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## 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.

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."

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## 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.

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### 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

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\* 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,

DEAR SIR NAPIER SHAW, 5th November, 1920.

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 administrative 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.

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10, Moreton Gardens,  
Old Brompton Road, S.W.5,

DEAR GENERAL SYKES, 16 November 1920.

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 Meteorology 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.

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### 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 9d. 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.

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### 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  $180^{\circ}$  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.

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## Correspondence.

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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  $15^{\circ}$  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  $40^{\circ}$  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 floccular 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 parheliion of  $22^\circ$  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 parheliion, 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.

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### **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.

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### 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.

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### 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.

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### 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.

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### 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.

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### 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*

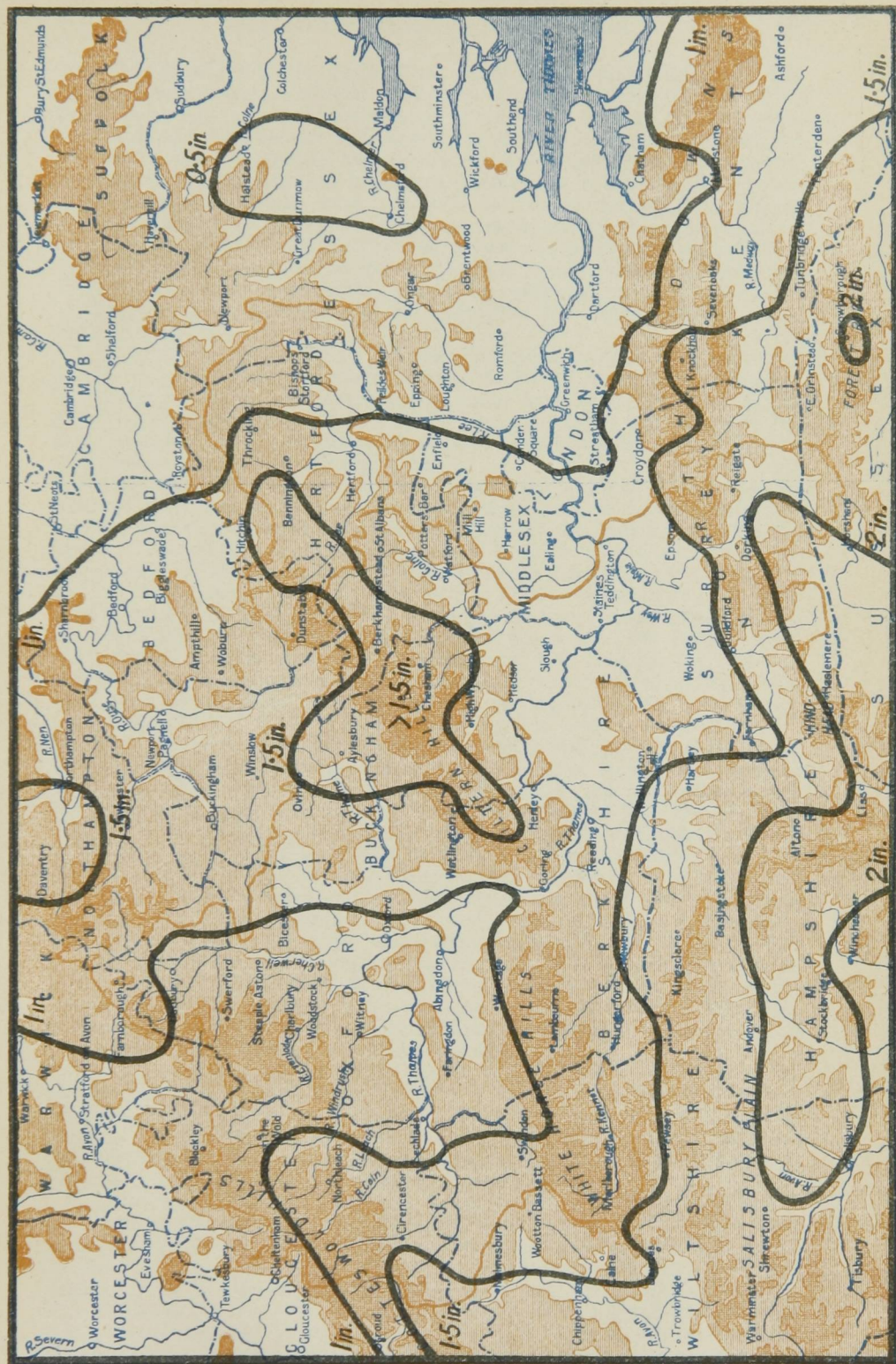
\* Indeterminate—183.

## 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





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  $51.9^{\circ}$  F., compared with  $42.8^{\circ}$  F. last year, and there was no snow this year, whereas it fell on eleven days last year. Equally conspicuous contrasts 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,  $30^{\circ}$  F. was recorded in the shade and  $18^{\circ}$  F. on the ground at Manchester, and on the 4th corresponding readings at South Farnborough were  $25^{\circ}$  F. and  $22^{\circ}$  F., the maximum on the latter day at Kew Observatory, owing to persistent fog, being only  $37^{\circ}$  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  $61^{\circ}$  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  $20^{\circ}$  F., while on the 21st and 22nd a few places had maxima as low as  $32^{\circ}$  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) .....	Suffolk .....	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) .....	Northland ..	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 (Pinnore) .....	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
Drumadrochit .....	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.		Div.	STATION.	RAIN.	
		in.	mm.			in.	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.	Rothsay . . . . .	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
"	Barnet 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-Deerne . . .	·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	· . .	· . .
"	Oton . . . . .	5·71	145	"	Balbriggan, Ardgillan . .	2·43	62
XI.	Llanfrehfa 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	"	Glendarm 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							
	Mean of Day M.S.L.	Diff. from Normal	Absolute				Mean Values			
			Max.	Date	Min.	Date	Max.	Min.	1 2 max. and min.	Diff. from Normal
	mb.	mb.	° F.		° F.		° F.	° F.	° F.	° 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		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 ° F.	Min. on Grass ° F.			in.	mm.					
° F.	° F.	%	0-10	in.	mm.	mm.				
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  $43\cdot5^{\circ}$  F. or  $0\cdot1^{\circ}$  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  $3^{\circ}$  F. At Breslau and Prague on the night of 21st the temperature fell to  $14^{\circ}$  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  $93^{\circ}$  F.

*Erratum*.—Duration of rainfall at Camden Square, October, 1920, should be 26·5 hours.