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The Warming Arctic

In recent years attention is being directed more and more towards a problem which may possibly prove of great significance in human affairs, the rise of temperature in the northern hemisphere, and especially in the Arctic regions. This warming up has been especially noticeable in the winter of 1937–8, as shown by the four charts of Fig. 1, which represent the departures from " normal " during the months of October to December, 1937, and January, 1938. All of them show a marked excess of temperature especially in Arctic Russia, culminating in January. February also shows an excess of 10°F. in the Barents Sea and northern Sweden. Moreover, the normals with which the current observations are compared are themselves limited to two or three decades of the present century, and it is safe to say that had they covered a longer period, the departures would have been still greater.

A study of the problem has recently been published by R. Scherhag.* At Spitsbergen the average winter (Nov.–March) temperature for 1931–5 was 16° F. higher than for 1911–20, and in the neighbouring seas the edge of the ice in late summer has retreated an average distance of some 150 miles. The Spitsbergen branch of the North Atlantic Current has greatly increased in strength and the surface layer of cold water in the Arctic Ocean has decreased

* Die Erwärmung der Arktis. *Copenhague, J. Cons. int. Explor. Mer*, 12, 1937, pp. 263–76.

from 200 to 100 metres in thickness. Scherhag also finds that the temperature of the Gulf Stream in 1926–33 was about 0·75° F. higher than in 1912–8, and there has been a similar rise in the surface temperature of the English Channel.

Scherhag explains the rise of temperature in high latitudes quite simply by an increase in the strength of the atmospheric circulation. In the last decade the mean pressure has decreased considerably in the Icelandic and Aleutian lows and increased in the sub-tropical belt of high pressure. There has been an increase in the strength of the westerly winds of temperate latitudes which has driven more warm surface water into the Arctic Basin. He points out, however, that the zones both of greatest decrease of pressure and of marked rise of temperature have moved gradually northward during the past 50 years. In central and western Europe the main rise of temperature began about 1900, in the Arctic not until 1922. On the basis of C. Easton's coefficients of winter temperatures since 1235, he considers that this variation in the circulation has a periodicity of about 220 years and that the crest of the warm period is already past. The latter conclusion seems to be borne out by the variations of temperature at Oxford,* where the maximum of the smoothed curve of winter temperatures occurred in the 20 years 1909–28.

Variations of winter temperature alone are not a very good basis for determining variations in the strength of the general circulation. Observations of wind direction in the British Isles show that about 220 years ago the westerlies in this country were less persistent than in the nineteenth century, and other data suggest that the last maximum of westerly winds lasted from about 1300 to 1550.† The present maximum began about 1810 and the downward trend of temperature at Oxford during the past few years may be only a minor oscillation.

Attributing the recent period of warm winters to an increase in the strength of the atmospheric circulation only pushes the problem one stage further back, for we should still have to account for the change of circulation. Moreover, it is almost equally plausible to regard the change of circulation as a *result* of the warming of the Arctic, for open ice conditions in the Arctic Ocean are favourable to the formation of depressions. More probably the increased circulation is both cause and effect of the warmed Arctic ; high temperature causes storminess and decrease of pressure in high latitudes, which in turn is associated with stronger west winds in middle latitudes, driving an excess of warm sea water into the Arctic and raising the temperature still further. Again, the decrease in the area of ice means less ice-cooled water sinking to the ocean floor, a higher

* Lilian F. Lewis. Variations of temperature at Oxford 1815–1934. *London, Prof. Notes, met. Off.* 5, No. 77, 1937.

† *London, Quart. J. R. met. Soc.*, 60, 1934, p. 165.

temperature in the upwelling water off the west coast of Africa, a warmer Gulf Stream (actually observed) and more heat carried into the Arctic. Both these possible processes, once begun, are cumulative in their action, and reinforce each other. In this connexion it is interesting to note that, as illustrated in Fig. 1, the warming up appears to have been greatest on the coast of western Siberia, just where the warm current from the Atlantic is reaching the limit of its influence, and consequently where a strengthening of this current might be expected to have the greatest effect on temperature. The main objection to this suggestion is

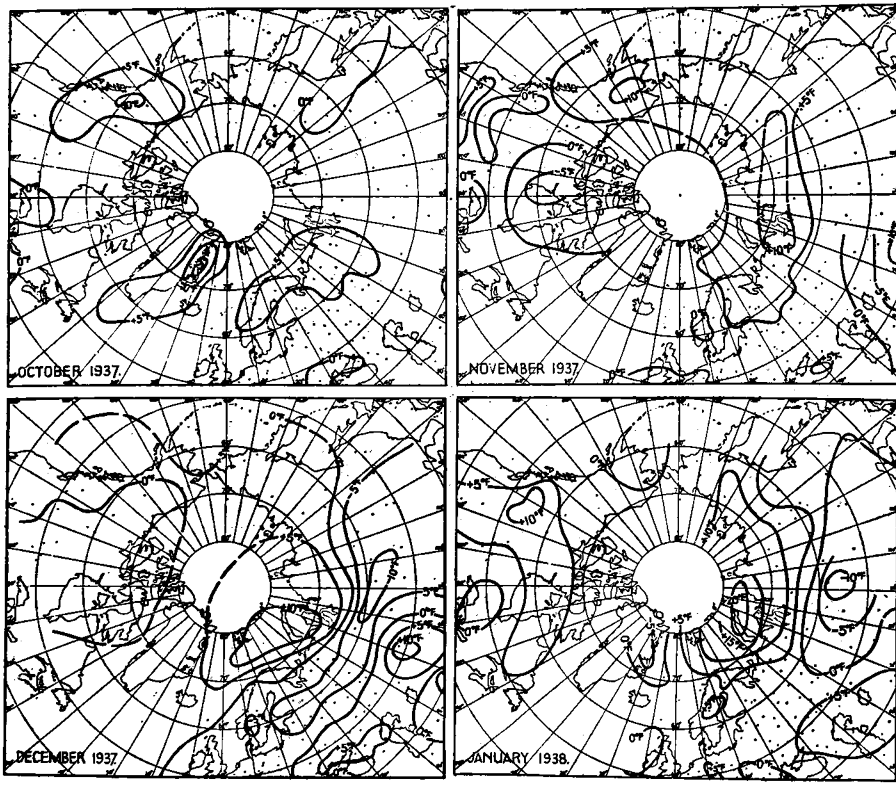

FIG. 1—DEVIATIONS OF TEMPERATURE FROM NORMAL.

that the warming up apparently began not in the Arctic but in middle latitudes, especially in central Europe,* and two decades elapsed before it penetrated far beyond the Arctic circle. At Spitsbergen at least, the rise occurred in two stages, the winters of 1922–3 to 1924–5 being warm, those of 1925–6 to 1929–30 somewhat cooler, and those of 1930–1 onwards warmer than the first group, while even during the last eight winters there has been a steady rise.

It may also be objected that the atmospheric circulation depends on the difference of temperature between low and high latitudes

* *Met. Mag., London*, 57, 1922, p. 203.

and hence should be weakened instead of strengthened by a warming of the Arctic. This has apparently happened in low latitudes, as is shown by the rise of pressure at tropical stations mentioned by Scherhag, and also by the decreasing wind velocity at St. Helena, but a weakening of the circulation in low latitudes may not be incompatible with a local strengthening in middle latitudes, and it is the latter which would be mainly operative in raising the temperature of the Arctic regions.

Whatever the mechanism, the rise of temperature did begin, and presumably had a cause, though it is conceivable that it arose spontaneously in the incessant kaleidoscope of temporary pressure distributions. One possible cause was put forward at the February meeting of the Royal Meteorological Society by G. S. Callendar, namely, the addition of carbon dioxide to the air by consumption of fuel (*see* p. 35), but the effects of this addition seem to require further examination. There have been great climatic oscillations before this, even since the last Ice Age, about the causes of which we are quite ignorant.

C. E. P. BROOKS.

Meteorology in Ceylon

The *Ceylon Journal of Science* was founded in 1924 by the Ceylon Government to provide facilities for the publication of papers dealing with scientific researches, which are being carried out in Ceylon. The journal is divided into six sections, of which Section E is devoted to Meteorology. Prior to 1924 such material was published as *Bulletins of the Colombo Observatory*.

The first article of the volume under review* compares the intense falls of rain experienced in Ceylon with those of this country, as classified in *British Rainfall*, 1935,† by constant frequency graphs. The frequency of occurrence of intense falls for certain specified limits are given for two stations which have annual averages of 91 and 163 in. respectively. The rainfall in Ceylon is largely orographical and heavier than that in most parts of the British Isles. The amounts which occur at Colombo on one day per year during 10 to 120 minutes correspond closely with falls in the British Isles defined by Mill in *British Rainfall*, 1908, as "very rare". These "very rare" falls have been shown to occur in the British Isles with a frequency of about "one day in 160 years" for durations of 22 to 110 minutes. For Ceylon there is apparently "an upper limit to the rate at which rain can fall . . . . The strong gusts of wind that so frequently precede and accompany heavy rain

* Colombo, Ceylon *J. Sci.* (*E*). Vol. II, Part 2, 1937.

† Classification of heavy falls in short periods. By E. G. Bilham. *London, Brit. Rainf.*, 1935, p. 262.

suggest that the following rain forces the air beneath it to spread out, and that these outward gusts, in their turn, spread out the rain. The heavier the rain, the greater the area over which it might be dispersed, and hence the possibility of an automatic upper limit to rainfall intensities". It will be interesting to learn whether additional observations there confirm this theory.

The second paper gives an account of heavy rains during the seven days May 20th to 26th, 1933, in Ceylon, when unusually intense rains are attributed to convergence of different air streams. The largest entry for any individual day was 14·45 in. The maximum recorded for any day in the British Isles is 9·56 in.

Another paper includes tables of the saturation deficit, in millibars, for the sixteen principal climatological stations in Ceylon. In each case monthly values are given for about eight years. Values are given for the saturation deficit for 9h. 30m., 15h. 30m., and night. The values at night are usually low, the differences between night and afternoon being particularly marked inland and in the lower country. At the higher stations the saturation deficit is usually lower at 15h. 30m. than at 9h. 30m. "due probably to the joint effect of the moisture brought in by converging sea-breezes and the fall in temperature caused by the resultant early clouding". The mean values for the year vary from 3·0 mb. to 8·2 mb., compared with 1·7 mb. at Eskdalemuir and 2·8 mb. at Kew. In London the early morning value tends to remain the same throughout the year, while the afternoon value is greater in summer than in winter. The range is from 1·0 mb. in the early morning in January to 10·0 mb. in the early afternoon in July. In Ceylon the means for certain months for 15h. 30m. exceed 20 mb.

The fourth article is, from many aspects, a more detailed discussion of earth temperatures than has been carried out for any station in the British Isles. It gives monthly means of earth temperatures at depths of 1, 2, 3, 4, 5 and 10 ft. for the fifteen years 1919 to 1933 at Colombo Observatory. Diurnal variations are not noticeable at 2 ft. or below. It was also found that the mean of readings at 9h. 30m. and 15h. 30m. (Ceylon Standard Time) could be taken, with sufficient accuracy, to represent the mean for the 24 hours. The annual mean temperature at each depth was approximately 85½° F. and 5° to 5½° F. higher than the mean air temperature. At Camden Square, London, the mean annual temperatures at 1 ft., 4 ft. and 10 ft. are almost identical with the mean air temperature 50° F., the temperature at 10 ft. being about ½° F. less than those at 1 ft. and 4 ft. At Colombo, as at Camden Square, the range in the monthly values decreases appreciably as the depth increases. At Colombo, the curves of mean monthly earth temperature show two maxima and two minima. This is related to the sun's zenith distance from Colombo at mean noon (Colombo being at 7° N.). There are, however, three other factors. During the first half of the year (*a*) the duration of sunshine is greater, (*b*) the rainfall is less, and (*c*) the diurnal variation of rainfall is more marked, the bulk falling in the evening, resulting in a reduced effect on the solar heating of the ground. The spring maximum of earth temperature is, therefore, higher than the autumn maximum and the summer minimum than the winter minimum. The lag in the various phases is about 4 to 5 days per foot. The effect of rain water percolating through the ground is also studied. In general the effect is to decrease the temperature on the following day but the decreases are not proportional to the amounts of rainfall.

In order to test whether it would be an advantage to have rain-gauges painted white in tropical countries like Ceylon, where evaporation is considerable, experiments were carried out with rain-gauges painted white and black respectively. When this experiment was carried out in this country* the comparison was vitiated by the amount of rain held up on the varnished surface and subsequently evaporated. In Colombo this difficulty was overcome by adding given quantities of water to the inner cans of 2½ in. diameter and exposing the gauges during 40 to 50 hours of sunshine without any rain falling. The loss per sunny day was about ·005 in. in the case of the white gauge and ·01 in. with the black gauge. Thus while the losses are small, there is a slight advantage in using white gauges. Reference is made to the experiments carried out by Dr. A. J. Bamford,† which showed that the loss by evaporation is mainly a function of the container. In these circumstances the problem of devising a suitable white rain-gauge, i.e. without painting the surface of the funnel, has not been pursued.

The source of light from the Milne-Shaw seismograph at the Colombo Observatory is a 6-volt electric bulb, worked off a 4-volt accumulator battery. It occasionally happens that the battery runs down unexpectedly, causing a loss of record which becomes considerable when the failure occurs at night. In order to overcome this difficulty an air thermometer is mounted by the side of the electric bulb and by a simple device an electric bell is rung when the temperature falls. Even when the supply was obtained from the mains this device, which is explained in detail, was found to be advantageous.

The last note in the volume deals with a type of pen which has been found satisfactory in giving a continuous record in self-recording anemometers. The pen is triangular in shape, with a small cylinder soldered into one side, and is nearly filled with a pad of cotton wool.

It is clear from these papers that much useful meteorological work is being carried out at Colombo Observatory under the Directorship of Dr. H. Jameson.

J. GLASSPOOLE.

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*Experiments with rain-gauges with black and white funnels. *London, Brit. Rainf.*, 1929, p. 284.

†*Met. Mag., London*, 57, 1922, p. 240 and 65, 1930, p. 81.

OFFICIAL NOTICE

Sir George Simpson, K.C.B., F.R.S., will retire from the position of Director of the Meteorological Office in September next, and the Secretary of State has appointed Mr. N. K. Johnson, M.Sc., A.R.C.S., to succeed him. Mr. Johnson is at present Chief Superintendent of the Chemical Defence Research Department, War Office.

Royal Meteorological Society

The monthly meeting of the Society was held on Wednesday, February 16th, at 49, Cromwell Road, South Kensington. Dr. B. A. Keen, F.R.S., F.Inst.P., President, was in the Chair.

Mr. E. W. Barlow, B.Sc., F.R.A.S., described the auroral display of January 25th–26th, 1938, and Prof. S. Chapman, M.A., D.Sc., F.R.S., gave a short account of the physics of aurora.

The following papers were read and discussed :—

G. S. Callendar.—The artificial production of carbon dioxide and its influence upon surface temperature.

By fuel combustion man has added about 150,000 million tons of carbon dioxide to the air during the past half century. The author estimates from the best available data that approximately three quarters of this has remained in the atmosphere.

The radiation absorption coefficients of carbon dioxide and water vapour are used to show the effect of carbon dioxide on "sky radiation". From this the increase in mean temperature, due to the artificial production of carbon dioxide, is estimated to be at the rate of 0·003° C. per year at the present time.

The temperature observations at 200 meteorological stations are used to show that world temperatures have actually increased at an average rate of 0·005° C. per year during the past half century.

R. A. Hamilton.—The Oxford Expedition to North-East Land, 1935–6. General meteorology.

The expedition maintained a station for a year at 80° 23′ N. 19° 31′ E. on the north-west coast of North-East Land and other stations for shorter periods on the west coast and on the ice cap in the interior of the country.

This paper gives monthly means and extreme values of the usual meteorological elements as observed at these various stations together with a general comparison between them.

Although there is reason to believe that the winter was an unusually mild one, the observations seem to disprove the tradition of continual gales, a wind velocity of 12 to 14 m.p.h. being maintained during the dark time. Sudden large fluctuations in temperature occurred in the winter and spring, changes of 30° F. being recorded in one day. In spite of the high latitude, temperatures above 15° F. were recorded during every month of the year. An almost constant feature of the summer weather was the mist which enveloped the ice-cap station (1,700 ft.) and which was usually observed about 300 ft. up on the hills near the Base Camp.

G. Manley, M.A., B.Sc.—Meteorological observations of the British East Greenland Expedition 1935–6, at Kangerdlugssuak.

Systematic and detailed meteorological observations were maintained by the British East Greenland Expedition, 1935–6, under the leadership of L. R. Wager. The expedition's coastal base was at Kangerdlugssuak (68° 10′ N.) in a region, previously little known, which is of distinct meteorological interest. The records have been discussed in some detail and compared with those of Danish stations and those of a previous Norwegian expedition; the courtesy and help of the Danish and Norwegian authorities is gratefully acknowledged. The British observations, reduced and tabulated, are available at the Royal Meteorological Society, summaries only are appended to the paper, by reason of lack of space. Conclusions are reached with regard to the meteorological characteristics of the region, notably the occurrence of fjord gales and precipitation. It is hoped that the general discussion of this excellent set of observations will be of value to others working on the problems of Greenland meteorology. Maps and photographs will be found, accompanying the general account of the expedition, in the *Geographical Journal*, Vol. 90, November, 1937.

R. M. Poulter.—Cloud forecasting: the daily use of the tephigram.

For air-survey work and other specialised daylight flying it is important to know for some hours ahead in fine weather the amount of the sky that will be covered by cloud and the height at which the cloud will exist. Readings of the dry- and wet-bulb thermometers at 50 mb. intervals provide information which, when plotted on a tephigram or similar diagram, enables a forecaster to predict with useful accuracy the amount, height and thickness of clouds during the day. Temperature and dew-point at 4 ft. in the forecast area and the probable rise of temperature are required to give the height of potential condensation, while the relation between the condensation temperature and the temperature of the environment is the criterion for cloud formation.

Cloud thickness is judged by the relation between the saturation adiabatic through the condensation point and the actual temperatures above, while cloud amount is estimated by the relative humidity of the environment at the condensation level.

The application of this technique to the various situations met in day-to-day forecasting is described and illustrated.

S. K. Banerji, D.Sc.—Does rain play any part in the replenishment of the earth's negative charge? (Read in title only.)

A number of thunderstorms passed over the Bombay Observatory and the data of rainfall and of charge, as given by Simpson's apparatus are here discussed. The rainfall brings down definitely more negative than positive charge.

Correspondence

To the Editor, *Meteorological Magazine*

Persistent Fog

It is, I think, unusual for fog.to persist all day in the country outside London as early as October 21st. The persistence of fog in the area north of London on October 21st, 1937 therefore deserves mention.

In the early morning the fog appears to have been generally thick, but in the northern suburbs it cleared considerably during the forenoon and the sun shone. North of Mill Hill and east towards Hatfield the fog did not clear, the visibility about 2 p.m. still being of the order of 100 to 200 yards and the sun entirely obscured. The fog persisted towards the north also and was if anything thicker on rising ground than on low ground. This condition continued at least to the junction of the North Orbital Road and Watling Street, north to London Colney. Conditions were similar along the North Orbital Road towards the west for two or three miles, and then the sun became just visible through the fog and visibility improved and continued to improve towards the west, and the sun began to shine when the Watford By-Pass was reached.

In the Chilterns, towards Chesham, visibility was generally better—never I think less than 1,000 yards and generally 2,000 or 3,000 yards. The sunshine was continuous though not powerful. Visibility continued to be good through Chesham to Rickmansworth, through Pinner and Stanmore, but fog was again met on the Watford By-Pass where the visibility was in places only about 30 yards; this was about 4 p.m. It was distinctly patchy and further patches of fog were met between Mill Hill and the junction with the North Circular Road: La Déliverance.

It was quite clear from the conditions experienced that the fog north of London was not fog drifting from London northwards but the fog of the previous night which was persisting. I could find out no satisfactory reason to explain the simultaneous facts of its persistence in the region mentioned and its absence west of the Watford By-Pass. After examining the synoptic charts and the upper winds and discussing the matter with Mr. Absalom I am led to suggest that the pall of smoke and fog over London on the night of October 20th–21st had drifted northwards in the early morning and forenoon and formed a screen which prevented the sun from dissipating the fog in the area covered by this pall. The direction of the upper wind was about 160 degrees and if the pall drifted with this upper wind that would have left the area of the Chilterns to the west of the pall and would explain the clearing of the fog there and the sunshine in the afternoon of the 21st. This clearing in the afternoon was quite distinct from the clearing which took place in the morning of the 22nd.

By 6 p.m. on the 21st the Hunton Bridge, Berkhamstead Valley, was again filled with fog. It seems a degree worse than ironical that the London surface fog should have been dispersed on the 21st while its upper pall of smoke and fog should have been responsible for the persistence of fog over the fair countryside. E. GOLD.

October 22nd, 1937.

Sea Disturbance at Coastal Stations

With reference to the article in the December issue, I think it would be difficult to convince any sailor that the sea disturbance in an off-shore westerly gale at Spurn Head could be in any way comparable to that rolling home at Tiree or the Scillies under similar conditions with the whole Atlantic behind it.

At the former—especially with a weather-going spring flood tide in the Humber Estuary—one might expect a nasty broken short sea, but in seaman's parlance it would amount to little more than a " wind-lop " and would probably cause but little motion to a paddle-steamer.

At Scilly or Tiree one would expect a 1st class battleship to be " taking it green " over the bows.

JACK BLAKE.

Monckton House, Alverstoke, Hants, December 26th, 1937.

The article by Mr. Donald L. Champion on " Wind Velocity and Sea Disturbance " in last month's issue raises several points which appear to call for clarification.

Firstly, can the personal element in estimating sea disturbance be entirely disregarded in such a set of observations ? It is not made clear in the article if *both* the daily observations at 7h. and 18h. were utilised in the preparation of the isopleths, but if such be the case is it really safe to accept such estimates taken on a dark night from low elevations such as Spurn Head or Point of Ayre ? Must there not be a subconscious connection in the observer's mind on such occasions collating say a NW. wind force 6 at Point of Ayre with a sea disturbance of 4.

Secondly, do observers at land stations differentiate between swell and wind waves when reporting sea disturbance ? There must be many occasions particularly at the " deep water " stations Scilly and Tiree where swell is of much greater amplitude than would be warranted by wind force alone. Such instances might account for Mr. Champion's conclusion regarding gales from SE. at Tiree causing waves exceeding 10 ft. amplitude. Would not these waves probably be swell from the Atlantic formed by the winds blowing in the right front of a disturbance moving from south-west or west ? From a map it seems most unlikely that SE. winds even of gale force would have sufficient " fetch " to cause such high seas at Tiree.

Thirdly, does not the fact that both Spurn Head and Point of Ayre are at positions where tidal currents meet make possible over-estimation of sea disturbance likely ? Such situations are notorious at certain states of the tide for the pyramidal formation of the waves, and this apart from any wind influence must have some effect on the results. Also the state of the tide must surely make a difference to the state of the sea at Spurn. At dead low water there must surely be a reduction in the "fetch" down the Humber owing to the sandbanks.

Lastly, as regards the greater amplitude ratio of wave to wind in the North Sea, it is surely hardly safe to venture such a conclusion from data taken from a single observing point at Spurn Head. To obtain a truer estimate would not the records of sea disturbance at one of the light-ships, e.g. Outer Dowsing, give a more correct result, and as regards the big Atlantic seas, do they not batter themselves to destruction on the west Irish and Outer Hebridean coasts ?

FRANK EDWARDS.

"*Trevor,*" *Greave, Romiley, Cheshire, December 29th,* 1937.

It must freely be admitted that, as pointed out by Messrs. Blake and Edwards, the results published on the above subject in the December issue of this magazine are somewhat disconcertingly contrary to expectation, but the following points should particularly be noted :—

1. In all eye observations, the personal element is doubtless more pronounced than in instrumental measurements, but the fact that the 18h. observations are included should not have any marked effect, because in winter the darkness frequently is just as intense at 7h. as it is at 18h. ; also, in dealing with the estimation of wave amplitude the observer is noting a phenomenon of considerable dimensions—even in comparative darkness one must admit that errors of several feet are extremely unlikely to be made by routine observers.

Furthermore, even if "subconscious connexion in the observer's mind" were made between a given wind and resultant wave amplitude, it would naturally be based on previous observations made in broad daylight, and there is little reason to assume that the amplitude for a given wind would be any different during hours of darkness.

2. If the waves exceeding 10 ft. in amplitude observed with south-easterly gales at Tiree were due to Atlantic "swell," it is very difficult to understand why a corresponding swell was not observed with winds of equal or higher velocity from the west.

In the case of the intense depression which developed in mid-Atlantic and moved rapidly ENE. towards the Faeroes on the night of December 15th, 1936, giving an almost "straight" fetch for SW. winds of over 1,000 miles across the open sea towards our western shores, it will be noted that at the height of the storm at

18h. (*see* Fig. 1), in spite of " precipitous " seas at Blacksod Point, there was no apparent swell at either Tiree or Scilly, and at Malin Head the sea was described as " slight." At all stations on the east coast of Great Britain except Spurn Head, the seas were slight or

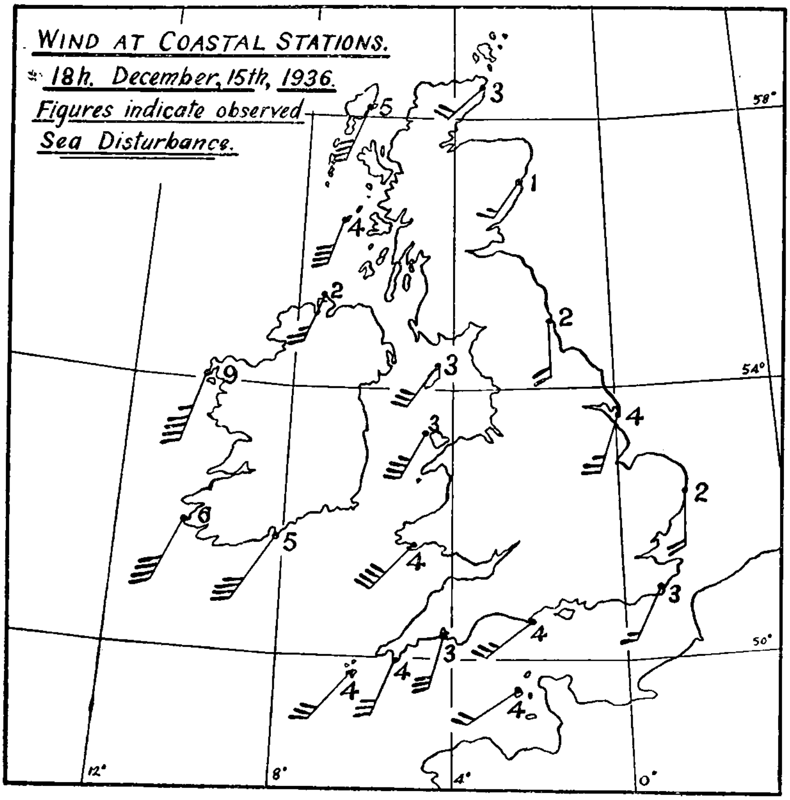


FIG. 1.

moderate ; yet at Spurn, where obviously no Atlantic swell could ever reach, the sea was described as " rough," which seems to indicate something more than " wind-lop."

3. One must agree that where tidal currents meet, the sea disturbance may be increased, but if in this particular case the increased disturbance at Spurn is due to this cause, it is certainly not shown by any marked increase in amplitude at Point of Ayre. It is true that sandbanks at low water must influence the resultant sea disturbance at Spurn, but there is no reason to assume that all gales in any year at this station occur at high water, which makes the higher mean amplitude observed at this station all the more perplexing.

4. Estimates of sea disturbance from points in the North Sea, such as the Outer Dowsing, Outer Gabbard, etc., would certainly give a fairer computation of the roughness of the *open* North Sea, but one could hardly describe such places as " coastal " stations. It is true that big Atlantic seas may, and probably do, " batter themselves to

destruction " on the west coasts of Ireland and the Outer Hebrides, but again, one must admit that neither Tiree nor the Scillies are sheltered from Atlantic rollers from the west ; and one wonders why, with precipitous seas at Blacksod on the night of December 15th, 1936, the seas at Tiree and Malin were only observed to be " rough " and " slight " respectively.

DONALD L. CHAMPION.

7, Robinson Avenue, Goffs Oak, Herts, January 8th, 1938.

Fine coloured Parhelion

On December 12th, 1937 between 3.10–3.20 p.m., a fine mock sun, with full prismatic colours, appeared in the west-south-west at 22 degrees from the sun. This parhelion appeared to be " right," or north of the true sun and was apparently square in shape as if it were a segment cut from a rainbow. The prismatic colours were perfect from the red on the " left " or south side, to violet on the " right " or north limb of the mock sun. The mock sun which normally should have been seen to the " left," or south side of the true sun was obliterated by dark rain clouds. As is usually the case, stormy weather followed this phenomenon.

DONALD W. HORNER.

51, Manor Road, Weston-super-Mare, January 8th, 1938.

Dispersal of Cloud by an Aeroplane

An interesting phenomenon was witnessed here at 14h. 25m. G.M.T. on Friday, November 26th. The sky at the time was covered with very thin stratocumulus cloud and an aeroplane flying horizontally in it was observed to be leaving a path, entirely devoid of cloud. The length of the path was at least half a mile and the width seemed to correspond with the wing span of the aeroplane. The most remarkable feature, however, was the clean-cut nature of the sides of the path, which remained very distinct for a duration of one minute, after which the cloud gradually closed in. The track of the aeroplane was, however, still discernible, and appeared as a long thin cylinder of cloud with a slight roll form which enabled it to be distinguished from the surrounding cloud.

Pilot balloon observations made immediately after the occurrence showed that the cloud was at a height of 3,000 ft. The pilot concerned confirms this height, and states that the layer of cloud was extremely thin. There was a calm at the surface and winds of less than 7 m.p.h. up to 3,000 ft.

The upper air record for Mildenhall at 13h. showed that there was a strong inversion above the cloud layer. In this case any mixing brought about by the propellor would cause a certain amount of heating, but it seems impossible that this could have given the observed effects.

A suggested explanation is that the cloud was swept aside mechanically by the propellor, not closing in immediately behind the machine owing to the presence of the exhaust gases, and to the fact that there was practically no wind.

T. H. KIRK.

Meteorological Station, R.A.F., Dishforth, Thirsk, Yorkshire, December 2nd, 1937.

NOTES AND QUERIES

St. Elmo's Fire in Egypt

In the *Meteorological Magazine* for May, 1937, appears a letter from Mr. W. D. Flower, Sudan Government Meteorologist, describing the occurrence of St. Elmo's fire at Khartoum. Sparks passed between the finger tips of the observer and the bed blankets. He states that this is a common occurrence in the winter, and is due to the accumulation of electricity produced by friction of sand particles raised by the wind.

I have received the following letter from Mr. G. W. Murray, of the Desert Survey of Egypt, describing a striking exhibition of St. Elmo's fire at Aswan. It was in this case not due to electrification of sand particles, as for some days the air had been very clear, but to induction from charged clouds. About that time there was considerable cumulonimbus ; the air was dry, but not so dry as usual at the time of year, humidity being 50 per cent at 8h. and 40 per cent at 14h. on the 5th compared with normal values of 45 per cent and 25 per cent respectively, and there was light rain just before 14h.

"Aswan Dam,
February 6, 1938.

Dear Sutton,

We are at present in camp about one kilometre west of Aswan Dam. The following electrical phenomena took place yesterday and today :

1. My assistant inspector, Khalaf Eff. Mursi, while plane-tabling here yesterday about 200 metres from camp reported that his pencil hissed whenever he put it in a vertical direction, but not in others. One of his instruments emitted a spark. There was thunder and lightning at the time.

2. At 1h.30m. today my wife woke me to show me St. Elmo's fire. She was sleeping in a small bivouac tent with two little poles. Each of these was crowned by a small flame, and everything in the tent fizzed and crackled. She received several small shocks. This stopped after five minutes and she went to bed, but shortly after saw two 'corposants' or balls of fire about the diameter of a five piastre piece (an inch). One ran up a rope and the other floated in the air.

I have often read of these phenomena, but this is the first time I have come across them in thirty years of desert surveying in Egypt.

Yours sincerely,
G. W. Murray."

In this connexion the following incident, reported by Dr. J. Ball and published in *Survey Notes*, Cairo, Vol. I, 1906, is of interest:

"I have just experienced a rather remarkable manifestation of atmospheric electricity whilst occupying the summit of Gebel Dahanib (altitude, 1,270 metres; 30 kilometres inland from Foul Bay, Red Sea) as a trigonometrical station.

About 10.30 a.m. on February 13th, I was observing in cloudy weather, with clouds drifting eastwards not far overhead. On approaching my eye to the eye-piece of the theodolite I received an electric spark above the eye from the instrument. At the same time a rapid succession of sparks about a centimetre long passed between my hand and the tangent screw of the horizontal circle. Before I had time to realise that was happening the whole instrument began to hiss and crackle. Simultaneously my head began to do the same, and I felt a prickly sensation all over it; the men who were with me remarked that my hair stood up stiffly like bristles. My sai was standing near, wearing a headcloth with long fringe, and I noticed that the threads of the fringe stood out stiffly, pointing upwards. A rather dense cloud was passing over at the time, and a few drops of rain fell. I at once ordered a general retreat from the immediate summit, fearing something stronger than I had just witnessed. My assistant endeavoured before descending to close the cap of the theodolite objective, but he received an electric shock in his arm which prevented further attempts.

I remarked in descending that as I clutched the rocks for support (the mountain face is exceedingly rough and steep) sparks passed between my hands and the rock. We remained away from the summit till the cloud had passed well over. On re-approaching the instrument twenty minutes later I found it uncharged.

The phenomena were evidently due to induction from a highly electrified cloud. The theodolite had a dry wooden tripod. I was wearing ordinary boots with nails in the sole. I stand slightly higher than the instrument. The hissing and crackling of both instrument and my hair seemed to show that both of us were acting as discharge points, and that the difference of potential between us was due to unequal efficiency as dischargers.

I may add that there was no sign of lightning or anything to indicate a special electrical condition of the air until I felt the spark, and nothing further was noticed beyond what I have stated. While no one would think of remaining on a high peak during a thunder-storm, the experience would tend to show that caution is advisable at mountain stations in cloudy weather even when there is no sign of thunder or lightning. The potential gradient may evidently be many thousands of volts per metre without a disruptive discharge, but when one takes sparks a centimetre or more long from one's theodolite one is inclined to wonder how much the conditions would need to be intensified for a lightning-stroke to occur and put a finish to one's geometrical activities."

L. J. SUTTON.

A Remark on " Divergent Winds "

In reading through the leading article in the December number of the *Meteorological Magazine* I was struck by the sentence: " The characteristic of this type of distribution is that the isobars, running fairly parallel from west to east over the western Atlantic open out over southern England, giving divergent winds and very pleasant weather ". It is natural for anyone familiar with the elements of dynamical meteorology immediately to connect divergence with subsidence and fair weather, so that it is fair to assume that the writer of the article implied a causal connexion between the winds and the weather. Whether or not such a connexion was intended, it is to be observed that " divergent ", according to the context, signifies merely a spreading out of the isobars, a very different matter from " divergence " as understood dynamically. It is a well-known fact that if the winds are everywhere geostrophic there is, very rigorously, no divergence or convergence however the isobars may run—the isobars may be regarded as defining tubes of flow through which the air moves, faster where the tube is narrow, more slowly where the tube is wide but, as in the case of the flow of water through a pipe of variable bore, with no accumulation or loss anywhere.

The winds are of course never more than approximately geostrophic and it is the departure from the geostrophic value which determines all divergence. The effect of spreading isobars upon the " geostrophic departure " is not difficult to determine with certain approximations, but theory does not suggest that the effect is such as to produce simple divergence. (It tends rather to produce divergence on the low pressure side balanced by convergence on the high pressure side due to an outflow across the isobars from low to high, other causes of divergence being ignored.)

In view of this fact there seems no obvious physical justification for the simple association of " divergent winds " with " pleasant weather ". Even if experience were to suggest such an association it would I think, without being pedantic, be desirable to avoid the use of the word " divergent " in this connexion if confusion is to be avoided.

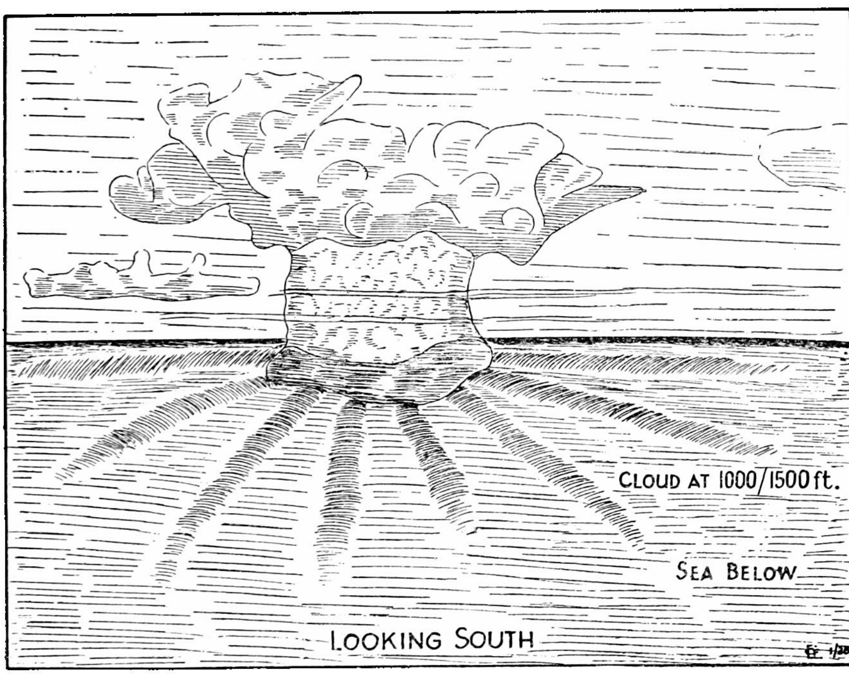
The article referred to was a discussion of average pressures and weather over a period of months and one is interested to learn that the summarized climatic data broadcast monthly are being charted regularly in the Meteorological Office. How one longs to see the charts studied critically and regularly in the manner of synoptic charts! Is there not scope for the classification of different types with an attempt at discovering some sort of connexion between pressure and weather somewhat similar perhaps to the old empirical rules of the early days of forecasting? But perhaps this work is already in hand and we may hope to see further discussions in the Magazine. The problem of seasonal forecasting is always at the back of one's mind and here we have at any rate a possible mode of attack.

R. C. SUTCLIFFE.

[Whatever the explanation, a pressure distribution of the type shown in Fig. 1 of the *Meteorological Magazine* for December, 1937, p. 254, does appear to be definitely associated with fine summer weather in England. The same type occurred in connexion with the droughts of 1887 and 1921, as illustrated in the *Quarterly Journal* of the Royal Meteorological Society, Vol. 48, 1922, p. 158, and on p. 167 of the same issue Mr. Carle Salter referred to the association as being well known. He used the term " fanning out " of the winds however, instead of divergence. The same type reappeared in the drought of 1933 and was illustrated in the *Quarterly Journal* for 1934, p. 51.—Ed. *M.M.*]

Curious cloud formation

We are indebted to Sergeant Winton, of the Royal Air Force Station, Boscombe Down, Wiltshire, for the accompanying sketch of a curious cloud formation observed from the air off the South Devon



coast on November 1st, 1937. Mr. C. V. Ockenden, Meteorological Officer at Boscombe Down, supplies the following particulars :— "A shallow depression was centred in the western English Channel. Conditions were mainly fair in the west, but much low cloud and rain were encountered on the return journey eastward of Yeovil. It is not improbable that the large cumulus up to 9,000 ft. was quite close to the centre of the depression. The pilot was flying at 10,000 ft., and he estimates his distance from the towering cloud to be 12 to 15 miles."

The main body of the cloud with its anvil-like development is typical of a large cumulus cloud, but the radiating bands extending horizontally from the cloud base are remarkable. A continuous layer of low cloud was observed farther east and it is reasonable to suppose that the air at this level was almost saturated, and so required little upward motion to produce condensation. One is tempted to visualize a wave motion circulating round the cloud base although it is doubtful whether such an explanation would be dynamically acceptable. Judging from the diagram the bands might, however, be regarded as radiating from a point on the horizon rather than from the cloud base, in which case they would be parallel. The formation might therefore have to be explained as merely an illusion of perspective.

Rainfall in North and North-West Spain

A correspondent to the Editor of the *Meteorological Magazine* has drawn attention to reports of bad weather experienced by the opposing forces engaged in the Spanish civil war, particularly in the Bilbao sector, where Gen. Franco's forces were impeded by rain, wind and mist right up to the end of June. His impression appears to be that by the end of June, the weather in Spain should be fairly dry and quiet, unless the northern area differs from the remainder of the Iberian Peninsula. Alternatively, he suggests that conditions for 1937 are abnormal.

Unfortunately, regular reports are no longer received from Spain so that it is not possible to determine if conditions were abnormal last year, but an examination of rainfall averages indicates that there is definitely a considerable difference between the weather along the northern coast and that of the interior.

The prevailing NW. wind in advance of the Azores anticyclone brings most of the bad weather to northern Spain, and rain is deposited in large amounts (comparable with the rainfall of the west coast of Ireland) on the coastal slopes of the Cantabrian Mountains. Immediately to the south of this range there is a marked decrease followed by a steady decline southwards to the interior. In order to illustrate this, a table of averages is included for selected places ranging from the north coast of Spain to the interior at Madrid. The selected places are Santander, Bilbao and San Sebastien on the northern coast ; Vitoria (30 miles inland from Bilbao) ; Burgos, to the south of the Cantabrian range ; Valladolid and Salamanca on the plateau between the Cantabrian Mountains and the Sierra de Guarderrama ; and, finally, Madrid, to the south of the Sierra de Guarderrama.

The variations of rainfall are clearly indicated by this table, and the following interesting points are observed :—

(*a*) The large falls along the coast compared with the interior.

(*b*) The exceptional total for San Sebastien. This is probably due to the westerly exposure of the station rather than to the height which is only 75 ft. above mean sea level.

(*c*) The driest months at San Sebastien are wetter than any month of the year at any station in the interior with the exception of Vitoria in May.

(*d*) At Vitoria, which is only 30 miles inland, the annual total is approximately half of that of the coast.

(*e*) At Madrid, the total fall is approximately one-third of that of the coast.

	Santander.	Bilbao.	San Sebastien.	Vitoria.	Burgos.	Valladolid.	Salamanca.	Madrid.
	in.	in.	in.	in.	in.	in.	in.	in.
January ...	4·6	4·3	6·5	2·6	0·9	0·9	1·0	1·3
February ...	3·5	3·7	4·5	2·8	1·9	2·0	1·9	1·3
March ...	3·7	4·4	4·8	2·8	2·4	2·2	2·4	1·6
April... ...	3·4	3·9	3·0	2·4	1·4	1·4	1·0	1·7
May	2·7	3·2	5·0	4·1	2·2	1·6	1·0	1·7
June ...	2·0	3·1	3·9	1·8	1·5	1·2	1·4	1·3
July	1·9	2·2	3·3	1·5	0·9	0·6	0·6	0·4
August ...	2·3	2·0	3·3	1·3	0·6	0·6	0·5	0·5
September ...	3·7	3·7	5·4	2·0	1·3	1·2	0·9	1·5
October ...	6·6	4·9	5·6	3·1	2·2	2·0	1·6	1·8
November ...	7·0	5·1	6·7	3·2	2·8	3·2	2·6	2·0
December ...	5·3	5·1	5·5	3·2	2·4	1·9	1·9	1·6
Year ...	46·7	45·6	57·5	30·8	20·5	18·8	16·8	16·7

It should be pointed out that the averages included in the table (with the exception of Bilbao and Madrid) are only for the five years 1925 to 1929, and were extracted from the *Resumen de las Observaciones* of the Spanish Meteorological Service. They appear to be sufficient, however, to indicate that conditions last year were not necessarily abnormal in the Bilbao sector and that near the northern coast considerable rainfall may be expected up to the end of June.

E. L. CLINCH.

REVIEWS

Icing measurements on Mount Washington. By S. Pagliuca. J.aero.Sci., New York, 4, 1937, pp. 399–402.

In a recent paper* on ice formation as affecting aircraft it was suggested that the ideal place for the study of this problem would be at one of the mountain top observatories. An account of a series of tests on a metal model of an aeroplane wing during a rime-forming fog is given by the author whilst on a vist to Mount Washington (1915m.) on February 4th, 1936. The model was installed 5 metres above the ground and free to adjust itself to windward. Measurements of rate of deposit and density (weight of water per unit volume) of

* *London, Prof. Notes, met. Off.*, 6, No. 81, 1937.

deposit were taken at frequent intervals, the latter being obtained by melting a known volume of ice. At the time of the tests the air supply was of polar maritime origin with temperature ranging from —9° C. to —15° C., specific humidity from 1·4 to 2·2 gm/Kg. and wind velocity from 50 to 150 Km./hr. As would be expected at fairly low temperatures the deposit was slight, 0·4 to 1·7 cm./hr., the description being hard rime in nearly all tests. This was found to have a similar density to that of ordinary ice, but two samples of soft rime had considerably lower densities. Tests were also made on two vertical rods of different diameters and it is evident from the results that the rate of deposit, as well as the average density, varied considerably with the exposure and shape of the test object. The wind distribution was the chief factor and three very interesting photographs are included in the paper showing the increasing length of rime formation with height above ground, a direct result of increasing velocity with height. Rime-forming fogs are very frequent on Mount Washington and it is to be hoped that the results of further tests will be published, including if possible, data concerning the size and number of supercooled water drops concerned in the production of the ice deposits.

W. H. Bigg.

The Climate of the Netherlands. E. Evaporation. By Dr. C. Braak. K. Ned. Meteor. Inst., No. 102, Med. en Verh. 39, pp. 34 (Dutch) + 16 (English summary). *Illus.*, 's-Gravenhage, 1936.

This memoir on evaporation forms the fifth part of an official publication on the climate of the Netherlands. The first two parts, A and B, dealing with rainfall and temperature appeared as long ago as 1913 and 1918 under the authorship of C. M. A. Hartman. The later volumes are by Dr. C. Braak. Of these, C. Pressure and D. Wind appeared together in 1929. In 1930 additional information was published about temperature and in 1933–4 a revised edition of Part A, Rainfall.

The text of the volumes is in Dutch but there is a very full English summary, amounting almost to a translation, and the headings of the tables are given in both languages.

The paper is divided into four parts. The first deals with observations from water surfaces. The standard observations are those made at De Bilt since 1909 using a balance and a shallow brass reservoir with a surface of 400 sq. cm. which is protected against strong winds and radiation from the sides by a white metal cylinder. The average annual evaporation from these measurements is 825 mm., the monthly averages varying from 15 mm. in December to 133 mm. in June and July. With these figures the data at some 16 stations in various parts of the Netherlands are compared, and it is pointed out that the differences in the results are due more to differences in the types of instruments and their exposure than to true differences in climate.

In the second part a short account is given of other observations than those of free water surfaces.

The third part discusses the annual and diurnal variation of evaporation at De Bilt and Den Helder and on the isle of Schokland in the Yssel-lake (the former Zuider Zee). Incidentally, the difficulties which arise from the introduction of " summer time " are illustrated by the fact that, in discussing the diurnal variation, data for the later years have had to be omitted on account of a shift in the time of observation during part of the year.

The paper concludes with a calculation of the constants in the well-known formula connecting evaporation with temperature, wind-velocity and difference of vapour pressure from saturation.

BOOKS RECEIVED

A study of correlation coefficients of mean maximum temperatures between successive months at a few selected stations in India. By R. J. Kalamkar, Ph.D. India, Meteor. Dept., Sci. Notes, Vol. VII, 1936, No. 70.

Ergebnisse Aerologischer Beobachtungen, 24, 1935. K. Ned. Meteor. Inst. (No. 106A) Utrecht, 1936.

OBITUARY

We regret to learn of the death of Dr. G. E. Hale, one of the founders of Yerkes and Mount Wilson Observatories, on February 22nd, at Pasadena, California.

NEWS IN BRIEF

A gold medal has been awarded to the Director of the Meteorological Office by the Committee of the 1937 International Exhibition in Paris for the exhibit of apparatus used in the Meteorological Office for the exploration of the upper atmosphere.

On February 28th, 1938, Prof. E. van Everdingen retired from his position as Director of the Koninklijk Nederlandsch Meteorologisch Instituut. He is succeeded by Dr. H. G. Cannegieter.

Prof. Dr. H. v. Ficker, Director of the Austrian Zentralanstalt für Meteorologie und Geodynamik, in succession to Dr. W. Schmidt, has been awarded the Hellmann Silver Medal, and has been elected an honorary member of the German Meteorological Society.

A branch of the German Meteorological Society has been founded at Frankfurt a.M., incorporating the Frankfurt Forschungsinstitut and the Rhine-Main section of the Reichswetterdienst. The President is Prof. Dr. F. Linke, Vice-President: Dr. F. Baur.

We learn that Prof. M. N. Saha of the Allahabad University has been elected President of the National Institute of Sciences of India.

The seventeenth Annual Dinner of the Meteorological Office staff, Shoeburyness, was held at the Palace Hotel, Southend-on-Sea, on Saturday, February 12th. The guests of the staff were Mr. J. S. Dines, M.A., Superintendent for Army Services, and Col. F. N. C. Rossiter, R.A., the Superintendent of Experiments, Shoeburyness. After the dinner an excellent entertainment was given by members of the staff.

The Weather of February, 1938

Pressure was very high over central and southern Europe, exceeding 1020 mb. from lat. 57° N. to the Mediterranean and 1025 mb. over southern Ireland, southern England, most of France, Switzerland, Austria and Czechoslovakia. An area of low pressure (below 1005 mb.) extended from south of Greenland across Jan Mayen to the Barents Sea, falling below 1000 mb. over Spitsbergen and Bear Is. A tongue of low pressure extended southwards in mid-Atlantic to 40° N. Pressure was above 1025 mb. in the Siberian anticyclone, which extended nearly to the Arctic coast of east Siberia, and as in January there was a steep gradient for southerly winds in the Kara Sea. Pressure was also above 1025 mb. over most of Canada, falling to below 1010 mb. in the north Pacific. Pressure was 10 mb. or more above normal over the British Isles, the Faeroes and Iceland, and also in central Canada and Alaska. The Barents Sea was 10 mb. below normal and the Azores 5 mb. below.

Weather was again abnormally warm in many parts of the Arctic. The strong south-westerly winds were reflected in a tongue of high temperature extending across Scandinavia and the Barents Sea to the north of Novaya Zemlya; northern Sweden (25°–30° F.) and Spitsbergen (19° F.) were more than 10° F. above normal. The British Isles with averages of 40°–45° F. were slightly above normal, as was central Europe, while in Turkestan and southern Siberia the excess was more than 5° F. The " cold pole " however, with −35° F. at Jakutsk, was 3° F. colder than usual. The United States was abnormally warm, temperatures of 50° F. south of Chicago representing an excess of 9° F., but north-east Canada was very cold, the figure of −21° F. at Dawson being 10° F. below normal.

Precipitation was generally scanty over the whole of Europe except for local marked excesses of 4 in. at Malta and Athens. Northern Asia was also dry on the whole. North America was dry except for local areas of heavy rains north-west of the Great Lakes (Minnedosa nearly 4 in.), and on the Pacific coast of the United States, where disastrous floods occurred. At San Francisco the rainfall for the month was 9 in. or 6 in. above normal.

Over Australia, the East Indies and the West Pacific pressure was below normal, especially in south-east Australia (Hobart−8 mb.). The low pressure area in the interior of Australia was more intense and extended further to the south-east than usual. New Zealand was normal. Temperature was several degrees below normal in central Australia but above normal in eastern Australia and New Zealand, the excess being more than 5° F. at Brisbane and over most of New Zealand. Rainfall was very heavy in the north-east of West Australia, the Northern Territories, South Australia and northern Queensland, exceeding 6 in. in many districts, and 12 in. locally; rainfall was also much above normal in most of New Zealand.

The earlier part of the month was stormy and mild, but depressions moving south-east in the middle of the month brought arctic air to the British Isles. The cold spell was accompanied by northerly gales in the North Sea, and as this period corresponded with spring tides considerable damage was done in eastern coastal districts. Quieter anticyclonic conditions with night fog and frost followed, but the mild stormy weather returned at the close of the month. Rainfall was generally scanty, some areas receiving only 23–30 per cent of the normal. Sunshine was slightly below average in the Midlands, but elsewhere about normal. An intense depression centred to the north of Scotland brought widespread westerly gales on the 1st, gusts of 85 m.p.h. and 82 m.p.h. being recorded at the Lizard and Pembroke respectively; rain and hail fell in most districts. Temperatures rose generally from the 2nd–4th and winds remained high reaching gale force again on the 3rd and 4th. There was little rain but considerable sunshine, the Channel Islands recording 6–8 hrs. on the 5th, and Scotland and Ireland on the 6th. Aurora was observed in north Scotland on the 1st, 5th, 6th and 8th. Fog was reported locally from the 6th to 9th. Minimum temperatures were low in Scotland on the 7th. The 9th to 13th saw a return to squally conditions, and gales were reported every day. Rain fell heavily on the 9th, 1·37 in. being recorded at Blaenau Festiniog, Merionethshire. Snow and hail fell in Scotland and the north on the 10th; temperatures were high in England, screen minima of 49° F. being recorded at Ross-on-Wye and Falmouth, and thunderstorms were reported from Kew and Whitstable. Complex depressions moving south-east from the Baltic on the 11th and 12th brought colder weather and northerly gales. An anticyclone spread eastwards from Ireland, and centred over Scotland on the 14th. Temperatures were generally low, maxima of 35° F. being recorded generally in the south on the 14th–16th. In Scotland Dalwhinnie had a screen minimum of 17° F. on the 16th, with grass minimum of 8° F. Snow and hail fell locally in all districts except north Scotland from the 11th–17th, being particularly severe in the south-east of England where drifts up to 8 ft. were formed. There was considerable sunshine over the whole country except the Channel Islands on most days, Oban recording 9·1 hrs. on the 17th and 8·7 hrs. on the 18th; Hastings 9·0 hrs. on the 19th and Plymouth 9·1 hrs. on the 20th. Temperature rose generally on the 18th and 19th, but fell in the south on the 22nd, when maxima of 35° F. were again reported. Snow fell in Dublin on the 21st and 22nd. Good sunshine records were obtained in the Channel Isles on the 20th–24th, in England on the 23rd—over 9 hrs. at several places in the south—and generally on the 24th. A depression extending from Greenland to the Azores moved eastwards on the 24th and brought rain to Ireland. Temperature rose rapidly on the 25th and 26th when Nottingham had a maximum of 60° F. on the 25th, and Dublin on the 25th and 26th. The maximum of 59° F. at Ross-on-Wye on the 25th was the highest since 1921. Rain fell generally on the 25th and 26th, the heaviest falls being 1·44 in. at Rhayader and 1·27 in. at Ponterwyd, Cardigan, on the 26th. Fog was reported daily in south Scotland, north and east England from the 20th–26th. Deep depressions crossing the country brought renewed southerly gales to the north, west and south coasts on the 26th–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 ..	52	− 3	Chester ..	56	− 6
Aberdeen ..	62	− 8	Ross-on-Wye	54	−15
Dublin	53	−22	Falmouth ..	70	−10
Birr Castle ..	69	+ 3	Gorleston ..	83	+ 8
Valentia ..	71	+ 5	Kew.. ..	70	+ 9

Kew, Temperature, Mean, 40·1, Diff. from average — 1·2.

Miscellaneous notes on weather abroad culled from various sources. After several days of sunny weather snow fell in Switzerland on the 9th down to the 3,000 ft. level—ski-ing conditions improved and remained good throughout the month. Gales were reported from the North Sea on the 10th, and on the 11th and 14th from the north Mediterranean coasts, where shipping was delayed and air services from Marignane suspended. Rain fell on the Riviera on the 16th breaking the drought which, with bright sunshine, has prevailed since December. Heavy rain and snow caused flooding in the Naples district on the 17th. (*The Times*, February 11th–18th.)

Floods followed heavy rain near Smyrna on the 5th, much property was damaged and 13 villages isolated. A series of blizzards over South Sakhalin from the 17th–20th caused avalanches which destroyed many houses and killed 116 people. (*The Times*, February 5th–21st.)

Torrential monsoon rains fell in Northern Territory and Central and South Australia during February, and the extensive floods resulted in the breakdown of railway and telegraphic communication, but opened up arid land for grazing. Adelaide experienced the wettest February since records began 100 years ago. A cloudburst in Hawkes Bay, New Zealand caused a torrent to overwhelm a camp and 21 people were drowned. (*The Times*, February 21st-28th.)

A sharp thaw and rain in Ontario on the 5th, followed by a keen frost gave icy roads and all traffic was suspended. Floods were reported from Wisconsin on the 5th and 6th and from the Mohawk River region of New York State, and the Canadian Thames on the 7th. Violent gales on the Californian coast on the 9th caused the death of six people and much damage to trees and property. A blizzard swept across the Prairie Provinces of Canada on the 13th–14th. After a month of northerly winds the north-east coast of Newfoundland was reported to be completely blocked by ice on the 25th and all navigation ceased. A blizzard in Ontario on the 28th was accompanied by a sharp drop in temperature, the fall being as much as 30° F. in a few hours at some places. (*The Times*, February 8th–March 1st.)

Daily Readings at Kew Observatory, February, 1938

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	1000·3	SW.5	39	45	61	0·01	5·5	r_0 1h., pr_0 13h., 14h.
2	1014·9	W.4	38	48	69	—	1·1	pr_0 15h., 17h.
3	1027·3	SW.3	41	54	74	—	1·3	
4	1031·5	SW.4	42	52	63	—	0·7	
5	1024·4	SSW.3	41	51	64	—	4·8	
6	1029·6	WSW.1	35	49	73	—	0·1	x early, f 9h.–13h.
7	1029·2	NE.4	40	46	73	—	0·0	f 9h., m 15h.
8	1023·7	SSE.1	41	45	77	—	0·1	
9	1021·5	SW.4	40	48	72	Trace	3·3	r_0 13h., 14h.–15h.
10	1015·9	NNW.5	45	53	83	0·06	1·5	ir_0–r 11h.–13h. R 12h.
11	1036·0	NNW.3	34	43	50	—	6·8	
12	1017·8	NW.5	35	50	50	—	5·3	pr_0 15h., 23h.
13	1024·1	NNE.5	35	41	64	—	3·6	r_0 6h., is_0 19h.–20h.
14	1025·2	NE.4	32	36	72	Trace	3·6	is_0 7h.–9h., 13h., 21h.
15	1024·3	NE.5	32	37	62	—	0·0	is_0 most of day.
16	1025·5	NE.4	34	36	82	0·01	0·0	ir_0 6h.–18h., s_0 9h.
17	1022·5	ENE.4	35	38	87	0·08	0·0	r_0s_0–s 11h.–16h.
18	1026·8	NE.5	31	50	54	—	6·0	x early.
19	1031·3	NE.4	36	44	77	—	4·1	
20	1035·5	NNE.4	33	43	78	—	1·6	x early.
21	1032·3	NE.3	38	40	77	—	0·0	m 8h.–16h.
22	1027·5	NE.2	34	37	72	—	0·0	m 21h., f 22h.–24h.
23	1027·9	E.3	33	44	63	—	4·2	fx early, m till 10h.
24	1027·2	SE.2	32	46	67	—	6·3	fx till 10h., x late.
25	1024·1	SSE.3	28	56	63	—	1·8	Fx–fx till 10h.
26	1017·9	S.3	47	55	71	0·12	1·8	r_0–r 7h.–9h., 18h.–20h
27	1027·8	W.5	42	50	48	0·02	6·4	ir_0 17h.–23h.
28	1024·0	SSW.5	45	53	78	0·01	0·0	r–r_0 24h.
*	1024·9	—	37	46	69	0·31	2·5	* Means or Totals.

General Rainfall for February, 1938

England and Wales	52	per cent of the average 1881–1915.
Scotland	80	
Ireland	66	
British Isles ...	62	

Rainfall : February, 1938 : England and Wales

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
Lond .	Camden Square..........	·48	29	*Leics* .	Thornton Reservoir ...	·90	54
Sur .	Reigate, Wray Pk. Rd..	·89	41	,, .	Belvoir Castle............	·87	52
Kent .	Tenterden, Ashenden...	1·07	54	*Rut* .	Ridlington	·99	60
,, .	Folkestone, Boro. San.	1·35	...	*Lincs* .	Boston, Skirbeck.........	·87	60
,, .	Margate, Cliftonville....	·64	46	,, .	Cranwell Aerodrome...	1·44	96
,, .	Eden'bdg., Falconhurst	1·24	56	,, .	Skegness, Marine Gdns.	·56	37
Sus .	Compton, Compton Ho.	·54	20	,, .	Louth, Westgate.........	·92	48
,, .	Patching Farm..........	·86	39	,, .	Brigg, Wrawby St.......	1·19	...
,, .	Eastbourne, Wil. Sq....	·97	44	*Notts* .	Mansfield, Carr Bank...	·59	31
Hants.	Ventnor, Roy.Nat.Hos.	1·08	51	*Derby*.	Derby, The Arboretum	·61	36
,, .	Southampton,East Park	·68	30	,, .	Buxton, Terrace Slopes	2·49	66
,, .	Ovington Rectory.......	·73	28	*Ches* .	Bidston Obsy.............	·43	26
,, .	Sherborne St. John......	·51	23	*Lancs*.	Manchester, Whit. Pk.	1·07	56
Herts .	Royston,Therfield Rec.	·40	26	,, .	Stonyhurst College......	2·11	63
Bucks.	Slough, Upton............	·35	21	,, .	Southport, Bedford Pk.	1·09	52
Oxf .	Oxford, Radcliffe.........	·83	51	,, .	Ulverston, Poaka Beck	1·71	46
N'hant	Wellingboro, Swanspool	·80	50	,, .	Lancaster, Greg Obsy.	1·55	54
,, .	Oundle	·61	...	,, .	Blackpool	1·13	50
Beds .	Woburn, Exptl. Farm...	·63	43	*Yorks*.	Wath-upon-Dearne......	1·09	66
Cam .	Cambridge, Bot. Gdns.	·44	34	,, .	Wakefield,Clarence Pk.	·81	47
,, .	March......................	·75	58	,, .	Oughtershaw Hall.......	4·51	...
Essex .	Chelmsford,County Gdns	·47	32	,, .	Wetherby, Ribston H..	1·97	114
,, .	Lexden Hill House......	·49	...	,, .	Hull, Pearson Park......	·90	54
Suff .	Haughley House.........	·78	...	,, .	Holme-on-Spalding......	1·27	76
,, .	Rendlesham Hall........	·71	51	,, .	Felixkirk, Mt. St. John.	2·16	128
,, .	Lowestoft Sec. School...	·76	54	,, .	York, Museum Gdns....	1·26	83
,, .	Bury St. Ed., WestleyH.	·97	65	,, .	Pickering, Houndgate...	1·20	69
Norf. .	Wells, Holkham Hall...	·85	57	,, .	Scarborough..............	·98	58
Wilts .	Porton, W.D. Exp'l. Stn	·60	30	,, .	Middlesbrough...........	1·40	108
,, .	Bishops Cannings........	1·14	54	,, .	Baldersdale, Hury Res.	1·67	55
Dor .	Weymouth, Westham.	·69	32	*Durh* .	Ushaw College...........	1·34	84
,, .	Beaminster, East St....	1·48	49	*Nor* .	Newcastle, Leazes Pk...	·98	64
,, .	Shaftesbury,Abbey Ho.	·78	34	,, .	Bellingham, Highgreen	1·34	53
Devon.	Plymouth, The Hoe....	1·29	43	,, .	Lilburn Tower Gdns....	1·24	62
,, .	Holne, Church Pk. Cott.	3·35	61	*Cumb*.	Carlisle, Scaleby Hall...	1·08	48
,, .	Teignmouth, Den Gdns.	·89	33	,, .	Borrowdale, Seathwaite	6·75	60
,, .	Cullompton	1·28	46	,, .	Thirlmere, Dale Head H.	5·26	69
,, .	Sidmouth, U.D.C.........	·82	...	,, .	Keswick, High Hill......	2·37	48
,, .	Barnstaple, N. Dev.Ath	1·20	44	,, .	Ravenglass, The Grove	1·57	51
,, .	Dartm'r,Cranmere Pool	4·90	...	*West* .	Appleby, Castle Bank...	1·29	44
,, .	Okehampton, Uplands.	1·92	44	*Mon* .	Abergavenny, Larchf'd	1·03	32
Corn .	Redruth, Trewirgie......	2·27	60	*Glam* .	Ystalyfera, Wern Ho....	4·14	81
,, .	Penzance, Morrab Gdns.	2·11	63	,, .	Treherbert, Tynywaun.	5·41	...
,, .	St. Austell, Trevarna...	2·31	60	,, .	Cardiff, Penylan..........	1·83	62
Soms .	Chewton Mendip.........	1·77	53	*Carm* .	Carmarthen,M. & P. Sch.	2·29	59
,, .	Long Ashton............	1·11	47	*Pemb* .	Pembroke,Stackpole Ct.	1·64	59
,, .	Street, Millfield..........	·84	43	*Card* .	Aberystwyth	1·57	...
Glos .	Blockley	·83	...	*Rad* .	BirmW.W.Tyrmynydd	3·77	72
,, .	Cirencester, Gwynfa....	·98	43	*Mont* .	Newtown, Penarth Weir	1·36	54
Here .	Ross-on-Wye.............	·69	34	,,	Lake Vyrnwy	3·37	74
Salop .	Church Stretton.........	·88	40	*Flint* .	Sealand Aerodrome......	·48	31
,, .	Shifnal, Hatton Grange	·37	23	*Mer* .	Blaenau Festiniog	5·78	78
,, .	Cheswardine Hall........	·73	41	,, .	Dolgelley, Bontddu......	3·32	57
Worc .	Malvern, Free Library...	·66	37	*Carn* .	Llandudno	·47	24
,, .	Ombersley, Holt Lock.	·48	29	,, .	Snowdon, L. Llydaw 9..	10·65	...
War .	Alcester, Ragley Hall...	·55	33	*Ang* .	Holyhead, Salt Island...	·92	38
,, .	Birminghm, Edgbaston	·89	53	,, .	Lligwy	1·17	...

Rainfall : February, 1938 : Scotland and Ireland

Co.	Station.	In.	Per cent of Av.	Co.	Station.	In.	Per cent of Av.
I. Man	Douglas, Boro' Cem....	1·62	51	*R&C* .	Achnashellach............	7·83	108
Guern.	St.Peter P't.Grange Rd.	1·65	67	,, .	Stornoway,C.GuardStn.	3·56	84
Wig .	Pt. William, Monreith.	2·04	66	*Suth* .	Lairg..........................	3·20	103
,, .	New Luce School.........	2·94	77	,, .	Skerray Borgie............	4·04	...
Kirk .	Dalry, Glendarroch......	3·92	77	,, .	Melvich......................	2·56	86
Dumf.	Dumfries,Crichton R.I.	1·99	65	,, .	Loch More, Achfary....	8·32	126
,, .	Eskdalemuir Obs........	4·48	91	*Caith* .	Wick..........................	2·05	90
Roxb .	Hawick, Wolfelee........	1·58	48	*Ork* .	Deerness	2·82	94
Peeb .	Stobo Castle..............	1·26	46	*Shet* .	Lerwick Observatory...	2·40	76
Berw .	Marchmont House......	·85	41	*Cork* .	Cork, University Coll...	3·11	83
E.Lot .	North Berwick Res.....	·46	30	,, .	Roches Point, C.G. Stn.	2·38	64
Midl .	Edinburgh, Blackfd. H.	·58	35	,, .	Mallow, Longueville....	3·42	101
Lan .	Auchtyfardle	1·49	...	*Kerry*.	Valentia Observatory...	3·59	69
Ayr .	Kilmarnock, Kay Park	1·73	...	,, .	Gearhameen...............	9·50	107
,, .	Girvan, Pinmore.........	2·75	64	,, .	Bally McElligott Rec...	2·72	...
,, .	Glen Afton, Ayr San....	3·68	84	,, .	Darrynane Abbey.......	2·94	63
Renf .	Glasgow, Queen's Park	2·10	71	*Wat* .	Waterford, Gortmore...	2·30	71
,, .	Greenock, Prospect H..	4·33	82	*Tip* .	Nenagh, Castle Lough.	1·72	55
Bute .	Rothesay, Ardencraig...	3·06	77	,, .	Cashel, Ballinamona....	2·28	72
,, .	Dougarie Lodge..........	1·99	53	*Lim* .	Foynes, Coolnanes......	1·61	50
Arg .	Loch Sunart, G'dale....	7·49	125	*Clare* .	Inagh, Mount Callan....	2·91	...
,, .	Ardgour House..........	15·00	...	*Wexf* .	Gorey, Courtown Ho...	1·59	57
,, .	Glen Etive.................	...	...	*Wick* .	Rathnew, Clonmannon.	1·17	...
,, .	Oban.........................	4·98	...	*Carl* .	Bagnalstown,Fenagh H.	2·16	85
,, .	Poltalloch..................	4·35	101	,, .	Hacketstown Rectory...	1·78	59
,, .	Inveraray Castle.........	12·62	186	*Leix* .	Blandsfort House.......	1·90	71
,, .	Islay, Eallabus............	3·39	81	*Offaly*.	Birr Castle................	1·44	63
,, .	Mull, Benmore............	14·60	131	*Kild* .	Straffan House...........	1·17	54
,, .	Tiree	3·26	95	*Dublin*	Dublin, Phoenix Park..	·59	33
Kinr .	Loch Leven Sluice.......	·95	34	,, .	Balbriggan, Ardgillan...	...	...
Fife .	Leuchars Aerodrome...	·47	27	*Meath*.	Kells, Headfort..........	1·55	57
Perth .	Loch Dhu..................	9·25	124	*W.M* .	Moate, Coolatore.........	1·38	...
,, .	Crieff, Strathearn Hyd.	2·48	70	,, .	Mullingar, Belvedere...	1·66	60
,, .	Blair Castle Gardens....	1·97	71	*Long* .	Castle Forbes Gdns......	2·08	73
Angus.	Kettins School............	·67	29	*Gal* .	Galway, Grammar Sch.	·96	32
,, .	Pearsie House............	1·17	...	,, .	Ballynahinch Castle....	4·62	90
,, .	Montrose, Sunnyside...	·84	46	,, .	Ahascragh, Clonbrock.	2·32	75
Aber .	Balmoral Castle Gdns..	1·36	52	*Rosc* .	Strokestown, C'node.....	1·91	72
,, .	Logie Coldstone Sch....	1·24	60	*Mayo*.	Blacksod Point..........	3·07	76
,, .	Aberdeen Observatory.	1·03	50	,, .	Mallaranny	4·21	...
,, .	New Deer School House	1·42	67	,, .	Westport House.........	2·16	55
Moray	Gordon Castle............	1·40	73	,, .	Delphi Lodge.............	8·25	98
,, .	Grantown-on-Spey	2·13	100	*Sligo* .	Markree Castle...........	2·48	71
Nairn.	Nairn	1·11	62	*Cavan*.	Crossdoney, Kevit Cas..	1·93	...
Inv's .	Ben Alder Lodge.........	7·06	...	*Ferm* .	Crom Castle..............	2·50	85
,, .	Kingussie, The Birches.	2·46	...	*Arm* .	Armagh Obsy............	1·19	54
,, .	Loch Ness, Foyers	...	...	*Down*.	Fofanny Reservoir......	4·02	...
,, .	Inverness, Culduthel R.	1·13	50	,, .	Seaforde	1·76	58
,, .	Loch Quoich, Loan......	19·63	...	,, .	Donaghadee, C. G. Stn.	1·20	52
,, .	Glenquoich.................	16·72	162	*Antr* .	Belfast,Queen's Univ....	1·21	49
,, .	Arisaig House............	5·08	102	,, .	Aldergrove Aerodrome.	1·05	44
,, .	Glenleven, Corrour......	9·03	137	,, .	Ballymena, Harryville.	2·01	62
,, .	Fort William, Glasdrum	12·86	...	*Lon* .	Garvagh, Moneydig....	2·65	...
,, .	Skye, Dunvegan.........	6·26	...	,, .	Londonderry, Creggan.	2·69	84
,, .	Barra, Skallary.........	3·06	...	*Tyr* .	Omagh, Edenfel.........	1·95	65
R&C.	Tain, Ardlarach..........	2·16	87	*Don* .	Malin Head...............	1·46	49
,,	Ullapool	4·37	102	,,	Dunkineely................	2·34	...

Climatological Table for the British Empire, September, 1937

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.	1013·8	− 3·6	76	41	65·3	49·5	57·4	+ 0·1	51·1	91	7·1	2·04	+ 0·17	12	5·1	40
Gibraltar	1015·4	− 1 8	92	60	75·5	65·4	70·5	− 1·9	64·4	84	4·2	0·08	...	2	...	...
Malta	1015·5	− 0·8	88	63	80·1	70·5	75·3	− 0·7	70·6	80	4·7	2·15	+ 0·88	6	7·3	59
St. Helena	1015·5	− 0·5	64	52	59·6	53·9	56·7	+ 0·2	54·5	94	10·0	1·99	− 0·19	18	...	...
Freetown, Sierra Leone	1012·9	+ 2·4	86	68	82·9	72·1	77·5	...	74·5	87	7·5	25·08	− 3·40	26	...	...
Lagos, Nigeria	1013·2	+ 1·0	86	71	82·9	74·6	78·7	0·0	75·0	90	8·7	12·54	+ 6·95	19	3·8	31
Kaduna, Nigeria	1012·1	...	89	65	85·1	68·4	76·7	+ 1·4	70·9	88	8·3	8·56	− 2·94	19	6·2	51
Zomba, Nyasaland	1013·2	− 0·4	86	52	79·8	60·3	70·1	+ 0·6	66·5	77	2·9	0·00	− 0·34	...	...	...
Salisbury, Rhodesia	1013·7	− 0·9	87	43	79·9	53·9	66·9	+ 0·5	54·7	44	1·0	0·00	...	...	9·8	82
Cape Town	1021·0	+ 1·9	84	42	66·8	51·7	59·3	+ 1·4	53·1	83	5·5	1·69	− 0·55	9	...	...
Johannesburg	1016·1	+ 0·7	84	30	69·8	47·0	58·4	− 1·0	46·7	45	3·7	1·06	+ 0·10	6	8·6	72
Mauritius	1020·1	0·0	80	61	77·5	64·6	71·1	+ 1·0	67·1	74	5·3	1·83	+ 0·43	20	7·9	66
Calcutta, Alipore Obsy.	1004·5	0·0	93	75	89·0	79·1	84·1	+ 0·9	79·8	90	8·1	13·31	+ 3·30	15*	...	...
Bombay	1007·7	− 0·3	88	73	85·6	76·2	80·9	0·0	76·4	87	8·1	14·20	+ 3·52	19*	...	...
Madras	1006·9	+ 0·4	97	74	93·4	77·7	85·5	+ 0·3	76·3	73	6·4	4·00	− 0·85	7*	...	...
Colombo, Ceylon	1010·4	+ 0·5	88	73	85·9	76·3	81·1	− 0·1	76·5	74	6·9	14·97	+ 10·21	14	7·1	58
Singapore	1010·3	+ 0·5	88	73	85·3	76·6	80·9	− 0·2	77·2	81	7·3	7·95	+ 1·16	14	5·2	43
Hongkong	1010·2	+ 1·9	91	75	87·0	78·9	82·9	+ 1·9	78·3	79	6·3	12·53	+ 2·84	12	6·9	57
Sandakan	1009·8	...	92	73	88·7	75·3	82·0	+ 0·3	77·1	83	7·2	7·60	− 1·73	17	...	...
Sydney, N.S.W.	1016·5	+ 0·4	89	44	70·5	53·5	62·0	+ 2·8	54·8	54	4·5	0·49	− 2·37	5	8·1	68
Melbourne	1015·3	− 0·5	75	41	64·4	48·5	56·5	+ 2·4	51·2	66	6·3	1·70	− 0·74	15	4·3	37
Adelaide	1017·9	+ 0·4	81	42	66·8	49·5	58·1	+ 0·9	52·7	64	7·4	2·92	+ 0·84	14	5·4	46
Perth, W. Australia	1026·6	+ 8·6	80	39	66·3	49·4	57·9	− 0·3	53·0	63	5·0	2·69	− 0·73	12	7·9	67
Coolgardie	1019·0	+ 1·8	92	37	71·9	46·0	58·9	+ 0·2	49·9	55	3·7	0·19	− 0·48	4	...	...
Brisbane	1020·3	+ 2·7	87	46	76·6	55·5	66·1	+ 0·9	58·7	56	2·6	0·20	− 1·80	1	9·3	78
Hobart, Tasmania	1011·7	+ 0·7	74	36	59·6	44·9	52·3	+ 1·3	47·4	64	6·4	1·87	− 0·20	16	5·2	44
Wellington, N.Z.	1013·7	− 0·9	60	37	54·3	44·6	49·5	− 2·1	47·1	80	8·5	3·51	− 0·46	20	4·2	36
Suva, Fiji	1016·1	+ 1·8	85	64	78·5	69·2	73·9	− 0·6	68·3	75	6·8	6·95	− 0·74	16	4·5	38
Apia, Samoa	1012·6	+ 0·4	87	69	84·4	73·7	79·1	+ 0·9	74·5	73	4·8	5·46	+ 0·35	16	7·4	62
Kingston, Jamaica	1011·9	− 0·3	93	73	89·8	74·6	82·2	+ 0·7	72·7	82	2·7	1·88	− 2·15	4	8·8	72
Grenada, W.I.	1010·5	− 1·3	88	70	86	73	79·5	− 0·8	74	74	5	6·79	− 1·20	16	...	...
Toronto	1017·5	− 0·3	90	37	69·9	50·3	60·1	− 0·2	53·0	84	3·6	1·39	− 1·28	11	7·5	60
Winnipeg	1015·0	+ 1·2	87	26	64·8	42·6	53·7	0·0	43·8	89	6·4	2·29	+ 0·07	12	5·6	44
St. John, N.B.	1016·3	− 1·1	74	42	65·0	50·6	57·8	+ 1·9	53·3	84	6·3	5·97	+ 2·23	16	5·5	44
Victoria, B.C.	1017·1	+ 0·7	88	45	65·3	50·6	57·9	+ 1·8	54·6	83	5·3	0·38	− 1·43	6	6·6	52

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

(41113) Wt. 20/31 1125 3/38 Hw. G. 377/6