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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 x 9½, pp. (Vol. I.) xii and 326, with plates and illustrations.

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 express 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 outwards 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 $\frac{3}{4}$ 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, $5\frac{1}{2}$ 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 ($1\frac{1}{2}$ 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 $3\frac{1}{2}$ 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 $5\frac{1}{2}$ 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.

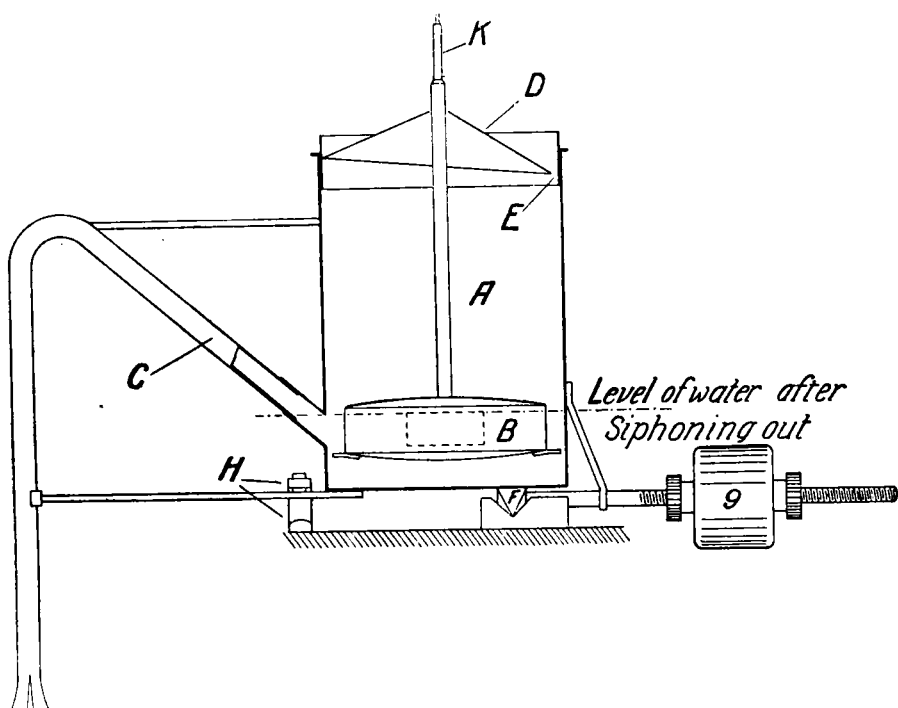
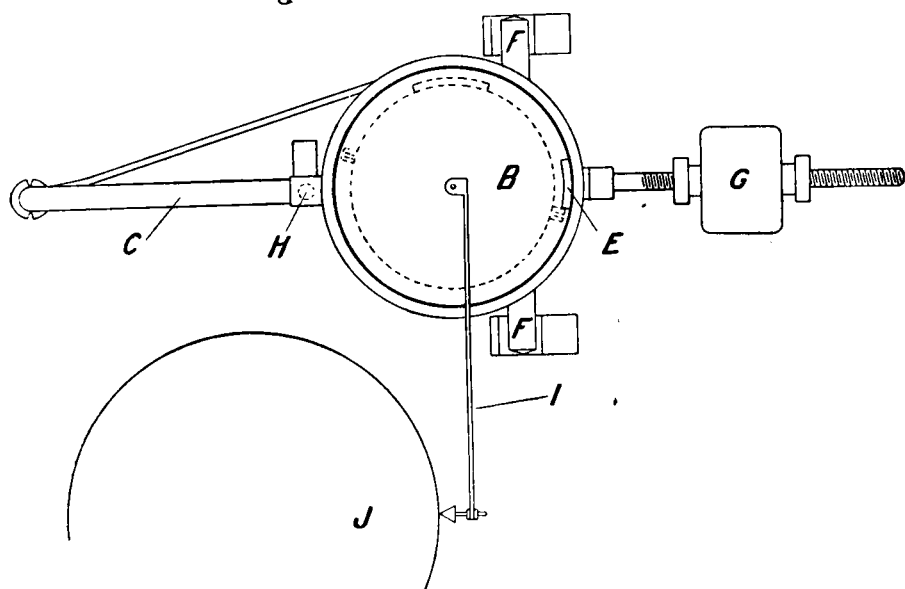


Fig. 1. Sectional Elevation.

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

OFFICIAL NOTICES.

Telegraphic Addresses.

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 anemobiograph 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. This 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 Apri1s 1871-80 and the inclusion of the five Apri1s 1911-15. Taking the Greenwich values as an example, it appears that in the ten years 1871-80 five Apri1s 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 Apri1s 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 excess 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., 21st 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 4d. 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 Expedition" 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 $54\cdot0^{\circ}$ F. (50 years) to $54\cdot3^{\circ}$ F. (55 years), $54\cdot5^{\circ}$ F. (60 years) and $54\cdot6^{\circ}$ F. (61 years, 1860-1920). December shows an increase of $0\cdot4^{\circ}$ F. in mean temperature between the 50- and 60-year periods, but no other month varies by more than $0\cdot2^{\circ}$ 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; $2\frac{1}{2}$ 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 $10^{\circ} 31' N.$, $66^{\circ} 56' W.$) 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.		
						Pres- sure.	Temp.	Rain- fall.
London, Kew Ob- servatory.	51° 28' N	0° 19' W	Ft. 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	16° 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 Ob- servatories, Simla.	'89-'10	'78-'10	'78-'10
Bombay - - -	18° 54' N	72° 48' 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 Observa- tory.	'84-'13	'71-'10	'84-'13
Sydney - - -	33° 51' S	151° 13' E	133	9, 15, 21	Commonwealth Meteoro- logist, 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 Obser- vatory.	'65-'17	{ '69-'87 '94-'17	'65-'17
Suva, Fiji - -	18° 8' S	178° 26' E	55	9	Superintendent, Depart- ment of Agriculture.	'86-'16	'86-'18	'86-'18
Kingston, Jamaica	17° 55' N	76° 12' W	24	7, 15	Government Meteoro- logist.	'80-'99	{ '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							
	Mean M.S.L.	Diff. from Normal	Absolute				Mean Values			
			Max.	Date	Min.	Date	Max.	Min.	$\frac{1}{2}$ 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	..
<i>Cape Town</i>.....	..	..	103.4	Feb. 5	34.1	July	72.1	54.1	63.1	+1.0
<i>Johannesburg</i>.....	..	..	89.9	Feb. 8	28.2	Aug. 4	71.5	49.9	60.7	+1.2
<i>Mauritius</i>	1015.8	-0.2	94.8	Jan. 15	55.4	Aug. 22	81.4	67.6	74.5	+0.3
<i>Bloemfontein</i>.....	..	..	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
<i>Sydney</i>.....	..	..	..	..	..	..	..	..	..	..
†Melbourne.....	..	..	106.6	? Feb. 15	29.9	Aug. 4	68.6	50.5	59.5	+1.1
<i>Adelaide</i>.....	..	..	109.3	Dec. 10	35.6	Aug. 21	74.1	54.1	64.1	+1.1
<i>Perth</i>.....	..	..	103.2	Mar. 9	39.1	Aug. 14, 15.	72.3	54.8	63.5	-0.8
<i>Coolgardie</i>.....	..	..	111.8	Jan. 22	32.2	Aug. 12	77.6	52.5	65.1	+0.8
<i>Brisbane</i>.....	..	..	99.4	Mar. 5	38.4	Aug. 5	78.3	60.6	69.5	+0.6
<i>Hobart, Tasmania</i>..	..	..	92.8	Dec. 21	32.8	Aug. 5	63.1	47.6	55.4	+1.1
<i>Wellington</i>	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't	Bright Sun- shine Hours per day	STATIONS Those in italics are South of the Equator.
Mean Values		Absolute		Amount		Diff. from Normal	Days				
Dew Point ° F	R'tive Humi- dity %	Max. in Sun ° F.	Min. on Grass ° F.	in.	mm.						
42·3	76	144·0	11·5	24·3	619	+ 13	160	6·5	3·86	London, Kew Obser- vatory.	
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	..	<i>Cape Town.</i>
45·1	67	..	225·2	23·53	598	- 148	89	3·5	..	<i>Johannesburg.</i>	
65·0	74	..	49·5	39·44	1002	- 260	186	6·0	..	<i>Mauritius.</i>	
45·0	55	..	..	11·64	296	- 299	59	2·8	..	<i>Bloemfontein.</i>
..	76	..	38·5	61·74	1568	..	76	4·6	..	Calcutta, Alipore	
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.
..	..	..	..	..	..	..	..	..	..	<i>Sydney.</i>
..	64	153·8	21·8	24·22	615	..	138	5·5	..	<i>Melbourne.</i>	
49·4	58	168·4	25·2	17·00	432	- 103	108	4·7	..	<i>Adelaide.</i>	
..	67	166·3	28·2	24·54	623	- 230	113	4·3	..	<i>Perth.</i>	
46·1	48	171·0	26·8	17·99	457	+ 219	58	3·7	..	<i>Coolgardie.</i>	
57·3	66	158·1	30·8	19·35	491	- 688	92	4·0	..	<i>Brisbane.</i>	
43·5	62	156·0	26·4	21·28	541	- 61	137	6·2	..	<i>Hobart, Tasmania.</i>	
47·0	76	152·0	18·5	28·51	724	- 540	136	6·1	5·58	<i>Wellington.</i>	
..	..	..	..	125·89	3198	..	227	6·9	..	<i>Suva, Fiji.</i>
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		TEMPERATURE							
	Mean of Day M.S.L.	Diff. from Normal	Absolute				Mean Values			
			Max.	Date	Min.	Date	Max.	Min.	$\frac{1}{2}$ max. and min.	Diff. from Normal
	mb.	mb.	° F.		° F.		° F.	° F.	° F.	° 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	1015·2	+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		Relative Humidity	Mean Cloud Am't	PRECIPITATION				BRIGHT SUNSHINE		STATIONS
Absolute				Amount		Diff. from Normal	Days	Hours per day	Percentage of possible	
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	8	..	..	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 $5\frac{1}{2}$ 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 $\frac{3}{4}$ 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-Farøe 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 the 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
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H. M. Stationery Office, P. 1135, Kingsway, W. 1.

SCALE OF MILES

No. 5542/135 105 P. 25 1250 7-70

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.	
Gamden Square.....	London	2·28	1·59	40	70	·54	20	10
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
Hawkeston 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
Work-sop (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	1·66	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) ..	Cumbe land ..	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	Cornarvon ..	1·97	3·15	80	160	1·06	12	14
Dumfries (Cargen)	Kirkcudbright	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 (Fitz William 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 (Ennisceoe)	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.		Div.	STATION.	RAIN.	
		in.	mm.			in.	mm.
II.	Ramsgate	1·01	26	XII.	Langholm, Drove Rd.	2·16	55
"	Sevenoaks, Speldhurst	1·61	41	XIII.	Selkirk, Hangingshaw	1·05	27
"	Hailsam Vicarage...	1·22	31	"	North Berwick Res. ...	·69	18
"	Totland Bay, Aston ..	2·80	71	"	Edinburgh, Royal Ob.	1·04	26
"	Ashley, Old Manor Ho.	2·41	61	XIV.	Biggar.....	·83	21
"	Grayshott.....	1·94	50	"	Leadhills	2·63	67
"	Ufton Nervet.....	2·19	56	"	Maybole, Knockdon ...	2·62	66
III.	Harrow Weald, Hill Ho.	2·04	52	"	Rothesay	3·36	85
"	Pitsford, Sedgebrook..	2·25	57	XV.	Ardgour House	4·49	113
"	Chatteris, The Priory.	1·18	30	"	Inveraray Castle	2·56	65
IV.	Elsenham, Gaunts End	1·24	32	"	Holy Loch, Ardnadam	2·36	60
"	Lexden, Hill House ..	·81	21	XVI.	Loch Venachar	2·50	64
"	Aylsham, Rippon Hall	1·86	47	"	Glenguey Reservoir ...	2·70	69
"	Swaffham.....	2·22	56	"	Loch Rannoch, Dall...	1·62	41
V.	Devizes, Highclere...	2·66	68	"	Coupar Angus.....	·87	22
"	Weymouth.....	2·16	55	"	Montrose Asylum	·70	18
"	Ashburton, Druid Ho.	2·37	60	XVII.	Balmoral Castle.....	·47	12
"	Cullompton	2·52	63	"	Fyvie Castle.....	·45	11
"	Hartland Abbey	2·75	70	"	Peterhead, Forehill....	·48	12
"	St. Austell, Trevarna ..	2·94	75	"	Grantown-on-Spey ...	·51	13
"	North Cadbury Rec. .	2·32	59	XVIII.	Cluny Castle	1·25	32
"	Cutcombe, Wheddon Cr.	2·94	75	"	Loch Quoich, Loan ...	5·60	142
VI.	Clifton, Stoke Bishop.	3·43	87	"	Skye, Dunvegan	4·41	112
"	Ledbury, Underdown.	2·56	65	"	Fortrose	·36	9
"	Shifnal, Hatton Grange	3·70	94	"	Ardross Castle	·54	14
"	Ashbourne, Mayfield .	4·22	107	"	Glencarron Lodge	2·34	59
"	Barnt Green, Upwood	1·84	47	XIX.	Tongue Manse	1·32	34
"	Blockley, Upton Wold	2·91	74	"	Melvich Schoolhouse ..	1·25	32
"	Grantham, Saltersford	1·91	48	"	Loch More, Achfary...	2·21	56
VII.	Louth, Westgate	1·33	34	XX.	Dunmanway Rectory..	3·84	98
"	Mansfield, West Bank	2·05	52	"	Mitchelstown Castle...	1·91	48
VIII.	Nantwich, Dorfold Hall	3·65	93	"	Gearahameen	3·80	97
"	Bolton, Queen's Park.	2·80	71	"	Darrynane Abbey	4·37	111
"	Lancaster, Strathspey.	2·22	56	"	Clonmel, Bruce Villa ..	2·14	54
IX.	Wath-upon-Deane...	2·64	67	"	Cashel, Ballinamona...	1·72	44
"	Bradford, Lister Park.	2·21	56	"	Roscrea, Timoney Pk..	1·66	42
"	West Witton.....	·81	21	"	Foynes.....	2·11	54
"	Scarborough, Scalby ..	·73	18	"	Broadford, Hurdlesto'n	2·11	54
"	Ingleby Greenhow ...	·58	15	XXI.	Kilkenny Castle.....	1·37	35
"	Mickleton.....	1·90	48	"	Rathnew, Clonmannon	1·80	46
X.	Bellingham	1·24	32	"	Hacketstown Rectory .	2·12	54
"	Ilderton, Lilburn	·54	14	"	Ballycumber, Moorock	·69	18
"	Orton.....	1·65	42	"	Balbriggan, Ardgillan .	2·44	62
XI.	Llanfrehfa Grange ..	3·68	94	"	Drogheda	1·97	50
"	Treherbert, Tyn-y-waun	5·14	131	"	Athlone, Twyford	1·44	37
"	Carmarthen Friary...	3·13	80	"	Castle Forbes Gdns....	1·93	49
"	Fishguard.....	2·09	53	XXII.	Ballynahinch Castle...	3·44	87
"	Lampeter, Falcondale	4·30	109	"	Westport House	2·20	56
"	Abergwngy.....	4·85	123	XXIII.	Enniskillen, Portora...	1·62	41
"	Crickhowell, Tallymaes	3·90	99	"	Cootehill, Dartrey....	4·42	112
"	Sennybridge.....	4·72	120	"	Armagh Observatory ..	2·38	60
"	Lake Vyrnwy.....	3·93	100	"	Warrenpoint	2·84	72
"	Llangynhafal, P. Drâw	3·14	80	"	Belfast, Cave Hill Rd..	3·45	88
"	Dolgelly, Bryntirion..	5·02	128	"	Glenarm Castle	3·34	85
"	Lligwy	3·21	82	"	Londonderry, Creggan.	1·85	47
XII.	Stoneykirk, Ardwell Ho.	3·60	91	"	Sion Mills.....	1·94	49
"	Whithorn, Cutroach...	2·64	67	"	Milford, The Manse ...	1·76	45
"	Carsphairn, Shiel.....	2·85	72	"	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 (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.	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.