires developed in Ontario, Quebec and New Brunswick, but fortunately the flames were checked by heavy rains at the beginning of June.

The drought which had been experienced since Christmas in the hinterland of Queensland, New South Wales and Victoria was broken by heavy rain at the end of May. These heavy rains extended into South Australia, where a general fall of 2 inches occurred over the whole of the agricultural and much of the pastoral region, the best rainfall for years.

British Rainfall, 1919, is now in an advanced stage of preparation. It would greatly assist in the compilation of the year's statistics of rainfall if any observers who have not yet sent in their returns for the year would do so at an early date. Blank forms when required for this purpose can be obtained by application to the Superintendent, 62, Camden Square, London, N.W.1.

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Meteorology in the Antarctic—A Review.*

By HUGH ROBERT MILL, D.Sc.

THE last expedition of Captain Scott which brought that explorer to the South Pole and ended in the one great tragedy of Antarctic history has, after the long interruption of the War, produced one of the most brilliant monographs on Meteorology which has ever appeared.

Hitherto, with the exception of Mr. Mossman's work on the Meteorology of the *Scotia* expedition, it has been usual for meteorological observations to be taken by various members of an expedition, who were not always highly trained observers, and the results were subsequently discussed by specialists at home who had no personal experience of the conditions dealt with; but here we have the ideal arrangement of a highly trained meteorologist discussing the observations which he had made himself and those simultaneously obtained by other expeditions in the Antarctic area. It is only in such conditions that the method adopted by Dr. Simpson could be successfully carried out, for he boldly disregards details and permits himself to generalise with a width that would take away the breath of a traditional statistical student. The method in the hands of a crank or even of an enthusiastic exponent of an accepted theory would

* British Antarctic Expedition, 1910–1913, Meteorology, Vol. I., Discussion; Vol. II., Charts. By G. C. Simpson, D.Sc., F.R.S. Calcutta, printed by Thacker, Spink & Co., 1919. Size 10 × 9½, pp. (Vol. I.) xii and 326, with plates and illustrations.

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lead only to the confirmation of foregone conclusions. But, as Dr. Simpson uses it, it is a bold effort to arrive at a possible explanation of observed facts handled without prejudice and with full knowledge of the difference between attractive hypothesis and a demonstrated certainty. If the observational basis is very narrow for the great superstructure imposed upon it, we must remember that a cone balanced on its apex is not in unstable equilibrium when it has a good spin to begin with, and this is exactly what Dr. Simpson imparts to his theory—perhaps we might tempt metaphor further and expresss our belief that the whips of the critics who are sure to deal with these volumes will only increase the stability of the system by intensifying its go.

Dr. Simpson reserves the publication of the actual figures of his observations to a third volume devoted solely to statistics; but in the various chapters of the discussion he gives summaries of the data relied upon, and in the volume of plates a full collection of isobaric maps, reproductions of traces of recording instruments and other diagrams. All through the treatment is physical rather than statistical, and the discussion is written in so clear a style and with such obvious enjoyment in the doing of it that even the abstruser portions can be read with pleasure.

Chapter I. describes the geographical conditions of the Ross Sea area, with which the data of the expedition deal, and gives a sketch of the history of the stations.

Chapter II. is devoted to temperature, and in the free drawing of isotherms and the original handling of the observations, one first appreciates how widely this discussion differs from all that have gone before. Dr. Simpson does not disguise the fact that he speculates boldly in his generalisations, but he hardly realises that what would be mere assumption on the part of a specialist unacquainted with the region may be—and we believe in this case it is—an unconscious integration of actual experience on the part of the man who lived through the phenomena he is tracing to their causes, and who therefore knows far more about them than the recorded curves or figures set out.

Dr. Simpson criticises the meteorological discussions of the *Discovery* expedition with considerable force, and he dissents strongly from the explanation of the temperature differences put forward by Mr. W. H. Dines. He dismisses the Föhn explanation of the sudden rises of temperature in winter as disproved; but we venture to think that he is perhaps too confident in developing his argument as to the normal temperature on the Plateau, for the months in which the few available observations were made may have been abnormal months. However, Dr. Simpson sets out to frame a physical system that will include all known facts, and he himself would be the last to claim that all the constituent links are of equal strength.

The problem of the higher temperature of the "day" hours when the sun is far below the horizon in winter is stated as one yet unsolved. Dr. Simpson attributes the very low temperatures on the Plateau (8,000 feet above sea-level) to radiation at night and in winter. The temperature on the Barrier (about 170 feet above sea-level) is nearly equally low when the correction for altitude is applied to both, and this is also accounted for by radiation from the surface, the thickness of the deeply snow-covered ice preventing any appreciable warming of the air by the sea-water beneath. On the frozen Ross Sea the temperature of the air is higher, for the comparatively thin sheet of ice is a good conductor of heat compared with thick snow, and the sea-water of course is never below the freezing-point appropriate to its salinity. It is extremely unfortunate that no "grass-minimum" temperatures on the surface of the ice were recorded, as on still clear nights they would have given very useful information. In the isothermal charts the most interesting features are the steep temperature gradients between the open sea and the edge of the sea-ice and the temperature precipice which occurs between the sea-ice and the Barrier.

It is impossible in a few pages to describe how the motive power of radiation in the absence of the sun is made to account for the curious variations of temperature in relation to wind. The rise of temperature in blizzards and the abrupt cessation of these winds is explained by the mounting of one stratum of violently agitated air upon another of nearly still air, the thickness of which is subject to rapid change, thus accounting for the extraordinary gustiness of many of the anemometer records.

Precipitation in the Antarctic could not be measured, as there is no means of distinguishing falling snow from snow raised and carried forward by the wind.

In the general account of wind and pressure, which forms the most important part of the memoir from a theoretical point of view, it is most unfortunate that the results of Sir Douglas Mawson's Australian Antarctic Expedition were not available, as for much of the time they would have supplied two additional and distant points for the isobaric charts, and Dr. Simpson acknowledges the possibility that his theoretical distribution of pressure might not fit so neatly with a larger number of points as it does with those at Cape Evans, Framheim and Cape Adare only. We recognise that in this part of the work at least the discussion of Sir Douglas Mawson's records now proceeding in Australia must, if it is not already too far advanced, be in the main a criticism of Dr. Simpson's conclusions with greatly increased data.

Dr. Simpson arrives at "normal" values and seasonal and diurnal variations by most ingenious treatment of the barograph traces grouped in various ways, and we can see no possibility of giving an idea of the methods and results in fewer words than he himself employs. We must content ourselves by saying that the frequency of winds from various directions over the Antarctic area, and other cumulative evidence, indicate the existence of an anticyclonic distribution of pressure extending outwards from the continent. The discussion directly controverts the hypothesis of a succession of cyclones in the southern part of the Southern Ocean claimed by Prof. Meinardus as a result of his discussion of the *Gauss* results and by Dr. W. J. S. Lockyer in his discussion of pressure changes over the globe. These authors will doubtless have something to say on the new interpretation of the data they employed.

The central fact of Dr. Simpson's discussion seems to be that although the normal Antarctic distribution of pressure is anticyclonic in type it is not that of a fixed conventional anticyclone. By smoothing the barograph records of the extremely frequent and rapid pressure changes he finds certain long waves of pressure extending over many days and synchronously throughout the whole Antarctic area, being detected even in the north of the Southern Ocean. To these pressure waves he gives the name of surges, and shows that their passage outwards from some area in the Antarctic continent produces the weather changes on the coast, which have hitherto been held as due to cyclones.

Chapter VII. is devoted to the circulation of air over the Antarctic regions. It commences with an analysis of Professor Hobbs's theory of a glacial anticyclone; and although failing to give weight to Hobbs's postulate of a domed or shield-like land-mass to set up a radial outflow of chilled air, Dr. Simpson pronounces substantially in favour of Professor Hobbs's theory. He then examines the hypothesis arrived at by Meinardus from the *Gauss* expedition's records that cyclonic conditions undoubtedly prevail over the Antarctic: he reconciles the two by taking account of the different circulation at sea-level and above 3,000 metres. He concludes:—

> "Over the snow-covered surface of the Antarctic, whether at sea-level or at the height of the plateau, radiation is so strong that the air is

abnormally cooled especially in the layers of air immediately above the surface. This cooled air is heavier than the surrounding air, and therefore the pressure increases from the exterior to the interior of the polar area; in other words, the pressure distribution is anticyclonic and the air-motion is in general outward. Above each anticyclone a cyclone forms on account of the relatively rapid vertical pressure change caused by the cold dense air. These cyclones convey air from higher latitudes over the polar region and supply the air which passes ontwards near the surface. . . . On these normal fine-weather conditions are superposed a series of pressure waves which travel more or less radially outwards from the centre of the continent. These waves alter the surface pressure distribution and cause air-motion which is frequently, and especially over the west of the Barrier, accompanied by forced ascending currents. The abnormally cold surface air is forced upwards in these currents, rapidly cooled in the ascent. and the water contained is precipitated as snow, which when combined with the high surface winds produces the typical antarctic blizzard."

We must reluctantly pass over the concluding chapters regarding upper air observations, atmospheric electricity and the determination of heights, without even such meagre comment as the foregoing. This matters the less because every meteorologist must read the original work for himself, and we are much mistaken if it does not prove the germ of a fruitful and friendly controversy which will go far to build up a satisfactory theory of world-meteorology.

June Thunderstorms.

THE spell of fine weather which was experienced over the British Isles under the influence of an extensive anticyclone stretching from the Arctic to the Continent, came to an end on the 10th with the approach of a "low" to the west coast of Ireland. From the 12th, thundery conditions prevailed over the greater part of the British Isles except in the North. Thunderstorms of uncommon severity followed each other in quick succession. A few interesting accounts of local thunderstorms are given below.

Thunderstorms at Croydon Aerodrome.—Mr. G. R. Hay writes: "A series of thunderstorms passed over Croydon on Saturday afternoon, June 12th. During the forenoon several showers of a thundery type occurred, and by 13 h. the atmosphere had become very sultry and oppressive. Heavy Cu. and Cu.Nb. clouds appeared in the south and east, and at 13 h. 36 m. the first mutterings of the approaching storms were heard and lightning became visible on the eastern horizon.

"The first storm, however, beyond causing a sudden drop of 2° F. in temperature and a slight shower at 13 h. 53 m., passed harmlessly in a north-westerly direction to the north of this area. Immediately behind it, also moving north-west, came a second storm. Its track was a little further south than its predecessor, and its southern edge passed over here from 14 h. to 14 h. 23 m., causing heavy rain and hail, especially from 14 h. 20 m. to 14 h. 23 m. Hailstones were actually measured, and several found to be ¾ of an inch in diameter. On being cut they were found to consist of concentric layers, alternately white and transparent, while some had pure white cores. During the 23 minutes of this storm the temperature fell 6·5° F.

"This storm was followed very quickly by a third which burst upon us with a heavy squall lasting from 14 h. 35 m. to 14 h. 43 m., the wind reaching Force 7 and the temperature falling another 5·5° F., making a total fall of 12° F. (from 72° F. to 60° F.) in 43 minutes. During the next hour the sky continued threatening, but beyond some distant thunder and lightning in the south-west, the weather was quiet and the temperature rose to 63° F.

"Towards 15 h. 30 m. ominous and continuous rumblings were heard in the south-east, and at 15 h. 35 m. the heaviest storm of the day broke in a violent squall. For 15 minutes the thunder was practically continuous and very heavy rain fell, and at the height of the squall, during which the wind reached Force 9, had the appearance of a blinding snowstorm, although there was no snow or solid precipitation. During the passage of the squall the barometer jumped up 2 m.b., and almost instantaneously the temperature dropped 7° F. By 15 h. 50 m. the fury of the storm had passed, but thunder continued to be heard till 16 h. 10 m., and the rain did not cease till 16 h. 20 m. This storm caused heavy floods in the neighbourhood. A house on Russel Hill, about a mile to the south, was struck by lightning. Still another storm made its appearance in the east at 17 h. 15 m. Heavy thunder was heard and at 17 h. 18 m. heavy rain began once more, but this time it was of short duration. During the evening distant thunder was heard from time to time and moderate rain fell occasionally, but no further storm directly affected this area. The rainfall from 7 h. to 18 h. was 19·6 mm."

Roaring Noise.—Mr. C. H. Grinling gives an account of his experience of the thunderstorm on June 12th over Peaslake, Surrey, 5½ miles W.S.W. of Dorking. He heard a distant thunderstorm somewhere about 14 h., first from the E., and later from the S.W. Shortly after the first lightning a roaring noise was heard, which resembled the sound of water rushing out of a burst dam, and was persistent and increasing in loudness. There was a very heavy crash of thunder at 14 h. 30 m., when the first hailstone fell. At the beginning large egg-shaped hailstones fell, some of which measured 2 inches across. Heavy rain followed and the hail subsided. Hailstones lay on the ground for a considerable time after the rain had ceased. A gauge in the neighbourhood measured ·90 in. of rain.

A man from Winterfolds, which is some 2 or 3 miles away beyond Pitch Hill (1½ miles S. of Peaslake) reported that he heard a roaring noise for some minutes before the hailstorm. He also drew attention to the loud crash before the first hail fell, and said that five of the hailstone weighed 3½ ounces.

High Rates of Precipitation.—Mr. W. H. Dines, F.R.S., writes: "Severe thunderstorms occurred at Benson at the same time, about 13 h. 30 m., on both June 15th and 16th. On June 15th the thunder was continuous from 13 h. to 15 h. (G.M.T.), and of a very exceptional character from 13 h. 20 m. to 13 h. 30 m., when lightning within a mile or less distance occurred at about 30-second intervals. The precipitation took the form almost entirely of hail, and 11 mm. fell, so far as can be estimated from the recording gauge, in 5½ minutes. The storm developed a few miles to the E.S.E. and passed away to W.N.W. No hail fell 1 mile to the S.W.

"The storm of the 16th was of very similar character, though the lightning and thunder were not nearly so violent. It passed from S.E. to N.W. Rain and hail fell, giving 10 mm. in 7 minutes, and half of this seems to have fallen in from 1 to 2 minutes.

"Thunderstorms also occurred at Benson on the afternoon of the 12th and 14th, that of the 12th giving very heavy rain for a short period."

Disruptive Action of Lightning.—Mr. Francis Capel Cure, of Badger Hall, Shropshire, has reported that at the close of a heavy thunderstorm on Wednesday, June 16th, the lightning dislodged a large quantity of earth from the side of the dingle and threw it into the water at the foot of the slope.

The Tilting Rain Gauge: A new Autographic Instrument.

By W. H. Dines, F.R.S.

SINCE January 1915, the self-recording rain gauge of which drawings are given on the opposite page has been in use at Benson and has given satisfactory records. The peculiarity of the gauge is that the float cistern (*A*) itself tips so as to start the siphon (*C*). The cistern is carried on a knife-edge (*FF*, Fig. 2), which is about one inch horizontally from the central line, and works in a pair of V-shaped notches. The play is limited by two stops (*H*, Fig. 1). When the gauge is empty there is pressure against the upper stop in consequence of the heavy balance weight (*g* or *G*) shown on the right-hand side of the figures. The rain collected in the funnel of the rain gauge falls through a pipe on to the conical lid (*D*, Fig. 1) and enters the float vessel (*A*) by a hole (*E*). As the cistern fills, the weight of water overcomes the balance weight and the centre of gravity moves to the left. As soon as the centre of gravity has passed the vertical plane through the knife-edge, the cistern tips over to the left, the swing being limited by the lower stop (*H*). The process starts the siphon which projects to the left and, as soon as the cistern has emptied to the extent of one-half to two-thirds, the balance weight restores it to its normal position. The exit of the siphon is splayed out to prevent dribbling.

The pen which is hinged about the float-rod (*K*) remains on the paper when the cistern tilts, and by adjusting the length of the pen-arm (*I*) and the position of the clock-drum (*J*, Fig. 2) with regard to the line of the knife-edge, the down stroke of the pen can be made very nearly straight, but in any case the down stroke is distinguishable from the upward rise. It is essential that the float (*B*) should have a counter-balance for the pen and the pen-arm, otherwise the friction between the float and its guides will interfere with the good action of the gauge.

The only trouble at Benson has been due to earwigs, which have once or twice blocked the siphon-tube. It is desirable, therefore, in dry summer months, to pass sufficient water through to make the rain gauge empty at intervals of a week or so.

Dines' Tilting Rain Gauge.

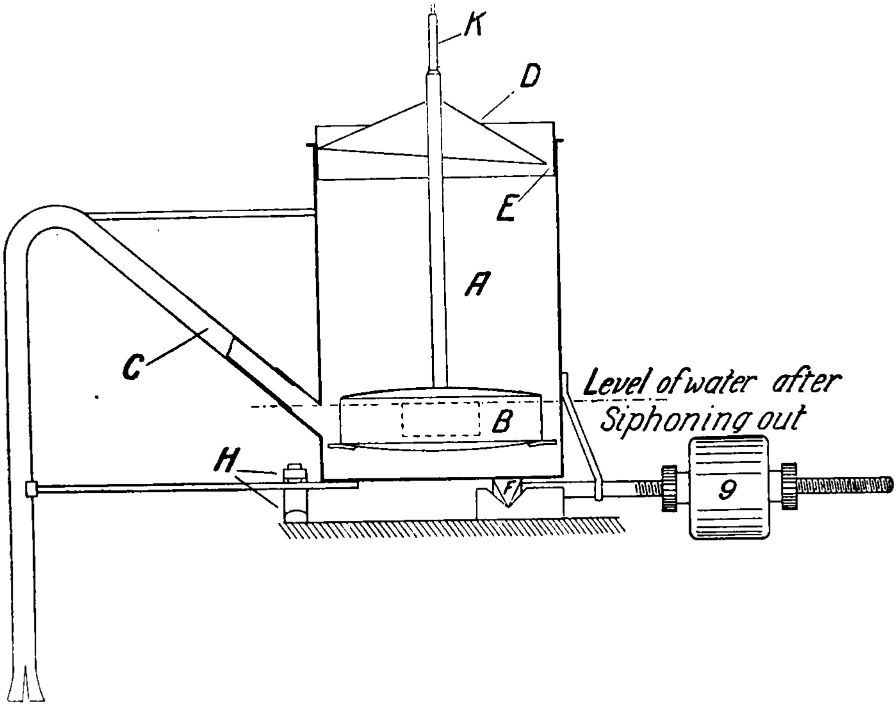

Fig. 1. Sectional Elevation.

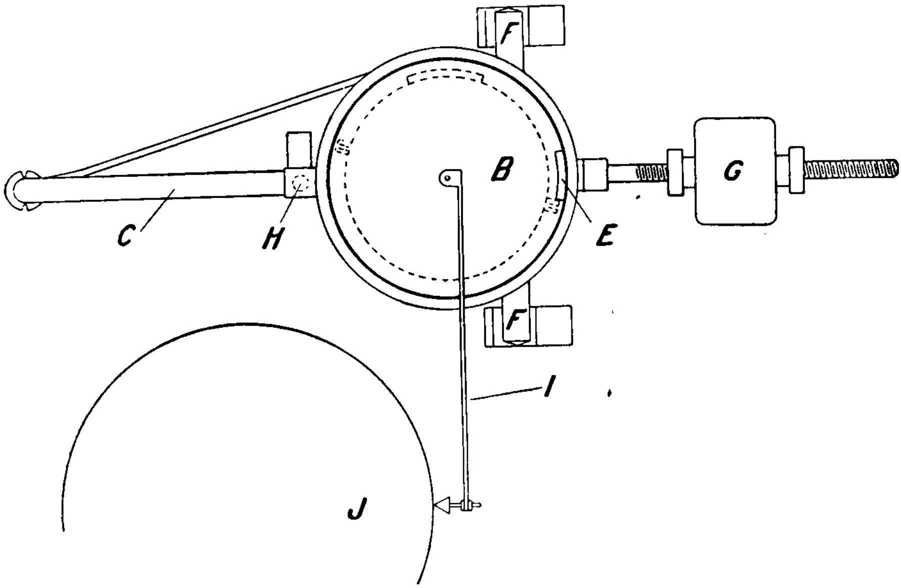

Fig. 2. Plan.
Scale, one-third of full size.

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OBSERVERS are requested to note that telegrams relating to the supply of stores should be addressed to *Meteorology South-kens, London.* The telegraphic address *Weather London* is reserved exclusively for the Headquarters and the Forecast Service of the Meteorological Office at the Air Ministry, Kingsway, W.C.2.

Climatological Stations.

Butler's Cross.—Autographic records from the anemo-biagraph at Butler's Cross have been discontinued from May 3rd, 1920. The instrument is being moved to Larkhill, which is about 2 miles N.E. of Stonehenge.

Gorleston.—The provision at Gorleston of a new Dines anemograph fitted with a director-recorder is of interest as it closes the history of the anemograph at the neighbouring station at Great Yarmouth. This anemograph at the Sailor's Home was supplied in 1869, when similar instruments were being set up at the observatories and at the old lighthouse at Holyhead and has been in continuous operation until recently. The records have been supplemented by those from a Dines anemograph at Gorleston, where the exposure is excellent.

The following stations appear for the first time in the *Monthly Weather Report* for May 1920:—

Mursley.—The station at Mursley Hall, Bucks, has been equipped by Lady Beecham for her sons, Messrs. A. and T. Beecham.

Long Ashton.—This station, for which Mr. A. H. Lees, M.A., is responsible, is in connection with the Agricultural and Horticultural Research Station, University of Bristol.

Mr. F. L. McCreary, Technical Assistant on the Meteorological Office Staff at Renfrew, who was last seen on Wednesday, June 9th, when he was setting out to climb Ben Lomond, has been posted as "missing." On June 10th, Mr. McCreary not having returned to duty, inquiries were instituted by the Meteorologist-in-Charge, and from June 11th a systematic search by the police proceeded. Hitherto the search has been fruitless. It is regretted that little hope now remains of his ever being found alive.

Mr. McCreary, who was barely over 20 years of age, served in the Royal Air Force as a meteorological observer at East Fortune, Fifeness and Longside. He joined the Meteorological Office staff last March, and was posted at Lympne, and subsequently at Renfrew. Mr. McCreary was an exceedingly capable and conscientious observer, and was very popular amongst those with whom he worked.

Royal Meteorological Society.

THE last monthly meeting for the session was held on June 16th in the rooms of the Royal Astronomical Society, Burlington House, Sir Napier Shaw, Vice-President, in the chair.

Mr. J. S. Dines brought forward a paper on "The Ether-Differential Radiometer" by Mr. W. H. Dines, F.R.S. This instrument has been designed to measure radiation from the sky after sunset. It consists of two glass test tubes containing air and a few drops of ether, and connected by a glass U-shaped tube containing ether to serve as a pressure gauge. Each test tube is provided with a movable shield which protects it from draughts and allows radiation from one direction only to fall upon it. It is used by first directing radiation from the sky upon one of the test tubes, and then radiation from a "black" body at a known temperature. The known temperature is adjusted until the change has no effect upon the pressure gauge, and when this is the case it may be assumed that the radiant energy absorbed by the test tube from the sky is the same as that from the black body whence the radiation from the sky is found by a table. The equivalent radiation temperature of the sky is often below 0° F., and a method is shown by which in this case the sky radiation can be found without the use of freezing mixtures. This is done by compensating the small radiation from the sky by the excess of radiation from a hot body so that neutral effect is obtained. The method of calculation and of making up the results was given.

Lieut.-Col. E. Gold referred to previous researches. He regarded Mr. Dines's investigations as likely to be of practical use in forecasting. Mr. W. W. Bryant and Sir Napier Shaw also spoke.

A paper by Prof. S. Chapman, F.R.S., and Mr. E. A. Milne was read, entitled "The Composition, Ionisation and Viscosity of the Atmosphere at great Heights." In the stratosphere, owing to the absence of large-scale mixing, the different constituents of the atmosphere must tend to separate out by diffusion, so that the composition varies with the height; in particular, well-known calculations have shown that, on the usual assumption of the presence of free hydrogen, the atmosphere above 150 k. must consist almost entirely of hydrogen. An examination of the evidence rendered uncertain the actual existence of this hydrogen atmosphere, and the authors accordingly recalculated the variation of composition with height on the assumption that hydrogen is absent; in this case helium, the next lightest element, is the predominating constituent above 100 k. The results were then used to make an estimate of the depth to which α, β, or γ radiation arriving from an extra-terrestrial source would penetrate the atmosphere. It appeared that the range of α particles would extend down to about 80 k.—some 20 k. below the auroral zone. In the case of β and γ radiation it was found that the maximum absorption, and consequently the maximum ionisation, should occur at heights of about 50 k. and 25 k. respectively; in each case the region of appreciable ionisation would be confined to a layer of 35 k. thickness, and the unexpected result emerged that the layers would be comparatively sharply defined at their under surfaces, which practically coincide with the positions of the maxima. These estimates have an interesting bearing on recent theories of the existence of ionised layers in the atmosphere. Attention was directed to the fact that at great heights, though the coefficient of viscosity is little altered, the density is so small that the effective viscosity is very high, and any large-scale motion must die down immediately.

Major Erskine Murray discussed the conditions favourable to the transmission of "wireless" signals, and showed how the observations could be explained by variations in the position and inclination of a conducting layer in the upper atmosphere. Dr. C. Chree, Sir Napier Shaw, Mr. W. H. Dines and Capt. C. J. P. Cave also spoke, and Mr. Milne replied.

The following candidates were elected Fellows of the Society:—Mr. Willis R. Gregg, Mr. G. R. Hay, Mr. F. W. Macaulay, M.Inst.C.E., Mr. H. C. McKinley, Mr. P. R. Sharman, Capt. B. J. Sherry and Mr. C. Vaughan-Starr.

Erratum.—In Mr. E. H. Harrison's letter on "Thunderstorm Days" on p. 91 of the issue for June 1920, line 9, *for* March *read* May.

Correspondence.

To the *Editors, "Meteorological Magazine."*

Apparent "Cirrus" below Stratus.

THE sky presented an unusual appearance from the Victoria Embankment, near Charing Cross, at sunset on the evening of May 25th. There was a good deal of cloud over the sky—a rather high stratus type—but the sun's rays penetrated through a break on the north-west horizon and illuminated the lower surface of the cloud sheet in bands, which stood out of a pink colour against the dark cloud above. The bands, which ran about S.S.W.-N.N.E., were parallel and showed at irregular intervals over a considerable area. Being of a filmy nature, they might readily have been mistaken for cirrus bands. The appearance of cirrus below stratus struck the attention at once, and was very remarkable. After about ten minutes the sun had set and the clouds took on a normal high stratus appearance with little to distinguish them from the ordinary type. Evidently the lower surface had a wave formation upon it, though this did not show except where illuminated by the horizontal rays of the setting sun.

J. S. DINES.

Temperature and "Scent."

DURING the last hunting season I made an effort to investigate the subject of "scent." I find that scent is generally good, *i.e.*, hounds can run a fox well, when the temperature of the ground is higher than that of the air. I presume that the reason of this is that the colder air prevents the scent from rising, whereas when the temperature of the air is higher than that of the ground the scent rises with the warmer air and quickly reaches above the level of the hounds' heads, so that they are unable to hunt it.

Secondly, I found that out of the 18 days when the ground temperature was lower than that of the air, so that a poor scent was to be expected, hounds were able to hunt well on six occasions. On all these six days the hounds were hunting at an elevation of a thousand feet or more above the point of observation. At that elevation the temperature of the air would naturally be lower, but I do not know what the temperature of the ground would be in comparison.

I should be glad if any of your readers are able to give any information on the subject.

A. S. LOCKE.

Carhampton Vicarage, Taunton, 3rd July, 1920.

The Driest Month.

THE recent publication by the Meteorological Office of a "Book of Normals" of Temperature, Rainfall and Bright Sunshine for stations in the British Isles seems to invite a re-opening of the old and somewhat vexed question as to the choice of suitable periods of years for the compilation of authentic meteorological averages.

Since the earliest publication of such data (I believe in 1891) it has been customary to issue a new and revised set of averages at the end of each lustrum, and prior to 1915 the Meteorological Office seems to have employed for this purpose observations extending over the longest series of years for which reliable figures were available. Ths set of monthly normals issued in 1915 included averages of temperature and rainfall for the 35 years 1876–1910, and also, for many stations, for the 40 years 1871–1910, as well as of bright sunshine for the 30 years 1881–1910. In the new "Book of Normals," issued at the close of last year, the periods dealt with in the case of each of the three meteorological elements were synchronous and covered the 35 years 1881–1915.

The practice of ignoring all observations taken prior to the year 1881 may have been adopted for some excellent reason, but as regards rainfall it has certainly led to one rather surprising result. According to the new set of averages it would appear that over a large portion of the United Kingdom April may now be regarded as the driest month in the year. In all previous sets of rainfall averages with which I am acquainted, this enviable position was occupied either by February or March. The change in the relative position of the various months which now confronts us has evidently been brought about by the omission of the ten Aprils 1871–80 and the inclusion of the five Aprils 1911–15. Taking the Greenwich values as an example, it appears that in the ten years 1871–80 five Aprils had a rainfall largely in excess of the 100 years average 1815–1914, and that the mean for the whole ten was more than half an inch in excess. In the five years 1911–15 all but two of the Aprils were marked by a deficient rainfall, and the mean for the whole five was slightly below the 100 years average. The Greenwich averages for the 100 years ended 1914 give the driest months in the following order:—February 1·53 ins., March 1·59 ins., April 1·61 ins. For the 40 years 1871–1910 a similar order was shown, viz., February 1·53 ins., March 1·54 ins., April 1·64 ins. Taking into account the fact that February has as a rule only 28 days, while March has 31, it will be seen that according to each of these sets of averages the two months February and March occupy a twin position as the driest in the year. According to the "Book of Normals" just issued, the three driest months rank in the following order:—April 1·47 ins., February 1·57 ins., and January 1·69 ins., March and May both occupying fourth place with a total of 1·73 ins.

It seems pretty clear that as regards rainfall the selection of records made during the 35 years 1881–1915 for the purpose of obtaining reliable monthly averages was, to say the least, a trifle unfortunate.

There is one consoling thought. During the five years ended 1920 there have been three Aprils with a rainfall largely in exc ss of the average, so that when another lustrum is added to the period of 35 years ended 1915, the sequence of dry months will in all probability again appear in what one cannot but regard as its true order.

FREDK. J. BRODIE.

30, *Loxley Road, Wandsworth Common, London, S.W.*, 21*st June*, 1920.

[It may be noted that, taking the general values for the British Isles for the period 1875–1909 (*see Q.J.R. Met. Soc*, Vol. XLI., p. 18), April was the driest month of the year, having 6·1 per cent. of the annual fall compared with 7·5 per cent in both February and March. For England alone April gave 6·4 per cent., compared with 7·1 per cent. in February and March.—ED. M.M.]

NOTES AND QUERIES.

The Development of Water Power.

THE Conjoint Board of Scientific Societies in its third annual report, issued March 24th, 1920, and dealing with the activities of the Board during 1919, gives some particulars of the work of the Committee on the Water Power of the British Empire. Much valuable preliminary information has been collated and numerous applications for advice or assistance have reached the Committee from various Colonial Governments interested in the development of their hydraulic resources. These have served to strengthen the opinion expressed in the first report, that some permanent central body is urgently required to co-ordinate, advise, collect and distribute data relating to water powers throughout the Empire. The Committee welcome the suggestion to hold an Imperial Conference on Water Powers in London during the present summer.

The second Interim Report of the Water Power Resources Committee of the Board of Trade is now issued (Cmd. 776, 1920, price 4*d*. net). In October 1919 the terms of reference of this committee were enlarged to include the water resources of the country in their widest sense instead of from the point of view of water power only. The Committee has accordingly been strengthened by the addition of Sir F. G. Willis, C.B., Chief Assistant Secretary of the Board of Health, and a number of leading engineers.

The points dealt with in the Interim Report relate principally to the revision of the prevent unwieldy and in some respects extremely unsatisfactory machinery for the control of the water resources of the country. It is recommended that there should be established a Water Commission for England and Wales, assisted by an Interdepartmental Committee, with a view to maintaining a *liaison* with the various departments interested in different aspects of water both as it occurs in nature and as utilised for economic purposes.

From the point of view of those interested in scientific investigations the most important duty proposed to be laid upon the new body is that of compilation of proper records of water resources and the collection of information on the subject through existing departments and other agencies as well as by their own hydrometric staff; such data to refer to Scotland and Ireland as well as to England and Wales. Advisory committees including representatives of scientific institutions are suggested as desirable adjuncts in this work. This extremely valuable proposal is coupled with a full recognition of the immense utility of the work of the great body of voluntary rainfall observers whose records have been brought together by the British Rainfall Organisation, forming a mass of orderly data which must inevitably be the basis of any hydrometric survey of the British Isles. The preparation of a large-scale rainfall survey map of the country formed one of the cherished ambitions of Dr. H. R. Mill, the late Director of the Organisation. Thanks to his pioneer work towards this end, a great part of the preliminary experimental work and no small amount of the actual preparation of the rainfall map have already been done. The increased resources of the Organisation under Government control should certainly allow of the completion of this work and the revision where necessary of what has already been compiled. The growing need for careful supervision of water allocation in England and Wales, where much wasteful utilisation of water-bearing areas has brought the country in some cases to the verge of actual want, and the desirability of preventing a repetition of similar extravagance in Scotland and Ireland, demand a careful stocktaking of our available assets. For this purpose a rainfall survey is the primary requirement; and the completion and publication of such a map would, we believe be the best form of recognition which could be devised of the patient accumulation of rainfall records during the past sixty years by many thousands of volunteer observers, as well as the fullest justification of the indomitable faith of the founder of the British Rainfall Organisation, the late Mr. G. J. Symons.

Meteorological Log for Airmen.

METEOROLOGICAL information gleaned mostly from observations made from the ground is now being supplied systematically for the use of the navigation of the air. The reciprocal service, observation of the conditions aloft, is now being put on a similar footing by the provision of a meteorological log for airmen. It is intended that the airmen shall make observations of air temperature, of visibility, cloud and ground fog, and when possible of the top of the haze layer. He is also asked to note the "bumpiness" on the stages of his journey. The log which is being issued is printed on thin cardboard, and it is intended to be posted to the Meteorological Office on the conclusion of a flight. The analysis of such logs will, it is hoped, give information of permanent value.

New Cards for the Campbell-Stokes Sunshine Recorder.

OBSERVERS accustomed to tabulating the traces on the cards of the Campbell-Stokes Sunshine Recorder will have noticed that the white parts of the card, *i.e.*, the central and cross lines and the figures, do not burn so readily as the blue background, which is calculated to absorb most of the light which a white card would reflect.

The tabulation of the record for a day such as May 1st, when the trace should be along the central line, has tended to be prejudiced adversely by this phenomenon. To get over the difficulty the cards are now being printed with a central line merely indicated by crosses and the transverse hour lines are made thinner than before.

It is regretted that there was some delay in printing and cutting the new cards, so that the old stock of cards had to be issued very sparingly.

Co-operation in the Investigation of Geophysical Problems in High Latitudes.

THE recent visit of Captain Roald Amundsen to Behrings Strait has again directed general attention to his projected voyage across the Polar Sea. In spite of the difficulties of organising international co-operation at the present time, it is hoped that a large number of stations will be provided at various points in high latitudes so that observations of meteorological and magnetic phenomena, and especially of the Aurora Borealis, may be available for comparison with those of Amundsen's party. The Meteorological Office is organising an observing station in the Shetland Islands for the purpose.

A publication entitled "Various Papers on the Projected "Co-operation with Roald Amundsen's North Polar Expedi-"tion" has been circulated from Kristiania by the Norwegian Geophysical Commission. It contains memoirs on the importance of various parts of the work, and also practical suggestions with regard to apparatus and methods. The authors are Th. Hesselberg, O. Krogness and Carl Størmer.

Of special interest in connection with the projected observations is the memoir by L. Vegard and O. Krogness on "The Position in Space of the Aurora Polaris," issued by the same Commission. The memoir is illustrated by no less than 434 pairs of photographs from which the height of the aurora has been determined on as many occasions. Even on the small scale of the reproductions the corresponding points on the photographs taken with cameras about 30 km. apart can generally be recognised. An interesting novelty is the successful use of the kinematograph for auroral photography. As to the results set out in the memoir the most important appears to be a confirmation of the discovery that the lower limit of the draperies tends to fall at one or other of two somewhat closely defined levels, 100 and 107 km. above sea-level, a discovery which must, in the opinion of the authors, almost inevitably lead to the conclusion that a predominant part of the cosmic rays coming from the sea and producing the aurora borealis is made up of two groups of rays, each of which has its own quite definite penetrating power.

The development of auroral photography in the Shetlands, the most promising region of the British Isles for the purpose, will be awaited with great interest.

Long Range Forecasts.

PROFESSOR V. BJERKNES contributes to *Nature* of January 24th, 1920, an important article on "The Meteorology of the Temperate Zone and the General Atmospheric Circulation," in which he puts forward evidence for the existence of a recognisable "polar front line," the boundary between air proceeding from the Pole and from Equatorial regions. The desirability of tracing the movements of this line as the clue to weather changes in the Temperate Zone is emphasised.

Warm Mays.

An examination of the long record at Camden Square reveals the interesting fact that not since 1902 has the mean temperature of May been below the average of the 50 years 1860–1909. The effect of so long a run of warm Mays upon the long period average is to increase it from 54·0° F. (50 years) to 54·3° F. (55 years), 54·5° F. (60 years) and 54·6° F. (61 years, 1860–1920). December shows an increase of 0·4° F. in mean temperature between the 50- and 60-year periods, but no other month varies by more than 0·2° F. The warm Mays of recent years were as notable for high minima as for high maxima.

High Pilot Balloon Ascent at Shoeburyness.

On May 25th, 1920, a balloon was followed for 70 minutes by two theodolites. It attained a height of 41,800 feet and had a horizontal trajectory of 98,600 feet. During the first 50 minutes of this ascent three theodolites were employed, the third instrument being situated on the top of the "Conning Tower" in the New Ranges. The length of the base line from here to the further theodolite is 10,972 feet, and to the nearer theodolite 8,159 feet. Although the surface wind was nearly perpendicular to this base line, it veered higher up, and the effective length of the base was considerably shortened. The respective heights given by the two stations on the 8,159 feet base line from the 45th to the 49th minute are given below :—

Minute.	45th.	46th.	47th.	48th.	49th.
Heights in feet :—					
H. - - -	23.940	24,190	24,540	25,450	25,730
h. - - -	23,870	24,210	24,420	25,340	25,650
Difference, feet -	70	20	120	110	80

It will be noted that the agreement is excellent. The horizontal trajectories at the 49th minute computed for the two stations were 50,000 feet and 43,610 feet.

The Frequency of High and Low Temperatures.

MR. E. A. LEE, of Liphook, who has had one or more thermographs in operation for over ten years, has recently analysed the records in a way which brings out very clearly the characteristics of the several months or years.

By taking the ten years 1910–19 together it is found that for 7 per cent. of the time temperature was below the freezing point, for 0·4 per cent. below 20° F., and for 0·01 per cent. below 10° F. On the other hand, for nearly 16 per cent. of the time temperature was above 60° F., for 3·4 per cent. above 70° F., for 0·4 per cent. above 80°, and for 0·01 per cent. above 90° F.

The ten hours with temperature above 90° were all in the famous hot year 1911; 2½ occurred in July, one in September, the remainder in August. There were 180 hours above 80° F. in this year; only 186 in the other nine together. The ten hours below 10° were shared by January 1910, February 1912, and February 1917.

Mr. Lee wishes it to be known that copies of the analysis sheet are available for persons interested.

Meteorological Conditions at Lu-Kia-Pang, China.

A SUMMARY of the meteorological observations for 1919 at Lu-Kia-Pang has been received from the Rev. J. de Moidrey, S.J. Such summaries have been published in *Symons's Meteorological Magazine* for every year since 1914, but, unfortunately, limited space does not allow of the continuance of the practice. The summary is, however, available now for reference in the Meteorological Office, as well as the daily readings which are given for this station in the *Revue Mensuelle* of the Observatory of Zi-kai-Wei.

In 1918 one rainless period of 52 days and two of 22 days each occurred at Lu-Kia-Pang, but in 1919 there was no drought of more than 13 days.

News in Brief.

Establishment of a Meteorological Service in Ecuador.—The Association of Agriculturalists of Ecuador has inaugurated a meteorological service for the coastal provinces including the Galapagos Islands. Sites have been selected for fifty stations which are being provided with maximum and minimum thermometers and rain gauges, and the observations will be published in a quarterly bulletin. While it is realised that weather forecasting in the strict sense will not be possible at present, it is hoped that the collection of reliable statistics will be a great boon to farmers. Five of the stations are already in operation.

Parachute Descent of 19,800 *feet.*—A parachute leap said to be a "world's record" was made by Lieutenant John Wilson, of the Air Service, at San Antonio, Texas, on June 8th. He jumped from an aeroplane when it was at an altitude of 19,800 feet. He came to earth like "a man from Mars" after drifting more than 10 miles.

The jump was made backwards from the cockpit of the aeroplane. A strong west wind first caught the parachute and sent him sailing along in the direction of the Pacific coast for nearly five miles, when an opposite current sent him back in the direction of the Florida coast. Lieutenant Wilson's head was in a whirl as the wind pulled him first one way and then another, and in the last stage of the descent he narrowly escaped striking a church steeple. The previous "record" parachute jump from an aeroplane was 14,000 ft. made by a French airman.—*The Times*, June 10th, 1920.

Twenty-seven years Observations in Venezuela (Documentos de la memoria de Instruccion Publica, pp. 625).—Dr. Luis Ugueto, Director of the Cajigal Observatory, Caracas, Venezuela (lat 10° 31′ N., 66° 56′ W.) has recently published the results of meteorological observations in the Observatory from its foundation in 1891 to the end of 1917. For the first two years only rainfall was recorded, but later pressure, temperature, humidity, cloudiness, sunshine and wind were added.

Fuller information as to the force of the wind would no doubt have appeared had not the Osler anemometer, installed in October, 1901, been blown away in April, 1902. During its short history it recorded four gales, three of them from W. or WNW.

The wind frequency from each direction in each month is ingeniously shown by a system of thickened portions of concentric circles, one circle representing one month's observations.

It is to be regretted that information as to the exposure of the instruments and the hours of observation is wanting. The barometric readings show that the height of the station is about 1,000 m. above sea level.

Asservazioni Pluviometriche raccolte a tutto l'anno 1915.—A publication compiled by Prof. Filippo Eredia and issued in March 1920 by the Hydrographic Service of Rome, contains an abstract of the accumulated records of monthly rainfall up to the year 1915 at 73 widely distributed stations. Many records extend over half a century, and at Bologna an unbroken series of observations extends for 103 years up to 1915. For each station the arithmetical means are given for the months, but no attempt is made to allow for the varying lengths of the periods.

A Correction.—It is regretted that Mr. C. T. R. Wilson was referred to on p. 98 of this Magazine as Director of the Solar Physics Observatory, Cambridge. Mr. Wilson, who holds the position of University Reader in Electrical Meteorology, has carried out his researches at the Solar Physics Observatory. Professor H. F. Newall, F.R.S., remains Director of the Observatory.

Meteorological Tables for the British Empire.

THE tables of climatological observations for the British Empire have formed one of the principal features of *Symons's Meteorological Magazine* since 1882, having appeared previously for a period of ten years in *The Colonies*, for which periodical they were collected and prepared by the late Mr. Symons. For nearly the whole of the 48 years which have elapsed since their inauguration they formed the only systematic attempt to publish, in a collected form and on a uniform plan, current meteorological data from so extensive a part of the Earth's surface. The recent and more ambitious undertaking of the Meteorological Office in bringing together carefully selected records for the whole globe in the *Réseau Mondial* has naturally eclipsed the older and less comprehensive effort, but the Climatological Tables still possess the advantage of relatively prompt publication. Advantage has been taken of the facilities now available to extend the scope of the tables and include a number of additional stations which make the list more representative of the varied climates of the Empire. For convenience of reference a complete list of the stations is printed on p. 127, giving particulars of their positions, the authority for the records, and the period covered by the normal values. The tables themselves have been remodelled, and now include, in addition to the observations previously given, the mean barometric pressure in millibars, the mean temperature and the mean duration of bright sunshine per day, as well as the departures of the pressure, temperature and rainfall from the normal values for the month. The new elements are in some cases missing from the tables for the last few months of 1919, but it is hoped that in the near future it will be possible to make the data more complete in these particulars.

Reference Table.—Climatological Table for the British Empire.

STATIONS.	Lat.	Long.	Height above M.S.L.	Hours of Observation.*	AUTHORITY.	Period of Normals.		
						Pressure.	Temp.	Rainfall.
			Ft.					
London, Kew Observatory.	51° 28′ N	0° 19′ W	34	9, 15, 21	Meteorological Office, London.	'71–'15	'81–'15	'81–'15
Gibraltar	36° 6′ N	5° 21′ W	53	7, 13, 21	Colonial Secretary, Gibraltar.	'91–'15	'76–'19	'52–'19
Malta	35° 54′ N	14° 31′ E	193	8	Dr. Thomas Agius	'83–'19	'53–'65 '04–'19	'53–'19
Sierra Leone	8° 29′ N	13° 9′ W	224	9, 17	Principal Medical Officer	'91–'19	'75–'19	'47–'51 '75–'19
Lagos, Nigeria	6° 22′ N	3° 28′ E	13	9½, 15½	Medical Officer	'91–'15	'86–'00 '06–'15	'86–'19
Kaduna, Nigeria	10° 32′ N	7° 25′ E	2,088	9	The Secretariat, Kaduna	'91–'15	'07, '09–'19	'04–'18
Zomba, Nyasaland	15° 23′ S	35° 18′ E	3,100	9, 21	Director of Agriculture	'92–'16	'92–'16	'92–'16
Cape Town	33° 56′ S	18° 29′ E	40	9, 14, 21	Chief Meteorologist, Pretoria.	'41–'15	'42–'14	'41 '13
Johannesburg	26° 11′ S	28° 4′ E	5,925	8½	Chief Meteorologist, Pretoria.	9 yrs. '04–'13	'04–'19	'88–'13
Mauritius	20° 6′ S	57° 33′ E	181	hourly	Royal Alfred Observatory	'61–'19	'61–'19	'61–'19
Bloemfontein	29° 7′ S	26° 13′ E	4,550	8	Chief Meteorologist, Pretoria.	'70–'84	'81–'99 '03–'06	'78–'99 '03–'13
Calcutta, Alipore Observatory.	22° 36′ N	88° 23′ E	21	10, 16	Director-General of Observatories, Simla.	'89–'10	'78–'10	'78–'10
Bombay	18° 54′ N	72° 49′ E	37	10, 16	Do. do.	'89–'10	'78–'10	'78–'10
Madras	13° 4′ N	80° 14′ E	22	10, 16	Do. do.	'89–'10	'78–'10	'78–'10
Colombo, Ceylon	6° 54′ N	79° 53 E	24	7, 9½, 15½	Superintendent, Colombo Observatory.	'52–'16	'52–'16	63 yrs. '52–'17
Hong Kong	22° 18′ N	114° 10′ E	109	hourly	Director, Royal Observatory.	'84–'13	'71–'10	'84–'13
Sydney	33° 51′ S	151° 13′ E	133	9, 15, 21	Commonwealth Meteorologist, Melbourne.	'60–'18	'59–'17	'59–'17
Melbourne	37° 49′ S	144° 57′ E	115	9, 15, 21	Do. do.	'58–'18	'56–'17	'56–'17
Adelaide	34° 56′ S	138° 35′ E	140	9, 15, 21	Do. do.	'57–'18	'57–'17	'39–'17
Perth	31° 57′ S	115° 51′ E	197	9, 15, 21	Do. do.	'85–'18	'97–'17	'76–'17
Coolgardie	30° 57′ S	121° 10′ E	1,389	9, 15	Do. do.	'97–'19	'97–'19	'93–'19
Brisbane	27° 28′ S	153° 2′ E	125	9, 15, 21	Do. do.	'87–'18	'87 '17	'52–'17
Hobart, Tasmania	42° 53′ S	147° 22′ E	177	9, 15, 21	Do. do.	'85–'18	'71–'17	'43–'17
Wellington, New Zealand.	41° 16′ S	174° 46′ E	8	9	Director, Government Meteorological Observatory.	'65–'17	'69–'87 '94–'17	'65–'17
Suva, Fiji	18° 8′ S	178° 26′ E	55	9	Superintendent, Department of Agriculture.	'86–'16	'86–'18	'86–'18
Kingston, Jamaica	17° 55′ N	76° 12′ W	24	7, 15	Government Meteorologist.	'80–'99 '07–'18	'80–'99 '07–'18	'70, '72–'18
Grenada, W.I.	12° 3′ N	61° 45′ W	509	9, 18	Observer, Richmond Hill	'76–'15	'87, '91–'18	'87, '91–'18
Toronto	43° 40′ N	79° 24′ W	379	8, 20	Director, Meteorological Service of Canada.	'00–'18	78 yrs.	70 yrs.
Fredericton, N.B.	45° 57′ N	66° 36′ W	164	9, 21	Do. do.	'70–'84 '02–'18	47 yrs.	47 yrs.
St. John, N.B.	45° 17′ N	66° 4′ W	118	9, 21	Do. do.	'02–'18	45 yrs.	'61–'10
Victoria, B.C.	48° 24′ N	123° 19′ W	230	5, 17	Do. do.	'00–'18	29 yrs.	'81–'10

* Local or zone time.

Climatological Table for the

STATIONS Those in italics are South of the Equator	PRESSURE		TEMPERATURE							
			Absolute				Mean Values			
	Mean M.S.L.	Diff. from Normal	Max.	Date	Min.	Date	Max.	Min.	½ max. and min.	Diff. from Normal
	mb.	mb.	° F.		° F.		° F.	° F.	° F.	° F.
London, Kew Observatory.	1014·5	−0·7	84	Aug. 9	21	Feb. 9	55·6	41·9	48·8	−0·9
Gibraltar..........	1018·3	+1·7	97	Aug. 6, 30	39	Dec. 27	69·6	56·4	63·0	−1·4
Malta.............	1014·3	..	103·6	July 13	40·0	Jan. 21	70·9	60·1	65·5	0·0
Sierra Leone,......	1013·4	+1·7	100	Aug. 31	58	Sept. 17	87·2	..	..	..
Lagos............	..	..	99·0	Apr. 9	69·0	May 9 Aug. 9	85·1	75·0	80·0	−0·2
Kaduna, N. Nigeria	*944·3	..	99	Mar. 10, Apr. 7, 8, 9.	45	Jan. 12	87·5	65·1	76·3	..
Cape Town........	..	..	103·4	Feb 5	34·1	July	72·1	54·1	63·1	+1·0
Johannesburg......	..	..	89·9	Feb. 8	28·2	Aug. 4	71·5	49·9	60·7	+1·2
Mauritius..........	1015·8	−0·2	94·8	Jan. 15	55·4	Aug. 22	81·4	67·6	74·5	+0·3
Bloemfontein......	..	..	96·0	Dec. 10	20·5	July 15	76·9	47·7	62·3	+0·7
†Calcutta, Alipore Obsy.	..	..	104·6	May 21	49·4	Jan. 17	87·5	71·0	79·3	+0·7
Bombay..........	..	..	94·0	June 2	61·1	Jan. 13	86·4	75·3	80·8	+0·4
Madras...........	..	..	108·2	May 21	64·5	Jan. 2	91·2	76·1	83·6	+0·7
Colombo, Ceylon...	..	..	93·5	Mar. 29	65·9	Jan. 12	86·8	75·1	81·0	−0·5
Hong Kong.......	1012·6	−0·1	92·2	Aug. 1	39·4	Feb. 4	76·5	68·8	72·6	+0·3
Sydney...........	..	..	..	..	..	..	..	..	..	..
†*Melbourne*........	..	..	106·6	? Feb. 15	29·9	Aug. 4	68·6	50·5	59·5	+1·1
Adelaide..........	..	..	109·3	Dec. 10	35·6	Aug. 21	74·1	54·1	64·1	+1·1
Perth.............	..	..	103·2	Mar. 9	39·1	Aug. 14, 15.	72·3	54·8	63·5	−0·8
Coolgardie........	..	..	111·8	Jan. 22	32·2	Aug. 12	77·6	52·5	65·1	+0·8
Brisbane..........	..	..	99·4	Mar. 5	38·4	Aug. 5	78·3	60·6	69·5	+0·6
Hobart, Tasmania..	..	..	92·8	Dec. 21	32·8	Aug. 5	63·1	47·6	55·4	+1·1
Wellington........	1014·8	+1·7	81·1	Feb. 24	29·9	June 1	60·5	48·7	54·6	−0·5
†*Suva, Fiji*........	1014·3	+1·5	? 90·6	? Jan. 30 ? Feb. 26	62·4	May 21	81·5	71·3	76·4	−0·8
Jamaica, Kingston..	..	..	97·5	Aug. 9	62·6	Feb. 13	88·1	72·0	80·1	+0·8
Grenada..........	1012·2	−0·3	90	Oct. 2.	68	Aug 23, 24.	84·7	74·1	79·4	+0·6
Toronto...........	1017·0	+0·4	98·0	July 4	− 7·2	Dec. 17	57·1	39·5	48·3	+2·8
Fredericton.......	1016·4	..	92·5	July 5	−26·0	Dec. 17	51·6	30·5	41·0	+0·7
St. John, N.B.....	1015·4	+0·4	83·5	June 4	−17·2	Dec. 18	48·7	34·5	41·6	−0·1
Victoria, B.C......	1017·0	+0·8	84·5	July 14	15·5	Dec. 11	54·7	42·8	48·7	−1·5

* At Station Level, height of 2088 feet.

LONDON, KEW OBSERVATORY.—9 thunderstorms, 53 days of fog.

GIBRALTAR.—8 thunderstorms, 28 days of gale.

SIERRA LEONE.—61 thunderstorms, 9 days of gale.

British Empire, Year 1919.

TEMPERATURE				PRECIPITATION				Mean Cloud Am'nt	Bright Sun-shine	STATIONS
Mean Values		Absolute		Amount		Diff. from Normal	Days		Hours per day	Those in italics are South of the Equator.
Dew Point °F	R'tive Humi-dity %	Max. in Sun °F.	Min. on Grass °F.	in.	mm.	mm.				
42·3	76	144·0	11·5	24·3	619	+ 13	160	6·5	3·86	London, Kew Observatory.
54·4	75	153	32	37·67	957	+ 49	73	3·8	..	Gibraltar.
..	80	153	..	15·73	400	− 50	66	5·2	7·7	Malta.
72·6	79	..	..	117·98	2997	−1049	180	..	..	Sierra Leone.
73·9	78	163·5	55·2	48·39	1229	− 595	109	7·3	..	Lagos.
64·2	71	..	..	43·53	1106	− 240	106	..	..	Kaduna, N. Nigeria.
52·6	70	..	..	19·59	498	− 151	94	4·2	..	*Cape Town.*
45·1	67	..	?25·2	23·53	598	− 148	89	3·5	..	*Johannesburg.*
65·0	74	..	49·5	39·44	1002	− 260	186	6·0	..	*Mauritius.*
45·0	55	..	..	11·64	296	− 299	59	2·8	..	*Bloemfontein.*
..	76	..	38·5	61·74	1568	..	76	4·6	..	Calcutta, Alipore Obsy.
72·0	76	140·2	52·0	68·32	1735	− 91	106	3·8	..	Bombay.
72·2	74	165·6	61·2	50·72	1288	+ 33	90	4·7	..	Madras.
73·2	81	164·0	58·1	93·70	2380	+ 22	208	6·9	..	Colombo, Ceylon.
..	78	..	..	76·16	1934	− 195	143	7·0	5·33	Hong Kong.
..	..	..	..	..	..	..	..	..	..	*Sydney.*
..	64	?153·8	21·8	24·22	615	..	138	5·5	..	*Melbourne.*
49·4	58	168·4	25·2	17·00	432	− 103	108	4·7	..	*Adelaide.*
..	67	166·3	28·2	24·54	623	− 230	113	4·3	..	*Perth.*
46·1	48	171·0	26·8	17·99	457	+ 219	58	3·7	..	*Coolgardie.*
57·3	66	158·1	30·8	19·35	491	− 688	92	4·0	..	*Brisbane.*
43·5	62	156·0	26·4	21·28	541	− 61	137	6·2	..	*Hobart, Tasmania.*
47·0	76	152·0	18·5	28·51	724	− 540	136	6·1	5·58	*Wellington.*
..	..	..	..	125·89	3198	..	227	6·9	..	*Suva, Fiji.*
70·0	77	..	..	27·72	704	− 157	75	4·3	..	Jamaica, Kingston.
71·1	76	143	..	73·09	1856	− 62	217	4·0	..	Grenada.
38·0	74	134·9	? − 11·0	29·70	754	− 43	138	5·4	..	Toronto.
33·1	74	..	..	43·31	1100	− 79	125	5·6	..	Fredericton.
34·6	77	140·7	− 18·5	48·14	1223	+ 77	166	6·1	..	St. John, N.B.
40·7	80	140·0	9·8	28·33	720	− 97	148	5·5	..	Victoria, B.C.

† Totals for 11 months only.

COLOMBO, CEYLON.—27 thunderstorms.

Wellington.—3 thunderstorms.

GRENADA.—20 thunderstorms.

Climatological Table for the

STATIONS	PRESSURE: Mean of Day M.S.L. (mb.)	PRESSURE: Diff. from Normal (mb.)	TEMPERATURE, Absolute: Max. (° F.)	Date	Min. (° F.)	Date	TEMPERATURE, Mean Values: Max. (° F.)	Min. (° F.)	½ max. and min. (° F.)	Diff. from Normal (° F.)
London, Kew Observatory	1013·3	−4·0	57	13	23	7	47·5	37·9	42·7	+3·8
Gibraltar	1024·9	+5·4	66	28	41	8	59·8	47·4	53·6	−1·1
Malta	1018·3	+2·1	68	8	47	21	59·3	52·0	55·6	+1·3
Sierra Leone	1011·8	+0·7	92	9, 23	69	11, 12	88·7	73·9	81·3	−0·1
Lagos, Nigeria	1011·7	+1·8	89	23	69	23	87·4	74·7	81·1	+0·1
Kaduna, Nigeria	1014·6	+4·8	96	7	54	2, 30	87·0	56·8	71·9	−2·4
Zomba, Nyasaland	1007·5	−0·4	90	3,6,25	62	7, 19	84·5	65·3	74·9	+2·5
Cape Town	..	..	94	8	56	10	83·1	62·4	72·7	+2·9
Johannesburg	..	..	90	5	53	9	78·7	56·2	67·5	+1·3
Mauritius	1010·5	−1·4	91	20	64	15	87·1	72·1	79·6	+0·3
Bloemfontein	..	..	97	23	53	25	89·1	61·5	75·3	+2·1
Calcutta, Alipore Obsy.	1015·4	+0·2	83	31	51	2	78·2	57·2	67·7	+1·3
Bombay	..	..	88	28	68	20	84·4	72·0	78·2	+3·0
Madras	..	..	86	29	65	18	84·2	69·9	77·1	+1·0
Colombo, Ceylon	1011·5	+0·7	91	29	67	30	86·3	71·8	79·1	−0·7
Hong Kong	1020·5	+1·1	75	31	45	5	64·9	54·3	59·6	−0·7
Sydney	1012·6	+0·1	86	16	56	28	76·0	63·4	69·7	−2·0
Melbourne	1015·2	+2·5	97	31	47	27	73·3	56·6	64·9	−2·5
Adelaide	1016·2	+2·2	103	14	51	22	84·0	60·2	72·1	−2·0
Perth, West Australia	1011·8	−0·7	107	27	57	5	88·5	67·3	77·9	+5·2
Coolgardie	1012·8	+1·3	108	13	56	17	90·4	62·5	76·5	−0·5
Brisbane	1010·6	−0·7	88	9	61	28	82·3	68·1	75·2	−2·1
Hobart, Tasmania	1015·1	+4·8	90	6	42	22	68·1	51·0	59·5	−2·8
Wellington, N.Z.	1016·0	+3·2	76	31	45	16	66·2	53·6	59·9	−2·8
Suva, Fiji	..	..	..	..	..	..	..	..	..	..
Kingston, Jamaica	..	..	91	23	64	9	87·3	67·7	77·5	+0·7
Grenada, W.I.	1012·8	0·0	88	12	69	21, 22, 23	82·5	72·0	77·3	+0·3
Toronto	1023·6	+6·2	37	7	−18	31	21·3	4·7	13·0	−9·1
Fredericton, N.B.	1019·3	+2·8	36	8	−24	3	15·7	7·2	11·5	−1·5
St. John, N.B.	1018·1	+2·4	37	27	−20	31	19·4	0·6	10·0	−9·2
Victoria, B.C.	1022·8	+7·5	53	30	25	22	42·7	35·6	39·1	−1·0

London, Kew Observatory.—1 fog. Gibraltar.—6 fogs, 4 gales.
Malta.—Prevailing wind direction NW ; mean speed, 11·6 mi/hr.
Perth.—Absolute shade max. highest for Jan. since 1897.

British Empire, January 1920.

TEMPERATURE				PRECIPITATION				BRIGHT SUNSHINE		
Absolute		Relative Humidity	Mean Cloud Am'nt	Amount		Diff. from Normal	Days	Hours per day	Percentage of possible	STATIONS
Max. in Sun	Min. on Grass									
° F.	° F.	%	0–10	in.	mm.	mm.				
89	20	82	7·3	2·1	55	+ 10	17	1·5	19	London, Kew Observatory.
121	35	78	3·9	0·98	25	−105	5	..	..	Gibraltar.
118	..	81	5·0	0·36	9	− 66	3	5·5	56	Malta.
..	..	70	2·0	0·0	0	− 11	0	..	..	Sierra Leone.
146	52	71	5·9	0·37	9	− 19	1	..	..	Lagos, Nigeria.
..	..	43	1·0	0·0	0	0	0	..	..	Kaduna, Nigeria.
..	..	82	7·9	9·42	239	− 46	19	..	..	Zomba, Nyasaland.
..	..	64	3·1	0·29	7	− 10	4	..	..	Cape Town.
..	51	71	4·8	5·14	131	− 28	13	8·0	59	Johannesburg.
..	59	74	6·6	7·07	180	− 17	21	8·1	61	Mauritius.
..	..	50	2·7	2·17	55	− 47	4	..	..	Bloemfontein.
..	43	51	2·7	0·00	0	− 10	0	..	..	Calcutta, Alipore Obsy
133	57	74	2·0	0·99	25	+ 23	2	..	..	Bombay.
155	62	77	3·9	5·66	144	+121	6	..	..	Madras.
163	59	73	4·3	0·83	21	− 70	3	..	..	Colombo, Ceylon.
..	..	59	3·4	0·07	2	− 35	1	7·3	67	Hong Kong.
146	50	70	6·3	6·80	173	+ 86	19	..	..	Sydney.
151	41	63	5·5	1·51	38	− 9	8	..	..	Melbourne.
160	38	43	2·6	0·20	5	− 13	2	..	..	Adelaide.
172	52	44	4·4	0·03	1	− 6	3	..	..	Perth, West Australia.
169	53	34	3·1	0·07	2	− 8	3	..	..	Coolgardie.
155	51	65	6·1	11·86	301	+136	13	..	..	Brisbane.
153	36	60	6·5	1·00	25	− 21	12	..	..	Hobart, Tasmania.
145	35	73	7·2	5·91	150	+ 64	12	5·5	37	Wellington, N.Z.
..	..	..	..	..	..	..	..	..	..	Suva, Fiji.
..	..	73	1·9	0·07	2	− 22	2	..	..	Kingston, Jamaica.
140	..	75	3·3	4·86	123	+ 10	19	..	..	Grenada, W.I.
74	−20	64	5·4	2·38	60	− 13	18	..	..	Toronto.
..	..	80	4·3	1·50	38	− 64	10	..	..	Fredericton, N.B.
102	−21	80	5·3	3·42	87	− 35	11	..	..	St. John, N.B.
111	19	91	8·1	5·55	141	+ 26	15	..	..	Victoria, B.C.

MAURITIUS.—Prevailing wind direction ESE ; mean speed, 6·2 mi/hr.
COLOMBO, CEYLON.—Prevailing wind direction N ; mean speed, 4·9 mi/hr.
HONG KONG.—Prevailing wind direction E ; mean speed, 10·3 mi/hr.

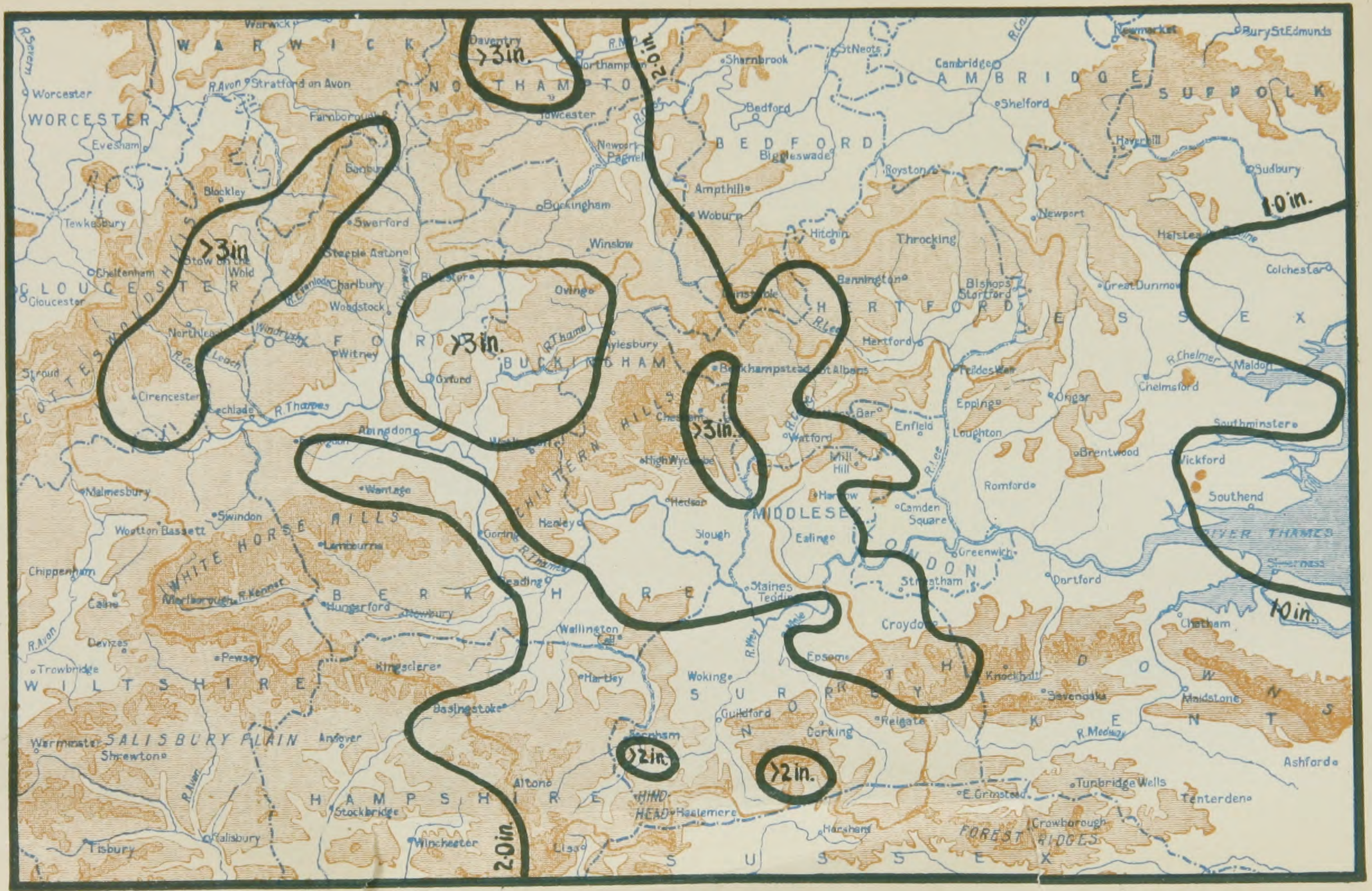
Weather in the British Isles: June 1920.

AMONG the notable features of the weather of June were the marked absence of rapid movements in the barometer and the regularity of the air pressure. Other conspicuous events were the frequent thunderstorms which occurred between the 10th and 20th, and the almost entire absence of any very hot days. Very commonly the warmest day of the month was the 17th, when a few stations in the Midlands recorded maximum temperatures of 80° F. and above, amongst the highest readings being 82° F. at Raunds (Northants) and 81° F. at Eye (Peterborough). In Ireland at the majority of the stations the highest temperatures during the month were below 70° F. Under the influence of a northerly current flowing southwards to the British Isles between an anticyclone near Iceland and a depression over Scandinavia a spell of cold dry weather set in on the 4th and prevailed until the 10th. During this period ground frosts occurred on several nights, and in some instances the temperature in the screen fell below the freezing-point. In North Buckinghamshire allotment holders are reported to have lost this year's entire crop as the result of one night's frost. Between the 2nd and 5th the temperature fell rapidly, and at several stations a drop of as much as 20° F. occurred, a shade minimum of 30° F. being recorded at West Linton on the 5th and 33° F. at Marlborough and Rhayader. On the 10th a secondary depression connected with a shallow "low" off the west of Ireland developed over the English Channel, and the spell of fine weather which had lasted since the beginning of the month came to an end.

Then followed a cyclonic type of weather which gave rise to thunderstorms and heavy showers of rain and hail in many parts of the kingdom. Between the 11th and 18th many stations reported storms on five or six days, sometimes in succession, and on the 16th thunder was heard at 23 daily reporting stations. In some cases the thunderstorms were accompanied by heavy falls of rain, 37 mm. being registered at Kew Observatory on the 12th, when a very severe storm passed over London, during which many houses and a church steeple in Haggerston were struck by lightning. In Warwickshire during a severe storm two men were killed. The varied character of the weather during this day is illustrated by the snow which was reported from Carmarthenshire. Severe thunderstorms occurred at Benson about 13 h 30 m. on both June 15th and 16th. On the 15th the thunder was continuous from 13 h. to 15 h., and of a very exceptional character from 13 h. 20 m. to 13 h. 30 m., when lightning within a mile or less distance occurred at about 30 second intervals. The precipitation almost entirely took the form of hail, and 11 mm. fell in 5½ minutes. The storm of the 16th was of a very similar character, though the lightning and thunder were not nearly so violent. Rain and hail fell, giving 10 mm. in 7 minutes, half of which fell in from one to two minutes. On the 15th during a thunderstorm at Reading 26 mm. fell in 45 minutes; and at York on the 18th there was a downpour of 14 mm. in 10 minutes, followed half an hour later by a fall of 20 mm. in 20 minutes, with hail measuring ¾ in. in diameter. On the 17th a line-squall passed over Kew Observatory at 12 h. 30 m., and was accompanied by thunder, lightning, hail, and rain. On this day 52 mm. was recorded at Senny, near Brecon.

In Scotland during this thunderstorm period, owing to the influence of an anticyclone over the Icelandic-Faröe region, the weather was much finer than over England. At Deerness the sunshine recorded during the week which ended on the 19th was very remarkable, the total for tke week being 112 hours, equal to 16 hours per day and 87 per cent. of the "possible." During this week the mean range of temperature at Balmoral was unusually large and was as much as 31·5° F., the mean maximum being 70·6° F. and the mean minimum 39·1° F. Mostly about this time the nights in Scotland

THAMES VALLEY RAINFALL. JUNE, 1920.



ALTITUDE SCALE: Below 250 feet | 250 to 500 feet | 500 to 1000 feet | Above 1000 feet

SCALE OF MILES: 0 5 10 15 20

H. M. Stationery Office Press, Kingsway, W.C. 2.

Ps. 5542/135 105 P.35 1250 7.20.

Watershed of River Thames above Teddington and River Lea above [illegible]

Isohyetals

were very cool, and at Balmoral on the 14th, 15th, and 16th the thermometer went down to 35° F. In Aberdeen sunshine records were good and the daily mean was more than 1½ hrs. in excess of the normal.

For the first time in 1920 the total monthly rainfall was generally deficient over the British Isles, exceeding the average only in small isolated areas, particularly in the south of England and Wales. Less than half the average occurred in considerable areas in the east of Scotland, and locally in the north of Leinster and near Newcastle-on-Tyne. Only 30 per cent. fell in the south of Aberdeenshire. Less than 1 in. was confined to a wide band on the east coast from about Hull to Inverness, and to small areas near Mullingar, Westmeath and the Thames Estuary. More than 5 ins. was reached only in isolated patches across Wales, in the Lake District and at Loch Quoich, Inverness-shire. Over 10 ins. was recorded in the Lake District. The general rainfall expressed as a percentage of the average was: England and Wales, 99; Scotland, 65; Ireland, 78; British Isles, 82.

In London (Camden Square) the mean temperature was 61·5° F., or 1·3° F. above the average. Duration of rainfall, 28·6 hrs. Evaporation, 2·85 ins.

Weather Abroad: June 1920.

The anti-cyclone which was centred over the Bay of Biscay at the end of May moved northward to Iceland on June 3rd, and with a depression over the Baltic caused northerly gales and heavy rain over Scandinavia and the North Sea. These conditions lasted with decreasing intensity until the 10th, frost being experienced in Scandinavia on several days and snow in Spitzbergen. In Central and Southern Europe, however, temperature rose again by the 8th to 86° F. at Rochefort and 91° F. at Tripoli. From the 10th to about the 20th a depression lay off the mouth of the English Channel, causing a period of heavy rain and great thunderstorm activity. The heaviest falls occurred on the 14th—59 mm. at Munich and 24 mm. at Rennes. Lugano experienced 16 mm. on the 15th, 33 mm. on the 16th and 36 mm. on the 17th—a total of 85 mm. (3·4 inches) in three days. Four people were killed by lightning in Belgium on the 19th. Meanwhile anti-cyclonic conditions prevailed over the Northern North Sea, Iceland and Scandinavia, with fine weather and high temperatures, reaching 62°. F. at Seydisfjord and exceeding 70° F. in Norway and Denmark. Very high temperatures were experienced during this period and for the remainder of the month in the Mediterranean—101° F. at Cairo on the 11th, 99° F. at Tripoli on the 14th, and 97° F. at Gibraltar on the 16th. On June 21st a heavy storm or "cloud burst" did much damage in Naples. By the 22nd pressure became low and irregular over Iceland and North-Western Europe, with a good deal of rain and some high temperatures—81° F. at Haparanda on the 24th. Finally on the 27th a depression developed to the westward of Scotland and conditions became almost stormy, with further heavy rain—27 mm. at Stockholm on the 27th, 34 mm. at Geneva on the 29th. The Mediterranean, however, remained fine and hot, with maxima of 106° F. at Cairo on the 22nd, 95°. at Lisbon on the 23rd (on the following night the minimum did not fall below 73° F.) and 90° F. at Perpignan on two occasions. The month closed with violent storms among the Pyrenees, causing damage and loss of life.

Of great interest has been the expedition of Captain Sverdrup in the ice-breaker "Sviatogor" to rescue the Russian steamer "Solovei," which had been caught in the ice outside the White Sea and afterwards carried away into the Kara Sea. Captain Sverdrup's account does not throw

(*Continued on* p. 136)

Rainfall Table for June 1920.

STATION.	COUNTY.	Aver. 1875–1909.	1920.		Per cent. of Av.	Max. in 24 hrs.		No. of Rain Days.
		in.	in.	mm.		in.	Date.	
Camden Square	*London*	2·28	1·59	40	70	·54	20	[illegible]
Tenterden (View Tower)	*Kent*	2·03	1·48	38	73	·62	12, 20	10
Arundel (Patching)	*Sussex*	2·13	2·04	52	96	·91	20	9
Fordingbridge (Oaklands)	*Hampshire*	1·93	2·74	70	142	1·03	12	13
Oxford (Magdalen College)	*Oxfordshire*	2·27	3·38	86	149	1·22	12	11
Wellingborough	*Northampton*	2·14	2·15	55	100	·76	27	12
Hawkedon Rectory	*Suffolk*	2·01	1·37	35	68	·78	20	8
Norwich (Eaton)	*Norfolk*	2·01	2·11	54	105	·62	20	9
Launceston (Polapit Tamar)	*Devon*	2·18	2·20	56	101	·38	15	17
Lyme Regis (Rousdon)	,,	2·18	2·55	65	117	·57	20	11
Ross (Birchlea)	*Herefordshire*	2·43	2·16	55	89	·62	12	17
Church Stretton (Wolstaston)	*Shropshire*	2·59	2·58	66	100	·48	12	15
Boston (Black Sluice)	*Lincoln*	1·95	2·46	62	126	1·06	13	9
Worksop (Hodsock Priory)	*Nottingham*	2·06	1·99	50	97	·79	13	12
Mickleover Manor	*Derbyshire*	2·55	2·07	53	81	·71	14	12
Southport (Hesketh Park)	*Lancashire*	2·26	2·58	65	114	·94	11	13
Wetherby (Ribston Hall)	*York, W. R.*	2·17	1·56	40	72	·66	27	6
Hull (Pearson Park)	,, *E. R.*	2·09	1·28	32	61	·70	20	9
Newcastle (Town Moor)	*North'land*	2·04	·73	18	36	·32	27	7
Borrowdale (Seathwaite)	*Cumberland*	6·94	6·85	174	99	..	..	..
Cardiff (Ely)	*Glamorgan*	2·55	3·22	82	126	·73	27	18
Haverfordwest	*Pembroke*	2·74	2·55	65	93	·62	27	15
Aberystwyth (Gogerddan)	*Cardigan*	2·97	3·01	76	101	·99	27	7
Llandudno	*Carnarvon*	1·97	3·15	80	160	1·06	12	14
Dumfries (Cargen)	*Kirkcudbrt.*	2·84	1·73	44	61	·73	27	14
Marchmont House	*Berwick*	2·38	·72	18	30	·38	27	6
Girvan (Pinmore)	*Ayr*	3·04	2·74	70	90	·72	27	17
Glasgow (Queen's Park)	*Renfrew*	2·41	2·03	52	84	1·10	27	10
Islay (Eallabus)	*Argyll*	2·80	2·40	61	86	·52	17	17
Mull (Quinish)	,,	3·30	1·88	48	57	·64	19	16
Loch Dhu	*Perth*	4·45	3·55	90	80	·80	17	14
Dundee (Eastern Necropolis)	*Forfar*	2·06	1·09	28	53	·36	27	10
Braemar	*Aberdeen*	2·18	·64	16	29	·24	27	6
Aberdeen (Cranford)	,,	2·02	·62	16	31	·23	27	9
Gordon Castle	*Moray*	2·13	1·33	34	62	·43	2	10
Drumnadrochit	*Inverness*	2·26	·56	14	25	·20	28	9
Fort William	,,	3·77	3·28	83	87	·54	20	16
Loch Torridon (Bendamph)	*Ross*	4·07	3·51	89	86	·89	1	11
Stornoway	,,	2·43	1·51	39	62	·30	29	15
Dunrobin Castle	*Sutherland*	2·10	..	..	..	..	..	..
Wick	*Caithness*	1·33	·78	20	43	·37	2	8
Glanmire (Lota Lodge)	*Cork*	2·91	2·71	69	93	1·35	10	12
Killarney (District Asylum)	*Kerry*	2·92	2·08	53	71	·50	10	20
Waterford (Brook Lodge)	*Waterford*	2·79	1·75	44	63	·32	27	15
Nenagh (Castle Lough)	*Tipperary*	2·70	2·08	53	77	·39	16	20
Ennistymon House	*Clare*	3·18	2·68	68	84	·59	10	17
Gorey (Courtown House)	*Wexford*	2·59	1·08	27	42	·23	27	10
Abbey Leix (Blandsfort)	*Queen's Co.*	2·58	1·37	35	53	·30	30	13
Dublin (FitzWilliam Square)	*Dublin*	2·00	1·93	49	96	·51	12	15
Mullingar (Belvedere)	*Westmeath*	2·72	·83	21	31	·40	28	6
Woodlawn	*Galway*	2·98	1·68	43	56	·45	15	17
Crossmolina (Enniscoe)	*Mayo*	3·17	4·73	120	149	1·22	15	17
Collooney (Markree Obsy.)	*Sligo*	3·11	2·36	60	76	·48	12	15
Seaforde	*Down*	2·88	3·35	85	116	·94	27	14
Ballymena (Harryville)	*Antrim*	2·89	2·37	60	82	·78	27	18
Omagh (Edenfel)	*Tyrone*	2·82	2·13	54	76	·70	12	15

Supplementary Rainfall, June 1920.

Div.	STATION.	RAIN. in.	RAIN. mm.
II.	Ramsgate	1·01	26
,,	Sevenoaks, Speldhurst	1·61	41
,,	Hailsham Vicarage	1·22	31
,,	Totland Bay, Aston	2·80	71
,,	Ashley, Old Manor Ho.	2·41	61
,,	Grayshott	1·94	50
,,	Ufton Nervet	2·19	56
III.	Harrow Weald, Hill Ho.	2·04	52
,,	Pitsford, Sedgebrook	2·25	57
,,	Chatteris, The Priory	1·18	30
IV.	Elsenham, Gaunts End	1·24	32
,,	Lexden, Hill House	·81	21
,,	Aylsham, Rippon Hall	1·86	47
,,	Swaffham	2·22	56
V.	Devizes, Highclere	2·66	68
,,	Weymouth	2·16	55
,,	Ashburton, Druid Ho.	2·37	60
,,	Cullompton	2·52	63
,,	Hartland Abbey	2·75	70
,,	St. Austell, Trevarna	2·94	75
,,	North Cadbury Rec.	2·32	59
,,	Cutcombe, Wheddon Cr.	2·94	75
VI.	Clifton, Stoke Bishop	3·43	87
,,	Ledbury, Underdown	2·56	65
,,	Shifnal, Hatton Grange	3·70	94
,,	Ashbourne, Mayfield	4·22	107
,,	Barnt Green, Upwood	1·84	47
,,	Blockley, Upton Wold	2·91	74
VII.	Grantham, Saltersford	1·91	48
,,	Louth, Westgate	1·33	34
,,	Mansfield, West Bank	2·05	52
VIII.	Nantwich, Dorfold Hall	3·65	93
,,	Bolton, Queen's Park	2·80	71
,,	Lancaster, Strathspey	2·22	56
IX.	Wath-upon-Dearne	2·64	67
,,	Bradford, Lister Park	2·21	56
,,	West Witton	·81	21
,,	Scarborough, Scalby	·73	18
,,	Ingleby Greenhow	·58	15
,,	Mickleton	1·90	48
X.	Bellingham	1·24	32
,,	Ilderton, Lilburn	·54	14
,,	Orton	1·65	42
XI.	Llanfrechfa Grange	3·68	94
,,	Treherbert, Tyn-y-waun	5·14	131
,,	Carmarthen Friary	3·13	80
,,	Fishguard	2·09	53
,,	Lampeter, Falcondale	4·30	109
,,	Abergwngy	4·85	123
,,	Crickhowell, Talymaes	3·90	99
,,	Sennybridge	4·72	120
,,	Lake Vyrnwy	3·93	100
,,	Llangynhafal, P. Drâw	3·14	80
,,	Dolgelly, Bryntirion	5·02	128
,,	Lligwy	3·21	82
XII.	Stoneykirk, Ardwell Ho.	3·60	91
,,	Whithorn, Cutroach	2·64	67
,,	Carsphairn, Shiel	2·85	72
XII.	Langholm, Drove Rd.	2·16	55
XIII.	Selkirk, Hangingshaw	1·05	27
,,	North Berwick Res.	·69	18
,,	Edinburgh, Royal Ob.	1·04	26
XIV.	Biggar	·83	21
,,	Leadhills	2·63	67
,,	Maybole, Knockdon	2·62	66
XV.	Rothesay	3·36	85
,,	Ardgour House	4·49	113
,,	Inveraray Castle	2·56	65
,,	Holy Loch, Ardnadam	2·36	60
XVI.	Loch Venachar	2·50	64
,,	Glenquey Reservoir	2·70	69
,,	Loch Rannoch, Dall	1·62	41
,,	Coupar Angus	·87	22
,,	Montrose Asylum	·70	18
XVII.	Balmoral Castle	·47	12
,,	Fyvie Castle	·45	11
,,	Peterhead, Forehill	·48	12
,,	Grantown-on-Spey	·51	13
XVIII.	Cluny Castle	1·25	32
,,	Loch Quoich, Loan	5·60	142
,,	Skye, Dunvegan	4·41	112
,,	Fortrose	·36	9
,,	Ardross Castle	·54	14
,,	Glencarron Lodge	2·34	59
XIX.	Tongue Manse	1·32	34
,,	Melvich Schoolhouse	1·25	32
,,	Loch More, Achfary	2·21	56
XX.	Dunmanway Rectory	3·84	98
,,	Mitchelstown Castle	1·91	48
,,	Gearahameen	3·80	97
,,	Darrynane Abbey	4·37	111
,,	Clonmel, Bruce Villa	2·14	54
,,	Cashel, Ballinamona	1·72	44
,,	Roscrea, Timoney Pk.	1·66	42
,,	Foynes	2·11	54
,,	Broadford, Hurdlesto'n	2·11	54
XXI.	Kilkenny Castle	1·37	35
,,	Rathnew, Clonmannon	1·80	46
,,	Hacketstown Rectory	2·12	54
,,	Ballycumber, Moorock	·69	18
,,	Balbriggan, Ardgillan	2·44	62
,,	Drogheda	1·97	50
,,	Athlone, Twyford	1·44	37
,,	Castle Forbes Gdns.	1·93	49
XXII.	Ballynahinch Castle	3·44	87
,,	Westport House	2·20	56
XXIII.	Enniskillen, Portora	1·62	41
,,	Cootehill, Dartrey	4·42	112
,,	Armagh Observatory	2·38	60
,,	Warrenpoint	2·84	72
,,	Belfast, Cave Hill Rd.	3·45	88
,,	Glenarm Castle	3·34	85
,,	Londonderry, Creggan	1·85	47
,,	Sion Mills	1·94	49
,,	Milford, The Manse	1·76	45
,,	Killybegs, Rockmount	3·37	86

much light on the meteorological conditions, but from the ease with which he passed through the Kara Strait we can infer that the ice was not severe there. Heavy "Polar ice" was however met with east of Kara Strait, and this the "Sviatogor" had to avoid until on the 16th it was driven away by a north-esterly breeze and the course could be set due north in the direction of the "Solovei." The expedition was interrupted by snow and sleet on the 17th and by fog several times on the return journey.

In India the south-west monsoon set in on June 2nd in Malabar and penetrated inland a few days later. It was weak at first in most parts (except Burma, Assam and Central India), but the condition of crops was satisfactory except in Bihar, Western Bengal and the Deccan, where rain was needed. The monsoon appears to have set in vigorously in Africa, for sudden rises of the Nile at Roseires and Mongalla have brought the water to its normal level.

In Canada rain set in early in the month, checking the forest fires which were reported in May as a consequence of the long dry spell and greatly improving the harvest prospects. In the United States conditions remained unusually quiet, except for a crop of thunderstorms in the north-eastern States associated with the passage of a shallow depression from west to east across the continent.

In Australia copious rains have continued to fall, and there is now a prospect of abundant herbage for stock. in the possible wheat belt of New South Wales the rain has enabled an unusually large acreage to be brought into cultivation. At the close of the month snow fell for the first time on record at Albany, in the interior of West Australia (latitude 35° south), probably in the rear of an Antarctic "reversed V" depression.

Geostrophic Wind over London; August, 1881–1915.

FREQUENCY OF STRENGTH AND DIRECTION.

Estimates based on the D.W.R. charts (8*h.*, 1881–1908; 7*h.*, 1909–1915).

Direction.	5 m/s. 11 mi/hr.	10 m/s. 22 mi/hr.	15 m/s. 33 mi/hr.	20 m/s. 44 mi/hr.	Over 20 m/s. Over 44 mi/hr.	Total Frequency of Direction.
N.	16	16	8	—	2	42
NE.	21	22	8	2	—	53
E.	8	19	7	—	1	35
SE.	19	9	1	1	—	30
S.	24	19	10	1	1	55
SW.	45	96	46	15	5	207
W.	35	131	83	17	6	272
NW.	39	74	42	5	3	163
Total Frequency of strength	207	386	205	41	18	857*

* Indeterminate—228.

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Visibility on Cloudy Nights.

By CAPT. WILLIAM H. PICK, B.Sc.

THE visibility at night is at present determined either by making use of distant lights as equivalents to the objects for the determination of visibility during the day, or just by estimation without the aid of any objects at all.

In practice, the first method is found of little avail, as a meteorological station, even in the neighbourhood of towns, is indeed fortunate to find lights of any sort at the various distances required by the visibility scale; and even if the lights be there, exactly positioned, they naturally vary in intensity according to their type. For meteorological stations in rural situations lights do not exist at all. The method of simple estimation is thus left as the sole means of determining night visibility; and its great drawback is that it calls for a large amount of experience on the part of the observer, an experience which is not always available.

The following experimental method of determining night visibility is proposed as an attempt to overcome the difficulties put forward. It is the Grease Spot Photometer of Bunsen calibrated in accordance with the visibility scale at present used at the distributive stations of the Meteorological Office.

The grease spot is made by allowing a drop or two of molten grease to fall from a lighted candle upon the centre of a sheet of ordinary writing paper, and then pressing the

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grease into the paper by the aid of a hot knife blade. The sheet of paper is mounted into a suitable support and the photometer is ready. The only other apparatus required is a candle lantern and a tape measure. The candle carried in the lantern should be for the greatest exactitude a sperm standard one, as used in laboratory photometric determinations; these, however, are expensive, and in ordinary practice a household candle is sufficiently accurate.

The Grease Spot Photometer is set up with its spot at the height of the observer's eye, and the candle lantern at a fixed distance behind the spot and in the same horizontal line as the spot. The observer then walks away from the spot, keeping in the same straight line as the spot and candle, but on the side of the spot remote from the candle. He faces the spot and notices the exact position at which the spot of grease becomes indistinguishable from the paper. The distance between the position of indistinguishability and the spot is then measured. The process of measurement is much facilitated if a permanent marking in feet be laid down on the ground by means of white marks or by a knotted line.

Once such a distance has been obtained for one accurately estimated visibility, the other distances may be calculated from that one. But, clearly, everything depends upon the distance of the candle from the spot. For each such distance of candle from spot a different standard of distance of indistinguishability for the same visibility is obtained, and hence a whole series of tables of other values.

It is recommended that two tables be prepared, one with the candle 10 to 15 feet behind the spot to serve for visibilities of 4 and upward, and the other with the candle 2 to 3 feet behind the spot to serve for the lower visibilities.

To construct the table below the candle was placed 15 feet behind the spot, and it was found that the distance of indistinguishability was 40 feet when an accurate estimate of visibility was 16,000 metres. The other distances of indistinguishability are calculated in accordance with the following:—

Let x be the distance of indistinguishability required for a visibility of 7,000 metres.

Then, as a distance of 40 feet corresponds with a visibility of 16,000 metres, we have

$$\frac{x^2}{40^2} = \frac{7000^2}{16000^2}$$

giving the photometric distance of distinguishability of the grease spot as 17·5 feet for a visibility of 7,000 metres.

Working out similarly for the various distances, the visibility scale comes out as in the following Table :—

Description.	Specification.	Distance of Indistinguishability in Feet.
X	Objects visible at 0 but not at 25 metres	
A	" " 25 " 50 "	
B	" " 50 " 100 "	
C	" " 100 " 200 "	
D	" " 200 " 500 "	<10
E	" " 500 " 1,000 "	
F	" " 1,000 " 2,000 "	
G	" " 2,000 " 4,000 "	
H	" " 4,000 " 7,000 "	10–17·5
I	" " 7,000 " 12,000 "	17·5–30
J	" " 12,000 " 20,000 "	30–50
K	" " 20,000 " 30,000 "	50–75
L	" " 30,000 and above -	>75
Exceptional.	Exceptional visibility.	

This table has been confirmed by the various experiments which have been carried out at night, the distance of indistinguishability found for the estimated visibility falling in each case within the theoretical limits as shown by the table.

Visibility is generally good at Cranwell and there has been no opportunity to calibrate the apparatus for the lower part of the scale with the candle at the nearer distance.

The method is only applicable on moonless and cloudy or overcast nights; but it is just on such nights that the ordinary methods of simple estimation fail.

The cheapness of the apparatus and the fact that it can be made in a few minutes at any station are advantages; and it can be fixed up permanently on two stands by providing the lantern and the photometer with waterproof covers. The distances may be also marked out either as distances or directly as visibilities by using a cord stretched on the ground as a permanent feature and carrying labels at the various intervals.

[The correspondence of the letters X, A, B, &c., with Code V for Surface Visibility and Fog of the "Convention relating to International Air Navigation," 1919 (Cmd. 266), is as follows :—

X A B C D   E F   G H   I J   K   L
8f 7f 6f 5f 4f   1v 2v   3v 4v   5v 6v   7v   8v.—Ed. M.M.]
(X–D) 0v   (E–F) 3f   (G–H) 2f   (I–J) 1f

OFFICIAL NOTICES.

Issue of Meteorological Reports by Wireless Telegraphy.

FROM June 1st, 1920, general inferences based upon the 7 h. and 18 h. charts have been issued from the Air Ministry Wireless Station in plain language at 9 h. 15 m. and 20 h. G.M.T. on a wave length of 1,400 metres (C.W.). The synoptic report in code which was previously issued at 9 h. 15 m. is now being issued at 8 h. 45 m. G.M.T.; the synoptic reports issued at 3 h. 15 m. and 20 h. 15 m. G.M.T. continue as before.

The issue of synoptic reports from Aberdeen Wireless Station is made at 2 h. 30 m. and 14 h. 30 m. G.M.T. on a wave length of 3,300 (C.W.).

From August 2nd, 1920, the code for the Collective Weather Reports for London and England, S.E., has been slightly modified. Particulars will be found in the revised copy of the M.O. Form 2622.

Official Publications.

Geophysical Memoirs No. 16. Aids to Forecasting Types of Pressure Distribution, with Notes and Tables for the fourteen years 1905–1918. By Lt.-Col. E. Gold, M.A., F.R.S., D.S.O. Price 2*s*. 6*d*.—The objects of this memoir are indicated in the following extract from the Preface:—

"At the present stage of the science and practice of forecasting, the forecaster who is confronted with a meteorological situation which is at all doubtful feels the need for reference to some previous situations of a similar character, so that he may see what developments occurred. . . . . . Experience is very largely conscious, or sub-conscious, memory of types or of decisive factors in the charts; and to a certain degree the value of experience increases with its length; but it is not possible for every forecaster to have had long experience, and, even if it were, the human mind is limited and retains by no means all the impressions which the daily charts produce upon it.

"Some classification, therefore, of the charts for preceding years is practically essential, both for the forecaster who is learning his job and for the experienced forecaster who wishes to make progress in accuracy and in length of time to which his forecasts can extend."

The classification adopted is based on fifteen types of pressure distribution with a number of sub-types, and the morning chart for each day in the period 1905–1918 has been allotted to its appropriate class. A second table shows all occasions on which each type occurred in the several months.

As an example of the use of the tables it may be noted that Type IXA, an anticyclone beyond the Hebrides and a "low" over Flanders occurred in August on nine occasions. It persisted for the first three days of August 1917, at the beginning of the battle of Ypres, when there was heavy rain in the area north of Arras. On this occasion, as in somewhat similar circumstances in 1911, the following type was No. XIII with areas of low pressure forming over the British Isles. On two other occasions the depression moved northwards, whereas on three others the depression filled up. Discrimination between the causes of these movements is not attempted in the Memoir, but it will be seen that the problem to be solved by the forecaster is more clearly defined than hitherto, and that must be regarded as a considerable step forward in such an empirical science.

Professional Notes No. 8. Temperatures and Humidities in the Upper Air conditions favourable for thunderstorm development, and Temperatures over Land and Sea. By Capt. C. K. M. Douglas. Price 2s. net.—The observations recorded in this note were made by pilots of "Meteor Flight" stationed at Berck in N.E. France during the last year of the War. The work of these pilots, and especially of Captain Douglas, is already well known through the beautiful series of photographs of clouds which has been published.

The first part of the note is devoted to a discussion of the conditions favourable to the development of thunderstorms. The thunderstorms of 1918 are grouped in three classes :—

(*a*) Those due mainly to heated surface air in fine sunny weather.

(*b*) Those associated with powerful upper currents from S.W., the surface wind being light and variable or south-easterly.

(*c*) Those associated with low temperature aloft on the south of cyclonic depressions.

The storms of classes (*b*) and (*c*) may occur by night, whereas those of class (*a*) are likely to be in the afternoon. The principal distinction between classes (*b*) and (*c*) is that in the latter case the westerly current prevails at the surface as well as above. Full details of the distribution of temperature and humidity before and after storms of all three classes are set out in the note.

It is of some interest, however, to note that the principal storms which occurred in this country in May and June of the present year were associated with currents from S.E., and do not appear to fall in any of Captain Douglas's classes.

The concluding pages of the note are devoted to temperatures over land and sea, and provide useful material for the discussion of land and sea breezes.

Correspondence.

To the *Editors*, "*Meteorological Magazine.*"

Black Rain in Devonshire.

On June 16th 0·03 in. of rain fell here which was perfectly black, though we are some hundreds of miles from the nearest manufacturing town. On the 17th there occurred a great darkness at about 18 h. 30 m. G.M.T. and at 18 h. 55 m. very heavy rain commenced to fall. On measuring at 20 h. 25 m. I found 1·23 ins. in the gauge, and at 9 h. next day the rainfall totalled up to 1·70 ins.

The points to observe are (1) the fall was quite local, the totals on that day being 0·96 in. at Manaton (only 4 miles away) and only 0·02 in. at Ipplepen (Newton Abbot) about 12 miles distant, (2) during the first 60 minutes rain must have fallen at the rate of one inch per hour. For more than half-an-hour the water descended like a solid wall, paths having ruts scored in them and plants being damaged, (3) notwithstanding the volume of water, it was still black and dirty, like the insignificant quantity of the day before, (4) the wind, which had been E. or S.E. for the previous week, became N.W. during the storm, (5) no lightning or thunder was observed.

D. W. Horner, F.R.Met. Soc.

Moretonhampstead, Devon, July 6th, 1920.

A Local Katabatic Current.

During weather experienced in the northern sector of anticyclones during the spring and summer months I have repeatedly noticed a tendency of the wind at nightfall in this district to cease to blow from a westerly point and to become a light air from south-east. This continues throughout the night and may attain a force of about 5 miles per hour. About 7 h. G.M.T. on the morning following the wind begins to veer and by 8 h. it is usually back at about south-west, at the same time freshening to about its normal diurnal velocity of force 4.

Is it possible that this south-easterly current is a katabatic flow from off the tableland of the Peak District, distant about 20 miles away in an E.S.E. direction?

It would be interesting to learn if any observers to the west of this district experience similar phenomena.

FRANK EDWARDS.

95, Clarendon Road, Whalley Range, Manchester, 13th July 1920.

Apparent Cirrus below Stratus.

THIS effect is often present as a mere optical illusion. I had an excellent example of it when reading the instruments here on July 19th at 9 h. G.M.T. The sky was partly covered with drifting masses of cloud, which it was difficult to classify, as they seemed low for cumulus and high for stratus. Some of these were large and dense, approaching cumulus in appearance, others thin, fleecy and transparent. They were drifting rapidly from S.W. to N.E. In the clear intervals could be seen numerous bright wisps and threads of true cirrus, which *appeared* to be moving in the opposite direction. Alignment with the points of the lightning-rod on the Observatory dome, however, showed that they had no motion perceptible in several minutes watching. Now, when masses of the thin drifting lower cloud passed over these, the illusion that the cirrus threads were much below the stratus was so persistent that it was very difficult to dispel. It was only by patient watching for a considerable time that I was able to satisfy myself that it was only an illusion. This was, of course, a totally different class of phenomenon from that mentioned by Mr. J. S. Dines. WM. F. A. ELLISON.

Armagh Observatory.

I WONDER if the "Cirrus below Stratus" described by Mr. J. S. Dines in the July *Meteorological Magazine* is similar to a cloud I observed on May 11th of this year. A curious cirrus-like cloud formed below patches of alto-stratus which were rapidly filling the sky. Wavy gossamer sheets were interspersed with feathery wisps of a beautiful delicacy. In the evening the sun shone through the alto-stratus from the western horizon, lighting the cirrus with golden tints, plainly showing that it was far below the upper cloud sheet which now practically covered the sky. Some parts were exactly like cirrus uncinus, large tufts appearing with flowing tails, others were rippled like cirro-cumulus. The cloud was moving from SW. over an easterly surface current; I am inclined to believe it was formed by mixing of the two currents, being just what one would expect under these conditions. I saw this cloud again on May 16th, but not since. On the latter occasion also a SW. current was crossing an easterly one. R. FRANCIS GRANGER.

Lenton Fields, Nottingham, 5th August, 1920.

The Moon and the Wind.

I AM too far off for controversy, but I shall be glad if you will allow me to make a few comments upon your notice of a short paper of mine dealing with a possible lunar influence upon the velocity of the wind at Kimberley.

First of all, I did not show more enthusiasm for my "discovery" for the simple reason that the particular point I set out to find, *i.e.*, a tiny semi-diurnal oscillation of wind velocity due to the moon, eluded me. I did find a large fourth harmonic term in the sine series, which may be of some importance, and I should have been glad of your comments upon it, since it may mean a sliding away of the air (if the matter may be put that way) down the gradients of pressure set up by the lunar atmospheric tide.

Next, your criticism that no allowance has been made for the influence of the sun on the wind, in separating moon south from moon north, will not stand in the form in which you state it. It is quite wrong that the diurnal variation of wind at Kimberley is greater in summer than it is in winter. On the contrary the range in summer (December and January) and the range in winter (June and July), deduced from 20 years of observation, are exactly the same, namely, 3·8 mi/hr. The hourly means are set out below.

WIND SPEED AT KIMBERLEY IN MILES PER HOUR, 1900–1910.

Hours ending—	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
Mid-Summer -	5·0	4·9	4·7	4·4	4·2	4·2	5·5	6·8	7·3	7·3	7·4	7·4
Mid-Winter -	3·2	3·0	2·8	2·8	2·7	2·6	2·5	2·6	3·5	4·9	5·7	6·2
Hours ending—	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*24*
Mid-Summer -	7·5	7·7	7·8	8·0	7·9	7·5	6·5	5·4	5·2	5·2	5·1	5·1
Mid-Winter -	6·3	6·2	5·9	5·3	3·8	2·6	3·1	3·5	3·6	3·5	3·3	3·3

Apart from that, the actual range from highest hourly mean to lowest does not come into the argument. What is involved is the matter of the differences in velocity about twelve hours apart, *e.g.*, say the velocity at noon to 13 h. minus the velocity at midnight to 1 h. If these differences be used it looks as if your argument could be used to emphasise rather than to contradict my result. Put it this way:—

1. Moon south and close to the sun in summer:
Wind speed at lunar noon $= V$.
" " midnight $= V'$
2. Moon south and opposite the sun in winter:—
Wind-speed at lunar noon $= v$
" " " midnight $= v'$

Then if your argument were true—

$$V - V' > v' - v$$
$$\text{or } V + v' > V' + v',$$

and the resulting curve would show a maximum wind-speed at lunar noon. But if $V - V' \not> v' - v$?! and it is not.

My own impression is that a discussion of the velocities for perigee and apogee should give the best result. I said in my paper that I hoped to attack this later on. I am undertaking it, not by using speeds, which are unsuitable in this case, but by means of departures from the monthly means, thus eliminating the effect of the solar diurnal oscillation altogether. But life is short.

J. R. SUTTON.

Kimberley, South Africa, 18th May 1920.

[It must be admitted that Dr. Sutton's figures, which show for Kimberley remarkable persistence of the wind during summer nights, dispose of the simple explanation of the apparent lunar tide put forward in this magazine. The complete elimination of the solar effects is evidently desirable, but not to be undertaken lightly. If the further investigation which is promised confirms the existence of the lunar tide with a 24-hour period the result will be of great interest. The diurnal tide should theoretically vary as the sine of twice the moon's declination, changing sign as the moon crosses the equator and so far agreeing with Dr. Sutton, but the magnitude of the effects which he computes far exceeds what would be anticipated on theoretical grounds. It is therefore to be hoped that similar studies will be undertaken for other stations in the tropics.—F. J. W. W.]

Line Squall of July 4th.

THE following description of a line squall which passed over this district on Sunday last may be of interest to your readers.

About 13 h. 38 m. G.M.T. my attention was attracted by an intense darkness in the room in which I was sitting. I looked out of the window to ascertain the cause of it, and saw an inky black cloud approaching rather rapidly from the north-west. The weather at the time was overcast and calm. Suddenly a violent gale sprang up which was quickly followed by a heavy shower of rain. The wind blew with such fury for a few minutes that trees were bent double and windows were rattled in their frames. During the height of the squall a tremendous clap of thunder occurred, which continued rumbling for some seconds, and then all was calm again. The thunder returned at 13 h. 55 m. G.M.T. even louder than before, also from the north-west, and heavy showers fell frequently during the afternoon and evening.

At Iford, some 4 miles E.N.E. of here, the squall was accompanied by torrential rain and hail, so violent that the driver of the Lymington-Bournemouth motor-bus was compelled to pull up as he was not able to see. The squall extended to Lymington, 17 miles E.N.E. of Bournemouth, but seemed to have spent most of its force by then, and was characterised chiefly by thunder and wind. I have not been able to trace it further than this, and it would be interesting to know if it was recorded by any observers in the Isle of Wight.

S. HYLA GREVES.

Rodney House, Bournemouth, July 9th, 1920.

Reversal of Wind Aloft.

I had a good opportunity of observing the thunderstorm on June 12th from Little Gaddesden, near Berkhampstead, Herts, and noted some unusual features which are perhaps worth recording. At about 9 h. a thunderstorm developed to south-west and moved away in a W.N.W. direction. Shortly afterwards the surface wind changed from east to west, and, except for occasional calms, it remained westerly or north-westerly for about seven hours up to the top of the Chilterns at 800 feet. All the time the lower clouds, which were certainly not more than 3,000 feet above sea level, were moving from E.S.E. All the clouds up to the cirrus were moving from a south-easterly direction, and this is confirmed up to 16,000 feet by a pilot balloon ascent at Shoeburyness at 11 h. The cirrus continued to move from south-east for three days afterwards.

There was much large cumulus and some cumulo-nimbus all morning, and a shower at 11 h. During the afternoon there was distant thunder to south from thunderstorms moving in a W.N.W. direction. There was a good deal of false cirrus up to the cirrus level, and some dense mammato-cumulus above 10,000 feet. A large mass of cumulo-nimbus up to the cirrus level was visible on the E.S.E. horizon at about 14 h. 30 m., joined in a continuous chain to the thunderstorms to the south. The storm to E.S.E. approached rather rapidly, and arrived overhead two hours later. Low clouds developed at various levels in front of it, showing remarkable wave structure. The rain was exceptionally heavy for the first few minutes, and was mixed with half melted hail. The heaviest rain was accompanied by a cold squall from the south, and was preceded by a very dark cloud in a band from E.N.E. to W.S.W. The storm was violent for half an hour, and it was followed by a series of other storms of less intensity until 20 h., all moving from about E.S.E. at a velocity estimated at thirty miles per hour. After the storm the surface wind was light and easterly.

The most unusual feature connected with the storm was the westerly surface wind with the E.S.E. current above it. The synoptic chart at the Meteorological Office for 13 h. on that day shows a west wind at Kew, Benson and South Farnborough, and an east wind on the east and south-east coasts, resulting in marked convergence. Simultaneously with the approach of a secondary depression from France a narrow belt of low pressure appeared to develop across England with converging surface winds. By evening the two disturbances had merged into one. Normally when secondaries move up from the south and cause thunderstorms the surface wind becomes east or north-east in front of it, and the thunderclouds up above move from a more southerly point.

C. K. M. DOUGLAS.

Deep Isothermal Layers in the Atmosphere.

The frequency of occurrence of truly isothermal layers of considerable thickness in the atmosphere is very low. It is, however, more common to find a thick layer which is very nearly isothermal owing to a slight temperature inversion inside the layer. The upper air temperature records for June 9th 1920 made in an aeroplane at South Farnborough, and supplied by Mr. R. A. Watson Watt, may be quoted here as an illustration :—

Height in Thousand Feet.	Gd.	1	2	3	4	5	6	7	8	9	10	11
	Temperature in Degrees absolute above 200*a*.											
June 9th, 1920. 5h. 0m.	79·0	79·5	77·5	78·5	79·0	78·5	79·5	78·0	76·0	75·0	–	–
6h. 15m.	81·0	79·0	78·5	78·5	79·0	79·0	79·0	78·5	76·0	75·0	74·0	72·0

Mr. Watt remarks that the records "are of interest on account of the surprisingly uniform temperature up to 7,000 feet." It will be noted that, owing to the slight inversion at 4,000 feet level, the whole layer between 2,000 feet and 7,000 feet is practically isothermal at 279*a*.

All the available upper air temperature graphs for Martlesham Heath and South Farnborough have been examined with a view to extracting cases similar to that quoted by Mr. Watt. Defining the "base" as the level at which the temperature lapse ceases, cases were selected in which the height of the inversion measured from the base up to the level where the base temperature was repeated was not less than 2,500 feet. Details are given in the following table.

Date.	Time, G.M.T. h.	m.	Base of Layer. Ft.	Top of Layer. Ft.	Thickness of Layer. Ft.	"Base" Temperature. a.	Range of Inversion. a.
			MARTLESHAM HEATH.				
1917—Jan. 7	9	48	8,000	11,200	3,200	258·0	1·0
Jan. 25	15	0	0	4,200	4,200	281·0	0·5
Feb. 27	16	0	5,600	9,800	4,200	268·0	1·5
May 25	6	0	0	4,000	4,000	284·5	0·5
Sept. 15	10	40	4,400	9,800	5,400	279·0	1·5
Dec. 19	9	35	800	6,400	5,600	274·5	0·25
1918—Feb. 15	12	0	800	6,000	5.200	273·5	1·5
Feb. 17	9	30	2,300	6,200	3,900	271·0	1·0
Feb. 25	16	0	8,800	12,000	3,200	262·5	0·5
Nov. 15	10	0	4,400	8,200	3,800	274·0	0·25
Nov. 22	10	15	2,200	7,400	5,200	278·5	1·5
Dec. 12	14	50	3,400	6,000	2,600	281·5	1·0
			SOUTH FARNBOROUGH.				
1918—Feb. 11	11	0	2,800	5,400	2,600	280·5	1·0
Feb. 16	9	50	0	6,100	6,100	274·5	1·0
1919—June 17	4	50	3,200	6,000	2,800	283·5	1·5
1920—June 9	5	0	2,500	7,000	4,500	278·5	1·0
June 9	6	15	2,000	7,000	5,000	278·5	0·5

The range of inversion is the maximum excess above the base temperature.

An examination of the Daily Weather Report shows that on all the dates mentioned in the table anticyclonic conditions prevailed.

S. N. SEN.

30 *July* 1920.

A Mock Sun and Rainbow Colours after Sunset.

On July 11th, shortly after sunset (20 h. 13 m. to 20 h. 35 m. G.M.T.), a remarkable colouration of the sky occurred. The clouds at the time, which covered about nine-tenths of the sky, were all Fr. St. Cu., and they did not change materially for two hours. Just as the green light—the greenish sky often seen at sunset, but more brilliant—was disappearing, an image of the sun, yellow surrounded by red, appeared on the clouds in the eastern horizon. The cliffs of France then drew attention by changing from white to pink and to a brilliant luminous carmine. The sun image faded and the colouration of the clouds became a brilliant pink, and about 50° above the horizon, in the same azimuth as the image which had gone, there appeared a portion of an arc of rainbow colours. The surrounding clouds were of different shades of purple and paynes-grey, and there was a large V-shaped cloud a pure white in the north-east. On the south horizon a replica of the irisation occurred, including the rainbow colouring. The cliffs of France changed to a thin purple line and the irisation gradually faded, and nearer the zenith a light brown colouring of the clouds took place. The phenomena lasted 20 minutes.

The weather following was overcast to continuous thunder, with lightning and rain. The rain reading on Monday 12th was 0·45 inches. A. E. Nichols, Borough Engineer.

Folkestone.

[The observations of Mr. Nichols are of great interest, as the phenomena seem to differ from any described in the treatises on Meteorological Optics.—Ed. M.M.]

NOTES AND QUERIES.

Daily Weather Report, British Section.

Arrangements having been made with various steamship companies on cross-channel and coastal services, reports of sea and air temperature and of the weather in home waters are now being received at the Meteorological Office each morning. Since July 1st such observations have been published in the Daily Weather Report.

Another feature introduced in the Report for August 1st is a small map showing barometric tendency. For many years telegraphic stations provided with barographs have reported the change in pressure during the three hours preceding the hour of observation, and the familiar remarks such as "barometer falling slowly" are based on this information. Maps of isallobars have been used with success in forecasting by Continental Meteorologists; an account of pioneer work in this direction is given in *Forecasting Weather*, chapter XV. The new D.W.R. map gives the barometric change from 4 h. to 7 h. as a multiple of the half-millibar, that unit having been found convenient for reading the barograms and adopted for telegraphic reporting. The isallobars of positive tendency (rising barometer) are drawn slightly thicker than those of negative tendency (falling barometer).

Weather at Health Resorts.

At the suggestion of the Press Association arrangements have been made for the issue by the Meteorological Office of accounts of the morning weather at certain health resorts in time for inclusion in the evening newspapers. About 20 health resorts have been invited to contribute reports for this purpose, and it is anticipated that it will be necessary to confine the list to that number.

Geostrophic Wind Scale.

In order to meet the requirements of the Daily Weather Report in its new form with isobars at intervals of 2 or 4 millibars, scales for measuring the geostrophic wind speed in miles per hour have been constructed. The scales are printed by a photographic process on transparent celluloid, and directions as to the necessary corrections to be applied to the readings are also shown on the celluloid.

The scales are on sale, price 2s. 6*d*. each, postage extra. Applications should be made to the Meteorological Office, South Kensington.

The New Form of the Norwegian Daily Weather Report.

The Norwegian weather report for the 1st July is issued in a form different to that previously adopted. The chart, which is issued without tables, is drawn on a mean scale of $1 : 10^7$, and the actual scale, which varies from $0{\cdot}97 : 10^7$ in Lat. 45° to $1{\cdot}08 : 10^7$ in Lat. 70°, is shown for every 5° in the margin.

Isobars are drawn for every 5 millimetres (which is surprising in the country of one of the strongest advocates of the millibar, Professor V. Bjerknes).

The weather is shown by slight modifications of the conventional symbols, and the area in which precipitation is occurring at the time of the report is shaded.

The leading new feature, however, is the inclusion in the chart of a line indicating the "polar front," along which are placed arrows to indicate the direction in which the polar front is moving. The polar front indicates the line separating the polar air from the warmer air of the temperate zone, and it was recently the subject of an interesting article by Professor Bjerknes, who regards the polar front as fundamental in the solution of the meteorological problems of these latitudes. For July 1st the polar front is shown as extending from the south of Ireland to the Alps and passing up the western side of the Baltic. Across the British Isles it is the southern boundary of a rainbelt where the air on the east of a depression is presumably rising over the polar air. The evidence for the other parts of the line is not so obvious.

A Conference at Bergen.

To STUDY the new methods of forecasting which are exemplified by the Norwegian D.W.R., and which has been developed by the Meteorological Staff of the Geographical Institute, a delegation of the Meteorological Office, headed by Sir Napier Shaw, left London on July 17th and visited Bergen on the invitation of Prof. Bjerknes. Some account of the visit will be printed in the September *Magazine.*

Aurora in Low Latitudes.

THE aurora of March 22nd–23rd, 1920, which was observed in all parts of the British Isles, was remarkable as being visible as far south as Switzerland. The Reverend M. Dechevrens, observer at St. Louis Observatory, Jersey, calls attention to the rarity of aurora at that station, and mentions that the last previous occasion was August 22–23, 1916. On March 22nd, 1920, the aurora was first observed at St. Louis at 19 h. 40 m., the N.E. sky being a brilliant red; further north there was seen a vividly white segment, the axis of which coincided sensibly with the vertical of the Polar Star. At 20 h. 5 m. a primary beam of vivid light sprang from the horizon, rising to within 2° of the Pole Star and then dividing into several other less brilliant beams. At 20 h. 30 m. the phenomenon was reduced to the white segment, the maximum height of which was estimated at 15°. Observations were not continued after 21 h., but subsequent examination of the earth current record indicated that the maximum perturbation of the magnetic storm was from 23 h. on the 22nd to 5 h. on the 23rd.

According to a note by J. Maurer, Met. Zeitschrift, May 1920, the last previous appearance of aurora in Switzerland was on Sept. 9th, 1898. Appearances of aurora have been remarkably scanty since 1875, as compared with an almost unbroken series of observations in the previous 45 years. A similar alternation occurred in the years 1630 to 1700.

The Dimensions of a Waterspout.

PARTICULARS have been received from Mr. V. H. Rozier of a fine waterspout observed by him on December 28th, 1919, while on board the s.s. "War Hermit" on her voyage from Singapore to Suez. The ship's position at the time was south of Cape Comorin, in lat. 6° 46′ N., long. 77° 23′ E. A gentle breeze was blowing from the north and the sea was smooth to rippled. Cirro-cumuli and fracto-cumuli occupied the greater part of the sky. At the north-west point there was a cumulo-nimbus of a russet-grey colour, and at 14 h. 7 m. local time the waterspout formed between this cloud and the sea, at a distance from the ship estimated by means of a rangefinder to be 8,500 yards. The waterspout was of a neutral dove-grey colour, but the middle of the column was transparent, and the sides, which were sharply defined, of a slate-grey hue. After persisting for 13 minutes it broke up and appeared to retire upwards into the cloud. The estimated distance at this time was 7,500 yards.

The following approximate measurements have been derived from observations made with a sextant. At the beginning of the phenomenon the distance between the base of the cloud and the surface of the sea was 4,600 ft., the width of the column tapering from 500 ft. at its junction with the cloud to 150 ft. at the sea. Spray was thrown up to a height of more than 300 ft. over a region 250 ft. in diameter.

The vortex appeared to consist of a hollow tube with uniformly tapering sides and a central column. Each wall, the width of which was about one-sixth of the diameter of the waterspout, was sharply defined, and thought to consist of water moving downwards, being clearly differentiated from the major portion of the column, which consisted of a central (ascending) column of a width about half the total diameter, with an intermediate region of whirls and eddies on either side between it and the wall.

When the waterspout was breaking up the central column as a whole lifted and retired into the cloud; the walls dissipated into spray, part of which fell outward into the sea, the remainder entering the ascending column and being carried upwards. The width of the column as it retreated into the cloud was estimated to be 400 feet.

The weather was fine and the sea smooth to rippled throughout the day. The corrected barometer reading at the time of the occurrence was 29·79 in., and the temperature 82·5° F.

Reviews.

Tropical Control of Australian Rainfall. Commonwealth of Australia, Bulletin No. 15. By E. T. Quayle. Size 12 × 10, pp. 24, and 12 pages of diagrams and maps.

The possibility of forecasting rain upon which so much of meteorological research turns, whilst of importance in the British Isles, becomes a vital problem in the large tropical and sub-tropical land areas, the fertility of which is entirely dependent upon a variable rainy season. Among these the Australian continent is a typical example, and Mr. Quayle's suggestive monograph has therefore an economic value outweighing its abstract scientific interest.

The departure from normal of minimum temperature at various stations and groups of stations in the north of Australia is graphed for the period 1911 to 1916, and it is found that for spells of considerable length the departure is of one sign; there is a high correlation between the values at eastern and western stations in these latitudes, the changes showing some tendency to propagation from east to west. The rainfall of the south of Australia is associated with the passage of depressions, but it is found that it is also related to these departures from normal of the minimum temperature in the north of the continent. Spells of high temperature in the north are favourable for rainfall in the south, whilst cold spells are unfavourable. If this were merely a case of correlation between contemporaneous phenomena it would be of considerable interest, but the advantage from the forecaster's point of view lies in the fact that the warm spells can be identified as soon as they are established. For example, if the minimum temperature at Darwin averages 2·5° F. above normal for two consecutive nights, it is found that the odds are three to one in favour of the run of warm nights lasting at least three weeks. During such a run the rainfall to be anticipated in Northern Victoria, nearly 2,000 miles from Darwin, is about ·06 in. per day, whereas under the opposite condition it is only ·03 in. per day. The relations in question are only established for the winter months, the summer rainfall being governed by other circumstances. A detailed study of the progress of the weather during the winters of the years 1911 to 1916 is made the basis of a set of practical rules for forecasting, too technical for quotation here, and these are now being tested in the everyday work of the Commonwealth Weather Bureau.

Weather in the British Isles: July 1920.

WITH the exception of a brief interval between the 18th and 21st, during which atmospheric conditions were under the influence of an anticyclone which spread in from the Atlantic, the weather of July was dominated by a series of depressions, several of which passed directly across these Islands. As a result the month was wet, cool and cloudy, with a marked deficiency of sunshine.

For a few days about the middle of the month, the day temperature was about equal to the normal, but during the first fortnight and the last week it was decidedly below.

The night temperatures were not particularly low, the persistent cloudiness retarding radiation and making the range less than would have been the case under ordinary fine weather conditions.

At Southport (Lancs) the day temperatures were uniformly cold, and never rose higher than 66° F., while at Totland Bay (I. of W.) the July maximum was the coldest during 34 years, and at Redruth (Cornwall) it was the lowest for at least 20 years.

The warmest days of the month were at the beginning, round about the 20th, and at the end. Although at many stations the thermometer never reached 70°, readings of 77° were recorded in London and Copdock (Ipswich) on the 17th, and at Hull on the 20th. The weather of the 5th, a wet day, with wind from the north in the rear of a depression of moderate depth, was remarkable, there being hardly any variation of temperature for 24 hours in some parts of the country. In many parts of England the maximum temperature for this day was below 55°. At Over Court, Almondsbury, it was as low as 50°, and at Whitby (Yorks) and Princetown (Devon) it was 52°. On this day the temperature at Kew Observatory at midday was 50°, which is more than 4° lower than the normal night reading for July.

Rather low minima occurred in Scotland in the same cold current, the temperatures at Balmoral going down to the freezing point on the 4th and 7th, but very generally the coldest night was towards the end of the month, when the temperature at many places was below 40°, *e.g.*, 37° at Sheepstor (Devon) on the 25th and at Garforth (Yorks) on the 31st, and 36° at Cambridge on the 25th.

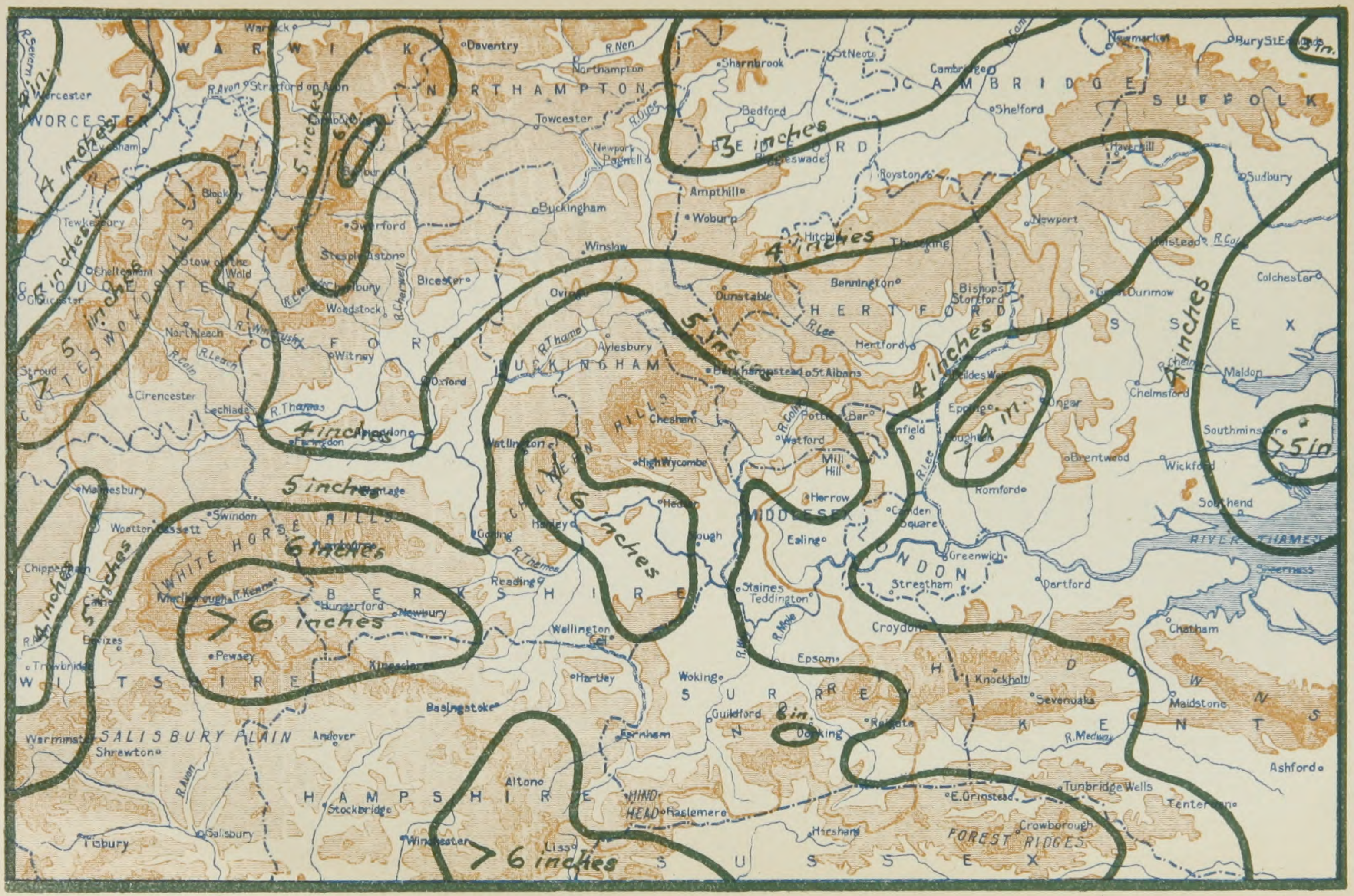
Thunderstorms were experienced in most districts at the beginning of the month, locally in Scotland on the 9th, on the Essex and Kentish coasts during the early morning of the 11th, and at Falmouth on the 14th. On the 18th thunderstorms were reported along the East Coast from Yarmouth to Edinburgh, but the rainfall was nowhere very heavy.

Scotland North, alone of all the districts, received an amount of sunshine in excess of the normal. In all other cases the monthly amount was deficient.

During the week ended the 10th, this was very marked, the percentage of the possible being only 14 in the Midland Counties, 17 in England North-East, and 18 in England North-West and South-East. At several stations in the Midland and Southern counties there was less than 2·0 hrs. per day, which represented only about 11 per cent. of the normal.

At some stations there were a good many days on which no sunshine was recorded at all; the greatest numbers of such sunless days were 5 at Birr Castle (King's Co.), 6 at Bidston (Cheshire), and 8 at Cahirciveen (Kerry). Among the largest daily amounts, which occurred mostly around the 19th and 24th, were 14·0 hrs. at Cullompton (Devon) on the 24th 14·3 hrs. at Salcombe (Devon) on the 19th and 24th, and 14·6 hrs. at Copdock (Ipswich) on the 19th.

THAMES VALLEY RAINFALL, JULY 1920.



ALTITUDE SCALE: Below 250 feet | 250 to 500 feet | 500 to 1000 feet | Above 1000 feet

SCALE OF MILES 0 5 10 15 20

Meteorological Magazine.

Watershed of River Thames above Teddington and River Lea above Feildes Weir.

Isohyetals

H.M. Stationery Office Press, Kingsway, W.C.2.

Ps.3540/138. 105/P13. 1250. 9/20.

At Totland Bay the sunshine total (150 hrs.) was the smallest on record for July. At Southport the worst previous July was that of 1912 with 147 hrs., when the effects of the volcanic dust from the eruption of Katmai, in Alaska, were being observed, but the total for July 1920 is only 127 hrs.

The rainfall of the month was almost everywhere in excess of the average and exceeded double the average in parts of the southern counties, Lincolnshire, and over a considerable portion of Wales. In the north of Scotland the fall was deficient, and less than 2 ins. fell over Caithness. More than 5 ins. fell over large areas in the west and south of Scotland, over practically all the northern counties of England, the whole of Wales, and considerable areas in the Thames Valley (*see* accompanying map). Areas on Dartmoor and Exmoor had from 8 to 10 ins., and more than 12 ins. fell over Central Wales, the English Lakes, and the wettest parts of the Western Highlands. In Ireland, only a strip of the northern coast had less than 3 ins., whilst Snowdon had no less than 25 ins. More than 5 ins. fell over the greater part of Munster and Leinster, and 9 ins. were reached in the mountains of Connemara. The general rainfall expresssed as a percentage of the average was: England and Wales, 161; Scotland, 104; Ireland, 153; British Isles, 143.

In London (Camden Square) it was a dull, cool and showery month. The mean temperature was 60·9°, or 2·9° below the average. The duration of rain was 74·4 hrs., the highest for July in the past 40 years; the only other July with so much as 60 hrs. duration of rainfall was 1917, with 63·8 hrs. Evaporation, 2·09 ins.

Weather Abroad: July 1920.

DURING the first part of the month anticyclonic conditions existed in the Baltic region and over the Azores, France, and Spain, while a series of depressions passed from the Atlantic in a north-easterly direction near the British Isles. The Netherlands, Denmark, and parts of France were affected by these depressions and their secondaries, and early in the month there were thunderstorms in France and the Netherlands, and heavy rain in Switzerland.

Shallow depressions formed occasionally in the Mediterranean region, but caused no intense cyclonic conditions. When the Azores anti-cyclone was dominant in S.W. Europe there was fine weather, accompanied by high day temperatures. On the 7th the temperature at Clermont reached 95° F.

After the 11th, pressure conditions altered in the North. The area between Greenland and Norway, originally under low pressure, now became covered by an anticyclone which had moved westward from Scandinavia, where pressure now became low. A secondary depression caused a thunderstorm in Paris on the 12th, but after this, the Azores anticyclone spread over France and Italy, while anticyclonic conditions prevailed in Germany and West Russia. In the South of France temperature rose to nearly 90° F. at this period.

The depressions in the neighbourhood of the British Isles continued to cause unsettled conditions in N.W. Europe, but later on they took a more northerly course and ceased to affect the mainland of Europe (with the exception of Scandinavia), leaving the Azores anticyclone again dominant in Southern Europe.

On the 22nd the anticyclone near Greenland moved further west, and the depressions from the Atlantic began to follow more southerly courses. Rainy, unsettled conditions again set in over France and Germany, and gales were frequent in the Baltic region. On the 22nd there were thunderstorms in Sweden and 42 mm. of rain fell at Haparanda.

Rainfall Table for July 1920.

STATION.	COUNTY.	Aver. 1875—1909. in.	1920. in.	1920. mm.	Per cent. of Av.	Max. in 24 hrs. in.	Max. in 24 hrs. Date.	No. of Rain Days.
Camden Square	*London*	2·57	4·06	103	158	·89	21	16
Tenterden (View Tower)	*Kent*	2·21	3·50	89	158	·62	23	19
Arundel (Patching)	*Sussex*	2·46	5·89	150	240	1·19	4	15
Fordingbridge (Oaklands)	*Hampshire*	2·14	5·50	140	257	·74	5	25
Oxford (Magdalen College)	*Oxfordshire*	2·43	4·23	107	174	·70	5	21
Wellingborough	*Northampton*	2·54	3·01	76	118	·48	26	24
Hawkedon Rectory	*Suffolk*	2·51	3·61	92	144	·53	3	19
Norwich (Eaton)	*Norfolk*	2·93	3·16	80	108	·52	21	20
Launceston (Polapit Tamar)	*Devon*	2·74	5·02	128	183	1·05	25	26
Lyme Regis (Rousdon)	„	2·68	5·02	128	187	·69	25	24
Ross (Birchlea)	*Herefordshire*	2·75	4·11	104	149	·93	3	22
Church Stretton (Wolstaston)	*Shropshire*	2·58	6·29	160	244	1·49	3	25
Boston (Black Sluice)	*Lincoln*	2·35	3·18	81	135	·73	3	21
Worksop (Hodsock Priory)	*Nottingham*	2·35	2·93	74	125	·45	25	21
Mickleover Manor	*Derbyshire*	2·57	4·13	105	161	·79	3	26
Southport (Hesketh Park)	*Lancashire*	2·92	4·73	120	162	·74	25	24
Wetherby (Ribston Hall)	*York, W. R.*	2·56	5·97	152	233	1·05	3	17
Hull (Pearson Park)	„ *E. R.*	2·39	4·31	110	180	·61	25, 31	27
Newcastle (Town Moor)	*North'land*	2·90	4·29	109	148	·97	2	25
Borrowdale (Seathwaite)	*Cumberland*	8·91	10·50	267	118	..	..	..
Cardiff (Ely)	*Glamorgan*	3·26	5·92	150	182	·99	25	30
Haverfordwest	*Pembroke*	3·39	6·79	172	200	1·32	25	25
Aberystwyth (Gogerddan)	*Cardigan*	4·03	8·55	217	212	1·36	29	21
Llandudno	*Carnarvon*	2·52	5·41	137	215	1·31	25	23
Dumfries (Cargen)	*Kirkcudbrt.*	3·20	4·87	124	152	·66	16	30
Marchmont House	*Berwick*	3·30	4·07	103	123	·87	2	20
Girvan (Pinmore)	*Ayr*	3·73	3·75	95	101	·45	8	26
Glasgow (Queen's Park)	*Renfrew*	2·91	2·91	74	100	·60	1	28
Islay (Eallabus)	*Argyll*	3·41	4·45	113	130	·46	8	27
Mull (Quinish)	„	4·12	5·47	139	133	1·27	14	24
Loch Dhu	*Perth*	4·69	5·70	145	122	1·00	9	19
Dundee (Eastern Necropolis)	*Forfar*	2·84	2·11	54	74	·33	18	22
Braemar	*Aberdeen*	2·65	2·65	67	100	·36	9	24
Aberdeen (Cranford)	„	3·00	3·81	97	127	·73	5	23
Gordon Castle	*Moray*	3·25	2·70	69	83	·57	6	23
Drumnadrochit	*Inverness*	3·37	1·59?	40	47	·29	27	28
Fort William	„	4·92	6·20	158	126	·80	15	28
Loch Torridon (Bendamph)	*Ross*	5·35	5·12	130	96	·84	29	18
Stornoway	„	2·94	2·77	70	94	·41	29	24
Dunrobin Castle	*Sutherland*	2·91	1·49	38	51	·40	5	15
Wick	*Caithness*	2·67	1·80	46	67	·59	6	18
Glanmire (Lota Lodge)	*Cork*	2·73	5·09	129	186	·79	7	24
Killarney (District Asylum)	*Kerry*	3·53	3·79	96	107	·78	29	28
Waterford (Brook Lodge)	*Waterford*	3·13	5·20	132	166	1·11	7	24
Nenagh (Castle Lough)	*Tipperary*	3·02	5·30	135	175	1·07	1	29
Ennistymon House	*Clare*	3·57	..	..	..	..	..	..
Gorey (Courtown House)	*Wexford*	2·90	5·50	140	190	1·04	25	22
Abbey Leix (Blandsfort)	*Queen's Co.*	2·99	5·26	134	176	1·77	25	25
Dublin (FitzWilliam Square)	*Dublin*	2·60	5·12	130	197	1·35	25	25
Mullingar (Belvedere)	*Westmeath*	3·16	4·37	111	138	·98	26	25
Woodlawn	*Galway*	3·48	5·54	141	159	·78	25	24
Crossmolina (Enniscoe)	*Mayo*	3·26	4·31	110	132	·58	14	22
Collooney (Markree Obsy.)	*Sligo*	3·36	4·85	123	144	·65	17	25
Seaforde	*Down*	3·32	3·59	91	108	·68	8	22
Ballymena (Harryville)	*Antrim*	3·44	4·95	126	144	·67	10	26
Omagh (Edenfel)	*Tyrone*	3·34	4·81	122	144	·67	10	27

Supplementary Rainfall, July 1920.

Div.	STATION.	RAIN. in.	RAIN. mm.
II.	Ramsgate	2·06	52
”	Sevenoaks, Speldhurst	4·70	119
”	Hailsham Vicarage	4·36	111
”	Totland Bay, Aston	6·53	166
”	Ashley, Old Manor Ho.	5·51	140
”	Grayshott	6·08	154
”	Ufton Nervet	5·82	148
III.	Harrow Weald, Hill Ho.	5·97	152
”	Pitsford, Sedgebrook	3·48	88
”	Chatteris, The Priory	1·99	50
IV.	Elsenham, Gaunts End	4·06	103
”	Lexden, Hill House	4·61	117
”	Aylsham, Rippon Hall	3·10	79
”	Swaffham	3·61	92
V.	Devizes, Highclere	5·64	143
”	Weymouth	3·93	100
”	Ashburton, Druid Ho.	4·93	125
”	Cullompton	5·31	135
”	Hartland Abbey	5·81	148
”	St. Austell, Trevarna	5·45	138
”	North Cadbury Rec.	5·09	129
”	Cutcombe, Wheddon Cr.	6·04	153
VI.	Clifton, Stoke Bishop	5·16	131
”	Ledbury, Underdown	3·45	88
”	Shifnal, Hatton Grange	4·09	104
”	Ashbourne, Mayfield	5·13	130
”	Barnt Green, Upwood	4·70	119
”	Blockley, Upton Wold	5·61	142
VII.	Grantham, Saltersford	2·72	69
”	Louth, Westgate	2·41	61
”	Mansfield, West Bank	4·52	115
VIII.	Nantwich, Dorfold Hall	4·91	125
”	Bolton, Queen's Park	7·71	196
”	Lancaster, Strathspey	6·43	163
IX.	Wath-upon-Dearne	4·97	126
”	Bradford, Lister Park	6·58	167
”	West Witton	5·43	138
”	Scarborough, Scalby	7·55	192
”	Ingleby Greenhow	6·34	161
”	Mickleton	3·70	94
X.	Bellingham	2·97	75
”	Ilderton, Lilburn	4·24	108
”	Orton	9·07	230
XI.	Llanfrechfa Grange	5·95	151
”	Treherbert, Tyn-y-waun	11·37	289
”	Carmarthen Friary	7·33	186
”	Fishguard	5·50	140
”	Lampeter, Falcondale	6·04	153
”	Abergwngy	7·00	178
”	Crickhowell, Talymaes	7·00	178
”	Sennybridge	4·82	122
”	Lake Vyrnwy	8·36	212
”	Llangynhafal, P. Drâw	4·74	120
”	Dolgelly, Bryntirion	10·46	266
”	Lligwy	6·68	170
XII.	Stoneykirk, Ardwell Ho.	3·91	99
”	Whithorn, Cutroach	3·85	98
”	Carsphairn, Shiel	6·71	170
XII.	Langholm, Drove Rd.	5·61	142
XIII.	Selkirk, Hangingshaw	2·49	63
”	North Berwick Res.	2·34	59
”	Edinburgh, Royal Ob.	3·86	98
XIV.	Biggar	3·59	91
”	Leadhills	6·12	155
”	Maybole, Knockdon	4·48	114
XV.	Rothesay	4·46	113
”	Oban	3·35	85
”	Inveraray Castle	4·39	112
”	Holy Loch, Ardnadam	6·46	164
XVI.	Loch Venachar	4·00	102
”	Glenquey Reservoir	3·60	91
”	Loch Rannoch, Dall	3·17	80
”	Coupar Angus	1·83	46
”	Montrose Asylum	2·86	73
XVII.	Balmoral Castle	2·77	70
”	Fyvie Castle	2·77	70
”	Peterhead, Forehill	3·54	90
”	Grantown-on-Spey	3·33	85
XVIII.	Cluny Castle	2·88	73
”	Loch Quoich, Loan	13·60	345
”	Skye, Dunvegan	6·24	158
”	Fortrose	2·89	73
”	Ardross Castle	2·29	58
”	Glencarron Lodge	6·12	155
XIX.	Tongue Manse	2·16	55
”	Melvich Schoolhouse	1·79	46
”	Loch More, Achfary	4·81	122
XX.	Dunmanway Rectory	5·25	133
”	Mitchelstown Castle	5·43	138
”	Gearahameen	6·70	170
”	Darrynane Abbey	5·09	129
”	Clonmel, Bruce Villa	6·09	155
”	Cashel, Ballinamona	4·58	116
”	Roscrea, Timoney Pk.	3·91	99
”	Foynes	4·32	110
”	Broadford, Hurdlesto'n	5·45	138
XXI.	Kilkenny Castle	4·58	116
”	Rathnew, Clonmannon	5·57	142
”	Hacketstown Rectory	6·70	170
”	Ballycumber, Moorock	4·12	105
”	Balbriggan, Ardgillan	5·27	134
”	Drogheda	3·97	101
”	Athlone, Twyford	4·35	110
”	Castle Forbes Gdns.	3·71	94
XXII.	Ballynahinch Castle	5·46	139
”	Westport House	3·88	99
XXIII.	Enniskillen, Portora	5·84	148
”	Cootehill, Dartrey	4·37	111
”	Armagh Observatory	3·08	78
”	Warrenpoint	3·52	89
”	Belfast, Cave Hill Rd.	3·13	80
”	Glenarm Castle	3·91	99
”	Londonderry, Creggan	3·58	91
”	Sion Mills	3·53	90
”	Milford, The Manse	2·58	66
”	Killybegs, Rockmount	5·67	144

Climatological Table for the

STATIONS	PRESSURE		TEMPERATURE							
			Absolute				Mean Values			
	Mean of Day M.S.L.	Diff. from Normal	Max.	Date	Min.	Date	Max.	Min.	½ max. and min.	Diff. from Normal
	mb.	mb.	° F.		° F.		° F.	° F.	° F.	° F.
London, Kew Observatory	1023·5	+7·8	58	18	28	5	49·8	36·9	43·4	+3·3
Gibraltar	1020·4	+1·6	65	4, 21	43	1, 5	60·3	51·3	55·8	−0·1
Malta	1021·0	+6·0	66	23	48	9, 10	58·4	50·5	54·5	+0·2
Sierra Leone	1011·1	+0·1	99	24	71	2, 3	90·6	74·3	82·5	+0·2
Lagos, Nigeria	1011·1	+1·0	96	24	70	3	89·4	75·6	82·5	+0·4
Kaduna, Nigeria	1013·4	+4·2	98	22, 23, 24	55	13	88·6	60·4	74·5	−3·7
Zomba, Nyasaland	1009·3	+1·5	88	7	62	4, 27	83·0	64·9	73·9	+2·2
Cape Town	..	..	93	2	55	22	80·6	61·4	71·0	+1·0
Johannesburg	..	..	86	18	50	3	77·0	56·6	66·8	+1·4
Mauritius	1010·0	−1·0	87	21	67	9	84·0	72·0	78·0	−1·3
Bloemfontein	..	..	87	18	54	12	82·8	60·5	71·7	−0·2
Calcutta, Alipore Obsy.	1012·7	−0·6	93	29	51	13	82·1	62·7	72·4	+1·4
Bombay	..	..	90	23	62	7	84·0	69·9	76·9	+1·3
Madras	..	..	92	29	67	24	87·8	70·9	79·3	+1·6
Colombo, Ceylon	1012·2	+1·6	92	26	65	22	87·9	71·5	79·7	−0·9
Hong Kong	1018·7	−0·1	77	1	49	9	62·4	55·9	59·1	0·0
Sydney	1014·8	+0·8	87	5	54	7	78·0	63·7	70·9	−0·2
Melbourne	1014·8	+0·5	105	16	46	25	80·1	58·3	69·2	+1·8
Adelaide	1015·1	+0·8	107	16	50	7	88·2	60·7	74·5	+0·4
Perth, West Australia	1013·4	+0·4	102	8	55	11	84·8	62·4	73·6	−0·4
Coolgardie	1012·6	+0·1	108	14	53	6	91·0	60·5	75·7	−0·3
Brisbane	1013·1	+1·0	93	24	63	11	83·1	66·8	74·9	−1·6
Hobart, Tasmania	1012·3	−1·0	90	16	43	29	72·0	54·6	63·3	+1·0
Wellington, N.Z.	1015·3	0·0	80	9	44	22	69·8	57·0	63·4	+1·0
Suva, Fiji	..	..	..	..	..	..	..	..	..	..
Kingston, Jamaica	..	..	90	28	64	7	86·6	68·7	77·7	+1·2
Grenada, W.I.	1011·9	−1·5	89	9	70	6, 10	83·2	72·1	77·7	+0·7
Toronto	1017·2	−0·8	46	2	− 9	1	28·0	12·3	20·1	−1·6
Fredericton, N.B.	1013·2	−1·8	41	18	−20	1	25·4	7·3	16·3	+1·2
St. John, N.B.	1011·9	−2·2	43	19	−16	1	27·7	13·7	20·7	+0·8
Victoria, B.C.	1024·6	+8·7	53	28	32	9	47·1	36·0	41·5	+1·2

LONDON, KEW OBSERVATORY.—13 fogs. GIBRALTAR.—2 gales.

MALTA.—Prevailing wind direction ESE ; mean speed, 11·9 mi/hr.

SIERRA LEONE.—1 gale.

LAGOS.—Harmatlan ceased on 18th.

British Empire, February 1920.

TEMPERATURE Absolute Max. in Sun °F.	TEMPERATURE Absolute Min. on Grass °F.	Relative Humidity %	Mean Cloud Am'nt 0–10	PRECIPITATION Amount in.	PRECIPITATION Amount mm.	Diff. from Normal mm.	Days	BRIGHT SUNSHINE Hours per day	BRIGHT SUNSHINE Percentage of possible	STATIONS
103	20	83	6·3	0·41	10	− 29	9	2·3	23	London, Kew Observatory.
124	37	78	5·7	4·42	112	+ 5	11	..	..	Gibraltar.
124	..	83	6·0	2·83	72	+ 21	13	4·9	45	Malta.
..	..	65	2·3	0·00	0	− 7	0	..	..	Sierra Leone.
159	42	70	5·6	0·11	3	− 48	1	..	..	Lagos, Nigeria.
..	..	40	1·0	0·00	0	− 5	0	..	..	Kaduna, Nigeria.
..	..	89	8·9	13·29	338	+ 62	25	..	..	Zomba, Nyasaland.
..	..	66	2·9	0·29	7	− 8	3	..	..	Cape Town.
..	50	81	7·4	1·67	42	− 88	10	8·1	62	Johannesburg.
..	63	81	7·7	13·27	337	+124	25	..	..	Mauritius.
..	..	72	6·2	8·20	208	+120	15	..	..	Bloemfontein.
..	43	53	2·1	1·48	38	+ 9	2	..	..	Calcutta, Alipore Obsy.
136	53	67	0·3	0·33	8	+ 7	3	..	..	Bombay.
160	62	73	1·3	0·00	0	− 8	0	..	..	Madras.
160	58	72	2·3	3·36	85	+ 32	5	..	..	Colombo, Ceylon.
..	..	84	9·8	2·64	67	+ 24	14	0·8	7	Hong Kong.
148	50	68	5·0	1·87	47	− 68	12	..	..	Sydney.
156	38	53	3·6	0·60	15	− 28	5	..	..	Melbourne.
164	39	38	2·5	0·06	2	− 14	3	..	..	Adelaide.
164	45	50	2·6	0·01	0	− 11	1	..	..	Perth, West Australia.
159	50	34	3·3	0·70	18	− 1	1	..	..	Coolgardie.
153	59	62	5·0	1·04	26	−142	7	..	..	Brisbane.
148	38	59	5·6	0·25	6	− 31	8	..	..	Hobart, Tasmania.
139	30	73	6·6	5·92	150	+ 67	7	6·5	47	Wellington, N.Z.
..	..	..	..	..	..	..	..	..	..	Suva, Fiji.
..	..	82	2·2	1·26	32	+ 17	4	..	..	Kingston, Jamaica.
139	..	74	3·9	1·40	36	− 36	12	..	..	Grenada, W.I.
78	−11	56	5·4	1·62	41	− 25	12	..	..	Toronto.
..	..	68	5·8	6·89	175	+ 31	17	..	..	Fredericton, N.B.
121	−18	70	7·1	7·90	201	+102	17	..	..	St. John, N.B.
114	25	80	5·1	0·62	16	− 74	6	..	..	Victoria, B.C.

MAURITIUS.—Prevailing wind direction ESE; mean speed, 6·9 mi/hr.

BLOEMFONTEIN.—Record rainfall for February.

COLOMBO.—Wind direction variable; mean speed, 4·1 mi/hr.; 3 thunderstorms.

HONG KONG.—Prevailing wind direction E; mean speed, 12·8 mi/hr.

On the 27th a deep depression approached and remained in the vicinity of Iceland. Secondaries from this depression, moving eastward, caused a continuation of unsettled weather in North-West Europe up to the end of the month.

In Italy and the Eastern Mediterranean the weather throughout the month was fine and warm, temperatures frequently exceeding 90° F., while at Cairo on the 12th a temperature of 101° F. was reached.

At the beginning of the month very violent storms swept the Cerdaña district in the eastern Pyrenees, with damage to life and property. On the 26th a violent thunderstorm and cloudburst occurred at Barcelona, flooding the city. Six persons were killed.

About the 14th of the month Buenos Ayres was visited by a snowstorm, this being the second experienced within 300 years. A message arriving on the 28th stated that a typhoon had swept over Luzon, the largest of the Philippine Islands. The loss of life was small, but thousands were rendered homeless.

Captain Amundsen arrived at Nome (Alaska) on the 27th, and stated that his ship was still icebound in the Arctic Ocean, but her position was not given. Bering Strait is now open.

As a result of prolonged rainfall splendid crops are now anticipated at Alberta. Great damage has been caused to crops in the Fraser River Valley, B.C., by floods, the late spring mountain snow having melted too quickly. Many thousands of acres have been flooded and scores of settlers rendered homeless. On the 21st Matsqui Dam also gave way, flooding a further ten thousand acres. A thunderstorm associated with the southern portion of a large double depression situated in the east of the Great Lakes caused a very serious accident at Scranton, Penn., on the 3rd. Eighteen persons were killed and a hundred injured as the result of a triple tram-car collision caused by lightning striking a telegraph pole, which fell across the track.

It is not usual for Australia to suffer from excess of rain, but floods in N.W. Australia have done much damage to wheatlands, and heavy rains, followed by destructive floods, have occurred in Western Queensland. New South Wales also suffered, numerous washouts taking place on the railways, but the floods were subsiding on the 6th. The temperature generally has been mild throughout Australia.

A message from Simla states that the monsoon in India continues to blow steadily.

Geostrophic Wind over London; September, 1881–1915.

FREQUENCY OF STRENGTH AND DIRECTION.

Estimates based on the D.W.R. charts (8*h*., 1881–1908; 7*h*., 1909–1915).

Direction.	5 m/s. 11 mi/hr.	10 m/s. 22 mi/hr.	15 m/s. 33 mi/hr.	20 m/s. 44 mi/hr.	Over 20 m/s. Over 44 mi/hr.	Total Frequency of Direction.
N.	30	18	20	8	5	81
NE.	24	23	14	1	1	63
E.	16	35	10	5	1	67
SE.	21	32	8	4	—	65
S.	38	43	6	—	1	88
SW.	47	63	36	14	8	168
W.	30	82	48	17	7	184
NW.	29	42	23	4	5	103
Total Frequency of Strength	235	338	165	53	28	819*

* Indeterminate—231.

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Retirement of Sir Napier Shaw, Sc.D., LL.D., F.R.S.

THE retirement of Sir Napier Shaw from the Directorship of the Meteorological Office, on the completion of the third term of his appointment, will be received with regret by all who have been associated with meteorological work in this country and abroad. Sir Napier's connection with the Office has extended over 40 years, for it began in 1879, when, at the request of the Meteorological Council, he undertook an experimental comparison of the various methods of determining the hygrometric state of the air, the results of which were published in the *Philosophical Transactions* of the Royal Society in 1888. In 1897 he was appointed a member of the Meteorological Council to fill the vacancy caused by the death of Mr. E. J. Stone, F.R.S. In 1900 he succeeded the late Dr. R. H. Scott as Secretary to the Council. From that date the work of the Office has been carried on under his immediate supervision, and the present eminence to which the Office has attained is due in no small measure to his personal initiative and "drive."

In 1905 the direction of the Office became vested in the Meteorological Committee appointed by the Treasury, with Sir Napier as Director and Chairman of Committee. Busy

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years followed. The planning of the new office building at South Kensington occupied much time and thought. It was to be no mere office, but a centre for meteorological and geophysical research, with ample library accommodation and a museum in which the results obtained might be adequately displayed. The building was completed in 1910, and the transfer from Victoria Street was accomplished in the summer and autumn of that year. The educational side of the Office work benefited immediately and parties of students and teachers visiting the establishment to acquire at first-hand a knowledge of meteorological practice were frequently met with at the Office.

The transfer to the Meteorological Committee of responsibility for the work of the Observatories at Kew and Eskdalemuir in 1910 further widened the scope of office work and increased the duties and responsibilities of the Director. The Office ceased to be a purely meteorological institution and became the official centre for carrying out geophysical investigations, terrestrial magnetism, atmospheric electricity and seismology.

In the purely meteorological sphere, in addition to extending the work of the forecast service and of the stations and observatories directly under the jurisdiction of the Office, Sir Napier was ever anxious to bring the large number of voluntary observers into relation with the Office in order to render their work readily available for the public good. He devoted much time and thought to devising arrangements for supervising such voluntary work and directing it along useful lines. The publication of summaries of approved observations in the *Monthly Weather Report* was the chief means adopted for attaining this end, and the Report came to be regarded as an index of the material available in the Office for "keeping the public memory of the weather."

The twenty years of Sir Napier's control of the Office have witnessed a rapid development of upper air research in this and other countries, and it became necessary to see that the Office took its proper share in this pioneer work. The spending of the available funds in a manner to secure the best results was no easy task. Sir Napier was fortunate in having the assistance of Mr. W. H. Dines, F.R.S., in this part of his work. He was singularly happy in devising arrangements under which Mr. Dines was enabled to carry on his individual work at Pyrton Hill, and subsequently at Benson, and bring it into close co-operation with the work of the Office. He was equally fortunate in securing co-operation between the Office and institutions like the upper air observatory of the University of Manchester or the private observatory of Capt. C. J. P. Cave, of Ditcham Park.

In international meteorological work Sir Napier was also called upon to play a large part. He became a member of the International Meteorological Committee soon after his appointment as Secretary to the Meteorological Council, and on the retirement of M. Mascart he was elected President of the Committee at the meeting held in Paris in 1907. From that time onwards he was constantly called upon to deal with questions of international co-operation between the meteorological services of different countries.

It had been Sir Napier's often expressed intention to resign from the Directorship in 1915 in order that he might have leisure to devote himself to furthering the academic side of meteorology, but the outbreak of war put all idea of resignation out of question, as it soon became clear that the national emergency would make great demands on the Office. Limitation of space makes it impossible to detail the steps which led to the formation of the separate meteorological services established by the Army, Navy and Air Force, but the Office organisation had to supply the essential information for all these, and to supply or undertake the training of a large part of the personnel required. The demands were not only for weather forecasts, but for help in the applications of meteorology to gunnery, aircraft construction and navigation, and numerous other subjects. The work of directing the Office operations became more than one man could accomplish, and arrangements were made, with the consent of the War Office, for Colonel H. G. Lyons to undertake the administration of the Office, leaving Sir Napier free to devote himself to the scientific problems which he was eminently fitted to solve. Among other things the need of an advanced text-book of meteorology for the training of expert personnel became acutely felt, and Sir Napier met that demand by compiling the *Manual of Meteorology*, of which Part IV., dealing with the relation of wind to the distribution of pressure, was issued early in 1919. The first three parts are still to come.

Some months after the signing of the armistice Colonel Lyons relinquished his temporary position as administrative head of the Office and the full responsibility once more devolved upon Sir Napier. During the months that have intervened the control of the Office has passed to the Air Ministry and Sir Napier has had to carry through the unification under a single control of the independent services established during the war. Another important step in the unification of meteorological work in this country also occurred at this time, namely, the transfer to the Office of responsibility for the work of the British Rainfall Organisation, which took place during the summer of 1919.

We are glad to learn that Sir Napier's retirement from the Directorship does not involve his complete dissociation from active meteorological work at South Kensington. He has undertaken the duties of the Professorship of Meteorology at the Imperial College of Science and Technology in connection with the School of Aviation recently established there in association with the University of London, and as such will, with the courtesy of the Air Ministry, retain the use of a room in the building which he was instrumental in calling into being. The good wishes of all will go with Sir Napier in his new work.

OFFICIAL NOTICES.

The Meteorological Office.

The retirement of Sir Napier Shaw, Sc.D., LL.D., F.R.S., from the Directorship of the Meteorological Office took place on September 6th. The Air Council have appointed Dr. George C. Simpson, F.R.S., to succeed him. Dr. Simpson is best known to meteorologists by his theory of thunderstorms and by his work as meteorologist and physicist to the Scott South Polar Expedition, which was discussed by Dr. H. R. Mill in our July number. He has held an appointment on the staff of the Indian Meteorological Department since 1906.

The unification of the National Meteorological Services was completed on August 12th, 1920, on which date the special meteorological service established during the war at the Admiralty was incorporated with the Meteorological Office. The Air Ministry has thus become responsible for all branches of official meteorological work.

An official meteorological station for the local distribution of meteorological information has been opened at Cattewater, Plymouth. Mr. C. D. Stewart, B.Sc., has been placed in charge.

Summer Time Act.

Public clocks are to resume Greenwich Time as from 3 a.m. (summer time) on September 27th. Observers are requested to indicate the standard of time on their returns for the months of September and October.

Issue of Meteorological Reports by Wireless.

On August 16th, 1920, the following revised time-table for the issue of synoptic reports came into force :—

Reports from Air Ministry Wireless Station have been issued at 3 h. 15 m., 8 h. 45 m. and 20 h. 15 m. G.M.T. on a wave length of 1,400 m. (C.W.).

Reports from Aberdeen Wireless Station have been issued at 2 h. 30 m., 8 h. 30 m., 14h. 30 m., and 19 h. 30 m. G.M.T. on a wave length of 3,300 m.

From September 1st, the form of these reports has been modified and the information supplied has been made more complete. Particulars of the code now in use will be found in the revised copy of M.O. Form 2621, copies of which may be obtained on application.

Official Publications.

Professional Notes No. 10. *Methods of Computation for Pilot Balloon Ascents.* By J. S. Dines, M.A. Price 8*d.* net.—In this pamphlet, which was first issued as a typewritten memorandum, Mr. J. S. Dines summarises the various systems of computation in use for the reduction of pilot balloon observations. The note is divided into three parts, viz. : Part I., Single Theodolite Method ; Part II., Double Theodolite Method ; and Part III., Balloon Tail Method. The publication is likely to prove useful to those who are interested in pilot balloon work.

Professional Notes No. 11. *On the Ground Day Visibility at Cranwell, Lincolnshire.* By Capt. W. H. Pick, B.Sc. Price 6*d.* net.—The observations utilised in this note cover a period of 68 days, February 1st to April 8th, 1920. The scope of the note is to investigate the relationship, if any, of visibility during day time to pressure distribution, wind direction and wind force. In spite of the difficulty of basing satisfactory generalisations on so short a record, Capt. Pick brings out some interesting points. He finds that at Cranwell visibility is best with winds from the SW. quadrant and worst with winds from the SE. quadrant. While investigating the relation of wind force to visibility he finds that the mean visibility is considerably improved with wind speeds above 12 mi/hr. " with a possible exception in the case of winds " from SE. by S. to SSE. Capt. Pick has also made an attempt to correlate visibility with isobaric distributions. It is remarkable that straight isobars across the British Isles are accompanied by high mean visibility at Cranwell. It would be interesting to know if this is generally the case at other stations.

A Conference at Bergen.

An Extract from the Report by Sir NAPIER SHAW, Sc.D , LL.D., F.R.S.

ON the invitation of Professor V. Bjerknes, Director of Section B. of the Geophysical Institute, Bergen, a delegation of the Meteorological Office visited Bergen for the purpose of inspecting new methods of forecasting which have been developed by the meteorological staff of the Institute under the direction of Professor Bjerknes. The Geophysical Institute consists of two sections, viz., A., the Oceanographical Section, under Professor Helland-Hansen, who is also the Director-General of the Institute, and B., the Meteorological Section, under Professor Bjerknes.

The invitation had the practical support of the Bergen Steamship Company and the Bergen-America Line on account of the interest of those companies in the development of meteorological methods with a view to forecasting for North Sea steamers and ocean liners. The companies observe for the Institute at 8 h. 14 h. and 20 h. Norwegian time, and transmit their observations by wireless telegraphy for incorporation with other data on the regular maps.

The invitation was extended to four or more representatives of the Meteorological Office. The delegation consisted of Sir Napier Shaw, Director, Colonel L. F. Blandy, Controller of Communications, with Major A. H. R. Goldie, Mr. L. F. Richardson and Captain C. K. M. Douglas. The delegation left London on July 17th for Newcastle and landed at Bergen on the morning of July 19th.

The members of the staff of the Bergen Institute who took part in the proceedings, besides Professors Bjerknes and Helland-Hansen, were Mr. J. Bjerknes, Mr. B. Björkdal and Mr. Rossby, who are in charge of forecasts, Mr. Fjeten, who is in charge of instruments. Professor Hesselberg, Director of the Norwegian Meteorological Service, came from Christiania, and Mr. Bergeron, a former assistant at Bergen and now in the Hydrographic-Meteorological Bureau of Stockholm, came with his colleague, Mr. Calwagen, from Stockholm. Dr. Jakobsen, a Danish oceanographer, was also present with Professor Helland-Hansen, and Mr. Jon Eyporsson, who is in training for the Meteorological Service of Iceland.

The ordinary daily programme of business was to meet in a lecture-room of the Bergen Museum in the morning (which lasts till 15 h.) for the discussion of scientific questions, and later in the afternoon to visit the Institute to inspect the working charts for the day and to consider as a committee the administrative aspects of the questions raised. This plan was followed on July 20th to 24th inclusive and July 27th to 30th. Proceedings commenced with a lecture, followed by discussion, and the reading and discussion of supplementary papers.

The projects which the visit was designed to develop have arisen out of a discovery by the Bergen Institute, principally by Messrs. Solberg, J. Bjerknes and Bergeron, that the phenomena of the weather of the Northern Hemisphere are largely dependent upon the surface of junction of polar and equatorial air which can be detected at the earth's surface as a line of discontinuity in the conditions of pressure, temperature, wind-direction and force, humidity and visibility. The line of discontinuity passes through the centres of cyclones and connects the centre of one cyclone with those of the preceding and succeeding ones by a line which can be identified somewhere in the westerly current lying on the south side of the line of centres of cyclones. It may possibly be as far south as the margin of the permanent Atlantic anticyclone, and it may even be carried round with the north-east trade to the southern margin of the anticyclone. The polar air is identified at the surface as being cold, dry, very transparent, and often blowing from some easterly point, and the equatorial air as relatively warm, moist, with poor visibility, and always blowing from some westerly point.

The surface of demarcation between these two types of air is called the "polar front," which is divided into the "steering surface" or "anaphalanx" from the front margin of the cyclone to its centre, the intermediate section between the margin of successive cyclones, the "squall surface" or "kataphalanx" from the centre to the rear margin. Attempts to identify the line in which the polar front cuts the earth's surface on the detailed maps of Western Norway have apparently been generally successful, and its extension over Western Europe and ultimately round the earth is obviously a practical proposition. The complete front must be regarded as a surface of irregular shape extending from the line marked out at the earth's surface obliquely upward to a considerable, but at present unknown, height. The Bergen investigators set no limit below the stratosphere (say 33,000 feet). *A priori* we should regard it as belonging to the peculiar juxtaposition of relatively warm and cold air which is inevitable at the surface, but not to be expected in the upper layers; observations in aeroplanes have, however, been adduced in support of the Bergen views. They associate most of the phenomena of cyclones with different parts of the polar front, and in particular on all their maps they set out definite rain areas in connection with the anaphalanx and the kataphalanx, the two parts of the front that meet in a cyclonic centre; and they use the two parts of the line in which the front cuts the surface (provisionally called the steering line and the squall line) as axes meeting in the cyclone-centre: to one or other of which they refer all the the weather incidental to the passage of the cyclonic depression. The sector of the cyclone within the angle between the anaphalanx and kataphalanx they call the "warm" sector of equatorial air, and endow it with showery possibilities but not continuous rain.

Moreover, they find that the one part of the polar front the kataphalanx may encroach to such an extent on the warm sector as to reach the steering line or surface line of the anaphalanx and ultimately overlap it; thus it will cut off an isolated patch of the equatorial air, upon which the warm sector of the cyclone depends for its existence, and will bring about the "death" of the cyclone.

As to the nature and origin of cyclones, Professor Bjerknes, relying upon a proposition of Helmholtz that in consequence of the rotation of the earth the surface of separation at a discontinuity between polar air (or air moving eastward) would not be vertical, but would tend to become parallel to the earth's axis of rotation and therefore inclined to the vertical anywhere except at the pole, is developing a theory of the motion of air in a cyclonic depression as the result of wave motion, different in character on either side of the polar front and advancing in the inclined surface of separation which forms the front.

In consequence of these developments the Bergen meteorologists have come to consider that a new step in advance in practical meteorology is possible, and indeed almost certain, if attention is concentrated upon this new feature, viz., the polar front.

The more serious business of the meeting was interrupted for the 25th and 26th July for an excursion, on the invitation of Professor Helland-Hansen, to Väring Voss, at the head of the Hardanger Fjord, which was reached partly by rail, partly by motor over remarkable roads, and partly by the motor ship *Armauer-Hansen*, a craft belonging to the Oceanographical Section of the Geophysical Institute for the purpose of investigation of the fjords and the ocean. This afforded an opportunity of inspecting the methods of investigation of physical oceanography.

Meteorology at the British Association Meeting at Cardiff.

THERE was very little sign of activity in meteorology in the programme of papers prepared for the meeting of the British Association at Cardiff this year. The working part of the meeting was confined to the four days Tuesday, 24th August to Friday, 27th, and since the last meeting of a sub-section for Cosmical Physics the expansion of subjects belonging to Section A. has been more marked than ever, so that no place is likely to be obtained for meteorological subjects in the time-table unless meteorologists prepare for it betimes.

The programmes of Section A., Mathematics and Physics, showed the Report of the Seismology Committee by Professor H. H. Turner, F.R.S., and Mr. J. J. Shaw, which mentioned the transfer of Dr. Milne's organisation to Oxford and was still more notable for an interesting examination of the travel of microseisms by Mr. Shaw. There was also a paper by Professor S. Chapman upon Terrestrial Magnetism, Auroræ, Solar Disturbance and the Upper Atmosphere, a further development of the subject so well set out in the recent paper before the Royal Meteorological Society. A Report of the Committee on Tides was presented by Professor Proudman and Dr. Doodson. In Section B. (Chemistry) Dr. J. S. Owens gave an account of the recent work of the Committee on Atmospheric Pollution in the investigation of the acid impurities of the atmosphere, and in Section E. (Geography) Dr. E. C. Gee, of the Ministry of Agriculture and Fisheries, discussed the movements of the sea.

It has been customary for many years, since the time of Mr. Symons and Dr. Buchan, for meteorologists who are present at this Association to meet at breakfast or luncheon, and in recent years, since the operations of the Meteorological Office have included the geophysical work of the Observatories at Richmond and Eskdalemuir, representatives of the geophysical subjects Terrestrial Magnetism, Seismology, Hydrography, and Physical Oceanography have associated themselves with the meteorologists.

Accordingly it was possible to get together a company of twenty-three at the Dorothy Café in Cardiff for a meteorological and seismological luncheon on Thursday, August 26th. The company included Sir Napier and Lady Shaw, Sir Richard Gregory, Professor, Mrs., and Miss Turner, Dr. Walford (Cardiff), Mr. Wilson Fox (Falmouth), Dr. J. S. and

Mrs. Owens, Dr. W. Mansergh Varley (Technical College, Brighton), Professor Proudman and Dr. Doodson (Liverpool), Rev. M. Evanson, Mr. A. Borns, Mr. W. E. Brain, Mr. C. G. Barton, Mr. Wilfred Hall, Mr. J. J. Shaw, Mr. J. Jackson (Royal Observatory) and Mrs. Jackson, the Misses Bellamy (Oxford).

After luncheon Sir Napier Shaw thanked the members of the party for maintaining the traditional assembly of those interested in geophysical studies, and referred to the widening circle of activity. He cited the work done in seismology, in the study of atmospheric pollution, and the institution of a new establishment for the study of tidal phenomena in connection with the University of Liverpool. He also referred to the long service of Mr. Wilson Fox to meteorology and magnetism at Falmouth, and to the local observatory at Cardiff in the control of Dr. Walford.

Professor Turner spoke appreciatively of the useful work on meteorology which had been carried on for so long by Mr. Wilson Fox at Falmouth. His work constituted a link with the past, and it was only right that his labours should be recognised by them. Professor Turner was very pleased indeed to welcome to that table Professor Proudman and Dr. Doodson, who were doing excellent work on tidal analysis and prediction at Liverpool. They represented one of those branches of cosmical physics which were not adequately cared for by any scientific institution, and therefore one to which the British Association was always willing to lend a helping hand. In the past those wishing to obtain information about tides had applied to such men as Lord Kelvin and Sir George Darwin, and it was very pleasing to him that the work was again being carried on vigorously. A proposal to send out a new *Challenger* expedition for scientific observations of the sea was being pressed forward by several sections of the British Association. This was a question in which Section A. was closely interested, and such branches of science as were represented at the table could be properly included amongst those which would benefit from such an expedition. Professor Duffield, who was unable to be present, was urging the claims of the Committee for the Determination of Gravity at Sea. Continued experiments at sea were required.

Mr. Wilson Lloyd Fox, of Falmouth, after thanking Sir Napier Shaw and Professor Turner for their kind references to him, remarked that he was a Delegate to the Corresponding Societies on behalf of the Royal Cornwall Polytechnic Society of Falmouth for the Advancement of Science and Art, whose career commenced in 1833. Since its early infancy, it had fostered the science of meteorology, and tables had continuously appeared in the Annual Reports. At one period it printed the returns from some half-dozen localities in the county. The observatory was started as one of the seven principal meteorological observatories of Great Britain, and was equipped with self-recording photographic and other instruments. Latterly, under the guiding hand of Sir Napier Shaw, it became one of the "Weather Stations" of the Meteorological Office, furnished with the latest patterns of instruments for observing pressure, clouds and the higher atmosphere, besides sending 1 a.m. observations to the Office. It might not be out of place to recall that one of its early secretaries was the Mr. Jordan who had the distinction of inventing the self-recording instruments, diagrams of which appear in one of the early reports of the Society. During the meeting of the Corresponding Societies at the British Association meeting at Bournemouth last year, Mr. Salter read a paper on "Rainfall" in which he advocated setting up stations in the numerous districts in which they were conspicuous by their absence. Mr. Pearse Jenkin, of Redruth, had previously taken the matter up and initiated the formation of a "Rainfall Association of Cornwall." His efforts had been warmly supported by the Polytechnic Society. Several new stations had been started, and it was hoped the example would be followed by other voluntary observers.

Professor Proudman said: "I wish to thank Sir Napier Shaw and Professor Turner for their kind references to the efforts of Dr. Doodson and myself in Liverpool. Perhaps they do not realise that the existence of our Institute is due to the British Association. There is no institution, of any nationality, whether Government or not, with which progress in our knowledge of the tides is associated to such an extent as it is with the British Association. The very first grant which it made in aid of research was one of £20 in 1834, for the reduction of tidal observations. This was made to Lubbock, and in subsequent years he received many others, as did also Whewell. When Thomson (Lord Kelvin) conceived the idea of harmonic analysis he immediately placed its development in the hands of the Association, which spent £1,000 on the work. Kelvin's work was continued by Sir George Darwin, again with assistance from the Association, and when the names of Lubbock, Whewell, Kelvin and Darwin are removed from the list of pioneers in work on actual tides, those that remain are of secondary importance. Some years ago the Geodetic Committee of the Association asked Professor Lamb for a report on the present state of the subject of tides. Lamb collected material from all parts of the British Dominions and asked me to examine it. This I did, and it proved to be a revelation. The subject called most urgently for nothing less than a large institute to make an organised attack on its many problems and to clear away some of the uncertainty which everywhere prevails. I managed to secure the interest of a prominent Liverpool shipowner, and was provided with just enough money to enlist the great abilities of Dr. Doodson on full-time work. Shortly after, the British Association came to our aid and gave us £150 (bringing the total amount they have spent on tidal research to about £2,500) with which to engage a full-time computer. In Section A., to-morrow, Dr. Doodson will show some of the results of our first year's work. On all sides we have received expressions of good will and we are very grateful."

Dr. J. S. Owens drew attention to the gradual recognition of the importance of measurements of atmospheric pollution by dust, both from the meteorological point of view and from that of the ventilating engineer and the preservation of public health. He pointed out that the question of visibility, which is of such vital importance in connection with aerial navigation, is intimately connected with that of atmospheric pollution by dust. From the public health point of view it was important to remember that for practical purposes gaseous impurities in the atmosphere were harmless, whereas all transmissible diseases were carried by solid particles. The time was, therefore, probably coming when so much attention would not be paid to the quantity of carbon-dioxide in the air, and the suspended impurities would receive the consideration due to their importance.

Dr. Walford, Medical Officer of Health for Cardiff, spoke of the part taken by Sir Napier Shaw, not only in the founding of their small observatory, but also in the efforts he made to have the work recognised by the University. More support was required to run the station as it deserved. Besides meteorological instruments, they had a seismograph and telescope.

Earthquakes.

A TELEGRAM from Ilfracombe, dated September 3rd, records two shocks, believed to be seismic, at 23 h. 50 m. on September 2nd and 1 h. on September 3rd. The Superintendent of Eskdalemuir Observatory reported an earthquake at 5 h. 55 m. 50 s. on September 7th. The epicentre was distant 1,510 km., probably in the region of Iceland.

Correspondence.

To the *Editors*, "*Meteorological Magazine.*"

Visibility on Cloudy Nights.

CAPTAIN W. H. Pick's stimulating article under the above title in the August number of this magazine calls for serious consideration on account both of the importance and also the very complex nature of the subject. Perhaps on this account I may be allowed to raise one or two points, which the article suggests, in the hope that they may contribute to the development of the method.

Firstly, night visibility requires definition but is presumably concerned with that of a standard light. In effect, Captain Pick's method seems to be to take a feeble standard on a small scale and then to pass to a larger scale proportionally. Now the grease spot and paper are near enough to form a finite image on the retina of the eye and accordingly, in perfectly clear air, the *apparent* brightness would be independent of the distance, and is only reduced in practice by the failure of the air to transmit all the light, and then by an exponential law. A distant light, however, is viewed as a point, and there is an additional decrease in apparent brightness following the inverse square law. There is not, therefore, strict proportionality between the two cases. However, to some extent this is a consequence of definition.

Secondly, the *intrinsic* brightness of the grease spot (and paper) for a fixed distance (d) of the candle is not standard, but each may be expected to vary as $e^{-\mu d}$, where μ depends on the state of transparency of the air between the candle and the paper. The *apparent* brightness then varies as $e^{-\mu(x+d)}$, so that it appears that one should consider $(x + d)$ rather than x or, better, should bring the candle up close to the paper and secure in some other way the advantages which accrue from having it at a distance. If on two occasions the spot becomes indistinguishable at distances x_1 and x_2, it would not seem unreasonable to assume $\frac{x_1 + d}{x_2 + d} = \frac{\mu_2}{\mu_1}$; and if the definition of the corresponding visibilities v_1 and v_2 makes $\frac{v_1}{v_2} = \frac{\mu_2}{\mu_1}$, then proportionality between the small and large scale cases is obtained. The reason for the presence of the squares in the equation of the original article is by no means self-evident.

However, lastly, as one recedes from the paper, the apparent brightness of the grease spot and paper decrease in the same proportion, and thus the ratio of their difference to either of them remains constant. Now, according to Weber, the smallest perceptible increment in the brightness of an object is proportional to the brightness itself, so that if the grease-spot is distinguishable from the paper at the outset it should remain so, and one would not predict its vanishing until the paper no longer appears to transmit any light. It would therefore be very interesting to know if this is the case in practice with a person of normal vision.

M. A. GIBLETT.

West Hampstead, 28th August, 1920.

VISIBILITY is so important an element in the modern development of meteorology that any method of estimating it under unfavourable conditions deserves close attention. The device described by Capt. W. H. Pick in the August number of this magazine is therefore worthy of careful consideration by meteorologists in general and observers in particular. There are, however, one or two points connected with it upon which discussion would be profitable.

To begin with, there is the purely philosophical question as to what is really meant by "visibility" at night. Put baldly, Capt. Pick seeks to determine the transparency of a small sample of air and thereby to arrive at the distance of visibility supposing the surrounding gloom to be suddenly replaced by broad daylight. So long as we bear in mind that this is all that can be achieved by any estimate of "visibility" on a dark night, and that the term cannot be regarded as having any other meaning whatever, we need have no quarrel with Capt. Pick's use of the term. To follow up this side issue would, however, lead us rather far afield.

I have not tried Capt. Pick's method myself, but I suppose it will be safe to assume that for a given "visibility" there *is* a point at which a normal person would find the grease-spot indistinguishable from the surrounding paper. But why should it become indistinguishable? It is easy to understand why the grease-spot becomes invisible when properly adjusted in the ordinary photometric use of Bunsen's device, that is to say, when the sum of the transmitted and reflected light is the same for grease-spot and surrounding paper, but as used by Capt Pick the conditions are fundamentally different. In the latter case, unless I have completely misunderstood the method, we are concerned only with the difference between the light transmitted by the spot and surrounding paper. One would have thought that so long as anything could be seen at all the grease-spot would appear brighter than the plain paper. A physical explanation of the phenomenon would be highly desirable.

Capt. Pick's method of calibration is also somewhat puzzling. In the example given $x^2/40^2 = 7000^2/16{,}000^2$; there is no obvious reason for the squaring of each quantity. It amounts to assuming that the hypothetical visibility is proportional to the "distance of indistinguishability," which seems reasonable enough, though a rigorous proof would be desirable before using it as a basis of calibration.

E. G. BILHAM.

Twickenham, 27th August, 1920.

A Fog Bank at Malta.

ON July 9th a phenomenon was noticed in this Island which for the time and the season at which it took place is to be considered as a rare occurrence. For the last four days a persistent SE. wind was blowing with its usual accompaniment of high temperature and damp air. A maximum temperature of 91·4° F. was recorded on the 6th.

At 11 h. a bank of fog was seen advancing from the West, and by 11 h. 15 m. it had reached the N. and NW. part of the Island. What I noticed about it was that from a light blue colour this cloud of fog changed to a smoky white when it reached the land and where it rested on the buildings; it looked as if dense smoke was coming from the same. By 12 h. the bank was dissipated.

The wind, which at 8 h. was blowing SSE., Force 1, changed to NW. at 11 h., kept blowing in this direction for some time, then it started veering, and by 15 h. it was again blowing SE. No special fluctuations were noticed at the time in the barometer or the microbarograph.

D. THOS. AGIUS.

R.A.F. Meteorological Headquarters, University, Malta, 11th July, 1920.

Black Rain in Devonshire.

I NOTICE in the *Meteorological Magazine* for August a letter describing a fall of black rain in Devonshire. It would be of the utmost interest if Mr. Horner could give us some information as to the cause of the blackness. Was it due to soot carried from some industrial area, or to some other cause?

J. S. OWENS.

Advisory Committee on Atmospheric Pollution,
47, Victoria Street, S.W.1, 2nd September, 1920.

High Pilot Balloon Ascents at Valencia Observatory.

An unusually high pilot balloon ascent was made at Valencia Observatory on June 3rd, 1920, when a white balloon, weighing 36 grammes, was followed for 143 minutes with one theodolite and finally lost to view in the distance. The rate of ascent on the usual formula was 152·5 metres per minute, giving a final theoretical height of 21·8 kilometres, with a horizontal trajectory of 67·2 kilometres. It is, of course, impossible to assert that these were the real values. There was, however, no evidence that any leak had developed in the balloon, since the angular elevation, though falling more rapidly during the last 20 minutes, did not do so at a steadily increasing rate, and up to the 130th minute the computed velocities did not show any particular general increase. Also the nature of the results did not suggest that the balloon had ceased to rise.

It seems then to be clear that the stratosphere was penetrated to a considerable distance. It is, therefore, more interesting to notice that the velocity and direction of the wind in different layers of the stratosphere were by no means constant or uniform in their variation.

Variations took place which could not be accounted for by errors in the setting or reading of the theodolite, they were too consistent in every way. The general range of velocity above 11 kilometres was from 6 to 19 m./s., and of direction between 90° and 155° from North. In general, direction and velocity changed together, the most notable cases occurring at 15 kilometres, where, through about 500 metres height, a wind of 6 m./s. from 155° was sandwiched between two of 9–10 m./s. from 95°. Other erratic variations were observed at about 21 kilometres.

Another ascent on June 4th under similar conditions reached 17·2 kilometres and showed effects of a like nature, the most pronounced being a rise in velocity from 15 m./s. on either side to about 22 m./s. over a layer 1 kilometre thick at 16 kilometres.

Vertical currents are unthinkable in such lofty regions, so that there seems to be no doubt that the above cases were genuine and that layers of air from ½ to 1 kilometre thick in the stratosphere may be travelling with velocities differing widely both in magnitude and direction from those above and below them.

L. H. G. Dines.

Valencia Observatory, Cahirciveen.

Hay transported by a Whirlwind.

A SOMEWHAT curious phenomenon occurred here about 5.30 p.m. on Saturday, July 31st. It rained hay over the whole of Stone, and to my own knowledge as far as Moddershall, over two miles away. A good many of the wisps which fell were larger than dinner plates, all were soaked through being in a cloud, and everyone agrees that the hay seemed to fall from a great height. The hay was accompanied by a whirling wind which knocked over an umpire on the cricket ground.

I have tried to give you certain facts, and avoid the many rumours which are flying round the town.

H. MALCOLM FRASER.

Alleyne's Grammar School, Stone, Staffs, 4th August, 1920.

Weather Lore.

I SHOULD be much obliged if any of your readers would send me any weather sayings current in the district in which they live. I particularly desire to know the effect of approaching bad weather on birds, animals, insects and flowers. If anyone can help, will they please send to address below.

B. BROTHERTON.

St. George's Boys' School, Worcester, 6th Sept., 1920.

Geostrophic Wind over London; October, 1881–1915.

FREQUENCY OF STRENGTH AND DIRECTION.

Estimates based on the D.W.R. charts (8*h.*, 1881–1908; 7*h.*, 1909–1915).

Direction.	5 m/s. 11 mi/hr.	10 m/s. 22 mi/hr.	15 m/s. 33 mi/hr.	20 m/s. 44 mi/hr.	Over 20 m/s. Over 44 mi/hr.	Total Frequency of Direction.
N.	20	29	27	10	12	98
NE.	10	17	19	4	2	52
E.	12	16	27	11	4	70
SE.	21	28	19	7	5	80
S.	41	40	26	13	9	129
SW.	33	46	58	27	10	174
W.	18	44	62	36	23	183
NW.	18	34	32	18	9	111
Total Frequency of Strength	173	254	270	126	74	897*

* Indeterminate—183.

NOTES AND QUERIES.

Weekly Weather Report.

APPENDIX I., First Quarter 1920, giving District values for Rainfall, Mean Temperature and Sunshine has recently been issued and contains some new features. There is a separate table giving temperatures in degrees absolute above 200 a in addition to the old table giving corresponding information in degrees Fahrenheit. In the case of rainfall, amounts are expressed in millimetres, and not in inches as hitherto. No change has been made in the sunshine table.

A Canadian Eden.

AN illustrated pamphlet entitled "The Climate of Victoria," issued by the Victoria and Island Development Association, British Columbia, introduces us to one of Nature's favoured regions. In the same latitude as Jersey it has more sunshine and less rainfall. Its summers are cool and its winters are so mild that it is termed "The Evergreen City," and withal it is free from fogs. These advantages have induced the Dominion Government to make Victoria the site of the new Dominion Astrophysical Observatory, which is under Dr. J. S. Plaskett. The Meteorological Observatory is under the direction of Mr. F. Napier Denison.

Relation of Temperature to Solar Radiation.

AN interesting account of his researches concerning the relation of temperature to solar radiation has been received from Mr. A. H. Wallis, C.E. If there are places on the surface of the sun which are ordinarily brighter than normal places in the same latitude, the solar radiation will be greatest when most of these are on the side of the sun nearest the earth. Thus a periodic variation in the solar radiation will be produced, depending on the period of the sun's synodic rotation, 27·33 days. The author has divided up four years' temperature observations at Mafeking into 27·33-day batches and averaged the results for corresponding days in all the batches, thus finding the part of the temperature variation that could be attributed to such changes in radiation. The resulting curve has two main maxima in a period, one strikingly sharp and the other smoother, and it seems that the range of the variation thus caused is about a third of that of the actual variation. Thus a notable part of the observed temperature irregularities may have been accounted for.—H. J.

Review.

Some Broader Aspects of Rain Intensities in Relation to Sewer Design. By R. E. Horton. Reprinted from *Municipal and County Engineering*, June–July, 1919. Albany, N.Y. Size $11\frac{1}{2}$ × 7, pp. 12. Numerous diagrams.

Mr. Horton has devoted so much skilled attention to the study of high rainfall intensities in the United States that a generalized epitome of his views is welcome. The subject is approached largely from the economic side as affecting the design of sewers, in which respect it is of course of paramount importance, but it is not lacking in scientific interest.

The author clearly recognises the fact that rainfalls of the highest intensity are almost invariably associated with thunderstorms; he regards the latter as of convectional origin as a rule, though also liable to occur in conjunction with cyclonic storms. The characteristics of thunderstorm rain in any case are so distinct from those of other types of rain as to require separate study. Nearly all high rainfall intensities occur in the summer, since apart from the relative frequency of thunderstorms winter cyclonic rains differ in some essential respects from those of summer. We note with interest that in the United States the proportion of excessively intense rains which occur in conjunction with thunderstorms increases with the altitude. So far as the British Isles are concerned we have always found that in the hilly districts of the west, both summer thunderstorms and intense rainfalls are comparatively rare. The difficulty of defining both phenomena and their extremely local nature render statistical comparisons somewhat fallacious.

The physical processes of thunderstorm rain are explained on the convectional hypothesis, the intense rain being largely due to suspension and sudden release of the condensed drops. An important argument is put forward that since during convectional action the precipitation must be drawn almost entirely from local sources, there is an approximately ascertainable limit to the possible amount of rainfall, which does not exist in the case of cyclonic or more especially of orographical rainfall. In other words, although thunderstorm rain is likely to be heavier than that of other kinds while it lasts, larger amounts may fall during non-thunderstorm rains if sufficiently long continued. In this connection it is of interest to note that the two most remarkable daily rainfalls ever recorded in England, those of August 25th–26th, 1912, at Norwich, and of June 28th, 1917, at Bruton, were essentially cyclonic. In both these rains the rate of fall was approximately one inch per hour, an extremely high rate for cyclonic rain, but low compared with severe thunderstorm rain. In the extraordinary orographic rain at Baguio, Philippine Islands, on July 14th–17th, 1911, when 88·2 inches of rain fell in four days, the average rate of rainfall during the 20 hours of most intense fall was about 2 inches per hour, though for short intervals it rose to 3 inches, and once to 4 inches per hour, a rate fully comparable with high thunderstorm rates, but exceeded in the British Isles for all periods up to 30 minutes on a considerable number of occasions. It is notable that the limit of maximum rain intensity, due to storage suspension, does not appear to vary greatly in amount even between places having widely different annual rainfalls and thunderstorm frequencies. Throughout most of the eastern United States it seems to correspond with an intensity of 10–12 inches per hour for a period of five minutes.* The characteristic of thunderstorm rain is its lack of constancy, the high rate seldom being maintained for any great length of time. At New York during 45 years only 4 per cent. of rains exceeded 30 minutes in duration.

Speaking broadly, the author finds that thunderstorms and excessively heavy rains vary in frequency, and occur under the same conditions, as high values of the annual, or more precisely the summer, rainfall. They are most common in tropical latitudes and decrease towards the poles owing to decreased temperature, and their occurrence is mainly limited to the summer months. They usually decrease proceeding inland from the coast as the moisture content of the air decreases. Whilst these statements are undoubtedly true in their broadest sense, they must not be applied too narrowly, and, except in a limited degree, do not hold good in Western Europe. In England intense rainfalls are probably commonest in the Fen District, where the annual rainfall is least. Further, it is found that in the United States the greatest daily maximum rainfalls and the greatest intensities for short periods usually occur in years having the highest total rainfall. In a region where the bulk of the rain is orographical this is certainly not the case.

Mr. Horton shows so extensive a knowledge of this intricate and difficult subject that we hope he will be induced to extend his purview to include the British Isles, and make use of very large collection of statistical material published annually in *British Rainfall.* C. S.

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* For the British Isles the actual observed limit is 15 inches per hour for five minutes at Preston on August 10th, 1893.

Obituary.

Sir Joseph Norman Lockyer, K.C.B., LL.D., D.Sc., F.R.S.

(Born at Rugby May 17th, 1836; died at Salcombe Regis, Sidmouth, August 16th, 1920.)

THE death of Sir Norman Lockyer on August 16th marks the end of the career not only of a famous astronomer and exponent of the physics of the sun, but also of a keen meteorologist whose claim to fame in that department of natural knowledge will increase as time goes on and " the thoughts of men are widened with the process of the suns." In science he began as an amateur, for he was educated at various private schools which had no laboratories in those days, and at the age of twenty-one he received an appointment at the War Office. After eight years' experience, in 1865 he was entrusted with the duty of editing the Army regulations. By 1868 he had become so famous as an astronomer, in conjunction with the French astronomer Janssen, by certain spectroscopic researches on the sun, that a medal was struck in honour of the two men. Two years afterwards he left the War Office to become secretary of the Duke of Devonshire's Royal Commission on Scientific Instruction and the Advancement of Science; in 1875 he was transferred to the Science and Art Department, and in 1885 became director of an Observatory for the Study of Solar Physics established at South Kensington.

It was the study of solar physics that brought him into relation with meteorology. Certain indications of relationship between the frequency of sunspots and the phenomena of the Earth's atmosphere had been brought forward by Charles Chambers as regards Indian rainfall, and by Charles Meldrum as regards the frequency of tropical revolving storms in the region of the Mauritius. The relations were sufficiently marked to make further investigation practically imperative, but not sufficiently so to be put into practice forthwith. To develop the relationship into practical utility required on the one hand the study of the sun, and on the other hand the study of the meteorology of the Earth as a whole. The case for this co-operative study was set out by Sir Norman Lockyer at a meeting of the International Metereological Committee at Southport in 1903, when that Committee met simultaneously with the BritishAssociation, of which Lockyer was then President. His memorandum will be found in the Official Report of the meeting of the Committee at Southport. It was this economic importance of correlation of solar and terrestrial changes, particularly in relation to Indian rainfall and famines, which formed the justification of the maintenance of a solar physics observatory out of public funds; and during Sir Norman Lockyer's tenure of the office of Director the two sides of the obligation were regarded. The meteorological side involved the study of the meteorology of the globe as a whole, and the prosecution of that study required the co-operation of meteorologists all over the world. The work of compilation and discussion was entrusted mainly to Dr. W. J. S. Lockyer, Sir Norman's youngest son, and to their activity we owe a number of volumes on the distribution of pressure and rainfall over the globe, the barometric see-saw, the meteorology of Australia, and the circulation of air in the Southern hemisphere.

When the Solar Physics Observatory was removed to Cambridge, much to Sir Norman's chagrin, the original purpose of exploring the connection between solar and terrestrial changes was no longer made a primary object, and the study of the sun for its own sake was admitted as a legitimate object of the expenditure of public money. The study of meteorology in relation to the sun became specialized as the physics of the Earth's atmosphere, and the Meteorological Office had to take up the duty of compiling observations to exhibit the meteorology of the globe as a whole. The work in this direction is exemplified by the publication of the *Réseau Mondial*, of which the volumes for 1911, 1912 and 1913 have already appeared, indirectly owing to Sir Norman's initiative.

For many years, until his removal to Sidmouth, Sir Norman Lockyer's home in Penywern Road, South Kensington, was a rendezvous for those who were interested in science. Each year invitations were issued to a weekly assembly in the evening, and many meteorologists have enjoyed his hospitality. His wide influence as Editor of *Nature* made these gatherings of more than ordinary interest, and the absence of any continuance of that kind of assembly will be recognised by many as one of the ways in which the world of science is the poorer by Sir Norman's departure.

NAPIER SHAW.

Weather in the British Isles: August 1920.

LIKE June and July, August was characterised by dull, cool weather and a general absence of any really hot days, a prominent feature of the month's weather being the few occasions on which the maximum temperature touched or exceeded the normal. At most stations, moreover, the mean temperature was lower than that of the two months which preceded it; a result largely due to the unusually low temperatures which occurred during several of the nights. The minimum temperatures recorded at some of the stations on the 20th, although equalled, have never been lower in August in records extending in some instances over more than forty years. At Eskdalemuir there were seven occasions, and at Benson six, when the minimum temperature fell below 43° F. Ground frosts, moreover, although not very severe, were experienced at an abnormally large number of stations.

A striking feature of the month was the erratic way in which the sunshine was distributed on many occasions. Thus during the week which ended on the 14th the percentage of the possible sunshine at Rhayader, in Central Wales, was only 5 and at Crathes (Kincardineshire) only 9, but in Guernsey it was as high as 73. During the week ended on the 21st, large differences were again recorded, the percentage at Gordon Castle being only 15, compared with 42 at Dundee; 14 at Norwich, compared with 28 at Yarmouth and 38 at Southend; and 28 at Southampton, but 52 at St. Leonards. During the following week the percentage in Guernsey was 54, but locally at Malin Head and Castlebay it was as low as 8 and 10 respectively.

Between the 10th and 16th, and again from the 20th to the close of the month, anticyclonic conditions predominated, and during these two periods many stations had no rain. At places however, heavy precipitation occurred on the 4th and 17th. At 7 h. on the former day a depression was shown on the weather map over the north-west coast of the British Isles, which as it passed eastwards caused continuous rain in several localities, 52 mm. falling at Holyhead, 30 mm. at Pembroke, 117 mm. at Beddgelert, and 26 mm. at Eskdalemuir. Another depression passed eastwards across the British Isles on the 17th, its passage being associated with exceptionally heavy falls of rain in Scotland, Ireland, and the north of England, 77 mm. falling at West Linton (Pentland Hills), 66 mm. at Glasgow, 79 mm. at Paisley, 72 mm. at Egremont and Leith, 71 mm. at Renfrew, 49 mm. at Eskdalemuir, and 47 mm. at Malin Head. At the rear of a depression centred over Denmark on the 20th, the temperature in parts of Scotland did not rise above 52° F., and 54° F. in the north of England, and remained as low as 58° F. even in Cornwall. Similar conditions prevailed on the 21st; some very low temperatures were also recorded on the 30th and 31st, the temperature at Kew Observatory at 13 h. on the 30th being only 53° F., compared with 72° F. at the same hour at Akureyi in northern Iceland.

The thunderstorms of August, which mainly occurred during the early part of the month, were less frequent and much less widespread than those of June and July. Strong winds were infrequent and gales were rare. At Tenbury, on the 12th, there was a time of pitch black darkness with heavy rain and hail, the latter the size of marbles. On the same day at Birmingham, when 23 mm. of rain fell, there was loss of life and much damage caused by floods.

The total rainfall for the month was nearly everywhere deficient, especially in England, where several areas in the Midlands had less than 25 mm. Practically the whole of England had less than half the average, and in Wales the rainfall was generally below the average in spite of the heavy rain on the 4th. The fall was also deficient in Ireland, but was almost everywhere in excess of 50 mm. In Scotland the rainfall was considerably heavier, particularly in the valleys of the Forth and Clyde, where more than 130 mm. fell widely. The general rainfall expressed as a percentage of the average was :—England and Wales, 59; Scotland, 85; Ireland, 62; British Isles, 68.

In London (Camden Square) the mean temperature was 59·1° F., or 3·3° below the average; a lower mean temperature was only reached on three occasions in August since observations were commenced in 1858. The duration of rainfall was 27·8 hours. Evaporation, 2·00 in.

Weather Abroad: August 1920.

DURING the first part of the month a series of depressions and their secondaries moving in from the Atlantic caused very unsettled weather in North-west Europe. Local thunderstorms and heavy falls of rain occurred

(*Continued on* p. 188.)

Rainfall Table for August 1920.

STATION.	COUNTY.	Aver. 1875—1909.	1920.		Per cent. of Av.	Max. in 24 hrs.		No. of Rain Days.
		in.	in.	mm.		in.	Date.	
Camden Square	*London*	2·39	1·75	44	73	·82	18	7
Tenterden (View Tower)	*Kent*	2·42	1·58	40	65	·99	18	5
Arundel (Patching)	*Sussex*	2·52	1·29	33	51	·70	18	5
Fordingbridge (Oaklands)	*Hampshire*	2·76	1·62	41	59	·41	18	7
Oxford (Magdalen College)	*Oxfordshire*	2·44	1·05	27	43	·45	4	8
Wellingborough	*Northampton*	2·36	·84	21	36	·24	4	8
Hawkedon Rectory	*Suffolk*	2·30	1·61	41	70	·46	22	14
Norwich (Eaton)	*Norfolk*	2·52	2·07	53	82	·40	19	13
Launceston (Polapit Tamar)	*Devon*	3·17	1·59	40	50	·63	4	11
Lyme Regis (Rousdon)	"	2·84	1·34	34	47	·58	4	5
Ross (Birchlea)	*Herefordshire*	2·90	·87	22	30	·29	4	9
Church Stretton (Wolstaston)	*Shropshire*	3·43	·98	25	29	·29	4	12
Boston (Black Sluice)	*Lincoln*	2·39	1·72	44	72	·57	19	11
Worksop (Hodsock Priory)	*Nottingham*	2·55	·65	16	25	·28	4	10
Mickleover Manor	*Derbyshire*	2·80	1·05	27	37	·45	4	10
Southport (Hesketh Park)	*Lancashire*	3·73	1·49	38	40	·80	4	12
Wetherby (Ribston Hall)	*York, W. R.*	2·78	1·66	42	60	·59	4	7
Hull (Pearson Park)	" *E. R.*	3·05	1·25	32	41	·46	4	7
Newcastle (Town Moor)	*North'land*	3·20	1·90	48	59	·86	4	11
Borrowdale (Seathwaite)	*Cumberland*	11·47	8·70	221	76	..	..	..
Cardiff (Ely)	*Glamorgan*	4·54	2·73	69	60	1·73	4	15
Haverfordwest (Portfield)	*Pembroke*	4·21	3·71	94	88	2·03	4	13
Aberystwyth (Gogerddan)	*Cardigan*	4·88	2·66	68	55	1·07	4	..
Llandudno	*Carnarvon*	3·16	3·39	86	107	1·14	18	15
Dumfries (Cargen)	*Kirkcudbrt.*	4·23	4·02	102	95	1·40	4	16
Marchmont House	*Berwick*	3·54	3·56	90	101	1·73	17	..
Girvan (Pinmore)	*Ayr*	4·54	4·48	114	99	·96	17	19
Glasgow (Queen's Park)	*Renfrew*	3·62	4·85	123	134	2·30	17	15
Islay (Eallabus)	*Argyll*	4·49	4·43	112	101	1·18	17	18
Mull (Quinish)	"	5·00	3·45	88	69	·93	16	18
Loch Dhu	*Perth*	6·70	7·30	185	109	2·15	17	13
Dundee (Eastern Necropolis)	*Forfar*	3·34	4·22	107	126	1·47	17	13
Braemar	*Aberdeen*	3·63	3·05	78	84	·90	19	13
Aberdeen (Cranford)	"	3·07	2·06	52	67	·76	17	10
Gordon Castle	*Moray*	3·29	2·30	58	70	·58	16	14
Drumnadrochit	*Inverness*	3·11	2·57	65	83	·67	6	18
Fort William	"	6·15	5·75	146	93	1·55	16	18
Loch Torridon (Bendamph)	*Ross*	6·61	3·76	96	57	1·24	16	10
Stornoway	"	3·82	2·25	57	59	·41	2	17
Dunrobin Castle	*Sutherland*	2·71	·82	21	30	·20	3	10
Wick	*Caithness*	2·73	·95	24	35	·23	2	16
Glanmire (Lota Lodge)	*Cork*	3·83	2·58	66	67	·73	7	15
Killarney (District Asylum)	*Kerry*	4·57	2·01	51	43	·57	7	14
Waterford (Brook Lodge)	*Waterford*	3·73	2·69	68	72	·91	7	9
Nenagh (Castle Lough)	*Tipperary*	4·04	2·13	54	53	·59	7	17
Ennistymon House	*Clare*	5·01	2·71	69	54	·70	11	17
Gorey (Courtown House)	*Wexford*	3·31	2·97	75	90	1·01	4	9
Abbey Leix (Blandsfort)	*Queen's Co.*	3·94	2·61	66	66	·75	7	14
Dublin (FitzWilliam Square)	*Dublin*	3·08	1·52	39	49	·39	4	15
Mullingar (Belvedere)	*Westmeath*	4·00	1·95	50	49	·45	8	14
Woodlawn	*Galway*	4·62	2·51	64	54	·43	17	21
Crossmolina (Enniscoe)	*Mayo*	4·68	2·86	73	61	·79	7	18
Collooney (Markree Obsy.)	*Sligo*	4·30	2·85	72	66	·41	2	18
Seaforde	*Down*	3·64	1·99	50	55	·48	7	13
Ballymena (Harryville)	*Antrim*	4·18	2·86	73	68	·69	7	16
Omagh (Edenfel)	*Tyrone*	4·22	3·55	90	84	·87	31	20

THAMES VALLEY RAINFALL, AUGUST 1920.

ALTITUDE SCALE: Below 250 feet | 250 to 500 feet | 500 to 1000 feet | Above 1000 feet

SCALE OF MILES: 0 5 10 15 20

H.M.Stationery Office Press Kingsway, W.C.2.
P.S. 5544/197. 105/P35. 1250. 9/20.

Supplementary Rainfall, August 1920.

Div.	STATION.	RAIN. in.	RAIN. mm.	Div.	STATION.	RAIN. in.	RAIN. mm.
II.	Ramsgate	2·07	53	XII.	Langholm, Drove Rd.	4·18	106
"	Sevenoaks, Speldhurst	1·80	46	XIII.	Selkirk, Hangingshaw	3·14	80
"	Hailsham Vicarage	1·78	45	"	North Berwick Res.	4·34	110
"	Totland Bay, Aston	1·03	26	"	Edinburgh, Royal Ob.	5·33	135
"	Ashley, Old Manor Ho.	1·61	41	XIV.	Biggar	5·74	146
"	Grayshott	2·03	51	"	Leadhills	6·22	158
"	Ufton Nervet	1·43	36	"	Maybole, Knockdon	4·11	104
III.	Harrow Weald, Hill Ho.	1·77	45	XV.	Rothesay	5·34	136
"	Pitsford, Sedgebrook	·95	24	"	Oban	3·66	93
"	Chatteris, The Priory	1·06	27	"	Inveraray Castle	1·89	48
IV.	Elsenham, Gaunts End	1·22	31	"	Holy Loch, Ardnadam	8·56	217
"	Lexden, Hill House	2·18	55	XVI.	Loch Venachar	6·80	173
"	Aylsham, Rippon Hall	1·98	50	"	Glenquey Reservoir	6·10	155
"	Swaffham	1·33	34	"	Loch Rannoch, Dall	3·62	92
V.	Devizes, Highclere	1·23	31	"	Coupar Angus	3·15	80
"	Weymouth	1·55	39	"	Montrose Asylum	1·96	50
"	Ashburton, Druid Ho.	1·70	43	XVII.	Balmoral Castle	3·44	87
"	Cullompton	1·35	34	"	Fyvie Castle	2·17	55
"	Hartland Abbey	2·73	69	"	Peterhead, Forehill	2·92	74
"	St. Austell, Trevarna	1·30	33	"	Grantown-on-Spey	2·92	74
"	North Cadbury Rec.	1·60	41	XVIII.	Cluny Castle	2·80	71
"	Cutcombe, Wheddon Cr.	1·97	50	"	Loch Quoich, Loan	9·26	235
VI.	Clifton, Stoke Bishop.	1·98	50	"	Skye, Dunvegan	3·58	91
"	Ledbury, Underdown.	·79	20	"	Fortrose	2·08	53
"	Shifnal, Hatton Grange	1·17	30	"	Ardross Castle	2·36	60
"	Ashbourne, Mayfield	1·28	32	"	Glencarron Lodge	3·77	96
"	Barnt Green, Upwood	1·87	48	XIX.	Tongue Manse	2·43	62
"	Blockley, Upton Wold	1·92	49	"	Melvich Schoolhouse	1·14	29
VII.	Grantham, Saltersford	..	..	"	Loch More, Achfary	3·89	99
"	Louth, Westgate	1·71	43	XX.	Dunmanway Rectory	3·33	85
"	Mansfield, West Bank	·94	24	"	Mitchelstown Castle	2·72	69
VIII.	Nantwich, Dorfold Hall	1·44	37	"	Gearahameen	2·40	61
"	Bolton, Queen's Park.	2·55	65	"	Darrynane Abbey	2·24	57
"	Lancaster, Strathspey.	2·24	57	"	Clonmel, Bruce Villa	2·90	74
IX.	Wath-upon-Dearne	1·12	28	"	Cashel, Ballinamona	2·08	53
"	Bradford, Lister Park.	1·68	43	"	Roscrea, Timoney Pk.	2·28	58
"	West Witton	1·42	36	"	Foynes	1·98	50
"	Scarborough, Scalby	2·99	76	"	Broadford, Hurdlesto'n	2·40	61
"	Ingleby Greenhow	2·45	62	XXI.	Kilkenny Castle	2·12	54
"	Mickleton	1·20	30	"	Rathnew, Clonmannon	1·79	46
X.	Bellingham	1·90	48	"	Hacketstown Rectory	3·52	89
"	Ilderton, Lilburn	3·25	82	"	Ballycumber, Moorock	2·45	62
"	Orton	3·73	95	"	Balbriggan, Ardgillan	1·98	50
XI.	Llanfrechfa Grange	1·60	41	"	Drogheda	2·24	57
"	Treherbert, Tyn-y-waun	5·52	140	"	Athlone, Twyford	2·74	70
"	Carmarthen Friary	3·56	90	"	Castle Forbes Gdns.	2·31	59
"	Fishguard	3·59	91	XXII.	Ballynahinch Castle	4·14	105
"	Lampeter, Falcondale	3·60	91	"	Westport House	3·95	100
"	Abergwngy	2·55	65	XXIII.	Enniskillen, Portora	..	..
"	Crickhowell, Talymaes	8·00	203	"	Cootehill, Dartrey	..	..
"	Sennybridge	1·82	46	"	Armagh Observatory	1·92	49
"	Lake Vyrnwy	2·75	70	"	Warrenpoint	2·63	67
"	Llangynhafal, P. Drâw	2·05	52	"	Belfast, Cave Hill Rd.	2·57	65
"	Dolgelly, Bryntirion	3·17	80	"	Glenarm Castle	1·93	49
"	Lligwy	4·16	106	"	Londonderry, Creggan.	2·98	76
XII.	Stoneykirk, Ardwell Ho.	3·40	86	"	Sion Mills	2·73	69
"	Whithorn, Cutroach	2·92	74	"	Milford, The Manse	2·72	69
"	Carsphairn, Shiel	5·31	135	"	Killybegs, Rockmount	3·40	86

Erratum.—In July Armagh should read 2·99 in. or 76 mm.

Climatological Table for the

STATIONS	PRESSURE		TEMPERATURE							
			Absolute				Mean Values			
	Mean of Day M.S.L.	Diff. from Normal	Max.	Date	Min.	Date	Max.	Min.	½ max. and min.	Diff. from Normal
	mb.	mb.	° F.		° F.		° F.	° F.	° F.	° F.
London, Kew Observatory	1013·8	0·0	66	30	29	9	54·1	39·0	46·6	+4·2
Gibraltar	1021·1	+5·3	71	23	37	11	62·5	49·6	56·1	−1·4
Malta	..	..	..	..	..	..	..	..	..	..
Sierra Leone	1011·4	+0·5	99	7	70	24	89·3	73·9	81·6	−1·0
Lagos, Nigeria	1011·8	+2·4	99	24	71	22	89·3	77·6	83·5	+0·6
Kaduna, Nigeria	1012·9	+4·8	100	19, 20	55	5	93·6	62·7	78·1	−3·6
Zomba, Nyasaland	1010·7	+1·0	86	2	60	28,29,31	79·1	64·9	72·0	+1·3
Cape Town	..	..	96	19	50	25	79·5	57·4	68·5	+0·3
Johannesburg	..	..	83	15	41	27	73·0	53·0	63·0	−0·3
Mauritius	1013·1	+1·1	86	11	65	5	83·5	71·6	77·5	−0·5
Bloemfontein	..	..	83	10	38	27	74·0	52·1	63·1	−4·3
Calcutta, Alipore Obsy.	1009·4	−0·5	96	21	61	7	88·8	71·7	80·3	+0·2
Bombay	1009·9	−0·8	91	25	71	2	87·4	74·3	80·9	+1·4
Madras	..	..	92	30	70	21	89·9	73·7	81·8	+0·8
Colombo, Ceylon	1010·1	+0·1	93	26	73	1, 3, 7,	88·4	74·3	81·3	−0·7
Hong Kong	1016·6	+0·8	80	11	51	4	66·7	59·3	63·0	−0·3
Sydney	1017·5	+1·3	82	5	51	19	75·1	59·7	67·4	−1·8
Melbourne	1017·7	+0·9	98	13	46	10	73·4	53·8	63·6	−0·9
Adelaide	1018·7	+1·7	105	14	47	22	80·9	58·2	69·5	−0·4
Perth, West Australia	1015·5	+0·1	104	23	47	30	81·6	61·5	71·5	+0·7
Coolgardie	1015·0	+0·2	104	9	46	14	86·0	59·9	72·9	+1·2
Brisbane	1016·2	+2·1	90	7	57	18	81·6	64·6	73·1	−1·3
Hobart, Tasmania	1013·2	−0·9	88	13	41	18	68·5	49·9	59·2	−0·2
Wellington, N.Z.	1016·2	−0·8	76	19	45	26	67·3	54·9	61·1	+0·4
Suva, Fiji	..	..	..	..	..	..	..	..	..	..
Kingston, Jamaica	..	..	90	10	65	21	87·0	69·3	78·1	+1·0
Grenada, W.I.	1013·5	+0·6	85	30	69	8	82·8	71·6	77·2	−0·5
Toronto	1014·1	−2·9	66	26	−1	2	43·1	24·6	33·9	+5·0
Fredericton, N.B.	..	..	65	24, 25	−19	2	39·0	15·2	27·1	+1·5
St. John, N.B.	1011·2	−3·0	58	25	−9	2	37·8	22·1	29·9	+1·5
Victoria, B.C.	1012·0	−3·8	59	20	32	31	49·6	38·2	43·9	+0·7

London, Kew Observatory.—6 fogs. 2 days of snow; mean speed of wind 8·5 mi/hr.

Gibraltar.—3 fogs, 3 gales.

Sierra Leone.—Prevailing wind direction S.W.

Mauritius.—Prevailing wind direction E; mean speed, 7·5 mi/hr.

British Empire, March 1920.

TEMPERATURE Absolute Max. in Sun °F.	TEMPERATURE Absolute Min. on Grass °F.	Relative Humidity %	Mean Cloud Am'nt 0–10	PRECIPITATION Amount in.	PRECIPITATION Amount mm.	PRECIPITATION Diff. from Normal mm.	PRECIPITATION Days	BRIGHT SUNSHINE Hours per day	BRIGHT SUNSHINE Percentage of possible	STATIONS
118	17	76	6·1	1·17	30	− 13	14	4·1	35	London, Kew Observatory.
138	32	77	4·1	1·96	50	− 72	10	..	..	Gibraltar.
..	..	..	..	..	..	..	..	..	..	Malta.
..	..	65	2·3	0·00	0	− 28	0	..	..	Sierra Leone.
163	55	71	6·2	3·78	96	0	6	..	..	Lagos, Nigeria.
..	..	40	1·0	0·00	0	− 10	0	..	..	Kaduna, Nigeria.
..	..	90	9·2	21·78	553	+343	23	..	..	Zomba, Nyasaland.
..	..	65	2·6	0·16	4	− 20	4	..	..	Cape Town.
..	..	76	5·0	4·40	112	+ 5	10	7·6	62	Johannesburg.
..	60	78	6·1	8·98	228	− 10	27	8·4	69	Mauritius.
..	..	73	3·9	5·99	152	+ 51	10	..	..	Bloemfontein.
..	57	55	3·6	6·27	159	+127	5	..	..	Calcutta, Alipore Obsy.
..	..	77	1·9	0·00	0	− 1	0	..	..	Bombay.
157	67	73	2·1	0·00	0	− 5	0	..	..	Madras.
161	68	76	6·3	5·95	151	+ 39	13	..	..	Colombo, Ceylon.
..	..	84	9·0	1·39	35	− 41	8	2·7	22	Hong Kong.
137	45	66	4·1	1·49	38	− 93	13	..	..	Sydney.
147	37	59	5·5	1·08	27	− 28	11	..	..	Melbourne.
157	36	44	3·6	1·44	37	+ 10	3	..	..	Adelaide.
165	40	56	3·5	1·63	41	+ 23	6	..	..	Perth, West Australia.
164	44	35	4·3	0·52	13	− 6	5	..	..	Coolgardie.
146	53	62	4·1	1·80	46	−106	7	..	..	Brisbane.
141	34	69	6·1	1·78	45	+ 3	17	..	..	Hobart, Tasmania.
140	34	73	4·5	2·13	54	− 29	7	8·2	67	Wellington, N.Z.
..	..		..	..	..	..	..	..	..	Suva, Fiji.
..	..	80	3·0	0·34	9	− 17	7	..	..	Kingston, Jamaica.
137	..	71	4·3	2·51	64	− 6	17	..	..	Grenada, W.I.
104	−11	63	4·7	2·31	59	− 8	10	..	..	Toronto.
..	..	..	..	2·99	76	− 44	13	..	..	Fredericton, N.B.
..	..	72	5·6	8·04	204	+ 89	15	..	..	St. John, N.B.
119	23	80	6·7	2·28	58	− 7	18	..	..	Victoria, B.C.

BLOEMFONTEIN.—Coolest March yet experienced.

COLOMBO, CEYLON.—Wind direction variable; mean speed, 3·7 mi/hr.; 14 thunderstorms.

HONG KONG.—Prevailing wind direction E; mean speed, 15·1 mi/hr.; 1 thunderstorm, 11 fogs.

GRENADA.—Prevailing wind direction E.

at various places, 66 mm. of rain falling at Hernosand (Sweden) during the 24 hours ending 7 a.m. on the 7th. During this period the Azores were under the influence of an anticyclone with extensions over southern Europe. On the 9th the temperature reached 95° F. at Madrid. About this date the Azores anticyclone moved up in a northerly direction and by the 11th was centred over the British Isles. It afterwards moved SW. and remained off the SW. coasts of the British Isles for some days, but by the 17th it had retreated to the Azores again. High temperatures were recorded in the south of France during this period, the temperature at Perpignan reaching 101° F. on the 16th. With the retreat of the anticyclone, further depressions moved in from the Atlantic, one of which crossed the British Isles on the 17th–18th to the North Sea, and after remaining in the vicinity of the southern North Sea and Denmark for some days, moved eastward, where it remained over Germany and Poland until the end of the month. On the 20th, 48 mm. of rain fell at Saerna (Sweden) and 43 mm. at Lugano (Switzerland).

The Azores anticyclone again spread northward on the 18th, and remained off the west and south-west coasts of the British Isles until the 25th, when it moved up over the British Isles. By the 28th it was centred over the Färoe Islands, and by the 31st over the Gulf of Bothnia. This northern movement of the anticyclone caused a considerable improvement in the weather of Northern and North-western Europe during the last days of the month.

In Italy and the Eastern Mediterranean the weather continued for the most part fine and warm throughout the month. A temperature of 108° F. was reached at Cairo on the 17th, and again on the 27th, while on the latter date 106° F. was recorded at Alexandria.

On the 9th and 10th, New York and the North-Eastern States experienced temperatures above the normal. On the former day 100° F. in the shade was registered at Oneco, Connecticut, this being the highest temperature experienced there for 40 years. The hot weather was associated with an extensive area of high pressure occupying the Western Atlantic, but although this maintained itself for nearly three weeks, temperatures were normal the greater part of the time. There had been no previous hot periods this summer.

A message from Bombay, dated August 9th, stated that there had been abnormal rainfall accompanied by unprecedented floods in the region of the new industrial town of Jamshedpur, near Bombay. The low-lying parts of the town were under water and over 100 persons perished. On the whole, however, the monsoon in India was poor; at Bombay Observatory only 35 inches of rain fell from June to August, compared with a ten-year average of 55 inches in the same period. In some sections rain was badly needed, especially in Berar, the Bombay Presidency and the Western Deccan. Good rain, however, fell throughout the area affected by the long drought in the Eastern Deccan and Haidarabad. In the southern part of the latter province it exceeded the normal. The naturally rainy province of Assam also had heavier rain than usual. The condition of the cotton crop was poor on the whole owing to the dry weather, but Indian meteorologists were of opinion that there was no cause for anxiety.

In Australia extraordinary cold was experienced in Victoria, snow falling as far north as Albury, on the River Murray, where it had not been seen for 20 years. Good general rains were again registered over Victoria and New South Wales. South Australia is anticipating a record harvest.

There were very serious floods in portions of the Japanese islands of Kyushu and Shikoka, many whole towns and villages being overwhelmed. The casualties are believed to be enormous.

During a recent storm the collapse of a mountain top in the Philippines buried a village of Igorot Malays under hundreds of feet of earth and caused the loss of 70 lives.

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Back Radiation from the Sky.

By W. H. DINES, F.R.S.

APPARATUS has been fitted up at Benson by means of which the radiation from the sky can be read off at sight in gramme-calories per day or any other convenient unit on the scale of a mirror galvanometer. It consists of a thermo-electric pile of 120 pairs of copper-eureka junctions. The separate elements are of the shape and size of a two dimensional tadpole, if such an expression may be allowed, and are cut from sheet copper ·003 inch thick and from sheet eureka ·006 inch thick. The tail of each tadpole is soldered to the body of the next so as to form a long string of alternate circles and narrow strips, the different metals occurring, of course, alternately. A twist through a right angle is then given to each strip or tail so that the copper to eureka junctions all remain in one plane while the eureka to copper junctions are parallel to another plane at right angles to the first. A small cone of radiation falling upon such an arrangement heats the one set of junctions because it falls on them perpendicularly, but is almost without effect upon the other set because it catches them edgewise. The whole strip of junctions is rendered a dull black and there are no polished surfaces to deteriorate with time.

The junctions of the thermopile are distributed as symmetrically as possible over a 4 inch circle and are placed

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4 inches from the inner end of a metal cylinder 2 feet long which is buried in a 40-gallon tank of water. The axis is horizontal and the cylinder has a 4-inch circular opening at the end through which the radiation enters; thus the cone of radiation dealt with has a semi-vertical angle of $\tan^{-1} \frac{2}{10}$. Just outside the opening a polished metal spherical mirror (of 4 feet radius) is placed which can revolve about the axis of the cylinder. The axis of the mirror is inclined to the axis of the cylinder at an angle of 45°, and by its use the cone of radiation can be directed to any part of the sky lying in one fixed vertical circle and, further, the semi-vertical angle of the cone is reduced to nearly one-half of its former value.

The instrument is calibrated thus. An equally spaced scale about 15 inches long, showing from 0 to 1,200 gramme calories per square centimetre per day, is prepared on tracing paper. Parallel to this and at a distance above it equal to the diameter of the bright spot a second scale is made indicating absolute temperatures. The numbers on this scale are such that they indicate the temperature at which one square centimetre of a full radiator will give out per day the number of gramme-calories indicated on the lower scale. Thus at 245a the radiation is 400 g.c. per day, and hence the 400 division of the g.c. scale lies below and in line with the 245 of the temperature scale. The scale so prepared is mounted on a stand so that it can slide longitudinally and any temperature be brought into coincidence with the light spot. Now the galvanometer scale can be altered by a shunt of variable resistance or by altering the distance of the scale from the mirror, and by one or both of these means the scale is so adjusted that a change in the radiation of 100 g.c. per day falling on the pile may shift the light spot over 100 divisions of the lower scale. The requisite change of 100 g.c. is obtained by taking first radiation from a black body at a temperature T and then raising the temperature to the requisite point to produce another 100 g.c. Thus, assuming the zero line to be in the right position, the light spot should show on the upper scale the precise temperature of the black body which is giving the radiant energy to the thermopile, and there is no difficulty in obtaining this condition over a range of 50° C. with an accuracy of at least ·5 of a degree.

The zero is adjusted thus. A cylinder, a glazed 9-inch drain pipe in fact, is partially buried in the ground vertically below the mirror and is half filled with water. Water is almost a full radiator and with the drain pipe forms an efficient black body, especially as its temperature is very little different from that of all neighbouring objects. The cone of radiation is directed downwards to the water in the drain pipe and the prepared scale is then shifted longitudinally so that the light-spot may coincide with the temperature of the water in the drain pipe. The zero will change with change of temperature of the junction of the pile because it is the difference between the pile and the external source of radiation which actuates the galvanometer, but the temperature of the pile depends so largely upon that of the enclosure in which it is placed, which in turn depends on the surrounding water, that any change of zero is quite slow and gives no difficulty.

The instrument so adjusted is then turned to any part of the sky and gives on the upper scale the equivalent radiation temperature of that part of the sky, or on the lower scale the gramme-calories per day that would be given by a hemisphere of such sky to one square centimetre of surface.

The diffuse solar radiation prevalent while the sun is above the horizon can also be determined thus. Directing the cone of radiation towards a pane of window-glass with a sheet of bright metal at the back, the scale reading gives the radiation from the glass. Removing the metal backing, the scale reading rises because diffuse solar radiation can pass through the glass almost unimpeded. The difference in the readings is the diffuse solar radiation, and by subtracting this from the observed sky radiation the true sky radiation during the daylight hours can be obtained.

OFFICIAL NOTICES.

Discussions at the Meteorological Office.

At the request of the Director of the Meteorological Office, Sir Napier Shaw, Professor of Meteorology in the Imperial College of Science and Technology, and Reader in Meteorology in the University of London, proposes to continue the series of meetings commenced in 1905 for the informal discussion of important contributions to meteorological literature, particularly those by Colonial or Foreign Meteorologists.

The meetings will be held at the Meteorological Office, South Kensington, at 5 p.m. on Mondays, November 1st, 15th, 29th, December 13th, 1920; January 10th, 24th, February 7th, 21st, March 7th, 21st, 1921. On November 1st Sir Napier Shaw will open the discussion of two important papers by Prof. V. Bjerknes, viz.:—

(1) The Meteorology of the Temperate Zone and the General Atmospheric Circulation;

(2) The Structure of the Atmosphere when rain is falling.

London University Lectures.

As Reader in Meteorology in the University of London, Sir Napier Shaw, Sc.D., LL.D., F.R.S., will deliver at the Meteorological Office, South Kensington, a course of lectures entitled "A Historical Review of Meteorological Theory." The lectures, which will be on Fridays at 3 p.m., and will be followed by a practical class, commence on Friday, January 21st.

Admission to the lectures is free by ticket, to be obtained on application to the Reader at the Meteorological Office, South Kensington.

Summer Time Act.

In view of the threatened coal strike the Government announced that the period of Summer Time was to be extended. Accordingly, the public clocks did not resume Greenwich Time on September 27th, as had been anticipated in the notice in the last number of this Magazine.

The reversion is to be effected as from 3 h. (Summer Time) on Monday, October 25th. Observers are requested to state explicitly the standard of time on their returns for October and November 1920.

New Meteorological Station.

On August 19th, 1920, a reporting station was established at Flamborough Head Coastguard Station. This station is to report six times daily to the Meteorological Office at Howden by telegraph.

Official Publications.

Professional Notes No. 12. An Analysis of the Rate of Ascent of Pilot Balloons at Butler's Cross, Salisbury Plain. By R. P. Batty, B.A. Price 6*d.* net.—The method of obtaining the velocity of the wind by the use of observations of pilot balloons with a single theodolite is known to be open to the objection that the assumptions that the rate of ascent of a balloon is constant and that it can be determined by a formula from the weight and buoyancy of the balloon are only roughly true.

At the meteorological station attached to the School of Artillery on Salisbury Plain it is the practice to make observations with two theodolites when possible. In Mr. Batty's analysis 225 ascents have been utilised. The ascents considered were mostly made during the morning hours from 9 h. to 13 h., and it appears that during these hours the rate of ascent of a balloon is normally much higher than the rate computed by the standard formula. The highest rate, between 12 h. and 13 h. indicates an upward current of no less than 60 ft. min. The effects of cloud and rain and of the character of the wind are also shown to be of considerable importance in determining the rate of ascent. Mr. Batty's paper should go far towards providing empirical rules for modifying the assumed rate of ascent of pilot balloons for single theodolite work in different types of weather.

Correspondence.

To the *Editors*, "*Meteorological Magazine.*"

Cirrus Formation at a Low Level; also a Mammato Effect.

YESTERDAY evening, September 14th, 1920, the sky at Barnet was practically overcast and the wind light from a westerly direction, the lower and intermediate clouds drifting slowly from a point north of west.

At 17 h. 40 m. G.M.T. the sun became visible for a short period through a break in the clouds, and my attention was attracted to a very long delicate ribbon of cloud, below the general cloud mass, slightly waved and rendered relatively brilliant by the rays of the declining sun.

As this ribbon approached my zenith its apparent width greatly increased owing to changed perspective and to a probable lateral extension, and it was then that I noticed a striking resemblance to the "wavy gossamer sheets interspersed with feathery wisps of beautiful delicacy" described by Mr. R. Francis Granger in your August number, but there was an absence of tufts with flowing tails described by him.

The phenomenon—or perhaps the appropriate combination of conditions of perspective and ideal illumination—lasted a few minutes only, but during that time possessed to a very marked degree all the outstanding features shown in the illustrations of Ci-Macula (Speckle Cloud) and Ci-Inconstans in Mr. Clayden's "Cloudland."

The clouds above were of a nondescript character, but in the main of a stratiform nature and with some rather clumsy and irregular Cu-Castellatus intermixed. They appeared to be at no very great altitude and, far above, hard white Cirrus fibres were discernible.

The barograph trace, although its general trend was downward, at about this time betrayed a hesitating tendency to rise but fell decidedly at a later hour owing to the withdrawal to the south-west of a High, and the ensuing weather has been in striking contrast to that recently experienced.

To-day it has been overcast with drizzle and occasional heavy thin rain from low Nimbus, and at 18 h. 30 m. I observed another rather unusual cloud modification, namely, the much-maligned Mammato effect.

This, although admittedly not an everyday occurrence, is not so uncommon as some would have us believe; moreover, it is not confined to the under-surface of more or less horizontal cumuliform cloud canopies, but is frequently an attribute of the "cirrified" extrusion of the "Anvil" cloud, and is also seen occasionally as a modification of low dense Nimbus as in this instance, when well-defined mammillations appeared on two planes together forming an obtuse angle.

The general effect was not unlike that illustrated in Capt. Cave's "The Forms of Clouds," but the protuberances were rather more pronounced and the cloud mass was apparently at a considerably lower altitude.

The phenomenon was unattended here by any demonstration of frightfulness other than the purely spectacular, and, although a rain curtain was noticed in the distance, no precipitation reached earth at this place.

The barometer rose ·04 inch in rather less than an hour, and the wind, which had been feeble, dropped to a complete calm.

A. S. Martin-Smith.

71, Wood Street, Barnet, Herts, 15th September, 1920.

Mammato-Cumulus Clouds over Manchester.

During the last three months five observations of Mammato-Cumulus clouds have been made at this station, one in June, one in July and three in August. Since this type of cloud is perhaps not observed so frequently at other stations, it is thought that a few remarks will be of interest.

On June 14th, 1920, a shallow secondary moved up from England SE. to the Irish Sea. By 18 h. G.M.T. the sky was overcast and gloomy, with A-Cu amount 3, and Cu-Nb amount 6 ($\frac{9}{10}$ of the sky being thus covered with A-Cu and Cu-Nb), travelling at 15–20 mi./hr. from E. at about 2,000 feet height. From 18 h. 15 m. to 18 h. 25 m. Mammato-Cumulus 3, and Cu-Nb 7, were observed.

On July 13th at 18 h. G.M.T. there was a westerly current over this district, due to a low-pressure belt extending from Iceland to Scandinavia and the anticyclone over the Bay of Biscay. The clouds were Cu-Nb 9 and Mammato-Cumulus at about 3,000 feet which were travelling at 30–40 mi./hr. and had a threatening appearance.

The August observations were on the 3rd, 10th and 14th. On the 3rd at 7 h. G.M.T. the general conditions was similar to those experienced on 13th July, but the westerly current was only about 20 mi./hr. at 2,000 feet. The clouds observed from 9 h. 34 m. to 9 h. 41 m. were A-Cu 1, Mammato-Cumulus 3, and Cu-Nb 6 travelling at the height and speed above mentioned.

On the 10th at 18 h. G.M.T. an anticyclone was spreading in slowly from Ireland, but the locality was still under the influence of the depression over Denmark. The clouds observed were St-Cu 4, Mammato-Cumulus 3 and St. 3 at about 3,000 ft. travelling at 15–20 mi./hr. from WNW.

On the 14th, the pressure distribution at 18 h. G.M.T. was somewhat similar to that on the 10th, the weather of the locality being governed by the north-westerly current between the high pressure over South Ireland, Wales and England SW. and the low pressure over Scandinavia. The clouds were St-Cu 7 and Stratus 3. The Mammato-Cumulus clouds were observed at 20 h. to 20 h. 16 m., and the cloud amount was 3. The sky by then had become cloudy, and as the low St-Cu clouds were passing away to the SE., the structure of these clouds, when observed near the horizon, showed that they were really a degraded type of Cu-Nb.

G. H. L. DOUGLAS-LANE, Capt.

Civil Aerodrome, Alexandra Park, Manchester.

Parallel Bands of Cloud at High Levels.

AN extensive display of parallel bands of cloud at a high level on the evening of September 10th recalled to me a recent article in the *Comptes Rendus* (July 5th, 1920, p. 42) in which M. P. Idrac gives an explanation of such phenomena, opposing that of wave motion. By means of a laboratory experiment he succeeded in showing that if a moving stratum of air of uniform temperature and velocity is adjacent to another of uniform but different temperature and velocity, then a series of vortices is set up, with parallel horizontal axes, and from this he suggests that in the higher strata of the atmosphere, where the condition of horizontal uniformity of temperature and velocity is most easily realised, such may take place, resulting in parallel cloud bands marking the tops of the vortices.

The experiment showed (1) that the bands should be parallel to the relative wind of the two strata (or the vertical gradient of wind velocity); (2) that the sense of rotation of one vortex is opposite to that of the two adjacent vortices.

The explanation that the bands mark the crests of atmospheric waves demands that the bands should be perpendicular to the vertical gradient of wind velocity, and this fact, in conjunction with his first generalization enabled M. Idrac to produce observations in support of his suggestion. It seems to me that the second generalization might also be used, for the edge of the band where the air is rising and cloud forming might well present an appearance differing from that of the other edge, where air is descending and cloud dissipating. Distinguishing between the edges of the bands by "left" and "right" (as one looks along them), M. Idrac's rule demands that the left edge of one band should resemble the right edge of the next, and so on. In my observation of September 10th, all the left edges were alike and also all the right edges, but the left differed markedly from the right. This opposes the vortex suggestion and to some extent supports that of atmospheric waves, which might be expected to produce identical bands. However, M. Idrac has observational support, and his suggestion cannot be ignored. Even if the difference of sharpness of the edges is due solely to the relative wind having a component across the bands as in the wave case, the vortex case should present an observable difference, all edges being identical since the relative wind is along the bands. Perhaps bands of both kinds occur, and observers who have opportunities of watching the skies closely day by day may be able to obtain evidence on this interesting point. M. A. GIBLETT.

W. Hampstead, 10th September, 1920.

Visibilty on Cloudy Nights.

OBJECTIONS based on Weber's law were raised last month in connection with Captain Pick's method of determining visibility at night. Weber verified his law for illuminations of a white screen varying from 1 to 1,000 centimetre-candles, but the intensities ultimately used in Captain Pick's experiments are very much smaller, and these experiments indicate that Weber's law may not be true for small intensities of illumination.

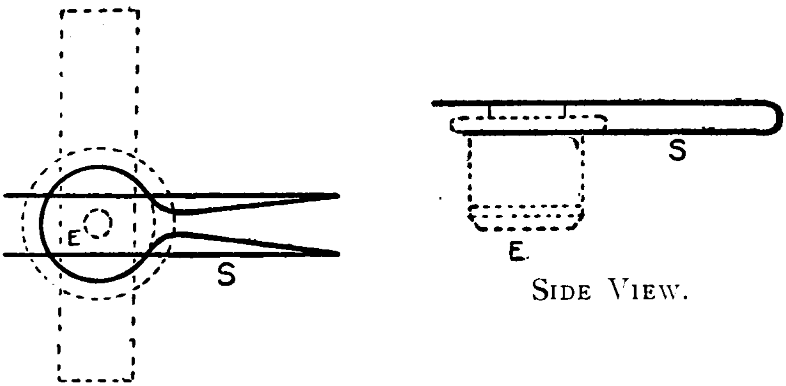
Further, there are two different sets of receptive organs in the retina, known generally as "rods" and "cones," the former coming into play when the light is faint, and having different properties from the "cones," one of which is their inability to distinguish colour. The success of Captain Pick's method might therefore be traceable to the transference from the one set of nerves to the other at faint illuminations.

J. WADSWORTH.

A Simple Form of Light-Filter for Pilot Balloon Work.

A REPORT* has already been published by Mr. Watson Watt on the use of light filters in the observation of pilot balloons, and a form of mounting for the filters was described by him. The following description deals with an extremely simple form of mounting which is very easily constructed, and which has been found to be quite serviceable.

The filters which are used, and which were recommended to the writer by Mr. Watson Watt, are five Wratten Gelatine Filters of the following colours:—1, Dark Red; 2, Stage Red; 3, Orange; 4, Yellow; 5, Blue Green. The Wratten Series "numbers" are F, 27, G, K2, and 44 A respectively. From an old photographic negative two slips of glass were cut, $2\frac{1}{2}$ inches by $\frac{1}{2}$ inch, and on one of them a mask of black paper was built up enclosing a rectangular space $1\frac{7}{8}$ inches by $\frac{5}{16}$ inch. Into this space were laid a $\frac{5}{16}$-inch square of each of the filters in the order given above, with a gap of the same size between Nos. 4 and 5. A mere trace of liquid fish-glue at alternate corners of the filters prevents them from moving, and the other slip of glass is then cemented over them. This completes the filter proper. If desired it can be improved by cementing the whole with soft balsam. A diagram of the device for holding the filter in position against the eye-piece of the theodolite is given below. The middle part of a piece of No. 20 S.W.G. steel



END VIEW. SIDE VIEW.

piano-wire about 9 inches long is bent into a ring, which is a spring (S) fitting over the barrel of the eye-piece (E). The two ends are led radially outwards side by side for about an inch, at which point they are both bent back upon

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* M.O. Circular, No. 44, p. 6.

themselves and return as two parallel prongs about $\frac{5}{16}$ inch apart. The ring is sprung open and slipped over the barrel of the eyepiece so that the two prongs lie across, and press against the milled face of the eye-piece. All that remains to be done is to slip the filter underneath the prongs, so that it is held securely against the face of the eye-piece. In use, it is found to be quite easy to slide the filter parallel to itself, and so change the colour of the filter, without losing sight of the image of the balloon for an instant. By sliding the filter perpendicularly to its length a clear view is obtained, which is better than that obtained by using the blank space in the filter, as was first intended.

The advantage derived from the use of these filters has become evident during the short time that they have been in use here. It has sometimes been found quite easy to retain the balloon by the use of a filter for some time after it has become absolutely invisible without a filter. Moreover, it is found that a change of colour is very restful to the eye, which again conduces to longer ascents.

In particular, a red balloon used with the blue-green filter is very pleasant to work with, especially against a white background of Ci. or A-Cu. The "stage-red" is also extremely effective in cutting out haze.

N. K. JOHNSON.

Shoeburyness, 5th July, 1920.

Line-Squall of July 4th.

THE following information may be of interest in connection with the line-squall of July 4th, mentioned by S. Hyla Greves in the August number of the *Meteorological Magazine.*

The observer on duty on July 4th wrote in the pocket register:—

> "Line-squall, 12.30 G.M.T. Rain commenced 12.40. Wind veered to NE. and increased to 22 mi./hr. Sharp rise on micro-barograph. Thunder 12 h. 43 m. Temperature fell 4° F."

I personally remember that the sky presented a very ugly appearance in the early afternoon. The rainfall associated with the squall was slight; indeed the tabulation of the hyetogram shows that the quantity in the hour centred at 13 h. was negligible.

A pilot balloon (rate of ascent 400 ft./min.) released during the passage of the squall was "lost behind the hut" at the end of the first minute, and the computation showed that the wind was from NE. with a speed of 36 m.p.h. It is probable, however, that the balloon had not attained its nominal rate of ascent. At 13 h. the surface wind (40 ft.) was ENE., 16 m.p.h. Bournemouth is situated W. 15° S. of Calshot, and at a distance of 25 miles. The difference between the times of occurrence of the squall at the two places was approximately 1 h. 10 m.

H. W. L. Absalom.

Aerial Navigation School, Calshot, Hants, 23rd August, 1920.

Line Squall of July 24th.

I read with interest the account of a "Line Squall of July 4th" which occurred in the vicinity of Bournemouth, and should like to give some particulars of a very similar line squall I experienced while at home at Shanklin, Isle of Wight.

On July 24th, at 5h. 30m. G.M.T., I was roused from sleep by the wind, which, after being strong and squally from SW. for the previous 24 hours, had suddenly veered to NNE. and was blowing with great fury, bending trees double and rattling windows. Rain descended in torrents, and it grew so dark that I expected thunder, but none came, only this violent N. gale and torrential rain, and a decided decrease of temperature. This squall continued for about an hour, and then suddenly the sky cleared, the wind backed to NW. and dropped, the rain ceased and a glorious but cool day followed. The amount of rain was 10 millimetres, but at Sandown, 1½ miles NNE. of Shanklin, 20 millimetres were collected. The barograph showed the line squall well, having started to rise immediately the wind shifted. The feature of this sudden squall was the violence of the northerly gale, which swept along, carrying all before it. As far as I could gather, the squall was not noticed in the mainland, though SE. England generally had heavy rain in the early hours of the morning.

J. E. Cowper, Captain.

Mist Formation.

On September 27th at about 18 h. I saw little wisps of mist forming on the surface of a grass field, not only in the lowest lying ground, but in various parts of the meadow under observation. It gradually spread and flowed down a gentle slope till by 18 h. 15 m. the surface generally was covered to a depth of about 3 feet. About this time I stooped down and noticed that in most parts the mist had risen slightly off the surface and lay like a blanket some 2 feet above the ground. The layer of mist showed a tendency to rise till by 18 h. 30 m. it was 5 feet above the ground in places. At this time the air became misty underneath it again, and a haze began to form which later changed to fog.

The first development of mist was clearly due to cooling of the surface layers by contact with ground which was radiating heat to a clear sky. Further explanation of the phenomenon is hazardous ; I would suggest that the density of the surface layer was reduced owing to the release of latent heat by condensation This layer would be forced up by katabatic currents and radiation being delayed by the blanket of mist, there would be a small interval before the dew-point of the new surface layer could be reached. The humidity at the time was 100 per cent. The haze which changed to fog was probably due to the usual process of mixing.

R. FRANCIS GRANGER.

Lenton Fields, Nottingham, 3rd October, 1920.

A Mock Sun in false Cirrus.

ON two occasions lately a mock sun has been seen at Valencia Observatory in a false cirrus cloud. Presumably this must be a common occurrence, but I do not remember to have seen it before. On the latter occasion the mock sun was very brilliant, and a short portion of the halo of 22° was also to be seen close to it showing well-marked colours.

L. H. G. DINES.

Valencia Observatory, Cahirciveen, 4th Oct. 1920.

Snow at Jerusalem.

MR. GODDEN in a letter to the June number of the *Meteorological Magazine* asks for particulars of the heavy fall of snow which occurred at Jerusalem last February. I happened to be there at the time and so can answer his questions.

The American colony who have been taking meteorological observations there since 1860 reported 29 inches of snow, and 10 inches of rain and melted snow in the six days February 8th to 13th. It was the greatest fall of snow they had ever recorded. It began with heavy rain on February 8th and rain and sleet on February 9th. A blizzard with wind of gale force was blowing on the Mount of Olives on the 9th, but the snow did not lie on the ground until the night of that day. It snowed almost continually all the 10th and 11th, and as far as I can remember some fell on the 12th. It lay thick on the ground until the 15th, and there was still some lying in sheltered spots when I left Jerusalem on the 17th.

The minimum temperature registered on the Mount of Olives during the week was −4° C. Snow fell over a wide area, not only on the hills. It is reported that it lay on the ground at El Arish and some fell at Port Said. The storm was due to a depression which deepened considerably when over the Eastern Mediterranean. Gales and very cold weather were experienced throughout lower Egypt.

H. KNOX-SHAW.

Helwan Observatory, Egypt, 7th July, 1920.

In connection with Mr. Godden's letter in the June Magazine the following may be of interest:

Dr. Shaw was English chaplain at Algiers 1719–34, and during that time travelled extensively, not only in the Barbary States, but also in Egypt, the Sinai Peninsula, Palestine and Syria.

Touching snow at Jerusalem, he writes:—

"It is an observation at or near Jerusalem that provided a moderate quantity of snow falls at the beginning of February, whereby the fountains are made to overflow a little afterwards; there is a prospect of a fruitful and plentiful year; the inhabitants making upon these occasions the like rejoicings with the Egyptians upon the cutting of the Nile."

"The rejoicings that were used upon these occasions seem to have been very great, even to a Proverb: as we may infer from Psalm iv., 7: 'Lord, Thou hast put gladness in my heart, more than at the time when the corn and wine increased.'"

This may be fairly enough paraphrased as follows:—

"There is greater rejoicing over a bountiful snow in February than at a Harvest Festival."

Can any one tell us whether such rejoicings were made after the snow of February 1920?

H. A. Boys,
English Chaplain at Algiers 1875–1889.

North Cadbury Rectory, Somerset, 7th August, 1920.

[Is not the following verse from Proverbs xxv. 13 even more to the point? "As the cold of snow in the time of harvest, so is a faithful messenger to them that send him. For he refresheth the soul of his masters." —Ed. M.M.]

Geostrophic Wind over London; November, 1881–1915.

FREQUENCY OF STRENGTH AND DIRECTION.

Estimates based on the D.W.R. charts (8*h.*, 1881–1908; 7*h.*, 1909–1915).

Direction.	5 m/s. 11 mi/hr.	10 m/s. 22 mi/hr.	15 m/s. 33 mi/hr.	20 m/s. 44 mi/hr.	Over 20 m/s. Over 44 mi/hr.	Total Frequency of Direction.
N.	19	22	23	11	13	88
NE.	2	8	19	4	4	87
E.	12	22	26	11	9	80
SE.	13	20	16	2	—	51
S.	21	39	24	14	9	107
SW.	25	48	58	26	22	179
W.	19	49	86	40	29	223
NW.	18	26	20	25	7	96
Total Frequency of Strength	129	234	272	133	93	861*

* Indeterminate—189.

NOTES AND QUERIES.

The Monthly Flysheet.

WITH the issue on September 1st of a new monthly supplement to the Daily Weather Report the history of the *Monthly Flysheet* was closed. Up to the end of 1916 no information as to the weather of each month as a whole was published officially, until the appearance of the Monthly Weather Report, inevitably about four weeks after the end of the month, though zealous private individuals could, and did, utilise the daily and weekly weather reports in preparing summaries for the newspapers. In other countries, notably in Egypt and in India, summaries based on the telegraphic reports are issued officially within a day or two of the end of the month and the Flysheet was designed to serve the same purpose. The circumstances of the time made it desirable not to incur the expense of printing, and the Flysheet was therefore typewritten and duplicated. The tables which supplement the account of the weather were designed to include data which could not be recapitulated in the Monthly Weather Report. For example, the Monthly Weather Report gives the warmest day and coldest night of the month, but the Flysheet gives the coldest day (lowest maximum temperature) and the warmest night (highest minimum temperature). So that data for Dublin might be included in the tables the Superintendent of the Ordnance Survey Office was so good as to arrange for special telegrams to be sent on the first day of each month. Mr. F. J. Brodie was responsible for the preparation of the Flysheet from the first number up to his retirement in March 1920. The new supplement of the Daily Weather Report continues the tables of the Flysheet, whilst tables of upper air conditions and of surface visibility had been introduced.

A Method of Reaching Extreme Altitudes.

MR. R. H. GODDARD, Professor of Physics, Clark College, Worcester, Mass., contributes to *Nature* of August 26th, 1920, an interesting article on "A Method of Reaching Extreme Altitudes," in which he discusses the general principles and possibilities of the method of reaching great altitudes. Professor Goddard proposes to send up rockets which are to be propelled through the air by the ejection of exploded gases at suitable intervals.

He states that "the most important of the immediate applications of the method is in the providing of a simple and, when sufficiently developed, inexpensive means of obtaining meteorological data at the 10-kilometre level. It is well recognised that this is the most important level for studying pressure, temperature, humidity, and wind velocity; and any means of sending recording instruments rapidly into this region, and of obtaining data soon after the ascent has been made, is certain to be of value in weather forecasting. At greater elevations the study of temperature pressure, wind velocity and composition of the atmosphere is of scientific importance, and also the study of the aurora, during the day as well as at night, and the radiations from the sun that are otherwise absorbed by the atmosphere."

"A further application of much general interest is the possibility of sending a mass beyond the predominating gravitational field of the earth. Concerning the possibility of demonstrating this point by hitting the moon with a rocket, it can be said, apart from the questions of aiming and of correcting the flight, that the ignition of but a few pounds of flash powder should be visible in a powerful telescope, provided, of course, that the conditions of ignition were substantially the same as those in certain experiments described in a recent Smithsonian publication, in which $\frac{1}{20}$ of a grain fired *in vacuo* was observed at a distance of $2\frac{1}{4}$ miles."

Drought and the Climate of Australia.

THE following remarks are summarised from an article which appeared in *The Times* of September 9th :—

The five States of the Australian Continent occupy a fringe of the western, southern and eastern coasts, stretching into an interior that becomes more vaguely known as the tropic is approached. The coast belt contains all the great cities. It is comparatively well watered, has winter rain and is cool in winter almost throughout.

At varying distances from the coast this country gives place to land where rain is always the anxiety of the cultivator. The modern attitude is, however, one of frank acquiescence in drought as a phenomenon of annual occurrence in at least some parts of the continent. Its terrors have also been to some extent removed. All the States keep accurate records of each day's rainfall, and this information is made public daily so that a man threatened with loss of live-stock knows where he can send it if necessary. The multiplication of railways has rendered stock transportation comparatively easy though expensive. The man with capital can thus defy drought, suffering serious temporary loss, but knowing that if he can hold on, the loss will be more than made good. Inland, Australia is undoubtedly very hot in summer, and this may be the reason for the existing tendency for the country population, even in the most prosperous districts, to drift towards the big cities of the seaboard.

Investigation of the Upper Atmosphere.

AT the recent meeting of the British Association at Cardiff the Committee for the Investigation of the Upper Atmosphere was re-appointed with the following members:—Sir Napier Shaw (*Chairman*), Mr. C. J. P. Cave (*Secretary*), Professor S. Chapman, Mr. J. S. Dines, Mr. W. H. Dines, Sir R. T. Glazebrook, Colonel E. Gold, Dr. H. Jeffreys, Sir J. Larmor, Mr. R. G. K. Lempfert, Professor F. A. Lindemann, Dr. W. Makower, Sir J. E. Petavel, Sir A. Schuster, Dr. G. C. Simpson, Mr. F. J. W. Whipple, Professor H. H. Turner.

There has been great development of observations of conditions in the regions accessible to aircraft since the work of the Committee was interrupted by the war, and it will now resume its activities with many new problems calling for investigation.

Obituary.

METEOROLOGISTS will regret to hear of the death of *Dr. Max Margules*, of Vienna, on October 4th, 1920. Dr. Margules was born in 1856, and was for many years Secretary of the Zentralanstalt für Meteorologie und Geodynamik at Vienna. His original work dealt mostly with the dynamics of the atmosphere, and particularly with the energy and thermodynamics of storms.

We note with regret the news of the death of *Mr. John Boyd*, Crown Forester, Ford, announced in the *Glasgow Herald* of September 16th. In 1917, when the observations at Poltalloch ceased, Mr. Boyd, at the request of the Office of Woods, converted his rainfall station at Ford into a climatological station with apparatus supplied by the Meteorological Office, since when summaries of his observations have appeared in the weekly and monthy Weather Reports. Mr. Boyd was a well-known forester and published a practical volume on Forestry and numerous other professional papers. Mr. Alexander Cuming is now in charge of the station at Ford.

Review.

A Mechanism of Climatic Cycles.

Batavia, K. Magn. en Meteor. Observatorium. Verh. No. 5. Atmospheric variations of short and long duration in the Malay Archipelago, and the possibility to forecast them. By C. Braak. Batavia, 1919.—One of the main lines of research followed in the attempt to forecast the general character of a season several months of a year in advance has been the investigation of "weather cycles." The cycles which we have been asked at one time or another to accept vary in period indefinitely, but the favourites are the sunspot cycle of 11·2 years and a shorter one of approximately three years. The sunspot cycle, in spite of a sufficient solar basis, has proved disappointing, its meteorological effects being always small and usually debatable. It is well developed only where the response of climatic to solar conditions is of the simplest, as, for example, on the west coast of Africa, where the rainfall, *e.g.*, at Bathurst shows three periodicities of 11 years, amplitude* 192 mm.; 3·2 years, amplitude 180 mm., and 2·1 years, amplitude 102 mm., together with a "secular variation" corresponding to that observable in sunspots since 1870. Even here the amplitude of the short period nearly equals that of the sunspot cycle. On the other hand the three-year period is often very obviously developed, and its only apparent cause—the solar prominence cycle—seems insufficient. To meet this difficulty in the case of Java rainfall, C. Braak has put forward in this memoir a "resonance hypothesis." According to this hypothesis, there may be a a purely terrestrial cycle of cause and effect, which completes itself and returns to its starting point in *about* the same time as the solar prominence cycle. When this happens, the latter fixes the period of the former, and greatly increases the range of its phenomena. The best known effect of "resonance" is the semi-diurnal variation of pressure.

In the case of Java rainfall the chain of events is briefly as follows: Pressure variations at Batavia coincide with those at Port Darwin in Australia, but the latter have double the amplitude of the former. Consequently, remembering that we are dealing with the southern hemisphere, high pressure increases the strength of the East monsoon (November to April) and decreases that of the West monsoon (May to October). It happens that, during the former, high pressure causes low temperature and is self-sustaining, but during the latter high pressure causes high temperature. This in the

* *i.e.*, the coefficient a in the formula $R = \overline{R} + a \sin t$.

course of two years penetrates to the upper air and reduces the pressure below normal. Consequently there is a three-yearly variation of pressure of a "saw-tooth" type, the curve rising slowly for two years and then sinking rapidly for one year. Note that the changes from low to high, or *vice-versa*, can take place only in the West monsoon, and the period is thus limited to exactly three years.

It is obvious that a similar sequence of events must take place at many localities near the equator where conditions are suitable. An example is Lagos, Nigeria, where there is a marked three-year rainfall periodicity. Although pressure data are lacking, we may infer that this is analogous to the case of Batavia, the Sahara taking the place of Northern Australia.

A self-regulating system of a different type has been described by W. Meinardus in the North Atlantic.* Here ice plays a part. A weak Atlantic circulation means ice at Iceland and little off Newfoundland; this raises the pressure to the east of Greenland and lowers it to the west, causing northerly winds over Baffin's Bay and southerly winds at Iceland, so increasing the strength of the Atlantic circulation and reversing the ice conditions. The winter weather in Western Europe is known to be influenced by the strength of the Gulf Drift, and we may suppose the latter to be affected to some extent by the solar prominence period, acting perhaps only at certain seasons of the year. Hence there are indications of a forced periodicity of three years in the weather of Western Europe.

And here, it seems, we have the explanation of why these periodicities so frequently persist for a time, and then break down. For the solar prominence period is not exactly three years, but a few months longer, so that it will gradually outstrip the terrestrial period. After aiding the latter for a few cycles, it will gradually come to oppose it, the periodicity will die out, or perhaps skip a year or two, and reappear at the wrong dates, when the resonance is re-established. This has hitherto been ascribed to a failure of the cycle, but bearing in mind the new principle, it may be possible in the future to forecast these vagaries. Rainfall forecasts based on the modifications of the three-year period are in fact already being issued in Java, and there seems no reason why they should not be equally practicable in other tropical regions.

C. E. P. Brooks.

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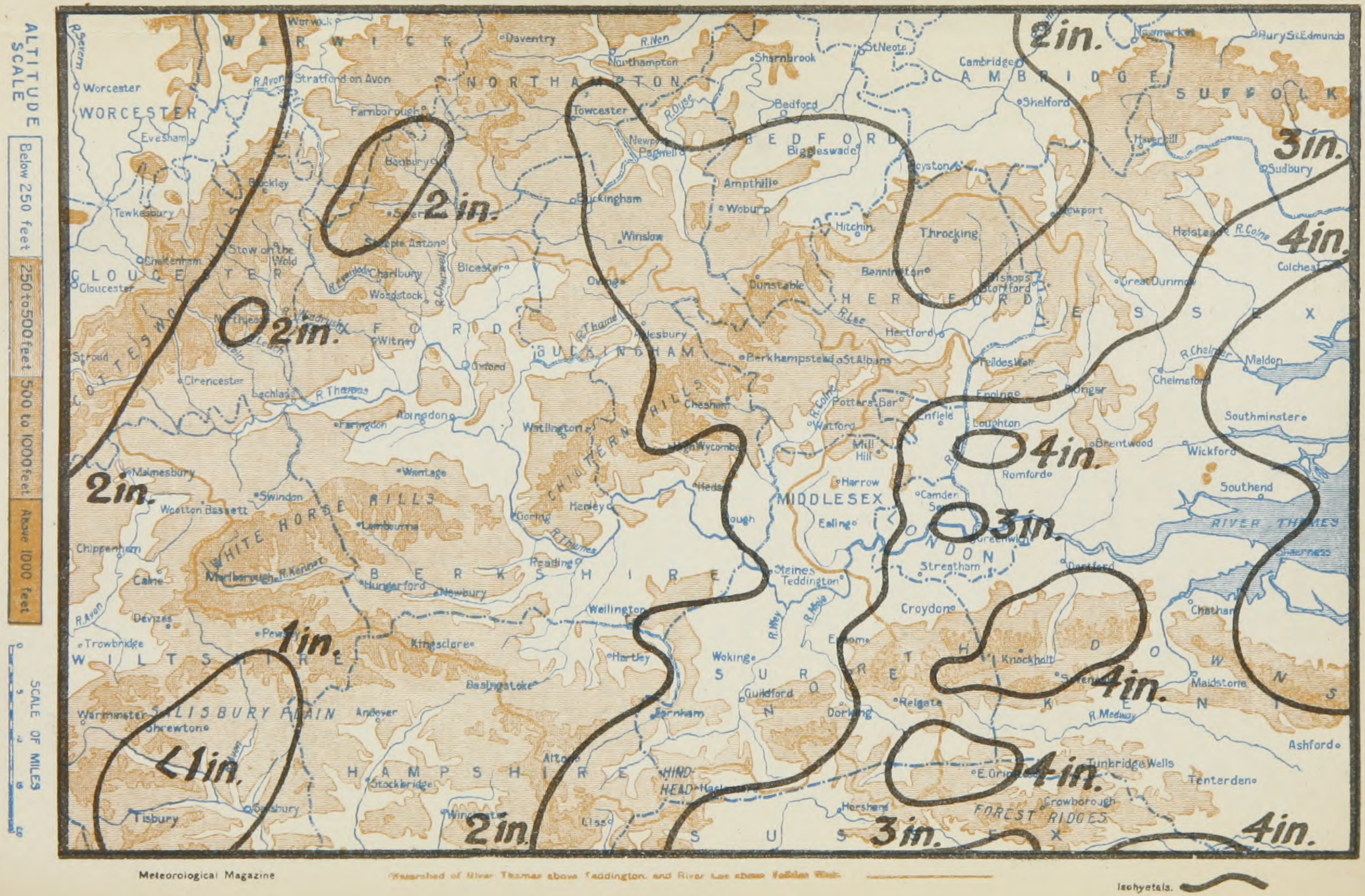
* Ann. Hydrogr., Berlin, 1904, p. 353.

THAMES VALLEY RAINFALL. SEPTEMBER, 1920.



H.M. Stationery Office Press, Kingsway W.C.2.
Ps. 5545/198. 105. P.35. 1250. 10/20.

Weather in the British Isles: September 1920.

In many respects the weather of September was more nearly normal than was the case during the three previous months. In the southern districts the temperature not infrequently rose to 70° F., and on some occasions reached 75° F. There were, however, relapses from these pleasant conditions, and on some days in parts of England the temperature remained below 55° F.; while in Scotland on the 20th the maximum at Nairn and Wick was only 47° F. Commonly the maximum occurred on the 12th, when 75° F. was recorded at Bath, Cullompton (Devon), Sevenoaks, South Farnborough, and Weston-super-Mare; and 76° F. at Sparkhill (Worcester) and Kensington Palace. The coldest days occurred during a cold spell which was widely experienced from the 16th to 24th, some of the lowest temperatures recorded being 30° F. at Howden (Yorks), 32° F. at Birr Castle, and 33° F. at Eskdalemuir and Ross-on-Wye on the 20th, and 29° F. at Howden, 31° F. at Nottingham, and 32° F. at Renfrew on the 21st. On the latter date a grass minimum of 24° F. was recorded at Howden and 26° F. at Renfrew. Contrasted with these low readings were the minima at Roche's Point and Scilly on the 26th, 57° F., and at Valencia Observatory on the 27th, 59° F.

On the 14th a large depression over the Icelandic region extended its influence to the whole of the British Isles, and was followed on the 16th by another depression and attendant secondaries, with the result that dull, rainy weather prevailed until the 18th. During this period (14th–18th) there were some heavy falls of rain, 21 mm. falling at Pembroke on the 14th, 20 mm. at Jersey on 15th, 20 mm. at Yarmouth on the 16th, 21 mm. at Falmouth on the 17th, and 26 mm. at Banff, and 25 mm. at Nairn on the 18th. On the latter date there was a gale in the English Channel and thunder at Falmouth. Between the 19th and 23rd, owing largely to shallow depressions over France, there were frequent thunderstorms in Southern and Eastern England, accompanied in some instances by very heavy rain. At Margate on the 21st rain fell from 6 h.–23 h. to a depth of 44 mm., the downpour between 9 h. and 10 h., when there was a thunderstorm, being torrential, with the result that the lower parts of the town were flooded. At Faversham, also during a thunderstorm, and on this same day large hailstones fell. On the 21st Lowestoft experienced a severe thunderstorm and heavy rain which was described as a "cloud-burst," and floods resulted, a visitation which was accompanied by a waterspout at sea. Between the 18th and 21st some very wet weather, with thunderstorms, was also experienced at Guernsey, the total fall for these four days at Brooklyn being 92 mm. and at Villa Carey 90 mm.

Generally speaking, the sunshine of the month was deficient, but there were a good many sunny days, especially from the 9th to the 14th, when more than ten hours a day were recorded in some parts of the country. There was also plentiful sunshine during the week which ended on the 25th, the percentage of the possible duration for this week being as high as at any time during the year.

Over the British Isles as a whole the rainfall was below the average. A considerable area in the South-east of England, and small isolated patches in Ireland and Central Scotland had, however, more than the average. Less than 50 mm. was recorded over large areas in England, from Bournemouth and Torquay across to Boston, and extending along the east coast in a broad band to Aberdeen. In Ireland the south-eastern portion had less than 50 mm. More than 150 mm. was confined to the high land of the Lake District, Wales, Inverness, Connemara and Kerry. The general rainfall expressed as a percentage of the average was:—England and Wales, 95; Scotland, 87; Ireland, 85; British Isles, 89. Apart from the rainfall, there was a good deal of precipitation in the form of dew; wet fogs and mists were especially prevalent during two anticyclonic periods which

(*Continued on* p. 212.)

Rainfall Table for September 1920.

STATION.	COUNTY.	Aver. 1875—1909. in.	1920. in.	1920. mm.	Per cent. of Av.	Max. in 24 hrs. in.	Max. in 24 hrs. Date.	No. of Rain Days.
Camden Square	*London*	2·00	3·27	83	163	·74	15	14
Tenterden (View Tower)	*Kent*	2·25	3·32	84	148	·78	15	17
Arundel (Patching)	*Sussex*	2·58	4·25	108	165	1·23	15	11
Fordingbridge (Oaklands)	*Hampshire*	2·39	1·35	34	56	·32	17*	14
Oxford (Magdalen College)	*Oxfordshire*	1·98	1·55	39	78	·27	30	13
Wellingborough	*Northampton*	2·13	..	..	..	..	..	..
Hawkedon Rectory	*Suffolk*	1·95	2·32	59	119	·48	15	14
Norwich (Eaton)	*Norfolk*	2·34	2·21	56	94	·55	16	19
Launceston (Polapit Tamar)	*Devon*	3·11	2·03	52	65	·90	30	15
Lyme Regis (Rousdon)	,,	2·69	1·46	37	54	·54	30	9
Ross (Birchlea)	*Herefordshire*	2·39	1·75	44	73	·45	17	12
Church Stretton (Wolstaston)	*Shropshire*	2·40	2·02	51	84	·54	14	11
Boston (Black Sluice)	*Lincoln*	2·07	1·57	40	76	·29	17	15
Worksop (Hodsock Priory)	*Nottingham*	1·84	1·59	40	86	·44	14	15
Mickleover Manor	*Derbyshire*	2·11	1·95	50	92	·78	17	13
Southport (Hesketh Park)	*Lancashire*	3·09	3·14	80	102	·62	30	15
Wetherby (Ribston Hall)	*York, W. R.*	2·11	1·15	29	55	·24	14	..
Hull (Pearson Park)	,, *E. R.*	2·05	1·60	41	78	·38	14	11
Newcastle (Town Moor)	*North'land*	2·00	1·72	44	86	·38	16	17
Borrowdale (Seathwaite)	*Cumberland*	11·28	10·50	267	93	..	..	..
Cardiff (Ely)	*Glamorgan*	3·61	3·05	78	84	1·30	17	14
Haverfordwest	*Pembroke*	3·91	3·74	95	96	1·24	14	18
B'ham W. W. (Tyrmynydd)	*Radnor*	4·43	4·34	110	98	1·03	14	13
Llandudno	*Carnarvon*	2·50	4·10	104	164	·81	18	16
Dumfries (Cargen)	*Kirkcudbrt.*	3·34	2·62	66	78	·55	17	16
Marchmont House	*Berwick*	2·67	1·81	46	68	·31	9	16
Girvan (Pinmore)	*Ayr*	4·30	3·00	76	70	·65	9	21
Glasgow (Queen's Park)	*Renfrew*	2·99	2·43	62	81	·60	9	19
Islay (Eallabus)	*Argyll*	4·49	4·74	120	106	·59	16	27
Mull (Quinish)	,,	5·20	6·04	153	116	·72	9	25
Loch Dhu	*Perth*	6·22	4·50	114	72	·80	11	13
Dundee (Eastern Necropolis)	*Forfar*	2·34	2·79	71	119	·52	16	19
Braemar	*Aberdeen*	2·73	1·45	37	53	·30	17	16
Aberdeen (Cranford)	,,	2·69	2·24	57	83	·81	18	15
Gordon Castle	*Moray*	2·58	3·10	79	120	1·76	18	14
Drumnadrochit	*Inverness*	2·94	1·40	36	48	·45	10	14
Fort William	,,	6·66	4·76	121	71	1·01	27	26
Loch Torridon (Bendamph)	*Ross*	7·28	6·44	164	88	·97	27	21
Stornoway	,,	3·99	4·26	108	107	·43	20	24
Dunrobin Castle	*Sutherland*	2·51	3·01	76	112	·31	17	18
Wick	*Caithness*	2·57	2·44	62	95	·74	9	13
Glanmire (Lota Lodge)	*Cork*	3·20	2·98	76	93	·76	29	13
Killarney (District Asylum)	*Kerry*	3·79	4·32	110	114	1·25	29	23
Waterford (Brook Lodge)	*Waterford*	3·19	1·79	46	56	·49	14	13
Nenagh (Castle Lough)	*Tipperary*	3·16	2·06	52	65	·28	16	21
Ennistymon House	*Clare*	4·22	4·51	115	107	·82	29	21
Gorey (Courtown House)	*Wexford*	2·78	1·06	27	38	·44	30	10
Abbey Leix (Blandsfort)	*Queen's Co.*	2·93	1·06	27	36	·22	9	15
Dublin (FitzWilliam Square)	*Dublin*	2·06	1·02	26	50	·23	9	14
Mullingar (Belvedere)	*Westmeath*	3·02	1·96	50	65	·30	14	13
Woodlawn	*Galway*	3·47	2·77	70	80	·51	16	21
Crossmolina (Enniscoe)	*Mayo*	4·42	5·92	150	134	·73	26	26
Collooney (Markree Obsy.)	*Sligo*	3·65	3·15	80	86	·74	1	25
Seaforde	*Down*	3·25	2·81	71	86	·72	30	13
Ballymena (Harryville)	*Antrim*	3·43	4·11	104	112	·73	1	19
Omagh (Edenfel)	*Tyrone*	3·39	2·72	69	80	·40	1	21

* And 30.

Supplementary Rainfall, September 1920.

Div.	STATION.	RAIN. in.	RAIN. mm.
II.	Ramsgate	3·38	86
"	Sevenoaks, Speldhurst	3·96	101
"	Hailsham Vicarage	3·26	83
"	Totland Bay, Aston	2·26	57
"	Ashley, Old Manor Ho.	1·31	33
"	Grayshott	2·81	71
"	Ufton Nervet	1·25	32
III.	Harrow Weald, Hill Ho.	2·37	60
"	Pitsford, Sedgebrook	1·46	37
"	Chatteris, The Priory	2·03	52
IV.	Elsenham, Gaunts End	2·37	60
"	Lexden, Hill House	3·74	95
"	Aylsham, Rippon Hall	2·66	68
"	Swaffham	2·10	53
V.	Devizes, Highclere	1·34	34
"	Weymouth	1·59	40
"	Ashburton, Druid Ho.	2·18	55
"	Cullompton	1·84	47
"	Hartland Abbey	3·42	87
"	St. Austell, Trevarna	3·82	97
"	North Cadbury Rec.	1·55	39
"	Cutcombe, Wheddon Cr.	1·95	50
VI.	Clifton, Stoke Bishop	2·51	64
"	Ledbury, Underdown	1·96	50
"	Shifnal, Hatton Grange	1·88	48
"	Ashbourne, Mayfield	1·92	49
"	Barnt Green, Upwood	2·70	69
"	Blockley, Upton Wold	2·72	69
VII.	Grantham, Saltersford	1·38	35
"	Louth, Westgate	1·44	37
"	Mansfield, West Bank	1·49	38
VIII.	Nantwich, Dorfold Hall	2·87	73
"	Bolton, Queen's Park	3·45	88
"	Lancaster, Strathspey	2·91	74
IX.	Wath-upon-Dearne	1·16	30
"	Bradford, Lister Park	1·46	37
"	West Witton	1·31	33
"	Scarborough, Scalby	1·68	43
"	Ingleby Greenhow	1·61	41
"	Mickleton	1·20	30
X.	Bellingham	1·40	36
"	Ilderton, Lilburn	2·02	51
"	Orton	2·94	75
XI.	Llanfrechfa Grange	3·23	82
"	Treherbert, Tyn-y-waun	7·71	196
"	Carmarthen Friary	5·92	150
"	Fishguard	4·37	111
"	Lampeter, Falcondale	5·21	132
"	Abergwngy	6·75	171
"	Cray Station	6·70	170
"	Crickhowell, Talymaes	4·50	114
"	Lake Vyrnwy	2·18	55
"	Llangynhafal, P. Drâw	3·11	79
"	Dolgelly, Bryntirion	7·55	192
"	Lligwy	2·77	70
XII.	Stoneykirk, Ardwell Ho.	3·43	87
"	Whithorn, Cutroach	3·52	89
"	Carsphairn, Shiel	4·14	105
XII.	Langholm, Drove Rd.	2·55	65
XIII.	Selkirk, Hangingshaw	1·79	46
"	North Berwick Res	1·20	30
"	Edinburgh, Royal Ob.	1·47	37
XIV.	Biggar	2·33	59
"	Leadhills	5·58	142
"	Maybole, Knockdon	2·53	64
XV.	Rothesay	4·08	104
"	Ardgour House	6·48	165
"	Inveraray Castle	5·79	147
"	Holy Loch, Ardnadam	5·70	145
XVI.	Loch Venachar	3·50	89
"	Glenquey Reservoir	4·00	102
"	Loch Rannoch, Dall	1·89	48
"	Coupar Angus	1·48	38
"	Montrose Asylum	1·25	32
XVII.	Balmoral Castle	2·29	58
"	Fyvie Castle	2·99	76
"	Peterhead, Forehill	2·67	68
"	Grantown-on-Spey	2·56	65
XVIII.	Cluny Castle	2·69	68
"	Loch Quoich, Loan	11·26	286
"	Skye, Dunvegan	6·96	177
"	Fortrose	2·03	52
"	Ardross Castle	2·68	68
"	Glencarron Lodge	4·96	126
XIX.	Tongue Manse	3·85	98
"	Melvich Schoolhouse	3·24	82
"	Loch More, Achfary	6·70	170
XX.	Dunmanway Rectory	4·08	104
"	Mitchelstown Castle	2·53	64
"	Gearahameen	7·00	178
"	Darrynane Abbey	5·42	138
"	Clonmel, Bruce Villa	1·69	43
"	Cashel, Ballinamona	1·81	46
"	Roscrea, Timoney Pk.	1·46	37
"	Foynes	3·13	80
"	Broadford, Hurdlesto'n	3·21	82
XXI.	Kilkenny Castle	1·18	30
"	Rathnew, Clonmannon	1·06	27
"	Hacketstown Rectory	1·54	39
"	Ballycumber, Moorock	1·30	33
"	Balbriggan, Ardgillan	1·40	36
"	Drogheda	1·56	40
"	Athlone, Twyford	1·77	45
"	Castle Forbes Gdns.	2·47	63
XXII.	Ballynahinch Castle	7·69	195
"	Westport House	3·93	100
XXIII.	Enniskillen, Portora	2·98	76
"	Armagh Observatory	2·27	58
"	Warrenpoint	2·56	65
"	Banbridge, Miltown	2·49	63
"	Belfast, Cave Hill Rd.	2·82	72
"	Glenarm Castle	3·40	86
"	Londonderry, Creggan	3·50	89
"	Sion Mills	2·85	72
"	Milford, The Manse	3·99	101
"	Killybegs, Rockmount	6·50	165

Climatological Table for the

STATIONS	PRESSURE		TEMPERATURE							
			Absolute				Mean Values			
	Mean of Day M.S.L.	Diff. from Normal	Max.	Date	Min.	Date	Max.	Min.	½ max. and min.	Diff. from Normal
	mb.	mb.	° F.		° F.		° F.	° F.	° F.	° F.
London, Kew Observatory	1006·8	−7·1	63	24	35	30	55·2	43·3	49·3	+2·0
Gibraltar	1017·4	+2·1	74	26	48	1	68·7	54·4	61·5	+0·7
Malta	..	..	..	..	..	..	..	..	..	..
Sierra Leone	1012·2	+1·2	91	5,22,25	71	9, 10	88·8	73·9	81·3	−1·5
Lagos, Nigeria	1012·6	+2·8	89	5	71	12	87·6	75·8	81·7	−0·6
Kaduna, Nigeria	1013·9	+5·6	98	3, 8, 14	66	20	93·3	70·8	82·1	−0·4
Zomba, Nyasaland	1016·4	+4·5	81	9, 10	55	20, 29	74·7	58·8	66·7	−2·6
Cape Town	..	..	96	14	48	25	77·3	56·6	66·9	+3·8
Johannesburg	..	..	77	20	44	29	72·0	50·3	61·1	+1·5
Mauritius	1013·2	−0·8	84	12	58	17	80·2	69·4	74·8	−1·0
Bloemfontein	..	..	79	5	40	27	75·1	47·3	61·2	+0·4
Calcutta, Alipore Obsy.	1006·9	+0·6	103	29	69	12	94·6	76·7	85·7	0·0
Bombay	1008·7	+0·1	92	22	73	5	89·5	77·7	83·6	+0·5
Madras	..	..	98	24	74	15	93·0	77·7	85·3	0·0
Colombo, Ceylon	1009·3	+0·2	91	17	73	14	87·7	74·9	81·3	−1·4
Hong Kong	1012·9	+0·3	82	19	60	7	73·3	66·5	69·9	−1·0
Sydney	1020·3	+2·0	81	23	48	18	70·7	56·0	63·3	−1·1
Melbourne	..	..	..	..	..	..	..	..	..	..
Adelaide	1022·4	+2·6	95	1	46	19	72·8	53·1	62·9	−0·9
Perth, West Australia	1019·6	+1·2	81	7	51	30	79·2	57·7	68·5	+2·2
Coolgardie	1020·9	+2·4	85	28	44	30	73·3	50·0	61·7	−3·4
Brisbane	1018·7	+1·4	87	12	52	26	78·2	61·0	69·6	−0·8
Hobart, Tasmania	1018·1	+3·7	82	2	39	25	62·8	47·2	55·0	−0·1
Wellington, N.Z.	1018·6	+0·8	70	8	38	15	61·6	52·6	57·1	+0·3
Suva, Fiji	..	..	..	..	..	..	..	..	..	..
Kingston, Jamaica	1013·8	−0·5	90	26	67	8	87·5	71·7	79·6	+1·2
Grenada, W.I.	1014·1	+1·5	87	6	70	2	83·4	73·5	78·5	−0·3
Toronto	1009·3	−6·2	60	19	18	8	47·6	32·6	40·1	−1·3
Fredericton, N.B.	..	..	67	20	15	2	47·5	28·7	38·1	−0·4
St. John, N.B.	1007·8	−5·8	62	20	21	1	45·1	30·6	37·9	−1·1
Victoria, B.C.	1016·4	−0·9	65	25	30	2	51·9	39·0	45·5	−2·2

LONDON, KEW OBSERVATORY.—1 day of thunder. Mean speed of wind 8·6 mi/hr.

GIBRALTAR.—2 gales.

SIERRA LEONE.—1 day with thunder heard; 1 gale.

MAURITIUS.—Prevailing wind direction ESE.; mean speed, 9·3 mi/hr.

BOMBAY.—1 day of thunder.

COLOMBO, CEYLON.—Prevailing wind direction SW.; mean speed, 3·4 mi/hr.; 3·6 ins. rainfall in 131 mins. on 26th, April 30–May 1, first night of continuous SW. wind through night this year. 12 days with thunder.

British Empire, April 1920.

TEMPERATURE Absolute Max. in Sun °F.	TEMPERATURE Absolute Min. on Grass °F.	Relative Humidity %	Mean Cloud Am'nt 0–10	PRECIPITATION Amount in.	PRECIPITATION Amount mm.	Diff. from Normal mm.	Days	BRIGHT SUNSHINE Hours per day	BRIGHT SUNSHINE Percentage of possible	STATIONS
126	27	79	8·1	2·67	68	+ 31	20	2·6	19	London, Kew Observatory.
153	44	77	3·9	0·99	25	– 43	6	..	..	Gibraltar.
..	..	..	..	..	..	..	..	..	..	Malta.
..	..	67	3·5	0·31	8	– 97	3	..	..	Sierra Leone.
165	64	73	6·5	5·71	145	– 4	14	..	..	Lagos, Nigeria.
..	..	70	..	5·90	150	+ 82	7	..	..	Kaduna, Nigeria.
..	..	89	5·9	1·63	41	– 64	10	..	..	Zomba, Nyasaland.
..	..	67	3·5	0·76	19	– 32	4	..	..	Cape Town.
..	36	67	2·6	0·84	21	– 31	8	8·6	75	Johannesburg.
..	52	77	7·1	4·60	117	+ 3	15	5·6	49	Mauritius.
..	..	62	1·5	0·21	5	– 49	4	..	..	Bloemfontein.
..	61	57	3·2	0·04	1	– 43	1	..	..	Calcutta, Alipore Obsy.
..	..	77	2·5	0·00	0	– 2	0	..	..	Bombay.
168	72	74	3·8	0·06	2	– 13	1	..	..	Madras.
159	69	78	8·4	14·77	375	+123	22	..	..	Colombo, Ceylon.
..	..	82	9·0	8·27	210	+ 70	16	2·6	21	Hong Kong.
128	42	71	5·6	2·82	72	– 67	17	..	..	Sydney.
..	..	..	..	..	..	..	..	..	..	Melbourne.
144	33	54	4·7	0·57	14	– 33	8	..	..	Adelaide.
151	40	50	2·1	0·00	0	– 41	0	..	..	Perth, West Australia.
143	35	49	3·9	0·70	18	– 6	7	..	..	Coolgardie.
144	44	65	4·7	1·99	51	– 42	13	..	..	Brisbane.
131	34	67	6·1	1·04	26	– 22	12	..	..	Hobart, Tasmania.
141	33	78	7·7	8·77	223	+124	15	3·7	34	Wellington, N.Z.
..	..	..	..	..	..	..	..	..	..	Suva, Fiji.
..	..	69	1·8	0·00	0	– 31	0	..	..	Kingston, Jamaica.
138	..	68	3·5	0·30	8	– 52	7	..	..	Grenada, W.I.
110	15	75	5·7	3·26	83	+ 22	14	..	..	Toronto.
..	..	..	..	5·73	146	+ 71	11	..	..	Fredericton, N.B.
123	18	79	6·6	5·01	127	+ 38	16	..	..	St. John, N.B.
128	26	75	5·2	1·45	37	– 7	13	..	..	Victoria, B.C.

HONG KONG.—Prevailing wind direction E ; mean speed, 14·0 mi/hr. ; 4 days with thunder heard ; 8 fogs.

GRENADA.—Prevailing wind direction E.

PERTH.—Only recorded instance of a totally rainless April in Perth.

BRISBANE.—Rainfall below average 24 months out of last 27 months.

KINGSTON ISLAND.—Drought —0·29 in. for the Island—lowest fall ever recorded.

extended from the 8th to 14th and from the 19th to 29th. At Totland Bay (Isle of Wight) the mean humidity at 9 h. was 87 per cent., this being the dampest September since 1897.

In London (Camden Square) the month was generally cloudy with frequent rain. The mean temperature was 57·9° F., or 0·2° F. above the average. The duration of rainfall was 48·2 hours, and the evaporation 1·04 inch.

Weather Abroad: September 1920.

At the beginning of the month anticyclonic areas were situated over Scandinavia and the Azores, and low-pressure areas over Central Europe and Iceland. On the 3rd, the northern anticyclone moved northwards to Spitzbergen, and a depression moving in from Iceland was by the 5th centred over Southern Scandinavia, causing very unsettled weather in its passage, with gales over Denmark and the Southern Baltic.

Meanwhile the Azores anticyclone began to spread slowly in a north-easterly direction. By the 8th this anticyclone covered southern England, Northern France and Germany, and by the 11th it was centred over Western Germany, whence it moved slowly south-east.

Pressure still continued high at the Azores and Spitzbergen, and depressions, moving in an easterly direction from Iceland, caused heavy rain in places. At Oxo (Southern Norway) 72 mm. of rain fell on the 15th. On the 16th a depression appeared to the westward of the British Isles, crossed them on the 18th, and reached Southern Scandinavia on the 19th, whence it moved northwards and by the 22nd was over Spitzbergen. Some heavy falls of rain occurred during this period, especially in France and Switzerland (51 mm. at Lugano on the 17th, 47 mm. at Lyons on the 18th, 59 mm. at Lugano on the 19th, and 70 mm. at Lugano on the 20th).

By the 22nd an anticyclone extended from the Azores to the Baltic, and high pressure was maintained over Western and Central Europe until the end of the month, although small, shallow depressions over France caused local heavy rain. On the last day of the month a deep depression approached the SW. of the British Isles, and affected France, causing heavy falls of rain (*e.g.*, 48 mm. at Clermont). Temperatures throughout the month were not high except locally in Southern Europe (*e.g.*, 90° F. at Madrid on the 7th and at Rochefort on the 11th, and 91° F. at Marseilles on the 30th).

In Italy and the Eastern Mediterranean the weather throughout the month was warm and for the most part fine, except for some local rain in Italy, more especially in the northern districts.

A severe wind and hail storm in the middle of the month destroyed orchards and vineyards in the Niagara fruit district, and on the 20th lightning struck seven oil storage tanks at the Anglo-American oil refinery at Tampico, setting them on fire and causing considerable damage.

At the end of September there were many prairie fires in Saskatchewan and Manitoba. Sufficient rain fell at the beginning of October to extinguish them, but not before considerable loss had been caused to farmers.

A message from Buenos Aires, dated September 22nd, stated that moderate to heavy rains were falling generally over the Argentine. This rainfall constitutes a definite break in the drought which has been damaging the various crops for a considerable period.

The rainfall in India has been variable, many districts receiving an excess and others a deficiency. The Punjab is badly in need of rain, but the position has improved in the Bombay Presidency, as well as in the Western Deccan, in the United Provinces, in Hyderabad and in Madras.

The long-continued drought in the Honan Province of China has led to severe famine, so that thousands of lives are in danger, and it is estimated that it will take years for the district to recover. A certain amount of rain fell, however, in the province during September.

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Discussion at the Meteorological Office. New Methods of Forecasting.

GATHERINGS at the Meteorological Office for the discussion of the recent work of foreign meteorologists were inaugurated by Sir Napier Shaw (then Dr. W. N. Shaw) in 1905. At the request of Dr. Simpson, Sir Napier is continuing the series this winter, and he opened the first discussion, on November 1st, himself.

The works to be discussed were two papers by Professor Bjerknes, his lecture before the Royal Meteorological Society on "The Structure of the Atmosphere when rain is falling"* and an article in *Nature* entitled "The Meteorology of the Temperate Zone and the General Atmospheric Circulation,"† and Sir Napier Shaw explained how the article had originated after the delivery of the lecture. It is not possible to summarize here the whole discussion, which covered a very wide field. Some random notes must suffice.

We have long been familiar with the undercutting of warm currents by cold as exhibited in line-squalls, and also with the rising of streams of warm air over cold ones in their path. These are made to play the leading parts in Bjerknes's analysis of the nature of a cyclone. In the case of a cyclone making progress towards the east a sector to the south is occupied by a warm current; this warm area on the earth's surface is

* Q.J.R. Met. Soc., April 1920. Vol. XLVI, No. 194.

† *Nature*, January 24th, 1920. Sir Napier Shaw's report on the Conference at Bergen (*Met. Mag.*, Sept. 1920) may also be consulted.

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bounded to the north by the "steering line," to the west by the "squall-line," and Bjerknes' recent generalisation is that these squall-lines and steering-lines of all the cyclones of the northern hemisphere are parts of a single line—"the polar front." We are to think of two great streams of air, both flowing from the west, the more northerly stream being colder and carrying less moisture. The boundary between these two streams is unstable and its oscillations manifest themselves as cyclones. The warm stream overrides the cold one, which retaliates, so to speak, by turning round and kicking its partner in the back.

Apparently experience has shown that even if the polar front cannot be traced throughout the complete circuit of the globe the terminology is really helpful in the close study of weather maps. Forecasters who took part in the discussion were able to give instances in which the bearing of the "steering-line" has shown the direction in which a depression would move, or in which the formation of a loop in the polar front has led to the rapid filling up of the depression.

A few years ago meteorologists were inclined to regard cyclones as originating in the upper air. As Gold puts it in "The Ballad of the Stratosphere"—

"I am the rolling stratosphere,
I long to perturbate;
So I tickle the top of the troposphere
To make him undulate."

The newer theories direct attention to the conditions prevailing nearer the earth's surface, and therefore readily observed; to correlate the two views of the subject should be the next advance.

A paper on the causes of the formation of Mist and Fog by Walter Georgii (*Ann. Hydrogr.*, Berlin, 1920) was announced as the subject for discussion on November 15th. The meeting on November 29th will be devoted to "Investigations on lightning discharges and on the electric field of thunderstorms" by C. T. R. Wilson (*Phil. Trans. A.*, vol. 221).

Hill-fog in Relation to Rainfall.

By L. C. W. Bonacina.

In *Symons's Meteorological Magazine* for March 1916 I provisionally drew the conclusion (founded upon personal experience in various ranges in the southern part of England between, say, 500 and 1,500 feet above sea level) that hill-mist was incompatible with real rain, and that when heavy rain fell on the hills their summits were for the time being clear or free from fog, even though they might be shrouded immediately before and after the rain. Since then I have taken every opportunity to study the question, and further experience, together with what I can glean from others, only serves to substantiate the generalization, although certainty on the question can only come with far more abundant data. It will be readily appreciated that in the case of observations of such a purely qualitative nature vicarious reports must be unreliable, and for that reason I have been very careful before accepting the information of others upon the question.

In discussing the theory of this subject there are two facts to be reconciled—(1) Rain gauge records declare that the total annual precipitation increases with height up to the highest elevations in Britain—a little over 4,000 feet above the sea, so that, speaking in general terms, the tops of the hills are wetter than their bases. (2) There are undoubtedly many occasions in all hill districts when a decided, sometimes even heavy, rain in the valleys degenerate into a hill mist, often relatively dry, at a height which may vary from about 600 feet upwards. Clearly fact (2) suggests that true rainfall is less frequent in the uplands than in the lowlands at their feet, and the reconciliation between (1) and (2) consists in explaining *how* the heavier precipitation on the hills, as shown by the rain gauge, is made up.

Part of the upland excess is no doubt due to drizzle, wet fog and drifting showers, which the rain gauge records as rain; but in view of the circumstance referred to under (2) that hill-mist associated with rain below is not infrequently too dry to deposit much moisture, it seems very doubtful if the whole excess can be thus accounted for. Part of the excess would appear to be due to greater intensity of precipitation at higher levels than at lower on those occasions when heavy rain does occur on hills and plateaux. Consequently, I provisionally conclude that in the case of ranges such as the Mendips or the various chalk downs with a general plateau level of about 800 feet, or of uplands like Dartmoor and Exmoor with a plateau level about 1,500 feet, or of mountainous regions like Wales with a higher level still, heavy rain occurs more frequently in the valleys than on the heights, but that when it does occur on the latter the amount is greater. In the case of high mountain systems, like the Alps, the higher slopes, no doubt, get a good many heavy falls of rain and snow which do not fall in the subjacent valleys, but this paper deals with English hills often barely 1,000 feet high.

Considering the frequency with which the summits of the English hills are shrouded in driving moorland mist, especially during unsettled cyclonic types of weather, it is somewhat strange that such mist habitually disappears during heavy rain. This has been explained on the supposition that the rain falling through the mist washes the latter out, and it seems such a natural process that I cannot think why I never thought of it in my 1916 paper, but went to the rather unnecessary hypothesis of supposing that among the hills, where orographic effects reinforce cyclonic influences, condensation may proceed so actively that the vapour contained in the atmosphere passes straight into rain-drops without going through the mist stage. Of course, there is no theoretical objection to such an explanation, for is not the invisible vapour in the air supposed to pass straight into snow crystals, a stage farther than raindrops? My original explanation may be true, though the washing out process must evidently take effect as well. But, whatever the reason may be, there is no doubt about the general truth of the observation that when heavy rain approaches the hills the cloud level over them rises. Owing to orographical effects the average cloud-level is probably lower in the hills than in the free atmosphere, often descending in unsettled weather to nearly 500 feet above sea-level, whereas the cyclonic cloud level in the free atmosphere is probably seldom much below 1,000 feet. It is clear that if raindrops dissolve out the mist droplets they must cause the amount of water caught by a rain gauge per given time to be increased.

The study of hill-fog in relation to precipitation is, perhaps, even more interesting with snow than with rain. If clouds rest on the hills in cold weather when snow is falling in the valleys below, they must consist either of small snow itself, in which case their appearance is highly characteristic, or of water droplets in a super-cooled condition, in which case shrubs and other objects, or even the ground itself, will often collect snow upon them.

I once asked an observer in the north of England whether a certain Pennine mountain was usually clear during heavy rain, and he replied that the mountain could not be seen at all when there was a rain-sheet between; and this is an aspect of the subject which needs to be borne in mind. It may be taken as a general rule that through short distances of, say, less than 5 miles, even dense rain-sheets are quite transparent, and do not obscure the outline of the hills; but even through greater distances, though rain-sheets become increasingly opaque, the appearance of opacity is quite different from that of mist or cloud, and no keen observer with normal vision could possibly, even at a great distance, confuse the two phenomena, notwithstanding that the rain-sheet gradually merges into cloud.

Matters directly bearing on this subject have been studied by Captain C. K. M. Douglas, whose flying observations upon various forms of condensation are of great value. But

I am studying the subject from the standpoint of *elevated ground*, not from that of the free upper air. After all, we cannot dwell in the free air, and it is in relation to the hills and mountains that the climatological importance of the problems discussed is specially brought out, often in a very practical way.

There must be many local peculiarities, and I have dealt with the subject in highly generalized terms.

In conclusion, I want to ask all who live in hill districts, together with any who may have had previous experience, such as at the Ben Nevis Observatory, the following question :—

Is it usual on the high hills to get steady rain and dense moorland mist at the same time?

Wind, Temperature, and Fog, October 27th, 1920.

SUDDEN changes of temperature occurring when a cold layer of fog is driven away by a rising breeze are not uncommon. That which occurred in London on Wednesday, October 27th, has, however, some unusual features.

The records for South Kensington show that the temperature was almost steady during the morning at 45° F., the minimum having been 40° F. at 5 h. 30 m. G.M.T. The anemometer pen was on the zero line during this period. At 12 h. 50 m. a wind of 4 mi/hr. sprang up, the temperature rose by 4° F. in 10 minutes and reached 54° F. by 13 h. 30 m. The maximum for the day was 55·2° F.

At Kew Observatory, 5½ miles to WSW. from South Kensington there was no appreciable wind until after 15 h., and then it took half an hour to get up to 4 mi/hr. The maximum temperature, which was only 48·6° F. was reached at 17 h. 25 m., by which time the relative humidity had fallen to 83 per cent. It is reported that the fog became less dense about 16 h. and cleared during the evening. The temperatures reached at the other London stations were about as high as at South Kensington—Westminster, 57° F.; Greenwich, 56° F.; Camden Square, Kensington Palace and Croydon, 55° F.; and Hampstead, 54° F.

On the other hand, farther up the Thames Valley the maxima were lower than at Kew Observatory. At Benson only 44° F. was reached, at Reading 47° F., at Wisley 46° F., though 53° F. was reported from Wantage and Farnborough on the higher ground to the south. It looks as if the N.E. wind was able to slide over the cold air in the Thames basin without displacing it.

North of the Thames there were higher temperatures again, 56° F. being reported at Berkhamsted, but the Ouse basin was covered by cold fog, and the maximum at Hitchin and Cambridge did not exceed 45° F. The most remarkable contrast was perhaps that between 63° F. at Woburn and 43° F. at Mursley. At the latter station, which is near Winslow, the fog persisted all day, though the wind, from NE. or NNE., was estimated at Force 3 at all three observations. It should be mentioned that at none of the stations mentioned when a rise of temperature took place could it be ascribed to sunshine, as there was practically none over the whole area.

OFFICIAL NOTICES.

Meteorological Stations.

THE removal of the Meteorological Office (Army Services) from *West Lavington* to the School of Artillery, *Larkhill*, Salisbury Plain, was effected on October 22nd, 1920.

Two new stations appear for the first time in the *Monthly Weather Report* for September 1920. That at *Bungay* (Flixton Hall) has been equipped by Sir R. Shafto Adair, who formerly maintained the station at Minehead. That at *Lenton Fields*, Nottingham, has been started by Mr. R. Francis Granger.

The returns from *Rugeley* and from *Leighton Park, Reading*, have been discontinued.

Cloud and Visibility Signals at Lympne Aerodrome.

A SYSTEM of ground signals has recently been established at Lympne Aerodrome, on the main route from Paris to London, to indicate to pilots the height of clouds at Biggin Hill and Croydon Aerodrome and the visibility at those places. The signals are made by large white letters and figures. Thus "B 1 2 ; C 2 3" means:—Biggin Hill, clouds below 200 feet, visibility 500 to 1,000 yards ; Croydon, clouds 200 to 500 feet, visibility over 1,000 yards.

Wireless Weather Reports from the Eiffel Tower.

THE issue of weather reports by wireless telegraphy from the Eiffel Tower (FL) dates from the year 1911. The morning reports gave an eight-figure group for each of 20 places (Reykjavik, Valentia (Ireland), Ushant, Corruna, Horta (Azores), St. Pierre (America), Paris, Clermont Ferrand, Biarritz, Marseilles, Nice, Algiers, Stornoway, Shields, Helder, Skudesnaes, Stockholm, Prague, Trieste, Rome), a general plain-language statement of the existing weather in Europe, forecasts for France, and the wind on the top of the Eiffel Tower. The eight-figure group provided barometer, wind, weather and state of the sea. A second, shorter report, giving observations for 2 p.m. was issued at 5 p.m. daily. This service was interrupted by the war. When the strict censorship of meteorological information ceased, the reports were recommenced, but in a modified form. This service has been extended more than once, and from November, 1st 1920, four reports based on observations at French stations are being issued daily at 2 h. 45 m., 8 h. 15 m., 14 h. 15 m., and 19 h. 30 m. G.M.T. in a wave-length of 2,600 m. From the same date the comprehensive report of the Bureau Central Météorologique has also been transmitted on pre-war lines, but with six-figure groups instead of eight-figure groups. This report gives pressure, wind and weather at 14 stations distributed from Stornoway to Algiers, and also the positions of centres of high and low pressure. A general forecast for the following day is also included in the telegram, which is sent out at 11 h. 30 m. on a wave-length of 2,600 m.

Copies of the codes may be seen at the Meteorological Office.

Forecasts by Telegraph and Telephone.

THE following revised regulations have been prepared for insertion in the Post Office Guide :—

The latest information as to the state of the weather in various parts of the United Kingdom or the Continent, and also forecasts to cover a period of 24 hours from the time of issue, can be obtained by telegraph from the Meteorological Office by sending a reply-paid telegram. The number of words to be paid for in the reply is to be arrived at by adding 10 to the number of words required for the applicant's address. Thus, if there were five words in the applicant's address, a reply of 15 words must be paid for. If a further outlook of the probable conditions beyond the period of 24 hours is also desired, an additional 10 words must be paid for.

Forecasts can also be obtained at any time by telephone if a sum has been previously deposited to cover the charges, which are 3*d*. for each forecast telephoned. Telephone inquiries should be made to Regent 8000, Extension 174.

The Meteorological Office is open day and night, including Sundays, and its telegraphic address is "Weather, London."

Forecasts are prepared at 3 h., 9 h., 15 h., and 20 h. G.M.T. daily. When Summer Time is in operation, forecasts are prepared half an hour later by the clock.

Report of the Meteorological Committee.

THE fifteenth Annual Report of the Meteorological Committee for the year ended March 1920 has recently been published. The year under review was notable on the one hand for the absorption of the British Rainfall Organization, and on the other for the decision of the Government to entrust the administration of the Office to the Air Ministry. The formal transfer of responsibilities for the Meteorological Service took place in October 1919

The Research Committee of the War Cabinet had appointed a sub-committee to consider the needs of the Meteorological Services, and the report of this sub-committee, which was presided over by Mr. H. A. L. Fisher, President of the Board of Education, is reprinted here as Appendix I. This report emphasises the desirability of a single Meteorological Service for the country and of close touch with other Government departments.

The constitution and functions of the Meteorological Committee under the new arrangement are set out in Appendix II. of the Report. The present membership of the Committee (Nov. 1920) is as follows:—

Ex-officio Members.

The Controller-General of Civil Aviation, Major-General Sir F. H. Sykes, C.B.E., K.C.B., C.M.G. (*President*).

The Director of the Meteorological Office, Dr. G. C. Simpson, C.B.E., F.R.S.

The Hydrographer to the Navy, Rear-Admiral F. C. Learmonth, C.B., C.B.E.

Nominated Members.

Air Ministry—Mr. H. W. W. McAnally, C.B.
Mr. L. V. Meadowcroft.

War Office—Lieut.-Colonel H. A. Lewis, R.A.

Agriculture and Fisheries—Sir Thomas Middleton, K.B.E., C.B.

Board of Trade—Captain J. M. Harvey.

Colonial Office—Mr. J. E. W. Flood.

Royal Society—Sir Arthur Schuster, D.Sc., F.R.S.
Colonel H. G. Lyons, D.Sc., F.R.S.

Royal Society, Edinburgh—Dr. E. M. Wedderburn, F R.S.E.

Official Publications.

The Book of Normals of Meteorological Elements for the British Isles. Section III. Maps of the Normal Distribution of Temperature, Rainfall, and Sunshine for the British Isles. Price 1s. 6*d*.

THE newly issued third section of the Book of Normals is an atlas illustrating the normal distribution of temperature, rainfall, and sunshine over the British Isles. There is no occasion to emphasise the utility of such an atlas, but attention may be drawn to the modest price.

The Meteorological Office arranged some years ago to collaborate with the Royal Meteorological Society in the production of an atlas which should be representative of British climatology, but circumstances arising out of the war delayed the execution of this scheme. The present publication, though less ambitious in its scope, will, it is hoped, be of considerable use. The maps, which represent the normals for the period 1881–1915, do not show conspicuous differences from those of the earlier series, now out of print, which were for 35 years ending 1910.

Professional Notes No. 14. Tables of Frequencies of Surface Wind Directions and Cloud Amounts at Metz, Mulhausen, Karlsruhe and Frankfurt. By D. Brunt, M.A., B.Sc. Price 6*d*. Net.

IN the summer of 1918 Captain Brunt was in charge of the meteorological service for the Independent Air Force, and had occasion to study meteorological conditions in Southern Germany. The forecasting of wind direction comes within the ordinary routine of the weather service, but there is comparatively little information on which estimates of probable cloud amount can be based. Accordingly, tables in which the frequency of various amounts of cloud with each wind direction are given should be of immediate service in the analysis of conditions favourable for military operations. Striking differences in the local conditions are brought out in Captain Brunt's note, which is on the same lines as *Professional Notes No.* 1, in which he discussed cloud amount at stations near London. A similar analysis is shown graphically in *Professional Notes No.* 7, "The Climate of North-West Russia."

Correspondence.

To the *Editors*, "*Meteorological Magazine.*"

Mock Suns and False Cirrus.

I HAD supposed that the phenomenon described by Mr. L. H. G. Dines in the October number of the *Meteorological*

Magazine was of comparatively frequent occurrence. On examination, however, I find that I have recorded it only twice in five years, at South Farnborough, as follows:—

April 25th, 1916, 17 h. 15 m., brilliant parhelia of 22° in "false" cirrus.

March 26th, 1917, 16 h. 50 m., large Cu. Nb. in W., with South parhelion of 22° in "false" cirrus.

The circumstances for the earlier of the two cases, in which both mock suns were simultaneously visible, must be somewhat rare. R. A. WATSON WATT.

South Farnborough, 25th October, 1920.

A Midday Rainbow.

ON Saturday, October 2nd, there was visible here from 12 h. 5 m. to 12 h. 10 m. G.M.T. a brilliant double rainbow. Surely a practically midday rainbow is a very rare phenomenon. I am over 60 and never recollect having seen one before.

I see by Ganot's Physics that if the sun is higher than 42° 2′ there can be no rainbow, but I should have thought that the sun was higher than that at the date and hour mentioned.

H. P. CHOLMELEY, M.D.

Forest Edge, Forest Row, Sussex, 4th October, 1920.

[The altitude of the sun at the time would be about 35·5°, so that the phenomenon was in accordance with the text-book. It is believed that tables of the frequency of occurrence of rainbows at various hours in different months have been published occasionally. Perhaps some reader can give a reference. —ED. M.M.]

Rainbows at Lympne.

ON August 19th two exceptional rainbows were visible in the afternoon. The first occurred at 16 h. 30 m. G.M.T. after a small shower, and showed the primary rainbow and the secondary rainbow (with reversed order of colours). Outside the secondary, three faint supernumerary rainbows were just visible, but the colours could not be marked with certainty other than the red.

The second occurred at 16 h. 50 m. G.M.T. and lasted with undiminished brilliance for 15 minutes, and then faded away in another 15 minutes. With the second the primary and secondary rainbows were very vivid. Inside the primary there were three supernumerary rainbows visible. None were noticed outside the secondary in this case. The intervals between the three supernumerary reds were approximately one-third of the distance of the first of these from the primary red. The effects were enhanced by the background formed by dark Cu. Nb. clouds. R. S. READ.

Lympne Aerodrome, 20th August, 1920.

Remarkable Rain Storm at Bournemouth.

On Friday, October 15th, we were visited by a remarkable rainstorm. The morning had been dull, and light rain fell more or less continuously, but there was nothing in the nature of the weather generally to suggest in any way the tremendous downpour which occurred between 12 h. 30 m. and 13 h. G.M.T. In this half hour no less than 1·15 in. fell out of a total of 1·17 for the 24 hours ending at 9 h. G.M.T. on the 16th.

The following extract from the *Times and Directory* of Saturday, October 23rd, gives some idea of the damage caused by flooding:—

> "A number of low-lying houses and business establishments suffered from flooding, and stocks in some cases could not be removed in time to prevent their being damaged. The roads in various parts of the town were rendered almost impassable for a time; in the Central Pleasure Gardens the rush of water was so considerable that a manhole over the surface water drain blew up and the water poured out in considerable volume. Flower beds were submerged, and even some of the seats. At Boscombe the tram track was slightly damaged and repairs had to be done before traffic could continue. In one way and another the damage done throughout the town was considerable."

It appears from the Daily Weather Report that a depression passed directly along the south coast and that Bournemouth had more rain than any of the places mentioned with the exception of Scilly, where 31 mm. fell.

S. HYLA GREVES.

Rodney House, Bournemouth, 26th October, 1920.

Heavy Rainfall in Southern France.

IN the months of September and October 1920, owing to shallow depressions moving eastwards along the Pyrenees and across the Gulf of Lyons, some places in southern France experienced excessive rains. At Montpellier, rain gauges registered no less than 629 mm. of rain from September 17th to October 17th. The average for this period is only 82 mm., and the annual average based on the 39 years 1873–1911 is 734 mm.

From October 7th–17th sharp thunderstorms caused exceptional downpours, 450 mm. being recorded at Montpellier. On Saturday, October 16th, 204 mm. of rain fell during two local storms of a few hours' duration. Many parts of the town were flooded and serious damage was done.

Last summer was very dry and warm, but the drought was broken with almost tropical violence. The same feature characterised the years 1907 and 1914. M. MOYE.

University of Montpellier, France, October, 1920.

Cirrus at 10,000 Feet.

AT 16 h. 40 m. G.M.T. on October 6th, 1920, a registering balloon was sent up and was distinctly seen in the theodolite telescope to enter the clouds after 17 minutes. The rate of ascent of similar balloons is known from long experience to be close to 1 kilometre in 5 minutes, so the height of the clouds cannot have exceeded 3·5 kilometres. But the clouds were distinctly cirrus; at least, they were clouds that the three observers present would have unhesitatingly entered as cirrus. Neither would they have been taken for false cirrus, as no cumuli were present or had been for some hours.

Benson Observatory, 13*th October*, 1920. W. H. DINES.

Cloud-pendants over the Comeragh Mountains.

I WAS taking a Sunday afternoon walk with friends on a small hill north of this station about a mile, known as Ballydrehid; it stands north and about half a mile away from the extreme easterly spur of the Galtee Mountains, and is probably a glacial moraine. This little hill commands a magnificent panoramic view of the surrounding country, the Keeper Mountains, Slievenaman, Comeragh, and Knockmealdown Mountains. The afternoon was sultry, with intervals of hot sunshine, but some heavy threatening cumulus were in evidence. At the top of Ballydrehid Hill there is a field of oats which had been cut and the sheaves "stooked," *i.e.*, standing on end in groups of three or four. The air was perfectly calm, when we were standing admiring the view in a field next to the oat field and about 20 feet above it, and we were discussing the advisability of turning homewards, as there was a dark heavy mass of cloud gathering over the Keeper Mountain, NW., and also over the Comeraghs, SE., when the sheaves in the field next to us began to behave in a weird fashion. One sheaf stood up on end and commenced waltzing round and then fell down; then others in various other parts of the field did exactly the same thing; while round us it was perfectly still, although we were not 50 yards away. Then we saw over the Monavullagh Mountain (a spur of the Comeraghs), and about 12–15 miles SE. of us, a long tongue had dropped down from the heavy clouds above mentioned. It appeared like a long arm which was feeling for something, and I should say was 1,000 yards long. It travelled slowly towards NE. We watched it for about 10 minutes, and then the cloud seemed to draw it up into itself; this was between 14 h. 30 m. and 14 h. 40 m. G.M.T.

I may add that we were caught in a sudden drenching rain on our way home, but without wind. However, I got a report of a similar local wind on the same afternoon from another person about a mile distant SW. Putting all these things together, it seemed to me the whole type of weather was one favouring a series of whirlwinds of varying intensity. I had evidence of three of them. There may have been many more. R. W. SMITH.

Bengurragh, Cahir, October 9th, 1920.

NOTES AND QUERIES.

Relation of Malaria to Temperature.

A PAPER on the relation of temperature to the occurrence of malaria in England appears in the Journal of the Royal Army Medical Corps for August, 1920. The author, Major Angus Macdonald, O.B.E., R.A.M.C., has examined English temperature records from 1763 to 1919 in conjunction with malaria prevalence, and estimated the probabilities of continuous endemicity of the disease in the past in this country and of its occurrence or recurrence in the present. It will be remembered that a disease is endemic when it continues without the importation of germ carriers from other localities.

The mean isotherm of 60° F. in the northern hemisphere has long been considered the northern boundary of recognised endemic malaria, and on the whole the disease increases in intensity towards the equator. The observation of epidemics justifies the assumption that for the development of malarial infection in countries occupied by the anopheline mosquito, this mean temperature, 60° F., is necessary over at least 16 days. These mosquitoes are widespread in England. During the period 1763–1919 there has been no definite change in the temperature conditions in England; the mean of the whole differs little from means taken for casual decennia throughout. The four years 1856–59 presented a seasonal malaria potentiality far beyond normal; in only seven of the fifty years 1841–90 was the required monthly mean reached in each of the months June, July and August, and of these, three were consecutive years, viz., 1857, 1858 and 1859. It was in these years that the last widespread and intense occurrence of malaria occurred of which we have record in this country. No other comparable period of continued high temperature existed, the nearest being 1825–6, when there was a marked occurrence of malaria, and 1808–9. Furthermore, 1860 was a phenomenally cold year and official recognition of endemic malaria ended suddenly in that year. Greenwich records are used as representing the south of England, and differing but little from those of the Fen district. Evidence of indigenous malaria north of the Humber is very rare.

The period of greatest importation of malaria carriers (*i.e.*, persons already infected) in history was 1916–19; the disease developed considerably in 1917–19 in those months when the requisite thermal conditions obtained and in approximate proportion to the extent of these conditions. The outbreak was more severe in 1856–59, in spite of the smaller number of carriers, because of the more continuous high mean temperature of the summer months.

Elevation of temperature does not occur in England with the regularity and continuity necessary to maintain endemic malaria. When the necessary coincidence of carrier importation and high mean temperature occurs, both epidemic and endemic malaria may break out for a limited time in limited areas. Many other factors affect the disease, and the living conditions in England over 100 years ago may have been more favourable to its incidence, but the temperature factor is essential.

The Highest Aerial Sounding.

The record of 35,030 metres which is alleged to have been established by a balloon sent up at Pavia on December 7th, 1911, has been accepted by many authorities; it is therefore desirable to examine the available evidence concerning it. The usual details of the ascent are set out in a paper by Professor Pericle Gamba.* The balloon was a Continental one, diameter 190 cm., and it carried a parachute with a Teisserence de Bort meteorograph. Hydrogen was used, and the residual ascensional force was 2,200 gramme weight. The balloon was sent up at 8 h. 14 m. The details in the first columns of the following table have been taken from Professor Gamba's paper. The mean speed of ascent has been computed from the tabulated heights. It will be seen from the table that the rate of ascent for the last eight minutes is no less than 900 metres per minute and nearly four times the

* Reale Istituto Lombardo di Scienze e Lettre, *Rendiconti.* Serie II, Vol. XLVI. Fasc. xi, p. 505.

initial rate. Such a phenomenon is so improbable that some error in the readings of the barograph from which the heights were computed is certain. No evidence as to the calibration of this instrument is given in the paper.

Time from Start.	Pressure.	Temperature.	Nominal Height.	Mean Rate of Ascent.
min.	mm.	a.	metres.	metres/minutes.
0	762	278·6	77	—
10	569	272·0	2,435	235·8
20	408	258·9	5,025	259·0
30	279	241·3	7,810	278·5
40	175	221·4	10.905	309·5
50	85	217·6	15,520	461·5
60	44	216·1	19,730	421·0
70	14	217·2	26,990	726·0
78m. 40s.	4	221·4	35,030	927·7

It may be noticed, however, that if a balloon could retain its hydrogen and rise to such a height that the pressure was only 4 mm., the volume would be nearly 200 times that at starting and the diameter six times, so that the Pavia balloon would have had a diameter of about 36 feet when it burst.

In all probability the barograph was not working properly and the rate of ascent was really approximately constant at the initial rate, say 240 metres per minute. On this assumption the stratsphere was reached at 10·3 km., and the greatest height attained was 18·9 km. If the Pavia ascent is to be deprived of pride of place as the highest on record, the question naturally arises which is the next claimant. Perhaps some reader of the *Magazine* can say. F. J. W. W.

A Defective Sunshine Recorder.

STUDENTS of the *Monthly Weather Report* may have noticed the very low amount of sunshine registered at Hull, as shown by the marked bend in the isohel on the monthly map. The deficiency was accepted in the Office as due to atmospheric conditions, but about a year ago a closer consideration showed that this could not account for the discrepancy, and an examination of the sunshine recorder followed. An instrument was lent to the station by the Meteorological Office, and during February 1920 the Meteorological Office recorder was running with the local recorder. In April the balls were interchanged. Upon comparing the two sets of cards for each month the discrepancy between the standard recorder and the local recorder was found to be the same for both February and April, which lead to the conclusion that the ball of the local recorder was at fault, as it had only been registering about 74 per cent. of the conventional duration of "bright sunshine." On this evidence the normal, quoted as 2·71 hours in the *Book of Normals*, should be brought up to 3·65 hours per day.

The defective ball has since been examined at the Meteorological Office. The distance between the centre of the sphere and the point where the sunlight is focussed has been found to be about a tenth of an inch less than the specified 2·97 in. Owing to this shortened focal length the ball had to be tilted to bring a sharp image of the sun on the card. Consequently, if the sun is not sufficiently bright, no trace or "burn" will be left on the card. With such a ball there will be a systematic error in the case of morning and evening sunshine, and on the whole there will be a deficiency in the percentage of "bright sunshine."

Geostrophic Wind over London; December, 1881–1915.

FREQUENCY OF STRENGTH AND DIRECTION.

Estimates based on the D.W.R. charts (8 *h.*, 1881–1908; 7 *h.*, 1909–1915).

Direction.	5 m/s. 11 mi/hr.	10 m/s. 22 mi/hr.	15 m/s. 33 mi/hr.	20 m/s. 44 mi/hr.	Over 20 m/s. Over 44 mi/hr.	Total Frequency of Direction.
N.	7	20	14	17	9	67
NE.	4	14	10	2	3	33
E.	5	19	15	8	2	49
SE.	23	29	15	7	5	79
S.	21	26	22	20	16	105
SW.	22	53	76	64	27	242
W.	13	43	72	82	33	243
NW.	15	20	35	20	15	105
Total Frequency of strength	110	224	259	220	110	923*

* Indeterminate—162.

News in Brief.

The Folkestone Corporation Bill of 1920 contained a section providing for the keeping of meteorological records, which is probably unique in the annals of Private Bill legislation:—

"The Corporation may provide and maintain barometrical and other instruments for recording the state of the weather and may take all necessary steps for making and publishing weather reports and statistics."

Dr. O. S. Sinnatt, M.C., D.Sc., M.Sc., at present lecturer in Mechanical Engineering, London University, King's College, has been appointed to the Professorship of Aeronautical Science at the R.A.F. Cadet College, Cranwell.

Mr. L. F. Richardson, formerly Superintendent of Eskdalemuir Observatory, who has recently been engaged on experimental investigations at Benson, has accepted an appointment on the staff of the Westminster Training College.

Summer Time in Belgium ended on Saturday night, October 23rd, 1920.

Readers who are familiar with Mr. Lempfert's little book *Weather Science* will welcome a larger work from his pen. The volume (*Meteorology.* By R. G. K. Lempfert, M.A., C.B.E., Assistant Director of the Meteorological Office. London, Methuen & Co. Price 7*s.* 6*d.* net), which has recently been published by Messrs. Methuen & Co., contains a general survey of dynamical meteorology. Special attention has been given to the developments of the past 15 years, during which period the systematic exploration of the upper air has opened up so many new fields of investigation. The treatment is elementary, and does not assume a knowledge of advanced mathematics or physics. It is hoped that a review will be published in the *Magazine* at an early date.

Review.

Australian Meteorology: A textbook including sections on aviation and climatology. By Griffith Taylor, D.Sc. Oxford Clarendon Press, 1920. 12*s.* 6*d.* Net.

Dr. Griffith Taylor, whose writings on Australian climatology are well known, has done good service in preparing this textbook, which is a comprehensive study of meteorology, but written from the Australian point of view.

The books on meteorology by English authors are primarily concerned with the conditions in the temperate zone and on the eastern margin of a continent. Australian meteorology is concerned, on the other hand, with the whole of a continent which lies partly in the tropics, so that Dr. Taylor has scope for much pioner work in his treatment of the subject.

The most speculative chapter in the book is devoted to the origin of the tropical "lows" in Australia. The argument is based on the supposition that "convective domes" of rising air formed over the hottest parts of the continent have such stability that they act like solid obstacles in producing great eddies in the planetary circulation. It is to be hoped that the author will find an opportunity to set out his theory in greater detail. In the semi-popular exposition it is difficult to follow. A primary objection is that the desert regions are generally regarded as localities where in spite of the heating of the lower layers the air is descending on the whole.

There are 229 illustrations in the book, and the majority are excellent, but a few details call for criticism. For example, the Dines balloon meteorograph is shown in the diagrams and described in the text as having two pens for pressure and temperature respectively, whereas it is an essential feature of this instrument that the synchronous temperature and pressure are indicated by a single point on the record. The illustration of the Dines anemometer is apparently intended to represent the anemobiagraph rather than Mr. Dines' own instrument, but the spring control which is an essential detail in the anemobiagraph is not shown. The instrument illustrated would presumably record wind pressure or the square of the wind speed. A theoretical diagram showing the paths of bodies moving without friction over the globe seems to require reconsideration. The path of a body projected eastward with less than a certain critical velocity is shown rightly as a series of loops, but these loops should not have touched the equator, and in the limiting case of the critical velocity the path should be asymptotic to the equator and not built up of two parts, a short curve and the equator itself.

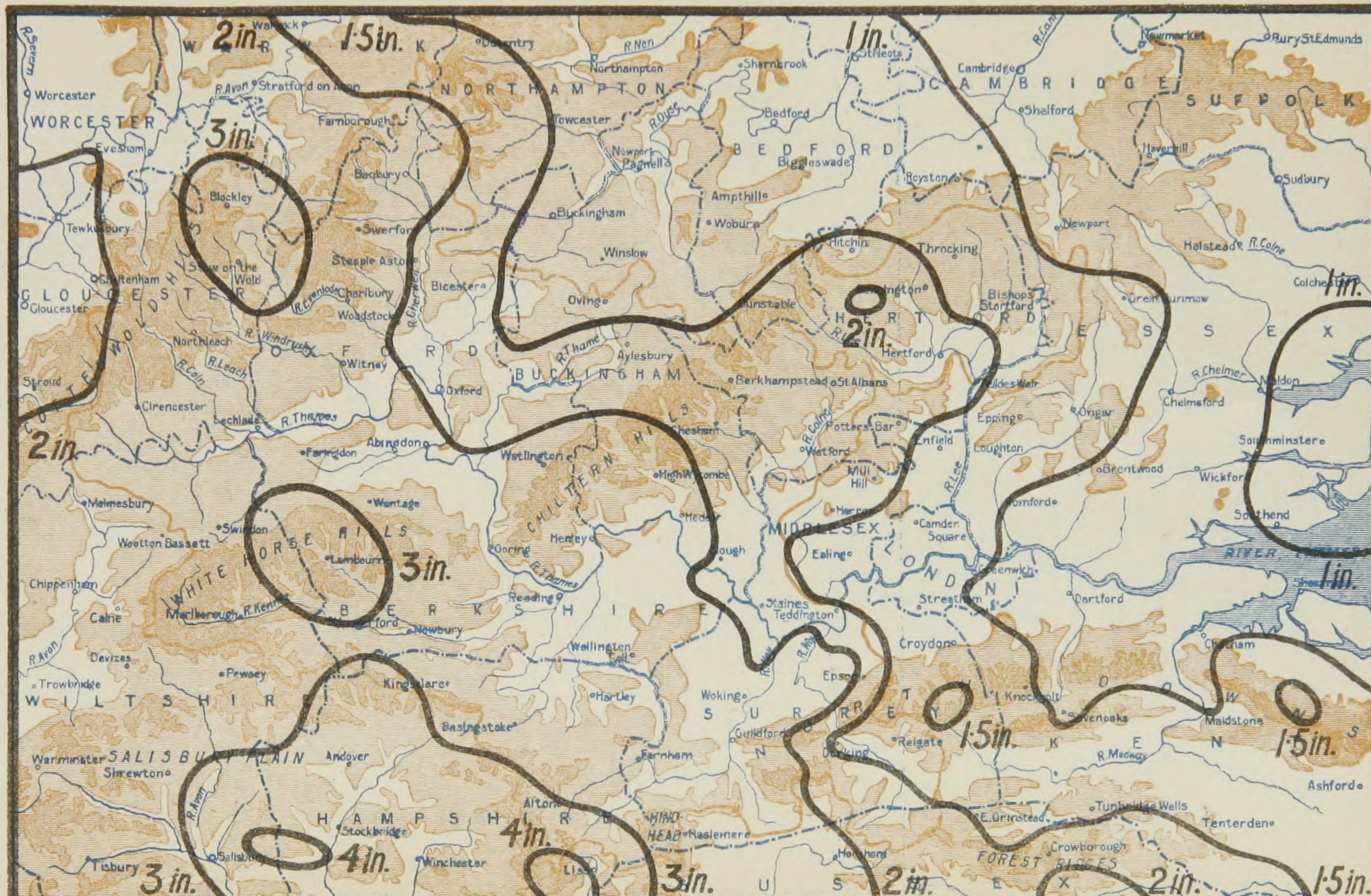
Australian Meteorology can be warmly recommended to the notice of those whose interest is primarily in the science of meteorology as well as to those who are more concerned with Australia.

Weather in the British Isles: October 1920.

THE outstanding characteristic of October was the abundant sunshine in the east and south of England. At Yarmouth only 7 mm. of rain were recorded and there were nineteen days on which the duration of bright sunshine exceeded six hours, whereas at the Valentia Observatory (Co. Kerry) there were 203 mm. of rain and only one day with as much as six hours' sunshine. At Felixstowe the sunny hours during the month amounted to 207, and at Copdock (Ipswich) 200 were recorded, the latter figure being well above any October total recorded at this station during the past 18 years. The observer at Southport reports that it was the driest and yet the most humid October for at least 50 years, and that easterly winds were exceptionally persistent.

A depression which advanced quickly from the westward during the night of the 1st caused gales from the south-east and south in Ireland, in the Hebrides, and in the south-west of England early in the morning of the 3rd, but did not affect the eastern districts. This gale was severe in the south of Ireland and especially in Cork Harbour, where much damage was done to

THAMES VALLEY RAINFALL.——OCTOBER, 1920.



Meteorological Magazine

Watershed of River Thames above Teddington, and River Lee above Feildes Weir

Isohyetals

ALTITUDE SCALE

Below 250 feet	250 to 500 feet	500 to 1000 feet	Above 1000 feet

SCALE OF MILES

0 5 10 15 20

H.M. Stationery Office Press, Kingsway W.C.2.

Ps. 5546/139. 105. P.35 1250. 11/20.

wharves and shipping. At Valentia Observatory a gust of 67 miles per hour was recorded at 5 h., and there was one of 54 miles per hour at Weaver Point (Cork Harbour) at 11 h. 40 m. Much rain accompanied this gale. As a result of the incessant rainfall in the Dee Valley (27 mm. fell at Crathes on the 1st, 20 mm. on the 2nd, and 38 mm. on the 4th, and 41 mm. on the latter date at Balmoral, whilst Braemar reported 83 mm. on the 3rd and 4th), there were serious floods, said to be even more extensive than those of 1829, previously the worst on record for the neighbourhood. In Shetland there was a continuous gale during the four days, 2nd to 5th. On the 5th secondary depressions passed northward over St. George's Channel, and in many places caused thunderstorms and heavy rain.

After this date pleasanter conditions set in and under the influence of a warm southerly current of air a spell of summer-like weather which synchronised with "St. Luke's Summer" was widely experienced. For many consecutive days the temperature rose to 70° F. and above, and in some instances maxima unequalled in October since 1908 were recorded. At Sheepstor (Devon) on the 9th the maximum was 73° F., the first time that 70° F. has been reached at this station in this month during 14 years. The nights also were very warm and minima between 55° F. and 60° F. were frequently registered, some of the minima being as high as the normal maxima for the time of year.

At some of the western stations, rain fell heavily on the 15th, when there was 29 mm. at Bournemouth in half an hour (12 h. 30 m. to 13 h.) and 57 mm. at Newquay between 17 h. and 19 h. 30 m.

During the last two weeks of the month there was high pressure over Scandinavia, and the dry easterly winds brought clear skies to this country. The days were generally sunny and mild, but there was much local fog and mist; on the other hand the nights were colder and there were occasional frosts. During the week which ended on the 30th, the mean daily amount of sunshine was 8·9 hours at three widely separated stations, Cromer, St. Leonards and St. Heliers, the percentage of the possible duration being 89, 88 and 87 respectively. These figures may be compared with 87 per cent. at Deerness for the week ending 19th June, and 78 per cent. at Castlebay for the previous week. Over a large part of the country there was no cloud from the 24th to the 30th, with the exception of low-lying fog and mist, these and the previous sunny days combined with unusually bright moonlight nights making the month the most brilliant October experienced for very many years. The closing days of the month were boisterous; there was a southerly gale in the north of Scotland, in the Hebrides, and in the northern parts of the North Sea on the 30th, and in most parts of the east and south-east coast on the 31st.

As the result of the long spells of fine weather the conditions for daylight flying were much better than in an average October. There was much fog at night and in the morning, but, except in the immediate neighbourhood of large towns, it never lasted all day. Near the beginning and in the middle of the month there were spells of unsettled weather, but there was no continuously bad day in the south-east area. In the extreme west conditions were less favourable for flying than elsewhere.

The rainfall of the month was in general below the average, but the local departures from the normal were very remarkable. In England a considerable area in East Anglia had less than 13 mm., while in Devon and Cornwall 150 mm. was recorded, this being the only large area with excess. In Scotland and Ireland an inversion of the usual distribution occurred, the wet areas being in general to the east. The north of Scotland was unusually dry, large areas recording less than 50 mm. and only 20 per cent. of the average; but in Aberdeenshire and Perthshire heavy rains occurred at the beginning of the month.

(*Continued on* p. 236.)

Rainfall Table for October 1920.

STATION.	COUNTY.	Aver. 1875—1909.	1920.		Per cent. of Av.	Max. in 24 hrs.		No. of Rain Days.
		in.	in.	mm.		in.	Date.	
Camden Square	*London*	2·72	1·09	28	40	·38	16	13
Tenterden (View Tower)	*Kent*	3·48	1·40	36	40	·56	15	9
Arundel (Patching)	*Sussex*	4·01	2·39	61	60	·61	31	7
Fordingbridge (Oaklands)	*Hampshire*	3·97	3·17	80	80	·62	14*	18
Oxford (Magdalen College)	*Oxfordshire*	2·82	2·08	53	74	1·13	31	11
Wellingborough (Swanspool)	*Northampton*	2·60	1·60	41	62	·54	14	10
Hawkedon Rectory	*Suffolk*	2·65	·55	14	21	·23	31	5
Norwich (Eaton)	*Norfolk*	3·17	·77	20	24	·42	1	6
Launceston (Polapit Tamar)	*Devon*	4·84	6·36	162	131	1·81	3	16
Lyme Regis (Rousdon)	,,	3·81	2·50	64	66	·46	21	12
Ross (Birchlea)	*Herefordshire*	3·21	3·50	89	109	·70	3	18
Church Stretton (Wolstaston)	*Shropshire*	3·77	3·32	84	88	1·03	16	13
Boston (Black Sluice)	*Lincoln*	2·75	1·50	38	55	1·26	1	7
Worksop (Hodsock Priory)	*Nottingham*	2·77	1·88	48	68	·58	4	14
Mickleover Manor	*Derbyshire*	2·81	1·95	50	69	·56	15	10
Southport (Hesketh Park)	*Lancashire*	3·74	1·13	29	30	·29	31	9
Wetherby (Ribston Hall)	*York, W. R.*	3·18	2·92	74	92	1·04	15	8
Hull (Pearson Park)	,, *E. R.*	3·19	1·50	38	47	·87	1	9
Newcastle (Town Moor)	*North'land*	3·20	1·62	41	51	·74	4	11
Borrowdale (Seathwaite)	*Cumberland*	12·71	2·20	56	17	..	..	..
Cardiff (Ely)	*Glamorgan*	4·87	3·65	93	75	·76	16	16
Haverfordwest	*Pembroke*	5·51	..	..	..	..	..	..
Aberystwyth (Gogerddan)	*Cardigan*	5·38	3·14	80	58	..	..	..
Llandudno	*Carnarvon*	3·78	1·64	42	43	·31	3	11
Dumfries (Cargen)	*Kirkcudbrt.*	4·45	3·29	84	74	1·22	3	13
Marchmont House	*Berwick*	3·83	2·27	58	59	1·26	4	16
Girvan (Pinmore)	*Ayr*	5·38	5·75	146	107	1·17	5	14
Glasgow (Queen's Park)	*Renfrew*	3·36	1·31	33	39	·59	5	10
Islay (Eallabus)	*Argyll*	4·95	6·26	159	126	1·97	30	12
Mull (Quinish)	,,	5·87	4·73	120	81	1·51	30	12
Loch Dhu	*Perth*	7·53	5·35	136	71	1·85	5	12
Dundee (Eastern Necropolis)	*Forfar*	2·81	2·26	57	80	·80	4	16
Braemar	*Aberdeen*	3·88	5·03	128	130	1·95	3	9
Aberdeen (Cranford)	,,	3·23	2·89	73	89	·91	2	13
Gordon Castle	*Moray*	3·38	1·42	36	42	·36	4	10
Drumnadrochit	*Inverness*	3·49	..	..	..	..	..	..
Fort William	,,	7·32	3·03	77	41	·86	30	13
Loch Torridon (Bendamph)	*Ross*	8·38	1·72	44	21	·42	4	5
Stornoway	,,	3·58	2·66	68	74	1·05	6	12
Dunrobin Castle	*Sutherland*	3·15	·90	23	29	·48	5	8
Wick	*Caithness*	3·14	·61	16	19	·19	4	9
Glanmire (Lota Lodge)	*Cork*	4·35	4·60	117	106	1·16	3	19
Killarney (District Asylum)	*Kerry*	5·59	4·48	114	80	1·34	2	17
Waterford (Brook Lodge)	*Waterford*	4·00	7·99	203	200	2·09	6	16
Nenagh (Castle Lough)	*Tipperary*	3·48	4·38	111	126	·83	5	15
Ennistymon House	*Clare*	4·40	3·39	86	77	·85	2	15
Gorey (Courtown House)	*Wexford*	3·75	8·33	212	222	1·87	30	17
Abbey Leix (Blandsfort)	*Queen's Co.*	3·53	5·64	143	160	1·37	5	15
Dublin (FitzWilliam Square)	*Dublin*	2·88	6·39	162	222	·97	19	16
Mullingar (Belvedere)	*Westmeath*	3·19	3·42	87	107	·75	31	13
Woodlawn	*Galway*	3·80	3·11	79	82	·83	3	19
Crossmolina (Enniscoe)	*Mayo*	5·27	3·52	89	67	·79	3	17
Collooney (Markree Obsy.)	*Sligo*	4·21	2·64	67	63	1·01	3	15
Seaforde	*Down*	3·65	7·47	190	205	1·29	3	13
Ballymena (Harryville)	*Antrim*	3·78	5·79	147	153	1·27	30	14
Omagh (Edenfel)	*Tyrone*	3·76	4·69	119	125	1·20	6	15

* and 3.

Supplementary Rainfall, October 1920.

Div.	STATION.	RAIN. in.	RAIN. mm.	Div.	STATION.	RAIN. in.	RAIN. mm.
II.	Ramsgate	·92	23	XII.	Langholm, Drove Rd.	1·92	49
"	Sevenoaks, Speldhurst	·94	24	XIII.	Selkirk, Hangingshaw	2·37	60
"	Hailsham Vicarage	1·69	43	"	North Berwick Res.	·90	23
"	Totland Bay, Aston	2·55	65	"	Edinburgh, Royal Ob.	·87	22
"	Ashley, Old Manor Ho.	3·48	88	XIV.	Biggar	1·57	40
"	Grayshott	2·91	74	"	Leadhills	3·00	76
"	Ufton Nervet	2·51	64	"	Maybole, Knockdon	2·00	51
III.	Harrow Weald, Hill Ho.	1·93	49	XV.	Rothesay	4·29	109
"	Pitsford, Sedgebrook	1·02	26	"	Ardgour House	3·31	84
"	Chatteris, The Priory	..	..	"	Inveraray Castle	4·24	108
IV.	Elsenham, Gaunts End	·91	23	"	Holy Loch, Ardnadam	2·93	74
"	Lexden, Hill House	·82	21	XVI.	Loch Venachar	3·30	86
"	Aylsham, Rippon Hall	1·27	32	"	Glenquey Reservoir	1·90	48
"	Swaffham	·77	20	"	Loch Rannoch, Dall	4·63	118
V.	Devizes, Highclere	2·32	59	"	Coupar Angus	3·13	80
"	Weymouth	2·94	74	"	Montrose Asylum	2·47	63
"	Ashburton, Druid Ho.	4·95	126	XVII.	Balmoral Castle	4·64	118
"	Cullompton	3·68	94	"	Fyvie Castle	4·02	102
"	Hartland Abbey	6·20	158	"	Peterhead, Forehill	..	..
"	St. Austell, Trevarna	7·14	181	"	Grantown-on-Spey	1·30	33
"	North Cadbury Rec.	2·86	73	XVIII.	Cluny Castle	1·96	50
"	Cutcombe, Wheddon Cr.	4·80	122	"	Loch Quoich, Loan	6·80	173
VI.	Clifton, Stoke Bishop	3·00	76	"	Skye, Dunvegan	5·29	134
"	Ledbury, Underdown	2·51	64	"	Fortrose	·72	18
"	Shifnal, Hatton Grange	4·21	107	"	Ardross Castle	1·86	47
"	Ashbourne, Mayfield	2·06	52	"	Glencarron Lodge	1·32	34
"	Barnt Green, Upwood	3·44	87	XIX.	Tongue Manse	·78	20
"	Blockley, Upton Wold	3·74	95	"	Melvich Schoolhouse	·55	14
VII.	Grantham, Saltersford	1·29	33	"	Loch More, Achfary	1·40	36
"	Louth, Westgate	1·18	30	XX.	Dunmanway Rectory	6·04	153
"	Mansfield, West Bank	2·18	55	"	Mitchelstown Castle	5·58	142
VIII.	Nantwich, Dorfold Hall	1·71	43	"	Gearahameen	10·00	254
"	Bolton, Queen's Park	1·65	42	"	Darrynane Abbey	5·83	148
"	Lancaster, Strathspey	1·23	31	"	Clonmel, Bruce Villa	7·38	188
IX.	Wath-upon-Dearne	1·65	42	"	Cashel, Ballinamona	3·84	98
"	Bradford, Lister Park	3·19	81	"	Roscrea, Timoney Pk.	4·83	123
"	West Witton	3·61	92	"	Foynes	2·93	74
"	Scarborough, Scalby	2·49	63	"	Broadford, Hurdlesto'n	..	..
"	Ingleby Greenhow	2·36	60	XXI.	Kilkenny Castle	6·17	157
"	Mickleton	2·80	71	"	Rathnew, Clonmannon	7·32	186
X.	Bellingham	2·13	54	"	Hacketstown Rectory	6·69	170
"	Ilderton, Lilburn	2·19	56	"	Ballycumber, Moorock	3·22	82
"	Orton	1·45	37	"	Balbriggan, Ardgillan	6·05	154
XI.	Llanfrechfa Grange	4·13	105	"	Drogheda	4·48	114
"	Treherbert, Tyn-y-waun	7·36	187	"	Athlone, Twyford	3·23	82
"	Carmarthen Friary	6·20	158	"	Castle Forbes Gdns.	2·85	72
"	Fishguard	6·05	154	XXII.	Ballynahinch Castle	5·25	133
"	Lampeter, Falcondale	5·20	132	"	Westport House	3·35	85
"	Abergwngy	5·00	127	XXIII.	Enniskillen, Portora	2·90	74
"	Cray Station	7·00	178	"	Armagh Observatory	5·36	136
"	Crickhowell, Talymaes	3·50	89	"	Warrenpoint	5·40	137
"	Lake Vyrnwy	4·38	111	"	Banbridge, Milltown	5·94	151
"	Llangynhafal, P. Drâw	2·33	59	"	Belfast, Cave Hill Rd.	6·56	167
"	Dolgelly, Bryntirion	5·05	128	"	Glenarm Castle	7·14	181
"	Lligwy	3·25	82	"	Londonderry, Creggan	4·10	104
XII.	Stoneykirk, Ardwell Ho.	5·12	130	"	Sion Mills	3·71	94
"	Whithorn, Cutroach	3·51	89	"	Milford, The Manse	2·90	74
"	Carsphairn, Shiel	5·27	134	"	Killybegs, Rockmount	1·66	42

Climatological Table for the

STATIONS	PRESSURE		TEMPERATURE							
			Absolute				Mean Values			
	Mean of Day M.S.L.	Diff. from Normal	Max.	Date	Min.	Date	Max.	Min.	½ max. and min.	Diff. from Normal
	mb.	mb.	° F.		° F.		° F.	° F.	° F.	° F.
London, Kew Observatory	1018·1	+2·2	79	25	36	5	63·9	47·3	55·6	+2·2
Gibraltar	1015·7	+0·8	79	29	52	20	72·6	59·0	65·8	+0·5
Malta	1017·1	+3·4	82	23	57	6	75·2	62·0	68·6	+3·5
Sierra Leone	1011·5	−0·2	92	21, 30	65	22	88·8	73·5	81·1	−0·8
Lagos, Nigeria	1012·2	+1·2	89	11	71	6	86·6	75·2	80·9	−0·3
Kaduna, Nigeria	1013·0	+3·4	92	9,11,14	66	5,29,31	86·6	68·9	77·7	−1·4
Zomba, Nyasaland	1015·7	+1·4	82	4,26,27	53	7	74·6	58·3	66·5	+0·8
Salisbury, Rhodesia	1017·4	−1·7	81	27	45	6,14,24	76·0	49·5	62·7	+2·3
Cape Town	..	..	83	14	41	25	67·2	52·0	59·6	+1·0
Johannesburg	1016·2	−0·3	77	6	31	27	65·8	46·4	56·1	+1·7
Mauritius	1016·9	+0·5	80	16, 21	61	9	78·3	66·0	72·1	−0·5
Bloemfontein	..	..	77	6	23	27	65·7	40·5	53·1	+0·4
Calcutta, Alipore Obsy.	1003·7	+0·2	104	7	70	14	96·8	77·7	87·3	+1·3
Bombay	1007·9	+0·2	93	29	79	3, 4	91·5	81·0	86·3	+0·6
Madras	1005·3	−0·1	109	6	74	26	99·5	81·4	90·5	+0·6
Colombo, Ceylon	1009·3	+1·1	89	21	73	29	87·7	78·2	82·9	+0·1
Hong Kong	1007·1	−2·3	88	23	68	1	80·1	73·1	76·6	−0·8
Sydney	1019·3	+0·7	77	14	43	19	68·8	49·6	59·2	+0·7
Melbourne	1019·6	+0·4	67	29, 31	36	28	58·5	45·6	52·1	−1·9
Adelaide	1020·0	−0·1	74	30	37	23	65·1	48·8	56·9	−0·8
Perth, West Australia	1016·9	−1·8	81	5	45	1	68·8	52·9	60·9	+0·5
Coolgardie	1016·8	−3·0	82	24	37	12, 31	69·0	45·9	57·5	−0·1
Brisbane	1018·3	−0·6	83	16	47	13	73·4	55·8	64·6	+0·2
Hobart, Tasmania	1014·8	−0·5	64	25	34	23	57·5	43·8	50·7	+0·3
Wellington, N.Z.	1009·2	−6·0	63	5	31	21	56·3	44·7	50·5	−2·3
Suva, Fiji	..	..	..	..	..	..	..	..	..	..
Kingston, Jamaica	1012·4	−0·9	90	30	69	24	87·4	72·2	79·8	+0·1
Grenada, W.I.	1013·1	+0·5	86	4, 10	71	15, 16	84·2	74·2	79·2	−0·3
Toronto	1018·6	+3·8	83	31	31	2	65·2	43·7	54·5	+1·8
Fredericton, N.B.	..	..	83	27	25	5	65·7	37·3	51·5	−0·1
St. John, N.B.	1017·3	+3·3	74	26	30	4	56·4	40·0	48·2	+0·5
Victoria, B.C.	1018·5	+2·1	67	6	40	13, 24	57·1	42·9	50·0	−3·1

LONDON, KEW OBSERVATORY.—Mean speed of wind 8·9 mi/hr; 2 fogs; 1 day with thunder heard.

GIBRALTAR.—3 gales; 3 days with thunder heard.

MALTA.—Prevailing wind direction NW.; mean speed 4·8 mi/hr.

SIERRA LEONE.—7 gales; 3 days with thunder heard.

MAURITIUS.—Mean speed of wind 7·2 mi/hr.; 2 days with thunder heard.

British Empire, May 1920.

TEMPERATURE Absolute Max. in Sun °F.	TEMPERATURE Absolute Min. on Grass °F.	Relative Humidity %	Mean Cloud Am'nt 0–10	PRECIPITATION Amount in.	PRECIPITATION Amount mm.	PRECIPITATION Diff. from Normal mm.	PRECIPITATION Days	BRIGHT SUNSHINE Hours per day	BRIGHT SUNSHINE Percentage of possible	STATIONS
132	26	67	6·4	0·85	22	− 22	12	6·8	44	London, Kew Observatory
146	51	74	4·0	1·41	36	− 9	6	..	..	Gibraltar.
144	..	78	2·5	0·00	0	− 10	0	9·7	69	Malta.
..	..	72	6·3	5·67	144	−142	16	..	..	Sierra Leone.
160	68	75	6·6	8·91	226	− 37	18	..	..	Lagos, Nigeria.
..	..	83	..	3·56	90	− 96	17	..	..	Kaduna, Nigeria.
..	..	90	6·3	2·42	61	+ 36	12	..	..	Zomba, Nyasaland.
140	37	54	3·5	0·39	10	+ 5	3	..	..	Salisbury, Rhodesia.
..	..	77	5·1	3·43	87	− 14	11	..	..	Cape Town.
..	30	56	2·0	1·67	42	+ 24	8	8·7	81	Johannesburg.
..	57	81	5·2	4·55	116	+ 39	15	7·5	67	Mauritius.
..	..	64	3·9	0·39	10	− 20	2	..	..	Bloemfontein.
..	67	51	3·8	2·61	66	− 80	6	..	..	Calcutta, Alipore Obsy.
..	..	73	4·4	0·00	0	− 18	0	..	..	Bombay.
..	..	65	3·2	1·25	32	+ 5	4	..	..	Madras.
154	71	76	6·5	8·68	220	− 91	15	..	..	Colombo, Ceylon.
..	..	86	7·9	18·15	461	+164	19	4·4	33	Hong Kong.
122	36	65	2·3	0·29	7	−119	4	..	..	Sydney.
115	30	75	6·2	1·98	50	− 5	21	..	..	Melbourne.
132	27	63	4·4	2·36	60	− 9	11	..	..	Adelaide.
139	36	66	6·2	6·70	170	+ 50	20	..	..	Perth, West Australia.
137	33	48	5·1	0·26	7	− 28	6	..	..	Coolgardie.
133	40	67	5·1	2·02	51	− 23	12	..	..	Brisbane.
..	27	72	5·7	2·17	55	+ 8	13	5·5	57	Hobart, Tasmania.
121	22	77	6·2	2·27	58	− 62	13	4·1	42	Wellington, N.Z.
..	..	..	..	..	..	..	..	..	..	Suva, Fiji.
..	..	75	5·0	3·46	88	− 22	8	..	..	Kingston, Jamaica.
138	..	72	5·0	1·35	34	− 84	13	..	..	Grenada, W.I.
142	26	64	3·8	0·39	10	− 66	6	..	..	Toronto.
..	..	..	..	1·44	37	− 45	5	..	..	Fredericton, N.B.
129	24	79	5·2	1·56	40	− 54	6	..	..	St. John, N.B.
133	31	90	4·2	1·37	35	+ 2	9	..	..	Victoria, B.C.

COLOMBO, CEYLON.—Prevailing wind direction SW.; mean speed 5·7 mi/hr.; 3 days with thunder heard.

HONG KONG.—Prevailing wind direction E; mean speed 14·0 mi/hr.; 3 fogs; 6 days with thunder heard.

GRENADA.—Prevailing wind direction E.

WELLINGTON, N.Z.—1 day with thunder heard.

BLOEMFONTEIN.—Absolute min. one of the lowest yet recorded.

In Ireland the total fall was below 75 mm. only in the west, and nearly the whole of the east coast received more than 150 mm. Twice the average was reached in small areas locally, and at Brook Lodge, Waterford, only two wetter Octobers have been recorded since 1850. The general rainfall expressed as a percentage of the average was:—England and Wales, 58; Scotland, 67; Ireland, 127; British Isles, 79.

In London (Camden Square) the mean temperature was 51·9° F., or 1·7° F. above the average. The duration of rainfall was 22·6 hours, and the evaporation, ·66 inch.

Weather Abroad: October 1920.

THE most noteworthy feature of the month was the remarkable persistence of high pressure over the Scandinavian area. The anticyclone which was established over that region throughout the last week of September persisted until October 13th, when it withdrew in a south-easterly direction. By the 18th, however, another anticyclone had reached Scandinavia from the westward; this increased in intensity, and persisted till the end of the month. The Atlantic depressions were unable to proceed either eastward or north-eastward, most of them remaining stationary off the west of Ireland and slowly filling up, though on the 17th and 18th a depression penetrated to Central France. During most of the month there were shallow irregular depressions over the Mediterranean and South France. In accordance with the pressure distribution, the general wind current over north-west Europe was between east and south.

There were some heavy rainstorms in France, especially in the south. Among the most notable falls were 61 mm. at Nice, and 45 mm. at Marseilles on the 1st; 80 mm. at Sanguinaire (Corsica) on the 2nd; 57 mm. at Marseilles and 48 mm. at Perpignan on the 8th; 60 mm. at Sanguinaire on the 11th; and 64 mm. at Paris on the 17th. A fall of 51 mm. was also recorded at Aix-la-Chapelle on the 1st.

The month was unusually dry over most of the Scandinavian area, and there was no rain except on the 2nd and 15th. The dry conditions extended over the Netherlands and the eastern part of the British Isles.

For the first half of the month temperature was high over Western Europe, a maximum of 79° F. being recorded at Paris on the 5th. Towards the end of the month the persistent east winds brought lower temperatures, night frosts being experienced over a wide area, and severe frost over Central Europe. On the 30th the minimum at Warsaw was 14° F. and the maximum 30° F. There were also occasional sharp frosts locally over Scandinavia in anticyclonic conditions, a minimum of 14° F. being recorded at Saerna (Sweden) on 19th.

The autumn was warm and late in Ontario, and many vagaries of plant and tree life have occurred. Wild fruits and flowers were plentiful even near the end of the month.

The monsoon rainfall in India has, on the whole, been deficient. Between the 1st and 21st of October Kashmir received an excess and the Bombay Deccan a normal amount of rain. The Bay Islands and Lower Burma had a fair amount, but other regions suffered from scanty rainfall.

A message received on the 23rd states that light to heavy general rains have fallen through South Australia and an exceptional wheat harvest is now practically assured. Good rainfall has also been experienced in New South Wales and Victoria.

Abundant rain fell in the Argentine during the first few days of the month, and the crop prospects were much improved. Some damage was, however, caused at the end of the month by sharp frost in the littoral provinces.

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

The International Commission for Weather Telegraphy.

THE International Commission for Weather Telegraphy, which was appointed at the Conference at Paris in 1919, met at the Air Ministry during the week November 22nd–27th. The following delegates were present at the meeting:—Lieut.-Col. E. Gold (President), Dr. W. Van Bemmelen (Batavia), Captain C. Ryder (Copenhagen), M. A. Angot (Paris), M. Rey (Paris), M. Gain (Paris), Colonel L. F. Blandy (London), Lieut. H. D. Grant (London), Professor E. Van Everdingen (Holland), Mr. T. Thorkelsson (Reykjavik), Lieut.-Col. Matteuzzi (Rome), Dr. T. Hesselberg (Christiania), Señor J. Galbis (Madrid), Dr. A. Wallen (Stockholm), Professor A. de Quervain (Zürich).

The delegates were welcomed on Monday, November 22nd, by Major-General Sir F. H. Sykes, Controller-General of Civil Aviation.

As a result of the meeting a standard code, which incorporates some of the developments of recent years, has been agreed upon for the international exchange of observations. Agreement has also been reached upon codes for reports from ships at sea and for special reports for the purposes of aviation, although these have still to be considered by the Commission for Marine Meteorology and the Commission for the Application of Meteorology to Aerial Navigation. Details of the revised codes will, it is hoped, be published without delay.

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The business meetings were interspersed by a number of social gatherings. On Monday night Sir Napier and Lady Shaw gave a reception to the delegates at 10 Moreton Gardens, S.W. On Wednesday afternoon a visit was paid to Croydon, where the general arrangements and different types of aeroplanes evoked much interest; the radio-telegraphic arrangements at the Air Ministry were also inspected. On Thursday the delegates were entertained to luncheon at the Carlton Hotel, when the Marquess of Londonderry presided, and on Friday night they dined with the Maharaj Rana of Jhalawar, whose association with international meteorology dates from the meeting of the Commission in London in 1912.

In proposing the health of the guests at the luncheon at the Carlton Hotel, the Marquess of Londonderry delivered the following speech:—

"Gentlemen, it gives me great pleasure to preside at this luncheon of the Weather Telegraphy Commission of the International Meteorological Committee, and to offer to all its members a welcome to London. This Commission was, as you all know, instituted in 1907 in Paris, as the successor to a series of sub-committees which had from 1872 dealt with this special aspect of international meteorology. It has already on two previous occasions met in London, in 1909 and again in 1912, and I think I am right in saying that as a result of its meetings the barometric tendency, now so universally acknowledged to be of fundamental importance in forecasting, was introduced into the weather reports.

"The actual subject of weather telegraphy, upon which you have come over here to deliberate this week, is naturally of greater age than the Commission. I understand that it owed its birth in the middle of last century to an incident in the Crimean War, when the French and British Fleets in the Black Sea were overtaken by a sudden unexpected hurricane which had travelled eastwards north of the Balkans. Is it necessary to say that this hurricane would not have been unexpected had the means of warning then existed which we have at our disposal in 1920?

"Leverrier, the great compatriot of M. Angot and the joint discoverer of the outermost planet Neptune, applied his great talents to the meteorological problem, and in co-operation with Sir George Airy, then Astronomer Royal, whose successor, Sir F. Dyson, we are pleased to see here to-day, devised a scheme of warnings of storms for western Europe. Leverrier, I believe, unlike most of you gentlemen, never produced a 'code'; but whether that was the result of wisdom or diplomacy, I leave you to judge. From these small beginnings, by a development slow but certain, as is inevitable in all State enterprises, 'meteorological telegraphy' or, as it is called in our more modern language, 'synoptic meteorology' has extended over the whole inhabited globe. The speed of means of transport for individuals, however, does not yet equal that of the telegraph, and many representatives from distant lands have not been able to attend this Conference; and we have to regret the absence of Dr. Marvin, Chief of the United States Weather Bureau; Dr. Gilbert Walker, Director-General of Observatories, India; General Ferrie, Captain Franck and M. Goutereau, of the French Telegraphic and Meteorological Services, and Professor Eredia, of the Italian Meteorological Office at Rome. In spite of these drawbacks, we have here with us Dr. Van Bemmelen, Head of the Magnetic and Meteorological Observatory of so distant a spot as Java, who is distinguished for his researches in the magnetism and meteorology of the equatorial regions; and Mr. Thorkelsson, Director of the New Service in Iceland, whose gentle easterly breezes so frequently foretell a depression on the Atlantic and the renewal of gales on our north-west coasts.

"Present also are Señor Galbis, Director of the Meteorological Service of Spain, whose observatory on the Peak of Teneriffe may furnish us with the solution of the problem of the vertical constitution of the trade winds; Dr. Hesselberg, Director of the enterprising meteorological service of Norway, distinguished for his researches on pilot balloons, which we hope he will be able to put to further practical use for the whole of western Europe, at the projected observatory on the lonely island of Jan Mayen (north of Iceland): Dr. Wallen, Director of the Bureau of Stockholm, who has shown his interest in one of the most important sides of meteorological work, namely, its application to agriculture—may his recent visit to the Agricultural Congress at Rome result in benefits to both sciences: Captain Ryder, Director of the Institute at Copenhagen, and Professor Van Everdingen, of Utrecht, both well-known authorities in the meteorology of the ocean, and the latter also Secretary of the International Meteorological Committee. Colonel Matteuzi, from Rome, represents the aviation meteorology of Italy. The meteorological problems of that country partake alike of the difficulties of an island such as our own and of a mountainous country like Switzerland, whose representative, Professor A. de Quervain, is so greatly distinguished for his ingenuity in devising means of investigating the upper air.

"From Paris we welcome Colonel Delcambre, who first achieved fame as a meteorologist to Marshal Foch during the first years of the war; M. Gain, the devoted meteorologist of civil aviation; M. Rey, who advises the Ministry of Agriculture; and last, but not least, M. Angot, the distinguished Chief of the Central Meteorological Bureau and Vice-President of the International Meteorological Committee. The services of M. Angot in meteorology are well known to you all, and the production by him in the midst of his official duties of a comprehensive book on the climate of France is evidence at once of his erudition and his energy. I believe I am correct in regarding him as the *doyen* of the meteorological services represented in your Commission.

"Gentlemen, it only remains for me now to propose the health of our distinguished guests and to add that I am sure you are with me in the sincere hope that the results of our meeting together will be as productive of benefits as have been the previous international meetings devoted to the study of this subject, a subject which has so greatly affected the happiness and destinies of the human race and, now that we have learned to travel and move above the surface of Mother Earth, is bound to exert an ever increasing influence."

The Relation of Visibility to Suspended Impurity.

By J. S. Owens, M.D., A.M.I.C.E.

IN the *Meteorological Magazine* for August 1920 a method of measuring visibility was described by Captain W. H. Pick. In this the difference between the illumination of a grease spot and the surrounding paper was examined from a distance and the visibility taken as proportional to the distance at which the two became indistinguishable. It has been criticised* on the grounds that the percentage difference of brilliance of the spot and surrounding paper remains constant when the light reaching the eye from them is gradually reduced by increasing opacity of the intervening air, or by increasing the distance from the eye.

It is stated in this criticism that, "according to Webber, the smallest perceptible increment in the brightness of an object is proportional to the brightness itself, so that if the grease spot is distinguishable from the paper at the outset it should remain so, and one would not predict its vanishing until the paper no longer appears to transmit any light."

As thus stated, it appears to me that the conclusion drawn is incorrect. The percentage change of tone which can be perceived by the human eye appears to vary from half per cent. under favourable conditions to as much as ten per

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* M. A. Giblett. *Meteorological Magazine*, September 1920.

cent. when the conditions are unfavourable. This change, known as Fechner's Fraction, varies with the individual and with the order of illumination. The sensitiveness of the human eye to differences of light and shade is therefore not constant for different illuminations, and it has been found that as the illumination of the object is increased from 0 up to ·5 foot-candles, the sensitiveness rapidly increases; as the illumination is increased up to about 4 foot-candles the sensitiveness rises more slowly, and for still greater illuminations there is very little increase. Thus, given a constant percentage difference between the luminosity of grease spot and paper in Pick's apparatus, the contrast will become imperceptible when the illumination is sufficiently reduced. This result cannot be deduced from physical considerations, as the causes are physiological. In fact, the method suggested by Captain Pick depends for its validity upon this peculiar variation in sensitiveness of the eye.

The whole subject of visibility is a very difficult one to deal with experimentally, as so many factors affect the observations. For example, it is probable that the visibility of lights, which may be regarded as points, the brilliance of which falls off inversely as the square of the distance, will be different from that of illuminated surfaces, the apparent brightness of which is independent of the distance, except in so far as light may be obstructed in its path.

Again, there is the scattering of light by the small suspended particles in the air, which becomes of the greatest importance in daylight when these particles are brightly illuminated; so that a sort of luminous veil is interposed between the eye and the object. This factor does not enter to such an extent during darkness.

A curious incident occurred to me during the recent fogs. When walking along the road in the country during a dense white fog at night, a friend who was with me drew my attention to a large notice-board which was clearly visible outlined against the sky, but, the letters on the board being quite invisible, my friend directed a beam from a pocket electric lamp upon the board, with the curious result that it promptly became invisible. He repeated this on telegraph posts and other objects with the same result. The fact was clearly due to the illumination of the particles of the fog by the beam of light. There was no doubt an increase in the amount of light reaching the eye from the object and from the background, but the visibility was clearly not improved.

It appears to me that, during daylight, the visibility or otherwise of distant objects depends more upon the scattering of light from other sources by the fine suspended particles in the air rather than upon the amount of light transmitted from the object towards the eye. When there are no other sources of light but the object looked at, the conditions are different. On approaching a lamp through a fog at night the eye becomes conscious first of a diffused illumination, the actual lamp itself being quite invisible. The illumination is due to the scattering of the light, and the invisibility of the source itself is doubtless due partly to this factor and partly to the direct obstruction of the rays by the suspended particles. As you get nearer the light it becomes very faintly visible as a bright spot surrounded by the diffused luminous cloud referred to above.

The perception of form was examined by Laporte and Broca by reading print under different illuminations, and the acuteness of vision was found to obey the same law as in the perception of light and shade, that is, the acuteness varied with the amount of illumination in the same way.

Again, perception of colour plays an important part in visibility, and it has been found that the sensitiveness of the human eye for blue-greens is greater than for reds when the light is faint. Thus, at twilight red flowers become black while the green colour of the foliage is still visible. Again, owing to the fact that the human eye is not achromatic,* it cannot focus widely different colours simultaneously, and objects at a distance illuminated by a blue light tend to become blurred; this is not the case for objects close to the eye, owing to the capacity for accommodation.

Luchiesh (*Electric World*, November 11th, 1911) found that monochromatic light generally gave more acute vision than white light, and the maximum degree of acuteness was given by yellow.

Discussions at the Meteorological Office.

AS previously announced, the subject for discussion on November 15th was the paper by Walter Georgii on "The Causes of the Formation of Mist and Fog." Major Goldie gave an account of the paper. The author was in the Meteorological Service in Flanders during the war, so that his interest in fog formation was stimulated by the urgent needs of forecasting. Upper air observations from a dozen stations were available, and from study of these Georgii concluded that fog was always associated with more or less sharp inversions of temperature. The typical stratification could frequently be traced over very large areas; the

* Shelford Bidwell, "Curiosities of Light and Sight," pages 95–7.

isothermal surfaces were not horizontal, however, but slightly inclined, and the adjustment of wind and temperature above and below such inclined surfaces was found to be consistent with a formula of Helmholtz's which explains how the pressure gradients can be adjusted to secure a calm below with wind above an inversion. Georgii recognises five classes of fog—dust-fog ; ground or settling fog ; radiation fog ; warm or floating fog ; mixing fog—but the distinctions between the types seem to be artificial. In particular it was pointed out in the discussion that there is always sufficient dust to provide the nuclei for fog formation, and Captain Douglas showed that the author's examples of mixing fogs were more satisfactorily explained by the cooling of a single current by eddy motion.

On November 29th Dr. G C. Simpson gave an account of Mr. C. T. R. Wilson's paper, " Investigations on lightning discharges and on the electric field of thunderstorms." Mr. Wilson has invented very ingenious apparatus by which rapid changes in electric force near the ground are recorded, and he has obtained records which show how the electric field varies during a thunderstorm. Between two lightning flashes the change in the force is gradual, an asymptotic approach towards a limit, but when a flash occurs there is a sudden change in the field. In the flash equal positive and negative charges run together and the electric moment which is proportional to the magnitude of these charges and their distance apart can be estimated from the record. It is found that the charges are of the order of 20 coulombs. According to Mr. Wilson, the clouds may carry either negative charges above and positive below or positive above and negative below. Dr. Simpson demonstrated, however, that the new evidence was consistent with his own theory, according to which the electrification, being due to the breaking up of drops, was always negative above and positive below. He criticised with some severity an extension of Wilson's theory which purported to explain the normal fine weather potential gradient as a by-product of thunderstorms.

In the subsequent discussion Dr. Chree explained the bearing of these researches on the growth of crops under electric stimulus. Sir Napier Shaw emphasized the desirability of obtaining simultaneous records from three or more stations during the progress of a storm. A paper entitled " Etude préliminaire sur les vitesses du vent et les températures dans l'air libre à des hauteurs différentes " (Stockholm, *Geog. Ann.*, 1920. No. 2, 97–118), by H. H. Hildebrandsson, was announced as the subject for discussion on December 13th. The subject on January 10th, 1921, will be " The position in space of the Aurora Polaris," by L. Vegard and O. Krogness (Kristiania, 1920).

The Retirement of Sir Napier Shaw.

THE following correspondence between the Chairman of the Meteorological Committee, Major-General Sir F. H. Sykes, Controller-General of Civil Aviation, and Sir Napier Shaw, late Director of the Meteorological Office, has been communicated for publication :—

Air Ministry, Kingsway,
London, W.C. 2,
5th November, 1920.

DEAR SIR NAPIER SHAW,

THE members of the Meteorological Committee, at the last meeting at which you were present, took the opportunity of bidding you farewell, but they also wish me to express to you in writing their high appreciation of your past services as Director of the Meteorological Office, and their good wishes for the future.

The Committee are deeply sensible of all they owe to you, for they realise that it is the unique position which your scientific abilities have gained for you in international meteorology, combined with your great adminstrative skill, which has placed this country in the van of meteorological progress.

While feeling great regret that your association with them has come to an end, they are pleased to know that your services will not be lost to the science of meteorology, and they trust that your work at the School of Meteorology will be as markedly successful as your work in the past at the Meteorological Office.

May I add a personal note of thanks to you for the very successful way in which you carried through the amalgamation of the meteorological services and the incorporation of the Meteorological Office in the Civil Aviation Department of the Air Ministry ?

Yours sincerely,
(Signed) F. H. SYKES.

Sir Napier Shaw, F.R.S.,
10, Moreton Gardens,
London, S.W. 5.

10, Moreton Gardens,
Old Brompton Road, S.W.5,
16 November 1920.

DEAR GENERAL SYKES,

PLEASE convey to the Members of the Meteorological Committee my warm acknowledgment of their kindness in sending by you so cordial an appreciation of my services to the Meteorological Office.

I have indeed been fortunate. In the early days of my work as Secretary I was rather disconcerted by Sir Francis

Galton. He had retired after giving a large part of his life to the control and also the practical management of the Office, and of the Kew Observatory at Richmond. He had been also largely responsible for advising the Government upon meteorological affairs from 1860 onwards. When I went to see him about some office business he inquired very dubiously whether I really thought that anything could be made of it, and gave me to understand that he had little or no hope.

The situation was indeed difficult because the acknowledged ground of appeal for public funds for the Office was not the collection and ordering of trustworthy facts about the weather of all parts of the world for economic and scientific purposes, as it should be, but simply and solely forecasting the weather of to-morrow. And making predictions for publication was from the beginning, is, and always will be, rather abhorrent to the mind of a person of scientific habit like Galton's, unless it can be conducted by a strict process of calculation like the predictions of the Nautical Almanack. The objection is fundamental.

Galton had been instrumental in developing at the Office from 1867 to 1876 the chief properties of the travelling cyclone and anticyclone, the latter of which he had named; and in 1878 it appeared as though the process of understanding the weather would be the simple continuity of what had been already achieved. His disappointment at finding that nothing further came out of the study of cyclones and anticyclones protracted over twenty years was perhaps a legitimate cause for his pessimism. It was, I think, shared in 1899 by a Committee of the Royal Society appointed to consider what the Office was doing.

I found that the comparative stagnation in which the science was thus bogged arose with the formation of meteorology as a new science, partly geographical and partly physical, with the weather map as its basis of experience as distinguished from the individual observation. It was thus distinguished from the older meteorology, which had been entirely physical. Curiously the stagnation was compatible with the direction of the Office by the strongest body of scientific men that has ever directed anything. But the Office itself was simply clerical in its training, and it had no experimental observatories of its own.

I managed gradually to introduce a staff with scientific training, partly paid and partly voluntary, to take charge of various activities. They could look at the work from an extraneous point of view, and later on, not without some tears, I unified the control of the observational establishments of the Office.

So it happened that when General Seely wanted meteorological assistance at the beginning of the R.F.C. we could indicate the lines on which it could be given; and when the war broke out we had the type of organisation already in operation which could be developed simply by multiplication to meet the requirements of the case.

I am satisfied that the stagnation which overcame Galton is no longer to be feared. We have begun to see the way through, and that not by any facilities of a new era, but simply by following out methods which Galton himself had thought of and even commenced but had no trained staff to carry out.

I certainly shall like to give reasons at greater length for not accepting Galton's pessimism as a guiding principle in the administration of the Office, and I think I can do so by the development of the School of Meterology to which you allude so kindly; and I can still look upon the development of the science as some contribution to public service.

That I shall still have to rely upon the support and assistance of the Meteorological Committee in making that endeavour successful is only a pleasure for me, as the relations between myself and the Committee have always been in the past.

It was my experience of the old Meteorological Council that the capacity of distinguished men of science for understanding a difficult situation was only equalled by their capacity for misunderstanding a simple one when they were so inclined. It has been my good fortune always to have difficult situations for the Committee to deal with, and they have always been at their best. I need hardly assure them of my grateful thanks.

Let me also thank you for your personal note. The essential difficulty of the organisation of the Office is the proper adjustment of the scientific staff in relation to administration. At the time of its development it was necessary for the administration to be largely in the personal charge of the Director. That arrangement was not, of course, intended to be permanent, but the war broke out while we were still unfledged. Consequently, in transferring to the Air Ministry I had not only to think of what had been, but also of what might have been and would have been in the natural course of events. The difficulty of working a scientific establishment as part of a public office is that the customary duty of a public office is to exercise control, whereas the primary duty of a scientific establishment is experimental initiative, which to any controlling authority must have something of rash speculation about it.

I sincerely trust that the framework of the organisation which the Committee of 1905–20 gave to the Office will be found serviceable to the Air Ministry, and through them to the many folk for whom meteorological work has an interest of one sort or another.

With best wishes for its continued success,

Believe me,

Yours sincerely,

(Signed) NAPIER SHAW.

Major-General Sir Frederick Sykes, G.B.E., K.C.B.,
Air Ministry.

Official Publications.

Professional Notes, No. 13. A Report on Two Pilot Balloon Ascents made at Shoeburyness. By N. K. Johnson, B.Sc., A.R.C.Sc. Price 9*d*. Net.

IN the two ascents to which this note is devoted the pilot balloons were followed with two theodolites and also with a rangefinder. It so happened that in each case the balloon developed a defect after reaching 25 or 30 thousand feet; the first dropped rather quickly, the second very slowly. The usual assumption of the single-theodolite method, that the rate of ascent was uniform, would have led to entirely false results, the wind being credited with speed of 100 feet per second at 60,000 feet.

The principal moral of the paper is that when information as to air currents at considerable heights is derived from the one-theodolite method it must be used with the greatest caution; it also brings out how much is to be learned concerning the structure of the atmosphere by the more elaborate two-theodolite method.

The Royal Meteorological Society.

AT a meeting held on November 17th the Royal Meteorological Society adopted proposals put forward by the Council for increasing the rates of subscription, proposals necessitated by the decreased purchasing power of money. The new rate of subscription for Fellows paying annually is to be three guineas per annum, but the Council is given power to retain Fellows at the previous rate of subscription.

At the same meeting it was announced that the Council were in negotiation for freehold premises at 49, Cromwell Road, South Kensington, where there would be a commodious meeting room and ample accommodation for the library. A resolution authorising the issue of debentures to provide the capital required for the purchase was passed.

A paper on "The Clash of the Trades in the Pacific," by C. E. P. Brooks and H. W. Braby, was based on a study of climatic conditions in the Central Pacific as shown by the registers kept at the scattered island stations. The authors find that in the part of the ocean on the American side of the 180° meridian rainfall occur with the N.E. Trades, and adduce evidence to show that in that region the S.E. Trade is the warmer and produces the rain in rising over the N.E. current. A good deal of the rain occurs with W. winds, and it is suggested that these winds form the lower part of vertical eddies. Nearer to New Guinea the two trades have not the same individuality. The rainfall of the equatorial Pacific appears to be correlated with the position of the area of low pressure in the neighbourhood of New Guinea. The further west this "low" is situated, the drier the season. A feature of interest is the great uniformity which exists over an area 2,000 miles in extent. Observations at Malden Island, Ocean Island and Fanning Island are intimately related.

Sir David Wilson-Barker and Mr. C. Harding, in discussion, laid stress on the utility of marine observations and suggested the co-ordination of records taken on the mainland of Australia, in New Guinea, Borneo and Java in order to amplify the somewhat meagre data upon which the authors had depended. Mr. Harding in particular referred to the work of Maury and Toynbee, which was extremely detailed. He suggested that some of the anomalies referred to would be eliminated if charts for individual months were considered instead of for six-monthly periods, the periodical movement of the Doldrums north or south undoubtedly shifting the field of operations from time to time.

Dr. Steavenson's paper on "Notes on Mirage as seen in Egypt" was illustrated by photographs taken with telephotographic apparatus. The first two photographs were a pair, the one showing a landscape just before sunset, the other in the early afternoon when mirage was well developed. A ridge of light-coloured sand crowned with bushes was shown in the latter picture as a wide band at the lower edge of which images of the bushes appeared. The third photograph, taken a few miles away from the others, showed the irregularities of a distant ridge as a number of symmetrical islets all apparently in the sky well above the horizon. Dr. Steavenson discussed the circumstances in which such mirages were formed and gave a table of thermometer readings showing the rapid increase of temperature near the sand. In the discussion Colonel Lyons described some experiences of his own in Egypt. When making a survey he and his companions had found it almost impossible to deny the real existence of a limestone cliff which was to be seen day by day to one side of their route. It was found eventually, as had been suspected from the first, that the cliff was only mirage, the conspicuous black markings on it being the drawn out images of large black pebbles lying on sand. Mr. Inwards gave an account of what he had seen in the Andes. Mr. J. S. Dines mentioned that bright patches which he attributed to mirage could often be seen on tarred roads in England in summer. It was remarkable, however, that on occasions he had seen such patches when the sun was not shining. Messrs. L. F. Richardson and F. J. W. Whipple also took part in the discussion.

Correspondence.

To the *Editors*, "*Meteorological Magazine.*"

Visibility of Pilot Balloons.

An attempt has been made at Shoeburyness to determine directly which colour is most suitable for pilot balloons under various conditions, and especially for long-distance work. The method consists in sending up two balloons tied together with about 20 feet of light thread, and following them with theodolites. In this manner a direct comparison of the relative visibility of the two colours is obtained. Up to the present four good ascents have been obtained, and the results indicated by them are so definite that it is thought that the following particulars may be of some interest.

In each case the double theodolite method of observation was employed, so that the heights and distances which follow may be regarded as absolute, as distinct from the hypothetical values obtained by the single theodolite method. Both observers made their settings on the same balloon, the white one, and noted the visibility of the second balloon, which was always in the field of view.

The first ascent was commenced with a clear sky and a high wind, and lasted for 15 minutes. During this time alto-stratus developed rather rapidly, so that, during the course of the ascent, the background changed from a deep blue to a white haze, and then to a full opaque white. The balloons employed in this case were a red and a white, and the changes in the background produced striking variations in the relative visibility of the two balloons. Against the blue sky, the white balloon was easily the most visible. As the whiteness of the background developed, the balloons became more nearly equal in distinctness. The red continued to gain in this respect, until, at the 14th minute, the white had become quite invisible in one theodolite and was only visible occasionally in the other. The horizontal distance of the balloon at this time was 43,000 feet. The red balloon was still quite easily seen, and could probably have been followed to nearly double the distance. The ascent was terminated, however, by the balloons entering the alto-stratus layer at the 15th minute.

The second ascent was made when the sky contained patches of fracto-cumulus. At first the sun was shining on the balloons, again a red and a white, and the phenomena observed as the balloons passed from a blue background to a white one were the same as those experienced before. As soon, however, as the balloons passed into the shadow of a cloud, the effect was reversed. So long as the sun is shining on a balloon, its visibility depends on its reflective power. Cut off the sunshine, however, and you have to rely on the opacity of the balloon. In other words, in sunshine the white is the more visible because it appears brighter; but when sunshine is cut off, the red is more visible because it appears darker.

For the third ascent, the balloons were followed by three theodolites. The sky was a deep blue overhead, with some haze round the horizon. The white balloon was retained by all three observers until the 49th minute, its height being then 23,450 feet and its average horizontal distance from the three theodolites 66,000 feet. The red balloon was by this time invisible to one observer, but it was just visible to the other two, although it could not have been held for so long if it had not been for its connection with the white balloon.

Just after the 49th minute the white balloon was observed to burst and the system commenced to fall rapidly. It is a point of some interest that the remains of the burst white balloon were more conspicuous than the red balloon. They were followed downwards for another 7 minutes, when the whole became lost in haze at a height of 21,300 feet and at a distance of 82,000 feet.

A piece of thin bright tin, 3 inches in diameter, was suspended just below the white balloon, in the hope that, by flashing in the sunshine, it might increase the visibility of the system. It was glimpsed occasionally up to the 42nd minute, but did not help materially in the direction hoped for.

Both balloons were filled to rise at 500 feet per minute, allowance being made for the weight of the thread but not for the piece of tin just referred to. It was nevertheless observed that the white balloon led all the way up, its rate of ascent being increased by the weight of the piece of tin—an effect which is already well-known. After the white balloon burst, the remains, of course, fell below the red one.

The present writer was observing with one of the theodolites during this ascent, and he discovered that when the distance had become so great that both balloons were reduced almost to points, then the optimum focus of the theodolite was different for the two balloons. The necessary adjustment was small but quite well defined. The effect is presumably due to lack of achromatism in the optical system of the theodolite.

In the three ascents described so far, the comparison has in each case been made between a red and a white balloon. No experiments were made with blue balloons, as it has already been found that the visibility of this colour is very poor except against a dense white background.

A fourth experiment was made to see whether the visibility of a white balloon could be increased by painting it with aluminium paint. An ascent was made with a white balloon treated in this manner and connected to another plain white one. The combination was followed by two theodolites for 133 minutes, and was then lost to one observer by its crossing the sun's disc. The other observer retained it for another 18 minutes. This ascent, together with others of a like nature, is being described in detail elsewhere. It will suffice to mention here that, at the 133rd minute, the height was 27,500 feet and the horizontal distance about 95,000 feet. The long duration of this ascent, however, was in no way due to the aluminium painting of one of the balloons, as it was found that the painted balloon dried a drab grey without any metallic lustre. The visibility of this balloon was consequently impaired by the painting instead of being improved as it was hoped. It is thought, however, that if a pilot balloon could be coated with aluminium in the same manner as are kite balloons, then both its opacity and reflective power would be considerably improved.

The results may be briefly summarised as follows:—

(1) Against a background of continuous, dense white cloud either red or blue should be used.

(2) If the sky contains slight cirrus or haze, red is the correct colour to employ.

(3) On occasions on which the sky is cloudless and of a deep blue colour, a white balloon should be selected.

NELSON K. JOHNSON.

Shoeburyness, 3rd November, 1920.

A Fine Example of "Silver Thaw."

AT 7 h. G.M.T. on the 24th November, in the southern suburbs of Manchester, a fine example of "silver thaw" was to be seen. The previous three days had been very cold, with grass minima ranging down to 15° F., but on the evening of the 23rd a warmer easterly current sprang up and the minimum in the screen was above the freezing-point. During the night all unmetalled roads and paths were coated with a deposit of frozen moisture up to about $\frac{1}{8}$-inch maximum thickness. It did not appear on the grass, the roofs, the pavements nor metalled roads, though the last two were wet. It is interesting to note that in the interstices between the flagstones and the setts—which were, of course, filled with earth—a deposit appeared.

The wind was easterly throughout and had freshened during the night from Force 3 to 5. The screen temperature at 7 h. was 40° F.

FRANK EDWARDS.

95, *Clarendon Road, Whalley Range, Manchester, 25th November,* 1920.

[According to the *Observer's Handbook* (1919 edition, p. 56) the term "silver thaw" has been used sometimes as equivalent to glazed frost, sometimes for rime. In the phenomenon described by Mr. Edwards the deposit is actually associated with air-temperature above the freezing-point, and the name "silver thaw" seems appropriate. The corresponding term in Hellmann's classification (M.W.R., Washington, July, 1916, p. 386) appears to be Frostbeschlag, *i.e.*, frost sweat, though Hellmann does not refer to the roads but mentions the deposit as occurring especially on house walls and smooth-barked tree trunks.—ED. M.M.]

Mountain Mist and Rain.

MR. BONACINA in his article in the November *Meteorological Magazine* invites others to tell their experience. For 25 years past I have not been in a position to make observations on this point, but prior to that period I paid several visits to the Lake District, amounting in all to more than four months. It is true that all these visits were in July, August, or September, which may, perhaps, have some bearing on the subject, but my experience does not at all bear out his views. Time after time I have seen approaching rain heralded by mist on the hill tops, this gradually extending downwards as the rain developed. I particularly recall one occasion when I had ascended to the summit of Great Gable with some friends and was unable to point out the Isle of Man to them because of the puffs of wet mist which at short intervals blew in our faces from the west; these rapidly thickened and threatened to envelop us, so we hastily descended into Ennerdale, but before we had gone very far the whole of the dome of the mountain was enveloped in mist, and rain was falling steadily. On climbing up again at Scarf Gap on our way to Buttermere, the rain continuing all the time, the mist was so low over the pass that one could thrust a stick into it. Of course, I have often known the hill tops enveloped in mist without any rain, and have even known two strata of mist, one round the summit and another lower down, with a clear interval between them, no rain falling.

F. J. WARDALE.

Shrewton, Wilts, 25th November, 1920.

A Mock Sun in False Cirrus.

WITH regard to the recent correspondence upon mock suns in false cirrus, it is somewhat curious to relate that, like Mr. Watson Watt, I had the impression that such phenomena were by no means rare occurrences. The paucity of cases coming under his observation led me to investigate the Aberdeen records during the years 1915–19 inclusive, with the result here shown :—

Phenomena.	Number of Observations.					
	1915.	1916.	1917.	1918.	1919.	Total.
Both parhelia	3	2	2	2	3	12
One parhelion	0	2	0	2	2	6
Both paraselenæ	0	0	0	1	1	2
One paraselena	0	0	0	0	0	0
Total	3	4	2	5	6	20

Of these observations, only four—all in 1919—were occasions when the parhelia were seen in false cirrus that was undoubtedly connected with cumulo-nimbus cloud ; and of these four observations, two were cases in which only one parhelion was seen, one in which both parhelia were brilliantly visible, and one in which both paraselenæ were showing.

It might, however, be of interest to say that, in the great majority of the other cases, the parhelia were formed in sheets of cirro-stratus of rather heavy, and generally of flocular or striated structure, having an appearance suggestive of their being at a much lower level than that at which the normal cirro-stratus and cirro-nebula are formed.

G. A. CLARKE.

Aberdeen Observatory, 27th November, 1920.

WITH regard to Mr. R. A. Watson Watt's letter in the November number of the *Meteorological Magazine,* I am writing to inform you of a brilliant parhelion which I observed here on the afternoon of November 16th. The day was fair, with light passing showers, and numerous "anvils" skirted the western horizon throughout the afternoon. Towards 15 h. G.M.T. the sun became low enough to be almost level with the "false" cirrus spreading from an anvil cloud on the right, almost due west. The cirrus had a golden tint due to the sunlight, and at 15 h. a brilliant parhelion of 22° appeared in the "false" cirrus as a large "blob" of white light, iridescent at its edge with remarkable colouring, principally red, blue and violet, especially on the side nearer the sun. There was no halo at the time, nor did I see more than this one parhelion, which was almost continuous from 15 h. to 15 h. 40 m.—even after the sun had sunk low enough to become dimmed and partly obscured itself by the cirrus fringe, there was little diminution in its brilliance.

The air was exceedingly clear and the sun shone powerfully at the time of the phenomenon.

FREDERICK J. PARSONS.

The Observatory, Ross-on-Wye, 20th November, 1920.

Cirrus at 10,000 Feet.

MR. W. H. DINES's report of low cirrus in the November *Magazine* is in very close agreement with an observation made here on the morning of November 11th, 1920. Two layers of cloud, apparently at considerably different heights, were classed as cirrus by the two most experienced observers in the Branch Office. A third observer, mainly on grounds of apparent height, classed the lower layer as alto-stratus. At 11 h. 30 m., using a two-metre height and rangefinder, I determined the height of a filament, which I unhesitatingly classed as cirrus, to be 11,000 feet. At 11 h. 50 m. a fourth observer reported that a pilot balloon had entered cirrus at 10,000 feet (assuming uniform rate of ascent).

Thus the height of a cloud classed as cirrus by three or four observers was determined by the independent methods as 3·1 and 3·4 k. The cloud had no apparent relation to the small amount of cumulus (1/10) present at the time.

R. A. WATSON WATT.

South Farnborough, 18th November, 1920.

NOTES AND QUERIES.

Molecular and Cosmical Magnetism.

IN a letter to *Nature* (Nov. 25th, 1920, Vol. 106, p. 407) Prof. S. Chapman propounds a theory which accounts for the permanent magnetism of the earth and sun. He points out that recent researches tend to confirm the hypothesis that elementary electric charges (negative electrons) are in the form of rings in rapid rotation and therefore act as minute magnets. At a sufficiently high temperature a large proportion of the electrons will be dissociated from the atoms, and by gyrostatic action such electrons may be expected to set themselves parallel to the axis of rotation of the earth or sun, as the case may be. The theory gives the right sign and order of magnitude for the earth's magnetic-field and also for the field in sunspots. Moreover, the movement of the earth's magnetic axis is explained as due to precession, and the direction in which the magnetic poles actually move round the geographical poles is in accordance with the theory.

The Deposit of Hoar-Frost from Fog.

The hoar-frost deposited from fog has characteristics which differentiate it from that found under a clear sky and from rime. An exceptionally good instance of such a deposit occurred at Bedford Park, Chiswick, on November 22nd, 1920. The previous evening was cold and clear, and there was no fog between sunrise and 8 h. The appearance of the hoar-frost suggested that it had been freezing hard all night. At 8 h. a thick fog came on very suddenly; at 9 h. 30 m. the horizontal range of visibility was less than 25 feet, and I am told that during the day it got worse so that traffic was only kept moving with difficulty. The fog gradually subsided; it averaged perhaps 6 feet deep at about 15 h. and nearly disappeared soon afterwards. At 18 h., on my return from the Office, I noticed how the deposit of hoar-frost was general. The most conspicuous feature was the way in which the fences were marked. Broad white horizontal lines showed where the thin split oak was backed by thicker wood, and in the same way the framework at the back of heavy gates was outlined on the front. The upper parts of brickwork pillars were uniformly whitened; foliage, on the other hand, was dripping wet. The rule with such a deposit is evidently that cold objects with a large capacity for heat are able to accumulate a large amount of hoar-frost, whilst slighter objects get little. This is in contrast with ordinary hoar-frost which is deposited round the edges of leaves and generally on objects which have the smallest capacity for heat. An interesting illustration was provided by the cast-iron name-plates on two sides of a road. One, which was screwed to a heavy plank, was so well frosted that the lettering, white on black, could hardly be deciphered, whilst the other, screwed to the split-oak fence, was almost free from deposit.

I have frequently seen the framework "through" fences and have been puzzled by the phenomenon, which is so simply explained now. I should like to know whether it has been photographed.

F. J. W. W.

A Notable Cloud.

On Monday, November 29th, a straight-edged cloud advanced rapidly across the midlands and the eastern counties of England from the west between the hours of 7 and 11 in the morning. The height of the cloud was estimated at about 15,000 feet, and the edge moved at about 15 miles an hour. The cloud motion was not at right angles to the edge, but from NW. Captain C. J. P. Cave is working up the life history of this cloud. Any observations not already communicated to the Office should be sent to Captain Cave at Ditcham Park, Petersfield.

The False Horizon.

On several occasions last September it happened that when looking at a distant coast I noticed a bright whitish strip along the sea horizon in front of the coast. At first glance the strip seemed to be the actual shore, but it was much too uniform for that, and, moreover, the shore-line would have been well below the sea horizon. On one occasion at least the sea was quite calm.

The effect is, I believe, an example of mirage such as might be expected if the water were warmer than the air. The reflection of the land in the heated layer just over the water is inconspicuous, and the whitish strip is the reflection of the sky above the land.

The objects of this note are two: the first is to inquire whether there is any popular name for the phenomenon, which is, I am told, well known to sailors; the second is to ask for references to any measurements of sea and air temperatures in conjunction with observations of this character.

F. J. W. W.

Rain-making up to Date.

According to a telegram from the *Daily Mail's* Winnipeg correspondent, dated November 1st, Mr. A. E. Cole, father of Captain Homer Cole, formerly of the Royal Air Force, states that he and his son are planning to form an aerial irrigation company. Their scheme is to cause rain by spraying liquid air in the clouds from an aeroplane, causing the moisture in the atmosphere to condense. He claims that this will supply rain for agricultural districts subject to drought, and also serve to put out forest fires.

The *Daily Mail* also mentions that dust has been thrown from an aeroplane on to the clouds 5,000 feet high in an unsuccessful attempt to cause rain in Pretoria.

Physicists will find it difficult to take these methods of rain-making seriously. It is not easy, however, to set out in a few words the reasons why their success is improbable.

Sir John Moore's Observations.

At the end of the present year Sir John Moore will have been sending Monthly Meteorological Registers to the Meteorological Office for fifty years, the first being that for January 1871. Sir John has, however, been an observer longer than this, his record going back to 1859, and in the Office Library there are weekly observations from him from November 1869, such observations having been continued in recent years for the purposes of the Weekly Weather Report. The observations have without a break been taken at 9 h. and 21 h., and in some of the earlier years there were in addition readings at 15 h.; and on all returns the daily notes on weather have always been very fully given.

Sir John has supplemented his work as an observer by preparing regular reports on Irish weather for the Registrar-General and for the newspapers. In 1894 he published a very successful book entitled "Meteorology, Practical and Applied."

It may be added that Sir John Moore is a man of many interests, and that his genial personality has earned a special place in the affections of the Meteorological Office staff.

Review.

Climate of New Zealand. Wellington, 1920, pp. 16. (Prepared by Lieut.-Col. D. C. Bates, Dominion Meteorologist, for publication in the "New Zealand Official Year-Book.")

This useful book gives averages of temperature, rainfall, and, in some cases, sunshine, for eleven stations in New Zealand, ranging from Auckland in the north, with a superb sub-tropical climate, to Invercargill in the south, with the climate of south-west England. The climatic features of each district are succinctly described, but we miss the generalised account of the meteorology of the region which would bind the sections together and enable the reader to see how far the local characteristics are subservient to the prevailing winds and other far-reaching causes.

News in Brief.

Professor K. Nakamura will retire from the direction of the Central Meteorological Observatory of Japan on Dec. 31st of this year. Professor T. Okada has been selected for appointment as his successor. Professor Okada is the author of many contributions to meteorological literature, most of which have appeared in the Journal of the Meteorological Society of Japan.

It is announced that the Astronomical and Meteorological Observatory at Bucharest has been divided into two institutions, astronomy coming under the Ministry of Instruction, whilst a newly constituted Central Meteorological Institute, with M. Otetelesanu as Director, is placed under the Ministry of Agriculture.

A Correction.—In the article on "Wind Temperature and Fog on October 27th" in the last number of the *Magazine* (p. 217) the maximum temperature at Woburn was given as 63° F. It has now been established by correspondence with the observer that there was a clerical error in the return of observations, and that the actual reading was 43° F. With this correction the map now shows a regular boundary between high and low maximum temperatures along the Chilterns.

Geostrophic Wind at London; January, 1881–1915.

FREQUENCY OF STRENGTH AND DIRECTION.

Estimates based on the D.W.R. charts (8 *h.*, 1881–1908; 7 *h.*, 1909–1915).

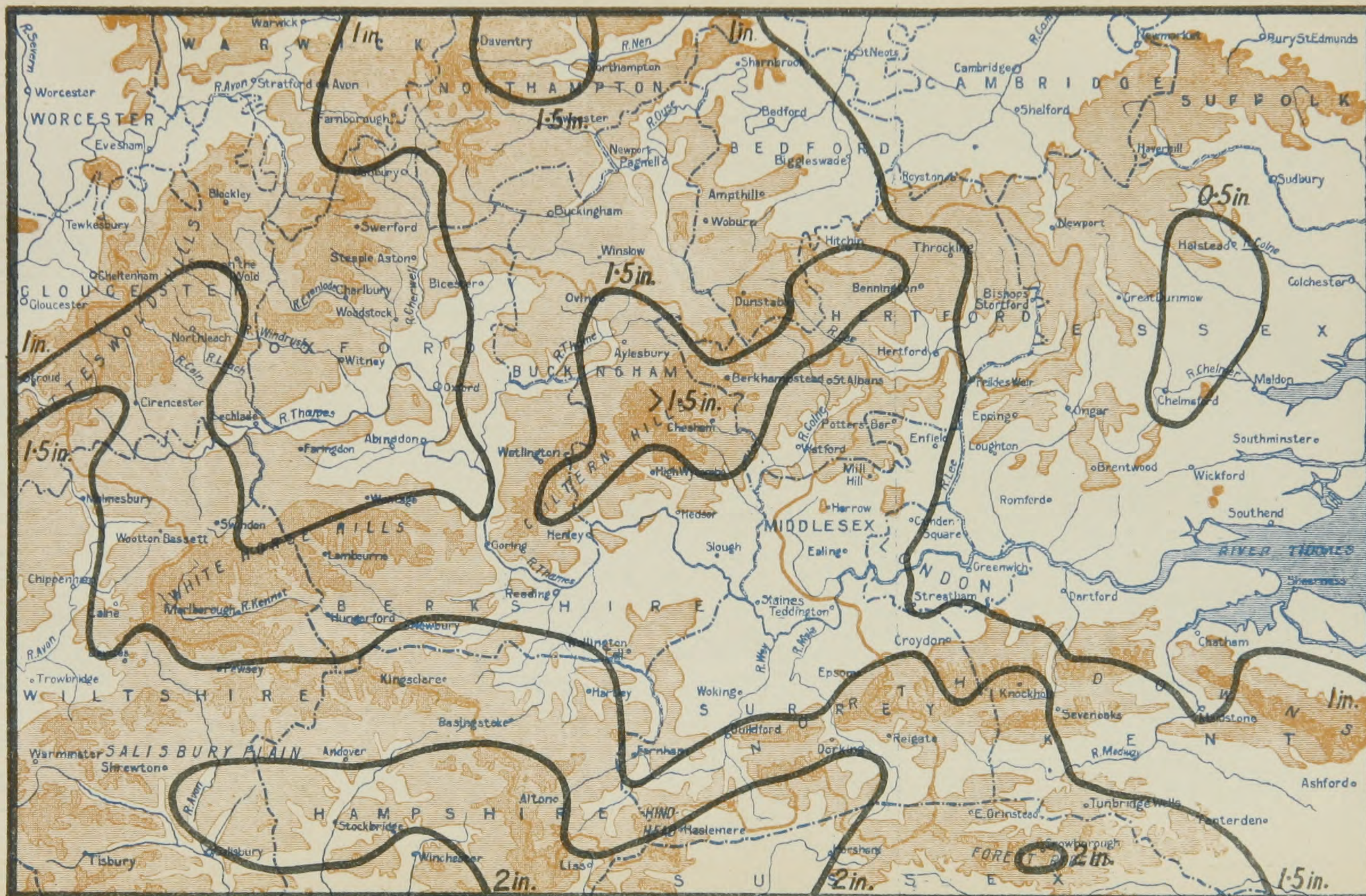
Direction.	5 m/s. 11 mi/hr.	10 m/s. 22 mi/hr.	15 m/s. 33 mi/hr.	20 m/s. 44 mi/hr.	Over 20 m/s. Over 44 mi/hr.	Total Frequency of Direction.
N.	5	11	26	9	10	61
NE.	6	21	11	9	2	49
E.	6	17	21	10	3	57
SE.	23	22	14	9	1	69
S.	12	43	20	14	8	97
SW.	28	52	50	41	19	190
W.	10	48	88	67	49	262
NW.	5	33	38	29	12	117
Total Frequency of strength	95	247	268	188	104	902*

* Indeterminate—183.

Weather in the British Isles: November 1920.

During the greater part of November the British Isles lay on the western edge of a continental anticyclone, and under these conditions the month for the most part was a fine one. During the first week, however, and from the

THAMES VALLEY RAINFALL —— NOVEMBER, 1920.



ALTITUDE SCALE: Below 250 feet | 250 to 500 feet | 500 to 1000 feet | Above 1000 feet

SCALE OF MILES 0 5 10 15 20

Meteorological Magazine

Watershed of River Thames above Teddington and River &c.

Isohyetals.

H.M. Stationery Office Press, Kingsway, W.C.2.

Ps.5547/200. Wt. 105. D.P. 35. 1250. 12/20.

20th to 24th, sharp frosts occurred at many of the inland stations. The minimum temperatures recorded during the second of these cold spells were lower than any recorded this season. From time to time, on the other hand, cyclonic disturbances approached the British Isles from the Atlantic, and under these influences the winds on many days blew from points between south and west and brought a general rise in temperature, so that on the balance the mean temperature of the month did not differ greatly from the normal. There were, moreover, many sunny days, especially in East Anglia; and at Copdock (Ipswich), where 104 hours were registered, it was the sunniest November on record. At this station, during October and November, the total sunshine was 304 hours, compared with only 289 hours in August and September; and at Felixstowe the corresponding figures were 321 and 314.

A notable feature of the month was the great contrast it presented to November of last year, a month memorable for its record frost and snow. At Sheepstor, Devon, for instance, the mean maximum temperature was 51·9° F., compared with 42·8° F. last year, and there was no snow this year, whereas it fell on eleven days last year. Equally conspicuous oontrasts were shown at numerous other stations.

During the first four days of the month the principal feature on the weather map was an anticyclone over Scandinavia, a system which was associated with low temperatures in some parts of the British Isles. On the 2nd, 30° F. was recorded in the shade and 18° F. on the ground at Manchester, and on the 4th corresponding readings at South Farnborough were 25° F. and 22° F., the maximum on the latter day at Kew Observatory, owing to persistent fog, being only 37° F. On the 5th an anticyclone moved north-eastwards from the Azores, and over the greater part of the British Isles a quiet type of weather prevailed until the 11th, with frequent fog and cold nights. The 9th was an especially fine day, and from seven to eight hours of sunshine were registered in the south-west of England, with a maximum temperature of 61° F. at Torquay. During the 10th a deep depression passed to the north of Scotland, and caused south-west gales and rain along the western seaboard and in the Shetlands. Another very deep depression appeared in the same region during the night of the 14th, and caused strong south-westerly gales on the 15th over the whole of the British Isles, which were especially severe in the north and west of Scotland. From Strathpeffer to Rothesay trees were uprooted by the wind, which also caused exceptionally high tides in some of the lochs. At 8 h. 5 m. on the 15th a gust of 74 miles per hour was recorded at Edinburgh, and at 12 h. 30 m. 70 m.p.h. at Paisley. Torrential rains and floods occurred in Cumberland and Westmorland; and there were many shipwrecks round the British coasts. During the 20th to 24th an anticyclonic type of weather prevailed and a sharp frost occurred, the minimum temperatures at some of the inland stations being below 20° F., while on the 21st and 22nd a few places had maxima as low as 32° F., the conditions being largely due to fog. The closing days of the month were mild and rainy.

For the autumn season which ended on November 27th the mean temperature was in excess of the normal in all parts of the United Kingdom, except in England East, the Midlands and England South-east, where it was normal. Rainfall for the same period, except in Ireland, was decidedly less than the normal. Bright sunshine was deficient, except in England East and England North-east, where there was a slight excess.

Considering the time of the year, the month was favourable for flying, the principal exceptions being that conditions were unsettled for a few days about the middle of the month, with a general gale on the 15th, and again for the last few days. The 28th was very unfavourable in south-east England, with low clouds, mist and occasional rain. The rest of the month was mainly fair in the eastern districts, but there was a good deal of fog at night, which occasionally persisted locally all day. On the 4th fog persisted all day at Kew, but at Croydon part of the day was fine. From the 8th to the 10th there was a spell of overcast weather without fog, the sky being

(*Continued on* p. 264.)

Rainfall Table for November 1920.

STATION.	COUNTY.	Aver. 1875—1909.	1920.		Per cent. of Av.	Max. in 24 hrs.		No. of Rain Days.
		in.	in.	mm.		in.	Date.	
Camden Square	*London*	2·34	1·12	28	48	·50	27	9
Tenterden (View Tower)	*Kent*	3·07	1·38	35	45	·34	28	11
Arundel (Patching)	*Sussex*	3·54	1·90	48	54	·66	14	8
Fordingbridge (Oaklands)	*Hampshire*	3·41	2·10	53	62	·65	1	17
Oxford (Magdalen College)	*Oxfordshire*	2·25	·88	22	39	·30	14	12
Wellingborough (Swanspool)	*Northampton*	2·22	1·00	25	45	·48	27	10
Hawkedon Rectory	*Suffolk*	2·30	·68	17	30	·21	14	8
Norwich (Eaton)	*Norfolk*	2·83	·78	20	28	·27	14	9
Launceston (Polapit Tamar)	*Devon*	4·07	3·32	84	82	·92	27	14
Lyme Regis (Rousdon)	,,	3·51	1·64	42	47	·42	30	10
Ross (Birchlea)	*Herefordshire*	2·77	·73	18	26	·23	14*	10
Church Stretton (Wolstaston)	*Shropshire*	2·94	·99	25	34	·27	14	10
Boston (Black Sluice)	*Lincoln*	2·05	·64	16	31	·20	14	10
Worksop (Hodsock Priory)	*Nottingham*	1·98	1·05	27	53	·39	27	9
Mickleover Manor	*Derbyshire*	2·21	1·03	26	47	·50	27	7
Southport (Hesketh Park)	*Lancashire*	3·16	1·36	35	43	·51	14	14
Wetherby (Ribston Hall)	*York, W. R.*	2·34	1·27	32	54	·38	27	8
Hull (Pearson Park)	,, *E. R.*	2·34	·64	17	27	·14	27†	9
Newcastle (Town Moor)	*North'land*	2·63	1·15	29	44	·30	27	13
Borrowdale (Seathwaite)	*Cumberland*	13·59	8·10	206	60	..	..	..
Cardiff (Ely)	*Glamorgan*	4·08	2·87	73	70	·61	14	22
Haverfordwest	*Pembroke*	5·16	..	..	..	..	..	..
Aberystwyth (Gogerddan)	*Cardigan*	4·50	2·33	59	52	·60	15	7
Llandudno	*Carnarvon*	3·19	1·27	32	40	·30	14	14
Dumfries (Cargen)	*Kirkcudbrt.*	4·35	2·78	71	64	·91	14	14
Marchmont House	*Berwick*	3·21	1·88	48	59	·42	27	13
Girvan (Pinmore)	*Ayr*	5·24	4·18	106	80	·70	28	23
Glasgow (Queen's Park)	*Renfrew*	3·63	3·59	91	99	·60	14	19
Islay (Eallabus)	*Argyll*	5·33	6·75	171	127	1·22	27	24
Mull (Quinish)	,,	6·24	7·26	184	116	·75	18	21
Loch Dhu	*Perth*	8·36	10·20	259	122	1·55	14	22
Dundee (Eastern Necropolis)	*Forfar*	2·62	2·40	61	92	·58	14	15
Braemar	*Aberdeen*	3·76	4·09	104	109	1·30	13	15
Aberdeen (Cranford)	,,	3·29	1·75	44	53	·60	27	9
Gordon Castle	*Moray*	2·85	1·80	46	63	·40	27	12
Drumnadrochit	*Inverness*	3·41	.	..	..	..	..	..
Fort William	,,	7·55	9·65	245	128	1·45	12	22
Loch Torridon (Bendamph)	*Ross*	8·90	11·02	280	124	1·93	12	19
Stornoway	,,	5·56	8·53	217	153	1·85	18	22
Dunrobin Castle	*Sutherland*	3·25	2·34	59	72	·52	15	13
Wick	*Caithness*	2·95	3·33	84	113	·77	15	19
Glanmire (Lota Lodge)	*Cork*	4·45	5·11	130	115	1·45	25	22
Killarney (District Asylum)	*Kerry*	5·54	6·07	154	110	1·11	26	25
Waterford (Brook Lodge)	*Waterford*	3·80	3·01	76	79	·51	27	15
Nenagh (Castle Lough)	*Tipperary*	3·88	4·66	118	120	·92	25	23
Ennistymon House	*Clare*	4·62	5·85	149	127	·77	30	25
Gorey (Courtown House)	*Wexford*	3·41	3·61	92	106	1·18	27	17
Abbey Leix (Blandsfort)	*Queen's Co.*	3·28	3·20	81	98	·48	27	20
Dublin (FitzWilliam Square)	*Dublin*	2·64	2·36	60	89	1·00	27	17
Mullingar (Belvedere)	*Westmeath*	3·38	2·68	68	79	·70	28	14
Woodlawn	*Galway*	3·91	3·69	94	94	·45	25	24
Crossmolina (Enniscoe)	*Mayo*	5·75	7·84	199	136	1·04	18	24
Collooney (Markree Obsy.)	*Sligo*	4·02	5·08	129	126	·85	14	25
Seaforde	*Down*	3·86	4·21	107	109	1·06	27	17
Ballymena (Harryville)	*Antrim*	3·95	3·84	98	97	·92	27	20
Omagh (Edenfel)	*Tyrone*	3·66	5·21	132	142	·80	27	24

* and 30. † and 28.

Supplementary Rainfall, November 1920.

Div.	STATION.	RAIN. in.	RAIN. mm.	Div.	STATION.	RAIN. in.	RAIN. mm.
II.	Ramsgate	·62	16	XII.	Langholm, Drove Rd.	3·79	96
„	Sevenoaks, Speldhurst	1·35	34	XIII.	Selkirk, Hangingshaw	2·62	66
„	Hailsham Vicarage	1·78	45	„	North Berwick Res.	1·86	47
„	Totland Bay, Aston	1·31	33	„	Edinburgh, Royal Ob.	1·89	48
„	Ashley, Old Manor Ho.	2·03	52	XIV.	Biggar	2·54	64
„	Grayshott	2·04	52	„	Leadhills	4·38	111
„	Ufton Nervet	1·52	39	„	Maybole, Knockdon	2·51	64
III.	Harrow Weald, Hill Ho.	1·25	32	XV.	Rothesay	7·29	185
„	Pitsford, Sedgebrook	1·48	38	„	Ardgour House	13·70	348
„	Chatteris, The Priory	·45	11	„	Inveraray Castle	7·10	180
IV.	Elsenham, Gaunts End	·72	18	„	Holy Loch, Ardnadam	8·95	227
„	Lexden, Hill House	·59	15	XVI.	Loch Venachar	6·30	160
„	Aylsham, Rippon Hall	·83	21	„	Glenquey Reservoir	5·70	145
„	Swaffham	·68	17	„	Loch Rannoch, Dall	6·34	161
V.	Devizes, Highclere	1·45	37	„	Coupar Angus	2·20	56
„	Weymouth	1·35	34	„	Montrose Asylum	2·49	63
„	Ashburton, Druid Ho.	3·46	88	XVII.	Balmoral Castle	2·57	65
„	Cullompton	2·42	61	„	Fyvie Castle	1·34	34
„	Hartland Abbey	2·70	69	„	Keith Station	1·93	49
„	St. Austell, Trevarna	2·65	67	„	Grantown-on-Spey	2·11	54
„	North Cadbury Rec.	1·37	35	XVIII.	Cluny Castle	4·22	107
„	Cutcombe, Wheddon Cr.	4·42	112	„	Loch Quoich, Loan	20·00	508
VI.	Clifton, Stoke Bishop	2·19	56	„	Skye, Dunvegan	9·48	241
„	Ledbury, Underdown	·58	15	„	Fortrose	·83	21
„	Shifnal, Hatton Grange	·70	18	„	Ardross Castle	4·56	116
„	Ashbourne, Mayfield	1·11	28	„	Glencarron Lodge	8·41	214
„	Barnt Green, Upwood	·69	18	XIX.	Tongue Manse	4·08	104
„	Blockley, Upton Wold	·76	19	„	Melvich Schoolhouse	3·93	100
VII.	Grantham, Saltersford	·97	25	„	Loch More, Achfary	10·61	270
„	Louth, Westgate	·61	16	XX.	Dunmanway Rectory	7·40	188
„	Mansfield, West Bank	1·15	29	„	Mitchelstown Castle	4·52	115
VIII.	Nantwich, Dorfold Hall	·66	17	„	Gearahameen	11·00	279
„	Bolton, Queen's Park	1·79	46	„	Darrynane Abbey	6·17	157
„	Lancaster, Strathspey	2·62	66	„	Clonmel, Bruce Villa	2·88	73
IX.	Wath-upon-Dearne	·95	24	„	Cashel, Ballinamona	2·79	71
„	Bradford, Lister Park	2·03	51	„	Roscrea, Timoney Pk.	2·53	64
„	West Witton	2·53	64	„	Foynes	4·62	117
„	Scarborough, Scalby	·75	19	„	Broadford, Hurdlesto'n	4·89	124
„	Ingleby Greenhow	·88	22	XXI.	Kilkenny Castle	2·54	65
„	Mickleton	1·70	43	„	Rathnew, Clonmannon	3·00	76
X.	Bellingham	2·45	62	„	Hacketstown Rectory	3·90	99
„	Ilderton, Lilburn	1·81	46	„	Ballycumber, Moorock	..	..
„	Orton	5·71	145	„	Balbriggan, Ardgillan	2·43	62
XI.	Llanfrechfa Grange	2·70	69	„	Drogheda	2·41	61
„	Treherbert, Tyn-y-waun	6·30	160	„	Athlone, Twyford	3·34	85
„	Carmarthen Friary	2·64	67	„	Castle Forbes Gdns.	5·36	136
„	Fishguard	3·66	93	XXII.	Ballynahinch Castle	7·90	201
„	Lampeter, Falcondale	2·84	72	„	Westport House	5·30	135
„	Abergwngy	2·85	72	XXIII.	Enniskillen, Portora	4·67	119
„	Cray Station	6·20	158	„	Armagh Observatory	2·72	69
„	Crickhowell, Talymaes	3·00	76	„	Warrenpoint	3·15	80
„	Lake Vyrnwy	5·32	135	„	Banbridge, Milltown	3·16	80
„	Llangynhafal, P. Drâw	1·05	27	„	Belfast, Cave Hill Rd.	3·76	96
„	Dolgelly, Bryntirion	2·82	72	„	Glenarm Castle	3·82	97
„	Lligwy	1·56	40	„	Londonderry, Creggan	4·22	107
XII.	Stoneykirk, Ardwell Ho.	3·02	77	„	Sion Mills	5·08	129
„	Whithorn, Cutroach	2·98	76	„	Milford, The Manse	4·69	119
„	Carsphairn, Shiel	6·31	160	„	Killybegs, Rockmount	7·67	195

Climatological Table for the

STATIONS	PRESSURE		TEMPERATURE							
			Absolute				Mean Values			
	Mean of Day M.S.L. mb.	Diff. from Normal mb.	Max. ° F.	Date	Min. ° F.	Date	Max. ° F.	Min. ° F.	½ max. and min. ° F.	Diff. from Normal ° F.
London, Kew Observatory	1017·6	+1·4	75	16	40	6, 7	68·4	52·2	60·3	+1·1
Gibraltar	1016·3	+0·5	85	23	57	13, 14	78·5	63·6	71·1	+0·8
Malta	1014·1	−0·5	87	30	65	2	78·6	68·2	73·4	+1·4
Sierra Leone	1012·8	+0·1	89	1	69	10, 19	85·5	73·2	79·3	−1·1
Lagos, Nigeria	1013·7	+0·8	87	3	70	2	84·2	74·3	79·3	+0·7
Kaduna, Nigeria	1016·5	+5·2	89	9	61	19	84·6	67·5	76·1	+0·1
Zomba, Nyasaland	1019·0	+1·6	78	6,22,24	42	3	72·5	52·6	62·5	0·0
Salisbury, Rhodesia	1021·1	−1·9	79	18,20,22	35	4	73·7	41·3	57·5	+1·4
Cape Town	..	..	75	28	38	23	61·4	47·7	54·5	−1·3
Johannesburg	1027·9	−1·3	70	22	25	24	59·8	39·6	49·7	−1·0
Mauritius	1019·0	0·0	79	3	55	8	75·2	59·7	67·5	−1·9
Bloemfontein	..	..	69	12	18	14	59·6	28·1	43·9	−3·7
Calcutta, Alipore Obsy.	999·0	−0·7	105	1	76	27	96·3	81·2	88·7	+3·6
Bombay	..	..	94	7	76	11	89·0	80·9	84·9	+1·0
Madras	..	..	104	12	75	28, 29	100·2	81·4	90·8	+0·9
Colombo, Ceylon	1009·0	+0·7	88	1	73	23	85·3	76·4	80·9	−1·0
Hong Kong	1004·0	−2·1	89	13	73	4	85·0	77·9	81·5	0·0
Sydney	1012·7	−5·2	72	12	38	5	65·2	48·0	56·6	+2·3
Melbourne	1009·4	−8·9	64	29	36	14	57·4	46·4	51·9	+1·5
Adelaide	1010·1	−9·0	65	29	37	5	58·8	47·9	53·3	−0·1
Perth, West Australia	1013·5	−4·5	70	13	35	30	63·6	50·3	56·9	+0·5
Coolgardie	1013·6	−5·5	69	4	34	9, 30	61·3	42·9	52·1	−0·6
Brisbane	1016·6	−1·4	77	29	42	5, 7	69·8	51·2	60·5	+0·5
Hobart, Tasmania	1003·9	−10·4	65	29	33	15	52·5	41·3	46·9	+0·1
Wellington, N.Z.	1019·7	+5·4	60	20	32	29	54·6	42·1	48·3	−1·4
Suva, Fiji	1012·4	−1·2	81	4, 21	61	14	76·7	67·6	72·1	−2·8
Kingston, Jamaica	1013·9	−0·1	92	16	70	14	89·0	73·1	81·1	−0·2
Grenada, W.I.	1013·7	+0·4	86	5,14,30	72	24	84·1	74·5	79·3	+0·5
Toronto	1014·7	+0·4	93	10	46	23	76·0	55·4	65·7	+3·1
Fredericton, N.B.	..	..	85	28	36	18	72·2	46·7	59·5	−1·1
St. John, N.B.	1013·0	−1·0	75	26, 27	43	10	63·8	47·8	55·8	−0·7
Victoria, B.C.	1016·8	−0·1	78	3	43	1	63·6	47·9	55·7	−1·3

London, Kew.—Mean speed of wind 6·5 mi/hr ; 5 days with thunder heard, 1 day with fog.
Malta.—Prevailing wind direction NW ; mean speed 6·9 mi/hr.
Sierra Leone.—Prevailing wind direction SW ; 2 days with thunder heard.
Salisbury.—Prevailing wind direction ENE.
Mauritius.—Prevailing wind direction SE.
Colombo.—Prevailing wind direction WSW ; mean speed 6·2 mi/hr. ; 2 days with thunder heard.

British Empire, June 1920.

TEMPERATURE Absolute Max. in Sun °F.	TEMPERATURE Absolute Min. on Grass °F.	Relative Humidity %	Mean Cloud Am'nt 0–10	PRECIPITATION Amount in.	PRECIPITATION Amount mm.	Diff. from Normal mm.	Days	BRIGHT SUNSHINE Hours per day	Percentage of possible	STATIONS
140	29	69	6·8	3·07	78	+ 23	11	6·5	39	London, Kew Observatory.
152	55	69	2·1	0·01	0·3	− 12	1	..	..	Gibraltar.
142	..	74	3·0	0·10	3	+ 1	3	9·7	67	Malta.
..	..	82	7·1	13·91	353	−140	21	..	..	Sierra Leone.
158	68	76	7·0	14·97	380	−103	19	..	..	Lagos, Nigeria.
..	..	87	..	9·57	243	+ 18	17	..	..	Kaduna, Nigeria.
..	..	80	3·3	0·22	6	− 9	3	..	..	Zomba, Nyasaland.
135	29	52	1·7	0·08	2	+ 1	1	..	..	Salisbury, Rhodesia.
..	..	82	6·3	5·47	139	+ 26	15	..	..	Cape Town.
..	22	51	0·7	0·00	0	− 3	0	9·5	90	Johannesburg.
..	47	73	5·1	0·70	18	− 53	14	..	..	Mauritius.
..	..	64	3·0	0·07	2	− 10	2	..	..	Bloemfontein.
..	73	59	7·0	5·13	130	−160	6	..	..	Calcutta, Alipore Obsy.
131	69	79	6·9	8·16	207	−262	18	..	..	Bombay.
156	73	61	4·7	0·61	15	− 33	6	..	..	Madras.
158	71	77	8·8	17·44	443	+251	26	..	..	Colombo, Ceylon.
..	..	81	7·9	15·55	395	− 3	20	4·9	37	Hong Kong.
117	33	63	5·0	2·42	61	− 69	12	..	..	Sydney.
106	31	74	6·6	3·09	78	+ 24	15	..	..	Melbourne.
122	26	78	6·7	7·00	178	+ 99	22	..	..	Adelaide.
121	27	75	7·0	11·82	300	+130	21	..	..	Perth, West Australia.
125	29	61	5·5	1·38	35	+ 4	10	..	..	Coolgardie.
131	35	65	4·6	3·24	82	+ 15	10	..	..	Brisbane.
..	27	73	6·4	2·41	61	+ 5	20	..	..	Hobart, Tasmania.
110	20	83	6·4	5·75	146	+ 25	13	3·5	38	Wellington, N.Z.
..	..	87	6·2	2·95	75	− 81	18	..	..	Suva, Fiji.
..	..	73	7·3	0·00	0	−105	0	..	..	Kingston, Jamaica.
138	..	73	6·1	3·61	92	−127	21	..	..	Grenada, W.I.
147	42	70	6·1	2·89	73	+ 3	14	..	..	Toronto.
..	..	..	..	3·00	76	− 18	15	..	..	Fredericton, N.B.
139	37	79	5·5	3·24	82	− 1	13	..	..	St. John, N.B.
135	37	73	5·8	1·04	26	+ 2	11	..	..	Victoria, B.C.

HONG KONG.—Prevailing wind direction S; mean speed 10·4 mi/hr.; 8 days with thunder heard, 2 days with fog.

SYDNEY.—Lowest min. temperature on record for June.

ADELAIDE.—Lowest mean pressure on record for June, and only 3 wetter Junes in past 81 years.

PERTH.—Total rainfall only once exceeded in June; 3·90 in. on 10th, greatest ever recorded in 24 hrs.

WELLINGTON, N.Z.—1 day with fog.

GRENADA.—Prevailing wind direction E.

covered with a uniform cloud-sheet at about 2,000 feet. On the 22nd there was fog all day at Kew and Farnborough, but fine weather over the greater part of south-east England. In the Midlands there was much fog between the 20th and 23rd.

The total rainfall for the month was everywhere in England and Wales below the average, and, except in the west and part of the south, was generally less than half the average. Over the remainder of the British Isles the total rainfall relative to the average exhibited an increase from south-east to north-west, and there was an excess over the whole of the western half of Ireland and north-western half of Scotland, reaching a maximum excess of 50 per cent. in the Hebrides. The general values for the countries were England and Wales, 49; Scotland, 106; Ireland, 110; British Isles, 87. Broadly speaking, the fall was below 50 mm. in the eastern half of Great Britain, and more than that amount in the west, but less than 25 mm. fell in the western midlands.

In London (Camden Square) the mean temperature was 43·5° F. or 0·1° F. above the average. The duration of rainfall was 23·0 hours, and the evaporation, ·04 in.

Weather Abroad: November 1920.

At the beginning of the month a depression which was situated over the south-west coasts of the British Isles moved south-east over France to the Mediterranean, causing heavy rain in the south of France. Cape Sanguinaire (Corsica) reported a fall of 60 mm., of rain on the 2nd.

Meanwhile the Scandinavian anticyclone, the persistence of which was the striking feature of the pressure distribution for October, began to move slowly southward; by the 7th it was centred over Germany and Central Europe, and was connected with the Azores by a band of high pressure. By the 13th the Continental anticyclone had moved further south and extended over Spain and North Italy.

With this southerly movement of the anticyclone, the Atlantic depressions, which had been moving on a northerly track, began to move east, and on the 9th–11th a depression moved from Iceland across Scandinavia, and was shortly followed by another, which also moved across Scandinavia, thus causing a period of unsettled weather in north-west Europe.

On the 16th a depression approached the Azores, and the Continental anticyclone retreated to Southern Central Europe. Later it moved back to North Germany and Southern Scandinavia, and the Atlantic depressions resumed their northerly track.

In the regions under the influence of the Continental anticyclone the weather was fine and cold, with a considerable amount of mist and fog. Some very low temperatures were recorded during the month in Scandinavia, Germany and Central Europe. On the nights of the 1st and 2nd the screen temperature at Saerna (Sweden) fell to 3° F. At Breslau and Prague on the night of 21st the temperature fell to 14° F.

In the western and central parts of the Mediterranean the weather, except for a period from about the 15th to the 21st, was rather unsettled, and several heavy falls of rain were recorded. On the 8th, 9th and 10th relatively low pressure over the Central Mediterranean, in conjunction with the high pressure over Central Europe, produced strong winds at Malta, culminating on the 9th in a gale with a mean velocity of 50 miles per hour and gusts of 60. This is Malta's "Gregale," or equinoctial gale. On the 22nd Gibraltar registered a rainfall of 64 mm. in a thunderstorm, and on the same day Malta had 48 mm. of rain. On the 26th Gibraltar recorded 53 mm. of rain, and on the 13th Malta had 39 mm.

In the extreme eastern portion of the Mediterranean the weather for the most part was fine. On the 5th the temperature at Alexandria reached 93° F.

Erratum:—Duration of rainfall at Camden Square, October, 1920, should be 26·5 hours.

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Artificial Dissipation of Fog.

WE are glad to be allowed to publish the following letter from Sir Napier Shaw concerning the possibility of dissipating fog by artificial heating. The subject was suggested to Sir Napier by an inquirer who had seen fog disperse over a football ground as the game proceeded:—

"It is not easy to get at the actual core of the question of dissipating fog by artificial heat; there are so few effective facts to go upon. The late Sir Norman Lockyer used to tell me of his experience of a thick fog in the Atlantic off 'the banks.' The steamer in which he was travelling was going dead slow and hearing the siren of another vessel in the neighbourhood for some time, when suddenly they came upon the other vessel stopped in the centre of a clear space free of fog. He attributed the clear space to the warmth of the vessel in the middle of it; but I have never made out why, of all the vessels that have been adrift in fog on the Atlantic, that should be the only one to form a clear space for itself. And so with your football play. I should have thought it more likely that whenever the game stopped for a moment the players would have been shrouded in a thick mist of their own making rather than the creators of a clear space for all to see them in. On a foggy day a team of waggon horses is a sort of travelling cloud though their coats are quite as thick as a footer shirt. Are you sure that the appearance of clearing was not due to the players forming something

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definite to look at? It is very difficult to estimate the facility of seeing unless there is some definite object to be seen. Gazing into vague vacancy produces curious effects upon one's seeing. But you must know about such things better than I.

"It is, of course, within the bounds of physical possibility to dissolve the fog of a limited space by artificial heating. Colonel Moore Brabazon has talked lately of doing it on a scale suitable for an aerodrome. But air in the open is very slippery stuff and it has all sorts of ways of evading control that are very disappointing.

"For example, I do not think that in a fog air is ever 'dead calm.' I have never seen a fog that was not obviously drifting slowly if one took notice. In fact the formation of fog is dependent upon the air being in slow motion, not 'dead calm.' I think you may allow two miles an hour for the motion. It makes a good deal of difference, because when you are clearing an aerodrome the air that you are spending your money on will be going along in a very leisurely way without fluttering a flag or moving an anemometer, but at the end of an hour it will be two miles away and you will be clearing away a fresh lot of fog.

"I do not know how much the air would have to be warmed to dissipate the fog. The fog itself you say was 50 feet thick. I think you would have to calculate upon warming up to at least double that height to produce any effect, because the automatic mixing due to the slow eddies would not allow you to confine your attention to 50 feet. It is the inexorable principle of 'share and share alike' that the air acts upon in the surface layers that causes the mixing which finds expression as fog in the bottom half or quarter of the layers affected. You cannot deal exclusively with the layers in which fog is formed.

"Now for some figures. Let us suppose you allow for warming the foggy air by 5° F. in order to dissipate the fog and make things safe. A cube of air 10 yards each way weighs a ton. Take an aerodrome 400 yards wide and allow for a cross drift of 4,000 yards in an hour and an air thickness of 100 feet (30 yards) to be warmed. You have to warm about 50,000 tons of air per hour through 5°; each ton of air requires ·24 ton-units of heat for 1° rise so the air will carry off 60,000 ton-units of heat. A ton of coal gives about 10,000 ton-units, so if you can get the heat perfectly distributed without loss 6 tons of coal an hour might do that part of it. Here is another calculation that indicates a larger demand for coal. From Glossary, p. 67, we may take the amount of water in a fog as, say, 2·5 grammes per cubic yard. We are dealing with 400 × 4,000 × 15 cubic yards in this case, *i.e.*, about 24,000,000 cubic yards, or 60,000,000 grammes, or 60 tons of water, which wants 6 tons of coal for its evaporation. Allowing for both, we may estimate 12 tons an hour as the coal consumption. Distribution by electrical heating would be much more manageable than hot-water pipes or flues, and I suppose that would mean at least five times as much fuel, say 60 tons an hour, as the amount to be devoted to clearing an aerodrome. This is a good deal, and we have assumed that the visitation only runs to 50 feet of fog. If the air outside the aerodrome goes on getting colder and the fog getting thicker we may have to reckon with 300 or 400 feet of fog; so we must think of 400 or 500 tons of coal an hour.

"You must of course arrange to have the heating on the side from which the air is drifting; it is not of much use to warm the air just as it is leaving the space you want to clear, so your installation must be four-sided.

"Having made the calculation, let me say that if it were possible to operate in this way I think we should have found more evidence for it than has hitherto come to light. A football crowd would be a very good way of trying the experiment. Arrange for a 50,000 crowd to surround a football field on the occasion of the next fog; there are always 50,000 people who have an hour or two to spare for an easy job of that kind. Has anybody ever known a ring of sightseers dissipate a fog by their mere presence? I wonder if 8,000 people are really as good as a ton of coal; they certainly ought to be.

"There must be other ways of trying the thing on the small scale. Anything of the kind must be done in the country because in fog-times the air of a place like London is full of smoke; there is a 'deck' about 300 feet up which prevents anything getting away, and the slow drift just mixes up the chimney smoke with the rest of the air *below the deck.* A deck is a layer where the temperature increases with height instead of obeying the ordinary law of getting colder with height.

"My feeling about attempting such experiments is perhaps best described by saying that the problem is about the same as trying to raise by a few degrees the temperature of the top 2 inches of the Thames between the Lots Road Power Station and Battersea Bridge when the tide has just begun to ebb. I would not like to say it is impossible with unlimited funds and coal. I do not know how much coal they burn in an hour at Lots Road, but if it is to be tried it had better be on a small brook first.

"It is much the same with the suggestion of dissipating fog by electric bursts discharge. Mr. Watson, who is working for the Committee on Atmospheric Pollution, has a contrivance which clears away tobacco smoke from a tube the size of your finger as fast as one blows it in. If you magnify the scale by 10,000,000,000, what you want is done. Multiplication by 10 will be rather an undertaking, and to do that ten times over may fairly be called impossible at this period of our history."

School of Meteorology, NAPIER SHAW.
Imperial College of Science and Technology,
South Kensington, S.W. 7.

OFFICIAL NOTICES.

Lectures on Meteorology.

THE arrangements for lectures and classes in the current term of the School of Meteorology in connection with the Aeronautical Department of the Imperial College of Science and Technology are as follows :—

1. *Mr. C. T. R. Wilson, F.R.S.*—A course of 10 lectures on Atmospheric Electricity on Wednesdays, at 2.30, beginning Wednesday, 12th January.
2. *Captain D. Brunt.*—A course of lectures on Dynamical Meteorology on Tuesdays and Thursdays, at 3.0, beginning Tuesday, 11th January. (2 terms.)
3. *Sir Napier Shaw, F.R.S.*—Continuation of the course on Instruments and Methods (weather maps, forecasts, gale-warnings, fog-warnings, and the artificial control of weather); lecture on Mondays, at 3.30, with (daily) practical work, beginning on Monday, 17th January.
4. *Sir Napier Shaw, F.R.S.*—Course of lectures for the University of London on "An Historical Review of Meteorological Theory," on Fridays, at 3.0, beginning on 21st January.

Admission to No. 4 is free, by ticket, to be obtained from the Meteorological Office; a fee is payable for Nos. 1, 2, and 3.

The Royal Institution.

ON March 10th and 17th, 1921, the Director of the Meteorological Office, Dr. G. C. Simpson, F.R.S., will deliver two lectures on "The Meteorology of the Antarctic" at the Royal Institution.

Retirement.

Mr. A. R. Simpkins, who retired on December 31st, 1920, entered the Office in September 1876 at the age of 20, being introduced by Captain Toynbee. After serving for 37 years in the Forecast Division, he joined the Statistical Division in 1913, and from that time was responsible for the compilation of the Weekly and Monthly Weather Reports. At the beginning of 1920, Mr. Simpkins succeeded Mr. Sheerman as Principal Assistant in the Statistical Division.

Climatological Stations.

OBSERVATIONS at *Wilton House, Salisbury*, a station which has been maintained by the Earls of Pembroke since about 1866, have been discontinued as from December 1920. The first Monthly Return from this station received at the Office was that for January 1903. Since March 1913, when Wilton was adopted as a District Value Station in place of Swarraton, weekly returns have been made. Mr. W. Butler, who was appointed observer in January 1916, succeeded Mr. T. Challis, who had completed 55 years' service in that capacity.

British Rainfall, 1919.

THE fifty-ninth annual volume of *British Rainfall*, and the first to be published under the authority of the Meteorological Office, was issued on December 22nd. The lateness of the date was due to the difficulty in arranging for the transfer of the printing from the old printers to the Stationery Office, which has now accepted responsibility for the work. It is hoped that a return to an earlier date will be possible in future years.

The arrangement of the volume has been kept unchanged with one exception. In order to bring together all the administrative and non-scientific sections and to obviate the awkward double pagination hitherto used, the general articles have been placed at the end of the book, forming Part IV., instead of in Part I. These include a valuable article by Mr. D. Halton Thomson, C.E., on "The Effect of Rainfall on the Saturation-level in the Chalk at Chilgrove, West Sussex, from 1836 to 1919." Mr. Thomson has carefully standardised the remarkable record of well-depth and correlated it with the monthly rainfall throughout the 84 years covered by the observations. Another article, by Mr. Salter, on "The Exposure of Rain Gauges," calls attention to some important sources of error arising from faulty rain gauge exposure, and suggests methods of detecting and obviating them.

The contents of Part II. include a discussion of the relation of the evaporation records at Camden Square from 1905 to

1918 to other meteorological elements, based upon the five-day means. This article summarises and brings to a close the series of annual articles on the subject. In the section dealing with "The Distribution of Rainfall in Time" an account is given of a tentative experiment in the revision of the units hitherto used in the computation of rainfall frequency. This was suggested by the great difficulty experienced in studying the frequency of "rain days" owing to the smallness of the unit. Together with the data for rain days, droughts and rain spells based on the unit ·01 in. are given parallel tables based on ·04 in. or 1·0 mm. No definite step is suggested in the direction of abandoning the older definitions for the present, and it is proposed to examine the relative advantages of the new method for some years before coming to any decision on the point.

An important improvement is the introduction into the volume for the first time of maps showing the distribution of annual rainfall and a description based upon them. This is a step which had been in the minds of the Editors for many years but had never been found practicable.

The observational basis of the volume was provided by 4,896 complete records—103 fewer than in 1918. The shrinkage in numbers, which represents 2 per cent. of the whole body of observers, was almost entirely confined to England and does not in any way impair the representative value of the records. In respect of distribution there is a continued tendency to improvement.

The general tables have unfortunately been set in a much smaller type than formerly, making their perusal very trying to the eyesight. This is one of the least desirable forms of economy, and it is to be hoped that a return to the more readable type of former volumes will be possible in the next issue.

Discussion at the Meteorological Office.

THE subject for discussion on December 13th, 1920, was the paper entitled "Étude préliminaire sur les vitesses du vent et les températures dans l'air libre à des hauteurs différentes," by H. H. Hildebrandsson (Stockholm, *Geog. Ann.*, 1920, No. 2, pp. 97–118).

This paper, which was brought to the notice of the meeting by Dr. H. Jeffreys, contains a useful summary of observations in various parts of the world, but not much that is novel. A striking result is arrived at in the comparison of the upper air temperatures in the quadrants of a cyclone; for the winter it is found that whilst the southern and eastern quadrants are warmer than the north and west near the ground, from 1,500 metres upwards this relation is reversed.

It will be remembered that, according to Mr. W. H. Dines, it is only in the lowest levels that any appreciable difference in temperature distribution is to be found between the quadrants; Hildebrandsson's results are based on very few observations, however. In this case of winter cyclones there are eight observations in the north and west quadrants, 23 in the sout and east quadrants. There is no evidence as to how far these refer to the same locality.

It is well known that observations of clouds and of pilot balloons do not give concordant values for the mean speed of the air currents at specified heights. Hildebrandsson's explanation is that the pilot balloon ascents are only practicable in clear weather. A more important consideration is probably that when the wind is strong balloons are lost to sight before reaching any great height. In support of this view it was mentioned by Captain Douglas that observations of shell-bursts had given some very high speeds.

With regard to the absence of information concerning the temperature of the upper air over India, Dr. Simpson explained the difficulties which had delayed the organisation of observations. He mentioned the ingenious system devised by Mr. Field to secure the return of balloon meteorographs intact. To counter the possibility that the record should be damaged through curiosity, mechanism was devised which made the record spring out of harm's way between two metal plates directly the instrument touched the ground.

The Royal Meteorological Society.

A MEETING of the Society was held on December 15th, the President, Mr. R. H. Hooker, in the chair. Captain C. K. M. Douglas presented a paper on *Temperature variation in the lowest four kilometres*. The chief object of this paper is to emphasise the importance of the source of air-supply in causing variations of the upper air temperature, and to discuss the bearing of these variations and the accompanying weather changes on the theories of Professor V. Bjerknes.

The material utilised by Captain Douglas was derived from the observations made in aeroplanes during the last year of the war in Northern France, and his vivid portrayal of the circumstances gave a special interest to his exposition. Mr. W. H. Dines' investigations have shown that temperature at such a height as 4 km. is closely correlated with the pressure, and that for a given locality the temperature at such a height is not determined by the direction of the local wind. The evidence adduced by Captain Douglas is hardly consistent with the latter conclusion, and the question will evidently require further examination.

Mr. A. P. Wainwright showed drawings of a suggested form of sunshine recorder.

A paper by Lieut.-Colonel J. E. E. Craster, entitled "An investigation of river-flow, rainfall and evaporation records," was also read. The paper is devoted to a discussion of the economy of the water supply of the Shannon Basin. The average outflow of the river month by month is known from gaugings, and the author has set out to estimate the rainfall and evaporation over the Basin, in spite of being handicapped by the entire absence of Irish observations of the latter element. The method by which the conclusions were reached received a good deal of adverse criticism in the discussion, but the general result that the difference between rainfall and river-flow is accounted for by evaporation comparable with that measured at Rothamsted, appears to be substantiated.

Correspondence.

To the *Editors*, "*Meteorological Magazine.*"

A Midday Rainbow.

IN the November issue of the *Meteorological Magazine* Dr. Cholmeley states "surely a practically midday rainbow is a very rare phenomenon," and he instances a brilliant double one witnessed on October 2nd.

At Putney Bridge Station on December 1st, from 11 h. 47 m. to 11 h. 50 m., the north-western portion of a rainbow was clearly visible.

I did not think there was anything exceptional in seeing a bow so near midday. What puzzled me was that it appeared on a beautifully fine winter's day, when there was nothing in the dry, crisp feeling of the air or in the aspect of the sky to suggest that there were showers anywhere in the neighbourhood.

On referring to the *Daily Weather Report* I find that while Greenwich and Camden Square give "b" and Kensington Palace "bc, b" for the morning of the 1st, Kew Observatory gives, for 7 h. 13 h., "w2fpbbc." H. HARRIES.

Fulham, 6th December 1920.

A RAINBOW was observed here by several members of the staff on December 1st at 11 h. 40 m. A very light shower, not shown on the Beckley trace, occurred at the time. The electrogram also showed some negative potential. The amount of cloud at the time was about 3/10. It was cirro-stratus with a suspicion of light fracto-nimbus below. There was a light SW. wind. The phenomena would naturally occur a little earlier here than at Putney Bridge.

Kew Observatory, Richmond, 16th December 1920. C. CHREE.

Mr. Harries' letter reminds me of an experience of my own at Parkstone, Dorset, one Christmas a few years ago. At about 12 h. 30 m. heavy clouds came up on a strong wind from the north, and there was a little rain. About 13 h. the cloud had passed to the south, leaving the whole of the northern half of the sky free, and against the blue sky a brilliant rainbow stood out. The bow lasted for at least five minutes.

It is an interesting question whether the rain in such a case could have fallen from the cloud before it passed over the observer's head. The drops fall from the fast moving cloud into strata where the air is travelling comparatively slowly and then get left behind, but it is remarkable that they should get so far behind as they appear to have done on this occasion. F. J. W. W.

The Sun through Black Fog.

I happened to notice some rather interesting kaleidoscopic effects in the black fog on December 8th in London, which I thought might be of some interest. At about 14 h. the blackness was intense over London, but gradually it became lighter until the sun's disc appeared as a bright red orb and shone faintly for a few minutes. Again gloom settled down, but this time it was deep yellow in colour, which gradually changed to a lurid red and gave the impression of a large conflagration. Later the colour changed again to pale yellow, and finally the intense blackness re-asserted itself as in the morning. I witnessed these changes from Piccadilly.

J. E. Cowper, Captain.

9th December 1920.

Meteorology and Private Bill Legislation.

I see on page 228 of the *Meteorological Magazine*, under the heading "News in Brief," reference to the Folkestone Corporation Bill, 1920, which you say is "probably unique in the annals of private Bill legislation," and would like to call your attention to the fact that the Nottingham Improvement Act, 1874, section 64, reads :—

> "The Corporation may, from time to time, establish and maintain such meteorological apparatus as they think expedient."

You will see, therefore, that the Nottingham Corporation obtained similar powers to the Folkestone Corporation 46 years ago.

Arthur Brown, City Engineer.

Guildhall, Nottingham, 6th December, 1920.

Simultaneous Halo and Corona.

A LUNAR halo and corona were visible simultaneously from Hampstead soon after 9 p.m. on December 25th. The sky was covered with a thin cirro-nebula, and no definite clouds could be seen drifting over the moon's disc. Cirro-nebula normally consists of thinly scattered ice-cystals in a layer some thousands of feet thick, not always at a great height. On this occasion the lower part of the layer evidently consisted of super-cooled water drops. I witnessed this phenomenon once before from an aeroplane. On that occasion a solar corona was caused by a thin layer of ordinary water-drop cloud in the middle of finely scattered ice-crystals which caused a halo. C. K. M. DOUGLAS.

False Cirrus and Optical Phenomena.

MENTION has been made recently of halo phenomena in false cirrus. An aeroplane observer flying in the top of a shower can usually find a region where minute ice-crystals cause a fine series of coloured phenomena at close quarters, with complete halos, arcs of contact, sun pillars, and mock suns. Most of the false cirrus, however, consists of snow flakes without optical phenomena. It may therefore be expected that a ground observer would only occasionally observe optical phenomena, and very rarely a complete halo. C. K. M. DOUGLAS.

The Word "Forecast."

THE "Meteorological Glossary" gives the following definition of "Forecast":—"The name given by Admiral R. Fitzroy to a statement of the weather to be anticipated in the near future from a study of a synoptic chart or 'weather map.'" A casual reader is not perhaps altogether to be blamed for forming the impression that the word was *coined* by Fitzroy in order to avoid the objection which might reasonably have been taken to the use of such a word as "prophecy" or "prediction." With such an impression in my own mind I was a little surprised to come across the word in the following sentence of de Quincey:—

"I never once admitted them to my thoughts in *forecasting* the eventual consequences," etc. ("Opium Eater," 1821).

A reference to the New English Dictionary shows that the word was in use as a verb as early as 1388. Among numerous examples of its use since that date the following are culled:—

"Oure forecastes are but uncertayne" (Coverdale, 1535).

"A shypmaster forecasteth and is in gret thought and feare of tempests and stormes to come" (Ld. Berners, 1533).

"A good *forecaster* is better than a bad worker" (J. Clarke, 1639).

"Give me a wise *forecast*, that the subtelty of the devil may not entrap me" (Quarles, 1644).

"No skill . . . could *forecast*
The approach of this destructive blast" (Falconer, 1762).

The following are examples of the use of the word in the sense of pre-arrangement of details, rather than foreseeing of events which it is impossible to alter:—

"(He) to whome a Soveraign hath entrusted the command of an Army should well *forecast* his measures before he go into the Field" (Gaya, 1678).

"At the first sight the thing which was *forecast* by good order, seemeth to happen by adventure" (Golding, 1587).

"On some day *forecast* in Heaven" (Rossetti, 1871).

Should it ever be possible to obtain control of the weather, it would hardly be necessary to make any change in our terminology.

The exact date of the introduction of the word by Fitzroy appears to be 1861 (ninth number of *Meteorological Papers published by the Board of Trade*). The addition of "ed" to form the præterite and past participle is largely a modern innovation. As, however, this modification has been accepted by lexicographers and poets, except when forbidden by the the requirements of scansion, meteorologists would hardly seem to be called upon to go back to such a form as "fine weather was forecast!" E. G. BILHAM.

19th November, 1920.

A Good Example of Mammato-Cumulus Cloud.

DURING the afternoon of December 28th two heavy showers occurred during the passage of a V-shaped secondary which was moving in a northerly direction. The wind at the time was south-west. At 16 h. the sky broke up in the SW. and it soon became apparent that the lower surface of the rain cloud was deeply festooned near the horizon. Quite suddenly three of the festoons began to extend downwards and, catching the sunlight, turned a brilliant yellow. They soon assumed remarkable proportions, hanging like elongated thimbles; they must have been very transparent, since as the sun was behind and low on the horizon the whole of the festoon was brilliantly lit up with transmitted rather than reflected light. The lower part of the festoons soon began to move forward and assume a curved shape, they appeared to join together and looked exactly like a well-developed cumulus inverted in the sky. There was a further development of mammato-cumulus in the zenith which, owing to perspective, was not so pronounced. In this case the festoons were not individual pockets, but appeared to be deep waves curved downwards in the centre. A curtain of rain hung between me and the mammato-cumulus on the horizon, but no precipitation appeared to reach the ground.

I have often been sceptical about the illustration of this phenomenon in the Meteorological Office publication, "Cloud

Forms," but I must say that, far from being an exaggeration, I should consider that it barely does justice to this cloud-formation. To produce the deep pockets I saw on this occasion I should imagine some vertical motion would take place: they looked rather like the top part of a water-spout, except that they were cylindrical rather than conical. The mere cessation of ascending currents could hardly account for them. I may add that the cloud they hung from was cumulo-nimbus with no visible false cirrus: thunder and lightning occurred about 17 h. R. FRANCIS GRANGER.

Denton Fields, Nottingham, 29th December, 1920.

NOTES AND QUERIES.

The Effect of Rainfall on River Fisheries.

A MEMORANDUM prepared by a Joint Committee of the Ministry of Agriculture and Fisheries and the Ministry of Transport has recently been issued under the title "Damage to Fisheries by Pollution." Allegations made from time to time of damage to fisheries by washings from tarred and other roads have led to the formation of the Committee and to the establishment of a special station for experimental investigations. The observations which are now asked for include notes on the behaviour of fish affected by pollution and the collection of samples of water and of mud. Instructions are given that when heavy rainfall occurs after a period of drought a sample should be taken of the rain-water (preferably at the height of the storm) from a clean roof or surface. Its temperature should be noted at once and the sample forwarded to an analyst, who should be asked to examine it for ammonia and nitrous and nitric acids. Presumably the flushing of the roof in the earlier part of a storm is relied on to give a sufficiently clean surface.

One difficulty in ascertaining how far any bad effects of a downpour of rain may be due to the pollution of the river is, that fish are extremely sensitive to sudden changes of water temperature, and the pamphlet recommends that temperature readings should be taken immediately after a storm for comparison with the pre-rainfall temperature. It will be noted that the organisation of regular readings of thermometers is pre-supposed by this recommendation. At present the only river temperatures which are published regularly in this country are those made by Mr. Hunter of the Derwent at Belper. These have appeared in the Monthly Weather Report for some years (up to September 1920 in a footnote to Table III, from October 1920 in Table IIIB). Much valuable information bearing on the subject of river pollution can be derived from the regular observations of the impurities, both organic and inorganic, of the water of the Thames, the Lea and the New River, carried on by Sir Alexander Houston for the Metropolitan Water Board, in connection with the water supply of London; whilst the work of the Atmospheric Pollution Committee of the Meteorological Office shows to what extent pollution can be traced back to the fouling of the air by smoke.

Many rainfall observers are also keen fishermen, and it is hoped that such as have opportunities for making the required observations will communicate with the *Fisheries Secretary, Ministry of Agriculture and Fisheries, 43 Parliament Street, London, S.W.1.*

Official Publications.

The Rainfall of 1920.

Any preliminary survey of the rainfall of the year must of necessity be incomplete and provisional, but it is useful at as early a date as possible to ascertain the broad outlines of the distribution in relation to the average.

In dealing with the returns for 1920, use has been made for the first time of a new set of rainfall averages prepared during the past few months. These are for the 35 years 1881–1915, the period selected for the standard climatological normals in the *Monthly Weather Report.* The number of averages available is greater than was the case formerly.

The rainfall of 1920 falls into two well-marked periods, the first seven months being generally wet, the latter five months generally dry. The general values for the months show, however, no striking departures from the average. The most unusual month was October when the distribution of rainfall was extremely abnormal.

Monthly General Rainfall as Percentage of Average.

1920.	England and Wales.	Scotland.	Ireland.	British Isles.
January -	150	142	151	147
February -	77	164	89	112
March -	150	137	129	139
April - - -	204	100	146	153
May - - -	117	164	145	141
June - -	99	65	78	82
July -	170	104	153	143
August - - -	59	85	62	68
September -	95	87	85	89
October - - -	58	67	127	79
November -	49	106	110	87
December - -	101	91	97	96

The total rainfall of the year was above the average in the west, but a strip with slightly defective fall extended almost unbroken along the east coast of Great Britain. The deficiency in this strip was most marked in the extreme north and in the extreme south, less than 80 per cent. of the average falling at Dunrobin and at Dungeness. The only westerly areas with a defective fall were patches in the centre and north of Ireland and in the neighbourhood of Sidmouth.

In the wet districts excesses of more than 10 per cent. were widespread occurring over nearly the whole of the west of Great Britain, and in Ireland principally in the east and south. The areas of greatest excess were in Wales where the total rose in places to 30 per cent. above the average.

The general rainfall for the greater divisions of the British Isles was as follows:—

England, South	102 per cent. of the average.
,, North	110 ,, ,, ,,
Wales	121 ,, ,, ,,
England and Wales	109 ,, ,, ,,
Scotland	108 ,, ,, ,,
Ireland	113 ,, ,, ,,

For the British Isles as a whole the percentage is estimated as 109.

Winter Weather in Calypso Bay, Spitsbergen.

A FEW observations taken in Calypso Bay, Spitzbergen (1919–20), probably on board ship, by Colonel Boston, of the Northern Exploration Company, have been received from the Hydrographer.

The following short table summarises the results of the temperature observations:—

Temperature.	1919.	1920.				
	Dec.	Jan.	Feb.	Mar.	Apr.	May.
	° F.	° F.	° F.	° F.	° F.	° F
Highest	32	37	34	32	34	41
Lowest	−15	−20	−29	−29	−4	12
Mean of weekly extremes	15	12	4	12	12	29

It is noteworthy that rain was recorded on two occasions, on one of which the temperature did not rise above 23° F. A hurricane was experienced in January and a blizzard in February. The greatest frequency of snow was in March, when it occurred on 14 days. The ice in the bay broke up in April, and in May a rapid thaw set in.

A Mechanical Forecaster.

A SIMPLE mechanical forecaster has been put on the market by Messrs. Negretti and Zambra. Given a certain pressure and a certain wind direction, there must be a certain sequence of weather which is the most probable, and it should be possible to construct tables showing this probable sequence. It would be expected that the tables would be of enhanced value if separate ones were provided for summer and winter, for rising, falling or steady barometer.

Such tables are virtually combined in Messrs. Negretti and Zambra's mechanical contrivance, but there is nothing on the instrument to show on what statistics they are based.

A mechanical device has certainly great advantages over a set of tables from the point of view of compactness and convenience in use, but it limits the freedom of the designer in his choice of weather anticipated under different sets of circumstances. Thus, when he has settled the weather which will follow different barometric readings from 28·0 in. to 31·0 in. with a south wind, his choice of the weather for similar pressures with west wind or north wind is somewhat circumscribed by the form of the instrument.

That the expectation of bad weather should be accounted higher when the barometer is falling is in accordance with our usual habits of thought. It is not certain, however, whether the facts bear out this idea. E. H. Chapman has shown* that the correlation between the change in pressure in 12 hours and the rainfall in the following 24 hours is slight. No doubt the period of 12 hours is too long; the barometric tendency of our weather reports, *i.e.*, the change of pressure in 3 hours, should be a more reliable guide. The amateur who is provided with the new "Forecaster" should consult his barograph to learn whether pressure is rising or falling; comparison of this morning's reading of the barometer with last night's will not help him much.

Dr. Chapman has also investigated† the association of pressure at a definite hour with rainfall in the subsequent 24 hours. His conclusions are incorporated in a "Seasonal Aneroid," which is represented in his paper and which we understand has been put on the market by Messrs. Pastorelli and Rapkin.

It should be pointed out that any such instrument can only be of service in a restricted area. The Forecaster should be the London Forecaster or the Falmouth Forecaster or what not.

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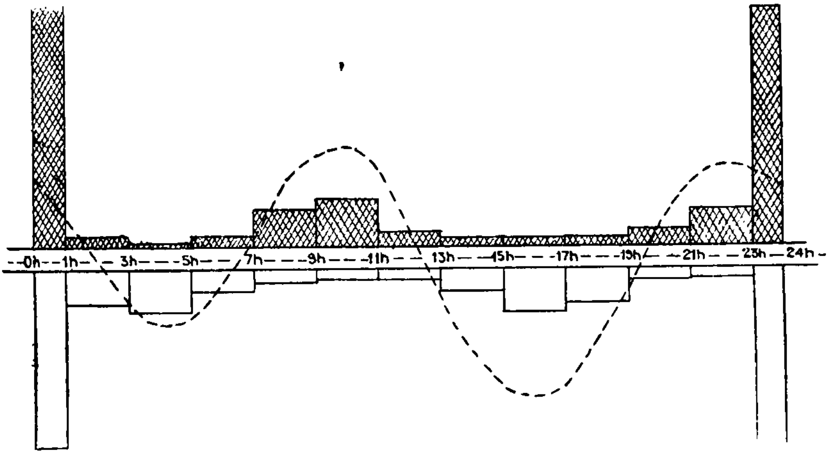
* Q.J.R. Met. Soc., Vol. XL., No. 172, October 1914.
† Q.J.R. Met. Soc., Vol. XLII., No. 180, Ootober 1916.

The Incidence of Barometric Maxima and Minima.

THE daily maxima and minima of pressure at British observatories have been published for many years in *Hourly Values from Autographic Records*, but their significance does not appear to have been closely investigated.* Dr. Arthur Turnbull, whose interest in the question is due to certain speculations about tides, has recently† examined the original tabulations of extreme pressures at Kew Observatory during five years, 1910–14, and has prepared tables showing the

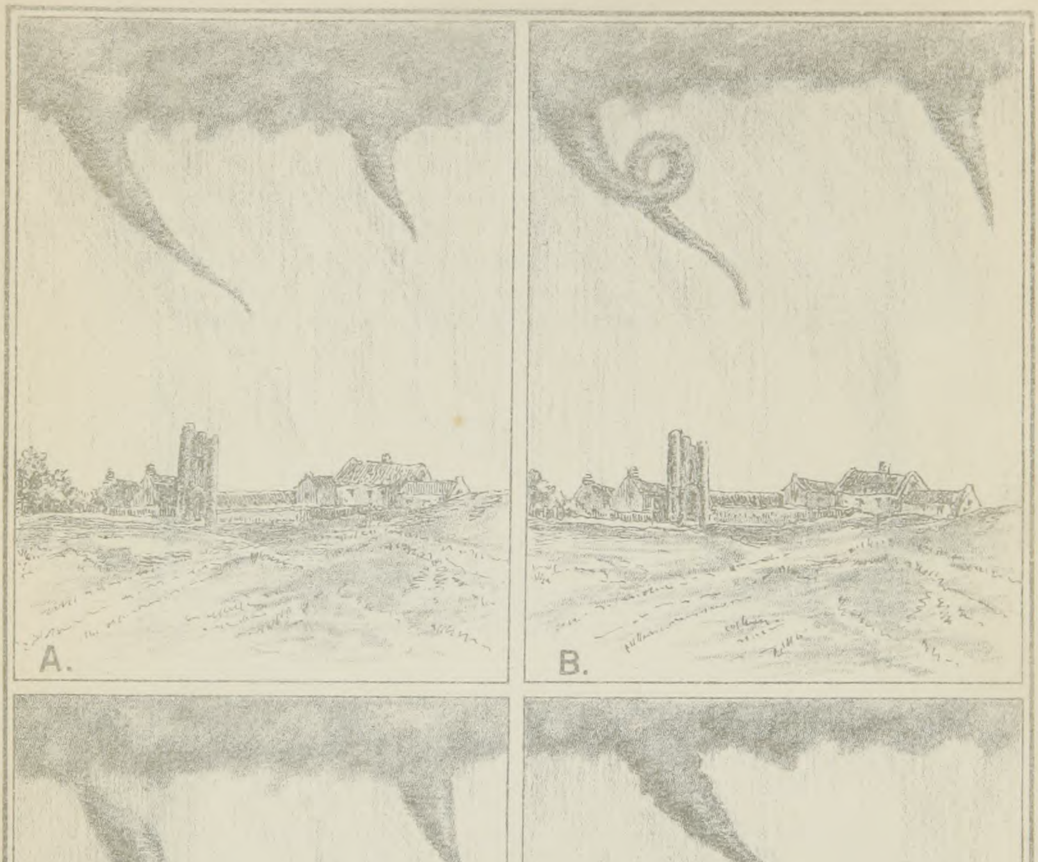


frequency with which maxima and minima of pressure occur at various times of day. Dr. Turnbull's results have been used in the preparation of the diagram reproduced herewith.

The frequency with which the maximum for the calendar day occurs between specified hours is represented by the area of the corresponding block, whilst the frequencies for the minimum are represented by the unshaded blocks. It will be noticed that, except at the beginning and end of the day, 2-hour intervals are utilised. The graph of the normal diurnal variation of pressure for Kew Observatory is superimposed on the frequency diagram. The crests and troughs of this graph are in close agreement with the greatest frequencies of the extremes of pressure. The striking excess of maxima and minima of pressure about midnight is no doubt due to the fact that when pressure is rising more or less steadily, the midnight reading is generally the maximum for the preceding 24 hours and minimum for the following 24 hours. The sum of the areas of the blocks on either flank

* An analysis of the time of occurrence of the extremes of temperature at Eskdalemuir has been published by Dr. Crichton Mitchell in the *Journal of the Scottish Meteorological Society*, Third Series Vol. XVII, No. XXXIV., 1917, p. 156.

† M.O. Letter 58,227/20.



CLOUD — PENDANTS: DUNMORE 1816.

By Robert Jacob.

H.M.Stationery Office Press, Kingsway W.C.2.

J. 201. Wt. 105 ° 55 1250 1/21.

of the diagram being about equal to the total area of the remaining blocks, it will be seen that it is about an even chance whether an extreme for the calendar day is really a turning point of the barogram or is merely incidental to the selection of midnight as the limit of the record.

Weather Lore.

It is appropriate that "The Shepherd of Banbury's Weather Rules and Sayings"* should be reprinted by Mr. E. A. Walford, of Banbury. In his introductory remarks Mr. Walford tells us that John Claridge published his Shepherd's Legacy in 1670, but that the "Rules to Judge of Changes in the Weather" appear to have been issued earlier. Whether Claridge was actually a shepherd is not stated.

Mr. Walford mentions some of the other sources from which he has derived proverbs, but does not refer to Mr. Richard Inwards's book on Weather Lore. There is a large field for statistical investigation offered by all this proverbial wisdom. In these opening days of the year 1921 one cannot have much faith in the proverb

"In the decay of the moon, a cloudy morning bodes a fair afternoon,"

and some experiences mentioned lately in our correspondence columns do not bear out

"A rainbow at noon, rain very soon."

Few proverbs are quoted more frequently than

"Red at night is the shepherd's delight,
Red in the morning the shepherd's warning."

The first half of this couplet is plausible enough; but does experience bear out the second line? There should be observational evidence, but where is it to be found? If there had been an international symbol for a red sky our climatological summaries would have provided the information. The only summary we can recall is Lieut. Silvester's,† covering the single month of March 1917, which gives five "pink" sunrises, two of which were followed by gales with rain or snow.

Some Old Sketches of Cloud-Pendants.

In connection with Mr. R. W. Smith's letter on cloud-pendants, published in the *Meteorological Magazine*, November, 1920, p. 224, Mr. J. Ernest Grubb, of Seskin, Carrick-on-Suir, has forwarded some interesting sketches of similar phenomena observed at Dunmore in 1816 by Robert Jacob. The sketches represent the aspect presented to an observer looking north towards Killea Hill. The following is Jacob's account of what he saw:—

* "The Shepherd of Banbury's Weather Rules and some Rhymes and Sayings," Edwin A. Walford, Bookseller, 71, High Street, Banbury.

† Q.J.R. Met. Soc., Vol. XLVI., No. 195, p. 268.

"Towards the latter end of summer 1816, while walking in the fields near the village of Dunmore at the entrance of Waterford Harbour, about 2 o'clock in the afternoon, I observed a gloomy appearance towards the north, which was evidently a heavy and partial shower of rain; the cloud from which it proceeded was of that form known by the name of nimbus, at no great distance, approaching me, being borne along by a gentle breeze. I had not long observed it when the margin next me, which was well defined, presented an unusual appearance in two places, as represented in the sketch marked A. These appendices had a very rapid spiral motion, and repeatedly increased and decreased; that to the left extended downwards and soon became much longer; it again contracted and in contracting assumed a very remarkable form which was indescribably beautiful and interesting. No sooner had it taken this peculiar shape, delineated in the sketch marked B, than it increased to a considerable length, every part still preserving the rapid spiral motion as at first. It continued to play in the air and extend itself towards the earth, and after some time it suddenly assumed the form represented in the sketch marked C. The second one disappeared, having retained the rapid spiral motion to the last. The other seemed for a short time to detach itself from the margin of the cloud, and something of a similar nature made its appearance near the earth; they approached, united, and formed the waterspout delineated in the sketch marked D. By this time it was not far from me, the spiral motion extremely beautiful from the margin of the cloud to the earth. The shower soon reached me, but ere I felt the falling drops of rain this curious phenomenon had disappeared.

"The rain was very heavy in that part of the country over which the cloud had passed. I had no instruments near me to ascertain the temperature of the atmosphere, height of the barometric column or quantity of rain which fell. The shower passed on to the wide extended ocean and nature resumed her smiling aspect."

Sunshine and Seed Culture.

WITH reference to the utility of the Book of Normals, Mr. J. L. North, of the Royal Botanic Society of London, writes: "I have long wanted to know what it was that made Essex and Suffolk and part of Norfolk the super counties for seed growers, and now I can see it is the excess of sunshine in July and August—the seed-maturing months. I had an idea it was some difference in the light itself—some actinic difference to which plants are sensitive, though we are not."

Messrs. Pastorelli & Rapkin, Ltd., of 46, Hatton Garden, E.C., send an attractive list of self-recording barometers, thermometers, and hygrometers, showing a number of handsome models at prices which, in these days, one can regard as moderate.

A BOOKLET recently issued by Messrs. Negretti and Zambra, under the title "Meteorological Data and other Facts," contains much out-of-the-way information, from the date of the Krakatoa Eruption to the weight of Cleopatra's Needle and the heaviest and lightest rainfall in the world. The quoting of authorities for the information is an excellent feature of the work, though it may not avert the criticism that in some cases the records have not been brought up to date.

Review.

Meteorology. By R. G. K. Lempfert, M.A., C.B.E., Assistant Director of the Meteorological Office. London: Methuen & Co., price 7s. 6*d*. net.

This little book contains an extensive but by no means an exhaustive account of meteorological phenomena. It is essentially the work of an experienced meteorologist; a physicist possessed of Mr. Lempfert's knowledge would have been tempted to treat the matter differently. A physicist is prone to regard meteorology as a storehouse of phenomena upon which he may draw to illustrate his laboratory experiments or his mathematical deductions; a meteorologist untiringly collects his data before venturing upon an explanation, and if he has a fault it is that he hesitates a little too long before attempting to introduce a physical theory. This, fortunately, cannot be strongly urged against the author, because, though the strength of Mr. Lempfert's book undoubtedly lies in its adherence to accredited meteorological facts, he has not hesitated to give *résumés* of modern theories designed to account for the phenomena he describes; this is indeed a valuable feature of his book. A wealth of material has become available since the publication of Mr. Lempfert's earlier booklet on "Weather Science," particularly with respect to upper air investigations, and it is because a most discriminating selection has been made from this material that the reader into whose hands the work falls will gain an excellent survey over recent meteorological work and will welcome it as an important addition to his library.

The author begins with a description of the weather map, and in presenting the salient features of the anticyclone and the depression he does well not to overwhelm his reader with too large a variety of isobaric distributions. The rainfall in a depression is treated at some length, and in a later chapter we have an interesting account of his own and Sir Napier Shaw's work upon air trajectories in a travelling depression.

In a chapter upon Pressure, attention is drawn to the assumption regarding air temperature upon which continental observers base their barometric reductions to sea level, and it is subsequently pointed out that over elevated land the winds are nowhere blowing in accordance with the distributions of isobars drawn on the usual weather map. A relative error possessed by aneroids used as altimeters on aircraft receives attention, and it is evident that the correction involved may be large compared with the "lag" error, which these instruments usually possess.

Taken in conjunction with the account of the physical processes in the atmosphere, the three chapters in which the thermal structure of the atmosphere are discussed provide an excellent review of our present state of knowledge of this important branch of the subject. We find adiabatic lapse rate simply explained, and brief accounts are given of G. I. Taylor's work upon eddy motion and its influence upon fog formation, of Gold's explanation of the temperature conditions in the stratosphere, and of W. H. Dines' remarkable observations of temperature and pressure at different levels in cyclonic and anticyclonic distributions.

The phenomena associated with winds are first discussed from the point of view of the measurement of their velocities, their gustiness and their relation to the pressure distribution. In this we learn the trick of steering a wind across a track of country or ocean by applying a suitable pressure gradient at right angles to the direction which it is desired that the flow shall take, and we find also accounts of the distribution of average pressure at ground level and at 4,000 metres. The stimulating effect of the war is shown by the development of Bjerknes' schematic representation of the flow of air in a cyclonic disturbance, which was used by the Norwegian meteorologists when deprived of weather telegrams; and it is also shown by the method suggested for estimating the wind at considerable altitudes.

The diurnal variation of the wind and its variations with altitude is treated in the light of the researches of Taylor, the Eiffel Tower observers, and J. S. Dines, and one is glad to find a diagrammatic summary of G. M. Dobson's work upon the winds in the neighbourhood of the troposphere. Some rearrangement of material would have assisted the reader here, and we miss a reference to Cave's work at Ditcham Park.

The investigation of the correlation coefficients between pressure and temperature at heights up to 13 kilometres by W. H. Dines leads to the conclusion that the pressure at the surface is mainly governed by the pressure at 9 kilometres, and on this point Mr. Lempfert subscribes to the view that it is probable that the main features of the distribution of pressure are dictated from above.

As has already been indicated, there are subjects which have not been fully treated: little will be found on thunderstorms or upon insolation; the suggestive results of Abbott's investigation into the variation of the solar constant surely deserve recognition in a work upon meteorology, and more upon the subject of forecasting from so experienced a meteorologist would have been welcome.

The book comes at a time when public interest in meteorology is greater than it has ever been before, thanks largely to the war, in which, as the author points out, the subject played a notable part, and thanks also to the development of aviation. It is no credit to us that before the war our agricultural and pastoral industries were so little alive to the value of meteorological studies that public opinion did not demand the widespread publication of weather maps in the daily press—elsewhere, notably in some of the Colonies, the usefulness of this knowledge has long been recognised. One is inclined to regret that Mr. Lempfert has missed the opportunity of insisting upon the benefits which a more extended knowledge of meteorological conditions may confer upon farming and allied industries. Something has already been done—I find around me a dairy bacteriologist keeping daily records of sunshine, a wheat expert correlating his crop with rainfall, a dairy farmer who looks askance at the approach of a thunderstorm, and many whose interest in weather forecasting only requires quickening. In his own book Sir Napier Shaw, by appealing to the agriculturalist, sets an example which might, I think, be followed with advantage. But the scope of the book before us is necessarily limited by its size, and it undoubtedly serves as an admirable text-book. It is well printed, and the illustrations are both numerous and clear; it should prove of interest both to the official meteorologist and to those whose work only touches the fringe of the subject.

W. G. DUFFIELD.

Reading, Jan., 1921.

Weather in the British Isles: December 1920.

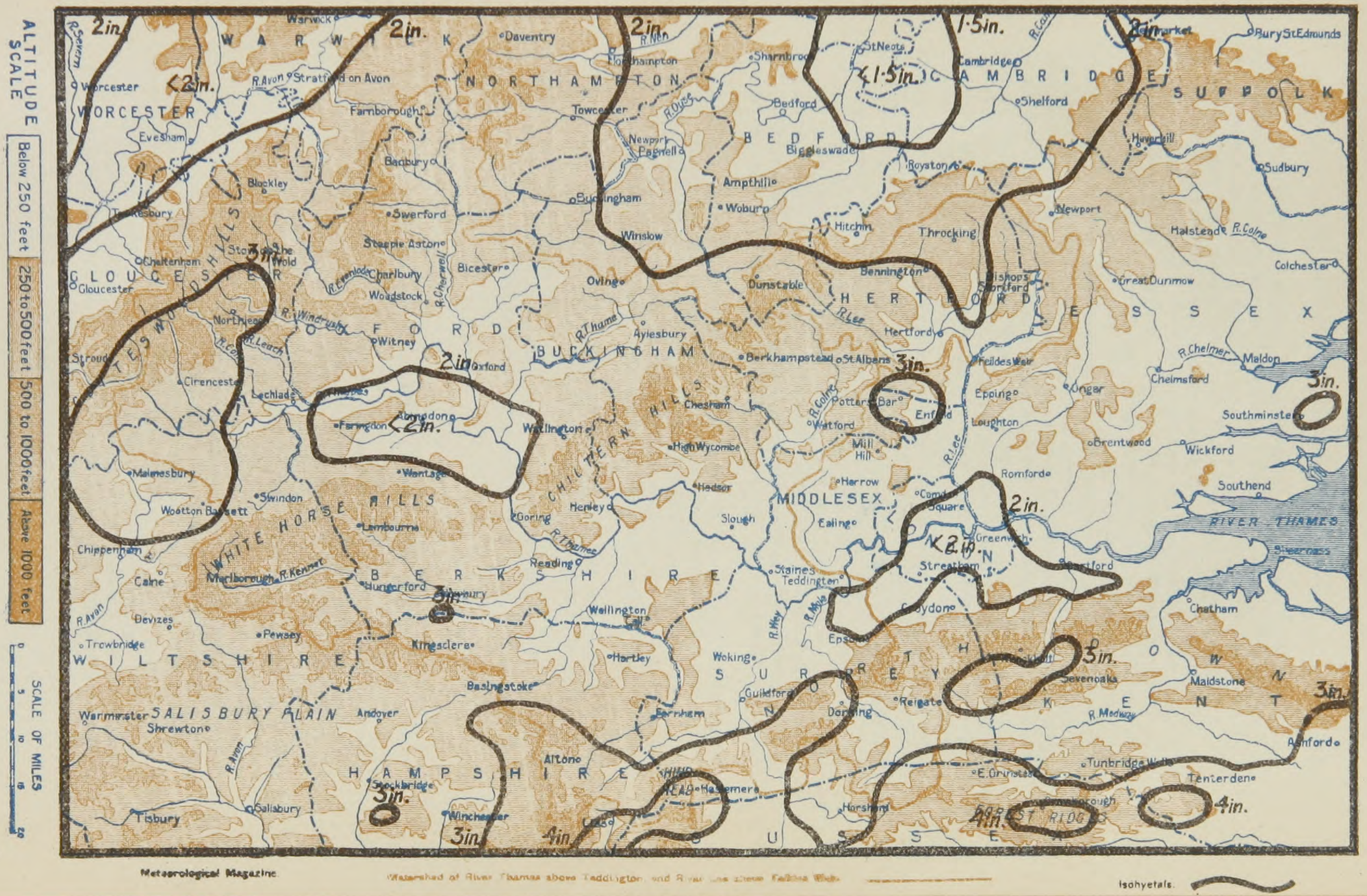
OUTSTANDING features of the weather in the British Isles during Deecmber were the wintry spell which occurred during the second week, and the unusual warmth which set in just before Christmas. Other notable events were the gales which were experienced all over the kingdom on the 3rd, and the fogs which were very general between the 6th and 9th.

On the first day of the month an anticyclone extended over the Baltic and Central Europe, and at the same time a large cyclonic system, the main centre of which lay near Iceland, affected the British Isles, to which it brought gales and rainy weather, 24 mm. of rain falling at Blacksod Point and 19 mm. at Portland Bill. During the night of the 1st–2nd a depression over the English Channel moved across France, and filled up, and another depression crossed the north of Ireland, the cyclonic area being characterised by strong gales and unsettled weather with maximum temperatures as high as 55° F. on the 2nd over a large area in England and Ireland. On the 3rd a large depression over the British Isles moved first in a north-easterly direction to the North Sea, and then southwards towards Holland; and within the affected area there were further gales from the west or north-west, with unsettled weather generally. Gusts exceeding 30 metres per second were recorded on the 3rd at places as far apart as Dyce (near Aberdeen) and Falmouth, and at Southport 37 metres per second (84 miles per hour) was attained. Much damage was done to shipping, and at Halifax a tramcar was blown over and people injured. The weather map for this date records some very interesting changes in wind direction and in temperature, the latter being especially striking, the readings at Baldonnel (Dublin), for example, falling from 54° F. at 1 h. to 45° F. at 7 h., whereas at Lympne (Kent) during the same period there was a rise from 44° F. to 52° F.

An anticyclone which spread over the British Isles from the south-west in the rear of this depression reached Scandinavia by the 5th and remained the dominant feature on the weather map until the 18th. During this period the weather of the British Isles was also affected by depressions moving across the Icelandic region, but for the greater part the temperature was low, and although some of the days were sunny, fog occurred from time to time, and there were also occasional falls of snow and sleet. During the 5th sunshine was abundant in the south-west parts of the British Isles, and 7·4 hours were recorded at Penzance and 6·4 hours at Valencia Observatory. Fog was widely experienced on the 6th, 7th, and 9th; on the 6th, at Renfrew, and on the 9th, at Manchester, it persisted all day; during the night of the 7th there was fog over practically the whole of England. On the 10th there was slight snow in east and south-east England, and there was more over a wide area on the 11th, when it fell to a depth of 14 inches at Clacton. Mr. F. L. Bland, the observer at Copdock (Ipswich), reports that the heavy snowstorm on the night of the 11th ranks among the memorable falls of the last half-century, for it is extremely rare to find a uniform covering of 8 ins. without any drifting at all. The snow fell light and dry, so that the yield of water (17 mm.) is not large compared with some other snowstorms of recent years. Snow also fell at many places on the 12th, 13th, 15th and 16th, the melted snow yielding 15 mm. at Jersey on the 12th and 22 mm. at Plymouth on the 13th, the latter figure being in notable contrast to the fall which occurred at Princetown (9 mm.) and at Sheepstor (3 mm.). Some very low temperatures were associated with this wintry spell, and readings below 15° F. were recorded at many stations and were below 20° F. in parts of the London area on the 13th. The lowest reading reported was −1° F. at Raunds (Northants), other low minima in the shade being 4° F. at Cambridge and 3° F. at Oundle.

In striking contrast with these conditions was the abnormally mild weather which set in on the 18th and continued until the end of the year, the distribution of pressure over the British Isles during this period under the

THAMES VALLEY RAINFALL.——DECEMBER, 1920.



influence of Atlantic depressions being persistently cyclonic. At Christmas the weather was conspicuously abnormal. During the night of the 23rd a warm current from the south developed; the warm air had reached a line extending from the Thames Estuary to the north-west of Ireland by 7 h. on the 24th, on which day maximum temperatures of 55° F. were recorded at many southern stations. On Christmas Day, although there was a general deficiency of sunshine, maxima of 56° F. were reached at many places and 59° F. at Bude and at Llandudno. The minimum was 50° F. at Pembroke, Roche's Point, and Scilly, and only 49° F. at Kensington Palace—readings which may be compared with 32° F. at Nairn and 34° at Stornoway, Renfrew, and Eskdalemuir. Rain was general on Boxing Day, but the temperature remained high and maxima of 55° F. were common, and, except in the northern parts of the kingdom, these abnormally mild conditions were maintained until the close of the month.

The month was on the whole unfavourable for flying, being characterised by much low cloud and generally poor visibility. Conditions were very unsettled early in the month, with a south-west gale on the 3rd and a northerly gale next day. Afterwards there was a long spell of north-east winds and generally overcast weather, the clouds being usually very low, though occasionally above 2,000 feet. In the south-east of England conditions were rendered very unfavourable by fog on the 8th, snow on the 11th, and low clouds, rain and drizzle from the 17th and 19th. In the last ten days there was a change to a south-west type and rather better conditions, with some fine days of good visibility. In the south-east and east conditions were more favourable than elsewhere in this period, but low clouds and rain caused very bad flying weather on the 21st, 24th, 28th and 31st.

The total rainfall for the month was in excess of the average in nearly all parts of England and Wales, but the excess was extremely moderate. In Scotland and Ireland there was a slight deficiency except in parts of the east. Less than 75 mm. fell over the greater part of the English midlands and in the north-east of Scotland, but practically all westerly districts had more than 100 mm.

The areas with 250 mm. were apparently smaller than usual. The general values for the countries were England and Wales, 101; Scotland, 91; Ireland, 97; British Isles, 96.

In London (Camden Square) the mean temperature was 40·7° F., or ·6° F above the average. The duration of rainfall was 78·9 hours, and the evaporation, ·4 in.

Weather Abroad: December 1920.

AT the beginning of the month unsettled weather was general over the Continent. A depression, moving in from the Atlantic, crossed England on the 3rd to the northern North Sea, whence it moved south over France to the Mediterranean, causing gales in the North Sea and heavy rain in the area affected by its passage. Paris recorded 55 mm. of rain in the 24 hours ending 7 h. on the 5th.

An anticyclone, moving from SW., covered the British Isles by the 5th, and then moved across to Scandinavia, where it remained until the 17th. Under the influence of a deep depression which had developed over the North Cape by the 18th, this anticyclone moved in a southerly direction and remained over Central Europe until the 20th.

During this fortnight, easterly wind, and very cold weather, with falls of snow, were prevalent over many parts of the Continent. In Germany, Central Europe and parts of France maximum temperatures remained below freezing point on several days. For example, on the 9th the

(*Continued on p. 292.*)

Rainfall Table for December 1920.

STATION.	COUNTY.	Aver. 1875—1909. in.	1920. in.	1920. mm.	Per cent. of Av.	Max. in 24 hrs. in.	Max. in 24 hrs. Date.	No. of Rain Days.
Camden Square	*London*	2·13	2·36	60	111	·41	23	23
Tenterden (View Tower)	*Kent*	2·77	3·25	82	117	·34	1	26
Arundel (Patching)	*Sussex*	2·91	3·69	94	127	·74	23	14
Fordingbridge (Oaklands)	*Hampshire*	3·35	3·25	82	97	·42	1	19
Oxford (Magdalen College)	*Oxfordshire*	2·06	2·23	57	108	·32	23	22
Wellingborough (Swanspool)	*Northampton*	2·13	2·05	52	96	·62	29	16
Hawkedon Rectory	*Suffolk*	2·06	2·89	73	140	·49	4	24
Norwich (Eaton)	*Norfolk*	2·39	3·22	82	135	·31	5	28
Launceston (Polapit Tamar)	*Devon*	4·46	3·99	101	90	·57	30	18
Lyme Regis (Rousdon)	"	3·68	4·08	104	111	1·14	1	17
Ross (Birchlea)	*Herefordshire*	2·71	2·98	76	110	·57	1	23
Church Stretton (Wolstaston)	*Shropshire*	2·99	3·22	82	108	·68	29	20
Boston (Black Sluice)	*Lincoln*	1·88	2·39	61	127	·30	29	25
Worksop (Hodsock Priory)	*Nottingham*	2·17	2·35	60	108	·54	29	21
Mickleover Manor	*Derbyshire*	2·38	3·06	78	129	·68	29	19
Southport (Hesketh Park)	*Lancashire*	3·10	2·53	64	82	·54	24	17
Wetherby (Ribston Hall)	*York, W. R.*	2·27	3·08	78	136	·60	17	13
Hull (Pearson Park)	" *E. R.*	2·32	2·69	68	116	·35	29	26
Newcastle (Town Moor)	*North'land*	2·46	4·11	104	167	·81	29	21
Borrowdale (Seathwaite)	*Cumberland*	15·14	10·75	273	71	..	..	..
Cardiff (Ely)	*Glamorgan*	4·70	5·14	131	109	·95	30	22
Haverfordwest (Portfield)	*Pembroke*	5·18	5·00	127	97	·81	30	14
Aberystwyth (Gogerddan)	*Cardigan*	4·66	3·06	78	66	1·00	24	8
Llandudno	*Carnarvon*	2·84	2·21	56	78	·61	29	20
Dumfries (Cargen)	*Kirkcudbrt.*	4·84	6·15	156	127	1·06	29	19
Marchmont House	*Berwick*	2·83	4·48	114	158	1·00	29	19
Girvan (Pinmore)	*Ayr*	5·48	4·89	124	89	·88	1	19
Glasgow (Queen's Park)	*Renfrew*	3·95	3·28	83	83	·46	29*	19
Islay (Eallabus)	*Argyll*	5·73	4·47	114	78	·98	2	21
Mull (Quinish)	"	6·59	5·81	148	88	1·25	1	18
Loch Dhu	*Perth*	9·48	8·00	203	84	1·10	30†	17
Dundee (Eastern Necropolis)	*Forfar*	2·67	3·31	84	124	·39	21	21
Braemar	*Aberdeen*	3·13	4·96	126	158	1·09	3	17
Aberdeen (Cranford)	"	3·43	4·09	104	119	1·05	3	24
Gordon Castle	*Moray*	2·72	1·32	34	49	·37	3	13
Drumnadrochit	*Inverness*	3·76	2·69	68	72	·80	22	9
Fort William	"	9·41	6·57	167	70	1·12	25	19
Loch Torridon (Bendamph)	*Ross*	9·71	7·47	190	77	1·31	1	17
Stornoway	"	5·95	4·99	127	84	·88	20	20
Dunrobin Castle	*Sutherland*	3·09	2·08	53	67	·37	2	10
Wick	*Caithness*	3·11	2·39	61	77	·72	3	20
Glanmire (Lota Lodge)	*Cork*	5·29	5·41	137	102	·91	30	18
Killarney (District Asylum)	*Kerry*	6·92	5·84	148	84	·87	30	19
Waterford (Brook Lodge)	*Waterford*	4·32	4·42	112	102	·70	30	19
Nenagh (Castle Lough)	*Tipperary*	4·34	3·77	96	87	·58	28	20
Ennistymon House	*Clare*	5·03	3·68	94	73	·43	1	18
Gorey (Courtown House)	*Wexford*	3·42	4·48	114	131	·68	1	18
Abbey Leix (Blandsfort)	*Queen's Co.*	3·41	3·19	81	94	·62	29	17
Dublin (FitzWilliam Square)	*Dublin*	2·27	1·98	50	87	·49	29	18
Mullingar (Belvedere)	*Westmeath*	3·39	2·97	75	88	·55	24	15
Woodlawn	*Galway*	4·27	2·68	68	63	·42	23	17
Crossmolina (Enniscoe)	*Mayo*	6·11	5·76	146	94	·89	2	20
Collooney (Markree Obsy.)	*Sligo*	4·34	3·76	96	87	·53	3	18
Seaforde	*Down*	3·77	6·08	154	161	1·18	30	21
Ballymena (Harryville)	*Antrim*	3·97	4·79	122	121	1·02	30	22
Omagh (Edenfel)	*Tyrone*	3·91	3·86	98	99	·71	29	22

* and 30. † and 31.

Supplementary Rainfall, December 1920.

Div.	STATION.	RAIN. in.	RAIN. mm.
II.	Ramsgate	2·62	66
,,	Sevenoaks, Speldhurst	2·91	74
,,	Hailsham Vicarage	3·94	100
,,	Totland Bay, Aston	2·81	71
,,	Ashley, Old Manor Ho.	3·01	76
,,	Grayshott	3·86	98
,,	Ufton Nervet	2·59	66
III.	Harrow Weald, Hill Ho.	2·39	61
,,	Pitsford, Sedgebrook	1·98	50
,,	Chatteris, The Priory	1·93	49
IV.	Elsenham, Gaunts End	2·37	60
,,	Lexden, Hill House	2·57	65
,,	Aylsham, Rippon Hall	3·23	82
,,	Swaffham	2·59	66
V.	Devizes, Highclere	2·41	61
,,	Weymouth	3·40	86
,,	Ashburton, Druid Ho.	8·79	223
,,	Cullompton	3·31	84
,,	Hartland Abbey	3·12	79
,,	St. Austell, Trevarna	5·25	133
,,	North Cadbury Rec.	2·24	57
,,	Cutcombe, Wheddon Cr.	6·73	171
VI.	Clifton, Stoke Bishop.	3·47	88
,,	Ledbury, Underdown.	2·59	66
,,	Shifnal, Hatton Grange	2·48	63
,,	Ashbourne, Mayfield	3·17	80
,,	Barnt Green, Upwood	1·99	50
,,	Blockley, Upton Wold	2·89	73
VII.	Grantham, Saltersford	2·25	57
,,	Louth, Westgate	3·12	79
,,	Mansfield, West Bank	2·90	74
VIII.	Nantwich, Dorfold Hall	2·37	60
,,	Bolton, Queen's Park.	3·74	95
,,	Lancaster, Strathspey.	3·19	81
IX.	Wath-upon-Dearne	2·22	56
,,	Bradford, Lister Park.	3·74	95
,,	West Witton	3·71	94
,,	Scarborough, Scalby	3·96	101
,,	Ingleby Greenhow	3·21	82
,,	Mickleton	4·20	107
X.	Bellingham	5·32	135
,,	Ilderton, Lilburn	4·40	112
,,	Orton	6·42	163
XI.	Llanfrechfa Grange	6·08	154
,,	Treherbert, Tyn-y-waun	14·75	375
,,	Carmarthen Friary	5·31	135
,,	Fishguard	4·22	107
,,	Lampeter, Falcondale	4·09	104
,,	Abergwngy	4·90	124
,,	Cray Station	10·50	267
,,	B'ham W.W., Tyrmynydd	5·93	151
,,	Lake Vyrnwy	6·73	171
,,	Llangynhafal, P. Drâw	2·18	55
,,	Dolgelly, Bryntirion	4·79	122
,,	Lligwy	3·37	86
XII.	Stoneykirk, Ardwell Ho.	4·68	119
,,	Whithorn, Cutroach	3·32	84
,,	Carsphairn. Shiel	7·83	199
XII.	Langholm, Drove Rd.	5·73	146
XIII.	Selkirk, Hangingshaw	4·83	123
,,	North Berwick Res.	2·38	60
,,	Edinburgh, Royal Ob.	2·19	56
XIV.	Biggar	3·08	78
,,	Leadhills	7·38	188
,,	Maybole, Knockdon	2·96	75
XV.	Rothesay	5·16	131
,,	Ardgour House	8·44	214
,,	Inveraray Castle	5·56	141
,,	Holy Loch, Ardnadam	7·61	193
XVI.	Loch Venachar	5·30	135
,,	Glenquey Reservoir	5·60	142
,,	Loch Rannoch, Dall	5·22	133
,,	Coupar Angus	3·69	94
,,	Montrose Asylum	3·25	82
XVII.	Balmoral Castle	3·86	98
,,	Fyvie Castle	2·70	69
,,	Keith Station	2·11	54
,,	Grantown-on-Spey	1·13	29
XVIII.	Cluny Castle	3·50	89
,,	Loch Quoich, Loan	12·70	323
,,	Skye, Dunvegan	6·27	159
,,	Fortrose	·85	22
,,	Ardross Castle	3·31	·84
,,	Glencarron Lodge	7·01	178
XIX.	Tongue Manse	2·24	57
,,	Melvich Schoolhouse	1·58	40
,,	Loch More, Achfary	3·77	96
XX.	Dunmanway Rectory	8·45	215
,,	Mitchelstown Castle	5·22	133
,,	Gearahameen	10·00	254
,,	Darrynane Abbey	5·62	143
,,	Clonmel, Bruce Villa	3·77	96
,,	Cashel, Ballinamona	3·70	94
,,	Roscrea, Timoney Pk.	2·98	76
,,	Foynes	2·65	67
,,	Broadford, Hurdlesto'n	3·48	88
XXI.	Kilkenny Castle	3·26	83
,,	Rathnew, Clonmannon	3·82	97
,,	Hacketstown Rectory	3·76	96
,,	Tullamore, Rathrobin	2·56	65
,,	Balbriggan, Ardgillan	2·89	73
,,	Drogheda	3·30	84
,,	Athlone, Twyford	2·75	70
,,	Castle Forbes Gdns.	3·28	83
XXII.	Ballynahinch Castle	6·31	160
,,	Westport House	4·33	110
XXIII.	Enniskillen, Portora	4·24	108
,,	Armagh Observatory	3·05	77
,,	Warrenpoint	5·17	131
,,	Banbridge, Milltown	3·23	82
,,	Belfast, Cave Hill Rd.	5·71	145
,,	Glenarm Castle	6·01	153
,,	Londonderry, Creggan.	3·30	84
,,	Sion Mills	3·37	86
,,	Milford, The Manse	3·51	89
,,	Killybegs, Rockmount	4·53	115

Climatological Table for the

STATIONS	PRESSURE		TEMPERATURE							
			Absolute				Mean Values			
	Mean of Day M.S.L.	Diff. from Normal	Max.	Date	Min.	Date	Max.	Min.	½ max. and min.	Diff. from Normal
	mb.	mb.	° F.		° F.		° F.	° F.	° F.	° F.
London, Kew Observatory	1013·9	−1·6	73	19	46	25, 28	66·9	53·2	60·1	−2·6
Gibraltar	1016·9	+1·6	90	25	62	15	81·3	67·0	74·1	−0·6
Malta	1015·0	+1·0	92	23	70	31	86·1	76·2	81·1	+3·6
Sierra Leone	1015·4	+2·9	88	10	69	8	82·2	72·0	77·1	−1·8
Lagos, Nigeria	1015·3	+1·5	87	21	72	8	81·5	74·2	77·9	+0·6
Kaduna, Nigeria	1016·1	+4·3	85	14,17,18	61	2	81·1	66·5	73·8	−0·8
Zomba, Nyasaland	1020·8	+2·9	78	18	48	14	71·7	53·3	62·5	+0·8
Salisbury, Rhodesia	1023·3	−0·7	76	17, 18	38	31	70·3	43·0	56·7	+0·8
Cape Town	1021·8	+0·5	77	12	39	4	62·8	48·7	55·7	+0·8
Johannesburg	1030·0	+0·5	71	21	36	12	62·1	42·1	52·1	+1·5
Mauritius	1022·2	+1·8	76	7	52	28	73·4	60·8	67·1	−1·2
Bloemfontein	..	..	71	20	23	18	63·8	32·8	48·3	+1·0
Calcutta, Alipore Obsy.	996·7	−2·5	95	1	77	27	88·5	79·6	84·1	+0·6
Bombay	..	..	89	1	75	7	84·3	78·3	81·3	+0·2
Madras	..	..	103	19	76	13	99·5	80·6	90·1	+2·8
Colombo, Ceylon	1010·2	+2·1	85	20, 23	74	24	84·4	77·0	80·7	−0·6
Hong Kong	1001·1	−3·8	93	25	76	20	87·0	79·1	83·1	+0·6
Sydney	1018·9	+0·4	68	1	40	13	61·6	47·1	54·3	+1·9
Melbourne	1017·6	−1·3	67	28	34	17	57·3	42·0	49·7	+1·1
Adelaide	1018·1	−2·3	65	20	39	15	59·3	44·6	51·9	+0·3
Perth, West Australia	1018·0	−1·1	71	22	35	30	62·2	46·1	54·1	−0·9
Coolgardie	1018·7	−1·2	71	23	29	1	60·7	38·2	49·5	−1·7
Brisbane	1018·4	+0·2	74	1, 28	41	13	68·1	51·1	59·6	+1·3
Hobart, Tasmania	1014·6	+0·9	59	1	36	18	54·4	40·8	47·6	+2·2
Wellington, N.Z.	1021·1	+8·2	61	9	29	25	54·3	41·5	47·9	+0·4
Suva, Fiji	1012·8	−1·4	85	24	55	3	78·4	66·0	72·2	−1·4
Kingston, Jamaica	1015·5	+0·8	95	15	71	12	90·8	74·2	82·5	+0·8
Grenada, W.I.	1014·5	+1·2	87	7	71	11	83·5	74·2	78·9	0·0
Toronto	1014·0	−0·1	87	30	44	16	76·7	56·1	66·4	−1·8
Winnipeg	1015·0	+2·3	89	26	39	15	79·6	53·3	66·5	+0·3
St. John, N.B.	1013·1	−0·6	83	9	50	18	68·1	53·1	60·6	+0·2
Victoria, B.C.	1018·8	+2·1	91	7	49	3	68·1	51·5	59·8	−0·5

London, Kew Observatory.—Mean speed of wind 7·7 mi/hr; 3 days with thunder heard, 1 day with fog.

Gibraltar.—1 day with fog.

Malta.—Prevailing wind direction NW; mean speed 5·9 mi/hr.

Sierra Leone.—Prevailing wind direction SW.

Salisbury.—Prevailing wind direction Easterly.

Mauritius.—Prevailing wind direction NW; mean speed 9·6 mi/hr.

British Empire, July 1920.

Temperature Absolute Max. in Sun °F.	Temperature Absolute Min. on Grass °F.	Relative Humidity %	Mean Cloud Am'nt 0–10	Precipitation Amount in.	Precipitation Amount mm.	Precipitation Diff. from Normal mm.	Precipitation Days	Bright Sunshine Hours per day	Bright Sunshine Percentage of possible	STATIONS
138	34	74	8·0	4·40	112	+ 57	20	4·3	27	London, Kew Observatory.
151	58	73	2·1	0·00	0	− 1	0	..	..	Gibraltar.
147	..	76	0·7	0·00	0	− 1	0	11·6	81	Malta.
..	..	85	8·3	40·03	1017	+144	27	..	..	Sierra Leone.
158	70	88	6·6	9·55	243	− 26	21	..	..	Lagos, Nigeria.
..	..	93	..	6·78	172	− 60	22	..	..	Kaduna, Nigeria.
..	..	85	6·7	0·48	12	+ 5	4	..	..	Zomba, Nyasaland.
135	31	56	3·4	0·00	0	0	0	..	..	Salisbury, Rhodesia.
..	..	77	4·8	5·18	132	+ 42	13	..	..	Cape Town.
..	30	56	2·7	0·04	1	− 5	1	9·0	85	Johannesburg.
..	45	75	6·2	2·23	57	− 6	24	6·7	61	Mauritius.
..	..	57	2·1	0·00	0	− 10	0	..	..	Bloemfontein.
..	76	80	9·6	14·47	368	+ 41	18	..	..	Calcutta, Alipore Obsy
135	72	85	9·3	22·60	574	− 65	30	..	..	Bombay.
161	75	60	7·5	2·19	56	− 48	14	..	..	Madras.
157	72	76	8·2	2·54	65	− 65	15	..	..	Colombo, Ceylon.
..	..	81	7·4	24·04	611	+292	18	6·5	49	Hong Kong.
112	33	74	4·7	5·87	149	+ 27	16	..	..	Sydney.
109	30	76	4·9	1·53	39	− 7	17	..	..	Melbourne.
122	29	73	5·8	2·89	73	+ 6	16	..	..	Adelaide.
119	25	75	5·4	5·86	149	− 18	19	..	..	Perth, West Australia.
136	25	56	3·5	0·72	18	− 5	5	..	..	Coolgardie.
127	34	68	4·3	2·19	56	− 2	14	..	..	Brisbane.
105	28	72	5·1	0·77	20	− 34	16	5·3	57	Hobart, Tasmania.
111	18	82	5·7	2·42	61	− 83	11	4·1	44	Wellington, N.Z.
..	..	85	3·1	3·95	100	− 17	15	..	..	Suva, Fiji.
..	..	65	5·3	0·53	13	− 29	1	..	..	Kingston, Jamaica.
138	..	79	7·0	11·39	289	+ 40	28	..	..	Grenada, W.I.
147	38	73	4·5	3·64	92	+ 15	13	..	..	Toronto.
..	..	72	3·0	0·76	19	− 58	6	..	..	Winnipeg.
139	43	85	5·7	2·98	76	− 16	13	..	..	St. John, N.B.
145	43	75	3·3	1·00	25	+ 16	5	..	..	Victoria, B.C.

COLOMBO, CEYLON.—Prevailing wind direction WSW ; mean speed 5·8 mi/hr.

HONG KONG.—Prevailing wind direction SE ; mean speed 12·6 mi/hr. ; 3 days with thunder heard.

PERTH.—Prevailing wind direction N ; mean speed 10 mi/hr ; 1 day with fog, 3 gales.

WELLINGTON, N.Z.—1 day with fog.

SUVA, FIJI.—3 days with thunder heard.

GRENADA.—Prevailing wind direction E.

maximum temperature was 23° F. at Neufahrwasser and Memel. Maxima of 19° F. at Aachen and 21° F. at Flushing and Brussels occurred on the 16th; at Lyons and Belfort, on the 17th, the temperature failed to reach 20° F.

After this period, low-pressure areas moved from Iceland to Scandinavia and pressure remained low in the Eastern Atlantic over a very large area until the end of the month. Temperatures rose generally over Western and Central Europe, and for the last week of December mild weather predominated on the Continent, except in Northern Scandinavia where severe frosts occurred. The 7 h. temperature at Saerna on the 28th was − 13° F., while at Haparanda on the 29th there was a reading of 6° F.

In the Western Mediterranean region low-pressure areas caused rather unsettled weather for about the first three weeks of the month, but on the 22nd an anticyclone, which had moved eastward from the Azores, began to spread over the Western Mediterranean. By the 25th it covered this area, and persisted until the end of the month, causing a spell of rainless weather. The winter rain has so far been scanty in India.

At Cairo and Alexandria the weather, except for an unsettled period at the end of the month, was mostly fine with temperature maxima round about 70° F.

At the beginning of the month beneficial rain fell in New South Wales generally, but in the second week abnormally heavy rain fell over an extensive area round Sydney, doing great damage to the wheat harvest. The storm was the worst that has been experienced in the State for 70 years; 10 in. of rain was recorded in three days, the average December rainfall being 2·6 in. The rain was particularly disastrous, coming after a three years' drought.

Near the middle of the month a heavy storm occurred at the Japanese naval station at Kure, in which 29 vessels laden with iron and coal sank and several heavy guns were plunged into the sea by a landslide.

Geostrophic Wind over London; February, 1881–1915.

FREQUENCY OF STRENGTH AND DIRECTION.

Estimates based on the D.W.R. charts (8 *h.*, 1881–1908; 7 *h.*, 1909–1915).

Direction.	5 m/s. 11 mi/hr.	10 m/s. 22 mi/hr.	15 m/s. 33 mi/hr.	20 m/s. 44 mi/hr.	Over 20 m/s. Over 44 mi/hr.	Total Frequency of Direction.
N.	14	12	17	7	4	54
NE.	12	21	13	9	3	58
E.	9	19	16	11	3	58
SE.	27	14	7	6	3	57
S.	16	20	13	9	10	68
SW.	19	59	44	31	48	201
W.	11	50	56	39	41	197
NW.	16	25	36	23	13	113
Total Frequency of Strength	124	220	202	135	125	806*

* Indeterminate—181.