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Measurements of Solar Radiation Instruments and Some Results

BY LADISLAS GORCZYNSKI, D.SC.

(Member of the International Commission of Solar Radiation)

INTRODUCTION

Nobody will deny that in the series of meteorological elements solar radiation takes the predominant place. Nevertheless, we note the strange fact that of the many thousand meteorological stations in the world, a negligible number are making actinometric measurements.

The reason for this very unsatisfactory state of things is not an underestimation of the importance of solar radiation studies, but rather the lack of simple actinometers giving sufficiently reliable data on a determined scale. It is obvious that for daily observations at ordinary meteorological stations and for general use for those interested (agriculturists, botanists, medical men, etc.) only simple instruments can be employed. One needs an apparatus that will directly indicate the momentary values of radiation intensity like a thermometer or an anemometer. This objective is nearly gained by using thermopiles for solar radiation work. That cannot be claimed for some other methods, which, though simple in use, present very serious defects and cannot give us sufficiently comparable data. The reliability of the observations, obtained for instance with so-called "radiation thermometers" consisting of a black bulb in vacuo and so extensively used in some large sunny parts of the British Empire is so doubtful that these small instruments can now hardly be recommended. On account not only of simplicity but also of reliability, thermo-electric actinometers make possible the realization of the wish of meteorologists of all countries to include solar radiation measurements in daily routine observations, like other regular readings of air temperature, pressure, wind, etc.

I emphasize finally the scientific and practical importance of measurements of the sun and sky radiation not only at meteorological stations, but also for agriculture and for botanists, for photography (e.g. for determining the proper time exposure) and for different medical purposes (climatology and especially actinotherapy). It is even possible to apply the thermo-electric method to the study of smoke effects in big towns and agglomerations and also to aviation ; in this way one can rapidly obtain an idea of the transparency and thickness of clouds and fogs.

PART I

(a) *Actinometers for direct readings.*—Under the general name of actinometers are included all instruments for measurements of the intensity of solar radiation. For different kinds of actinometers, the following classification may be used.

(1) Pyrheliometers (or pyrheliographs) for measurement of the intensity of radiation received directly from the sun's disc upon a surface normally exposed to the solar rays.

(2) Solarimeters (or solarigraphs) for the total intensity of solar radiation coming not only directly from the sun but also diffused by the whole sky.

Special instruments like the diffusometer or diffusograph, albedometer, etc. (pyranometer corresponds in most cases to solarimeter) belonging mostly to the second group, may also be mentioned here. But a separate and very important group must be reserved for investigations of the solar spectrum by means of special spectrographs, spectrobolometers, etc. In order to save space, we cannot enter here into further details concerning spectral researches.

The pyrheliometers and solarimeters described in this paper are based on the thermo-electric method. I use special thermopiles (of Moll type, constructed by P. J. Kipp & Zonen, Delft, Holland) connected with simple needle galvanometers (e.g. millivoltmeters of Jules Richard in Paris, Cambridge recorders, Weston or others*).

* A description of solarimeters and solarigraphs may be found in my papers in the *Monthly Weather Review* (54, 1926, p. 381), and of pyrheliographs in the *Monthly Weather Review* (52, 1924, p. 299). See also my contribution in the *Quarterly Journal of the Royal Meteorological Society* (52, 1926, p. 210). Some new patterns of these instruments together with a study of the solar climate of Mediterranean shores are described in the following papers : (1) Climat solaire de Nice et de la Côte d'Azur (Nice, 1934) and (2) Enregistrements du rayonnement solaire au moyen des solarigraphes et des pyrheliographes (Nice, 1934).

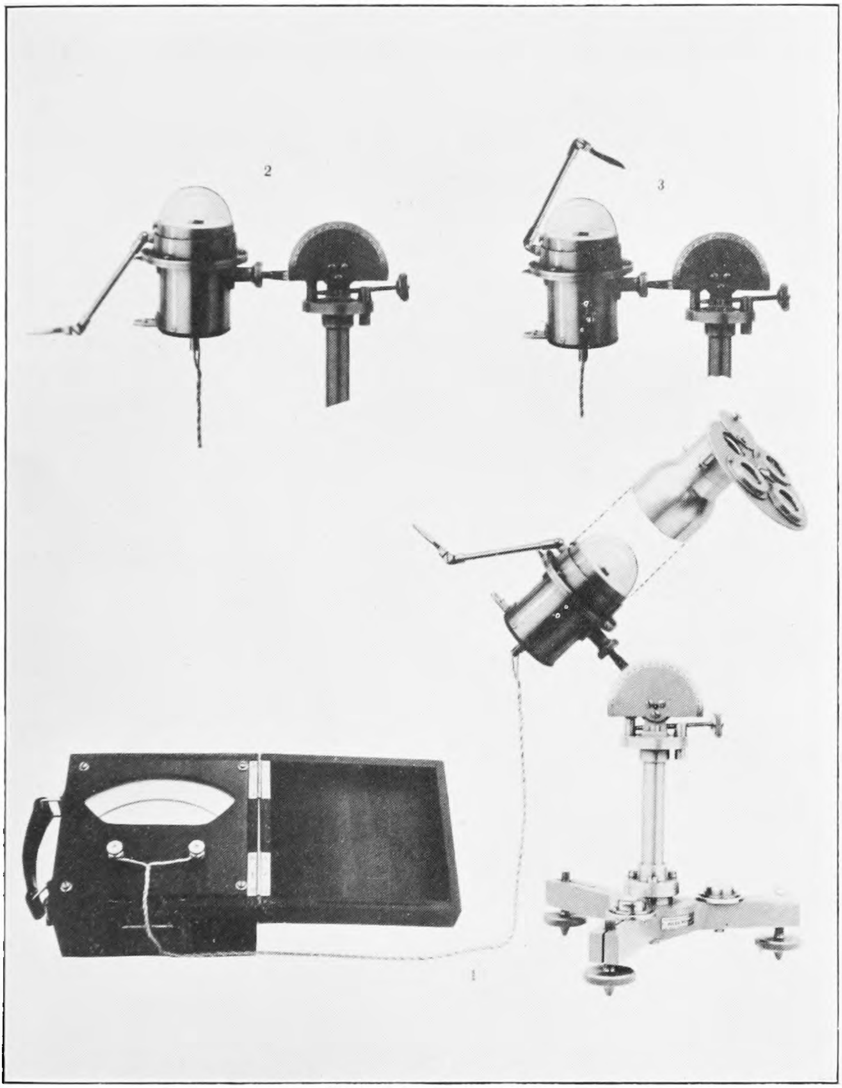

FIG. 1.—SOLARIMETER WITH PYRHELIOMETRIC TUBE
Mounted on an equatorial stand and connected with a needle-galvanometer (millivoltmeter type).

FIG. 2.—SOLARIGRAPH

Solarimetric pile on a stand for permanent outdoor installation connected with a recording galvanometer.

In the pyrheliometers or pyrheliographs the thermopile, enclosed in a cylindrical tube with diaphragms, is exposed normally to the rays coming directly from the sun. On the contrary, the thermopile destined for solarimetric or solarigraphic use has no tube and is freely exposed to the sun's rays coming directly from the sun and diffused by the whole sky.

Fig. 1 shows a recent pattern of an actinometer for direct readings, where a single thermopile, placed under a hemispherical glass cover, can be employed either for pyrheliometric (with a movable tube) or for solarimetric use (without any tube).

As shown in Fig. 1, the instrument can be used in three different ways, viz. :—

1. = PYRH. Instrument employed as pyrheliometer for measurement of solar radiation as received directly from the sun at normal incidence.

In this case the movable tube (shown in part 1 in a slightly displaced position, is placed on the thermopile and directed normally to the sun by means of an ordinary sight. The galvanometer deviation is read while the tube is open to the sun's rays; the "zero" position of the galvanometer (metallic shutter covering the tube) is determined twice, before and immediately after each reading of the deviation produced by the sun. The rotating disc, placed at the end of the pyrheliometric tube, makes easy the employment of light filters. Four openings are made for this purpose; one is destined to pass freely all the solar rays, while three others are fitted with coloured glass filters (mostly red, black and blue).

2. = SOL. Instrument employed as solarimeter for measurement of the total (sun and sky) radiation on a horizontal surface.

In this case the movable tube is removed and the thermopile is placed horizontally as shown in part 2 = SOL of Fig. 1. The galvanometer deviation then obtained results not only from direct solar rays, but also from diffused sky radiation coming from the whole sky to the hemispherical glass cover of the thermopile. The "zero" reading of the galvanometer, always connected with the pile, is obtained by completely covering the thermopile.

3. = DIFF. Instrument employed as diffusometer for measurement of sky radiation only.

In this case a special screen (sun's mask) is employed, as shown in part 3 of Fig. 1. The screen mask should be conveniently turned and placed so that the shadow from the opaque disc of the screen mask appears distinctly on the thermopile protecting it from the direct solar rays.

Moreover, this pattern is fitted—at the end of the movable tube—with a rotating disc (visible on Fig. 1) which contains three coloured glasses as light filters and an opaque screen as metallic shutter. The last one serves to intercept completely the sun's rays in order to determine the corresponding "zero" or "shadow" position of the galvanometer connected with the thermopile.

The metallic equatorial stand on which the thermopile is placed, contains a circle graduated in degrees which enables one to read directly the sun's altitude ; a spirit level and three adjusting screws readily permit the whole instrument to be placed horizontally.

(b) *Recording Actinometers (Solarigraphs, pyrheliographs, etc.).*—The solarimeters are employed not only as portable instruments for direct readings (Fig. 1) but also as solarigraphs for permanent registration of the total (direct and diffuse) solar radiation. For this purpose (see Fig. 2) the solarimetric pile, closed almost hermetically under a hemispherical glass cover and placed on a simple stand, is installed out of doors (e.g. on a tower, terrace or simply on a roof in a convenient place). The pile is connected with a recording galvanometer, placed indoors in a room where the temperature variations are not excessive. The accidental deposit of some water drops upon the inner parts of the glass cover can be avoided by changing, from time to time, the small quantity of hygroscopic substance introduced in the interior of the pile mounting. The small scent bag with this substance can be easily removed and replaced by a fresh one. For this purpose the lower part of the pile mounting should be unscrewed.

Millivoltgraphs of Etabl. Jules Richard in Paris, tested in calories with corresponding thermopiles by the Observatoire du Parc Saint-Maur are in common use. The Cambridge Thread Recorder has been used in the Meteorological Office and arrangements are being made for the manufacture of complete recording instruments by Messrs. C. F. Casella & Co., London. These will be certified at the National Physical Laboratory, Teddington. I mention also here the recording potentiometers of Leeds and Northrup, Philadelphia, U.S.A., though this excellent method is delicate for practical use.

In Fig. 3 (*a*) and (*b*) we find two solarigraphic diagrams obtained, with a Cambridge Recorder at South Kensington (Instrument Division of the Meteorological Office, London), with a nearly clear sky and with broken cloud*. It is interesting to note that even with a totally covered sky we find always some small but characteristic deviations by means of solarigraphs, when the normal pyrheliometer gives no indication at all.

In such cases, when the hourly variations are of less importance than the data concerning the total solar radiation received in a given interval of time (for the whole day or partially between each observation), an integrating device (see the corresponding illustration in Fig. 4) can be used. In this case the solarimetric thermopile for outdoor installation is connected to a special milliampere-hour indicator of high sensitivity. With this apparatus a difference in height of the liquid column of about 2 in. (50 mm.) may be easily

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* I am very indebted to the Director of the Meteorological Office for kind permission to reproduce here these two solarigraphic diagrams obtained at South Kensington.

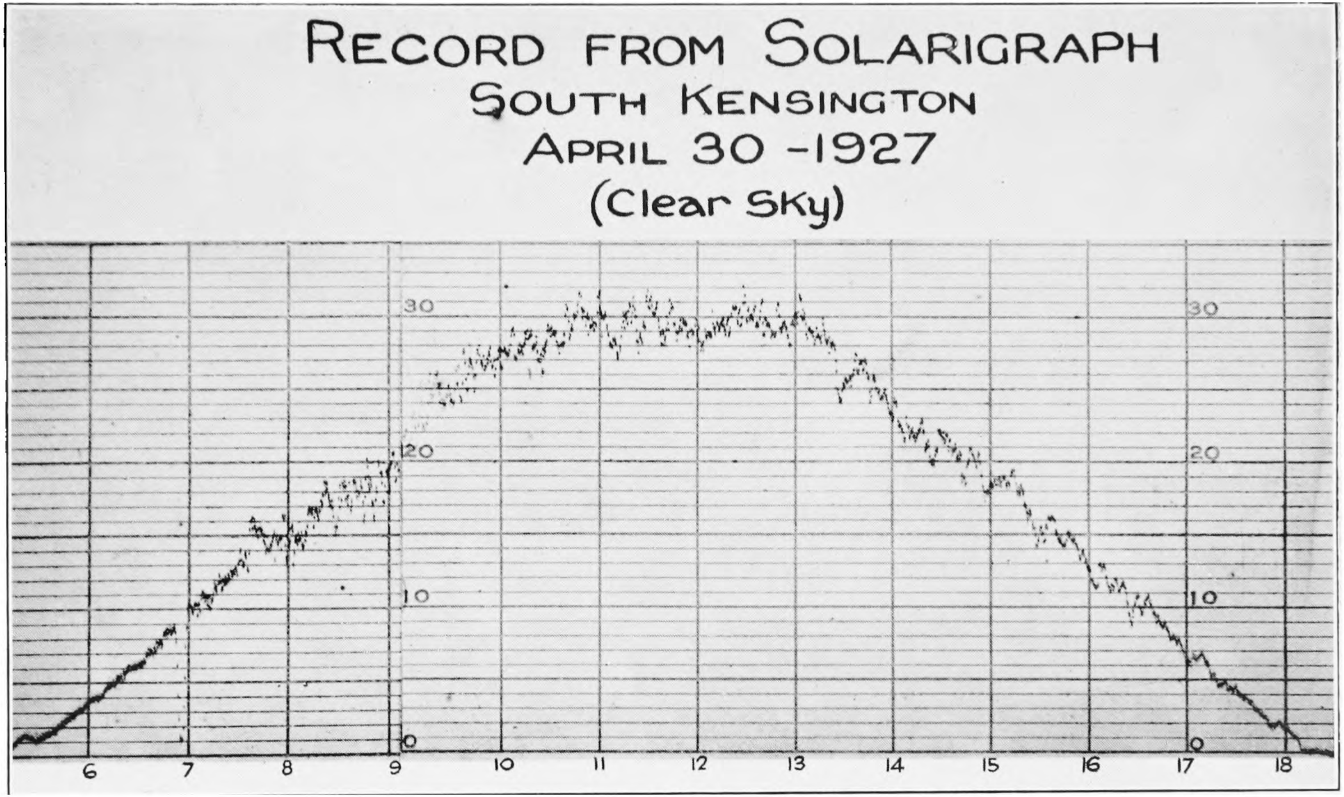


FIG. 3(a).—SOLARIGRAPHIC RECORDS OBTAINED AT SOUTH KENSINGTON WITH NEARLY CLEAR SKY.
The abscissae of the diurnal diagrams used for solarigraphs represent the hours (true solar time) and the ordinates the divisions obtained with a Cambridge recorder connected with the solarigraphic pile placed out of doors on a stand.

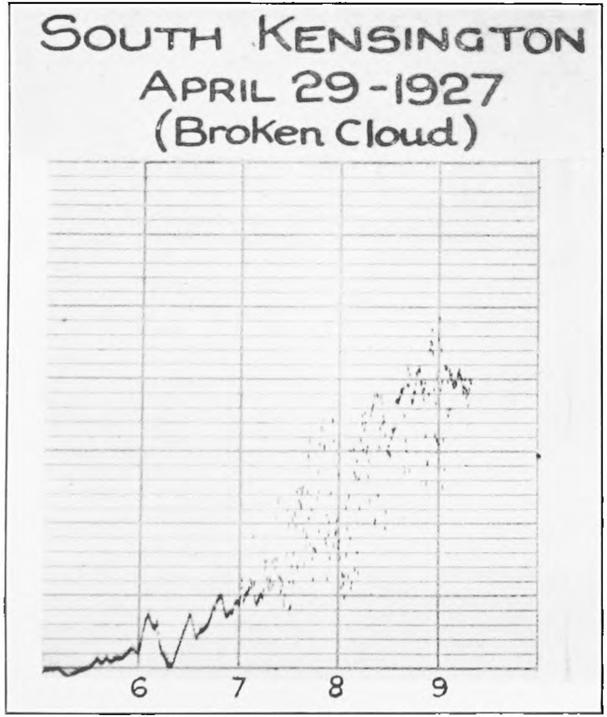


FIG. 3(b).—SOLARIGRAPHIC RECORDS OBTAINED AT SOUTH KENSINGTON WITH BROKEN CLOUD.

For explanation see Fig. 3(a) facing p. 4.

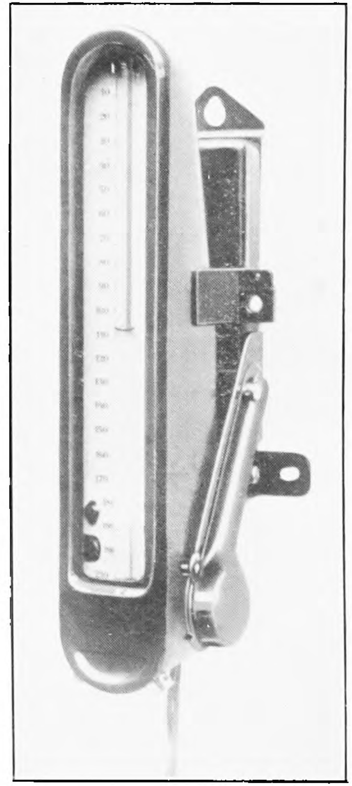


FIG. 4. AN INTEGRATING MILLIAMPERE-HOUR INDICATOR.

A very useful device for stations where the installation of a recording galvanometer is too difficult or too expensive.

obtained, when measuring over the whole day and with ordinary sky conditions prevailing in the temperate zone. By a simple manipulation the milliampere-hour indicator can be brought to zero again, after each daily observation. The value in calories of one division of the indicator scale is given for each integrating solarimeter.

The solarigraph duly transformed can be also adapted for recording diffuse radiation only. Such a diffusograph may be easily obtained by using a " sun mask " (see part 3 of Fig. 1), but, instead of moving it by hand, it should be placed on an equatorial mounting like that used for pyrheliographs. In this manner the screen (sun mask) follows the sun automatically, permanently shading the solarimetric pile immovable on its stand.

In order to save space, I cannot enter here into further details concerning diffusographs and pyrheliographs. I note only that a pyrheliograph, where a thermopile in a tube (placed on an equatorial mounting with clockwork) automatically follows the sun, gives nothing when the sky is clouded. On the contrary, some deviation is always given by the solarigraph, which registers not only under the influence of direct sun-rays (eliminated totally by appearance of each small cloud), but also the diffuse radiation. These deviations, produced everywhere by the sky, are sometimes very important, especially in broken or foggy weather or with a thin layer of clouds.

I mention also the extreme simplicity with which the solarimetric pile is adapted for measurement of the albedo. For this purpose it is sufficient simply to turn the receiving surface (pile under glass cover) to the ground (instead of the ordinary position directed towards the sun) in order to obtain an albedometer which enables us to measure the reflecting power of different kinds of soil, water surfaces, etc.

(*To be continued*)

Radio-sounding of the Atmosphere

In recent years the application of radio technique has led to new methods of sounding the atmosphere which have overcome a number of the drawbacks of the older methods, e.g. the limitation of pilot balloon ascents in cloudy weather, the time taken to recover ordinary meteorographs and the cost of aeroplane ascents. The new method consists of the ascent of either a simple pilot balloon or a meteorograph, combined with a small light radio transmitter, and under nearly all types of weather conditions, the transmitter can convey immediately to the ground station either the balloon's position or the air characteristics encountered at any moment, or both.

For details of the short-wave radio transmitters and receivers, and diagrams of the different apparatus used in these experiments, the reader is referred to the original papers. The list of these papers is somewhat lengthy but the more important are given in Table 1 together with the weight of the apparatus, the wave length of the emitted signals and the method employed to signal the variations of pressure, temperature and humidity. Four methods are available, viz. :—

(1) By varying the intensity of the transmitted signal.

(2) By varying the frequency of oscillation of the transmitter.

(3) By superimposing an audio frequency on the normal frequency of transmission.

(4) By interrupting the emitted signal either simply or in a complex manner.

or a combination of any of the above.

TABLE 1.

Author.	Country.	Reference.	Method of signalling.	Weight grams.	λ metres.
		General.			
Wenstrom...	United States	*Washington D.C., Mon. Weath. Rev.*, **62,** 1934, pp. 221–6.	—	—	
		Meteorographs.			
Bureau ...	France ...	*Météorologie, Paris*, 7, 1931, pp. 304–20.	3 and 4	1,500	60
Duckert ...	Germany ...	*Beitr. Phys. frei. Atmos., Leipzig*, **20,** 1933, pp. 303–11.	2 and 4	—	45
Molchanoff	Russia ...	(1) *Beitr. Geophys., Leipzig*, **34,** 1931, pp. 36–56; (2) *Nature, London*, **130,** 1932, pp. 1006–7.	4	2,000	25–100
Väisälä ...	Finland ...	(1) *Helsingfors, Mitt. met. Zent-Anst.*, **29,** 1935; (2) *Helsingfors, Soc. Sci. Fenn. Comm. Phys.-Math.* **6,** No. 2, 1932.	2 and 4	400	20–23
		Pilot Balloons.			
Blair and Lewis.	United States	*New York, Proc. Inst. Radio Engrs.*, **19,** 1931, pp. 1531–60.	—	450	125
Kölzer and Möller.	Germany ...	*Met. Z., Braunschweig*, **50,** 1933, pp. 297–300.	·	740	150–200

Meteorographs.—The instruments recording pressure, temperature and humidity are caused to vary some element of the radio transmission or to interrupt the transmission in such a way that nearly simultaneous records are conveyed to the receiver. The frequency of an oscillatory circuit is given by $1/2\pi\sqrt{LC}$ where L is the inductance and C the capacity of the circuit and in practice it is usual to vary the capacity in order to give changes in the frequency. Duckert employs this method to give continuous temperature readings, a bimetallic thermometer being linked to one plate of a condenser and the changes of capacity effected by the varying distances between the two condenser plates. The marking of pressure is given by a short break in the transmission at different pressure levels previously fixed by calibration. This is achieved by connecting two contact metal wheels in the anode circuit of the transmitter. On the rim of one of these wheels, pieces of insulated material are inserted at regular intervals. This wheel is turned by the alteration in curvature of a barometer diaphragm with changing pressure and a break in the anode current occurs whenever an insulated part of this wheel bears on the metallic rim of the other wheel. The whole apparatus is calibrated prior to the ascent. During the ascent condenser readings on the receiver (for temperature) and breaks in the transmission (for pressure) are recorded as a function of time.

In the instrument due to Moltchanoff, signals are emitted under the control of a contact which makes or breaks the anode circuit of the transmitter in accordance with the elements to be signalled. The arrangement of the control is shown diagrammatically in Fig. 1.

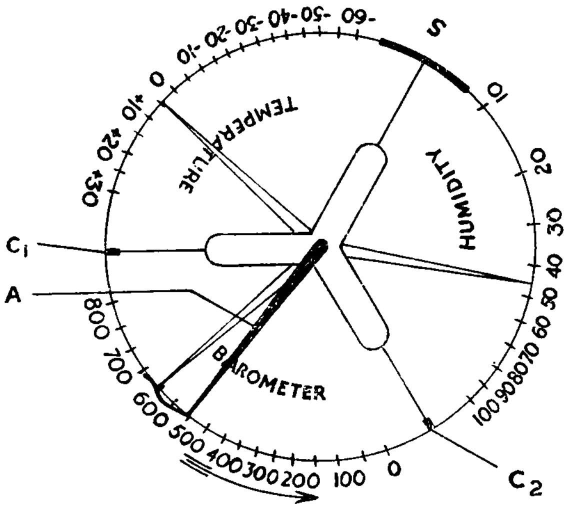


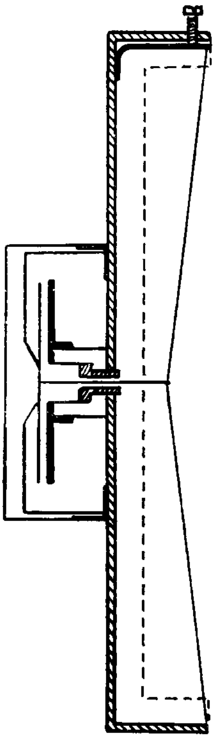
Fig. 1

Reproduced from Nature, London 130, 1932, *p.* 1007.

The contact arm A is connected to the positive plate of the anode battery and is rotated continuously by a clockwork drive making one revolution every 33 seconds. Fixed contacts S, C_1 and C_2 divide the rotation into three segments in each of which is a movable pointer which takes up a position in accordance with the particular changing meteorological element. The pressure pointer is connected to a barometer diaphragm, the thermometer pointer to a bimetallic thermometer and the humidity pointer to the usual bundle of hairs. The arm A in the course of its rotation makes fleeting contact with the top of these pointers and with the fixed contacts and as the pointers and contacts are all connected to the plate of the valve in the transmitter it will be seen that the effect is to complete the electrical circuit at each contact and for a signal to be heard in the receiver. The time interval between signals due to the fixed contacts and the following movable pointers thus gives the instantaneous position of the latter and by calibration the pressure, temperature or humidity reading. The relatively long contact at S is for the purpose of emitting a longer signal in order to synchronise the recording cylinder at the receiver on the ground. Reception is effected automatically by an ordinary receiver followed by a picture receiver of the rotating cylinder type, similar to the Fultograph receiver. Curves having time (altitude) as abscissa and pressure, temperature and humidity as ordinates are thus directly recorded as the sounding is made and a graduated scale is available for application to the record so that the readings can be converted.

Bureau's later instrument is in many respects similar to that of Moltchanoff but he retains the system of counting time between contacts designed in his earlier instruments. Clearly Moltchanoff's arrangement depends on a uniform rotation of the clockwork driven arm A. Bureau makes his readings independent of the speed of rotation of the contact arm by inserting in the transmitter circuit a very small plate condenser. Between the plates of this condenser passes a toothed wheel turned by a system of gears so that one revolution of the contact arm always corresponds to the passage of n teeth of the wheel between the condenser plates. The passage of each tooth leads to modulation by altering the frequency of the emitted signal, so that to know the time between contacts it is necessary to count the number of periods of modulation. This is effected by passing the received signals into the coil of an oscillograph. Bureau also arranges for his instrument to transmit for the longest possible time and the circuit is therefore broken at each contact and not made as in the Moltchanoff apparatus.

One of the latest instruments is that due to Väisälä and appears capable of further development. The whole method is a comparison of capacity and an outstanding feature is the lightness of the apparatus. Each meteorological element regulates a plate condenser, the arrangement being shown in Figs. 2 and 3. The thermometer consists of a length of silver wire stretched from a curved piece of invar. From the centre of the silver wire another wire leads to the movable plate of a condenser. For the pressure element he uses an aneroid box, one side of which is fixed and the other directly attached to the movable plate of another condenser. Two fixed condensers are also included in the circuit to give signals by means of which the individual characteristics of the transmitter are eliminated. Each condenser is inserted into the oscillatory circuit once during each rotation of a master switch S as indicated in Fig. 4. so that four signals of different frequency are emitted. As the frequency of the signals through the two fixed condensers changes very slowly during the ascent, reception can be chiefly confined to the signals emitted through the condensers which vary with the pressure and temperature elements. The switch is turned by means of a light propellor which rotates owing to the ascensional velocity of the apparatus. Condenser readings on the receiver are readily converted into pressure and temperature values by means of a calibration curve and good results appear to have been obtained. By means of this



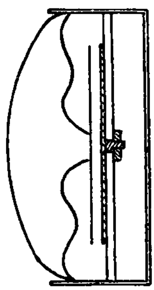


Fig. 3

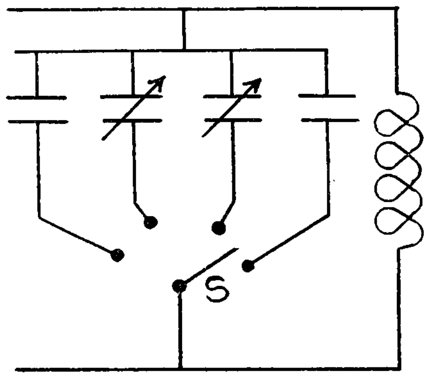


Fig. 4

Fig. 2

Figs. 2 and 3 are reproduced from Eine neue Radiosonde. By Vilho Väisälä. *Helsingfors, Mitt. Met. Inst. Univ. No. 29.* 1935.

condenser principle, Väisälä has made a suggestion together with practical details of åpparatus for the automatic recording of pressure, temperature, humidity, wind force and direction, and precipitation at an outstation and for the transmission of the readings by radio every three hours.

Pilot Balloons.—Experiments with the object of obtaining upper winds in cloudy weather have been taking place in Germany and other countries but the pioneer work was done by the United States and most of the paper by Blair and Lewis is concerned with the difficulties overcome in effecting a suitable transmitter and receiver. A transmitter is carried up by a balloon at a rate fixed by the free lift, as in the single theodolite method, and bearings are taken on it every minute by two or more directional radio receivers at the end of fixed base lines.

Balloons and Batteries.—There appears to have been little or no difficulty in finding suitable balloons to lift the somewhat heavy apparatus. In the case of batteries (filament 1 to 5v., anode 25 to 150v.) considerable research has taken place into suitable types and also methods of thermal insulation. In particular, Väisälä in 1932 designed very light batteries of the lead-acid type, and for insulation Duckert has employed a double layer of insulating material between which is placed moistened calcium carbide.

Future Development.—In meteorographs, this will be directed chiefly towards lightness, simplicity and lower cost, and in this connexion Väisälä's apparatus is worthy of note. In this, the total weight has been reduced to 400 grams and the cost to four pounds as compared with former weights of the order 1000 to 2000 grams and cost exceeding five pounds for each instrument exclusive of balloon and hydrogen.

For pilot balloon work a three-dimensional direction finder combined with a direct reading portable apparatus is being attempted. If, in addition, the pilot-balloon transmitter serves as meteorograph transmitter, the correct height of the balloon can be ascertained instead of the estimated height (from free lift) so far employed, and then only one receiving station is required.

On the radio side improvements in suitable transmitters and receivers will undoubtedly be undertaken probably adapted to the use of very short waves, less than 20 metres, and beam systems, a field which has so far not been explored. Improvements are also to be expected in the design of suitable batteries and their thermal insulation and the possible substitution of a buzzer-transformer for the high tension battery. Enclosure of the whole transmitter in a glass vacuum tube such as in Duckert's apparatus will probably become universal if these instruments are produced commercially as they are at present in Germany.

W. H. Bigg.

The Floods of January, 1936

The autumn of 1935 was unusually wet, and in December the low lands of England were generally in a waterlogged condition. Shortly before Christmas there occurred a cold spell during which a layer of snow accumulated in the north and west. During the last few days of December heavy rain set in and this joined with the melting of the snow to cause extensive flooding. The floods began on the 27th in the Midlands and west of England, but by the 29th, Kent and Sussex were also affected and the Thames was running bank high. Further heavy rain fell on the 29th and 30th ; the Thames overflowed its banks in the upper reaches and near Lechlade and Radcot thousands of acres were under water. Floods also spread widely in the Fen country. The heavy rain continued on the 31st and many main roads in the Thames valley became impassable. The saturation of the soil caused a landslip which interrupted traffic on the main Portsmouth-London line of the Southern Railway.

The rainy weather continued during the first days of January, 1936, and the rivers rose still further. The flow of the Thames at Teddington, which had been 5,500 million gallons a day on December 29th (the normal flow in December is 2,073 million gallons), rose to 7,500 on January 1st, 8,800 on the 2nd, and 9,000 on the 3rd ; on the latter day the river at Windsor was 4 ft. 3 in. above its normal level. This marked the peak of the floods, however, and with a temporary improvement in the weather the waters began to recede on the 4th. By January 7th, the flow at Teddington had again fallen to 5,500 million gallons. Further heavy rain brought a temporary rise, however, the flow of the Thames reaching 7,500 million gallons on the 10th, but after that date the weather improved again and the floods definitely abated.

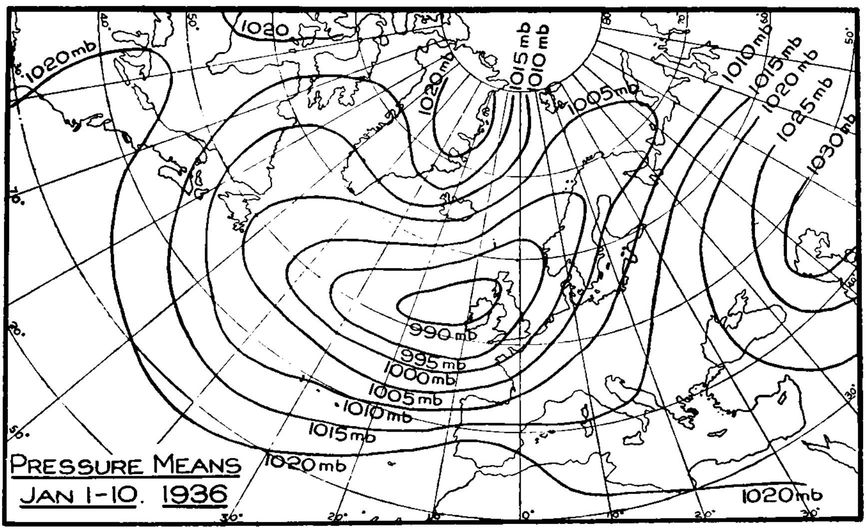


FIG. 1.

The chart of average pressures for January 1st–10th is shown in Fig. 1. A trough of low pressure extends from mid-Atlantic across the British Isles to southern Norway, and this marks the course followed by a series of deep depressions. That of the 9th–10th, which travelled along our north-western coasts, was exceptionally intense, pressure at the centre falling to 958 mb. The force of the wind displaced the Menai Bridge so that it had to be closed, while on the night of the 9th the tidal waters driven up the Severn and Wye caused these rivers to burst their banks. The resulting flood at Chepstow was the worst on record for 25 years.

The chart of pressures for December 16th–31st, closely resembles that for January 1st–10th ; but on January 11th, a remarkable change set in. The belt of low pressure across the Atlantic was interrupted by an anticyclonic ridge from Greenland to the western Mediterranean. This gave a short period of fine cold weather in Great Britain but on the 17th the depressions to the west and east joined up again and the unsettled stormy weather recommenced, beginning with widespread snow. The pressure chart for January 17th–February 2nd closely resembles that for January 1st–10th except that the lowest pressure was over the north of Scotland instead of Ireland and the rain was not so heavy. Flooding was again experienced towards the end of January, especially in the west and north of England, but the south-east was not exempt and some main roads near London were impassable. The flow of the Thames rose from 4,500 million gallons on the 29th to 6,500 on the 31st, but after February 2nd the floods again subsided.

The general rainfall over the Thames Valley above Teddington was above the average in each of the five months September, 1935, to January, 1936, the total being 21·24 in., compared with an average of 13·22 in. The rainfall of the 10 days December 23rd, 1935, to January 1st, 1936, amounted to 2·87 in. or more than the average for the whole of December (2·54 in.), that for the 6 days January 5th to 10th, 1·63 in., and of the 5 days January 27th to 31st, 1·45 in. The average for the whole of January was 4·32 in. compared with a normal of 1·94 in.

Extensive floods also occurred in France. On January 3rd, streets were under water in Toulon, the Rhone was high, the Loire had overflowed its banks and flooded Nantes, and the Seine at Paris was rising. The rivers continued to rise until the 7th and 8th ; the Seine did not approach the level of the disastrous floods of 1910, but at Nantes, that year was equalled. On the 10th the floods were definitely subsiding and after a recrudescence about the 20th there was no further mention of flood damage.

Discussions at the Meteorological Office

The subjects for discussion for the next two meetings are :—

February, 24th, 1936. *On the origin of local heat thunderstorms. Fourth paper. Investigation of the processes in the free atmosphere on days with thunderstorms.* By H. von Ficker. (Berlin, S.B. preuss. Akad. Wiss., 1934, XXIX, pp. 478-503) (in German). *Opener*—A. G. Forsdyke, Ph.D., D.I.C.

March 9th, 1936. (1) *Progressive lightning.* By B. F. J. Schonland and H. Collens. (London, Proc. Roy. Soc., A.143, 1934, pp. 654-74) and (2) *Progressive lightning II.* By B. F. J. Schonland, D. J. Malan and H. Collens (London Proc. Roy. Soc., A.152, 1935, pp. 595-625). *Opener*—C. E. Britton, B.Sc.

Royal Meteorological Society

The Annual General Meeting of this Society was held on Wednesday, January 15th, at 49, Cromwell Road, South Kensington, Lt.-Col. E. Gold, D.S.O., F.R.S., President in the Chair.

The Report of the Council for 1935 was read and adopted and the Council for 1936 duly elected, the new President being Dr. F. J. W. Whipple, F.Inst.P.

The Symons Gold Medal, which is awarded biennially for distinguished work done in connexion with meteorological science, was this year awarded to Professor Dr. Wilhelm Schmidt, Director of the Central Institute for Meteorology and Geodynamics, Vienna. The medal was presented to Herr von Blaas, of the Austrian Legation, who was present on behalf of Professor Schmidt.

An inscribed signet ring and a cheque were presented to Mr. A. Hampton Brown on his retirement from the position of assistant Secretary of the Society.

Lt.-Col. E. Gold delivered an address on "Wind in Britain: the Dines anemometer and some notable records during the last forty years," of which the following is an abstract:—

In 1882 J. K. Laughton described in his address the development of anemometers up to that time. He mentioned three: Lind's, Woollaston's and Adie's—elementary in character, but natural precursors of the Dines anemometer. This anemometer was developed by the late W. H. Dines in the succeeding 10 years, and has revolutionised anemometry. The instrument utilises the differences between the pressure of the wind blowing on an open tube and the suction caused by the wind blowing past holes around a vertical tube. This difference of pressure operates on a float which rises and falls as the strength of the wind changes. The float is shaped according to calculation (and not empirically) in such a way that the rise of the float is proportional to the velocity of the wind. The formulae on which the calculation is based are worked out from first principles.

A standard instrument of present day pattern is then described and the refinements which have been introduced, as the result of experience and modern knowledge of turbulent motion, explained. The methods adopted to prevent the instrument becoming choked with rime or snow and to permit of its use on board ship are also described.

A brief history is given of the introduction of the instrument and its spread over the British Isles in the last 40 years. Records from the instrument are given, showing the effect of obstacles and of topography on the wind. For example: a wind of 25 m.p.h. over the tops of the buildings at South Kensington oscillates between 5 and 45 m.p.h., while a wind of the same average strength blowing over the spit of sand known as Spurn Head, oscillates between 20 and 30 m p.h.; the effect of a low building 25 feet away from the anemometer and 15 feet lower than the vane of the anemometer of the Lizard upset the records altogether, so that the wind went right round the compass and varied from calm to double its average speed.

Further records show winds of special character, like isolated squalls, or rising and falling like regular waves at intervals varying from ½ hour to 5 or 6 hours.

A table is given showing the highest gust recorded in each year since 1909 at places equipped with the Dines anemometer, and the highest gust recorded at each place since the inception of the records. The actual records of the severest gales at a number of representative stations illustrate the varying ways in which the gales reach their climax; they show that the severest gales at most places came with winds between S. and W. and usually after a veer of two or three points of the compass. They also indicate that the highest gusts—reaching in some cases more than 110 m.p.h.—came usually in the afternoon or at night, and practically never in the forenoon.

Finally, it is suggested that as the Dines anemometer gives a satisfactory record of the velocity and the direction of the wind, but gives no information about the sound, which is a leading characteristic and the normal method of identification of the wind, an effort should be made to obtain satisfactory sound records as a natural complement to the satisfactory visual records of the Dines anemometer.

Correspondence

To the Editor, *Meteorological Magazine*

Winter Smoke Deposit Measurement

Mr. S. C. Blacktin's remarks under the above heading in the January issue recall a similar observation, though apparently with somewhat different results, made 120 years ago by that patriarch of meteorology, Luke Howard, F.R.S. In Vol. 2, p. 320, of "The Climate of London" (2nd edn.) Howard wrote:

"Soot on Snow

I have observed that the flakes of soot which are deposited on the surface of snow, and remain there exposed to the sun's rays, disappear after some hours, leaving a cavity, the bottom of which is visible and clean. There is therefore probably a real oxidation of the carbon, after which it is dissolved in the water, in the way in which the colouring matter of cloth is destroyed in bleaching."

It would be interesting to know whether the "small galaxy of disintegrated smut" which Mr. Blacktin found surrounding the lip of each cavity does actually vanish "after some hours," under the influence of continued sunshine, as is suggested by Howard's statement.

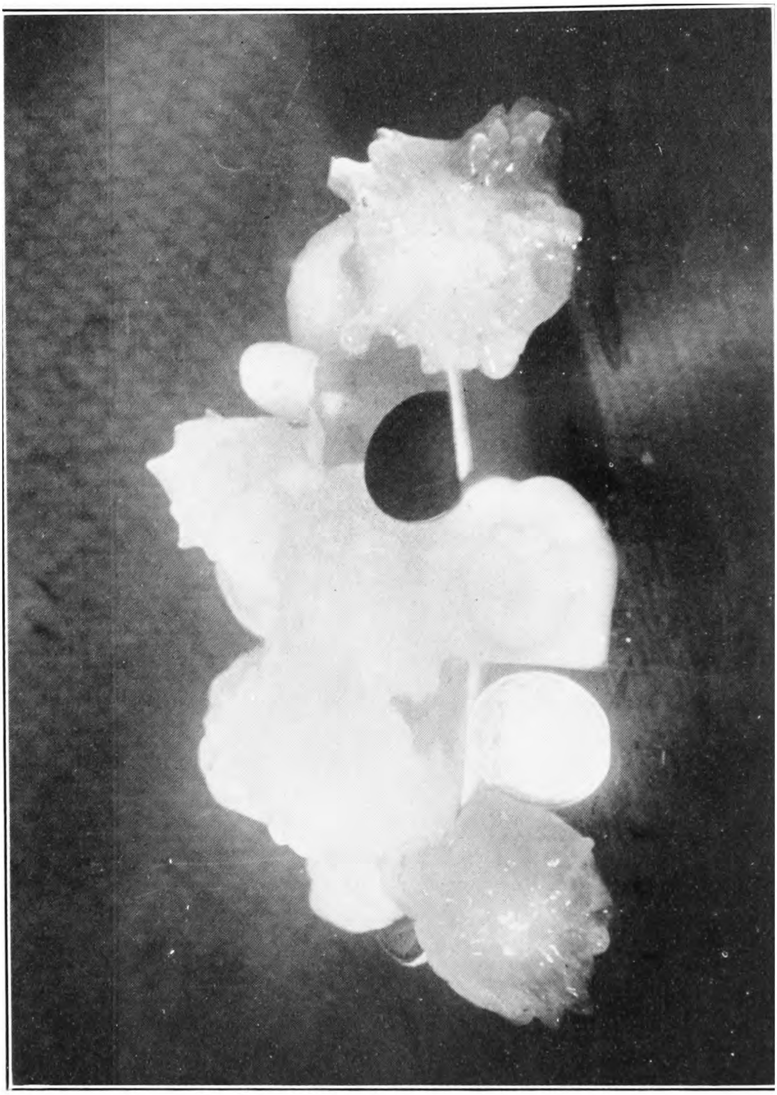
E. L. Hawke.

Caenwood, Valley Road, Rickmansworth, Herts, January 22nd, 1936.

New Meteorological Definitions

The following may perhaps be deemed a worthy addition to the examples of meteorological humour, conscious and unconscious,

facing p. 15]



Large Hailstones at Northampton

which appear in this magazine from time to time. Candidate's answer to the question " What is the difference between snow and hail ? ", set in a schoolgirls' general knowledge examination :— " Snow is frozen water gone fluffy, hail is when it has not."

E. L. HAWKE.

Caenwood, Valley Road, Rickmansworth, Herts., December 28th, 1935.

Large Hailstones at Northampton

On Sunday, September 22nd, 1935, I was awakened about 4.0 a.m. (summer time) by a bright flickering light and found this was due to lightning still too distant for thunder to be heard. The storm approached from a westerly direction through what seemed to be a greenish grey haze—quite uncanny to watch, one scarce knew what to expect.

The storm seemed to be in three adjoining sections and lightning flashes in one or other section were so frequent as to appear almost continuous. The flashes appeared to be more or less horizontal, but many with a distinctly upward tendency—there were few, if any, flashes giving the usual downward striking appearance.

As the storm approached, the thunder became one continuous rumble. Hail commenced usual size, but gradually larger stones arrived occasionally—we heard them strike a near-by corrugated iron roof. At no time was the ground more than barely covered—weather was warm so that smaller stones doubtless melted quickly. Stones up to about one inch diameter fell fairly thickly—just barely covering the ground. The larger stones, as photographed, were all found scattered over a piece of turf about 60 by 20 ft.; there must have been many more similar, but these few were picked up hurriedly —it was hailing and raining, and light by that time was poor.

As will be seen, there was considerable variation in the shape and structure of the stones. Some were more or less egg-shaped, some were convex on one side only, the other being smoother and flattened, reminding one of a small jelly fish left by the tide. In such as were smooth and had the flattened sides, one could clearly see banding, reminding one of the annular rings of a tree section. The markings were about $\frac{1}{16}$ in. apart, but were unfortunately too delicate to be shown by the crude photography.

There seemed to be a tiny nucleus covered with several layers of more or less transparent ice, thus forming a central core about $\frac{3}{16}$ in. diameter. Then followed several layers of what appeared to be snow frozen hard, forming a band about $\frac{1}{4}$ in. in thickness—then several layers of clear ice (this shows dark in the centre stone in the photograph) then more layers of the more opaque type followed by two or three layers of clear ice. Then more layers of the opaque type and the outside encrusted with further frozen snow and sometimes nodules as though smaller hailstones had attached themselves.

As suggested, there was considerable variation; for example, one stone, a flattened oval about $1\frac{1}{4}$ in. by $\frac{3}{4}$ in., appeared to consist wholly of frozen snow, smooth outside like a large sugared almond. In some, one seemed to be able to trace five or six radial markings formed by small bubbles.

A. E. POLLARD.

22, Church Way, Weston Favell, Northampton, December 13th, 1935.

Forecasting Weather from Height of Barometer and Temperature of Wet Bulb

Investigations on this subject have recently been initiated and some results published by Lt.-Cmdr. T. R. Beatty*. The method was to analyse, for a given station and period, the occurrence of various amounts of rain following upon given values of barometer and wet bulb. A table made up in an identical way to Lt.-Cmdr. Beatty's is given in Table I. Cmdr. Beatty came to the conclusion that "low barometer and high wet bulb" was followed by most rain, and "high barometer and low wet bulb" followed by least rain. Following on this statement, one is naturally led to expect that, confining one's attention to the occurrence of no rain, the probability of a rainless period of hours is greater with "high barometer and low wet bulb" than "low barometer and high wet bulb." Mr. H. G. Lloyd†, dealing with this aspect, gave some very encouraging numerical results for the months January and February at St. Mary's, Scilly. A note by Lt.-Col. E. Gold puts Mr. Lloyd's formula as—

$$P = 15 \frac{B - 1007}{T' - 32}$$

where P is the probability of no rain within 24 hours expressed as a percentage ; B is the pressure in mb. at M.S.L. and T' is the wet bulb temperature.

Lt.-Col. Gold invites others to see if similar formulae apply elsewhere and for other months ; Mr. Lloyd also states that the critical barometric pressure and the constants are likely to vary. Mr. A. H. R. Goldie** has called attention to a previous work of his†† in which good numerical relationships were obtained in correlating pressure, rainfall and wind speed at several stations, and advises the continuance of employing frequencies in this type of work. Accordingly I have analysed, through the kindness of the observer, the records of rainfall, barometric pressure and wet bulb, at Grayshott, for the ten years 1925–34.

Tables were prepared for each month similar to Lt.-Cmdr. Beatty's containing barometric pressure, wet bulb temperature, and percentage

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* *London, Meteorological Magazine* 70. 1935. pp. 34–6.

† *Ibid.* 70. 1935. pp. 162–3.

** *Ibid.* 70. 1935. p. 208.

†† *London, Geophys. Mem.* No. 53. 1931. p. 16.

number of cases of no rain, (*a*) within 12 hours, (*b*) within 24 hours. A specimen is given (Table I). Occasions of " no rain " include days of trace, and also when a measurable quantity of water was collected, known to be dew, condensed fog, etc. From these tables curves were plotted with percentage cases of no rain as ordinates, and barometric pressure as abscissae.

TABLE I. November–December, 1925–34

Barometer M.S.L.	Wet bulb °F.	No. of cases.	Percentage number of cases of		Total No. of observations.
			No rain in 12 hours.	No rain in 24 hours.	
Below 986 mb.	Above 48°	1	0	0	
	44°–48°	7	0	0	
	39°–43°	9	22	11	19
	34°–38°	2	0	0	
	Below 34°	0	—	—	
986–995 mb.	Above 48°	6	17	17	
	44°–48°	16	19	19	
	39°–43°	10	40	20	37
	34°–38°	5	20	20	
	Below 34°	0	—	—	
996–1005 mb.	Above 48°	11	9	9	
	44°–48°	33	18	3	
	39°–43°	31	32	16	103
	34°–38°	23	65	61	
	Below 34°	5	20	0	
1006–1015 mb.	Above 48°	10	0	0	
	44°–48°	28	29	14	
	39°–43°	39	61	31	149
	34°–38°	56	55	47	
	Below 34°	16	100	63	
1016–1025 mb.	Above 48°	16	44	31	
	44°–48°	27	67	41	
	39°–43°	41	63	46	159
	34°–38°	40	63	57	
	Below 34°	35	76	57	
1026–1035 mb.	44°–48°	20	70	60	
	39°–43°	36	67	58	
	34°–38°	26	81	61	107
	Below 34°	25	88	88	
Above 1035 mb.	44°–48°	6	100	100	
	39°–43°	9	100	100	36
	34°–38°	9	100	100	
	Below 34°	12	100	83	
		610			610

The results are as follows :—

Taking individual months, no simple relationships were discovered. The probability P of no rain in the next 24 hours, expressed as a percentage for January, is—

$$P = \frac{93\,[B - 1003]}{T' + 4}$$

and this formula has to be replaced for wet bulb temperature below 34° and barometer below 1010 mb. by—

$$P = \frac{22}{9}\,[1010 - B] + 16$$

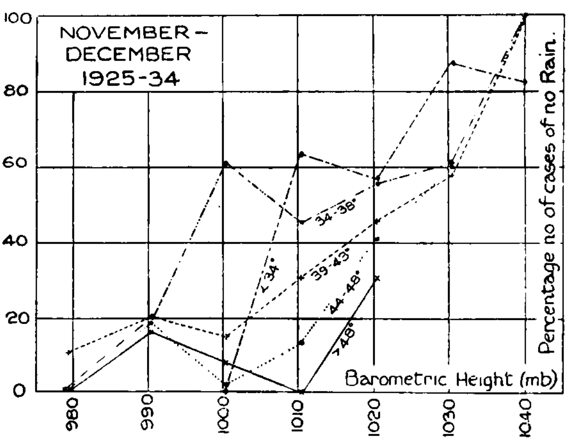
For February—

$$P = \frac{400\,[B - 1003]}{3T' + 16}$$

can be used for $T' > 38°$ but fails to hold for pressure below 1010 mb.

On proceeding, relationships more awkward were found for other months; and the same was found for P meaning no rain in 12 hours. It was suspected that the irregular results were due to too few data, so pairs of months were next tried, and the process repeated.

Fig. I is the result of the plotting of the percentage of no rain for 24 hours in Table I. Relationships were obtained from these graphs where possible, of the same form as Mr. Lloyd's, but in deriving these I came to the following conclusions :—



(1) It is often impossible to find a " critical barometric pressure " in the monthly or two-monthly curves (*see* Fig. 1).

(2) If $P = a\,[B - K]$, where K=critical barometric pressure, and a is a constant; $a = f(T')$, a function increasing with decrease of T' in Mr. Lloyd's work; in the above, however, often its variation is quite irregular, and in the summer, it tends to increase with increase of T'; i.e. " high barometer and low wet bulb " do not give the greatest probability of no rain in a given period of hours.

The above results refer to an inland high level station. They are offered as a comparison with St. Mary's, Scilly. It is desirable that such data should be found at other stations. The whole usefulness of forecasts from barometer and wet bulb is that of simplicity ;

it has been shown that for Grayshott no such simple relations exist ; this may be due to too short a period used for computation ; to a peculiar local climatic feature ; or to the fact that simple relations cannot in general be obtained between the elements concerned. It is a matter for further work to clear up.

S. E. ASHMORE.

Llannerch Gardens, St. Asaph, Flintshire, December 1st, 1935.

Virga and Secondary Rainbows

On Saturday, November 23rd, 1935, at 12h. 40m. G.M.T. an interesting rainbow phenomenon was observed. The eastern half of a patch of altocumulus (medium cloud type 4) was covered by three spectra, almost horizontal, for about 15 seconds, while a fourth was also in evidence for 5 seconds. The colours were exceptionally well defined with red at the lower limit and violet on the outside. As the altocumulus moved westwards (nephoscope reading 80°, 36 m.p.h.) the cloud became very narrow and only one spectrum was then observed.

The portion of the cloud covered by the spectra had a " smoking " appearance which obviously indicated wisps of rain, or virga, and the spectra observed were presumably secondary rainbows although there was no evidence of a primary bow. At the time the clouds present were large cumulus 7/10 and altocumulus 1/10 while a shallow layer of haze, about 50 feet deep, covered the countryside. Horizontal visibility in the haze was only 1,500 to 2,000 yards but looking up at a slight angle was as much as 4 to 6 miles.

WILLIAM D. FLOWER.

Lyndene, The Bache Estate, Liverpool Road, Chester, November 26th, 1935.

Fog-bow at Sealand

A good example of this phenomenon was witnessed on November 24th, 1935. At about 9h. 15m. a white semicircle of light, having a diameter of 38° and an elevation at the top of 25° (approx.), was observed in a direction opposed to the sun, and at its centre there was a very brilliant white patch. The sky was clear in the zenith but cirrus clouds were plentiful below about 40° and increasing. There was a thick ground mist with visibility only 1,000 yards. The temperature in the screen was 27° F. and on the ground about 25° F. The bow gradually disappeared as the sun rose above the layer of mist.

GEO. R. READ.

Roker, Station Road, Gt. Saughall, near Chester, November 26th, 1935.

NOTES AND QUERIES

The Formation of Cloud by Aeroplanes, September 3rd, 1935

On the afternoon of September 3rd, 1935, " cloud-streaks " of unusual length and persistence were formed by two aeroplanes, and were observed from several places in the south of England. One aeroplane was flying from the Isle of Wight to South Farnborough and back, and the cloud was formed during sustained level flight at a height given by the aneroid as 29,000 ft.; the other was flying over Tangmere, near Chichester, and the cloud was formed at a level of 31,000 ft.

Mr. C. J. P. Cave, who was at Chichester Harbour, describes the occurrence as " the best example of ' aeroplane cloud ' I have ever seen . . . . The time I first noticed it was about 3 p.m. summer time but the formation had been going on some time before that and it continued for some time after. The clouds remained visible for at least two hours, though after some time they became exactly like cirrus clouds, of which there were others about. It seemed to me that part of the formation took place at the cirrus level, and some of it, the later part, may have been a good deal higher than the level at which cirrus was forming."

Mr. H. W. L. Absalom, who saw the occurrence from Hayling Island, adds that there were two streaks of cloud, both in a general east to west azimuth, though the one was situated rather more east-north-east to west-south-west than the other.

At Tangmere the cloud was formed by an aeroplane flying in a north-easterly direction, but at one point the pilot made a complete turn and a complete ring of cloud was formed. The formation of this cloud ceased at 3.14 p.m. B.S.T. When first formed it was about 80 ft. wide, and in a quarter of an hour it had expanded to four times its original width, but it never widened beyond two solar diameters. The aeroplane itself could not be seen at first, but when the pilot turned against the sun there appeared to be a short gap, perhaps 40 ft. between the aircraft and the start of the cloud. The streak drifted slowly eastwards and was still visible at 5.30 p.m. The sky was blue overhead when the cloud was formed, but later it became mingled with thin cirrus and cirrocumulus clouds. The total length was estimated at between eight and nine miles. A second streak which may have been formed by the same machine earlier, was seen at the same time further to the north-west.

Conditions for the formation of clouds by aeroplanes are generally limited to a comparatively thin layer of air, of the order of 1,000 ft. in thickness and at a height of about 30,000 ft., though sometimes much less. On this occasion a solar halo was observed at 12.30 p.m., B.S.T., ; afterwards the sky cleared considerably but at the time the cloud was formed there were some wisps of cirrus, with about 3 tenths of cirrocumulus and 4 tenths of detached cumulus. The pilot of one machine noticed the existence of very fine ice specks at one point, and his goggles were frosted. At 3 p.m. the temperature at ground level was : dry bulb 66° F., wet bulb 61° F. A pilot balloon ascent at 7 a.m. showed a steady wind of 24–32 m.p.h. from WSW. up to 16,000 ft.

REVIEW

India Meteorological Department, Scientific Notes Vol. VI, No. 64.—*Some observations on the thermal structure of cumuliform cloud.* By Flt. Lt. R. G. Veryard, B.Sc.

The author made arrangements for pilots at Risalpur, Peshawar and Kohat to make observations of dry and wet bulb temperature inside and outside cumuliform clouds, as opportunities arose, during 1932 and 1933. This valuable paper gives full details of 34 cases, and a discussion of the results. Some personal observations on a hill summit are included.

The cloud was mainly colder than its environment on 19 occasions, mainly warmer on 10, and in the remaining 5 was about the same, or partly warmer and partly colder.

The cases which require explanation are those when the air in the clouds is denser than its environment, after the influence of water vapour has been allowed for. There are only two possible explanations. One is that the cloud is supported from below by air which is lighter than its environment. This must normally require a lapse-rate below the cloud at least up to the dry adiabatic rate, and also an absence of appreciable wind shearing. Veryard's observations reveal some cases of super-adiabatic lapse-rate below the clouds, but in these cases the cloud was nearly always warmer than its environment. The other explanation is that the cloud is not in equilibrium, and that dynamical factors are involved. In many cases the cloud base was about 7,000 or 8,000 ft. above the aerodrome level, and the lapse-rate through most or all of this range of height was not up to the dry adiabatic rate. When there is shear in the horizontal movement any vertical movement would introduce disturbance, with a dynamical element. The hilly nature of the country near the North-west Frontier must be taken into account, but actually the relative coldness of the clouds is frequent in England also. Probably sometimes a rising mass of air is carried by its momentum temporarily past its equilibrium position. Veryard notes that in 14 cases the cloud was dissolving, and that in 13 of these cases the air in the cloud was colder than its environment.

The paper brings out the variety of conditions prevailing in cumuliform clouds, and shows that in some cases it is difficult to avoid a partly dynamical explanation.

C. K. M. Douglas.

BOOK RECEIVED

Deutsches Meteorologisches Jahrbuch für Bayern, 1934. The Bavarian Meteorological Year book for 1934 contains as usual a number of valuable appendices among which may be mentioned "Der Gang des Winters auf der Zugspitze" by A. Schmauss and "Feldstärke-und Schwundmessungen im Rundfunkwellenbereich auf dem Zugspitzgipfel" by A. Agricola.

NEWS IN BRIEF

A solar-radiation station was established by the Smithsonian Institution at Mount St. Katherine, Sinai Peninsula, in the summer of 1933, and regular observations begun in December, 1933. A description of the station and a comparison of the results obtained there and at Montezuma, Chile, during 1934 and the early part of 1935, are given in "Mount St. Katherine : An excellent solar-radiation station", by C. G. Abbot, Smithsonian Miscellaneous Collections, Vol. 94, No. 12.

The Senate of the University of London has conferred the degree of D.Sc. in Physics on Mr. A. W. Lee of Kew Observatory.

The staff of the Meteorological Office, Shoeburyness, held their fifteenth Annual Dinner at the Palace Hotel, Southend-on-Sea, on Saturday, February 8th. There was a record attendance of past and present members of the staff including several from other Government Departments. The Superintendent for Army Services, Mr. J. S. Dines, M.A., was present and the two former Superintendents, Professor D. Brunt, M.A. and Mr. F. Entwistle, B.Sc., also attended the function.

The Weather of January, 1936

Pressure was below normal over Europe, the Mediterranean, the North Atlantic, most of the United States and Alaska, the greatest deficits being 18·0 mb. at Valentia and 3·0 mb. near New Orleans. Pressure was above normal over north-west Asia, Spitsbergen, Iceland, Greenland and most of Canada, the greatest excesses being 9·1 mb. at Waigatz, 13·8 mb. at Isafjord and 6·6 mb. near Lake Athabaska. Temperature was above normal generally over Spitsbergen and western and central Europe (except in north Sweden) and precipitation above normal except at Spitsbergen. Precipitation was twice the normal on the average in Sweden.

The outstanding features of the weather of the British Isles during January were the mild wet conditions during the first ten days and the low temperatures experienced in the middle of the month. Rainfall totals were mostly above normal, records being exceeded at a few places while sunshine was mainly below normal in England and Ireland but above normal in Scotland. From the 1st to the 10th, depressions passing in a north-easterly direction across the country gave generally wet mild conditions except during the 3rd–4th, when fair weather prevailed as a wedge of high pressure extending from Greenland crossed the country; 6·7 hrs. bright sunshine were experienced at the Scilly Isles on the 4th and 5·7 hrs. at Valentia on the 3rd. Mist or fog was prevalent on the 3rd and local on the 8th. Rain occurred on most days followed by floods* in

* See p. 10.

some areas, and was heaviest, generally on the 9th, when 2·28 in. fell at Borrowdale (Cumberland) and 2·09 in. at Trecastle (Brecon), and in Ireland and the Lake district on the 4th, when 2·60 in. fell at Borrowdale. Gales occurred in the south-west and west on the 5th, and in the north on the 6th, a gust of 84 m.p.h. being recorded at Scilly on the 5th, while on the 9th–10th still stronger winds prevailed in south-west England, a gust of 100 m.p.h., being registered at Pembroke on the 9th. Temperature was mainly high during this period especially on the 9th and 10th, when 58° F. was reached at Bath and Westminster on the 9th. Thunderstorms occurred locally in north England on the 9th. In the rear of the deep depression of the 9th and 10th cold N. to NW. winds spread across the country and temperature fell considerably while snow showers were general in Scotland. Gales occurred in north Scotland on the 11th. From the 12th–15th the country came under the influence of an anticyclone and cold quiet weather was experienced with local wintry showers but many bright periods especially in the north, 6·2 hrs. bright sunshine were recorded at Leuchars, Abbotsinch and Birmingham on the 13th. Mist or fog were, however, prevalent in England during this time. From the 16th to 19th, a complex low pressure system passed across the country and cold northerly winds with very low temperatures and much snow and sleet prevailed. Snow was lying to a depth of 2 to 3½ in. in many parts of the north on the 17th and 18th, and the lowest day temperatures of the month were recorded on the 19th when 21° F. and 24° F. were the maxima at Catterick and Eskdalemuir respectively. Screen minima fell to 8° F. at Dalwhinnie on the 20th and 9° F. at Manchester on the 19th, and ground minima to 6° F. at Rhayader on the 13th and 19th, and at Auchincruive on the 17th. Much sun occurred at times in the north, e.g., 7·2 hrs. at Leuchars on the 18th. From the 19th to 31st depressions passed across the country and temperature rose somewhat in the south but continued low in the north until about the 25th. Snow and sleet fell generally over the country between the 19th and 25th, even as far south as Falmouth and lay to a depth of 5 to 7 in. in parts of the north. Gales occurred in the extreme north on the 21st. From the 26th to 31st conditions were generally mild and unsettled with rain most days and strong winds at times. There were many bright intervals especially on the 23rd and 26th, but mist or fog occurred locally. Thunderstorms were reported locally on the 22nd and 28th. The distribution of bright sunshine for the month was as follows :—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway ...	43	+16	Chester ...	42	− 9
Aberdeen ...	53	+ 9	Ross-on-Wye ...	35	−17
Dublin	55	+ 1	Falmouth ...	56	− 3
Birr Castle ...	39	− 9	Gorleston ...	42	−13
Valentia... ...	34	− 8	Kew	30	−14

Miscellaneous notes on weather abroad culled from various sources

Floods and storms caused much damage in Portugal early in the month. A landslide due to heavy rain killed two people on the Paris–Mantes road on the 1st. Further heavy rain occurred in France during the first half of the month followed by severe floods.* The Föhn wind was blowing in Switzerland on the 2nd; rain fell up to the 4,000 feet level, but heavy snow above 6,000 feet. On the 5th there was a change to generally wintry conditions, which lasted until the 9th when the Föhn wind came again and temperature rose generally. A thunderstorm accompanied by a whirlwind occurred in the neighbourhood of Dusseldorf and in Westphalia on the 10th, when two people were killed and considerable damage done to property. Temperature fell below freezing point generally in Switzerland on the 15th. Violent whirlwinds accompanied a storm over Florence on the 20th. The port of Seville was opened on the 21st but closed again on the 24th, as the water was rising. Floods were continuing on the river Douro on the 25th. Navigation closed at Vasa on the 25th. (*The Times*, January 2nd–27th.)

Rain fell in parts of the northern Transvaal early in the month and later reports of torrential rain came from those areas which had suffered very severely from drought; dams were broken by the floods and roads washed away. Johannesburg experienced a sudden change from a heat wave to wintry conditions about the 20th. Heavy rains occurred in north Abyssinia between about the 19th and 24th and in south Abyssinia later in the month. (*The Times*, January 15th–February 2nd.)

Exceptionally cold weather was experienced in Afghanistan and the North-West Frontier with much snow early in the month. (*The Times*, January 7th.)

Extensive, heavy and beneficial rains fell in the pastoral and cattle districts of South Australia from the 1st to 9th, and floods occurred over large areas. The rainfall for the month was above normal generally in Western Australia, Tasmania and parts of Queensland. Calm clear weather was experienced by the Discovery II on her three days voyage from Dunedin through the ice pack to the Bay of Whales. (Cable and *The Times*, January 6th–18th.)

A blizzard swept across Wyoming on the 9th. On the 19th, bitterly cold weather accompanied by tornadoes resulted in the death of 17 persons in Georgia, Alabama and Florida and much damage to property while in the north-eastern States, gales accompanied by snowstorms occurred and seven people died. The intensely cold weather experienced in the central parts of North America during the middle of the month spread also to the eastern areas on the 23rd, with temperatures below zero. Blizzards occurred in many parts and the south from Texas to the Atlantic, except the coast and Florida, was covered with snow. The American falls at Niagara froze solid about the 29th; 75 people died from

* *See* p. 12.

the cold. The Nantucket lightship broke adrift during a severe gale on the 23rd. In the United States temperature was above normal during the first half of the month becoming considerably below normal towards the end except along the western coasts, while rainfall was mainly in excess early in the month becoming generally deficient towards the end. Frequent rains occurred in the Argentine early in the month. (*The Times*, January 11th–31st and *Washington, D.C., U.S. Dept., Agric., Weekly Weather and Crop Bulletin.*)

Daily Readings at Kew Observatory, January, 1936

Date	Pressure, M.S.L. 13h.	Wind, Dir., Force 13h.	Temp.		Rel. Hum. 13h.	Rain.	Sun.	REMARKS. (see vol. 69, 1934, p. 1).
			Min.	Max.				
	mb.		°F.	°F.	%	in.	hrs.	[19h.
1	987·8	S.2	47	48	92	0·40	0·0	r–r_0 4h.–6h. & 10h.–
2	987·7	SW.2	45	47	94	0·04	0·2	r–r_0 5h.–7h. & 11h.–
3	992·0	NW.1	37	40	89	—	0·4	f 9h.–15h. [15h.
4	1013·5	WSW.2	37	46	83	—	0·9	
5	1004·2	SSE.4	36	45	78	0·02	0·0	r_0 19h.–20h.
6	990·2	S.3	43	47	83	0·16	0·9	r–r_0 5h.–11h., 18h. &
7	989·7	SW.1	42	45	94	0·28	0·7	r–r_0 3h.–14h. [24h.
8	999·6	S.3	41	48	91	0·13	0·0	r–r_0 12h.–24h.
9	1000·3	SSW.4	47	54	89	0·28	0·0	r–r_0 0h.–1h. & 11h.–
10	998·6	SW.5	49	55	72	0·25	1·8	rR 1h.–4h. [19h.
11	1021·8	W.3	44	46	58	—	0·4	
12	1024·4	SW.1	38	39	85	—	0·0	fF 13h.–24h.
13	1023·2	W.2	29	41	73	—	0·0	f 0h.–13h., fx 18h.–
14	1027·1	Calm	26	31	94	trace	0·0	fFx all day. [24h.
15	1020·9	ESE.2	23	36	83	trace	0·0	Fxf till 18h.
16	1002·0	NE.2	33	36	91	0·35	0·0	rsf 11h.–20h., s 20h.–
17	996·6	NNW.4	33	36	73	0·11	2·0	s 0h.–3h. [24h.
18	995·5	W.1	27	37	90	0·20	2·4	r 4h.–7h., s 7h.–10h.
19	994·3	E.3	26	38	87	0·08	0·0	s_0 8h., r–r_0 18h.–24h.
20	980·6	SSW.5	37	47	74	0·11	1·5	r–r_0 0h.–5h.
21	989·2	W.5	36	43	58	—	6·1	
22	999·7	SW.2	30	40	78	0·12	0·6	r–rs 16h.–18h.
23	1009·3	WSW.2	32	42	82	trace	3·2	x early, r_0 23h.–24h.
24	1002·0	ESE.3	35	44	73	0·08	0·7	r_0 0h.–3h. & 17h.–24h.
25	992·4	E.3	38	49	93	0·02	0·0	r_0 0h.–6h. & 15h.–16h.
26	996·2	WSW.3	45	47	71	0·07	5·1	r_0–r 2h.–7h. [19h.
27	994·4	SSW.3	38	47	91	0·09	0·0	x early, r 10h.–12h. &
28	996·6	WSW.4	44	51	64	0·70	1·1	r–r_0 6h.–9h., 19h.–24h.
29	982·9	SW.1	45	50	91	0·03	0·1	r 0h.–1h., 9h.–10h.
30	1000·7	SW.3	38	50	80	0·06	1·5	r–r_0 3h.–4h., 16h.–17h.
31	991·0	SW.2	46	53	96	0·32	0·1	rR 12h.–15h.
*	1000·1	—	38	44	82	3·91	1·0	* Means or totals.

General Rainfall for January, 1936.

England and Wales ...	178	per cent. of the average 1881–1915.
Scotland	140	
Ireland	148	
British Isles	163	

Rainfall : January, 1936 : England and Wales

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Lond .	Camden Square.........	4·02	216	*Leics* .	Thornton Reservoir ...	3·75	189
Sur .	Reigate, Wray Pk. Rd..	5·71	238	,, .	Belvoir Castle...........	3·48	196
Kent .	Tenterden, Ashenden...	4·68	218	*Rut* .	Ridlington	3·81	206
,, .	Folkestone, Boro. San.	4·87	...	*Lincs* .	Boston, Skirbeck.........	3·02	186
,, .	Eden'bdg., Falconhurst	5·38	220	,, .	Cranwell Aerodrome...	3·30	192
,, .	Sevenoaks, Speldhurst.	5·42	...	,, .	Skegness, Marine Gdns.	2·99	173
Sus .	Compton, Compton Ho.	6·29	198	,, .	Louth, Westgate.........	2·89	133
,, .	Patching Farm..........	4·47	172	,, .	Brigg, Wrawby St.......	3·25	...
,, .	Eastbourne, Wil. Sq....	4·76	181	*Notts* .	Worksop, Hodsock......	3·45	195
,, .	Heathfield, Barklye....	6·12	249	*Derby*.	Derby, L. M. & S. Rly.	3·13	157
Hants.	Ventnor, Roy.Nat.Hos.	5·25	204	,, .	Buxton, Terr. Slopes...	7·23	162
,, .	Fordingbridge, Oaklnds	5·95	215	*Ches* .	Runcorn, Weston Pt....	4·79	202
,, .	Ovington Rectory.......	6·86	254	*Lancs*.	Manchester, Whit. Pk.	3·59	143
,, .	Sherborne St. John......	5·00	214	,, .	Stonyhurst College......	4·01	94
Herts .	Royston, Therfield Rec.	3·52	203	,, .	Southport, Bedford Pk.	4·14	162
Bucks.	Slough, Upton............	4·61	248	,, .	Lancaster, Greg Obsy.	4·27	122
,, .	H. Wycombe, Flackwell	4·22	194	*Yorks*.	Wath-upon-Dearne......	2·81	146
Oxf .	Oxford, Mag. College...	2·59	150	,, .	Wakefield, Clarence Pk.	3.07	160
Nor .	Wellingboro, Swanspool	3·59	194	,, .	Oughtershaw Hall.......	6·33	...
,, .	Oundle	3·20	...	,, .	Wetherby, Ribston H..	4·31	209
Beds .	Woburn, Exptl. Farm...	3·20	187	,, .	Hull, Pearson Park......	2·81	156
Cam .	Cambridge, Bot. Gdns.	2·72	181	,, .	Holme-on-Spalding......	3·44	182
Essex .	Chelmsford, County Gdns	4·19	274	,, .	West Witton, Ivy Ho.	4·98	157
,, .	Lexden Hill House......	4·22	...	,, .	Felixkirk, Mt. St. John.	3·68	184
Suff .	Haughley House.........	3·03	...	,, .	York, Museum Gdns....	3·31	187
,, .	Campsea Ashe...........	...	...	,, .	Pickering, Hungate......	4·31	206
,, .	Lowestoft Sec. School...	2·66	159	,, .	Scarborough..............	3·97	199
,, .	Bury St. Ed., WestleyH.	3·64	203	,, .	Middlesbrough............	3·04	190
Norf. .	Wells, Holkham Hall...	2·64	182	,, .	Baldersdale, Hury Res.	5·08	156
Wilts .	Calne, Castle Walk......	3·79	...	*Durh* .	Ushaw College............	4·26	208
,, .	Porton, W.D. Exp'l. Stn	4·30	187	*Nor* .	Newcastle, D. & D. Inst.	3·26	176
Dor .	Evershot, Melbury Ho.	6·72	193	,, .	Bellingham, Highgreen	5·13	179
,, .	Weymouth, Westham.	4·50	186	,, .	Lilburn Tower Gdns....	4·87	235
,, .	Shaftesbury, Abbey Ho.	3·79	146	*Cumb*.	Carlisle, Scaleby Hall...	3·35	135
Devon.	Plymouth, The Hoe....	6·57	197	,, .	Borrowdale, Seathwaite	16·00	127
,, .	Holne, Church Pk. Cott.	12·43	201	,, .	Borrowdale, Moraine...	13·46	134
,, .	Teignmouth, Den Gdns.	6·63	227	,, .	Keswick, High Hill......	6·72	133
,, .	Cullompton	4·92	152	*West* .	Appleby, Castle Bank...	4·80	150
,, .	Sidmouth, U.D.C........	5·21	...	*Mon* .	Abergavenny, Larchf'd	6·87	203
,, .	Barnstaple, N. Dev.Ath	4·02	123	*Glam* .	Ystalyfera, Wern Ho....	7·64	121
,, .	Dartm'r, Cranmere Pool	10·40	...	,, .	Cardiff, Ely P. Stn.......	4·15	110
,, .	Okehampton, Uplands.	8·52	167	,, .	Treherbert, Tynywaun.	11·86	...
Corn .	Redruth, Trewirgie......	7·35	174	*Carm* .	Carmarthen, The Friary	...	...
,, .	Penzance, Morrab Gdns.	6·59	174	*Pemb* .	St. Ann's Hd, C. Gd. Stn.	5·73	173
,, .	St. Austell, Trevarna...	8·50	199	*Card* .	Aberystwyth	4·62	...
Soms .	Chewton Mendip.........	5·17	135	*Rad* .	BirmW.W.Tyrmynydd	9·53	151
,, .	Long Ashton............	3·53	123	*Mont* .	Lake Vyrnwy	8·86	157
,, .	Street, Millfield.........	3·88	...	*Flint* .	Sealand Aerodrome......	6·10	...
Glos .	Blockley	3·77	...	*Mer* .	Dolgelley, Bontddu......	7·69	135
,, .	Cirencester, Gwynfa....	3·93	157	*Carn* .	Llandudno	3·90	162
Here .	Ross, Birchlea...........	4·39	182	,, .	Snowdon, L. Llydaw 9..	18·18	...
Salop.	Church Stretton.........	4·13	163	*Ang* .	Holyhead, Salt Island...	4·85	167
,, .	Shifnal, Hatton Grange	3·06	158	,, .	Lligwy	4·75	...
Staffs.	Market Drayt'n, Old Sp.	3·23	147	*Isle of Man*			
Worc .	Ombersley, Holt Lock.	3·23	168		Douglas, Boro' Cem....	6·44	192
War .	Alcester, Ragley Hall...	2·96	153	*Guernsey*			
,, .	Birminghm, Edgbaston	3·54	175		St. PeterP't. Grange Rd.	6·91	236

Rainfall: January, 1936: Scotland and Ireland

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Wig .	Pt. William, Monreith.	5·16	157	*Suth* .	Melvich	4·93	149
„ .	New Luce School	5·51	136	„ .	Loch More, Achfary	6·19	85
Kirk .	Dalry, Glendarroch	7·75	139	*Caith* .	Wick	4·06	165
„ .	Carsphairn, Shiel	9·63	131	*Ork* .	Deerness	4·76	138
Dumf.	Dumfries, Crichton R.I.	5·21	172	*Shet* .	Lerwick	3·64	85
„ .	Eskdalemuir Obs	8·08	150	*Cork* .	Caheragh Rectory	...	...
Roxb .	Hawick, Wolfelee	5·41	169	„ .	Dunmanway Rectory	7·82	125
Selk .	Ettrick Manse	7·22	153	„ .	Cork, University Coll	7·51	186
Peeb .	West Linton	4·46	...	„ .	Ballinacurra	6·65	167
Berw .	Marchmont House	4·33	192	„ .	Mallow, Longueville	6·93	178
E.Lot.	North Berwick Res	...	...	*Kerry.*	Valentia Obsy	8·79	160
Midl .	Edinburgh, Blackfd. H.	3·59	204	„ .	Gearhameen	12·20	120
Lan .	Auchtyfardle	4·21	...	„ .	Bally McElligott Rec	6·30	...
Ayr .	Kilmarnock, Kay Pk	4·17	...	„ .	Darrynane Abbey	8·33	166
„ .	Girvan, Pinmore	5·95	126	*Wat* .	Waterford, Gortmore	6·80	187
Renf .	Glasgow, Queen's Pk	4·69	140	*Tip* .	Nenagh, Cas. Lough	6·91	175
„ .	Greenock, Prospect H.	6·55	96	„ .	Roscrea, Timoney Park	4·27	...
Bute .	Rothesay, Ardencraig	4·50	...	„ .	Cashel, Ballinamona	5·04	135
„ .	Dougarie Lodge	4·02	...	*Lim* .	Foynes, Coolnanes	4·65	123
Arg .	Ardgour House	3·69	...	„ .	Castleconnel Rec	4·07	...
„ .	Glen Etive	...	...	*Clare* .	Inagh, Mount Callan	6·99	...
„ .	Oban	3·06	...	„ .	Broadford, Hurdlest'n.	3·59	...
„ .	Poltalloch	4·40	87	*Wexf* .	Gorey, Courtown Ho	7·44	238
„ .	Inveraray Castle	6·05	74	*Wick* .	Rathnew, Clonmannon.	6·94	...
„ .	Islay, Eallabus	4·53	97	*Carl* .	Hacketstown Rectory	5·39	152
„ .	Mull, Benmore	...	...	*Leix* .	Blandsfort House	4·66	142
„ .	Tiree	...	...	*Offaly.*	Birr Castle	5·96	211
Kinr .	Loch Leven Sluice	4·85	154	*Dublin*	Dublin, FitzWm. Sq	2·78	121
Perth .	Loch Dhu	...	...	„ .	Balbriggan, Ardgillan	4·24	185
„ .	Balquhidder, Stronvar.	...	...	*Meath.*	Beauparc, St. Cloud	4·50	...
„ .	Crieff, Strathearn Hyd.	4·98	124	„ .	Kells, Headfort	3·74	119
„ .	Blair Castle Gardens	2·94	88	*W.M* .	Moate, Coolatore	4·14	...
Angus.	Kettins School	5·17	197	„ .	Mullingar, Belvedere	4·58	143
„ .	Pearsie House	4·02	...	*Long* .	Castle Forbes Gdns	4·33	130
„ .	Montrose, Sunnyside	4·30	216	*Gal* .	Galway, Grammar Sch.	4·71	...
Aber .	Braemar, Bank	4·26	134	„ .	Ballynahinch Castle	6·80	109
„ .	Logie Coldstone Sch	3·53	160	„ .	Ahascragh, Clonbrock.	5·27	136
„ .	Aberdeen, Observatory.	4·44	204	*Mayo.*	Blacksod Point	4·04	79
„ .	Fyvie Castle	4·83	204	„ .	Mallaranny	7·82	...
Moray	Gordon Castle	4·07	202	„ .	Westport House	5·67	122
„ .	Grantown-on-Spey	2·84	117	„ .	Delphi Lodge	10·67	108
Nairn.	Nairn	2·57	129	*Sligo* .	Markree Castle	4·28	110
Inv's .	Ben Alder Lodge	3·04	...	*Cavan.*	Crossdoney, Kevit Cas.	4·83	...
„ .	Kingussie, The Birches.	2·82	...	*Ferm* .	Enniskillen, Portora	4·11	...
„ .	Inverness, Culduthel R.	2·78	...	*Arm* .	Armagh Obsy	3·29	131
„ .	Loch Quoich, Loan	4·97	...	*Down.*	Fofanny Reservoir	11·91	...
„ .	Glenquoich	...	...	„ .	Seaforde	6·03	191
„ .	Arisaig, Faire-na-Sguir.	...	...	„ .	Donaghadee, C. G. Stn.	4·88	192
„ .	Fort William, Glasdrum	3·18	...	„ .	Banbridge, Milltown	4·19	187
„ .	Skye, Dunvegan	2·94	...	*Antr* .	Belfast, Cavehill Rd	5·90	...
„ .	Barra, Skallary	2·48	...	„ .	Aldergrove Aerodrome.	4·28	156
R&C .	Alness, Ardross Castle.	4·87	128	„ .	Ballymena, Harryville.	5·26	142
„ .	Ullapool	2·63	57	*Lon* .	Garvagh, Moneydig	4·65	...
„ .	Achnashellach	...	...	„ .	Londonderry, Creggan.	4·05	113
„ .	Stornoway	2·85	55	*Tyr* .	Omagh, Edenfel	4·58	129
Suth .	Lairg	5·40	165	*Don* .	Malin Head	4·45	...
„ .	Tongue	5·62	143	„ .	Killybegs, Rockmount.	3·05	...

Climatological Table for the British Empire, August, 1935

STATIONS.	PRESSURE. Mean of Day M.S.L.	PRESSURE. Diff. from Normal.	TEMPERATURE. Absolute. Max.	TEMPERATURE. Absolute. Min.	TEMPERATURE. Mean Values. Max.	TEMPERATURE. Mean Values. Min.	TEMPERATURE. Mean Values. ½ Max. and Min.	TEMPERATURE. Mean Values. Diff. from Normal	TEMPERATURE. Mean. Wet Bulb.	Relative Humidity.	Mean Cloud Am'nt	PRECIPITATION. Am'nt.	PRECIPITATION. Diff. from Normal.	PRECIPITATION. Days.	BRIGHT SUNSHINE. Hours per day.	BRIGHT SUNSHINE. Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0–10	in.	in.			
London, Kew Obsy....	1015·9	+ 0·6	84	44	73·2	54·5	63·9	+ 2·3	56·4	83	5·6	1·99	− 0·25	7	6·2	43
Gibraltar..........	1014·2	− 2·3	96	64	83·0	70·3	76·7	+ 0·7	67·3	79	4·1	0·06	− 0·06	2	...	...
Malta..........	1015·0	+ 0·2	91	70	84·2	74·4	79·3	+ 0·2	72·6	74	2·8	0·01	− 0·13	1	11·2	83
St. Helena	1016·1	+ 0·2	63	52	60·2	54·2	57·2	− 0·2	54·8	92	8·7	1·44	...	15	...	...
Freetown, Sierra Leone	1013·5	+ 0·8	85	67	81·7	71·5	76·6	− 1·3	74·5	90	9·4	52·65	+ 16·08	24	...	...
Lagos, Nigeria	1013·3	+ 0·3	84	72	81·9	73·5	77·7	− 0·2	73·8	86	8·9	0·42	− 2·22	6	4·6	37
Kaduna, Nigeria	1009·2	...	88	65	81·5	68·7	75·1	+ 1·2	71·1	90	9·0	17·04	+ 4·72	29	3·9	31
Zomba, Nyasaland	1018·2	+ 1·4	83	48	70·9	53·0	61·9	− 3·0	55·1	67	5·1	0·28	− 0·09	5	...	...
Salisbury, Rhodesia...	1020·7	− 0·5	80	34	69·4	41·8	55·6	− 4·6	46·5	45	2·1	0·22	+ 0·16	1	8·9	77
Cape Town	1021·7	+ 1·4	82	41	67·4	49·3	58·3	+ 2·7	49·7	79	3·6	3·40	+ 0·03	8	...	...
Johannesburg	1023·1	+ 0·6	74	23	60·9	37·2	49·1	− 5·3	38·7	53	2·0	0·41	− 0·10	1	9·9	89
Mauritius	1018·9	− 1·6	80	56	75·9	61·7	68·8	+ 0·3	66·0	74	4·2	1·32	− 1·03	8	8·1	71
Calcutta, Alipore Obsy.	1002·6	+ 1·6	93	74	88·9	78·7	83·8	+ 0·6	79·3	90	8·5	11·79	− 1·59	16*	...	...
Bombay	1006·4	+ 0·5	87	73	85·0	76·5	80·7	− 0·1	76·5	87	9·3	16·69	+ 2·24	14*	...	...
Madras	1005·5	0·0	101	69	92·6	76·8	84·7	− 1·3	75·7	75	8·0	9·07	+ 4·53	11*	...	...
Colombo, Ceylon	1010·0	+ 0·7	86	71	84·1	76·0	80·1	− 1·1	75·9	79	7·9	7·87	+ 4·63	21	5·8	47
Singapore	1010·0	+ 0·5	89	73	85·6	76·6	81·1	0·0	77·2	79	6·5	7·25	− 0·70	19	6·7	55
Hongkong..........	1004·4	− 0·4	93	75	87·6	78·2	82·9	+ 0·8	78·9	82	6·2	6·03	− 8·37	10	7·0	55
Sandakan	1009·6	...	92	71	89·2	74·9	82·1	+ 0·3	76·8	80	5·2	10·18	+ 2·29	16	...	...
Sydney, N.S.W..........	1019·0	+ 0·8	78	41	66·3	47·4	56·9	+ 1·9	50·1	67	4·0	0·22	− 2·75	3	7·9	72
Melbourne	1018·2	+ 0·2	72	39	60·4	45·3	52·9	+ 1·9	48·4	74	5·9	1·43	− 0·44	18	4·3	41
Adelaide	1018·9	− 0·4	79	39	64·6	47·9	56·3	+ 2·4	50·5	67	6·3	3·22	+ 0·69	15	5·9	55
Perth, W. Australia ...	1018·7	− 0·2	77	37	64·6	47·5	56·1	+ 0·1	49·7	63	4·6	3·97	− 1·68	15	7·2	66
Coolgardie	1019·0	− 0·3	78	32	63·2	40·6	51·9	− 1·7	48·6	75	4·1	0·74	− 0·25	8	...	...
Brisbane..........	1021·1	+ 1·9	78	43	70·1	49·7	59·9	− 0·5	53·4	67	3·6	1·64	− 0·37	9	8·1	73
Hobart, Tasmania..........	1012·2	− 1·2	69	34	56·0	43·3	49·7	+ 1·7	45·1	72	5·5	2·08	+ 0·25	17	5·1	49
Wellington, N.Z.	1011·4	− 3·7	63	33	54·4	42·0	48·2	− 0·4	45·0	71	3·9	3·42	− 1·07	10	6·6	63
Suva, Fiji	1015·0	+ 0·8	85	64	78·5	69·6	74·1	+ 0·5	70·0	86	7·8	16·59	+ 8·30	24	3·0	26
Apia, Samoa	1012·1	− 0·2	88	71	84·2	73·6	78·9	+ 1·1	75·3	79	5·5	8·73	+ 5·10	16	7·3	62
Kingston, Jamaica	1012·8	− 0·7	91	71	87·2	73·0	80·1	− 1·4	72·3	83	4·6	4·65	+ 1·10	10	6·8	54
Grenada, W.I.	...	...	89	72	86	74	80	+ 0·3	74	74	5	9·37	+ 0·04	20	...	...
Toronto..........	1014·9	− 0·5	89	46	79·0	60·8	69·9	+ 2·7	62·8	81	3·8	0·45	− 2·34	6	8·4	60
Winnipeg	1012·7	− 0·5	95	34	74·3	52·9	63·6	− 0·2	54·2	87	5·0	4·75	+ 2·59	12	8·0	55
St. John, N.B.	1014·2	− 1·1	90	48	73·4	55·7	64·5	+ 3·9	59·6	80	5·4	2·31	− 1·55	12	7·4	52
Victoria, B.C..........	1016·5	− 0·4	88	47	68·4	52·0	60·2	+ 0·5	55·3	75	3·8	0·53	− 0·11	3	10·0	70

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

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Measurements of Solar Radiation. Instruments and Some Results

By Ladislas Gorczynski, D.Sc.

(*Member of the International Commission of Solar Radiation*)

Part II

Some results of solarimetric measurements.—As found from direct readings on sufficiently clear days and permanent solarigraphic registrations in all weather conditions, the intensity of diffuse radiation shows, with a cloudless sky, regular diurnal and seasonal variations depending on the altitude of the sun above the horizon. It is important to state that the values of diffuse radiation at the Riviera are very similar to those obtained in other regions for the same cloud and weather conditions. I note here particularly the important paper by W. H. Dines " Observations on radiation from the sky " (*Geophysical Memoirs No.* 18, *Meteorological Office, London,* 1921), where it is stated that, in Great Britain, dense and heavy cloud sheets supply about the same diffuse solar radiation as a clear sky does; on the other hand, broken clouds showing much white, reflect the most radiation.

The following data show the variations of the intensity of diffuse sky radiation (in gr. cal. min. cm^2), with the sun's altitude, at Nice, France and Warsaw, Poland.

Sun's Altitude	45°	30°	15°	5°
Clear days { Nice	0·14	0·12	0·09	..
Clear days { Warsaw	0·17	0·12	0·08	0·07
Half covered sky (Warsaw)	0·28	0·19	0·11	0·05
Overcast sky (Warsaw)	..	0·13	0·07	0·04

The changing amount and kind of clouds and veils cause very important differences in the values of diffuse sky radiation. I cannot enter here into details*, but I mention the following general conclusions obtained from comparisons between the values calculated by solarimeter method with the corresponding duration of bright sunshine.

The chief result is that the increase of daily totals of diffuse sky radiation is by no means directly proportional to the sunshine duration. From a certain initial value with a completely covered sky during the whole day (duration 0·0), the amount of the diffuse radiation begins to increase very rapidly owing to intermittent appearances of the sun. The highest daily amounts of sky radiation were observed at the Riviera for a sunshine duration from 2 (in winter) to 4 hours (in summer) during the whole day, which corresponds nearly to a quarter of the possible sunshine duration in these seasons. The maxima are frequently more than twice as great as corresponding amounts obtained with overcast or perfectly clear days, as may be seen from the following example, where the sunshine duration of 0·0 hours corresponds to completely overcast days with dense clouds and 0 to overcast days with some clear intervals.

Example :

Duration of insolation in hours	0·0	0	2	4	6	8	11	14 hours
Totals of diffuse sky radiation in gr. cal. per day								
January	55	75	100	65	50	40	..	..
July ...	120	210	290	305	290	250	170	115

In Table I are given the daily totals not only for diffuse but also for the total (sun and sky) radiation at Nice. The results are given separately for clear days only and for all days of each month without any exception.

We see in Table I, the important part played by the sky radiation in the total (sun and sky) values. The ratio of 30 per cent found at the Riviera is still more considerable (40–50 per cent or even more) in north-west and central Europe. Let me repeat that (as results from Table I) the sky radiation decreases (while the total radiation increases), when we consider clear days only instead of all days.

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* See the author's paper published in *C.R. Soc. Sci. Varsovie*, **27**, 1934, pp. 32–44, under the title "Interdependence between the amount of diffuse sky radiation and the duration of sunshine" (Polish with English summary).

TABLE I.—DAILY TOTALS (MEAN MONTHLY VALUES DURING THE PERIOD 1931–3) OF DIFFUSE (SKY) AND TOTAL (SUN AND SKY) SOLAR RADIATION AT NICE, FRANCE. (Gr. cal. per day and cm^2. of horizontal surface.)

Months	All days Diff.	All days Total.	Clear days Diff.	Clear days Total.
January	57	194	40	257
February	89	268	59	363
March	106	336	66	503
April	136	478	81	628
May	170	577	101	747
June	201	646	107	789
July	157	685	108	805
August	162	622	131	730
September	133	427	100	532
October	93	296	65	383
November	75	181	47	282
December	63	155	38	231

Annual means (per day) { All days — Diff. 120, Total 406, Ratio 30%
Clear days only — Diff. 79, Total 521, Ratio 15%

Some results of pyrheliometric measurements.—From numerous series of pyrheliometric and solarimetric data obtained at the Riviera by direct readings and by means of automatically recording

TABLE II.—HOURLY VALUES OF SOLAR RADIATION INTENSITY DURING CLEAR DAYS ONLY AND THE "ALL DAYS" TOTALS FOR WHOLE MONTHS AND YEAR AT NICE (means for 1931–3).

Intensity for 21st of each month	Intensity, Clear Days Only (gr. cal. min. cm^2.)						All Days	
	Pyrheliometry Normal incidence			Solarimetry Horizontal surface			Totals for whole months	
	8h. 16h.	10h. 14h.	True noon	True noon	10h. 14h.	8h. 16h.	Pyrh. (normal)	Sol. (horizontal)
January ...	0·71	1·18	1·27	0·68	0·52	0·13	11·2	6·0
February ...	0·93	1·23	1·29	0·87	0·71	0·28	12·2	7·6
March	1·11	1·28	1·33	1·10	0·94	0·50	13·9	10·4
April	1·16	1·31	1·35	1·32	1·13	0·69	17·3	14·3
May	1·16	1·29	1·33	1·41	1·23	0·78	20·1	17·9
June	1·12	1·24	1·27	1·41	1·22	0·80	18·9	19·4
July	1·10	1·22	1·26	1·36	1·17	0·76	23·3	21·2
August	1·06	1·21	1·26	1·24	1·05	0·64	23·1	19·3
September ...	1·04	1·23	1·28	1·08	0·92	0·49	16·4	12·8
October... ...	0·96	1·23	1·29	0·89	0·73	0·30	14·9	9·2
November ...	0·78	1·18	1·26	0·66	0·51	0·13	10·1	5·4
December ...	0·55	1·14	1·25	0·60	0·43	0·07	9·7	4·8
Annual totals (all days) in Kg. cal. per cm^2.							191·1	148·3

instruments, a small abstract is given in Table II. All values were frequently compared with an Ångstrom compensation pyrheliometer and are expressed in the Smithsonian scale.

The great differences between pyrheliometric and solarimetric values in the morning and evening hours are due to the low altitude of the sun over the horizon. At Nice (latitude 43·7° N.) the fraction sin *h* varies, at true noon, between 0·39 (December 21st) and 0·94 (June 21st). On the other hand the fact that sometimes in summer the total (sun and sky) radiation on a horizontal surface is greater than the direct solar radiation at normal incidence is due to the diffuse component from the whole sky (the direct sun component being during summer not very different in both cases).

Finally it is interesting to note the highest intensity values from pyrheliometric measurements. For two very distant stations: Nice (period 1928–33) and Sloutzk near Leningrad (1914–26), we find the following monthly maxima (directly measured and not reduced) in gr. cal., min. cm^2. by normal incidence :

Month	Nice	Sloutzk
January	1·41	1·09
February	1·46	1·26
March	**1·51**	1·41
April	1·48	**1·43**
May	1·49	1·40
June	1·45	1·41
July	1·45	1·38
August	*1·42*	1·35
September	**1·46**	1·34
October	1·44	1·28
November	1·41	1·12
December	*1·40*	*0·96*
Year	1·51	1·43

Two maxima (first in spring, second in autumn) are characteristic not only for the Riviera, but also for other regions although sometimes in a less accentuated manner. The great advantage of the solar climate of the Riviera consists first of all in the relatively abundant sunshine with strong intensity of solar radiation even in winter, while in this season all the northern part of Europe has very cloudy and frequently foggy weather.

Some comparisons between the Riviera and other European regions.—In Table III short comparisons are given between Nice and some other places of the European continent. The values could not be established for exactly the same periods of observations. We see that the differences are very great in winter, relatively small in the summer months; while in June the ratio (Nice) : (Helsinki) is nearly 3 : 2, we find 16 : 1 in December. The inhabitants of Finland and of many other places in Scandinavia or north-western Europe receive then not only a very small amount of solar radiation but also, almost wholly in the form of diffuse sky light, bright sunshine being rare in winter in this part of Europe.

TABLE III.—SOLAR RADIATION TOTALS, RECEIVED DIRECTLY FROM THE SUN AND DIFFUSELY FROM THE SKY (in Kg. cal. per cm^2. of the horizontal surface).

	December	June	Year
Nice, Riviera (lat. 43·7° N.)	4·8	19·4	148
Paris, France (lat. 48·8° N.)	2·0	14·7	98
Warsaw, Poland (lat. 52·2° N.) ...	1·0	15·1	91
Rothamsted, England (lat. 51·8° N.)	1·1	12·3	74
London, South Kensington (lat. 51·5° N.)	1·0	12·3	73
Helsinki, Finland (lat. 60·2° N.) ...	0·3	14·2	75

We see that the solar climate of London, though frequently foggy in winter, has monthly totals not very different in this season from many other places in central Europe, and higher than in the north of this continent.

As concerns Nice, it is well to keep in mind that there are in southern Europe three principal parts of the Riviera, namely :—

(1) Western Riviera.—Mediterranean and Atlantic coasts of the Iberian peninsula with Barcelona and Sitges in Catalonia. An especially long sunshine duration is to be found between Alicante, Almeria and Malaga ; other southern Spanish and Portuguese coasts from Lisbon to Oporto have also a remarkable solar climate but unfortunately little explored hitherto.

(2) Central Riviera including the French coast (St. Raphaël–Cannes–Nice–Menton) and various parts of the Italian coasts with San Remo as the chief place. Several Mediterranean isles show also, at least in certain parts of their coasts, characteristic features of the sunny climate of the Riviera.

(3) Eastern Riviera where the central part of the Dalmatian shores and small adjacent isles (e.g. Split, Dubrovnik or Ragusa, Hvar, etc., in Yugoslavia) are no less favoured than Nice from the solar climatic point of view. The natural prolongation of the eastern Riviera is formed by the Greek coasts and eastern Mediterranean isles. Most of the latter (e.g. Cyprus) have a long sunshine duration and represent a transition to the sunny lands of Egypt and Asia Minor with Arabia.

The Mediterranean type of climate is to be found not only in the south of Europe, but its main features are repeated in four other continents, namely, in California, in the South American Riviera, in South Africa (district round Cape Town) and in the south-west corner of West Australia. Unfortunately the solar climate of all these sunny lands is very little known as yet.

Fronts and Depressions

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

The following notes do not profess to contain anything new, but discuss certain aspects of a complex subject on which there is no complete agreement. In very many cases there is reasonably good agreement in the diagnoses of competent frontologists, but in others there is a difference of opinion. Some of the conditions in which disagreement may arise are referred to below. The opinions expressed are of course personal, but they are in general accord with the modern Bergen practice, as shown on their published charts. Professor J. Bjerknes has expressed substantial agreement with them.

(1) *Fronts and barometric tendencies.*—The extent to which sea-level pressure depends on tropospheric temperature is sometimes over-estimated. It is essential to draw a clear distinction between the factors determining the origin and development of atmospheric disturbances, and the simpler, but very limited, problem of the relation between sea-level pressure and the weight of the various layers of air. It is almost certain that in general the lower layers are ultimately the most important, though the upper troposphere and stratosphere also play a part and cannot be ignored. The weights of the various layers can be directly observed, and it has been known for over 30 years that in the British Isles and western and central Europe the troposphere is, on the average, colder over the depression than over the anticyclone, and that the stratosphere has an important influence. This is due mainly to the frequency of occluded depressions, but it must be remembered that intense depressions of frontal type* everywhere tend to be occluded at the centre through much more than half their total duration. S. Petterssen† has stated that "the deepening process and the occlusion process are only two different aspects of the same phenomenon". It follows that the deeper the depression the more likely it is to be occluded at the centre. Petterssen also says "symmetrical wave cyclones occlude with a velocity which is directly proportional to the deepening of the pressure system". This rule refers only to the rate of deepening of any given depression. When we consider different depressions, it is only too obvious that the intensity attained has a poor correlation with the initial size of the warm sector, and that the rate of deepening is not directly proportional to the amount of warm air displaced. Occasionally, though rarely, pressure becomes really low at the centre of a depression with a large warm sector. On October 11th, 1933, a depression centred near the Humber had a pressure of about 982 mb.

* If the term "frontal type" is given a sufficiently wide interpretation, all intense depressions in temperate and high latitudes are included.

† Practical rules for prognosticating the movement and the development of pressure centres. *U.G.G.I., Ass. Met. Proc. Verb., Lisbon,* 1933, II, 1935, p. 57.

at the centre, and still had a very large warm sector, though it had certainly deepened by fully 20 mb. since its origin.

It is widely recognised that the pressure fluctuation at sea level due to a moving depression can in a very rough manner be analysed into tropospheric and stratospheric fluctuations or " waves ", and that the high-level depression comes over from the rear of a sea-level depression and overtakes it during its deepening, the high depression probably itself intensifying to some extent. Thus obviously the use of barometric tendencies for frontal diagnosis requires discrimination, like everything else in synoptic meteorology. The fall of pressure over the warm sector of a deepening depression is due largely to the upper " wave ". During the greater part of the development the barometric tendency in the warm sector near the centre gives a good measure of the rate of deepening, as Petterssen has shown*. At a later stage, when the warm sector is narrow and the depression is developing a strong circulation the rule often breaks down. At Holyhead on November 16th, 1928†, pressure fell 5 mb. in an hour in a narrow and vanishing tip of a warm sector, and the centre was only deepening by 1 mb. per hour. The remaining fall of 4 mb. was due to the fact that the tip of the warm sector had been twisted round in front of the centre, which was overtaking it and also developing a forward elongation. None of the fall can be attributed to warming in the troposphere, but it must be remembered that if the only temperature change is the adiabatic cooling due to the fall of pressure at a fixed level, then the fall of pressure decreases upwards considerably.

A steady or rising barometer in the tropical air is rare near the centre of a depression but is quite common near the boundary, when the depression is receding and a warm anticyclone is advancing or spreading. The commencement of a barometric rise, perhaps with a slow veer of wind, does not necessarily mean that even a smooth front has passed (*see* for example October 28th, 1935). In doubtful cases the air should be traced back.

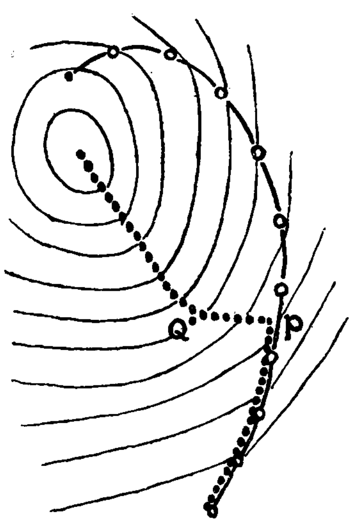
Within 500 miles or so of the centre of an intense depression the cold front or occlusion quickly sweeps round ahead of the barometric trough. Its passage is often marked by a sudden rise of pressure, followed by a further fall, slower than before but still occasionally very rapid. At Stornoway on the night of October 18th–19th, 1935, the sudden rise was followed by a fall of 26 mb. in 8 hours, the greatest fall in 3 hours being 12 mb. This was an exceptional case, but more moderate falls (say 3 to 5 mb. in 3 hours) are common in similar situations, which occur more often on our north-west seaboard than elsewhere.

The 7h. chart of September 17th, 1935, showed an intense occluded depression moving north-east with its centre off Tynemouth. Its

* *Geofys. Publ., Oslo,* **10**, No. 2, 1933, p. 83.

† *London, Quart. J. R. Met. Soc.,* **56**, 1930, p. 124, Fig. 3.

structure was typical, and is illustrated by the diagram. The occlusion is marked as on the International section of the *Daily Weather Report*, and the barometric trough is shown by a dotted line. South of the point P, which was about 500 miles from the centre, the two lines coincided. In the region PQ the barometric minimum was of a flattened type, while from Q to the centre the isobars at the trough were of a normal rounded type, with no front. The gradient wind at 250 miles from the isobaric centre was of the order of 70 m.p.h. between 1h. and 7h. (reduced from 100 m.p.h. by the correction for the curvature of the path of the air), while the speed of the trough was 40 m.p.h. Thus the air at 2,000 ft. flowed round the curved trough at an average speed of 30 m.p.h. In Scotland on October 19th the flow across the trough was about 40 m.p.h., and in all really intense depressions there is a flow of this type, so that a front cannot possibly remain at the trough. As a rule minor secondary cold fronts move quickly round the trough. Near the western seaboard in winter there are frequent instability squalls, one of which is sure to occur close to the trough, but in eastern districts in winter the final trough often passes without precipitation.



—o—o—o Occlusion.
······· Barometric trough.

Attention is called to a paper by E. Palmén,* and another by J. Bjerknes,† in which it is shown that the passage of troughs of the type we are considering was accompanied by practically no change of tropospheric temperature.

(2) *Back-bent occlusions.*—The essential condition for the formation of a back-bent occlusion is the motion of the centre of the depression along the occlusion, or along the tip of a warm sector which is being progressively occluded. So long as the motion of the centre is exactly parallel to the isobars in the warm sector, no back-bent occlusion can develop. We have already noted that when a depression becomes intense there is a marked tendency for an occlusion

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* Registrierballonaufstiege in einer tiefen Zyklone. *Helsingsfors, Mitt. Met. Inst. Univ.*, **26**, 1935.

† Investigations of selected European Cyclones by means of Serial Ascents. *Geofys. Publ., Oslo*, **11**, No. 4, 1935.

or vanishing warm sector to be twisted round ahead of the centre, and the formation of a back-bent occlusion soon follows, usually some 200 or 300 miles in length. In certain conditions back-bent occlusions form in less intense depressions, and in a few special cases may exceed 500 miles in length. If there is a definite flat portion at the bottom of a barograph curve due to a deep depression, it almost certainly corresponds to the region between the occlusion (possibly the cold front) and the back-bent occlusion. On other occasions pressure falls in this region. Subsequently the back-bent occlusion itself swings round the centre, and moves well ahead of the barometric trough. The case recently discussed by J. Bjerknes* was of this type. There was continuous rain just ahead of the final trough, but this was considered to be non-frontal.

The swinging round of the shrinking warm sector ahead of the centre often leads to the development of a second centre, and the centres then have a mutual rotation, the rear one (the original primary) usually filling up and ending as a trough. It is often tempting to draw a long back-bent occlusion along such a trough, but this practice is generally unjustified. In the first place, the development of a second centre is a substitute for the motion of the original centre along the occlusion, so that this centre develops no back-bent occlusion. In the second place, in a dumb-bell vortex system there is a rotation of each component vortex in addition to the mutual rotation, so that there is a flow of air round the trough outside the original centre, while inside it there is a distortion in the opposite direction.

(3) *Secondary Cold Fronts.*—In high latitudes pronounced fronts are commonly formed between maritime polar and arctic air. Occasionally these fronts come down over the British Isles, and may even develop there. More frequently secondary cold fronts form in a polar current which is being progressively heated by a warm sea surface, which gives rise to a horizontal temperature gradient. The development from this into a series of minor fronts is closely related to the breakdown of stability in the vertical. The instability may result in violent squalls, but the temperature at a fixed place often subsequently recovers its original level. The squalls are often of limited horizontal extent. The drawing of long secondary cold fronts can often be made in diverse ways, none of them necessarily right. One of the least probable structures is a front extending into the centre of a depression, like the spoke of a wheel. Small rotary systems often form in unstable air, and the passage of such a system produces effects resembling those at a front (e.g. veer of wind, barometric rise following a fall), so that great care is needed.

(4) *Centres of fully-developed depressions.*—The motion of a front is approximately determined by the component of motion at right angles to it in the colder air mass (i.e. the air mass which does

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* Loc. cit.

not ascend), and it is a matter of observation that cold fronts or cold occlusions travel roughly with the component of gradient wind. In the case of all fronts the possible departures from gradient velocity can be placed within certain limits. Near the centres of depressions this fact is not always given sufficient weight. In an intense depression the rotation quickly twists up the occlusion and must destroy it as a genuine discontinuity. So long as a strong rotation persists, further fronts cannot readily develop. At a distance of 200 miles from the centre, the air at 2,000 ft. probably occasionally makes the complete circuit in under 24 hours, but more often within 36 hours. In the region immediately to west and north-west of the British Isles, where the sea temperature is fairly uniform, frontogenesis is impossible in these conditions. In a region like the Newfoundland Banks a temperature difference will develop at the surface, but cannot readily extend upwards where the rotary motion is strong. Superficial temperature difference might have an important trigger effect when instability is developed over the warmer part of the sea. When a dying depression is centred over or near the British Isles temperature differences between land and sea, or orographic influence, combined with instability, may give heavy rainfall. In the rainy region (perhaps 3 or 4 or more counties) the surface temperature is relatively low, but the upper air temperature is generally somewhat higher than in the adjacent air, owing to the latent heat set free. The rain area may travel a considerable distance from its place of origin.

The angular type of isobar is not at all typical of fully developed depressions. It should be noted that the barograph curve corresponding with angular isobars is of angular form. The upward kink, often associated with an instability squall, does not in itself indicate angular isobars, but rather an isobaric kink similar to that of the barogram, but downward when the isobar is followed from left to right.

(5) *Precipitation and fronts.*—We have noted above that very minor fronts in unstable conditions may give heavy rainfall. Sometimes the front becomes vanishingly small. J. Bjerknes* has used the term " non-frontal rainfall " to describe a case of steady rain in Belgium, and the Bergen charts sometimes mark rain areas without fronts. To base a front on rainfall alone involves arguing in a circle. It is of course arguable that an elongated rain area must imply a front, but even that is by no means certain, unless the definition of a front is made so wide as greatly to limit its value. A normal horizontal temperature gradient would give some shearing motion aloft, which might in suitable conditions produce an elongated rain area, analogous to elongated cloud cells.

Sometimes a real line of discontinuity with all the properties of an occlusion seems to develop in unstable air, and I suggest that a new term might be introduced to cover such cases. It also sometimes

* Loc. cit.

happens that two depressions originating far apart, originally with quite separate fronts, become joined in such a way that there is to all appearance a single typical occlusion. The charts of September 23rd–24th, 1934 and of November 17th–19th, 1935 illustrate this development, and provide evidence that a so-called " occlusion " is liable to be formed by convergence, without a previous warm sector.

(6) *Drawing of doubtful fronts.*—Some of the difficulties have been mentioned and there are others not referred to here. Even if complete upper air information were available, there would be marginal cases, owing to the complexity of the actual air mass structure. When one has to rely on indirect evidence the situation is worse, as there is no single atmospheric feature not subject to other influences. When conditions are complex, plausible reasons can always be given for various solutions, but these do not constitute scientific evidence. The importance of agreement in scientific matters is great—indeed in the long run it is difficult to see what other criterion can be obtained for the reality of a scientific generalisation. In the pioneering stage personal views and provisional hypotheses are inevitable, but frontal analysis has now dominated synoptic meteorology for 16 years, and is no longer a new study. Personally I believe that the sphere of agreement is capable of extension, but that in order to describe certain groups of phenomena, the frontal ideas must be extended and supplemented by others.

Fronts should obviously not be published when there is a large element of doubt, though some interpolation is often inevitable on the Atlantic, not only with fronts but with isobars. On working charts forecasters must use the methods they find most practically useful, but they should be cautious in their interpretation, both from the point of view of a proper understanding of the atmosphere, and of future progress. If a forecast depends only on the movement of areas of rain and low cloud across the country, any method of marking them on the chart would serve, and the concept of a " front " is not necessarily brought into real use. Merely to call all bad weather areas " fronts " diverts attention from other factors which deserve fuller investigation.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, February 19th, in the Society's rooms at 49, Cromwell Road, South Kensington, Dr. F. J. W. Whipple, F.Inst.P., President, in the Chair.

The following papers were read and discussed :—

C. K. M. Douglas, B.A.—Rainfall from above 6,000 *ft., in relation to upper wind and fronts.*

Rainfall from above 6,000 ft., and the movement of rain areas with the winds at those levels, are of importance in forecasting, and sometimes cause difficulties. A suggested classification of "thermal" upper winds is into ideal frontal, frontal zonal, and non-frontal types. The upper wind system of an ideal front is briefly discussed. Non-frontal "thermal" winds sometimes cause an exceptional forward extension of a rain area (example on May 8th, 1934). A rain area is also liable to travel in an abnormal manner along a front, owing to upper winds of frontal zonal type (example on October 22nd, 1935). Quasi-frontal and non-frontal rainfall, in connexion with which upper winds are often important, are discussed briefly. In an appendix it is shown that the angle of slope of a surface of discontinuity should increase as a depression deepens, and that in consequence large-scale energy transformations are probably related only to converging and diverging movements over large areas, and only indirectly to surfaces of discontinuity.

David Lloyd.—Rainfall and loss over the Vyrnwy catchment area.

Rain falling over a catchment area is partly recovered in stream flow. In specific periods, rainfall is equated to stream flow plus loss. The loss is affected by several causal agents. Consequently in periods of similar rainfall the resulting stream flow varies. The relation of stream flow to rainfall is deduced by analysing data from the Vyrnwy catchment area, where water is impounded by the Liverpool Corporation Water Undertaking. Records are available over a period of fifty years. Annual loss is correlated with associated rainfall and temperature data by a recent statistical method after M. Ezekial, which overcomes the inflexibility of Pearsonian methods. The functional effects of rainfall and temperature in terms of loss are described numerically and graphically. The percentage of the variance in loss due to differences in those causal agents suggests the reason why loss cannot be related to rainfall without taking into consideration other casual factors. The relations are produced descriptive of conditions at the area with and without a reservoir.

John Glasspoole, Ph.D. and Dugald S. Hancock.—The distribution over the British Isles of the average duration of bright sunshine: monthly and annual maps and statistics.

In the paper the available information as to the distribution of bright sunshine over the British Isles is reviewed. Maps are included defining the distribution of average amounts of bright sunshine during each month and the year. Estimates are also given of the general sunshine for each month and year over England and Wales, Scotland, Ireland and the British Isles as a whole.

Correspondence

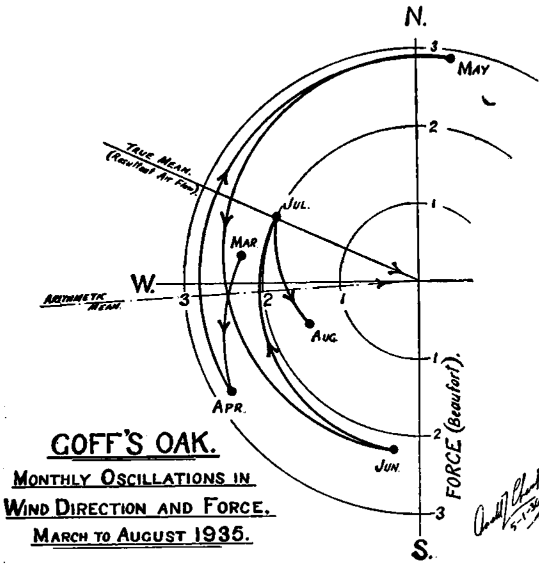
To the Editor, *Meteorological Magazine*

Periodic Oscillations in Wind Direction and Force

The weather changes, relative to movements of centres of excess and deficit of pressure, as set out by Mr. S. E. Ashmore and Dr. Brooks in the issue of this magazine for March 1935, have had an interesting parallel in the changes of wind during the months of March to August, 1935 at Goff's Oak, Herts.

Based on observations of wind taken at 7h. and 23h. (civil time) at this station, the wind appears to have performed five distinct oscillations, as if the atmosphere had been disturbed by a huge tidal wave.

The oscillations commenced with a mean wind of force 2·3 from 279° in March, reached the greatest phase at force 2·9 from 9° in May and then falling off in both angular swing and force each month, to the value of force 1·5 from 249° in August.



GOFF'S OAK.
MONTHLY OSCILLATIONS IN WIND DIRECTION AND FORCE.
MARCH TO AUGUST 1935.

The attached diagram shows these changes from month to month, and the damping out of the oscillation after the month of May is clearly apparent, being regular about the arithmetic mean* for the period.

The table below shows the numerical values of each month, together with the associated rainfall expressed as a percentage of the normal (as interpolated from isohyets in the "Rainfall Atlas of the British Isles").

The latter figures show a decided excess of rainfall as the wind backs and a corresponding deficit as it veers.

		Direction	*Force*	*Rainfall* %
March	...	279°	2·3	26
April	...	240°	2·8	220
May	...	9°	2·9	85
June	...	189°	2·2	143
July	...	295°	2·0	27
August	...	249°	1·5	79

The effect on the rainfall is as one would expect, but to have regular alternations of dry and wet months, coupled with such marked oscillations in air flow over a period of six consecutive months is

* The arithmetic mean was obtained by extracting the mean of twice the average of the monthly means; the first average being taken with the value for May as 9° and the second with this value as 369°.

remarkable. The momentum of this huge surge of air must have been tremendous, and its resultant effect on the weather in this locality goes far to confirm the belief that our climate is indeed decidedly variable.

DONALD. L. CHAMPION.

7, Robinson Avenue, Goff's Oak, Waltham Cross, Herts, January 10th, 1936.

Glazed Frost and Ice Pellets, February 11th and 13th

An interesting example of glazed frost occurred on February 11th in southern England. Mr. Norman E. Neville at Fareham writes: "At 9 a.m. rain fell, and immediately it made contact with exposed ground, became ice. It formed large globules of ice in my rain-gauge and on the top of the Stevenson Screen. All windows facing east became coated with thick ice, making the appearance of crinkled glass. . . . After this 'glazed rain' came hard pellets of snow (not hail) and finally softer flakes of snow. Around the street lampshades icicles formed at least six inches long. Walls of buildings facing east became sheets of shining ice making reflection possible at night when the street lamps went up."

Mr. R. S. Breton describes the same storm at Niton, Isle of Wight: "Immediately the strong ESE. gale subsided to a moderate breeze rain began to fall with the temperature at 29° and continued heavily from 8.30 a.m. till 1 p.m., accompanied by small hail later and a little snow for 10 minutes at 11.15. Grass, hedges, trees and buildings soon became encrusted with clear ice, and the country-side at the end of the storm was completely white as if snow had fallen. When examined, the conglomeration could be seen to consist of ice and tiny clear hailstones. The amount of rainfall was about 0·75 in. I examined one of the wire supports to the electric cable standing exposed on the top of the cliff and found it to be embedded in an elliptical casing of clear ice, over half an inch thick at the two sides. Evergreens were much bent over by the weight of the ice and in some cases boughs broke under their burden. There were icicles everywhere. The frost, which held all day, increased as soon as the sky cleared at night. At sunrise we had a truly marvellous picture of beauty, the hedges and trees glittering (without rime) and reflecting all kinds of extraordinary colours until the sun's power was enough to send the icy particles tinkling to the ground."

On February 13th at Garvagh, Co. Derry, Mr. J. Porter described a fall of ice pellets: "After a rather cold day, on which the maximum temperature in the screen reached 39° F., ice particles began to fall at about 6.30 p.m., continuing, for the most part slightly, up to 10.30 p.m. On examination they appeared to be very irregular in shape and size, varying from 'pin heads' to a little larger than coarse sugar; they were quite clear or transparent and just resembled broken ice. The wind was south, light to moderate, and the atmosphere hazy or misty. No low clouds could be detected but during the day what appeared to be cirrostratus spread up from the south and at 6 p.m. the sky was completely overcast."

Thunderstorms Associated with a Warm Front

In connexion with the note by Mr. R. P. Batty in the November issue of the *Meteorological Magazine* dealing with the occurrence of a thunderstorm as a warm front passed over Cranwell on September 24th 1935, I would like to draw attention to some further interesting features. A thunderstorm was associated with the passage of the warm front referred to by Batty not only at Cranwell but also at Holyhead at 11h. 48m. G.M.T., Sealand at 13h. G.M.T., and Birmingham between 13h. and 17h. G.M.T. which suggests that this phenomenon was a feature of the warm front over a distance of about 70 miles from the centre of the depression. Thunderstorms also occurred at Ross-on-Wye and Mildenhall at the passage of the cold front and this, taken in conjunction with the cases of thunderstorms at the warm front, suggests that instability was fairly easily produced in the warm air.

The synoptic situation was similar to that which gave a warm front thunderstorm at Valentia on November 9th 1929. Each warm front was associated with a newly-developed secondary. Both secondaries moved rapidly and increased in intensity as the depression passed across the British Isles. In November 1929 the secondary first appeared off south-west Ireland, pressure about 1008 mb. at 13h. G.M.T. on the 9th, and by 7h. G.M.T. on the 10th was over Tynemouth, pressure about 995 mb.; while in September 1935 the depression was first indicated about 300 miles west of Valentia, pressure 1008 mb. at 13h. G.M.T. on the 23rd, and by 7h. G.M.T. on the 25th was over Terschelling, pressure about 992 mb.

WILLIAM D. FLOWER

Meteorological Station, R.A.F., Sealand, Chester, December 18th, 1935.

Lunar Halo and Corona

Throughout the early part of the evening of Tuesday, February 4th, the sky was free from cloud and greyish blue in colour. From about 19h. 30m. G.M.T., to 21h. 30m. a small jagged (not circular) patch of thin haze surrounded the moon. At 21h. 30m. the moon was surrounded by a thin halo or ring of haze fully 40° in diameter. For a period of 15 minutes up to 22h., numerous straight lines of haze were faintly seen across the circle below its centre running parallel to the horizon. At 22h. 30m. a circular disk of haze which had covered the moon for a short period showed (for 15 minutes) very distinct rings in the prismatic colours; the outer ring was 10° in diameter. The large outer halo was still visible. By 23h. a veil of thick white haze and countless small clouds had spread over the entire sky.

At sunrise on February 7th six arcs of red cloud or haze stretched across the sky from due north to south. No other clouds were present. The red gradually faded out later to almost clear sky.

S. M. JAMESON.

Butterwick, Barton-le-Street, Malton, Yorkshire, February, 5th, 1936.

NOTES AND QUERIES

"Greenhouse" Effect in the Upper Atmosphere

The experiment was recently made of wrapping a Dines balloon meteorograph up in a number of layers of thin cellophane, and sending it up attached to a balloon in the usual manner to determine what temperature would be attained at great heights when the sun was shining. Two such soundings were made from Sealand this winter, one reaching a height of 13½ Km. and the other 6½ Km. The results obtained were of much the same type in both cases, and the following table is based on the former one, a sounding made near midday on February 1st, 1936.

Height Km.... ...	0·7	1·7	2·7	3·1	3·9	5·2	6·8	7·7	8·7	11·3	13·3
	°A.	°A.	°A.	°A.	°A.	°A.	°A.	°A.	°A.	°A.	°A.
Temperature of air ...	275	269	263	260	255	245	231	223	215	224	224
Temperature inside cellophane case—											
Ascent	285	288	307	308	303	292	280	276	282	302	308
Descent... ...	288	288	289	289	285	280	283	289	293	302	308

The temperature of the external air was determined from an independent sounding made an hour later with a normal instrument. As far as can be ascertained there were no high clouds present, though the sky was nearly covered with clouds of various heights up to 2 Km. The vertical velocity of the balloon during the ascent was about 3½ metres per second, and on the descent probably about 10 metres per second near the top falling off to about 5 near the ground.

The special jacketing of the meteorograph was effected by first placing a layer of black paper round the cylindrical case and then adding about five layers of thin cellophane and tying loosely. The thickness of the laminated jacket thus formed was about 8 mm. At the two ends of the case the cellophane was drawn together and tied tightly to keep out currents of air.

The elevation of the sun was about 18° above the horizon. It will be seen from the table that up to a height of 7 Km. the vertical velocity of the balloon has an appreciable effect on the temperature inside the cellophane, the higher velocity of the descent coinciding with a lower temperature. Above 7 Km. the effect is less and above

10 Km., it is negligible. From 7 Km. upwards the temperature continually increases with height, being 85° A. above that of the external air at 13½ Km. The latter result is to be expected, because the radiant heat absorbed by the black paper is mainly got rid of again by convection of the air in the narrow spaces between the layers of cellophane ; the less the density of the air the less heat it can carry, but the radiant heat from the sun remains the same. The experiment demonstrates the ease with which a body may be maintained at a high temperature in the stratosphere provided that the sun be above the horizon.

L. H. G. DINES.

REVIEWS

Atlas climatique de la Grèce. By. E. G. Mariolopoulos and A. N. Livathinos. Size 20 in. by 14 in. Observatoire National D'Athènes. Athens, 1935.

This lavishly produced climatological atlas contains no fewer than 118 charts, mostly of the full size of 13 by 11 inches, on a scale of 1/3,000,000. They are based on the records of 83 stations, of which 37 are rainfall stations, the whole being controlled by the first order Observatory of Athens. The positions of the stations are shown on a contour map and also, with the heights and periods of observation, in a table. The standard adopted is the thirty year period 1900–29, but not all the stations were in operation continuously throughout this period, and it does not appear that incomplete periods have been corrected for the missing years.

Temperature is represented by 13 charts showing the mean for each month and for the year, computed by the formula (8h. + 14h. + 2 × 21h.)/4, which is within about 0·1° C. of the 24-hour mean, and reduced to mean sea level at the rate of 0·6° C. per 100 metres. There is also a chart of annual range, and charts of the number of days (per thousand between November and April inclusive) of minima of 0° C. or less, and of the dates of first and last frosts. It would have been clearer if the actual number of days had been given ; it requires some mental arithmetic to determine that a frequency of 4 per thousand represents the occurrence of two frosts in thirty years.

Monthly charts of relative humidity are given, but data could be used for only 28 stations. For the lines of equal humidity the authors employ the term " isohygres ". Monthly charts of isonephs are based on 35 stations ; these, like the charts of humidity, show the direct means of three observations a day. There are also charts of the annual frequency of clear and overcast days, but for some unstated reason the authors adopt as criteria means of 1·3 tenths or less and 8·7 tenths or more instead of the customary criteria of less than 2 tenths and more than 8 tenths.

There is only one Campbell-Stokes sunshine recorder in Greece, that at the Observatory of Athens, and the charts of insolation are based on the mean cloudiness, assuming that the percentage of possible duration of sunshine is the complement of the percentage cloudiness. This relation does not hold in the British Isles in winter, but it is stated to be true for Athens.

Precipitation is represented by full-page coloured charts of monthly and annual rainfall, and by smaller charts of frequencies of rain-days (per month), and of hail, snow and thunderstorms (per thousand), but the meaning of the charts is not very clear. Finally there are a series of very useful charts of monthly mean pressures and wind-roses. The whole atlas forms a most valuable contribution to climatology of the eastern Mediterranean, and we look forward to receiving the companion volume of text, which is in the press.

C. E. P. Brooks.

Unsolved Problems of Science. By A. W. Haslett. Size 8 in. × 5½ in., pp. XI + 317. *Illus.* London, G. Bell and Sons, Ltd., 1935, 7*s.* 6*d.* net.

Popular scientific writers so frequently enlarge on the wonders and triumphs of science that the humble worker in one particular field, painfully aware of the gaps and uncertainties of his own knowledge, might perhaps be excused if he concluded that his own science was being outstripped by others in the race for new knowledge. For this reason he should welcome this book, which shows that other sciences too have their problems, unsolved and perhaps unsolvable. Mr. Haslett displays a wide knowledge, ranging from astronomy and physics to geology, archaeology and biology ; the chapters on physics are especially good, and really succeed in conveying in simple language a good idea of the present position of our knowledge of the constitution of matter.

The one meteorological chapter is however rather disappointing, dealing interestingly but almost exclusively with the practical problem of long range weather forecasting, and ignoring completely the more fundamental questions of the cycle of radiation, or the ultimate cause of oscillations within the atmosphere. Of course one must keep a sense of proportion and not expect a general book to consider all the subjects raised in the Royal Meteorological Society's " Problems of Modern Meteorology ", but one would at least have expected some discussion of the great problem of climatic changes.

A book like this does good service by introducing workers in one science to the lines along which their colleagues in other branches are thinking. The chapter on " Mathematics or Common Sense ? " is especially valuable in this connexion. It is shown that while atoms in the mass, whether solid, liquid or gaseous, act according to known laws, the behaviour of individual atoms is unpredictable.

A similar position is not unknown in meteorology; for example in thundery weather we can foresee the probable behaviour of the whole air-mass over southern England, but not of that particular portion of it which is over, for example, Kew Observatory.

Several problems of radiation are discussed in the chapter on "Messages from Space" which also deals with the highest sounding balloon ascents, sound waves, meteors, and cosmic rays. There is an interesting paradox about the temperature of inter-stellar space. This is now known to be occupied by a very tenuous "cosmic cloud", which is believed to be at a high temperature—some thousands of degrees. This high temperature however is rather an abstraction, for any solid body, such as a meteor, which traverses space would probably be intensely cold. If scientists ever succeed in penetrating these regions, the interpretation of the instrumental records will apparently be something of a problem.

The Climate of the Netherlands West Indies. By Dr. C. Braak. K. Ned. Meteor. Inst. No. 102, Med. en Verh. 36, pp. 85 (Dutch) + 32 (English Summary). *Illus. s* Gravenhage, 1935.

Dr. C. Braak continues his climatic survey of the Dutch colonies by a careful and thorough-going account of the data from Surinam (Dutch Guiana) and the Dutch islands of the West Indies.

Meteorologists generally have heard so little about this region in the past that it comes as a surprise to meet the great amount of data collected here—in Surinam 53 rainfall stations are listed; these are mostly near the coast, but the stations in the interior suffice to enable simple monthly charts of isohyets to be drawn. In the various islands of the Antilles there are 34 stations, but the rainfall distribution is not mapped.

The most complete data exist for Paramaribo in Surinam, including a rainfall series which is almost complete from 1847 to 1933, hourly means of rainfall, pressure, wind, mean and extreme temperature, humidity, sunshine, nebulosity, earth temperatures and phenomena; there are also data for four second-order stations in the Antilles, and even summaries of upper winds in Curaçao up to 13 Km. The whole publication is admirably compiled, with numerous tables and as usual, an excellent summary in English. The area, though not notable for extremes of climate (except that some of the islands are subject to drought), is one of great meteorological interest, and the work is a valuable addition to the literature.

BOOKS RECEIVED

Deutsches Meteorologisches Jahrbuch, 1931 *and* 1932. Freistaat Sachsen. Edited by Prof. Dr. E. Alt, Jahrg. 49 and 50, Dresden, 1933 and 1934.

Remarkable lightning photographs by C. G. Abbot, Washington, D.C., Smiths. Misc. Coll., Vol. 92, No. 12.

OBITUARY

Professor Luigi de Marchi.—We regret to learn of the death of Prof. L. de Marchi, at Padua on February 16th, 1936. Born at Milan on May 16th, 1857, he was educated at Pavia, where he received the degree of Doctor in Mathematics and Physics in 1880. He continued his studies in meteorology, publishing a text-book on "General Meteorology" in 1888 and on "Climatology" in 1890. In 1895 he broke new ground with a prize essay on " The Cause of the Glacial Period," in which the spread of the ice sheets is attributed to a fall of temperature due to a decrease in the transparency of the atmosphere. He returned to this subject in 1911 and again in 1935. In 1903 he became Reader in Meteorology and Librarian of the University of Pavia, and he was later appointed Professor of Physical Geography at Padua.

In recent years Prof. de Marchi played a large part in the organisation of scientific work in Italy. He was President of the Italian National Council for Research and of the Italian Commission for the Second Polar Year ; in the latter capacity he was co-opted a member of the International Commission for the Polar Year. He was first President, and at his death, Honorary President of the International Commission for the study of Climatic Variations, appointed by the International Union of Geography, and one of his last actions was to urge the creation of National Committees for the Study of Climatic Changes in all countries, charged with the preparation of national bibliographies and the pursuit of historical researches. The study of climatic changes was in fact one of the dominant interests of his long and busy life.

Richard Bentley.—We regret to learn of the death, on February 23rd, at the age of 81, of Mr. R. Bentley. He had been named after his grandfather, who founded the famous publishing house of Bentley and Son, subsequently taken over by Messrs. Macmillan in 1898. Mr. Bentley was President of the Royal Meteorological Society in 1905 and 1906, when he addressed the Fellows on " The Growth of Instrumental Meteorology " and " The Meteorology of Daily Life." Amongst his other contributions to meteorology, mention should be made of his rainfall record, which he continued after his father's death in 1895 at his residence at Upton, Slough. This record had been commenced there in the autumn of 1873. For many years Mr. Bentley sent a monthly report of his record to the British Rainfall Organization, and his return could be readily recognised by the handwriting, the extremely clear figures and the use of red ink to emphasize any unusual meteorological event. Mr. Bentley summarised the sixty years rainfall record and his temperature record covering thirty-six years in two pamphlets, published in 1934. In these pamphlets acknowledgment is given to Mr. George Baker, the deputy observer for over forty years. Mr. Bentley always maintained his interest in meteorology and completed himself the return for January, 1936, adding his comments in red ink, "eclipse of moon was itself eclipsed by weather." J. GLASSPOOLE.

Thomas Frederick Prosser.—It is with great regret that we learn of the death at the early age of 25 of Mr. T. F. Prosser, F.R.Met.Soc., meteorological observer and crop recorder at the Royal Agricultural College, Cirencester. Mr. Prosser was educated at the Cirencester Grammar School and joined the clerical staff of the Royal Agricultural College in 1928. He took charge of the climatological station at the College, which, after a period of inactivity, had recently been reconstituted as a Crop-Weather Station participating in the Agricultural Meteorological Scheme. Mr. Prosser showed great interest in this work, and made occasional contributions to this magazine and to the journal of the Royal Meteorological Society, besides furnishing regular weekly and monthly reports to local newspapers. His death on January 25th, 1936, deprives us of a valued co-operating observer.

We regret to learn of the death on February 7th, 1936, of Father Joseph de Moidrey, Director of the Lu-kia-pang Observatory from 1908 to 1932.

NEWS IN BRIEF

Prof. W. J. Humphreys, who retired on December 31st, 1935, after 30 years' service as meteorological physicist in the United States Weather Bureau, has become a collaborator of the Bureau to carry on research and advise on technical problems.

The 35th anniversary of the scientific career of the Academician B. P. Moultanovski, Director of the Institute for long-range forecasting was celebrated at the Central Physical Laboratory, Leningrad, on March 2nd, 1936.

Mrs. K. M. Dean of Kynaston Place, Much Marcle, Gloucestershire, informs us that she has a 5 in. rain-gauge of standard pattern which she desires to sell. Anyone wishing to purchase this should communicate direct with Mrs. Dean.

The Weather of February, 1936

Pressure was much above normal over the whole of the Arctic, the excess reaching 14 mb. at Mygbugten in north-east Greenland. A belt of pressure deficit in about 40° N. extended from the Pacific coast of America at least as far as the Caspian, with centres near Salt Lake City (— 6 mb.) and Brest (— 12 mb.). Temperature was above normal at Spitsbergen and in central and south-west Europe, but below normal in Scandinavia, 7°–11° in northern Norrland. Precipitation was mainly deficient in Spitsbergen and northern and central Europe being only 30 per cent. of the normal in north Gothaland.

From the 3rd to 14th a low pressure area lay over the North Atlantic giving a mean pressure of 988 mb. in 50° N., 30° W., while an anticyclone covered central Europe (Prague 1026 mb.). From the 15th to 24th the depression was centred over Scotland where pressure was below 995 mb. and the anticyclone had retreated to Siberia. The last few days of the month were characterised by extremely high pressure over Spitsbergen and a slight gradient for easterly winds over the British Isles.

The weather of February over the British Isles was mainly cold with sunshine above the normal except in south-west England and east Scotland and rainfall in excess in England, but deficient in Scotland and Ireland. Frosts were more frequent than usual. Mild unsettled conditions with rain in most places prevailed generally on the 1st as a depression passed eastwards across the country, but on the 2nd the winds were cold and northerly and there was much sun in the north and west. On the 3rd a ridge of high pressure crossed the country from the Atlantic, and from then to the 14th high pressure was maintained over or to the east of the British Isles, while depressions to the west influenced a varying amount of our western districts. Except in the south-west, conditions were of a wintry nature during this period and precipitation was mainly slight or moderate. Snow occurred generally in Scotland, north England and north Ireland and also on the 11th–13th in parts of south England and south Ireland. In the south-west precipitation was heavy at times especially on the 10th, when 3·10 in. were recorded at Dunmanway (Co. Cork) and 2·40 in. at the Scilly Isles. Southerly gales were experienced in the north and west on the 6th and 7th and south-easterly gales in the south-west on the 8th–11th—Beaufort force 10 was reached at the Lizard and St. Ann's Head on the 10th, and gusts of 92 m.p.h. and 88 m.p.h. were recorded at Valentia and the Scilly Isles respectively on the same day. Much sunshine occurred on the 3rd, 4th, 8th, 9th and 12th, in the south-east on the 7th and north on the 10th and 11th, over 8½ hours being recorded at several places in the south on these days. Mist or fog was prevalent from the 12th–14th and also occurred locally on the 5th and 6th. Except in the south-west temperature was low during this time and frost widespread—a maximum of 28° F. was recorded at Rhayader on the 11th, while temperature in the screen fell to 7° F. at Dalwhinnie and 11° F. at Huddersfield on the 13th, and on the ground to −2° F. at Dalwhinnie and 6° F. at Eskdalemuir and Penrith on the 13th. From the 15th–22nd complex low pressure areas passed in a north-easterly direction across the country. Conditions became milder on the 16th, and temperature was generally above normal until the 22nd, a maximum of 55° F. being reached at Manchester, Leamington and London on the 18th. Fog was widespread on the 15th–17th. Rain occurred most days and was heavy in the south on the 17th, when 2·02 in. fell at Holne (Devon), while snow was recorded in the north and Midlands on the 19th and 21st–22nd. On the 17th the winds increased to gale force in the south-west, and southerly gales were experienced in parts of the west and north on the 18th, continuing intermittently in the north until the 22nd. From the 23rd–29th depressions moved south-eastwards across the country and the weather became generally cold again with slight precipitation most days—snow was reported from many places. Fog occurred locally in south-east England and the Midlands, and on the 28th a thunderstorm was reported from Markree Castle. There was litle sun during the second half of the month except on the 20th, when 9·0 hours were recorded at Lowestoft. The distribution of bright sunshine for the month was as follows :—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway ...	81	+27	Chester ...	67	+ 8
Aberdeen ...	63	− 4	Ross-on-Wye ...	80	+25
Dublin	73	− 2	Falmouth ...	64	−15
Birr Castle ...	67	+ 3	Gorleston ...	75	0
Valentia... ...	72	+ 7	Kew	75	+14

Miscellaneous notes on weather abroad culled from various sources

A whirlwind in the Tremolat district near Bordeaux on the 3rd stripped roofs of tiles and uprooted trees. A strong south-westerly gale culminating in torrential rain was blowing in Switzerland on the 1st—on the 2nd the temperature dropped and snow fell generally. A gale occurred in the Gulf of Genoa on the 5th. Two lightvessels near Helsinki left their stations owing to ice about the 6th. Temperature fell generally over the whole of central and western Europe about the 9th—many rivers in the low country in Switzerland were frozen by the 10th, and six deaths occurred. Heavy snow fell in Germany on the 9th, and unusually heavy snowfalls were experienced in Austria, Hungary, the Balkans and north Italy about the 10th, while bitterly cold weather with strong winds was general in France—both here and in Germany ice on the roads caused many minor accidents. A severe northerly gale followed by heavy snowstorms did great damage on the 11th and 12th in the Balkans, Turkey and the Black Sea ports ; severe gales also occurred at the same time over the Adriatic Sea and as far east as Palestine and north Egypt—numerous lighters were sunk and much material damage done, while 92 deaths were reported in Bulgaria and 32 in Turkey. Mild weather prevailed generally in the lower parts of Switzerland on the 15th–18th, though in the Engadine and central Switzerland there was frost. Ice was obstructing navigation at Kalmar on the 18th. Fog occurred generally in extreme north-west Germany on the 3rd, 18th and 20th. Heavy continuous rains in Spain and Portugal were accompanied by serious floods about the 20th, especially near Seville, Zamora, Regua and Santarem—many villages were isolated, houses collapsed, and at Seville six people were drowned. By the 23rd the floods were subsiding, the port of Seville being re-opened to navigation on the 24th, and the Douro river almost normal near Oporto on the 27th. From the 16th–26th heavy snowstorms were experienced in Denmark —all traffic was snowbound, villages isolated and the food supply of Copenhagen endangered. A protracted spell of unusually cold weather occurred in Finland towards the end of the month so that the ice-breakers could keep only the ports of Hangö and Abo open. (*The Times*, February 3rd–29th.)

One of the most disastrous hailstorms experienced in the Northern Transvaal occurred on the edge of the foothills of Springbok Flats on the 1st. An enormous low black cloud was seen to approach— "About 3 in. of rain fell in a few minutes and then came the hail, which consisted of jagged lumps of ice. In 30 minutes the hail was lying everywhere to a depth of 3 ft." 19 natives and many cattle were killed and whole crops obliterated. Storms occurred over Southern Rhodesia on the 8th. A landslip following a storm destroyed part of Masisi, a village in Costermansville (Belgian Congo) about the 18th, and 31 Congolese lost their lives. The premature "little rains" continued in Abyssinia during the month. Extensive damage was done along the Algerian coast by a gale on the 27th and 28th.—(*The Times*, February 3rd–29th).

A blizzard said to be the worst for many years swept over Tokyo on the 4th—all traffic was snowbound. At the beginning of the month the sea was frozen along the entire coast of the Gulf of Chihli and the ice extended more than 50 miles seawards—Tientsin, Chefoo and other ports were closed. Heavy snowstorms were also experienced in north and central China. An improvement in the weather about the 9th caused the ice to break up, but Tientsin was again icebound on the 20th. Lahore experienced an exceptionally heavy hailstorm about the 26th, when some of the hailstones were said to weigh 11½ grams. (*The Times*, February 6th–28th.)

Rainfall for Australia was below normal except in parts of Queensland, South Australia and New South Wales. Early in February a severe cyclone swept practically the whole of the North Island of New Zealand. The damage caused by wind and rain was considerable, especially in the Manawatu and Taranaki divisions. Heavy stock losses occurred in Waikato and adjoining districts, and floods damaged many farms in Hawke's Bay. All traffic and communications were disorganised and nine men lost their lives. (Cable, *The Times*, February 4th–5th, and report from the Bank of New South Wales.)

Temperature was considerably below normal in the United States during most of the month, only rising above normal locally to the west of the Rockies about the middle and towards the end of the month. Precipitation was very variable, but above normal in several parts. About the 4th there was a slight thaw in New York State and floods were experienced in the south. Except for the short interval about the 18th, intense cold and intermittent heavy snowfalls prevailed over the whole of North America from the 6th–24th; on the 16th 50° F. was registered at Williston (N. Dakota) and—56° F. at Battleford (Saskatchewan). Dust storms occurred in the central States on the 24th and floods in many parts later in the month. A tornado swept across southern California on the 12th. (*The Times*, February 4th–28th, and *Washington, D.C., U.S. Dept. Agric. Weekly Weather and Crop Bulletin*.)

Daily Readings at Kew Observatory, February, 1936

Date	Pressure, M.S.L. 13h.	Wind, Dir., Force 13h.	Temp. Min.	Temp. Max.	Rel. Hum. 13h.	Rain.	Sun.	REMARKS. (see vol. 69, 1934, p. 1).
	mb.		°F.	°F.	%	in.	hrs.	
1	987·7	WSW.3	45	50	84	0·11	0·8	r 7h.–8h. r_0 21h.
2	987·8	NW.2	42	46	71	0·26	0·9	r 5h.–7h.; 15h.–17h.
3	1003·0	NW.4	34	40	60	—	4·1	x early.
4	1017·7	NW.2	27	37	57	—	7·0	x early & late.
5	1024·5	SE.2	28	42	57	—	0·0	x early.
6	1031·1	SE.3	35	44	57	—	5·2	x early.
7	1033·5	SE.3	30	38	53	—	6·8	x early.
8	1023·4	E.5	28	37	62	—	7·0	
9	1012·2	E.4	30	40	62	—	6·6	x early.
10	1018·4	E.6	35	38	53	—	3·2	
11	1010·6	E.4	27	31	47	—	0·0	
12	1020·8	E.3	25	39	53	—	3·6	x early. f. 9h.–13h.
13	1019·7	E.3	25	42	58	—	2·3	fx early.
14	1008·7	E.4	31	43	60	—	5·6	x early.
15	998·4	Calm.	35	41	100	0·09	0·0	Fd_0 all day.
16	1000·6	Calm.	32	38	85	—	2·2	f evening.
17	996·9	SSW.3	33	51	86	0·08	1·2	fd_0 early.
18	984·7	SSW.4	45	53	84	0·32	1·5	r 0h.–6h., pr 14h.
19	991·0	S.3	41	51	92	0·07	0·6	r–d_0 4h.–15h.
20	1010·5	SW.3	36	49	60	—	7·9	x early.
21	1006·6	WNW.2	42	48	70	0·04	0·2	r_0 0h.–5h.
22	995·5	ESE.4	28	45	96	0·35	0·0	r–r_0 7h.–17h.
23	995·6	WNW.2	38	42	71	0·04	0·1	r–r_0 1h.–7h.
24	1002·6	NE.1	31	43	81	0·04	0·0	r 23h.–24h.
25	1019·8	NNE.3	36	39	72	0·09	0·0	r–r_0 0h.–7h.
26	1015·7	SW.3	35	43	58	trace	0·7	r_0 18h.–23h.
27	995·4	WSW.2	40	46	66	0·07	4·5	r_0–r 0h.–6h. & 10h.
28	988·8	NNE.2	32	41	77	—	2·6	F till 11h.
29	986·8	NW.2	34	39	81	0·04	0·2	ir_0 10h.–24h.
*	1006·5	—	34	43	69	1·61	2·6	* Means or totals.

General Rainfall for February, 1936.

England and Wales ...	127	per cent. of the average 1881–1915.
Scotland	87	
Ireland	93	
British Isles	112	

Rainfall : February, 1936 : England and Wales

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Lond .	Camden Square	1·47	88	*Leics* .	Thornton Reservoir	2·97	177
Sur .	Reigate, Wray Pk. Rd.	1·98	90	,, .	Belvoir Castle	1·98	119
Kent .	Tenterden, Ashenden	1·90	97	*Rut* .	Ridlington	1·99	121
,, .	Folkestone, Boro. San.	3·16	...	*Lincs* .	Boston, Skirbeck	2·65	182
,, .	Eden'bdg., Falconhurst	2·20	100	,, .	Cranwell Aerodrome	2·19	146
,, .	Sevenoaks, Speldhurst.	1·99	...	,, .	Skegness, Marine Gdns.	2·28	149
Sus .	Compton, Compton Ho.	3·05	116	,, .	Louth, Westgate	3·08	161
,, .	Patching Farm	2·85	129	,, .	Brigg, Wrawby St.	2·36	...
,, .	Eastbourne, Wil. Sq.	2·26	102	*Notts* .	Worksop, Hodsock	2·67	173
,, .	Heathfield, Barklye	2·60	111	*Derby* .	Derby, L. M. & S. Rly.	1·47	91
Hants .	Ventnor, Roy.Nat.Hos.	3·11	148	,, .	Buxton, Terr. Slopes	3·58	95
,, .	Fordingbridge, Oaklnds	2·72	109	*Ches* .	Runcorn, Weston Pt.	1·96	105
,, .	Ovington Rectory	3·79	146	*Lancs* .	Manchester, Whit. Pk.	1·98	103
,, .	Sherborne St. John	2·16	99	,, .	Stonyhurst College	2·08	62
Herts .	Royston, Therfield Rec.	2·08	135	,, .	Southport, Bedford Pk.	2·28	109
Bucks .	Slough, Upton	...	...	,, .	Lancaster, Greg Obsy.	2·09	72
,, .	H. Wycombe, Flackwell	2·00	104	*Yorks* .	Wath-upon-Dearne	2.54	155
Oxf .	Oxford, Mag. College	1·34	85	,, .	Wakefield, Clarence Pk.	2·88	169
Nor .	Wellingboro, Swanspool	1·92	119	,, .	Oughtershaw Hall	3·35	...
,, .	Oundle	1·65	...	,, .	Wetherby, Ribston H.	...	...
Beds .	Woburn, Exptl. Farm	1·91	129	,, .	Hull, Pearson Park	2·19	132
Cam .	Cambridge, Bot. Gdns.	1·96	153	,, .	Holme-on-Spalding	2·23	133
Essex .	Chelmsford, County Gdns	1·64	111	,, .	West Witton, Ivy Ho.	3·33	116
,, .	Lexden Hill House	2·06	...	,, .	Felixkirk, Mt. St. John.	3·01	178
Suff .	Haughley House	2·50	...	,, .	York, Museum Gdns.	1·99	132
,, .	Campsea Ashe	2·94	214	,, .	Pickering, Hungate	2·66	153
,, .	Lowestoft Sec. School	2·70	193	,, .	Scarborough	2·30	137
,, .	Bury St. Ed., WestleyH.	3·19	213	,, .	Middlesbrough	2·95	227
Norf. .	Wells, Holkham Hall	2·42	163	,, .	Baldersdale, Hury Res.	...	...
Wilts .	Calne, Castle Walk	1·97	...	*Durh* .	Ushaw College	3·88	244
,, .	Porton, W.D. Exp'l. Stn	2·76	139	*Nor* .	Newcastle, D. & D. Inst.	3·37	234
Dor .	Evershot, Melbury Ho.	3·92	125	,, .	Bellingham, Highgreen	2·84	112
,, .	Weymouth, Westham.	3·29	152	,, .	Lilburn Tower Gdns.	4·05	207
,, .	Shaftesbury, Abbey Ho.	2·37	103	*Cumb* .	Carlisle, Scaleby Hall	1·78	80
Devon .	Plymouth, The Hoe	4·96	167	,, .	Borrowdale, Seathwaite	6·50	58
,, .	Holne, Church Pk. Cott.	6·77	123	,, .	Borrowdale, Moraine	5·34	57
,, .	Teignmouth, Den Gdns.	3·77	142	,, .	Keswick, High Hill	3·48	71
,, .	Cullompton	3·13	112	*West* .	Appleby, Castle Bank	1·90	64
,, .	Sidmouth, U.D.C.	2·91	...	*Mon* .	Abergavenny, Larchf'd	3·39	106
,, .	Barnstaple, N. Dev.Ath	2·47	91	*Glam* .	Ystalyfera, Wern Ho.	2·57	50
,, .	Dartm'r, Cranmere Pool	5·70	...	,, .	Cardiff, Ely P. Stn.	1·70	57
,, .	Okehampton, Uplands.	5·61	129	,, .	Treherbert, Tynywaun.	4·35	...
Corn .	Redruth, Trewirgie	7·43	197	*Carm* .	Carmarthen, Coll. Rd.	2·85	77
,, .	Penzance, Morrab Gdns.	7·26	217	*Pemb* .	St. Ann's Hd, C. Gd. Stn.	2·89	109
,, .	St. Austell, Trevarna	7·69	200	*Card* .	Aberystwyth	1·73	...
Soms .	Chewton Mendip	2·96	88	*Rad* .	BirmW.W.Tyrmynydd	3·66	70
,, .	Long Ashton	2·65	113	*Mont* .	Lake Vyrnwy	2·78	61
,, .	Street, Millfield	2·04	...	*Flint* .	Sealand Aerodrome	2·20	...
Glos .	Blockley	2·40	...	*Mer* .	Dolgelley, Bontddu	2·93	66
,, .	Cirencester, Gwynfa	2·42	107	*Carn* .	Llandudno	2·24	115
Here .	Ross, Birchlea	1·99	99	,, .	Snowdon, L. Llydaw 9.	7·31	...
Salop .	Church Stretton	2·89	131	*Ang* .	Holyhead, Salt Island	2·47	101
,, .	Shifnal, Hatton Grange	2·11	131	,, .	Lligwy	2·49	...
Staffs .	Market Drayt'n, Old Sp.	1·61	93	*Isle of Man*			
Worc .	Ombersley, Holt Lock.	2·25	137		Douglas, Boro' Cem.	3·71	116
War .	Alcester, Ragley Hall	1·93	117	*Guernsey*			
,, .	Birmingbm, Edgbaston	2·74	162		St. PeterP't.Grange Rd.	4·20	171

Erratum: Chelmsford, County Gdns., January, for 4·19/274 read 4·13/270

Rainfall: February, 1936: Scotland and Ireland

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Wig	Pt. William, Monreith	1·94	63	*Suth*	Melvich	1·61	54
„	New Luce School	2·63	69	„	Loch More, Achfary	2·99	45
Kirk	Dalry, Glendarroch	3·03	60	*Caith*	Wick	1·48	65
„	Carsphairn, Shiel	4·03	61	*Ork*	Deerness	2·09	69
Dumf.	Dumfries, Crichton R.I.	2·13	69	*Shet*	Lerwick	2·89	91
„	Eskdalemuir Obs	3·52	71	*Cork*	Caheragh Rectory	...	...
Roxb	Hawick, Wolfelee	3·81	117	„	Dunmanway Rectory	6·77	116
Selk	Ettrick Manse	3·84	83	„	Cork, University Coll	6·05	162
Peeb	West Linton	3·23	...	„	Ballinacurra	5·79	155
Berw	Marchmont House	3·95	190	„	Mallow, Longueville	4·57	134
E.Lot	North Berwick Res	2·75	176	*Kerry*	Valentia Obsy	3·59	69
Midl	Edinburgh, Blackfd. H.	2·44	147	„	Gearhameen	6·50	73
Lan	Auchtyfardle	2·33	...	„	Bally McElligott Rec	2·70	...
Ayr	Kilmarnock, Kay Pk	1·54	...	„	Darrynane Abbey	4·80	104
„	Girvan, Pinmore	1·94	45	*Wat*	Waterford, Gortmore	4·57	142
Renf	Glasgow, Queen's Pk	1·75	58	*Tip*	Nenagh, Cas. Lough	...	...
„	Greenock, Prospect H.	3·74	67	„	Roscrea, Timoney Park	...	...
Bute	Rothesay, Ardencraig	3·02	...	„	Cashel, Ballinamona	2·85	90
„	Dougarie Lodge	2·15	...	*Lim*	Foynes, Coolnanes	2·07	65
Arg	Ardgour House	3·97	...	„	Castleconnel Rec	1·77	...
„	Glen Etive	...	...	*Clare*	Inagh, Mount Callan	4·28	...
„	Oban	2·75	...	„	Broadford, Hurdlest'n.	1·87	...
„	Poltalloch	2·98	69	*Wexf*	Gorey, Courtown Ho	3·75	133
„	Inveraray Castle	4·64	68	*Wick*	Rathnew, Clonmannon.	3·73	...
„	Islay, Eallabus	...	...	*Carl*	Hacketstown Rectory	2·88	96
„	Mull, Benmore	...	...	*Leix*	Blandsfort House	2·03	76
„	Tiree	...	...	*Offaly.*	Birr Castle	1·78	78
Kinr	Loch Leven Sluice	...	...	*Dublin*	Dublin, FitzWm. Sq	1·69	89
Fife	Leuchars Aerodrome	3·53	202	„	Balbriggan, Ardgillan	1·86	95
Perth	Loch Dhu	...	...	*Meath.*	Beauparc, St. Cloud	1·78	...
„	Balquhidder, Stronvar.	3·45	...	„	Kells, Headfort	1·89	70
„	Crieff, Strathearn Hyd.	2·80	80	*W.M*	Moate, Coolatore	1·70	...
„	Blair Castle Gardens	1·66	60	„	Mullingar, Belvedere	2·07	75
Angus.	Kettins School	3·70	158	*Long*	Castle Forbes Gdns	2·16	76
„	Pearsie House	3·49	...	*Gal*	Galway, Grammar Sch.	1·80	...
„	Montrose, Sunnyside	2·72	148	„	Ballynahinch Castle	4·48	88
Aber	Braemar, Bank	2·00	70	„	Ahascragh, Clonbrock.	2·42	78
„	Logie Coldstone Sch	...	...	*Mayo.*	Blacksod Point	...	...
„	Aberdeen, Observatory.	1·91	93	„	Mallaranny	4·48	...
„	Fyvie Castle	3·28	146	„	Westport House	3·85	98
Moray	Gordon Castle	1·29	67	„	Delphi Lodge	6·28	75
„	Grantown-on-Spey	1·52	72	*Sligo*	Markree Castle	2·13	62
Nairn.	Nairn	1·40	78	*Cavan.*	Crossdoney, Kevit Cas.	2·23	...
Inv's	Ben Alder Lodge	1·67	...	*Ferm*	Enniskillen, Portora	1·80	...
„	Kingussie, The Birches.	1·58	...	*Arm*	Armagh Obsy	1·77	80
„	Inverness, Culduthel R.	1·89	...	*Down.*	Fofanny Reservoir	4·79	...
„	Loch Quoich, Loan	3·50	...	„	Seaforde	3·57	117
„	Glenquoich	...	...	„	Donaghadee, C. G. Stn.	2·32	100
„	Fort William, Glasdrum	3·19	...	„	Banbridge, Milltown	...	...
„	Skye, Dunvegan	2·53	...	*Antr*	Belfast, Cavehill Rd	2·60	...
„	Barra, Skallary	2·28	...	„	Aldergrove Aerodrome.	1·72	71
R&C	Alness, Ardross Castle.	3·34	101	„	Ballymena, Harryville.	2·29	71
„	Ullapool	1·71	40	*Lon*	Garvagh, Moneydig	1·75	...
„	Achnashellach	...	...	„	Londonderry, Creggan.	2·18	68
„	Stornoway	2·24	50	*Tyr*	Omagh, Edenfel	2·07	69
Suth	Lairg	3·14	101	*Don*	Malin Head	...	...
„	Tongue	2·46	70	„	Killybegs, Rockmount.	1·81	...

Climatological Table for the British Empire, September, 1935

STATIONS.	PRESSURE. Mean of Day M.S.L. mb.	PRESSURE. Diff. from Normal. mb.	TEMPERATURE. Absolute. Max. °F.	TEMPERATURE. Absolute. Min. °F.	TEMPERATURE. Mean Values. Max. °F.	TEMPERATURE. Mean Values. Min. °F.	TEMPERATURE. Mean Values. ½ Max. and Min. °F.	TEMPERATURE. Mean Values. Diff. from Normal °F.	TEMPERATURE. Mean. Wet Bulb. °F.	Relative Humidity. %	Mean Cloud Am'nt 0–10	PRECIPITATION. Am'nt. in.	PRECIPITATION. Diff. from Normal. in.	PRECIPITATION. Days.	BRIGHT SUNSHINE. Hours per day.	BRIGHT SUNSHINE. Percentage of possible.
London, Kew Obsy....	1012·1	− 5·3	71	39	65·7	51·4	58·5	+ 1·4	53·5	88	7·2	2·55	+ 0·68	18	5·0	40
Gibraltar........	1017·4	+ 0·2	94	61	81·2	66·0	73·6	+ 1·2	64·0	81	5·4	0·85	− 0·46	3	...	...
Malta........	1016·1	− 0·2	87	63	80·4	71·6	76·0	0·0	70·4	77	3·1	0·63	− 0·64	3	9·7	78
St. Helena	1015·6	0·0	62	52	59·1	53·4	56·3	− 1·1	54·0	92	9·9	2·33	...	19	...	...
Freetown, Sierra Leone	1012·9	+ 0·7	87	69	83·3	71·8	77·5	− 1·6	75·2	89	7·8	34·38	+ 5·90	26	...	...
Lagos, Nigeria	1012·9	+ 0·7	86	72	83·6	74·7	79·1	+ 0·4	74·7	85	8·9	2·32	− 3·27	17	4·4	36
Kaduna, Nigeria	1009·2	...	88	66	84·6	68·1	76·3	+ 1·0	71·4	89	7·9	13·34	+ 1·84	26	5·7	47
Zomba, Nyasaland	1012·0	− 1·7	90	52	82·9	59·9	71·4	+ 1·9	61·3	52	1·4	0·08	− 0·26	1	...	...
Salisbury, Rhodesia...	1013·4	− 1·8	92	48	82·2	54·2	68·2	+ 1·8	54·8	36	1·4	0·33	+ 0·05	2	8·7	73
Cape Town	1019·8	+ 0·7	75	40	64·3	49·5	56·9	− 1·0	51·7	83	5·7	2·10	− 0·14	16	...	...
Johannesburg	1014·3	− 1·5	81	40	71·2	47·7	59·5	+ 0·1	46·1	40	0·4	0·23	− 0·73	5	8·7	73
Mauritius	1019·7	− 0·5	81	60	76·5	64·0	70·3	+ 0·2	65·8	69	5·7	1·44	+ 0·14	19	7·8	65
Calcutta, Alipore Obsy.	1002·8	− 1·7	94	77	89·4	79·3	84·3	+ 1·1	79·6	89	7·3	6·67	− 3·34	12*	...	...
Bombay	1006·8	− 1·2	87	73	84·3	75·4	79·9	− 1·0	75·9	88	7·0	11·90	+ 1·22	16*	...	...
Madras	1005·8	− 0·7	97	74	91·9	77·0	84·5	− 0·7	75·8	74	6·9	2·98	− 1·87	6*	...	...
Colombo, Ceylon	1010·3	+ 0·4	86	71	84·6	75·9	80·3	− 0·9	76·4	77	6·7	3·80	− 0·96	17	7·5	62
Singapore........	1009·5	− 0·3	89	72	86·9	76·8	81·9	+ 0·8	77·9	80	5·4	4·03	− 2·76	10	7·3	60
Hongkong........	1008·1	− 0·2	89	65	83·1	74·7	78·9	− 2·1	74·3	79	7·2	7·37	− 2·32	17	5·1	42
Sandakan	1008·7	...	92	72	89·3	74·9	82·1	+ 0·4	76·7	79	7·1	12·69	+ 3·36	16	...	...
Sydney, N.S.W........	1016·0	− 0·1	79	44	66·0	49·5	57·7	− 1·5	52·7	63	4·8	2·16	− 0·70	14	7·0	59
Melbourne	1015·8	0·0	74	36	63·7	44·5	54·1	0·0	49·6	70	5·2	1·99	− 0·45	16	6·5	55
Adelaide	1015·2	− 2·3	79	43	67·8	49·1	58·5	+ 1·4	52·4	60	5·3	2·77	+ 0·72	11	6·9	58
Perth, W. Australia ...	1017·1	− 0·9	68	45	64·3	50·5	57·4	− 0·8	52·7	70	6·0	3·41	− 0·01	18	6·4	54
Coolgardie	1014·3	− 2·8	87	36	71·1	44·4	57·7	− 1·0	50·8	55	1·6	0·02	− 0·65	1	...	...
Brisbane........	1016·0	− 1·6	82	46	73·8	54·6	64·2	− 1·0	57·6	62	3·6	3·49	+ 1·49	8	7·6	64
Hobart, Tasmania........	1014·4	+ 3·4	66	37	57·9	43·0	50·5	− 0·5	45·4	66	5·7	0·79	− 1·28	16	6·1	52
Wellington, N.Z.	1019·8	+ 5·2	63	34	53·7	41·5	47·6	− 4·0	45·6	74	6·6	4·80	+ 0·83	13	6·5	55
Suva, Fiji	1013·2	− 1·1	88	63	79·9	70·7	75·3	+ 0·8	71·0	86	8·2	14·05	+ 6·36	26	3·2	27
Apia, Samoa	1011·1	− 1·1	87	71	85·3	74·5	79·9	+ 1·7	75·8	75	4·7	7·00	+ 1·89	15	8·2	68
Kingston, Jamaica	1011·6	− 0·6	94	72	88·5	74·5	81·5	0·0	72·5	81	6·2	6·98	+ 2·95	7	3·7	30
Grenada, W.I.	...	...	87	71	84	74	79	− 1·3	73	74	6	11·10	+ 3·11	18	...	...
Toronto........	1016·9	− 0·9	82	33	67·7	49·9	58·8	− 1·7	52·3	81	5·2	3·20	+ 0·53	13	6·4	51
Winnipeg	1015·3	+ 1·5	82	28	62·3	41·7	52·0	− 1·7	42·7	90	5·2	1·63	− 0·59	14	5·3	42
St. John, N.B.	1014·6	− 2·8	71	41	62·1	48·3	55·2	− 0·7	50·9	83	6·4	3·93	+ 0·19	16	5·7	45
Victoria, B.C........	1015·8	− 0·6	79	45	65·0	50·4	57·7	+ 1·6	50·7	91	2·5	1·18	− 0·63	5	9·0	72

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

(30851) Wt. 18/32 1050 3/36 Hw. G.377/6

M.O. 403.

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Recent Studies of Rainfall in Germany

(1) *Regenbeobachtungen, Wasserstands und Wassermengenmessungen* By F. Reinhold, Städtereinigung, Berlin, 27, 1935, pp. 666–9.

(2) *Grenzwerte starker Regenfälle.* By F. Reinhold, Gesundheitsing, Berlin, 58, 1935, pp. 369–70.

(3) *Einige Sonderfragen zur Durchführung und Auswertung von Regenbeobachtungen.* By F. Reinhold, Gesundheitsing, Berlin, 58, 1935, pp. 612–8 and pp. 626–30.

(4) *Die einheitliche Durchführung von Niederschlagsmessungen.* By F. Reinhold, Gesundheitsing, Berlin, 58, 1935, pp. 692–700.

These four papers by Dr. Reinhold of Dresden, published in periodicals circulating among municipal engineers and sanitary authorities, contain much matter of interest to students of rainfall. In this brief note I propose to refer in particular to papers (2) and (3) because they contain data relating to a subject which has recently received much attention in this country, namely the duration and intensity of heavy falls. An analysis of results obtained in the British Isles has recently been published* and it is proposed to publish in *British Rainfall*, 1935, a further paper on the classification of heavy falls in short periods, based on the same data. Dr. Reinhold's papers afford a welcome opportunity of comparing ideas in regard to this very important branch of rainfall study.

* The incidence of intense rainfall as shown by autographic records—*London, Water and Water Engineering*, 37, 1935, pp. 622–6.

In paper (2) Dr. Reinhold uses data from Dresden to determine the form of the relation between i the average intensity in millimetres per minute and T the duration in minutes, for various classes of intense rainfall. He distinguishes three classes, " Starkregen," " Platzregen " and " Wolkenbruch," which may be roughly rendered into English as " intense rain," " violent rain " and " torrential rain," and he reaches the conclusion that the lower limits of intensity for the three classes may be represented by curves of the form $i = C/(T + b)^a$; for all three classes the values of the constants b and a are 18 and 0·765 respectively; the constant C has the value 9·0 for " Starkregen," 13·5 for " Platzregen," and 18·0 for " Wolkenbruch." By multiplying the intensity by the time in minutes we obtain values of the total fall in time T which we can compare directly with the lower limits adopted in *British Rainfall* for the classification of heavy falls in short periods. The results of such a comparison are given in Table I. It will be seen that a Dresden

TABLE I.—Lower limits of intense rainfalls (millimetres)

Time in minutes.	5	10	20	30	60	90	120
	mm.	mm.	mm.	mm.	mm.	mm.	mm.
	Dresden (F. Reinhold)						
Starkregen	4·1	7·0	11·1	13·9	19·2	22·7	24·8
Platzregen	6·1	10·5	16·7	20·9	28·8	34·1	37·2
Wolkenbruch	8·2	14·0	22·1	27·8	38·4	45·4	49·6
	British Rainfall (H. R. Mill, introduced in 1908)						
Noteworthy	4·1	7·6	13·5	17·8	25·4	29·2	31·3
Remarkable	9·4	16·5	26·9	34·3	44·5	48·0	49·3
Very Rare	14·7	25·4	40·1	50·8	57·4	66·0	67·3
	British Rainfall (from January 1st, 1936)						
Noteworthy	10·9	13·8	17·3	19·7	24·5	27·8	30·4
Remarkable	17·3	21·6	26·8	30·3	37·6	42·4	46·2
Very Rare	26·8	33·2	40·9	46·2	56·8	64·0	69·4

" Starkregen " lasting 5 minutes just reaches the old *British Rainfall* " noteworthy " limit but no " Starkregen " would now qualify for that classification. A " Platzregen " lasting more than about 25 minutes would qualify as " noteworthy "; a " Wolkenbruch " lasting 10 minutes would qualify as " noteworthy " and one lasting 60 minutes would qualify as " remarkable."

The new limits in the *British Rainfall* classification, introduced January 1st, 1936, are computed to give a uniform frequency of incidence; thus, taking the " noteworthy " limits, a fall of 10·9 mm. in 5 minutes or less may be expected to occur neither more nor less often than a fall of 19·7 mm. in 30 minutes or less, or 27·8 mm. in 90 minutes or less. In other words, the limiting curves are "constant-frequency" graphs. We therefore turn with interest to a table in paper (3) which gives frequency data for various types of intense rain at Dresden. The table gives the mean intensity of rains lasting from 5 to 200 minutes which occur at Dresden on the average n times per year, data being given for $n = 0{\cdot}2, 0{\cdot}5, 1{\cdot}0, 2{\cdot}0$ and $3{\cdot}0$. The intensities are stated in terms of a rather peculiar unit, namely, litres per second per hectare. Since 1 mm. of rain is equivalent to 10,000 litres per hectare we can compute the corresponding total amounts of rain in millimetres and compare these with corresponding British data. Table II shows the results for times 5 to 100 minutes

TABLE II.—COMPUTED AMOUNTS OF RAIN FALLING IN STATED TIMES WITH A FREQUENCY OF (*a*) ONCE IN 5 YEARS, (*b*) ONCE A YEAR

Time	Once in 5 years.		Once a year.	
	Dresden.	England and Wales.*	Dresden.	England and Wales.*
	mm.	mm.	mm.	mm.
5 min. or less ...	7·7	8·4	4·3	4·6
10 " " ...	12·7	10·9	7·2	5·8
20 " " ...	18·7	14·0	10·7	7·9
30 " " ...	22·0	15·7	12·4	9·1
40 " " ...	23·5	17·5	13·7	10·2
60 " " ...	26·3	19·8	15·5	11·7
100 " " ...	28·2	23·1	17·4	14·0

* Average of 12 stations 1925–34.

corresponding to frequencies $n = 0{\cdot}2$ (once in 5 years) and $n = 1$ (once a year). The British data given in this table are computed from 10 years' observations at 12 stations in England and Wales. It will be noticed that the amounts of rain falling in stated times are substantially greater at Dresden than in England and Wales, except for a time of 5 minutes or less. It appears, therefore, that Dresden is more liable than most parts of England to heavy rains of moderate duration.

E. G. BILHAM.

Thunderstorms in the Tasman Sea and Coral Sea, March, 1934

BY H. C. WEBSTER, PH.D., F.INST.P., G. H. MUNRO, M.SC., A.M.I.E.E., AND A. J. HIGGS, B.SC.

Owing to the absence of fixed observing stations, relatively little is known concerning sea thunderstorms. The wireless direction-finders for atmospherics, developed by the British Radio Research

Board, have been used in Australia to locate sea thunderstorms (strictly groups of thunderstorms, which have been termed "sources"). Observations from Toowoomba and Canberra D.F. stations during March, 1934, gave reasonably accurately the locations of most, if not all, the active sources occurring in the Tasman Sea and Coral Sea. Frontal weather analysis of this region was carried out by the New Zealand Meteorological Office during this period and through the kindness of Dr. W. A. Macky of that office we have been able to compare the positions of the sources with the fronts.

We have classified the sources as "frontal" or "non-frontal", defining as frontal all sources which are near fronts or occlusions—allowing a generous margin of proximity on account of (*a*) inaccuracies in the location of the sources, (*b*) inaccuracies in the placing of the fronts and (*c*) movements of the fronts. In Fig. 1 the frontal sources are indicated by crosses and non-frontal sources by dots. It will be noted that in the lower latitudes non-frontal sources are in the majority. Table I makes this clear.

TABLE 1.—NUMBERS OF SOURCES LOCATED WITHIN EACH 5° INTERVAL OF LATITUDE

Latitudes. S.	Frontal sources.	Non-frontal sources.	Percentages of frontal sources.
10°–15° ...	1	6	12
15°–20° ...	9	15½*	37
20°–25° ...	14½	17½	45
25°–30° ...	11½	19	38
30°–35° ...	4½	2½	64
35°–45° ...	6½	1½	81

For thunderstorms over land it is permissible to assume that the majority of non-frontal sources would consist of thunderstorms of the "heat" type. In the case of sea sources, however, this appears improbable, since it is difficult to picture the normal mechanism of heat thunderstorms taking place at sea. The upper air instability, which supplies the bulk of the energy for the thunderstorm is of course not affected by the nature of the surface, but the necessary trigger action is ordinarily supplied by the convectional instability in the lower levels due to excessive surface heating. It is probable that additional secondary fronts, not shown in the New Zealand analysis, were present. Meteorological data for the area are too sparse to allow the detection of secondary fronts. Many of the sources were situated in low pressure areas which may have contained secondary fronts. Some of the thunderstorms, particularly for latitudes north of 25° were possibly heat thunderstorms over islets and reefs.

It has been suggested that the minor temperature discontinuities

* A source located on a boundary line is counted as half a source in each of the relevant squares.

where two ocean currents meet could possibly give the necessary trigger action. The chief ocean currents are indicated in the diagram.

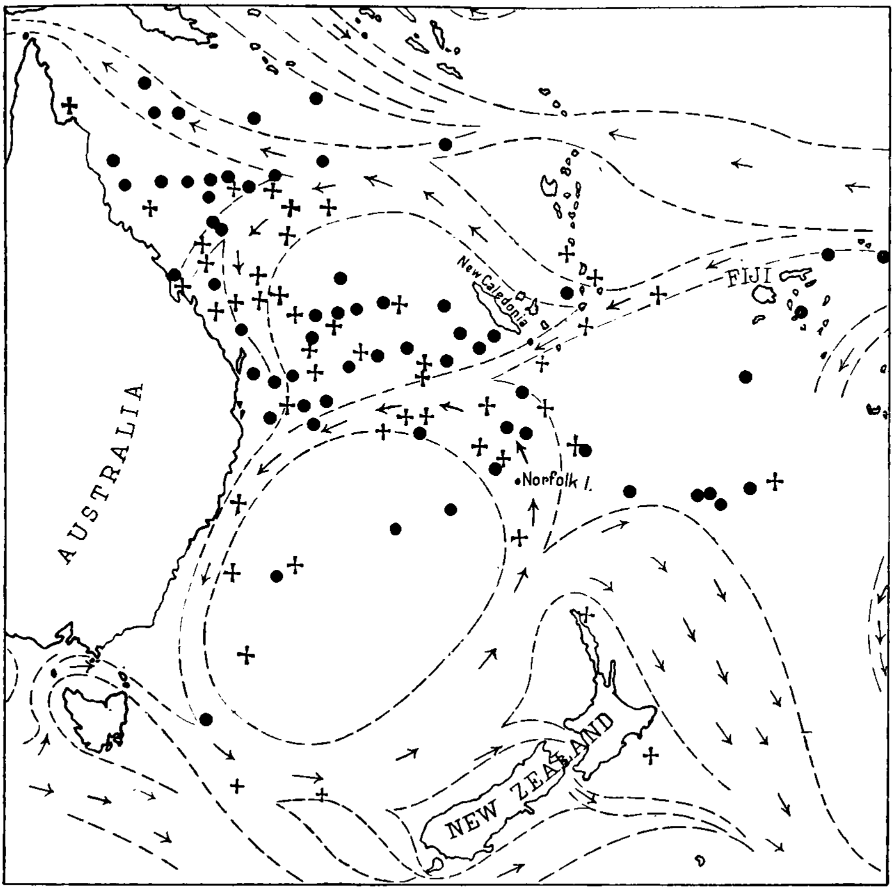

FIG. 1.

It will be seen that many, but not all, the non-frontal sources were situated in the region where the north-moving current from the west coast of New Zealand joins the south-west moving current from the Fiji Islands. Another group of heat sources occurs where a branch from the New Zealand current meets another branch of the Fiji current. The evidence as a whole is, however, inconclusive.

Particular interest attaches to a source which appeared to continue for four days having the following approximate locations at the times stated :—

2300 on 20th ...	22°	164°
1200 on 21st ...	22°	160°
1200 on 22nd	23°	158°
1200 on 23rd ...	21°	158°

and lasting until 0600 on the 24th.

No fronts were recorded in the vicinity during this period. The mechanism of production of these long-lived sources is still obscure. These results suggest that they are not due to slow-moving fronts.

Mediæval Weather Lore *

" Autres temps, autres moeurs "—in other words, it is hard to get inside the minds of our forefathers. The curious fact that in matters of astrology some of our forefathers are still alive does not make it any easier for the modern meteorologist to understand the peculiar weather " science " of the middle ages. Dr. Thorndike, in his notable compilation on the history of magic, quotes numerous references to the power of magic or astrology in making or foretelling the weather, which was an article of common faith even among the learned. Thus in 1326 the Pope, who was presumably a reasonably intelligent man, commissioned a Cardinal to judge the case of a Canon at Agen accused of invoking evil spirits to produce hail and thunderstorms and to kill men. In a book by Mark Twain the witch made a storm by taking off her stockings ; we are not told how the Canon did it.

The methods of weather prediction described by Thorndike fall into two classes—astrological and homely. One thinks of the " Science " of the Middle Ages as largely based on classical and Arabian sources, but it appears that in the first half of the fourteenth century there was a great deal of original writing on the subject, much of it by English authors, and Thorndike adds something to the well-known chapters by Hellmann on Mediæval meteorology.† The most noteworthy author is Robert of York (" Perscrutator ", c. 1340), whose argument is briefly as follows :—

Because the world needs rain and evaporation for the generation and growth of vegetation and support of animal life, there are certain parts of the Zodiac in which the sun elevates waters, " now strongly, now more strongly, now most strongly ", and others in which the sun causes no evaporation or scarcely any or but weakly. These six varieties of places are designated by the names of as many colours . . . white, yellow, red, black, green and jacinth, the lighter colours indicating the sun's power of evaporation, and the darker ones its absence. There are also dry, wet and neutral degrees among the signs . . . The exaltations of the planets in the signs are also taken into account. Thus about 1255 the influence of Saturn caused cold weather for five years running.

Thorndike gives a good deal more to the same effect, but repetition would be wearisome. To us it all sounds pretty much alike, but

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* THORNDIKE, L.—A history of magic and experimental science. Vol. III and IV. Fourteenth and Fifteenth centuries. (History of Science Society Publications, New Series, 4). Columbia (Univ. Press), 1934.

† HELLMANN, G.—Beiträge zur Geschichte der Meteorologie, II. Berlin, 1917, pp. 167–229.

there were weighty and dignified arguments, carried on in Latin treatises with sonorous and learned titles. " De iudiciis universalibus mutationum aeris per coniunctiones et oppositiones luminarium " somehow sounds much more compelling than " The influence of the sun and moon on the weather ", but the contents of such a work are about as intelligible to the modern meteorologist as a work on frontogenesis would have been to the ancients. The arguments are specious, based on false analogy and misunderstood premises, but the writers presumably believed in themselves, and the appearance of learning goes a very long way. So they had their patrons, who no doubt loudly applauded their successes and loyally forgot their failures. Even before the end of the fifteenth century, however, there are signs that the natural intelligence of the race was beginning to assert itself. The Rev. William Merle (Thorndike uses the alternative spelling Merlee), who was the first known person to keep a systematic record of the weather over several years, also wrote a work on weather forecasting, but although one copy is entitled " A Physical Treatise concerning favouring Stars ", Merle puts little faith in astrological methods, as against more homely weather lore— the biting of flies, audibility of bells, etc. Merle had a truly scientific mind, and it is not without interest that in one chapter he discusses the mental qualifications and experience required to make a successful weather forecaster. Later writers were more outspoken in their criticisms of astrological methods, and failures received unkind publicity. Thus it was remarked that although a very cold winter was predicted for 1373, the actual weather was very warm, while astrologers failed to predict great inundations throughout France and Germany in January, 1373. Astrological methods continued to be advocated for some centuries however, and the invention of printing gave them a new lease of life. Even today they are barely extinct, for a pamphlet " The weather forces of the planetary atmospheres " appeared in 1905, and still more recent examples could be quoted.

Turning now to the homely weather signs, we find a good deal of keen observation mixed with some utter nonsense. Thus, Nicholas of Cusa, about 1439, devised a method of weather prediction by weighing wool exposed to the air to determine the humidity. But even sound ideas can be pushed to fantastic extremes, and we read elsewhere : " To predict the weather for the ensuing year, before going to midnight mass one put salt in twelve split onions representing the months of the year and on returning estimated the humidity of each month by the state of the salt in each onion ". Perhaps even more extraordinary is the prognostic from Munich (1487), " If in autumn the cows lie on their right sides, the winter will be severe, but if they recline on their left sides, it will be mild ".

Enough has been said to show that these two volumes make an important contribution to the early history of meteorology, but mention must also be made of a note to the important chapter (Vol. III, Ch. IV) on " Weather records : William Merlee and Evno of Würzburg ". The passage runs : " Mr. Robert Steele calls my attention to notes recording the weather in the margin of planetary tables for the year ending 28 February, 1269–1270, in the left-hand margins of BM Royal 7 F VIII, fols. 176V–179V. This earlier record was for seven months, beginning in August with two brief jottings and becoming quite full for the last three months of December, January and February ". This record antedates Merle's by nearly seventy years, and is the earliest known in this country. Though not systematic, it is of great historical interest, and Mr. C. E. Britton, acting on a reference contained in a review in *Nature* (137, 1936, pp. 340–1), has obtained a photostat copy from the British Museum, which he has kindly presented to the Meteorological Office Library.

C. E. P. BROOKS.

OFFICIAL PUBLICATION

The Weather Map. An introduction to modern meteorology. 2nd edition. (M.O. 225i).

The Weather Map first appeared in 1915 and met with such a ready sale that five reprints were needed within ten years. In 1930 a new edition was prepared covering the latest developments in forecasting from daily weather maps and the demand for this second edition has been such that a third reprint has just appeared. This reprint differs from the previous issue only in the definitions of cloud forms which have been brought into conformity with the new International Cloud Atlas issued by the International Meteorological Committee in 1932. The Weather Map which is published by H.M. Stationery Office at 3*s*., describes the preparation of the weather maps which are now studied by an increasing number of people and gives its readers an understanding of the methods adopted by the Meteorological Office in the preparation of weather forecasts. It is widely used in schools.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday evening, March 18th in the Society's rooms at 49, Cromwell Road ; Dr. F. J. W. Whipple, F.Inst.P., President, in the Chair. As is customary in March the meeting took the form of a lecture, the Symons Memorial Lecture, which was delivered on this occasion by Dr. F. Loewe of the Scott Polar Research Institute, Cambridge, his subject being :—

The Greenland ice-cap as seen by a meteorologist.

The Greenland ice-cap covers a surface seven times as big as Great Britain ; it extends from the latitude of the Shetlands to near the northernmost land on earth. The continuous ice sheet forms special climatic conditions unique on the northern hemisphere. The main region for the formation and regeneration of cyclonic depressions south of Iceland is not very far from Greenland. As these depressions have a great influence on the weather of western Europe it is a question of scientific as well as practical importance to know whether it is the interaction of cold air from the ice-cap and warm maritime air which forms these depressions. The practical value of the meteorology of the ice-cap is strengthened by the fact that the shortest way from Europe to the interior of North America leads over Greenland.

Before 1930 the ice-cap was known from sledge journeys during the summer only. In 1930–1 the British Arctic Air Route Expedition, led by H. G. Watkins and the German Greenland Expedition, led by Alfred Wegener, wintered on the ice-cap. The lecturer stayed at one of the German stations, Mid-Ice, which with an annual mean temperature of — 22° F. and a minimum of — 85° F. proved to be the coldest place on earth where continuous observations have been taken. Based on his experiences at this station and during sledge journeys, the lecturer gave a description of the typical weather conditions in different seasons, and of their influence upon the surface of the ice-cap and the conditions of travelling. The most important climatic feature is a relatively shallow layer of cold air covering almost continually the surface of the ice-cap and flowing down the slopes under the influence of gravity. Whether the energy of this "skin" of cold air is sufficient to give birth to high-reaching and powerful depressions cannot yet be said; regarding the vastness of the region and the scientific problems involved, the results of the last expedition, useful as they are, must be regarded only as pioneer work for further research.

Correspondence

To the Editor, *Meteorological Magazine*

Peculiar phenomenon of March 15th, 1936

This morning the weather was overcast in a normal way and continued so till I went to a concert at about 14h. 45m. On leaving the hall at about 16h. 30m. I found everything like a London fog, the sky covered with low dark clouds, lights in vehicles and in houses, the landscape bathed in a weird, unwholesome, yellowish-grey light. The sea was very smooth and glassy, visibility was I think about 4 to 5. There was a slight drizzle, enough to mark the pavements. The clouds were not continuous and were moving from a westerly direction. I am told the darkness set in rather suddenly about 15h. 15m. About 17h. 10m. it began to lighten and in a few minutes it was possible to dispense with artificial lights. Now (17h. 40m.) pale misty blue sky is visible and the wind has freshened somewhat (NE.). The occurrence reminds me somewhat of the "black-out" described on p. 66 of the 1935 volume of the *Meteorological Magazine.*

CICELY M. BOTLEY.

17, Holmesdale Gardens, Hastings, March 15th, 1936.

Squall Cloud, Tananarive

Having recently read the November, 1934 issue of the *Meteorological Magazine*, my attention was called by the picture of a cloud drawn by Mr. Donald L. Champion (p. 238). The cloud he had observed is nearly like a type of cloud I have seen along the coasts of Madagascar and I am calling " Stratocumulus bourgeonnant" (budding stratocumulus). On the west coast that cloud gives birth very often to some showers but rarely to true squalls ; on the contrary on the east coast, for example in the part of that coast near Tamatave, it can be thought of as a squall cloud but without any violence.

Precise considerations about this cloud would be too long to be written in this short note ; but I am sending you, to explain it, the enclosed photograph taken on the west coast at Majunga on the eleventh of January, 1934, at 10h. 10m. in direction of the centre of Bombetoka Bay, direction, south-south-west (*see* opposite page).

J. MONDAIN.

Service Météorologique, Tananarive, Madagascar, November 10th, 1935.

Effect of wind on Macrocarpa tree

I am forwarding a photograph (*see* opposite page) taken by myself at Waipapapa Point, on the south coast of the South Island, 23 miles east of Bluff and at the eastern entrance to Foveaux Strait, New Zealand. The photograph shows in a striking manner the effect of the strong prevailing winds between NW. and SW. on a macrocarpa tree. Foveaux Strait separates the South and Stewart Islands, averages about twenty miles in width and runs in a general easterly and westerly direction between latitudes 46° and 47° S.

The tree, if upright, would be about 30 feet high, its present height being 10 feet, and is one of a number, all similarly shaped, planted some years ago as shelter for the gardens of the lighthouse keepers at Waipapapa Point. The surrounding country is low lying and level for several miles and the principal vegetation is grass with areas of short scrub.

R. G. SIMMERS.

Meteorological Office, Wellington, New Zealand, February 12th, 1936.

Tracking Thunder

The Thunderstorm Survey was this year extended to the winter months and will be continued throughout the coming summer. Some of your readers have very kindly given most valuable assistance in the observational work in the past, and I venture to hope that many may be good enough to join in the census during the coming season.

A note of the place, date and time of the occurrence of thunder, lightning or hail, with the direction in which the lightning was seen,

(reproduced by the courtesy of Mr. Mondain)

STRATOCUMULUS BOURGEONNANT AT TANANARIVE.

(reproduced by the courtesy of Mr. Simmers)

MACROCARPA TREE SHOWING EFFECT OF PREVAILING WINDS.

especially at night, will be extremely useful. Additional information of the following character will be valuable :—

1. Time of first observation of thunder or lightning, with direction and estimated distance.
2. Time of commencement of very heavy rain or hail, or approximate time of nearest approach of storm, with direction and estimated distance.
3. Approximate time of final observation of thunder or lightning, with direction.
4. Severity of storm ; changes in direction or strength of wind, changes in temperature, etc., during the storm.

The Lightning Damage Survey has now been commenced in some districts, maps have been issued to observers and help in noting the positions of damage and co-operating with the observer in charge of the local map will be very welcome.

Sectional organisations now include the investigation of trees struck by lightning, damage to wireless installations, personal injury, structural damage, etc. Full details of the survey will be sent to intending new observers on application to the undersigned.

More records are particularly required in moorland districts and rural areas generally. Records from high-level stations from which it is possible to ascertain the direction and distance of remote storms are very helpful.

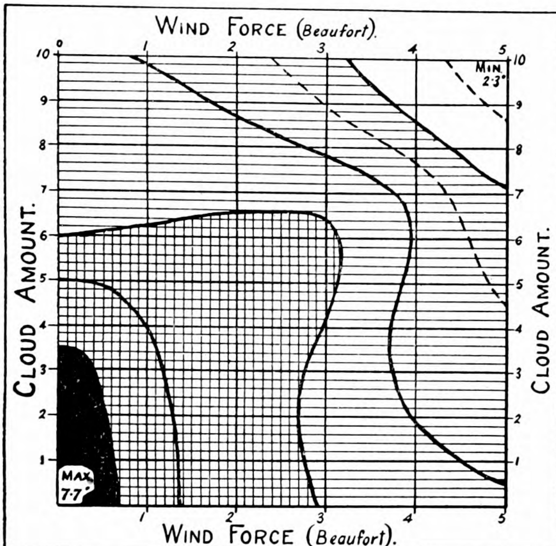
The results for the summer of 1934 indicate that there was more thunder in that season than in the same part of any of the previous three years. Thunder or lightning was recorded on 116 days out of 183, in some part of the British Isles. In the distribution map for the third quarter of 1934, included in the report, the storms again tend to group themselves into bands running roughly north-east and south-west, and the main belt of low frequency appears between Dorset and The Wash. S. MORRIS BOWER.

Langley Terrace, Oakes, Huddersfield, March 24th, 1936.

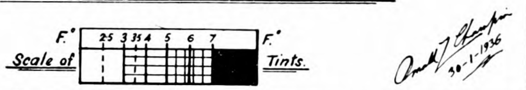
Night Radiation, Wind Force and Amount of Cloud

As a result of a recent request for data relative to ground frosts, some details of the effect of wind and cloud on night radiation during the year 1935 were required, and the data available have renewed the interest in the readings obtained from the grass minimum thermometer. Although only one year's observations were considered, the figures obtained required but little smoothing to produce isopleths showing the depression of the grass minima below screen minima, relative to wind force and amount of cloud.

The resultant isopleth diagram here reproduced, based on observations at Goff's Oak, Herts, is not without interest. The method adopted to obtain these curves was quite a simple matter. Observations of cloud amount and wind force were available for the hours of 7 a.m. and 11 p.m. (clock time) throughout the year, and the minimum thermometers were set at 11 p.m. and read at 7 a.m. The difference in temperature between the thermometer in the screen and the grass minimum was entered against the observation of cloud and wind at either 11 p.m. on the previous night, or at 7 a.m. on the same morning, whichever value gave the lowest figure for wind force and/or cloud amount. If the cloud amount was the same in each case, but in one case the cloud was of a cirriform character (or of medium height), the temperature difference was allotted to the latter in preference to an observation of low cloud. Owing to few observations of winds above force 5 the data for these winds are grouped together, the readings obtained showing little difference from those with winds of force 5.



YEAR 1935. ISOPLETHS OF DIFFERENCE BETWEEN SCREEN MINIMA AND MINIMA ON GRASS, AT GOFF'S OAK, HERTS.



Considering the extremely short period under review, the isopleths are remarkably regular and demonstrate that on the average, the grass minimum will be nearly 8° F. lower than that in the screen when the air is calm and clouds absent; whereas an overcast sky with a wind above force 4 will reduce this difference by over 70 per cent. The resultant effect of wind and cloud in preventing (or reducing the severity of) ground frosts is at once apparent.

If a longer period were considered, the sinuosity of the isopleths of 4° and 5° doubtless would be reduced, but even so, an average difference between the minima of over 4° with 7-tenths cloud and a wind above force 4 seems higher than one would anticipate and in this particular year, may be due to a clearing of the sky during the night which was, however, not apparent at 7 a.m. on the following morning. It is possible that the difference of over 4° with an overcast sky when the air is calm, may be attributed to the occurence of cirriform cloud sheets or thin fogs which are usually treated numerically as low cloud but have much less effect on radiation.

DONALD L. CHAMPION.

7, Robinson Avenue, Goff's Oak, Waltham Cross, Herts., January 31st, 1936.

NOTES AND QUERIES

Nocturnal Cooling and the Prediction of night minimum Temperatures

In your issue for April, 1934, R. T. Andrews describes an investigation at Larkhill concerning the prediction of minimum screen temperatures on winter nights. A table is given showing the average fall of temperature during a clear or partly clear night for known values of temperature and humidity at 15h. and for winds of 0–10 m.p.h. and 10–20 m.p.h. A figure is also given showing isopleths of the differences between the 15h. and night minimum temperature.

TABLE I

Mean difference between 16h. temperature and minimum screen temperature on clear or mainly clear nights when wind speed was not greater than 5 m.p.h. at Peshawar, October to March, 1926–35.

Temperature 16h.	45°–54° F.	55°–64° F.	65°–74° F.	75°–84° F.	85°–94° F.	95°–104° F.
Rel. Hum. 16h.		Temperature difference (T–M) °F.				
71–80%	12 (1)	14 (1)	15 (1)	—	—	—
61–70%	14 (3)	17 (9)	18 (1)	20 (1)	—	—
51–60%	16 (4)	19 (21)	21 (3)	22 (1)	—	—
41–50%	19 (4)	20 (32)	23 (33)	25 (9)	26 (3)	26 (1)
31–40%	21 (2)	24 (28)	25 (70)	26 (52)	27 (34)	28 (2)
21–30%	23 (3)	25 (32)	27 (66)	27 (110)	29 (83)	29 (1)
11–20%	25 (1)	27 (29)	28 (34)	29 (43)	30 (26)	31 (2)
0–10%	—	28 (2)	30 (1)	31 (1)	32 (1)	—

Figures in brackets are numbers of observations.

In your issue of May, 1934, Col. E. Gold discusses this investigation and points out that the fall of temperature diminishes in amount as the humidity increases. Col. Gold shows that if the amount of cooling (T — M) is plotted against the difference between the temperature and the dew point (T — D) one obtains a series of parallel straight lines leading to the formula $T - M = 0{\cdot}4\ (T - D) + 0{\cdot}15T + 5{\cdot}5$.

In your issues for November, 1934, and May, 1935, are recorded the results of similar investigations at Ismailia, Catterick and Abbotsinch. The relation between (T — M) and (T — D) for these stations was found to be very similar to that at Larkhill.

It was decided to carry out the same investigation at Peshawar using the 16h. local time observations. Data were extracted for the period October 1st, 1926 to March 31st, 1935. Peshawar is situated on a gently-sloping horse-shoe shaped plain with mountains all round except for a gap to the east-south-east, the foothills to the west being within 10 miles of the meteorological station. Only nights when the sky was continuously clear, or almost so, were selected. The average wind force was calculated from the difference between the cup anemometer readings at 16h. (local time) and 8h. (local time), the times of routine evening* and morning observations respectively.

Table I gives the mean difference between the 16h. temperature and the minimum screen temperature, during the months October to March, for various values of relative humidity at 16h. when the average wind force was 0–5 m.p.h. Insufficient data were available for preparing a table for nights when the average wind force was greater than 5 m.p.h. In Fig. 1 are drawn the isopleths of these differences. In Fig. 2 the values of (T — M) are plotted against the appropriate values of (T — D). The figures against the curved lines represent the temperature T at 16h. It will be seen that a series of parallel curves are obtained and not straight lines. Evidently the large values of (T — D) obtainable at Peshawar have brought out the true shape of the curve. According to Ångstrom† the net cooling of a horizontal body due to radiation alone involves an exponential factor in terms of e, the vapour pressure. Hence non-linear relationship is to be expected between (T — M) and (T — D).

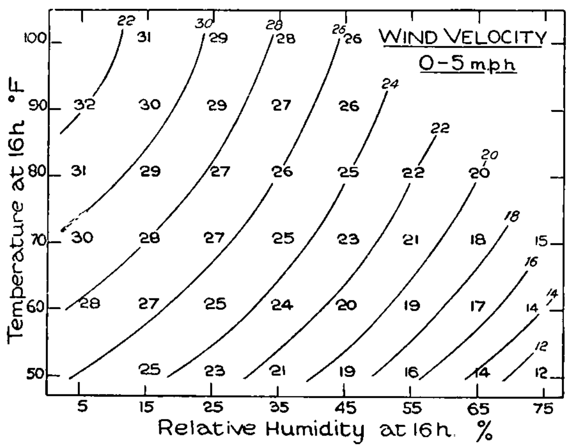


FIG. 1.

The processes taking place in the neighbourhood of the ground

* Since January 1st, 1931, the routine evening observations have been made at 17h. Indian standard time, i.e. 16h. 17m. local time.

† *Washington D.C., Smiths. Inst. Misc. Coll.*, 65, 1915, No. 3.

on radiation nights are undoubtedly complicated by a number of factors. For example, it has been noted that the fall in temperature at Peshawar on clear nights may be considerably less than the mean when there is much dust-haze. Dr. Ramdas of the India Meteoro-

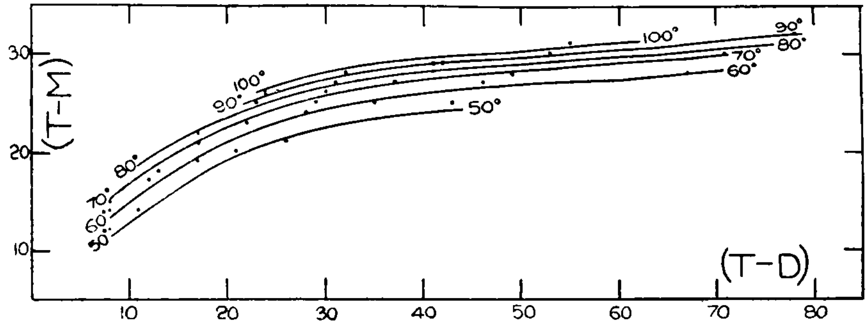


FIG. 2.

logical Department, who is carrying out an intensive study of radiative cooling at night, has observed* that on calm clear nights in winter the lowest temperature is observed to occur not in immediate contact with the ground, but at a distance of half to one foot above the ground. Dr. Ramdas and Dr. Ramanathan have shown† that, besides the cooling which spreads upwards from the ground by the process of eddy diffusion and radiation exchange, there may be an additional general cooling of the air layers near the ground caused by radiation exchange with the upper atmosphere.

R. G. VERYARD.

Monthly Charts of Rainfall over Germany‡

We have received from the Director of the German Meteorological Service (Reichsamt für Wetterdienst) copies of a new series of monthly rainfall charts. The first issue includes charts for January to May, 1935. The charts are on the scale 1 : 10^6 (1 inch =16 miles approximately) which entails the use of sheets about 4 feet by 3 feet in size. These, however, fold neatly to about 1 foot square for storage purposes. Isohyetal lines are drawn for every 10 millimetres of rain up to 100 mm., then at intervals of 20 mm. up to 200 mm., and at intervals of 50 mm. for greater amounts. Blue colouring is used to indicate amounts above 60 mm. and buff colouring to indicate amounts under 60 mm. Four shades of blue tone and three shades of buff tone are employed, and the distribution of rainfall is thus very clearly displayed. In this connexion the only criticism we have to make is that in wet months large areas of high ground, in which the variation of rainfall is very great, are uniformly tinted dark blue.

* *Beitr. Geophysik, Leipzig,* 37, 1932, p. 116.

† *Bangalore, Proc. Ind. Acad. Sci.,* 1, 1935, No. 11.

‡ Die Verteilung der Niederschläge in Deutschland im Januar bis Mai, 1935. Berlin Reichsamt für Wetterdienst, 1935.

The dark blue tint is actually produced by hatching in black lines over the blue printing. A distinction between areas with rainfall above and below say 250 mm. could thus be easily made by omitting the blue tinting over the former areas.

Dr. Weickmann has kindly furnished the following additional information. The charts are based on readings from about 4,100 stations, 800 of which are over 500 m. and 100 over 1,000 m. above mean sea level. The observations are collected and charted initially by the services centred at Königsberg, Berlin, Dresden, Breslau, Münster, Munich, and Stuttgart, and the final maps are prepared at Berlin under the supervision of Professor Knoch.

These magnificent charts set a new standard to all meteorological services in the presentation of rainfall data. The large scale employed makes it possible to show the distribution of rainfall to a degree of detail not hitherto attempted in published charts. We congratulate our German colleagues on their achievement and look forward with interest to the publication of further charts in the series.

E. G. BILHAM.

Föhn Winds in the Alps

In the *Meteorological Magazine* for February, 1936, p. 24, there appears the following statement, presumably copied from the Press :—" The Föhn wind was blowing in Switzerland on the 2nd ; rain fell up to the 4,000 feet level, but heavy snow above 6,000 feet." The wind " föhn " is universally used in the Alps to denote a winter thaw, but since this meaning of the term has only a slight and incidental relationship to the accepted meteorological usage, there is no reason why scientific journals should conform to it. So far as I am aware, the meteorological term was originally derived from the local name for warm, dry, descending winds in the northern Alpine valleys. Nowadays a greatly extended use of the term has become general among the natives, but this practice was quite probably started by visitors who thought they knew something about meteorology.

Winter thaws in the Alps, on slopes facing any direction in the northern semicircle, are invariably due to incursions of warm damp air. Genuine tropical air produces a thaw often extending up to 7,000 feet (higher in extreme cases) even at the coldest season, and the mildest varieties of maritime polar air may cause a thaw up to fully 5,000 feet. Since in such conditions there is usually a steep gradient for SW. winds, there is often some genuine föhn on the north side of the Alps, but on other occasions there is general precipitation and no föhn. In any case the föhn is in no sense the cause of the thaw. In so far as the condition of the snow surface is controlled by the over-lying air, the important feature is the wet-bulb temperature, and the föhn process leaves this unaffected when the air returns to its original pressure, as Dr. Normand* pointed out. If the dry bulb temperature only is raised, the effect on the snow surfaces is an increase of evaporation. If the snow covering were thin, as it may be in the early winter, excessive evaporation would damage ski-ing prospects, but such an event is certainly rare. I have spent many weeks in the Alps in January and February, and the snow has never been affected by evaporation, though it has often been spoilt by thaws and the crust which follows unless and until there is a fresh snowfall. C. K. M. DOUGLAS.

"Greenhouse" effect in the Upper Atmosphere.

In my Note appearing under the above title in the March number of the *Meteorological Magazine,* I should have mentioned that the experiment therein described was not original. About the year 1909 the Upper Air Station of the University of Manchester at Glossop Moor sent up a thin-walled rubber balloon with a Dines meteorograph inside. They found that in the stratosphere the temperature inside the balloon was about 50° C. higher than that of the surrounding air. Recently, Professor E. Regener of Stuttgart has sent up instruments enclosed in cellophane, and published the results. Having to solve a particular problem of keeping an instrument warm in the stratosphere I followed his method in the specific case described in my note, and gladly acknowledge my indebtedness to him.

L. H. G. DINES.

OBITUARY

Henry Victor Prigg.—We regret to record the death on March 28th of Mr. H. Victor Prigg, at the age of 70. Mr. Prigg's association with meteorology began in 1892 when he became observer at the Plymouth Meteorological Station. Later he was appointed to the position of City Meteorologist, and he has thus been closely engaged on climatological work for the long period of 44 years. His death deprives Plymouth of a very distinguished citizen, and the Meteorological Office of a valued co-operating worker. He was well known as a man of kindly personality, and was ready at all times to place his great knowledge of local climatology at the disposal of anyone seeking information.

Kapitan Siegfried Luensee.—We regret to learn of the death on January 11th, 1936, after a long and painful illness of Capt. S. Luensee, Marine Superintendent in the Deutsche Seewarte. Capt. Luensee was born in Berlin on January 29th, 1878, and went to sea at the age of fifteen. After serving in the German Mercantile Marine,

* *Poona, Mem., Indian met. Dep.* **23,** 1921, No. 1, p. 18. See also Physical and Dynamical Meteorology, by D. Brunt, p. 86.

Navy and Naval Airship Division, he entered the Deutsche Seewarte as a nautical assistant in 1920 and succeeded Capt. Schubart as Marine Superintendent in 1932. During this time he contributed many articles on nautical subjects to various publications, one of the latest he wrote being on " Meteorologische Navigation." At the International Meteorological Conference at Copenhagen in 1929 he was appointed Secretary of the International Commission for Marine Meteorology.

William Davies.—We regret to learn of the death of Mr. W. Davies at Holyhead on March 7th, 1936. Mr. Davies for many years looked after the anemometers at the anemometer station at Salt Island, Holyhead, and when, in 1913, the Holyhead climatological station was also transferred to Salt Island he became the full-time observer. He continued in that capacity until 1928.

We regret to learn of the death, on March 31st, 1936, at Bushy House, Teddington, of Sir Joseph E. Petavel, D.Sc., F.R.S., Director of the National Physical Laboratory.

The Weather of March, 1936

Pressure was below normal over the United States, most of southern Canada, north Alaska, the north coast of Africa, central and south-west Europe and the Azores, the greatest deficits being 6·1 mb. at James Bay, Ontario, 5·4 mb. at Pt. Barrow, Alaska, and 7·8 mb. at Brest. Pressure was above normal elsewhere in Europe and in western Siberia and from Bermuda to Greenland and thence across most of northern Canada, the greatest excesses being 5·4 mb. at Astrakhan, 7·0 mb. at Haparanda and 8·6 mb. near St. John's, Newfoundland. Temperature was above normal at Spitsbergen, in southern Scandinavia and central Europe, but below normal in northern Scandinavia and Portugal, while precipitation was generally below normal.

The main feature of the weather of March over the British Isles was the deficiency of sunshine, many new low records being established. Wintry conditions prevailed at first but during the greater part of the month the weather was mild and dull. On the 1st and 2nd cold northerly winds were experienced and snow fell in most parts of the country except the south-west, being heavy in the north Midlands. Floods occurred in Cheshire on the 1st and in south-east Yorkshire on the 1st–3rd, while gales were experienced in north Scotland on the 1st and in north Wales on the 2nd. Maximum temperatures did not exceed 36° F. in many inland places on the 1st and 2nd. From the 3rd–5th a depression, centred at first near Iceland, moved slowly eastwards giving rain generally in the south, with snow and sleet in north England and Scotland, and on the 4th S.–SW. gales in extreme north Scotland. Thick fog was prevalent in east England and the Midlands on the 3rd–4th. By the 5th temperature was rising somewhat generally and from then to the 10th complex low pressure areas covered the country. Conditions were generally mild with fog or mist in many parts and slight to moderate rain, except in Scotland where snow or sleet occurred on the 8th and 9th. In the south the warmest day was the 10th, when 62° F. was reached at Tunbridge Wells. During these first ten days good sunshine records were obtained in isolated areas on some days, 10·4 hrs. at Tiree and 9·5 hrs. at Mallarany on the 10th, 9·3 hrs. at Auchincruive on the 2nd and 9·1 hrs. at Ventnor on the 4th and 5th. By the 11th a narrow ridge of high pressure stretched across the country and in the south temperature was considerably lower with easterly winds. From the 12th–18th anticyclonic conditions prevailed—until the 16th the weather was cold, dull and dry in England and south Scotland, with maximum temperatures not rising above 37° F. at a few places on the 13th and 14th, while in north Scotland and Ireland slight rain and much sun occurred at times—in Ireland temperature was mainly above normal. On the 16th there was a general change to warmer weather with much sun in the south but less in the north, 10·5 hrs. were recorded at Bath, Portsmouth and Calshot on the 18th. During the 18th a depression moved northward from the Bay of Biscay and from then to the 24th remained centred to the west of the British Isles giving generally unsettled mild weather with rain at times but sunny periods—the 24th was the sunniest day over the whole country when 11·1 hrs. were recorded at Lympne and Hastings. Thunderstorms occurred in the north on the 20th and in the Midlands on the 23rd. On the 25th the centre of the low pressure area moved towards the English Channel and easterly winds prevailed until the 27th, but temperatures remained generally above normal, though there was not so much sun except at isolated places. Fog occurred in many parts during this period, and moderate to heavy rain in the south-west on the 26th. From the 28th–31st the main centre of the low pressure area was again to the west of the British Isles. Moderate to heavy rain occurred in the south and west, 2·35 in. at Snowdon (Carnarvon) on the 29th and 1·45 in. at Holne (Devon) on the 28th, but elsewhere the mild unsettled conditions continued with some rain and sunny intervals. Coastal mist or fog occurred locally. The distribution of bright sunshine for the month was as follows :—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway ...	91	−14	Chester ...	57	−56
Aberdeen ...	62	−45	Ross-on-Wye ...	70	−38
Dublin	69	−48	Falmouth ...	98	−37
Birr Castle ...	77	−33	Gorleston ...	89	−34
Valentia... ...	107	− 8	Kew	78	−25

Miscellaneous notes on weather abroad culled from various sources

A severe storm passed over Sicily and the extreme south of Italy on the 4th ; five fishing boats were wrecked at Palermo, and at

Taranto 300 people were stated to have been injured, rivers were in flood and many houses collapsed. After a series of gales the sea dykes in the Médoc Peninsula near Bordeaux gave way and sea water covered about 3,000 acres of sown land. Yellow snow was reported in the canton of Ticino, on the Simplon Pass, and in Piedmont on the 6th, while after heavy rain in a valley near Bergamo, Lombardy the trees and fields were found covered with a light powder. Ice conditions off the Finnish coast became worse about the 8th owing to SE. winds, and the ice-breakers were unable to keep the port of Hangö open. The port of Seville was closed on the 11th as the water was rising. After heavy rain at Barcelona about the 14th–16th it was stated that thin coatings of mud were found on trees, window panes, etc. Heavy rain again caused serious floods throughout Portugal about the 26th. The river Guadalquivir rose alarmingly by the 27th but the port of Seville could be re-opened on the 28th as the water was subsiding. Navigation was re-opened at Kotka (Finland) on the 29th. (*The Times*, March 5th–30th.)

Motor traffic was interrupted in many places on the North-West Frontier about the 5th owing to ten days heavy rain. The icefield outside the Taku bar in the port of Tientsin was breaking up on the 5th releasing many steamers. (*The Times*, March 5th–9th.)

The Finke river in central Australia was still in flood on the 5th. The total rainfall for the month was generally above normal in Queensland and New South Wales but mainly considerably below normal elsewhere. (*The Times*, March 6th and cable.)

Rapidly melting snow and heavy rain caused severe floods in many parts of the north-eastern United States between about the 10th and 15th. By the 12th conditions were improving in New York State and Pennsylvania and by the 15th the floods were receding generally. On the 17th, however the rivers in Pennsylvania, Maryland, West Virginia and New York, swollen by sudden heavy rains and melted snow and ice swept over their banks again and inundated several towns and wide stretches of the countryside. There were also floods generally in the eastern States from the Canadian border to South Carolina. In western Pennsylvania the floods were receding on the 19th and 20th but the rivers in the 13 other flooded States were still rising. Heavy snow fell on the 21st in the flooded areas of the Ohio and in Maryland, western Pennsylvania and western New York reaching blizzard force near the Niagara Falls. By the 23rd the rivers however were receding everywhere though on the 25th, the Ohio, Monongahela and Allegheny rivers rose again for a short time. 181 people are known to have been drowned in these floods while the damage to property in New England alone is estimated at over 10 million pounds. Heavy rain in parts of the Middle West on the 23rd raised the Mississippi to near the flood stage. A tornado swept across south-west Missouri on the 23rd, while in southern Kansas, Oklahoma and Texas there were dust storms, and snow was falling in western Kansas and south-east Colorado. A sharp thaw occurred in eastern Canada about the 20th but serious floods were only experienced in the southern districts of Ontario. A short, very warm spell was experienced in Newfoundland about the 21st when 66° F. was reached at St. John's, a record for March. In the United States, temperature was generally above normal except during the later part of the month in the west, and precipitation mainly below normal. (*The Times*, March 13th–26th and *Washington, D.C., U.S. Dept. Agric., Weekly Weather and Crop Bulletin.*)

Daily Readings at Kew Observatory, March, 1936

Date	Pressure, M.S.L. 13h.	Wind, Dir., Force 13h.	Temp. Min.	Temp. Max.	Rel. Hum. 13h.	Rain.	Sun.	REMARKS. (see vol. 69, 1934, p. 1).
	mb.		°F.	°F.	%	in.	hrs.	
1	989·8	WNW.2	34	39	77	0·06	0·0	r_0–r_0s_0 0h.–9h.
2	999·5	NNE.2	36	42	69	0·01	0·0	r_0 5h.–9h., r_0h_0–17h.
3	1009·8	ENE.1	37	41	71	—	0·0	f 21h.
4	1014·4	W.1	27	38	91	trace	0·5	f 0h.–20h. r_0 24h.
5	1010·9	WNW.2	32	49	58	0·09	6·2	r 0h.–5h.
6	1011·4	WNW.3	35	49	50	0·02	4·6	r–r_0 5h.–6h.
7	1010·5	S.3	32	49	70	trace	0·1	fx early. r_0 17h.–21h.
8	1011·8	E.2	44	54	85	—	0·4	
9	1008·4	S.3	44	55	75	0·04	0·1	r_0 2h.–7h. & 15h.–24h.
10	1010·3	NE.3	47	58	65	trace	0·1	r_0 0h.–2h. f 9h.
11	1009·8	ENE.3	42	46	85	—	0·0	d_0 9h.
12	1013·4	ENE.3	39	42	63	—	0·0	
13	1018·1	E.3	37	42	61	—	0·4	
14	1023·8	E.2	35	44	61	—	2·4	
15	1024·6	NW.2	31	44	71	—	0·2	
16	1024·7	N.2	38	49	50	—	3·9	
17	1023·8	WSW.2	33	52	62	—	5·5	x early. f 8h.–11h.
18	1020·4	E.3	31	54	39	—	8·7	Fx till 8h.
19	1011·8	SE.3	38	58	57	—	5·0	x early. r_0 19h.
20	1011·6	SSE.2	47	53	94	0·11	0·7	r_0 7h.–9h. & 12h.–13h.
21	1009·2	SE.4	44	62	55	—	5·2	
22	1000·5	S.4	51	60	58	—	3·3	r_0 23h.
23	994·6	ESE.3	51	55	75	0·10	0·7	r–r_0 3h.–9h. & 13h–16h.
24	1007·6	E.4	42	61	57	—	9·3	w early.
25	1005·0	ENE.4	46	60	61	—	4·3	
26	1001·2	SE.2	46	54	94	0·31	0·1	r–r_0 2h.–15h.
27	1007·1	S.4	45	57	69	0·02	3·2	r_0 9h. & 21h.
28	1010·9	S.E.2	43	59	68	—	5·5	w early.
29	1005·2	S.4	51	58	91	0·11	0·1	r_0–r 6h.–14h.
30	1009·7	SW.3	49	59	76	—	3·9	r_0 1h.–2h. pr_0 13h.
31	1011·7	SSW.3	49	60	88	0·04	3·9	r–r_0 11h.–12h. & 24h.
*	1010·4	—	41	52	69	0·90	2·5	* Means or totals.

General Rainfall for March, 1936

England and Wales ...	90	per cent. of the average 1881–1915.
Scotland	71	
Ireland	86	
British Isles	85	

Rainfall : March, 1936 : England and Wales

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Lond .	Camden Square..........	1·11	61	*Leics* .	Thornton Reservoir ...	1·85	100
Sur .	Reigate, Wray Pk. Rd..	1·79	76	,, .	Belvoir Castle...........	1·10	61
Kent .	Tenterden, Ashenden...	1·23	58	*Rut* .	Ridlington	1·42	82
,, .	Folkestone, Boro. San.	·85	...	*Lincs* .	Boston, Skirbeck.........	1·17	75
,, .	Eden'bdg., Falconhurst	1·17	47	,, .	Cranwell Aerodrome...	1·17	84
,, .	Sevenoaks, Speldhurst.	1·35	...	,, .	Skegness, Marine Gdns.	·78	47
Sus .	Compton, Compton Ho.	2·97	107	,, .	Louth, Westgate.........	·95	45
,, .	Patching Farm..........	1·96	91	,, .	Brigg, Wrawby St.......	·76	...
,, .	Eastbourne, Wil. Sq....	1·30	57	*Notts* .	Worksop, Hodsock......	1·54	91
,, .	Heathfield, Barklye....	1·30	52	*Derby*.	Derby, L. M. & S. Rly.	1·92	112
Hants.	Ventnor, Roy.Nat.Hos.	2·32	114	,, .	Buxton, Terr. Slopes...	3·13	76
,, .	Fordingbridge, Oaklnds	3·45	148	*Ches* .	Runcorn, Weston Pt....	1·57	77
,, .	Ovington Rectory.......	2·58	100	*Lancs*.	Manchester, Whit. Pk.	1·47	65
,, .	Sherborne St. John......	1·86	83	,, .	Stonyhurst College......	2·43	66
Herts .	Royston, Therfield Rec.	1·01	55	,, .	Southport, Bedford Pk.	1·87	84
Bucks.	Slough, Upton............	1·23	70	,, .	Lancaster, Greg Obsy.	2·03	64
,, .	H. Wycombe, Flackwell	1·62	81	*Yorks*.	Wath-upon-Dearne......	1.62	93
Oxf .	Oxford, Mag. College...	1·79	117	,, .	Wakefield,Clarence Pk.	1·73	96
Nor .	Wellingboro, Swanspool	1·42	79	,, .	Oughtershaw Hall.......	3·70	...
,, .	Oundle	1·04	...	,, .	Wetherby, Ribston H..	...	...
Beds .	Woburn, Exptl. Farm...	1·34	78	,, .	Hull, Pearson Park......	·66	36
Cam .	Cambridge, Bot. Gdns.	·53	36	,, .	Holme-on-Spalding......	1·12	62
Essex.	Chelmsford,County Gdns	·81	47	,, .	West Witton, Ivy Ho.	2·18	70
,, .	Lexden Hill House......	·68	...	,, .	Felixkirk, Mt. St. John.	1·91	97
Suff .	Haughley House.........	·54	...	,, .	York, Museum Gdns....	1·01	60
,, .	Campsea Ashe...........	·59	35	,, .	Pickering, Hungate......	1·41	71
,, .	Lowestoft Sec. School...	·41	25	,, .	Scarborough..............	1·04	58
,, .	Bury St. Ed., WestleyH.	·57	30	,, .	Middlesbrough...........	1·30	83
Norf. .	Wells, Holkham Hall...	·63	39	,, .	Baldersdale, Hury Res.	...	...
Wilts .	Calne, Castle Walk......	2·72	...	*Durh* .	Ushaw College............	2·59	118
,, .	Porton, W.D. Exp'l. Stn	2·41	122	*Nor* .	Newcastle, D. & D. Inst.	1·47	77
Dor .	Evershot, Melbury Ho.	4·94	166	,, .	Bellingham, Highgreen	2·98	101
,, .	Weymouth, Westham.	3·78	183	,, .	Lilburn Tower Gdns....	2·00	76
,, .	Shaftesbury,Abbey Ho.	3·58	152	*Cumb*.	Carlisle, Scaleby Hall...	1·31	53
Devon.	Plymouth, The Hoe....	3·73	128	,, .	Borrowdale, Seathwaite	8·75	83
,, .	Holne, Church Pk. Cott.	7·25	135	,, .	Borrowdale, Moraine...	6·45	77
,, .	Teignmouth, Den Gdns.	4·62	177	,, .	Keswick, High Hill......	2·32	52
,, .	Cullompton	3·97	145	*West* .	Appleby, Castle Bank...	1·89	70
,, .	Sidmouth, U.D.C........	4·12	...	*Mon* .	Abergavenny, Larchf'd	3·60	118
,, .	Barnstaple, N. Dev.Ath	2·39	91	*Glam* .	Ystalyfera, Wern Ho....	4·48	84
,, .	Dartm'r,Cranmere Pool	5·60	...	,, .	Cardiff, Ely P. Stn.......	3·88	121
,, .	Okehampton, Uplands.	3·99	96	,, .	Treherbert, Tynywaun.	6·84	...
Corn .	Redruth, Trewirgie......	4·93	137	*Carm* .	Carmarthen, Coll. Rd.	2·74	72
,, .	Penzance, Morrab Gdns.	4·43	138	*Pemb* .	St. Ann's Hd, C.Gd. Stn.	2·61	101
,, .	St. Austell, Trevarna...	5·78	168	*Card* .	Aberystwyth	1·99	...
Soms .	Chewton Mendip.........	4·25	119	*Rad* .	BirmW.W.Tyrmynydd	4·00	75
,, .	Long Ashton............	2·51	99	*Mont* .	Lake Vyrnwy	4·79	111
,, .	Street, Millfield.........	3·16	...	*Flint* .	Sealand Aerodrome......	1·99	...
Glos .	Blockley	1·91	...	*Mer* .	Dolgelley, Bontddu......	3·87	79
,, .	Cirencester, Gwynfa....	2·06	89	*Carn* .	Llandudno	2·33	115
Here .	Ross, Birchlea...........	2·90	143	,, .	Snowdon, L. Llydaw 9..	12·10	...
Salop.	Church Stretton.........	2·60	110	*Ang* .	Holyhead, Salt Island...	2·71	103
,, .	Shifnal, Hatton Grange	2·15	117	,, .	Lligwy	3·00	...
Staffs.	Market Drayt'n, Old Sp.	2·17	102	*Isle of Man*			
Worc .	Ombersley, Holt Lock.	2·89	170		Douglas, Boro' Cem....	2·67	90
War .	Alcester, Ragley Hall...	2·17	126	*Guernsey*			
,,	Birminghm, Edgbaston	2·31	121		St. PeterP't.Grange Rd.	3·15	127

Rainfall: March, 1936: Scotland and Ireland

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Wig .	Pt. William, Monreith.	2·16	76	*Suth* .	Melvich	1·32	46
„ .	New Luce School	2·62	74	„ .	Loch More, Achfary	4·39	68
Kirk .	Dalry, Glendarroch	3·79	84	*Caith* .	Wick	1·37	60
„ .	Carsphairn, Shiel	5·24	86	*Ork* .	Deerness	1·55	55
Dumf.	Dumfries, Crichton R.I.	2·67	95	*Shet* .	Lerwick	2·37	75
„ .	Eskdalemuir Obs	4·59	94	*Cork* .	Caheragh Rectory	...	...
Roxb .	Hawick, Wolfelee	2·93	87	„ .	Dunmanway Rectory	4·31	88
Selk .	Ettrick Manse	...	...	„ .	Cork, University Coll	3·21	107
Peeb .	West Linton	3·06	...	„ .	Ballinacurra	2·65	93
Berw .	Marchmont House	2·52	95	„ .	Mallow, Longueville	3·18	110
E.Lot.	North Berwick Res	1·71	91	*Kerry*.	Valentia Obsy	3·52	78
Midl .	Edinburgh, Blackfd. H.	1·74	88	„ .	Gearhameen	5·20	64
Lan .	Auchtyfardle	1·94	...	„ .	Bally McElligott Rec	2·19	...
Ayr .	Kilmarnock, Kay Pk	2·35	...	„ .	Darrynane Abbey	2·55	62
„ .	Girvan, Pinmore	2·97	79	*Wat* .	Waterford, Gortmore	3·42	125
Renf .	Glasgow, Queen's Pk	2·73	105	*Tip* .	Nenagh, Cas. Lough	2.37	76
„ .	Greenock, Prospect H.	4·04	82	„ .	Roscrea, Timoney Park	1.80	...
Bute .	Rothesay, Ardencraig	3·11	...	„ .	Cashel, Ballinamona	2·34	86
„ .	Dougarie Lodge	2·94	...	*Lim* .	Foynes, Coolnanes	1·89	64
Arg .	Ardgour House	4·69	...	„ .	Castleconnel Rec	2·59	...
„ .	Glen Etive	...	...	*Clare* .	Inagh, Mount Callan	3·53	...
„ .	Oban	2·16	...	„ .	Broadford, Hurdlest'n.	...	...
„ .	Poltalloch	4·11	107	*Wexf* .	Gorey, Courtown Ho	3·80	164
„ .	Inveraray Castle	5·43	86	*Wick* .	Rathnew, Clonmannon.	2·99	...
„ .	Islay, Eallabus	3.90	102	*Carl* .	Hacketstown Rectory	3·55	127
„ .	Mull, Benmore	...	...	*Leix* .	Blandsfort House	2·57	99
„ .	Tiree	2.54	76	*Offaly*.	Birr Castle	1·54	64
Kinr .	Loch Leven Sluice	...	...	*Dublin*	Dublin, FitzWm. Sq	1·74	90
Fife .	Leuchars Aerodrome	2·33	119	„ .	Balbriggan, Ardgillan	...	...
Perth .	Loch Dhu	...	...	*Meath*.	Beauparc, St. Cloud	2·11	...
„ .	Balquhidder, Stronvar.	4·05	...	„ .	Kells, Headfort	1·94	71
„ .	Crieff, Strathearn Hyd.	2·60	81	*W.M* .	Moate, Coolatore	2·07	...
„ .	Blair Castle Gardens	1·69	65	„ .	Mullingar, Belvedere	2·30	85
Angus.	Kettins School	2·02	83	*Long* .	Castle Forbes Gdns	2·09	71
„ .	Pearsie House	2·15	...	*Gal* .	Galway, Grammar Sch.	1·90	...
„ .	Montrose, Sunnyside	1·89	91	„ .	Ballynahinch Castle	3·52	69
Aber .	Braemar, Bank	1·48	50	„ .	Ahascragh, Clonbrock.	2·53	76
„ .	Logie Coldstone Sch	1·12	43	*Mayo*.	Blacksod Point	2.29	56
„ .	Aberdeen, Observatory.	1·63	68	„ .	Mallaranny	3·41	...
„ .	Fyvie Castle	1·31	48	„ .	Westport House	2·41	62
Moray	Gordon Castle	·63	27	„ .	Delphi Lodge	5·44	65
„ .	Grantown-on-Spey	...	...	*Sligo* .	Markree Castle	3·03	89
Nairn.	Nairn	·83	44	*Cavan*.	Crossdoney, Kevit Cas.	2·78	...
Inv's .	Ben Alder Lodge	2·17	...	*Ferm* .	Enniskillen, Portora	2·53	...
„ .	Kingussie, The Birches.	·91	...	*Arm* .	Armagh Obsy	1·67	71
„ .	Inverness, Culduthel R.	1·43	...	*Down*.	Fofanny Reservoir	9·24	...
„ .	Loch Quoich, Loan	5·35	...	„ .	Seaforde	3·40	116
„ .	Glenquoich	5·18	53	„ .	Donaghadee, C. G. Stn.	1·98	90
„ .	Fort William, Glasdrum	3·21	...	„ .	Banbridge, Milltown	...	...
„ .	Skye, Dunvegan	2·87	...	*Antr* .	Belfast, Cavehill Rd	2·39	...
„ .	Barra, Skallary	2·47	...	„ .	Aldergrove Aerodrome.	2·15	86
R&C .	Alness, Ardross Castle.	1·22	37	„ .	Ballymena, Harryville.	2·67	85
„ .	Ullapool	1·54	37	*Lon* .	Garvagh, Moneydig	2·43	...
„ .	Achnashellach	3·88	54	„ .	Londonderry, Creggan.	2·54	79
„ .	Stornoway, Matheson	1·64	40	*Tyr* .	Omagh, Edenfel	2·54	81
Suth .	Lairg	1·66	54	*Don* .	Malin Head	2·09	...
„ .	Tongue	1·33	40	„ .	Killybegs, Rockmount.	2·04	...

Climatological Table for the British Empire, October, 1935

STATIONS.	PRESSURE. Mean of Day M.S.L. mb.	PRESSURE. Diff. from Normal. mb.	TEMPERATURE. Absolute. Max. °F.	TEMPERATURE. Absolute. Min. °F.	TEMPERATURE. Mean Values. Max. °F.	TEMPERATURE. Mean Values. Min. °F.	TEMPERATURE. Mean Values. ½ Max. and Min. °F.	TEMPERATURE. Mean Values. Diff. from Normal °F.	TEMPERATURE. Mean. Wet Bulb. °F.	Relative Humidity. %	Mean Cloud Am'nt 0–10	PRECIPITATION. Am'nt. in.	PRECIPITATION. Diff. from Normal. in.	PRECIPITATION. Days.	BRIGHT SUNSHINE. Hours per day.	BRIGHT SUNSHINE. Percentage of possible.
London, Kew Obsy	1010·8	− 3·2	62	28	56·5	44·8	50·7	+ 0·8	45·9	88	7·1	1·98	− 0·72	13	3·1	29
Gibraltar	1017·1	− 0·1	79	51	72·1	57·6	64·9	− 1·5	56·1	79	3·9	1·97	− 1·30	5	...	...
Malta	1015·5	− 0·5	91	55	77·5	67·5	72·5	+ 1·6	66·2	74	5·0	1·00	− 1·87	9	8·0	71
St. Helena	1013·9	− 0·4	72	53	62·8	55·1	58·9	+ 0·6	56·4	92	9·7	0·62	...	9	...	...
Freetown, Sierra Leone	1012·5	+ 2·6	90	68	85·3	71·9	78·6	− 1·5	75·1	86	7·2	16·46	+ 3·84	24	...	...
Lagos, Nigeria	1011·3	+ 0·3	88	72	85·4	75·2	80·3	+ 0·6	75·9	85	7·4	6·08	− 1·69	16	6·1	51
Kaduna, Nigeria	1007·7	...	93	65	88·5	67·4	77·9	+ 1·6	72·4	85	4·8	2·89	+ 0·14	9	8·3	70
Zomba, Nyasaland	1010·3	− 0·6	93	58	87·1	64·5	75·8	+ 1·7	63·9	44	2·6	0·00	− 1·52	0	...	...
Salisbury, Rhodesia	1011·9	+ 0·1	91	52	84·8	57·4	71·1	+ 0·4	58·2	37	0·8	0·10	− 1·03	2	9·8	78
Cape Town	1018·2	+ 0·8	86	45	71·0	53·9	62·5	+ 1·3	55·5	72	4·9	1·05	− 0·60	7	...	...
Johannesburg	1012·5	+ 1·0	90	42	79·7	54·4	67·1	+ 4·3	53·2	42	2·8	1·08	− 1·48	7	9·7	76
Mauritius	1017·9	− 0·3	85	59	80·1	65·1	72·6	− 0·1	68·0	67	4·7	1·26	− 0·12	15	8·8	70
Calcutta, Alipore Obsy.	1008·9	− 0·5	93	66	90·9	73·9	82·4	+ 3·1	74·2	81	2·4	0·91	− 3·99	2*	...	...
Bombay	1008·8	− 1·0	97	72	90·0	76·9	83·5	+ 1·1	76·3	81	5·6	1·04	− 0·63	2*	...	...
Madras	1007·8	− 1·1	95	72	88·7	75·4	82·1	− 0·2	76·6	81	6·6	15·53	+ 4·38	9*	...	...
Colombo, Ceylon	1009·7	− 0·3	87	70	84·4	74·6	79·5	− 1·0	76·5	79	7·7	23·65	+ 10·29	24	5·6	47
Singapore	1008·8	− 0·9	89	74	86·0	76·3	81·1	0·0	77·7	79	7·8	4·06	− 4·01	13	5·1	42
Hongkong	1012·7	+ 1·0	89	70	82·0	74·8	78·4	+ 1·5	74·1	79	6·7	5·81	+ 0·87	11	6·0	51
Sandakan	1008·8	...	91	72	88·5	75·1	81·8	+ 0·4	77·7	82	7·6	12·58	+ 2·25	24	...	...
Sydney, N.S.W.	1015·2	+ 0·4	96	51	72·8	56·3	64·5	+ 0·9	59·0	59	6·0	3·48	+ 0·63	13	8·0	62
Melbourne	1015·4	+ 0·6	87	38	67·5	48·2	57·9	+ 0·2	53·4	65	7·0	2·89	+ 0·26	17	5·0	39
Adelaide	1016·2	+ 0·2	90	42	72·7	53·0	62·9	+ 0·9	55·6	51	6·5	2·63	+ 0·90	12	6·7	52
Perth, W. Australia	1017·9	+ 1·1	81	42	68·3	50·6	59·5	− 1·3	53·4	60	4·3	2·20	− 0·02	10	9·3	73
Coolgardie	1015·1	0·0	90	38	73·4	47·7	60·5	− 3·2	55·8	68	3·8	2·78	+ 2·12	8	...	...
Brisbane	1016·9	+ 0·7	91	55	78·6	61·1	69·9	+ 0·1	63·6	63	5·2	4·93	+ 2·40	11	8·3	65
Hobart, Tasmania	1012·1	+ 1·8	81	37	61·4	45·4	53·4	− 0·7	48·2	60	6·5	2·58	+ 0·32	18	6·3	48
Wellington, N.Z.	1012·0	− 1·1	65	39	58·4	47·8	53·1	− 1·3	51·4	81	7·8	5·12	+ 1·04	18	5·1	39
Suva, Fiji	1013·2	0·0	88	69	81·4	72·2	76·8	+ 1·0	73·2	86	8·3	16·34	+ 8·05	26	3·7	30
Apia, Samoa	1010·9	− 0·6	87	72	85·7	75·9	80·8	+ 2·4	77·0	74	5·5	3·61	− 2·77	19	8·4	68
Kingston, Jamaica	1010·2	− 1·3	89	67	85·4	71·9	78·7	− 1·8	71·5	88	6·5	10·08	+ 2·62	16	3·8	32
Grenada, W.I.	...	...	90	72	86	75	80·5	+ 0·4	75	79	4	5·33	− 2·43	12	...	...
Toronto	1021·0	+ 3·5	79	27	59·2	41·1	50·1	+ 1·5	43·2	83	6·0	1·57	− 1·00	15	5·8	52
Winnipeg	1015·6	+ 0·7	74	11	50·1	30·5	40·3	− 0·4	...	...	4·9	0·62	− 0·75	6	4·2	39
St. John, N.B.	1020·3	+ 4·5	62	28	54·4	39·5	46·9	+ 1·6	43·0	80	4·9	1·46	− 3·08	14	6·4	58
Victoria, B.C.	1019·1	+ 2·0	77	27	55·0	44·6	49·8	− 0·5	47·0	84	6·5	2·52	− 0·05	12	4·8	44

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

Errata: Freetown, Sierra Leone—a correction of 1·6 mb. should be applied to all pressure readings prior to August, 1935.

(31380) Wt. 19/32 1125 4/36 Hw. G.377/6

Frontispiece]

Zenith ↑

↓ Sun

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BRILLIANT CIRCUMZENITHAL ARC OBSERVED AT ABERDEEN, MARCH 24TH, 1936 (see p. 90)

M.O. 403.

The Meteorological Magazine

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The Weather of April, 1936

After the fine mild weather of the early part of April, Easter, 1936 was a great disappointment to holiday-makers. Apart from a small depression which crossed England on the 1st and 2nd, the first eleven days gave anticyclonic conditions over the whole country. It is true that the centre of the anticyclone during most of this period lay to the north or west of England, but the barometric gradient was slight, and the coolness of the northerly or north-easterly winds was more than counterbalanced by the absence of rain, and towards the end of the fine spell by a sufficiency of sunshine. On the 9th and 10th, conditions over this country were definitely anticyclonic. April 10th, Good Friday, gave very pleasant weather over most of the country. The average pressure distribution for April 1st–11th shows pressure above 1,015 mb. over the whole of the British Isles except Cornwall and the Scilly Isles, and exceeding 1,020 mb. over northern Ireland and most of Scotland.

After the 10th the anticyclone retreated steadily northwards, and two depressions which had lain over the Atlantic south-west of Ireland and over eastern Europe united to form a trough of low pressure over the southern half of England. Weather deteriorated rapidly, and Easter Sunday and Monday were characterised by cold showery conditions, with snow in many places, including London. As early as Saturday afternoon fairly heavy snow fell in parts of Kent, Surrey and Sussex, and impeded motor traffic. Monday was a cold, wet and gloomy day in most parts, though Cornwall and Devon escaped.

During the succeeding days the complex system of depressions gradually spread further north and covered the whole of western Europe. Easterly or northerly winds prevailed over the British Isles and the weather remained cold and gloomy, with frequent hail, snow or sleet, though the total of precipitation was not great. On the morning of the 15th pressure fell below 992 mb. in a depression centred over Rochefort, and two days later the whole of western and central Europe was occupied by a depression in which pressure fell below 982 mb. near Prague. A wide area of northerly winds spread over the British Isles, and sharp frosts occurred in Scotland and northern England. Abundant sunshine from the 17th to 19th, however gave fairly warm days in spite of the cold winds.

The mean pressure distribution for the period April 12th–19th inclusive is shown in Fig. 1, which brings out clearly the intense

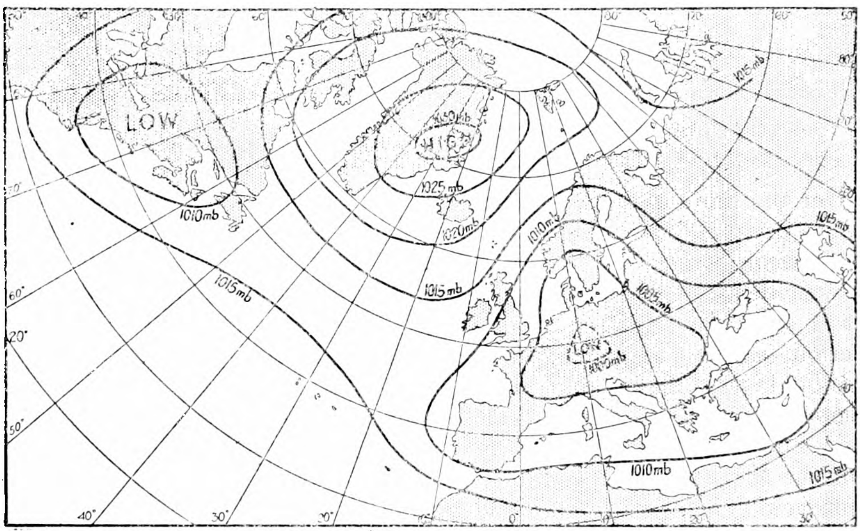


FIG. 1—Mean pressure distribution April 12th–19th, 1936

anticyclone over Greenland, the extensive depression over Europe, and the gradient for north-easterly winds over the British Isles—a situation which approaches a reversal of the normal pressure distribution.

On the 19th a small anticyclone developed off the west coast of Ireland, which gradually developed into a narrow ridge of high pressure extending from north to south across or to the west of the British Isles. Conditions remained cold and unsettled for several days however, and April 21st especially was marked by strong north-easterly winds. Some of the races on the first day of the Epsom spring meeting were run in snow showers, and on the night of the 21st–22nd strong winds, with squalls of rain and sleet, blew in the

English Channel. On the 24th a more normal distribution of pressure returned, and a depression south-west of Iceland brought south-westerly winds and milder weather to the British Isles. During the last few days of the month the Azores anticyclone spread north-eastwards over England and brought a welcome period of fine, warm and sunny days.

For the month as a whole the distribution of pressure was not very abnormal. Pressure was slightly above the average over the whole of the British Isles, the excess increasing north-westwards towards Iceland, where it reached 4·3 mb. at Reykjavik. On the other hand the Baltic showed a negative departure reaching 4·6 mb. at Skagen, and the chart for the whole month shows the tendency for northerly winds. Over the greater part of the North Atlantic pressure was almost normal.

The wintry weather of the middle part of the month extended over a large part of central Europe, and on the 17th, a party of 27 London schoolboys were caught in a heavy snowstorm and fog in the Black Forest, and five of them lost their lives. At the time, the Black Forest lay in an unstable and disturbed current of air from the north and north-west on the western side of a deep depression centred near Prague, but the storm appears to have come up suddenly and to have been unusually severe.

The Investigation of Fog and Mist in Winter

With the growth of aviation and the consequent demand for aerodromes in many parts of the country, it is a matter of great moment that sufficient data should be available on which to found opinions as to the suitability of aerodrome sites. These opinions moreover must, among other factors, take into account local variations in fog, which is the worst obstacle to the regular working of aircraft.

It is common experience that the incidence of fog is very variable from place to place. There are, of course, some days on which fog is widespread and envelops whole districts of the country in its pall, but on other occasions a motorist, for example, may encounter a patch where visibility is appreciably worse than it is 5 or 10 miles further on. That these patches of poor visibility do not occur haphazard is well known, often they lie over a valley with better visibility on the higher ground, sometimes they may be ascribed to the smoke of industrial areas. From the lie of the land and its relation to centres of smoke production it is possible from our present knowledge to give a rough estimate of whether any particular place is more liable to fogs than its general surroundings, but in consideration of the complexity of the problem the data available are scanty.

To rectify this lack of data an appeal was made to rainfall observers, and as a result about 950 offers to co-operate in a special investigation have been received. The form that the observations for this investigation take is as follows:—Each observer records at about 9 a.m. every day during the winter months which is the furthest of three objects that he can see; the three objects are at distances of about 220 yards, 1,100 yards and 2,200 yards—distances which correspond to the definitions of thick fog, fog and mist respectively. Each observer is also asked to fill in a questionnaire giving particulars of the topography of the observation point in relation to rivers, towns and also soil.

These observations are asked for at 9 a.m., because that is the time at which visibility is usually worst in the winter months, as is seen from Fig. 1 which shows the variation in frequency with which objects at 220 yards, 1,100 yards and 2,200 yards were visible at Croydon at various hours in winter. The investigation is also confined to winter since fog is comparatively rare at inland places in summer, and when it does occur its incidence is in the very early mornings. In the spring and summer fogs do occur over the sea and sometimes in those months these fogs drift a short way inland, but the investigation of fogs of that nature would have to follow a different line from that of the winter fogs.

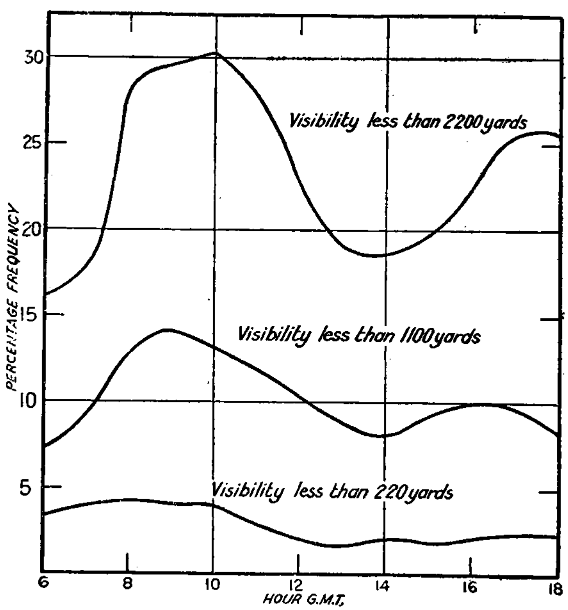


Fig. 1.

At a number of key stations which have sent in climatological summaries for a period of years the normal frequency of fogs is known. The new data now collected will be dealt with statistically, in the first instance, by counting up the number of days with thick fog, fog and mist at each place and comparing these numbers with those of the key stations. By this means it will be possible to obtain approximate values of the normal frequency of fogs for all the new stations even though observations are made over one winter.

It will moreover be possible with these data to obtain an insight into the effect on fog frequency of height above the surrounding country by comparing stations in various types of topography. Similarly, by choosing out days with certain wind directions, it may be possible to find out more precisely than is at present known how far away from a town the visibility is affected seriously by its smoke, and finally, by comparing sites with similar types of topography but different soils, it may be possible to learn definitely how far the type of soil affects the prevalence of fog.

When these questions have been solved, it will be possible by examining the lie of the land at any place, even though observations have not been made at it, and by comparing its topography with that of other places where observations of fog are available, to deduce fairly accurately how often fog is likely to occur at that particular spot.

C. S. DURST

Wet- and Dry-Bulb Hygrometry

In meteorological practice the accurate measurement of atmospheric humidity is made by means of wet- and dry-bulb thermometers, and in particular by means of an Assmann ventilated psychrometer. The "Dictionary of Applied Physics" (Vol. 3, p. 424) gives a curve in effect relating the depression of the wet bulb with the velocity of aspiration past the wet bulb which shows the depression increasing with velocity until a velocity of about 5 m/sec. is reached, when the depression becomes constant. Less than half this velocity is obtained with the Assmann psychrometer using a clockwork driven aspirating fan, and further, the velocity depends on the extent to which the motor is wound. Obviously, therefore, this instrument cannot yield thoroughly reliable measurements of humidity unless very great precautions are taken. This was confirmed by Best* who made comparisons between such instruments and a psychrometer with an electrically driven fan (velocity of aspiration 5·1 m/sec.) as now marketed by Casella. An electrically operated psychrometer is not always suitable for use in the open however, needing as it does a conveniently placed electric supply "point".

A recent paper by Simons† on the determination of low relative humidities by means of wet and dry thermocouples has led the writer to some considerations on psychrometry which may be of general interest and assist in a better experimental determination of humidities.

As far as the writer can discover from a search in the literature of the subject it does not seem to have been appreciated fully that it is not merely the velocity of aspiration which determines the amount of the wet-bulb depression but also the ratio of the surface area of the bulb to its volume. There is no adequate theory of evaporation to apply in a detailed way to the ventilated wet bulb, but certain factors are of obvious importance. For a constant humidity and velocity of aspiration below the critical it seems clear

* A. C. Best, *London Quart. J. R. met. Soc.* 56, 1930, pp. 365–73.
† A. Simons, *London, Proc. phys. Soc.*, 48, 264, 1936, pp. 135–44.

that the depression must be very nearly proportional to the surface area of the bulb, except in the region of maximum depression—the greater the surface exposed to the air stream the greater will be the quantity of water evaporated—and inversely proportional to the volume of the bulb, i.e., to the heat capacity of the bulb for a given thermometric liquid. Now for a cylindrical or spherical bulb the ratio of the surface area to volume is inversely proportional to the diameter *d*. Hence the smaller the bulb the greater this ratio becomes and the less the velocity of aspiration required to produce the maximum wet-bulb depression.

In support of these conclusions the figures already referred to in the "Dictionary of Applied Physics" and the results of Simons (loc. cit.) may be considered. The Assmann psychrometer (either as originally used by Assmann or the Casella pattern) is fitted with thermometers whose bulbs are about 5mm. diameter. Simons' thermocouple elements were made of 0·063 mm. diameter wire, and the values of $1/d$ for the Assmann and thermocouple elements are in the ratio of 0·013 : 1. Taking 5 m/sec. as the critical velocity for the Assmann the above argument would suggest a critical velocity of about 6 cm./sec. for the thermocouple. Simons actually found the critical velocity to be about 2 cm./sec. !

In general it is probably not desirable to replace mercury-in-glass thermometers by thermocouples, but two recommendations seem to be worth making :—

(1) That the present thermometers in use in Assmann clockwork psychrometers be replaced by others with finer bulbs of about 2 mm. diameter, say, so that the velocity of aspiration obtainable with the clockwork driven fan would be about sufficient to give the maximum depression. Errors due to conduction down the stem should be negligible.

(2) For humidity measurements of precision from apparatus to be used in a Stevenson Screen, wet and dry thermocouples might be used, for the air flow through screens is rather indeterminate and the appropriate factor to use in the humidity formula on any occasion is by no means certain when mercury-in-glass thermometers are used. Apart from periods of complete calm there would, however, be a constant factor to apply in the case of a small thermocouple.

With respect to (1) above, it may be noted that the thermometers supplied with Casella's Sling Psychrometers have bulbs approximately 2 mm. diameter and these instruments were shown by Best (loc. cit.) to give quite accurate measurements of humidity. Assuming a whirling rate of 3 rev./sec. and a radius of action of the bulb of 15 cm., the "aspiration" velocity is about 2½ m./sec. which should be sufficient to produce maximum depression for the size of bulb. There should be no difficulty in obtaining a thermometer of similar bulb size for use in the Assmann psychrometer.

P. A. SHEPPARD.

OFFICIAL PUBLICATION

The following publication has recently been issued :—

PROFESSIONAL NOTES

No. 70. *Observations of the blueness of the sky.* By J. S. Farquharson, M.A. (M.O. 336j.)

Observations of the blueness of the sky were made three times daily by means of a scale of standard tints devised by F. Linke, for 2 years at Cattewater (Plymouth) and Croydon and for 4½ years at Cranwell. The greatest blueness of the sky is found at Cattewater, the least at Croydon, and this is attributed to the greater atmospheric pollution due to smoke at Croydon. The diurnal variation shows a maximum blueness at midday, especially in winter ; at Croydon and Cranwell the sky is bluer in summer than in winter, but at Cattewater the greatest blueness occurs in spring.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, April 22nd, at 49, Cromwell Road, South Kensington, Dr. F. J. W. Whipple, F.Inst.P., President, in the Chair.

The following papers were read and discussed :—

L. H. G. Dines, M.A.—A form of apparatus for obtaining samples of the atmosphere from great heights.

The paper describes an apparatus which has been evolved by the Upper Air Section of Kew Observatory, in conjunction with Professor F. Paneth and Dr. E. Glückauf, of the Royal College of Science, for obtaining samples of the atmosphere from great heights for subsequent analysis of the helium content of the air. The instrument is raised by means of a free sounding balloon, and all relevant dimensions and details are given. The mode of operation is described.

E. W. Hewson, M.A.—The application of wet-bulb potential temperature to air mass analysis.

The horizontal component of the motion of air has been traced by means of upper wind observations, and the vertical component found by the use of wet-bulb potential temperatures. Knowing therefore the trajectory of the air, it has been possible to make an accurate study of the changes in the humidity mixing ratio x. Several situations have been investigated by this method, and independent checks confirm the accuracy of the results obtained by it. A discussion of the possible magnitude of the errors involved is given.

W. E. Knowles Middleton.—The apparent colour of lights at night ; with an observation of "blue fog."

On the basis of the Commission Internationale de l'Eclairage (1931) colour metric, an expression is developed for the colour co-ordinates and luminosity of a given light-source seen at night through an atmosphere of known optical properties. This is applied to an observation on a mercury vapour lamp in a highly selective haze of the type sometimes called "blue fog."

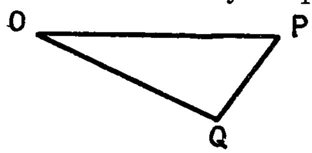
A meeting of the Royal Meteorological Society will be held at Edinburgh on Wednesday, September 16th, on the occasion of the assembly of the International Union of Geodesy and Geophysics at Edinburgh. It is anticipated that there will be addresses by Prof. F. Linke on "Moving cloud pictures", by Mr. R. H. Weightman on "Stratosphere flights in America," and by Dr. A. H. R. Goldie and Dr. A. Crichton Mitchell on "The Story of Ben Nevis Observatory."

Correspondence

To the Editor, *Meteorological Magazine*

Wind at Sea

I do not remember to have seen mention, in any discussions of wind at sea of the fact that observations from ships normally give the wind relative to the (moving) surface of the water and not the wind relative to a fixed point on the earth's surface. If there is a wind whose true velocity is represented by OP and an ocean current whose velocity is represented by QP, then the observed wind will be represented by OQ. This is true of winds obtained on board ship, whether they are measured by an anemometer and corrected for the motion of the ship through the water, or whether they are estimated from the appearance of the surface of the sea. This conclusion is independent of the depth of the surface current in both cases: but in the first case the speed of the ship through the water must be taken relative to the surface water, which would usually be the practice.



There is no practical means by which a ship in the open sea, away from land, can correct its observations of wind to give the true wind instead of the relative wind (except by deducing the current from astronomical observations). Naturally these corrections are not, in practice, applied; so that in all winds reported by observers at sea, it is the relative wind and not the true wind which is reported: and this relative wind has been used in the preparation of charts, tables and descriptive accounts of wind at sea. Fortunately, the speed of the wind is usually so much greater than the speed of ocean currents, that the relative wind reported from ships will generally be sufficiently near the true wind to be useful for meteorological purposes.

Near land the true velocity of the ship could be obtained from observation on fixed marks; and hence the true velocity of the wind derived from anemometer records on board the ship by the application of a correction for the ship's true velocity. True winds could also be obtained direct from anemometer records on a ship at anchor.

The fact that the appearance of the surface of the sea depends on the relative wind, and not on the true wind, is easily overlooked. It has an important bearing on the problem of wind and tide. The suggestion that there is a connexion between the wind and the tide has often been put forward, and some observations bearing on the question were discussed a few years ago in the *Meteorological Magazine* without any very definite conclusion being reached.

Ocean currents are generally slow, but in the case of the tides changes of current in the neighbourhood of land are well known and marked. Tidal currents frequently run at 1 or 2 knots and sometimes at 5 knots or more: and they must produce their effect on the apparent wind. For example, if the air were calm, in the sense that there was no motion of the atmosphere relative to the fixed surface of the earth, an observer on a vessel in a current of 5 knots would experience a wind of force 2: so would the surface of the sea, i.e., the surface would not be calm but there would be short waves.

Seamen are accustomed to observing the force of the wind by the appearance of the surface of the sea. This is true not only of observations made by them at sea, but also, in many cases, of observations made by seamen at coast stations; consequently, it would be surprising if they did not find that there was a connexion between the wind so observed and the tide. This would be an apparent and not a real connexion so far as the true motion of the air is concerned: consequently, it would not be found if winds recorded by an anemometer ashore were used for the comparison. (This does not mean that there is no variation of true wind with tide: there probably is a small variation).

The times of tidal currents do not have an invariable relation to the times of high and low tide: the relation varies with the place: frequently the stream turns at or near the times of high and low water; but in some places it may turn at half tide: thus the relation of observed wind to tide will vary with the relation of tidal stream to tide.

In the foregoing remarks it has been tacitly assumed that the true wind is unaffected by the ocean current: that would not be strictly true: in the case of a steady permanent current over a wide region the surface wind would probably be appreciably affected by the current, and conversely, in the case of a steady wind blowing for some time the ocean current would be affected by the wind. But it is unlikely that the tidal streams in the neighbourhood of land, which extend over relatively small areas for relatively short periods of time, would affect substantially the true wind; though the converse would not be true: the wind may and does affect tidal streams.

The fact that the state of the sea depends on the relative wind mollifies slightly the hardships of the landsman who ventures on coastal waters in a rowing boat. If he finds himself in the unhappy position of having to row against the wind *and* against the tidal stream he may take some small consolation from the fact that the sea will be slightly less rough than if there were no tide; while if he is rowing *with* the tidal stream *against* the wind, the assistance obtained from the tide enables him the better to bear the slight consequent increase in the roughness of the sea.

May 4th, 1936. E. GOLD.

Unusually brilliant Circumzenithal Arc observed at Aberdeen, March 24th, 1936

A particularly brilliant example of the circumzenithal arc was observed here at 15 h. on March 24th, 1936.

Earlier in the afternoon the halo of 22½° was seen—the sky then being covered with striated cirrus. By 15h. the cloud had become cirronebula (about 6-tenths) and the 22½° halo had practically vanished. A rather faint arc of contact could, however, be seen. To the right and left of the sun were very well marked parhelia, each displaying brilliant colouring. The mock-sun ring was visible for some 15° to 20° to the right of the right-hand parhelion and perhaps 10° to the left-hand parhelion and showed a quite distinct bluish colour. No trace of the mock-sun within the halo could be seen.

The most noteworthy part of the phenomena was the circumzenithal arc. This was rather narrow at first but displayed well-marked colour effects. The arc slowly broadened and at the same time its coloration became extremely brilliant and well defined (red, yellow, green and violet being noted). Of particular interest was the violet colouring, this being very deep and of a brilliancy rarely seen.

The phenomena were visible for some twenty minutes but then gradually faded, with the exception of the parhelion to the left of the sun; this was visible until 16 h. 40 m., when it was obscured by lower cloud.

W. F. WATSON.

The Observatory, King's College, Aberdeen, March 25th, 1936.

[The circumzenithal arc described above was certainly the most brilliantly (or strongly) coloured arc of its kind that I have yet seen, the saturation of the colours approaching that found in an average rainbow.

I was able, by employing the appropriate filter, to photograph the arc in the yellow-green region of the spectrum (see photograph reproduced as the frontispiece of this number of the magazine). In view of the fact that the blue-green, blue and violet spectral regions were absorbed by the filter, the arc appears in the photograph approximately only half as broad as it appeared to the eye. G. A. CLARKE.]

Halo Phenomena witnessed at Sealand

During the last days of March, 1936, halo phenomena were fairly frequent and the following two occurrences appear to be of unusual interest.

On March 20th, at about 9h. 15m., when the sky was 7-tenths covered with altocumulus and cirrostratus, a solar corona and halo were visible (Fig. 1). The angular measurements shown were made with a theodolite. The upper arc of contact and the horizontal circle, or mock sun ring, were particularly well developed, the latter extending almost the whole distance from the mock suns to the centre.

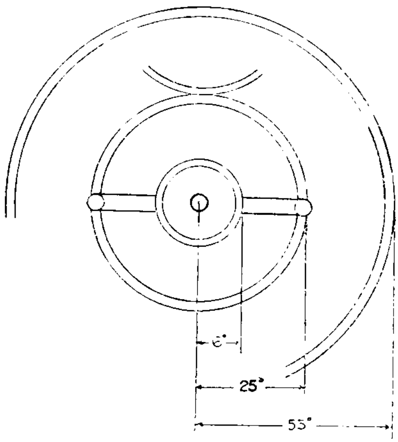


Fig. 1

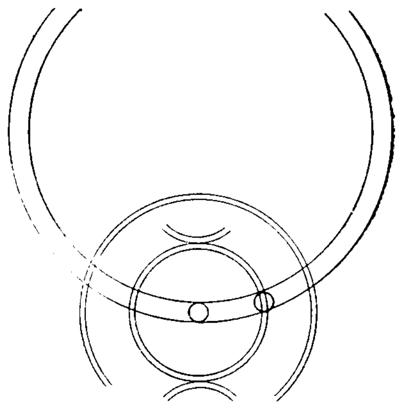


Fig. 2

The second case was a lunar halo which persisted from about 20h. 30m. on the 28th to 1h. on the 29th (Fig. 2). The sky was completely covered with a layer of cirrostratus which was so thin that even the faintest stars were plainly visible so that, except for the halo phenomenon, one would have thought that the sky was cloudless. Apart from the lower portion of the halo of 46° which was below the horizon (Llantysilio Mountains) the halos of 22° and 46° were complete. One of the paraselenae, the one on the right, was visible and the horizontal circle was almost complete. Both upper and lower arcs of contact were exceptionally well defined. A remarkable feature of this phenomenon was that the horizontal circle was approximately double the width of the halo. No colours were visible, but the whole phenomenon had a "milky white" appearance.

GEO. R. READ

Roker, Station Road, Great Saughall, Chester, April 14th, 1936.

Lunar Cross at Waringstown

A precursory sign of coming frost and of the apparent presence of ice crystals in upper reaches of the atmosphere was evident on the night of April 6th at 9.10 p.m. The moon, about full at the time, having risen an hour or two previously, was shining through a veil of homogeneous cirrus haze. Radiating from the moon in four different directions like searchlight beams, were four shafts of light forming a very convincing cross, with the moon at the intersection of the arms. The angular measurement of the vertical shaft, including the moon, was about nine lunar diameters; the traverse shaft, also including the moon, would have been about five lunar diameters: from extremity to extremity in each case. The night was perfectly calm, illumination good; and the spectacle lasted about 10 minutes.

WM. J. GIBSON.

Waringstown (near Lurgan) Co. Down, May 2nd, 1936.

The abnormal Weather at Ross-on-Wye

The present season is proving abnormal in many ways. The recent winter has been persistently wet, following a wet autumn, and March was the seventh consecutive month with rainfall above normal. From September to March inclusive the rainfall here was 25·75 inches—nearly 8½ inches above normal (or roughly 50 per cent).

But the strangest feature is the sunshine. Since records began here in July, 1914, I can find no instance of the first three months of any year passing without a single day's record reaching as much as 8 hours. Yet this has been our experience in 1936—the best record being only 7·9 hrs. on February 8th. Yet in spite of the absence of very high daily records February had a sunshine total of 90·4 hrs.—the result of consistency. Again in March there were five sunless days in succession (10th–14th inclusive), for which I can find no precedent. The total sunshine for the month, 70 hrs., is not our lowest, as in 1916 and 1928 the totals were 60 and 64 hrs. respectively. In March, 1928, the best day's record was only 7·4 hrs., as compared with one of 7·7 hrs. in March, 1936.

Our normal experience here is that records of 8 to 9 hrs. occur in February, the latter figure being exceeded in most seasons, whilst March usually provides records ranging from 9 to more than 11 hrs. in one day. Even April, to date, has not yet yielded as much as 7 hrs. in one day.

In other districts—especially in the far north and also in south-east England—there does not appear to have been this paucity of large daily records. And what of the cause of the dullness here?

F. J. PARSONS.

The Observatory, Ross-on-Wye, April 9th, 1936.

Note on the Past Winter

The winter of 1935–6 was remarkable for its regular alternation of very cold and very mild wet spells, the latter being unusually accentuated on the continent. In Scotland, however, the winter was decidedly rigorous. At some places, at no great altitude above sea-level, snow lay on the ground for nearly three months, and the fact that just before Christmas ice was forming in salt-water lochs, like Etive on the west coast, seems worthy of comment. Occurrences of sea-ice round the coasts of the British Isles are less rare than is commonly supposed, but they should always be carefully recorded as a useful index of the severity of a winter. In February ice appeared in the Essex tidal creeks. On January 17th, 4 to 5 inches of snow was lying on Hampstead Heath, more than at any time since the blizzard of Christmas, 1927. Very little, however, lay in central London, and the general lack of snow in London during the last 8 years is without a parallel for a very long period.

L. C. W. BONACINA.
35, Parliament Hill, Hampstead, N.W.3, May 5th, 1936.

NOTES AND QUERIES

Visibility in Specified Directions in the Early Morning

When stationed in Egypt it was noticed that at Heliopolis the visibility, soon after sunrise, appeared to be considerably greater towards the north-east than towards the south-west and in order to examine this effect further a series of observations of visibility towards each of the directions, north-east, south-east, south-west and north-west was taken during August, September and October, 1928, within three hours of sunrise. Heliopolis lies to the north-east of Cairo* so that the normal visibility objects are situated to the west of a line running roughly north and south through the station, and the outlook over the remaining directions is desert. Observations towards south-west and north-west were therefore of actual objects, but towards north-east and south-east the visibility estimates were based on the apparent obscuration in much the same way that visibility is estimated at sea. The minimum distance appropriate to each visibility letter was used in the analysis and the mean distances in each direction, cases of fog being excluded, were then determined.

The results are given in Table I and it will be seen that on an average, visibility towards north-east was not exceeded by that in any other direction, while the poorest visibility was always experienced towards south-west; towards north-west and south-east the visibility was approximately the same in each direction.

These figures indicate that when the elevation of the sun is small and the relative humidity high, visibility is greatest looking towards the sun, and least looking away from the sun—a conclusion to be anticipated from a consideration of Bennett's† work on the scattering of light by suspensoids if the hygroscopic nuclei present scatter the incident light from the sun and produce "glare". The effect is,

* *See Meteorological Magazine*, 67, 1932, p. 229, Fig. 1.
† *London, Quart. J. R. met. Soc.*, 56, 1930, pp. 6–10.

no doubt, accentuated by the greater number of nuclei in the air in the immediate vicinity of Cairo than over the desert and these nuclei will have their maximum concentration about sunrise when

TABLE I. VISIBILITY IN MILES AT HELIOPOLIS, 1928.

Visibility towards	August.			September.		October.	
	5h.	6h.	7h.	6h.	7h.	6h.	7h.
NW.	9	9	10	8	9	8	9
SE.	8	10	10	8	9	7½	8½
NE.	11	11	10	9½	9½	8½	10
SW.	4½	4½	5	4	4	4½	4½
No. of obs.	11	12	11	29	27	29	26
Sunrise	5h. 26m.			5h. 39m.		5h. 56m.	
Range of relative humidity at 3h.	79 to 94%			74 to 95%		75 to 97%	

All times are local time.

the nocturnal inversion, which is well developed throughout the year inland in Egypt, is at its maximum, but the differences are sufficiently large to indicate that the position of the sun, when the elevation of the latter is small, should be taken into account when visibility is under consideration.

WILLIAM D. FLOWER.

REVIEWS

Visibility in Meteorology. The theory and practice of the measurement of the visual range. By W. E. Knowles Middleton. Size 9 in. × 6 in., pp. viii + 104. *Illus.* Published by Mr. Milford at the University of Toronto Press, Toronto, 1935. 8*s*. 6*d*. net.

This monograph is designed, as the author states in his preface, to indicate the work done in the theory and measurement of visibility (defined as the brightness-contrast between adjacent bodies), and of visual range (defined as the maximum distance of clear vision); though short, it covers considerable ground.

The first half of the book is a consideration of the mathematics of the subject. For the most part, the mathematics have been followed through in detail; but in any case, there are abundant references to original papers. In these chapters visual range, by the use of threshold of contrast, is considered under differing circumstances. Thus the author gives the investigations, done under conditions of scattering and absorption by aerosols, etc., with black, white and grey objects against different backgrounds; emphasis is laid on the consideration of snow as such a background. Light sources are similarly considered, and the author lays stress, rightly, on the fact that much work needs to be done in the examination of coloured lights under different background conditions. Results are given for conditions of both night and day for the above cases; diffuse illumination also receives attention. This theoretical work is only followed through so far as it has practical application; thus, vertical and oblique visibility receives only the comment that it is a neglected field.

Chapters VI–X are concerned with the experimental side of the determination of visibility and visual range; the author discusses the use of photometers and visibility meters for both types of observation. His comments on the various instruments mentioned are interesting, and he favours the use of visibility meters rather than photometers for the determination of visual range. The last three chapters of the book are devoted to a detailed consideration of the drawbacks of the present system of measuring visual range, and the author gives some suggestions as to how to overcome these difficulties; in some cases, however, these suggestions do not appear entirely satisfactory. He comments on the determination of visibility readings at night, and advocates his own useful scheme of a system of lights of suitable strengths, which would be equally appropriate for day and night observations. Chapter IX also deals with the relations between visual range, and various meteorological elements (such as relative humidity, and diurnal variation); he comments briefly on relations with each element, but there are very few calculated figures quoted in this connexion, which seems rather a pity. Presumably his references cover this defect.

The book provides a useful survey of the work done in the field of visibility, and at the same time gives a condensed, yet fairly full summary of the more practical side of the subject applied in particular to navigation and observational meteorology. The bibliography is very good; its position at the end of the book makes it easy for reference. The diagrams printed are satisfactory, but more might have been introduced with advantage.

G. W. HURST.

Memorie del R. Ufficio Centrale di Meteorologia e Geofisica. Serie III. Vol. V. Ministero dell'agricultura e foreste, Rome, 1935.

This large volume contains a rich harvest from the meteorological activity in Italy during recent years. It includes ten memoirs, the majority of which deal with climatology and the investigation of the upper air. S. Aurino has a long memoir of 90 pages, with numerous tables, on the climate of Naples, while E. Guerrieri deals with intense falls of rains in the same city and G. Frongia discusses the climate of Cagliari, and the Director, E. Oddone, contributes with O. Burchi, an account of the snowfall of Sestola, including tables of daily falls from 1890 to 1930. The upper air memoirs include summaries by P. Gamba of the pilot-balloon observations at Pavia in 1917–8, and by G. Ingrao of those in 1933; the latter author also has a summary of the distribution of temperature in the free air above Pavia. Two other memoirs consist of an account by E. Oddone of the preparations for prospecting the sub-soil of Italy by seismological methods, and a study by P. Gamba of the surface temperatures of the north-eastern waters of the Adriatic in relation to the precipitation in the basins of the affluent rivers and other local meteorological conditions. Another gives the results of an investigation by G. Roncali into the secular variation of terrestrial magnetism in Italy and neighbouring countries which he extends back to 20,000 B.C., by means of the magnetic characteristics of the lavas of Etna ; he also gives a summary of the results of similar investigations into lavas of all parts of the world dating from various geological periods between the Permo-Carboniferous and the Tertiary, which leads him to the suggestion that while the magnetic axis has always made a small angle with the axis of rotation, it has sometimes changed its sign.

BOOKS RECEIVED

Meteorological Observations for 1933 *and for* 1934. Prepared in the Meteorological Office, Wellington. E. Kidson, D.Sc., Director, Wellington, N.Z., 1934 and 1935.

OBITUARY

Sir Joseph Petavel, K.B.E., F.R.S.—It must have come as a shock to many readers of the *Meteorological Magazine* to hear of the death of Sir Joseph Petavel on March 31st. Sir Joseph was only sixty-two years of age and although he had undergone a serious operation at the end of last year, few of his friends realised that he might not pull through.

As Director of the National Physical Laboratory, Sir Joseph frequently came into contact with meteorologists ; but it is not in that capacity that meteorologists know him best, for, thirty years ago he made valuable contributions to our knowledge of the upper atmosphere, which at that time was very meagre, and in more recent years the leading part he has played in the development of aerodynamics has constantly brought his name before meteorologists.

The *Meteorological Magazine* is not the place to give an account of Sir Joseph's great contributions to pure and applied science, but many readers will be interested to know how Sir Joseph, an engineer both by training and inclination, became interested in the upper atmosphere and consequently one of our leading authorities on aerodynamics.

Sir Arthur Schuster was greatly interested in meteorology and when a suitable vacancy occurred on his staff at Manchester University he decided to establish a lectureship in meteorology. I was appointed to the post and commenced to lecture on meteorology and mechanics in October, 1905. I was very keen on doing upper-air work, but we had no money for the equipment ; that was, however, a small matter to a man in his twenties. I hunted round and found a suitable spot for a kite station on the Derbyshire moors near to Glossop, and Mr. W. H. Dines presented me with some kites and an old winding winch, of which more later. Schuster found me a few pounds with which to buy an old boiler and steam engine to drive the winch, and the Glossop upper-air station was established in the spring of 1906. It was my practice to ask students and others who were interested—and who was not interested in flying kites ?—to come to Glossop and help with the work. One day when looking for someone to accompany me I met Petavel and asked him to come. With his usual readiness to help he consented and we set off—and I think I am justified in saying that that was a real turning point in Petavel's life.

The winding gear which had been given by Mr. W. H. Dines had been made by him for his work on kite flying from a boat on the west of Scotland. It was a most ingenious winding gear ; but anyone who ever saw pioneer apparatus made by Mr. W. H. Dines will know that there was nothing " engineering " about it. Petavel was highly amused. During the afternoon the winch gave trouble, as it always did, and when winding in, a piece of tin—which had been used for strengthening the wooden drums on which the wire was wound—got caught up in the wire and made such a mess of the whole complicated arrangement that it was clear the winch had at last come to the end of its life.

In the train on our way back to Manchester, Petavel made humorous remarks about the winch, and said that it should have been built of metal instead of wood and bits of tin. I stood up for the design, knowing so well the wonderful results obtained by Mr. Dines with that and other winches made on the same principle. Rather exasperated I turned to him and said that I had obviously got to get a new winch and asked if he, as an engineer, could design a better one than Mr. Dines. He took up the challenge and in a few days produced drawings of a winch, practically on the same principle as Mr. Dines's, but made of metal and introducing certain obvious improvements.

Schuster again found the money, and a local engineering workshop built a winch to Petavel's design. The winch was installed at Glossop in the summer term of 1906 and Petavel came several times to try it out with the kites. By that time I had, on the recommendation of Professor Schuster, been appointed to the staff of the India Meteorological Department and so my work at Glossop had to come to an end.

Schuster did not wish the work at Glossop, which had really not yet started to give results, to cease, and as Petavel, who was then free, was familiar with the work and obviously interested, Schuster asked him to carry on the lectureship and run the Glossop station. For two years Petavel gave lectures on mechanics and, with the assistance of students, ran the Glossop Kite Station, but as far as I know he did not give any lectures on meteorology. The upper air work was extended to include the use of registering balloons which were sent up from Manchester. The results of the observations were published by Petavel in collaboration with W. A. Harwood and Miss M. White and are well-known contributions to our knowledge of the upper atmosphere. During this period, Petavel made his first personal contact with the upper air in a free balloon.

In 1908, Petavel was appointed Professor of Engineering in the Manchester University and towards the end of 1909 the Glossop Kite Station came to an end after four years eventful and useful life. Petavel was now a Professor of Engineering with considerable knowledge of the upper atmosphere and he naturally became a member of the Advisory Committee for Aeronautics which was formed in 1909. When the Aeronautical Research Committee was formed in 1917, Petavel was a member and chairman of the Aerodynamics Sub-Committee, and in 1919, as Director of the National Physical Laboratory, he became responsible for one of the three largest equipments for aerodynamic research in the world.

Science has lost one of her real devotees and Government has lost a most efficient servant, but many of us have lost a true friend whose memory will always be associated with the flowers, especially the daffodils, which he planted so extensively at his home at Bushey House, and with which he loaded his guests so lavishly.

G. C. SIMPSON.

NEWS IN BRIEF

We learn that Herr Hilding Köhler, Professor at the University of Uppsala, who has been acting as Director of the Meteorological Institution at the University of Uppsala since September, 1934, has been definitely appointed Director from April 1st, 1936.

We learn that the Senate of the University of St. Andrews has awarded the degree of D.Sc. to Major A. H. R. Goldie, Superintendent of the Meteorological Office, Edinburgh, for a thesis entitled " The mechanism of the depressions of temperate latitudes."

The Weather of April, 1936

Pressure was above normal over western Canada, the United States (except the western coast), Bermuda, the northern North Atlantic, Greenland, Iceland, the British Isles, Spitsbergen, western Siberia and north-west Africa, the greatest excesses being 3·2 mb. near lake Athabasca, 4·7 mb. near Nantucket and 4·3 mb. at Reykjavik. Pressure was below normal along the west coast of the United States, over eastern Canada and over Europe, the greatest deficits being 1·6 mb. at the Skagen, 2·6 mb. at Madeira and 3·5 mb. at 60° N. 60° W. In Sweden temperature was generally about normal and precipitation between 50 and 75 per cent above normal.

The main feature of the weather of April over the British Isles was the persistence of the cold air current from the north during the first 19 days and also at times during the later part of the month. The month will also be remembered for the wintry weather experienced during Easter, and in many parts as the coldest April for several years. In England rainfall was near to average but sunshine was deficient in the south, while in Scotland and north Ireland sunshine totals were much above normal and rainfall was deficient. The small depression which crossed England in an easterly direction at the beginning of the month gave rain generally on the 1st and 2nd, becoming heavy in the south on the 3rd, when 1·22 in. were measured at Ipplepen (Devon). Snow and sleet were reported from Scotland on the 3rd, and south England on the 3rd and 4th, while mist or fog occurred locally in England on the 1st and 2nd. The 4th was a sunny day in Scotland, over 11 hrs. being recorded in many parts, and 11·7 hrs. at Oban and Dunbar. From then to the 11th, mainly sunny weather prevailed with cold northerly winds but scarcely any precipitation, 41° F. was the maximum at Edinburgh, Rothamsted and Rhayader on the 5th. The 9th was the sunniest day of this period, when 11·8 hrs. were recorded at Morecambe, and 11·2 hrs. at Aberystwyth, York and Rhayader. From the 12th–16th the weather remained cold but accompanied by rain, hail, sleet or snow, the precipitation being most at the beginning of the period, when the snow impeded traffic in parts of the south. A thunderstorm occurred at Armagh on the 13th and north-easterly gales were experienced in north Scotland on the 14th, while local mist or fog was reported from south-east and east England on the 14th. The 17th–19th were brilliantly sunny days, 13·5 hrs. were recorded at Ilfracombe, 13·4 hrs. at Weymouth and 13·1 hrs. at Ross-on-Wye and Sealand on the 18th. The cold sunny weather, with occasional sleet or snow showers continued in the north on the 19th–22nd, but a small depression centred off the mouth of the English Channel brought general rain, sleet or hail to the south. On the 21st there were strong SW. winds in the English Channel and a gale at Pembroke, while 1·23 in. of precipitation fell at Cardigan and 1·05 in. at Abergavenny (Monmouth). During these first 23 days frosts occurred frequently over the whole country, being most severe on the 4th–6th, 16th–19th, and on the 23rd, 10° F. was reported on the ground at Dalwhinnie on the 19th, 11° F. at Dalwhinnie on the 16th, Auchincruive on the 17th and Dumfries on the 23rd, and 15° F. at Dumfries, Eskdalemuir and Penrith on the 6th. On the 23rd a depression approached from the Atlantic giving heavy rain locally in Ireland, 1·92 in. at Fofanny (Co. Down) on the 23rd, and from then to the 26th mild unsettled weather with rain at times, but bright periods, prevailed For the last few days the weather was mainly sunny and mild, 66° F. was reached at Hull and 65° F. at Tottenham on the 28th, but in the south there were also cool northerly winds. The distribution of bright sunshine for the month was as follows :—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway ...	162	+ 5	Chester ...	169	+33
Aberdeen ...	177	+26	Ross-on-Wye ...	145	− 2
Dublin	128	−34	Falmouth ...	167	−21
Birr Castle ...	151	− 3	Gorleston ...	169	− 1
Valentia... ...	170	+11	Kew	132	−17

Miscellaneous notes on weather abroad culled from various sources

Cold squally weather, accompanied by occasional snow or sleet, prevailed over the north of France during Easter and a heavy snowstorm occurred to the north of Paris on the afternoon of the 12th. In Germany the weather was generally sunny and cool during Easter, but a fall of snow was reported from the Palatinate. Rain and gales were experienced generally over Spain on the 13th and south-westerly gales continued in the south during the 14th and 15th, when the P. and O. liner *Ranpura*, conveying the Chinese art treasures, grounded on the sandy bottom off Punta Mala, near Mayorga, inside the Bay of Gibraltar. Fog occurred in the north of Italy on the 15th, when an air liner crashed near Turin. Heavy rain and gales over the Upper Adriatic on the 15th and 16th caused floods over the whole city of Venice on the 17th. Fog occurred at Gothenburg on the 17th. Storms and floods were again experienced in Portugal about the 19th. Cold weather, with sleet and severe snowstorms, occurred in south Germany on the 17th–18th. Navigation re-opened at Vasa Kasko (Finland) on the 21st and at Riga on the 23rd. Fog occurred at Vasa on the 24th. (*The Times*, April 13th–25th.)

Heavy and frequent rains were reported from most of Abyssinia early in the month except in the Tigré. A dense sandstorm occurred at Port Said on the 12th. Severe drought prevailed in western Libya during April and a quantity of cattle were transported from there to the Bengasi region where the rainfall had been abundant. (*The Times*, April 11th–13th.)

A severe storm occurred near Nagasaki on the 3rd, during which the *Taiko Maru* foundered—14 people were drowned. High winds and sandstorms were experienced in the neighbourhood of the Persian Gulf on the 8th. Further blizzards were experienced in Mongolia about the 12th and many cattle lost. (*The Times*, April 6th–13th).

Rainfall in Australia was generally below normal except in Victoria and locally in Queensland and Tasmania. It was reported on the 9th that portions of the pastoral and wheat areas of Western Australia had been adversely affected by drought, involving serious loss of stock. (Cable and *The Times*, April 7th–9th.)

A tornado, said to be the third worst ever experienced, swept across Arkansas, Mississippi, Alabama, Tenessee, Georgia and South Carolina on the night of the 5th and morning of the 6th—408 people were killed and the damage in some of the towns amounted to over £1,000,000 in each. The St. Lawrence was opened to navigation on the 13th which is said to be the earliest date since 1902. The weather was unsettled in the state of Buenos Aires during the first 8 days of the month. In the United States, temperature was generally below normal in the east, and in the west much below normal at first, becoming above normal about the 9th especially in the Mountain Region, but below normal again in the central states towards the end of the month, while precipitation was mainly below normal, except at first, in the eastern States and the Ohio Valley. (*The Times*, April 7th–15th and *Washington D.C., U.S. Dept. Agric., Weekly Weather* and *Crop Bulletin.*)

Daily Readings at Kew Observatory, April, 1936

Date	Pressure, M.S.L. 13h.	Wind, Dir., Force 13h.	Temp. Min.	Temp. Max.	Rel. Hum. 13h.	Rain.	Sun.	REMARKS. (see vol. 69, 1934, p. 1).
	mb.		°F.	°F.	%	in.	hrs.	
1	1007·9	S.2	48	57	89	0·25	0·0	r_0–r 0h–11h. & 16h–
2	1016·1	N.3	51	53	87	0·03	0·0	r_0 2h.–7h. & 16h. [17h.
3	1017·8	ENE.4	41	45	69	0·10	0·0	r_0–rs 19h.–24h.
4	1015·0	ENE.5	35	48	54	0·11	2·6	r–r_0 0h.–6h.
5	1024·4	NE.4	37	43	56	—	1·4	
6	1022·0	NNE.3	39	44	59	—	0·6	m 21h.
7	1014·6	NE.4	35	48	50	—	3·9	
8	1019·6	NE.4	40	48	64	—	1·7	
9	1022·4	NE.4	43	51	65	—	3·2	
10	1020·5	NE.3	40	52	60	—	6·2	
11	1012·1	NNW.4	39	46	58	0·05	4·8	prh 14h.–17h.
12	1008·6	NNW.2	34	45	41	0·03	3·8	rs 16h. r_0 18h.–19h.
13	1004·0	SSE.2	34	43	83	0·06	0·9	rs–r_0 2h.–9h.
14	1003·6	NE.3	32	47	53	—	3·6	x early. f 9h.
15	999·8	NNW.4	35	46	69	—	4·2	x early.
16	1001·1	N.2	32	48	54	—	3·0	
17	1008·5	NW.4	33	50	34	—	10·2	x early.
18	1016·3	WNW.3	34	53	42	—	12·0	x early.
19	1014·7	NW.3	37	51	36	—	10·5	
20	1004·1	ENE.3	39	45	93	0·43	0·4	r_0–r 6h.–14h.
21	1001·9	SSE.4	32	47	56	0·19	0·9	x early. rs–r 16h.–24h.
22	1009·0	N.4	37	46	46	0·01	7·1	r_0 1h. & 5h. pr_0s_0 14h.
23	1016·7	WSW.2	30	51	40	0·01	5·6	x early. r_0 22h.–24h.
24	1017·1	WNW.3	43	60	46	0·06	8·5	r_0 0h.–3h.
25	1019·5	SW.4	51	61	75	0·01	0·6	r_0 18h. & 24h.
26	1016·5	WNW.3	48	57	65	0·35	7·6	r 0h.–6h. PRH 15h.
27	1025·8	NW.2	41	57	54	—	8·7	w early. pr_0 20h.
28	1026·4	NNW.2	39	63	41	—	10·6	w early.
29	1026·8	NW.2	47	60	57	—	3·1	w early.
30	1027·3	N.3	50	61	49	—	5·9	
*	1014·7	—	39	51	58	1·68	4·4	* Means or totals.

General Rainfall for April, 1936

England and Wales ...	96	per cent. of the average 1881-1915
Scotland	54	
Ireland	73	
British Isles	81	

Rainfall : April, 1936 : England and Wales

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Lond .	Camden Square	1·36	88	*Leics* .	Thornton Reservoir ...	2·69	158
Sur .	Reigate, Wray Pk. Rd..	2·02	121	„ .	Belvoir Castle	1·72	112
Kent .	Tenterden, Ashenden...	1·59	98	*Rut* .	Ridlington	2·30	147
„ .	Folkestone, Boro. San.	1·89	...	*Lincs* .	Boston, Skirbeck	1·76	130
„ .	Margate, Cliftonville....	·98	73	„ .	Cranwell Aerodrome...	1·71	129
„ .	Eden'bdg., Falconhurst	2·19	117	„ .	Skegness, Marine Gdns.	1·34	100
Sus .	Compton, Compton Ho.	2·83	141	„ .	Louth, Westgate	1·81	108
„ .	Patching Farm	2·09	119	„ .	Brigg, Wrawby St.	1·76	...
„ .	Eastbourne, Wil. Sq....	2·08	114	*Notts* .	Worksop, Hodsock	1·27	86
„ .	Heathfield, Barklye....	2·94	159	*Derby*.	Derby, L. M. & S. Rly.	1·65	101
Hants.	Ventnor, Roy.Nat.Hos.	1·65	98	„ .	Buxton, Terr. Slopes...	1·91	65
„ .	Fordingbridge, Oaklnds	1·76	96	*Ches* .	Runcorn, Weston Pt....	1·50	87
„ .	Ovington Rectory	3·19	169	*Lancs*.	Manchester, Whit. Pk.	·91	47
„ .	Sherborne St. John	1·72	97	„ .	Stonyhurst College	1·37	51
Herts .	Royston, Therfield Rec.	1·56	99	„ .	Southport, Bedford Pk.	1·23	66
Bucks.	Slough, Upton	1·63	114	„ .	Lancaster, Greg Obsy.	·56	25
„ .	H. Wycombe, Flackwell	1·44	89	*Yorks*.	Wath-upon-Dearne	1.14	73
Oxf .	Oxford, Mag. College...	1·55	100	„ .	Wakefield, Clarence Pk.	1·29	77
N'hant.	Wellingboro, Swanspool	1·96	132	„ .	Oughtershaw Hall	1·65	...
„ .	Oundle	1·89	...	„ .	Wetherby, Ribston H..	1·58	90
Beds .	Woburn, Exptl. Farm...	1·29	86	„ .	Hull, Pearson Park	1·63	105
Cam .	Cambridge, Bot. Gdns.	1·32	97	„ .	Holme-on-Spalding	1·66	100
Essex .	Chelmsford, County Gdns	1·29	100	„ .	West Witton, Ivy Ho.	1·34	62
„ .	Lexden Hill House	1·26	...	„ .	Felixkirk, Mt. St. John.	1·60	96
Suff .	Haughley House	1·23	...	„ .	York, Museum Gdns....	1·48	92
„ .	Campsea Ashe	1·14	81	„ .	Pickering, Hungate	1·58	95
„ .	Lowestoft Sec. School...	1·20	81	„ .	Scarborough	1·03	66
„ .	Bury St. Ed., WestleyH.	1·45	95	„ .	Middlesbrough	1·10	80
Norf. .	Wells, Holkham Hall...	1·25	98	„ .	Baldersdale, Hury Res.	·98	41
Wilts .	Calne, Castle Walk	2·09	...	*Durh* .	Ushaw College	1·37	73
„ .	Porton, W.D. Exp'l. Stn	2·07	124	*Nor* .	Newcastle, D. & D. Inst.	1·31	88
Dor .	Evershot, Melbury Ho.	2·52	107	„ .	Bellingham, Highgreen	1·80	83
„ .	Weymouth, Westham.	1·23	74	„ .	Lilburn Tower Gdns....	1·61	81
„ .	Shaftesbury, Abbey Ho.	1·50	70	*Cumb*.	Carlisle, Scaleby Hall...	·93	48
Devon.	Plymouth, The Hoe....	1·84	81	„ .	Borrowdale, Seathwaite	2·60	38
„ .	Holne, Church Pk. Cott.	4·39	122	„ .	Borrowdale, Moraine...	2·40	43
„ .	Teignmouth, Den Gdns.	2·63	131	„ .	Keswick, High Hill	·92	30
„ .	Cullompton	2·42	106	*West* .	Appleby, Castle Bank...	·64	33
„ .	Sidmouth, U.D.C.	2·35	...	*Mon* .	Abergavenny, Larchf'd	2·41	95
„ .	Barnstaple, N. Dev.Ath	2·28	108	*Glam* .	Ystalyfera, Wern Ho....	3·52	93
„ .	Dartm'r, Cranmere Pool	5·40	...	„ .	Cardiff, Ely P. Stn.	3·02	119
„ .	Okehampton, Uplands.	3·23	102	„ .	Treherbert, Tynywaun.	5·12	...
Corn .	Redruth, Trewirgie	2·87	100	*Carm* .	Carmarthen, Coll. Rd.	3·30	121
„ .	Penzance, Morrab Gdns.	2·92	120	*Pemb* .	St. Ann's Hd, C. Gd. Stn.	1·94	100
„ .	St. Austell, Trevarna...	3·06	109	*Card* .	Aberystwyth	1·71	...
Soms .	Chewton Mendip	3·15	106	*Rad* .	BirmW.W.Tyrmynydd	4·10	111
„ .	Long Ashton	2·71	124	*Mont* .	Lake Vyrnwy	2·84	94
„ .	Street, Millfield	2·51	...	*Flint* .	Sealand Aerodrome	1·74	...
Glos .	Blockley	2·45	...	*Mer* .	Dolgelley, Bontddu	2·19	60
„ .	Cirencester, Gwynfa....	1·95	104	*Carn* .	Llandudno	1·13	67
Here .	Ross, Birchlea	2·11	111	„ .	Snowdon, L. Llydaw 9..	4·44	...
Salop.	Church Stretton	2·88	133	*Ang* .	Holyhead, Salt Island...	1·36	65
„ .	Shifnal, Hatton Grange	2·28	136	„ .	Lligwy	1·17	...
Staffs.	Market Drayt'n, Old Sp.	1·49	86	*Isle of Man*			
Worc .	Ombersley, Holt Lock.	1·78	117		Douglas, Boro' Cem....	1·11	46
War .	Alcester, Ragley Hall...	1·93	114	*Guernsey*			
„	Birminghm, Edgbaston	2·02	116		St. PeterP't.Grange Rd.	1·73	86

Rainfall: April, 1936: Scotland and Ireland

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Wig	Pt. William, Monreith.	·59	27	*Suth*	Tongue	2·80	107
„	New Luce School	1·20	45	„	Melvich	1·52	66
Kirk	Dalry, Glendarroch	1·04	34	„	Loch More, Achfary	3·43	71
„	Carsphairn, Shiel	1·97	48	*Caith*	Wick	1·28	64
Dumf.	Dumfries, Crichton R.I.	·65	29	*Ork*	Deerness	1·08	52
„	Eskdalemuir Obs	1·47	43	*Shet*	Lerwick	1·35	59
Roxb	Hawick, Wolfelee	1·69	75	*Cork*	Dunmanway Rectory	2·70	65
Selk	Ettrick Manse	1·31	37	„	Cork, University Coll	1·58	60
Peeb	West Linton	1·64	...	„	Ballinacurra	1·79	69
Berw	Marchmont House	1·62	80	„	Mallow, Longueville	2·56	105
E.Lot.	North Berwick Res	1·08	77	*Kerry*	Valentia Obsy	2·68	73
Midl	Edinburgh, Blackfd. H.	1·41	96	„	Gearhameen	3·40	59
Lan	Auchtyfardle	1·03	...	„	Bally McElligott Rec	1·63	...
Ayr	Kilmarnock, Kay Pk	1·07	...	„	Darrynane Abbey	2·46	72
„	Girvan, Pinmore	·95	32	*Wat*	Waterford, Gortmore	1·77	71
Renf	Glasgow, Queen's Pk	1·06	54	*Tip*	Nenagh, Cas. Lough	2.85	114
„	Greenock, Prospect H.	1·55	43	„	Roscrea, Timoney Park	2.09	...
Bute	Rothesay, Ardencraig	1·84	...	„	Cashel, Ballinamona	2·33	95
„	Dougarie Lodge	1·16	...	*Lim*	Foynes, Coolnanes	2·62	107
Arg	Ardgour House	2·94	...	„	Castleconnel Rec	2·58	...
„	Oban	1·56	...	*Clare*	Inagh, Mount Callan	4·42	...
„	Poltalloch	2·05	68	„	Broadford, Hurdlest'n.	2·32	...
„	Inveraray Castle	3·42	74	*Wexf*	Gorey, Courtown Ho	2·24	103
„	Islay, Eallabus	1·93	67	*Wick*	Rathnew, Clonmannon.	2·27	...
„	Mull, Benmore	3.20	41	*Carl*	Hacketstown Rectory	2·54	96
„	Tiree	...	...	*Leix*	Blandsfort House	2·54	97
Kinr	Loch Leven Sluice	1.16	60	*Offaly*	Birr Castle	2·28	107
Fife	Leuchars Aerodrome	·52	33	*Dublin*	Dublin, FitzWm. Sq	1·98	104
Perth	Loch Dhu	2·65	56	„	Balbriggan, Ardgillan	1·49	75
„	Balquhidder, Stronvar.	...	...	*Meath*	Beauparc, St. Cloud	1·94	...
„	Crieff, Strathearn Hyd.	1·17	54	„	Kells, Headfort	1·26	50
„	Blair Castle Gardens	·65	31	*W.M*	Moate, Coolatore	1·79	...
Angus	Kettins School	·53	29	„	Mullingar, Belvedere	2·12	90
„	Pearsie House	·73	...	*Long*	Castle Forbes Gdns	1·50	63
„	Montrose, Sunnyside	·34	19	*Gal*	Galway, Grammar Sch.	2·05	...
Aber	Braemar, Bank	·83	35	„	Ballynahinch Castle	2·91	114
„	Logie Coldstone Sch	·79	39	„	Ahascragh, Clonbrock.	2·44	96
„	Aberdeen, Observatory.	·70	37	*Mayo*	Blacksod Point	...	...
„	Fyvie Castle	1·50	70	„	Mallaranny	3·65	...
Moray	Gordon Castle	·97	55	„	Westport House	2·48	92
„	Grantown-on-Spey	...	...	„	Delphi Lodge	4·59	80
Nairn	Nairn	·74	49	*Sligo*	Markree Castle	1·25	47
Inv's	Ben Alder Lodge	1·51	...	*Cavan*	Crossdoney, Kevit Cas.	1·18	...
„	Kingussie, The Birches.	1·26	...	*Ferm*	Enniskillen, Portora	·61	...
„	Loch Ness, Foyers	1·29	59	*Arm*	Armagh Obsy	·56	27
„	Inverness, Culduthel R.	·76	...	*Down*	Fofanny Reservoir	2·38	...
„	Loch Quoich, Loan	3·15	...	„	Seaforde	·96	37
„	Glenquoich	2·80	43	„	Donaghadee, C. G. Stn.	·85	42
„	Glenleven, Corrour	2·70	66	„	Banbridge, Milltown	·76	37
„	Fort William, Glasdrum	2·19	...	*Antr*	Belfast, Cavehill Rd	1·06	...
„	Skye, Dunvegan	1·73	...	„	Aldergrove Aerodrome.	·74	35
„	Barra, Skallary	1·28	...	„	Ballymena, Harryville.	1·10	42
R&C	Alness, Ardross Castle.	...	...	*Lon*	Garvagh, Moneydig	·99	...
„	Ullapool	1.98	64	„	Londonderry, Creggan.	1·29	50
„	Achnashellach	3·31	59	*Tyr*	Omagh, Edenfel	1·18	45
„	Stornoway, Matheson	2·04	67	*Don*	Malin Head	·80	...
Suth	Lairg	1·49	65	„	Killybegs, Rockmount.	1·02	...

Climatological Table for the British Empire, November, 1935

STATIONS.	PRESSURE. Mean of Day M.S.L.	PRESSURE. Diff. from Normal.	TEMPERATURE. Absolute. Max.	TEMPERATURE. Absolute. Min.	TEMPERATURE. Mean Values. Max.	TEMPERATURE. Mean Values. Min.	TEMPERATURE. Mean Values. ½ Max. and Min.	TEMPERATURE. Mean Values. Diff. from Normal	TEMPERATURE. Mean. Wet Bulb.	Relative Humidity.	Mean Cloud Am'nt	PRECIPITATION. Am'nt.	PRECIPITATION. Diff. from Normal.	PRECIPITATION. Days.	BRIGHT SUNSHINE. Hours per day.	BRIGHT SUNSHINE. Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0–10	in.	in.			
London, Kew Obsy.	1005·8	– 8·8	62	29	50·4	40·6	45·5	+ 1·5	42·6	90	7·7	4·36	+ 2·14	20	1·7	19
Gibraltar	1017·8	– 0·2	73	48	65·2	53·3	59·3	– 0·7	53·3	84	6·4	4·30	– 2·13	15	...	...
Malta	1016·2	+ 0·3	75	54	68·8	60·9	64·9	+ 1·0	59·7	77	6·7	4·38	+ 0·81	11	5·9	58
St. Helena	1013·1	– 0·5	67	53	61·7	54·9	58·3	– 1·3	55·6	93	9·5	0·72	...	8	...	...
Freetown, Sierra Leone	1012·7	+ 3·5	90	68	86·2	72·1	79·1	– 2·1	75·2	84	5·9	7·70	+ 1·58	15	...	...
Lagos, Nigeria	1010·1	0·0	90	73	87·7	76·6	82·1	+ 0·4	77·7	88	5·6	2·33	– 0·34	4	7·0	59
Kaduna, Nigeria	1008·6	...	95	54	92·1	58·5	75·3	– 0·9	61·4	59	1·9	0·00	– 0·21	0	9·3	80
Zomba, Nyasaland	1006·8	– 2·1	92	59	81·7	64·6	73·1	– 2·5	65·7	63	6·6	6·42	+ 1·34	12	...	...
Salisbury, Rhodesia	1011·4	+ 0·3	91	49	81·6	58·0	69·8	– 0·9	59·5	47	4·7	2·86	– 0·74	8	7·3	57
Cape Town	1016·6	+ 0·8	99	47	75·5	56·9	66·2	+ 1·8	58·6	62	3·5	1·10	+ 0·01	6	...	...
Johannesburg	1012·9	+ 1·0	86	39	76·9	51·2	64·1	+ 0·4	52·4	47	4·6	0·75	– 4·21	8	8·9	66
Mauritius	1016·0	– 0·1	86	67	81·9	69·4	75·7	+ 0·2	72·0	75	6·8	5·77	+ 4·19	22	6·4	49
Calcutta, Alipore Obsy.	1013·1	– 0·2	90	57	86·2	63·3	74·7	+ 1·2	63·9	79	1·1	0·00	– 0·65	0*	...	...
Bombay	1012·3	+ 0·3	93	70	89·9	72·9	81·4	+ 0·8	71·8	77	1·7	0·18	– 0·27	1*	...	...
Madras	1012·0	+ 0·7	89	66	85·5	71·4	78·5	– 0·4	73·7	83	4·8	6·40	– 7·21	6*	...	...
Colombo, Ceylon	1011·2	+ 1·2	87	71	85·0	73·5	79·3	– 0·7	75·8	78	6·0	11·93	+ 0·17	21	6·7	57
Singapore	1010·0	+ 0·6	89	73	85·5	75·3	80·4	– 0·2	76·8	79	8·4	9·86	– 0·65	23	4·6	38
Hongkong	1016·9	– 0·7	84	54	75·9	67·8	71·9	+ 2·3	66·5	75	6·6	0·35	– 1·39	3	5·8	53
Sandakan	1009·8	...	90	73	86·6	74·7	80·7	– 0·2	77·3	83	8·4	9·57	– 5·15	22	...	...
Sydney, N.S.W.	1014·1	+ 0·3	92	51	73·3	58·8	66·1	– 0·9	60·9	59	6·6	2·14	– 0·71	8	7·5	54
Melbourne	1014·5	+ 0·1	96	44	71·0	49·9	60·5	– 0·8	54·5	57	6·8	2·06	– 0·17	14	6·0	43
Adelaide	1015·9	+ 0·7	101	45	78·4	56·1	67·3	+ 0·3	56·3	35	6·3	0·91	– 0·24	7	8·3	60
Perth, W. Australia	1015·8	+ 0·4	93	49	73·5	56·1	64·8	– 1·3	56·7	53	4·6	0·24	– 0·56	5	10·1	73
Coolgardie	1012·4	– 0·7	107	48	85·6	57·1	71·3	+ 0·6	61·6	51	2·8	0·25	– 0·34	2	...	...
Brisbane	1015·8	+ 1·2	97	57	81·2	63·2	72·2	– 1·3	64·7	55	4·6	1·26	– 2·47	5	9·8	73
Hobart, Tasmania	1010·0	+ 0·4	84	39	64·5	48·4	56·5	– 0·7	50·4	56	6·6	2·91	+ 0·44	15	7·0	48
Wellington, N.Z.	1009·2	– 2·9	71	37	60·2	46·2	53·2	– 3·6	50·2	70	5·9	2·84	– 0·68	18	6·2	43
Suva, Fiji	1010·3	– 0·8	89	69	82·2	73·1	77·7	+ 0·6	73·7	82	8·2	26·55	+ 16·76	27	2·8	22
Apia, Samoa	1009·2	– 0·3	87	73	85·3	75·6	80·5	+ 1·8	77·1	79	6·9	15·45	+ 5·62	21	5·7	45
Kingston, Jamaica	1012·4	0·0	89	63	86·5	70·2	78·3	– 1·0	68·4	83	3·4	0·06	– 2·97	1	6·0	53
Grenada, W.I.	1010·8	+ 0·2	88	71	86	73	79·5	0·0	74	74	7	5·55	– 2·91	21	...	...
Toronto	1020·0	+ 2·7	64	15	44·8	34·7	39·7	+ 2·7	36·6	85	7·5	2·37	– 0·26	12	2·3	24
Winnipeg	1020·9	+ 3·5	41	–8	21·5	5·5	13·5	– 7·8	...	...	5·2	0·90	– 0·17	8	3·2	35
St. John, N.B.	1020·3	+ 5·7	55	18	44·8	33·8	39·3	+ 2·6	37·0	85	7·6	6·39	+ 1·98	17	2·2	23
Victoria, B.C.	1021·5	+ 5·6	53	29	46·8	39·4	43·1	– 1·4	40·4	86	6·6	1·79	– 3·62	14	3·4	37

*For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

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Recent Studies on the Mean Atmospheric Circulation

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

A recent paper by the Rev. C. E. Deppermann (1)* gives a series of charts of resultant winds for five-degree squares in the Indian and South Pacific Oceans. The resultants were calculated from the wind roses on the pilot charts published by the United States Hydrographic Office, using the mean Beaufort force of the wind, converted to metres per second, as well as the frequency, from each direction. For the Indian Ocean, charts are given for each month, for the South Pacific, only for the four seasons.

A few years ago S. T. A. Mirrlees and I constructed four charts of monthly stream-lines over tropical and sub-tropical Africa (2) and it was a matter of interest to combine Deppermann's charts with these. His resultant arrows were easily connected up to show the main stream-lines. Deppermann's charts were expressly made as an extension of a monthly series by Werenskiold (3) for the North Pacific; these also were included and the maps were completed as far as possible by the addition of seasonal stream-lines for Europe (4) and south-west Asia (5), conventionalised wind arrows for U.S.A. (6) and some isolated wind resultants for India (7) and Siberia (8). No resultant winds could be found for South America, the Atlantic or Australia, though for the Atlantic there would be no difficulty in computing them from the existing pilot charts.

* The numbers in brackets refer to the bibliography on p. 110.

The charts of stream-lines for January and July are shown in Figs. 1 and 2 (see pp. 108–9), necessarily somewhat simplified from the originals. The lines for Africa, U.S.A., Siberia and the Indian and North Pacific Oceans refer to the actual months of January and July, those for Europe, south-west Asia and the South Pacific to the seasons December to February and June to August.

The chart for January shows clearly the wind axis extending across Europe from France to Asia, where it merges with the Siberian anticyclone. On the northern side of this axis southerly or south-westerly winds blow towards the Arctic circle. On the southern side, and from the south-east of a similar wind shed in Spain, north-westerly winds pass into the north-easterly harmattan of northern Africa, except in Italy and Syria, where the wind structure appears to be complicated. The Siberian winter anticyclone is only slightly indicated in the north, but the great systems of outflowing winds on its eastern and southern sides are clearly seen. Africa appears as the battleground of four great systems of winds, blowing from Europe and the Mediterranean, south-west Asia, the south Indian Ocean and the south-east Atlantic; in south-west Africa especially the intermingling of these streams is complex.

In the North Pacific the most interesting features are the circulation round the Aleutian low and the great concentration of air on the rainy coast of British Columbia. Werenskiold shows the centre of the sub-tropical anticyclonic circulation in the North Pacific as a well-defined point; by contrast the centres of the circulation in the Indian and South Pacific oceans appear less definite, but for the South Pacific at least this may be due in part to the method of construction of the stream-lines. Werenskiold actually carries his lines to meet at a common point of convergence, but Deppermann remarks that "he could not help but feel that many of the lines of convergence and divergence on Werenskiold's maps, for regions where the resultant air flow is very small, have but little significance in fact and might easily lead to wrong impressions." I agree with this criticism, and in constructing Figs. 1 and 2 I opened out Werenskiold's lines a little, and left blank the area of rather indefinite winds in the centre of the South Pacific high.

The main "fronts" between the various air masses are shown by broken lines. For the Pacific these fronts follow fairly closely those laid down by T. Bergeron (9), but no attempt is made here to discriminate between warm and cold fronts. Bergeron distinguishes "tropic," "temperate" and "arctic" (or "antarctic") fronts. The tropic front generally separates the two trade-wind systems or a trade-wind and monsoon, but it is liable to extensive displacements over the continents. In January, starting north of the equator in West Africa, the heated land surface carries a line of wind convergence well into South Africa. In the Indian Ocean it remains a few degrees south of the equator but another southward bend is indicated in Australia. In the western Pacific the tropic front lies about 10° S., but about Long. 180° it seems to be duplicated. Part of the SE. trade wind crosses the equator, the eastern branch meeting the NE. trade wind in about 10° N., while the western branch turns southward and meets an easterly wind, also of southern origin, at a secondary front in about 10° S. East of 160° W. the latter disappears, and the northern front becomes the main region of convergence, but it is probable that this also turns southward over South America.

While in January air from the northern hemisphere plays a rather larger part in tropical regions than air from the southern hemisphere, there can be no doubt that in July (Fig. 2) the greater part of the tropics is dominated by southerly air. The tropic front between the northern and southern air crosses Africa in about 20° N. and then turns north-eastward into Asia, where currents from the South Indian Ocean spread over the whole of India, and those from the south-western Pacific travel as far north as Korea. In the central Pacific however the front lies only a few degrees north of the equator, shifting gradually to about 15° N. in Central America.

The "temperate" fronts are less clearly shown. They are much less stable than the tropic front, varying greatly from day to day, so that an apparently simple picture represents merely the summation of a constantly fluctuating series of barometric situations, and is not comparable with the almost unchanging systems of the subtropical trade winds. In January there are indications of a continuation of the main Atlantic front extending from the Bay of Biscay to the Mediterranean, and a more clearly marked front between Siberian or Arctic and Pacific air runs from north of New Guinea right across the Pacific to the coast of British Columbia and southern Alaska, where it joins a "coastal front" caused by the high coastal mountains. Traces of temperate fronts appear also in the southern Indian Ocean near Africa and in the South Pacific about 150° W.

In July the temperate fronts have disappeared from the northern hemisphere, but in the South Pacific there is a well-marked front extending from a few degrees south of the equator east of New Guinea, to the coast of South America in about 40° S; this front is closely analogous to that of the North Pacific in the northern winter. The charts do not extend into sufficiently high latitudes to show the arctic and antarctic fronts, except for a trace north-west of Saghalien in July.

In the Indian Ocean the convergence of winds near the equator in January is replaced in July by a right-angled bend in the great southerly current; Deppermann's charts show that while this bend lies almost exactly on the equator in the western Indian Ocean, further east the change of direction appears to begin in about latitude 3° S., the resultant winds for 0–5° S. showing a component from west in all squares between 75° E. and the coast of Sumatra. A similar bend is indicated in the eastern Pacific east of 120° W.,

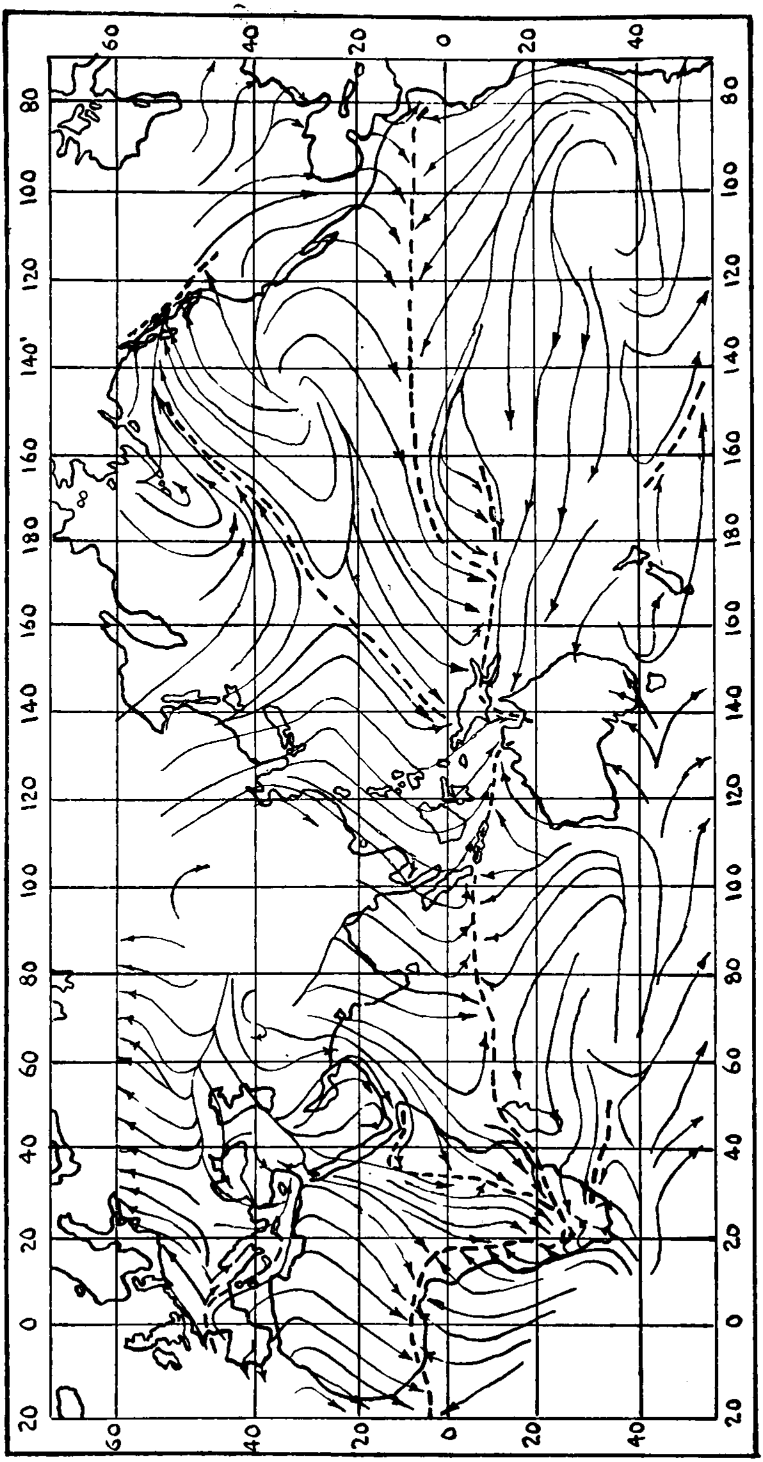

Fig. 1—January

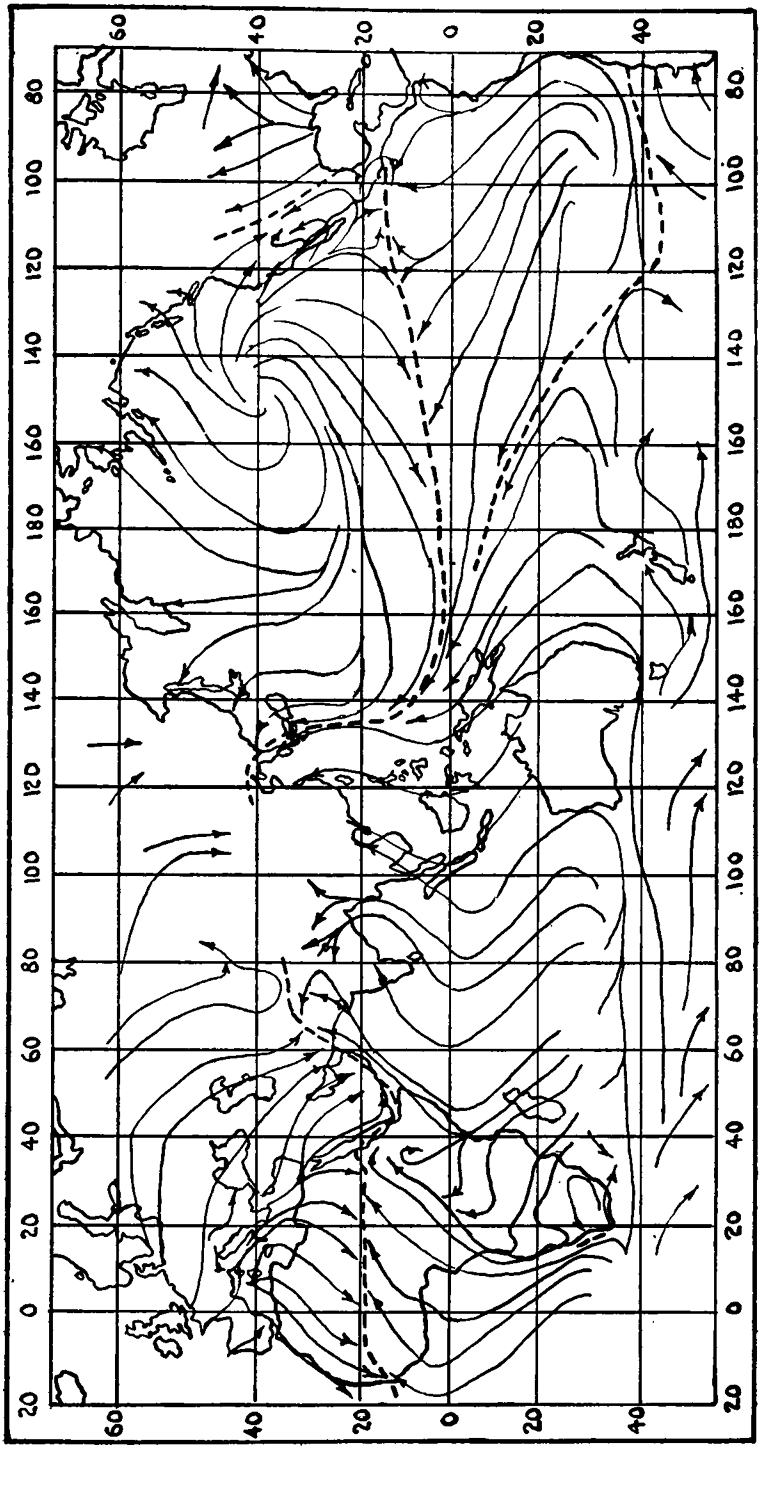
60 40 20 0 20 40
80 100 120 140 160 180 160 140 120 100 80 60 40 20 0 20

FIG. 2—JULY

where however the stream-lines become complex. For the northern Pacific generally the situation is simplified by the suppression of the Aleutian low pressure centre, and the coast of British Columbia becomes an area of divergence rather than of convergence.

In interpreting the maps it must not be assumed that a packet of air starting at the beginning of one of the arrows will necessarily or even probably follow it to its conclusion. Vertical interchange is constantly in progress with higher layers of air, in which the prevailing motion may be different in direction from that of the surface layers. But though the component particles may change, the general stream goes on, and it is the divergence and convergence of these great currents of air which govern the positions, season by season, of the great dry and rainy regions of the globe.

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Diurnal Variation of Wind

It is well known that on the average the surface wind speed is at a minimum at about dawn and increases to a maximum during the afternoon, subsequently falling off towards night. With light winds this effect is often very conspicuous on a Dines anemogram during periods when there is no variation in the gradient of pressure during the 24 hours, but with strong winds there are usually changes in the pressure field and the effect is not apparent. I have been unable to find anywhere any discussion as to whether the average variation of strong winds was greater or less than that for light winds, and so I have tabulated some figures for Kew which give an answer. I have taken from the hourly values the frequencies of winds of different speeds, using the months January and July and the hours 7h. and 13h. G.M.T. for January and 3h. and 13h. G.M.T. for July. The results are shown graphically in Fig. 1. The curves of this figure give the percentage frequency with which any given wind speed was not exceeded, for instance, a wind speed of 2 m/sec. was not exceeded on 8 per cent of occasions at 13h. in July, on 18 per cent at 13h. in January, on 30 per cent at 7h. in January and 51 per cent at 3h. in July.

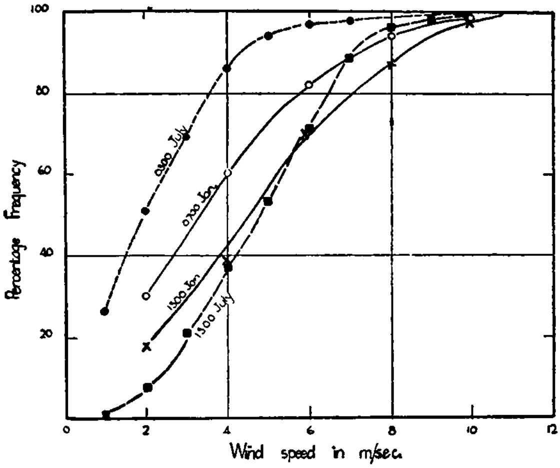


FIG. 1.

Smooth curves have been drawn through the points and at once it is apparent that there is a close parallelism between the two July curves and the two January curves.

Now the figure may be interpreted as follows :—

On the typical day which is just windier than, say, 30 per cent of days, the speed of the wind at 7h. in January is 2·0 m/sec. and at 13h. in the same month is 3·0 m/sec.; in July, on the other hand, at 3h. it is 1·2 m/sec. and at 13h. it is 3·6 m/sec. Thus the range for that type of day is 1·0 m/sec. in January and 2·4 m/sec. in July. Similarly the ranges may be computed for other typical days as has been done in the table below :—

TABLE I.—SPEEDS AND DIURNAL RANGES ON TYPICAL DAYS.

Type of day (Windier than)	30%	50%	70%	80%	90%	95%
Speed 7h. January	2·0	3·4	4·8	5·8	7·2	8·1
Speed 13h. January	3·0	4·5	6·1	7·0	8·3	9·2
Range, January	1·0	1·1	1·3	1·2	1·1	1·1
Speed 3h. July	1·2	2·0	3·1	3·6	4·4	5·2
Speed 13h. July	3·6	4·8	5·9	6·4	7·0	7·7
Range, July	2·4	2·8	2·8	2·8	2·6	2·5

This shows quite clearly that, provided the pressure field remains unaltered, there is little difference in the increase of wind between dawn and afternoon whether the wind speed is great or little.

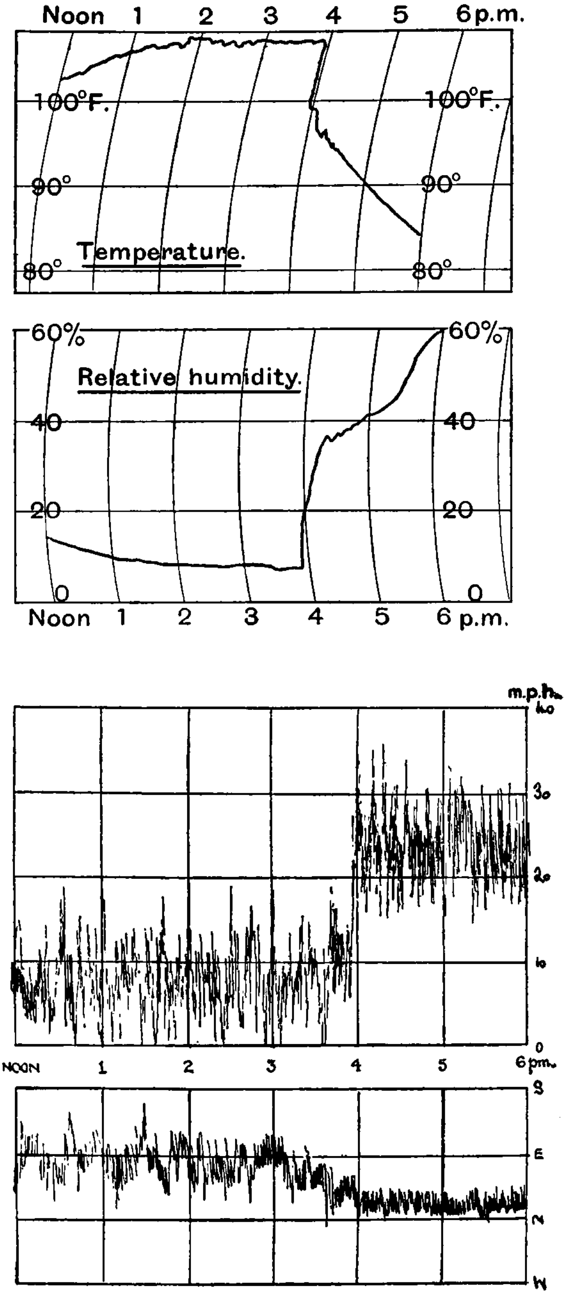
It would have been interesting to have seen in a comparable way how the direction of the wind and the cloudiness of the sky affected the diurnal variation, but such an investigation would need a considerable amount of labour.

C. S. DURST.

Minor "Haboob" at Ismailia, Egypt

A marked feature of the weather at Ismailia and neighbouring districts during the summer months is a cool breeze which develops during the late afternoon. The onset of this cool breeze, which is locally referred to as a "sea breeze," is accompanied by a sudden decrease in temperature, a sharp rise in relative humidity, an increase in wind velocity and either a change in wind direction or a decrease of the gustiness of the air current which is indicated on an anemograph by a narrowing of the direction trace. These phenomena accompanying the onset of the sea breeze are, on occasions, much more marked than on others, and an instance of extreme sharpness occurred on June 18th, 1932. On this day the sea breeze reached Ismailia at 3.55 p.m. when temperature suddenly fell 8° F., relative humidity increased by nearly 30 per cent in 20 minutes, wind velocity increased suddenly from 10 to 25 m.p.h., and the wind direction backed from NE. to NNE. (Fig. 1).

The movement of the "front" of the sea breeze towards the station was easily observed. At about 3.30 p.m. a bank of sand or haze appeared to the north of Ismailia and stretched as far as the eye could see to east and west—across a front of at least 10 miles. This bank, which was 2,500–3,000 ft. high, rapidly approached Ismailia and at 3.50 p.m. the sky immediately above the station was being obscured by sand haze at a height of approximately 2,000 ft. (Fig. 2). The base of this haze bank lowered and the "haze front" at the surface



FIGS. 1 AND 2

[*facing p. 112.*

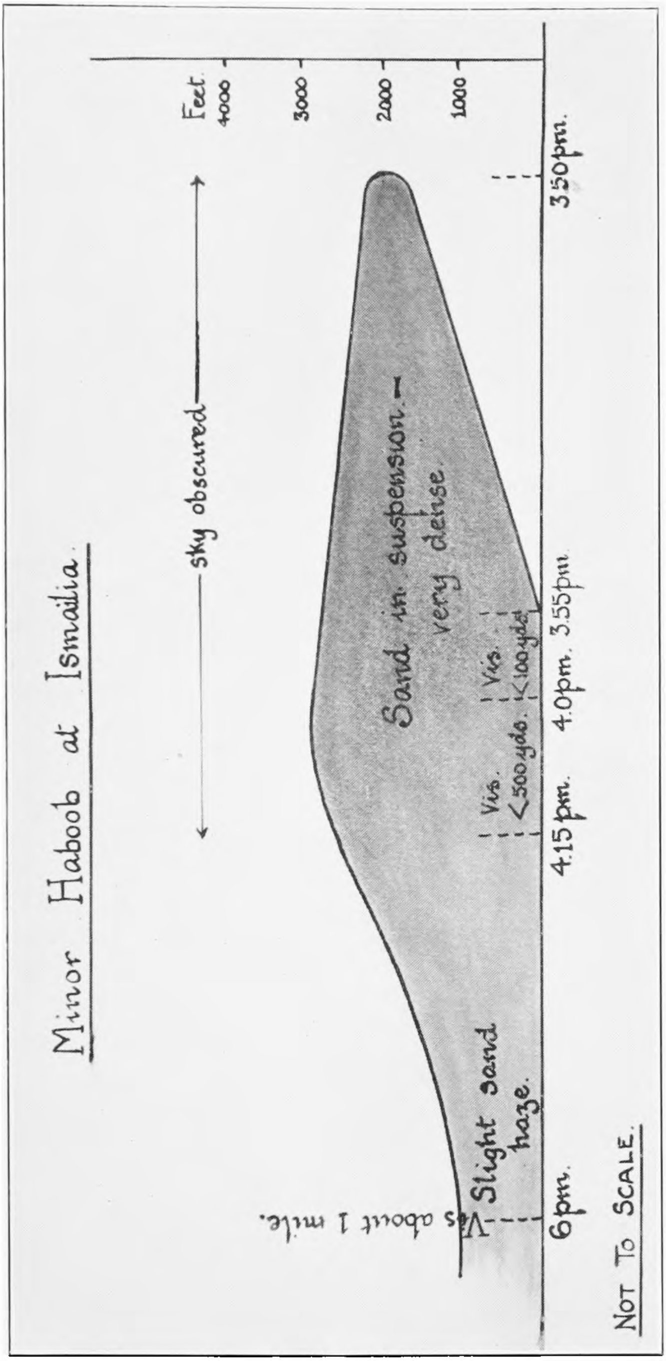


FIG. 2.

arrived at 3.55 p.m. when visibility suddenly decreased to less than 100 yards. Visibility improved slightly after 4.0 p.m. but was still less than 500 yards until 4.15 p.m., after which it gradually improved, although there was still sand in suspension at 6.0 p.m. A sketch made at the time (Fig. 2), indicates the apparent form of the advancing sea breeze which had all the characteristics of a " haboob " or severe sandstorm. The anemogram for Abu Sueir (Fig. 3), 8 miles west of Ismailia, shows that the sea breeze was also well marked when it passed that station, while at Port Fouad on the coast, 47 miles north of Ismailia, the wind was reported to have increased from ENE., force 3 at noon, to NNE., force 5 before 4 p.m.

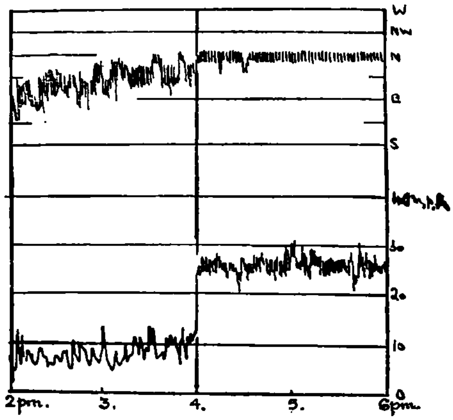


FIG. 3

In a discussion of haboobs in the Sudan, Sutton * concludes that the majority have their origin in the diurnal variation of temperature and pressure, so that if the phenomenon experienced at Ismailia was in the nature of a sea breeze the diurnal change of pressure and temperature near the coast and inland would need to be considered. The Mediterranean Sea lies to the north of Ismailia with the coast running approximately north-west to south-east, 47 miles distant at Port Said (Port Said and Port Fouad are on opposite banks of the Suez Canal). Pressure at Port Said decreased by 1·9 mb. from 1012·7 mb. and temperature increased from 81° F. to 84° F. between 8 a.m. and 2 p.m., while the corresponding changes at Ismailia were 3·7 mb. from 1012·1 mb. and 80° F. to 106° F. The respective maximum temperatures were 88° F. and 107° F. Further, at Ismailia pressure decreased by 2·4 mb. during the three hours preceding 2 p.m. Thus at 8 a.m. the pressure gradient between Port Said and Ismailia was 1·25 mb. per 100 miles and increased to 5·1 mb. per 100 miles at 2 p.m., while at the same time the average horizontal temperature gradient increased from +2° F. to —47° F. per 100 miles. This latter is almost certainly equal to gradients occurring in the Sudan and it is probable that the very steep temperature gradient was restricted to a relatively narrow strip between Kantara, 30 miles north of Ismailia, on the banks of the shallow Lake Menzaleh, and Port Said. The mean pressure gradients and horizontal temperature gradients per 100 miles between Port Said and Ismailia for June, 1932, were respectively 0·5 mb. and +6° F. at 8 a.m. and 2·7mb. and —22° F. at 2 p.m. which are considerably less than those experienced on June 18th.

WILLIAM D. FLOWER.

* *London, Quart. J.R. met. Soc.*, 57, 1931, p. 155.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, May 20th, at 49, Cromwell Road, South Kensington, Dr. F. J. W. Whipple, F.Inst.P., President, in the Chair.

The following papers were read and discussed :—

E. A. Cornish.—On the secular variation of the rainfall at Adelaide, S. Australia.

A detailed analysis of the rainfall of Adelaide, South Australia, has shown that throughout the 95 years 1839–1933, there has been a definite oscillation, with a period and amplitude of approximately 23 years and 30 days respectively in the incidence and duration of the winter rains. The amplitude is about 20 per cent of the length of the rainfall season. The total quantity precipitated has shown no statistically significant changes.

Richmond T. Zoch.—On the frequency distribution of rainfall at the Liverpool Observatory.

The desirability of a detailed study of the frequency distribution of rainfall by methods familiar to statisticians is emphasized, and the work of Messrs. A. T. Doodson and H. J. Bigelstone on 60 years' observations of rainfall at Liverpool is discussed. A rough check on the computation of the Pearson frequency curve is explained, and the 60 years' observations are graduated by a different method.

T. E. W. Schumann, M.Sc., Ph.D.—Interpolation of monthly rainfall data.

In this paper particular attention is given to the average errors involved when interpolation of missing monthly rainfall figures is carried out according to approved methods. In order to compute the monthly rainfall at a station O the method adopted here is to multiply the monthly rainfall at a control station A by the ratio of the average annual rainfall at O and A respectively.

Computing the rainfalls for 20 consecutive Januaries from 20 control stations in the neighbourhood of the Pretoria Meteorological Office, and comparing these with the actual January rainfalls as measured at the latter station, it is possible to determine the average deviation of the interpolated from the true values. When these average deviations are plotted against the respective distances of the control stations from the central station the line of regression of the deviation upon the distance may be drawn. By employing the results of two or more control stations simultaneously an appreciable reduction in the magnitude of the errors is attained, and hence it is always advisable to determine a missing rainfall figure from more than one neighbouring station. Before attempting any interpolation it is essential that one should first investigate the magnitude of the probable errors attaching to the interpolated values in order to find out the limits to which interpolation may legitimately be carried out.

Correspondence

To the Editor, *Meteorological Magazine*

Unusually severe Thunderstorm in Bedfordshire

An unusually severe thunderstorm occurred in the Dunstable district on the afternoon of Wednesday, May 6th, 1936. Mr. H. Simmons, Clerk of the Works at Whipsnade Zoological Park, is the authority for most of the following statements. His staff come from the towns and villages in the neighbourhood of Dunstable, so that he had excellent opportunities for ascertaining the facts.

During the afternoon distant thunder could be heard from Whipsnade in the east, afterwards moving towards north. Dunstable town caught the storm very badly. Many basements were flooded out, and considerable damage was done to gardens and fruit trees. The hailstones were in some instances fully an inch in diameter. Locally the floods in the streets reached a depth of 4 ft. 6 in. At Houghton Regis, about a mile north of Dunstable town, the rainfall, as measured by the Manager of the Dunstable Cement Works, was 2·08 in. between 16h. 55m. and 17h. 40m. G.M.T. The total for the day was 2·12 in. The Plough Inn, on the Icknield Way, just below Dunstable Downs, suffered severely. Many pigs were drowned in mud washed from the hillside fields by torrential rain. At Edlesborough, about 3 miles west-south-west of Dunstable, measurements made by Mr. Simmons himself gave seven-eighths of an inch as the diameter of some of the hailstones. Great damage was done to greenhouses in the track of the storm, and also to Waterlow's, the printers, of Dunstable. At Whipsnade Zoological Park 0·25 in. of rain was registered. The hail there was extremely local: some fell at the Tiger Pit, but none at the Lion Pit, a short distance away. Ivinghoe, on the south-west margin of the storm area, had only a little rain.

E. L. HAWKE.

Caenwood, The Valley Road, Rickmansworth, Herts., May 11th, 1936.

Peculiar Gloom Phenomena

In her letter, published in the April number of the *Meteorological Magazine*, Miss Cecily M. Botley describes conditions of peculiar gloom at Hastings.

Similar conditions are sometimes observed here with northerly winds, as for instance, on the afternoon of April 12th, 1936, when a cumulonimbus cloud with anvil gave a snow shower, which was accompanied by a thick brown murk, that lasted about half an hour and caused enough darkness to render necessary the use of artificial light. On occasions such as the above the obscurity seems to be attributable to three causes: the considerable vertical extent of the clouds; the presence of smoke particles in the surface air; and the evaporation of precipitation.

Cases of obscurity accompanying the passage of fronts, such as that described by Mr. F. K. Hare, whose letter Miss Botley mentions, are not, in my experience, remarkable for any unusual gloom here, though winds veering to northerly in the rear of a front or depression generally cause a change to a brownish or dirty orange-coloured sky. Changes of this type are, I believe, most pronounced during the colder months, especially with a slack pressure gradient.

My own observation suggests that examples of remarkable gloom are most likely to occur here during the late afternoon in showery weather with a gradient for northerly winds, particularly in the spring. At this time of day the development of convection clouds is likely to be near its maximum, while there is, in cold weather, a plentiful output of smoke from London and the suburbs which, with northerly winds, drifts over this district.

It seems probable that in this locality the spring and autumn would be the seasons most favourable to the occurrence of this phenomenon, since in winter cumulonimbus clouds are not often seen, and since in summer there is less smoke haze in the surface air, owing partly to more active convection and partly to the reduction in the amount of domestic fuel burnt.

I have no recollection of gloom like that of April 12th, previously mentioned, occurring here on a generally foggy day, even with an overcast sky, although in the "Meteorological Glossary," s.v. Fog, it is stated that in London fog may in certain circumstances produce darkness in the middle of the day equal to that of night.

C. STUART BAILEY.

Longbridge, 76, Woodcote Valley Road, Purley, Surrey, May 5th, 1936.

NOTES AND QUERIES

The Cold Spells in May

The treacherous weather of spring is expressed in the advice not to cast a clout till May be out, and the marked fluctuations of temperature during May, 1936, gave an unusual amount of justification to this proverb. At the time of writing full data are not yet available, but by taking the mean of six well-distributed stations in England and Wales (Tynemouth, Birmingham, Llandudno, Clacton, Kensington Palace and Bournemouth) it is possible to form a general idea of the changes during the month. The normal May temperature of these six stations is 52·7° F., and the average for May, 1936 was 52·5° F., so that as a whole the month was very nearly normal, but the mean temperatures of the individual days ranged over more than 12° F. The beginning was cool, the average for May 1st–3rd being only 48° F., but after this temperature rose steadily to 55° F. on the 6th. By the 9th the mean had fallen again to 50° F. and as this is the first day of Buchan's third cold spell (May 9th–14th) there were numerous references to yet another verification of Buchan.

The coincidence was illusory, however, for May 10th–14th were all above the normal for May, temperature climbing steadily to 60° F. on the 18th, which proved to be the warmest day of the month. On this day the maxima exceeded 75° F. at several stations. In the next three days, however, the thermometer fell more than 10° F., the mean remaining below 50° F. from the 21st to 23rd. May 25th–27th were again warm, but the 28th brought a third cold spell which continued over the Whitsun holidays into the first week of June.

The mean temperatures for these periods, together with the mean daily maxima and minima, are set out in the following table :—

May	1st-3rd.	5th-7th.	8th-9th.	11th-19th.	21st-23rd.	25th-27th.	30th-31st.	Mean.	Normal.
	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Mean ...	48	54	51	56	49	54	49	53	53
Mean Max. ...	54	61	55	63	55	62	54	59	60
Mean. Min. ...	41	47	47	49	43	47	43	46	45

For so little does the simple annual variation of temperature count in our climate that the last day of May was actually the coldest of the whole month.

A rather surprising feature of the month was that, in spite of the deficiency of rain and the frequency of north-easterly winds, the daily range of temperature was slightly less than the normal. There were, however, some severe ground frosts. At Rickmansworth the grass minimum fell to 30° F. or less on 15 occasions, reaching 18° F. on the 22nd and 29th ; on the latter day the screen minimum fell to 24° F.

The average pressure distribution for May, 1936, shows a belt of pressure, more than 5 mb. above normal, extending from mid-Atlantic west of the Azores across Scotland to Scandinavia and northern Russia. The greatest excess, 8 mb., occurred west of Ireland, and taking the month as a whole there was a distinct tendency for north-easterly winds over the British Isles. This distribution persisted through the greater part of May without much change, except that from May 1st–20th the two main anticyclones lay over the Azores and Finland, with a depression centred over southern Greenland, while from May 21st–31st the Atlantic anticyclone lay directly west of Ireland in about 30° W. and exceeded 1030 mb. in its centre, while the European anticyclone occupied central Russia. During the latter period the winds over the British Isles were persistently of Arctic origin. During nearly all May the rainfall had been slight—the first fortnight was completely rainless at many stations—but on June 1st a shallow complex depression developed over England and gave less settled, though still cold, weather in the first week of June.

Forecasting Weather from Height of Barometer and Temperature of Wet Bulb

The interesting results for Grayshott from Mr. S. E. Ashmore shown in the table and diagram in the February, 1936 issue of this magazine, though more irregular than those for St. Mary's, Scilly, may be analysed in the following manner :—

It is first necessary to find the " critical barometric pressure " which Mr. Ashmore calls K. To do so a direction line may be obtained by plotting the average percentage number of cases of no rain in 24 hours at 980·5 mb., 990·5 mb., 1,000·5 mb., 1,011·5 mb., 1,021·5 mb. and 1,031·5 mb. These averages are obtained by first combining the wet bulb results given in the table as " 34°–38° " and " below 34° " (as was done by Lt. Cmdr. T. R. Beatty) when the percentage number of cases of " no rain in 24 hours " for wet bulb " below 39° " become 0, 20, 50, 50, 57, 75 and 90 respectively in column 5. The results " above 48° " do not appear at each of the seven barometric heights and should, therefore, be omitted, and also the small values of 6 at 44°–48° and 9 at 39°–43° when the barometer was above 1,035 mb. The averages of the three divisions in column 5 then become 4, 19·7, 23, 31·6, 48 and 64·3 at each of the consecutive pressures from " Below 986 mb." to " 1,026–1,035 mb." These have been plotted in large circles on the diagram and the direction line obtained from them leads to 977 mb. as the " critical barometric pressure ".

It is then a simple matter to obtain the value 10 and so the formula becomes $P = 10\dfrac{B - 977}{T' - 32}$ for Grayshott.

The figures for " above 48° F." have not been plotted but the straight line obtained from the formula passes close to the average 11·4 for the five irregular readings if plotted at 1,000·5 mb.

The results for " no rain in 12 hours " have also been plotted but are not indicated here and the " critical barometric pressure " obtained therefrom was also 977 mb.

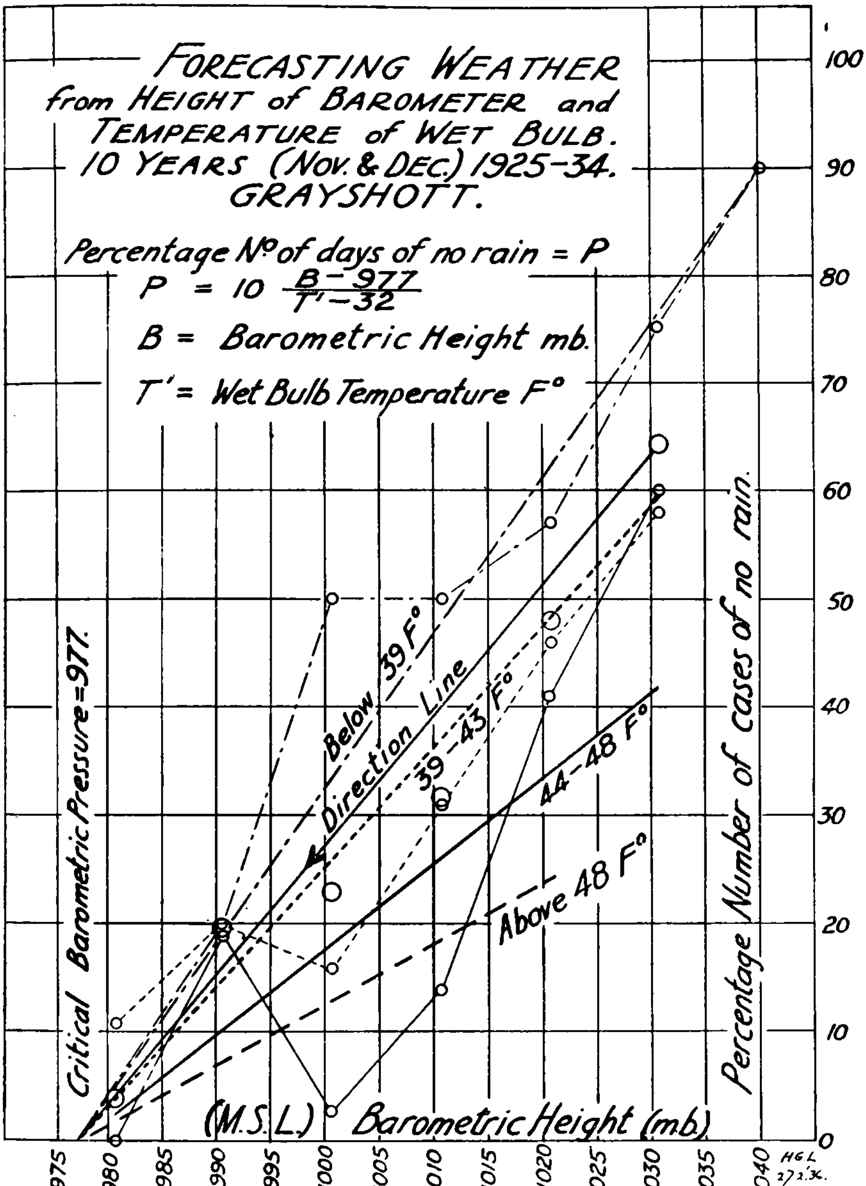
By courtesy of the Royal Meteorological Society the barometric and wet bulb observations for Edgbaston, Birmingham, for January and February from 1923 to 1932 inclusive have been abstracted by me from the records and a table and diagram prepared which show that the " critical barometric pressure " there is 976 mb. (reduced to M.S.L. for barometer at 542 ft.). The results vary little with humidity and the number of cases of no rain at 24 hours only justify an approximate formula of $P = 1\cdot3\ (B - 976)$ from the data. This may indicate also that the constant 1·3 or a which applies to B does not apply to the wet bulb temperature T'.

In the case of Grayshott if this were so then the constant for the averages (plotted for the direction line) would be

$b = \dfrac{64\cdot3}{1{,}030\cdot5 - 977} = 1\cdot20$; but $a = \dfrac{b}{c}$ where $b = 1\cdot2$ and $c = 0\cdot12$

therefore the formula becomes :—

$$P = \frac{b\,(B - K)}{c\,(T' - 32)}$$



but as the formula is for the "man in the street" it is more conveniently written $P = a\,\dfrac{B - K}{T' - 32}$

Perhaps the method for obtaining the "critical barometer pressure," and these remarks may be a help to others to obtain the corresponding results at other stations for the winter months and more especially January and February.

H. G. Lloyd.

REVIEWS

The Analysis of Weather Charts. By Dr. E. Kidson. (Reprinted from *The Australian Geographer,* Vol. II, No. 5.)

This paper gives a detailed analysis of a series of depressions which moved south-east from eastern Australia to the New Zealand area. The general principles illustrated were similar to those in our own area, but their detailed application was modified by local topographical features, especially near the Australian coast.

India Meteorological Department, Scientific Notes, Vol. VI, No. 66.—*Normal monthly percentage frequencies of upper winds at* 4, 6, 8 *and* 10 *Km. above sea-level obtained from pilot balloon ascents.*

In Scientific Notes No. 17, the India Meteorological Department published (in the form recommended by the International Commission for Air Navigation) tables of monthly percentage frequencies of upper winds in India for heights up to 3 Km. In the publication under review the tables have been extended from 4 Km. to 10 Km. at 2 Km. intervals, although the limits adopted for grouping the wind speeds have been reclassified according to forces ranging from below 5 m/s to above 40 m/s. The tables have been prepared from all the available data of morning ascents up to the end of 1931 —covering an area from Peshawar, Lat. 34° 2′ N., to Trivandrum, Lat. 8°. 31′ N., and from Aden, Long. 45° 3′ E., to Rangoon, Long. 96° 13′ N.

With the rapid development of new air routes in India, increasing demands will be made for information concerning upper winds. This publication will help the meteorologist to meet these demands. It will also provide valuable material for upper air investigation.

R. G. VERYARD.

On the colours of distant objects, and the visual range of coloured objects. By W. E. Knowles Middleton. (Trans. Roy. Soc. Can. (Toronto), XXIX, 1935.)

The author first outlines two usual methods of colour description—the monochromatic, and the Commission Internationale de l'Eclairage (C.I.E.) system; the paper has been carried through using the latter, with occasional transformation of results into terms of the former. He obtains the relation of the mean extinction coefficient, involving integration of brightness terms over the whole range of wave-length. Relations for the three components of colour for black, white and coloured objects at a distance are briefly described, and a considerable part of the paper is devoted to the method of computation of the apparent colours at several distances for a range of colour, together with black and white. He quotes results in an instructive table which gives apparent colour for black, white, red, yellow, green and blue at distances ranging from 10 to 300 Km. Assumptions and the necessary measurements are clearly stated. Visual range of coloured objects is briefly considered, and it is shown that at distances of the order of the visual range, all objects appear grey. Finally, the problems of the colour of shadows, and the illumination of an object seen at a small angle from the setting sun are suggested for further consideration. It is an interesting paper, but in common with all work on visual range, the sky has necessarily to be considered either as clear or overcast, which constitutes a great restriction. GEO. W. HURST.

BOOK RECEIVED

On forecasting weather over north-east Baluchistan during the monsoon months, July and August. By A. K. Roy, B.A., B.Sc., and R. C. Bhattacharva, M.Sc., India Meteor. Dept., Sci. Notes, **5**, No. 58.

OBITUARY

We regret to learn of the death on April 9th in Berlin-Friedenau, after a short illness, of Konteradmiral a. D. Alfred Herz. Konteradmiral a. D. Herz was born on April 29th, 1850, and was Director of the Deutsche Seewarte from 1903 to 1911.

Erratum

MAY, 1936, p. 94, Table I, *for* " Range of relative humidity at 3h." *read* " Range of relative humidity at 5h."

The Weather of May, 1936

Pressure was above normal over northern Europe, north-west Siberia, the North Atlantic, the eastern United States and central Canada, the greatest excess being 8·3 mb. at 50° N., 30° W. but below normal over southern and central Europe, Greenland, Alaska, western and eastern Canada and western United States, the greatest deficits being 10·1 mb. at Point Barrow and 3·9 mb. at Cairo. Temperature was above normal in Sweden, but considerably below normal in central and south-east Europe while rainfall was mainly below normal in Sweden and central and south-east Europe except Austria and Hungary where it was much above normal. For the first time monthly climatological broadcasts for Europe have been used in preparing this summary.

The outstanding features of the weather of May over the British Isles were the deficiency of rainfall and the north-easterly winds, and also in England generally the deficiency of sunshine*. An "absolute drought" occurred in several parts of south and east England during the first half of the month. From the 1st to 4th anticyclonic conditions prevailed with rather low temperatures but generally good sunshine records, 13·6 hrs. bright sunshine were registered at Spurn Head on the 1st and 13·5 hrs. at Bath on the 2nd. On the 4th the anticyclone was receding in a north-easterly direction, and on

* see p. 116.

the 5th and 6th a small area of low pressure passed across the south-western districts giving thunderstorms locally over the whole country on those two days; in the north the thunderstorms were accompanied by hail or sleet and in the south and west by moderate to heavy rain especially in Bedfordshire*. Mist or fog were also prevalent during these days but sunshine records were good locally and temperature was high. From the 7th to 9th the winds were light from between east and north and temperature fell considerably in the south. Local mist or fog occurred in the east and south but bright sunshine in the west and north. From the 10th to 14th a "col" extended over the country, day temperatures were generally about or above normal though there were local ground frosts at night and the weather was mainly dry and frequently sunny, 14·6 hrs. at Aberdeen on the 11th, but some local mist or fog occurred on the 11th and 12th. On the 14th a depression approached from the west and temperature rose generally, the 18th being the warmest day of the month in the south, 80° F. at Camden Square, and the 19th, in the north and west, 71° F. at Abbotsinch. Gales were recorded in north Ireland on the 14th and 15th and in north Scotland on the 16th, while thunderstorms were experienced on the 16th in the north and west and on the 17th and 18th in the south and east, 1·49 in. of rain fell at Rothesay on the 16th, 1·45 in. at Dunmanway (Co. Cork) on the 14th and 1·11 in. at Pondsmead (Somerset) on the 18th. By the 17th rain had fallen in most parts of the country breaking the "absolute droughts" which had prevailed in many parts of the south and east from April 26th or 27th. At Selbourne (Hants) the drought, however, was not broken until the 21st and at Oxford and Lexden (Essex) not until the 22nd making a total of 25 days "absolute drought" at Selbourne and Oxford and of 26 days at Lexden. The 18th and 19th were the sunniest days of the period in eastern England, 14·5 hrs. bright sunshine being recorded at York, Cranwell, Mildenhall, Oxford, Hastings and Lympne on the 19th. Except for the 22nd when a shallow depression moved south across the country the winds were between north and east from the 20th to 28th mainly light or moderate but strong on the east coast on the 21st and 27th and in the south-west on the 24th. Temperature was generally low with ground frosts during this period but rose above normal on the 25th to 27th. Rain fell in most parts from the 21st to 24th, while sunshine records were variable on most days but consistently good on the 20th and 21st. Fog occurred locally on the 25th to 26th. From the 28th to 31st a depression moved in a southerly direction to south Scandinavia and cold northerly winds prevailed with occasional rain but sunny periods; hail was reported from many places on the 30th and 31st. Thunderstorms occurred at Guernsey on the 24th, Valentia on the 26th and in the eastern districts on the 30th and 31st. The distribution of bright sunshine for the month was as follows:—

* see p. 115.

	Total (hrs.)	Diff. from normal (hrs.)
Stornoway ...	212	+31
Aberdeen ...	200	+27
Dublin	193	+ 6
Birr Castle ...	196	+22
Valentia... ...	233	+44
Chester ...	176	+14
Ross-on-Wye...	168	−25
Falmouth ...	213	− 2
Gorleston ...	164	−65
Kew	199	− 4

Miscellaneous notes on weather abroad culled from various sources

Thick fog was reported in the neighbourhood of Lugano about the 9th and a violent thunderstorm swept over central Switzerland on the evening of the 10th ; this was accompanied by hail, and rail and road communications were interrupted for several hours owing to floods—the fruit trees then in blossom were much damaged. Serious floods occurred in many parts of Spain after torrential rains causing much material damage. Northerly gales were experienced over Syra from the 19th–21st. A violent thunderstorm occurred at Siena on the 21st. During a sudden squall on Lake Neuchatel on the 21st, 3 students were drowned. A violent storm in the Gulf of Lions, on the 22nd, delayed inward shipping to Marseilles for 10 hours. Seven gypsies were drowned at Pakratz (Croatia) on the 30th when a sudden cloudburst caused a stream to overflow. (*The Times*, May 11th–30th.)

Snow, which has not been seen in May for many years, occurred on the mountains of Talarna (near Algiers) about the 10th and much damage was done to fruit trees in the same district by sharp frosts at night. Two aeroplanes were wrecked in a fog in Morocco about the 11th. Sixteen people were killed on the 24th when two houses collapsed in Fez (Morocco) as the result of undermining caused by recent heavy rains. Westerly gales occurred near Alexandria on the 29th. (*The Times*, May 11th–30th.)

A severe storm passed over the Kyaukpyu district of Burma on April 25th followed by floods—1,000 people were reported killed. The unusually heavy "little monsoon" reported on the 29th, though very welcome in famine-stricken western Bengal, caused anxiety in Assam where the level of the Brahmaputra was dangerously high. Bombay had several showers of rain and heavy rain was reported from Malabar. A severe storm occurred at Tura (Assam) on the 30th destroying many buildings. (*The Times*, May 4th–June 1st.)

Light and scattered showers prevailed generally in Australia during the middle of the month except along the north coast of Queensland and the north coast of New South Wales, where there were moderate to heavy rains. Light rains and mild sunny weather prevailed generally in New Zealand during the month. (*The Times*, May 27th–30th.)

An unusually early heat wave occurred in central Canada towards the middle of the month and heavy rains about the same time caused floods in the eastern provinces. About the 20th, however,

(*continued on p. 128*)

Rainfall : May, 1936 : England and Wales

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Lond .	Camden Square..........	·48	27	*Leics* .	Thornton Reservoir ...	·79	39
Sur .	Reigate, Wray Pk. Rd..	·55	30	,, .	Belvoir Castle............	1·40	66
Kent .	Tenterden, Ashenden...	·34	22	*Rut* .	Ridlington	1·71	85
,, .	Folkestone, Boro. San.	·15	...	*Lincs* .	Boston, Skirbeck.........	·68	39
,, .	Margate, Cliftonville....	·23	15	,, .	Cranwell Aerodrome...	·73	40
,, .	Eden'bdg., Falconhurst	·61	33	,, .	Skegness, Marine Gdns.	1·18	69
Sus .	Compton, Compton Ho.	·40	18	,, .	Louth, Westgate.........	2·07	102
,, .	Patching Farm..........	·59	32	,, .	Brigg, Wrawby St.......	1·63	...
,, .	Eastbourne, Wil. Sq....	·21	13	*Notts* .	Worksop, Hodsock......	·67	34
,, .	Heathfield, Barklye....	...	...	*Derby*.	Derby, L. M. & S. Rly.	·42	22
Hants.	Ventnor, Roy.Nat.Hos.	·22	13	,, .	Buxton, Terr. Slopes...	·51	16
,, .	Fordingbridge, Oaklnds	1·49	72	*Ches* .	Runcorn, Weston Pt....	1·65	71
,, .	Ovington Rectory.......	·64	29	*Lancs*.	Manchester, Whit. Pk.	·57	27
,, .	Sherborne St. John......	·41	21	,, .	Stonyhurst College......	1·74	61
Herts .	Royston, Therfield Rec.	·84	43	,, .	Southport, Bedford Pk.	·97	46
Bucks.	Slough, Upton............	·43	26	,, .	Lancaster, Greg Obsy.	1·35	55
,, .	H. Wycombe, Flackwell	·48	26	*Yorks*.	Wath-upon-Dearne......	·79	39
Oxf .	Oxford, Mag. College...	·42	23	,, .	Wakefield, Clarence Pk.	1·33	68
N'hant	Wellingboro, Swanspool	1·15	59	,, .	Oughtershaw Hall.......	1·77	...
,, .	Oundle	1·17	...	,, .	Wetherby, Ribston H..	...	...
Beds .	Woburn, Exptl. Farm...	1·25	64	,, .	Hull, Pearson Park......	1·38	72
Cam .	Cambridge, Bot. Gdns.	1·07	61	,, .	Holme-on-Spalding......	1·56	77
Essex .	Chelmsford, County Gdns	·78	54	,, .	West Witton, Ivy Ho.	1·99	88
,, .	Lexden Hill House......	·72	...	,, .	Felixkirk, Mt. St. John.	1·26	67
Suff .	Haughley House.........	·48	...	,, .	York, Museum Gdns....	1·31	66
,, .	Campsea Ashe............	·70	47	,, .	Pickering, Hungate......	1·49	76
,, .	Lowestoft Sec. School...	·74	46	,, .	Scarborough..............	2·04	107
,, .	Bury St. Ed., Westley H.	2·09	115	,, .	Middlesbrough............	1·70	89
Norf. .	Wells, Holkham Hall...	2·02	125	,, .	Baldersdale, Hury Res.	1·99	77
Wilts .	Calne, Castle Walk......	1·14	...	*Durh* .	Ushaw College............	2·25	104
,, .	Porton, W.D. Exp'l. Stn	·66	38	*Nor* .	Newcastle, D. & D. Inst.	1·80	98
Dor .	Evershot, Melbury Ho.	·61	30	,, .	Bellingham, Highgreen	2·00	83
,, .	Weymouth, Westham.	·51	31	,, .	Lilburn Tower Gdns....	1·47	64
,, .	Shaftesbury, Abbey Ho.	·51	24	*Cumb*.	Carlisle, Scaleby Hall...	·76	32
Devon.	Plymouth, The Hoe....	·60	29	,, .	Borrowdale, Seathwaite	2·00	29
,, .	Holne, Church Pk. Cott.	1·28	40	,, .	Borrowdale, Moraine...	1·18	21
,, .	Teignmouth, Den Gdns.	·76	42	,, .	Keswick, High Hill......	1·12	35
,, .	Cullompton	·65	30	*West* .	Appleby, Castle Bank...	·70	32
,, .	Sidmouth, U.D.C........	·78	...	*Mon* .	Abergavenny, Larchf'd	1·43	54
,, .	Barnstaple, N. Dev. Ath	·67	33	*Glam* .	Ystalyfera, Wern Ho....	1·53	44
,, .	Dartm'r, Cranmere Pool	1·40	...	,, .	Cardiff, Ely P. Stn.......	1·94	78
,, .	Okehampton, Uplands.	·89	33	,, .	Treherbert, Tynywaun.	1·92	...
Corn .	Redruth, Trewirgie......	1·50	65	*Carm* .	Carmarthen, Coll. Rd.	2·00	73
,, .	Penzance, Morrab Gdns.	·89	40	*Pemb* .	St. Ann's Hd, C. Gd. Stn.	1·35	71
,, .	St. Austell, Trevarna...	1·25	52	*Card* .	Aberystwyth	1·86	...
Soms .	Chewton Mendip.........	1·08	39	*Rad* .	BirmW.W.Tyrmynydd	2·23	65
,, .	Long Ashton...........	1·13	54	*Mont* .	Lake Vyrnwy	1·76	56
,, .	Street, Millfield..........	1·41	...	*Flint* .	Sealand Aerodrome......	1·10	...
Glos .	Blockley	·72	...	*Mer* .	Dolgelley, Bontddu......	2·14	65
,, .	Cirencester, Gwynfa....	1·27	62	*Carn* .	Llandudno	3·03	170
Here .	Ross, Birchlea............	·76	36	,, .	Snowdon, L. Llydaw 9..	3·46	...
Salop .	Church Stretton.........	1·12	43	*Ang* .	Holyhead, Salt Island...	1·22	62
,, .	Shifnal, Hatton Grange	1·70	82	,, .	Lligwy	1·87	...
Staffs .	Market Drayt'n, Old Sp.	·70	32	*Isle of Man*			
Worc .	Ombersley, Holt Lock.	1·09	53		Douglas, Boro' Cem....	3·11	124
War .	Alcester, Ragley Hall...	·99	48	*Guernsey*			
,,	Birminghm, Edgbaston	·99	46		St. PeterP't.Grange Rd.	·72	42

Rainfall : May, 1936 : Scotland and Ireland

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Wig .	Pt. William, Monreith.	3·56	152	*Suth* .	Tongue	1·26	53
,, .	New Luce School	4·14	145	,, .	Melvich	1·26	61
Kirk .	Dalry, Glendarroch	1·86	59	,, .	Loch More, Achfary	1·44	33
,, .	Carsphairn, Shiel	...	...	*Caith* .	Wick	1·96	95
Dumf.	Dumfries, Crichton R.I.	1·35	52	*Ork* .	Deerness	1·23	61
,, .	Eskdalemuir Obs	·60	18	*Shet* .	Lerwick	·91	44
Roxb .	Hawick, Wolfelee	·86	38	*Cork* .	Dunmanway Rectory	2·04	60
Selk .	Ettrick Manse	·59	16	,, .	Cork, University Coll.	1·38	61
Peeb .	West Linton	·67	...	,, .	Ballinacurra	1·29	54
Berw .	Marchmont House	1·56	63	,, .	Mallow, Longueville	1·72	77
E.Lot.	North Berwick Res	1·98	100	*Kerry*.	Valentia Obsy	2·09	66
Midl .	Edinburgh, Blackfd. H.	·83	40	,, .	Gearhameen	2·80	53
Lan .	Auchtyfardle	1·25	...	,, .	Bally McElligott Rec.	1·68	...
Ayr .	Kilmarnock, Kay Pk.	1·76	...	,, .	Darrynane Abbey	1·34	45
,, .	Girvan, Pinmore	3·23	108	*Wat* .	Waterford, Gortmore	1·45	63
Renf .	Glasgow, Queen's Pk.	1·66	68	*Tip* .	Nenagh, Cas. Lough	1·24	50
,, .	Greenock, Prospect H.	2·73	79	,, .	Roscrea, Timoney Park	·91	...
Bute .	Rothesay, Ardencraig	3·08	...	,, .	Cashel, Ballinamona	1·18	50
,, .	Dougarie Lodge	3·34	...	*Lim* .	Foynes, Coolnanes	1·10	47
Arg .	Ardgour House	3·34	...	,, .	Castleconnel Rec.	·78	...
,, .	Oban	2·93	...	*Clare* .	Inagh, Mount Callan	2·12	...
,, .	Poltalloch	5·87	186	,, .	Broadford, Hurdlest'n.	1·17	...
,, .	Inveraray Castle	3·65	93	*Wexf* .	Gorey, Courtown Ho.	1·33	60
,, .	Islay, Eallabus	2·49	94	*Wick* .	Rathnew, Clonmannon.	1·52	...
,, .	Mull, Benmore	6·55	88	*Carl* .	Hacketstown Rectory	·98	38
,, .	Tiree	2·30	92	*Leix* .	Blandsfort House	1·08	44
Kinr .	Loch Leven Sluice	·57	23	*Offaly*.	Birr Castle	2·50	112
Fife .	Leuchars Aerodrome	...	...	*Dublin*	Dublin, FitzWm. Sq.	1·18	58
Perth .	Loch Dhu	2·60	58	,, .	Balbriggan, Ardgillan	...	...
,, .	Balquhidder, Stronvar.	2·33	...	*Meath*.	Beauparc, St. Cloud	1·67	...
,, .	Crieff, Strathearn Hyd.	1·45	58	,, .	Kells, Headfort	1·78	66
,, .	Blair Castle Gardens	·87	43	*W.M* .	Moate, Coolatore	1·33	...
Angus.	Kettins School	·46	17	,, .	Mullingar, Belvedere	1·28	52
,, .	Pearsie House	·96	...	*Long* .	Castle Forbes Gdns	1·24	48
,, .	Montrose, Sunnyside	1·04	51	*Gal* .	Galway, Grammar Sch.	1·12	...
Aber .	Braemar, Bank	2·43	102	,, .	Ballynahinch Castle	2·11	59
,, .	Logie Coldstone Sch.	1·47	59	,, .	Ahascragh, Clonbrock.	1·21	44
,, .	Aberdeen, Observatory.	1·18	51	*Mayo*.	Blacksod Point	2·39	85
,, .	Fyvie Castle	1·26	49	,, .	Mallaranny	1·85	...
Moray	Gordon Castle	·82	39	,, .	Westport House	2·08	73
,, .	Grantown-on-Spey	...	...	,, .	Delphi Lodge	4·09	68
Nairn.	Nairn	1·17	65	*Sligo* .	Markree Castle	1·75	64
Inv's .	Ben Alder Lodge	1·19	...	*Cavan*.	Crossdoney, Kevit Cas.	1·92	...
,, .	Kingussie, The Birches.	1·77	...	*Ferm* .	Enniskillen, Portora	1·66	...
,, .	Loch Ness, Foyers	1·14	47	*Arm* .	Armagh Obsy	1·56	66
,, .	Inverness, Culduthel R.	·83	...	*Down*.	Fofanny Reservoir	2·97	...
,, .	Loch Quoich, Loan	2·65	...	,, .	Seaforde	1·71	65
,, .	Glenquoich	2·57	47	,, .	Donaghadee, C. G. Stn.	1·89	84
,, .	Glenleven, Corrour	2·28	59	,, .	Banbridge, Milltown	...	...
,, .	Fort William, Glasdrum	2·45	...	*Antr* .	Belfast, Cavehill Rd.	1·58	...
,, .	Skye, Dunvegan	2·32	...	,, .	Aldergrove Aerodrome.	1·30	57
,, .	Barra, Skallary	2·30	...	,, .	Ballymena, Harryville.	1·91	67
R&C .	Alness, Ardross Castle.	1·35	52	*Lon* .	Garvagh, Moneydig	1·29	...
,, .	Ullapool	1·13	44	,, .	Londonderry, Creggan.	1·62	62
,, .	Achnashellach	1·80	40	*Tyr* .	Omagh, Edenfel	2·16	83
,, .	Stornoway, Matheson	1·10	43	*Don* .	Malin Head	·85	...
Suth .	Lairg	1·07	42	,, .	Killybegs, Rockmount.	·89	...

Climatological Table for the British Empire, December, 1935

STATIONS.	PRESSURE.		TEMPERATURE.								Rela-tive Hum-idity.	Mean Cloud Am'nt	PRECIPITATION.			BRIGHT SUNSHINE.	
			Absolute.		Mean Values.				Mean.								
	Mean of Day M.S.L.	Diff. from Normal.	Max.	Min.	Max.	Min.	½ Max. and Min.	Diff. from Normal	Wet Bulb.				Am'nt.	Diff. from Normal.	Days.	Hours per day.	Per cent-age of possi-ble.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.		%	0–10	in.	in.			
London, Kew Obsy	1003·9	− 9·8	51	25	43·0	35·8	39·4	− 0·9	37·0		88	8·4	2·15	− 0·14	21	1·1	14
Gibraltar†	1017·5	− 2·8	65	42	58·9	50·6	54·7	...	50·5		78	5·7	4·48	...	9	...	...
Malta	1012·5	− 3·7	68	49	61·6	53·9	57·7	− 0·2	52·7		75	6·7	3·70	− 0·01	18	5·0	52
St. Helena	1013·1	− 0·2	69	55	64·5	56·6	60·5	− 1·2	57·4		93	9·4	0·80	...	18	...	...
Freetown, Sierra Leone	1012·3	+ 3·1	89	69	86·2	72·7	79·5	− 1·9	73·5		77	4·1	1·35	− 0·07	3	...	...
Lagos, Nigeria	1010·7	+ 0·7	90	74	87·4	75·9	81·7	− 0·1	76·3		89	5·7	0·43	− 0·38	2	6·8	58
Kaduna, Nigeria	1009·5	...	96	52	91·3	56·1	73·7	+ 0·4	55·9		48	2·5	0·00	0·00	0	9·0	78
Zomba, Nyasaland	1009·1	+ 0·8	88	56	81·1	63·7	72·4	− 0·7	67·6		75	6·7	8·01	− 2·86	13	...	...
Salisbury, Rhodesia	1010·2	− 0·2	89	49	81·0	58·7	69·9	+ 0·3	61·9		58	5·0	3·39	− 2·70	12	7·4	56
Cape Town	1015·0	+ 0·7	101	50	79·5	57·7	68·6	+ 0·7	59·1		61	3·1	0·33	− 0·48	6	...	...
Johannesburg	1011·3	+ 1·0	87	42	77·4	54·0	65·7	+ 0·2	56·2		61	4·7	5·85	+ 0·42	18	7·9	58
Mauritius	1013·5	− 0·5	91	64	87·4	73·4	80·4	+ 2·1	73·8		69	5·9	3·82	− 0·91	17	8·4	63
Bombay	1012·8	− 0·7	91	65	86·4	70·0	78·2	+ 0·8	68·5		75	2·1	0·00	− 0·05	0*	...	...
Calcutta, Alipore Obsy.	1015·3	− 0·4	83	50	80·2	56·6	68·4	+ 1·9	57·2		83	2·1	0·21	− 0·03	1*	...	...
Madras	1013·0	− 0·5	85	66	83·4	70·0	76·7	0·0	72·1		84	6·0	2·35	− 3·00	3*	...	...
Colombo, Ceylon	1010·8	+ 0·5	89	71	85·1	73·3	79·2	− 0·3	74·3		75	6·6	9·93	+ 4·81	13	5·9	50
Singapore	1009·8	+ 0·1	89	72	84·8	74·5	79·7	− 0·2	76·2		81	7·0	9·39	− 1·17	19	4·9	41
Hongkong	1020·0	+ 0·3	78	47	65·1	56·3	60·7	− 2·3	56·1		74	6·9	1·04	+ 0·01	7	4·2	39
Sandakan	1010·0	...	91	73	86·9	74·5	80·7	+ 0·5	76·8		82	8·3	9·68	− 8·96	21	...	...
Sydney, N.S.W.	1012·5	+ 0·6	89	54	74·4	62·7	68·5	− 1·6	63·6		70	7·7	4·70	+ 1·84	18	6·4	45
Melbourne	1014·2	+ 1·5	98	47	76·9	55·1	66·0	+ 1·2	58·4		56	6·8	1·53	− 0·74	12	7·2	48
Adelaide	1014·5	+ 1·3	102	49	83·0	59·0	71·0	− 0·1	58·4		35	5·1	1·16	+ 0·16	6	9·6	67
Perth, W. Australia	...	...	...	...	...	...	...	...	...		...	...	...	...	...	...	...
Coolgardie	1012·7	+ 1·5	102	44	87·0	58·8	72·9	− 2·8	64·2		61	4·4	0·39	− 0·30	2	...	...
Brisbane	1011·9	− 0·1	97	61	84·5	67·8	76·1	− 0·3	69·6		62	5·2	3·63	− 1·26	9	8·8	64
Hobart, Tasmania	1014·1	+ 4·4	91	47	66·9	52·2	59·5	− 0·7	54·2		66	6·8	3·25	+ 1·26	14	5·8	38
Wellington, N.Z.	1021·3	+ 9·1	74	48	68·3	55·9	62·1	+ 1·9	59·0		77	7·9	3·09	− 0·13	8	7·3	48
Suva, Fiji	1009·8	+ 1·2	88	71	84·1	74·0	79·1	+ 0·1	74·6		82	7·6	14·92	+ 2·40	24	4·9	37
Apia, Samoa	1007·7	− 0·6	87	71	85·3	74·2	79·7	+ 0·4	76·3		79	6·9	16·40	+ 2·51	18	5·2	40
Kingston, Jamaica	1013·7	− 0·3	91	66	85·9	68·9	77·4	− 0·3	66·8		84	2·6	0·74	− 0·85	4	6·3	57
Grenada, W.I.	1011·1	− 0·7	89	70	85	73	79	+ 0·8	74		74	4	4·97	− 2·23	22	...	...
Toronto	1019·9	+ 2·3	44	−6	27·9	17·4	22·7	− 4·4	20·1		77	8·2	0·60	− 1·87	8	1·8	20
Winnipeg	1021·9	+ 3·2	32	−24	14·7	0·0	7·3	+ 1·5	...		...	6·1	0·96	+ 0·02	13	1·7	21
St. John, N.B.	1010·3	− 3·7	40	−2	26·5	16·6	21·5	− 2·9	18·0		81	7·0	1·98	− 2·19	3	2·8	32
Victoria, B.C.	1015·4	− 1·3	52	35	47·5	41·3	44·4	+ 3·3	42·3		91	6·8	1·67	− 4·07	22	2·8	33

Climatological Table for the British Empire, Year 1935

STATIONS.	Pressure: Mean of Day M.S.L. mb.	Pressure: Diff. from Normal. mb.	Temperature Absolute: Max. °F.	Temperature Absolute: Min. °F.	Mean Values: Max. °F.	Mean Values: Min. °F.	Mean Values: ½ Max. and Min. °F.	Mean Values: Diff. from Normal. °F.	Mean: Wet Bulb. °F.	Relative Humidity. %	Mean Cloud Am'nt 0–10	Precipitation: Am'nt. in.	Precipitation: Diff. from Normal. in.	Precipitation: Days.	Bright Sunshine: Hours per day.	Bright Sunshine: Percentage of possible.
London, Kew Obsy.	1013·7	− 1·7	85	25	57·6	44·9	51·3	+ 1·5	46·1	84	7·1	26·17	+ 2·37	168	4·1	31
Gibraltar	1017·5	− 0·3	97	33	70·8	56·8	63·8	...	55·7	79	4·7	23·58	...	76	...	...
Malta	1015·2	− 0·1	91	42	70·1	60·8	65·5	− 0·7	59·9	75	4·8	20·43	+ 0·57	92	8·3	68
St. Helena	1016·7	0·0	74	52	64·6	57·7	61·1	− 0·4	58·6	93	9·2	32·54	...	218	...	...
Freetown, Sierra Leone	1012·3	+ 2·5	95	64	85·4	72·5	79·0	− 1·7	74·5	82	5·8	199·65	+ 41·82	172	...	...
Lagos, Nigeria	...	...	93	67	86·0	75·5	80·7	0·0	75·9	87	7·2	78·71	+ 6·73	133	5·6	46
Kaduna, Nigeria	1008·4	...	104	48	89·4	65·1	77·2	+ 0·8	66·3	69	4·8	61·34	+ 7·51	123	7·6	63
Zomba, Nyasaland	1012·6	+ 0·3	93	48	77·4	60·4	68·9	− 0·6	62·4	69	5·7	59·96	+ 5·42	103	...	...
Salisbury, Rhodesia	1014·7	− 0·5	92	34	76·6	52·2	64·4	− 0·9	56·1	57	3·4	29·42	− 2·13	70	8·1	67
Cape Town	1017·8	+ 0·8	101	35	72·2	54·4	63·3	+ 1·0	55·1	73	4·1	21·95	− 3·09	99	...	...
Johannesburg	1015·8	+ 0·2	90	23	70·5	48·3	59·4	− 0·3	49·1	56	3·1	20·39	− 12·83	79	8·7	72
Mauritius	1015·5	− 0·6	92	55	80·6	68·3	74·4	+ 0·4	70·5	75	5·7	65·85	+ 16·19	217	7·4	61
Bombay	1008·9	− 0·3	101	53	86·9	73·9	80·4	− 0·2	72·8	78	4·5	81·62	+ 9·43	75*	...	...
Calcutta, Alipore Obsy.	1007·3	− 0·3	108	48	89·0	71·6	80·3	+ 1·6	71·9	83	4·5	35·79	− 28·53	66*	...	...
Madras	1008·2	− 0·6	109	63	90·7	75·4	83·1	0·0	75·0	74	6·1	40·34	− 9·22	47*	...	...
Colombo, Ceylon	1010·1	+ 0·4	93	67	85·7	74·8	80·3	− 0·7	76·3	77	6·8	96·48	+ 16·35	189	6·8	56
Singapore	1009·4	− 0·1	91	70	86·2	75·7	80·9	0·0	77·0	80	7·4	72·76	− 22·36	177	5·9	49
Hongkong	1011·9	− 0·5	93	43	77·1	69·0	73·1	+ 0·8	68·8	80	7·5	71·31	− 14·42	140	4·7	39
Sandakan	1009·4	...	92	70	88·1	75·1	81·6	+ 0·3	77·0	81	7·0	116·24	− 8·55	211	...	...
Sydney, N.S.W.	1015·4	− 0·5	102	39	71·0	55·1	63·0	− 0·1	57·3	67	5·7	30·97	− 16·51	131	7·2	60
Melbourne	1015·9	− 0·4	104	33	67·2	49·4	58·3	− 0·1	52·8	70	6·5	29·98	+ 4·51	183	5·3	44
Adelaide	1016·8	− 0·3	108	38	72·5	53·3	62·9	− 0·1	54·5	54	6·2	23·45	+ 2·27	140	6·6	54
Perth, W. Australia	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Coolgardie	1015·6	− 0·3	111	32	76·1	50·6	63·3	− 1·2	56·1	63	3·8	10·47	+ 0·20	53	...	...
Brisbane	1015·5	− 0·4	97	38	77·8	59·2	68·5	− 0·4	61·8	64	4·4	34·63	− 10·66	111	8·3	69
Hobart, Tasmania	1013·0	− 0·5	91	32	61·1	47·2	54·1	− 0·3	48·8	68	6·4	32·22	+ 8·43	189	5·4	45
Wellington, N.Z.	1014·4	− 0·3	83	32	61·0	49·1	55·1	− 0·3	52·0	76	6·5	40·74	− 7·30	154	5·9	49
Suva, Fiji	1011·2	− 0·1	94	63	82·7	72·7	77·7	+ 0·7	73·3	85	7·3	163·62	+ 46·48	281	4·7	39
Apia, Samoa	1009·8	− 0·5	88	70	84·9	74·6	79·8	+ 1·3	76·2	79	6·0	133·49	+ 23·78	216	6·8	56
Kingston, Jamaica	1013·3	− 0·4	96	61	86·4	70·7	78·5	− 0·8	69·6	81	3·7	26·54	− 7·05	62	6·2	51
Grenada, W.I.	...	...	90	70	85	73	79	+ 0·1	74	75	5	67·35	− 7·24	239	...	...
Toronto	1017·3	+ 0·7	93	−11	53·9	38·3	46·1	+ 0·9	40·7	76	6·0	24·23	− 7·06	139	5·7	47
Winnipeg	1017·1	+ 0·9	95	−43	45·2	24·7	34·9	− 0·3	...	...	5·6	22·25	+ 2·07	123	5·5	45
St. John, N.B.	1014·5	− 0·1	90	−18	48·8	33·2	41·0	− 0·2	36·9	78	6·1	38·98	− 9·10	149	5·5	45
Victoria, B.C.	1016·8	+ 0·1	90	10	55·8	44·1	49·9	+ 0·5	46·1	81	5·6	26·01	− 4·30	136	6·6	54

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen

(*continued from p. 123*)
the weather turned cold in Ontario—snow fell in many parts and frost did much damage to crops and orchards. Unseasonably high temperatures and strong winds were experienced in western Canada at the end of the month. In the United States temperature was considerably above normal during the first half of the month, becoming about or somewhat above normal during the later half, while rainfall was mainly below normal. (*The Times*, May 12th–June 3rd, and *Washington, D.C., U.S. Dept. Agric. Weekly Weather and Crop Bulletin.*)

Daily Readings at Kew Observatory, May, 1936

Date	Pressure, M.S.L. 13h.	Wind, Dir., Force 13h.	Temp. Min.	Temp. Max.	Rel. Hum. 13h.	Rain.	Sun.	REMARKS. (see vol. 69, 1934, p. 1).
	mb.		°F	°F	%	in.	hrs.	
1	1027·8	ENE.3	41	54	62	—	2·6	
2	1028·5	E.3	39	55	60	—	4·1	
3	1026·4	ENE.3	43	57	61	—	5·4	
4	1015·3	ENE.4	47	62	56	—	7·8	
5	1007·6	E.4	48	68	57	—	7·5	m early.
6	1007·9	WSW.2	48	72	56	—	10·2	mw early., t 17h.
7	1013·1	N.4	51	61	77	—	8·0	
8	1014·2	N.4	48	55	69	—	0·0	
9	1014·5	NNW.2	46	55	79	—	0·0	
10	1015·6	WNW.2	48	62	70	—	2·0	
11	1017·9	N.2	45	67	48	—	9·4	
12	1018·0	N.1	45	62	63	—	0·8	w early.
13	1018·9	SSW.2	52	68	57	—	6·3	w early.
14	1020·5	WSW.2	48	68	58	—	8·9	
15	1013·9	S.4	44	73	53	—	8·6	
16	1008·5	ESE.4	55	77	35	—	12·4	
17	1012·0	E.2	55	72	57	0·07	4·2	tlr 15h.–17h., F 22h.
18	1017·5	ENE.4	52	75	52	—	12·9	Fw early.
19	1018·7	ENE.4	52	71	43	—	14·2	
20	1017·6	N.5	46	62	59	—	9·6	
21	1017·4	N.5	41	54	49	0·08	9·3	pr 14h., 16h. & 18h.
22	1012·6	N.2	37	60	47	0·17	7·2	t 15h., r-r_0 18h.–24h.
23	1010·0	ENE.4	48	55	59	0·11	2·1	r–r_0 0h.–9h.
24	1010·7	NE.3	45	61	48	—	5·8	
25	1016·1	E.2	49	68	53	—	6·1	
26	1019·5	NE.3	47	64	66	—	7·6	
27	1019·2	NNE.3	53	64	70	—	4·0	d_0 early.
28	1021·6	N.3	46	52	60	—	0·3	
29	1010·9	WSW.3	38	63	42	—	8·1	
30	1002·8	SSW.2	48	57	72	0·09	1·9	r 10h.–11h. & 15h.-16h.
31	1013·2	W.3	40	56	40	—	11·3	pr_0 20h.
*	1015·8	—	47	63	57	0·51	6·4	* Means or totals.

General Rainfall for May, 1936

England and Wales ...	53	per cent. of the average 1881–1915
Scotland	65	
Ireland	61	
British Isles	58	

(32222) Wt. 19 32 1050 6/36 Hw. G 377 6

Fig. 1 (*a*).—Wind vane mast with 10 ft. and 20 ft. thermometers

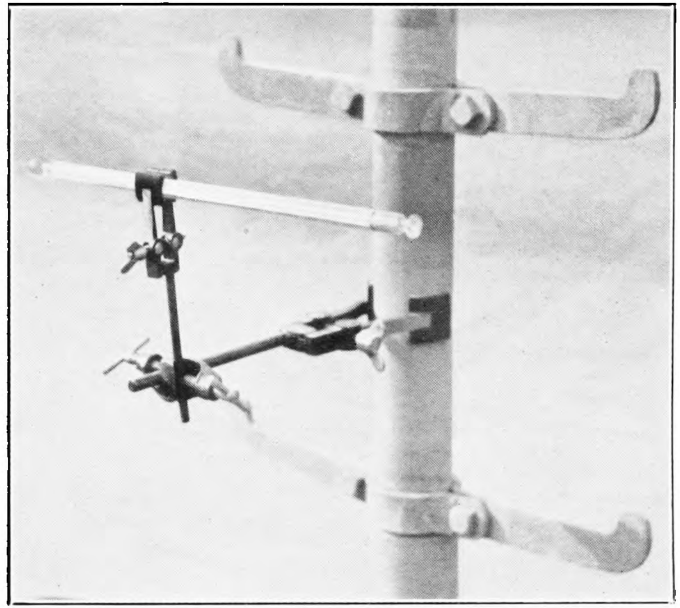


Fig. 1 (*b*).—Details of fixing of thermometers to mast

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Spring Frost and Fruit Crops

BY DONALD L. CHAMPION

It is well known that the sharp, though usually brief, frosts of late spring in southern England are frequently a source of anxiety to fruit growers; and the wide-spread damage to fruit and other trees, caused by the severe frosts of May, 1935,* will be long remembered. Sir Napier Shaw, commenting on the effect of frost on a walnut tree, remarks ". . . . One would like to know how far up the frost extends in different situations where there are no walnut trees to act as self-recording instruments . . ."† but it seems that in this country, little has been done to solve the problem.

On behalf of a firm interested in the production of Orchard Heaters, in order to ascertain how far above the surface so-called "ground" frosts may be experienced during late spring, standard M.O. pattern minimum thermometers have been installed on the wind vane mast at Goff's Oak, Herts, and the data so far obtained may not be without interest. The mast, of tubular steel construction, is exposed at an elevation of 330 ft. above ordnance datum, with open country to the west and north, and is about 70 yards and 30 yards respectively from the nearest buildings to the south and east. The thermometers are held in gun-metal clamps at heights of 5 ft., 10 ft. and 20 ft. above the ground. The photographs, Fig. 1, show the mast with the instruments at 10 ft. and 20 ft., and details of the method of fixing which was adopted, to ensure their being firmly held yet well clear of the mast itself.

* See *Meteorological Magazine* 70, 1935, p. 105.

† SIR NAPIER SHAW: Unofficial Meteorology, p. 10.

For the purpose of the investigation, night minima from freely exposed thermometers were required and the instruments are thus unscreened and as open to radiation effects as the grass minimum thermometer, which latter is exposed on the grass plot about 10 ft. east-south-east from the base of the mast. The instruments are all set at 11 p.m. and read at 7 a.m. (Civil Time), and in order that the resultant minima should not be affected by sluggishness on the part of any particular instrument, the thermometers were transposed from time to time during the three months' observations.

A curve, showing the deviation (D) in °F. of the various minima from the minimum in the screen, was prepared from the readings obtained each morning, and these curves can broadly be classified into three groups :—

(*a*) Clear sky, calm.
(*b*) Clear sky followed by cloud and/or increase in wind.
(*c*) Overcast sky and/or windy.

Typical curves selected from the series are reproduced in Fig. 2 and bring to light some interesting features, particularly the curve

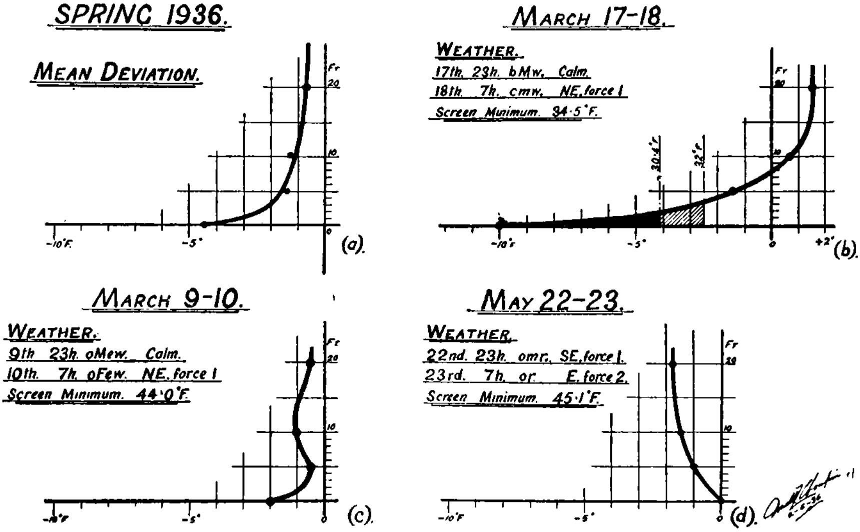


FIG. 2

from minima on the night of March 9th–10th (Fig. 2 (c)) which shows the curious effect obtained on an overcast night with a wet fog. The instruments, both at 23h. on the 9th and at 7h. the following morning, were all dripping with condensed moisture* and doubtless were acting as wet-bulb thermometers ; but even so, the air being almost calm throughout the night, evaporation must have been negligible or entirely absent. This curve is typical of the conditions on overcast nights, but the discontinuity shown was also observed on clear nights with winds of force 4, although in most cases there

* 0.02 in. of this precipitation was measured from the rain-gauge at 7h. on the 10th.

was considerably less difference between the minima at 10 ft. and 20 ft. than on this particular night.

It is reasonable to assume that the minima recorded by these instruments were the result of the balance between the loss of heat due to radiation and the gain of heat by conduction from the air itself. This being so, allowing for air movement, one can appreciate the minima approaching closer to the screen minimum at the higher levels such as in the case of Fig. 2 (*a*) ; but in the case of Fig. 2 (*c*), the minimum at 5 ft. was higher by 0·5° F. than at 10 ft. Assuming radiation constant and minima reached at the same time at all levels, the air at 10 ft. would apparently have been cooler than the strata immediately above and below. If the air at 10 ft. had been cooled by radiation, one would have expected it to sink to some level below 5 ft., or conversely, if cooled by expansion to rise to some level above 20 ft. In either case the conditions would be unstable and it would be difficult to understand its persistence, particularly on occasions when this discontinuity was still apparent with winds of force 6.

In this connexion it should be noted, that about 16 ft. west of the mast is a hawthorn hedge, about 8 to 10 ft. in height, which might tend to screen the thermometer at 5 ft. from westerly winds. Since, however, this instrument on many nights records minima 0·5° F. higher than at 10 ft. with winds above force 4 from all points of the compass, it seems that the hedge is not a contributory factor to the observed difference in minima. If these conditions were only observed to take place on totally overcast nights, it might be inferred that the higher minima at 5 ft. were due to the cumulative effect of terrestrial radiation and reflected radiation from the underside of the cloud sheet, the latter tending to reduce the cooling produced by the former ; but the difference being also apparent on clear nights with considerable wind makes the matter difficult of explanation, the effect of turbulence in removing the observed discontinuity being absent on these nights.

On a number of occasions with overcast skies, the grass minimum has been higher than the minima at 5 ft., 10 ft. or 20 ft., as shown in Fig. 2 (*d*). The greatest differences between the minima at all levels occur on nights which are calm and clear at first, but become considerably clouded before day-break. In the example shown, Fig. 2 (*b*), there was a difference of 11·5° F. between the grass minimum and that at 20 ft. On this occasion, the minimum on the grass was 7·5° F. below the freezing point, and whereas the screen minimum was 34·5° F., the minimum at 20 ft. was as high as 36·0° F. It would seem that the stratum of air below about 8 ft. had suffered considerable loss of heat by radiation, but before this effect could penetrate to a greater height, a slight increase in wind accompanied by considerable cloud, kept the air above this level at a higher temperature than the stratum below.

The average grass minimum in spring is about 4·5° F. lower than that in the screen, but the difference falls off rapidly with height, and the mean curve appears to become asymptotic to the line D = − 0·75° F. at about 25 ft. above the surface. On clear, calm nights the grass minimum averages about 8° F. lower than the screen minimum,* but even so the minimum at 5 ft. above the surface is then rarely more than 2° F. lower than that in the screen and at 20 ft. the difference is usually less than 1° F.

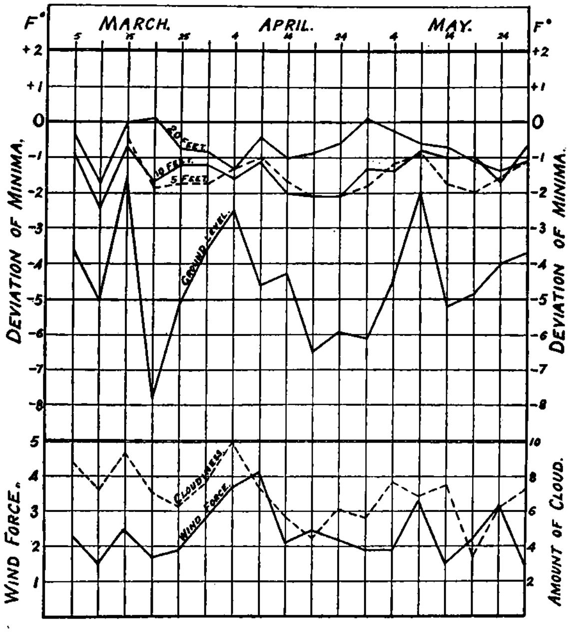


Fig. 3

In Fig. 3 are shown curves of the mean deviations at each level for five-day periods, together with the corresponding means of wind force and amount of cloud. The effect of wind and cloud is at once apparent, the greater difference between the minima when there is little wind and low nebulosity being clearly shown by the opening out of the curves. There is, however, usually less difference between the curves of minima at 5 ft. and 10 ft. than between 5 ft. and ground level or between the curves at 10 ft. and 20 ft.

The critical temperature from the fruit growers' point of view is 30·4° F., at which temperature, it is assumed, the tissues of growing plants may be destroyed and a "ground frost" is said to have occurred. The table below shows the number of occasions when the minima at various levels have reached or fallen below this point, and, for comparative purposes, the number of times a minimum of 32° F. or lower has been recorded.

Height.	Ground Level.		5 ft.		10 ft.		20 ft.	
	30·4°	32°	30·4°	32°	30·4°	32°	30·4°	32°
March	9	10	5	7	3	7	1	3
April	14	17	5	9	6	9	5	8
May	3	5	..	2	..	1	..	..
Total ...	26	32	10	18	9	17	6	11

From these results it would appear that as a rule the term

* See *Meteorological Magazine*, 71, 1936, p. 67.

"ground" frost is justified, but on the other hand, in extreme cases with a screen minimum of 33° F., a "ground" frost may be experienced at heights exceeding 10 ft. above the soil, and perhaps the designation "Crop Frost" would be more correct terminology. It would seem that fruit growers and others should take steps to protect their crops if the screen minimum is likely to fall below about 35° F.

The Design of Cup Anemometers

At the principal Meteorological Office stations the pressure tube anemometer is installed to give a continuous record of wind. There are, however, other stations where some instrumental record of wind speed is required but where the expense of installing and maintaining a pressure tube anemometer is not justified. At these stations anemometers of the small Robinson cup type are used. These are of two patterns—in one, the indicating type, the cups are connected by gearing with a counting mechanism so that the run of the wind can be read from a dial; in the other type, an electric contact is closed after a stated number of revolutions of the cups, causing a buzzer to ring. The interval between successive rings is taken by a stop-watch and the speed of the wind determined with the aid of a table. Cup anemometers have, in the past, suffered from the serious fault that the speed of the cups is not strictly proportional to the speed of the wind, i.e., the value of the factor by which the speed of the cup centre needs to be multiplied to obtain the speed of the wind differs markedly at high wind speeds from its value at low and moderate wind speeds. In the case of the electric type of anemometer this is not a matter of great moment, as the table which is used to relate the interval between successive rings of the buzzer with the speed of the wind can be made to take account of the change in the factor. In the indicating type of anemometer, no such allowance can be made, and if the gearing is such that the anemometer gives a correct record of the run of the wind at low speeds, it will give an incorrect record at high speeds.

A good deal of work has been done on the American continent during the past decade on the design of cup anemometers. Mr. J. Patterson, Director of the Canadian Meteorological Service, devised an instrument in which the customary 4 cups on arms spaced 90° apart were replaced by 3 cups on arms spaced at 120°. This system was found to give improved results and was adopted provisionally in the Meteorological Office for the indicating pattern of anemometer in the year 1930. In the United States *Monthly Weather Review* for April, 1934, Professor C. F. Marvin, Chief of the Weather Bureau, published a paper on recent advances in anemometry in which attention was directed to the marked improvement in the behaviour of cup anemometers which was achieved by turning over the edge of the cup to form a small circular beading. It was decided to make some experiments on the same lines in this country before deciding upon a final design for the cup anemometer. Accordingly, a 4-cup anemometer was made with beading round the edge of the cups and submitted to the National Physical Laboratory for test in a wind tunnel. The improvement at high wind speeds was most marked, the error in the measured run of the wind at 100 m.p.h. which, in a cup anemometer without beading was + 17 per cent, was reduced by the beading to +2 per cent. Unfortunately, at low speeds between 0 and 40 m.p.h. there was no improvement, in fact, the variation of the factor over this range of speed was, if anything, a little greater than before, and as the wind in this country falls within the range 0–40 m.p.h. for the greater part of the time, it was not felt that beading on a 4-cup system formed an entirely satisfactory solution to the problem. A 3-cup anemometer was then made up with ⅛ in. beading on the outside of the edges of the cups and submitted to the National Physical Laboratory for test. The results showed that the factor remained almost constant over the full range of speed covered by the test, that is from 5 m.p.h. to 95 m.p.h. The test shows that with suitable gearing it is now possible to reduce the error of a cup anemometer, so that in the range 5–95 m.p.h. the error would nowhere exceed 0·6 m.p.h. It is hardly necessary to point out that owing to difficulties in securing a satisfactory exposure, an error of ½ m.p.h. in wind measurement is negligible. It is not justifiable to assume that the behaviour of a cup system in a natural turbulent wind will be identical with its behaviour in a wind tunnel where the wind stream is almost free from turbulence. It is not claimed, therefore, that this cup system in a natural wind would necessarily give errors not exceeding 0·6 m.p.h. throughout the range. There can, however, be no reasonable doubt that the beaded 3-cup system marks a great advance on any other which has been tried in this country, and it has been decided to adopt it both for the indicating and electric types of cup anemometer which are purchased by the Meteorological Office in the future. A photograph of an anemometer of the indicating type with the new cup system is shown in Fig. 1 and the essential particulars of the cup head are as follows :—

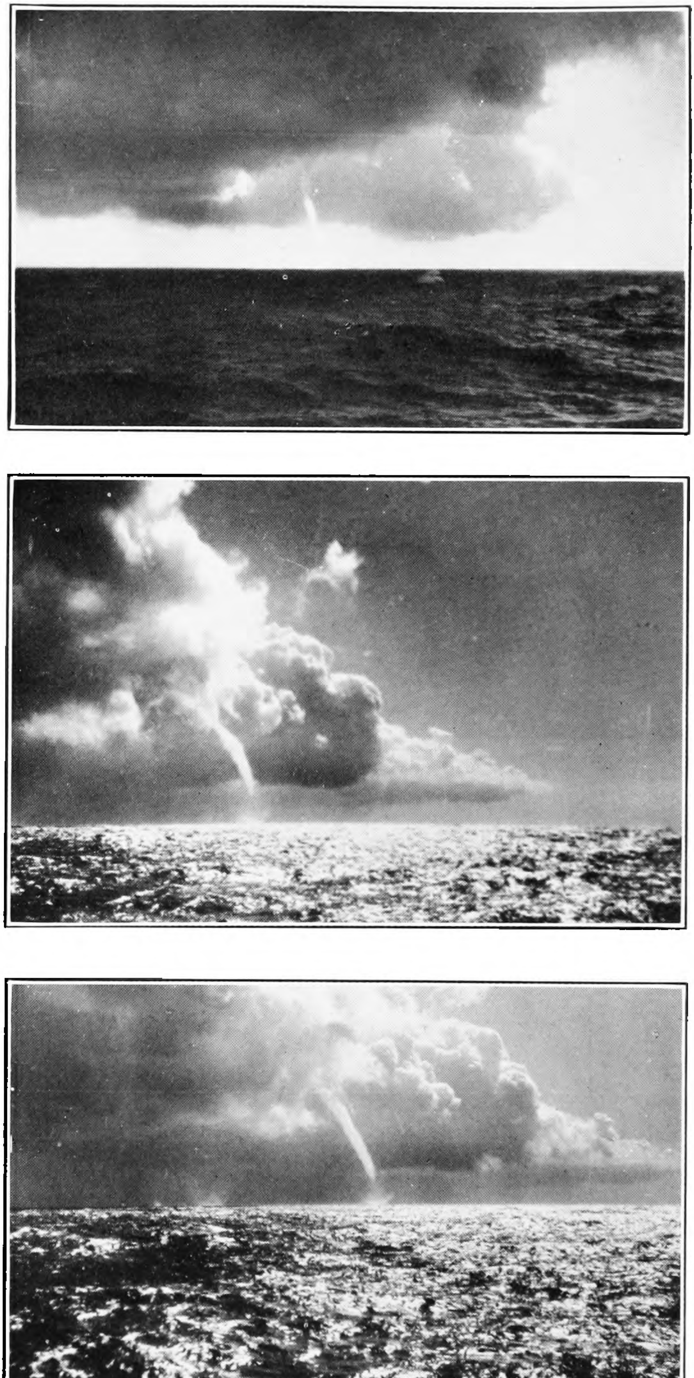
Three cups, 5·0 in. diameter, with ⅛ in. circular beading, mounted on arms spaced 120° apart. The centres of the cups are 6·3 in. from the axis of rotation and the gearing is such that the dials indicate one mile of wind for every 580 turns of the cups.

J. S. Dines.

Phenomenon Witnessed in New Zealand on February 29th, 1936

Travelling alone by car from Hamilton to Tauranga, I reached

Fig. 1.—3-Cup anemometer



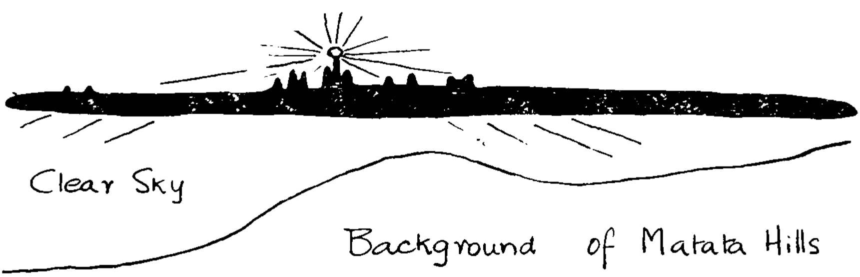
WATERSPOUT IN THE INDIAN OCEAN, OCTOBER, 1935 (*see p.* 138)

the top of the Kaimai Road, and was greatly struck with the vivid lightning display over the Bay of Plenty. As this display gradually increased in intensity, I stopped my car where I had a clear view to the east, at a spot 13 miles from Tauranga on the Kaimai Hills, about 500 ft. above sea level.

Having stopped the engine and extinguished the lights, I noticed that the major flashes came from behind a cloud lying practically due north. After a major flash from the north there would be a pause, and then from a point or two to the east of where the major flash had originated, forked lightning would run across the sky, through east to south. At about 10.10 p.m. I noted, due east, a faintly glowing light. At first I thought this came from a house window, or the headlights of a car. I subconsciously decided the former surmise was correct, as although it was definitely a light itself (and not the reflection of one) it was a bit faint for a car. All the same, I mentally registered the impression that it was a bit high up for a house or a car. (I am well acquainted with the district, so that I am fairly sure as regards localities and directions.)

Some minutes later, a bright flash from the north lit up the sky, and I was more than amazed to realise that the glowing light actually proceeded from the upper surface of a black bank of cloud. The time was then 10.15 p.m. and the glowing light had been practically steady for five minutes. By steady, I mean it had stayed in the same position, no movement right or left, up or down. It had waxed and waned, only very slightly, which had made me think, hitherto, that it was a house light, and that rain had drifted past, causing it to alter in apparent intensity.

At 10.15, as stated, I realised the glowing light was proceeding from a cloud. Before I had time to conjecture what that could mean, I witnessed one of the most weird and uncanny sights I have ever seen. It suddenly seemed to pulsate, it took definite shape as a molten ball of soft light, but although in itself not dazzling to the eyes, threw off an indescribably bright, greenish white light, or rather radiance. This radiance lit up the whole of the upper surface of the cloud bank and showed the ball of light balanced on a finger



of cloud. On either side of this finger were ugly looking black peaks, and all these were silhouetted against the radiance. From being a small ball of light, it instantly became larger, until it was the size of a half-crown, seen from a distance of 18 ft. The radiance became brighter and lit up all the landscape and countryside. The ball itself, although molten in appearance, did not hurt or dazzle the eyes. It held this size for about 15 seconds (I was far too interested in watching it, to take the time). Then it pulsated again (seeming to slightly contract and expand once or twice) and almost immediately became much enlarged. It appeared to be the size of a large orange seen from 18 ft. away. This time the radiance was terrific. Thousands of searchlights would not have equalled the intensity. But still the focal point or ball was not blinding.

My own feelings, although not scientific evidence, were interesting, to say the least. I had no time to be scared for it all was so absorbingly interesting. I felt literally that anything might happen, and nothing could have surprised me. Situated as I was, on an absolutely deserted road, I might have been watching the creation of a new world, or the extermination of an old world.

This phase could have lasted no longer than 15 seconds, but of course, time is only relative. Then the ball of light commenced to contract very quickly, and went back to its original glow. It disappeared momentarily, but for certainly ten more minutes kept on appearing and disappearing. For the 15 minutes that I saw it, it did not move in the sky. It did not again come into prominence, although I waited for at least half an hour. All this time the lightning display continued.

I also noticed a bright and constant radiance, somewhat similar to the one described above. This was approximately in the direction of Rotorua, but it would have needed a city the size of London to give the same effect as a reflection. I could not see the focal point of this radiance, owing to the tops of the hills which were outlined. This glow remained practically steady for 15 minutes.

One other detail I noted with regard to the phenomenon detailed at length above. After the glowing light had finally disappeared, one particular display of lightning emanating from the northern cloud flashed across the sky. One jagged fork was travelling horizontally above the spot where the ball had been. Suddenly this jagged fork resolved itself into an absolutely straight line, and drove itself directly into the spot where the ball had been. Its angle of flight was from 11 o'clock to 5 (i.e., slightly off the perpendicular).

I am writing this on the day following, while it is all fresh in my memory. I have heard no mention of any similar experience over the air, although I have been told that others have witnessed the same thing. Nevertheless, I have purposely refrained from discussing it with any of those people as I do not want to risk having my impressions varied by the experiences of others until I have put my record on paper.

M. D. LAURENSON.

Royal Meteorological Society

His Majesty the King has been graciously pleased to grant his Patronage to the Royal Meteorological Society.

The monthly meeting of this Society was held on Wednesday, June 17th, at 49, Cromwell Road, South Kensington, Dr. F. J. W. Whipple, F.Inst.P., President, in the Chair.

Prof. T. H. Laby, F.R.S., Professor of Physics at the University of Melbourne, and a member of the Australian Radio Research Board, opened a discussion on "Thunderstorm Researches", with an account of the following paper :—" Relation between sources of atmospherics and meteorological conditions in Southern Australia during October and November, 1934." By R. W. Boswell, M.Sc., and W. J. Wark, M.Sc.

The authors describe observations covering 24 hours per day of sources of atmospherics made by means of wireless direction-finding at Melbourne and Canberra during October and November, 1934. The observations are compared with meteorological data for that period for the purpose of ascertaining what relationship, if any, existed between the sources of atmospherics and the cold fronts. The results show that during that particular period there was a general correlation between the days on which sources of atmospherics were active and the days on which fronts were present in Southern Australia, but that any attempt at closer analysis of this problem must allow for the fact that the fronts determined by meteorological observations are merely the intersection of the frontal planes with the earth, and a front at the height of a lightning flash may be some distance from the same front as determined at the ground.

Prof. Laby gave some details of the work of the Radio Research Board of Australia in connexion with thunderstorm tracking, and described observations of atmospherics by means of wireless direction-finders made in Australia over a period of years. Evidence was submitted that lightning alone emits atmospherics and that thunderstorms associated with cold fronts can be followed over considerable distances.

The following papers were read in title :—

M. P. van Rooy, B.Sc.—Influence of berg winds on the temperatures along the west coast of South Africa.

The South African Berg winds, winds of a föhn-like character, blowing off the interior plateaux, are described, and their influence on the temperatures along the west coast of South Africa is discussed. It is found that the minimum temperatures are very seldom affected but that daily maxima are much increased when the Berg winds are blowing. As the number of affected maxima during any one month varies greatly from year to year the mean monthly maxima show wide fluctuations and mean temperature values for this region must therefore be used with discrimination.

S. Chapman, M.A., D.Sc., F.R.S., M. Hardman and J. C. P. Miller.—The lunar atmospheric tide at Melbourne, 1869–1892, 1900–1914.

The lunar atmospheric tide at Melbourne, Australia, has been determined from nearly 36 years' record. The mean result is 28 sin (2t + 84·0°) microbars, with a probable error of 2·3 microbars. This is compared with the determination made by Neumayer from data for the years 1858–63 : his result is found to be affected by so large a probable error as to be practically without value. The Melbourne tide is affected by a seasonal variation, of normal type as regards phase (high tide occurring later in December than in June), but abnormal in that the amplitude is greatest in December. The daily solar variation at Melbourne is also analysed, determined from all or almost all days, and separately from 421 days of barometric disturbance; the latter show the expected "concave variation," the complement of Bartels' "convex variation" characteristic of barometrically "quiet" days.

Correspondence

To the Editor, *Meteorological Magazine*

Waterspout in the Indian Ocean, October, 1935

The three photographs reproduced, facing p. 135, were obtained from a ship in the Indian Ocean, about 500 miles west of Bombay, by Mrs. T. Harford. The morning (about the middle of October, 1935) was at first sunny and cloudless, but suddenly the sky in the east grew very black and a waterspout appeared directly ahead of the ship.

The three photographs were taken in rapid succession. The interesting point about the phenomenon is that the waterspout seemed to progress in leaps. In the third photograph, traces of an earlier disturbance of the sea are visible to the left of the actual column. After the third photograph was taken the waterspout again made a jump and developed a "whirling corkscrew formation," but unfortunately Mrs. Harford was unable to obtain a photograph of this stage.

As the waterspout passed the ship, rain fell heavily accompanied by terrific wind. Rainstorms can be seen on each side of the spout in the first photograph. Dozens of dead land birds were afterwards picked up from the awnings.

Temperature Observations during the Solar Eclipse of June 19, 1936

The following observations of temperature were made from a point about 400 ft. above mean sea level near Chorleywood Common, Herts., during the partial solar eclipse at and soon after sunrise on June 19th 1936. A non-registering black-bulb thermometer *in vacuo* was used for the solar radiation readings, and the dry-bulb of a Casella sling psychrometer for the "air" readings. The sky was cloudless apart from a few wisps of cirrus, which all steered clear of the sun; the wind was NNE., 3 to 5 miles an hour; and though there was some mist in the neighbouring valleys, visibility from the hill-top was estimated at 8 to 10 miles. It will be seen that, as usual, the greatest depression of temperature resulting from the partial cutting-off of the heat rays was delayed for several minutes after the maximum phase of the eclipse, which occurred at 4h. 15m.

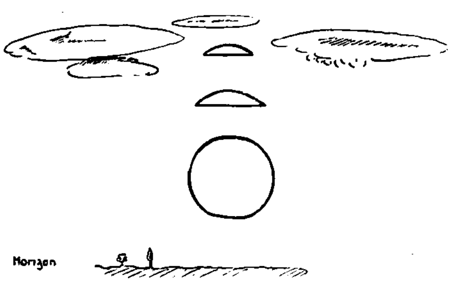
Time. G.M.T.	*Air Temperature.* °F.	*Black Bulb.* °F.	*Black Bulb—Air Temperature.* °F.
3h. 50m.	61·0	66·7	5·7
3h. 55m.	61·0	67·9	6·9
4h. 0m.	61·1	70·9	9·8
4h. 5m.	61·3	70·1	8·8
4h. 10m.	61·8	68·1	6·3
4h. 15m.	61·7	65·3	3·6
4h. 20m.	59·6	62·8	3·2
4h. 25m.	59·9	63·2	3·3
4h. 30m.	60·2	63·5	3·3
4h. 35m.	60·3	64·1	3·8
4h. 40m.	60·5	65·0	4·5
4h. 45m.	61·0	66·2	5·2
4h. 50m.	61·8	67·9	6·1
4h. 55m.	62·7	69·8	7·1
5h. 0m.	64·1	73·5	9·4

E. L. HAWKE.

Caenwood, The Valley Road, Rickmansworth, Herts., June 21st, 1936.

Unusual Solar Phenomenon

At 19h. 45m. G.M.T. on Monday, June 15th, 1936, an unusual solar phenomenon was witnessed at Saughall. At the time the sun was below a band of alto-cumulus lenticularis with the elevation of the centre of the sun about 8°. The sun appeared as a deep red orb while above it were two segments of a circle also deep red in colour. The upper and smaller segment (see diagram) was at a distance of approximately 2° from the upper limit of the sun and the second was about midway between this and the sun.



It is of interest to note that at the same time a particularly well-developed sun pillar was observed from a view point about six miles due east by Mr. W. G. Davies, of Upton Park, Chester.

GEO. R. READ.

Roker, Station Road, Great Saughall, Chester, June 19th, 1936.

Mirage Phenomena

The mirage phenomena reported in the Press as having been seen in the Channel were noted by myself from the train between Bexhill and St. Leonards yesterday evening, June 17th, about 19h. 30m. G.M.T. The line is only about 20–30 ft. above sea level and even without glasses I could see that a steamer with black hull and white upper works which was at an estimated distance of two or three miles had its inverted image on top of it. The sea was smooth and there was practically no wind. On the horizon there was a bank of haze out of which appeared some cumulus tops.

CICELY M. BOTLEY.

17. *Holmesdale Gardens, Hastings, June 18th*, 1936.

Visibility in Specified Directions

On reading Mr. Flower's note on this subject in the *Meteorological Magazine* for May, 1936, one wonders what the result of his investigation would be if (1) Heliopolis lay to the south-west of Cairo instead of to the north-east, (2) there were definite visibility objects over the desert to the north-east, and (3) the investigation had been confined to visibilities between one and four miles. His result, that within three hours of sunrise (elevation of sun small) and with a high relative humidity, visibility is greatest looking towards the sun, may be universally true for moderately good visibility, but it has always been my impression in this country, although I have made no actual measurements, that in generally hazy weather (visibility one to four miles) the visibility is least looking towards the sun whatever the sun's elevation, but more particularly when the elevation is comparatively small. I exclude from the last statement, however, the hour immediately following sunrise or preceding sunset, for as the sun sinks down just before sunset into the haze layer and assumes the familiar red colouration the visibility looking towards the sun appears to increase. In support of the above statements I have had frequent reports from aircraft pilots to the effect that in hazy weather the visibility when flying towards the sun has been much worse than when flying in other directions and on occasions has almost amounted to blind flying.

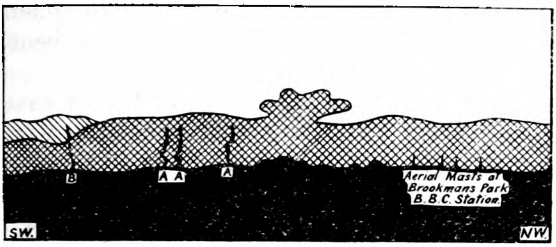
W. H. BIGG.

Meteorological Station, R.A.F., Bircham Newton, Norfolk, June 8th, 1936.

Recurrent Group Lightning Flashes

The exposure to the west of the Meteorological Station at Goff's Oak, Herts, is such that the natural horizon is visible from about south-west by south through west to north and thus is ideal for the observation of distant thunderstorms in this azimuth.

The storm of the night of June 18th–19th, as viewed from the anemometer mast, gave a brilliant and prolonged display of lightning. The storm was too far to the west for thunder to be audible, but the eastern boundary of the cloud, which appeared to move from the south, was clearly defined, and lightning was observed from 21h. 20m. to 23h. 0m. G.M.T. The attached sketch shows diagrammatically the form of the cloud as observed at 22h. 15m., when the storm centre appeared to be about due west from this station.



The point of interest is that the three lightning flashes (A) and the single flash (B) were alternately repeated at intervals of about one or two minutes during the period under observation. The three flashes would appear simultaneously and about 15 seconds after, the single flash, partly hidden by cloud, would follow to the south. The flashes kept to their relative positions as the cloud slowly moved northwards, but the curious fact was that the group of three always flashed together without any appreciable time interval and, as regularly, the single flash to the south of them would follow. Other flashes were observed at times but were far less distinct. It would be interesting to know if similar recurrent groups of flashes have been noted by other observers.

The wind was almost dead calm at 21h. but gradually increased to force 3 from NE, as the cloud moved northwards, the mean velocity from 22h. to 6h. the next day being 3·5 m.p.h. Barometer fairly steady at 1022 mb. and temperature at 22h. was 63° F., falling slowly to night minimum of 58° F.

DONALD L. CHAMPION.

7, Robinson Avenue, Goff's Oak, Herts, June 21*st,* 1936.

Severe Thunderstorms in the Chester District and over the Dee Estuary

Thunderstorms occurred in the Chester district and the regions surrounding the estuary of the River Dee on each day of the period June 19th to 22nd inclusive. The two which occurred on the 21st were particularly severe and the characteristics of these storms are a matter of some interest.

The pressure distribution at 2 p.m. on the 21st was characterised by an elongated centre of low pressure to the south-west of Ireland with two associated occlusions, one orientated roughly from Valentia to Plymouth and Abbeville and the other roughly from near Belfast to Conway and thence south-eastwards. These occlusions were moving slowly northward with a sharp contrast in temperature across the northern one, at least in so far as the North Wales coast region was concerned. The passage of both these occlusions across Chester and the Dee estuary was marked by an intense squall, severe thunderstorms and torrential rain with severe hail locally, particularly in Chester and Saughall where hailstones exceeding one inch diameter were experienced. Considerable damage was done to gardens and fruit trees, while portions of the main roads were temporarily flooded owing to the capacity of the sewers being insufficient to deal with the heavy rainfall.

Thunder and lightning were first reported at 5 p.m. to the east, and at 5.25 p.m. the storm was overhead. At this time the wind suddenly increased from 4 to 60 m.p.h. and after about 10 minutes decreased as suddenly to about 10 m.p.h. A sudden backing in direction of 90° occurred at the time of sudden increase and this was followed by a gradual veer to the original direction. There was slight rain, 0·1 in. between 5.10 and 5.25 p.m., but in the 10 minutes ended 5.35 p.m. there was a fall of 0·52 in. At the time of commencement of heavy rain temperature fell 19·5° F., relative humidity increased, atmospheric pressure rose by 3 mb. and visibility decreased temporarily to 50 yards.

The passage of the second occlusion at about 1 a.m. on the 22nd was accompanied by a less severe storm, although the individual characteristics were similar. In this storm the lightning was almost continuous for about 15 minutes giving the effect of a marvellous and awe-inspiring pyrotechnic display. Both storms moved towards the north-west.

The decrease in temperature and change in wind direction was well marked at Abergele, about 40 miles west of Chester, where thunder with slight rain occurred between 3.45 and 4.40 p.m.

The velocity recorded in the squalls was in no way connected with the pressure field, as that was very flat, so that the squalls were obviously associated with the inrush of air, beneath the cumulonimbus, which is necessary for intense thunderstorm development.

WILLIAM D. FLOWER.

Meteorological Station, R.A.F., Sealand, Chester. June 26th, 1936.

Thunderstorms and unsually heavy Rain at Shanklin

I thought it might be of interest to you to know that for the first 21 days of June no less than 3·8 in. of rain had fallen at Shanklin (Isle of Wight), which is a record since 1906. It is interesting to note that this has followed the driest May on record, when last month only 0·16 in. fell. The bulk of this June rain has come down in a series of extraordinarily violent thunderstorms, and it is almost unheard of for Shanklin to experience four storms on four successive days. The storm early on Friday, June 19th, was extremely severe, two houses being struck by lightning in Green Lane, and the total fall of rain and hail measured 1·27 in. in the gauge, which is the heaviest 24-hour fall at Shanklin in June on record. On Friday evening, June 19th, between 7.30 and 9 p.m., another severe thunderstorm came in from the sea, giving a total of 0·97 in. of rain; so for the four days, June 17th–20th, no less than 2·85 in. fell at Shanklin during thunderstorms. At Ventnor Park, both on June 18th and 19th, there were falls of more than 1 in. of rain, and the total is just over 4 in., which is remarkable, for June is normally the driest month of the year. The normal rainfall in June at Shanklin is 1·64 in.

J. E. COWPER.

18, *Duchess Road, Edgbaston, Birmingham, June 26th,* 1936.

Unusually severe Thunderstorms in Breconshire

On the night of June 20th and early hours of June 21st, we experienced a thunderstorm of terrific violence.

Storms of moderate intensity had moved from about east to north during the afternoon, and the cumulonimbus accompanying them was of immense height and showed signs of exceptionally violent convection. The day had been very hot with a light easterly surface breeze.

At 9.15 p.m. (summer time) conditions became extremely threatening—enormous cumulonimbus from east and two additional storm centres to the north. The lightning and thunder were almost continuous until about midnight, when a storm centre of terrific intensity rapidly came up from about east-south-east. This centre could be heard approaching above the roar of the other storm, and burst overhead at 12.25. The lightning was continuous—flash upon flash of blinding intensity which left the eyes aching, and the thunder shook the windows. Heavy hail fell very locally for a few minutes, then torrential rain. One observer saw a " ball of blue fire travelling from east to west high up in the sky."

The storm died out in the north about 2 a.m. on the early morning of the 21st. I measured 0·91 in. of rain, all of which must have fallen in about half an hour. This storm was comparable to the worst tropical storms.

R. G. SANDEMAN.

Dan Y Parc, Crickhowell, Breconshire, June 23rd, 1936.

NOTES AND QUERIES

British Health Resorts

In happy Victorian days only the rich could afford to be ill, and the rich found it more impressive to go for their cures to high-sounding continental spas than to trust to home resources. Hence, with a few fashionable exceptions, British medicinal waters were neglected or enjoyed only a local reputation, though several of them were known as long ago as Roman times. During the past few years, however, the British Health Resorts Association has been doing invaluable work in putting British Spas " on the map ", both by interesting doctors in their properties and powers and by encouraging the local authorities of the spas themselves to improve their facilities and amenities for patients. Even places which are not so fortunate as to possess healing springs may have climates which make them specially suitable for one purpose or another ; all health resorts are not equally appropriate even for restoring jaded nerves, and the ordinary holiday maker who has no intention of consulting a doctor may find guidance useful in selecting the venue for his annual holiday. An important element of this programme of education and guidance is the preparation and publication at a nominal price of an official handbook to the British Health Resorts*.

The fourth edition of this Handbook, published in 1936, has been considerably enlarged. Dr. R. Fortescue Fox, the editor, has had the support of a powerful sub-committee including two meteorologists, Mr. E. G. Bilham and Mr. L. C. W. Bonacina. Considering the intimate relations between climate and health, it is not inappropriate that the accident of alphabetical arrangement should bring these two gentlemen first on the list ! The plan of the book is simple and convenient ; after a medical introduction explaining the types of health resort and the medical purposes which each can serve, the main part of the book comprises three sections giving in alphabetical order descriptions of spas, seaside resorts and inland resorts. The spas naturally receive the most detailed treatment, and here again the alphabetical arrangement is fortunate in giving first place to Bath, the doyen of British spas. Each description includes a short section on climate, not only during the recognised holiday season of summer, but in many cases also during the " invalids' winter " (November to March, a new addition to the category of seasons), with special reference to sunshine and fog. The climatic notes are not merely dry statistics, but pay special attention to the requirements of leisure, in many cases discriminating between the frequency of rainy days and rainy nights.

An interesting section of the Handbook, included in this edition for the first time, gives descriptions of the main characteristics and chief health resorts of the Dominions and Colonies, though one gathers that with a few notable exceptions the resources of the Empire in this direction have not yet been extensively developed.

This very well produced and attractively illustrated Handbook

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* British Health Resorts, Spa, Seaside, Inland, including Australia, Canada' New Zealand, South Africa and British West Indies. Official Handbook of the British Health Resorts Association. Size 9¾ in. × 6¼ in., pp. 288. *Illus.*, London, 1936. 1*s*. net.

is published by J. & A. Churchill, Ltd., and is obtainable at all the establishments of W. H. Smith & Sons, Ltd., price 1s., at which price it is remarkably good value.

C. E. P. BROOKS.

Sir Thomas Middleton

We learn with pleasure of the election to Fellowship of the Royal Society of Sir Thomas Middleton, K.C.I.E., K.B.E., C.B., LL.D. As an agriculturist, Sir Thomas has had a long and distinguished career both in this country and in India. From 1889 to 1907 he held University appointments at Baroda, Aberystwyth, Durham and Cambridge. From 1906 to 1919 he was Assistant Secretary to the Board of Agriculture and was Director General of the Food Production Department from 1917 to 1919. Since 1919 Sir Thomas has been a member of the Development Commission.

Sir Thomas Middleton has always taken a keen interest in meteorology and in 1910 he was appointed by the Board of Agriculture and Fisheries as their representative on the newly-constituted Meteorological Committee, which is the advisory committee of the Meteorological Office, and in 1925 he became one of the original members of the Agricultural Meteorological Committee, of which Sir Napier Shaw is the Chairman. To both these committees Sir Thomas's wide knowledge, clear grasp of essentials, shrewd commonsense and genial personality have been of the utmost value. We are glad to take this opportunity of congratulating him on the honour now conferred upon him by the Royal Society.

BOOKS RECEIVED

Royal Alfred Obvservatory. Mauritius. Annual Report, 1933; Annual Report, 1934. Results of magnetical and meteorological observations for October to December, 1933; and January to October, 1934. Port Louis 1934 and 1935.

The distribution of temperature in the upper levels of a depression originating in the Bay of Bengal during the Indian south-west monsoon. By N. K. Sur, India Meteor. Dept., Sci. Notes, **6,** No. 62.

NEWS IN BRIEF

The Regents of the University of California have appointed Dr. H. U. Sverdrup, Professor of Geophysics at the Chr. Michelsens Institute of Bergen, to be Director of the Scripps Institution of Oceanography of the University of California.

The Senate of the University of Edinburgh has conferred the degree of D.Sc. on Mr. J. M. Stagg, M.A., B.Sc., of the Meteorological Office, Edinburgh.

The Council of the Royal Meteorological Society has awarded the Howard Prize for 1936 to Cadet John Burton Davies, of H.M.S. *Worcester*. The subject of the competition was an essay on "The causes of fog over the open sea and in coastal waters".

The Weather of June, 1936

Pressure was above normal over north-west Siberia, northern Europe, across Poland and Austria to Italy and Spain, over the northern North Atlantic including the Azores, central Canada, southern Alaska, the greatest excesses being 3·9 mb. at Ekaterinburg, 5·7 mb. at 50° N. 30° W., and 4·0 mb. near Lake Athabaska (Canada). Pressure was below normal over most of Alaska, western and eastern Canada, Greenland and Spitsbergen, the United States except Lower California, Bermuda, Madeira, France and the Netherlands, south-east Europe and south-west Siberia and the eastern Mediterranean. Temperature was above normal over northern, western and central Europe, but below normal generally in south-east Europe. Rainfall was mainly below normal.

The main features of the weather of June over the British Isles were the frequency and severity of the thunderstorms and in the north of Scotland the abundant sunshine. Rainfall was above normal except in Scotland and south-west Ireland, and sunshine, except in North Scotland, generally below normal. On the 1st a secondary depression developed over the Hebrides, and moved south to the Bristol Channel on the 2nd; it moved slowly east on the 3rd and 4th. Cool unsettled weather prevailed during this time with thunderstorms in many parts and hail locally. Maximum temperatures did not exceed 50° F. at several inland places on the 3rd, while 1·84 in. of rain was measured at Newbiggin (Durham) and 1·81 in. at Llangynhafal (Denbigh) on the 3rd. The 3rd and 4th were sunny days in Scotland and west Ireland and the 5th further south; 16·1 hrs. at Oban on the 4th, 15·5 hrs. at Inchkeith on the 3rd and 13·5 hrs. at Blackpool and Llandudno on the 5th. By the 5th the Azores anticyclone had extended north-east across the British Isles and from the 6th to 14th pressure was high to the south, while depressions moving in an easterly direction from Iceland passed at times across the country, though chiefly only across the north and west. Weather was generally unsettled with bright periods, but considerable falls of rain were recorded locally—local mist or fog also occurred at times in the south-west. Temperature was mainly about or below normal except on the 8th to 10th; on the 9th 70° F. was exceeded at many places—75° F. was recorded at South Farnborough and Greenwich and 74 F. at Aberdeen. The 9th was a very sunny day in England and the 10th in Scotland and Ireland. From the 15th to 17th pressure was low generally and the weather unsettled, with some rain but bright intervals, except in the south-east where it was dry and sunny. From the

18th to 23rd pressure was high to the north and east and low to the south-west, giving sunny warm weather. Temperature rose considerably above the normal after the 17th, exceeding 80° F. in many parts of England and locally in Scotland, 87° F. was recorded at Tottenham on the 20th, and 85° F. at Nairn on the 21st and 22nd. On the 18th thundery conditions again set in and widespread and frequent thunderstorms, severe locally, were experienced until the 23rd. Two distinct thunderstorms on the same day were reported from several places on both the 19th and 20th. At South Farnborough "two distinct thunderstorms occurred on each of the three days, 18th to 20th . . . . On the 20th the first thunderstorm, occurring from 14h. 5m. to 14h. 25m., was accompanied by squalls up to 30 m.p.h., while temperature fell from 85·5° F. to 70·0° F. in 28 minutes. During the second thunderstorm on the same day, lasting from 21h. 10m. to 22h. 20m., the wind rose from about 5 m.p.h. to 48 m.p.h. and 0·94 in. of rain and hail fell in 48 minutes, of which 0·79 in. fell in 26 minutes. The hailstones were generally described as the "size of cherries" and did considerable damage to plants . . . . Low-lying portions of roads were still flooded to a depth of 10 in. at 7h. next morning." During a thunderstorm on the 21st at Rothamsted Experimental Station (Herts) 3·15 in. of precipitation was recorded, mainly in two periods of half-an-hour. Severe squalls and heavy falls of hail accompanied the storms in many places and much flooding and damage to crops were experienced. At Hailsham, Sussex, 2·20 in. were measured on the 19th and at Wigan 2·11 in. on the 22nd. During this period, sunshine records were good especially in Scotland, 17·3 hrs. were recorded at Lerwick on the 21st and 16·3 hrs. at Inverness on the 18th. From the 24th to 28th a ridge of high pressure covered most of the country but shallow disturbances passed occasionally in a southerly direction affecting chiefly the eastern districts. Weather was generally sunny and dry, but there were occasional dull periods with rain, heavy locally. The Rev. C. L. O'Ferrall, of Hogmaston, Ashbourne (Derbyshire) writes that 2·33 in. of rain fell there on the 25th between 4.15 p.m. and 5.45 p.m., but there was no thunder or lightning, "the back of our house was a raging torrent." Temperature, though lower than the previous few days, still continued above the normal and mist or fog was experienced in the mornings and evenings locally. Thunderstorms were reported from Clacton on the 25th and from Ireland on the 27th. On the 28th a complex depression approached from the Atlantic and covered the country on the 30th. Unsettled weather, with heavy rain and hail at times and thunderstorms locally, prevailed generally ; 3·20 in. fell in 3 hrs. at Florencecourt (Co. Fermanagh) on the 30th and 1·18 in. in 4 hrs. at Campsea Ashe (Suffolk) on the 28th, while Mr. Everett of Rutlish School, Wimbledon, writes that "0·94 in. fell there between 8.40 and 10.30 a.m. on the 29th, the bulk of which fell in the first hour."

At Bodmin (Cornwall) 3.12 in. fell on the 29th. The distribution of bright sunshine for the month was as follows :—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway ...	241	+73	Chester ...	151	−43
Aberdeen ...	274	+93	Ross-on-Wye ...	153	−37
Dublin	187	+ 1	Falmouth ...	180	−42
Birr Castle ...	145	−16	Gorleston ...	239	+21
Valentia... ...	163	−13	Kew	190	− 9

Miscellaneous notes on weather abroad culled from various sources

Wintry weather prevailed in Switzerland at the beginning of the month causing much damage to the fruit trees. Snow fell on the mountains down to the 4,800 ft. level and some of the passes were closed to vehicular traffic. On the 8th two pilots were killed when their aeroplanes crashed into the side of Mount Grappa. Fog also occurred in Czechoslovakia and south Germany on the 12th, and 7 people were killed when a seaplane travelling from Bergen to the north crashed in a fog on the side of a mountain. Fog occurred also at Palamos (Spain) on the 21st. A whirlwind in the Mouscron district of Belgium did much material damage on the 29th and many people were injured. (*The Times*, June 5th–July 1st.)

The monsoon set in in Bombay on the 4th though the rain consisted only of sharp showers at intervals. The floods of the Brahmaputra had subsided in the Dibrugarh area by the 13th and the monsoon was approaching Calcutta. By the 20th Bombay city had had little rain and the dry spells had produced great heat. Rainfall was mainly fair to excess in the eastern part of India during the week ending the 17th, when the monsoon was extending to the United Provinces and north-west India ; during the following week the monsoon was active generally. Bombay had had copious rainfall by the 25th and by the 27th rain had also ended the drought in Kolhapur, and the fears of a drought in Poona. Six inches of rain fell in 24 hrs. in Bombay on the 28th and flooding was reported. A small boat containing 120 Koreans was overwhelmed in a heavy sea off Seoul on the 19th and only 12 people were saved. (*The Times*, June 4th–30th.)

A dense fog occurred in Wellington, N.Z., on the 5th. Gales were reported off Cape Jaffa, South Australia, on the 21st. The total rainfall for the month in Australia was generally below normal except in northern Queensland and southern New South Wales. (*The Times*, June 6th–24th and cable.)

Beneficial rain was experienced in most of the prairie country about the 6th and 7th though severe drought conditions were still prevailing in parts of Saskatchewan and Alberta on the 12th. Owing to floods railway communications were cut off for 100 miles between Kitwanga and Kwinitsa (British Columbia) on the 10th. A heat wave was experienced in Alaska about the 10th–17th. Fog frequently occurred off the eastern coast of the United States during the first half of the month. Prolonged drought and high temperatures were experienced in many parts of the wheat-growing areas of the United States. In the United States, temperature was above normal in the eastern districts and below normal in the west early in the month, becoming considerably above normal in the south and west but mainly below normal in the north-east during the middle and end of the month; rainfall was below normal generally. (*The Times*, June 8th–27th, and *Washington, D.C., U.S. Dept., Agric. Weekly Weather and Crop Bulletin.*)

Daily Readings at Kew Observatory, June, 1936

Date	Pressure, M.S.L. 13h.	Wind, Dir., Force 13h.	Temp.		Rel. Hum. 13h.	Rain.	Sun.	REMARKS. (see vol. 69, 1934, p. 1).
			Min.	Max.				
	mb.		°F	°F	%	in.	hrs.	
1	1014·1	SSW.3	44	61	42	0·06	6·7	pr_0 15h. r 19h.–20h.
2	1011·7	SSE.3	46	59	82	0·40	4·3	r 2h.–10h. R 14h.
3	1006·9	SW.3	44	58	63	0·19	5·5	PRH 6h.
4	1011·7	NNW.2	44	61	55	0·09	2·3	t pr 17h.
5	1015·5	N.5	48	62	66	0·07	7·9	r_0–r 4h.–6h.
6	1015·8	W.3	44	62	48	0·02	4·2	r–r_0 17h.–18h.
7	1014·7	NNW.2	54	61	74	0·15	1·0	r_0–r 3h.–10h.
8	1020·7	W.2	54	69	43	—	10·9	
9	1018·9	W.2	52	72	54	—	11·8	
10	1017·4	WNW.2	55	66	70	—	0·0	r_0 13h.
11	1016·3	SSW.3	54	65	69	—	0·7	
12	1013·8	SW.2	53	65	83	0·09	0·4	r–r_0 12h.–15h. [24h.
13	1014·9	WSW.3	55	62	87	0·57	0·2	r_0–r 0h.–11h. & 21h.–
14	1016·9	WSW.3	52	66	49	0·01	3·8	$r_0$0h.–3h., & 20h.–24h.
15	1013·0	SW.4	53	64	58	0·04	9·2	r_0 0h.–4h., pr_0 11h.–
16	1018·2	S.4	50	68	56	—	13·0	[13h.
17	1018·3	S.3	49	77	46	—	14·4	w early.
18	1023·3	W.1	57	76	80	0·52	1·9	TLR 9h. & 22h.–23h.
19	1016·0	ENE.3	61	79	55	0·32	7·8	tl 2h. TLR h 14h. tl 22h.
20	1010·1	E.2	64	86	55	—	12·8	tl 0h.–1h. & 21h.–23h.
21	1009·7	S.3	65	83	59	0·28	6·0	TLR 18h.–21h.
22	1015·3	SW.3	60	78	54	—	12·9	
23	1021·2	WSW.2	60	76	56	0·02	11·0	r_0 0h.–1h.
24	1020·7	WNW.2	60	77	47	—	14·3	w early.
25	1021·2	NNW.2	58	77	45	0·08	11·4	r 23h.
26	1021·0	E.2	60	63	89	0·19	0·0	r–r_0 0h.–13h. F 20h.
27	1020·4	SW.2	57	74	57	—	7·2	F early.
28	1017·0	SSW.2	51	75	65	—	5·3	
29	1007·3	NNW.2	59	67	81	0·36	0·0	r_0 8h.–10h. TR 18h
30	1007·7	S.4	59	69	79	0·08	2·8	r–r_0 21h.–24h.
*	1015·7	—	54	69	62	3·53	189·7	* Means or totals.

General Rainfall for June, 1936

England and Wales ...	151	per cent of the average 1881–1915
Scotland	74	
Ireland	115	
British Isles	124	

Rainfall : June, 1936 : England and Wales

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Lond	Camden Square	3·82	188	*Leics*	Belvoir Castle	2·53	132
Sur	Reigate, Wray Pk. Rd.	3·61	173	*Rut*	Ridlington	3·73	195
Kent	Tenterden, Ashenden	3·91	205	*Lincs*	Boston, Skirbeck	3·36	185
,,	Folkestone, Boro. San.	2·54	...	,,	Cranwell Aerodrome	3·20	190
,,	Margate, Cliftonville	3·54	202	,,	Skegness, Marine Gdns.	3·19	177
,,	Eden'bdg., Falconhurst	2·75	125	,,	Louth, Westgate	4·16	193
Sus	Compton, Compton Ho.	3·17	127	,,	Brigg, Wrawby St.	2·98	...
,,	Patching Farm	2·72	135	*Notts*	Worksop, Hodsock	4·37	220
,,	Eastbourne, Wil. Sq.	2·57	140	*Derby*	Derby, L. M. & S. Rly.	3·48	155
Hants	Ventnor, Roy.Nat.Hos.	4·09	224	,,	Buxton, Terr. Slopes	4·22	131
,,	Fordingbridge, Oaklnds	2·35	127	*Ches*	Runcorn, Weston Pt.	2·81	109
,,	Ovington Rectory	3·41	147	*Lancs*	Manchester, Whit. Pk.	3·43	130
,,	Sherborne St. John	2·98	140	,,	Stonyhurst College	3·55	115
Herts	Royston, Therfield Rec.	4·92	220	,,	Southport, Bedford Pk.	5·30	244
Bucks	Slough, Upton	2·89	140	,,	Lancaster, Greg Obsy.	4·64	181
,,	H. Wycombe, Flackwell	4·19	208	*Yorks*	Wath-upon-Dearne	4·04	182
Oxf	Oxford, Mag. College	3·35	157	,,	Wakefield,Clarence Pk.	4·03	187
N'hant	Wellingboro, Swanspool	4·39	209	,,	Oughtershaw Hall	5·08	...
,,	Oundle	3·46	...	,,	Wetherby, Ribston H.	4·27	203
Beds	Woburn, Exptl. Farm	3·58	183	,,	Hull, Pearson Park	2·98	144
Cam	Cambridge, Bot. Gdns.	3·53	167	,,	Holme-on-Spalding	2·75	125
Essex	Chelmsford,County Gdns	3·79	199	,,	West Witton, Ivy Ho.	6·66	327
,,	Lexden Hill House	3·11	...	,,	Felixkirk, Mt. St. John.	3·58	164
Suff	Haughley House	3·24	...	,,	York, Museum Gdns.	3·51	169
,,	Campsea Ashe	3·61	191	,,	Pickering, Hungate	2·86	135
,,	Lowestoft Sec. School	2·39	132	,,	Scarborough	2·12	115
,,	Bury St. Ed., WestleyH.	2·81	134	,,	Middlesbrough	3·57	189
Norf.	Wells, Holkham Hall	4·20	217	,,	Baldersdale, Hury Res.	3·60	153
Wilts	Calne, Castle Walk	2·23	...	*Durh*	Ushaw College	3·81	176
,,	Porton, W.D. Exp'l. Stn	1·89	98	*Nor*	Newcastle, D. & D. Inst.	2·95	150
Dor	Evershot, Melbury Ho.	2·32	102	,,	Bellingham, Highgreen	1·72	75
,,	Weymouth, Westham.	1·39	78	,,	Lilburn Tower Gdns.	2·42	117
,,	Shaftesbury,Abbey Ho.	2·39	103	*Cumb*	Carlisle, Scaleby Hall	2·67	106
Devon	Plymouth, The Hoe	·99	46	,,	Borrowdale, Seathwaite	..	...
,,	Holne, Church Pk. Cott.	2·30	80	,,	Borrowdale, Moraine	6·62	135
,,	Teignmouth, Den Gdns.	1·28	67	,,	Keswick, High Hill	3·75	129
,,	Cullompton	1·77	83	*West*	Appleby, Castle Bank	2·82	123
,,	Sidmouth, U.D.C.	1·50	...	*Mon*	Abergavenny, Larchf'd	4·88	200
,,	Barnstaple, N. Dev.Atb	2·04	91	*Glam*	Ystalyfera, Wern Ho.	4·95	132
,,	Dartm'r,Cranmere Pool	2·30	...	,,	Cardiff, Ely P. Stn	3·38	136
,,	Okehampton, Uplands.			,,	Treherbert, Tynywaun.	4·83	...
Corn	Redruth, Trewirgie	2·30	92	*Carm*	Carmarthen, Coll. Rd.	4·58	160
,,	Penzance, Morrab Gdns.	1·54	69	*Pemb*	St. Ann's Hd, C. Gd. Stn.	3·78	191
,,	St. Austell, Trevarna	2·57	99	*Card*	Aberystwyth	3·81	...
Soms	Chewton Mendip	2·84	96	*Rad*	BirmW.W.Tyrmynydd	6·61	202
,,	Long Ashton	2·93	116	*Mont*	Lake Vyrnwy	6·48	205
,,	Street, Millfield	2·07	...	*Flint*	Sealand Aerodrome	4·34	...
Glos	Blockley	2·98	...	*Mer*	Blaenau Festiniog	10·22	171
,,	Cirencester, Gwynfa	2·50	104	,,	Dolgelley, Bontddu	5·99	172
Here	Ross, Birchlea	3·85	177	*Carn*	Llandudno	3·21	169
Salop	Church Stretton	3·74	154	,,	Snowdon, L. Llydaw 9	12·25	...
,,	Shifnal, Hatton Grange	3·37	151	*Ang*	Holyhead, Salt Island	4·99	232
Staffs	Market Drayt'n, Old Sp.	3·23	133	,,	Lligwy	3·62	...
Worc	Ombersley, Holt Lock	3·06	136	*Isle of Man*			
War	Alcester, Ragley Hall	2·97	130		Douglas, Boro' Cem.	3·37	139
,,	Birminghm, Edgbaston	3·34	144	*Guernsey*			
Leics	Thornton Reservoir	4·90	226		St. PeterP't.Grange Rd.	1·77	96

Rainfall: June, 1936: Scotland and Ireland

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Wig	Pt. William, Monreith.	2·96	126	*Suth*	Tongue	1·03	50
„	New Luce School	3·94	136	„	Melvich	·96	49
Kirk	Dalry, Glendarroch	2·40	86	„	Loch More, Achfary	1·64	44
Dumf.	Dumfries, Crichton R.I.	2·68	112	*Caith*	Wick	1·11	62
„	Eskdalemuir Obs.	2·89	92	*Ork*	Deerness	1·50	81
Roxb	Hawick, Wolfelee	2·49	106	*Shet*	Lerwick	·87	49
Selk	Ettrick Manse	2·28	63	*Cork*	Dunmanway Rectory	2·16	62
Peeb	West Linton	1·67	...	„	Cork, University Coll.	1·55	61
Berw	Marchmont House	1·32	57	„	Ballinacurra	1·72	66
E.Lot	North Berwick Res.	2·18	132	„	Mallow, Longueville	1·77	80
Midl	Edinburgh, Blackfd. H.	1·28	64	*Kerry*	Valentia Obsy.	2·39	75
Lan	Auchtyfardle	1·84	...	„	Gearhameen	2·60	52
Ayr	Kilmarnock, Kay Pk.	1·80	...	„	Bally McElligott Rec.	2·69	...
„	Girvan, Pinmore	2·70	93	„	Darrynane Abbey	3·08	98
Renf	Glasgow, Queen's Pk.	1·61	70	*Wat*	Waterford, Gortmore	2·76	105
„	Greenock, Prospect H.	1·73	52	*Tip*	Nenagh, Cas. Lough	2·93	120
Bute	Rothesay, Ardencraig	2·34	...	„	Roscrea, Timoney Park	3·35	...
„	Dougarie Lodge	1·69	...	„	Cashel, Ballinamona	4·41	195
Arg	Ardgour House	4·22	...	*Lim*	Foynes, Coolnanes	3·46	134
„	Glen Etive	3.15	67	„	Castleconnel Rec.	3·18	...
„	Oban	2·51	...	*Clare*	Inagh, Mount Callan	5·40	...
„	Poltalloch	3·53	116	„	Broadford, Hurdlest'n.	3·71	...
„	Inveraray Castle	3·99	101	*Wexf*	Gorey, Courtown Ho.	2·16	89
„	Islay, Eallabus	2·75	105	*Wick*	Rathnew, Clonmannon.	2·95	...
„	Mull, Benmore	8·70	111	*Carl*	Hacketstown Rectory	2·71	97
„	Tiree	...	...	*Leix*	Blandsfort House	4·51	174
Kinr	Loch Leven Sluice	1·05	48	*Offaly*	Birr Castle	2·96	128
Fife	Leuchars Aerodrome	1·56	93	*Dublin*	Dublin, FitzWm. Sq.	3·25	167
Perth	Loch Dhu	2·75	66	„	Balbriggan, Ardgillan	...	...
„	Balquhidder, Stronvar.	...	...	*Meath*	Beauparc, St. Cloud	4·68	...
„	Crieff, Strathearn Hyd.	1·87	71	„	Kells, Headfort	4·62	174
„	Blair Castle Gardens	1·60	81	*W.M*	Moate, Coolatore	3·63	...
Angus	Kettins School	1·89	91	„	Mullingar, Belvedere	5·14	197
„	Pearsie House	1·89	...	*Long*	Castle Forbes Gdns.	3·19	124
„	Montrose, Sunnyside	1·31	79	*Gal*	Galway, Grammar Sch.	3·58	...
Aber	Braemar, Bank	·97	50	„	Ballynahinch Castle	3·71	105
„	Logie Coldstone Sch.	1·49	76	„	Ahascragh, Clonbrock.	2·89	103
„	Aberdeen, Observatory.	·84	49	*Mayo*	Blacksod Point	2·11	76
„	Fyvie Castle	1·30	62	„	Mallaranny	4·08	...
Moray	Gordon Castle	1·52	74	„	Westport House	2·13	79
„	Grantown-on-Spey	1·02	45	„	Delphi Lodge	4·23	74
Nairn	Nairn	1·01	57	*Sligo*	Markree Castle	5·23	178
Inv's	Ben Alder Lodge	...	...	*Cavan*	Crossdoney, Kevit Cas.	3·46	...
„	Kingussie, The Birches.	1·36	...	*Ferm*	Newtwnbtlr, Crom Cas.	3·03	112
„	Loch Ness, Foyers	1·24	56	„	Enniskillen, Portora	4·45	...
„	Inverness, Culduthel R.	·95	...	*Arm*	Armagh Obsy.	4·41	175
„	Loch Quoich, Loan	2·60	...	*Down*	Fofanny Reservoir	4·05	...
„	Glenquoich	2·80	57	„	Seaforde	2·12	77
„	Glenleven, Corrour	2·13	63	„	Donaghadee, C. G. Stn.	2·82	121
„	Fort William, Glasdrum	2·54	...	*Antr*	Belfast, Cavehill Rd.	4·94	...
„	Skye, Dunvegan	1·92	...	„	Aldergrove Aerodrome.	3·51	146
„	Barra, Skallary	2·05	...	„	Ballymena, Harryville.	2·43	84
R&C	Alness, Ardross Castle.	1·14	51	*Lon*	Garvagh, Moneydig	1·81	...
„	Ullapool	1·25	53	„	Londonderry, Creggan.	2·94	104
„	Achnashellach	1·63	41	*Tyr*	Omagh, Edenfel	3·49	124
„	Stornoway, Matheson	·93	40	*Don*	Malin Head	1·72	...
Suth	Lairg	1·60	77	„	Killybegs, Rockmount.	2·99	...

Erratum: Birr Castle, May, for 2·50/112 read ·98/44.

Climatological Table for the British Empire, January, 1936

STATIONS.	PRESSURE. Mean of Day M.S.L. mb.	PRESSURE. Diff. from Normal. mb.	TEMPERATURE. Absolute. Max. °F.	TEMPERATURE. Absolute. Min. °F.	TEMPERATURE. Mean Values. Max. °F.	TEMPERATURE. Mean Values. Min. °F.	TEMPERATURE. Mean Values. ½ Max. and Min. °F.	TEMPERATURE. Mean Values. Diff. from Normal °F.	TEMPERATURE. Mean. Wet Bulb. °F.	Relative Humidity. %	Mean Cloud Am'nt 0–10	PRECIPITATION. Am'nt. in.	PRECIPITATION. Diff. from Normal. in.	PRECIPITATION. Days.	BRIGHT SUNSHINE. Hours per day.	BRIGHT SUNSHINE. Percentage of possible.
London, Kew Obsy....	1000·7	−16·9	56	22	45·0	36·7	40·9	+ 2·0	39·0	90	7·8	3·91	+ 2·15	22	1·0	12
Gibraltar	1018·1	− 3·4	67	48	59·3	52·3	55·8	...	53·2	87	7·7	8·19	...	20	...	...
Malta........	1016·0	− 1·0	69	49	61·7	53·4	57·5	+ 2·2	52·8	80	6·5	0·89	− 2·32	7	5·8	58
St. Helena	1012·0	− 0·3	71	58	67·6	59·7	63·7	− 0·3	60·2	92	9·8	2·93	+ 0·89	17	...	...
Freetown, Sierra Leone	1011·9	+ 2·8	89	68	86·3	73·5	79·9	− 1·4	74·7	82	5·0	0·00	− 0·41	0	...	...
Lagos, Nigeria	1010·1	+ 0·5	90	71	87·4	75·2	81·3	+ 0·4	75·2	90	3·5	0·93	− 0·11	2	6·0	51
Kaduna, Nigeria	1010·1	− 1·8	93	49	89·0	55·8	72·4	− 1·0	52·1	35	1·0	0·00	0·00	0	8·9	77
Zomba, Nyasaland	1007·4	0·0	90	50	80·8	62·8	71·8	− 1·0	70·0	81	7·6	5·31	− 5·79	15	...	...
Salisbury, Rhodesia...	1009·1	− 1·3	86	47	79·7	59·1	69·4	− 0·3	62·3	65	7·0	5·22	− 2·10	16	6·4	49
Cape Town	1014·5	+ 1·1	87	51	75·6	58·2	66·9	− 3·0	59·1	69	3·3	2·13	+ 1·45	9	...	...
Johannesburg	1009·3	− 0·2	87	42	77·4	56·2	66·8	+ 0·1	57·5	63	5·0	3·94	− 2·23	11	8·3	61
Mauritius	1011·2	− 0·7	89	69	86·0	73·6	79·8	+ 0·5	75·9	76	5·6	9·81	+ 2·05	24	8·4	64
Calcutta, Alipore Obsy.	1014·8	− 0·4	83	50	79·0	56·0	67·5	+ 0·9	55·3	75	2·2	0·43	+ 0·01	1*	...	...
Bombay	1013·0	− 0·6	87	60	81·2	66·2	73·7	− 1·8	64·5	72	1·3	0·00	− 0·10	0*	...	...
Madras	1013·0	− 1·1	90	65	85·0	68·9	76·9	+ 0·7	71·7	86	3·6	0·10	− 1·04	0*	...	...
Colombo, Ceylon	1011·5	+ 0·7	88	67	85·4	71·1	78·3	− 1·2	72·4	72	5·5	2·52	− 0·73	3	7·7	65
Singapore........	1009·6	− 0·8	89	72	85·2	74·5	79·9	+ 0·2	75·5	83	7·9	6·22	− 3·67	19	4·3	36
Hongkong........	1020·1	+ 0·4	69	45	63·2	53·7	58·5	− 1·7	53·0	72	6·8	0·58	− 0·74	6	5·7	53
Sandakan	1009·9	...	88	72	85·4	73·8	79·6	− 0·2	76·1	85	9·0	15·37	− 4·03	21	...	...
Sydney, N.S.W........	1012.2	− 0·2	99	57	75·8	65·3	70·5	− 1·1	65·8	72	7·4	4·48	+ 0·81	16	5·9	42
Melbourne	1012·1	− 0·8	106	50	79·6	58·6	69·1	+ 1·7	61·1	59	6·7	1·30	− 0·59	11	6·9	48
Adelaide	1011·8	− 1·2	104	51	84·3	62·5	73·4	− 0·5	62·7	49	5·7	1·45	+ 0·73	8	8·6	61
Perth, W. Australia ...	1011·0	− 1·5	105	56	83·2	63·7	73·5	− 0·3	63·1	55	5·0	0·26	− 0·08	6	10·1	83
Coolgardie	1009·1	− 2·4	107	60	92·5	69·2	80·9	+ 3·5	67·0	62	2·2	1·63	+ 1·17	5	...	...
Brisbane........	1011·7	+ 0·4	97	62	83·6	67·8	75·7	− 1·5	69·4	71	6·4	5·73	− 0·72	15	7·5	55
Hobart, Tasmania......	1012·9	+ 2·6	88	45	70·0	54·3	62·1	+ 0·1	54·9	61	7·4	0·65	− 1·18	10	6·4	43
Wellington, N.Z.	1012·7	− 0·6	76	47	68·2	55·5	61·9	− 0·6	58·5	73	6·3	3·34	+ 0·01	8	7·5	51
Suva, Fiji	1007·9	+ 0·4	92	70	86·6	75·6	81·1	+ 1·2	76·3	83	7·2	9·38	− 2·05	21	6·2	47
Apia, Samoa	1006·4	− 1·5	89	73	85·8	75·7	80·7	+ 1·7	77·2	82	7·3	14·78	− 2·27	25	5·3	41
Kingston, Jamaica	1013·7	− 1·4	88	66	85·8	68·5	77·1	+ 0·3	66·2	83	2·7	0·66	− 0·30	4	5·5	49
Grenada, W.I.	1011·0	− 1·8	89	76	85	72	78·5	+ 1·4	74	79	4	5·35	+ 0·97	21	...	...
Toronto........	1014·8	− 3·1	41	− 2	27·8	17·0	22·4	+ 0·2	...	...	8·0	0·93	− 1·86	4	1·8	19
Winnipeg	1022·7	+ 1·8	21	−43	−3·1	−23·2	−13·1	− 9·2	...	...	4·0	1.07	+ 0·16	11	2·4	28
St. John, N.B.	1009·6	− 5·9	49	− 7	28·0	12·5	20·3	+ 1·1	15·3	78	5·9	4·29	− 0·51	7	3·0	33

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Conditions of the winds on the western and southern shores of the Sea of Galilee.

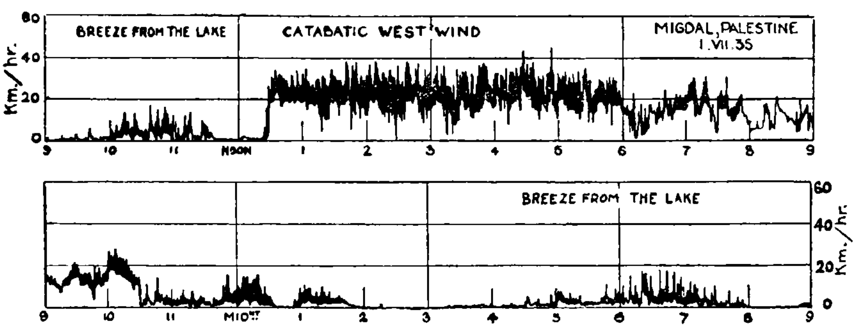
BY D. ASHBEL, P.D.

Hebrew University, Jerusalem.

The Sea of Galilee is a lake in the form of a pear, 23 Km. long and 14 Km. wide at the most. It is widest between Migdal (the village) and the Persian orange grove on the eastern shore. At Degania it is narrowest. Its area is 171 Km^2, and despite being so small, it has interesting local winds forming around it. The particular location of the Sea of Galilee in the Jordan Valley surrounded by the following mountains: the mountains of Upper and Lower Galilee to the west and to the north, the plateaux of the Golan and Bashan to the east—and the considerable difference in height between the bottom of the valley and the mountain tops cause great differences in the temperature of the air and a strong fall in the barometric pressure towards the valley from the distant neighbourhood, especially from the Mediterranean, and from the lake to its close neighbourhood.

In the summer, a western Mediterranean wind forms in the afternoon hours, due to the difference between the barometric pressure of the valley and that of the Mediterranean. And the difference in pressure between the lake and its near environment produces in the forenoon hours a wind from the water surface of the lake toward the land around it. Two sea-breezes in one day. The fall in the barometric pressure brought on as a result of the considerable warming of the air of the entire Jordan Valley induces a stream of cool air from the Mediterranean towards the valley. The greater the distance between the valley and the Mediterranean, the later is the western wind in reaching the valley. In the northern part of the valley, the western wind arrives early, whereas in the southern part it arrives about sunset. The distance between the Sea of Galilee and the Mediterranean is 50 Km. in a straight line and the western wind reaches the sea in the summer between noon and 2 p.m. Upon reaching the line of the valley, it falls from the mountains and when arriving at the bottom of the valley it is warm, dry, strong and gusty. The coolness and the high relative humidity of the Mediterranean air, particularly in regions where it rises on the western mountain slope for instance, disappear entirely when the air descends into the valley. This is due to the fact that the air contracts when descending several hundred metres below sea level. In this way, the air becomes warm and the relative humidity is reduced.

This wind is not a laminary wind of an uniform and continuous flow of air, but is gusty, the gusts attaining 30–50 Km. per hour. However, these gusts last only for some minutes ; each is followed by a short, minute-long pause till the strong gusts are again renewed, and so on. The appended figure illustrates clearly the structure of



this catabatic wind. This wind, occurring in the afternoons in the summer, agitates the lake. Since ancient times the storms of the Sea of Galilee have been famous, yet cannot be compared with storms on the open seas or on the ocean. They are especially dangerous to canoes and sail-boats in the corners of mountains on the western shore. The cape called " Kalaat el Rul " (the fortress of devils), between Tiberias and the settlement of Kinereth, has the worst reputation.

The above mentioned catabatic wind generally lasts till 10 or 11 p.m., and after that everything is quiet.

Plantations suffer from such a strong and continuous wind abundant during several successive months (from April till October), particularly if their leaves are hypersensitive, as are those of the banana-plantations. The citrus plantations suffer greatly from this wind, as well. The farms along the entire Jordan Valley, from Kfar

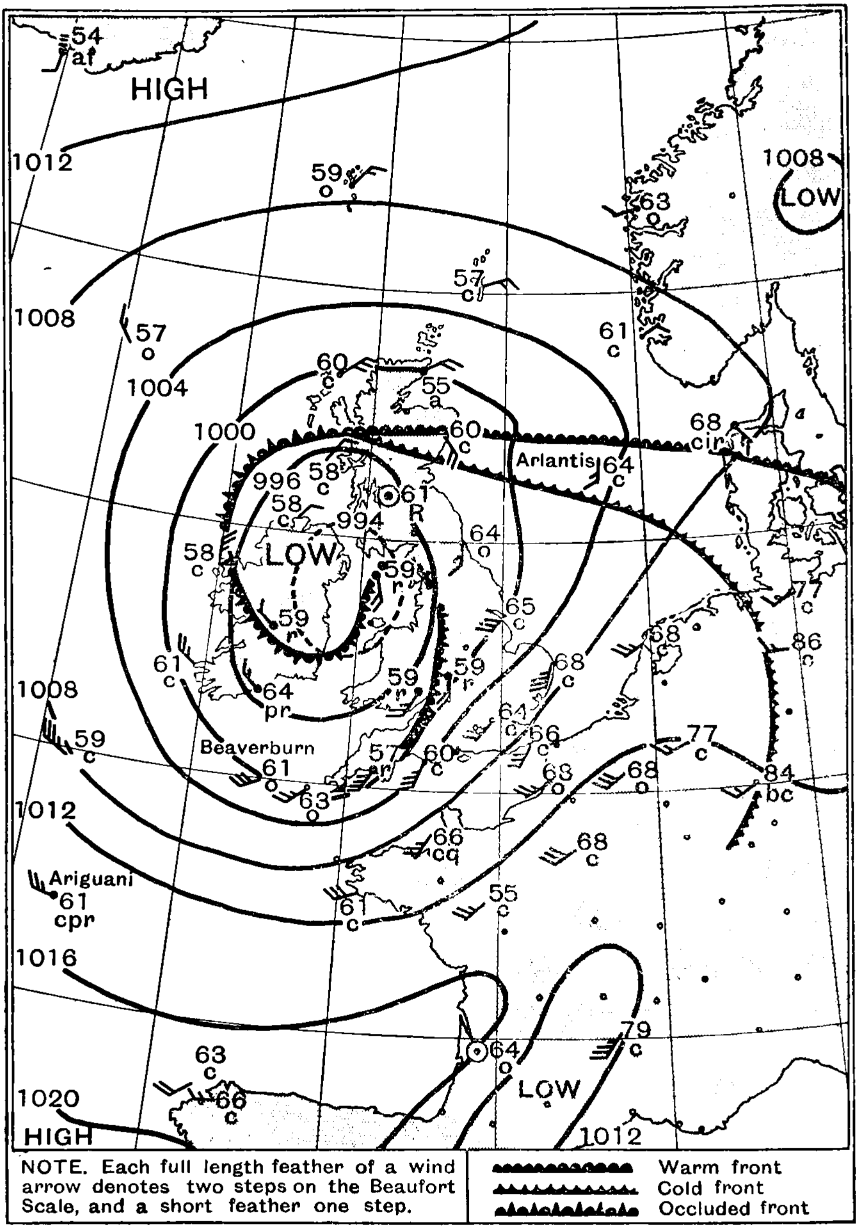
Gilady to the Dead Sea, need strong wind-breakers for the protection of the plantations.

Local winds.—Along the western and west-southern shores of the Sea of Galilee, blow in the summer in the forenoon and at dawn local winds which are less developed here than in the Dead Sea, the area of which is ten times larger than that of this lake. At night and at sunrise blows a south-easterly to south-south-westerly land wind in the southern part of the Sea of Galilee, from the surface of the valley toward the surface of the lake. In the morning and forenoon hours blows a northerly to north-easterly wind, sometimes more easterly, along the south-western shore of the lake. This wind arises from the water surface of the lake to the land. In the southern part of the lake it blows more from the north and in the western part from the east. We lack observations on the northern part of the sea and on its eastern shore, but judging from our experience on the Dead Sea it can safely be assumed that here also a soft southern wind blows towards the northern shore and a weak western wind towards the eastern shore. The wind from the water, which blows in the summer in the morning and forenoon, is cool, humid and refreshing in the hot valley. It should be greatly considered in the establishment of settlements and buildings.

Winter winds.—These winds do not differ from those in other parts of the country, as they are not specific of one zone only, but cover very extensive areas. It may well be that only the direction of the wind is a bit deviated in the Jordan Valley on windy days in accordance with the shape of the mountains or the valley. The ones that matter principally are the winds coming from the south and south-west during the period of rainfall, on cloudy and rainy days. At the end of the barometric minimum, they turn to the west, or north-west. The warm easterly winds are generally less abundant in the Jordan Valley than in the mountain zone. The cold winds from the east or north-east, however, are common here in the winter and are most severe.

The Gale of July 18th, 1936.

On the morning of Tuesday, July 14th, a depression was centred south of Newfoundland with lowest pressure approximately 1010 mb. This depression moved eastwards across the Atlantic and deepened, eventually giving rise to the gales experienced in south England on Saturday, July 18th. The 13h. synoptic map for July 18th is reproduced below and the position of fronts in the vicinity of the British Isles is shown on it. An interesting feature of this map is that the steepest pressure gradient is to be seen ahead of an " occluded front " which runs from the centre of the disturbance to south-west England. This front is the occluded end of the main frontal system



SYNOPTIC MAP FOR 13H., JULY 18TH, 1936.

of the depression. At some earlier stage in the history of the depression this end of the occlusion had been outrun by the centre of the depression and subsequently " bent back " to the position seen at 13h. by the circulation round the centre. Thus, although the centre of the depression travelled from the south of Ireland to north-east Scotland and the warm and cold fronts moved from south-west to north-east across the whole country, the gales were confined to south England, travelling with the " bent-back " occlusion across the southern counties. At Calshot wind of gale force was recorded from 17h. to 20h., the highest gust being 59 m.p.h.

Compared with winter storms the duration of the gale and the strength of the wind were not remarkable but gales occur infrequently in July in the south of England. During recent years winds have reached gale force in that month only in 1922, 1925, 1927, 1929 and now in 1936. Of these, the gale of 1922 was the most severe; it lasted for ten hours at Calshot and a gust of 66 m.p.h. was recorded. During the 30 years 1871–1900, which have been analysed by Brodie,* eleven gales occurred on the south coast of England in July, but only in seven separate years. In one of these years—1879—no fewer than three gales were experienced in the month.

M. T. SPENCE.

Visibility and Wind Direction at Manston.

The material used in this investigation consists of hourly observations over a period of two years, May 22nd, 1934, to May 21st, 1936, from 9h. to 16h. G.M.T. daily. All cases when precipitation was falling at the time of observation have been excluded. The average visibilities for the sixteen compass points are shown in the diagrams (Fig. 1) for light winds (force 2 and 3) and moderate or strong winds (force 4–9), and for summer and winter separately (April to September and October to March respectively). The total number of observations for any one wind direction varies from 16 for strong ESE. winds in summer to 238 for strong SW. winds in winter.

The variation with wind direction is very marked with light winds in winter. Visibility is best with winds from NE. and NNE., directions which have an open sea exposure; while winds from SW. to S. also show relatively good visibility after passing over the 15–30 miles of open country after leaving the English Channel. The lowest visibility occurs with winds from W. and WNW., and from E. and ESE. The former directions include the London area, the nearer side of which is about 60 miles distant; while the latter directions include Belgium, the nearest point of the Belgian coast being 55 miles distant to east-south-east (Fig. 2). Hence it appears that smoke from both these industrial areas produces a marked deterioration in visibility at Manston. The industrial towns of Gillingham, Chatham and Rochester lie close together due west from Manston at a distance of about 37 miles. Smoke from these would not be sufficient to produce all the observed deterioration, especially as with WNW. winds the smoke would be carried south of Manston. It is noteworthy also that the neighbouring residential towns of Margate and

* *London, Quart. J.R. met. Soc.*, 29, 1903, pp. 151–80.

Ramsgate, 3 to 4 miles away, have little or no discernible influence on the visibility. The poor visibility with winds from NW. to N. is probably mainly due to the transport of foggy or misty air from Essex and the Thames Estuary. Moreover, there must be a certain amount of spreadover of the observations owing to the fact that a wind does not usually maintain the same direction throughout a path of some 60 miles.

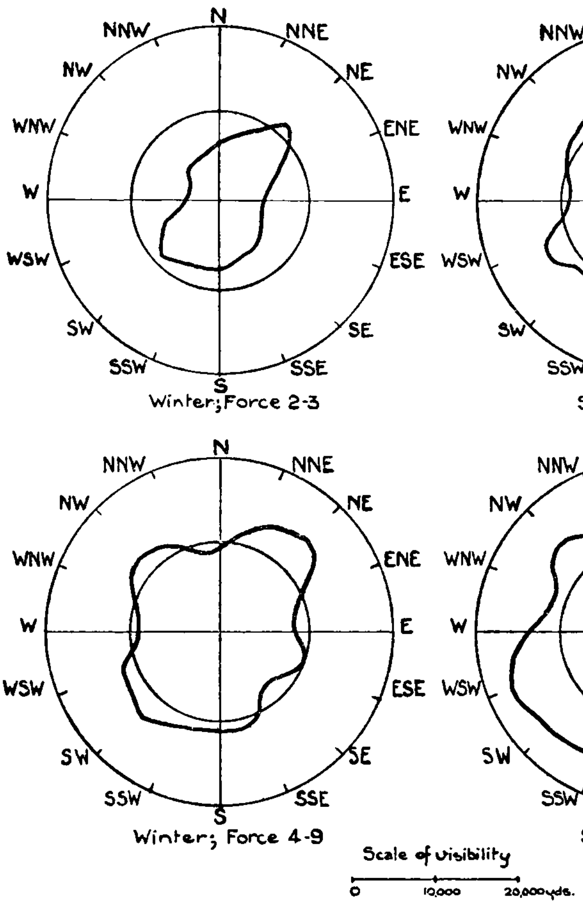


FIG. 1

With strong winds in winter the visibility is improved in all directions, especially with north-westerly winds. With this exception, the general shape of the curve for the strong winds is similar to that for light winds, the lowest visibilities occurring with W., E. and SE. winds.

In summer the light winds show considerably improved visibilities compared with winter. This may be partly due to the decreased smoke from domestic chimneys, but the more intense convection of this season would cause the smoke to dissipate to higher levels and so have less influence at ground level some distance away. Decreased visibilities with winds from W. and ESE. still remain noticeable. Strong winds in summer between SW. and NW. are associated with still further improved visibility when compared with light winds of this season; on the other hand, visibility with winds from S. to NNE. is about the same or less, for strong than for light winds. Somewhat similar differences are noted between summer and winter. In particular with strong winds from NE. and NNE. visibility is less in summer than in winter. These differences are to be attributed to the comparatively high frequency of fogs over the southern North Sea and Straits of Dover in summer. With light winds the drift of air on-shore is slow enough for the fog to be dissipated on reaching the warmer land, leaving good visibility inland (the sea is not visible from ground level at Manston). With stronger winds this dissipation does not occur so completely and visibility is reduced.

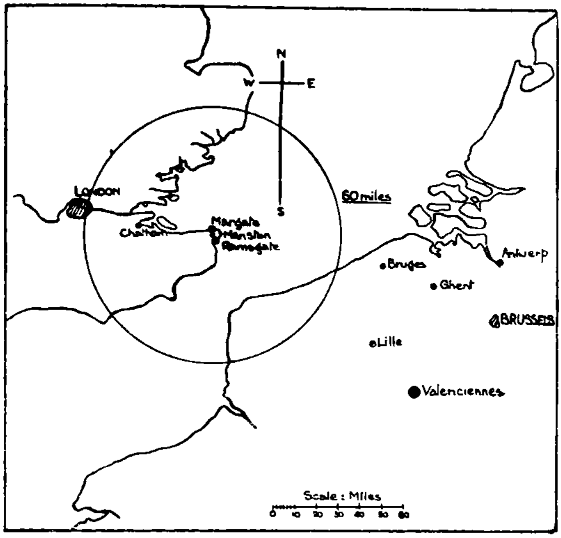


FIG. 2

Conclusion.—It is shown that visibility at Manston is reduced by smoke from London and its outskirts and also from Belgium, the effect being most noticeable with light winds in winter.

A. F. CROSSLEY.
C. WILDE.

Correspondence

To the Editor, *Meteorological Magazine*

Snow in June

On June 3rd the *Daily Telegraph* reported a foot of snow on Carnedd Llewelyn but from information received from the Pass of Llanberis the fall appears to have been local and may have been hail. Also on June 3rd I heard that there was 4 in. of snow on the Brecon Beacons. I saw two men who had seen it at a distance, who said it was snow and not hail and I heard of a man who had motored over the Beacons that day and said the snow had clogged his wind-screen. Such an occurrence must be almost unprecedented.

Kentchurch Rectory, Hereford, July 27th, 1936. R. P. DANSEY.

Recurrent Group Lightning Flashes.

The phenomenon described at Goff's Oak, Herts, by Mr. Donald L. Champion in the *Meteorological Magazine* for July, pp. 140–1, was reported also by Mr. D. S. Hancock as seen from Greenways School, Bognor Regis, on June 19th, between 9 p.m. and 10 p.m., B.S.T. " A heavy bank of cumulonimbus lay over the Downs to the north of the town, too distant for thunder to be audible. A series of flashes from near the western end of the cloud bank was followed, at almost the same interval on each occasion, by a fainter flash at the other end of the cloud."

Miss Cicely M. Botley of 17, Holmesdale Gardens, Hastings, has also written to say that she " noticed an analogous phenomenon about 21h. G.M.T. on June 19th; about 3 centres in the storm cloud kept flashing regularly. The storm (or storms) on the 19th was the most severe of the series June 17th, 18th, 19th, 21st. At 22h. there were one or two vicious overhead discharges and minor damage was done in the district."

Peculiar Cloud Formation seen from Catterick.

At 14h. 40m. G.M.T., on July 9th, 1936, a black elongated projection was observed hanging from the base of a heavy cumulonimbus cloud to the east of Catterick. This projection which had the appearance of a tail was first observed at 14h. 35m., and was then observed to be growing; it attained its maximum length at 14h. 40m., and afterwards slowly dissolved, appearing to be gradually drawn back into the cloud. The projection disappeared completely at 14h. 50m. with the exception of the tip which was rather ragged and which seemed to dissolve quickly and then reform; the projection was extremely well defined.

Thunder was heard at 14h. 50m., and lightning was seen at 15h. 3m., while the rain started at Catterick at 15h. 38m.

J. H. Brazell.

Meteorological Station, R.A.F., Catterick, Yorkshire, July 21st, 1936.

Funnel Cloud seen from Hastings.

A short funnel cloud from a large black-based cumulus at 8h. 55m. G.M.T., was observed over the sea here on July 10th. It was only seen for five minutes, for at 9h. it quickly dissolved when cloud appeared to fall rapidly from the outer margins of the funnel and disappear as it did so; this process continued until the whole funnel had dispersed, the base of the cloud assuming the normal smooth horizontal form. During the time it was watched it was in rapid motion and at one time elongated remarkably and appeared as though it would descend to the sea. When first observed it was almost due south over the sea. The weather was stormy at the time and thunder had been heard for about two hours previously.

Other features of the day in question were the immense banks of black cloud with heavy rain falling over the land between 12h. and 13h. 30m., where heavy thunder occurred, particularly between 12h. 40m. and 13h. 15m., the greatest activity being between north-west and north. Little rain was experienced here during the day though a smart shower occurred at 14h. 15m. Distant thunder was heard at intervals all the forenoon from about 6h. 30m. onwards.

A. E. MOON.

39, Clive Avenue, Clive Vale, Hastings, July 13th, 1936.

A Remarkable Rainstorm

On Tuesday afternoon, July 7th, an extraordinary rainstorm occurred here resulting in what I am informed is a record fall for the period. I was away in London at the time and had no opportunity of examining the gauge, which is at the bottom of my garden, north of the house, until at 8.30 a.m. next morning, when I measured exactly 3·09 in. The morning before I had examined the gauge and found it empty. I am informed by several people here that practically the whole of this rain fell in about half an hour between 4.5 and 4.35 p.m., no other rain falling earlier that day and the night being fairly fine. Thunder and lightning accompanied the rain but were not at all severe compared to the rain. The storm was apparently moving in a north-westerly direction, for a party which reached Sandy Lodge Golf Club at 4 p.m. just before it began, reported that their train had passed through a heavy storm at Kenton and parts of the golf links there were under water.

Here within a few minutes after the rain suddenly commenced, torrents of water rushed down a gravel slope and through the back door flooding the kitchen.

I find on inquiry that the gauge at Sandy Lodge Golf Club a short distance away only recorded 1·40 in. during the storm, but this gauge is much sheltered by bushes. Under such exceptional conditions two neighbouring gauges might record very differently. The rainfall was not nearly so severe at Rickmansworth. Mr. Hawke, at Caenwood, Rickmansworth, had 0·56 in., and Mr. Grimmett, at the Rickmansworth and Uxbridge Valley Waterworks, nearer Sandy Lodge, had 0·62 in. At Watford, Mr. E. A. Robins tells me that he recorded 1·06 in.

The total rainfall here this month has reached 6·12 in.

H. LANGFORD LEWIS.

The Fairway, Sandy Lodge, Northwood, Middlesex, July 25th, 1936.

[*British Rainfall* classifies intense falls of rain under three categories: " noteworthy ", " remarkable " and " very rare ". New limits in this classification were brought into use in January 1936, and are set out in the *Meteorological Magazine* for April, 1936, p. 58. The fall at Northwood, Middlesex, on July 7th described above, comes under the category " very rare ". During the latter half of June and the first half of July, heavy falls of rain in short periods of time have been so widespread and so frequent that it is interesting to note some of the heaviest while the memory of the storms is still clear. The following table gives the place and date of occurrence of a number of intense falls of rain classified according to whether they were " noteworthy ", " remarkable " or " very rare ".

Date.	Place.	Rainfall.	Duration.	Type of Fall.
1936		in.	min.	
June 20th	South Farnborough ...	0·79	26	Noteworthy.
June 21st	Crickhowell (Breconshire).	0·91	about 30	Noteworthy.
June 22nd	Rothamsted	1·50	30	Remarkable.
June 25th	Ashbourne (Derbyshire).	2·33	90	Remarkable.
June 29th	Bristol (Horfield) ...	1·50	60	Remarkable.
June 29th	Bristol (Waterworks, Clifton).	1·95	20	Very rare.
June 29th	Bodmin	2·98	60	Very rare.
June 30th	Florencecourt (Co. Fermanagh).	3·20	180	Remarkable.
July 7th	Northwood (Sandy Lodge).	3·09	about 30	Very rare.
July 10th	Eastbourne	1·97	60	Remarkable.

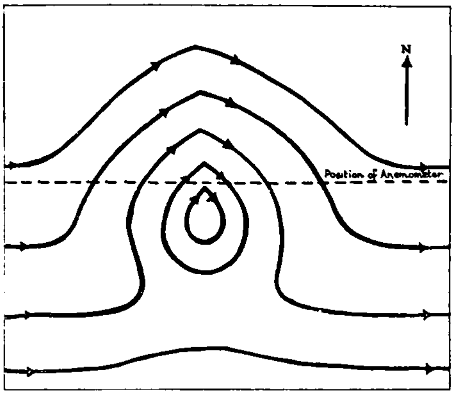
In most of the cases cited above, the details have been communicated to the Meteorological Office direct but in a few, they have been taken from reports in the Press. Descriptions of some of the thunderstorms have already been published in the *Meteorological Magazine* for July, 1936. An important feature of a number of the heavy rainstorms was the heavy hail which accompanied them. In the thunderstorm at Rothamsted on June 22nd some of the hailstones were nearly an inch in diameter.—L. F. LEWIS.]

Sand Devil, Heliopolis

One of the best developed sand devils which has passed near the Meteorological Office, Heliopolis, occurred at 11h. 57m. G.M.T. on May 29th, 1936.

Fresh cold air had arrived late on the previous afternoon (maximum on the 28th, 105°F., on the 29th, 84°F.) and the wind was about 20 m.p.h. from the west, the range of gustiness being 6–38 m.p.h. At 11h. 57m. G.M.T., the sand devil passed slightly to the south side of the anemometer—all open doors were slammed violently, the barograph and microbarograph showed an instantaneous fall of pressure of 0·8 mb. and about 2–3 seconds after the doors slammed, a gust of 55 m.p.h. was recorded. Just before the passage of the devil, the wind veered suddenly NW.—a change which probably resulted in the slamming of the doors—and at the passage the wind backed to SW. and then veered again to W. or NW. The direction of rotation was clockwise, height about 500 ft. and diameter about 40 ft.

The devil was observed five minutes later about 1,500 yards to the east and then it appeared to have a much larger diameter and a funnel-shaped top. The speed of travel, 1,500 yards in five minutes, is about 10 m.p.h., which is about half the average wind speed at the time.



The sequence of events at the anemometer may be explained in a general way by the attached air flow diagram. Here the devil is represented as an eddy moving along in but not necessarily with the speed of the air stream; the eddy has not been drawn as a circular one so that the rapid or instantaneous change from NW. to SW. with the accompanying strong gust may be explained.

J. DURWARD.

Meteorological Station, R.A.F., Heliopolis, Egypt, June 4th, 1936.

NOTES AND QUERIES

A New Series of Meteorological Memoirs from Germany.

The political changes that have taken place in Germany in recent years have had their repercussions in the meteorological activities in that country and have led to a reorganisation of the meteorological services. Formerly each of the constituent states of the federal Empire had its own service and the Directors in many cases were University professors responsible for advanced teaching of the subject as well as for the organisation of their services. The Seewarte at Hamburg was the only meteorological institution directly dependent on the Imperial Government, being a department of the German Admiralty. Since the reorganisation, the public services have been united under the control of the German Air Ministry, but the Universities which are independent of the Ministry still have their Meteorological Institutes which continue their teaching and research activities.

Thus, it comes about that we have received the first four numbers of a new series of meteorological memoirs entitled *Veröffentlichungen des Meteorologischen Instituts der Universität Berlin,* edited by H. Ertel and H. von Ficker. The first two memoirs, respectively by H. Ertel and K. Stampf are mathematical. Dr. Ertel deals with the theory of the variation of a pressure field from the dynamic and advection point of view, while Dr. Stampf discusses the probabilities of chance coincidences in periodicities found in long series of observations. The third memoir by O. Schneider takes us into the realm of terrestrial magnetism and discusses the influence of the sun on the lunar variation of the earth's magnetism. The fourth memoir is from the pen of Professor von Ficker himself and is more descriptive in character. It deals with the rôle played by inversions of temperature in determining the circulation in the Atlantic trade winds. It will be seen, therefore, that the new memoirs are intended to cover a wide field and we look forward to the receipt of future numbers with much interest.

R. G. K. LEMPFERT.

Beit Fellowship for Research in Meteorology

The Trustees of the Beit Fellowships have awarded, amongst others, an extension of his Beit Fellowship at the Imperial College of Science and Technology during the academic year 1936–7 to Mr. E. W. Hewson, of the Mount Allison University, Sackville, Canada and the University of Toronto, for the continuation of his research in meteorology under the direction of Prof. D. Brunt, more especially the detailed structure of discontinuities between air masses as occurring in England and Canada.

The Heat Wave of July 13th, 1808

Mr. J. E. Clark has called attention to a passage in the Diary of Thos. Shillitoe, 2nd ed., 1839, Vol. 1, pp. 80–1. Shillitoe, then aged 54 years, was engaged on one of his many journeys for religious service, and on July 13th was walking from Lower Heaford to Hinckley, in Leicestershire, along the old Watling Street. He notes: "About 9 o'clock the sun shone out very hot, exceeding anything I had before experienced . . . By 12 o'clock the air became so affected in the shade that I felt as if I was surrounded every way by heat from a fire." His strength gave out, and although he was a practised walker he suffered severely from heat, thirst and exhaustion in that almost deserted region before reaching an inn. He concludes: "The gooseberries on the trees next morning appeared, where they were exposed to the sun, as if they had been in an oven or saucepan in the fire. Near 50 horses, it was reported, had dropped down dead on the North Road and many people, who were working in the fields. It was supposed to have been the hottest day known in this nation."

Actual observations for 1808 are few and not very reliable, but it is interesting to note that two weather diaries both show July 13th as a day of great heat. That at Sunbury Vicarage, Middlesex, gives 105° F. as the greatest thermometer reading, but this was apparently a thermometer exposed to the sun, for a marginal note states: "In the shade 94". A glance through the book shows no other reading exceeding 100° F. during the whole period from 1795 to 1839. The Meteorological Journal at the apartments of the Royal Society gives as the greatest heat recorded by Six's thermometer, 93½° F. The readings of the Royal Society thermometers are not strictly comparable with those obtained in recent years under more standard conditions, but some idea of the meaning of these figures may be obtained from the mean annual maxima (obtained by finding the highest daily maximum in each of a series of years and forming the mean). For the ten years 1800–6, 1808–10 the mean annual maximum at the Royal Society was 84° F. For the twelve years 1910–21 the mean annual maximum at the Royal Observatory, Greenwich, was 89° F. If we add the difference, 5° F., to the reading of 93½° F. on July 13th, 1808, we obtain a value of 98½° F., which approaches the famous reading of 100° F. at Greenwich on August 9th, 1911. It seems probable therefore that in London the heat of July 13th, 1808, was not very different from that of August 9th, 1911.

Strong Vertical Current

A pilot balloon ascent, by tail method, made at Abbotsinch at 12h. 10m. G.M.T. on September 21st, 1935, revealed a very remarkable upward vertical current existing from about 8,000 to 23,000 feet.

A large size balloon (90 in.), with tails at 25 and 100 feet, inflated for the normal lift of 500 feet per minute, was used.

In the computation of the ascent, shown below, it will be seen that the balloon made a fairly steady rise of 500 feet per minute for the first 14 minutes, followed by a more rapid rise at a mean rate of 700 ft./min. for the next 5 minutes, and then the normal rate was resumed for 5 minutes. At this height, 12,000 ft. (by tail) reached in 22 minutes, a very strong upward vertical current commenced resulting in the balloon ascending 11,500 ft. in 12 minutes. The most rapid rise occurred between the 22nd and 27th minute when the balloon rose at a mean rate of 1,300 ft./min., indicating a vertical current of 13 ft./sec. The readings of the tail were taken at frequent intervals during the ascent as soon as the computation showed that something unusual was happening. After 34 minutes the balloon was abandoned as the tail was no longer distinguishable and a uniform rate of ascent could not be assumed in view of the fluctuations in lift.

During the ascent the sky was completely covered with cirrostratus cloud in the east, gradually lowering to altostratus in the west. The pressure distribution on the 13h. synoptic chart shows a shallow depression off southern Ireland with a warm front across central England running from east to west. Another shallow depression was developing near the mouth of the English Channel, afterwards deepening considerably while moving north-east to Yorkshire and later to Norway. This depression was centred near Spurn Head at 7h. on the 22nd and the rainfall from the 21st to 22nd was very heavy particularly in Yorkshire and Lancashire. Only slight rain occurred at Abbotsinch in the following 24 hours.

This case shows that pilot balloon ascents may give rise to very unreliable data occasionally unless the ascent is made using tails or double theodolite method throughout the ascent. It is obvious that an assumed lift of 500 ft./min. in this ascent would give a resultant velocity of only one-third of its actual value (apart from error in height) in some parts of the result. Tail readings at great heights should frequently show this convection but readings cannot be obtained except when the wind lower down is of a strength similar to that in the ascent described.

The following are the details of the ascent :—

FREE LIFT 500 FT./MIN.

Minute.	Tail Reading.	Height.	Vertical Velocity.	Resultant Wind.	
				Direction.	Speed.
		ft.	ft./min.	°	m.p.h.
1	25	510	+ 10		
2	13	1,070	+ 60	211	15
3	8·4	1,710	+ 140		
4	6·8	2,090	− 120	211	10
5	5·1	2,740	+ 150		
6	17·0	3,250	+ 10	202	9
7	14·7	3,750	0		
8	12·7	4,300	+ 50	208	10
9	11·4	4,800	0		
10	10·0	5,300	0	212	15
11	8·8	5,800	0		
12	7·8	6,200	− 100	205	19
13	7·1	6,620	− 80		
14	6·6	6,900	− 220	195	15
15	6·0	7,600	+ 200		
16	5·6	8,200	+ 100	192	17
17	5·1	9,000	+ 300		
18	4·85	9,550	+ 50		
19	4·4	10,500	+ 450	189	16
20	4·15	11,000	0		
21	4·0	11,500	0		
22	3·85	12,000	0	191	18
23	3·4	13,500	+ 1,000		
24	3·1	14,900	+ 900	203	21
25	3·0	15,400	0		
26	2·75	16,900	+ 1,000	209	33
27	2·5	18,500	+ 1,100		
28	2·4	19,500	+ 500		
29	2·3+	20,400	+ 400	230	34
30	2·2	21,200	+ 300		
31	2·1	22,000	+ 300		
32	—	(22,800)	+ 300		
33	1·85	23,500	+ 200	223	46

Nephoscope observations on the 21st :—

At 7h. cirrus 270°, 75 m.p.h. At 17h. cirrus 230°, 80 m.p.h.

R. T. ANDREWS.

Spreading of Burns on the Cards of Campbell Stokes Sunshine Recorders

In the Campbell Stokes sunshine recorder the sun's rays are concentrated by a glass sphere and burn the card, the duration of the burn being taken as a measure of the duration of bright sunshine. The strength of the burn varies from a faint mark on the surface of the card, when the sun is shining faintly, to a charred channel burnt through the thickness of the card in bright sunshine on a clear day. It occasionally happens on occurrence of bright sunshine that considerable spreading of the burn takes place and the customary straight channel, which is burnt in the card, may in such cases expand in places into a circular hole measuring about $\frac{1}{4}$ in. in diameter. An example of these " blobs," as they are termed, is shown in the figure facing p. 168. Captain J. Durward, Superintendent of the Meteorological Office, Heliopolis, reported in the spring of 1932 that blobs had been unusually frequent at stations in the Middle East Area, and made a suggestion that the cause might be the burning of the resin which is contained in the composition of the card. This led to an inquiry into the whole subject. It is noticeable that when a card is burnt, a considerable amount of resinous compound is driven out and accumulates on the bowl behind the card. It seemed at least possible that the sun's rays might set fire to an accumulation of resin, thus burning a hole in the card.

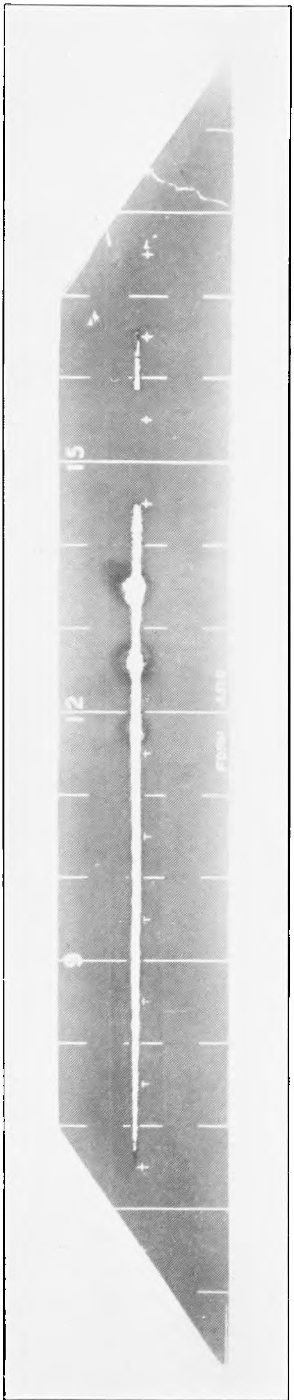
Mr. E. G. Bilham, who considered the matter, did not feel that this explanation was altogether satisfactory and suggested that the spreading might occur on occasions when the sun's rays were of unusual intensity, owing to the card itself becoming ignited, and that other favourable conditions would be high temperature and low humidity, rendering the card " bone dry " and a dead calm favouring temporary accumulation of hot air near the burn.

In order that the resin theory might be tested, a sunshine card from the current stock, together with a series of older cards dating back to 1927, were forwarded to the Government Chemist for analysis. In his report he said that there was no important difference in the resin content of the several cards and that if anything, the more recent card had a smaller resin content. He further pointed out that tests with a burning glass had shown that the card could be ignited by concentration of the sun's rays, especially when the test was carried out in a draught. The Government Chemist's report, therefore, supported Mr. Bilham's suggestion that blobs might be due to abnormally strong heating rather than to an accumulation of resinous compound. The suggestion was further made by the Government Chemist that the best means of overcoming the trouble might prove to be by the use of fire-proofed cards. Two sets of cards were accordingly obtained having fire-proof qualities, one printed on a fire-proofed board and the other on a one-sided coated board. The cards were finished with the same blue coloured surface as the standard cards but preliminary test showed that the one-sided coated cards suffered from the drawback that when the surface was moist, the colour rubbed off very easily. Both sets of cards were subjected to a test during the summer of 1934 in recorders set up (1) on the roof of the Science Museum at South Kensington, and (2) at Heliopolis.

Blobs are not a frequent occurrence in this country and none were experienced either on the standard card or on the two experimental cards during the month of the trial at South Kensington. This part of the trial was therefore directed rather to the testing of the comparability of the records obtained from the experimental cards with those obtained from the standard cards. It was found that the burn produced on the one-sided coated cards was of a lighter colour than normal and that the duration of the record was less, the deficiency for the month being 2 per cent. The total duration obtained on the completely fire-proofed cards was, on the other hand, in excellent agreement with that given by the standard cards. An examination of the individual cards suggested that this must be regarded as being to some extent a fortuitous result. The burn on these cards seemed wider than on the standard cards in bright sunshine with a consequent spread when the burn was interrupted by clouds. Thus the record gave too long duration on days of broken cloud, this being compensated by too short duration when the sun was shining faintly. The trial in Middle East Area did not give any definite information regarding the comparability of the records as the recorders used were not all in perfect adjustment; but here again a broader burn was found on the completely fire-proofed cards. On one occasion spreads were found on a standard card inserted in an old recorder but only slight blobs on a standard card mounted in a new recorder. It was unfortunate that during the greater part of the two months during which the test was continued, no blobs occurred on the standard card. It was only during the last week that blobs were experienced though during this period they were frequent. No blobs occurred on the one-sided coated cards throughout the whole period and one blob only, and this of no great magnitude, on the completely fire-proofed cards. Spreading chars did, however, appear on the back of some of these fire-proofed cards. The fire-proofing thus appears to provide a means of avoiding the occurrence of blobs, but as the records obtained on the fire-proofed cards are not strictly comparable with those of the standard cards, it was decided to make no change in the composition of the cards.

The fire-proofed cards were of the summer pattern only and therefore could not be used after the end of August. The additional recorder which had been set up at Heliopolis for the comparison was, however, used occasionally thereafter with a standard card. Evidence was found that a "spreading char" occurs with pronounced regularity at about 11h. 15m. and 12h. 45m. which are positions coincident with two holes drilled right through the bowl. In view of this the records for September 27th, 1934, are surprising.

[*facing p. 168*



CAMPBELL STOKES SUNSHINE RECORDER CARD

On that day the standard card in the standard recorder gave the largest blob which had been experienced since the trials commenced, at 12h. 45m. and smaller blobs at 8h. 45m. and 15h. 15m. But on the standard card on the new recorder there was only the very slightest evidence of spreading on the front of the card and on the back there was rather less than the usual amount of "spreading char" at the positions of the holes which are drilled in the bowl of tropical recorders to facilitate the egress of water.

Although the occurrence of blobs spoils the appearance of a card, it has no practical effect on the duration of sunshine measured. The blobs only occur on days of unusually bright sunshine and on such days the burn is generally continuous, so that the measurement is the same whether the record contains a blob or not. It would be only when a blob occurred immediately before or after the sun was obscured by a cloud that the record would be unduly extended, leading to a false measurement of sunshine. As blobs are not a frequent occurrence, such cases must be extremely rare and can have no appreciable effect on the total measurement of duration of sunshine.

OBITUARY

Dr. William James Stewart Lockyer.—We record with great regret the death of Dr. W. J. S. Lockyer, the Director of the Norman Lockyer Observatory at Sidmouth, at the age of 68. Though primarily an astronomer, a great deal of Lockyer's scientific work dealt with meteorology as might be expected when one remembers the outward circumstances of his career. For many years he was on the staff of the Solar Physics Observatory at South Kensington, serving under his distinguished father, the late Sir Norman Lockyer. Now it will be remembered that the Solar Physics Observatory was founded for the express purpose of collecting information about solar changes, which should provide material for working out the details of the connexion between solar activity and terrestrial weather which the elder Lockyer had established in his earlier researches on Indian rainfall in relation to sunspots. The meteorological problem was, therefore, ever present in the minds of those in charge at South Kensington.

Lack of suitable data for attacking the fundamental problems of world meteorology still hampers us, but thirty years ago the situation was very much worse than it is now. Much attention was devoted at the Observatory to the collection of records of long observations and resulted in the publication of a valuable series of pressure records, the forerunner of "World Weather Records" issued some years ago for the Smithsonian Institution acting on behalf of the International Meteorological Organisation. This pioneer work of the Solar Physics Observatory in which Dr. Lockyer took a considerable part also contributed not a little towards making possible the international enterprise which we now know as the Réseau Mondial.

Many valuable discussions of world meteorology emanated from the Solar Physics Observatory. Dr. Lockyer was particularly attracted by the meteorology of the southern hemisphere where the distribution of land and water renders the problems perhaps rather simpler than they are north of the equator. He contributed valuable papers on surface-air circulation in the southern hemisphere and on Australian meteorology to the memoirs issued by the Solar Physics Committee.

Outside his official work, Lockyer was a keen balloonist and also a photographer. He was particularly expert at cloud photography and had amassed a large collection of beautiful and striking cloud photographs, copies of which he generously presented to the library of the Meteorological Office.

R. G. K. LEMPFERT.

We regret to learn of the death on June 15th, 1936, in his eighty-second year, of Professor Eugène Lagrange, the well known Belgian astronomer, who has also published work on the connexion between solar and meteorological phenomena.

NEWS IN BRIEF

We learn that Professor P. A. Moltchanoff has been appointed Director of the Central Geophysical Observatory, Leningrad, as from June 25th, 1936.

BOOK RECEIVED

Standard scale of solar radiation by C. G. Abbot and L. B. Aldrich Washington, D.C., Smiths.Misc. Coll., Vol. 92, No. 13.

The Weather of July, 1936

Pressure was below normal over Alaska, western Canada, the United States, eastern Canada and across Bermuda and northern North Atlantic to Scandinavia, Germany and France, and also over south-east Europe and south-west Asia, the greatest deficits being 6·5 mb. at Lerwick and 4·7 mb. near Erzerum, near Quebec and at Juneau, Alaska. Pressure was above normal over Mexico, the southern North Atlantic, north-west Africa, Spain, the western Mediterranean and in a belt across Austria and Poland to Russia, the greatest excesses being 3·3 mb. at Moscow and 3·6 mb. at Lisbon. Temperature was generally above normal in Scandinavia, Germany and south-east Europe but below normal in the Netherlands, while precipitation was mainly in excess except near the borders of the Black Sea.

The weather of July was generally unseasonable over the British Isles. The outstanding features were a persistence of cyclonic conditions, abnormally heavy rainfall, little sunshine and generally low day temperatures though minimum temperatures were often above normal. At Valentia Observatory there was no day during the month without rain. At several stations the total rainfall was the highest on record for July while at Birr Castle the total sunshine was the lowest on record for July. Sunshine generally was considerably below normal except in north-west Scotland. Thunderstorms were fairly frequent in the Midlands. July opened with low pressure systems extending across the Atlantic from the British Isles to eastern Canada. From the 1st–4th unsettled conditions prevailed with local heavy rain, 2·52 in. at Hartland, Devon on the 1st and 1·16 in. at Birmingham on the 2nd, but long sunny periods in parts of north England and Scotland, 12·2 hrs. bright sunshine being registered at Cockle Park on the 4th and 11·8 hrs. at Stornoway on the 2nd. Thunderstorms occurred at several places on the 1st and 2nd and coastal mist or fog was experienced locally. A brief interval of more settled weather occurred on the 5th when the anticyclone over central and southern Europe spread north. This was followed by a prolonged spell of cyclonic conditions which lasted until the 22nd. During this time rain occurred almost daily and some heavy falls were recorded especially between the 7th and 10th, 3·09 in. at Northwood, Middlesex on the 7th*, 2·06 in. at Abbeyfeale, Co. Limerick on the 8th, 2·04 in. at Wellingborough, Northants and 1·97 in. at Eastbourne on the 10th. Thunderstorms were reported from several places on the 7th–10th, 14th, 15th and 17th–19th and on the 10th waterspouts accompanying a thunderstorm were observed in the English Channel off Newhaven. Strong winds occurred on a few days mainly in the south and gales were experienced in south England on the 18th–19th. Throughout this time day temperatures were rather low but night minima were frequently above normal, 64°F. was the minimum at Gorleston and Tottenham during the night of the 6th–7th. There was also a general lack of sunshine though on isolated days there were long sunny periods, especially in the north. Tiree had 16·8 hrs. on the 9th, Oban 15·8 hrs. on the 10th, and Hastings 14·6 hrs. on the 16th. A wedge of high pressure crossing the country on the 22nd brought bright weather to most districts but a fresh depression moving from north-west Ireland to the Faroes from the 23rd to 26th caused a renewal of unsettled conditions generally though there was considerable sunshine except in the north. Gales were experienced in western districts on the 24th and thunderstorms occurred generally in England on the 25th while rainfall was heavy locally, 2·56 in. at Fofanny, Co. Down on the 23rd. The 27th was mainly a sunny day, 14·1 hrs. at Aberdeen, but on the 28th–29th a depression in the English Channel brought rain again and thunderstorms occurred locally. On the 30th the Azores anticyclone spread eastwards so that there was sunny weather over most of south England but the unsettled conditions had spread over the country again on the 31st. The

* See p. 161.

distribution of bright sunshine for the month was as follows :—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway ...	163	+15	Chester ...	127	−33
Aberdeen ...	138	−13	Ross-on-Wye...	125	−63
Dublin	116	−56	Falmouth ...	159	−62
Birr Castle ...	93	−55	Gorleston ...	184	—22
Valentia... ...	148	−10	Kew	139	−56

Miscellaneous notes on weather abroad culled from various sources

Heavy rain in Moldavia and Bessarabia on the 5th caused floods which washed away two railway bridges—6 people were reported to have been killed by lightning. About the middle of the month the crops in the Volga Basin and the Ural Region were suffering from lack of rain. The Great St. Bernard Pass was re-opened to traffic on the 12th. Abnormally wet and cold weather was experienced in Switzerland during the middle of the month and as a result the rivers began to rise and Lake Constance to overflow. In the Canton Grisons several roads were blocked by landslips. Snow fell on the 13th in the Alps down to the 4,000 ft. level. During a storm on the night of the 16th–17th a schooner foundered off Utklippoma, Sweden, and her crew were drowned. Cold stormy weather was again experienced in the Bernese Oberland later in the month. A gale occurred at Venice on the 21st doing damage to crops and trees. Much damage was done by thunderstorms in Constantinople about the 26th and 27th when 2 people were killed and many houses in low-lying districts were washed away. After a series of thunderstorms the temperature dropped in north Italy and 2 ft. of snow fell in the valley near Domodossola. A severe forest fire broke out on the 30th between Vence and St. Paul on the French Riviera and a strong mistral hampered the fire fighters. (*The Times*, July 7th–August 1st.)

A typhoon swept over South Kyushu (Japan) on the 23rd causing extensive floods while much damage was done to shipping. Seventy villages over an area of 20 sq. miles were submerged about the 20th as a result of the flooding of the River Rapti in the Gorakhpur district of the United Provinces. Heavy rain occurred later but by the 27th the floods were slowly subsiding. Further heavy rain on the 28th however seriously increased the floods, and on the 29th the rivers were still rising. A landslip occurred in the Teesta Valley near Darjeeling about the 27th and floods were reported in the hill country of Bengal, Assam and Bihar. (*The Times*, July 22nd–30th.)

The total rainfall for the month in Australia was generally above normal except in Western Australia and parts of New South Wales and Tasmania. (Cable.)

Temperature was generally considerably above normal except in the western Gulf States and at the beginning and end of the month in the eastern States. Rainfall was mainly below normal except in parts of the Gulf States. Great heat and drought caused extensive damage to all crops and pasturage in the prairie provinces of Canada and in the north and central United States and to a less extent in the south-east States. Extensive hail about the 20th caused losses to crops in Saskatchewan and Alberta. Towards the end of the month heavy rain greatly benefited the crops in eastern Canada and showers and lower temperatures brought some relief to the drought areas generally. A severe thunderstorm accompanied by hail did much damage east of Ottawa on the 28th. (*The Times*, July 6th–31st and *Washington, D.C., U.S. Dept. Agric. Weekly Weather and Crop Bulletin.*)

Daily Readings at Kew Observatory, July, 1936

Date	Pressure, M.S.L. 13h.	Wind, Dir., Force 13h.	Temp. Min.	Temp. Max.	Rel. Hum. 13h.	Rain.	Sun.	REMARKS. (see vol. 69, 1934, p. 1).
	mb.		°F	°F	%	in.	hrs.	
1	1005·3	S.4	59	70	56	trace	6·7	r_0 24h.
2	1003·7	S.4	57	69	75	0·11	2·1	r_0–r 0h.–10h.
3	1007·7	SSW.3	58	68	66	0·03	1·4	r_0 0h.–5h.; 16h. & 24h.
4	1014·4	SSW.5	59	73	51	trace	4·7	r_0 0h.
5	1017·3	W.3	61	75	59	—	6·9	
6	1014·7	S.3	57	75	60	—	2·2	W early.
7	1008·9	SSE.2	63	75	69	0·01	1·1	t 13h. r_0 15h. pr_0 19h.
8	1011·2	SW.3	56	70	48	—	7·7	pr_0 16h.
9	1008·6	W.2	51	61	91	0·56	0·0	r–r_0 8h.–18h. [24h.
10	1007·5	WSW.2	52	64	74	0·08	1·1	r–r_0 9h.–12h. & 20h.–
11	1010·7	WSW.4	55	65	59	0·12	4·5	r_0 0h.–4h.; pR 13h.
12	1011·0	SW.4	56	66	64	0·21	4·6	r_0 14h.–18h. & 19h.–
13	1007·3	W.4	59	68	56	—	7·3	r_0 3h. [22h.
14	1009·9	SW.5	55	69	55	0·03	5·5	r–r_0 20h.–24h.
15	999·7	WNW.3	54	67	62	0·48	3·0	rR 0h.–8h.; pr_0 21h.
16	1014·0	WSW.3	55	71	56	—	7·4	
17	1009·1	SE.2	54	76	63	0·02	2·8	r_0 0h.–6h.
18	1005·6	S.6	61	69	57	trace	4·8	r_0 19h.–24h.
19	1007·9	WSW.4	58	68	62	0·18	2·0	r 0h.–2h.; R 18h.
20	1006·8	SW.4	55	66	68	0·01	6·5	r_0 12h., 16h. & 17h.
21	1011·9	W.2	54	65	62	0·01	3·1	r 15h.
22	1013·1	NW.1	50	67	59	—	6·5	w early.
23	1003·7	S.4	57	64	91	0·18	0·0	r–d_0 4h.–18h.
24	1008·3	SSW.5	58	68	57	0·01	11·1	r_0 6h.–7h.
25	1010·2	SW.2	58	68	64	0·04	8·9	t 10h. pr during day.
26	1014·9	SW.3	51	65	61	0·01	7·1	r_0 13h., 16h. & 18h.
27	1016·5	S.3	48	68	58	—	9·4	w early. [L 21h.
28	1012·1	SW.2	55	65	86	0·11	0·4	r 12h.–14h.; t 13h.
29	1016·9	N.4	55	64	69	0·04	2·8	r 8h.–10h.; pr 12h.
30	1024·8	WSW.3	49	68	56	—	7·2	w early; r_0 20h.
31	1014·1	SW.4	56	67	87	0·11	0·7	r_0–r 6h.–12h.; r_0 23h.
*	1010·6	—	56	68	65	2·35	4·5	* Means or totals.

General Rainfall for July, 1936

England and Wales ...	191	per cent of the average 1881–1915
Scotland	150	
Ireland	197	
British Isles	182	

Rainfall : July, 1936 : England and Wales

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Lond .	Camden Square.........	2·98	125	*Leics* .	Belvoir Castle...........	5·46	225
Sur .	Reigate, Wray Pk. Rd..	4·28	190	*Rut* .	Ridlington	5·50	219
Kent .	Tenterden, Ashenden...	4·06	194	*Lincs* .	Boston, Skirbeck.........	4·28	195
,, .	Folkestone, Boro. San.	5·26	...	,, .	Cranwell Aerodrome...	4·63	198
,, .	Margate, Cliftonville....	3·57	180	,, .	Skegness, Marine Gdns.	3·91	179
,, .	Eden'bdg., Falconhurst	4·66	203	,, .	Louth, Westgate.........	3·89	156
Sus .	Compton, Compton Ho.	5·64	199	,, .	Brigg, Wrawby St.......	4·02	...
,, .	Patching Farm..........	4·05	169	*Notts* .	Worksop, Hodsock......	3·76	166
,, .	Eastbourne, Wil. Sq....	5·36	245	*Derby*.	Derby, L. M. & S. Rly.	3·97	167
Hants.	Ventnor, Roy.Nat.Hos.	3·95	195	,, .	Buxton, Terr. Slopes...	7·20	183
,, .	Fordingbridge, Oaklnds	5·25	262	*Ches* .	Runcorn, Weston Pt....	3·72	135
,, .	Ovington Rectory.......	...	...	*Lancs*.	Manchester, Whit. Pk.	3·67	111
,, .	Sherborne St. John......	4·30	193	,, .	Stonyhurst College......	5·07	131
Herts .	Royston, Therfield Rec.	5·53	219	,, .	Southport, Bedford Pk.	2·91	102
Bucks.	Slough, Upton............	2·95	154	,, .	Lancaster, Greg Obsy.	3·43	98
,, .	H. Wycombe, Flackwell	3·34	166	*Yorks*.	Wath-upon-Dearne......	3·93	156
Oxf .	Oxford, Mag. College...	3·40	150	,, .	Wakefield, Clarence Pk.	3·69	146
N'hant	Wellingboro, Swanspool	7·88	344	,, .	Oughtershaw Hall.......	6·98	...
,, .	Oundle	5·63	...	,, .	Wetherby, Ribston H..	3·94	158
Beds .	Woburn, Exptl. Farm...	6·42	288	,, .	Hull, Pearson Park......	3·64	156
Cam .	Cambridge, Bot. Gdns.	5·04	233	,, .	Holme-on-Spalding......	3·61	139
Essex .	Chelmsford, County Gdns	3·48	163	,, .	West Witton, Ivy Ho.	3·35	127
,, .	Lexden Hill House......	2·95	...	,, .	Felixkirk, Mt. St. John.	4·53	166
Suff .	Haughley House.........	3·08	...	,, .	York, Museum Gdns....	3·01	119
,, .	Campsea Ashe............	3·68	160	,, .	Pickering, Hungate......	3·14	117
,, .	Lowestoft Sec. School...	3·42	151	,, .	Scarborough...............	2·88	119
,, .	Bury St. Ed., WestleyH.	4·33	173	,, .	Middlesbrough............	3·45	135
Norf. .	Wells, Holkham Hall...	5·18	223	,, .	Baldersdale, Hury Res.	2·81	88
Wilts .	Calne, Castle Walk......	4·54	...	*Durh* .	Ushaw College............	2·94	105
,, .	Porton, W.D. Exp'l. Stn	3·66	185	*Nor* .	Newcastle, D. & D. Inst.	2·18	90
Dor .	Evershot, Melbury Ho.	6·89	272	,, .	Bellingham, Highgreen	5·27	160
,, .	Weymouth, Westham.	3·16	176	,, .	Lilburn Tower Gdns....	3·18	129
,, .	Shaftesbury, Abbey Ho.	4·66	181	*Cumb*.	Carlisle, Scaleby Hall...	4·65	142
Devon.	Plymouth, The Hoe....	6·52	236	,, .	Borrowdale, Seathwaite	15·50	196
,, .	Holne, Church Pk. Cott.	10·74	305	,, .	Borrowdale, Moraine...	10·85	171
,, .	Teignmouth, Den Gdns.	5·56	239	,, .	Keswick, High Hill......	6·63	173
,, .	Cullompton	6·29	234	*West* .	Appleby, Castle Bank...	5·07	160
,, .	Sidmouth, U.D.C.........	4·83	...	*Mon* .	Abergavenny, Larchf'd	6·23	250
,, .	Barnstaple, N. Dev.Ath	6·55	243	*Glam* .	Ystalyfera, Wern Ho....	9·83	214
,, .	Dartm'r, Cranmere Pool	15·80	...	,, .	Cardiff, Ely P. Stn.......	7·30	234
,, .	Okehampton, Uplands.	11·23	346	,, .	Treherbert, Tynywaun.	14·26	...
Corn .	Redruth, Trewirgie......	7·16	235	*Carm* .	Carmarthen, Coll. Rd.	6·56	187
,, .	Penzance, Morrab Gdns.	7·97	293	*Pemb* .	St. Ann's Hd, C. Gd. Stn.	4·34	176
,, .	St. Austell, Trevarna...	8·22	245	*Card* .	Aberystwyth	6·82	...
Soms .	Chewton Mendip.........	7·57	217	*Rad* .	BirmW.W.Tyrmynydd	7·91	193
,, .	Long Ashton............	5·85	206	*Mont* .	Lake Vyrnwy	8·51	248
,, .	Street, Millfield..........	...	...	*Flint* .	Sealand Aerodrome......	2·49	...
Glos .	Blockley	4·92	...	*Mer* .	Blaenau Festiniog ...	12.40	159
,, .	Cirencester, Gwynfa....	6·28	243	,, .	Dolgelley, Bontddu......	10·14	238
Here .	Ross, Birchlea...........	5·80	256	*Carn* .	Llandudno	2·95	132
Salop.	Church Stretton.........	6·03	246	,, .	Snowdon, L. Llydaw 9..	17·50	...
,, .	Shifnal, Hatton Grange	6·24	277	*Ang* .	Holyhead, Salt Island...	3·67	141
Staffs.	Market Drayt'n, Old Sp.	4·39	163	,, .	Lligwy	3·84	...
Worc .	Ombersley, Holt Lock.	5·16	241	*Isle of Man*			
War .	Alcester, Ragley Hall...	5·18	218		Douglas, Boro' Cem....	5·75	188
,, .	Birminghm, Edgbaston	6·59	284	*Guernsey*			
Leics .	Thornton Reservoir ...	5·29	213		St. PeterP't.Grange Rd.	5·45	270

Rainfall : July, 1936 : Scotland and Ireland

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av
Wig .	Pt. William, Monreith.	5·92	211	*Suth* .	Tongue	4·53	148
" .	New Luce School	...	...	" .	Melvich	5·12	183
Kirk .	Dalry, Glendarroch	...	...	" .	Loch More, Achfary	6·61	124
Dumf.	Dumfries, Crichton R.I.	4·23	137	*Caith* .	Wick	4·77	181
" .	Eskdalemuir Obs	6·87	168	*Ork* .	Deerness	3·79	147
Roxb .	Hawick, Wolfelee	5·93	192	*Shet* .	Lerwick	3·45	151
Selk .	Ettrick Manse	6·89	155	*Cork* .	Dunmanway Rectory	4·76	122
Peeb .	West Linton	6·78	...	" .	Cork, University Coll	5·67	209
Berw .	Marchmont House	2·37	78	" .	Ballinacurra	4·61	165
E.Lot.	North Berwick Res	3·57	138	" .	Mallow, Longueville	5·35	214
Midl .	Edinburgh, Blackfd. H.	4·36	155	*Kerry*.	Valentia Obsy	4·69	124
Lan .	Auchtyfardle	3·71	...	" .	Gearhameen	9·20	160
Ayr .	Kilmarnock, Kay Pk	6·09	...	" .	Bally McElligott Rec	4·44	...
" .	Girvan, Pinmore	7·43	204	" .	Darrynane Abbey	4·90	129
Renf .	Glasgow, Queen's Pk	5·10	175	*Wat* .	Waterford, Gortmore	6·37	200
" .	Greenock, Prospect H.	6·66	170	*Tip* .	Nenagh, Cas. Lough	6·80	216
Bute .	Rothesay, Ardencraig	5·66	...	" .	Roscrea, Timoney Park	8·56	...
" .	Dougarie Lodge	5·11	...	" .	Cashel, Ballinamona	7·10	248
Arg .	Ardgour House	8·41	...	*Lim* .	Foynes, Coolnanes	7·26	236
" .	Glen Etive	...	...	" .	Castleconnel Rec	6·30	...
" .	Oban	4·82	...	*Clare* .	Inagh, Mount Callan	12·05	...
" .	Poltalloch	5·12	124	" .	Broadford, Hurdlest'n.	6·94	...
" .	Inveraray Castle	6·58	132	*Wexf* .	Gorey, Courtown Ho	5·89	200
" .	Islay, Eallabus	4·09	120	*Wick* .	Rathnew, Clonmannon.	6·57	...
" .	Mull, Benmore	11·60	115	*Carl* .	Hacketstown Rectory	7·67	222
" .	Tiree	...	...	*Leix* .	Blandsfort House	8·78	280
Kinr .	Loch Leven Sluice	4·78	166	*Offaly*.	Birr Castle	6·14	208
Fife .	Leuchars Aerodrome	...	...	*Dublin*	Dublin, FitzWm. Sq	5·63	220
Perth .	Loch Dhu	6·85	142	" .	Balbriggan, Ardgillan	...	...
" .	Balquhidder, Stronvar.	7·95	...	*Meath*.	Beauparc, St. Cloud	6·47	...
" .	Crieff, Strathearn Hyd.	4·84	163	" .	Kells, Headfort	7·71	242
" .	Blair Castle Gardens	4·99	195	*W.M* .	Moate, Coolatore	7·04	...
Angus.	Kettins School	3·11	120	" .	Mullingar, Belvedere	6·67	210
" .	Pearsie House	4·94	...	*Long* .	Castle Forbes Gdns	6·77	217
" .	Montrose, Sunnyside	4·12	157	*Gal* .	Galway, Grammar Sch.	...	...
Aber .	Braemar, Bank	3·14	122	" .	Ballynahinch Castle	4·64	112
" .	Logie Coldstone Sch	...	...	" .	Ahascragh, Clonbrock.	6·43	185
" .	Aberdeen, Observatory.	4·67	166	*Mayo*.	Blacksod Point	5·09	162
" .	Fyvie Castle	4·53	139	" .	Mallaranny	6·86	...
Moray	Gordon Castle	4·20	131	" .	Westport House	5·15	166
" .	Grantown-on-Spey	5·02	164	" .	Delphi Lodge	11·16	168
Nairn.	Nairn	4·65	173	*Sligo* .	Markree Castle	6·22	181
Inv's .	Ben Alder Lodge	4·53	...	*Cavan*.	Crossdoney, Kevit Cas..	5·78	...
" .	Kingussie, The Birches.	4·45	...	*Ferm* .	Newtwnbtlr, Crom Cas.	5·89	169
" .	Loch Ness, Foyers	4·92	163	" .	Enniskillen, Portora	...	...
" .	Inverness, Culduthel R.	3·66	...	*Arm* .	Armagh Obsy	5·89	203
" .	Loch Quoich, Loan	6·45	...	*Down*.	Fofanny Reservoir	11·02	...
" .	Glenquoich	6·03	94	" .	Seaforde	6·44	202
" .	Glenleven, Corrour	5·50	133	" .	Donaghadee, C. G. Stn.	5·60	200
" .	Fort William, Glasdrum	6·75	...	*Antr* .	Belfast, Cavehill Rd	6·56	...
" .	Skye, Dunvegan	3·15	...	" .	Aldergrove Aerodrome.	5·81	207
" .	Barra, Skallary	2·87	...	" .	Ballymena, Harryville.	7·05	206
R&C .	Alness, Ardross Castle.	4·74	156	*Lon* .	Garvagh, Moneydig	6·96	...
" .	Ullapool	4·51	142	" .	Londonderry, Creggan.	9·62	262
" .	Achnashellach	5·19	101	*Tyr* .	Omagh, Edenfel	8·17	240
" .	Stornoway, Matheson	3·74	123	*Don* .	Malin Head	5·22	...
Suth .	Lairg	6·16	197	" .	Killybegs, Rockmount.	4·45	...

Climatological Table for the British Empire, February, 1936

STATIONS.	PRESSURE. Mean of Day M.S.L.	PRESSURE. Diff. from Normal.	TEMPERATURE. Absolute. Max.	TEMPERATURE. Absolute. Min.	TEMPERATURE. Mean Values. Max.	TEMPERATURE. Mean Values. Min.	TEMPERATURE. Mean Values. ½ Max. and Min.	TEMPERATURE. Mean Values. Diff. from Normal	TEMPERATURE. Mean. Wet Bulb.	Relative Humidity.	Mean Cloud Am'nt	PRECIPITATION. Am'nt.	PRECIPITATION. Diff. from Normal.	PRECIPITATION. Days.	BRIGHT SUNSHINE. Hours per day.	BRIGHT SUNSHINE. Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0–10	in.	in.			
London, Kew Obsy.	1006·8	− 9·2	53	23	42·6	32·9	37·7	− 3·0	34·3	87	6·5	1·61	+ 0·07	13	2·6	26
Gibraltar	1012·5	− 7·5	67	43	59·8	52·1	55·9	...	53·1	88	6·3	10·89	...	19	...	...
Malta	1009·8	− 6·3	76	41	60·3	51·6	55·9	+ 0·6	51·1	77	6·5	0·72	− 1·48	6	5·5	51
St. Helena	1012·7	+ 0·5	71	57	68·0	59·9	63·9	− 2·0	60·6	90	9·5	1·54	− 1·14	15	...	...
Freetown, Sierra Leone	1011·5	+ 2·4	94	72	87·2	74·5	80·9	− 1·4	75·0	78	6·4	0·02	− 0·28	1	...	...
Lagos, Nigeria	1009·9	+ 0·2	92	74	88·7	77·8	83·3	+ 0·8	77·3	88	6·4	1·54	− 0·36	6	7·1	60
Kaduna, Nigeria	1008·1	− 2·6	97	54	93·4	61·9	77·7	+ 0·8	60·2	50	2·1	0·08	+ 0·06	1	9·1	77
Zomba, Nyasaland	1007·4	− 0·5	83	53	79·6	64·3	71·9	− 0·1	70·6	87	8·3	18·50	+ 7·85	24	...	...
Salisbury, Rhodesia	1009·2	− 1·0	83	56	79·4	61·4	70·4	+ 1·6	63·9	77	8·5	6·41	− 0·41	18	5·3	42
Cape Town	1014·7	+ 1·3	96	46	76·8	58·1	67·5	− 2·8	58·1	70	4·1	0·36	− 0·22	6	...	...
Johannesburg	1009·9	− 0·7	84	48	75·8	55·9	65·9	+ 0·3	58·7	73	5·3	3·56	− 1·66	14	8·1	62
Mauritius	1011·1	+ 0·1	88	70	85·8	73·4	79·6	+ 0·3	75·9	75	5·3	6·92	− 1·48	20	9·0	70
Calcutta, Alipore Obsy.	1012·5	− 0·8	94	55	83·6	61·3	72·5	+ 1·3	63·1	89	3·9	1·05	+ 0·06	1*	...	...
Bombay	1012·2	− 0·5	90	65	82·8	68·6	75·7	0·0	67·9	78	2·9	0·07	+ 0·04	0*	...	...
Madras	1011·6	− 1·3	88	68	85·4	73·2	79·3	+ 1·6	74·5	84	6·2	2·53	+ 2·23	7*	...	...
Colombo, Ceylon	1011·3	+ 0·5	89	69	86·4	73·1	79·7	− 0·7	75·1	70	4·3	4·07	+ 2·13	10	9·8	82
Singapore	1010·5	+ 0·3	90	73	87·7	75·2	81·5	+ 1·3	76·9	80	5·9	1·12	− 5·50	9	7·1	59
Hongkong	1016·0	− 2·6	76	46	64·1	55·9	60·0	+ 0·9	56·7	85	9·2	3·35	+ 1·52	20	1·7	15
Sandakan	1011·2	...	92	72	88·5	74·8	81·7	+ 1·5	77·5	81	7·0	1·62	− 9·35	5	...	...
Sydney, N.S.W.	1015.1	+ 1·2	82	58	75·1	64·6	69·9	− 1·4	65·5	74	8·7	5·05	+ 0·85	16	5·1	40
Melbourne	1014·6	+ 0·1	93	46	79·4	57·4	68·4	+ 0·8	60·8	61	5·5	0·58	− 1·13	8	7·9	60
Adelaide	1014·9	+ 0·7	101	52	83·6	60·6	72·1	− 1·9	60·6	44	5·5	0·82	+ 0·10	4	9·0	68
Perth, W. Australia	1013·4	+ 0·4	104	52	84·2	62·9	73·5	− 0·6	61·1	48	3·1	0·00	− 0·45	0	10·6	80
Coolgardie	1011·4	− 1·1	109	50	89·9	61·7	75·8	− 0·4	63·7	53	2·2	0·12	− 0·73	1	...	...
Brisbane	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Hobart, Tasmania	1015·4	+ 2·2	92	45	72·5	53·6	63·1	+ 0·8	55·7	59	5·2	0·28	− 1·20	7	7·2	52
Wellington, N.Z.	1014·5	− 1·3	79	49	67·5	55·0	61·3	− 1·3	57·8	75	7·4	9·90	+ 6·76	14	5·8	42
Suva, Fiji	1007·7	− 0·1	91	73	87·7	76·3	82·0	+ 1·7	77·2	83	5·8	9·14	− 1·58	20	7·7	61
Apia, Samoa	1007·2	− 1·2	87	74	85·3	76·1	80·7	+ 1·7	77·4	82	7·3	11·72	− 3·57	20	5·7	45
Kingston, Jamaica	1014·4	− 0·9	89	66	85·0	68·0	76·5	0·0	65·8	83	1·4	0·55	− 0·05	4	5·4	47
Grenada, W.I.	1011·4	− 2·1	87	76	85	73	79·0	+ 1·9	73	57	4	1·35	− 1·43	14	...	...
Toronto	1018·2	− 0·2	47	− 3	24·7	10·2	17·5	− 3·6	...	...	6·5	2·79	+ 0·41	13	4·0	38
Winnipeg	1023·0	+ 1·2	18	−43	−4·9	−23·1	−14·0	−14·1	...	...	4·1	1·40	+ 0·66	11	5·2	52
St. John, N.B.	1012·5	− 1·4	42	−10	23·7	8·3	16·0	− 3·9	12·5	69	6·0	0·50	− 3·40	2	5·4	52
Victoria, B.C.	1012·7	− 3·9	49	9	37·5	28·8	33·1	− 7·4	30·2	79	9·6	3·95	+ 0·69	11	3·2	31

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

(33210) Wt. 19/32 1050 8/36 Hw. G.377

M.O. 403.

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Recent Studies on the Mean Atmospheric Circulation—II Upper Air Data

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

In the *Meteorological Magazine* for June a number of recent studies of resultant winds and stream lines at the earth's surface were combined to give pictures of the general movements of the lowermost air masses over a considerable area of the earth. When we extend these studies to the upper air it is not practicable to adopt the same procedure, partly because the data available are not yet sufficient, especially over the oceans, and partly because maps of a series of different levels cannot be readily compared unless they are superposed, in the form of a solid model. Hence it seemed better to represent the available data in the form of a series of sections of the atmosphere, running from north to south, for regions where the density of stations is sufficient. This form of diagram was adopted by H. Hubert (1) for the system of upper air currents up to a height of 10 Km. above west Africa, between 22° N. and 5° S., in January and August. Hubert's diagrams are reproduced in Fig. 1.

Hubert shows four main systems of wind, the NE. trade (alizé), which is limited to the extreme north in January and is very shallow, the SW. monsoon (mousson) which is likewise shallow and extends across the equator to about 5° N. in January and 20° N. in August, the great easterly equatorial current, part of which forms the Harmattan, and, in January, the south-westerly anti-trade (contre-alizé). Disregarding the trade wind and monsoon, which are shallow surface phenomena, we find that the great mass of the atmosphere above west Africa is divided into two main systems, an equatorial current, predominantly easterly, and a current in higher latitudes, predominantly westerly. In January the boundary between these two runs from 20° N. above the trade wind at a height of 2 Km. to 5° N. at a height of 9 Km. In August on the other hand the

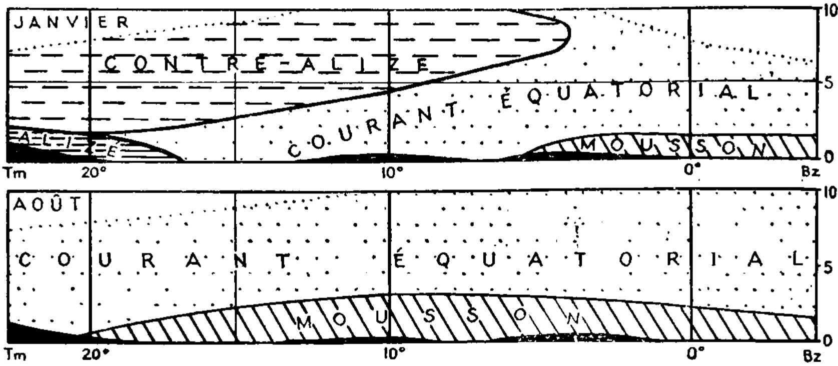

FIG. 1.—WEST AFRICA.
Reproduced from Sur les limites des courants aériens dans l'Afrique de l'Ouest. By H. Hubert, *Paris, C.—R. Acad. Sci.*, **202,** 1936, pp. 1695–7.

easterly current occupies the whole thickness of the atmosphere above the monsoon as far as the limit of the section in 22° N.

Three pairs of diagrams have been prepared for comparison with Hubert's, representing winter and summer conditions over India, eastern North America and eastern Africa. The method of representation was rather a problem. The first attempt was by conventional resultant arrows representing the direction, the plane of the paper being supposed flat and extending from east to west, but since the plane of the paper also represented a vertical section extending from north to south, the result was most confusing. Hubert uses shading and stippling with names of the winds printed across; the shading represents the facts and the names the interpretation, but here it seemed better to give the facts only. The method adopted was accordingly shading in four directions to give the four cardinal points, diagonal for east and west winds, vertical for north, horizontal for south, the closeness of the shading being roughly proportional to the strength and steadiness of the resultant winds. Intermediate directions are shown by the crossing of the shading lines, and definite discontinuities, where such appeared, by broken lines. The solid base represents the smoothed contours on the same scale. The vertical scale is about 275 times the horizontal.

Fig. 2 shows sections over India (2) and Ceylon (3), extending from 35° to 5° N, along the line Peshawar–Agra–Bombay–Madras–Colombo. In winter (December–February) the greater part of the section is occupied by westerly winds, becoming north-westerly near the surface. The boundary between the westerly and easterly currents extends from about 20° N. near the ground to about 8° N. at 10 Km., agreeing closely with the limits in west Africa. Above 4 Km. it is quite definite, but below that height a belt of southerly winds comes between the two main currents.

In summer (June–August) the boundary between the westerly and easterly currents is nearly vertical above 2 Km. in about 30° N. (outside the limit of Hubert's section) while in the south the westerly monsoon extends as far north as 20° N., separated from the easterly upper current by a belt of rather indeterminate winds. The general conditions over India thus resemble those over west Africa rather closely.

Fig. 3 shows similar sections over eastern North America between latitudes 52° and 10° N., along the line Newfoundland (4)–eastern U.S.A. (5)–Porto Rico (6)–Columbia (7); data for the last are available only for summer. In winter almost the whole section is occupied by the westerly current, the equatorial easterly current extending only from the surface in 28° N. to 5 Km. in about 17° N. In contrast to west Africa and India the boundary of westerly and easterly winds at the surface migrates only a short distance north in summer, but it is nearly vertical instead of sloping southwards as in winter. Above Porto Rico there is a curious intercalation of north-westerly winds above 6 Km. in summer, which may be due to the difference of longitude between Florida and Porto Rico.

Both in India and North America the sections are limited to the northern hemisphere. In eastern Africa (Fig. 4) it is possible to carry them right across the equator along the line Egypt–Sudan–Nairobi (8)–Rhodesia–South Africa (9). The upper diagram shows the conditions in the northern winter (December–February). The solid easterly current on both sides of the equator is clearly seen. The circulation is roughly symmetrical about a vertical in 5° S., but below 3 Km. a belt of northerly winds is intercalated between the easterly and westerly winds in both hemispheres. In the southern hemisphere only there is also a belt of southerly winds in about 24° S. from 3 to 7 Km. In the northern summer (June–August) the centre of the easterly current has moved northwards to about 5° N., but the symmetry is marred by a layer of winds from SSW. from the surface to 2 Km. in the Sudan, while the main westerly current fails to reach the ground even in the north of Egypt. In Rhodesia and South Africa the solid westerly current is well shown.

In eastern Asia the data are not yet sufficient to draw a continuous section, but at Hong Kong in 22° N. (10) results obtained over a long period show that in winter easterly resultant winds extend from the surface to a height of little more than 1 Km., while from 2 Km. upwards westerly winds steadily increase in frequency and strength. In summer on the other hand winds are indefinite up to a height of 3 Km. above which easterly winds predominate to the limit of sufficient observations at 8 Km.

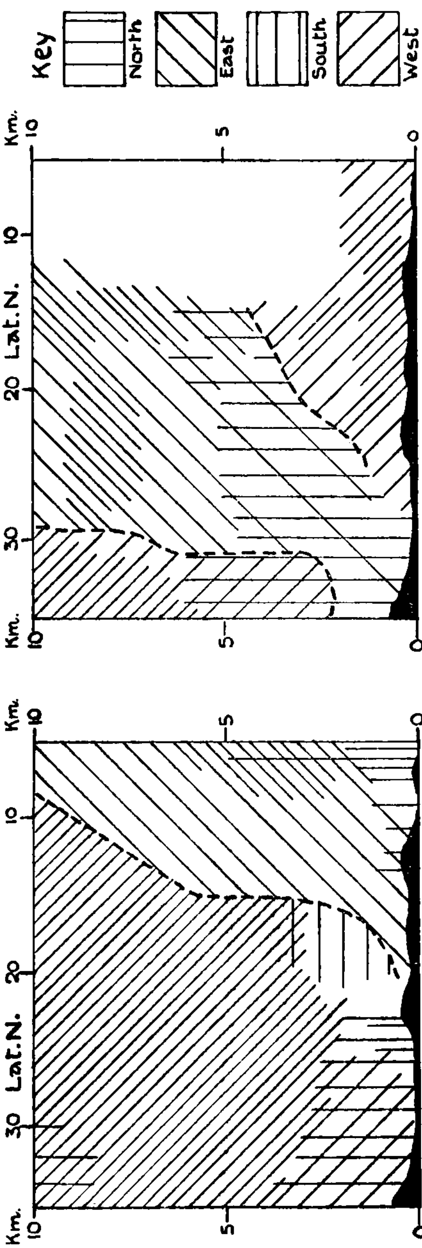
Key
North
East
South
West
INDIA, JUNE - AUGUST
INDIA, DECEMBER - FEBRUARY
Lat. N.
Km.

FIG. 2

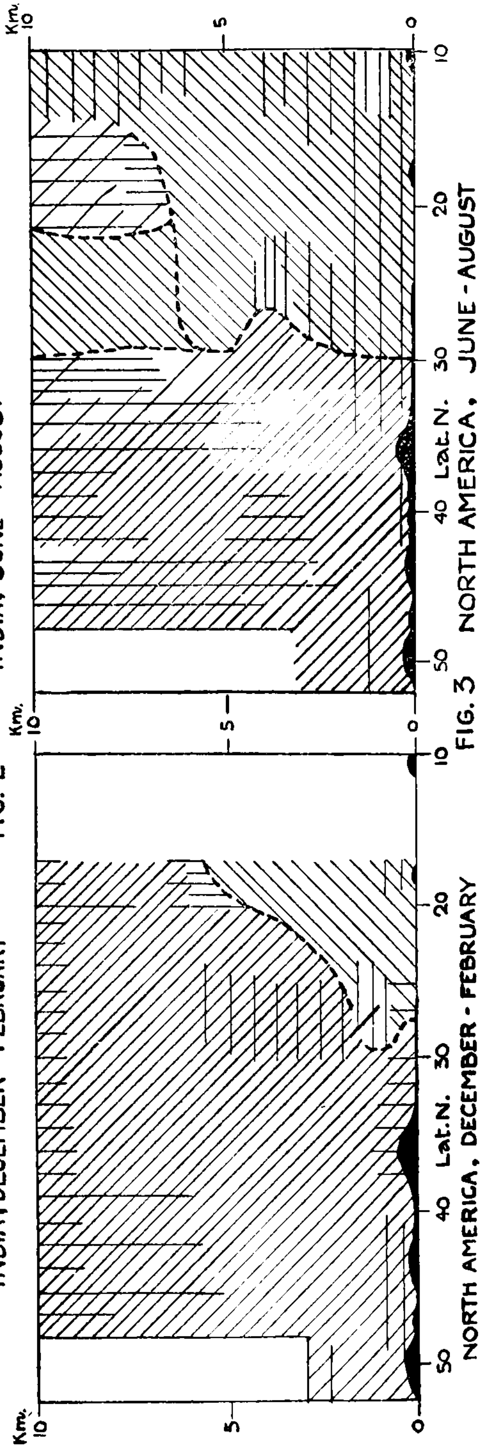
NORTH AMERICA, JUNE - AUGUST
NORTH AMERICA, DECEMBER - FEBRUARY
Lat. N.
Km.

FIG. 3

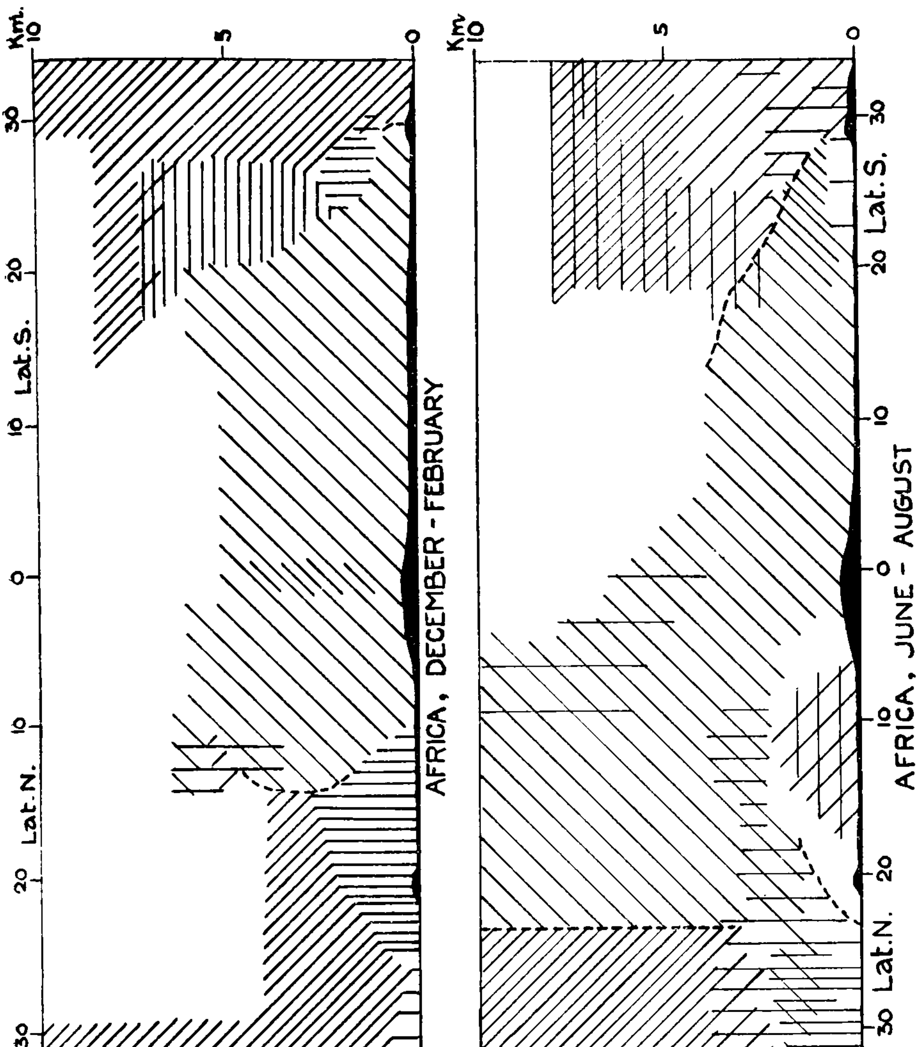

FIG. 4.

Similar changes, with due allowance for the reversal of the seasons, are seen at Samoa in latitude 14° S. in the South Pacific (11). In the southern summer (January–February) the easterly current extends from sea level to a height of 9 Km., above which it is replaced by a wind from north-west. In the southern winter (July–August) the easterly current though much stronger at the surface, is shallower, being replaced by a west wind above 4 Km.

It is evident that all these sections show a great degree of similarity, the boundary between the westerly and easterly currents sloping upwards towards the equator with only relatively slight differences of latitude in different parts of the globe. The approximate limits in winter (of the hemisphere concerned) are brought together in Fig. 5, in which the heights at which the boundary is crossed above Hongkong and Samoa are also shown. On the average, the boundary seems to extend roughly from 25° lat. at the surface to 7° lat. at a height of 8 Km., at a fairly uniform slope of about one in 250. In summer the limits are all shifted towards the poles, generally by about ten degrees, and the slope apparently becomes steeper, but the material available is not sufficient to construct a diagram similar to Fig. 5 for this season.

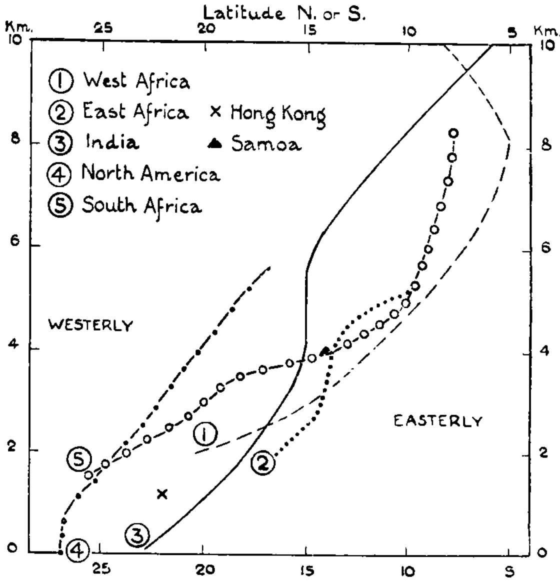

FIG. 5

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The Smoke Pall of England

On the morning of February 13th, 1936, an anticyclone lay off the north-east coast of England giving very light winds from E. and SE. over almost the whole of England. The night sky had been nearly unclouded except in the south-west and a considerable inversion was present in the lowest layers in the morning (as was shown by an aeroplane ascent at Duxford). Under these conditions smoke spread out to west and north-west of the points at which pollution was being generated. The general distribution of pressure and wind at 7h. on that morning is shown in Fig. 1, the arrows in which figure represent the surface winds with flèches to indicate the speed by the Beaufort Scale. It should however be remembered that the wind at about 1,000 feet will flow more nearly along the isobars. From the observations made at Duxford it appeared that the smoky layer there at any rate was confined to about 1,000 or 1,200 feet, though the inversion extended to greater heights.

PRESSURE DISTRIBUTION, FEB 13, 1936. 0700.

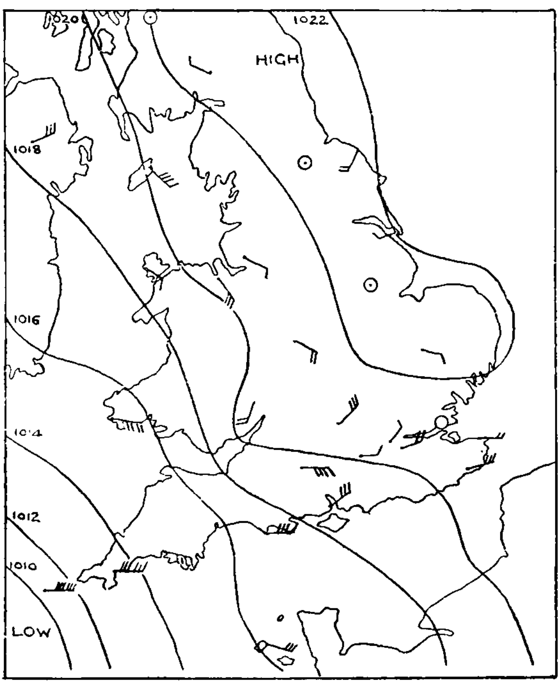


FIG. 1.

In order to see how far the smoke of industrial areas affected the visibility, the individual observations made for the fog and mist investigation were plotted for this day. These observations (a short note on which was published in the *Meteorological Magazine* for May, 1936, p. 83) are made about 9h. each day by a considerable number of observers scattered over the British Isles, and about 800 observations were plotted in the preparation of Fig. 2 in England and Wales alone.

It is thought that the result which represents the first fruits of this investigation is of sufficient interest to warrant reproduction in Fig. 2. In this map the various degrees of visibility prevailing

AREAS WITH POPULATION OVER 500 PER SQ. MILE.

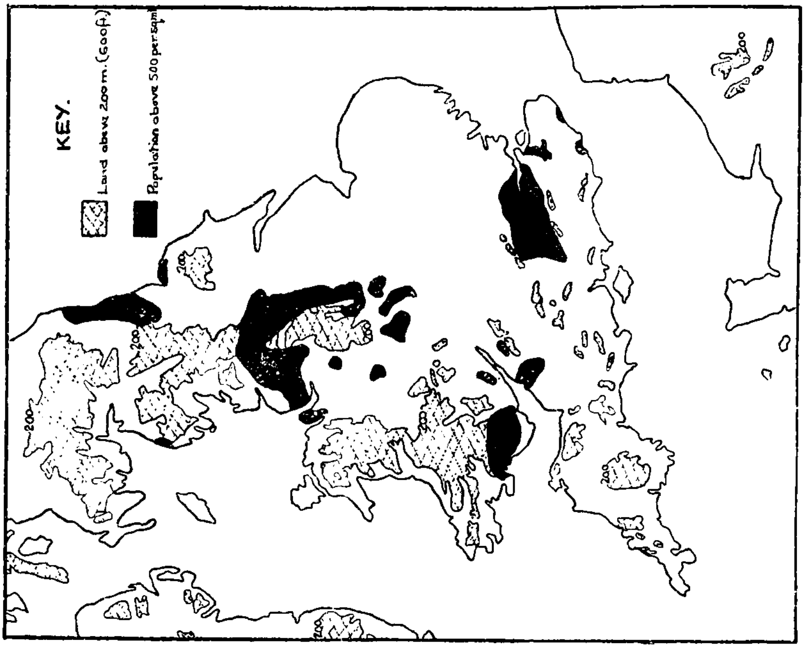


FIG. 3.

VISIBILITY DISTRIBUTION. Feb. 13th 1936.

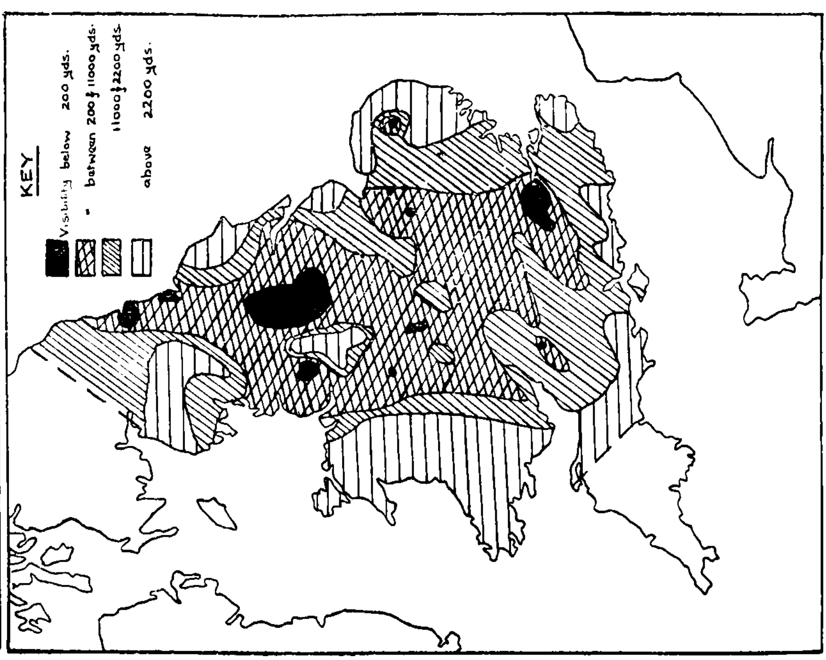


FIG. 2.

in different areas are shown by different shadings, the most intense shading covering those localities where horizontal visibility was below 200 yards, the next most intense where it was generally between 200 and 1,100 yards, a lighter shading those in which it was generally 1,100 and 2,200 yards and the lightest those in which it was more than 2,200 yards. In Fig. 3 is shown those districts where the population exceeds 500 to the square mile and hence shows roughly where pollution chiefly originates.

The comparison of these three figures brings out very forcibly how intimately visibility is associated with smoke.

London on that morning was a black spot but it was very noticeable how rapidly visibility improved in the south-east as soon as the area of dense population was left behind. There was a large area of visibility below 200 yards in the Leeds–Sheffield area and Manchester, Birmingham, Newcastle and Hartlepool each had their own gloom. Even Norwich had a little patch of dense fog with foggy conditions extending a little way outside. It was however noticeable that the Welsh coalfield and the Bristol area were comparatively clear, though Swindon achieved a dense fog patch of its own. In contrast with the industrial areas East Anglia though below the central portion of the anticyclone was free of fog and the same was true of most of the counties south of the Thames except where they were affected by London smoke. Visibility in Wales was almost uniformly above 2,200 yards. Even leaving aside those places where visibility was very bad, such maps as these must impress one how the smoke from densely populated areas is spread far and wide over the countryside, and by contrast between East Anglia and the Midlands one must realise how often we must artificially bring down on even country districts the fog which foreigners imagine is the natural propensity of these islands.

C. S. DURST.

Smoke Abatement Exhibition at the Science Museum

This exhibition has been organised by the National Smoke Abatement Society of Great Britain, with the co-operation of interested Government Departments and industrial associations. Its purpose is to illustrate the nature and effects of the pollution of our atmosphere by coal smoke and the scientific means now available for investigating the pollution and preventing it.

The smoke problem is as old as the use of coal for heating purposes, but research in pure and applied science has now shown ways in which raw coal can be burned smokelessly or can be so treated by high or low temperature carbonisation that a smokeless fuel is produced.

The exhibition is divided into three main sections dealing respectively with the effects, measurement and abatement of atmospheric pollution. The " effects " section includes a number of exhibits illustrating the destruction wrought by smoke upon vegetation, stonework and metals, while a reminder of the effect upon human beings is given by specimens of polluted lungs and by diagrams showing the effect of smoke pollution upon the death-rate in an industrial town during a severe smoke fog. The amount of sunlight, cut off by the smoke pall over large towns is also well shown.

Exhibits contributed by the Department of Scientific and Industrial Research show the way in which the products of combustion of various fuels are investigated in the laboratory, and how the constituents of polluted atmospheres are measured at a large number of stations distributed all over the country.

In the "abatement" section, methods of smokeless heating for industrial and for domestic purposes are shown in two separate series of exhibits, including, on the domestic side, a group of model houses each fitted with entirely smokeless heating appliances.

The formal opening of the exhibition will take place on Thursday October 1st, 1936, and the exhibition will remain on view to the public from October 2nd to 31st inclusive. A guide to the exhibition has been prepared, price 6*d.*, which will contain a description of the exhibits in catalogue form and a series of articles on the most important aspects of the smoke problem, together with communications from correspondents on the progress that is being made in other countries.

Discussions at the Meteorological Office

The series of meetings for the discussion of recent contributions to meteorological literature, especially in foreign and colonial journals, will be resumed at the Meteorological Office, South Kensington, during the session 1936-7. The meetings will be held on alternate Mondays at 5 p.m., beginning on Monday October 19th, 1936, when Sir George Simpson, K.C.B., D.Sc., F.R.S., will open the discussion of a paper by T. Bergeron entitled "On the physics of cloud and precipitation" (*Paris, P.V. Mét. Un. géod. géophys. int. Lisbon,* 1933. *II. Memoires et Discussions,* 1935, pp. 156-70).

The dates for subsequent meetings are as follows:—

November 2nd, 16th and 30th, December 14th, 1936; January 18th, February 1st and 15th, March 1st and 15th, 1937.

The Director of the Meteorological Office wishes it to be known that visitors are welcomed at these meetings.

Correspondence

To the Editor, *Meteorological Magazine*

Diurnal Temperature Range of 50·9° F.

On August 29th, 1936, an exceptionally great diurnal range of temperature was recorded at the Rickmansworth climatological station, where both the character of the soil (sand and gravel over chalk) and the situation near the bottom of an enclosed valley tend to induce extremes of cold and heat during the prevalence of quiet, clear weather. The lowest and highest readings of the thermometers in the standard screen were, respectively, 34·0° F. and 84·9° F.; from the thermograph exposed in a smaller Stevenson screen, 15 ft. south of the other, they were 35·3° F. and 84·6°F. According to the trace of this instrument, the minimum occurred at about 5h. 45m. (G.M.T.) and the maximum at 14h. 30m. There was thus a variation over 50·9° F. in approximately 8¾ hours. Hitherto, the greatest diurnal range registered at the station was one of 47·7° F. on March 28th, 1933 (see the issue of this magazine for April, 1933, p. 64).

On August 29th, 1936, eye observations were made hourly from 9h. to 13h., from 15h. to 19h., and from 21h. to 23h. These are given below, together with corrected values taken from the thermograph chart for the remaining 11 hours of the 24 (the actual figures on the trace are about 1° F. higher to 6h.):—

Time. G.M.T.	Temp. ° F.	Time. G.M.T.	Temp. ° F.	Time. G.M.T.	Temp. ° F.
1h.	38·8	9h.	70·7	17h.	79·7
2h.	37·9	10h.	74·1	18h.	69·2
3h.	36·2	11h.	78·0	19h.	56·8
4h.	35·1	12h.	80·9	20h.	51·1
5h.	34·4	13h.	83·0	21h.	47·7
6h.	35·5	14h.	84·5	22h	46·6
7h.	46·7	15h.	84·5	23h.	45·7
8h.	58·3	16h.	83·1	24h.	44·1

The extreme readings of the radiation thermometers were 26·3° F. and 150·4° F.

Hertfordshire lay within the central region of a large anticyclone on August 29th. The wind at Rickmansworth was variable in direction and very light, falling dead calm at intervals. Except for a few small patches of lenticular cirrocumulus between about 18h. and 20h., no cloud was seen throughout the day. Ground fog prevailed from before dawn to just after 6h., haze to 10h., and slight haze to 11h.; thereafter, visibility remained good until evening, when some valley mist began to form. Relative humidity decreased from 56 per cent at 9h. to 28 per cent at 13h. The duration of sunshine, 12·6 hrs., represented about 91 per cent of the "possible."

August 30th, 1936, gave a minimum temperature of 39·5° F. and a maximum of 81·3° F. This was the 67th day since May, 1929, on which the diurnal range has reached or exceeded 40° F. at the Rickmansworth climatological station. It is noteworthy that the eight Augusts have accounted for as many as 23, or 34 per cent of these occasions. The next most prolific months have been July with 13 instances, and June with 11.

E. L. Hawke.

Caenwood, The Valley Road, Rickmansworth, Herts. *September 1st,* 1936.

The Heat Wave of July 13th, 1808

Mr. J. E. Clark's note on the above reminds me that some years ago a letter appeared in *The Times* signed by the Rev. A. R. Tucker, then at North Thoresby, Lincs, in which he mentions " an interesting conversation which I had recently with an old man concerning the great drought of 1868, who informed me that his grandfather frequently mentioned to him about ' Hot Wednesday ' which he thought was a year or two after 1800, when men and animals in great numbers succumbed under the pressure of the excessive heat. For years afterwards this day was talked of as ' Hot Wednesday '." July 13th, 1808, seems to have been a Wednesday.

CICELY M. BOTLEY.

17, Holmesdale Gardens, Hastings, August 19th, 1936.

With reference to the article in this month's *Meteorological Magazine* " The heat wave of July 13th, 1808 " I find the following in " Howard's Climate of London."

" July 13, 1808. Temperature at 9 a.m. 84°. The intense heat of the maximum lasted nearly three hours till about 4 p.m. At 6 p.m. temperature 90° after which it declined rapidly. The shade maximum for the day was 96° ".

The above observations were taken at Plaistow near London.

H. K. G. ROGERS.

Seaforde, Mary Tavy, near Tavistock, Devon, August 20th, 1936.

Low Rainfall Total for August

The total rainfall in August at Hinton St. George, Somerset, was 0·11 in. Although there were only 6 rain-days there was no period of drought. The longest rainless period was the 12 days from the 20th to the end of the month. The largest fall on any one day was 0·03 in. on the 3rd. This very low total is far below any month's record during the past three years here.

It would be very interesting to know if any lower totals for August have been recorded by other observers.*

J. M. BRIERLEY.

Springfield, Hinton St. George, Somerset, September 7th, 1936.

Tree Struck by Lightning

A case of a tree being struck by lightning was brought to my notice last week by Mr. L. J. Cutbill, Chemist at the Cheshire Joint Sanatorium, Market Drayton.

The tree was struck on Sunday, June 21st, 1936, during one of the two severe thunderstorms experienced on that day. The tree was situated in the centre of a wood and a strip of bark three inches wide was torn off for the whole length of the tree. The strip described

* See the August totals for Teignmouth, Weymouth and Sidmouth given on p. 198.—Ed. *M.M.*

one half revolution about the trunk so that at the bottom it was diametrically opposite the point at which the removal of bark commenced. In addition to the removal of bark the wood beneath was torn out for a depth of 1 to 1½ inches. Apart from the removal of bark and wood the tree was not split in any way, nor were there any signs of burning.

W. D. FLOWER.

Meteorological Station, R.A.F., Sealand, Chester, August 18th, 1936.

A Lunar Glory

Last night, September 3rd, going upstairs soon after 10 o'clock, I saw that there was round the moon a marked " glory," 4° or more across, of a clear, rather dark-blue tint, and remarked its exceptionally even tone from centre to circumference.

This morning my sister, Mrs. Edith Hinde, brought me a written description of what she had seen on waking later in the night through her south window, presumably therefore about 2 or 3 a.m. :—" A wonderful circle round the moon, first a bright ethereal dark blue as wide as half the circumference of the moon ; then a circle of blue green, followed by a very narrow line of red. It was marvellous, only it was all too soon past." She had gone to the window attracted by the brilliant moonlight. The sky had been very clear down to the horizon at sunset and about 6·45 I had noticed the marked visibility of the Mendips wall, eight miles off where nearest. Clouds supervened later on and smart rain began before 6 (B.S.T.) this morning.

J. EDMUND CLARK.

Portway, Street, Somerset, September 4th, 1936.

"False Dawn"

I write to describe a phenomenon which much interested me. On the night January 6th–7th, 1933, I had occasion to proceed from London to Torquay. I left London at 1 a.m. precisely and travelled by car by the main road, i.e. A.30. The night was very dark and at Bagshot I ran into a storm area, heavy rain and gusts of wind. I reached Shaftesbury, 101 miles, between 4.30 and 5 a.m. I cannot give exact times but I have driven over this road many times and have often had to plan my departure from London so as to reach certain places in Somerset and Devon at certain times, so that in actual fact the times will be only a few minutes out, one way or the other. Descending the hill from Shaftesbury, where in daylight you get such a magnificent view westward, I could see nothing of the surrounding country owing to the darkness. I proceeded for a few miles and then stopped for a short halt, and whilst I cannot name the exact spot it was a small village and geographically would correspond with East Stour, i.e. between Shaftesbury and Milbourne port.

I got out of the car and found the rain had ceased and strolled up and down for a few minutes, when I suddenly realised that it was getting light, and at first I thought it was the dawn, but knowing it was only about 5 a.m. I realised I was mistaken, but very unfortunately I cannot give exact times. But the time was almost certainly about 5.10 a.m. It became so light that I was able to see the surrounding countryside. I could see the Dorsetshire hills sufficiently plainly to see that the clouds lay on their tops and that they were clear below, and I was able to turn off my headlights. The light was a general diffused light with no apparent focal point but I should say it was lighter towards the south and east, although I could quite well see towards the north and west—and here again I failed to note times; but this condition lasted probably for about 20 minutes, after which period, and about as suddenly as it appeared, it became quite dark again. I had to switch on my headlights and keep them on until Fairmile, which is 10 miles short of Exeter, at about 7.30 a.m., when the true dawn commenced. The other I can only call a "False Dawn". I have many times read of it, chiefly in seafaring stories, and have asked many people but found none who have seen it. There was nothing remarkable about it beyond the fact that it became light about two hours before dawn was due, as at that time sunrise is about 8.4 a.m., and then became quite dark again. J. H. CUMMING.

35c, Queen's Gate, London, S.W.7, June 8th, 1936.

NOTES AND QUERIES

Pilot Balloon Ascent near Duststorm.

A rather interesting pilot balloon ascent was made at Heliopolis during the late afternoon of June 11th, 1936. Several small Khamsin depressions with a well-marked cold front were moving eastwards and dust rising had been forecasted for the late afternoon. Temperature was high, the day maximum being 110° F., and the temperature at 16h. G.M.T. (6 p.m. local time) 108° F. A pilot balloon ascent at 12h. 40m. G.M.T. showed very light winds, 5–15 m.p.h. up to 6,000 ft. —the wind had already become almost westerly on the ground but backed to SSW. at 6,000 ft. There was a marked upward current—the average up to 6,000 ft. being 200 ft./min.

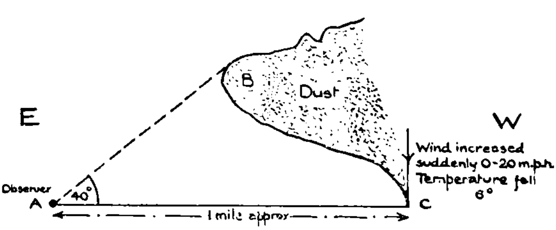


FIG. 1.

At 16h. dust was seen to the west—it had a buttressed appearance similar to that of a Sudan Haboob (vide *London, Quart. J. R. met. Soc.*, 57, 1931, facing pp. 148 and 149). At 16h. 25m. the appearance of the dust was as in Fig. 1. At this time a balloon was released from A ; the dust at B was overhead at 16h. 28m. and the front at C passed at 16h. 31m. The balloon showed that the wind up to 3,000 ft. had changed to NW. and above this height it backed rapidly. Unfortunately it was impossible to see the tail after five minutes, but in order to get reasonable values of the wind above 3,000 ft., i.e., to make them roughly similar to those in the previous ascent, it is necessary to assume an upward current of 400 ft./min.

Complete details of the 16h. 25 m. G.M.T. ascent are as follows :—

Time.	Height.	Vertical Velocity.	Resultant Wind.	
			Direction.	Speed.
min.	ft.	ft./min.	°	m.p.h.
0	0	..	..	Calm
1	620	+120	311	8
2	1,160	+ 40	304	8
3	2,080	+420	299	14
4	3,100	+520	297	10
5	4,060	+460	270	10
6	(5,000)	(+440)	270	8
7	(5,900)	(+400)	225	3
8	(6,800)	(+400)	189	3

This shows that vigorous convection was taking place above 2,000 ft. where the warm air was being pushed up by the advancing wedge of cold. Behind the front at C there was little evidence of any downward movement in the cold air, i.e., the wind increased suddenly from 0–20 m.p.h. in a gust and then continued for some time 10–12 m.p.h. The lack of downward movement may explain why the duststorm did not develop to any extent near Cairo—the visibility not falling below 1,100 metres at any time.

J. DURWARD.

REVIEWS

Probleme der Kosmischen Physik. Edited by Dr. C. Jensen. Band XVI. Die Wolken. By R. Süring. Size 9¼ in. by 6¼ in. pp. x + 122. *Illus.* Leipzig Akademische Verlagsgesellschaft m.b.H. 1936.

The first thing that strikes one on opening this very unusual book is that there are very few photographs, or even diagrams. Indeed the chapter (Ch. II) in which the cloud types are defined is quite unillustrated. But the author has a great contempt—as anyone reading the preface will perceive—for books which degenerate into mere illustrated catalogues of clouds. He refers the reader to the International Cloud Atlas ; which is hardly logical. If one has a cloud atlas, Herr Süring's second chapter is superfluous, if one has not, it is, at any rate, not entirely comprehensible, since nobody supposes that it is possible to identify all the cloud types from definitions, however full and careful. This, however, is no great matter, and the difficulty which the photograph problem presents to a writer on this subject is sufficiently obvious.

The book is volume 16 of the series "Probleme der Kosmischen Physik," edited by Dr. Christian Jensen. It is not intended to be a text-book—is indeed, almost the exact reverse of a text-book. Its object, as stated in the preface is "to attract amateur and professional meteorologists once more to the observation and investigation of clouds." This object the author obviously kept in mind during the writing of every page; and although the book is in form a short outline of our knowledge of clouds, the author has devoted his energy especially to showing how great and numerous are the gaps in that knowledge, and to suggesting lines for future research.

"Amateur and professional." One has only to study the chapter on instruments and methods of observation to see on which side the author's sympathy lies. There is no account of sounding-balloon or other aerological apparatus such as is necessary (as often pointed out in this book) for the solution of many cloud problems; but there is much homely advice on the selection of cameras, the use of light filters, and even methods of developing negatives. Indeed the real message of the book is this—that there is a great deal of valuable work awaiting anybody who can use a camera and, perhaps, a home-made nephoscope. This is a somewhat revolutionary doctrine, but salutory. In meteorology, more than in any other science, the lion's share has fallen to the professional in overwhelming measure. In all its most interesting branches it is today practically a Civil Servants' science. To encourage the amateur—which means to show him something that he can feel sure is genuinely useful to do—is one of the great needs of meteorology; and if this book has anything like the success in this direction which it deserves, it may prove of more importance than many more pretentious works.

It is perhaps further evidence of the author's affection for the amateur that all the usual interruptions of the text of a scientific work—mathematics, tables, complicated diagrams—have been reduced to a minimum. The text has indeed almost the continuity of an essay; a fact which, combined with the great clarity of the style, makes the whole book exceptionally easy reading for a scientific work. As might be expected in a book which aims at provoking further study, there is a full bibliography at the end of each chapter.

From the professional meteorologist's point of view the best chapters—they form nearly half the book—are II and IV. In these the relationship between cloud form and physical causes is examined. The matter is not new, but it is a very complete and concise account of the subject, and where theory is dealt with the criticisms are admirable. It is unfortunate that Chapter IV contains a diagram (on p. 70) which is, to say the least, inaccurate.

One small complaint about the covers. They are of light grey cloth, and attract dirt in a manner unique in my experience.

B. C. V. ODDIE.

India Meteorological Department, Scientific Notes, Vol. VI, No. 65.—*The thermal structure of the upper air over a depression during the Indian south-west monsoon.* By N. K. Sür.

In this publication the author makes another of his valuable contributions to our knowledge of the thermal structure of depressions which cross the Indian Peninsula during the south-west monsoon.

Four sounding-balloon ascents were made at Agra during the approach of one of these depressions. It was found that as the intensity of the depression increased the temperature at upper levels below the tropopause decreased. As the depression deepened further and became stationary near Agra the fall of temperature between 8 and 12 Km. ceased and the level of the tropopause above the depression was lowered, with an increase of temperature in the lower stratosphere, and a decrease at levels immediately below the tropopause. These phenomena are explained as being due to the divergence of air of the troposphere just below the tropopause and the sucking down, accompanied by heating, of the air of the lower stratosphere.

There were also indications that the cyclone underwent some process of occlusion similar to that experienced by an extra-tropical cyclone, but apart from this there does not appear to be a very close analogy betweeen the two.

It is to be hoped that in the near future the structure of a monsoon depression will be more fully investigated by means of " serial " ascents, as has been done by Prof. J. Bjerknes in the case of the extra-tropical depression.

R. G. VERYARD.

BOOKS RECEIVED

Ergebnisse Aerologischer Beobachtungen, 22, 1933, and 23, 1934, and 22A. Aerologische Beobachtungen und Terminbeobachtungen in Angmagssalik während des Internationalen Polarjahres 1932-1933. K. Ned. Meteor. Inst. (No. 106A) Utrecht 1934 and 1935.

Onweders, optische verschijnselen, enz. in Nederland. Naar vrijwillige waarnemingen in 1932 and 1933. Deel LIII and LIV, Utrecht, 1934 and 1935.

OBITUARY

Dr. Nanabhai Ardesher Framji Moos, L.C.E., F.R.S.E.—We regret to learn of the death on March 12th, 1936, of Dr. N. A. F. Moos at the age of 77. Dr. Moos was born on October 29th, 1859, and took his degree in Engineering at the Poona College of Science in 1878. For five years he served on the staff of that College after which he came to Europe and took his degree at Edinburgh University. A little time after his return to India he became Professor of Physics at Elphinstone College, Bombay, and in 1896 he was appointed Director of Bombay Observatory, a post which he held until his retirement in 1919.

Dr. Moos was chiefly interested in terrestrial magnetism and seismology, and he published in addition to the usual observational data, a large number of valuable discussions on these and other allied data, amongst which may be mentioned "Colaba Magnetic Data, 1846–1905." It was while he was Director that the magnetic work of the Bombay Observatory was moved from Colaba to Alibagh, about 19 miles to the south-east of Bombay, and he also set up the Time Ball Observatory at Karachi. Besides his official and scientific work, Dr. Moos took a prominent part in the University and civic life of Bombay.

We regret to learn of the death on July 24th, aged 61 years, of Mr. C. F. Talman, meteorologist in the United States Weather Bureau since 1922.

NEWS IN BRIEF

We learn that Dr. Jan Blaton has been appointed Director of the Polish National Meteorological Institute as from May 1st, 1936, in succession to Dr. Ing. Jean Lugeon, who has retired.

The Weather of August, 1936

Pressure was below normal over the central United States, Labrador, Greenland, Iceland, Spitsbergen, northern Scandinavia, eastern Mediterranean, Greece, south-west Asia and in the neighbourhood of Madeira, the greatest deficits being 1·9 mb. near St. Louis, 5·9 mb. at Myggbukta, and 4·1 mb. near Erzerum. Pressure was above normal over most of Canada, western and eastern United States, the North Atlantic including Bermuda and the Azores, most of Europe and north-west Siberia, the greatest excesses being 5·8 mb. at Kodiak, 5·6 mb. at Valentia and 8·6 mb. at Ekaterinburg. Temperature was generally above normal in northern Europe and Spitsbergen but below normal in central and south-west Europe. In Sweden rainfall was in excess in west Norrland and east Svealand but about or below normal elsewhere.

The weather over the British Isles during August was generally dry with cloudy cool conditions at first, becoming warm and sunny later. Rainfall was considerably below normal in most districts, many new low records being set up in the south; at Ross-on-Wye and Holne (Devon) the totals of 0·16 in. and 0·52 in. were the lowest for August since records began in 1859 and 1875 respectively. Sunshine records were above normal in many districts, but early morning mist or fog occurred frequently. From the 1st to 4th depressions moving across the country gave rise to unsettled weather generally, with strong westerly winds locally on the 2nd and 3rd ; 1·49 in. of rain fell at Kirkwall, Orkneys, on the 2nd and 1·14 in. at Falconhurst, Kent, on the 1st. On the 4th thunderstorms occurred at several places in north-east and east England, but locally there was much sunshine. A ridge of high pressure crossed the country on the 5th, followed by shallow disturbances on the 6th to 7th, when dull, cool, unsettled conditions with rain prevailed generally, 1·85 in. was measured at Festiniog (Merioneth) on the 5th and 1·25 in. at East Ayton (Yorkshire) on the 6th, while day temperatures did not exceed 54° F. at Edinburgh and Marchmont on the 6th. On the 8th a wedge of high pressure extended across the south of the country spreading north until the 10th and giving fairer, warmer weather, though some rain was experienced in Scotland and on the 8th in Ireland. The 8th was generally a sunny day with over 12 hours' bright sunshine at most places in north and south-west England—14·0 hrs. at Morecambe. Thunderstorms occurred locally on the 10th accompanied in some cases by heavy rain, 1·97 in. were recorded in just over 1½ hrs., of which 1·50 in. fell between 18h. 15m. and 19h. 15m. at Leyland (Lancashire). From the 11th to 14th the weather was mainly cloudy, somewhat cooler but with some sun each day, while thunderstorms were reported locally on the 11th and 12th, 2·60 in. of rain fell in a thunderstorm between 5.30 and 6.45 on the 12th at Leatherhead (Surrey). The 15th was generally sunny in England, though thunderstorms were again experienced in north England. From the 16th to 24th pressure was high to the south, but a complex low pressure area to the north-west and north with secondaries passing across the British Isles brought alternating periods of rain and sun though only occasionally did these affect the south-east and east where for the most part fine sunny warm weather prevailed with temperatures locally above 80° F. on the 16th and 17th, and sunshine totals in excess of 12 hours at many places on the 16th, 17th and 22nd to 24th—13·4 hrs. at Margate on the 17th and 13·5 hrs. at Weymouth on the 22nd. On the 19th, however, rain was general over the whole country and temperature low, not reaching 60° F. in parts of the Midlands and Scotland, 2·35 in. of rain were measured at Festiniog (Merioneth). In the north and west during the rest of this period the rain, though frequent, was usually slight and there were many hours sunshine, Aberdeen had 12·0 hrs. on the 18th and Tiree 11·5 hrs. on the 21st. From the 25th to 28th the anticyclone to the south spread over the whole country and warm sunny weather was experienced with temperatures exceeding 70° F. generally and rising above 80° F. on the 29th in the south and Midlands, while sunshine records frequently exceeded 11 or 12 hours. On the 29th to 31st a depression to the north-west brought cloudy conditions and slight rain to north Scotland and Ireland, but in the south and east the fine sunny weather continued. The distribution of bright sunshine for the month was as follows :—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway ...	98	−33	Chester ...	180	+26
Aberdeen ...	177	+38	Ross-on-Wye...	185	+18
Dublin	169	+13	Falmouth ...	230	+32
Birr Castle ...	129	− 9	Gorleston ...	185	−10
Valentia... ...	147	− 3	Kew	185	+ 2

Miscellaneous notes on weather abroad culled from various sources

Drought and intense heat prevailed generally in Russia at the beginning of the month and duststorms were experienced in the neighbourhood of Moscow. During the first two or three days snow fell generally on the Alps down to the 4,200 ft. level and nearly 2 ft. of fresh snow were recorded at 6,000 ft. Many lives were lost and wide-spread damage done as the result of a severe storm which swept across north-east Poland on the 6th. Between the 1st and 10th vast forest fires were reported in the districts of Archangel, Vologda, Kargopol and Komi. Intense heat was also the cause of forest fires in the Moscow district, and of forest and peat fires along great tracts of the Gorky, Kazan, Riazan and Tumskaya railway lines. An unusually severe thunderstorm with torrential rain broke over Grenoble on the 12th and did much harm to the crops. Fine weather occurred generally in the Alps towards the end of the month. (*The Times*, August 3rd–September 1st.)

Exceptionally heavy rain was experienced in the Chercher region of Abyssinia near the beginning of the month. Thirty-eight people were drowned when a steamer capsized off Mostaganem (Algeria) owing to heavy seas. (*The Times*, August 10th–17th.)

Floods occurred in Sivas, Anatolia, at the beginning of the month. Heavy monsoon rain occurred in Bombay city and the coastal belt and also in the United Provinces, Bihar, Bengal and Assam during the first part of the month causing devastating floods of the Ganges and Brahmaputra and their tributaries, while in the Deccan and elsewhere in the Bombay Presidency severe drought was experienced. A break in the rains improved the flood situation in the United Provinces about the 12th and rain had fallen in parts of Gujerat and at Bijapur by the 19th and heavy rain generally in Gujerat and Kathiawar by the 24th, though the drought was still continuing in the Deccan. In consequence of heavy rain the Punjab rivers were in flood about the 23rd. A typhoon wrecked 9 Japanese ships about the 7th off the Pratas Islands south-west of Hongkong. Extensive flooding was reported in Korea on the 14th—96 people lost their lives. A typhoon swept across Hongkong on the night of the 16th–17th causing 10 deaths and doing much superficial damage—a wind speed of 131 m.p.h. was recorded at Hongkong but the centre passed 50 miles away. A typhoon swept across Korea on the 23rd and one on the 27th, together causing 1,939 deaths, while 40,000 houses were destroyed. (*The Times*, August 5th–September 1st.)

The total rainfall for the month in Australia was generally below normal except in Victoria and Tasmania. (*Cable.*)

In the United States temperature was generally about normal at the beginning of the month, but later on it was considerably above normal, while rainfall, except for some local heavy falls, was mainly below normal. The drought also continued in many parts of Canada. Extensive forest fires occurred in the west and middle-west of the United States during the middle of the month. (*The Times*, August 5th–September 1st and *Washington, D.C., U.S. Dept. Agric., Weekly Weather and Crop Bulletin.*)

Daily Readings at Kew Observatory, August, 1936

Date	Pressure, M.S.L. 13h.	Wind, Dir., Force 13h.	Temp. Min.	Temp. Max.	Rel. Hum. 13h.	Rain.	Sun.	REMARKS. (see vol. 69, 1934, p. 1).
	mb.		°F	°F	%	in.	hrs.	
1	1009·7	NW.2	60	67	76	0·02	0·2	r_0 0h.–2h., 8h. & 13h.
2	1004·8	SW.4	53	69	91	0·09	3·0	r_0 10h.–11h. & 23h.
3	1010·8	W.5	58	66	46	—	3·9	
4	1018·0	W.4	53	66	56	—	6·5	w early.
5	1021·1	SW.3	55	67	54	—	3·9	
6	1017·0	SSW.4	57	66	79	0·11	0·5	ir_0–r, 1h.–18h.
7	1024·2	NNW.3	57	60	80	trace	0·0	r_0 0h.–1h., d_0 17h.
8	1024·2	SE.2	53	69	67	—	3·9	
9	1017·3	E.2	50	72	64	—	4·4	w early.
10	1012·8	E.2	55	72	65	0·03	3·2	t 17h., r_0 23h.–24h.
11	1013·9	N.2	58	69	63	0·19	2·0	r_0–r 0h.–8h.
12	1012·3	WSW.2	54	69	70	—	1·9	w early.
13	1016·3	SW.2	53	68	58	—	3·4	w early & late.
14	1015·6	SW.3	55	69	60	—	6·3	w early & late.
15	1016·0	S.2	48	77	59	—	10·2	fw early.
16	1018·6	WSW.2	55	78	57	—	9·8	F early.
17	1018·7	SW.3	59	76	57	—	11·4	
18	1019·4	W.2	61	71	60	—	6·4	
19	1015·8	SW.4	57	67	59	0·03	0·0	ir_0 15h.–20h.
20	1014·7	WSW.3	59	73	65	—	5·4	
21	1018·0	NW.2	58	71	67	—	3·9	w early.
22	1026·4	NW.2	51	69	53	—	9·8	w early & late.
23	1029·0	WSW.2	47	73	49	—	12·3	w early & late.
24	1029·0	NNW.2	54	78	59	—	12·9	w early.
25	1028·6	NNW.2	56	78	52	—	8·0	m w early.
26	1029·3	NE.3	63	70	56	—	7·8	
27	1027·8	ENE.4	55	69	59	—	10·9	w early.
28	1026·7	NE.2	52	77	59	—	8·6	fe early.
29	1027·7	S.1	48	79	42	—	10·8	Fe early.
30	1023·3	W.3	54	79	41	—	9·0	w early.
31	1022·4	NW.2	60	69	63	—	4·2	
*	1019·7	—	55	71	61	0·47	5·9	* Means or Totals.

General Rainfall for August, 1936

England and Wales ...	39	per cent of the average 1881–1915
Scotland	70	
Ireland	45	
British Isles	48	

Rainfall: August, 1936: England and Wales

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Lond .	Camden Square..........	·48	22	*Leics* .	Belvoir Castle............	1·70	65
Sur .	Reigate, Wray Pk. Rd..	·59	24	*Rut* .	Ridlington	·97	39
Kent .	Tenterden, Ashenden...	1·54	67	*Lincs* .	Boston, Skirbeck.........	·98	41
,, .	Folkestone, Boro. San.	1·76	...	,, .	Cranwell Aerodrome...	·80	29
,, .	Margate, Cliftonville....	1·26	65	,, .	Skegness, Marine Gdns.	1·42	58
,, .	Eden'bdg., Falconhurst	1·86	71	,, .	Louth, Westgate.........	1·34	48
Sus .	Compton, Compton Ho.	·91	29	,, .	Brigg, Wrawby St.......	1·41	...
,, .	Patching Farm..........	·72	29	*Notts* .	Worksop, Hodsock......	1·16	47
,, .	Eastbourne, Wil. Sq....	·76	31	*Derby*.	Derby, L. M. & S. Rly.	·93	36
Hants.	Ventnor, Roy.Nat.Hos.	·21	11	,, .	Buxton, Terr. Slopes...	2·23	51
,, .	Fordingbridge, Oaklnds	·41	16	*Ches* .	Runcorn, Weston Pt....	1·66	46
,, .	Ovington Rectory.......	.37	14	*Lancs*.	Manchester, Whit. Pk.	2·37	69
,, .	Sherborne St. John......	·89	37	,, .	Stonyhurst College......	3·45	68
Herts .	Royston, Therfield Rec.	·53	21	,, .	Southport, Bedford Pk.	1·81	52
Bucks.	Slough, Upton............	·43	20	,, .	Lancaster, Greg Obsy.	3·30	73
,, .	H. Wycombe, Flackwell	·68	28	*Yorks*.	Wath-upon-Dearne......	1·21	50
Oxf .	Oxford, Mag. College...	·47	21	,, .	Wakefield, Clarence Pk.	1·40	54
N'hant	Wellingboro, Swanspool	·46	19	,, .	Oughtershaw Hall.......	3·17	...
,, .	Oundle	·54	...	,, .	Wetherby, Ribston H..	...	...
Beds .	Woburn, Exptl. Farm...	·34	15	,, .	Hull, Pearson Park......	1·01	35
Cam .	Cambridge, Bot. Gdns.	·46	20	,, .	Holme-on-Spalding......	1·77	66
Essex .	Chelmsford, County Gdns	·55	25	,, .	West Witton, Ivy Ho.	1·71	58
,, .	Lexden Hill House......	·59	...	,, .	Felixkirk, Mt. St. John.	2·96	104
Suff .	Haughley House.........	·77	...	,, .	York, Museum Gdns....	1·95	77
,, .	Campsea Ashe............	·74	37	,, .	Pickering, Hungate......	3·26	127
,, .	Lowestoft Sec. School...	1·02	46	,, .	Scarborough..............	2·44	88
,, .	Bury St. Ed., WestleyH.	·98	38	,, .	Middlesbrough...........	2·10	77
Norf. .	Wells, Holkham Hall...	1·46	61	,, .	Baldersdale, Hury Res.	...	...
Wilts .	Calne, Castle Walk......	·36	...	*Durh* .	Ushaw College...........	1·89	65
,, .	Porton, W.D. Exp'l. Stn	·17	8	*Nor* .	Newcastle, D. & D. Inst.	2·35	88
Dor .	Evershot, Melbury Ho.	·27	9	,, .	Bellingham, Highgreen	1·84	52
,, .	Weymouth, Westham.	·08	4	,, .	Lilburn Tower Gdns....	1·26	45
,, .	Shaftesbury, Abbey Ho.	·28	10	*Cumb*.	Carlisle, Scaleby Hall...	2·11	51
Devon.	Plymouth, The Hoe....	·52	17	,, .	Borrowdale, Seathwaite	5·00	46
,, .	Holne, Church Pk. Cott.	·52	12	,, .	Borrowdale, Moraine...	4·60	53
,, .	Teignmouth, Den Gdns.	·03	1	,, .	Keswick, High Hill......	1·70	33
,, .	Cullompton	·28	9	*West* .	Appleby, Castle Bank...	1·65	50
,, .	Sidmouth, U.D.C........	·10	...	*Mon* .	Abergavenny, Larchf'd	·31	10
,, .	Barnstaple, N. Dev.Ath	·60	18	*Glam* .	Ystalyfera, Wern Ho....	3·17	51
,, .	Dartm'r, Cranmere Pool	1·50	...	,, .	Cardiff, Ely P. Stn.......	1·16	27
,, .	Okehampton, Uplands.	·82	19	,, .	Treherbert, Tynywaun.	2·68	...
Corn .	Redruth, Trewirgie......	·65	20	*Carm* .	Carmarthen, Coll. Rd.	2·24	48
,, .	Penzance, Morrab Gdns.	·47	15	*Pemb* .	St. Ann's Hd. C. Gd. Stn.	·78	25
,, .	St. Austell, Trevarna...	·68	19	*Card* .	Aberystwyth	1·40	...
Soms .	Chewton Mendip.........	1·02	23	*Rad* .	BirmW.W.Tyrmynydd	·80	15
,, .	Long Ashton............	·56	16	*Mont* .	Lake Vyrnwy	2·37	46
,, .	Street, Millfield..........	·49	...	*Flint* .	Sealand Aerodrome......	1·31	...
Glos .	Blockley	·45	...	*Mer* .	Blaenau Festiniog ...	10·08	98
,, .	Cirencester, Gwynfa....	·48	16	,, .	Dolgelley, Bontddu......	3·11	55
Here .	Ross, Birchlea...........	·23	9	*Carn* .	Llandudno	·59	21
Salop .	Church Stretton.........	·62	19	,, .	Snowdon, L. Llydaw 9..	13·53	...
,, .	Shifnal, Hatton Grange	·90	32	*Ang* .	Holyhead, Salt Island...	2·10	66
Staffs .	Market Drayt'n, Old Sp.	1·08	33	,, .	Lligwy	2·40	...
Worc .	Ombersley, Holt Lock.	·52	19	*Isle of Man*			
War .	Alcester, Ragley Hall...	·69	25		Douglas, Boro' Cem....	3·32	87
,,	Birminghm, Edgbaston	·82	30	*Guernsey*			
Leics .	Thornton Reservoir ...	·76	27		St. PeterP't.Grange Rd.	·67	28

Rainfall: August, 1936: Scotland and Ireland

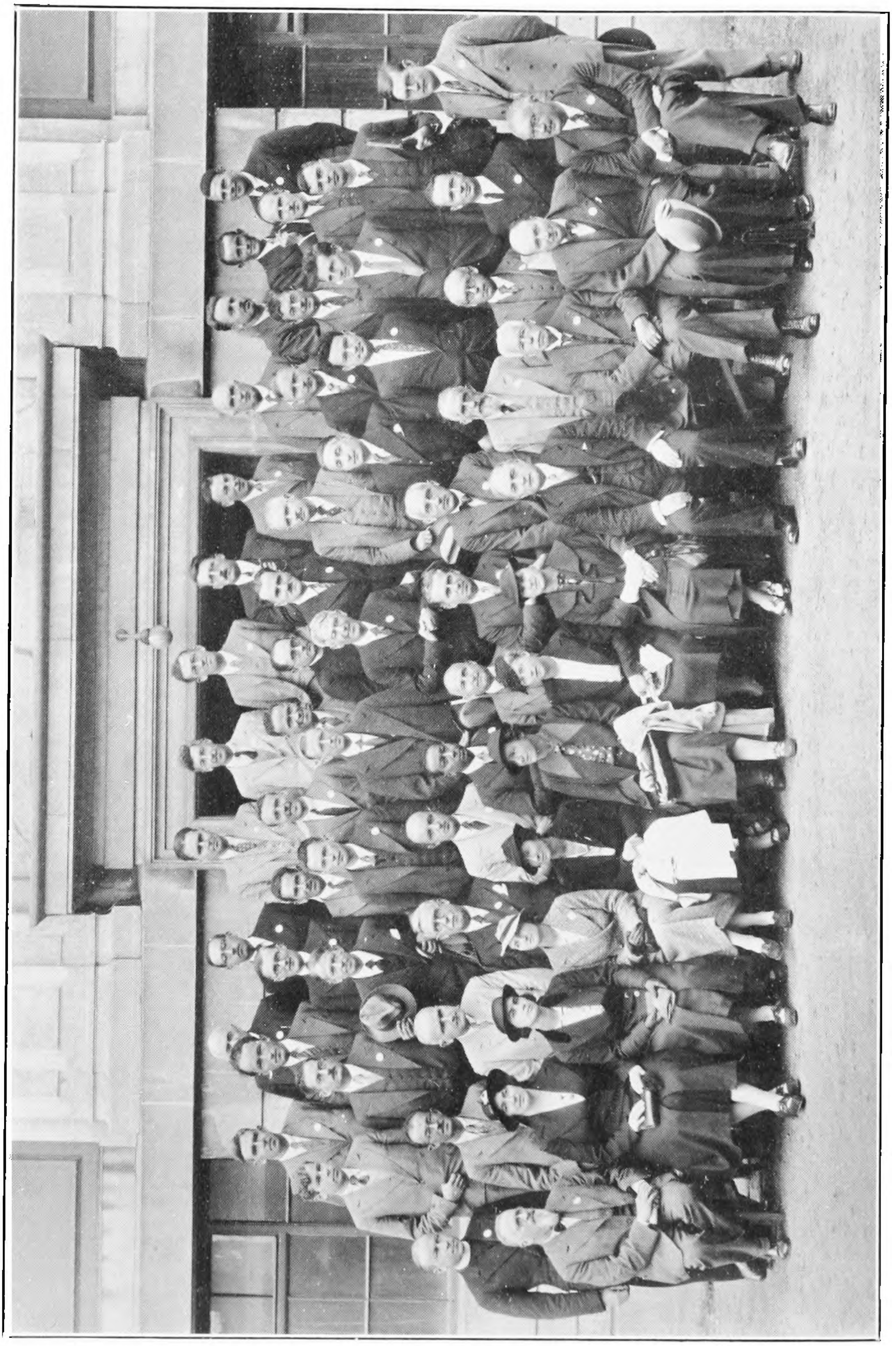
Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Wig	Pt. William, Monreith	2·81	73	*Suth*	Tongue	3·08	96
"	New Luce School	4·29	96	"	Melvich	3·21	107
Kirk	Dalry, Glendarroch	2·97	62	"	Loch More, Achfary	5·64	97
Dumf.	Dumfries, Crichton R.I.	1·51	40	*Caith*	Wick	2·53	92
"	Eskdalemuir Obs	3·22	62	*Ork*	Deerness	3·07	107
Roxb	Hawick, Wolfelee	1·18	35	*Shet*	Lerwick	2·00	66
Selk	Ettrick Manse	2·79	83	*Cork*	Dunmanway Rectory	1·61	34
Peeb	West Linton	2·43	...	"	Cork, University Coll	·58	17
Berw	Marchmont House	1·66	50	"	Ballinacurra	·64	17
E.Lot	North Berwick Res	2·11	67	"	Mallow, Longueville	·57	18
Midl	Edinburgh, Blackfd. H.	1·19	37	*Kerry*	Valentia Obsy	1·76	37
Lan	Auchtyfardle	2·02	...	"	Gearhameen	2·50	33
Ayr	Kilmarnock, Kay Pk	4·33	...	"	Bally McElligott Rec	1·20	...
"	Girvan, Pinmore	4·15	93	"	Darrynane Abbey	1·85	43
Renf	Glasgow, Queen's Pk	2·97	84	*Wat*	Waterford, Gortmore	·96	25
"	Greenock, Prospect H.	2·75	51	*Tip*	Nenagh, Cas. Lough	1·44	37
Bute	Rothesay, Ardencraig	3·74	...	"	Roscrea, Timoney Park	1·73	...
"	Dougarie Lodge	2·44	...	"	Cashel, Ballinamona	·85	24
Arg	Ardgour House	6·97	...	*Lim*	Foynes, Coolnanes	1·28	33
"	Glen Etive	...	...	"	Castleconnel Rec	1·75	...
"	Oban	3·50	...	*Clare*	Inagh, Mount Callan	4·27	...
"	Poltalloch	4·28	87	"	Broadford, Hurdlest'n.	1·47	...
"	Inveraray Castle	6·86	104	*Wexf*	Gorey, Courtown Ho	·66	20
"	Islay, Eallabus	3·36	77	*Wick*	Rathnew, Clonmannon	·91	...
"	Mull, Benmore	12·70	109	*Carl*	Hacketstown Rectory	1·25	31
"	Tiree	...	...	*Leix*	Blandsfort House	1·68	43
Kinr	Loch Leven Sluice	1·76	46	*Offaly*	Birr Castle	1·92	50
Fife	Leuchars Aerodrome	·96	31	*Dublin*	Dublin, FitzWm. Sq	1·15	38
Perth	Loch Dhu	4·20	62	"	Balbriggan, Ardgillan	...	...
"	Balquhidder, Stronvar	4·02	...	*Meath*	Beauparc, St. Cloud	2·15	...
"	Crieff, Strathearn Hyd.	2·04	48	"	Kells, Headfort	1·99	48
"	Blair Castle Gardens	2·66	79	*W.M*	Moate, Coolatore	1·73	...
Angus	Kettins School	1·35	37	"	Mullingar, Belvedere	2·11	51
"	Pearsie House	1·88	...	*Long*	Castle Forbes Gdns	1·57	38
"	Montrose, Sunnyside	·89	32	*Gal*	Galway, Grammar Sch.	2·25	...
Aber	Braemar, Bank	1·50	44	"	Ballynahinch Castle	4·48	82
"	Logie Coldstone Sch	1·92	61	"	Ahascragh, Clonbrock	1·75	42
"	Aberdeen, Observatory	1·41	51	*Mayo*	Blacksod Point	2·48	54
"	Fyvie Castle	1·52	48	"	Mallaranny	3·85	...
Moray	Gordon Castle	1·87	59	"	Westport House	1·41	35
"	Grantown-on-Spey	...	...	"	Delphi Lodge	5·78	67
Nairn	Nairn	2·09	87	*Sligo*	Markree Castle	2·44	56
Inv's	Ben Alder Lodge	2·15	...	*Cavan*	Crossdoney, Kevit Cas.	2·03	...
"	Kingussie, The Birches	1·48	...	*Ferm*	Newtwnbtlr, Crom Cas.	1·88	45
"	Loch Ness, Foyers	1·92	63	"	Enniskillen, Portora	...	...
"	Inverness, Culduthel R.	2·47	...	*Arm*	Armagh Obsy	1·74	48
"	Loch Quoich, Loan	6·50	...	*Down*	Fofanny Reservoir	3·33	...
"	Glenquoich	6·52	79	"	Seaforde	2·20	59
"	Glenleven, Corrour	3·82	70	"	Donaghadee, C. G. Stn.	2·65	79
"	Fort William, Glasdrum	4·62	...	*Antr*	Belfast, Cavehill Rd	2·96	...
"	Skye, Dunvegan	4·64	...	"	Aldergrove Aerodrome	2·41	67
"	Barra, Skallary	3·67	...	"	Ballymena, Harryville	3·04	71
R&C	Alness, Ardross Castle	1·64	56	*Lon*	Garvagh, Moneydig	2·78	...
"	Ullapool	2·70	76	"	Londonderry, Creggan	3·76	81
"	Achnashellach	5·05	76	*Tyr*	Omagh, Edenfel	2·71	64
"	Stornoway, Matheson	3·53	89	*Don*	Malin Head	2·94	...
Suth	Lairg	2·42	76	"	Killybegs, Rockmount	2·08	...

Climatological Table for the British Empire, March, 1936

STATIONS.	PRESSURE. Mean of Day M.S.L.	PRESSURE. Diff. from Normal.	TEMPERATURE. Absolute. Max.	TEMPERATURE. Absolute. Min.	TEMPERATURE. Mean Values. Max.	TEMPERATURE. Mean Values. Min.	TEMPERATURE. Mean Values. ½ Max. and Min.	TEMPERATURE. Mean Values. Diff. from Normal	TEMPERATURE. Mean. Wet Bulb.	Relative Humidity.	Mean Cloud Am'nt	PRECIPITATION. Am'nt.	PRECIPITATION. Diff. from Normal.	PRECIPITATION. Days.	BRIGHT SUNSHINE. Hours per day.	BRIGHT SUNSHINE. Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0–10	in.	in.			
London, Kew Obsy.	1010·7	− 2·7	62	27	51·8	40·3	46·1	+ 2·9	40·8	88	8·4	0·90	− 0·79	11	2·5	21
Gibraltar	1013·5	− 3·6	73	43	59·6	50·7	55·1	...	51·9	90	6·4	5·23	...	16	...	...
Malta	1014·5	+ 0·3	69	47	61·8	53·7	57·7	+ 0·6	53·1	75	5·0	0·30	− 1·18	7	7·3	62
St. Helena	1012·7	+ 0·3	71	58	68·2	60·3	64·3	− 2·0	61·3	94	9·3	3·34	− 0·68	25	...	...
Freetown, Sierra Leone	1011·5	+ 2·5	95	71	89·1	74·8	81·9	− 0·5	75·4	74	5·7	1·03	− 0·13	4	...	...
Lagos, Nigeria	1009·9	+ 1·0	93	72	89·0	78·5	83·7	+ 0·3	77·9	83	7·9	5·78	+ 2·03	9	6·8	57
Kaduna, Nigeria	...	...	101	59	96·9	68·1	82·5	+ 1·4	69·7	65	4·2	0·51	− 0·03	4	8·8	73
Zomba, Nyasaland	1009·4	− 0·3	82	62	78·9	65·4	72·1	+ 0·8	70·3	91	8·6	10·08	+ 1·00	30	...	...
Salisbury, Rhodesia	1010·8	− 1·0	83	54	77·3	59·8	68·5	+ 0·3	62·8	79	7·1	6·06	+ 1·36	21	5·2	43
Cape Town	1014·2	− 0·3	100	51	80·6	60·6	70·6	+ 2·5	60·5	77	3·9	1·19	+ 0·31	6	...	...
Johannesburg	1013·0	− 0·3	82	47	72·0	54·2	63·1	− 0·3	56·0	74	6·3	6·11	+ 1·67	14	6·1	50
Mauritius	1011·6	− 0·4	87	66	84·7	73·6	79·1	+ 1·1	75·4	78	5·5	5·18	− 4·19	21	8·4	69
Calcutta, Alipore Obsy.	1010·6	+ 0·7	100	61	95·9	71·9	83·9	+ 3·7	70·7	75	2·8	0·42	− 0·96	1*	...	...
Bombay	1010·6	− 0·3	101	66	87·2	72·4	79·8	+ 0·3	70·2	69	1·2	0·00	− 0·02	0*	...	...
Madras	1011·0	+ 0·1	90	66	87·5	72·9	80·2	− 0·9	75·3	79	4·9	0·90	+ 0·56	2*	...	...
Colombo, Ceylon	1010·6	+ 0·5	92	70	87·4	74·1	80·7	− 1·1	76·0	73	5·1	5·29	+ 1·01	16	7·4	61
Singapore	1010·0	+ 0·3	92	72	86·7	74·8	80·7	− 0·5	76·7	79	7·0	7·77	+ 0·37	15	5·4	45
Hongkong	1019·6	+ 3·6	80	43	61·5	53·8	57·7	− 5·6	53·7	78	8·8	0·47	− 2·47	7	2·1	18
Sandakan	1010·3	...	90	72	87·0	75·0	81·0	0·0	77·3	84	8·7	23·86	+ 15·39	21	...	...
Sydney, N.S.W.	1017·1	+ 0·8	85	55	75·7	62·1	68·9	− 0·4	64·8	75	6·2	3·98	− 1·00	11	6·7	55
Melbourne	1016·5	− 0·4	94	47	79·7	57·3	68·5	+ 4·0	59·6	59	5·2	0·52	− 1·66	7	8·1	66
Adelaide	1017·3	+ 0·2	99	50	82·8	59·0	70·9	+ 1·1	60·8	49	4·4	0·07	− 0·96	3	9·4	77
Perth, W. Australia	1015·1	− 0·2	102	54	84·9	64·0	74·5	+ 3·3	62·2	56	4·5	0·21	− 0·60	1	8·7	71
Coolgardie	1014·4	− 0·5	100	52	89·0	61·9	75·5	+ 3·6	63·1	54	4·2	0·09	− 0·85	3	...	...
Brisbane	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Hobart, Tasmania	1016·2	+ 2·0	83	43	68·8	51·4	60·1	+ 0·8	52·7	61	6·1	0·81	− 0·89	13	6·1	49
Wellington, N.Z.	1013·5	− 3·7	71	43	61·9	50·1	56·0	− 4·6	52·5	73	6·2	4·64	+ 1·31	13	6·3	51
Suva, Fiji	1009·1	+ 0·7	94	73	88·2	75·2	81·7	+ 1·6	76·8	84	6·1	11·56	− 2·93	25	6·6	54
Apia, Samoa	1009·3	+ 0·1	88	72	85·7	74·7	80·2	+ 0·9	76·9	80	5·8	10·92	− 3·06	20	6·5	53
Kingston, Jamaica	1013·0	− 1·9	91	66	85·6	69·8	77·7	+ 0·6	67·7	80	2·9	0·20	− 0·82	3	4·5	38
Grenada, W.I.	1011·4	− 1·6	87	71	85	74	79·5	+ 1·7	75	79	4	0·52	− 2·14	12	...	...
Toronto	1011·8	− 5·5	61	6	40·4	28·5	34·5	+ 4·9	...	...	7·7	1·99	− 0·42	8	3·3	28
Winnipeg	1011·9	− 7·3	40	−25	27·0	9·2	18·1	+ 3·1	...	...	6·5	1·89	+ 0·73	14	3·6	30
St. John, N.B.	1014·9	+ 0·8	60	4	43·6	29·1	36·3	+ 7·9	32·1	84	7·9	4·01	− 0·53	16	3·8	32
Victoria, B.C.	1017·8	+ 1·9	56	27	46·7	37·4	42·1	− 1·4	38·6	79	7·3	2·25	− 0·18	19	4·9	41

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

(33540) Wt. 19/32 1,050 9/36 Hw. G.377



CONFERENCE ON ATMOSPHERIC OZONE, OXFORD, SEPTEMBER 9TH–11TH, 1936

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Conference on Atmospheric Ozone

Oxford: September 9th—11th, 1936

The band of workers on the problems of atmospheric ozone is not large; it was nearly fully represented at last month's Ozone Conference,* attended by about 60 members, and this 60 included a

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* The photograph reproduced on the opposite page was taken during the Conference. The names reading from left to right are:—Front row: Prof. V. Conrad, Austria; Mlle. Michel, France; Mme. Gauzit, France; Mme. Vassy, France; Mme. Prettre, France; Mme. Lijot, France; Mme. Chalonge, France; Mme. Cabannes, France; Dr. W. Gorczynski, Poland; Prof. E. van Everdingen, Holland; Mons. Ph. Wehrlé, France; Prof. L. Weickmann, Germany. Second row: Father P. Lejay, China; Mons. D. Chalonge, France; Dr. J. A. Fleming, United States; Prof. R. Ayres, Egypt; Dr. D. F. Martyn, Australia; Prof. S. K. Mitra, India; Prof. B. Gutenberg, United States; Prof. E. V. Appleton, Great Britain; Dr. Hoelper, Germany; Prof. Schmidt, Austria; Prof. J. Cabannes, France; Prof. J. Gauzit, France; Dr. C. L. Godske, Norway. Third row: Dr. Kohn, Great Britain; Dr. W. Morikofer, Switzerland; Dr. A. Ångström, Sweden; Dr. O. R. Wulf, United States; Dr. R. H. Weightman, United States; Dr. F. W. Paul Götz, Switzerland; Mons. Dedebant, France; Dr. C. L. Pekcvis, United States; Mr. C. H. Collie, Great Britain; Dr. A. R. Meetham, Great Britain. Fourth row: Dr. G. M. B. Dobson, Great Britain; Dr. J. Bjerknes, Norway; Mons. E. Vassy, France; Mons. B. Lijot, France; Dr. Ratcliffe, Great Britain; Prof. R. Ladenburg, United States; Father L. Dumas, China; Prof. E. Stenz, Poland; Dr. H. D. Harradon, United States; Prof. J. Bartels, Germany; Prof. S. Chapman, Great Britain; Prof. F. A. Paneth, England. Fifth row: Capt. Heck, United States; Prof. M. Hessaby, Persia; Prof. Cario, Germany; Dr. T. W. Wormell, Great Britain; Dr. White, Great Britain; Mons. D. Barbier, France; Mr. F. J. Scrase, Great Britain; Dr. F. J. W. Whipple, Great Britain; Dr. E. H. Gowan, Canada; Mons. M. Prettre, France; Dr. R. Penndorf, Germany.

number of scientists whose interest in the subject is that of the onlooker. Yet 16 countries were represented and there were members from the United States, Canada, Australia, China, Egypt and Persia. It is remarkable too, that so many branches of science are interested in ozone—meteorologists, physicists, chemists, physical chemists, mathematicians (of course), biochemists and astronomers. The papers at this conference were of wide scientific interest and showed that considerable progress has been made since the last similar conference was held in Paris in 1929.

It is not hard to find the attraction of atmospheric ozone. The whole lot of it would form a layer only 2 or 3 mm. thick at N.T.P., and yet it absorbs 5–6 per cent of the total energy of sunlight. If it were not for this absorption, which is chiefly in the ultraviolet, we could never expose our skin to direct daylight; while astronomers, who learn many things from stellar spectra, would have much more work to do. Above the limits of sounding balloons our knowledge of temperatures is partly learned from ozone, and we believe the temperatures themselves depend on the presence of ozone. At these heights the geophysicists know more about the distribution of this comparatively rare gas than of oxygen and nitrogen. Meteorologists, in their turn, in their fundamental problem of explaining the weather, are confronted with the ozone, which far into the stratosphere behaves differently with different surface conditions of weather.

Methods of Measurement.—A few years ago the process of measuring upper atmospheric ozone, by using its property of absorbing ultraviolet light from the sun, was extremely tedious and not very accurate. Today it is little more wearisome than reading a barometer. Dobson showed how measurements can be made in a few minutes with a photoelectric spectrophotometer even when the sky is completely overcast, and with a standard error under the worst conditions of less than 3 per cent. Gauzit has developed a simple visual spectroscope which uses the Chappuis absorption bands of ozone in the yellow. Chalonge and others have measured ozone at night with the light of stars and the moon, using the more classical methods of photographic photometry. Chemical methods, which should be very valuable and straightforward for measurements of ozone concentrations near the earth's surface, are still struggling against the handicaps of the very low concentrations which occur in nature. One other technique is being applied to measurement of ultraviolet light intensities—that of the photon counter. At present this method is in its infancy, but it may develop into one of great power.

Demonstrations of Apparatus.—It was hoped to arrange for a demonstration of various pieces of apparatus used by different workers. Unfortunately Customs and other difficulties interfered with this and the only apparatus shown was that of Gauzit for measuring the amount of ozone by visual methods, and the photoelectric instrument shown by Dobson.

Vertical Distribution of Ozone.—In 1929 very little was known of the whereabouts of high concentrations of ozone in the upper atmosphere. There was some evidence which seemed to show that if atmospheric ozone existed in a fairly thin layer, its height above the surface would be about 50Km. With the help of photoelectric instruments measuring intensities of ultraviolet light from the zenith sky near sunset, the vertical distribution of ozone has now been roughly evaluated. The bulk of it lies between the surface and a height of 40Km., with maximum density between 20 and 30Km. The height of the centre of gravity of ozone, which can be evaluated with much greater accuracy, is 22Km. $\pm$ 1Km. under all kinds of conditions in our part of the world. It should be emphasised that these results were deduced rather indirectly from observations at the earth's surface, but they have been strikingly confirmed by the Regeners, using the far more direct method of a spectroscopic camera attached to a sounding balloon. Discordant results are, however, reported from the recent United States stratosphere flight when similar methods to the Regeners were used. Ozone concentrations from sea level to 3Km. have also been determined in France and Switzerland by chemical and photometric methods.

The problem of the vertical distribution of ozone has been approached theoretically by Chapman, and by Wulf and Deming, but theoreticians are severely handicapped by lack of information about absorption coefficients and constants of reaction. With more information from the laboratory they might go very far. At present they can only say that the results of measurements of the vertical distribution are plausible.

Temperatures of the Upper Air.—At heights which are just out of reach of sounding balloons it is believed that temperatures increase very appreciably. If this is so, then some mechanism must be found whereby heat is taken up by the upper air from the radiation which passes it. Now oxygen molecules are known to absorb ultraviolet light, which splits them up into atoms. Where there are atoms and molecules of oxygen, ozone is formed, and ozone itself strongly absorbs some wave lengths of ultraviolet light in the process of disintegrating into oxygen. The radiant energy absorbed by oxygen and ozone degenerates into heat, and hence an atmosphere containing ozone should be warm. The Oxford conference devoted a full day to discussing this important matter of upper air temperatures.

Whipple showed that to account for the reflection of sound waves a negative lapse rate must exist at heights of about 35Km. This has been known for some time, but a possible new method of investigating upper air temperatures is being developed by Vassy, Barbier and Chalonge. It depends on the results of laboratory experiments which show that the absorption curve of ozone in the ultraviolet has an undulatory form if plotted as absorption against wave length, and that the amplitude of undulation is dependent on the temperature of the ozone. Comparison with absorption curves from upper atmospheric ozone will give the mean temperature of the ozone traversed. It should be possible to arrange that ultraviolet light is used which undergoes its greatest absorption by ozone at heights above, say, 40Km. so that this new method may be used to measure temperatures at these heights. Appleton and Martyn discussed temperatures likely to be associated with the regions of the ionosphere, and showed evidence of very high temperatures at 250Km. and above. Eropkin suggested that oxygen at a height of 30Km. or more might be in the form of atomic oxygen, and that the abnormal propagation of sound could be explained in this way.

From the theoretical point of view Gowan has recalculated temperature distributions in the light of modern results about the vertical distribution of ozone. His results depend very much on what percentage of water vapour he assumes to be present, and little information is available about this. However, under all reasonable assumptions he arrives at high temperatures such as Whipple, Dobson and Lindemann require. Ladenburg dealt with the absorption of energy by oxygen.

Horizontal Distribution of Ozone, and Weather Conditions.—Chalonge and Tönsberg brought forward results of measurements of ozone in polar regions both in summer and winter. They confirmed the great correlation of ozone with surface weather conditions. Lejay in Shanghai found that ozone was not high in cyclonic weather, as it is in Europe. Using statistical methods, Meetham showed that in Europe ozone was very highly correlated with potential temperature, entropy, and air density at heights of 15–18Km. above the ground. He further showed that although there is undoubtedly high correlation between surface weather conditions and total ozone content, this is not so high as between surface weather conditions and height of tropopause. He put forward the suggestion that the variations of ozone and potential temperature at 18Km. which are found in association with cyclones might be explained by considering the effect of air of the stratosphere sinking into a depression of the tropopause. In considering this qualitatively, however, he was compelled to assume a vertical circulation of the stratospheric air in association with depressions, and geophysicists are dubious about any assumption of vertical circulation in the stratosphere.

General Papers.—Götz gave a résumé of 10 years' measurements of ozone in Switzerland, in consideration of a possible 11 year cycle of variation of ozone. He showed that there might be an 11 year cycle, but there was also a possibility of a real variation in ultraviolet intensities emitted by the sun. Vassy discussed laboratory technique in handling ozone. V. H. Regener described the technique of automatic spectrographic apparatus used by himself and Professor Regener with sounding balloons, and his efforts to obtain solar spectrophotographs in the far ultraviolet. Much interest was aroused by his ultraviolet light filter, which employed a new principle depending on the variation of the refractive index of paraffin with wave length.

Programme of Future Research.—During the conference Dobson reported on the new survey of ozone in north-west Europe which it is hoped to inaugurate. The following are his own words :—

" The possible aid which ozone observations might give to weather forecasting, makes it very desirable that the subject should be thoroughly explored. Since a suitable instrument for routine observations of ozone is now available, a programme has been drawn up which would require daily observations at some fifteen stations suitably placed in Europe. It is suggested that daily observations should be continued for about two years in the first instance. The programme has received the general approval of the International Meteorological Organization (the Conference of Directors) but it rests with the individual meteorological services to carry out the work. It was suggested that the cost of the instruments should be met by the various countries in which the instruments were used. I have personally been in touch with all the meteorological services concerned, and the countries where observations are most required are willing to co-operate by having observations made if they can be provided with the necessary instruments. The majority are also willing to meet the cost of at least one of the instruments required for use there. Unfortunately the cost of the instruments is high (approximately £400 each), and the money for six instruments is still required in order to make the research a success.

The sort of question which it is hoped will be answered by this research (and can only be answered by such co-operative work) is :—

(1) How does the distribution of ozone round a depression vary with the state of occlusion of the depression ?

(2) How is the distribution related to the speed and direction of movement of the depression ?

If, for instance, it is found that the distribution of ozone is related to the direction of movement of a depression in some definite way, then a knowledge of the ozone distribution must be of great value to the weather forecaster, and while the cost of the investigation is necessarily high, such results would abundantly repay the outlay. At the present time there is some danger that full value of this work may not be obtained owing to lack of money for all the instruments required."

In the subsequent discussion the Conference showed considerable enthusiasm and decided to publish a motion expressing their view that such a survey would give valuable results.

The conference concluded with a vote of thanks to Dr. G. M. B. Dobson, who organised it in such a way that it will have been a great help to all who are engaged in studying the problem of ozone.

Papers and discussions of the conference are to be published by the Royal Meteorological Society as an extra number of the Quarterly Journal.

A. R. MEETHAM.

Melting Hail, Snow, and Soft Hail in the Rain-gauge

By Dugald S. Hancock and Alfred E. V. Pinnock

Considerable difficulty is often experienced by rainfall observers in melting hail, snow, or soft hail when arctic or semi-arctic conditions prevail, e.g. with a strong east wind and screen temperature below freezing-point.

We have frequently found it exceedingly difficult, if not almost impossible, to melt the frozen deposit in the manner suggested on pp. 10 and 11 of " Rules for Rainfall Observers ", viz., by adding a known quantity of boiling water; or by applying a cloth soaked in boiling water round the gauge: either around the cylinder itself or over the cone of the funnel, taking care to prevent any moisture percolating from the cloth into the bottle below.

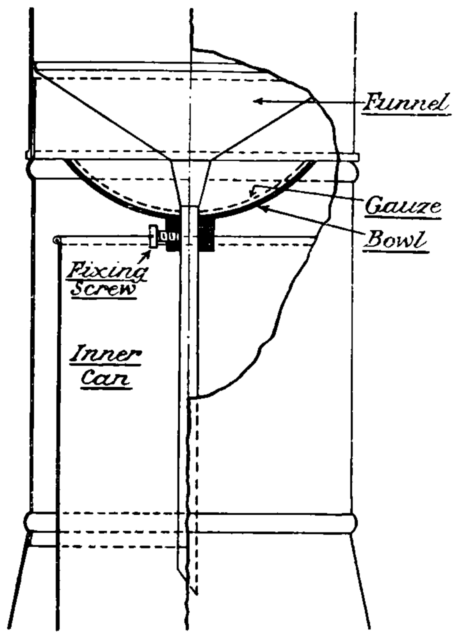
On February 11th last, snow fell, mingled with soft hail, at Greenways School, Bognor Regis. To prevent the gauge from " overflowing ", an attempt was made during a lull in the storm to melt out some of the snow. Although the equivalent of 0·5 in. of boiling water was poured down the funnel, this was not sufficient to get rid of all the soft hail at the apex of the cone. No more satisfactory result was obtained on adding a further 0·5 in. We then resorted to the second " official " method, but even when the contents of two pudding-basins of boiling water had been poured around the outside of the gauge there still remained a few obstinate pellets of soft hail. Fortunately, however, no further snow fell during the following night, otherwise the pellets which persisted would have acted as a cork the next morning and would have frustrated our efforts to melt out the residue by approved methods. On taking out the funnel and removing the bottle at 8h. 30m. (the observation hour) it was found that some of the added water had become ice! The station has been in operation since October, 1928, and, although the severe winter of February, 1929, when a screen temperature of 10·0° F. was recorded, comes within this period, ice has never before been found in the bottle of the gauge. Presumably, the only reason for its appearance on February 12th, 1936, was that boiling water, which had therefore lost some of its air, had been poured into the bottle on the previous day, and this would naturally have a tendency to reach the freezing-point more easily than would cold water. Added to this was the persistence of a biting easterly wind.

It was this sequence of facts that led one of us to the conclusion that if delay and considerable inconvenience could be caused in Sussex, while following the conventional methods, much worse delay and discomfort no doubt often occur in higher latitudes, and, therefore, something ought to be done about it!

The practice employed at some mountain stations of removing the funnel and bottle from the gauge and thawing the contents " in the office " is strongly to be deprecated.

It was evident that if accurate measurements are to be made, without undue waste of time, some form of dry heat must be employed. We first contemplated the use of an electrical method of heating, but rejected this for economical rather than technical reasons, and we have now evolved a simple device which can be fitted to all standard "B.R.O." gauges at a very small cost.

By means of a shallow copper bowl carrying a tray of copper gauze (to facilitate combustion) constructed to slide over the tube of the rain-gauge, and the use of "Metä" solid fuel, we first experimented with a half-scale model under "laboratory" conditions. Later, a full-size attachment was tested on our own 5 in. gauge. We found that one "Meta" tablet (these can be purchased at any chemist, price 6*d.* per box) burnt for 10 minutes, during which time we were continually adding broken ice, some fragments of which were more than 1 in. in length. It will be realised that our object in this test was not to record the amount of "rain" melted out, but to prove that "Meta" fuel will generate sufficient dry heat to melt even the most obstinate hail pellets which may have lodged at the apex of the cone, without at the same time running any risk of melting the joints in the funnel, and thus causing a leak.



No difficulty was experienced in keeping the fuel alight. It was merely necessary to apply a lighted match to the "Meta", stand to windward of the gauge, and then lower the funnel, to which the bowl had previously been fitted, until the locking-nut on the latter rested against the bottle inside the gauge. This enables one (*a*) to watch the flame, and (*b*) permits of sufficient draught through the gauze.

Unfortunately, there is so little space to spare between the copper bowl on the rain-gauge funnel and the bottle, when the former is in position, that it is not possible to allow of our attachment remaining *in situ* the whole time. However, it is an easy matter to slip the bowl over the tube of the gauge, and to adjust its level to allow room to light the fuel from above, before lowering the funnel back into the gauge.

Although the experiment was carried out with "artificial" ice, with one tablet, we are quite convinced that it would be possible to obtain the same results in a shorter time by using several tablets, suitably distributed around the funnel. To the objection that this extra heat might melt the soldering at the joints, it must be pointed out that so long as there is any moisture remaining in the funnel there is no fear of this. Naturally, as soon as all the " solids " have passed through into the bottle below, the fuel must be extinguished. This is best done by tipping the remainder of the " Meta " off the gauze.

Our aim was rather to help the observer who finds the obstinate pellet or two of hail, or a small amount of frozen snow, coagulated at the base of his rain-gauge funnel, than his colleague on the mountain-top, or where heavy falls of snow are recorded. We are none the less confident that our attachment might well be employed under more rigorous conditions, viz., on an arctic or sub-arctic expedition when it is desirable to take hourly readings of all instruments, including the rain-gauge.

[In response to an invitation from the Editor the following comments on the preceding article are offered :—In the first place the British Rainfall Organization has never recommended its observers to melt snow in a rain-gauge by adding a known amount of *boiling* water ; " Rules for Rainfall Observers " definitely says " very warm, but not hot ". I should be interested to know if other observers have experienced difficulty in melting snow by this method. In theory, one gram of water at a temperature of 80° C. (176° F.) should be capable of converting one gram of ice at 0° C. (32° F.) into water at 0° C. It would be very unusual for the funnel of a rain-gauge to contain at any time snow or hail equivalent to more than 0·5 in. of rain. Consequently the addition of a quantity of water at 80° C. equivalent to 0·5 in. of rain should usually suffice to melt out the contents of the funnel, though it might be necessary to pour the water through the funnel more than once before all the ice pellets were melted or washed through. If the deep funnel of the Snowdon or M.O. pattern gauge is quite full of snow, two measuring glasses full (i.e., the equivalent of 1·0 in.) of very warm water should be more than sufficient. Frankly, therefore, I am at a loss to understand why the method failed to satisfy Messrs. Hancock and Pinnock. Also I should be interested to know why the practice of bringing the funnel and receiver indoors and thawing out the contents " is strongly to be deprecated ". I have not heard of it being done at mountain stations, which are usually a long way from " the office ", but I see no reason why ordinary observers should not do it, provided of course that precipitation is not occurring at the time of observation.

The B.R.O. is not favourably disposed towards the fitting of "gadgets" to rain-gauges and would need to be convinced that the methods already recommended for dealing with snow and hail are inadequate before recommending its observers to employ any such device as that described by Messrs. Hancock and Pinnock. Personally, I am by no means convinced, and I hope observers will write to express their views.—Superintendent, British Rainfall Organization.]

OFFICIAL NOTICE

Discussions at the Meteorological Office

The subjects for discussion for the next two meetings are:—

November 2nd, 1936, *Teleconnections of climatic changes in present time.* By A. Ångström (Stockholm, Geogr. Ann. 17, 1935, pp. 242–58) and *Biochronology.* By Ebba H. De Geer (Scot. geogr. Mag., 52, 1936, pp. 145–57). *Opener.*—C. E. P. Brooks, D.Sc.

November 16th, 1936. *On the technique of meteorological airplane ascents of the Massachusetts Institute of Technology.* By K. O. Lange (Cambridge, Mass., Pap. Phys. Ocean. Met. 3, 1934, No. 2, Pt. I). *Opener*—R. F. Budden, M.A.

OFFICIAL PUBLICATION

The following publication has recently been issued:—

Annual Report *of the Director of the Meteorological Office,* presented by the Meteorological Committee to the Air Council for the year ended March 31st, 1936.

The demands on the Meteorological Office during the year under review were greatly increased due to the rapid development of civil aviation, the great expansion of the Royal Air Force, and the international situation which developed in the autumn of 1935. Each of these developments demanded the establishment of more meteorological stations, not only in this country but overseas. As no additional trained staff was available it was impossible to meet all these needs adequately and at Headquarters and several stations it was necessary to carry on with depleted staff in spite of the general increase of work. The position was still further complicated by the fact that on April 1st, 1935, a general regrading of the staff was carried out following upon the decision to apply to the Meteorological Office the scheme of grading and pay recommended by the Committee on the Staffs of Government Scientific Establishments presided over by Sir Harold Carpenter. As the needs became clear additional officers were recruited to meet special requirements and for the purpose of training.

The year was also a memorable one on account of the important Empire and International Conferences held, in London in August, and in Warsaw in September, respectively. The Empire Conference met mainly for the purpose of discussion—the subjects for discussion having been prepared in 68 memoranda which were circulated to the delegates before the meeting. At the International Conference of Directors the principal technical matters on which agreement was reached were, Collective issues, Uniformity in weather maps, Distribution by radio telegraphy of monthly values of pressure, temperature and rainfall, Meteorological reports from Iceland, and Observations of ozone.

In 1935 the Air Ministry invited Dr. J. Bjerknes, Professor at the Geophysical Institute, Bergen, to the Meteorological Office to demonstrate to the staff the further progress made in the Norwegian method of forecasting since his visit in 1925. He arrived on December 14th, 1935, for a 5 months' visit and during his stay he gave particular attention to the frontal analysis of the northern hemisphere, more especially to fronts over the Atlantic Ocean.

Early in October the Overseas Division was formed to deal with meteorological questions connected with Empire Air Routes, including the projected trans-Atlantic routes and the Empire Air Mail Scheme. The division is also responsible for the administration of Meteorological Office establishments overseas. Three new stations were opened during the year—at Aden, Khartoum and Gibraltar.

Another change of importance during the year was the introduction into the library on January 1st, 1936, of the revised classification of meteorological literature, based on that employed by the International Institute for Documentation, The Hague. This Classification was adopted by the International Meteorological Conference at Warsaw in September, 1935.

Correspondence

To the Editor, *Meteorological Magazine*

Crepuscular Rays seen from Hastings

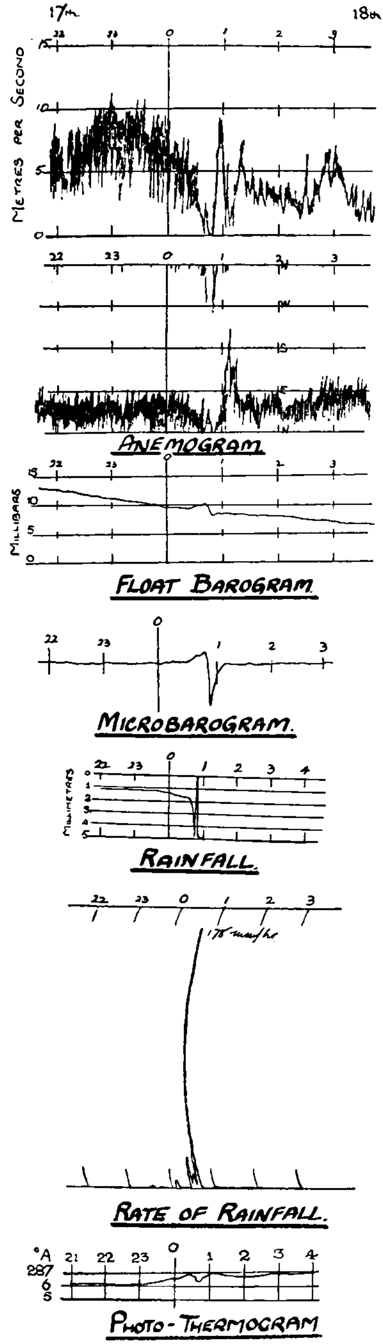
Between 18h. 20m. (G.M.T.) and 18h. 30m. on September 12th a fine display of crepuscular rays was observed here. When first noticed there were three wide orange-yellow bands of quite bright intensity extending completely across the sky from the west to a point in the east, where the convergence due to perspective was extremely well and strikingly seen. A fourth band made its appearance shortly after 18h. 20m.; the whole display had faded somewhat by 18h. 25m. There were large cumuli and cumulonimbi round the western horizon forming a bank covering about 2 tenths of the sky in that direction. The remainder of the sky was covered with 9 tenths of cirrostratus and cirrocumulus. It may be worth noting that there was a very red sunrise glow which was particularly noticeable at 5h. 15m. on the same day.

A. E. Moon.

39, *Clive Avenue, Clive Vale, Hastings, September 17th*, 1936.

Thunderstorm at Eskdalemuir, July 18th, 1936

In the early morning of July 18th, 1936, a thunderstorm, rather severe in intensity, passed over Eskdalemuir. The most important feature of the storm was the heavy rainfall which occurred during part of it.



The storm approached from the south-east at 0h. 20m. and within half an hour had reached its greatest intensity. Rain commenced at 23h. 30m. and fell very heavily for a short time about 0h. 39m., when the Jardi rate of rainfall recorder gave the rate of rainfall as 178 mm./hr. (=7·0 in./hr.), this being the greatest value since the records commenced with this instrument at Eskdalemuir. It is worthy of note, however, that on the same day, July 18th, but in 1934, during a thunderstorm, a rate of 300 mm./hr. was registered at Kew.*

Temperature fell only 1° F. during the storm and recovered its previous value within a few minutes. Pressure changes were also of interest, there apparently being a wave variation superimposed upon a gradual fall, this being evident in the traces from both the float barograph and the microbarograph. The wave came first as a slight surge or increase, this being followed by a very sharp fall, 2·3 millibars in five minutes (0h. 47m. to 0h. 52m.), and this in turn by a slight rise. The microbarograph trace brings out prominently the intensity of the sudden fall in pressure.

The end of the heavy rain was marked by a slight squall in which the wind returned rapidly from NW. to NE. These changes are shown in greater detail on the accompanying diagram, which illustrates the various autographic records.

* See *Meteorological Magazine*, **69**, 1934, p. 157.

On the night of July 17th–18th, 1936, thunderstorms were reported widely over southern Scotland, parts of England and northern Ireland.

R. F. M. HAY.

Eskdalemuir Observatory, Langholm, Dumfriesshire, August 24th, 1936.

Funnel Cloud at Felixstowe

I am indebted to Mr. T. W. Evans for the following notes on a funnel cloud which nearly developed into a waterspout off the coast at Felixstowe, Suffolk, on Saturday, September 5th, 1936.

Mr. Evans remarks—" the weather during the morning was showery with considerable bright intervals, and at 12.45 p.m., B.S.T., a line squall approached from the south-south-west. At 12.55 p.m. the well-developed line of dark cloud extended to the horizon from north-west to south-east and to the north-east the funnel formed at the base of the cloud. The phenomenon lasted about 15 minutes and the sea beneath the funnel, which appeared to be off the mouth of the river Deben, was much disturbed, but the spout failed to complete its development.

The squall was accompanied by heavy rainfall which lasted for seven minutes."

DONALD L. CHAMPION.

7, Robinson Avenue, Goff's Oak, Herts. September 14th, 1936.

NOTES AND QUERIES

An early Portable Barometer

An interesting addition has been made to the Museum of the Meteorological Office, South Kensington, namely, a specimen of the portable barometer patented by Daniel Quare in 1695. The barometer was acquired by the Office in 1891, but it has not previously been exhibited at South Kensington and a few notes about it may, therefore, be of interest.

The spindle-pattern case of the instrument is of mahogany, beautifully carved. The upper portion of the tube, which is of about ¼-inch bore, is visible through a window which also encloses silvered plates engraved with an inch scale, divided to twentieths and with the following legends :—

Above the reading 30 *inches*
on the left " Rising Fair or Frost "
on the right " Dry, Serene "
Between 29 *inches and* 30 *inches*
" Variable "
Below 29 *inches*
on the left " Falling, Rain, Snow or Wind "
on the right " Rainy, stormy ".

A brass plate below the window bears the inscription " Invented and made by Dan Quare, London ".

Two pointers for setting purposes are provided on either side of the tube, these being operated by ornamental brass knobs at the top of the case. The barometer is rendered portable by turning a brass knob at the bottom of the case ; this operation causes the mercury to rise to the top of the tube and to be retained in that position by the pressure of a leather pad against the end of the dipping tube.

Before its acquisition by the Meteorological Office in 1891, the barometer to which this note refers was on exhibition at the Royal Naval Exhibition held in that year at Chelsea. While there it is known to have been broken and repaired. Apparently the breakage affected the tube only ; externally the barometer is, so far as one can judge, in its original condition.

Daniel Quare was a very distinguished maker of clocks and watches, a contemporary of Thomas Tompion. He was born in 1649 and carried on business, later in partnership with Edward Horseman, for most of his life at the Kings Arms, Exchange Alley, London. Clocks and watches by Quare are greatly esteemed by collectors and one of his outstanding productions, a twelve-months clock, is to be seen at Hampton Court Palace. According to F. J. Britten* six or seven portable barometers by Quare are known to exist ; one of them is in the United Service Institution. Another, the property of C. F. Bell, Esq., is figured on p. 298 of Britten's work. The Victoria and Albert Museum also possesses a specimen, bequeathed by Lt. Col. G. B. Croft Lyons. The same Museum possesses another barometer bequeathed by Lt. Col. Croft Lyons, unsigned, but of the same period (c.1700). It strongly resembles the Quare barometers in its external features and was found on examination to be fitted with his portability device ; it is very probable, therefore, that this barometer was also made by Quare.

E. G. BILHAM.

Luminous Night Cloud, July 26th, 1936

A luminous cloud was observed at Croydon by Mr. R. S. Read from 2.50 a.m. B.S.T. on July 26th, 1936, attaining its maximum brilliance at 3.10 a.m. and fading about 3.35 a.m. In appearance it was of a hard pearly whiteness (similar to lenticular altocumulus) and the top and sides were well defined. The bottom of the cloud was of a reddish colour and was not well defined. Numerous filaments, similar to fine cirrus, spread out from its northern side.

The cloud was also observed from Biggin Hill. The elevation of the upper part was between 4° and 5°, and the azimuth between 344° and 40° ; but owing to the short distance between Croydon

* " Old Clocks and Watches and their makers " 1911, p. 299.

and Biggin Hill the observations are not sufficient for a determination of its height and position. If observations of the azimuth and elevation were made at any other stations in this country, an accurate determination may be possible, and Mr. Read, Meteorological Station, Croydon Airport, will be glad to have a note of any such observations.

Relatively Low Temperature during Khamsin Conditions, Ismailia, Egypt.

An interesting case of relatively low temperature during warm southerly or " Khamsin " conditions occurred at Ismailia on April 22nd, 1936. A depression centred near Tobruk at 6h. G.M.T. was moving east about 25 m.p.h., while pressure was high over Syria and northern Iraq. This distribution gave rise to a rather steep gradient for S. or SE. winds over northern Egypt and Palestine, and in consequence very high temperatures were to be expected. At Heliopolis a maximum of 109° F. was recorded, Aboukir 103° F., and Port Said 102° F. At Ismailia only 101° F. was recorded at the Royal Air Force Station, and 95° F. at the Suez Canal Company's station, though at Abu-Sueir, about 8 miles to westward of Ismailia, the temperature reached 110° F. Usually it is found that during such conditions Ismailia experiences temperatures nearly as high as Cairo, so it appears that there must have been some local cause for the relative coolness of the day.

The wind was persistently between 140° and 160° throughout the day and was fresh to strong in force. It appears, therefore, that the relatively low maximum temperature might be accounted for by the fact that the wind was blowing over fairly large expanses of water before reaching Ismailia, coming from the Gulf of Suez and crossing the Bitter Lakes and Lake Timsah. A local inversion at low altitude would thus be set up, and this continued all day over the Canal zone, to which also the relative absence of rising sand might be attributed. Upper wind observations showed that the strongest wind, 35 to 38 m.p.h. was at 1,000 feet with a veer of 10°–15° from the surface. At higher levels up to 7,000 feet the speed decreased gradually, but was persistently southerly.

There was remarkable evidence of an inversion about 6h. G.M.T., as the smell from the oil refineries at Suez, 48 miles south-south-east of Ismailia, was distinctly noticeable ; a most unusual distance for smell to carry. Inversions are, of course, quite common in the early morning when no low cloud is present and the surface wind light.

The front, which appeared to be rather diffuse as the wind veered irregularly to NW, passed Ismailia at 22h. 40m. G.M.T. The temperature which had been falling slowly though still high for the time of night, 79°F, rose suddenly to 85°F, probably due to subsidence of air. It remained about the same for half an hour after which it fell rapidly. It seems, therefore, that should the direction of the wind be such that it blows persistently within the small limit of about 10° either side of 150° and thus crosses fairly large expanses of water before reaching Ismailia, the rise of temperature will be curtailed in " Khamsin " conditions. The maximum of 110°F at Abu-Sueir some eight miles to westward, where the wind came directly over the desert, and also the progressively higher maxima from south to north recorded at the Suez Canal Company's stations (Port Thewfik 91°F, Ismailia 95°F, Port Fouad 102°F) bears this out.

T. F. TWIST.

Climatic Maps of North America *

The section on the climate of North America in Köppen and Geiger's great " Handbuch der Klimatologie ", which was begun by the late R. de C. Ward and completed by C. F. Brooks includes a series of climatic maps for that continent. The originals of these maps were drawn by co-operation between the climatologists of Canada, the United States and Mexico, on a scale too large to be reproduced in detail in the " Handbuch," and in order that the enormous amount of material collected might be made generally available, Dr. C. F. Brooks and Mr. A. J. Connor, with the aid of a grant from Harvard University, have published the 26 full scale charts in the form of a loose-leaf atlas.

They form a very fine series, presenting the essential features of the climate of North America in a way never previously attempted. The charts are in black and white, and so as not to obscure the background no shading has been attempted. Orientation is provided by 10° lines of latitude and longitude and by the boundaries of the states or provinces, so that with the aid of an ordinary atlas any point can be located with ease. The absence of shading is only felt seriously in the charts of rainfall and snowfall, and even for these the difficulty of interpretation is minimised by skilful draughtsmanship.

Isotherms for each 2° C, reduced to sea level, are given for each alternate month and unreduced isotherms for January and July. The latter pair are of course extremely complicated over the mountain areas, especially the chart for July ; in January the flow of cold air down the slopes smoothes out the differences to a great extent. A useful pair of maps show the mean annual maxima and minima of temperature (i.e. the highest and lowest temperatures to be expected in a normal year). The maximum exceeds 40° C. (104° F.) over considerable areas in the west and south, but the map of minima is even more striking, and repays detailed study. Maps of mean pressure at M.S.L. in millimetres are given for January and July.

* Climatic maps of North America by Charles F. Brooks, A. J. Connor and others. 26 charts, Cambridge, Mass., Blue Hill Meteorological Observatory, 1936.

Rainfall (inches) is represented by the mean annual fall and by maps for alternate months ; in winter there was some difficulty in joining up the isohyets across the boundary between the United States and Canada, owing to differences in the method of measuring the rainfall equivalent of snow. For the United States, Alaska and the West Indies the compilations are said to have been reduced to months of 30·44 days, which would also introduce a slight break of continuity across the Canadian frontiers.

The chart of mean annual snowfall in inches is a remarkable document, amounts exceeding 400 inches in several places. It would be interesting to know just what this means in terms of depth of snow cover, or if it is to be taken literally as implying that in these localities the snow actually accumulated to a depth of over 30 feet. The remaining charts deal with relative humidity (as always, this element presents difficulties, and for most of Canada the January chart is left blank), mean cloudiness and number of days with thunderstorms. Here again differences of procedure caused difficulties at the boundaries, and no attempt has been made to connect the isobronts of the United States with those for Canada.

C. F. Brooks contributes a brief explanation of the charts, with acknowledgements to the numerous research students in the United States who have taken part in the work, as well as the Canadian climatological staff under A. J. Connor. A valuable feature is the series of brief notes under each chart, pointing out the features of greatest interest and giving short physical explanations. The atlas as a whole is a most valuable contribution to American climatology. Some elements such as sunshine are not represented, but these are to be found in the Atlas of American Agriculture.

C. E. P. Brooks.

BOOKS RECEIVED

Meteorological Results for the Royal Observatory, Hong Kong, 1934 and 1935 and *Report of the Director of the Royal Observatory, Hong Kong, for the year* 1934 and *for the year* 1935. Hong Kong, 1935 and 1936.

Jaarboek, Koninklijk Nederlandsch Meteorologisch Instituut, 1933 *and* 1934. A. Meteorologie, B. Aard-Magnetisme (Nos. 97 and 98), Utrecht, 1934 and 1935.

OBITUARY

Dr. J. B. Charcot.—We regret to learn of the death of Dr. Charcot, the veteran French explorer, who perished in the wreck of the "Pourquoi Pas ?" off the coast of Iceland on September 16th. Dr. Charcot was born at Neuilly in July, 1867, and educated for the medical profession, but he became attracted to polar exploration and in 1903–5 he organised and led an Antarctic expedition in the

"Francais" which explored the region south of Graham Land and added several new lands to the map. He confirmed and extended these discoveries in his famous specially-designed ship the "Pourquoi Pas?" in 1908–10, one coast being named Charcot Land in his honour. These expeditions brought back important meteorological as well as geographical results. The subsequent years he spent exploring in Arctic and northern Atlantic waters, his knowledge of which proved invaluable for anti-submarine work during the war. In the Second International Polar Year of 1932–3 he organised the French expedition to Scoresby Sound, and he himself took charge of the onerous duties of installing and bringing off the members of the party and their material, in which operations the "Pourquoi Pas ?" again took a large share. Dr. Charcot took the opportunity of continuing his geographical and glaciological investigations in the Greenland Sea. In 1936 he again voyaged to East Greenland in the "Pourquoi Pas ?" to bring back the members of a French trans-Greenland expedition at Angmagssalik, but during a severe gale off the coast of Iceland the ship struck the reefs and sank. Of 40 men on board, only one was saved.

C. Fitzburgh Talman.—Mr. C. F. Talman, Librarian of the United States Weather Bureau since 1908, died on July 24th at the age of 61. He was born at Detroit on August 31st, 1874, and after being educated at Kalamazoo College, Michigan, he joined the United States Weather Bureau in October, 1896. In 1898 and 1899 he was in charge of the meteorological stations which the Bureau was actively establishing in the West Indies ; subsequently he joined the Library as assistant to Prof. Kimball. At that time the Bureau Library was beginning to build up a subject catalogue in addition to the author catalogue, and Talman developed a great interest in library work. He became Librarian in 1908, a post which he retained throughout the remainder of his official service, while he passed through the grades of Junior Professor (1912), Professor (1914) and Meteorologist (1922). Talman was especially interested in weather terminology which he studied both from the etymological and meteorological sides. He wrote a few semi-popular articles on this subject: "The language of Meteorology", "The meteorological Isograms" and "The vocabulary of Weather" and he acted as meteorological adviser for the "Standard Dictionary" in 1910–11, but he actually published only a small fraction of the material which he collected, and the great "Meteorological Dictionary" which he had in mind remained a project only. The scope of such a work is indicated by his remark that there are at least fifteen hundred weather terms in the British dialects alone. Moreover the number of such terms grows continually, for example by such recent additions as "substratosphere" and "frontology".

Talman had a pleasant literary style, and besides his etymological researches he published a few articles which mainly reflect the historical aspect of meteorology, and two popular books :—"Meteorology, the Science of the Atmosphere" (republished in 1925 as "Our Weather") and "The Realm of the Air" (1931).

Miles William Binns.—We regret to learn of the death on September 14th of Mr. M. W. Binns, at Rugby. Before moving to Rugby last year Mr. Binns had kept a climatological record at Lutterworth, Leicestershire, for about 15 years. He was also prominently associated with Mr. Morris Bower of Oakes, Huddersfield in his work on thunderstorms and had also assisted in the fog survey organised by the Meteorological Office last winter. His death at the early age of 37 years followed upon a long period of physical disability, in spite of which he was able to accomplish much useful meteorological work. He was a keen student of long-range forecasting and had made experimental forecasts for several years.

NEWS IN BRIEF

We learn that Mr. R. A. Watson Watt, superintendent of the Radio Department of the National Physical Laboratory since it was formed in 1933, has been appointed superintendent of the Air Ministry Research Station, Bawdsey Manor, Suffolk.

Prof. Dr. Wladimir Köppen, the world-famous climatologist and co-editor with Dr. R. Geiger of the great "Handbuch der Klimatologie" now in course of publication, celebrated his 90th birthday at Graz on September 25th, 1936.

Mr. A. Westley of Blisworth, Northamptonshire, informs us that he has for disposal a complete series of *British Rainfall* for the years 1894 to 1920 in good condition. Anyone wishing to purchase these should communicate direct with Mr. Westley.

The Weather of September, 1936

Pressure was above normal over the eastern United States and Bermuda, most of Canada, Alaska, Greenland, Iceland, Scandinavia and southern and central Europe, the greatest excesses being 2·3 mb. at Kodiak, 6·3 mb. at Jan Mayen and 2·4 mb. at Lisbon. Pressure was below normal over western and central United States, most of the North Atlantic, north Germany, Holland, eastern Europe and north-west Asia, the greatest deficits being 9·4 mb. at Waigatz, 6·2 mb. at 50° N. 30° W. and 3·4 mb. near S. Antonio (Texas). Temperature was generally above normal over Holland, west Germany and Switzerland, below normal in eastern Germany and Hungary and about normal in Sweden. Precipitation was mainly above normal but not in eastern Germany. In Sweden there was a general deficiency of precipitation except in eastern Svealand and sunshine totals were exceptionally large.

The outstanding features of the weather of September over the British Isles were, temperature above normal for most of the month, general deficiency of sunshine except in south Ireland, the prevalence of morning mist or fog and the frequency of thunderstorms. On the 1st, warm dry sunny weather was general in southern England—77° F. was recorded at Southampton and Marlborough that day—but with the approach of a depression from the Altantic the unsettled conditions in the north spread also over the rest of the country, continuing until the 6th with mist or fog locally and thunderstorms in many parts on the 3rd to 5th, 1·85 in. of rain were measured at Inverness on the 4th and 1·62 in. at Wirswall (Cheshire) on the 3rd, of which 1·48 in. fell in 1 hour. Strong squally winds reaching gale force locally at exposed places occurred on the 7th and 8th, when a vigorous disturbance crossed the British Isles giving rain generally, though there were many hours bright sunshine in south-east England on the 7th and in Scotland on the 8th. From the 9th to 13th pressure was low to the west and high to the east so that warm, light to moderate southerly winds prevailed with unsettled weather and morning mist or fog. Temperature exceeded 70° F. at numerous places on the 11th and 13th, even reaching 71° F. at Nairn on the 11th while night minima did not fall below 63° F. at Bath on the 12th and 62° F. at Tottenham on the 13th. Sunshine records were good in the south on the 11th and generally on the 13th but on the 12th rain was experienced at most places, 1·60 in. at Cirencester (Gloucestershire), with thunderstorms in the south and east. On the 14th and 15th shallow depressions lay over the British Isles and thunderstorms, sometimes accompanied by heavy rain—1·97 in. at Middleton-in-Teesdale (Durham)—were widespread. There was also much sunshine, e.g. 10·9 hrs. at Dover on the 14th and 10·8 hrs. at Stornoway on the 15th but a considerable amount of morning mist or fog. From the 16th to 19th pressure was high over the British Isles and the weather fair to cloudy with slight showers or drizzle locally. On the 20th and 21st a depression moved northwards from the Bay of Biscay and caused heavy rain and thunderstorms locally in the south, 3·13 in. at Berkhamsted (Herts) and 2·19 in. at Cottenham (Cambridge) on the 20th, while fair to cloudy weather continued in the north and in Ireland. From the 22nd to 23rd anticyclonic conditions prevailed over the whole country with widespread morning mist or fog—thick fog persisted all day in the western English Channel on the 22nd—but elsewhere there was much sunshine, 10·0 hrs. at Dover and Douglas on the 22nd. On the 24th and 25th a depression passing eastwards across the country brought dull rainy weather with heavy local thunderstorms, 1·87 in. at Dumfries on the 24th and 1·81 in. at Birr Castle on the 25th. High minimum temperatures were again experienced generally on the night of the 24th–25th, 62° F. at Gorleston, Tottenham, Kew and Portsmouth, but on the 26th cold northerly winds brought a fall of temperature. Thunderstorms occurred in the south-east on the 27th. From the 28th to 30th an anticyclone extended over the whole country with low temperatures and ground frosts but much sun on the 28th and 29th, over 10 hrs. being recorded on either day in parts of western Great Britain and Ireland. The distribution of bright sunshine for the month was as follows :—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway ...	104	−10	Chester ...	80	−44
Aberdeen ...	95	−29	Ross-on-Wye...	91	−45
Dublin	98	−35	Falmouth ...	153	− 7
Birr Castle ...	133	+14	Gorleston ...	147	−11
Valentia... ...	127	+ 3	Kew	90	−55

Miscellaneous notes on weather abroad culled from various sources

As a result of a violent storm over central Switzerland on the 3rd a torrent from the Dent du Midi cut the Simplon Railway line in the Rhone Valley near St. Maurice and caused a landslip on the Schüpserberg between Berne and Lucerne killing 6 people. Cold unseasonable weather was experienced in northern Italy about the middle of the month when snow fell in Piedmont—on the 18th the snow was 6 ft. deep on the Great St. Bernard Pass. Bad weather occurred generally in Germany during the harvesting. During a severe storm on the 16th the French exploring ship the *Pourquoi Pas?* ran on the rocks off the west coast of Iceland and was completely wrecked; 39 out of the 40 people on board were drowned. The storm also caused damage to other shipping. Fog was prevalent in the Baltic on the 22nd and off Holland on the 23rd and 25th. (*The Times*, September 5th–24th.)

Snow fell in many of the country districts of South Africa and was general along the reef about the 11th. At Johannesburg it was said to be the first snowstorm in September for 32 years. Heavy weather was experienced by shipping north of Durban about the 20th. (*The Times*, September 12th–22nd.)

Drought was experienced in the Bombay Presidency during the first 7 days but on the 8th heavy rain or showers occurred generally. The monsoon was strong in the central part of India early in the month and floods and landslips occurred in the United Provinces, Bihar and Bengal. By the 22nd drought conditions were again prevailing in the Bombay Presidency and the monsoon was withdrawing from the country. (*The Times*, September 8th–25th.)

The total rainfall for the month in Australia was considerably below normal except in parts of Queensland and New South Wales where it was above normal. (Cable.)

The fringe of an Atlantic hurricane struck Bermuda on the 17th. On the evening of the 17th a hurricane moving northwards from the West Indies struck North Carolina and Virginia. During the 18th it continued to move northwards along the Atlantic coast but on the 19th, it decreased in intensity and swung eastwards out to sea. There was some loss of life in the south and damage to shipping. In the United States temperature was above normal generally, except at the beginning of the month along the eastern coasts, about the middle along the western coasts and towards the end in the Middle States, while rainfall was on the whole below normal except in the Middle States towards the end of the month. (*The Times*, September 18th–21st, and *Washington, D.C., U.S. Dept. Agric., Weekly Weather and Crop Bulletin.*)

Daily Readings at Kew Observatory, September, 1936

Date	Pressure, M.S.L. 13h.	Wind, Dir., Force 13h.	Temp. Min.	Temp. Max.	Rel. Hum. 13h.	Rain.	Sun.	Remarks. (see vol. 69, 1934, p. 1).
	mb.		°F	°F	%	in.	hrs.	
1	1021·6	NW 2	56	71	74	—	3·7	w early.
2	1014·3	WSW.3	60	73	63	—	3·5	w evening.
3	1007·7	SSW.4	56	70	71	0·02	0·8	pr_0 8h.–11h. r 15h.
4	1001·8	SW.5	57	67	82	0·19	2·1	r_0–r 7h.–16h.
5	1001·1	W.3	58	65	89	0·75	2·6	r 1h.–6h. TLR 14h–[15h.
6	1010·0	W.4	56	64	57	—	0·9	r_0 21h.
7	998·0	W.5	60	65	42	0·02	8·5	r_0 3h.–7h. & 21h.
8	1004·4	WNW.5	54	65	61	0·04	2·9	r_0–r 6h –9h.
9	1016·4	SSE.2	52	67	75	0·01	2·1	r_0 13h. & 23h.–24h.
10	1016·1	S.2	57	68	85	0·41	1·4	r–r_0 4h.–10h., pr_0 13h.
11	1017·2	SSE.4	57	73	57	—	9·3	w early.
12	1015·5	SSE.2	60	67	82	0·20	0·1	ir_0 11h.–15h. T 15h.
13	1018·2	W.2	59	70	74	—	5·6	r_0 0h.–1h. [PR 17h.
14	1020·2	W.2	50	67	58	—	6·2	w early. Tr_0 15h.–[16h.
15	1022·4	N 1	51	62	68	0·09	2·5	TLr 15h.–16h.
16	1025·3	NE 3	51	65	56	0·01	3·8	pr_0 14h. r_0 21h. & 24h.
17	1022·1	NNE.3	58	69	70	0·03	0·4	r_0 0h.–1h. pr_0 13h.
18	1020·8	SW.2	57	65	70	—	1·4	F from 20h.
19	1024·1	E 3	50	64	77	—	2·7	Fe till 8h.
20	1020·8	E.4	55	69	65	0·62	3·8	r 17h.–18h., 22h.–24h.
21	1020·7	WSW.2	61	66	84	0·20	0·0	r_0–R 0h.–3h. pr 11h.
22	1029·9	W.1	52	66	86	trace	2·9	Fe till 11h. & from [20h.
23	1025·0	ENE.3	52	67	82	trace	3·6	Fe till 10h.
24	1013·1	E.3	58	71	73	—	1·0	d_0 21h.
25	1011·5	W.3	62	66	80	—	0·0	d 5h.–6h.
26	1019·9	N.2	50	57	74	0·06	0·6	r–r_0 1h.–11h.
27	1007·5	W.3	48	55	84	0·13	0·9	r_0–R 10h.–17h. TL [14h.
28	1018·7	ENE.5	45	57	67	0·01	7·8	pr 12h.–13h.
29	1025·3	N.3	42	57	59	—	9·0	w early.
30	1024·3	N.3	42	56	70	—	0·0	w early.
*	1016·5	—	54	65	71	2·81	3·0	* Means or Totals

General Rainfall for September, 1936

England and Wales ...	142	per cent of the average 1881–1915.
Scotland	119	
Ireland	140	
British Isles	136	

Rainfall : September, 1936 : England and Wales

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Lond .	Camden Square	2·99	165	*Leics* .	Belvoir Castle	2·67	143
Sur .	Reigate, Wray Pk. Rd.	2·06	99	*Rut* .	Ridlington	2·15	112
Kent .	Tenterden, Ashenden	1·96	92	*Lincs* .	Boston, Skirbeck	1·45	82
,, .	Folkestone, Boro. San.	3·29	...	,, .	Cranwell Aerodrome	2·30	129
,, .	Margate, Cliftonville	2·16	110	,, .	Skegness, Marine Gdns.	1·69	93
,, .	Eden'bdg., Falconhurst	2·64	117	,, .	Louth, Westgate	1·36	67
Sus .	Compton, Compton Ho.	3·24	116	,, .	Brigg, Wrawby St.	2·03	...
,, .	Patching Farm	2·34	98	*Notts* .	Worksop, Hodsock	1·82	120
,, .	Eastbourne, Wil. Sq.	1·72	69	*Derby*.	Derby, L. M. & S. Rly.	3·15	191
Hants.	Ventnor, Roy.Nat.Hos.	2·72	110	,, .	Buxton, Terr. Slopes	6·00	186
,, .	Fordingbridge, Oaklnds	4·26	199	*Ches* .	Runcorn, Weston Pt.	4·16	156
,, .	Ovington Rectory	3·90	171	*Lancs*.	Manchester, Whit. Pk.	3·88	163
,, .	Sherborne St. John	4·15	202	,, .	Stonyhurst College	5·46	143
Herts .	Royston, Therfield Rec.	2·92	155	,, .	Southport, Bedford Pk.	3·34	122
Bucks.	Slough, Upton	2·45	139	,, .	Lancaster, Greg Obsy.	5·30	157
,, .	H. Wycombe, Flackwell	3·96	202	*Yorks*.	Wath-upon-Dearne	2·10	133
Oxf .	Oxford, Mag. College	3·30	196	,, .	Wakefield, Clarence Pk.	2·43	152
N'hant	Wellingboro, Swanspool	2·18	121	,, .	Oughtershaw Hall	3·45	...
,, .	Oundle	2·20	...	,, .	Wetherby, Ribston H.	2·72	151
Beds .	Woburn, Exptl. Farm	3·00	168	,, .	Hull, Pearson Park	1·57	92
Cam .	Cambridge, Bot. Gdns.	2·61	162	,, .	Holme-on-Spalding	2·30	132
Essex.	Chelmsford, County Gdns	...	...	,, .	West Witton, Ivy Ho.	3·01	140
,, .	Lexden Hill House	2·00	...	,, .	Felixkirk, Mt. St. John.	2·76	152
Suff .	Haughley House	2·30	...	,, .	York, Museum Gdns.	1·61	99
,, .	Campsea Ashe	2·23	117	,, .	Pickering, Hungate	1·98	104
,, .	Lowestoft Sec. School	2·40	122	,, .	Scarborough	1·73	97
,, .	Bury St. Ed., WestleyH.	2·44	123	,, .	Middlesbrough	2·93	176
Norf. .	Wells, Holkham Hall	2·96	156	,, .	Baldersdale, Hury Res.	5·52	220
Wilts .	Calne, Castle Walk	4·01	...	*Durh* .	Ushaw College	2·68	133
,, .	Porton, W.D. Exp'l. Stn	3·52	201	*Nor* .	Newcastle, D. & D. Inst.	2·43	131
Dor .	Evershot, Melbury Ho.	3·70	139	,, .	Bellingham, Highgreen	4·72	196
,, .	Weymouth, Westham.	2·08	99	,, .	Lilburn Tower Gdns.	2·86	121
,, .	Shaftesbury, Abbey Ho.	2·97	122	*Cumb*.	Carlisle, Scaleby Hall	5·13	190
Devon.	Plymouth, The Hoe	2·96	116	,, .	Borrowdale, Seathwaite	12·00	128
,, .	Holne, Church Pk. Cott.	4·94	137	,, .	Borrowdale, Moraine	9·26	123
,, .	Teignmouth, Den Gdns.	2·86	146	,, .	Keswick, High Hill	6·85	162
,, .	Cullompton	3·06	136	*West* .	Appleby, Castle Bank	4·15	164
,, .	Sidmouth, U.D.C.	2·65	...	*Mon* .	Abergavenny, Larchf'd	3·50	150
,, .	Barnstaple, N. Dev.Ath	3·86	143	*Glam* .	Ystalyfera, Wern Ho.	4·09	94
,, .	Dartm'r, Cranmere Pool	5·80	...	,, .	Cardiff, Ely P. Stn	3·11	100
,, .	Okehampton, Uplands.	3·08	95	,, .	Treherbert, Tynywaun.	6·05	...
Corn .	Redruth, Trewirgie	3·82	122	*Carm* .	Carmarthen, Coll. Rd.	4·10	119
,, .	Penzance, Morrab Gdns.	4·14	141	*Pemb* .	St. Ann's Hd, C. Gd. Stn.	2·39	88
,, .	St. Austell, Trevarna	2·83	89	*Card* .	Aberystwyth	5·42	...
Soms .	Chewton Mendip	4·28	140	*Rad* .	BirmW.W.Tyrmynydd	4·79	124
,, .	Long Ashton	3·18	133	*Mont* .	Lake Vyrnwy	6·31	179
,, .	Street, Millfield	3·26	...	*Flint* .	Sealand Aerodrome	3·11	...
Glos .	Blockley	5·33	...	*Mer* .	Blaenau Festiniog	10·96	153
,, .	Cirencester, Gwynfa	4·29	194	,, .	Dolgelley, Bontddu	6·94	163
Here .	Ross, Birchlea	3·02	157	*Carn* .	Llandudno	3·22	152
Salop.	Church Stretton	5·03	248	,, .	Snowdon, L. Llydaw 9.	15·65	...
,, .	Shifnal, Hatton Grange	3·98	206	*Ang* .	Holyhead, Salt Island	3·49	131
Staffs.	Market Drayt'n, Old Sp.	3·22	159	,, .	Lligwy	2·70	...
Worc .	Ombersley, Holt Lock.	2·25	127	*Isle of Man*			
War .	Alcester, Ragley Hall	3·02	170		Douglas, Boro' Cem.	5·93	182
,, .	Birminghm, Edgbaston	2·98	166	*Guernsey*			
Leics .	Thornton Reservoir	3·07	170		St. PeterP't.Grange Rd.	4·30	165

Rainfall: September, 1936: Scotland and Ireland

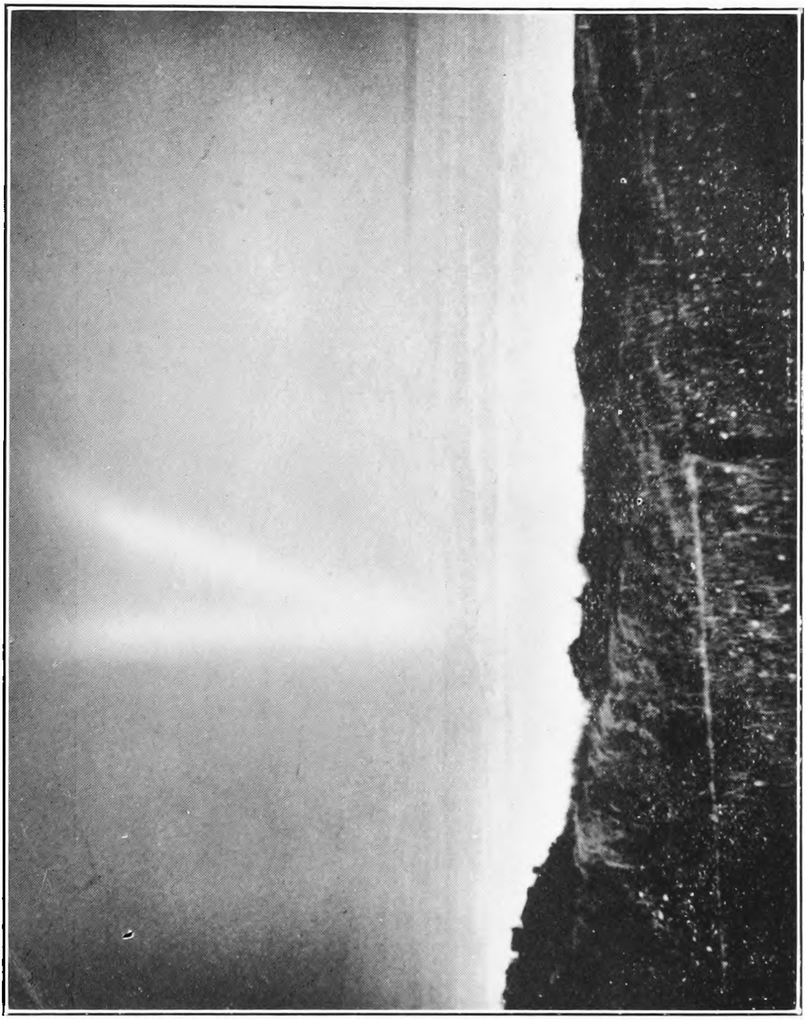
Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Wig .	Pt. William, Monreith.	4·91	168	*Suth* .	Lairg	2·78	98
,, .	New Luce School	5·38	149	,, .	Tongue	3·65	115
Kirk .	Dalry, Glendarroch	6·18	168	,, .	Melvich	2·08	74
Dumf.	Dumfries, Crichton R.I.	5·28	207	,, .	Loch More, Achfary	4·73	82
,, .	Eskdalemuir Obs	5·59	151	*Caith* .	Wick	2·74	110
Roxb .	Hawick, Wolfelee	3·40	133	*Ork* .	Deerness	2·98	103
Selk .	Ettrick Manse	4·49	125	*Shet* .	Lerwick	1·96	65
Peeb .	West Linton	3·14	...	*Cork* .	Dunmanway Rectory	4·08	100
Berw .	Marchmont House	3·41	141	,, .	Cork, University Coll	2·88	107
E.Lot.	North Berwick Res	3·90	186	,, .	Ballinacurra	2·68	107
Midl .	Edinburgh, Blackfd. H.	2·92	142	,, .	Mallow, Longueville	3·26	136
Lan .	Auchtyfardle	3·52	...	*Kerry*.	Valentia Obsy	4·19	101
Ayr .	Kilmarnock, Kay Pk	3·81	...	,, .	Gearhameen	5·70	93
,, .	Girvan, Pinmore	4·71	123	,, .	Bally McElligott Rec	3·80	...
,, .	Glen Afton, Ayr San.	4·46	114	,, .	Darrynane Abbey	3·85	108
Renf .	Glasgow, Queen's Pk	4·23	153	*Wat* .	Waterford, Gortmore	2·94	107
,, .	Greenock, Prospect H.	4·12	87	*Tip* .	Nenagh, Cas. Lough	4·17	148
Bute .	Rothesay, Ardencraig	4·78	...	,, .	Roscrea, Timoney Park	4·09	...
,, .	Dougarie Lodge	3·78	...	,, .	Cashel, Ballinamona	4·60	190
Arg .	Ardgour House	4·72	...	*Lim* .	Foynes, Coolnanes	3·03	109
,, .	Glen Etive	...	...	,, .	Castleconnel Rec	4·31	...
,, .	Oban	3·38	...	*Clare* .	Inagh, Mount Callan	5·59	...
,, .	Poltalloch	4·37	96	,, .	Broadford, Hurdlest'n.	4·72	...
,, .	Inveraray Castle	4·75	74	*Wexf* .	Gorey, Courtown Ho	3·33	135
,, .	Islay, Eallabus	3·55	85	*Wick* .	Rathnew, Clonmannon.	3·25	...
,, .	Mull, Benmore	12·20	106	*Carl* .	Hacketstown Rectory	4·36	155
,, .	Tiree	...	...	*Leix* .	Blandsfort House	4·11	151
Kinr .	Loch Leven Sluice	3·74	146	*Offaly*.	Birr Castle	4·67	204
Fife .	Leuchars Aerodrome	2·93	152	*Dublin*	Dublin, FitzWm. Sq	2·64	138
Perth .	Loch Dhu	7·05	123	*Meath*.	Beauparc, St. Cloud	4·33	...
,, .	Balquhidder, Stronvar.	4·12	...	,, .	Kells, Headfort	4·40	165
,, .	Crieff, Strathearn Hyd.	4·26	149	*W.M* .	Moate, Coolatore	4·31	...
,, .	Blair Castle Gardens	2·95	125	,, .	Mullingar, Belvedere	4·39	164
Angus.	Kettins School	2.65	120	*Long* .	Castle Forbes Gdns	4·08	142
,, .	Pearsie House	4·07	...	*Gal* .	Galway, Grammar Sch.	3·66	...
,, .	Montrose, Sunnyside	3·12	157	,, .	Ballynahinch Castle	5·65	119
Aber .	Braemar, Bank	3·03	121	,, .	Ahascragh, Clonbrock.	4·47	145
,, .	Logie Coldstone Sch	2·34	100	*Mayo*.	Blacksod Point	4·57	118
,, .	Aberdeen, Observatory.	2·60	117	,, .	Mallaranny	5·74	...
,, .	Fyvie Castle	2·60	100	,, .	Westport House	4·93	139
Moray	Gordon Castle	2·52	101	,, .	Delphi Lodge	9·13	121
,, .	Grantown-on-Spey	...	...	*Sligo* .	Markree Castle	4·38	129
Nairn.	Nairn	2·26	103	*Cavan*.	Crossdoney, Kevit Cas.	3·86	...
Inv's .	Ben Alder Lodge	3·62	...	*Ferm* .	Newtwnbtlr, Crom Cas.	4·41	158
,, .	Kingussie, The Birches.	3·32	...	,, .	Enniskillen, Portora	5·37	...
,, .	Loch Ness, Foyers	...	...	*Arm* .	Armagh Obsy	4·35	177
,, .	Inverness, Culduthel R.	4·13	...	*Down*.	Fofanny Reservoir	7·83	...
,, .	Loch Quoich, Loan	5·47	...	,, .	Seaforde	5·03	182
,, .	Glenquoich	4·36	51	,, .	Donaghadee, C. G. Stn.	4·07	171
,, .	Glenleven, Corrour	6·20	115	*Antr* .	Belfast, Cavehill Rd	4·53	...
,, .	Fort William, Glasdrum	3·70	...	,, .	Aldergrove Aerodrome.	3·80	153
,, .	Skye, Dunvegan	2·98	...	,, .	Ballymena, Harryville.	4·93	158
,, .	Barra, Skallary	3·27	...	*Lon* .	Garvagh, Moneydig	5·15	...
R&C .	Alness, Ardross Castle.	3·38	116	,, .	Londonderry, Creggan.	5·46	166
,, .	Ullapool	3·11	83	*Tyr* .	Omagh, Edenfel	4·11	135
,, .	Achnashellach	5·04	69	*Don* .	Malin Head	4·11	...
,, .	Stornoway, Matheson	4·21	107	,, .	Killybegs, Rockmount.	3·18	...

Climatological Table for the British Empire, April, 1936

STATIONS.	PRESSURE. Mean of Day M.S.L.	PRESSURE. Diff. from Normal.	TEMPERATURE. Absolute. Max.	TEMPERATURE. Absolute. Min.	TEMPERATURE. Mean Values. Max.	TEMPERATURE. Mean Values. Min.	TEMPERATURE. Mean Values. ½ Max. and Min.	TEMPERATURE. Mean Values. Diff. from Normal	TEMPERATURE. Mean. Wet Bulb.	Relative Humidity.	Mean Cloud Am'nt	PRECIPITATION. Am'nt.	PRECIPITATION. Diff. from Normal.	PRECIPITATION. Days.	BRIGHT SUNSHINE. Hours per day.	BRIGHT SUNSHINE. Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0–10	in.	in.			
London, Kew Obsy....	1014·8	+ 0·4	63	31	50·9	38·3	44·6	− 2·5	39·8	82	6·9	1·68	+ 0·23	14	4·4	32
Gibraltar	1014·8	− 1·6	68	46	62·5	54·4	58·5	...	54·4	84	6·3	5·67	...	10	...	...
Malta....................	1013·0	− 0·4	72	51	65·7	56·9	61·3	+ 0·4	56·2	74	5·1	0·93	+ 0·07	5	8·7	67
St. Helena	1012·6	− 0·3	71	58	67·4	60·6	64·0	− 1·3	62·1	95	9·1	2·23	− 0·99	21	...	...
Freetown, Sierra Leone	1008·3	− 0·8	92	68	87·9	74·2	81·1	− 1·3	77·2	84	8·7	6·81	+ 2·75	16	...	...
Lagos, Nigeria	1010·0	+ 0·6	91	73	88·2	78·3	83·3	+ 0·5	78·1	83	7·7	2·57	− 3·51	6	6·7	55
Kaduna, Nigeria	1006·6	− 2·3	99	65	93·3	71·5	82·4	+ 0·9	73·1	76	5·6	2·38	− 0·70	10	8·3	67
Zomba, Nyasaland	1013·7	+ 1·2	81	56	76·7	61·7	69·2	− 0·1	66·2	81	6·8	3·46	− 0·20	11	...	...
Salisbury, Rhodesia...	1016·4	+ 0·7	81	47	76·0	52·7	64·3	− 1·4	58·3	67	4·1	1·03	+ 0·04	8	8·0	68
Cape Town	1017·9	+ 1·5	97	45	74·9	55·5	65·2	+ 2·0	55·4	75	3·8	0·52	− 1·35	4	...	...
Johannesburg	1017·8	+ 1·6	78	42	70·9	50·7	60·8	+ 0·8	53·3	68	3·4	0·10	− 1·64	4	8·2	71
Mauritius	1014·1	+ 0·1	86	65	83·3	70·3	76·8	+ 1·0	72·0	71	4·0	1·04	− 3·43	14	8·5	73
Calcutta, Alipore Obsy.	1005·4	− 0·9	107	69	98·8	77·6	88·2	+ 2·6	77·8	79	2·9	0·25	− 1·93	1*	...	...
Bombay	1008·8	0·0	90	73	88·9	76·3	82·6	− 0·5	75·6	77	1·9	0·00	− 0·05	0*	...	...
Madras	1007·0	− 1·4	105	73	94·4	78·2	86·3	+ 1·0	77·9	73	5·8	0·46	− 0·17	1*	...	...
Colombo, Ceylon	1009·3	+ 0·6	91	73	89·0	77·2	83·1	+ 0·4	77·9	71	6·7	2·86	− 6·87	8	7·4	60
Singapore	1008·6	− 0·3	90	74	87·0	76·2	81·6	0·0	77·8	79	6·9	7·00	− 0·63	18	6·2	51
Hongkong................	1012·0	− 0·6	86	58	76·5	66·9	71·7	+ 0·9	68·4	85	8·9	4·60	− 1·05	9	3·3	26
Sandakan	1008·9	...	92	74	89·1	76·6	82·9	+ 0·7	78·4	80	8·0	4·76	+ 0·27	16	...	...
Sydney, N.S.W..........	1017·6	− 0·8	91	48	70·8	55·3	63·1	− 1·6	57·7	69	4·9	1·85	− 3·67	10	7·6	67
Melbourne	1019·4	− 0·1	80	39	65·5	48·6	57·1	− 2·4	52·7	72	7·2	4·30	+ 2·13	18	4·3	39
Adelaide	1021·7	+ 1·8	85	43	72·1	53·2	62·7	− 1·2	54·9	55	4·8	1·21	− 0·52	10	7·0	63
Perth, W. Australia ...	1020·2	+ 1·8	93	47	77·1	57·6	67·3	+ 0·5	56·7	55	4·3	0·59	− 1·06	8	7·3	65
Coolgardie	1019·8	+ 1·5	91	43	78·1	52·7	65·4	+ 0·4	56·3	55	3·3	0·18	− 0·78	2	...	...
Brisbane	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Hobart, Tasmania......	1014·1	− 0·7	72	39	62·4	46·8	54·6	− 0·6	47·3	60	6·6	1·50	− 0·35	14	5·1	47
Wellington, N.Z.	1017·8	− 0·3	73	43	63·5	51·8	57·7	+ 0·6	55·2	81	6·5	3·33	− 0·55	12	4·9	45
Suva, Fiji	1009·7	− 0·9	93	72	87·4	74·6	81·0	+ 2·4	76·2	83	5·5	7·60	− 4·61	19	6·8	58
Apia, Samoa	1009·3	− 0·6	89	73	86·1	75·6	80·9	+ 2·0	77·2	79	6·0	8·70	− 1·45	21	6·6	56
Kingston, Jamaica	1014·0	− 0·1	92	68	87·3	71·8	79·5	+ 1·1	70·6	78	4·2	1·20	− 0·04	3	6·6	53
Grenada, W.I.	1011·9	− 0·6	84	71	83	72	77·5	− 1·4	76	83	5	2·38	+ 0·22	18	...	...
Toronto..................	1015·7	− 0·4	64	24	45·8	33·4	39·6	− 2·5	...	...	7·5	2·82	+ 0·53	12	3·3	25
Winnipeg	1019·6	+ 2·9	65	−16	40·1	19·6	29·9	− 7·8	...	...	4·0	0·44	− 0·96	9	8·2	60
St. John, N.B.	1013·2	− 0·2	55	26	44·6	32·5	38·5	− 0·5	34·6	76	7·6	3·29	− 0·23	15	4·1	30
Victoria, B.C...........	1018·6	+ 1·1	67	32	56·3	43·6	49·9	+ 2·0	46·7	81	6·9	0·88	− 0·64	10	6·9	51

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

(33884) Wt. 19/32 1,125 10/36 Hw. G.377



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RAINBOW WITH VERTICAL SHAFT SEEN FROM SKYE, JULY 7TH, 1936 (*see* p. 230)

M.O. 403.

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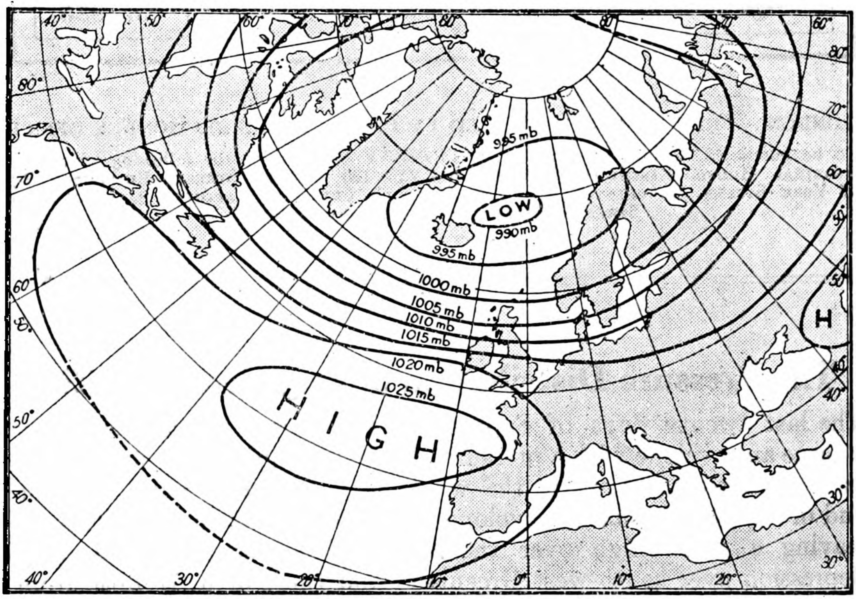
The Pressure Distribution during October, 1936

The last twenty days of September, 1936, were characterised by a large anticyclone with a pressure above 1020 mb. over the greater part of Europe, including the whole of the British Isles. At the end of September this anticyclone broke down over most of Europe, leaving a small high over the British Isles, separating a deep depression over south-west Greenland and the North Atlantic from a complex system of shallow lows over Europe. This type of distribution persisted with minor changes until October 10th; on the 11th the anticyclone over the British Isles receded towards the west-south-west while depressions south of Greenland and over Scandinavia began to unite across Iceland. This process was practically complete by the 14th, when a small secondary depression over Scotland definitely terminated the long regime of anticyclonic conditions.

The chart of average pressure for October 1st–13th shows an anticyclone covering the British Isles, where the pressure was everywhere above 1020 mb. and reached 1024 mb. at Lerwick. From here a long curved anticyclonic ridge extended across the Azores to Bermuda, partially enclosing a depression centred west of Cape Farewell, Greenland, with a minimum pressure of about 1002 mb.

By October 15th pressure had fallen below 980 mb. in Iceland and a steep gradient for westerly winds extended across the British Isles. This type of distribution continued with minor changes until the end of October, giving a series of strong winds or gales on our western and northern coasts. There was a short interval of more anticyclonic conditions from the 20th to 22nd but on the 23rd another depression approached from the west, and from the 24th to 27th very low pressures were recorded north and north-east of Scotland, falling below 964 mb. on the 26th and 27th, with widespread gales, especially in Scotland and northern Ireland, where considerable damage was done and three lives were lost. The " Queen Mary " suffered a very rough crossing, eight passengers and four members of the crew being hurt, while several other ships were sunk with loss of life.



The average pressure distribution during the period October 14th to 31st is shown in the figure. The steep gradient from south to north over Scotland and northern England is especially notable. The distribution is very similar to, though less intense than, that for January 1st–15th, 1934, and the succession of changes during the whole period from September 11th to October 31st, 1936, follows fairly closely the development from December 1st, 1933, to January 15th, 1934, illustrated in the *Meteorological Magazine* for January and February, 1934. In that remarkable sequence a deep area of low pressure travelled from south-west of Greenland to Iceland, and in the succeeding half-month (January 16th–31st) passed on to Spitsbergen, while the anticyclone retreated from Europe across the British Isles to a position west of Spain. Whether the parallel will complete itself during the first half of November, 1936, is not known at the time of writing, though the daily charts for the first few days of November appear to indicate a trend in that direction.

The area of low pressure shown north-east of Iceland in the figure is to be regarded not as an active individual depression but as a focus of cyclonic activity through or about which a whole series of different depressions passed from west to east, reaching their greatest intensity as they passed through the focus.

The average pressure for the month shows a steady decrease from 1021 mb. at Scilly and Brest towards the east-north-east, falling to 1008 mb. at Riga. The greater part of Europe accordingly experienced a great influx of polar maritime air, which brought low temperatures and heavy rainfall. The broadcast monthly means show that in most parts of Germany temperature was 3–4° F. below normal and rainfall an inch or more above normal; further to the south-east, in Hungary, the deficit of temperature averaged 6–7° F. and the excess of rainfall 2–3 in. At high-level stations the abnormality of temperature was even greater, reaching —8·5° F. at the Zugspitze in the extreme south of Germany at a height of 9,720ft.

C. E. P. Brooks.

Weather Changes on the West African Air Route

The opening of new air routes nearly always leads to extension of and precision in our knowledge of meteorological conditions provided that the operating pilots are careful in the preparation of the weather section of their navigation reports. The navigation report of the Imperial Airways aircraft *Delia* (Capt. R. O. O. Taylor) Geneina–Kano on April 22nd, 1936, is interesting because it seems possible to connect changes of weather on the West African Air Route with the passage of depressions across the Mediterranean and the western desert of Egypt.

The prevailing wind between November and May over this route and for the greater part of the Sudan, Chad and French West Africa is NE.–E. being a circulation round the high pressure area of the Sahara; occasionally, however, this circulation is interrupted by the passage of depressions along the Mediterranean and on this particular occasion it seems that a well-marked cold front extended from southern Europe across the Mediterranean and the Sahara to the vicinity of Kano—a distance of at least 2,000 miles.

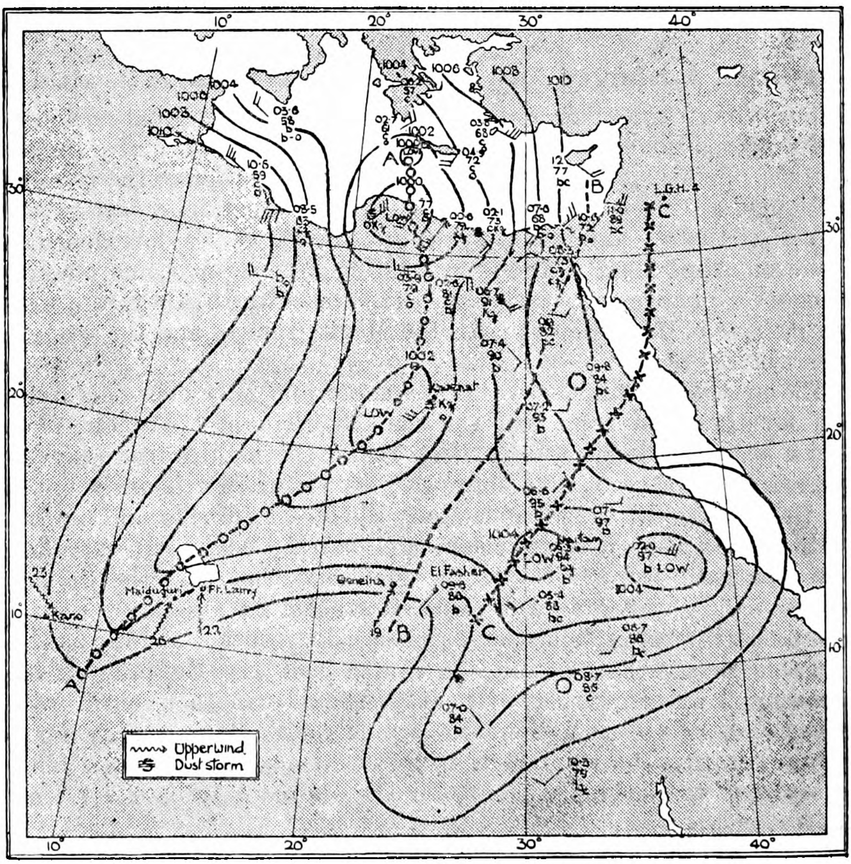
The chart on p. 228 shows the pressure distribution as fully as the available observations permit. A centre near the Egyptian coast is causing sandstorms there; there is probably another centre west of the oasis of Owenat where the wind is SW. force 6 with duststorms. It may be recalled that these duststorms caused a temporary stop to the aerial search for the German Ambassador who was lost in the western desert.

No observations of pressure are available west of El Fasher (all efforts to obtain them have so far failed) but the normal NE.–E.

winds over the route Khartoum to Kano were replaced on the 22nd by wind from S.–SW. except near Kano where the wind was WNW.

TABLE I.—UPPER WINDS BETWEEN GENEINA AND KANO ON APRIL 22ND, 1936.

Height.	Geneina		Lamy		Maiduguri		Kano	
ft.	°	m.p.h.	°	m.p.h.	°	m.p.h.	°	m.p.h.
2,000	...	...	S	27	SSW	25	...	...
3,000	SW'S	10	S	22	SSW	26	WNW	23
4,000	SW	19	...	...	...	...	...	...
5,000	SW	22	...	...	SW'S	30	W	22
6,000	SW	13	...	...	...	...	...	...
7,000	SW	7	SW	12	SW'S	16	W'N	23
8,000	SW'W	7	...	...	...	...	...	...
10,000	SSE	4	NW	11	...	...	W'S	5



Capt. Taylor's remarks are as follows :—

April 22nd, 1936.

0430	Geneina	S. 5–8 m.p.h., 5 tenths stratocumulus, visibility good.
0530	Abeche	SW. 8–10 m.p.h., 7 tenths stratocumulus and altocumulus, visibility good.
0530–0955	Abeche–Lamy.	Cloud 10 tenths altostratus and altocumulus—rain showers, visibility good except in rain.
	Lamy–Maiduguri	10 tenths stratocumulus and altocumulus, visibility good.
1140	Maiduguri	SW. 20–25 m.p.h., 10 tenths stratocumulus and altocumulus—rain in west.
1145–1445	Maiduguri–Kano.	Continuous heavy rain over almost whole route from 10 tenths high nimbus. Areas of low stratus at about 500 ft. above ground, visibility poor in rain—thunder and lightning.

It is fairly certain from the weather experienced that the front was crossed between Maiduguri and Kano between 11h. 40m. and 14h. 45m. G.M.T. on April 22nd and that the front on that date was as indicated by the line AA. on the chart.

On the 23rd the front was as indicated by the line BB. Its position over Egypt and the northern Sudan is very well marked and the upper winds at Geneina at 5h. 45m. were :—

3,000 ft.	W'N.	10 m.p.h.
4,000 ft.	W'S.	9 m.p.h.

which would indicate that the front had just passed that station. During the 23rd El Fasher had 6 mm. of rain and by 6h. G.M.T. on the 24th the wind had become NW. force 3.

Khartoum's upper winds on the 24th had become southerly and reports from Merowe, M.V. *Strathmore* in the Red Sea and L.G. H.4 (Syrian Desert) indicate that the position of the front on the 24th was as shown by the line CC.

J. Durward.

OFFICIAL PUBLICATION

The following publication has recently been issued :—

Professional Notes

No. 72. Upper winds at Wadi Halfa (Sudan). By J. Durward, M.A. (M.O. 336l).

In Professional Notes No. 72 is discussed the variation of wind with height at Wadi Halfa. The upper winds at this station are characterized by great constancy of direction and therefore the most graphic method of presenting the data is by the construction of direction frequency vectors and curves of average velocity.

The wind from ground level up to a height of about 4,000 feet is nearly always between N. and NE. In the months of December to February the wind above this height usually backs and is about 300° at 10,000 feet. In July to September the backing is much greater, the wind becoming 230°–260° at 10,000 feet. In the transitional period March to June the wind does not as a rule back beyond north and particularly in June the "constancy" at high levels is very small. The same applies to the winds during the second transitional period October and November.

The maximum wind speed in the early morning is generally encountered at 2,000 feet whilst the highest velocity at all heights occurs in April.

Certain cases are discussed in which the wind at Wadi Halfa is SE.–S. These are associated either with an extensive low pressure area in the western desert or with a northerly extension of the low pressure area in the Sudan. In the former case the change from SE. to N. or NE. is nearly always accompanied by sandstorms.

Discussions at the Meteorological Office

The subjects for discussion for the next two meetings are :—

November 30th, 1936. *Visibility : its measurement and significance in seeing.* By M. Luckiesh and F. K. Moss (Philadelphia, J. Franklin Inst. 220, 1935, pp. 431–66) and *Visibility and visibility determination.* By H. Sebastian (Beitr. Geophys., Leipzig, 45, 1935, pp. 35–62) (in German). *Opener*—G. W. Hurst, B.Sc., D.I.C.

December 14th, 1936. *Cooling in the lower atmosphere and the structure of polar continental air.* By H. Wexler (Washington, D.C., Mon. Weath. Rev., 64, 1936, pp. 122–36). *Opener*—C. S. Durst, B.A.

Correspondence

To the Editor, *Meteorological Magazine*

Rainbow with Vertical Shaft

On the evening of July 7th, 1936, I was driving with friends northward near Staffin towards Flodigarry on the east coast of the Isle of Skye and we witnessed the phenomenon which is illustrated in the photograph forming the frontispiece to this number of the magazine. The road runs not far from the edge of high cliffs down to the sea. The time was about 21h. B.S.T. The photograph faces roughly south-east and shews a primary rainbow (there was a secondary bow, but this does not appear in the photograph).

What seems to be noteworthy is that from the northern foot of both primary and secondary rainbows sprang a vertical shaft of light, each shaft exhibiting the colours in the order proper to its bow.

The shafts extended to approximately three-fifths the height of the top of the bows. Their bases coincided with the bases of the bows. No shafts were seen at the southern feet of the bows which were not "in" the sea as were the northern feet. The shafts were visible for about 40 minutes. When, however, we arrived at Flodigarry about 22h. the shafts and the secondary bow were no longer to be seen, but the primary bow persisted with brilliant colouring. The shafts did not appear to shew any trace of curvature.

I should be glad to have an explanation of the phenomenon, the like of which I have certainly never seen before.

FRANCIS DRUCE.

60, Burton Court, London, S.W.3, October 28th, 1936.

Again: St. Elmo's Fire on a Cloud

It is a great advantage of this magazine, that observers may contribute to its contents in writing down their observations of general interest. This stimulates the activity of others and is of much importance for the collection of material.

Only a few weeks ago I read about the phenomenon observed by Mr. M. D. Laurenson in New Zealand (July, 1936, page 134). In a period of 14 years' thunderstorm observations I have observed on two occasions clouds lit up during night time. In both cases, on May 3rd, 1934, at 20h. 26m. G.M.T., and June 21st, 1936, at 0h. 46m. G.M.T., the sky was overcast and a part was seen in the south-west direction illuminated by approaching thunderstorm, and respectively during 5 and 10 seconds. After reading Mr. Laurenson's article, I had the intention to write these observations to the *Meteorological Magazine.* It is obvious that in these two observations the light was originating from the same kind of phenomenon (St. Elmo's fire) as Mr. Laurenson described, though the source could not be seen, the sky being overcast.

Now before writing I saw the same phenomenon myself.

On September 5th at 16h. 15m. G.M.T. the sky was covered with cumulostratus about 9 tenths, associated with altocumulus and altostratus for about 5 tenths, bulging cumulus and lower cumulus with caps to the north-west, at which part of the sky from south-west to north clouds grew thicker to rather dark nimbostratus at the horizon. In the west-north-west at a height of about 30° an intense light was seen. At first I thought it was a mock sun (there was actually a slight part of a halo visible above the sun), but it was too high for it and the light was of one colour and of great intensity. As far as I can state it, the colour was greenish white. The light did not pulsate, but I did not see its development. I had just come out-of-doors when I first saw it.

There remained no question about its being an electric phenomenon. The light was so intense that it was just unpleasant for the eye. At night time this unusual phenomenon would have attracted general attention, its brilliancy being many times more intense than the light of the moon and it would have set the town and country side in a bright illumination.

During its display (from 16h. 14m. until 16h. 16m.) the cumulonimbus-clouds over which it was situated could not be seen. Unfortunately they were just covered by altocumulus clouds. A few minutes afterwards the cumulonimbus calvus was coming from behind the lower clouds. So I could not state if there was a peak-formed head present at the time of occurrence, which makes an outflow of electricity possible. Mr. Laurenson saw " a ball of light balanced on a finger of cloud " (see his sketch). What I saw was shaped like a flame without a sharp limit and a little more than 1° in diameter.

At 16h. 37m. thunder became audible in the west. That afternoon a depression was centred over the north of Scotland. At the Dutch coast stations (middle and southern part) wind blew from W. force 4 and at stations 20–50 Km. inland wind was from S.–SSW. force 2–3. Thus strong vertical air currents were very likely. The friction for the air currents over land, and besides that, the downs along the coast, cause this effect. In this connexion it should be noted, that thunderstorms starting over the sea and dying out at about 10 Km. inland are very common at Leiden, especially in autumn in the evening and night. From this it follows that St. Elmo's fire on cloud will be most likely to occur in Holland near the coast and in other countries under similar conditions, viz. in favourable circumstances in the atmosphere.

K. VAN DER HEYDEN.

Garenmarkt 9, *Leiden, October* 7*th*, 1936.

" False Dawn "

In connexion with the account of a " false dawn " by Mr. Cumming in the *Meteorological Magazine* for September, 1936 (page 189), the following lines from The Kasidah by Sir Richard Burton (written in 1853) are of interest :—

The Wolf-tail* sweeps the paling East to leave a deeper
gloom behind,
And Dawn uprears her shining head, sighing with semblance
of a wind :

The Kasidah was written on Burton's return journey from Mecca.

I am indebted to Squadron Leader J. C. Foden, A.F.C., of this station, for bringing this reference to a " false dawn " to my notice.

The night January 6th–7th, 1933, was clear so that presumably 1933 in Mr. Cumming's letter is a mistake ; I have, in fact, been informed by the Editor that the date should be 1934. On the corresponding night of that year the weather in southern England

* The false dawn.

generally was very unsettled with fresh SSW. winds associated with cyclonic centres to north and west of Ireland; the moon was approaching last quarter and southed at 4h. 36m. Is it possible that low cloud prevented the moon being seen, and that a rift in a higher cloud layer was the cause of the increased illumination which enabled the Dorsetshire Hills to be discerned between 5h. 10m. and 5h. 30m. on this occasion?

C. V. OCKENDEN.

Meteorological Station, R.A.F., Boscombe Down, Wilts., September 25th, 1936.

A Double Corona Round the Moon

On the evening of Saturday October 31st, 1936, I observed a "Rainbow effect" surrounding half the moon. The colours were as follows: a band of yellow, then brown, purple and finally a distinct green. The whole of this was repeated again, once, like a reflection.

The moon was in the east and had just emerged from a high cloud and the rainbow effect was projected on to the surface of the cloud.

NORMAN E. NEVILLE.

83, *West Street, Fareham, Hampshire, November 3rd,* 1936.

Cyclones in the Tasman Sea

In the June, 1936, number of the *Meteorological Magazine*, p. 120, is a short reference to a paper by me which discusses the analysis of a series of weather charts covering the Australia-New Zealand area. The principal feature of the series was a deep cyclone which developed in the neighbourhood of the 30th parallel. Cyclones of this type are of considerable interest in view of the prospective development of trans-ocean air services in this region since they are one of the principal sources of danger to aviation. So far as I know, nothing closely parallel to them occurs in corresponding latitudes in the northern hemisphere. Tropical cyclones occasionally develop into the same type in their later stages when moving into higher latitudes, but generally they are of different origin, of much smaller area, much less frequent, and have a very different annual variation of frequency. The number of cyclones, of the type described, observed in each month during the past 38 years is indicated in the first line of the following table. The second line gives the number described on the coast of New South Wales in 36 years according to Mr. H. A. Hunt:—

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
16	20	21	15	35	38	40	21	17	18	8	6	255
20	21	15	17	24	33	28	20	17	15	7	7	225

The agreement is surprisingly close, and the differences probably correspond to a real difference in régime, the presence of the Australian continent affecting the New South Wales conditions. In winter, for example, a warm sea borders the cold continent. The New Zealand figures probably underestimate the position slightly, since on a number of occasions recently, but for a single ship's report, we should have been unaware that a deep cyclone was crossing some portion of the waters to the north. In the early years, there were no reports from north of New Zealand. In this area the cyclones occur most frequently between the tropic and 36° S. or right in the high pressure zone. Further south, though cyclones do occur, they are very much rarer. The strong southward pressure gradient and consequent westerly winds make it very difficult for a complete wind circulation to develop. It has been commonly assumed that the so-called V-depressions experienced in New Zealand and Australia were connected with cyclones whose centres were passing much further south, in the neighbourhood of the 60° parallel.

It is probable that as the gradient for westerly winds decreases in high southern latitudes, south of 55° about, the number of cyclones does increase somewhat.

EDWARD KIDSON.

Meteorological Office, Wellington, New Zealand, September 7th, 1936.

Minor Haboob at Ismailia, Egypt.*

The abrupt changes of wind direction and speed which take place in the Ismailia district were considered to be of great importance in connexion with airship mooring and at the request of the late M. A. Giblett, I undertook an investigation into this problem in 1928. Twenty-five cases of abrupt change of afternoon wind occurring between mid-April and mid-October were discussed and a memorandum submitted in 1928. The conclusion was reached in this memorandum that the majority, if not all, of the abrupt changes of wind which occurred at Ismailia and district during the afternoon were associated with the passage of a cold front or small desert disturbances which were often to be seen on the morning synoptic chart.

Since 1928 the amount of data received from the desert west of Egypt has increased considerably and it is now possible to trace the passage of desert depressions across Egypt more readily, and so far there has been no occasion to modify the conclusion reached in 1928.

The sequence of events described by Mr. Flower was almost certainly due to the passage of a well-defined cold front which at 8 a.m. zone time on the 17th had just passed Benghasi. The eastward movement of this front was about 20 m.p.h.; it passed Aboukir at 10.50 a.m., and would therefore reach Ismailia just before 4 p.m. A synoptic chart showing the situation at 8 a.m. (6h.G.M.T.) is on p. 235—the surface and upper winds at Aboukir should be noted.

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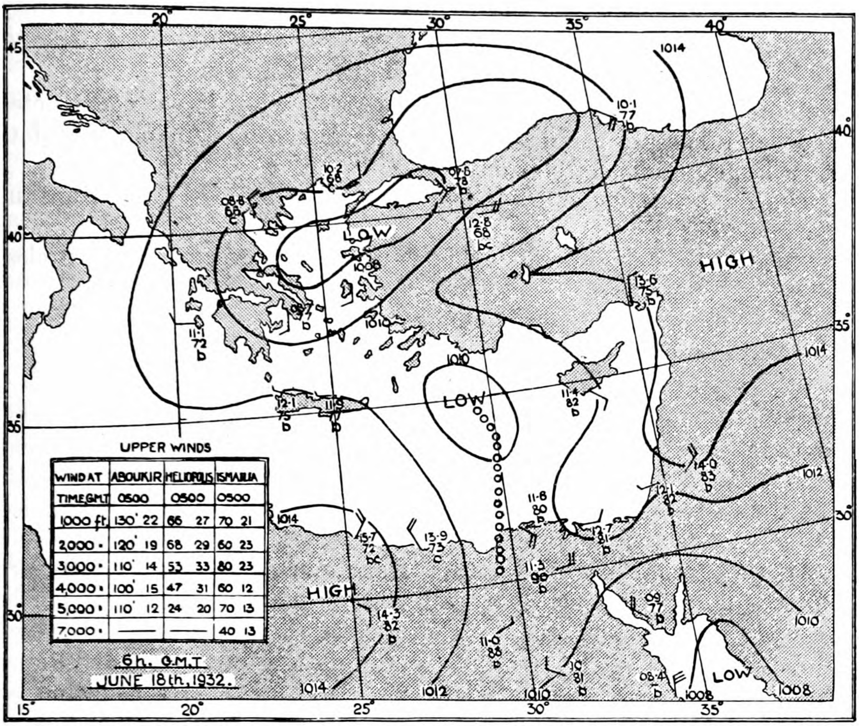
* This note refers to the article by Mr. W. D. Flower in the *Meteorological Magazine* for June, 1936, p. 111.



The sandstorm or minor haboob which accompanied the abrupt change of wind is a fairly common occurrence when a sharp cold front passes over a sandy or dusty area.

J. DURWARD.

Meteorological Station R.A.F., Heliopolis, Egypt, July 1st, 1936.

Recent Weather Phenomenon

Once again I have discovered a saline deposit on the sphere of the sunshine recorder here. The appearance of the sphere was " smeary," with " blobs " or " splashes " of a greyish-white colour, not unlike soap marks or stains.

Some years ago you may remember a similar case of salt deposited on the ball at this Observatory.

This incident helped to clear up a mystery in connexion with electrical transmission wires on pylons—the salt having impaired the efficiency of the wires. Most of the deposit of yesterday still remains on the sunshine sphere. Evidently the strong to high SW. wind brought salt spray inland from Bristol Channel.*

F. G. PARSONS.

Ross-on-Wye Observatory, Herefordshire, October 27th, 1936.

* See *Meteorological Magazine,* **62,** 1927, p. 277 and **63,** 1928, p. 129.

NOTES AND QUERIES

The Plotting of Weather Charts

Meteorologists, professional or amateur, who have constructed weather maps are familiar with the task involved in plotting data for a large number of stations.

The data received by wireless usually undergoes three transformations :—

1. Morse to numerals (this is usually performed by wireless operators).
2. Numerals to plain language.
3. Plain language to symbols on the chart.

With practice it becomes possible to combine transformations 2 and 3, although this entails knowledge of the positions of some 3,000 stations, and the symbols corresponding to some 200 different code figures. This procedure is normally adopted by meteorologists, but it must be unusual for all three transformations to be carried out simultaneously.

At the Royal Naval College, Dartmouth, synoptic charts are plotted daily and recently Cadet Satow plotted a chart of north-western Europe and the northern Atlantic, combining all three transformations. The symbols were plotted on the chart direct from the wireless signals of G.F.A. and F.L.E. (transmitted at approximately 30 words per minute) and heard in the headphone without any intermediate writing down of the code groups. The plotting was done in two colours, and the temperature from all countries, except the British Isles, was corrected from Centigrade to Fahrenheit before entry on the chart. The chart was examined by a Master of the College and no error was detected. It must be agreed that this involves a very thorough knowledge of the codes, the positions of stations and mental concentration of a high order.

L. G. Garbett.

New Observatory at Bulawayo named after Father Goetz

Permission has been obtained from the Government and the Jesuit Fathers to name the new Meteorological Observatory at Bulawayo, the Goetz Observatory.

The late Rev. Fr. E. Goetz, S.J., M.A., was very closely associated with meteorology in Rhodesia. Observations were commenced at St. George's School, Bulawayo, in March, 1897, by the Rev. Fr. V. Nicot, S.J., and continued up to May, 1903, when an observatory was opened.

Fr. Goetz took over the work here and remained in charge up to June, 1929, when the work was taken over by the Meteorological Office. During this period, in addition to making a unique series of local observations, he interested himself in the weather processes affecting the Colony and in the collection of old records. He published papers in the Journals of the South African Society for the Advancement of Science and the Rhodesian Scientific Society; one paper in the latter, "The Rainfall of Rhodesia," is a very complete treatment of the rain conditions in this Colony.

The growth of Bulawayo and the development of civil aviation have necessitated the removal of the observatory to a more suitable site near the aerodrome, where a modern observatory with the latest meteorological equipment has been erected. The new observatory has been named the Goetz Observatory as a fitting memorial to the work of one of our pioneer meteorologists, the late Father Goetz.

Note on the Formation of Low Stratus at the Isle of Man

On January 24th, 1936, at 7h. G.M.T. a depression was approaching the Scilly Isles from the Bay of Biscay and a large part of the country lay in a light south to south-east gradient which, however, was increasing. Fog was present in the estuaries of the Mersey and the Dee, visibility being 220–550 yards at Speke and Sealand, while at 10h. the visibility at the latter place had decreased to 55 yards. At 7h. at the Isle of Man (Ronaldsway) visibility was 3–6 miles, there were 8 tenths of cloud at 800 feet, the wind being SSW. 15 m.p.h., while at Point of Ayre there was slight rain, visibility was twelve miles, there were 10 tenths cloud at 1,500 feet and the wind south by west 15 m.p.h.

The temperature at Sealand from 7h.–13h. was 33–34° F. and relative humidity was about 95 per cent, and these conditions may be taken as applying to a large part of west Lancashire. By noon, 10 tenths of stratus at 200–300 ft. were reported from Ronaldsway, while at 13h. Point of Ayre gave 10 tenths of stratus at 300–600 ft. with visibility 1,100 yards, the wind having backed to south by east, 21 m.p.h. Conditions improved considerably during the afternoon although at 18h. the cloud was still 10 tenths at 1,500 ft. Inland the cloud was high or medium except for a short period up till 8h. 30m.

It is almost certain that the serious deterioration at the Isle of Man was due to the setting in of eddy convexion caused by the passage of cold damp air over the relatively warm sea, together with the topographical lifting such as the high ground at the Isle of Man would cause.* It is quite likely that the low stratus formed first at the south end of the Island and then drifted northwards.

A similar case occurred on February 5th, 1936, although in this instance, in addition to mist or fog being present, snow had fallen during the latter part of the night and was falling intermittently inland in Lancashire until midday. The temperature between 7h. and 13h. was 32–35° F. with relative humidity 95–98 per cent,

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* *See* Sir Napier Shaw, Manual of Meteorology, Vol. III, pp. 349–50, and Vol. IV, p. 152.

almost identical readings to those of the previous case. Low stratus 10 tenths at 300 ft. and visibility about 1,000 yards occurred at Ronaldsway just before noon and extended in a south-easterly direction for four to five miles, the cloud height beyond this point being 1,500–2,000 ft. As before, Point of Ayre reported similar conditions at 13h.

Thus, it appears that when the gradient wind is south-south-easterly about 30–35 m.p.h. over the Irish Sea, and a current of cold damp air flows from the mainland towards the Isle of Man, the sea being relatively warm, low stratus and very poor visibility may occur along the coast from Castletown to Point of Ayre. The distance from Speke to Ronaldsway is 88 miles, and this is the only sea track between the Isle of Man and adjacent coasts in which the conditions described have been known to occur; it is also the longest, which may be significant.

In the first case, when fog with clear sky or high cloud above it was present, the conditions at the Island did not persist for more than three hours or so, but in the latter case, when drizzle or rain was falling on the mainland with cloud 10 tenths at 1,000–1,500 ft. the low stratus at the Island persisted for about twelve hours.

C. W. G. Daking.

REVIEWS

Typhoons and Indian Weather by V. Doraiswamy Iyer, B.A. India Meteor. Dept. Memoirs, Vol. XXVI, Part VI, Delhi, 1936.

In the tropics the most violent winds are generally those associated with circular storms (tropical cyclones) having a diameter of several hundred miles and a more or less calm centre, surrounded by a ring of hurricane winds. These are known by different names in different parts of the world. In the China Seas they are called typhoons. There is no sharp line of demarcation between the tropical cyclone and the temperate depression, for tropical cyclones that pass into temperate latitudes become ordinary temperate depressions. The ideal type of the tropical revolving storm is approached more often far out at sea than near land, for near the land there tends to be greater variability due to the effects of the land upon both wind and weather. In general these storms show what may be described as a marked aversion for passing across land, especially mountainous land. An abundance of moisture appears to be essential for their formation and for their continued existence. Therefore, as the supply of moisture is progressively reduced by distance from the sea, the cyclone that passes inland usually loses energy and eventually dies out. The interesting case sometimes arises, on the other hand, where a land barrier in the path of the storm is over-passed and then the weakened circulation may regain its former energy. When Sir John Eliot wrote his well known "Handbook of Cyclonic Storms in the Bay of Bengal" he thought that it was only in extremely rare instances that a typhoon crossed Indo-China to enter the Andaman Sea and the Bay of Bengal, and that practically every cyclone in the Bay of Bengal had originated in the Bay itself. This was many years ago. With more information about the weather in the tropics, the life history of Indian cyclones is now seen to be longer than was formerly supposed and the author of this paper finds that out of 370 typhoons that moved westwards from the Pacific Ocean or the China Seas and struck the coast of Indo-China or south China, in the years 1884 to 1930, no fewer than 135 affected the weather in India. A similar case of cyclones being credited with too short a life-history is that of the West Indian hurricanes—the Atlantic representatives of the typhoon—many of which are now known to originate off the coast of Africa, east of the Cape Verde Islands, which in less well-informed days would have been regarded as having formed in the more frequented waters of the Carribean Sea.

To return to the 135 typhoons that affected Indian weather, of these only 20 re-developed into revolving storms that could be classed as tropical in type; 48 re-developed into systems that were regarded as cyclonic depressions; 11 merely fortified existing Indian depressions, and 56 resulted only in rain areas with little or no barometric disturbance. It appeared that September and, to a lesser extent, October were the months most favourable for the first two types of revival, yielding 39 out of 68 cases. It was observed that with the advance of the typhoon season the normal track across Indo-China shifts southwards; that by September northerly to north-easterly winds of continental origin flow into Indo-China down to about 20° N., while the damp monsoons of both the China Sea and the Bay of Bengal have retreated southwards. The contrast between the air masses of continental and equatorial origin is believed to be greater than in previous months, and this is held by the author to be a reason why there is then a greater chance of survival for westward moving typhoons. But another and more obvious reason also given is that the land which they must cross is narrower and less mountainous in the lower latitudes generally traversed by the storms during their westward movement in autumn.

It is very satisfactory to find that in spite of the fact that the Indian Meteorological Service has had to face increased responsibilities with reduced grants, an official in that Service has found time in which to modify the generalisations of a pioneer worker like Eliot, by taking advantage of the greatly increased amount of meteorological data now available. It should not be forgotten, however, that such pioneer workers also had to contend with great difficulties, being hampered by dearth of information and the need to create a meteorological organization in a climate so exhausting for Europeans.

E. V. NEWNHAM.

Weather Science for Everybody.—By D. Brunt, M.A., Professor of Meteorology in the University of London. Size $7\frac{1}{2}$ in. × 5 in. pp. xii+170. *Illus.* C. A. Watts & Co., Ltd., London, 1936. Price 2*s.* 6*d.* net.

The small book entitled "Weather Science for Everybody" by Professor D. Brunt comprises only 170 pages and yet gives in clear and concise language a masterly summary of the phenomena of the weather in most of its aspects and in its effects on many phases of human life.

A glance at the titles of the fourteen chapters shows the comprehensive nature of the book. The first two chapters are concerned respectively with weather and human affairs in time of peace and war and with weather observations and what they mean. The third chapter gives a lucid account of that difficult subject, radiation, and its relation to such matters as night frost, mist and fog and the differences between continental and oceanic climates. Chapter IV deals with conditions in the free atmosphere ; it describes the vertical distribution of pressure and temperature in the troposphere and stratosphere and explains the conditions necessary for stability and instability. Reference is made to the increase in temperature above the stratosphere due to the intense absorption of the ultra-violet rays of the sun by ozone, and also to the Kennelly-Heaviside and Appleton layers. Water vapour in the atmosphere and the formation of cloud, rain, hail, snow, etc., are the subjects discussed in Chapter V, and Chapter VI describes the clouds and their classification. Chapter VII gives a short but adequate account of the weather map and the preparation of the weather forecast; it includes the Norwegian scheme of the polar front. This account should materially help the non-meteorologist to interpret the chart published in the press and should promote a better understanding between the public and the forecaster. The subjects of the remaining chapters are other weather disturbances, average climatic conditions over the globe, the world's climates, special types of winds, cycles in weather, special activities affected by the weather and the effect of weather on health and comfort. The last is a subject of widespread and increasing interest and is a happy inclusion in a book entitled "Weather Science for Everybody".

The book is eminently readable with references throughout to affairs of everyday life. It is well produced and the numerous illustrations are excellent. The reviewer noticed one error; on page 98, the ordinates in Fig. 17 refer to millibars of pressure and not to degrees of temperature. L. F. Lewis.

BOOKS RECEIVED

Apia Observatory, Western Samoa, Annual Report for 1933, Wellington, 1936.

Monthly Rainfall of India for 1933 *and for* 1934. Published by the various Provincial Governments and issued by the India Meteorological Department, Delhi, 1935 and 1936.

OBITUARY

Dr. Alfred Nippoldt.—We regret to learn of the death, on October 4th, of Dr. A. Nippoldt. He was born on July 2nd, 1874, at Frankfurt-am-Main, and educated at Göttingen, where he became Assistant in the Magnetic Observatory in 1895. In April, 1898, he joined the combined Magnetic and Meteorological Observatory of Potsdam as a Scientific Assistant. His work lay almost entirely on the magnetic side, and as early as 1902 he published a paper on the meteorological nature of the variations of terrestrial magnetism. In 1903 he was awarded his doctorate at the University of Göttingen. He remained at the Observatory of Potsdam through the whole of his scientific life, becoming head of the magnetic side in October, 1928. When the various German official meteorological services were unified in 1934 in the Reichsamt für Wetterdienst, the Magnetic Observatory at Potsdam became a separate institution with Dr. Nippoldt as Director.

During the course of his life he accomplished a great deal of valuable work, including the preparation of magnetic charts of parts of Germany. He contributed the section on terrestrial magnetism and aurora to the " Einführung in die Geophysik," and the chapter on terrestrial magnetism and part of that on terrestrial electricity in the tenth edition of Müller-Pouillet's " Lehrbuch der Physik." He was also the author of a well-known text book on " Terrestrial Magnetism, Earth Current and Aurora " which passed through three editions; the last appeared in 1921.

Rev. Henry Hugh Breton. M.A.—We regret to record the death on September 13th, 1936, of the Rev. H. H. Breton at Westham, Sussex. Mr. Breton was a zealous parish priest who found time, nevertheless, to carry on climatological work, in which he was keenly interested. He maintained climatological stations at the various parishes where he ministered, including in succession, Sheepstor (Devon), Alfriston (Sussex), Morwenstow (Cornwall), Dean Prior (Devon) and Meshaw (Devon), covering in all a period of 26 years. He was an authority on the climate and weather of Dartmoor and his publications include two small books, " The great blizzard of Christmas, 1927 " and " The great winter of 1928–9."

ERRATUM

SEPTEMBER, 1936, p. 189, line 30 *for* " January 6th–7th, 1933 " *read* " January 6th–7th, 1934."

OCTOBER, 1936, p. 217, line 20 *for* " Mr. C. Fitzburgh Talman " *read* " Mr. C. Fitzhugh Talman."

NEWS IN BRIEF

The Cobb lectures of the Royal Society of Arts, for the session 1936–7 will be given by Prof. E. V. Appleton, M.A., LL.D., D.Sc., F.R.S. on the subject "Some problems of atmospheric physics". There will be three lectures, on Monday evenings, November 16th, 23rd and 30th at 8 p.m. in the Society's house in John Street, Adelphi, W.C.2.

We learn that Prof. S. Chapman, chief professor of mathematics in the Imperial College of Science, has been elected a member of the Kaiserlich Deutsche Akademie der Naturforscher, Halle, in recognition of his researches in terrestrial magnetism.

We learn that Señor Francisco Souza has been appointed Director of the Brazilian Meteorological Service in succession to Señor l'Ing. Herminio Silva who has retired.

The "Georg-Neumayer" Gold Medal of the Deutsche Seewarte, awarded at intervals of five to seven years for notable work in terrestrial magnetism, marine meteorology, oceanography or polar exploration, has been awarded to Prof. Gerhard Schott.

The Weather of October, 1936

Pressure was above normal over Alaska, western Canada, western United States, except California, and across the North Atlantic from eastern United States to south-west Europe, the greatest excesses being 5·8 mb. at Juneau, Alaska and 8·5 mb. at Scilly Islands. Pressure was below normal over central United States, California eastern Canada and across Greenland and northern, eastern and south-eastern Europe to western Asia, the greatest deficit being 8·2 mb. at Myggbukta and 6·0 mb. at Moscow*. In Spitsbergen temperature and rainfall were above normal but in Sweden they were both somewhat below normal.

The most notable feature of the weather of October over the British Isles was the frequency and severity of the gales and also the lack of appreciable rainfall in many districts until late in the month. Rainfall totals were generally below average except in south Scotland. From the 1st to 11th the British Isles came under the influence of a high pressure system centred during the 1st to 6th mainly to the north-east of Scotland; from then to the 11th the centre passed west-south-westwards across the country. Quiet conditions prevailed generally with little or no rainfall except locally in the east and south-east and in south-west Ireland, but strong winds were recorded on the west and south-west coasts on the 2nd, 3rd, 6th and 9th. Sunshine records were very good during the earlier part of this period, 10·6 hrs. being recorded at Clacton, Manston and Littlehampton on the 3rd,

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* See p. 225.

but became less so after the 8th, while temperature was above average except in the south-east until about the 7th when the weather became cold generally ; 60° F. was exceeded in many parts on the 3rd to 5th, and on the 4th even in the south-east as well, 66° F. occurred at S. Farnborough and 65° F. at Colwyn Bay on the 4th, and 63° F. at Fort Augustus on the 3rd. Mist or fog was prevalent during this time. On the 12th a depression moved south-eastwards from Iceland causing rain and strong winds in Scotland and was followed on the 13th by a ridge of high pressure. From the 14th, however, to the end of the month pressure was generally low to the north and high to the south-west with depressions moving from Iceland to Scandinavia. Between the 14th and 16th the winds reached gale force in northern Scotland and from the 17th to 20th the gales became more severe and widespread affecting most exposed places except in the south-east; at Lerwick Beaufort force 10 was registered at 18h. on the 17th and a gust of 90 m.p.h. on the same day. During this period (12th–20th) rain occurred on most days in the north with some heavy falls locally, but in the south the rainfall was slight and only occurred on a few days; 1·59 in. was measured at Oban on the 16th. There were, however, considerable bright periods, especially in the north, and the 18th was a sunny day generally with 9·4 hrs. bright sunshine at Rothamsted and 9·3 hrs. at Catterick and Dovercourt, while temperature was mainly a little above average. From the 20th to 22nd there was an interval of quiet weather as a ridge of high pressure passed across the country. Rainfall amounts were generally small and the weather mainly cloudy, while temperature was unusually high on the 22nd in the eastern districts, 68° F. was reached at Aberdeen, the highest temperature recorded there in October since 1871, 65° F. at Durham and 64° F. at Clacton. From the 24th to 28th another period of severe stormy weather prevailed and numerous gales were reported from nearly all parts with gusts frequently exceeding 70 m.p.h. ; on the 27th 89 m.p.h. was recorded at Renfrew and 85 m.p.h. at Eskdalemuir and on the 26th 85 m.p.h. at Fleetwood. Heavy rain fell in places, especially the Lake District, 5·30 in. at Watendlath (Cumberland) on the 24th and 1·60 in. at Festiniog (Merioneth). Between the 25th and 27th hail showers were widespread, and sleet or snow fell on the high ground in a few parts of Scotland and north England. Thunderstorms occurred in many parts on the 25th and 27th and at a few places on the 26th. Day temperatures were rather low but the 25th and 28th were generally sunny days; 9·1 hrs.bright sunshine occurred at Catterick and 8·6 hrs. at York, Penrith, Tynemouth, Lowestoft and Torquay on the 28th. From the 28th to 30th the anticyclone off our south-west coasts extended north-east and quiet misty or foggy weather was experienced, but on the 30th–31st a secondary depression passed across the south of England causing heavy rain there, 1·26 in. at St. Briavels, Gloucester on the 30th, while fair sunny weather prevailed in Scotland. The distribution of bright sunshine for the month was as follows :—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway ...	98	+19	Chester ...	90	−5
Aberdeen ...	111	+15	Ross-on-Wye...	106	+6
Dublin	108	+11	Falmouth ...	116	+3
Birr Castle ...	98	+ 7	Gorleston ...	117	0
Valentia... ...	87	− 5	Kew	91	−2

Miscellaneous notes on weather abroad culled from various sources

Severe weather prevailed generally in Switzerland and northern Italy at the beginning of the month and again on the 8th and 9th. In Switzerland on the 1st snow fell down to the 2,000 ft. level and the passes were closed to vehicles, while on the 8th and 9th communications were interrupted owing to snow, and numerous trees were uprooted. Snow also occurred generally in northern Italy and even at Catania in Sicily. An unusually heavy north-westerly gale did much damage on the 18th to south Denmark and the North Sea coast of Germany and on the 19th to the Baltic coast of Germany; floods occurred in many parts and one person was drowned owing to a dyke breaking in Schleswig-Holstein. Stormy weather was experienced in the Ionian Sea on the 26th. Gales occurred generally in the North Sea on the 26th and 27th and in the Baltic on the 28th, causing much damage to shipping and floods on the north-west coasts of Germany. There was thick fog at the mouth of the English Channel on the 30th. (*The Times*, October 1st–31st.)

A typhoon passed across the island of Luzon (Philippines) on the 9th and 10th striking with the greatest force in the province of Nueva Ecija ; over 300 people were killed and much damage done to the crops and property. The typhoon returned on its course on the 11th, and on the 12th two dykes on the Pampanga River gave way causing further floods. During the week ending the 14th the monsoon rains were in excess in Upper Burma, normal in north-west India and mainly scanty elsewhere in India. Gales were experienced off the coasts of Yezo (Japan) on the 24th and over southern Japan on the 26th. (*The Times*, October 12–28th.)

The total rainfall for the month in Australia was below normal in Western Australia, Queensland and New South Wales but mainly above normal in South Australia, Victoria and Tasmania.

Dense fog occurred over San Francisco on the 8th. A lake dredger foundered in Lake Erie, about 14 miles north-west of Cleveland, during a heavy gale on the 17th, drowning 20 people. In the United States temperature was mainly below normal at the beginning of the month, becoming above normal after about the 6th in the eastern and western States and Ohio Valley and above normal everywhere during the middle of the month. Temperatures considerably below normal were experienced in north-west and middle States towards the end of the month and extended to the eastern States on the 27th. Rainfall was mainly below normal except in the Atlantic coast States and locally in the Ohio Valley and Lake region. Widespread floods occurred early in the month in the province of Porto Alegre, Brazil. (*The Times*, October 9th–28th and *Washington, D.C., U.S. Dept. Agric., Weekly Weather and Crop Bulletin.*)

Gales were experienced frequently on the North Atlantic during the month.

Daily Readings at Kew Observatory, October, 1936

Date	Pressure, M.S.L. 13h.	Wind, Dir., Force 13h.	Temp. Min.	Temp. Max.	Rel. Hum. 13h.	Rain.	Sun.	REMARKS. (see vol. 69, 1934, p. 1).
	mb.		°F.	°F.	%	in.	hrs.	
1	1024·6	NW.2	50	56	68	—	0·0	
2	1025·7	ESE.2	51	58	65	—	1·9	
3	1025·1	SE.3	38	57	49	—	9·8	Fx early. F 21h.
4	1017·3	ESE.1	37	60	51	—	9·0	Fx early. f 18h.
5	1018·2	E.5	33	53	54	trace	2·0	Fex early. d_0 9h.
6	1022·3	NE.4	40	52	54	trace	4·8	pr_0 14h.–15h.
7	1025·0	NNE.3	38	52	59	—	2·3	w early.
8	1022·1	SE.3	42	50	72	—	1·4	x early. r_0 9h.
9	1020·4	NNE.4	39	51	61	—	1·1	r_0. 13h.–15h.
10	1022·8	NE.4	43	52	64	—	2·2	
11	1026·3	N.3	39	53	65	—	5·5	x early. f 21h.
12	1024·1	SW.2	38	58	76	—	1·3	fe early.
13	1019·2	NNW.2	45	57	68	—	2·3	w early.
14	1012·9	SW.3	43	58	89	0·04	0·0	r_0 3h.–13h.
15	1017·0	W.3	49	65	71	—	4·6	w early.
16	1022·9	WNW.4	46	59	55	—	4·6	w early.
17	1017·0	SW.5	50	59	67	0·02	0·1	ir_0 21h.–24h.
18	1019·9	W.4	49	57	46	—	8·3	
19	1006·9	W.5	42	56	55	0·05	2·6	r-r_0 6h.–9h. and 17h.
20	1023·0	NNW.4	42	52	46	—	6·7	pr_0 23h.
21	1023·0	W.3	48	56	77	—	0·0	
22	1024·7	W.2	45	60	75	—	0·3	w early.
23	1020·9	SW.4	52	58	78	0·06	0·2	r-r_0 14h. & 22h.–24h.
24	1017·8	SW.2	47	56	83	0·05	3·9	r_0 0h.–4h. f to 8h.
25	1004·1	WSW.4	49	55	47	0·37	4·1	r 3h–7h. TLH 15h.
26	998·9	SW.4	41	60	92	0·20	0·0	r_0–r 7h.–11h.
27	1009·0	WSW.5	46	52	65	0·16	3·8	r_0 15h. R 18h.–19h.
28	1019·3	WNW.4	42	52	61	—	5·2	
29	1026·8	SW.3	33	53	75	0·01	0·8	xf early. d_0 16h.
30	1021·7	WSW.2	49	62	77	0·01	2·3	r_0 17h.–18h.
31	1016·5	N.4	50	51	93	0·82	0·0	r_0–r 2h.—18h.
*	1019·2	—	44	56	66	1·80	2·9	* Means or Totals.

General Rainfall for October, 1936

England and Wales ...	62	per cent of the average 1881–1915.
Scotland	105	
Ireland	72	
British Isles	75	

Rainfall: October, 1936: England and Wales

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Lond .	Camden Square.........	2·04	78	*Leics* .	Belvoir Castle...........	1·89	70
Sur .	Reigate, Wray Pk. Rd..	2·05	62	*Rut* .	Ridlington	1·60	57
Kent .	Tenterden, Ashenden...	1·87	54	*Lincs* .	Boston, Skirbeck.........	2·08	76
,, .	Folkestone, Boro. San.	2·48	...	,, .	Cranwell Aerodrome...	1·86	65
,, .	Margate, Cliftonville....	1·94	66	,, .	Skegness, Marine Gdns.	2·28	83
,, .	Eden'bdg., Falconhurst	2·27	63	,, .	Louth, Westgate.........	2·45	63
Sus .	Compton, Compton Ho.	1·59	35	,, .	Brigg, Wrawby St.......	1·77	...
,, .	Patching Farm.........	1·96	49	*Notts* .	Worksop, Hodsock......	1·87	71
,, .	Eastbourne, Wil. Sq....	1·19	29	*Derby*.	Derby, L. M. & S. Rly.	1·49	57
Hants.	Ventnor, Roy.Nat.Hos.	1·39	35	,, .	Buxton, Terr. Slopes...	6·61	135
,, .	Fordingbridge, Oaklnds	2·10	51	*Ches* .	Runcorn, Weston Pt....	1·84	53
,, .	Ovington Rectory.......	1·81	45	*Lancs*.	Manchester, Whit. Pk.	2·98	90
,, .	Sherborne St. John......	1·93	55	,, .	Stonyhurst College......	4·90	109
Herts .	Royston, Therfield Rec.	1·71	63	,, .	Southport, Bedford Pk.	2·09	59
Bucks.	Slough, Upton...........	1·65	59	,, .	Lancaster, Greg Obsy.	3·60	87
,, .	H. Wycombe, Flackwell	1·75	54	*Yorks*.	Wath-upon-Dearne......	2·19	79
Oxf .	Oxford, Mag. College...	1·37	49	,, .	Wakefield, Clarence Pk.	2·07	72
N'hant	Wellingboro, Swanspool	1·66	66	,, .	Oughtershaw Hall.......	6·76	...
,, .	Oundle	1·22	...	,, .	Wetherby, Ribston H..	2·04	68
Beds .	Woburn, Exptl. Farm...	1·80	68	,, .	Hull, Pearson Park......	1·55	52
Cam .	Cambridge, Bot. Gdns.	1·91	81	,, .	Holme-on-Spalding......	1·72	57
Essex .	Chelmsford, County Gdns	1·09	44	,, .	West Witton, Ivy Ho.	2·23	60
,, .	Lexden Hill House......	1·44	...	,, .	Felixkirk, Mt. St. John.	1·50	52
Suff .	Haughley House.........	1·46	...	,, .	York, Museum Gdns....	1·47	55
,, .	Campsea Ashe...........	2·41	92	,, .	Pickering, Hungate......	2·01	66
,, .	Lowestoft Sec. School...	2·28	82	,, .	Scarborough..............	1·88	60
,, .	Bury St. Ed., WestleyH.	1·88	69	,, .	Middlesbrough...........	1·34	45
Norf. .	Wells, Holkham Hall...	2·49	89	,, .	Baldersdale, Hury Res.	3·78	95
Wilts .	Calne, Castle Walk......	1·46	...	*Durh* .	Ushaw College...........	1·50	44
,, .	Porton, W.D. Exp'l. Stn	1·91	61	*Nor* .	Newcastle, D. & D. Inst.	1·41	49
Dor .	Evershot, Melbury Ho.	1·53	33	,, .	Bellingham, Highgreen	2·86	73
,, .	Weymouth, Westham.	1·16	32	,, .	Lilburn Tower Gdns....	1·56	42
,, .	Shaftesbury, Abbey Ho.	1·68	43	*Cumb*.	Carlisle, Scaleby Hall...	3·44	103
Devon.	Plymouth, The Hoe....	1·11	28	,, .	Borrowdale, Seathwaite	15·50	136
,, .	Holne, Church Pk. Cott.	2·35	36	,, .	Borrowdale, Moraine...	12·29	135
,, .	Teignmouth, Den Gdns.	·65	17	,, .	Keswick, High Hill......	7·52	66
,, .	Cullompton	1·81	44	*West* .	Appleby, Castle Bank...	3·36	96
,, .	Sidmouth, U.D.C........	1·03	...	*Mon* .	Abergavenny, Larchf'd	1·85	44
,, .	Barnstaple, N. Dev.Ath	2·40	53	*Glam* .	Ystalyfera, Wern Ho....	3·61	52
,, .	Dartm'r, Cranmere Pool	4·60	...	,, .	Cardiff, Ely P. Stn.......	1·96	41
,, .	Okehampton, Uplands.	2·79	46	,, .	Treherbert, Tynywaun.	5·06	...
Corn .	Redruth, Trewirgie......	1·82	35	*Carm* .	Carmarthen, Coll. Rd.	2·27	40
,, .	Penzance, Morrab Gdns.	1·91	41	*Pemb* .	St. Ann's Hd, C. Gd. Stn.	1·11	26
,, .	St. Austell, Trevarna...	1·98	38	*Card* .	Aberystwyth	4·08	...
Soms .	Chewton Mendip.........	3·21	66	*Rad* .	BirmW.W.Tyrmynydd	5·15	78
,, .	Long Ashton...........	1·93	51	*Mont* .	Lake Vyrnwy	5·59	98
,, .	Street, Millfield..........	1·63	...	*Flint* .	Sealand Aerodrome......	1·32	...
Glos .	Blockley	1·64	...	*Mer* .	Blaenau Festiniog ...	11·10	119
,, .	Cirencester, Gwynfa....	1·44	44	,, .	Dolgelley, Bontddu......	4·79	79
Here .	Ross, Birchlea...........	1·70	51	*Carn* .	Llandudno	2·04	61
Salop .	Church Stretton.........	2·40	66	,, .	Snowdon, L. Llydaw 9..	15·04	...
,, .	Shifnal, Hatton Grange	1·85	65	*Ang* .	Holyhead, Salt Island...	2·00	50
Staffs .	Market Drayt'n, Old Sp.	1·59	52	,, .	Lligwy	2·41	...
Worc .	Ombersley, Holt Lock.	1·24	47	*Isle of Man*			
War .	Alcester, Ragley Hall...	·91	33		Douglas, Boro' Cem....	3·00	66
,, .	Birminghm, Edgbaston	1·61	58	*Guernsey*			
Leics .	Thornton Reservoir ...	1·79	64		St. PeterP't. Grange Rd.	2·59	58

Rainfall : October, 1936 : Scotland and Ireland

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Wig .	Pt. William, Monreith.	2·95	74	*Suth* .	Lairg	5·54	148
„ .	New Luce School	4·96	106	„ .	Tongue	4·70	112
Kirk .	Dalry, Glendarroch	5·94	113	„ .	Melvich	4·16	113
Dumf.	Dumfries, Crichton R.I.	3·36	90	„ .	Loch More, Achfary	11·68	150
„ .	Eskdalemuir Obs	6·85	127	*Caith* .	Wick	3·46	117
Roxb .	Hawick, Wolfelee	2·92	76	*Ork* .	Deerness	4·21	111
Selk .	Ettrick Manse	6·85	124	*Shet* .	Lerwick	4·12	104
Peeb .	West Linton	4·49	...	*Cork* .	Dunmanway Rectory	2·70	45
Berw .	Marchmont House	1·81	47	„ .	Cork, University Coll	1·53	39
E.Lot.	North Berwick Res	1·25	42	„ .	Ballinacurra	1·15	28
Midl .	Edinburgh, Blackfd. H.	1·35	49	„ .	Mallow, Longueville	2·15	60
Lan .	Auchtyfardle	4·60	...	*Kerry*.	Valentia Obsy	3·05	55
Ayr .	Kilmarnock, Kay Pk	5·28	...	„ .	Gearhameen	8·20	89
„ .	Girvan, Pinmore	5·47	109	„ .	Bally McElligott Rec	2·79	...
„ .	Glen Afton, Ayr San.	5·52	108	„ .	Darrynane Abbey	3·57	71
Renf .	Glasgow, Queen's Pk	4·05	125	*Wat* .	Waterford, Gortmore	1·42	36
„ .	Greenock, Prospect H.	7·72	143	*Tip* .	Nenagh, Cas. Lough	2·63	78
Bute .	Rothesay, Ardencraig	5·96	...	„ .	Roscrea, Timoney Park	2·53	...
„ .	Dougarie Lodge	4·49	...	„ .	Cashel, Ballinamona	1·91	54
Arg .	Ardgour House	13·66	...	*Lim* .	Foynes, Coolnanes	3·12	84
„ .	Glen Etive	...	...	„ .	Castleconnel Rec	2·42	...
„ .	Oban	7·16	...	*Clare* .	Inagh, Mount Callan	5·86	...
„ .	Poltalloch	7·88	160	„ .	Broadford, Hurdlest'n.	1·92	...
„ .	Inveraray Castle	14·12	201	*Wexf* .	Gorey, Courtown Ho	1·49	42
„ .	Islay, Eallabus	5·46	114	*Wick* .	Rathnew, Clonmannon.	1·21	...
„ .	Mull, Benmore	13·20	102	*Carl* .	Hacketstown Rectory	1·65	43
„ .	Tiree	...	...	*Leix* .	Blandsfort House	2·22	63
Kinr .	Loch Leven Sluice	2·61	76	*Offaly*.	Birr Castle	1·95	67
Fife .	Leuchars Aerodrome	1·12	43	*Dublin*	Dublin, FitzWm. Sq	1·32	49
Perth .	Loch Dhu	10·05	141	*Meath*.	Beauparc, St. Cloud	2·08	...
„ .	Balquhidder, Stronvar.	8·67	...	„ .	Kells, Headfort	1·87	56
„ .	Crieff, Strathearn Hyd.	2·93	75	*W.M* .	Moate, Coolatore	2·11	...
„ .	Blair Castle Gardens	3·86	124	„ .	Mullingar, Belvedere	2·79	89
Angus.	Kettins School	1·81	57	*Long* .	Castle Forbes Gdns	2·37	73
„ .	Pearsie House	1·96	...	*Gal* .	Galway, Grammar Sch.	3·04	...
„ .	Montrose, Sunnyside	0·68	25	„ .	Ballynahinch Castle	4·88	82
Aber .	Braemar, Bank	3·04	81	„ .	Ahascragh, Clonbrock.	2·94	81
„ .	Logie Coldstone Sch	1·69	52	*Mayo*.	Blacksod Point	3·77	76
„ .	Aberdeen, Observatory.	1·18	39	„ .	Mallaranny	5·43	...
„ .	Fyvie Castle	2·81	73	„ .	Westport House	3·35	74
Moray	Gordon Castle	2·57	81	„ .	Delphi Lodge	7·53	79
„ .	Grantown-on-Spey	3·24	109	*Sligo* .	Markree Castle	3·82	94
Nairn.	Nairn	2·33	99	*Cavan*.	Crossdoney, Kevit Cas.	2·56	...
Inv's .	Ben Alder Lodge	7·55	...	*Ferm* .	Newtwnbtlr, Crom Cas.	2·74	84
„ .	Kingussie, The Birches.	4·86	...	„ .	Enniskillen, Portora	3·42	...
„ .	Loch Ness, Foyers	5·18	154	*Arm* .	Armagh Obsy	2·80	103
„ .	Inverness, Culduthel R.	3·13	...	*Down*.	Fofanny Reservoir	3·36	...
„ .	Loch Quoich, Loan	17·75	...	„ .	Seaforde	2·68	75
„ .	Glenquoich	15·60	156	„ .	Donaghadee, C. G. Stn.	2·02	70
„ .	Glenleven, Corrour	11·42	187	*Antr* .	Belfast, Cavehill Rd	3·18	...
„ .	Fort William, Glasdrum	9·63	...	„ .	Aldergrove Aerodrome.	2·46	82
„ .	Skye, Dunvegan	6·62	...	„ .	Ballymena, Harryville.	3·94	107
„ .	Barra, Skallary	4·98	...	*Lon* .	Garvagh, Moneydig	3·41	...
R&C .	Alness, Ardross Castle.	5·03	131	„ .	Londonderry, Creggan.	4·68	127
„ .	Ullapool	6·46	133	*Tyr* .	Omagh, Edenfel	4·57	125
„ .	Achnashellach	12·41	155	*Don* .	Malin Head	3·81	...
„ .	Stornoway, Matheson	5·70	110	„ .	Killybegs, Rockmount.	4·15	...

Climatological Table for the British Empire, May, 1936

STATIONS.	PRESSURE. Mean of Day M.S.L.	PRESSURE. Diff. from Normal.	TEMPERATURE. Absolute. Max.	TEMPERATURE. Absolute. Min.	TEMPERATURE. Mean Values. Max.	TEMPERATURE. Mean Values. Min.	TEMPERATURE. Mean Values. ½ Max. and Min.	TEMPERATURE. Mean Values. Diff. from Normal	TEMPERATURE. Mean. Wet Bulb.	Relative Humidity.	Mean Cloud Am'nt	PRECIPITATION. Am'nt.	PRECIPITATION. Diff. from Normal.	PRECIPITATION. Days.	BRIGHT SUNSHINE. Hours per day.	BRIGHT SUNSHINE. Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0–10	in.	in.			
London, Kew Obsy....	1016·1	+ 0·2	77	37	62·8	46·0	54·4	− 0·1	47·6	81	7·9	0·51	− 1·21	5	6·4	41
Gibraltar	1013·3	− 2·8	68	47	63·3	54·7	59·0	...	54·1	83	6·5	5·43	...	14	...	...
Malta..................	1011·0	− 3·5	77	54	68·7	59·6	64·1	− 1·8	59·3	78	4·2	1·19	+ 0·78	6	10·1	72
St. Helena	1014·3	− 0·2	68	55	63·9	57·8	60·9	− 2·2	58·6	91	9·7	3·04	+ 0·36	28	...	...
Freetown, Sierra Leone	1011·3	+ 1·8	92	68	87·3	72·8	80·1	− 1·4	76·5	82	8·2	17·87	+ 6·40	23	...	...
Lagos, Nigeria	1010·5	− 0·1	89	72	86·5	76·0	81·3	− 0·5	76·7	87	8·3	12·08	+ 1·33	20	4·8	39
Kaduna, Nigeria	1006·5	− 4·3	96	63	89·1	70·8	79·9	+ 0·5	73·3	85	8·0	7·26	+ 1·56	17	7·6	60
Zomba, Nyasaland	1014·2	− 1·2	81	48	75·8	58·2	67·0	+ 1·2	63·0	74	4·4	0·51	− 0·53	3	...	...
Salisbury, Rhodesia...	1016·8	− 1·3	80	37	72·9	49·2	61·1	+ 0·5	54·9	62	2·2	0·42	− 0·06	5	8·3	73
Cape Town	1020·4	− 2·3	84	38	64·8	48·4	56·6	− 2·3	49·3	86	4·4	2·70	− 1·05	10	...	...
Johannesburg	1018·9	− 1·1	73	24	60·8	44·0	52·4	− 2·0	45·0	68	3·3	5·74	+ 4·98	10	7·3	67
Mauritius	1016·1	− 0·3	84	59	79·5	65·7	72·6	0·0	68·5	72	4·9	2·10	− 0·93	21	7·8	70
Calcutta, Alipore Obsy.	1002·3	− 1·2	100	71	92·8	78·0	85·4	− 0·7	79·5	85	6·9	9·49	+ 3·93	13*	...	...
Bombay	1005·6	− 1·8	93	77	91·3	80·2	85·7	− 0·1	78·3	76	5·2	0·33	− 0·22	1*	...	...
Madras	1003·7	− 1·7	104	76	95·5	81·5	88·5	− 1·3	78·6	67	6·8	0·02	− 1·82	0*	...	...
Colombo, Ceylon	1007·6	− 0·8	89	71	85·4	76·3	80·9	− 1·9	76·8	79	8·4	33·81	+ 22·87	25	4·2	34
Singapore..............	1007·9	− 0·8	90	74	86·8	77·2	82·0	0·0	78·2	82	6·8	10·34	+ 3·70	17	5·9	49
Hongkong..............	1009·7	+ 0·6	88	68	81·5	73·5	77·5	+ 0·1	74·0	84	8·1	10·16	− 1·91	15	4·6	35
Sandakan	1007·9	...	91	73	89·4	76·5	82·9	+ 0·4	78·5	81	6·9	9·92	+ 3·59	12	...	...
Sydney, N.S.W..........	1021·8	+ 3·2	80	44	68·4	51·1	59·7	+ 0·9	54·1	73	5·4	2·27	− 2·91	9	6·2	60
Melbourne	1020·8	+ 1·6	77	36	65·1	44·5	54·8	+ 0·7	47·6	76	4·2	0·90	− 1·26	12	6·0	59
Adelaide	1019·6	− 0·4	80	42	70·1	51·3	60·7	+ 2·8	52·3	55	4·2	2·08	− 0·70	7	6·4	63
Perth, W. Australia ...	1018·8	+ 0·4	83	38	68·1	51·7	59·9	− 0·8	52·4	67	6·2	5·43	+ 0·46	15	5·3	51
Coolgardie	1018·0	− 1·1	84	34	70·8	44·3	57·5	− 0·2	48·7	60	3·5	0·26	− 1·07	5	...	...
Brisbane...............	1020·3	+ 1·7	80	51	73·0	57·0	65·0	+ 0·4	59·6	73	3·8	1·14	− 1·67	11	6·3	58
Hobart, Tasmania......	1019·1	+ 3·8	74	35	58·7	43·8	51·3	+ 0·8	44·6	70	5·0	0·76	− 1·14	9	6·2	64
Wellington, N.Z.	1022·0	+ 6·4	63	37	54·6	44·6	49·6	− 3·2	47·1	79	7·3	2·87	− 1·81	13	3·9	39
Suva, Fiji	1011·3	− 1·4	89	67	81·4	72·4	76·9	+ 0·4	73·1	87	8·2	25·63	+ 15·56	24	2·8	25
Apia, Samoa	1009·9	− 1·2	87	71	85·7	75·2	80·5	+ 2·1	76·9	79	5·7	7·21	+ 1·14	20	7·2	63
Kingston, Jamaica	1010·9	− 2·2	90	69	88·2	73·4	80·8	+ 1·1	73·3	79	4·5	8·95	+ 4·56	8	5·7	44
Grenada, W.I.	1010·6	− 2·0	89	70	86	72	79·0	− 0·7	74	79	5	7·90	+ 3·71	19	...	...
Toronto.................	1016·5	+ 1·6	90	32	70·1	47·3	58·7	+ 4·9	50·8	70	8·3	0·72	− 2·07	10	8·9	61
Winnipeg	1014·0	+ 0·2	93	29	71·2	43·8	57·5	+ 5·5	45·0	77	5·2	0·94	− 1·06	8	8·7	57
St. John, N.B.	1013·9	0·0	70	30	54·5	40·1	47·3	− 0·4	44·1	78	6·9	5·37	+ 1·66	15	5·9	40
Victoria, B.C...........	1016·0	− 0·7	74	42	61·4	47·9	54·7	+ 1·7	50·8	81	6·5	1·68	+ 0·55	16	6·8	45

Addendum :

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

4407) Wt. 19/32 1,125 11/36 Hw. G.377

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A Year's Experience of the Universal Decimal Classification in Meteorology

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

After the International Meteorological Conference at Warsaw in September, 1935, had adopted the revised section for Meteorology in the Universal Decimal Classification,* preparations were at once begun for the introduction of this classification into the Library of the Meteorological Office. At that time the subject classification in use was that of the International Catalogue of Scientific Literature, which had been adopted in 1897. The earlier edition of the Universal Decimal Classification was not used in the Meteorological Office, as the section on meteorology was not regarded as satisfactory. The date fixed for the official change to the Decimal Classification was January 1st, 1936, but in order to gain experience in the latter, all literature received during the last three months of 1935 was classified on both systems. The Universal Decimal Classification has now been in use in the Meteorological Office Library for over a year, and some account of the difficulties encountered and the methods adopted to deal with them, may be of interest to the librarians of other meteorological institutions considering the adoption of this classification.

It was soon found that one of the greatest bugbears of the

* The meteorological classification, with an account of the principles on which it is based, was printed in the *Quarterly Journal of the Royal Meteorological Society* for January, 1936, pp. 134–44.

meteorological numbers—their length—did not in practice prove a serious inconvenience. The initial figures for Meteorology, 551.5, are longer than those of, for example, Botany, 58, and at first the possibility of substituting some conventional letter such as M was considered, but this proved unnecessary. The full numbers are now used regularly, and no difficulty has resulted.

In other ways also the purely meteorological part of the classification has on the whole proved successful, though it has been found advisable to define the scope of a few numbers in greater detail than was possible in the schedule. As an example may be mentioned the sub-division 551.506.1. The title of this is " Weekly, monthly and annual weather reports and bulletins," but the general title of 551.506, " Observational data (including weekly, monthly and annual means) " shows that it should also include periodical publications of observational data for any one meteorological element, such as rainfall, and tables of rainfall observations are classified here and not under 551.577, Precipitation. In practice, however, it was found convenient to distinguish between the data which are found in most meteorological year books, such as rainfall or wind direction, and those which are rarely found in the ordinary year books, such as data of atmospheric pollution. An annual report containing only the latter would be given two numbers, i.e., 551.506.1 and 551.510.42 (058), and would therefore appear under "Atmospheric Impurities " as well as under " Observational data," the (058) indicating that it is an annual publication. It would occupy too much space to give all these definitions in full here, but the Director of the Meteorological Office will be pleased to supply copies to Librarians of Meteorological Services and Institutions interested in the Universal Decimal Classification.

Much greater difficulty was experienced in dealing with border-line subjects, even where a definite number was assigned in the meteorological classification. For example, it was necessary to distinguish carefully between 551.586, Bioclimatology ; 614, Hygiene ; and 615.834, Climatotherapy. In this connexion it may be remarked that the subject of Bioclimatology is growing so rapidly that it is already desirable to sub-divide the number 551.586, and a provisional schedule has been made for use in the Meteorological Office Library.

Some border-line papers are classified by means of the colon, the sign of relationship, which has proved of the greatest value. A few examples of colon numbers are given in the general tables, such as 551.5 : 016, General Meteorological Bibliographies, and 551.5 : 92, Biographies of Meteorologists. Another compound number of frequent occurrence is 551.508.1 : 621.396.9, Radiosonde meteorographs (literally " Instruments for upper air investigation ; Application of Wireless ") which in spite of its formidable appearance, is already an old friend. The subject

"Daylight illumination" when discussed from the meteorological standpoint receives the compound number 551.521 : 535.24 (Photometry in relation to radiation). The number for aerial navigation, 629.13, is also frequently found in association with various meteorological numbers.

"Meteorological Societies and Institutions" have the compound number 551.5 : 06. For our purposes it was found desirable to discriminate between International, National and Private Institutions, e.g., between the International Meteorological Organisation, the British Meteorological Office and the Royal Meteorological Society. A distinction somewhat along these lines is now part of the official tables of the Universal Decimal Classification, though unfortunately not in a very convenient form.

Apart from a relatively few numbers such as these, representing subjects which are closely bound up with meteorology, border-line papers may deal with the relations of meteorology to almost the whole range of human knowledge. Here it was considered undesirable to classify the non-meteorological aspects in extreme detail.

The result of connecting two numbers by a colon is in effect to construct a new sub-division for each of them. For example, the meteorological tables do not include a specific number for the subject of "Effects of wind on buildings," but "Effects of wind" is 551.556 and a suitable sub-division is readily made by combining this with the number for buildings, giving 551.556 : 69. There are many sub-divisions of 69 representing different types of building, but for the purposes of a meteorological library it is not necessary to discriminate between them, and the one class is sufficient. To obtain uniformity in dealing with non-meteorological subjects a standard list of numbers has been compiled, and finer sub-divisions of these numbers are ignored. In the same way most of the finer sub-divisions of the geographical classification are ignored. In the Universal Decimal Classification the geographical numbers are carried into the most minute detail, but the general arrangement unfortunately leaves much to be desired.

Since any compound number is written in two ways, it requires two entries in the subject index. Where, however, two numbers frequently occur in conjunction, as with radio-sonde meteorographs, labour can be saved by making all the entries under one number, merely inserting a cross-reference under the other number. Thus in the Meteorological Office Library all papers on radio-sondes are entered under "Instruments for upper air investigation" but not individually under "Applications of wireless." This procedure is also adopted in a few cases where the two numbers connected by the colon are both meteorological, if the subject is clearly defined and of frequent occurrence. The works on "Air-mass climatology" are all entered under 551.582 : 551.515.8, but not individually under 551.515.8 : 551.582.

Apart from the problems of classification, it was necessary to decide how the great subject bibliography based on the old classification should be handled. This bibliography is a continuation up to the end of 1935 of section F of the International Catalogue of Scientific Literature, which ran from 1900 to 1914, and it includes many thousands of entries. The re-classification of the whole of these was not practicable, especially as the entries are on a series of foolscap sheets for each number and not in the form of a card index. All that could be done was to collate the two classifications as far as possible, so that cross references could be made from one to the other, and tables were constructed for this purpose.

The disadvantage of a break in continuity will, no doubt, continue to be felt for many years, but it is hoped that this will soon be more than counter-balanced by the advantage of a modern and more flexible classification, and one which is already being widely adopted by meteorological institutions in all parts of the world.

Unusual Persistence of Fog

The period November 19th–28th, 1936 in the Manchester and Liverpool areas was characterised by almost continuous fog, which for the greater part of the period was thick (visibility less than 220 yards), at any rate in the Manchester area. Such continuity has not been experienced before by any of the members of the Staff of this station so that it was felt that some details of the occurrence should be made more widely known.

The first signs of fog appeared on Thursday, November 19th as, with pressure steadily rising, a ridge of high pressure began to intensify over the British Isles with its axis approximately north-east to south-west. Visibility during the afternoon of this day fell to 600 yards owing to a light easterly wind which carried smoke from Manchester over the aerodrome. Before midnight the sky cleared and dense fog appeared before 7h. G.M.T. on the 20th. Though the fog on this day decreased in intensity during the midday period visibility was consistently below 1,100 yards except for a period of less than an hour about 16h.

The 21st was almost a repetition of the 20th—dense fog early, visibility improving to 1,100 yards by 15h. 40m. and falling below that distance by 17h. 15m. with fog (visibility 220 yards) by 18h. 20m. When the visibility fell to below 1,100 yards on this occasion we were not destined to see this visibility point for nearly a week, i.e. until 4h. 15m. on Saturday, November 28th. Surely this is in itself remarkable, but actually only for a very brief period during this time did visibility reach 220 yards, so that from 18h. 30m. approximately on the 21st to 10h. 40m. on the 28th visibility was practically continuously below 220 yards, i.e. a period of over 160 hours of thick fog.

During the evening of the 28th visibility again grew steadily worse after 18h. 30m. and fell to 5 yards in many places by 22h.; soon after midnight however a freshening SW. wind dispersed the fog.

The variations of thickness of the fog are worthy of note. For most of the thick fog period visibility varied from 30 to 150 yards but at times, notably on the night of the 24th and the afternoon and evening of the 27th visibility at times was 1 to 3 yards and it was difficult to find one's way about on foot, the outline of the kerb alone being really visible. On these occasions, the smoke and dirt in the fog were indescribable, causing it to have a rancid smell whilst evidence of the presence of sulphurous compounds was only too obvious, from the effect they had on the eyes, nose and throat.

After two or three days of the fog the soot deposit began to get more and more definite and soon everything exposed to the fog was covered by a black wet slime, making even grass and shrubs appear drab (it is impossible to say exactly how their colour was modified). On one day a pilot flying over Liverpool in the fog, while trying to land at Speke Airport, encountered slight ice formation, but the ice was almost black. Several cotton mills in this area not equipped with air purifying plant had to close down as the pollution in the air was soiling the yarn as it was being spun.

On Saturday, November 28th, visibility after being 60 yards at 7h. steadily improved to 1,400 yards at 16h. the sky being practically clear and the wind north-westerly force 1–2. During the afternoon visibility in the north of the city improved to several hundreds of yards and racing took place at Broughton in bright sunshine, but a football match in progress on the south side of the city had to be abandoned before half-time owing to the re-formation of dense fog. Undoubtedly the wind direction and speed largely contributed to the adverse conditions experienced in this case. By dusk visibility was again below 500 yards generally and by 20h. shallow thick fog was widespread, the moon being plainly visible; by 22h. however the fog was dense, visibility generally less than 5 yards and the sky obscured.

C. W. G. Daking.

F. Edwards, Esq., writing from Romiley near Stockport gives some interesting details covering the period 12 noon on November 21st to 7h. on November 22nd. His attention is mainly concentrated on peculiar temperature changes during this period, but his account includes also some interesting details of fog at Romiley. In view of the proximity of Stockport to Manchester the facts related bear indirectly on the subject matter of the foregoing note.

Although the night of November 21st–22nd was cloudless at Romiley there was a brief rise in temperature of 2° F. at 20h.

followed by a more noticeable rise of 5° F. beginning at midnight and persisting for 2 hours. In spite of the fog at Manchester, and as Mr. Edwards stresses, at many other stations at 7h. on the 22nd, visibility at Romiley was 20 miles and after daybreak the temperature rose steadily to 48·5° F. by 11h. 15m. It was not until 12h.15m. that fog drifted up from the valley from south-west, visibility falling to 200 yards and the thermograph falling to 41·2° F. After a temporary clearance during which the temperature began to rise, the wind suddenly shifted to NNW. force 2 and a mass of fog reduced the visibility to 100 yards with a sharp drop in temperature. At this stage at a height of 800 ft. there was clear sky and bright warm sun with a SE. breeze of 10–15 m.p.h., whilst the tops of chimneys and the tops of the Peakland hills were all standing out above the fog. Ultimately a dense fog bank settled down for the night and temperature fell to a minimum of 24° F.—an unusual range for a November day of 24·4° F.

Stockport lies some 6–7 miles south-east of Manchester and under the Peakland hills so that throughout the period indicated, with a prevailing light SE. breeze it was mainly free from drifting industrial smoke fog and haze until some local effects caused a change in the surface wind as at 12h. 15m. and again at 13h. 40m. A consideration of the upper air distribution over England however suggests that other and more important conditions were also operative at Romiley both to account for the variability of the visibility and the peculiar temperature changes.

The aeroplane ascents at Mildenhall show that towards the end of the week in question, a very warm air mass overlay the cold surface layers. On the afternoon of November 20th, the cold surface air extended to about 4,300 ft. but by Saturday morning the 21st the surface of separation or base of the inversion had fallen to about 1,200 ft. Above the surface of separation warm dry air prevailed—at 2,300 ft. 45° F. and 71 per cent relative humidity. It is feasible to suppose that subsequently the inversion came lower, and the facts suggest that at about midnight on the 21st the station at Romiley at a height of 510 ft. was affected by the warmer air from above and the temperature rose. Surface radiation was then active for the remainder of the night, but with sunrise the air temperature steadily rose to the high level recorded. All the evidence indicates that the warmer air from above never, as a whole, reached the surface, and the fog was trapped between the lower lying ground and the base of the inversion.

Without a detailed examination of the records it is of course impossible to delineate the areas where the warmer air from above may have penetrated almost to the surface but an almost complete clearance of the prevailing fog towards morning at Upper Heyford and Cranwell for example, suggests that the drier air came very close to the surface. On the Air Ministry roof in central London there was a slow irregular rise in temperature from 20h. on the 21st to 6h. on the 22nd, again with a clear sky throughout. During Sunday, November 22nd, the gradient for easterly winds increased which would have the effect of increasing the depth of the cold air near the surface, so that it is to be expected that during Sunday, the warm air would be lifted above the level of Romiley with the establishment of conditions suitable for persistent fog. The aeroplane ascent on November 23rd showed the cold air to have a depth of about 2,000 ft.

F. H. DIGHT.

Dense Fog at Bournville

It is thought that a few comments on the dense fog of November 21st–26th, 1936, easily the most prolonged experienced at Bournville since observations were commenced in 1911, may be of general interest.

At 9 o'clock on the morning of the 21st there was a belt of dense but beautifully white fog at ground level. So shallow was this belt at first that the sunshine recorder, which is on a roof some 80 ft. above ground level, registered 3·8 hours of sunshine during the day.

It was extremely depressing in the week which followed to see the gradual blackening of the fog owing to the accumulation of Birmingham's products of combustion. What slight breezes there were came from the north-east and aggravated the contamination of the air in so far as Bournville was concerned. Rarely has there been in the Midlands a more striking indication of the need for smoke abatement.

0·07 in. of rain fell during the afternoon of the 26th. This had a hydrogen ion concentration value of 3·0 which is remarkably acid for Bournville. During the week copper and silver articles within doors acquired a lustrous black film within an hour or two of cleaning. Out-of-doors, metals, for example the copper rim of the rain gauge, displayed an unusual black iridescence. Pavements, roads, grass verges, window sills, etc., became intensely sooty within a short time. Housewives, window cleaners and others will have tangible reminders of this visitation for many days.

The fog was not dispersed completely until the advent of a fresh south-westerly breeze on the 29th.

J. K. BEST.

Cadbury Brothers Ltd., Bournville, December 3rd, 1936.

Persistent Fog at Rotherham

From the point of view of persistence and of density, no fog in my fifteen years of observing the weather has equalled the one just ended here. It was first in evidence on Friday morning, November 20th, but had dispersed by noon ; Saturday was a pleasant misty day, but the fog had returned by Sunday morning the 22nd, and from then until Friday a state of fog persisted continuously ; it was thick—visibility less than 220 yards—until Wednesday and then moderate—visibility 220–1,100 yards—until Friday when it disappeared.

LESLIE ATKINSON.

187, *Broom Lane, Rotherham, Yorkshire, December 1st*, 1936.

Snow in the Rain-gauge

In summarising the rainfall records received in the Meteorological Office periods of snow often give rise to considerable difficulties. In some cases the gauge may become buried in a local snow-drift, while in others the snow may be blown out of the funnel. Then there are the difficulties experienced by the observer in making readings during semi-arctic conditions. In the case of certain monthly gauges on exposed moors the observer often runs considerable risks of getting lost in the blinding blizzards or buried in snow drifts during extreme conditions. The inspector usually sees such stations during the summer months, but many observers have commented on the severity of the conditions and even asked that the suggestion should be made to their employee that under such conditions the round of reading the gauges should be undertaken by two observers together, in order to minimise the risks of disaster and make the trip more bearable. Fortunately heavy falls of snow are relatively rare in most parts of the British Isles and the depth of snow as it falls is fairly uniform over large areas, much more uniform than in the case of intense rains. Each such storm warrants therefore special study and it is all the more desirable that reliable records of the precipitation should be obtained. At Headquarters it is usually necessary to plot the values for individual days and the monthly totals covering periods of snow and to suggest modifications to the values in certain cases.

In order to obtain the most reliable results the observers are asked to make the following measurements :—(1) the amount of water (i.e. actual rain or thawed snow) in the gauge, (2) the amount of unmelted snow (also converted into water) including any snow immediately above the funnel, which should be separated and pressed into the funnel, and (3) the depth of fresh undrifted snow. The sum of (1) and (2) gives the amount of precipitation for entry in the register ; (3) is an additional piece of useful information. If these three observations are supplied it is usually practicable, in conjunction with the maps showing the general distribution of the precipitation over the country, to ascertain whether the final figure given for the precipitation is the best estimate available.

Messrs. Hancock and Pinnock in their article in the October number of the magazine have made suggestions for obtaining more reliable readings under (2). They contend that the methods suggested in "Rules" are unsatisfactory, even under the relatively mild conditions prevailing on the south coast. These methods are (*a*) if no precipitation is falling the gauge may be brought indoors so that the contents may be melted, (*b*) a cloth dipped in hot water may be applied to the outside of the funnel and receiver or (*c*) a definite amount of very warm water may be poured into the gauge. Observers were asked to comment on the method suggested by Messrs. Hancock and Pinnock, which consisted of applying heat by the use of the solid fuel "Meta" under the funnel of the gauge. It is now possible to give a summary of the comments already received.

Mr. G. B. Davie, of Moreton-Hampstead, Devon agrees with Messrs. Hancock and Pinnock "that considerable difficulty is experienced in melting snow in the rain-gauge, when the amount is large, by the approved methods." Mr. Davie finds that when the depth of snow is 2 inches or more the method (*c*) of adding very warm water is unsatisfactory and he advocates tipping the snow out of the funnel and into some receptacle for melting indoors.

Mr. D. L. Champion, of Goff's Oak, Hertfordshire reports that on rare occasions he has found the funnel half full of snow and ice. Then he has added ·50 in. of very warm water but it has been found necessary to pour the liquid at least twice through the funnel before all the solid matter is washed through. Mr. Champion has not tried the method advocated by Messrs. Hancock and Pinnock but considers the standard method quicker and safer than that of applying dry heat to the funnel.

Mr. A. E. Moon of Hastings has always found the method of wrapping a hot cloth round the funnel of the gauge quite satisfactory, while if snow is falling at the time of observation the contents of the funnel are turned out into a flat dish rather larger than the funnel. Again Mr. Moon has not tried the proposed new method which he considers may result in a loss by evaporation or the weakening of a joint in the funnel.

Mr. J. G. Goodyear sends the following comments based on his experiences at certain of the Meteorological Office stations. "I have never found much difficulty in melting snow and ice by the method of pouring hot water into the funnel. I think the problem is not the fact that there is snow and ice, but that a supply of hot water may not be easily available at 7 a.m. on a winter morning at all stations. This lack of hot water applied at certain stations I have served at, and I agree with Messrs. Hancock and Pinnock that the application of dry heat in some form is a very excellent method—though the best method is undoubtedly that of an electric current illuminating a bulb. This applies a steady gentle heat and reduces the loss by evaporation, which otherwise might be considerable, to a minimum. The excellence of this method was demonstrated at Upper Heyford where the self-recording gauge was heated in this way, thus melting the snow as it fell and at the same time preventing the water in the float-chamber from freezing".

On the whole the most useful result of the correspondence arising from the article by Messrs. Hancock and Pinnock seems to be that of directing attention to a simple procedure not mentioned in "Rules for Rainfall Observers," viz. to scrape out the entire contents of the gauge into a suitable vessel for subsequent measurement indoors. The procedure is likely to be particularly useful when precipitation is occurring at the hour of observation. In any case it is desirable that the vessel should be covered during transit.

Mr. Hudleston, in his experiments at Hutton John (see articles in *British Rainfall* 1926 to 1933) was concerned with comparative readings from various gauges. He therefore usually preferred to wait until the snow had melted without the application of artificial heat before taking readings. Where necessary, however, he used hot water obtained from a thermos flask. He suggested on page 288 of his final report in *British Rainfall*, 1933 that useful additional information is supplied by taking, with the funnel inverted, a "cheese" of the snow off the ground at some place where it seems to be of average depth and melting at leisure. This corresponds with method (3) above of measuring the depth of fresh undrifted snow.

Reference should also be made to the useful hints to assist the rainfall observer in securing reliable readings during the winter, given in an article by Mr. Bilham on "Rain-gauges in Winter" in this magazine for December 1929.

J. GLASSPOOLE.

OFFICIAL PUBLICATIONS

The following publication has recently been issued :—

PROFESSIONAL NOTES

No. 73. Notes on the behaviour of the anemograph at Lizard. Compiled from reports by M. J. Thomas, B.Sc. (M.O. 336m.)

This paper contains an account of certain experiments to determine the cause and the character of eddies which made the anemograph at Lizard behave in an abnormal manner. The eddies were found to be formed in the lee of certain houses and by means of balloons and streamers the forms of the eddies were successfully mapped out.

Discussions at the Meteorological Office

The dates for these meetings in the New Year have been altered and the meetings will now take place on—

January 11th and 25th, February 8th and 22nd and March 8th, 1937.

Royal Meteorological Society

The Buchan Prize of the Royal Meteorological Society for 1937 has been awarded to Mr. C. S. Durst, B.A., for papers contributed to the *Quarterly Journal* of the Society during the years 1931–1935.

The opening meeting of this Society for the present session was held on Wednesday, November 18th, at 49, Cromwell Road, South Kensington. Dr. F. J. W. Whipple, F.Inst.P., President, was in the chair.

The following papers were read and discussed :—

Ivan D. Margary.—Report on the phenological observations in the British Isles from December, 1934, *to November*, 1935.

This report, which is issued annually, was published in July.

Sir Gilbert Walker and E. W. Bliss.—World Weather VI.

The fluctuations of pressure, temperature, and rainfall in winter in the region of the North Atlantic had been studied as a connected system in the last paper of this series ; and a similar system is now shown to hold in the spring, summer, and autumn. But the amount of persistence is small, so that the results are of little value for foreshadowing weather ; nor does a consideration of the trade wind region lead to success in this respect. Similarly, the Southern Oscillation which was found active in the summer and winter seasons over a large part of the globe is now shown to function in the two remaining seasons ; and while that of March to May has little control over the following quarter, the Southern Oscillation of September to November has a correlation coefficient of ·90 with the Oscillation of December to February. Thus there are a number of relationships between ·60 and ·82 available for foreshadowing weather.

Correspondence

To the Editor, *Meteorological Magazine*

Rainbow with Vertical Shaft

As the observation of an extraordinary rainbow by Mr. Francis Druce was published* without the explanation asked for by the author, I venture to draw your attention to the explanation to be found in Bravais' article on the rainbow.†

The image of the sun reflected in a smooth sheet of water may give rise to a rainbow the centre of which, like that of the ordinary rainbow, is at 180° from the sun, but at a height above the horizon equal to that of the sun.

If the sheet of water is slightly ruffled, the image of the sun forms a trail of light, each point of which may give rise to a fragment of an extraordinary rainbow. The envelope of these arcs is a vertical arc, tangential to the ordinary rainbow, similar to that of which

* See *Meteorological Magazine*, 71, November, 1936, p. 230.

† Bravais, A. Notice sur l'arc-en-ciel. *Annu. mét. Paris*, 1849, pp. 311–31.

Mr. Druce has sent such a beautiful photograph. The sun must have been reflected in the sea.

L. BESSON.

Service Météorologique de la Ville de Paris, Paris, November 25th, 1936.

[As the paper by Bravais referred to by M. Besson is not readily accessible in this country, at Dr. Whipple's suggestion a translation of the relevant part (page 320) is given here.

"If the sun is near the horizon, and if the surface of the sheet of water is slightly ruffled, the bow produced by the reflected image assumes a remarkable appearance; its upper part disappears; the lateral parts alone remain visible in the form of vertical columns tangential to the right and left parts of the ordinary bow. The reflected image of the sun is then greatly elongated in the vertical direction; the reflected bow is the envelope of a series of bows of the first order having their centres in the vertical through the sun; these bows are almost superimposed on each other in the parts near the horizon; but they are separated from one another towards their uppermost parts, and the dispersal of brightness resulting from this separation of the various bows tends to render them invisible in this part of the sky. It was in this form that the phenomenon was seen by Bowman shortly after sunrise (Report of the British Association, 1840, Notices and Abstracts, page 12). Playfair and Brandes similarly saw only the lateral parts of the bows of reflection; they were tangential to the ordinary bow over a length of 7° to 8°. The height of the sun above the horizon was only 2°." Ed. *M.M.*]

Mr. Druce and Miss Campbell are to be congratulated on securing such happy evidence for an almost unique phenomenon, the vertical shaft beside a rainbow.

May I elaborate a little the explanation given by M. Besson that the shaft was produced by light reflected from the water before reflection from the raindrops? It would hardly be expected according to the Bravais theory that the shafts would be so well defined that colours could be seen, so, to explain Mr. Druce's observations the theory should perhaps be modified. Can it be that in the actual case the sea waves were very regular owing to a swell passing from the open sea into the Sound to the east of Skye? The need for such a special combination of circumstances, low sun, distant shower, calm sea, strong swell in the right direction, would account for the rarity of a phenomenon which, so far as I know, has not been observed for nearly a century.

F. J. W. WHIPPLE.

Kew Observatory, Richmond, Surrey, December 3rd, 1936.

Irisation and Altocumulus Lenticularis

On October 16th, 1936, an interesting example of altocumulus lenticularis, of thick lens shape, was observed at Abbotsinch. From the commencement of observation at 14h. 30m. until 17h. 10m., when it was obscured by a sheet of lower cloud, it remained practically stationary although the wind up to 5,000 ft. was 30 to 50 m.p.h. (by pilot balloon ascent), and the speed at the cirrus level was shown by nephoscope observation to be about 100 m.p.h. At 14h. 30m. there was a small cumulus under the altocumulus in such a position that it reflected the sun's rays on to the base of the upper cloud, clearly revealing an undulating or roll structure. When first observed, the altocumulus was surmounted by an anvil of dense cirrus, which was fibrous at the upper edge, and the whole of this cloud mass exhibited beautiful irisations on the western and upper edges, the sun being concealed by the altocumulus. The bands of colour were in the order of the spectrum, red being nearest to the sun.

Statistical evidence provided by pilot balloon ascents shows that, in general, iridescence on cloud at Abbotsinch occurs with an air flow from a direction between 230° and 260° from north, i.e., one which passes over the hills in west Renfrewshire which lie west-south-west of the station.

We may infer therefore that irisation is due to diffraction by waterdrops in cloud newly formed in vertical air currents. These drops are consequently of uniform size, an essential condition for iridescence. This view has been advanced by Sir Napier Shaw.* The apparent lack of movement in the altocumulus was hence due to its formation in an ascending air current on the western side, where irisation was observed, and to its dispersion in a downward current, on its eastern side. The cloud was in what may be called a state of " dynamic equilibrium ".

A. M. YOUNG.

Meteorological Station, Abbotsinch, Paisley, November 6th, 1936.

Corona at Bala

I observed on Friday night, November 27th, 1936, a rainbow effect round the whole of the moon. The colours were very distinct, a band of yellow, then blue, then green and finally white. The moon was almost overhead and the effect lasted while a thin high cloud covered the moon. This was for about 2½ minutes from 10.25 to 10.27½ p.m. The effect was on the cloud.

W. WALKER.

Plas Coch Hotel, Bala, north Wales, November 29th, 1936.

Triple Corona at Aberdeen

A very fine triple corona was witnessed here at 21h. 45m. G.M.T. on Sunday, November 29th, 1936. Shortly before this time the sky was covered with altocumulus combined with altostratus. This by 21h. 30m. was clearing rapidly and very beautiful irisation

* Manual of Meteorology, Vol. III, p. 85.

effects were seen along the edge of the altocumulus sheets. It was noticed that four long bands of higher thin cloud were moving rapidly out of the north-west. These bands were quite distinct from the altocumulus, which latter cloud was passing away leaving the thin higher bands quite clear. The bands were very translucent, and the brighter stars could be seen through them. One of these bands of cloud passed over the moon at 21h. 45m. and showed magnificent corona effects. Three distinct coronae were observed. In the first the aureole was very clear and definite indeed, the brownish-red ring being unusually strong. Next came violet—perfect in colour and well defined. This was followed by green, yellow and red. The second corona was quite clear and the colours of violet (rather faint), green and yellow (both strong) and again red were perfectly distinct. In the case of the third corona the colours noted were green and yellow (both clearly distinct) and red (rather faint).

This triple corona lasted for about five minutes only, but was followed about fifteen minutes later by a very brilliant single corona.

W. F. WATSON.

The Observatory, King's College, Aberdeen, November 30th, 1936.

"Weeping" Trees

A familiar sight during fog is the "weeping" of trees. A less frequent case occurred here on the evening of November 25th, 1936. Fog, not very dense, had persisted for several days, but on this day the air cleared, and after sunset the visibility was fairly good, the street lamps showing clearly at over a mile; the sky was overcast, wind NE. force 1, temperature about 33° F. But the elm trees were weeping very copiously indeed, so that the ground below had puddles of water, and the hedges also were dripping. All the time the streets were quite dry, and the air felt fairly dry for the time of day but unfortunately no humidity readings are available. The air temperature had been rising from 30·1° F. at 13h. to 32·8° F. at 17h., but the rise was so slow that it cannot in itself account for the heavy condensation. This continued till about 20h. 30m. when a very light drizzle set in wetting the roads, so that the drip from the trees was not so conspicuous.

W. G. KENDREW.

Radcliffe Meteorological Station, Oxford, November 28th, 1936.

Ben Nevis and its Snow Problems

In an address to the International Commission for Snow, which sat in Edinburgh from September 14th–16th, 1936, entitled "Drift problems suggested by severe snowstorms in the British Isles with special reference to the Scottish snow-beds", I lamented the closing of the Ben Nevis Observatory on the ground that it required men living on the spot to study the relation of the drifting and avalanching of snow to the snow-beds which last all the year round in the great Alt-a-Mhuilin corrie on the northern flank of the mountain. A knowledge of the precise relationship in question would be of much interest from the point of view of climatology, hydrology and glaciology alike. According to the records of the Ben Nevis Observatory, snow accumulates on the summit of the Ben to the great depth of 8 feet in May ; but it has been estimated since that this great accumulation only represents quite a small fraction of the amount of snow which actually falls on the summit, the greater part being blown off by the terrific winds. Now since the summit is only clear of snow for a few weeks in late summer and early autumn it is fairly evident that if the snowfall of Ben Nevis came with calmer weather, clearance would be quite impossible in the time available. It would appear, indeed, that the critical factor preventing the formation of small glaciers in the Highlands to-day is the severity of the drifting, whereby large quantities of snow are blown off the summits and ridges and scattered on to the lower ground where under present climatic conditions it soon disappears.

All parts of the British Isles at an elevation greater than 1,000 feet above sea-level—one might almost say above 500 feet—are liable now and then to severe drifting snowstorms, but the Grampian summits of Scotland lie so near to the limit of perpetual snow that drifting becomes a determining factor.

As regards the more or less permanent snow-beds in the corries of Ben Nevis, Braeriach and other Scottish mountains it should be noted that such small snow fields or semi-glaciers must be far more sensitive to the climatic rhythm from year to year and century to century than fully developed glaciers would be. Had our predecessors through the centuries recorded the size and condition of these residues of the winter snows we should now be in possession of a climatic index of incomparable value. Hence we should see to it that our successors are possessed of it by commencing systematic observations.

Quite a number of people in Scotland are interested in the subject, and it is hoped to organize a scheme of research. I should like to conclude this note with a reference to Mr. Seton Gordon's fine book " The Cairngorm Hills of Scotland " which portrays most impressively the environmental importance of snowfall in the Highlands.

L. C. W. BONACINA.

15, Christ Church Rd., London, N.W. 3, October 20th, 1936.

Waterspouts off the Coast of Kent

The following information has been received from Lieutenant A. A. C. Gage, R.N. :—

During the period September 28th–October 2nd, 1936 no less than 5 waterspouts were observed at sea between Sheerness and Dover.

Four of them were close enough to the ship for it to be noted that their height was about 500 feet, their diameter 50–150 feet, their speed 10–15 knots and their life less than 5 minutes.

All of them formed from heavy cumulonimbus cloud but one dispersed before actually descending to sea level. In two of the remaining three cases, the sea was disturbed considerably. The direction of spin in each case was clockwise as far as could be judged.

The visibility during these few days was exceptional: the northerly wind, reaching force 6 about midday each day, was accompanied by occasional heavy showers of rain.

NOTES AND QUERIES

The Relation between Wind and Visibility in Winter

The effects on visibility of the drift of smoke from industrial areas and of fog from the Thames estuary, which have been so clearly set out in recent notes in this magazine*, doubtless have been of great interest to meteorologists and many others, and as a result of the interest stimulated, it was decided to ascertain if the smoke from the industrial areas to the east of London has any appreciable effect on the visibility at Goff's Oak, Herts.

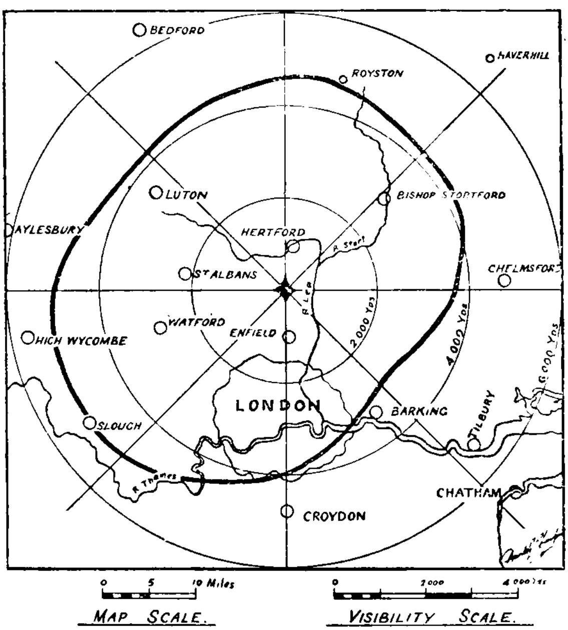


FIG. 1.

Observations of visibility and wind at 7 a.m. and 11 p.m. (Civil Time) for the months of September to March in the winters of 1934–5 and 1935–6 were available; and since, for topographical reasons, visibility on clear days of a conspicuous object on the horizon, is limited to about four miles, it was assumed that the maximum possible visibility was 6,600 yards. Within this limit, the mean visibility was estimated for winds from each of the eight points of the compass, and the resultant curve is shown in the composite map, Fig. 1.

It will be seen, that the atmospheric pollution from the industrial

* *See* Vol. 71, 1936, pp. 157 and 183.

area east of London and along the Thames towards Tilbury, reduces the visibility with SE. winds by about 1,300 yards below the average. The fogs of the lower Lea Valley, with its own smoke-producing factories, have considerable effect on visibility with winds from the east; while the residential and business areas to the west and north of London are also effective in reducing visibility when the wind is in the south, the reduction is not so serious as with SE. or E. winds. The slight reduction in visibility indicated with NW. winds may possibly be due to pollution from the industrial areas around Luton and Dunstable.

At this station it is apparent that fog in winter is usually associated with calm (or nearly calm) conditions, and in order to ascertain the effect of wind velocity on visibility, the mean visibility was calculated for winds of each force on the Beaufort scale, irrespective of direction. The resultant curve, shown in Fig. 2, indicates that there is usually a marked improvement in visibility as the wind increases from force 1 to force 3, but the improvement falls off rapidly with any further increase in velocity and the curve appears to become asymptotic to the "maximum visibility" line V = 6,600 yards, at about force 6.

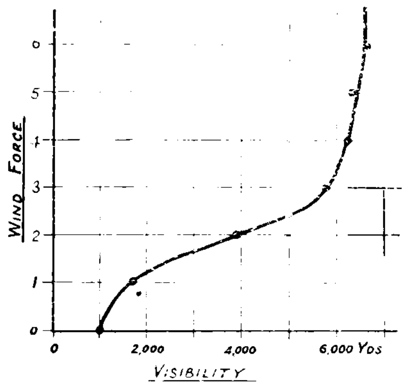


Fig. 2.

Doubtless curves from data at other stations would have different characteristics, owing to differences in exposure relative to the natural horizon; and doubtless also, different curves would be obtained for different hours of observation at the same station. Curves from stations where the "maximum possible" visibility exceeds 6,600 yards, would bring to light some interesting facts regarding the relation between wind velocity and horizontal visibility.

DONALD L. CHAMPION.

Showers and Squalls at Ismailia, Egypt, July 28th and 29th, 1936

A very heavy shower occurred at Ismailia during the afternoon of both July 28th and 29th.

The occurrence of rain in July is almost unique.

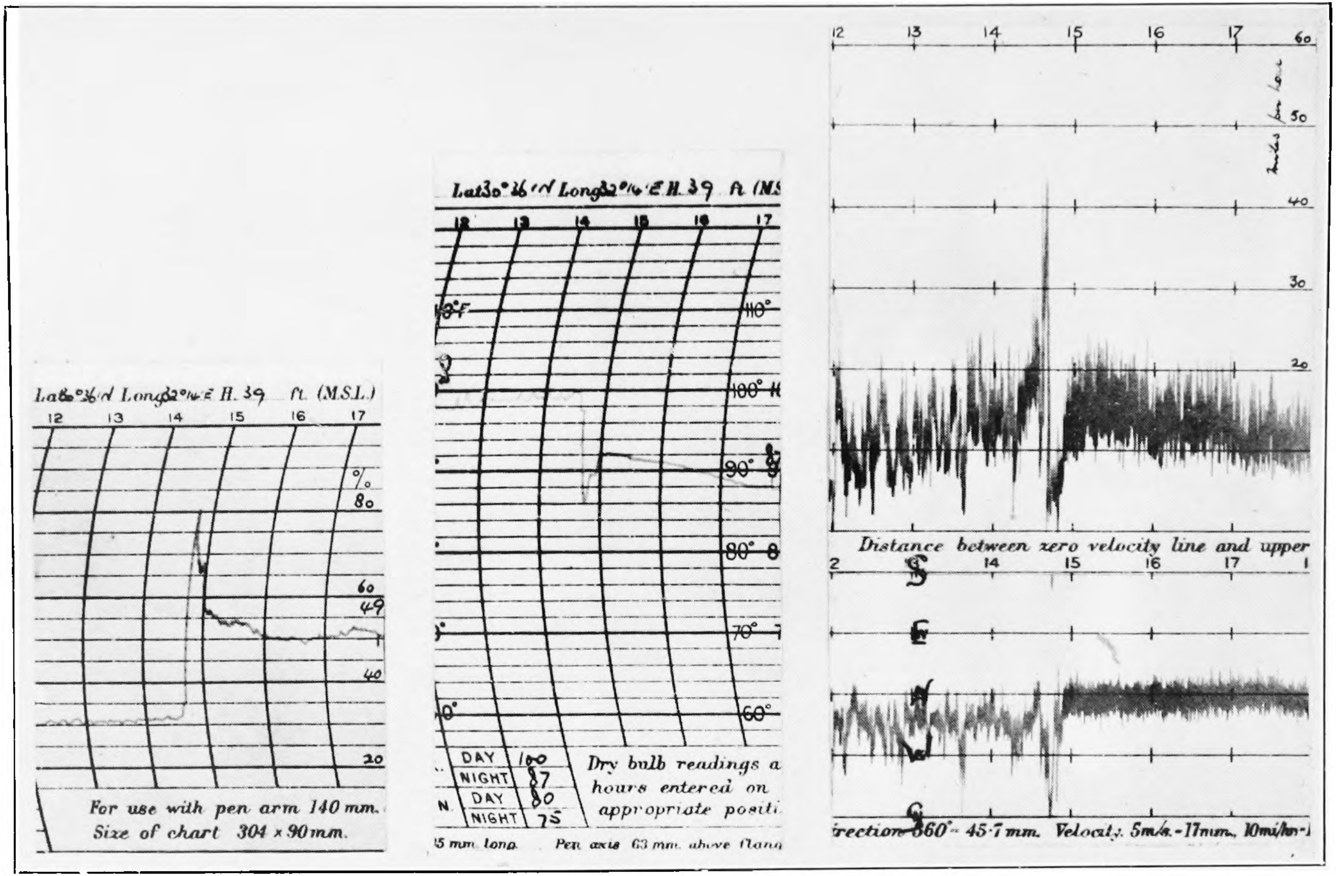
As far as can be ascertained from records no rain has been recorded for at least 33 years. Old inhabitants, both European and native, agree that the rain was unprecedented, and had not occurred within living memory. So unusual was it that many natives were terrified, saying that it was a judgment of Allah. It so happened that the heaviest rain fell in the native quarter of the town on both occasions; and the falls of 3·2 mm. and 4·0 mm. at the Meteorological Office were evidently not the heaviest that occurred. Streets on both occasions were flooded in the native quarter, though only a very little rain fell elsewhere. Pressure distribution at 6h. G.M.T. on the 28th showed that the usual " low " over Iraq had deepened, and that there was a well-defined trough and front extending from it in a west-south-west direction across Syria to the eastern Mediterranean. This front appeared to move at about 18 m.p.h. in a south-easterly direction and was probably near Port Said about 12h. G.M.T., the wind having veered NNW. This was the only indication as the sky was cloudless ; but the pressure there was over 2 mb. higher than at Ismailia while the gradient between Ismailia and Suez was negligible. The first indication at Ismailia was a line of cumulus to north-west and north. This line of cloud is, however, quite common in summer, marking the front of the usual northerly sea-breeze, which sets in sometime during the afternoon. On this occasion, however, the cumulus increased considerably in size when the line was nearly over Ismailia. The wind was north-westerly, moderate and rather gusty, and the temperature about 100° F. At 14h. 40m. G.M.T. the wind veered N. in a strong squall, gusts reaching 46 m.p.h., and was accompanied by a heavy shower, the sky both to north and south being almost cloudless. Temperature fell rapidly to 86° F. and relative humidity rose from 32 per cent to 80 per cent, most of the change taking place in under five minutes. The wind fell immediately afterwards for ten minutes and then settled down at 14h. 55m. G.M.T. to a steady moderate breeze from north. Temperature at the same time rose to 92° F. and relative humidity fell to 56 per cent. It seems that the latter temperature and humidity indicated approximately that of the new air, the extra fall of temperature and rise of relative humidity being attributal to rain. Rain was reported with a cloudy sky at Toussoum, seven miles south-south-east of Ismailia, about 16h. G.M.T. and a squall from north-west at Deversoir, fifteen miles south-south-east, later. The front appeared to become diffuse after this, as beyond cloud no special phenomena were reported from the Suez Canal stations further south.

On the 29th a very similar set of conditions prevailed, though with certain differences. Another front moved south-eastward, and again appeared to be situated near Port Said about 12h. G.M.T. Temperatures were generally much higher than on the previous day ; but a " heat low " was situated inland, pressure being 2·5 mb. lower at Ismailia than at Port Said, and about 1 mb. lower than at Suez. This distribution is fairly normal, however, for the time of year, though showing greater pressure differences.

A marked fall of temperature from 98° F. to 86° F. and a rise of humidity from 34 per cent to 78 per cent occurred at Port Said between 12h. and 15h. G.M.T.

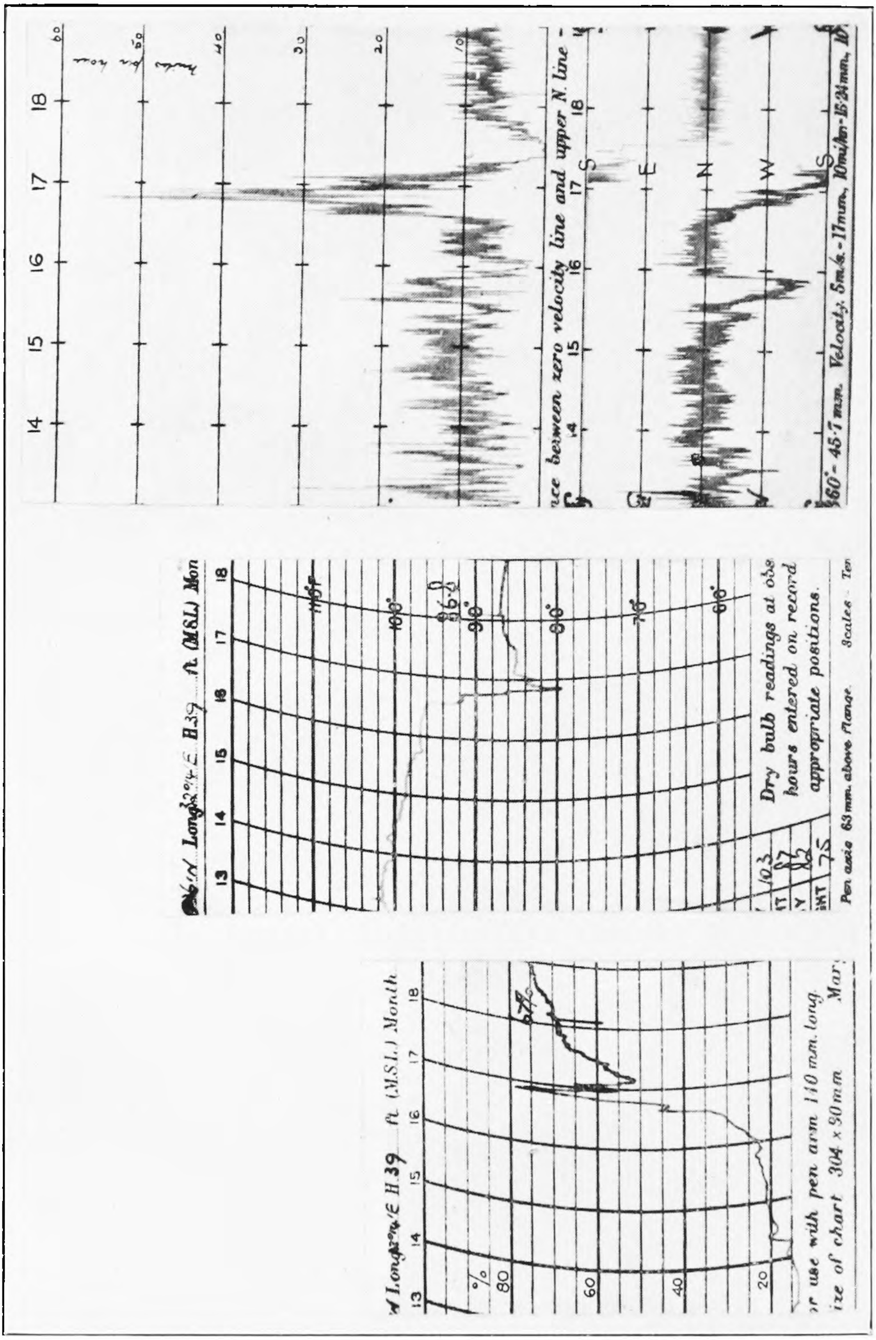
The line of cloud worked up from north-west as on the 28th, but the front became almost stationary over Ismailia about 13h. G.M.T. This cloud increased in amount during the afternoon and had

[To face p. 266.



Autographic records, Ismailia, Egypt, July 28th. 1936.

To face p. 267]



AUTOGRAPHIC RECORDS, ISMAILIA, EGYPT, JULY 29TH, 1936.

grown to large cumulonimbus by 16h. G.M.T. A violent squall with gusts reaching 57·m.p.h. accompanied by heavy rain occurred at 16h. 30m. G.M.T., commencing from N. and backing during the squall rapidly through W. and S. to SE., after which a gentle northerly breeze set in. The fall of temperature and rise of relative humidity were even larger than on the 28th. No rain was reported on this occasion at the Suez Canal stations to southward ; but a northerly squall was experienced at Toussoum at 17h. 10m. G.M.T., and from NE. at Geniffa, about 35 miles south-south-east of Ismailia, at 18h. 15m. G.M.T. ; the sky at all stations being cloudy.

It seems probable that with the conditions obtaining the topography of the country was the essential cause of the rain. To the north of Ismailia on the western side of the Suez Canal is a large area of desert, as far as the edge of Lake Menzaleh near Kantara, while east of the Canal is entirely desert. The desert is, of course, very dry and hot. At Ismailia the Canal broadens into Lake Timsah, and a cultivated and heavily irrigated strip of land extends from it in a westerly direction along the fresh water canal, and southward along the western side of the Suez Canal to the Great Bitter Lake. South of this strip is unbroken desert.

It seems probable that sufficient moisture for " cloud and rain making " was obtained from the lake and this strip of land near Ismailia, and in conjunction with the forced ascent of air on the arrival of the cold front, was sufficient to produce rain. In the usual weaker " sea-breeze fronts " it is quite common for the cloud to increase greatly on reaching Ismailia area.

In the case of the squall of the 29th, it seems that a definite small centre formed on the almost stationary front and a more " tornado effect " occurred. There is evidence at 18h. G.M.T. of a separate low pressure area having formed between Cairo and Suez, and altocumulus castellatus was observed at Port Thewfik.

No special phenomena were recorded at other Middle East stations ; but these are so far apart that the actual conditions obtaining at any one time are largely a matter of conjecture. T. F. Twist.

Humours of Meteorology

A correspondent of a New Zealand newspaper evidently feeling the term " cyclonic " inadequate recently described a storm in New Zealand as " a strong nor-westerly wind . . . of almost *anti-cyclonic* force ". The italics are ours.

REVIEWS

Zweites Köppen-Heft der Annalen der Hydrographie und Maritimen Meteorologie. pp. 94, *Illus.*, 8 folding charts. Deutsche Seewarte, Hamburg, 1936.

In 1926, on the occasion of the 80th birthday of Professor Wladimir Köppen, the Deutsche Seewarte published a " Köppen-Heft " which included contributions from many of his old friends and colleagues in all parts of the world. Ten years later a second special volume commemorates his 90th birthday, but this is a more personal contribution, being entirely the work of the staff of the Deutsche Seewarte and its marine and overseas correspondents.

Fourteen articles are included, dealing as would be expected, largely with various aspects of marine meteorology—comparison of estimates of wind force at sea with measurements of velocity; diurnal variation of temperature; wind and swell; sub-tropical cyclones etc. Land and upper air meteorology are not forgotten however, as for example in the discussion on mountain observations and high-level charts.

An interesting feature is a series of reproductions of Köppen's handwriting at intervals of ten years from 1876 to 1926. In 1926 he wrote that his life's work was done; in a brief foreword Dr. Spiess, President of the Deutsche Seewarte, comments on the way in which events falsified this forecast, and the handwriting of 1936 still shows plenty of vigour.

Die Frequenz der Sonnenhalobeobachtungen in den Niederlanden, besonders von 1914–1931. By C. Visser, De Bilt, K. Ned. Meteor. Inst. No. 102. Med. en Verh. 37, pp. 86 (Dutch) + 9 (German Summary). *Illus.* 's Gravenhage, 1936.

The records of optical meteorological phenomena systematically collected by the Dutch Meteorological Institute over many years, and published annually in "Onweders, Optische Verschijnselen enz. in Nederland", provide a mine of information on the frequency of occurrence of the various types of haloes at different hours and different seasons. These have been studied statistically by C. Visser. For the common halo of 22° his tables are based on more than 13,000 observations, which show that this halo is most frequent in April and May, when temperature contrasts in the upper air are greatest, with a secondary maximum in August and a minimum in December. These features remain even after correction for length of day, etc., though the resulting annual curve is much flatter. The most favourable hours are about noon and the most favourable elevation of the sun, 56–59°.

Similar tables are given for the upper arc of contact and mock suns of the 22° halo, circumzenithal arc and halo of 46°, all of which show a similar annual variation except that the secondary maximum tends to come in October or November instead of August. They are, however, most frequently observed with a comparatively low sun, 12–15° for the arcs of contact and mock suns, 20–23° for the halo of 46°. Even the rare Arc of Lowitz follows roughly the same distribution, the smoothed table based on 68 observations showing a maximum in April and a secondary maximum in September. This phenomenon is discussed in detail and in the last chapter a new explanation is given, based on an experimental investigation, in which a hexagonal prism, with a refracting angle of 60°, undergoes two rotatory movements in such a way that it rolls round the surface of an imaginary cone. Other halo phenomena are listed but are too rare for statistical treatment.

The text is in Dutch but the tables are fully intelligible and there is an adequate summary in German.

Kan man förutse, huruvida en vinter blir warm eller kall ? and Kan man förutse, huruvida en sommar blie torr eller regnig ? By O. Pettersson. Göteborg, 1935.

In these two papers Professor Pettersson sets out the bearing of his researches into lunar tides of long period on the problems of climatic pulsations. In the first he shows how the nine-year lunar " node-apside " period dominates the winter temperature of Berlin, the date of breaking-up of ice on Lake Malar, and the rainfall of Lund. Superposed on this is a longer periodicity which fits in closely with the cycle of 186 years in the orientation of the major axis of the lunar orbit compared with that of the earth. This effect takes place partly by inducing changes in the flow of warm ocean currents into the Arctic, and partly directly in the earth's atmosphere. The variations in the combined action of the earth and moon also affect sunspots and so give rise to an apparent relation between the frequency of sunspots and terrestrial weather.

In the second paper the mechanism of the direct lunar action on the earth's atmosphere is examined more closely as a gravitational problem. The resulting variations of pressure, complicated by the existence of the tropopause and the polar fronts, produce marked variations and recurrences of storminess. The discussion will interest those meteorologists who can read Swedish, though not all will agree with the author's conclusions.

BOOKS RECEIVED

Schweizerisches Forschungsinstitut für Hochgebirgsklima und Tuberkulose in Davos (i) *Gesamtverzeichnis der Publikationen,* by Prof. Dr. C. Dorno ; (ii) *Verzeichnis der Veröffentlichungen.* Davos, 1935.

Resumen de las observaciones efectuadas en la red termopluviométrica durante el año 1934. Observatorio de Igueldo, San Sebastian, 1935.

OBITUARY

Edward Kitto.—We regret to learn of the death on June 8th, 1936, of Mr. E. Kitto, Superintendent of the Falmouth Observatory from 1882 to 1913. Mr. Kitto's total period of service at the Observatory extended over more than 44 years. From May, 1869, he acted as Assistant to the late Mr. Lovell Squire, the Superintendent, until Mr. Squire's retirement in 1882, when Mr. Kitto was appointed his successor. He became a fellow of the Royal Meteorological Society in the same year. Mr. Kitto's services under the Royal Cornwall Polytechnic Society covered practically the whole of the period during which Falmouth maintained the status of a First Order Observatory. He was well known as an accurate and most conscientious observer, and the long series of valuable data which we possess for Falmouth will remain as an enduring monument to his memory.

We regret to learn of the death on November 23rd, 1936, at the age of 59, of the Rev. James Gordon Hayes, M.A., for many years vicar of Storridge, in the diocese of Hereford. Mr. Hayes will be remembered as the author of a series of critical and historical works on Polar exploration among which may be mentioned " Antarctica " and " The Conquest of the South Pole."

We regret to learn of the death on November 27th, 1936, of Prof. Dr. Wilhelm Schmidt, Director since 1930 of the Central Institute for Meteorology and Geodynamics at Vienna.

ERRATUM

OCTOBER, 1936, p. 201, 4th line from bottom, *for* " Prof. Cario, Germany " *read* " L. V. Berkner, United States."

NEWS IN BRIEF

Dr. A. H. R. Goldie, F.R.S.E., has been made one of the secretaries to the Associations forming the International Union of Geodesy and Geophysics.

We learn that Commandant Correia Pereira has been appointed Director of the Portuguese Meteorological Service in succession to Commandant Morna.

The Nobel Prize for physics for 1936 has been divided equally between Professor Victor F. Hess, of Innsbruck, for his work on cosmic radiation, and Dr. C. D. Anderson, of Pasadena, for his discovery of the positron.

The Weather of November, 1936

Pressure was below normal over Greenland, eastern Canada, Iceland, Spitsbergen, Scandinavia, north Germany, the Netherlands, France, north Spain, north-east coast of Africa, Palestine and Turkey, the greatest deficits being 7·8 mb. at 60° N., 60° W., 9·0 mb. at Spitsbergen and 1·4 mb. near Erzerum (Turkey). Pressure was above normal over most of the United States, western and central Canada, Alaska and across Newfoundland and the North Atlantic to north-west Africa, the western Mediterranean, southern and central Europe and most of

Russia, the greatest excesses being 4·2 mb. at Sverdlovsk, 7·4 mb. at Horta and 12·2 mb. near Vancouver. Throughout the month an intense anticyclone lay over the Rocky Mountains exceeding 1030 mb. in the latter half. Temperature was mainly above normal and precipitation about or below normal in Sweden, Estonia, Germany, the Netherlands and most of Hungary.

The chief features of the weather of the British Isles during November was the general lack of sunshine, the frequency of gales in the first part of the month and the widespread inland fog in the later part. Rainfall was considerably above normal in south-east England but only about half the normal in parts of Scotland. In the main lines of the pressure distribution November falls into two parts. From the 1st to 17th the average distribution was similar to that for October 14th to 31st shown on p. 226 of the November, 1936, *Meteorological Magazine.* During the second period, from 18th to 29th, a ridge of high pressure extended from the Azores across the British Isles and central Europe to Russia and western Siberia, exceeding 1025 mb. south of Moscow, while the low pressure area formerly situated near Iceland was centred over Spitsbergen, where pressure averaged below 990 mb., and extended across Greenland. During the 1st strong winds and rain were experienced in north Scotland and Ireland but anticyclonic conditions with some mist or fog prevailed in the southern regions and on the 2nd extended also to the north. By the night of the 2nd however a large area of low pressure was advancing eastwards from the Atlantic and from then to the 13th depressions passed across the country. Unsettled stormy weather with rain most days occurred generally, the heaviest falls being on the 7th and 11th, 2·80 in. at Borrowdale (Cumberland) and 2·35 in. at Belleek (Co. Fermanagh) on the 7th and 2·15 in. at Emsworth (Sussex) and 2·00 in. at Compton (Sussex) on the 11th. Hail showers were reported on several days and thunderstorms in the Midlands and south Scotland on the 4th and 5th and in south England on the 8th and 9th, while snow was experienced on high ground in Scotland. Gales occurred generally in the south-west and west from the 7th to 9th, Beaufort force 10 being reached at Pembroke at 1h. on the 8th and force 9 at Pembroke, Lizard and Scilly at 1h. on the 9th. Gales also occurred in Ireland, west England and Scotland on the 11th and 12th and at isolated exposed places on other days. Sunshine records were mainly poor during this period except in Scotland and north England on the 3rd and 5th, and in south England on the 1st, 8th and 9th., 8·5 hrs. at Eastbourne on the 1st and 7·3 hrs. at Tynemouth on the 3rd, while temperature was generally above normal though ground frosts occurred at times. A short interval of fair to cloudy misty anticyclonic weather was experienced on the 13th–14th as a ridge of high pressure passed across the country but mild unsettled conditions were renewed on the 14th and lasted to the 18th with gales mainly in Scotland on the 15th and on the east coast on the 17th–18th. Rain occurred on most days with 1·90 in. at Lake Vyrnwy, Montgomery on the 15th and 1·58 in. at Bolventor, Cornwall, on the 16th. On the 18th conditions changed and from then to the 28th an anticyclone covered the country giving quiet cold weather with widespread inland fog. The fog dense at times lasted in many parts of the Midlands, north England, south Scotland, and north Ireland, from the 20th to 28th.* Owing to the fog temperature did not rise above 28° F. all day at Morecambe on the 23rd and at Catterick on the 24th, while screen minima fell to 20° F. at some places on one or two nights—20° F. at Stonyhurst on the 23rd—and a ground minimum of 11° F. was recorded at Dalwhinnie on the 23rd. Sunny conditions obtained occasionally near the coast, generally on the 21st, 22nd and 28th—7·4 hrs. at Clacton and Lowestoft on the 21st. On the 27th a depression to the north caused rain in Scotland and Ireland, and on the night of the 28th another depression spread southwards and covered the country on the 29th and 30th bringing a return to mild rainy weather with gales in the north and west mostly on the 30th. Beaufort force 9 was reported from Lerwick at 13h. and 18h. on the 30th. The distribution of bright sunshine for the month was as follows :—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway ...	25	−20	Chester ...	47	−10
Aberdeen ...	62	+ 2	Ross-on-Wye ...	42	−24
Dublin	70	0	Falmouth ...	55	−24
Birr Castle ...	51	−11	Gorleston ...	58	−12
Valentia... ...	53	−11	Kew	41	−12

Miscellaneous notes on weather abroad culled from various sources

Severe gales were experienced over the North Atlantic, North Sea and Baltic during the first part of the month up to about the 17th when the Hamburg-Amerika line motorship *Isis* was lost with all her crew except one, many other vessels were damaged and members of their crew drowned and numerous liners were late berthing by as much as 24 hours. Wintry conditions prevailed in Madrid during the middle of the month. An unusually dense fog was experienced off south-east Norway on the 23rd. Gales were reported from Malta on the 24th and from the Bosphorus on the 25th. (*The Times*, November 4th–26th.)

Owing to heavy rains, the 40 ft. dam containing the residues of the Osarizawa Copper Mine at Akita, Hondo, Japan burst at 3 a.m. on the 20th and several hundreds of people in the nearby villages were drowned. Heavy rain was experienced in Palestine for the 3 days, the 21st–23rd, so that the airport at Gaza was under water on the 24th. (*The Times*, November 21st–25th.)

* See p. 252.

The total rainfall for the month in Australia was mainly considerably below normal except in parts of Western Australia. (*Cable.*)

In the United States during the early part of the month temperature was mainly below normal except along the Atlantic seaboard, but during the rest of the month temperature was mainly above normal in the western States, below normal in the eastern States and in the central States above normal at first, becoming cold later. Precipitation was generally deficient, except early in the month, in parts of the Atlantic seaboard and the Ohio Valley. (*Washington D.C., U.S. Dept., Agric., Weekly Weather and Crop Bulletin.*)

Daily Readings at Kew Observatory, November, 1936

Date	Pressure M.S.L. 13h.	Wind, Dir., Force 13h.	Temp. Min.	Temp. Max.	Rel. Hum. 13h.	Rain.	Sun.	REMARKS. (see vol. 69, 1934, p. 1).
	mb.		°F.	°F.	%	in.	hrs.	
1	1024·0	WSW.2	35	50	74	0·03	7·4	x early, r_0 19h.–24h.
2	1017·6	N.2	45	53	82	0·02	0·0	r_0 0h.–5h. & 15h.
3	1013·5	SW.2	39	49	98	0·31	0·0	r_0–r 8h.–19h.
4	1014·8	W.2	43	52	61	—	2·1	fw early.
5	1005·2	SW.3	45	53	77	0·07	0·6	r_0–r 8h.–11h.
6	989·5	SSE.3	37	53	77	0·07	3·7	x early, r 17h.–20h.
7	980·0	S.4	43	50	76	0·16	2·3	r_0–r 2h.–10h.
8	988·4	SW.5	45	50	51	0·08	6·7	r 2h.–6h. prq 15h.
9	989·5	WSW.5	42	54	64	0·21	4·5	r 1h.–7h.
10	1003·3	WSW.4	44	49	66	—	3·2	w early, pr_0 13h.
11	1000·0	SSE.3	33	48	83	0·44	0·0	f early, r_0 12h.–24h.
12	985·6	SSW.5	48	54	88	0·57	1·1	r–r_0 0h.–21h.
13	1015·5	NNW.3	47	49	74	trace	0·9	r_0 4h. f 21h.
14	1017·7	SW.4	34	51	85	0·11	3·0	r_0 7h.–10h.
15	1022·3	SW.4	36	51	79	0·01	0·2	r_0 15h.–16h.
16	1014·1	W.2	51	54	71	0·17	0·0	r–r_0 18h.–24h.
17	1008·8	SW.4	51	56	91	0·38	0·1	r–r_0 0h.–20h.
18	1014·2	N.5	45	48	69	0·01	0·2	r_0 7h.–3h.
19	1023·3	NE.4	45	46	85	—	0·0	id_0 8h.–18h.
20	1035·1	ENE.4	40	45	65	—	0·5	
21	1032·9	E.4	38	45	76	—	2·6	w early.
22	1026·9	SW.1	38	41	97	—	0·0	x early, F 10h.–24h.
23	1021·2	NNE.1	33	38	92	—	0·0	F till 16h.
24	1019·2	NW.1	35	36	85	—	0·0	w early.
25	1021·9	NNE.2	32	39	90	trace	0·0	id_0 13h.–24h.
26	1017·7	NNE.2	38	43	90	0·01	0·0	d_0 0h.–7h. f 9h.–17h.
27	1018·8	NNE.2	32	42	84	—	0·4	f 9h.
28	1023·8	NW.2	38	42	84	—	0·0	f to 10h. & 20h.–24h.
29	1022·2	SW.3	31	44	89	0·13	0·0	Fe to 10h. r_0 12h.–20h.
30	1013·9	W.3	44	55	71	—	1·2	
*	1012·7	—	40	48	79	2·79	1·4	* Means or Totals.

General Rainfall for November, 1936

England and Wales ...	121	per cent of the average 1881–1915.
Scotland	81	
Ireland	104	
British Isles	107	

Rainfall : November, 1936 : England and Wales

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Lond .	Camden Square	3·07	130	*Leics* .	Belvoir Castle	2·93	131
Sur .	Reigate, Wray Pk. Rd.	4·68	150	*Rut* .	Ridlington	2·03	88
Kent .	Tenterden, Ashenden	4·52	151	*Lincs* .	Boston, Skirbeck	1 87	93
,, .	Folkestone, Boro. San.	4·43	...	,, .	Cranwell Aerodrome	2·19	117
,, .	Margate, Cliftonville	3·26	135	,, .	Skegness, Marine Gdns.	2·32	107
,, .	Eden'bdg., Falconhurst	5·02	141	,, .	Louth, Westgate	2·76	107
Sus .	Compton, Compton Ho.	5·44	143	,, .	Brigg, Wrawby St.	2·23	...
,, .	Patching Farm	4·97	140	*Notts* .	Worksop, Hodsock	2·45	125
,, .	Eastbourne, Wil. Sq.	5·00	143	*Derby*.	Derby, L. M. & S. Rly.	2·03	94
Hants.	Ventnor, Roy.Nat.Hos.	5·26	164	,, .	Buxton, Terr. Slopes	5·74	123
,, .	Fordingbridge, Oaklnds	3·75	110	*Ches* .	Runcorn, Weston Pt.	3·22	116
,, .	Ovington Rectory	4·35	131	*Lancs*.	Manchester, Whit. Pk.	3·67	139
,, .	Sherborne St. John	3·37	118	,, .	Stonyhurst College	5·72	127
Herts .	Royston, Therfield Rec.	3·21	138	,, .	Southport, Bedford Pk.	4·45	142
Bucks.	Slough, Upton	3·37	152	,, .	Lancaster, Greg Obsy.	5·07	127
,, .	H. Wycombe, Flackwell	3·39	132	*Yorks*.	Wath-upon-Dearne	2·80	137
Oxf .	Oxford, Mag. College	2·49	113	,, .	Wakefield, Clarence Pk.	3·09	146
N'hant	Wellingboro, Swanspool	2·35	109	,, .	Oughtershaw Hall	7·28	...
,, .	Oundle	2·35	...	,, .	Wetherby, Ribston H.	3·83	164
Beds .	Woburn, Exptl. Farm	2·14	96	,, .	Hull, Pearson Park	2·00	91
Cam .	Cambridge, Bot. Gdns.	2·13	110	,, .	Holme-on-Spalding	3·27	150
Essex.	Chelmsford, County Gdns	3·06	136	,, .	West Witton, Ivy Ho.	3·54	103
,, .	Lexden Hill House	3·25	...	,, .	Felixkirk, Mt. St. John.	3·22	131
Suff .	Haughley House	3·28	...	,, .	York, Museum Gdns.	2·89	138
,, .	Campsea Ashe	3·73	168	,, .	Pickering, Hungate	2·76	111
,, .	Lowestoft Sec. School	2·70	115	,, .	Scarborough	2·46	100
,, .	Bury St. Ed., WestleyH.	3·40	148	,, .	Middlesbrough	2·42	114
Norf. .	Wells, Holkham Hall	2·75	128	,, .	Baldersdale, Hury Res.	4·26	115
Wilts .	Calne, Castle Walk	3·58	...	*Durh* .	Ushaw College	3·13	123
,, .	Porton, W.D. Exp'l. Stn	2·79	106	*Nor* .	Newcastle, D. & D. Inst.	3·00	136
Dor .	Evershot, Melbury Ho.	3·98	93	,, .	Bellingham, Highgreen	3·17	92
,, .	Weymouth, Westham.	3·27	105	,, .	Lilburn Tower Gdns.	3·49	104
,, .	Shaftesbury, Abbey Ho.	3·02	93	*Cumb*.	Carlisle, Scaleby Hall	3·48	116
Devon.	Plymouth, The Hoe	3·33	91	,, .	Borrowdale, Seathwaite	17·00	133
,, .	Holne, Church Pk. Cott.	6·98	109	,, .	Borrowdale, Moraine	13·71	134
,, .	Teignmouth, Den Gdns.	2·75	86	,, .	Keswick, High Hill	6·37	113
,, .	Cullompton	3·71	108	*West* .	Appleby, Castle Bank	4·26	128
,, .	Sidmouth, U.D.C.	2·61	...	*Mon* .	Abergavenny, Larchf'd	4·23	111
,, .	Barnstaple, N. Dev.Ath	3·88	99	*Glam* .	Ystalyfera, Wern Ho.	6·87	105
,, .	Dartm'r, Cranmere Pool	9·60	...	,, .	Cardiff, Ely P. Stn.	4·26	102
,, .	Okehampton, Uplands.	7·30	137	,, .	Treherbert, Tynywaun.	11·48	...
Corn .	Redruth, Trewirgie	5·33	109	*Carm* .	Carmarthen, Coll. Rd.	5·44	109
,, .	Penzance, Morrab Gdns.	5·02	110	*Pemb* .	St. Ann's Hd. C. Gd. Stn.	4·55	120
,, .	St. Austell, Trevarna	6·01	122	*Card* .	Aberystwyth	5·18	...
Soms .	Chewton Mendip	5·63	132	*Rad* .	BirmW.W.Tyrmynydd	7·54	113
,, .	Long Ashton	4·78	151	*Mont* .	Lake Vyrnwy	7·61	137
,, .	Street, Millfield	3·22	...	*Flint* .	Sealand Aerodrome	2·46	...
Glos .	Blockley	2·42	...	*Mer* .	Blaenau Festiniog	12·21	126
,, .	Cirencester, Gwynfa	3·06	103	,, .	Dolgelley, Bontddu	9·96	161
Here .	Ross, Birchlea	2·51	99	*Carn* .	Llandudno	3·00	104
Salop.	Church Stretton	4·43	151	,, .	Snowdon, L. Llydaw 9.	19·67	...
,, .	Shifnal, Hatton Grange	2·83	118	*Ang* .	Holyhead, Salt Island	3·44	83
Staffs.	Market Drayt'n, Old Sp.	2·73	104	,, .	Lligwy	4·24	...
Worc .	Ombersley, Holt Lock.	2·21	97	*Isle of Man*			
War .	Alcester, Ragley Hall	1·99	86		Douglas, Boro' Cem.	6·13	130
,, .	Birminghm, Edgbaston	2·91	122	*Guernsey*			
Leics	Thornton Reservoir	2·45	108		St. PeterP't.Grange Rd.	5 67	135

Rainfall : November, 1936 : Scotland and Ireland

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Wig .	Pt. William, Monreith.	3·44	80	*Suth* .	Lairg	3·12	78
,, .	New Luce School	5·30	103	,, .	Tongue	...	...
Kirk .	Dalry, Glendarroch	5·93	99	,, .	Melvich	3·05	76
Dumf.	Dumfries, Crichton R.I.	3·83	110	,, .	Loch More, Achfary	6·94	81
,, .	Eskdalemuir Obs.	5·35	92	*Caith* .	Wick	2·65	84
Roxb .	Hawick, Wolfelee	4·14	107	*Ork* .	Deerness	2·98	76
Selk .	Ettrick Manse	4·16	76	*Shet* .	Lerwick	2·89	68
Peeb .	West Linton	4·04	...	*Cork* .	Dunmanway Rectory	5·72	92
Berw .	Marchmont House	4·03	134	,, .	Cork, University Coll.	3·46	86
E.Lot.	North Berwick Res.	2·31	103	,, .	Ballinacurra	2·94	73
Midl .	Edinburgh, Blackfd. H.	2·11	94	,, .	Mallow, Longueville	4·12	110
Lan .	Auchtyfardle	3·78	...	*Kerry*.	Valentia Obsy.	5·44	100
Ayr .	Kilmarnock, Kay Pk.	3·97	...	,, .	Gearhameen	9·80	101
,, .	Girvan, Pinmore	5·87	110	,, .	Bally McElligott Rec.	3·80	...
,, .	Glen Afton, Ayr San.	...	...	,, .	Darrynane Abbey	6·74	132
Renf .	Glasgow, Queen's Pk.	3·93	105	*Wat* .	Waterford, Gortmore	2·97	80
,, .	Greenock, Prospect H.	4·94	77	*Tip* .	Nenagh, Cas. Lough	3·72	93
Bute .	Rothesay, Ardencraig	4·07	80	,, .	Roscrea, Timoney Park	3·15	...
,, .	Dougarie Lodge	5·13	98	,, .	Cashel, Ballinamona	2·95	85
Arg .	Ardgour House	8·35	...	*Lim* .	Foynes, Coolnanes	5·18	130
,, .	Glen Etive	...	...	,, .	Castleconnel Rec.	4·01	...
,, .	Oban	4·52	...	*Clare* .	Inagh, Mount Callan	10·22	...
,, .	Poltalloch	5·33	95	,, .	Broadford, Hurdlest'n.	2·78	...
,, .	Inveraray Castle	7·67	91	*Wexf* .	Gorey, Courtown Ho.	3·66	105
,, .	Islay, Eallabus	5·13	95	*Wick* .	Rathnew, Clonmannon.	3·42	...
,, .	Mull, Benmore	7·60	53	*Carl* .	Hacketstown Rectory	3·68	94
,, .	Tiree	4·39	91	*Leix* .	Blandsfort House	3·67	110
Kinr .	Loch Leven Sluice	3·04	85	*Offaly*.	Birr Castle	3·07	99
Fife .	Leuchars Aerodrome	1·74	76	*Dublin*	Dublin, FitzWm. Sq.	2·28	85
Perth .	Loch Dhu	5·25	60	*Meath*.	Beauparc, St. Cloud	3·46	...
,, .	Balquhidder, Stronvar.	4·82	...	,, .	Kells, Headfort	2·68	79
,, .	Crieff, Strathearn Hyd.	2·67	62	*W.M* .	Moate, Coolatore	3·18	...
,, .	Blair Castle Gardens	2·69	77	,, .	Mullingar, Belvedere	3·43	100
Angus.	Kettins School	1·98	64	*Long* .	Castle Forbes Gdns.	3·81	106
,, .	Pearsie House	2·87	...	*Gal* .	Galway, Grammar Sch.	4·03	99
,, .	Montrose, Sunnyside	...	...	,, .	Ballynahinch Castle	6·99	117
Aber .	Braemar, Bank	2·98	78	,, .	Ahascragh, Clonbrock.	4·07	101
,, .	Logie Coldstone Sch.	2·35	77	*Mayo*.	Blacksod Point	5·03	97
,, .	Aberdeen, Observatory.	1·36	46	,, .	Mallaranny	7·01	...
,, .	Fyvie Castle	1·93	56	,, .	Westport House	5·51	112
Moray	Gordon Castle	1·65	57	,, .	Delphi Lodge	11·58	111
,, .	Grantown-on-Spey	2·08	70	*Sligo* .	Markree Castle	4·69	111
Nairn.	Nairn	1·47	62	*Cavan*.	Crossdoney, Kevit Cas.	3·99	...
Inv's .	Ben Alder Lodge	3·23	...	*Ferm* .	Newtwnbtlr, Crom Cas.	3·96	114
,, .	Kingussie, The Birches.	3·39	...	,, .	Enniskillen, Portora	3·37	...
,, .	Loch Ness, Foyers	...	...	*Arm* .	Armagh Obsy.	3·76	132
,, .	Inverness, Culduthel R.	1·98	78	*Down*.	Fofanny Reservoir	6·03	...
,, .	Loch Quoich, Loan	9·75	...	,, .	Seaforde	4·51	119
,, .	Glenquoich	7·42	61	,, .	Donaghadee, C. G. Stn.	3·06	100
,, .	Glenleven, Corrour	6·66	89	*Antr* .	Belfast, Cavehill Rd.	4·38	...
,, .	Fort William, Glasdrum	5·44	...	,, .	Aldergrove Aerodrome.	3·20	99
,, .	Skye, Dunvegan	6·13	...	,, .	Ballymena, Harryville.	4·62	114
,, .	Barra, Skallary	4·02	...	*Lon* .	Garvagh, Moneydig	4·41	...
R&C .	Alness, Ardross Castle.	2·70	67	,, .	Londonderry, Creggan.	5·42	132
,, .	Ullapool	3·42	64	*Tyr* .	Omagh, Edenfel	4·62	122
,, .	Achnashellach	4·51	49	*Don* .	Malin Head	5·82	...
,, .	Stornoway, Matheson	4·53	78	,, .	Killybegs, Rockmount.	4·75	...

Erratum.—Fort William, Glasdrum, October, 1936, *for* 9·63 *read* 10·63.

Climatological Table for the British Empire, June, 1936

STATIONS.	PRESSURE. Mean of Day M.S.L.	PRESSURE. Diff. from Normal.	TEMPERATURE. Absolute. Max.	TEMPERATURE. Absolute. Min.	TEMPERATURE. Mean Values. Max.	TEMPERATURE. Mean Values. Min.	TEMPERATURE. Mean Values. ½ Max. and Min.	TEMPERATURE. Mean Values. Diff. from Normal	TEMPERATURE. Mean. Wet Bulb.	Relative Humidity.	Mean Cloud Am'nt	PRECIPITATION. Am'nt.	PRECIPITATION. Diff. from Normal.	PRECIPITATION. Days.	BRIGHT SUNSHINE. Hours per day.	BRIGHT SUNSHINE. Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0–10	in.	in.			
London, Kew Obsy.	1015·8	− 0·9	85	44	69·3	54·0	61·7	+ 2·7	54·6	81	7·2	3·53	+ 1·38	19	6·3	38
Gibraltar	1017·9	+ 0·6	89	52	70·1	59·2	64·7	...	57·9	78	4·0	0·14	...	1	...	...
Malta	1015·7	+ 0·5	95	59	75·7	65·1	70·4	− 2·3	63·5	70	3·5	0·01	− 0·08	1	11·2	77
St. Helena	1017·0	+ 0·7	66	53	61·9	55·2	58·5	− 2·0	55·9	90	8·4	2·87	+ 0·05	20	...	...
Freetown, Sierra Leone	1013·7	+ 3·4	88	67	84·6	71·2	77·9	− 2·4	75·5	83	6·6	18·28	− 1·76	24	...	...
Lagos, Nigeria	1013·5	+ 1·1	86	70	82·6	73·9	78·3	− 1·2	74·5	88	9·0	14·70	− 3·78	18	3·3	27
Kaduna, Nigeria	1008·8	...	96	60	86·5	68·9	77·7	+ 1·2	71·5	86	8·0	5·50	− 1·59	11	6·9	54
Zomba, Nyasaland	1018·9	+ 1·2	79	48	72·6	54·7	63·7	+ 0·8	58·9	71	5·5	0·07	− 0·41	1	...	...
Salisbury, Rhodesia	1024·5	+ 2·4	77	33	69·9	43·3	56·6	− 0·3	50·1	63	1·6	0·03	− 0·02	2	9·0	81
Cape Town	1021·6	+ 1·5	86	38	67·1	49·4	58·3	+ 2·6	50·0	83	5·1	2·87	− 1·63	11	...	...
Johannesburg	1025·1	+ 3·0	69	27	62·5	42·1	52·3	+ 1·6	42·1	49	1·1	0·00	− 0·14	0	8·6	82
Mauritius	1020·7	+ 1·7	78	55	75·4	64·2	69·8	+ 0·4	65·1	71	4·7	1·71	− 1·09	23	7·7	71
Calcutta, Alipore Obsy.	999·8	+ 0·1	94	73	89·1	77·8	83·5	− 1·6	78·9	89	8·5	16·00	+ 4·09	23*	...	...
Bombay	1003·9	− 0·1	93	70	87·2	77·5	82·3	− 1·7	77·4	84	7·9	32·63	+ 12·76	21*	...	...
Madras	1004·4	+ 0·6	102	72	96·6	80·2	88·4	− 1·6	75·2	62	8·3	2·82	+ 0·85	8*	...	...
Colombo, Ceylon	1010·3	+ 1·7	86	73	84·8	76·3	80·5	− 1·1	76·1	77	7·4	5·97	− 1·35	21	7·0	56
Singapore	1009·3	+ 0·4	89	72	86·1	76·6	81·3	− 0·2	77·5	79	6·3	3·65	− 3·22	16	6·6	54
Hongkong	1006·5	+ 0·7	92	76	87·5	79·4	83·5	+ 2·1	79·0	81	7·7	5·70	− 10·00	19	6·6	49
Sandakan	1009·1	...	92	73	88·7	74·9	81·8	+ 0·1	76·8	84	7·0	8·10	+ 0·60	15	...	...
Sydney, N.S.W.	1018·8	+ 0·9	70	41	62·7	45·6	54·1	− 0·6	47·5	72	3·9	2·83	− 1·91	9	6·7	69
Melbourne	1021·0	+ 2·5	61	34	56·1	43·6	49·9	− 0·5	45·1	83	7·2	2·68	+ 0·62	20	3·4	35
Adelaide	1023·0	+ 3·9	65	38	59·5	45·1	52·3	− 1·2	48·3	78	7·1	2·27	− 0·83	13	3·7	38
Perth, W. Australia	1020·2	+ 2·2	73	41	63·4	49·4	56·4	− 0·4	49·8	69	5·8	7·43	+ 0·49	15	5·0	50
Coolgardie	1021·6	+ 2·7	78	30	63·5	41·9	52·7	− 0·1	44·0	60	5·2	0·99	− 0·27	7	...	...
Brisbane	1016·9	− 1·4	79	41	68·3	51·1	59·7	− 0·5	53·4	73	5·0	1·90	− 0·89	8	6·3	60
Hobart, Tasmania	1018·8	+ 4·5	59	33	51·4	40·2	45·8	− 1·2	41·7	79	6·0	2·14	− 0·09	14	4·0	44
Wellington, N.Z.	1020·6	+ 5·7	58	36	53·1	42·6	47·9	− 1·6	45·1	82	6·9	3·33	− 1·44	13	3·8	41
Suva, Fiji	1015·4	+ 1·8	86	65	79·6	69·4	74·5	− 0·2	69·2	79	6·5	3·42	− 3·29	19	5·4	49
Apia, Samoa	1011·8	+ 0·2	87	69	84·4	73·1	78·7	+ 0·9	74·5	75	4·9	4·10	− 1·25	6	7·3	65
Kingston, Jamaica	1011·7	− 2·1	90	70	86·5	74·0	80·3	− 1·0	74·7	85	7·2	13·80	+ 9·70	18	4·3	33
Grenada, W.I.	1011·2	− 2·1	89	70	86	73	79·5	+ 0·5	74	74	5	6·27	− 1·98	20	...	...
Toronto	1012·8	− 1·9	87	48	75·0	54·8	64·9	+ 1·1	57·3	73	4·6	2·91	+ 0·25	9	10·0	65
Winnipeg	1012·9	+ 1·1	92	33	72·8	48·9	60·9	− 1·4	50·9	76	5·8	2·41	− 0·70	9	8·4	52
St. John, N.B.	1011·9	− 1·6	77	43	64·9	49·5	57·2	+ 0·7	53·2	83	7·1	3·17	− 0·10	17	5·9	38
Victoria, B.C.	1014·5	− 2·3	74	49	65·2	51·4	58·3	+ 1·3	55·4	82	5·5	1·68	+ 0·84	12	8·0	50

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

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Pressure, weather and rainfall of 1936

Variations of Pressure near the British Isles during 1936

Pressure over the North Atlantic and western Europe during 1936 showed a considerable degree of variability. Over the British Isles the general distribution during the first three months was almost continuously cyclonic, but later in the year an anticyclonic type occurred with increasing frequency.

Unsettled cyclonic weather set in about December 26th, 1935, and January gave a record low mean pressure at many places in the British Isles. At Southport the mean of 997·3 mb. was the lowest for any month since before 1871, with the exception of December, 1876. The average was below 990 mb. from January 1st–10th over Ireland and from January 17th to February 2nd over Scotland. Pressure again averaged less than 995 mb. over Scotland from February 15th–24th. The only interruptions were brief periods of more anticyclonic type from January 11th–16th and March 15th–18th; the average for the whole quarter (Fig. 1) shows a quite considerable area of low pressure centred over Ireland, the mean for Malin Head being 1001·8 mb.

A complete change of type set in at the beginning of April. From April 1st–19th the British Isles came under the influence of anti-cyclones, at first directly over the country and later further north, giving predominantly northerly winds. The last part of April brought exceptionally high pressure (exceeding 1030 mb.) over the Azores and mainly westerly winds in the British Isles. Easterly and northerly winds returned at the beginning of May, however, and continued throughout the month. June opened with the Azores anticyclone extending north-eastward across the British Isles, giving divergent westerly winds in Great Britain, but from the 18th to 28th an anticyclone lay definitely over Scotland. Thus the second quarter of 1936 showed anticyclonic conditions over and near the British Isles, almost as persistent as the cyclonic conditions of the first quarter. For the three months the average pressure was about 1016 mb. along a ridge from Spain across the British Isles to Scandinavia.

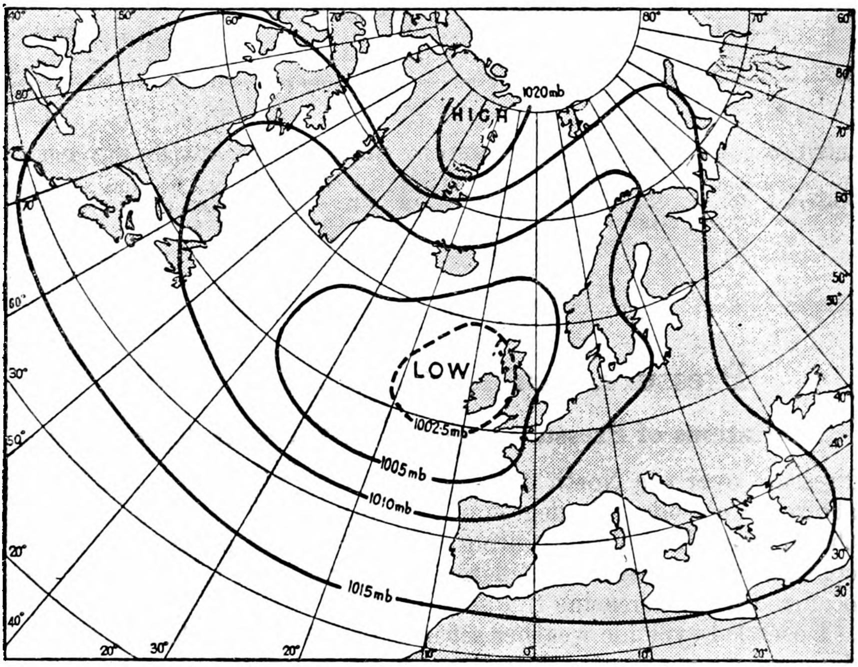


Fig. 1.—PRESSURE AVERAGES, JANUARY–MARCH, 1936

The pressure variations of the third quarter, July to September, were very marked, and the choice of holiday periods was even more of a lottery than usual. From June 29th to July 27th there was a long period of very disturbed weather, the net result being an area of low pressure (below 1005 mb.) centred over Scotland. From July 28th to the end of August there was a great improvement; the average chart for July 28th to August 21st shows a westerly type, with generally high pressure, especially in the south, and divergent isobars over the British Isles, a distribution favourable for dry weather over England and one characteristic of the great drought of 1921. During the last ten days of August an intense anticyclone was centred directly on England, with average pressures above 1025 mb. over the whole country.

The first ten days of September brought a complete reversal, with an area of pressure below 1005 mb. over Scotland and Ireland, but anticyclonic conditions returned on September 11th and remained with a few interruptions until October 13th. From September 11th–30th a powerful anticyclone covered the greater part of Europe, and the British Isles on the western fringe were disturbed from time to time by the passage of shallow depressions, but from October 1st–13th the high-pressure centre lay directly over Great Britain.

The five weeks from October 14th to November 17th were marked by an intense westerly type of weather, with frequent depressions passing across or to the north of Scotland. The average chart for October 14th-31st was reproduced in the *Meteorological Magazine* for November, p. 226; that for November 1st–17th is almost identical. From November 18th–29th the whole system lay further north, with a mean pressure of 988 mb. over Spitsbergen, while an anticyclonic ridge extended from the Azores across the British Isles to Russia. This period was notable for persistent dense and widespread fogs.

On November 30th the westerly-cyclonic type returned, and continued during the first three weeks of December with frequent depressions passing over or near the British Isles causing widespread gales. Some very low barometer readings were recorded, especially on the 14th and 16th, when two intense centres with pressures below 952 mb. passed between the Faroes and the Shetlands. The chart of mean pressure for December 1st–21st shows a centre about 985 mb. east of Jan Mayen, with a steep gradient across northern Europe to an anticyclonic ridge which exceeded 1030 mb. over the Urals.

During the last ten days of December conditions over north-western Europe were much quieter. The centre of low pressure had returned north-east to Spitsbergen with secondaries over southern Greenland and north-eastern Russia (at Sverdlovsk the average dropped from 1030 mb. for December 1st–21st to 995 mb. for December 22nd–31st), while the anticyclone was centred over the Rhineland, where pressure reached 1033 mb. The British Isles still lay under the influence of a westerly type of weather, but much more stable, fine and mild.

C. E. P. Brooks.

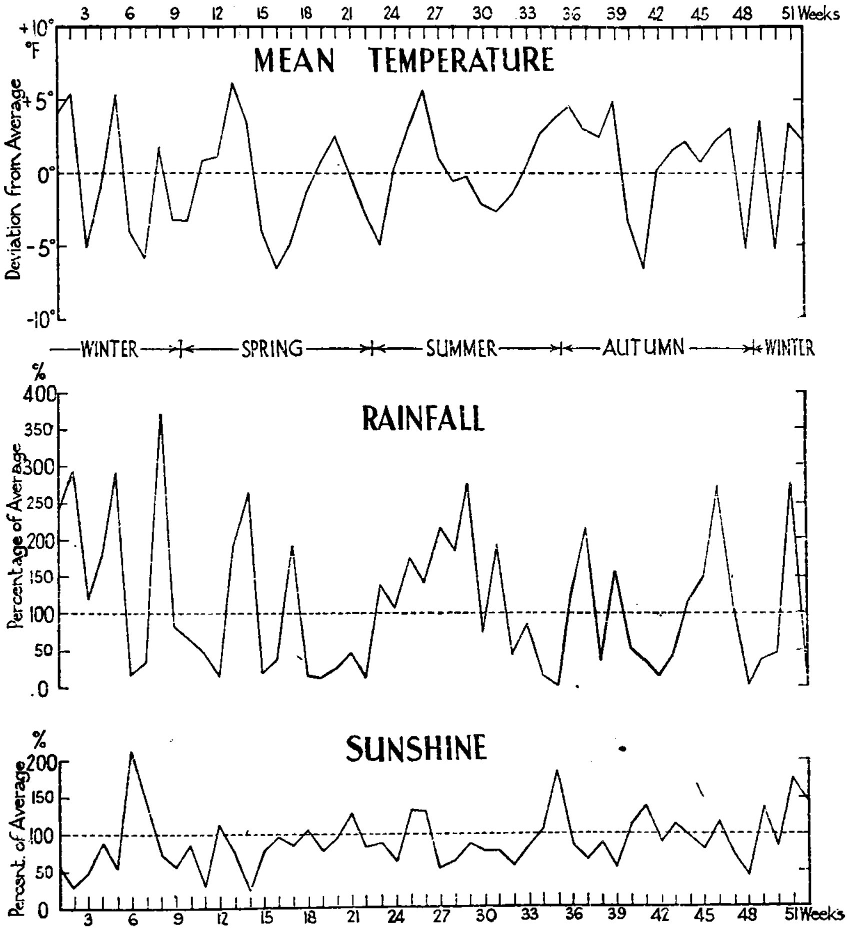
The Weather of 1936

Complete information is not yet available, but as far as can be ascertained at present the year 1936 was dull and wet, on the whole, in England and Wales; on the other hand, locally in the northern half of Scotland sunshine exceeded the average and rainfall was deficient.

Among notable features of the weather of the year may be mentioned extensive floods in England in early January, a long drought locally in south and east England during the end of April and first three weeks of May, and unusually frequent thunderstorms, accompanied locally by large hailstones and intense falls of rain, in June and July. The bad impression of the summer holiday period created by a wet, dull and, in southern districts, cool July, was somewhat modified later by a dry August, with warm days and abundant sunshine during the latter part of the month. The period covering the latter half of October and the first half of November was remarkable for strong winds and frequent gales, the gale of October 26th–27th being very violent, while the persistent and sometimes dense fog which was widespread from November 19th–28th will long be remembered particularly in parts of northern England and the Midlands. In the closing month of the year, extensive and destructive floods resulted from the heavy rains of December 13th–15th, but mild, dry and sunny periods were enjoyed at times in many parts during the Christmas holiday season.

Considering the British Isles as a whole, January, February, June, July, September and November were wet, January and July notably so. The spring months, March to May inclusive, were all dry as was October, while August was exceptionally dry. At Oxford, the drought of 25 days ending May 21st was the longest on record for this time of year. July was the wettest on record at a number of stations and, in strong contrast, August, 1936 was the driest August at numerous stations of long standing in the south and west of England. Details for each month are given on p. 283.

Mean temperature for the year differed little from the average, but marked deviations from the average occurred in different periods. Interesting cold spells include January 12th–23rd, February 3rd–5th and 8th–14th, October 4th–10th and November 22nd–25th. Some unusually low screen minima were recorded during the earlier periods; for example, 5° F. was recorded at Braemar on February 5th and 13th, 6° F. at Logie Coldstone on January 20th and at Balmoral on February 5th and 13th and 7° F. at Rickmansworth on February 12th, at Braemar on January 19th and at Balmoral on January 20th. At Shoeburyness on February 11th a thin layer of ice formed on the sea and extended 20 ft. out. Temperature remained below 32° F. all day locally in England on November 22nd, 23rd and 24th. April was the coldest month of that name at West Kirby since 1917 and at Hampstead, Ross-on-Wye and Teignmouth since 1922; the first week of June was exceptionally cool, screen minima of 25° F., 26° F. and 26° F. being registered at Dalwhinnie, Braemar and Balmoral respectively on the 5th, while the maximum temperature at West Kirby on the 3rd, 46° F., was the lowest in June since records began in 1904. The coolness of July in southern districts was mainly due to persistently cool days, the absence of really warm days being a striking feature of the month. On the other hand, March 19th–31st was notably mild, June 19th–22nd very warm (some of the highest temperatures of the year being recorded on June 20th and 21st), and August 23rd to 31st was also very warm, though a large diurnal range occurred at times. The first 25 days of September were warm, the nights as well as the days being mild ; the highest minimum of the year was recorded at numerous places during this spell, while the mean minimum for the month at Oxford was the highest there for September since records were first taken in 1881.



THE WEATHER OF 1936 IN SOUTH-EAST ENGLAND
Weekly variations from long period averages computed from observations at five representative stations

The large deficiency of sunshine over most of England and parts of Ireland and southern Scotland was a feature of the weather of the year ; the total sunshine at Eastbourne was the lowest since 1913 and at Ross-on-Wye since 1920, while the totals were the lowest on record at Croydon, Lympne and Shoeburyness since observations were first taken in 1922, 1921 and 1919 respectively. In parts of northern Scotland, however, there was a marked excess; at Aberdeen the excess amounted to 135 hours and at Stornoway to 99 hours. For the British Isles as a whole the sunniest months, compared with the average, were February and October, and the dullest March, July and September. June was exceptionally sunny in the east and extreme north of Scotland; at Aberdeen the total, 274 hours, was the highest monthly total ever recorded in a record back to 1881. In Scotland, northern England and at certain stations in north Ireland, sunshine was very excessive in April; at Wakefield, Yorkshire it was the sunniest April since 1921. Abundant sunshine was also enjoyed for the most part from August 22nd–29th while in east and south-east England sunshine was markedly excessive in December. On the other hand, March, July and September were exceedingly dull; at Southport and Phoenix Park it was the dullest March in records back to 1892 and 1881 respectively; at Birr Castle it was the dullest July since before 1881 and at Oxford and Kew Observatory, September was the dullest month of that name in records back to 1881 and 1880 respectively.

Strong winds and gales were fairly frequent. In a severe gale on January 9th, speeds of 92 m.p.h. and 91 m.p.h. were registered in gusts at Bidston and the Lizard. On February 10th–11th a widespread and notable gale was reported in England and Ireland, 92 m.p.h. being registered in a gust at Valentia and 90 m.p.h. at Pendennis Castle on the 10th. As a rule gales are infrequent in southern England in July and in consequence the gale of July 18th was noteworthy. The period covering the latter half of October and the first half of November was very disturbed, with frequent strong winds and gales; the gale of the night of October 26th–27th was destructive and unusually severe, gusts of 104 m.p.h. and 94 m.p.h. being registered at Tiree and Bell Rock Lighthouse on the 26th and 95 m.p.h. at Paisley on the 27th. On November 30th a gust of 92 m.p.h. was registered at Lerwick and notable gales occurred at times also in December; gusts exceeding 90 m.p.h. were registered at Tiree on the 4th, 16th and 17th.

The diagram on page 281 shows the weekly variations in temperature, rainfall and sunshine in south-east England in 1936. The variations are given in the form of deviation from the average of temperature and percentages of the average of rainfall and sunshine. The district value is the arithmetic mean of the values for the following stations:—Kew Observatory, Margate, Hastings, Southampton and Marlborough.

L. F. LEWIS.

The Rainfall of 1936

Provisional estimates of the general rainfall for 1936 are given below, both in actual inches and as percentages of the average:—

	in.	per cent.
England and Wales	38·5	109
Scotland	48·4	96
Ireland	44·6	103
British Isles	43·6	105

Over England and Wales, 1936 was slightly drier than 1935; over Scotland, 1936 ranks as the driest year since 1922 with the one exception of 1933; over Ireland, 1936 was wetter than either 1935, 1933 or 1932, and over the British Isles as a whole, 1936 was not as wet as 1935, although wetter than 1934.

General values for each month are set out in the table below, both as percentages of the average and in actual inches of rainfall.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	%	%	%	%	%	%	%	%	%	%	%	%
England and Wales	178	127	90	96	53	151	191	39	142	62	121	90
Scotland	140	87	71	54	65	74	150	70	119	105	81	107
Ireland	148	93	86	73	61	115	197	45	140	72	104	104
British Isles	163	112	85	81	58	124	182	48	136	75	107	97
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
England and Wales ..	5·3	3·3	2·4	2·0	1·2	3·7	5·5	1·3	3·6	2·5	4·2	3·5
Scotland	6·9	3·6	2·9	1·6	2·0	2·1	5·7	3·1	4·8	5·1	4·3	6·3
Ireland	6·0	3·3	2·9	2·0	1·7	3·2	6·6	1·9	4·4	2·9	4·5	5·2
British Isles	6·2	3·6	2·7	2·0	1·5	3·3	5·9	1·9	4·2	3·2	4·5	4·6

The wettest months of the year were January and July with 6·2 in. and 5·9 in., and the driest months May and August with 1·5 in. and 1·9 in. respectively. In February the rainfall slightly exceeded the average, but there were deficiencies in each of the next three months, so that by the end of May the total rainfall was only 0·6 in. in excess of the average. June and July contributed an excess of 3·3 in., but August gave a deficiency of 2·0 in., so that by the end of August the rainfall was only 1·9 in. in excess of the average. The remainder of the year gave a rainfall approximating closely to the average, so that the year ended with an excess of 2·2 in.

J. GLASSPOOLE.

OFFICIAL PUBLICATION

The following publication has recently been issued:—

The measurement of upper winds by means of pilot balloons. (M.O. 396.)

This publication collects in a single pamphlet the hitherto scattered and, in many cases, unwritten instructions in the methods of pilot balloon observations as carried out at Meteorological Office out-stations. In the early sections are contained descriptions of the necessary equipment and instructions regarding its management and preparation for an ascent. The methods of procedure for the single theodolite, tail and night ascents are described, preceded by a section devoted to the fundamental trigonometry on which the computations of the winds, illustrated by examples, are based. An appendix deals with the care, periodical examination and adjustment of theodolites, which are described with the aid of diagrams.

Discussions at the Meteorological Office

The subjects for discussion for the next two meetings are :—

January 25th, 1937. *On vorticity in the atmosphere as a weather factor.* By S. Fujiwhara and others. (Tokyo, J. Fac, Sci. Tokyo Univ. (Sec. I). Vol. 3, Pt. 2, 1935, pp. 65–106.) *Opener.*—Mr. W. R. Morgans, M.Sc.

February 8th, 1937. (a) *The importance of the stratosphere as regards the "Grosswetterlage".* By F. Baur. (Met. Z. Braunschweig, 53, 1936, pp. 237–47). (In German.) (b) *Official weather forecasting for 10-day periods in Germany.* By F. Baur. (Worcester, Mass., Bull. Amer. Met. Soc., 17, 1936, pp. 148–52, 252–4.) *Opener.*—Sir Gilbert Walker. C.S.I., F.R.S.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, December 16th, in the Society's rooms at 49, Cromwell Road, South Kensington, Dr. F. J. W. Whipple, F.Inst.P., President, was in the Chair.

The following papers were read and discussed :—

E. W. Hewson, M.A.—The application of wet-bulb potential temperature to air mass analysis, II.

In this paper, the horizontal component of the motion of air in a depression has been traced approximately by means of upper wind and high cloud observations, and by the pressure distribution at 2Km. and 5Km., and the vertical component found by the use of wet-bulb potential temperatures. The trajectories found in this way show clearly that there is considerable horizontal divergence in the warm air ascending at the warm front of a depression. A study has also been made of the changes which occurred in the humidity mixing ratio x.

R. M. Poulter.—The presentation of visibility observations.

The range of distance embraced by a visibility number used at meteorological stations varies roughly as the lower limit of the range, so that one occasion in a year of visibility 3 (500m.–1Km.) is twenty times as significant as one occasion of visibility 7 (10–20Km.), and so on. Accordingly, frequency curves characteristic of six types of meteorological stations in the British Isles, judged by the surrounding country, have been drawn by plotting the number of occasions per kilometre (n/d) covered by each visibility number. The 54 curves refer to 7h., 13h., and 18h. for summer, winter, and the year for stations grouped in the following categories :—

Coastal—clean air.	Inland—clean air.
clean air with sea fogs.	polluted air, rural.
polluted air.	polluted air, urban.

and show marked seasonal and diurnal variations.

C. J. Boyden, B.A.—The formation of coloured rain.

An examination is made of the meteorological conditions leading up to a thunderstorm which gave heavy falls of coloured rain in Shetland on March 16th, 1935. Evidence is given that the instability was caused in an air mass which was initially very stable, by forced ascent through the undercutting by denser air. The rare combination of conditions described is consistent with the scarcity of coloured rain in this country. The hypothesis put forward for the particular case of the Shetland thunderstorm is suggested as applicable to the more common "red rain" originating in desert areas.

D. Lloyd.—Rainfall over the Rivington catchment area.

The paper's purport is to describe shortly the rainfall over the Rivington catchment area and its disposal. The probable frequency of dry periods is sought by examining the variance (as defined by Fisher). The relation of stream discharge to precipitation is mentioned with a view to analysing effective rainfall as a function of climate in a further stage.

Correspondence

To the Editor, *Meteorological Magazine*

Saline Deposit by Strong Winds

From time to time the occurrence of sea salt blown inland by strong winds has been put on record and I read in the *Meteorological Magazine* for November, 1936, p. 235, that salt has been found on the sun recorder sphere by Mr. F. J. Parsons at Ross-on-Wye.

In addition to the effects already reported, such as crystals on windows, and the effect on power lines, I should like to call attention to a fresh effect which I believe has not been reported before.

In the *Gardeners' Chronicle*, Vol. 100, 1936, p. 341, is reported a biological effect on plant growth, observed by my father, Mr. S. Ashmore. Young sycamores were found with leaves badly shrivelled, those most exposed being the most shrivelled. A lesser amount of damage was done to thorn hedges, elm trees and hardy fuchsias. The damage was discovered after the gale of October 19th, 1936. We are situated in the Clwyd Valley, which runs north-north-west to the sea, with mountains on either side. Anemometer records from Sealand show that the highest hourly wind was from 290° at 48 m.p.h. and the highest gust was 70 m.p.h. This shows that the wind blew straight up the valley from the sea, and at such a speed it should be easy for sea-spray to be transported.

Llannerch is $6\frac{1}{2}$ miles from the sea at its nearest point. Other reports have been received of vegetation having been damaged at similar distances. Mr. L. E. Alder reports that after a gale in the early autumn of 1935 at Kilkhampton, Devon, runner beans were killed 3 miles from the coast by sea-salt, and that in the early autumn of this year at Holsworthy, Devon, a gale brought in sufficient salt to scorch sycamores and ash trees 10¼ miles inland.

Mr. G. Haig (*Gardeners' Chronicle*, Vol. 100, 1936, p. 377) reports damage to plant life near Hastings as far as 20 miles inland after a severe gale early in October, 1935.

One theory tries to explain the damage on this occasion as due to sand particles brought with great force against the leaf surface. But at Hastings this explanation fails since apparently there is little sand on the beach there; it is mostly pebbles. If salt is responsible I suggest that it is due to the osmotic pressure of a strong solution of salt in contact with the surface of the leaves.

S. E. Ashmore.

Llannerch Gardens, St. Asaph, Flintshire, North Wales, December 16th, 1936.

Night Radiation and Fog associated with different types of pressure distribution

Night minima from thermometers exposed at different levels near the ground present some curious differences during foggy weather,* and data recently obtained during fogs associated with different sources of air supply show some interesting contrasts.

The attached figures show curves of deviation from the screen minimum, of minima from standard thermometers exposed at various levels above the ground. The curves in Fig. 1 are typical of "radiation nights" such as are usually associated with a clear, calm atmosphere.

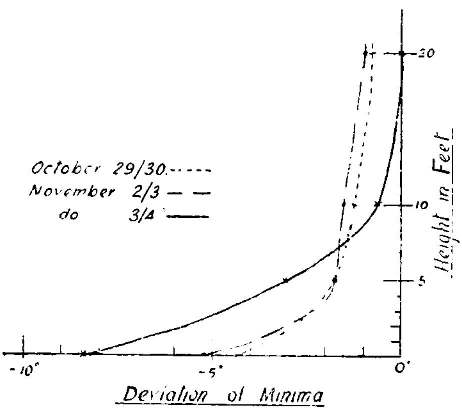


Fig. 1—Maritime cyclonic fogs

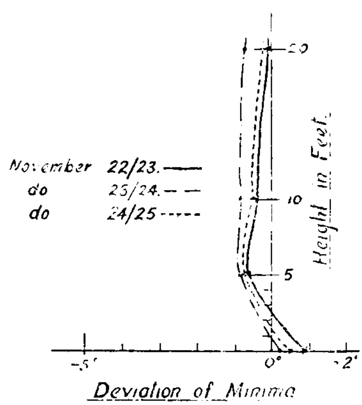


Fig. 2—Continental anticyclonic fogs

The air over southern England on these nights was derived from the Atlantic Ocean, being within westerly currents associated with Icelandic depressions. The fogs were relatively dry, though a little

* See *Meteorological Magazine*, 71, 1936, p. 129.

dew was deposited in each case. The fog on the night of November 3rd/4th though fairly dense horizontally, had no great vertical depth, the sky in the zenith being faintly visible from the anemometer mast at a height of 20 ft. from the ground. The surface wind was light, the mean velocity for the eight hours ending at 7h. on the morning of the 4th being only 2·9 m.p.h.

Vertically, the fog being relatively thin and the wind light, there was little hindrance to radiation, hence the pronounced inversion of minima in the lower layers of the fog.

In marked contrast, the air in the case of the curves in Fig. 2 was of continental anticyclonic origin, being mainly derived from a large anticyclone over Europe, with extensions to the north of the British Isles.

The fog on the night of November 22nd/23rd gave a thick deposit of rime, the ice on the windward side of the anemometer mast approaching 1/16 in. in thickness. This fog was of greater vertical depth, the sky being totally obscured, and the wind velocity was 0·5 m.p.h. higher than in the case of the night of November 3rd/4th. In spite of this, and the fact that the earth temperature at 12 in. depth was 5° F. lower than in the former case, the minimum on the grass was 0·9° F. higher than that in the screen. On the other hand, the deviation at 5 ft. was negative, the minimum being 1·5° F. lower than at the surface ; and from the former level upwards to at least 20 ft., the minima show little change, and it is curious that with a higher wind velocity, the layer near the ground maintained a higher temperature.

It would seem that the greater depth of the fog acted as a check on radiation and that a warmer layer of air formed like a "skin" at ground level, beneath the fog.

These conditions were repeated on the two following nights, but the deviation of the grass minimum was reduced to + 0·2° F. and + 0·5° F. respectively, and no rime was deposited.

The great difference between these two types of curve is obviously something more than mere chance, and although superficially similar, from these results it would seem that night radiation, from objects exposed in fog, assumes different characteristics in maritime cyclonic air, as distinct from continental anticyclonic air.

The higher moisture content of the latter in the case of the night of November 22nd/23rd, as evidenced by the heavy deposit of rime, seems worthy of comment.

DONALD L. CHAMPION.

7, Robinson Avenue, Goff's Oak, Herts, December 1st, 1936.

NOTES AND QUERIES

Heavy Rainfall at Hongkong

Fig. 1 is a reproduction of a record obtained from a Dines Tilting Syphon rain-gauge at the Regional Seminary, Aberdeen, Hongkong, which has been kindly forwarded by Father P. J. Howatson, S. J. for reproduction. The record was obtained on August 1st–2nd, 1936, the fall for the 24 hours, 11h.–11h., at the Royal Observatory, Hongkong being recorded as 222·4mm. (8·76 in.). Father Howatson has recently started the observations at the Regional Seminary and in his covering letter he explains that the gauge had only just been unpacked and set in the ground when the downpour occurred. This explains the fact that the gauge was not in perfect adjustment as shown by the record. The fall occurred in a thunderstorm at the

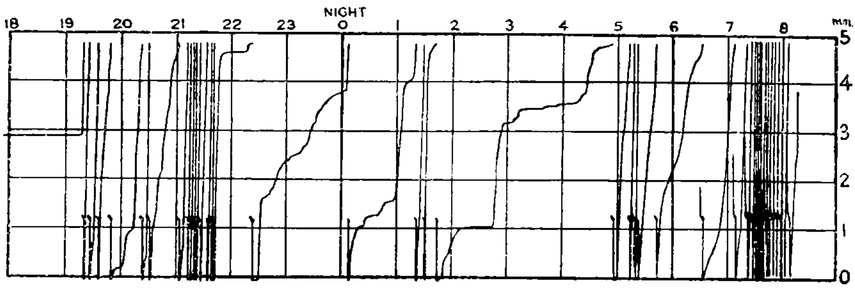


FIG. 1

tail end of a typhoon which turned north when within about 150 miles of Hongkong. During the most intense period of fall the record shows that 65mm. (2·56 in.) fell in a little under an hour between 7h. 20m. and 8h. 20m. on August 2nd.

A fall of 8·76 in. is not heavy compared with some of the enormous downpours on record in the wettest parts of the world. On June 14th–15th, 1911, a total of 1168·1mm. (45·99 in.) fell at Baguio, Philippine Islands, in 24 hours from noon to noon. Fortunately this fall was recorded on a Friez pluviograph, which works on a tilting bucket principle. Other falls however, such as that of 40·8 in. at Cherrapunji, India, on June 14th, 1876, depend on eye readings only. Autographic records of intense falls are sufficiently rare to make that of the storm at Hongkong of sufficient interest for publication.

REVIEWS

Singularitäten des Davoser Klimas. By G. Riedel. Reichsamt für Wetterdienst, Wissenschaftliche Abhandlungen, Band I, No. 5, *Illus*. Julius Springer, Berlin, 1936.

The mountain station of Davos in Switzerland, at a height of 5,120 ft., has climatically a very favourable situation, being sheltered to the north-east and above the level of the fogs and clouds of winter. In this paper G. Riedel makes an interesting comparison of the annual variation of temperature in this valley station with that at the freely exposed station of Zugspitze, at a height of 9,720 ft. The general trend of the two curves differs appreciably ; at Davos, on account of its sheltered situation, temperature begins to rise much earlier in spring and continues to fall much later in autumn, but the minor irregularities of temperature at the two stations show considerable agreement. These are the "singularities" of the title; they are analysed in detail and associated with sunshine, precipitation and wind direction or air mass. Owing to the configuration of the narrow valley, there are practically only two wind directions at Davos, south-west and north-east. The work ends with summaries and diagrams of frequencies of temperatures and temperature changes.

Snow structure and ski fields. By G. Seligman, B.A. With an appendix on Alpine Weather by C. K. M. Douglas, B.A. Medium 8vo. pp. xii + 555, *Illus.* London (Macmillan and Co.), 1936. 25*s*.

This book is written primarily for the ski mountaineer—to help him to avoid avalanches. To quote the author's own words, he aims at setting down "with very full illustrations all the known factors which influence avalanche development *both practical and theoretical*—a report of progress, as it were, upon which the scientific investigator can build and from which the practical man can cull the facts he wishes to keep in mind." The result is a valuable book of reference containing a summary of present knowledge of snow, including the author's own contributions, and a comprehensive bibliography of the literature on the subject. The book is divided into three parts: the first discusses the physical and mechanical processes involved in the snow cover of the mountains, the second, the conditions favouring avalanche development, and the third classifies the different types of avalanches and indicates the best tactics to adopt when danger threatens.

After describing the apparatus used in the author's practical work, Part I opens with descriptions of the various forms of solid water found in nature. The author points out that the nomenclature and classification of these forms are at present rather unsatisfactory. In English writings there is a paucity of terms, and in German writings confusion sometimes arises by the use of the same term for different phenomena. The English word hoar frost, for example, covers all the different kinds of sublimed deposits of water vapour on fixed objects; the author subdivides this into surface hoar, depth hoar (a deposit which grows beneath the surface of the snow and with which is associated "crevasse hoar") and air hoar, wind-oriented and free growing. These subdivisions are perhaps too detailed for ordinary meteorological purposes, but appear to be useful in practical snowcraft, owing to the different roles played by the phenomena; for example, surface hoar provides a good running surface for ski and protects the snow beneath it, and depth hoar is likely to contribute to the release of an avalanche. Rime is given three sub-divisions, and the word "arien" is introduced to cover all deposits of hoar and rime. In his snow terminology the author uses the word " snowflake " for all snow in the act of falling, and " fallen snow " as a group name for all snow lying on the ground before it becomes glacier ice ; the latter is sub-divided into powder snow, which is again sub-divided into new, settling and settled, and old snow which is sub-divided into new firn (including sun and wind crust) and advanced firn. The use of the term " granular snow " in the International Cloud Atlas as a translation of the precipitation form *Reifgraupeln* is described as misleading in view of the many forms of granular snow found in the snow cover on the Alps, for example, the type called *Kornschnee* by the Swiss.

The changes which are continually taking place in the snow particles after they have fallen are described in detail in Chapters V to VIII. A feature of this part of the book is the collection of microphotographs of snow in its various stages from the snowflake just fallen until it has become advanced firn snow. Chapter VIII describes interesting laboratory experiments which show that wind-packing of snow occurs in a moist wind ; comments on the author's work by such authorities as Sir William Bragg, Sir George Simpson, C. S. Wright and L. G. Dobbs are quoted.

The last chapters of Part I deal with the mechanical effects of wind on the snow—the shapes taken up by the snow cover due to eddies produced by wind blowing over obstacles, in particular snow cornices are very fully discussed in Chapter X, and the causes of the various ripplings and markings in the snow.

In Part II the different factors influencing avalanche development are discussed. First, regarding the shape of the mountain side we learn that slopes steeper than 22° should be suspected, but this angle should not be regarded as a hard-and-fast border line, a slope is more dangerous if it is of uniform gradient than if it is broken up by irregularities and terraces, convex slopes are in general more dangerous than concave slopes. Secondly, the anchorage supplied by the underlayer must be considered—scree and boulders are safe, so is mown grass, but long grass is dangerous ; most often, however, the underlayer is snow, and it is important to know the history of this snow cover before an estimate can be made as to whether or no it will afford a good anchorage for a new fall; to quote the author—" I want to stress . . . the extreme importance of knowing the conditions under which the more important and especially the last two falls of snow took place. With this knowledge we can tell whether conditions in the mountains can be presumed safe or suspicious." A third factor is the thickness and weight of the snow cover, and a fourth the internal cohesion of the top layers of snow. With reference to the last, the well-known fact that new snow does not avalanche as a rule until some hours after it has fallen and that then the mountains are unsafe for a few days until the snow has settled, can be explained by a study of the microphotographs of snow in the different stages of firnification. When snow has just fallen and is still in the feathery stage, the rays of the different particles can interlock; as the rays become blunt and disappear the particles can no longer interlock and there is little cohesion until the flakes have disappeared and the snow has become granular, when the grains lying close together again give some cohesion. The rate at which these stages are arrived at depends on the weather; high temperature after a fall will speed up the process, while abnormal cold may delay the safe stage for a week or more.

The wind caused by an avalanche, the avalanche blast, is described as capable of doing more material damage than the snow, in fact "its power is unbelievable"; and it can travel to great distances. It sometimes brings down avalanches on the opposite side of a valley.

In Part III avalanches are classified, according to their behaviour, into four main groups—dry snow, wet snow, wind slab and ice. The characteristics of the different types are described and the conditions under which they are likely to occur are examined. A chapter is devoted to tactics on avalanche ground. Again, in the chapter on "Safety in the mountains," the importance of a knowledge of the past weather is emphasised. The author keeps his own record of weather in the Alps, observing, twice daily, wind direction and force, maximum and minimum temperature, and relative humidity; he considers the trouble taken amply repaid by the help the records give him in understanding the snow conditions.

The short appendix on "Weather conditions in the Alps," by C. K. M. Douglas, contains a good deal of practical information in a few pages.

The keen interest of the author in his subject "gets across" and makes the book excellent reading. It contains a great deal to interest the scientific investigator, while to the winter-sports enthusiast, intending to make excurions on ski, its information is invaluable. There are nearly 400 illustrations, many of them very beautiful; a notice on the jacket of the book claiming that they "constitute without question the finest and largest collection of snow and ice photographs in existence" may well be justified.

E. H. Geake.

A view of the structure of the Muroto typhoon. By Tadao Namekawa and Shiichi Aoki. Reprinted from Mem. Coll. Sci. Kyoto, Series A, Vol. XIX, No. 2, 1936.

The authors of this paper are of the opinion that in the case of the very severe typhoon which passed over Japan on September 21st, 1934, the so-called "Muroto typhoon," a secondary of great intensity, developed within the main system when the latter was in a position just south of Japan. They contend that this secondary system was of the tornado type but on a much larger scale, and that it was very short-lived. It must be confessed that the authors' reasoning is not easy to follow, nor is the reviewer convinced that it is in all respects sound.

The Muroto typhoon certainly seems to have exhibited certain peculiarities, and though the authors' explanation of these peculiarities may be the true one yet the reviewer cannot help feeling that there may well be other more plausible explanations. At the same time there is no doubt that the authors have studied the typhoon in question in great detail and therefore their conclusions ought not to be lightly set aside.

A. E. M. DODINGTON.

BOOKS RECEIVED

Summary of the Meteorological Observations made at the Meteorological Stations in the Netherlands West Indies during the year 1934 *and the year* 1935, compiled by the Royal Dutch Meteor. Inst., The Hague, 1935 and 1936.

Anales del Observatorio Nacional de San Bartolomé en los Andes Colombianos. Observaciones Meteorologicas de 1932 *y* 1933. Bogota 1935 and 1936.

OBITUARY

Wilhelm Schmidt.—The national meteorological service of Austria has in recent years suffered severely by the loss of its distinguished chiefs. It seems only yesterday that we were sharing with our colleagues in Vienna the loss of F. M. Exner and now comes news of the sudden death of his successor Wilhelm Schmidt on November 27th. The blow is the more severe to meteorologists in Great Britain because we had him with us in Edinburgh and London as recently as September last, when he was full of spirit and energy and appeared to have completely recovered from his recent illness.

Wilhelm Schmidt was only fifty-three at the time of his death; but he had long held a leading place amongst European meteorologists. He has published many papers, commencing in the first decade of this century with communications on the upper atmosphere and ending with recent papers on microclimatology, a subject which he took up with great energy; but his name will go down in meteorological history linked with that of G. I. Taylor as the discoverer of the role played by turbulence or *Austausch* in the processes of the atmosphere.

Probably largely as a consequence of working together with E. Gold in Vienna, when both were young men and keen on the new meteorology brought to birth by the discovery of the stratosphere (or isotherm layer as it was then called), Schmidt always had friendly feelings for British meteorologists and visited this country on several occasions. In 1910 he described his work on atmospheric waves before the British Association at Sheffield. In 1934 he came to

England and delivered a lecture before the Royal Meteorological Society dealing with local climatology in the mountains of Austria, and later in the same year he was back again to lecture before the Royal Aeronautical Society on turbulence near the ground.

In October, 1935, the President of the Royal Meteorological Society announced that Schmidt had been awarded the Symons' Gold Medal for 1936, an honour greatly appreciated by him.

Meteorology owes a great deal to Schmidt and not least that since 1930 he has, in collaboration with Süring, edited the *Meteorologische Zeitschrift*. It was always a pleasure to meet Schmidt on his visits to England and at the meetings of the International Meteorological Organization ; his high-pitched voice and cheery smile will be greatly missed when the International Meteorological Committee meets in Salzburg later in the year.

G. C. SIMPSON.

Prof. A. A. Kaminsky.—We regret to learn of the death on August 5th, 1936, of Prof. Kaminsky, the well-known Russian climatologist. Kaminsky was born on November 17th, 1862, in Vitebsk and studied at the University of St. Petersburg. In 1887 he joined the staff of the Central Physical Observatory. He published a number of climatological studies of Russia and Siberia, of which the best known are his discussions of the data of humidity and pressure. In 1922 he was Professor at the Agricultural Institute, Leningrad, as well as head of the Climatological section of the Observatory.

NEWS IN BRIEF

Three lectures on Cosmic Rays will be given on Monday evenings, January 18th and 25th, and February 1st, at 8 o'clock, at the Royal Society of Arts, John Street, Adelphi, W.C.2. The lecturer will be Professor P. M. S. Blackett, M.A., F.R.S., Professor of Physics at Birkbeck College. Applications for tickets should be made to the Secretary, Royal Society of Arts.

The Gold Medal of the Royal Astronomical Society has been awarded to Dr. Harold Jeffreys, F.R.S., Reader in Geophysics in the University of Cambridge, for his researches into the physics of the earth and other planets, and for his contributions to the study of the origin and age of the solar system.

Staff News.—Mr. C. W. Atkins, who for the past thirteen years had been storekeeper in the Instruments' Division of the Meteorological Office, retired after sixteen years' service on November 11th, 1936. The instrument store at South Kensington is in the basement of the building; Mr. Atkins, therefore, was not often seen in his work except by those of his colleagues who had business with him, but his efficiency in the management of the store and supervision of the packing of instruments has contributed in no small degree to the smooth working of the instruments branch for many years. Mr. Atkins' forceful personality and cheery nature will be missed by all who knew him.

On November 14th, 1936, Mr. C. E. Goad retired after forty-seven years' service on the staff of the Meteorological Office. He was appointed in 1889 when the Office was situated in Victoria Street, Westminster, and the earlier years of his career were associated with the work of distribution of weather reports to subscribers and the press, until in 1915 when he was promoted to the grade of Office Keeper. After the War he was selected for transfer to the established clerical staff, and served from that time in the General Services section at the Kensington office. His retirement was made the occasion of a presentation from the Director and staff of the office in recognition of his long and valued service.

The Weather of December, 1936

The pressure distribution during December shows a deep low (below 990 mb.) centred over Spitsbergen, where the mean was 21 mb. below normal, and extending across Iceland. A steep gradient for westerly or south-westerly winds ran from north of Newfoundland across the Atlantic and northern Europe to Siberia ; in Sweden, for example, pressure was slightly above normal in the south and about 13 mb. below normal in the north. A belt of high pressure extended from the eastern United States across the Azores and southern Europe to southern Siberia ; pressure was above normal over the greater part of this belt, the excess reaching 8 mb. over New Brunswick and at Scilly, but the Siberian anticyclone was weaker than usual in December. The broadcast data show mild conditions over western Europe, mean temperatures exceeding 40° F. over the whole of the British Isles, western and southern France and approaching 50° F. in the west. The whole of Europe west of 30° E. was above 30° F. except the extreme north of Scandinavia. In northern Sweden, the temperature was 15° F. or more above normal, and the mean differed little from that for south-eastern Europe which was rather colder than usual. The abnormally high temperatures in the north extended eastwards into Siberia, where Dickson on the Arctic Coast with a temperature of —0·6° F. was 11° F. above normal, and even Verkhoïansk, with a mean of —46° F. was about 5° F. above normal. From the " cold pole " temperatures rose rapidly again towards the Pacific Coast of Siberia. Precipitation was abnormally heavy on the north-western coasts of Europe, the amount for Thorshavn being about 11 inches, but decreased rapidly south-eastwards and in the Balkan Peninsula the totals were generally below one inch.

Disturbed weather persisted over the British Isles during most of the month, with gales at the beginning and in the middle ; temperature and sunshine were generally above normal ; rainfall was generally below normal in England and east Scotland, about normal in Ireland, and above normal in parts of Wales and west Scotland. During anticyclonic weather on the 9th–10th and 23rd–27th, fog developed. Between the 3rd and 5th two depressions passed across northern Scotland and the second was centred over the North Sea on the 6th ; at exposed stations in most parts of the British Isles and especially in the north and west, gales were recorded between the 3rd and 6th. Snow fell in many parts of Scotland between the 3rd and 6th, in Ireland on the 5th, and in parts of England between the 5th and 8th ; it was recorded as far south as Birmingham and Oxford on the 5th and London and Margate on the 6th. The 1st and the 5th–7th were cold in most parts ; at Eskdalemuir the maximum temperature was 37° F. on the 5th and 26° F. on the 7th ; some low minimum temperatures recorded during these few days were 19° F. at Marlborough on the 8th, 18° F. at Auchincruive and 15° F. at Penrith on the 7th ; on the other hand the minimum at Valentia on the 8th was 50° F. Glazed roads were experienced in south-east England and the Midlands on the morning of the 8th, the cold interval being followed by rain and drizzle spreading eastwards during the early hours. The 4th was sunny in many places, Hastings recording 6·8 hours and Cullompton 7 hours of bright sunshine ; again on the 7th, 6·8 hours was recorded at Ross-on-Wye and 7·2 hours at Boscombe Down. By the 9th the British Isles lay in a ridge of high pressure, and fog and mist were prevalent in many parts of England and Scotland ; it recurred in England on the 10th and 11th, but by this time most of Scotland and Ireland were coming under the influence of a deep depression to the north of Iceland. On the 12th a trough of low pressure lay over the British Isles ; snow fell again in some districts on the 11th and 12th. From the 13th–18th the weather was controlled by depressions passing between Scotland and Iceland ; gales were recorded at many coast stations between the 13th and 18th and also at exposed inland stations ; gusts exceeding 90 m.p.h. were registered at Tiree on the 16th and 17th. Rain fell in many districts on the 13th, and some heavy falls were recorded in the west and north, notably 2·86 in. at Bettws-y-Coed, Denbigh, 4·60 in. at Trecastle, Brecon, 2·41 in. at Troutbeck, Cumberland, and 3·75 in. at Oughtershaw, West Riding. On the 17th, 3·55 in. was recorded at Holne, Devon. Snow fell in some northern districts and in northern Ireland between the 13th and 16th. The 17th and 18th were unusually mild for the time of year ; the maximum temperature reached 58° F. at Bath and Chester, and 57° F. at Dublin, York and Manchester on the 17th. On the night of the 17th–18th the minimum temperature was 52° at Kew, Greenwich and Edgbaston and 53° F. at Ross-on-Wye. On the 20th a deep depression over Iceland caused gales in many parts of the northern half of the British Isles. Day temperatures were rather high on the 20th and 21st in parts of the west and south; the maximum again reached 57° F. at Dublin on the 21st. High pressure to the south over Europe and the Atlantic gradually spread northward, and from the 23rd to the 27th anticyclonic conditions prevailed over most of the British Isles. Fog occurred at Eskdalemuir and Abbotsinch on the 21st, in parts of southern England on the 23rd, and in many districts on the 26th–28th. By the 29th a depression to the north-west of Scotland was affecting the British Isles bringing strong winds and rain to most districts. The distribution of bright sunshine for the month was as follows:—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway ...	12	−10	Chester ...	45	+1
Aberdeen ...	51	+14	Ross-on-Wye...	53	+5
Dublin	49	+3	Falmouth ...	59	+3
Birr Castle ...	42	−1	Gorleston ...	67	+24
Valentia... ...	33	−5	Kew	59	+22

Miscellaneous notes on weather abroad culled from various sources.

Gales in the English Channel and North Sea during the first few days of the month caused accidents to shipping; nine English fishermen were lost when a trawler was wrecked near Calais on the 1st, and a German ship sank off the Dutch coast on the 2nd. Gales occurred in the North Sea again in the middle of the month; much damage is said to have been done at Bergen. Heavy rain also caused floods at Limassol in Cyprus. (*The Times, December 3rd–16th.*)

Heavy rain in Turkey caused extensive floods near Adana during the first week, and more than 100 people were reported drowned; the town of Adana where the river Seyhan rose 18 ft. suffered severely. A typhoon passed south of Manila in the Philippine Islands on the 2nd; many native houses were blown away. In the north of Luzon heavy rain began on the 2nd and continued until the 6th, when the Cagayen River rose rapidly, flooding over 50 towns and villages. The dam at the Osaruzawa Copper Mine at Akita, Hondo, Japan burst again on the 22nd causing further loss of life. On the Yangste River navigation has been interfered with owing to the river falling 26 ft. below its normal level; the middle river is said to be lower than it has been for 35 years. Heavy rain and snow occurred in many parts of Palestine, Syria, Trans-Jordan and Iraq towards the end of the month. (*The Times, December 8th, 1936–January 1st, 1937.*)

Rainfall was above normal in New South Wales, Victoria and South Australia, below normal in Northern Territory and variable in amount in Western Australia, Queensland and Tasmania. (*Cable.*)

In the United States at the beginning of the month weather was generally cold east of the Rocky Mountains, with frequent rains in the south and some snow in northern districts; in the middle of the month weather became warmer, and precipitation was plentiful in eastern districts. During the last week the temperature was well above normal everywhere except on the Pacific coast, being unusually high in the central states; precipitation was mainly below normal except in the west. (*Washington, D.C., U.S. Dept. Agric., Weekly Weather and Crop Bulletin*).

Daily Readings at Kew Observatory, December, 1936

Date	Pressure, M.S.L. 13h.	Wind, Dir., Force 13h.	Temp. Min.	Temp. Max.	Rel. Hum. 13h.	Rain.	Sun.	REMARKS. (see vol. 69, 1934, p. 1).
	mb.		°F.	°F.	%	in.	hrs.	
1	1018·8	W.4	40	47	61	—	0·9	
2	1007·0	WNW.5	42	55	76	0·08	0·0	r–r_0 6h.–8h.
3	1013·6	W.3	50	53	73	—	2·0	
4	1016·6	W.4	48	49	47	—	6·2	
5	1006·6	W.4	39	45	61	0·02	2·5	r_0 6h.–10h., pr_0 13h.
6	1012·1	WNW.5	34	40	76	0·11	0·7	s–rs 1h.–11h.
7	1029·7	NW.3	31	35	63	—	6·3	x early and late.
8	1024·3	SW.2	27	44	97	0·18	0·0	r_0–r 6h.–18h.
9	1029·6	N.2	34	39	100	—	0·0	x early, f 9h.–17h.
10	1026·7	SE.2	36	38	85	—	0·0	r_0 19h.–20h.
11	1015·8	S.2	29	39	90	—	0·0	x early, f 7h.–12h.
12	1008·7	Calm	33	42	89	0·10	0·0	r_0 16h.–21h.
13	1010·4	S.3	30	43	83	trace	6·4	x early, pr_0 16h.
14	986·8	SSW.6	41	51	86	0·50	0·0	r–r_0 0h.–24h.
15	1007·7	SW.3	38	44	71	—	6·2	
16	999·1	WSW.4	40	50	67	0·06	1·4	r 2h.–10h., pr to 17h.
17	1004·2	SSW.4	41	55	94	0·09	0·0	r_0 9h.–20h.
18	1010·8	SW.6	52	54	85	0·10	0·0	r_0–r 1h.–18h.
19	1031·0	SW.3	42	47	70	—	3·5	
20	1026·1	SSW.4	45	49	71	—	2·5	
21	1024·5	S.3	45	49	80	—	0·0	w early.
22	1025·5	SW.3	39	52	84	0·04	2·0	r_0–r 19h.–22h.
23	1039·7	W.2	35	44	83	trace	5·1	x early, f 19h.
24	1036·4	WSW.2	31	42	93	—	0·0	fx till 11h.
25	1035·3	W.2	37	47	79	—	3·9	w early.
26	1034·8	Calm	43	45	99	0·03	0·0	d_0 5h.–20h., f till 15h.
27	1029·2	E.3	41	45	78	—	2·4	
28	1020·6	E.3	32	37	96	0·02	0·0	fd_0 14h.–18h.
29	1016·1	SW.3	37	52	84	0·04	0·5	ir_0 3h.–5h., 15h.–22h.
30	1027·8	SW.2	44	48	77	—	6·2	
31	1025·0	SSW.4	40	48	81	0·01	0·0	w early, r_0 23h.–24h.
*	1019·4	—	39	46	80	1·38	1·9	* Means or totals.

Rainfall, 1936—General Distribution

	Dec.	Year	
England and Wales	90	109	per cent of the average 1881–1915.
Scotland	107	96	
Ireland	104	103	
British Isles ...	97	105	

Rainfall: December, 1936: England and Wales

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Lond .	Camden Square	1·87	78	*Leics* .	Belvoir Castle	1·61	65
Sur .	Reigate, Wray Pk. Rd.	3·72	117	*Rut* .	Ridlington	1·86	74
Kent .	Tenterden, Ashenden	2·66	86	*Lincs* .	Boston, Skirbeck	1·25	58
,, .	Folkestone, Boro. San.	2·62	...	,, .	Cranwell Aerodrome	1·52	69
,, .	Margate, Cliftonville	1·30	57	,, .	Skegness, Marine Gdns.	·98	45
,, .	Eden'bdg., Falconhurst	3·56	108	,, .	Louth, Westgate	1·67	60
Sus .	Compton, Compton Ho.	3·13	75	,, .	Brigg, Wrawby St.	1·09	...
,, .	Patching Farm	2·04	61	*Notts* .	Worksop, Hodsock	1·41	60
,, .	Eastbourne, Wil. Sq.	2·39	68	*Derby* .	Derby, L. M. & S. Rly.	1·74	67
Hants .	Ventnor, Roy.Nat.Hos.	2·70	82	,, .	Buxton, Terr. Slopes	6·16	109
,, .	Fordingbridge, Oaklnds	...	...	*Ches* .	Runcorn, Weston Pt.	3·47	110
,, .	Ovington Rectory	4·22	107	*Lancs* .	Manchester, Whit. Pk.	3·14	97
,, .	Sherborne St. John	3·13	95	,, .	Stonyhurst College	6·48	134
Herts .	Royston, Therfield Rec.	1·76	76	,, .	Southport, Bedford Pk.	3·46	107
Bucks .	Slough, Upton	1·85	73	,, .	Lancaster, Greg Obsy.	5·26	121
,, .	H. Wycombe, Flackwell	2·30	76	*Yorks* .	Wath-upon-Dearne	1·36	57
Oxf .	Oxford, Mag. College	1·86	80	,, .	Wakefield, Clarence Pk.	1·32	54
N'hant	Wellingboro, Swanspool	1·72	73	,, .	Oughtershaw Hall	8·47	...
,, .	Oundle	1·26	...	,, .	Wetherby, Ribston H.	2·32	95
Beds .	Woburn, Exptl. Farm	1·38	59	,, .	Hull, Pearson Park	·91	38
Cam .	Cambridge, Bot. Gdns.	1·53	79	,, .	Holme-on-Spalding	1·41	57
Essex .	Chelmsford, County Gdns	1·79	81	,, .	West Witton, Ivy Ho.	5·09	139
,, .	Lexden Hill House	1·74	...	,, .	Felixkirk, Mt. St. John.	1·76	73
Suff .	Haughley House	1·59	...	,, .	York, Museum Gdns.	1·30	58
,, .	Campsea Ashe	1·24	54	,, .	Pickering, Hungate	1·55	62
,, .	Lowestoft Sec. School	1·46	63	,, .	Scarborough	2·26	95
,, .	Bury St. Ed., WestleyH.	1·83	76	,, .	Middlesbrough	1·13	58
Norf. .	Wells, Holkham Hall	1·75	85	,, .	Baldersdale, Hury Res.	4·29	116
Wilts .	Calne, Castle Walk	2·75	...	*Durh* .	Ushaw College	1·88	75
,, .	Porton, W.D. Exp'l. Stn	3·28	104	*Nor* .	Newcastle, D. & D. Inst.	1·37	63
Dor .	Evershot, Melbury Ho.	5·84	113	,, .	Bellingham, Highgreen	2·95	81
,, .	Weymouth, Westham.	3·11	89	,, .	Lilburn Tower Gdns.	1·72	65
,, .	Shaftesbury, Abbey Ho.	2·28	63	*Cumb* .	Carlisle, Scaleby Hall	3·63	113
Devon .	Plymouth, The Hoe	3·40	68	,, .	Borrowdale, Seathwaite	19·25	125
,, .	Holne, Church Pk. Cott.	13·09	155	,, .	Borrowdale, Moraine	19·63	160
,, .	Teignmouth, Den Gdns.	4·06	96	,, .	Keswick, High Hill	9·28	139
,, .	Cullompton	3·65	83	*West* .	Appleby, Castle Bank	5·85	148
,, .	Sidmouth, U.D.C.	3·18	...	*Mon* .	Abergavenny, Larchf'd	6·57	147
,, .	Barnstaple, N. Dev.Ath	3·96	89	*Glam* .	Ystalyfera, Wern Ho.	8·00	96
,, .	Dartm'r, Cranmere Pool	12·70	...	,, .	Cardiff, Ely P. Stn	3·99	78
,, .	Okehampton, Uplands.	7·82	111	,, .	Treherbert, Tynywaun.	13·95	...
Corn .	Redruth, Trewirgie	5·86	94	*Carm* .	Carmarthen, Coll. Rd.	5·64	98
,, .	Penzance, Morrab Gdns.	3·90	69	*Pemb* .	St. Ann's Hd. C. Gd. Stn.	3·60	80
,, .	St. Austell, Trevarna	4·95	81	*Card* .	Aberystwyth	5·60	...
Soms .	Chewton Mendip	4·45	83	*Rad* .	BirmW.W.Tyrmynydd	9·83	120
,, .	Long Ashton	3·47	90	*Mont* .	Lake Vyrnwy	9·27	135
,, .	Street, Millfield	2·21	...	*Flint* .	Sealand Aerodrome	2·52	...
Glos .	Blockley	3·38	...	*Mer* .	Blaenau Festiniog	14·09	122
,, .	Cirencester, Gwynfa	3·69	110	,, .	Dolgelley, Bontddu	8·69	127
Here .	Ross, Birchlea	4·12	139	*Carn* .	Llandudno	4·43	153
Salop .	Church Stretton	4·67	139	,, .	Snowdon, L. Llydaw 9..	27·05	...
,, .	Shifnal, Hatton Grange	2·34	91	*Ang* .	Holyhead, Salt Island	5·63	135
Staffs .	Market Drayt'n, Old Sp.	2·18	78	,, .	Lligwy	6·02	...
Worc .	Ombersley, Holt Lock.	2·50	95	*Isle of Man*			
War .	Alcester, Ragley Hall	2·34	95		Douglas, Boro' Cem.	5·88	119
,, .	Birminghm. Edgbaston	2·67	99	*Guernsey*			
Leics .	Thornton Reservoir	1·70	63		St. PeterP't.Grange Rd.	2·40	59

Rainfall: December, 1936: Scotland and Ireland

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Wig	Pt. William, Monreith	4·00	88	*Suth*	Lairg	5·45	135
,,	New Luce School	5·36	97	,,	Tongue	3·90	79
Kirk	Dalry, Glendarroch	6·66	94	,,	Melvich	3·41	79
Dumf.	Dumfries, Crichton R.I.	5·12	127	,,	Loch More, Achfary	13·99	151
,,	Eskdalemuir Obs	9·44	135	*Caith*	Wick	3·27	106
Roxb	Hawick, Wolfelee	4·00	96	*Ork*	Deerness	3·32	79
Selk	Ettrick Manse	8·65	140	*Shet*	Lerwick	3·89	81
Peeb	West Linton	3·38	...	*Cork*	Dunmanway Rectory	7·67	95
Berw	Marchmont House	2·11	75	,,	Cork, University Coll.	4·89	95
E.Lot	North Berwick Res	1·43	67	,,	Ballinacurra	3·76	73
Midl	Edinburgh, Blackfd. H.	1·95	83	,,	Mallow, Longueville	5·59	114
Lan	Auchtyfardle	4·94	...	*Kerry*	Valentia Obsy	7·12	107
Ayr	Kilmarnock, Kay Pk	6·11	...	,,	Gearhameen	17·10	137
,,	Girvan, Pinmore	5·87	98	,,	Bally McElligott Rec.	4·54	...
,,	Glen Afton, Ayr San.	9·78	153	,,	Darrynane Abbey	5·84	99
Renf	Glasgow, Queen's Pk	6·13	145	*Wat*	Waterford, Gortmore	4·30	94
,,	Greenock, Prospect H.	9·90	125	*Tip*	Nenagh, Cas. Lough	5·24	114
Bute	Rothesay, Ardencraig	7·65	140	,,	Roscrea, Timoney Park	4·07	...
,,	Dougarie Lodge	5·37	98	,,	Cashel, Ballinamona	4·38	102
Arg	Ardgour House	19·85	...	*Lim*	Foynes, Coolnanes	5·07	107
,,	Glen Etive	...	...	,,	Castleconnel Rec.	4·04	...
,,	Oban	9·83	...	*Clare*	Inagh, Mount Callan	10·60	...
,,	Poltalloch	9·48	149	,,	Broadford, Hurdlest'n.	...	...
,,	Inveraray Castle	18·10	182	*Wexf*	Gorey, Courtown Ho.	4·21	110
,,	Islay, Eallabus	6·77	114	*Wick*	Rathnew, Clonmannon.	3·18	...
,,	Mull, Benmore	...	...	*Carl*	Hacketstown Rectory	3·12	76
,,	Tiree	4·59	88	*Leix*	Blandsfort House	3·51	95
Kinr	Loch Leven Sluice	3·52	89	*Offaly*	Birr Castle	3·13	95
Fife	Leuchars Aerodrome	1·57	64	*Dublin*	Dublin, FitzWm. Sq.	2·38	96
Perth	Loch Dhu	13·40	133	*Meath*	Beauparc, St. Cloud	3·51	...
,,	Balquhidder, Stronvar.	...	...	,,	Kells, Headfort	3·67	96
,,	Crieff, Strathearn Hyd.	4·83	108	*W.M*	Moate, Coolatore	2·80	...
,,	Blair Castle Gardens	5·24	137	,,	Mullingar, Belvedere	3·64	99
Angus	Kettins School	3·24	98	*Long*	Castle Forbes Gdns	4·13	104
,,	Pearsie House	3·12	...	*Gal*	Galway, Grammar Sch.	4·94	108
,,	Montrose, Sunnyside	...	...	,,	Ballynahinch Castle	8·52	114
Aber	Braemar, Bank	4·09	115	,,	Ahascragh, Clonbrock.	4·74	101
,,	Logie Coldstone Sch.	...	...	*Mayo*	Blacksod Point	8·31	136
,,	Aberdeen, Observatory.	1·98	61	,,	Mallaranny	7·98	...
,,	Fyvie Castle	1·79	52	,,	Westport House	7·22	126
Moray	Gordon Castle	1·27	47	,,	Delphi Lodge	14·08	116
,,	Grantown-on-Spey	2·24	83	*Sligo*	Markree Castle	5·25	110
Nairn	Nairn	2·59	117	*Cavan*	Crossdoney, Kevit Cas.	3·80	...
Inv's	Ben Alder Lodge	9·93	...	*Ferm*	Newtwnbtlr, Crom Cas.	4·31	104
,,	Kingussie, The Birches.	5·30	...	,,	Enniskillen, Portora	...	...
,,	Loch Ness, Foyers	7·91	179	*Arm*	Armagh Obsy	3·21	103
,,	Inverness, Culduthel R.	3·47	129	*Down*	Fofanny Reservoir	5·47	...
,,	Loch Quoich, Loan	25·27	...	,,	Seaforde	2·97	72
,,	Glenquoich	21·25	145	,,	Donaghadee, C. G. Stn.	3·45	108
,,	Glenleven, Corrour	8·72	94	*Antr*	Belfast, Cavehill Rd.	4·09	...
,,	Fort William, Glasdrum	18·68	...	,,	Aldergrove Aerodrome.	3·74	109
,,	Skye, Dunvegan	10·64	...	,,	Ballymena, Harryville.	5·07	114
,,	Barra, Skallary	5·28	...	*Lon*	Garvagh, Moneydig	4·74	...
R&C	Alness, Ardross Castle.	5·22	126	,,	Londonderry, Creggan.	4·92	112
,,	Ullapool	7·72	123	*Tyr*	Omagh, Edenfel	5·96	141
,,	Achnashellach	...	...	*Don*	Malin Head	3·47	...
,,	Stornoway, Matheson	8·63	138	,,	Killybegs, Rockmount.	3·01	...

Climatological Table for the British Empire, July, 1936

STATIONS.	PRESSURE. Mean of Day M.S.L.	PRESSURE. Diff. from Normal.	TEMPERATURE. Absolute. Max.	TEMPERATURE. Absolute. Min.	TEMPERATURE. Mean Values. Max.	TEMPERATURE. Mean Values. Min.	TEMPERATURE. Mean Values. ½ Max. and Min.	TEMPERATURE. Mean Values. Diff. from Normal	TEMPERATURE. Mean. Wet Bulb.	Relative Humidity.	Mean Cloud Am'nt	PRECIPITATION. Am'nt.	PRECIPITATION. Diff. from Normal.	PRECIPITATION. Days.	BRIGHT SUNSHINE. Hours per day.	BRIGHT SUNSHINE. Per-cent-age of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0–10	in.	in.			
London, Kew Obsy.	1010·6	− 5·2	76	48	68·5	55·4	61·9	− 0·9	56·3	84	7·7	2·35	+ 0·18	20	4·5	28
Gibraltar	1017·2	+ 0·4	84	63	76·8	64·9	70·9	...	63·6	79	2·2	0·07	...	1	...	...
Malta	1015·4	+ 0·7	96	66	83·8	71·4	77·6	− 0·7	69·2	67	0·9	0·00	− 0·05	0	12·9	90
St. Helena	1017·8	+ 0·4	67	52	60·5	54·3	57·4	− 1·1	55·4	91	8·6	3·44	− 0·63	20	...	...
Freetown, Sierra Leone	1014·4	+ 3·4	84	68	80·8	70·9	75·9	...	73·3	88	8·6	25·03	− 10·55	25	...	...
Lagos, Nigeria	1015·3	+ 2·1	84	71	81·3	74·0	77·7	− 0·3	73·2	86	8·8	0·16	− 10·34	5	4·8	39
Kaduna, Nigeria	1010·4	...	88	65	82·8	68·8	75·8	+ 2·2	70·7	90	8·8	6·02	− 4·60	18	5·1	40
Zomba, Nyasaland	1019·5	+ 0·9	80	51	71·8	54·3	63·1	+ 1·1	58·2	72	5·5	0·12	− 0·23	4	...	...
Salisbury, Rhodesia	1024·3	+ 1·9	82	37	69·3	44·3	56·8	+ 0·7	49·0	57	3·1	0·02	− 0·01	2	8·5	76
Cape Town	1021·9	+ 0·6	81	40	64·9	49·7	57·3	+ 2·6	49·5	81	4·3	2·26	− 1·36	7	...	...
Johannesburg	1024·6	+ 0·7	69	32	60·5	40·7	50·6	+ 0·2	41·0	52	1·1	0·04	− 0·29	1	8·9	83
Mauritius	1021·8	+ 1·4	77	55	74·3	62·6	68·5	+ 0·2	63·7	72	5·6	1·30	− 1·19	22	7·1	65
Calcutta, Alipore Obsy.	999·3	+ 0·1	93	77	89·0	79·8	84·4	+ 0·7	80·1	91	8·9	10·73	− 1·97	16*	...	...
Bombay	1004·5	+ 0·6	88	76	86·6	77·4	82·0	+ 0·6	77·5	84	8·8	8·09	− 16·18	24*	...	...
Madras	1004·0	− 0·5	100	74	94·8	79·2	87·0	− 0·6	76·3	71	8·0	4·87	+ 1·03	6*	...	...
Colombo, Ceylon	1009·7	+ 0·6	85	72	84·4	77·8	81·1	− 0·1	76·2	77	8·1	1·88	− 2·55	12	5·2	42
Singapore	1009·2	+ 0·3	89	71	86·1	77·7	81·9	+ 0·6	77·7	80	6·3	4·88	− 1·91	12	6·8	56
Hongkong	1005·2	− 0·5	92	76	88·6	79·3	83·9	+ 1·4	79·4	79	6·9	8·81	− 5·61	20	8·0	60
Sandakan	1008·6	...	90	73	88·1	75·2	81·7	− 0·1	76·4	83	7·7	10·41	+ 3·69	13	...	...
Sydney, N.S.W.	1019·9	+ 1·6	68	41	62·6	46·4	54·5	+ 1·8	48·6	74	3·4	0·84	− 3·96	9	6·2	61
Melbourne	1019·4	+ 0·5	65	37	56·4	43·1	49·7	+ 1·0	45·6	83	7·0	4·41	+ 2·55	24	3·3	34
Adelaide	1020·0	− 0·3	68	39	59·7	46·1	52·9	+ 1·1	48·5	79	7·7	2·30	− 0·34	18	3·5	35
Perth, W. Australia	1019·7	+ 0·7	68	39	62·4	46·8	54·6	− 0·6	48·7	79	5·8	4·89	− 1·67	20	5·6	55
Coolgardie	1020·2	+ 0·3	73	33	60·7	40·8	50·7	− 0·5	44·7	66	3·9	1·15	+ 0·28	7	...	...
Brisbane	1021·5	+ 3·1	75	40	68·5	51·0	59·7	+ 1·2	53·0	72	4·7	1·31	− 0·89	8	6·2	58
Hobart, Tasmania	1017·3	+ 3·6	60	33	52·5	41·5	47·0	+ 1·3	42·0	75	6·2	1·20	− 0·98	17	3·9	42
Wellington, N.Z.	1013·2	− 0·7	58	34	50·2	41·1	45·7	− 2·3	42·9	80	7·3	8·42	+ 2·79	21	3·4	36
Suva, Fiji	1015·2	+ 1·2	86	66	79·0	69·9	74·5	+ 1·1	69·3	82	7·4	3·37	− 1·56	22	4·1	37
Apia, Samoa	1011·9	0·0	86	68	84·3	73·5	78·9	+ 1·7	75·1	79	4·6	3·15	+ 0·17	11	7·5	66
Kingston, Jamaica	1013·6	− 1·1	92	72	89·4	74·3	81·9	+ 0·2	73·3	79	3·6	0·97	− 0·65	4	7·7	59
Grenada, W.I.	1011·7	− 1·6	88	70	85	73	79·0	− 0·2	73	74	6	10·13	+ 0·70	20	...	...
Toronto	1013·0	− 1·4	105	52	84·1	62·2	73·1	+ 4·0	61·9	65	3·3	0·77	− 2·07	3	11·4	76
Winnipeg	1011·9	− 0·4	108	43	88·6	62·4	75·5	+ 9·1	62·2	79	3·2	1·87	− 1·23	7	10·6	67
St. John, N.B.	1010·4	− 3·2	82	49	69·3	53·1	61·2	+ 0·8	57·3	82	6·3	2·33	− 1·30	14	7·6	50
Victoria, B.C.	1016·2	− 1·1	74	51	67·7	53·2	60·5	+ 0·4	56·3	79	3·5	0·85	+ 0·43	6	11·2	71

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

(85267) Wt. 19/32 1125 1/37 Hw. G.377