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The Travel of Depressions

By LIEUT.-COL. E. GOLD, D.S.O., F.R.S.

A correspondent has recently asked for some information as to the bearing of the new ideas in meteorology on the travel of depressions.

In the earlier days of weather forecasting, attention was directed mainly to the cyclone or depression. In it was sought the key of weather forecasting and the search was directed mainly by the idea of averages. The average distribution of the meteorological elements in the different sectors of the depression was worked out and the average paths of the centres of depressions at different times of the year were laid down. This information was both necessary and useful. If the distribution of weather had never varied very much from the average and if the paths of all centres had been very close to the average paths, the method would indeed have solved the problem of forecasting ; but actually the distribution of weather in a cyclone varies between wide limits and the centres of cyclones move on tracks which are separated widely apart and the speeds of the centres along the tracks vary between zero and 50 or 60 miles per hour. Many of the changes of weather in this part of the world are produced by discontinuities in the circulation round depressions whose centres remain more or less stationary, generally in the triangle formed by Iceland, Scotland and the South of Greenland, and a knowledge of the genesis and motion

of these discontinuities is almost as important as a knowledge of the motion of the centres of the cyclones.

Progress beyond the limits of averages was being made gradually by such studies as those of Shaw and Lempfert on the life history of surface air currents where the idea of an unsymmetric discontinuous cyclone began tentatively to emerge; or those of Lempfert and of Durand-Gréville on the phenomena of the squall line. But until the development by Bjerknes of the idea of cold and warm sectors in the individual cyclone, separated by definite surfaces of discontinuity, practically the only guides which the forecaster had for the direction of motion of the cyclone were the average tracks and the barometric tendencies (the amount of rise or fall of the barometer in 3 hours) observed simultaneously at different places. From their very nature, the latter could give the probable direction of motion only for the comparatively short period of 3 or 6 hours after the time at which they were observed.

By their study of individual cyclones, the Bergen school were enabled to divide cyclones into different classes according to their stage of development. The simplest broad distinction is between:

- (A) Cyclones which have a definite warm sector with definite lines of separation from the cold sector.
- (B) Cyclones in which there is no warm sector at the surface of the earth.

Generally speaking, class A are growing cyclones which usually move with increasing speed as they grow, and class B are dying cyclones which tend to become stationary. In the method of averages these two classes were treated simply as one class and naturally the result of such treatment could not be very satisfactory. When they are treated separately, as they should be, it is found (and this is a discovery of fundamental importance) that the centres of cyclones of class A move in the direction of motion of the air in the warm sector and very nearly with the speed of motion of that warm air (the direction of motion of this air is taken to be along the isobars and its speed about three-quarters of the speed of the "gradient wind"). A diagrammatic representation of such a cyclone is given in Fig. 1.

OAB is the warm sector; OA and OB are the lines of discontinuity dividing the warm air from the cold air. The lines $a_1 b_1$; $a_2 b_2$, etc., are isobars; they are drawn straight because in practice they are found to be nearly straight in the warm sector. The direction of motion of the centre O is parallel to AB and its speed is determined by the distance between the isobars (more strictly by the distance between the isobars multiplied by the sine of the latitude). As the whole system is moving in the direction of motion of the warm air, AB is naturally a changing direction, but the change takes place continuously, and not as a rule very rapidly.

(Usually AB "backs" so that the path of the centre O tends to curve towards the left ; this is practically always the case with a large cyclone ; but sometimes, with a small cyclone moving along the edge of a warm anticyclone, the change is in the opposite direction).

This discovery does constitute a great step forward in our knowledge. But if the discovery applied only to those depressions which have a properly constituted warm sector, its application would be limited to a comparatively small number of occasions, though occasions of great importance. As I mentioned above, much of our weather is associated with nearly stationary depressions, and the Bergen school have discovered that in these

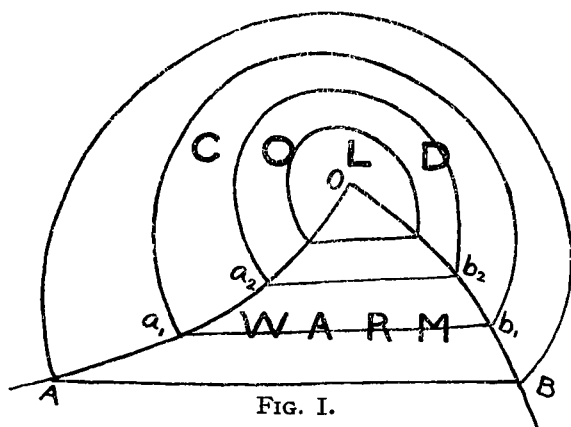


FIG. I.

depressions we get discontinuities having the same characteristics of weather as those found in the neighbourhood of the discontinuities between the warm and the cold air in the normally constituted cyclones ; and these discontinuities in the stationary cyclone move in the direction and with the approximate speed of the air in the sector which has the weather characteristics of a warm sector.

There are, however, occasions when the discontinuity in the stationary cyclone is practically a single discontinuity and no distinctive warm sector can be identified ; in such cases the discontinuity moves around the cyclone at a speed equal to the component of the colder wind at right angles to the line of discontinuity. There is one other case which should be mentioned : that of a secondary cyclone developing in, and usually to the south of, a dying cyclone. Such a secondary, if it has a warm sector, has its motion determined by that warm sector. If it has no warm sector, then it moves around the primary cyclone like any other discontinuity.

To return to the consideration of the constitution of the cyclone, those classed above as A eventually lose their warm sector and change into class B. Actually the warm sector only disappears

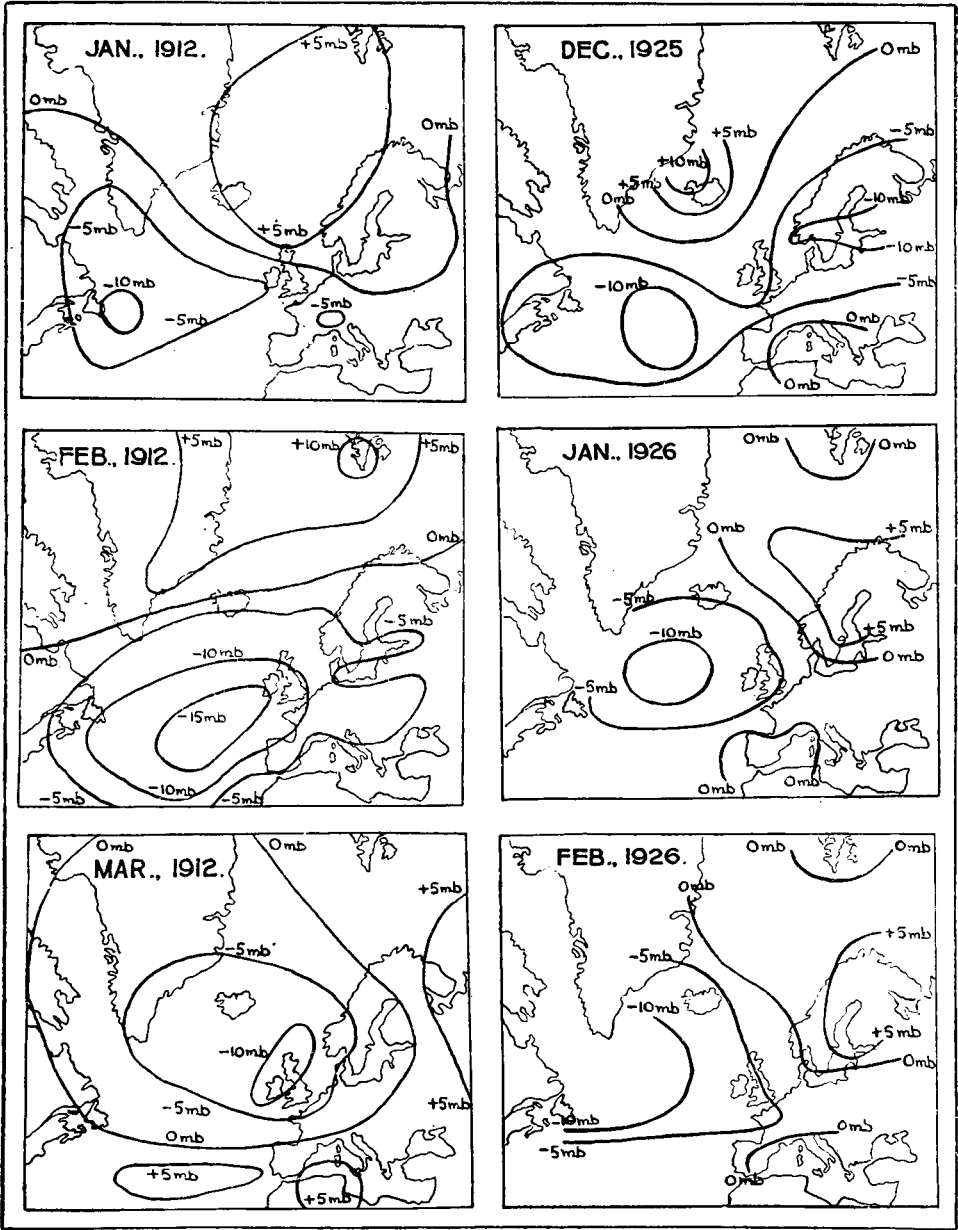
at the earth's surface ; the warm air which constitutes the sector is lifted up by the colder air and the discontinuity which has disappeared at the surface will continue to exist at greater heights. If the change from class A to class B takes place while the centre is still over the Atlantic (or in such a position that the major part of the depression is over the Atlantic) discontinuities develop in the depression owing to the variation in the temperature of the ocean and the resulting variation in the temperature of the air. The (cold) air as it approaches the southern regions of the depression gets warm and by the time it has made the circuit and come back to the region of France or the British Isles it may have become warm air relative to the air over these lands. It will never be quite so effective as warm air which has come up into a depression from the equatorial regions but it is sufficiently warm to produce on a small scale the characteristic weather phenomena of the large "normally constituted" depression.

This note is only intended to give some indication of the way in which the question put by our correspondent is being answered. It is not possible to give in simple language in a short article anything like a complete account of the results of the long technical investigations of other people : nor to explain in detail all the precautions necessary in practice to prevent oneself being misled by peculiarities in observations taken at the earth's surface.

The Weather of the Past Winter

THE winter of 1925-26 will long be remembered for the remarkable storminess which prevailed throughout over the North Atlantic Ocean, and which resulted, among other events, in the loss of the *Antinoë* and the *Laristan*, and the heroic rescues of their crews. Sir Napier Shaw, in an article published in the *Times* of February 6th, compared the meteorological situation at the end of January with that at the beginning of February 1899 : "one vast cyclonic circulation some 2,000 miles across, covering the North Atlantic from the north of Greenland to the Azores and from Nova Scotia to the English Channel." In 1898-99 the stormy period lasted from December 18th to February 15th ; in 1925-26 the weather was very disturbed from December 17th to February 27th, so that from this point of view the two periods were almost exactly analogous.

The charts on the right hand side of the figure show the deviation of pressure from normal over the North Atlantic and western Europe during December, 1925, January and February, 1926. The points to notice are that in all three months pressure was more than 10 mb. below normal over a considerable part of the



PRESSURE ANOMALIES IN TWO WINTERS.

ocean lying between Newfoundland and the British Isles, and that an area of pressure, 5 mb. or more above normal, lay to the north—Iceland in December, Scandinavia in January and February. In each month pressure was more than 5 mb. below normal over some part of the British Isles, but in no month was the deficit actually centred over these islands. In December, the position of Great Britain relatively to the lines of equal pressure deviation was such as to favour north-easterly winds, and this month, while it was rather cold and snowy, was not especially wet in England, and was appreciably drier than usual in Scotland and Ireland. In January and February the British Isles lay between the deficit of pressure over the North Atlantic and the excess of pressure over Scandinavia, and stormy southerly winds prevailed, giving generally mild, rainy weather. The rainfall of the British Isles was 156 per cent. of the normal in January, and 117 per cent. in February; there was a short cold spell in the middle of each month, but the mean temperature of January was above normal, while February was on the whole remarkably warm.

The charts of pressure deviations for December 1898, January and February, 1899, while they resemble those for 1925-26 in showing pressure below normal over the greater part of the North Atlantic, the deficit reaching 10 mb. over the Azores during February, differ considerably over Europe and Iceland. In December pressure was 5 mb. above normal over France and Spain, and 5 mb. below normal over Iceland; in January and February the pressure distribution over southern Europe was similar to that during the same months of this year, but pressure was markedly below normal over Scandinavia. A much closer parallel to the sequence during the past winter is provided by the first three months of 1912, the charts for which are shown on the left hand side of the figure. These are based on the pressure deviations at land stations only, while in the charts for 1925-26 the wireless reports from ships have been utilised to provide information from a point in the mid-Atlantic; if the same information had been available for 1912, the areas of greatest pressure deficit might have extended further over the ocean. As it is, the charts show an area with pressure more than 10 mb. below normal somewhere between Newfoundland and Ireland in each of the three months, while that for February, with a deficit of 15 mb. extending from the Azores to Valencia, is highly abnormal. According to the *Monthly Weather Report* for that month: "Cyclonic systems were never absent, and were often very deep, and had their centres much further south than usual." The chief differences between 1912 and 1925-26 were that the area of excess over Scandinavia did not develop until March in 1912, while the same month shows areas of 5 mb. above normal over

the Azores and Algeria which are absent in the chart for February, 1926.

In each of the three periods, 1898-99, 1912 and 1925-26, the long period of stormy conditions over the North Atlantic and of unsettled weather over these islands was followed by a period of anticyclonic weather, and the way this came about is of some interest. In 1899, an anticyclone spread across the British Isles from Denmark on February 27th, and except for the passage of a depression across Scotland on March 6th to 9th, pressure remained generally high until March 26th, giving a fine, dry month. In 1912, pressure remained generally high near the Azores throughout March, and in April a definite anticyclone moved north-eastward across the British Isles, though it was not until April 13th that the anticyclonic centre actually lay over southern Ireland and England. In 1926, events seem to be following a course which is strikingly similar to that of 1912. An anticyclone which lay over Bermuda in the middle of February apparently moved eastward on the 27th. From the beginning of March until the 11th it lay between the Azores and the Bay of Biscay, and by the 16th it had come to occupy a position directly over these islands. Continuing its northerly progress it was centred over the Faroes on the 17th, and between Iceland and Scandinavia until the 24th, after which it moved eastward and lay over Scandinavia. At the same time an extensive depression gradually approached our south-western coasts and began to influence our weather in the closing days of March. The chart of mean pressure deviations for March 1926 (described on p. 72) bears an extraordinary resemblance to that for April 1912.

These great atmospheric surges go far beyond anything to be accounted for by changes of density due to variations of temperature in the surface waters of the Atlantic which are communicated to the overlying air. Sir Napier Shaw, in the article referred to, calculates that the great depression of the beginning of February 1899, "involved, or perhaps was caused by, the removal of nearly two million million tons of air from the area between 40° and 60° North and between 10° and 60° West, and the quantity removed to make the depression that caused the end of the Antinoë and the Laristan is fully two million million tons." It is noteworthy that the "storm-centre" usually occurs in the west of the ocean where the contrasts of temperature within a short distance are greatest, but an examination of the charts for the months preceding the development of stormy conditions has not so far revealed any striking feature of which we can say "This is the villain," probably because we do not know where to look. The calm after the storm, which we have seen occurred in all three of our examples, may perhaps admit of a more facile treatment. The two million million tons of excavated air must

go somewhere, and the natural place for it is the anticyclonic belt in sub-tropical regions south of the storm centre. Thus we should expect an excess of pressure to develop between Bermuda and Madeira, and we find by experience that such an excess, when it occurs, tends to move slowly first eastwards and then north-eastwards, generally crossing the British Isles in its course, and giving us a period of fine weather which terminates the long spell of unsettled conditions.

Sir Napier Shaw has pointed out to me that, while in the North Atlantic the geographical situation tends to bring the centres of depressions together in a focus near Newfoundland, the southern hemisphere is quite differently situated, storminess being more or less equally developed in a band surrounding the pole, so that the focus of cyclonic activity, instead of being a point, becomes a line.

C. E. P. B.

OFFICIAL PUBLICATIONS

The following publications have recently been issued :—

The Meteorological Observer's Handbook. Approved for the use of observers by the Meteorological Office and the Royal Meteorological Society, 1926 Edition.

The 1926 edition of *The Meteorological Observer's Handbook* contains instructions in regard to the exposure, use and adjustment of the various instruments at ordinary meteorological stations and in the method of making and reporting non-instrumental observations. The edition differs from its predecessor, that for 1921, mainly in the fact that the instructions for completing the schedules of observations, and for preparing summaries of them have been omitted. It is proposed to issue these separately as supplements to the present volume, a separate supplement being devoted to each type of station.

The volume has been partially re-written, the section on the method of reducing barometer observations having been completely revised. Certain matter which did not directly affect the observer has been omitted, and a new section on the observation of visibility has been introduced.

Discussions at the Meteorological Office

March 15th, 1926. Untersuchungen über die Elemente des Nebels und der Wolken. By H. Köhler (Stockholm, Statens Meteor.-Hydrog. Anstalt. Med. Bd. 2, No. 5).
Opener—Lieut.-Col. E. Gold, D.S.O., F.R.S.

Col. E. Gold gave an account of Dr. Köhler's investigations of the constituents of fog and cloud. Dr. Köhler found from his researches at the Haldde Observatory, in continuation of previous researches in Sweden, that fog consisted of water drops, which may be super-cooled, but did not form crystals even down to a

temperature of -28°C . He examined the deposit from fog, both on wires and on plates, microscopically and found that drops were always present, even when ice crystals were falling through or from the fog. His observations of the size of the drops in fog and in cloud which were based on observations of coronæ, led him to the deduction that the drops were formed either by the combination of 2 drops of the same size or by the division of a drop into two drops of equal size, so that the masses of the drops of water in a fog are 2^n times the mass of some fundamental drop. Dr. Köhler analysed also the rime deposited from fog and found that this contained, on the average, about the same amount of chlorine as was found in rain water in England. The amount of chlorine on individual occasions varied greatly; from .07 milligrams per litre to 50 milligrams per litre of melted rime, but the same law of 2 appeared to be indicated in these amounts of chlorine, each amount being 2^n of the average amount, 3.52 milligrams per litre.

Dr. Köhler also found that cumulus, alto-cumulus and strato-cumulus clouds consisted of water drops, at least when they produced coronæ. In the case of cirrus and alto-stratus clouds it seemed at first sight that they were formed of ice crystals, but on further examination of his results Dr. Köhler came to the conclusion that even in these clouds when coronæ were formed, they were formed by drops.

In the discussion, Dr. Simpson expressed the view which he propounded 14 years ago that coronæ could not be formed by ice crystals but must be formed by drops. He was also convinced that there were no satisfactory physical reasons for the law of 2 which Dr. Köhler had advanced. The process of growth or diminution of drops was a continuous one, or if anything like quanta were involved, they were much smaller quanta than the smallest drops with which Dr. Köhler was dealing.

Sir Napier Shaw referred to the importance of probing these matters of drops and nuclei in the atmosphere to the very bottom. Upon evaporation in the atmosphere sea-water would not crystallise as "sea salt" but as separate components. If sea salt were present in a foggy atmosphere it would be in the form of solution of separate salts.

Captain Douglas referred to the great vertical extent of clouds consisting of ice crystals compared with the vertical extent of cloud-sheets consisting of water drops and confirmed that ice crystals were sometimes found below a cloud of drops as though they had fallen from it.

Other speakers mentioned phenomena which they had observed, and at the end of the discussion Dr. Simpson referred to the fact that this was the end of the 21st series of these discussions which had been inaugurated by Sir Napier Shaw in 1905.

Royal Meteorological Society

THE meeting of the Society, held on Wednesday, March 17th, at 49, Cromwell Road, with Sir Gilbert Walker, C.S.I., F.R.S., President, in the Chair, was devoted to the customary March lecture. These lectures were first started in 1893 to replace the exhibition of instruments, etc., which had been held annually by the Society between 1880 and 1892. From 1926 the expenses of this lecture are to be borne by the Symons Memorial Fund established in 1901, and the lecture is accordingly now termed the "Symons Memorial Lecture." On this occasion Professor S. Chapman, F.R.S., gave an account of "Some recent advances of Atmospheric Physics." Theories of the daily variation of the earth's magnetism require the existence in the upper atmosphere of a layer which is strongly ionized (ionization is the process of production of free positive and negative electrified particles or ions). Such a layer is a conductor of electricity, and is also required to explain the long distance transmission of wireless waves, and its existence has recently been strikingly demonstrated by observations of the reception of wireless signals at night reaching the ground at a high angle. Where data as to the ionized layer given by the wireless and magnetic results overlap, they are found to be in fair agreement, both qualitative and quantitative. The origin of the ionization appears to be capable of explanation as being due to ultraviolet radiation from the sun, absorbed by the atmosphere during the day, certain objections advanced by Swann on the ground that the amount of radiation available is insufficient, having been found invalid. Additional ionization occurs, at night as well as during the day, in higher latitudes, in association with auroræ. In this case, the nature of the ionizing agent is somewhat obscure, but the most likely hypothesis seems to be a stream of charged corpuscles. Various considerations show that the charges on these corpuscles are not all of the same sign, but a slight residual charge would suffice to explain the effect. The auroral spectrum shows that nitrogen is the principal gas which is ionized at the level at which the aurora occurs.

Correspondence

To the Editor, *The Meteorological Magazine*

Excessive Rain in Nyasaland

You asked correspondents abroad to send you accounts of any remarkable weather conditions experienced in their area. In parts of this Protectorate excessive rain has been experienced both last year and this.

The rainfall for the early months of 1925 was the greatest ever

experienced since European knowledge of this part of the tropics began, and resulted in excessive damage to crops and communications, both here and in Rhodesia and also in parts of South Africa.

January, 1926, seems to be a repetition and in parts even worse. The Zambesi floods so far as the writer is aware are not so extensive, but in a tributary of the Pungwe River (Portuguese East Africa), no less than 40 in. fell in 10 days. The rainfall for Blantyre and for Zomba was approximately 30 in. at each place for January, 1926, three times the normal fall.

L. S. NORMAN.

Konjeni Siding, Luchenza, Nyasaland Protectorate. February 8th, 1926.

Rainfall Intensities at Cork

THE outstanding results of an examination of thirteen years' (1913-25) records of automatic rainfall gaugings made here with a Hyetograph may be of interest to your readers, principally because of the low values of rainfall intensities.

No shower lasting less than two hours had an intensity even approaching the lower limit for "Remarkable" showers of the British Rainfall classification. The following formula gives a curve approximating closely to that drawn through the plotted values of the maximum recorded intensities of showers lasting less than two hours.

$$i = \frac{9.2}{\sqrt{t}}$$

where i = intensity in inches per hour and t = duration in minutes for times not exceeding 120 minutes.

The corresponding relation for the heaviest showers lasting from 2 to 15 hours is given very closely by the equation

$$I = \frac{1.42}{T^{0.76}}$$

where I = intensity in inches per hour, and T = duration in hours.

The maximum rainfall on a rainfall day recorded here since the beginning of 1884 is 2.78 in. on November 16th, 1916. The maximum amount recorded for two consecutive days is 4.85 in. on December 23rd and 24th (2.51 in. and 2.34 in. respectively), 1895. The average annual rainfall here is approximately 40 in.

H. N. WALSH.

University College, Cork. February 15th, 1926.

"A Red Sky at Night"

I was much interested in reading the article on this subject by S. C. Russell, in the *Meteorological Magazine* for February, as I have studied this subject for years and followed the teaching

laid down by the late Admiral Fitzroy, as to the varied colour evident at sunrise and sunset.

Weather clear or cloudy, a rosy sky at sunset presages fine weather ; a sickly looking greenish hue, wind and rain ; a dark or Indian red, rain ; a red sky in the morning, bad weather or much wind, perhaps rain. A bright yellow sky at sunset presages wind, a pale yellow, wet. My experience is that these various colours confirm the forecast which a student by observations and recording may make at sunset and sunrise, and follow fairly near Fitzroy's directions, although the morning reds if rosy are similar in result to the evening reds. Admiral Fitzroy said by these means coming weather could be foretold very nearly.

HENRY A. ROGERS.

31, Fernbank Road, Redlands, Bristol. March 3rd, 1926.

Prolonged Thunderstorm at S'Hertogenbosch March 4th, 1926

AN unusual thunderstorm for the time of year occurred here at S'Hertogenbosch yesterday evening. The town lies on an open plain in the province of Noord-Brabant, Holland, with much water on all sides, especially after the wet spell since the year commenced.

On the morning of March 4th, after a wild and stormy night, with south-west winds, an inky blackness with heavy rain and hail occurred at 9 a.m. This however soon passed, giving way to a beautiful day of sunshine with strong westerly winds. Towards 5 p.m. heavy cumulo-nimbus clouds gathered in the west and south, and a storm could be seen in the north moving from west to east but only a few drops of rain fell here. At 7 p.m. we had wild flurries of wet snow and angry sporadic gusts of cold west air that whirled the snow in all directions, and at 7.15 there was suddenly a blinding flash of lightning accompanied by an instantaneous clap of thunder that shook the place, while "torrential" snow and hail fell for a few minutes blotting out everything. Within ten minutes children were snowballing with the accumulated snow and hail. The thunder and lightning continued for two hours though there were fairly long intervals of quietness and at times the lightning flickered as it does so often in summer. The whole storm culminated in a heavy hail shower during which the wind quickly veered to west-north-west, and the temperature, which was over 40° F. at 7 p.m., fell considerably. By 10 p.m. all was calm though hail and snow fell again later in the night. The lightning caused a conflagration at a village 2 miles from this town.

J. E. COWPER.

S'Hertogenbosch, Holland. March 5th, 1926

An Extraordinary Thunderstorm

THE 3rd of March, 1926, was fair and sunny until 11.30 a.m. : the barometer at 9 a.m. stood at 29.95 in. (1014.2 mb.), the mercury having fallen steadily since March 1st, 9 a.m., when it had been 30.42 in. (1030.1 mb.). The wind on the 3rd was from west in the morning : slight rain fell at 11.30 a.m., and the wind veered to north-west increasing in force ; after this, the clouds cleared away, and it became rather cold ; the evening was clear and cold. At 9 p.m. the wind was rising, the sky became totally clouded, and some lightning flashes were seen ; at 9.40 p.m. it was raining, bar. 29.7 (1006 mb.) : at 9.48-50 there was a heavy squall from the north-west and a very strong flash, followed by a heavy hail storm, lasting a few minutes. The stormy weather cleared rather rapidly, and at 10.30 the stars were shining, the wind had gone down, but occasional lightning continued until 11 p.m. My barograph showed a steady falling line, but at 10.48-50 there was a well-marked " kick " of 0.05 in. (1.7 mb.) followed by a rapid fall at 11 p.m. with irregular line. Next day, the 4th, the barometer at 9 a.m. was 29.7 (1006 mb.), and hail storms continued from north-west until about 5 p.m.

In the morning of the 4th, I was informed that three lights on the roof of a room in C. & J. Clark's factory, on the east side, had been blown, two lights outwards and one inwards. Could this be caused by suction action of squall from north-west at time of lightning ?

I noticed the thunder, after the flash at 9.48-50 on the 3rd, came in about 2 to 3 seconds : a few days later I heard that an extraordinary hole had been made in a field in Sedgmoor, about a mile and a half from Hind Hayes, Street. The position of hole is about 51°7'40" N, 2°44'20" W. The Polden Hills ridge is just above this portion of Sedgmoor ; it rises to about 250-300 feet above mean sea level, falling steeply to the moor : the hole made by lightning is about 25 ft. above mean sea level, and about 400 yds. from the foot of the Polden Range ; about one-third of mile from the hole is a farm house, " New Ivythorn Farm," near the bottom of the hill, and facing south. The owner was, I believe, outside on the lawn when the lightning came ; he described it as very vivid and almost blinding.

Captain Edmund Page, the owner of the land, found the hole made in the grass field, about 2-3 ft. deep, into the black soil below. The hole was circular, about 7-8 ft. across ; from the lip of this crater ran north-east a zig-zag cut or furrow about 5 yds. in length, and half a foot to a foot deep. By the nearest tree, about 150 yds. north-east of the hole, were found next morning (4th) three cows in a ditch. One died soon after being got out : on examination by a veterinary surgeon it showed evident signs of being lightning struck. The other two cows were apparently

not hurt. As many as seven horses were also found in the rhynes (wide ditches) near the hole; these horses were not injured, but a horse, that had been either struck or stunned by the lightning, fell over a wire fence (there were no marks of galloping) and was seriously injured. The sods of turf were apparently thrown as far as 150 yds. from the hole: no signs of scorching on the sides of the hole were found.

Mr. Henry Corder, of Bridgwater, 12 miles west by north, tells me that, there also, about 9.45 p.m., there was a similar tremendous flash. Could it be the same as struck finally at Ivythorn? Could this have been ball-lightning? Are there many recorded effects of lightning as described?

JOSEPH CLARK.

Hind Hayes, Street, Somerset. March 20th, 1926.

NOTES AND QUERIES

The Aurora of March 9th

A fine aurora was widely observed over the British Isles on the night of March 9th and accounts of the phenomenon have kindly been sent to the Meteorological Office by many spectators. Only a few reports, however, have been received from Scotland, Ireland and Wales. The aurora was well seen in the Midlands but it is noteworthy that the majority of the more detailed and enthusiastic descriptions of the spectacle emanate from the south of England, over a region extending from Essex to Cornwall. This fact, coupled with the scarcity of reports north of Yorkshire, may indicate that the aurora was actually brighter as viewed in the south, but on the other hand it must be remembered that bright auroræ, and particularly those showing marked colour, are rare in our southern counties and hence attract much greater attention. It seems to be generally admitted that the aurora was the most brilliant one seen in the south during recent years.

The phenomenon appears to have attained its maximum development for a short time about 20h. over the greater part of the area and to have been almost entirely limited to the period 19h. 30m. to 20h. 30m. There are however two exceptions, the Yorkshire observers, who give the time as about 21h., and Mr. Hicks, of Rugby, who states that he made observations between 20h. 30m. and 21h. 30m.

The aurora mainly took the form of an extensive glow, sometimes with large detached masses, from which long beams resembling searchlights radiated upwards. A few observers noted that the part nearest the horizon formed a pearly arch with a well defined upper edge. The true auroral arch, with darker sky both below and above it, as was observed at Bourne-

mouth on the night of Christmas Day, 1918, is not clearly described in the present reports. The aurora was subject to rapid changes but more by the fading out of some parts and brightening of others than by an actual motion of translation across the sky. The latter motion is a very common one during fine displays but only six observers noted it on March 9th, while the Rev. W. M. De la Touche, of Wistanstow, Shropshire, stated that no movement was visible.

The predominating colour was red, and in widely separated parts of the country the glow was mistaken for that from a big fire. There was also much whitish light, while a considerable number of observers reported a green colour—undoubtedly a rare colour in auroræ observed in southern England.

A selection of parts of some of the more interesting accounts are given below.

Capt. F. Tymms writes that : " The aurora was first observed from Plough Lane near the Croydon Aerodrome buildings shortly after 7.30 p.m. The first appearance was similar to a battery of searchlights seen over the tops of buildings towards the north-northwest. The regularity of the beams, however, soon attracted further attention and when a clearer view of the northern horizon was obtained it was seen to consist of a belt of green light low down on the horizon stretching nearly from northwest to northeast ; above this was an arch of rose-coloured light extending to an altitude of approximately 30° - 35° with a maximum intensity round about 25° - 30° altitude ; the arch was most intense at that time near the northwest and northeast extremities ; projecting through the arch of rose-coloured light at each end were shafts of white light similar in appearance to searchlight beams ; these beams extended varying distances, up to a maximum of about 50° of altitude. The beams towards the northwest were most intense. This display lasted with varying brilliancy for about 10 minutes or more."

Meteorological Officer, Holyhead. " An aurora of exceptional brilliance was observed here By 20h. the illumination took the form of an arch from which streamers stretched to the zenith. The lines were red and streaked with apple green and extended from about westnorthwest to eastnortheast, gradually disappearing and leaving a searchlight effect to west and east."

Meteorological Officer, Larkhill. " This portion of the sky (the northwest) assumed a flame colour Through this the strongest white rays could still be seen penetrating, increasing and diminishing both in length and in width and the intensity of the light varying rapidly."

Mr. L. C. W. Bonacina, Hampstead. " The northern sky was a brilliant white This illuminated part was abruptly

bounded by an arc and long yellow streamers shot with red darted incessantly towards the zenith."

Mr. E. A. L. Attkins, Squirrel's Heath, Essex. "It was a magnificent spectacle. There was a high pearly arch over the horizon with four shafts 40° long In the northwest there was a glorious rose coloured pyramid extending to Cassiopeia's Chain. The pyramid moved slowly to the west, became stationary and faded out."

Mr. J. B. M. Ridout, Swanage. "It was deep red in colour It had no particular shape and may be said to have been in practically two portions, the eastern portion being about half the size of the western, the two being joined by a narrow band. Every now and again several vertical shafts of nearly white light, like the rays from a searchlight, appeared but only lasted for a minute or less."

Mr. R. T. Holmes, Monkokehampton, Devon. "The sky from west to northeast was ablaze with a beautiful pink and golden arch imposed on a greenish background, with streamers shooting up like lances to the height of the Pole Star The streamers were in constant movement with a slow rolling motion."

Observers who are interested in auroræ have good opportunities for observing the phenomenon during 1926 and the two following years, this being the period of maximum solar activity during the present cycle. An interval of about two days after a large sunspot has crossed the central meridian of the sun's disc constitutes a particularly favourable time for the appearance of auroræ but their manifestation is not confined to these occasions. There was no large spot accompanying the aurora of March 9th.

E.W.B.

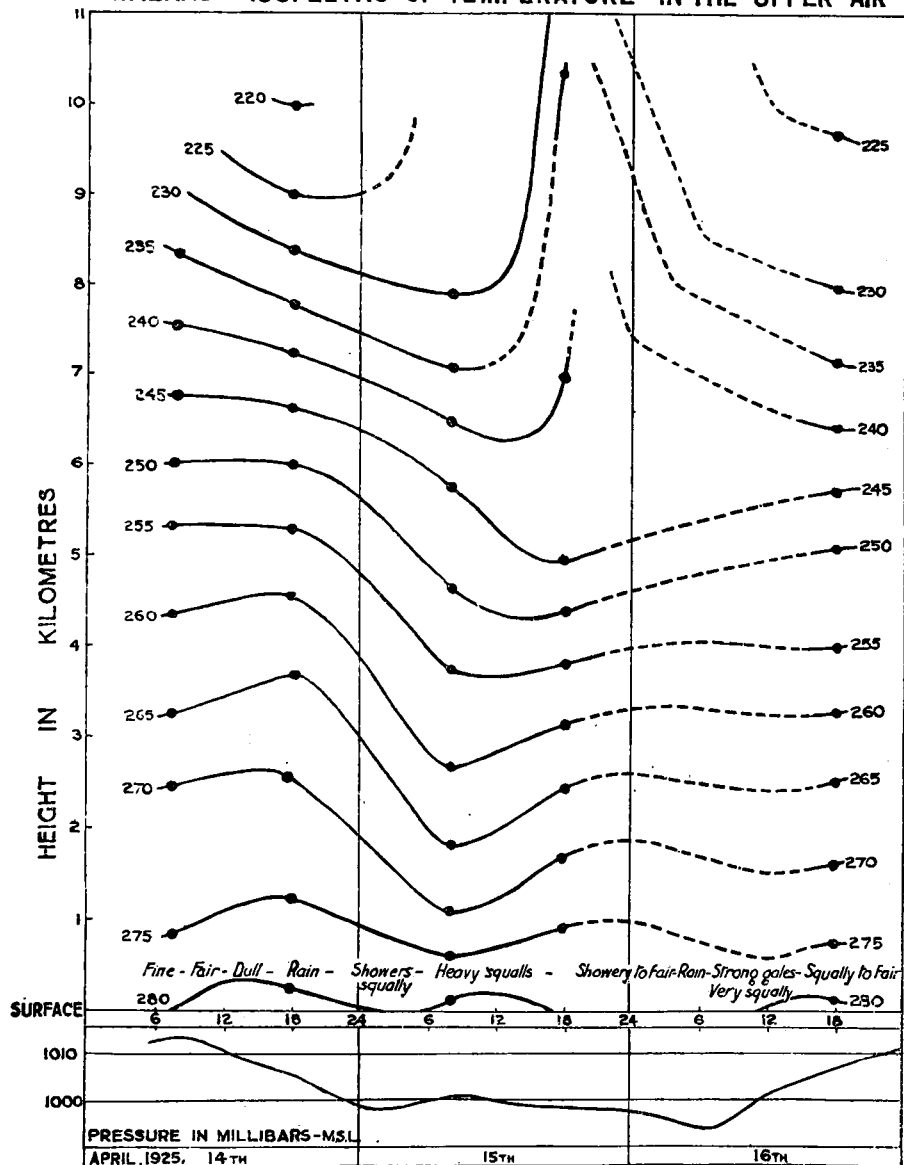
Remarkably low base of the stratosphere during the passage of a depression

ON April 14th, 15th, and 16th, 1925, a deep depression passed from the region south of Iceland towards the North Sea. The chart in the *Monthly Weather Report* shows that its motion was generally easterly, but of rather an erratic nature. From 18h on the 15th till 1h on the 16th, it was travelling south from the Orkneys to Inverness, thereafter it turned eastward again. It happened that an International period for the investigation of the upper air coincided with the passage of this depression, and a series of registering balloon ascents were made from Sealand on these three days. The illustration shows both the changes of surface pressure at Sealand, and isopleths of temperature up to 11 km.

The most noteworthy feature is the extremely small lapse

rate of temperature above 5 km. at 18h on the 15th, that is at about the middle of the trough period at the surface. No definite inversion marked the base of the stratosphere on this

SEALAND - ISOPLETHS OF TEMPERATURE IN THE UPPER AIR



occasion, but at a height of 5.1 km. the lapse rate changed suddenly from 9° C. per km. to 2° C. per km., and hardly again exceeded that value on the average. This suggests that 5.1 km. should be considered as the base of the stratosphere, which is a remarkably low value. In the cases of the other ascents made

both before and after, an inversion was found as usual at the boundary between the troposphere and stratosphere. The isopleths show that between 2 and 6 km. a mass of warm air on the 14th was replaced by a definitely colder mass on the 15th, but the peculiarity noted did not take place till some 12 or 18 hours after the arrival of the cold mass.

A detailed examination of the available data shows that on the evening of the 14th the troposphere was on the whole in a stable state, on the morning of the 15th the lower part of it was very unstable with respect to saturated air, while on the evening when the low stratosphere was found, traces of instability existed from 2 to 5 km., but the surface layers were fairly stable. By the evening of the 16th the troposphere showed no special peculiarities at any level.

The run of the surface isobars was westerly on the 14th and 15th, and north-westerly on the 16th, with a geostrophic velocity of about 55 m.p.h. on the 15th and 80 m.p.h. on the morning of the 16th, decreasing later. The run of the balloons was towards south-east on the 14th, east on the 15th, south-east on the 16th,

It was most unfortunate that a gap occurred in the sequence of ascents on the morning of the 16th, but the weather conditions at Sealand were such that it was impossible to launch a balloon. For the illustration I am indebted to Mr. G. Manley who prepared it from the original records.

L. H. G. DINES.

The Royal Alfred Observatory, Mauritius

Mr. A. Walter, who has been associated with the Royal Alfred Observatory at Mauritius for more than 25 years, at first as assistant and since 1911 as Director, retires this year in order to take up the appointment of Director of Statistics in Kenya. Mr. Walter is well known for his valuable work in the meteorology of Mauritius and of the Indian Ocean in general. He was among the first meteorologists to make use of the method of statistical correlation, which he applied to the conditions affecting the sugar crops ("The Sugar Industry of Mauritius," London, 1910), and he has continued these valuable studies in recent years (see *Meteorological Magazine* 60, 1925, p. 147). In 1915 he extended the service of storm signals during the cyclone season to include the ocean surrounding Mauritius to a distance of 500 miles, sending warnings when necessary to Madagascar, Réunion and Rodriguez. In 1923, arrangements were completed for sending daily weather messages to Pretoria. The investigation of the upper air has not been neglected, an aerological station being established at Vacaos in 1922, while plans have been made for a

kite station on the coast. We wish Mr. Walter all success in his new work.

Atmospheric Pollution

WE have received from Mr. Robert W. Ascroft, M.B.E., F.R.H.S., a pamphlet entitled "The Conservation of the Nation's Vegetation," which points out very strongly the serious effect of coal smoke on plant life, and the consequent economic loss to the country. The damage is due partly to the corroding effects of the sulphuric and sulphurous acids introduced into the air, partly to the blocking of the stomata by tarry matter, and partly to the direct loss of daylight. Private fires in sitting rooms supply most of the deleterious substances, and the remedy is to be found in the more extended use of gas and coke. The effect of the smoke pall in diminishing the sunshine records in great towns is well-known to meteorologists, and we hope that this pamphlet will help to draw the attention of the general public to the evil.

Obituary

We regret to learn of the death of Mrs. F. J. W. Whipple in a motor accident in the New Forest on April 6th.

We also regret to announce the death, on March 18th, consequent on injuries received in a motor cycle accident, of Mr. G. F. Golding, Grade III. clerk of the Meteorological Office, stationed at Lympne.

News in Brief

Dr. G. C. Simpson, F.R.S., read a paper "On Lightning" before the Royal Society on Thursday, March 25th.

On Saturdays, May 15th and 22nd, Dr. Simpson will deliver two lectures on "Atmospheric Electricity" at the Royal Institution, at 3 p.m.

Meteorological observers are reminded that Summer Time will come into force this year in Great Britain and northern Ireland, as well as in France and Belgium, at 2h. G.M.T. on Sunday, April 18th.

Books Received

Bollettino della sezione meteorologica della Cirenaica, Anno 1924.
R. Ufficio Agrario, No. 4. Tripoli, 1925.

Meteorology. Extracts from statistics of New Zealand for the year 1924. Wellington, 1925.

Diepteloodingen in den Indischen Archipel (Depth soundings in the East Indian Archipelago). K. Magn. Meteor. Obs.

Batavia, Verh. No. 17, Vol. 1, part 1, Size $10\frac{1}{2} \times 7$, pp. 12 (Dutch) + 4 (English). *Illus.* Batavia, 1925.

Calendario della Basilica Pontificia del santissimo rosario in Valle di Pompei per l'anno 1926. Pompei, 1926.

The Weather of March, 1926

54/ WITH the exception of a few days near the middle of the month, fair mild weather, with a scarcity of rain, prevailed generally throughout March. During the first fortnight the passage of vigorous secondaries associated with depressions near Iceland frequently caused the winds to strengthen to gale force, and considerable damage was done to shipping. On the 3rd and 4th, and again on the 9th and 10th, gusts of 70-80 miles per hour occurred in several places: Fleetwood registered a gust of 84 miles per hour on the 10th. In the rear of a depression which passed across Scandinavia on the 4th there was a marked, though temporary drop in temperature, with snow, hail or sleet showers in many places. Precipitation was heavy locally in the north and west early in the month; among the largest amounts recorded being 90 mm. (3.45 in.) at Achnashellach (Ross-shire) and 112 mm. (4.43 in.) at Snowdon (Carnarvon) on the 7th. A brilliant display of the Aurora Borealis was witnessed from many parts of the British Isles on the evening of the 9th.* After the 14th an anticyclone moved northwards across England, giving fair misty weather with fog locally inland, and then a few days later the winds became easterly, and there was a decided drop in the temperature. High easterly winds prevailed in the English Channel on the 21st to 23rd, and at times on the east coast also. Snow or sleet fell in many places, including London, though the amounts were generally small. A grass minimum reading of 11° F. occurred at Wisley on the 22nd, and a screen minimum of 23° F. at a few stations on the night of the 24th to 25th. Meanwhile a decrease of pressure was spreading from the southwest, and by the 26th a warm, southerly current was affecting the southern counties. Temperature rose above 55° F. again, and a shallow depression over the English Channel caused some rain in many places. During the last few days of the month a large depression approached from the Atlantic, giving cloudy showery weather in the northwest, though fair weather continued to prevail in the east. The total rainfall was much below normal in England and Ireland (only 10 per cent. of the normal occurred at Woburn, Bedford), but more than twice the normal in parts of North Scotland.

Pressure was above normal over the British Isles and southern and central Europe, the greatest excess being 7.3 mb. at Scilly, and below normal over the northern Atlantic and northern

* See p 66.

Europe, where the deficit amounted to 9·4 mb. at Vardo. This distribution favoured westerly winds over northwest Europe. Rainfall was below normal except in Spitsbergen and Norway. and temperature was above normal generally. In Sweden temperature was 4° to 5° F. above normal over the whole country, and precipitation normal. Early in the month there were heavy falls of snow in the Rhone Valley and in Switzerland, where winter sports were resumed. Gales were widespread over Italy between the 5th and 7th, after which the temperature dropped considerably and there were heavy falls of snow on the Apennines. Further snow and gales, extending even as far south as Sicily, were reported on the 12th. In Lithuania a sudden thaw about the 9th caused serious floods in Kovno and the neighbouring districts. Towards the end of the month snow again occurred in many parts of France. Reports from Moscow state that about the middle of the month a great storm raged over Central Asia for 26 hours, falling most heavily on the districts of Merv and Poltoratsk.

A great want of rain and the failure of the crops is reported from the Er Rif, Morocco.

The great heat experienced in South Australia in February continued for the first days of March, but about the middle of the month light and plenteous rains occurred generally, which proved the salvation of the cattle and sheep industries, and assured water supplies. Later the rains became heavy, and serious floods were threatened in Queensland and New South Wales.

Severe cold was experienced in Canada during the first fortnight – 38° F. being recorded at Doucet, Quebec, on the 14th and 16th, and – 36° F. at White River, Ontario, on the 5th and 11th. High winds and heavy snow storms occurred in the Middle States from the Rockies to New England on the 29th and 30th, and on the 31st a storm was raging along the east coast.

The special message from Brazil states that abundant rainfall fell in the northern and central districts, the totals for the month being 87 mm. and 114 mm. above normal respectively, while in the southern districts the rainfall was scanty, being 64 mm. below normal. Pressure changes were more frequent than in the previous month. The cotton and vegetable crops suffered from excess of rain in the north, but the coffee and cane crops are in excellent condition. At Rio de Janeiro, pressure was 0·8 mb. above normal, and temperature 0·2° F. below normal.

Rainfall, March, 1926—General Distribution

England and Wales ..	35	} per cent. of the average 1881-1915
Scotland	103	
Ireland	55	
British Isles	57	

Rainfall: March, 1926: England and Wales

CO.	STATION.	In.	mm.	Per- cent. of Av.	CO.	STATION.	In.	mm.	Per- cent. of Av.
<i>Lond.</i>	Camden Square .....	.30	8	16	<i>War.</i>	Birmingham, Edgbaston	.61	16	32
<i>Sur.</i>	Reigate, Hartswood ...	.42	11	19	<i>Leics</i>	Thornton Reservoir ..	1.15	29	63
<i>Kent.</i>	Tenterden, Ashenden ..	.30	8	14	<i>"</i>	Belvoir Castle .....	.49	12	27
<i>"</i>	Folkestone, Boro. San.	.25	6	...	<i>Rut.</i>	Ridlington .....	.56	14	...
<i>"</i>	Margate, Cliftonville ..	.28	7	18	<i>Linc.</i>	Boston, Skirbeck .....	.66	17	42
<i>"</i>	Sevenoaks, Speldhurst ..	.44	11	...	<i>"</i>	Lincoln, Sessions House	.53	13	34
<i>Sus.</i>	Patching Farm .....	.43	11	20	<i>"</i>	Skegness, Marine Gdns.	...	...	...
<i>"</i>	Brighton, Old Steyne ..	.59	15	29	<i>"</i>	Louth, Westgate .....	.46	12	22
<i>"</i>	Tottingworth Park .....	.50	13	20	<i>"</i>	Brigg .....	.65	17	36
<i>Hants</i>	Ventnor, Roy. Nat. Hos.	.42	11	20	<i>Notts.</i>	Worksop, Hodsock .....	.64	16	38
<i>"</i>	Fordingbridge, Oaklands	.70	18	30	<i>Derby</i>	Mickleover, Clyde Ho.	1.28	33	72
<i>"</i>	Ovington Rectory .....	.43	11	17	<i>"</i>	Buxton, Devon. Hos.	2.09	53	51
<i>"</i>	Sherborne St. John Rec.	.87	22	39	<i>Ches.</i>	Runcorn, Weston Pt. ...	1.05	27	52
<i>Berks</i>	Wellington College .....	.54	14	27	<i>"</i>	Nantwich, Dorfold Hall	1.02	26	...
<i>"</i>	Newbury, Greenham .....	.67	17	30	<i>Lancs</i>	Manchester, Whit. Pk.	1.44	37	64
<i>Herts.</i>	Benington House .....	...	...	...	<i>"</i>	Stonyhurst College	2.46	63	67
<i>Bucks</i>	High Wycombe .....	.34	9	17	<i>"</i>	Southport, Hesketh ...	1.02	26	46
<i>Oxf.</i>	Oxford, Mag. College ..	.62	16	41	<i>"</i>	Lancaster, Strathspey.	1.38	35	...
<i>Nor.</i>	Pitsford, Sedgebrook ..	.54	14	31	<i>Yorks</i>	Sedburgh, Akay	4.03	102	89
<i>"</i>	Eye, Northolme .....	...	...	...	<i>"</i>	Wath-upon-Deane .....	.61	15	35
<i>Beds.</i>	Woburn, Crawley Mill ..	.17	4	10	<i>"</i>	Bradford, Lister Pk. ...	1.36	35	56
<i>Cam.</i>	Cambridge, Bot. Gdns.	.29	7	20	<i>"</i>	Wetherby, Ribston H. ...	.92	23	47
<i>Essex</i>	Chelmsford, County Lab.	.20	5	12	<i>"</i>	Hull, Pearson Park ...	.54	14	30
<i>"</i>	Lexden, Hill House .....	.09	2	...	<i>"</i>	Holme-on-Spalding ...	.72	18	...
<i>Suff.</i>	Hawkedon Rectory .....	.24	6	13	<i>"</i>	West Witton, Ivy Ho. ...	...	...	...
<i>"</i>	Haughley House .....	.37	9	...	<i>"</i>	Felixkirk, Mt. St. John	.82	21	42
<i>Norfol.</i>	Beccles, Geldeston .....	.30	8	17	<i>"</i>	Pickering, Hungate ...	.65	17	...
<i>"</i>	Norwich, Eaton .....	...	...	...	<i>"</i>	Scarborough .....	...	...	...
<i>"</i>	Blakeney .....	.27	7	16	<i>"</i>	Middlesbrough .....	.77	20	50
<i>"</i>	Swaffham .....	.38	10	21	<i>"</i>	Baldersdale, Hury Res.	2.42	61	79
<i>Wills.</i>	Devizes, Highclere .....	.65	17	31	<i>Durh.</i>	Ushaw College .....	.68	17	31
<i>"</i>	Bishops Canning .....	.74	19	33	<i>Nor.</i>	Newcastle, Town Moor.	1.12	28	53
<i>Dor.</i>	Evershot, Melbury Ho.	.59	15	20	<i>"</i>	Bellingham, Highgreen	2.61	66	...
<i>"</i>	Creech Grange .....	.77	20	...	<i>"</i>	Lilburn Tower Gdns. ...	.98	25	...
<i>"</i>	Shaftesbury, Abbey Ho.	.80	20	34	<i>Cumb.</i>	Geltsdale	1.63	41	...
<i>Devon</i>	Plymouth, The Hoe	1.11	28	38	<i>"</i>	Carlisle, Scaleby Hall	1.43	36	58
<i>"</i>	Polapit Tamar .....	.90	23	30	<i>"</i>	Seathwaite M.	7.92	201	71
<i>"</i>	Ashburton, Druid Ho.	1.40	36	31	<i>Glam.</i>	Cardiff, Ely P. Stn. ....	.81	21	25
<i>"</i>	Cullompton .....	.69	17	25	<i>"</i>	Treherbert, Tynywaun	2.81	71	...
<i>"</i>	Sidmouth, Sidmount ..	.64	16	26	<i>Carm</i>	Carmarthen Friary ...	.94	24	25
<i>"</i>	Filleigh, Castle Hill ...	.83	21	...	<i>"</i>	Llanwrda, Dolaucothy.	1.89	48	41
<i>"</i>	Barnstaple, N. Dev. Ath.	.52	13	20	<i>Pemb.</i>	Haverfordwest, School	.72	18	21
<i>Corn.</i>	Redruth, Trewirgie .....	...	...	...	<i>Card.</i>	Gogerddan	1.60	41	46
<i>"</i>	Penzance, Morrab Gdn.	1.05	27	33	<i>"</i>	Cardigan, County Sch. .	.63	16	...
<i>"</i>	St. Austell, Trevarna ..	.95	24	28	<i>Brec.</i>	Crickhowell, Talymaes	1.20	30	...
<i>Soms</i>	Chewton Mendip	1.38	35	39	<i>Rad.</i>	Birm. W. W. Tyrmynydd	2.44	62	45
<i>"</i>	Street, Hind Hayes .....	.97	25	...	<i>Mont.</i>	Lake Vyrnwy	2.21	56	52
<i>Glos.</i>	Clifton College	1.03	26	41	<i>Denb.</i>	Llangynhafal .....	.94	24	...
<i>"</i>	Cirencester, Gwynfa ..	.84	21	35	<i>Mer.</i>	Dolgelly, Bryntirion ..	2.93	74	59
<i>Here.</i>	Ross, Birchlea .....	.22	6	11	<i>Carn.</i>	Llandudno .....	.66	17	30
<i>"</i>	Ledbury, Underdown ..	.38	10	20	<i>"</i>	Snowdon, L. Llydaw 9	8.57	218	...
<i>Salop</i>	Church Stretton .....	.89	23	38	<i>Ang.</i>	Holyhead, Salt Island.	.47	12	18
<i>"</i>	Shifnal, Hatton Grange	.61	15	33	<i>"</i>	Lligwy .....	.61	15	...
<i>Staff.</i>	Tea, The Heath Ho. ....	...	...	...	<i>Isle of Man</i>	Douglas, Boro' Cem. ...	1.42	36	48
<i>Worc.</i>	Ombersley, Holt Lock ..	.39	10	23	<i>Guernsey</i>	St. Peter P't, Grange Rd	1.19	30	48
<i>"</i>	Blockley, Upton Wold ..	.73	19	34					
<i>War.</i>	Farnborough .....	.78	20	37					

Rainfall: March, 1926: Scotland and Ireland

CO.	STATION	In.	mm.	Per- cent. of Av.	CO.	STATION.	In.	mm.	Per- cent. of Av.
<i>Wgt.</i>	Stoneykirk, Ardwell Ho	1.76	45	68	<i>Suth.</i>	Loch More, Achfary...	14.75	375	230
"	Pt. William, Monreith.	1.80	46	...	<i>Caith</i>	Wick	2.78	71	122
<i>Kirk.</i>	Carsphairn, Shiel.	5.76	146	...	<i>Ork.</i>	Pomona, Deerness	5.35	136	190
"	Dumfries, Cargen	2.49	63	69	<i>Shet.</i>	Lerwick	6.11	155	195
<i>Roxb.</i>	Branxholme	2.31	59	80					
<i>Selk.</i>	Ettrick Manse	3.22	82	...	<i>Cork.</i>	Caheragh Rectory	2.56	65	...
<i>Berk.</i>	Marchmont House	1.58	40	60	"	Dunmanway Rectory.	2.78	71	57
<i>Hadd.</i>	North Berwick Res.	1.17	30	62	"	Ballinacurra	2.17	55	76
<i>Midl.</i>	Edinburgh, Roy. Obs.	1.57	40	88	"	Glanmire, Lota Lo.	1.64	42	53
<i>Lan.</i>	Biggar	2.66	68	108	<i>Kerry</i>	Valencia Obsy.	1.72	44	38
"	Leadhills	4.63	118	...	"	Gearahameen	3.50	89	...
<i>Ayr.</i>	Kilmarnock, Agric. C.	3.07	78	110	"	Killarney Asylum .....	...	...	...
"	Girvan, Pinmore	3.04	77	81	"	Darrynane Abbey	2.25	57	55
<i>Renf.</i>	Glasgow, Queen's Pk..	2.76	70	106	<i>Wat.</i>	Waterford, Brook Lo..	1.04	26	38
"	Greenock, Prospect H.	6.13	156	124	<i>Tip.</i>	Nenagh, Cas. Lough...	2.16	55	70
<i>Bute.</i>	Rothsay, Ardenraig.	4.98	127	139	"	Tipperary	1.90	48	...
"	Dougair Lodge	3.31	84	...	"	Cashel, Ballinamona ..	1.78	45	65
<i>Arg.</i>	Ardroch House	11.94	303	...	<i>Lim.</i>	Foynes, Coolnanes	1.70	43	58
"	Manse of Glenorchy..	9.75	248	...	"	Castleconnell Rec.	1.65	42	...
"	Oban	4.98	126	...	<i>Clare</i>	Inagh, Mount Callan ..	2.57	65	...
"	Poltalloch	4.92	125	128	"	Broadford, Hurdlest'n.	1.83	46	...
"	Inveraray Castle	11.14	283	180	<i>Wexf.</i>	Newtownbarry .....	...	...	...
"	Islay, Eallabus	4.11	104	108	"	Gorey, Courtown Ho...	.63	16	27
"	Mull, Benmore	8.40	213	...	<i>Kilk.</i>	Kilkenny Castle .....	...	...	...
<i>Kinr.</i>	Loch Leven Sluice	1.56	40	52	<i>Wic.</i>	Dashel, Clonmannon ..	.65	17	...
<i>Perth</i>	Loch Dhu	8.40	213	127	<i>Carl.</i>	Hacketstown Rectory .	.77	20	27
"	Balquhidder, Stronvar.	6.39	162	103	<i>QCo.</i>	Blandsfort House .....	.97	25	37
"	Crieff, Strathearn Hyd.	1.82	46	57	"	Mountmellick	1.73	44	...
"	Blair Castle Gardens ..	2.55	65	97	<i>KCo.</i>	Birr Castle	1.11	28	46
"	Coupar Angus School ..	.96	24	44	<i>Dubl.</i>	Dublin, FitzWm. Sq...	.87	22	45
<i>Forf.</i>	Dundee, E. Necropolis.	1.17	30	57	"	Balbriggan, Ardgillan .	.94	24	47
"	Pearsie House	1.70	43	...	<i>Me'th</i>	Drogheda, Mornington	.91	23	...
"	Montrose, Sunnyside ..	.65	17	31	"	Kells, Headfort	1.54	39	56
<i>Aber.</i>	Braemar, Bank	1.49	38	50	<i>W.M.</i>	Mullingar, Belvedere .	1.55	39	57
"	Logie Coldstone Sch. ..	1.11	28	43	<i>Long</i>	Castle Forbes Gdns.	1.43	36	48
"	Aberdeen, King's Coll..	.99	25	41	<i>Gal.</i>	Ballynahinch Castle ..	2.01	51	39
"	Fyvie Castle .....	...	...	...	"	Galway, Grammar Sch.	.78	20	...
<i>Mor.</i>	Gordon Castle	1.37	35	59	<i>Mayo</i>	Mallaranny	2.50	63	...
"	Grantown-on-Spey	1.84	47	70	"	Westport House	2.16	55	55
<i>Na.</i>	Nairn, Delnies	2.08	53	111	"	Delphi Lodge	5.33	135	...
<i>Inv.</i>	Ben Alder Lodge	6.84	174	...	<i>Sligo</i>	Markree Obsy.	2.09	53	60
"	Kingussie, The Birches	3.53	90	...	<i>Cav'n</i>	Belturbet, Cloverhill..	1.35	34	49
"	Loch Quoich, Loan	20.50	509	...	<i>Ferm.</i>	Eniskillen, Portora ..	2.46	62	...
"	Glenquoich	16.59	421	171	<i>Arm.</i>	Armagh Obsy.	1.73	44	74
"	Inverness, Culduthel R.	2.66	68	...	<i>Down</i>	Warrenpoint	1.81	46	...
"	Arisaig, Faire-na-Squir	4.14	105	...	"	Seaforde	1.60	41	55
"	Fort William	11.12	282	162	"	Donaghadee, C. Stn...	1.05	27	48
"	Skye, Dunvegan	5.05	128	...	"	Banbridge, Milltown ..	1.05	27	48
"	Barra, Castlebay	1.50	38	...	<i>Antr.</i>	Belfast, Cavehill Rd. .	1.81	46	...
<i>R&C</i>	Alness, Ardross Cas. ..	4.38	111	135	"	Glenarm Castle	2.70	69	...
"	Ullapool	7.44	189	...	"	Ballymena, Harryville	2.22	56	71
"	Torridon, Bendamph ..	9.54	242	127	<i>Lon.</i>	Londonderry, Creggan	2.50	64	78
"	Achnashellach	13.00	330	...	<i>Tyr.</i>	Donaghmore	2.62	67	...
"	Stornoway	4.34	110	106	"	Omagh, Edenfel	2.10	53	67
<i>Suth.</i>	Laig	5.90	150	...	<i>Don.</i>	Malin Head	1.69	43	73
"	Tongue Manse	3.81	97	113	"	Duntanaghy .....	...	...	...
"	Melvich School	3.42	87	120	"	Killybegs, Rockmount.	4.01	102	79

Climatological Table for the British Empire, October, 1925

STATIONS	PRESSURE		TEMPERATURE								Rela- tive Humi- dity	Mean Cloud Am't	PRECIPITATION		BRIGHT SUNSHINE	
	Mean of Day M.S.L.	Diff. from Normal	Absolute		Mean Values				Mean from Normal	Days			Hours per day	Per- cent- age of possi- ble.		
			Max.	Min.	Max.	Min.	1 max. 2 min.	Diff. from Normal							Wet Bulb.	
																° F.
London, Kew Obsy.	1013.9	0.1	69	33	58.6	45.7	52.1	+ 2.2	47.4	93	7.8	78	+ 9	12	2.7	26
Gibraltar	1017.0	- 0.2	79	53	73.0	60.9	66.9	+ 0.8	60.4	84	5.6	34	- 50	9	...	...
Malta	1014.3	- 2.3	79	59	72.6	64.6	68.6	- 2.3	66.1	87	5.3	180	+ 107	15	6.7	59
Sierra Leone	1013.4	+ 1.4	90	67	85.1	72.3	78.7	- 1.5	74.9	85	6.7	501	+ 180	24	...	...
Lagos, Nigeria	1010.8	- 0.9	89	73	85.7	74.4	80.1	+ 1.0	75.3	79	8.6	76	- 120	9	...	...
Kaduna, Nigeria	1013.5	+ 1.2	91	63	87.2	66.7	76.9	+ 0.6	75.7	93	2.5	110	+ 55	15	...	...
Zomba, Nyasaland	1012.0	+ 0.8	92	53	84.0	61.5	72.7	- 1.4	...	79	5.3	67	+ 28	4	...	...
Salisbury, Rhodesia	1011.6	- 0.3	88	49	81.6	55.2	68.4	- 2.4	57.7	46	2.3	46	+ 16	7	9.3	74
Cape Town	1018.1	+ 0.9	84	43	69.3	54.7	62.0	+ 0.8	57.1	77	5.1	82	+ 39	13	...	...
Johannesburg	1014.4	+ 0.3	82	41	73.4	50.1	61.7	- 0.9	50.9	53	2.1	35	- 26	6	10.3	81
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	89	33	78.3	46.2	62.3	- 2.3	52.7	49	2.7	19	- 24	3	...	...
Calcutta, Alipore Obsy.	1011.1	+ 1.7	94	67	87.1	74.4	80.7	- 0.0	75.5	89	4.2	222	+ 116	8*	...	...
Bombay	1010.0	+ 0.2	94	77	91.7	79.6	85.7	+ 3.4	77.4	78	2.8	6	- 36	1*	...	...
Madras	1009.5	+ 0.6	96	71	88.5	74.9	81.7	- 0.6	76.3	83	6.9	425	+ 127	13*	...	...
Colombo, Ceylon	1010.6	+ 0.3	87	73	86.3	75.4	80.9	+ 0.6	78.0	74	7.2	349	+ 17	27	6.3	53
Hong Kong	1015.4	+ 1.8	86	67	80.2	71.7	75.9	- 1.0	67.8	60	4.1	81	- 42	5	8.7	75
Sandakan	...	...	91	73	87.8	74.5	81.1	- 0.4	76.3	81	...	307	+ 53	15	...	...
Sydney	1014.1	- 1.0	93	46	71.3	53.5	62.4	- 1.1	57.4	59	5.0	19	- 56	11	7.9	61
Melbourne	1012.1	- 2.6	96	39	69.6	49.1	59.3	+ 1.7	52.3	57	6.5	28	- 38	13	6.8	52
Adelaide	1013.9	- 2.2	89	39	72.2	50.1	61.1	- 0.8	53.1	50	6.1	24	- 20	9	7.7	60
Perth, W. Australia	1017.6	+ 0.8	88	42	67.2	51.9	59.5	- 1.5	54.7	65	6.6	55	+ 1	18	6.6	52
Coolgardie	1014.5	- 0.7	90	37	77.2	49.4	63.3	- 0.3	51.8	46	2.1	11	- 8	3	...	...
Brisbane	1015.5	- 0.8	91	46	78.3	59.0	68.7	- 1.1	61.9	57	3.5	9	- 58	4	9.5	75
Hobart, Tasmania	1006.1	- 4.5	87	37	63.4	45.5	54.5	+ 0.5	48.3	60	6.9	42	- 15	17	6.4	48
Wellington, N.Z.	1014.3	+ 2.0	73	35	61.0	48.9	54.9	+ 0.6	51.8	70	6.4	144	+ 39	18	6.0	45
Suva, Fiji	1012.8	- 0.4	86	65	80.3	69.6	74.9	- 1.1	71.7	77	8.1	465	+ 267	26	...	...
Apia, Samoa	1011.3	- 0.2	90	71	86.0	73.8	79.9	+ 1.5	75.2	71	5.1	129	- 25	11	7.1	57
Kingston, Jamaica	1012.8	+ 1.3	94	69	89.0	72.2	80.6	+ 0.1	71.2	82	3.0	44	- 146	8	...	...
Grenada, W.I.	1012.7	+ 1.7	87	72	84.7	74.9	79.8	- 0.3	76.6	80	5.7	184	- 5	19	4.2	38
Toronto	1014.9	- 3.1	65	24	49.2	35.5	42.3	- 4.6	37.7	88	5.4	67	+ 4	14	3.1	29
Winnipeg	1017.3	+ 2.0	57	6	39.5	26.5	33.0	- 7.8	...	...	7.3	34	- 99	18	5.0	45
St. John, N.B.	1009.8	- 6.7	58	20	48.2	35.5	41.9	- 3.4	37.8	83	5.2	214	+ 36	10	4.5	...
Victoria, B.C.	1019.1	+ 1.5	66	39	55.9	44.8	50.3	- 0.1	47.0	86	7.0	29	-	...	...	41

* For Indian stations a rain day is a day on which 0.1 in. (2.5 mm.) or more rain has fallen.