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Dr. Charles Chree

The death of Dr. Charles Chree, which occurred at Worthing on August 12th after a few months of illness has been announced in the *Meteorological Magazine*. It is only three years ago that Dr. Chree retired from his post as Superintendent of Kew Observatory. At that time, and, indeed, until quite recently there was every reason to suppose that he had still many years of vigorous life before him.

Charles Chree was born at Lintrathen in Forfarshire on May 5th, 1860, and after passing through the Grammar School, Old Aberdeen, he graduated in 1879 at the University of that city, winning the gold medal awarded to the most distinguished graduate in arts of the year. From Aberdeen he went to Cambridge; his studies there were interrupted by severe illness, he lost a year's work and the illness left him with white hair which he carried through life. He passed the mathematical tripos however as sixth wrangler and other distinctions led to his election as a Fellow of his College, King's. In that position he had time for research work and devoted himself to the mathematical theory of elasticity. On that subject he published several important papers. In 1893 he was selected for the post of Superintendent of Kew Observatory, vacant through the death of my father, G. M. Whipple, at the beginning of the year. From 1893 to 1925 Chree was identified with the Observatory.

When Chree was first appointed to the Observatory the idea of a National Physical Laboratory had been mooted already and a strong Committee of the British Association was exploring possibilities. A considerable amount of work appropriate for

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such a Laboratory was being done already at Kew, and, indeed, the income of the Observatory depended mostly on the fees for tests. The instruments submitted for verification included thermometers, barometers, sextants, telescopes, compasses, etc., as well as watches and chronometers. Chree's responsibility for much of this work continued after the National Physical Laboratory was constituted in 1901 and the new governing body took over the administration of the Observatory from the old Kew Committee. In 1910 the Observatory was transferred from the National Physical Laboratory to the Meteorological Office. Dr. Chree's last years of service were as an Assistant Director of the Office. He retired in 1925.

Soon after his appointment as Superintendent Chree began to publish papers connected with the work of the Observatory. Some of these were concerned with the standardization of instruments. To thermometry, for instance, he devoted some important papers in the *Philosophical Magazine*. He also discussed the testing of aneroid barometers, a subject which was then of interest mostly to mountaineers. Another paper he devoted to the theory of the Robinson cup anemometer.

The branches of the Observatory work which made the strongest appeal to Chree were atmospheric electricity and terrestrial magnetism. Before his time, though records of atmospheric potential were being made at various places the results were hardly comparable. Chree saw the importance of standardization and developed a method by which the photographic curves from the Kelvin electrograph could be utilised to give potential gradient in the open. Through this enterprise there is for Kew a longer series of reliable observations of potential gradient than for any other observatory. Dr. Chree devoted several papers to the discussion of the results. The latest, written with R. E. Watson, was especially concerned with the effects of atmospheric pollution on potential gradient.

As some guide to Dr. Chree's earlier work in terrestrial magnetism we have a valuable book which he published in 1912. (His activity in research continued unabated in later years, and it is to be hoped that means will be found to put the salient results on record in an equally convenient form.) His attitude to scientific investigation is well illustrated by a paragraph in the preface to this book.

"The book deals almost entirely with facts, or supposed facts. The absence of a definite theory as to the origin of the several magnetic changes is due to no lack of curiosity as to the causes of things, but to a belief that at the present stage theorising is less likely to be of substantial advantage than the extension of positive knowledge. It is sometimes claimed that a theory is essential as a guide in selecting the directions in which to prosecute research. This is a very partial truth. When a man devotes himself to a subject, allowing free ingress to his mind to all the ideas which the results obtained by investigators naturally suggest, he must be a very unimaginative person if profitable lines of enquiry do not force themselves on his intelligence. The difficulty is not in thinking of something to do but of deciding what to do next. In making a choice some may prefer the guidance supplied by a definite theory, but others will prefer to rely on their natural instinct for detecting a weak spot in the defence offered by Nature to the discovery of her secrets."

Such doctrines Chree never tired of repeating, and he had the justification that his natural instinct had indeed detected many weak spots in Nature's defence. Although he refrained from making known speculations of his own, he insisted on the credit due to Balfour Stewart for his hypothesis that the variations of magnetic force were to be explained by the existence of a highly conducting region in the upper air. Chree wished the name of Balfour Stewart to be associated with those of Schuster, Kennelly and Heaviside in references to the conducting layer.

The first of Chree's discoveries in terrestrial magnetism was it appears the "non-cyclic change" in the magnetic elements on quiet days. Just before his time the British Association had introduced the practice of tabulating the diurnal variation on magnetically quiet days, these days being selected by the Astronomer Royal. The idea was that the effect of magnetic storms would be eliminated. In studying the tabulations Chree found that the values entered for successive midnights differed systematically. In the typical case of horizontal force, the sign of this systematic difference implied that on quiet days horizontal force was increasing. In other words the net effect of disturbed days is to reduce horizontal force and in the subsequent quiet days there is a gradual recovery. Thus a weak spot was revealed in Nature's defence, and Chree proceeded to inaugurate the study of the diurnal variation of the magnetic elements on disturbed days. Here he found an entirely new type of variation. To quote what he says in another connexion he was in the position of the doctor who had established a distinction between two types of disease such as small-pox and chicken-pox which had been confused before. He had provided a new test which a theory of terrestrial magnetism would have to satisfy. In later papers Chree devoted much attention to the recurrence of magnetic disturbances at intervals governed by the rotation of the sun. Perhaps the most notable discovery in this field was the fact that quiet conditions tended to recur with the same regularity as disturbed ones.

Chree's weighty contributions to terrestrial magnetism include the discussions of the magnetic observations brought back by three Antarctic expeditions, Scott's two and Mawson's. The advantage is manifest of uniform treatment of these three valuable series of observations, taken in conjunction with the simultaneous observations made at observatories in other parts of the world. The whole of Chree's work on Mawson's expedition has not yet been published, he was engaged on it when his efforts were interrupted by his last illness. Another self-imposed task which he had successfully completed since his retirement was a discussion of the Kew records of magnetic declination from 1858 onwards. This discussion, which will be published in the near future, is a worthy conclusion to the fine series of papers he devoted to the observatory records.

In connexion with the organization of observations the large part which Dr. Chree took in the establishment of the Observatories at Eskdalemuir and Lerwick must be mentioned. As is well known the Observatory at Eskdalemuir was built to secure records of terrestrial magnetism at a place free from the disturbing influence of the electric currents used on tramways and railways. Dr. Chree made a careful magnetic survey round the site proposed for the Observatory and his influence was felt in many ways in the development of the Observatory. When the records from Eskdalemuir became available for study it was seen that the character of the magnetic variations there differed considerably from that found in the south of England. Dr. Chree was impressed with the importance of getting records from a station still nearer to the auroral zone, and it was largely through his advocacy that the Observatory at Lerwick was established.

Dr Chree's degrees were Sc.D. of Cambridge and LL.D. of Aberdeen. He was elected a Fellow of the Royal Society in 1897. He was awarded the James Watt medal by the Institution of Civil Engineers in 1905 and the Hughes medal of the Royal Society in 1919. He served as president of the Physical Society and of the Royal Meteorological Society. In later years his eminence as a magnetician was recognised by his election as president by both of the international bodies which deal with terrestrial magnetism and atmospheric electricity. Amongst the characteristics which made an impression on those who worked with Dr. Chree were his accuracy and speed in computation and his skill as an observer. His powers of concentration were remarkable; even the first drafts of his papers had but few corrections, and the copies which he always made with his own hand were ready for the printer and free from amendments. He was a patient teacher, as the magnetic observers who came to Kew from all parts of the world for training would testify. His sound judgment on man and affairs was tempered by kind consideration and by a sense of humour, which made him an acceptable, as well as lucid, public speaker.

Dr. Chree had won the warm affection of his colleagues and especially of those who had had the privilege of working with him at Kew; to them he was a wise counsellor and a good friend. Their keen sense of loss will be shared by his friends and fellow-workers the wide world over.

F. J. W. WHIPPLE.

Renewal of Muslin and Wick on Wet Bulb Thermometers

In the *Meteorological Magazine* for July, 1928, Mr. R. C. Sutcliffe discusses the effect of the renewal of the muslin on the wet bulb thermometer and reaches the conclusion that under London conditions in winter a wet bulb muslin should not be allowed to remain in use for more than a fortnight.

Certain experiments were carried out here [in Heliopolis] in June, 1927, with a view to determining the best distance between the wet bulb and the water in the container. Four wet bulb thermometers were exposed in a Stevenson Screen, the water levels being (*a*) 9cm., (*b*) 4½cm., (*c*) 2¼cm., (*d*) about 1cm. below the bulbs. Although the effect of a change of muslin was not specifically studied, it was noted that for a few hours after a change of muslin on all bulbs, the depression of wet bulb (*a*) was greater than that of (*d*). The differences were not large, being generally less than 0.5°F. but reaching 1°F. occasionally. After an interval of 2-3 hours the depression of the wet bulb (*d*) was invariably greater than that of (*a*), (*b*), or (*c*), and the difference increased with time up to

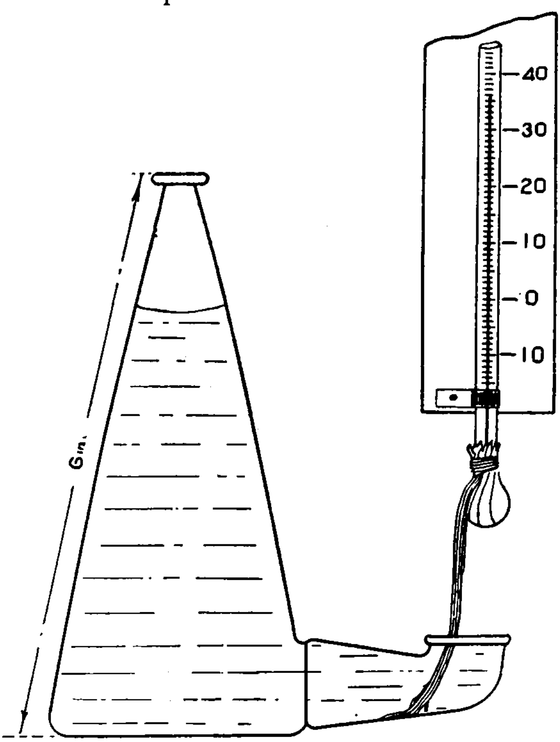


Fig. 1.

about 3 days when the depression of (*d*) exceeded that of (*a*) by as much as 5·6°F.

It appears therefore that unless special precautions are taken in this country to maintain a constant water level (about 1cm. below the wet bulb) during the summer months the muslin would require to be changed about every 3 hours. Actually a simple piece of apparatus as illustrated in Fig. 1 has been brought into use at all Air Ministry meteorological stations in this area, so that a constant water level is always maintained.

There still remains the question of the frequency of change of muslin and this depends amongst other things on the nature of the water used. At meteorological stations in the vicinity of wireless stations distilled water can be obtained fairly easily but at many outlying stations distilled water or rain water is not obtainable and it seemed worth while to investigate what difference there would be in the readings of a wet bulb (*a*) covered with a clean muslin and one (*b*) covered with a muslin a few days old—muslins being kept wet from the same container. Experiments were carried out using Heliopolis drinking water which contains a good deal of lime. After an interval of three hours during which both thermometers read alike, the muslin on (*a*) was changed. With dry bulb readings of over 90° the difference in the depressions of (*a*) and (*b*) was 0.5 to 0.8°; this difference remained under 1° when the muslin on (*b*) was one day older than that on (*a*) and also when two days older but when the muslin on (*b*) was three days older than that on (*a*) differences of as much as 4.8°F. were shown. This difference is apparently due to the deposit of lime from the water and to the fine sand which collects on the muslin.

The experiments were then repeated using distilled water, the muslin on (*a*) being changed daily.

The following table shows the results obtained :—

Difference in age between muslin on (*a*) and (*b*) in days.	Average difference in depression of Wet Bulb (*a*-*b*) Dry Bulb > 90 F.	Average difference in depression of Wet Bulb (*a*-*b*) Dry Bulb < 90°F.
0	0.0	0.0
1	0.0	0.3
2	0.8	0.8
3	1.3	1.0
5	2.4	0.8
6	2.7	1.5
7	3.0	1.5
8	3.0	1.8
9	3.1	2.9
10	3.3	2.1
20	4.5	—

To avoid systematic errors in wet bulb readings, it would therefore appear necessary even when using distilled water to change the muslin every two days, but if an error of 5% in the relative humidity be allowed (corresponding to an error of about 2° in the wet bulb) it will be necessary to change the muslin every four days when temperatures of over 90°F. are experienced, and every six days when temperatures of under 90°F. (generally 75-89°F.) are experienced.

The above results obtained from observations at Heliopolis probably apply to other areas as well, and they show that a great deal of attention is necessary if the best results are to be obtained from the wet bulb thermometer—more especially as in areas where high average temperatures are measured, humidity is regarded as being as important a factor as the actual temperature itself.

J. DURWARD.

Official Publications

Annual Report of the Director of the Meteorological Office, presented by the Meteorological Committee to the Air Council, for the Year ended 31st March, 1928.

This report, describing the activities of the Meteorological Office during the seventy-third year of its existence and the eighth year in which its cost has been borne on Air Ministry votes, is cast in a new and more attractive form than the reports for previous years. In place of formal accounts and tables cataloguing the work of each separate division into which the Office is divided for administrative purposes, the report discusses in turn the various practical applications of meteorology —Climatology, Ocean Meteorology, Aviation, &c. The last of these sections is naturally of the greatest interest; it details the meteorological arrangements for Trans-Atlantic and other long distance flights, and gives an account of the work of the Office in connexion with airships and the British Airship Mission. Under the heading of Climatology is the story of the substitution of an annual volume for the old *Weekly Weather Report*, while a new departure in Forecasting is the undertaking of warnings when weather conditions appear likely to cause high tides in the Thames. On the other hand, the Office is no longer charged with the investigation of atmospheric pollution, this duty having been transferred to the Department of Scientific and Industrial Research.

Discussions at the Meteorological Office

October 29th. *The evaporation of sea water and the thermal intercourse between the sea and atmosphere.* By Was Shoulejkin (Beitr. Geophysik, Leipzig, 20, 1928, pp. 99-122). *Opener*—Mr. R. S. Read, M.A., B.Sc.

November 12th. *On the brightness of the sky.* By N. N. Kalitin (Beitr. Geophysik, Leipzig, 18, 1927, pp. 383-397) (in German). *Opener*—Mr. E. W. Barlow, B.Sc.

Correspondence

To the Editor, *The Meteorological Magazine*

Remarkable Thunderstorm at Armagh

The thunderstorm of August 29th broke all records of the Armagh Observatory for intensity of rainfall. The locality is remarkable for its freedom from very heavy rains, and even more for the absence of severe electrical storms, which made the visitation the more unexpected. There was a good deal of distant thunder during the forenoon, and the clouds looked very threatening at times, but no rain fell, and by 13h. G.M.T., the threatening appearance of the weather had almost cleared off. It seemed as if the thunderclouds were about to disperse quietly as usual. But just before 15h., the storm broke without any warning. It did not approach, but seemed to develop right overhead out of nothing at all. A few very large drops of rain, making splashes as big as pennies, then a flash, and a crash of thunder following instantaneously, and not rain but hail, in stones as big as nuts and marbles, fell in sheets. All roof gutters and drain traps were quickly choked by the hailstones washed into them, and water poured into the houses through roofs, while the lower parts of the town were flooded to a depth of two to three feet [see the photographs which form the frontispiece of this issue]. Armagh lies in a depression, and most of the approaches to it are downhill. Each road leading into the town became in a few minutes a river discharging into the streets, bringing an amount of water which the drains could not have coped with, even had they not been obstructed by the masses of hail swept into them. The flood even lifted the manhole covers from culverts, and the water issuing therefrom added its quota to the surface deluge. The lightning and thunder were of a violent and terrifying description, such as the town had not seen for twenty years or more. According to some observers, two storms appeared to develop, one a little to the southeast and the other to the north of the town, and to converge upon it. There was little or no wind, and what there was came in uncertain puffs from different directions. The smoke from one mill chimney was seen to ascend in a corkscrew spiral towards the developing storm.

The storm lasted altogether less than an hour, but the greatest intensity lasted about 20 minutes. The rainfall, as recorded at the Observatory was 1.69in. in 50 minutes, of which one inch fell in the first 20 minutes. The trace of the Beckley recording rain-gauge was so close that it was difficult to say whether it had emptied itself four or five times during that time. The amount collected in the Snowdon gauge close beside it however agreed with the larger amount. The greater part of the precipitation being hail, the rate of fall must have been considerably greater than the gauges indicated, as the funnels were nearly full of hail, which took some time to melt. There were two distinct forms of hailstones; small cones with hemispherical base, and spheres of clear ice. These were mixed in about equal proportions. Such was the quantity of hail that heaps of it were still lying in corners on September 1st, in spite of a maximum temperature of 64° to 65°, on each of the three following days. The storm was quite local, places only a mile or two distant from the town having no hail, and only a moderate rainfall.

What makes the rainfall the more remarkable is that it followed two other rainstorms of 1.22in., and 1.51in., respectively, on the two previous Sundays, giving a fall of 5.10in. (including minor amounts) in 10 days.

WM. F. A. ELLISON.

The Observatory, Armagh. September 21st, 1928.

Squall at Southend-on-Sea

A severe squall, causing loss of life at Southend, and some local damage, occurred in this district on Sunday, September 9th, at about 17h. G.M.T. The passage of the squall was very clearly shown on the recording instruments at this station. The barograph showed signs of oscillation and a sudden rise; simultaneously the wind velocity, as measured by the Dines P.T. anemometer, showed an almost instantaneous rise from calm to nearly 34m.p.h. One gust of 34m.p.h. was recorded, and the wind dropped to calm again at about 18h. 40m. G.M.T. The thermograph at this time showed a sudden drop of 8°F., and the hygrograph a sudden drop, followed almost at once by a very rapid rise.

The weather before the storm was: overcast, strato-cumulus, with heavy showers at times; very oppresive and dark just before the wind rose. A mass of heavy cumulo-nimbus approached from the southwest, and was followed by a violent dust storm. Rain commenced about 10 minutes after the passage of the head of cloud.

O. G. SUTTON.

Shoeburyness. September 10th, 1928.

Observations of Auroræ

Aurora was seen by several observers in Huddersfield between 2h. and 2h. 30m. on the morning of August 27th last. A preliminary rosy glow in the northern sky gave way to a series of white pillars of light which moved slowly about and were sufficiently faint to allow the stars to be seen through them.

In view of the infrequency of the observation of aurora as far south as Yorkshire, I think it would be of interest to know whether it was observed in other parts of the country on this date; up to the present I have been unable to obtain further information. The two previous records of aurora in this district were in February, 1910, and March, 1926.

S. MORRIS BOWER.

Langley Terrace, Oakes, Huddersfield. October 3rd, 1928.

Cromer, September 7th, 1928. The aurora was first noticed at about 10.10 p.m. British Summer Time. It was a radiation night with a very heavy dew, the sky being clear except for a small bank of cloud over the sea on the northern horizon. Above this, a pale green glow was to be seen, extending from about north by east to north by west, and 5° vertically. Four beams of the same colour, but of differing intensities, and varying in length from about 15° to 20° were seen issuing nearly vertically; and at north by east there was a single pale pink streamer. By 10.20 the streamers had disappeared, and subsequently the glow faded gradually.

G. J. W. ODDIE.
D. W. JOHNSTON.

October 3rd, 1928.

Mr. Wm. J. Gibson, of Waringstown, Co. Down, reports the occurrence of an unusually brilliant display of aurora at midnight (B.S.T.) on September 18th, and the following details are extracted from his description. The light was sufficient to light up the ground and to cause the styles of sundials to cast noticeable shadows. The display began at 10 p.m. in a cloudless sky, with a bank of light low in the north. "At 11 p.m. B.S.T. the lights began to stir in the form of perpendicular shafts or beams emanating from the bank . . . which by this time had resolved into a low arch." Just after midnight the northern heavens from WNW to ENE were aflame with a brilliant corona of auroral light. "Detached portions of light emanating from the horizon moved in slow uniform alignment up the sky right to the Pole Star, suggesting ripples of water on the smooth surface of a lake, whilst a thousand streamers bombarded the region of the Pole Star with such velocity as I seldom, if ever, witnessed before. The most conspicuous feature of the display was a huge stationary column or pillar of rose light extending from the horizon up to 90°, and about six times the diameter of the full moon in width." The display lasted until 1 a.m. and was associated with an outbreak of sunspots.

Iridescence on Cirro-stratus Cloud

This morning at 10h. 16m. I observed iridescence on some thin cloud which appeared to be cirro-stratus. Only a small part of this cloud was visible, most of the sky being covered with heavy cumulus. The phenomenon appeared between two heavy masses of low strato-cumulus. The iridescence appeared on the left of the sun which was unobscured and took the form of parallel columns, perfectly straight, a complete spectrum being visible in each column. The columns, if produced, would have met the horizon at about 45°. As the phenomenon lasted only a matter of seconds, I had no time to get a protractor for measurements, but I should think that the length of the bands was 4°—5°. The perpendicular distance from the sun to the nearest iridescent band was about the same as the usual radius of a corona. As I have observed straight arcs of contact to solar halos on two occasions recently it occurred to me that to-day's phenomenon might be an arc of contact to a solar corona, akin to the halo phenomenon. I wonder if any of your readers can give evidence as to whether arcs of contact can really exist in connexion with coronæ.

S. E. Ashmore.

Windwhistle Cottage, Grayshott, Hindhead, Surrey. July 30th, 1928.

Minimum Temperatures on Radiation Nights

In the *Meteorological Magazine* for December, 1927, p. 260, the present writer gave, in conjunction with Mr. J. Paton, equations representing the relationships between the screen minimum and grass minimum temperatures during radiation nights at Cranwell, Lincolnshire, during winter, defined as the months October to March (inclusive) over the period October 1st, 1920, to March 31st, 1927.

That inquiry has now been rounded off by carrying out a similar investigation for summer, defined as the months April to September (inclusive) over the period April 1st, 1921, to September 30th, 1927. A radiation night was defined as in the initial note and the same three-fold differentiation with regard to wind speed employed, the anemometer and the thermometers employed being as before.

Using T as the screen minimum temperature and G as the grass minimum temperature, both read at 7h. G.M.T. on the morning following the night being considered, the three equations found were as follows :—

Mean Wind Speed m.p.h.	Equation.	No. of cases available.
0—8	$T = 0.96G + 8{\cdot}0$	113
8—15	$T = 0.97G + 6{\cdot}6$	87
15 or over	$T = 1.05G + 3{\cdot}2$	19

In each case the fitting of the actual points on the graphs to the lines represented by the above equations was good.

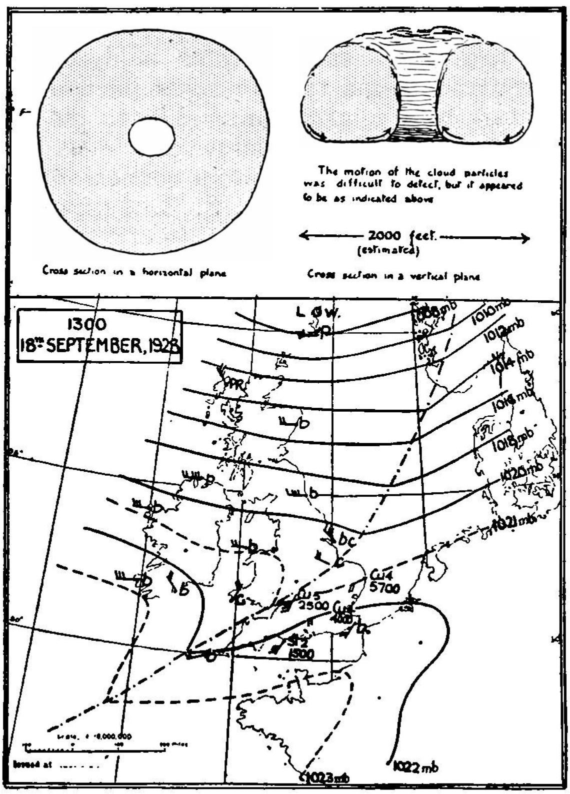
W. H. PICK.

R.A.F. Cadet College, Cranwell, Lincolnshire, March 21*st*, 1928.

NOTES AND QUERIES

A complete Cloud Vortex

At 3.30 p.m., G.M.T., on September 18th, 1928, I observed a complete cloud vortex passing from west to east directly over my garden at Forest Hill, London. At the time the sky was only about 3/10 covered with cloud which was neither true strato-cumulus nor cumulus; there was also some alto-stratus near the western horizon and this had by sunset changed to alto-cumulus. The main clouds were not really isolated in the sense that each was entirely independent of the other, they appeared to be intimately connected as their pattern and texture were very similar and although I observed only one complete vortex, other clouds showed signs of having recently been of a vortical type. The sky at once brought to mind an experiment shown to me three years ago by Mr. D. Brunt and described by him in the *Meteorological Magazine*.*



The vortex cloud appeared to have a vertical axis and it was rather domed on the top and flat on its under side. The centre of the vortex ring was quite distinct, the blue sky showing up very distinctly above the centre of the ring. I estimated that

*See Vol. 60, 1925, p. 1.

the cloud was travelling from west by north at an elevation of 2,000-3,000 feet with a velocity in the neighbourhood of 10m.p.h.

This cloud formation I have never before observed and it would be of interest to discover if it were an unusual phenomenon.

In the accompanying sketch I have endeavoured to give an idea of the size of the cumulus by means of a horizontal cross section and a vertical section; the horizontal section was not quite a regular circle but seemed very nearly so.

The following upper air temperature was taken at Duxford at 1.45 p.m. :—

Pressure	Height Above M.S.L.	Temperature		Relative Humidity
		Dry	Wet	
mb	ft.	°F.	°F.	%
1,021	M.S.L.	—	—	—
1,018	100	69	60	59
980	1,140	60	55	73
950	2,000	55·5	51	75
900	3,480	49	45·5	77
850	5,060	44	40	73
800	6,690	45	33	27
750	8,430	40	29·5	31
700	10,260	35	29	56
650	12,200	30	26	69

Cloud, 3/10, broken strato-cumulus 910-860mb., alto-stratus not reached by the aeroplane.

An inversion occurred between 5,700 feet, 830mb., temp. 40°F. and 6,370 feet, 810mb., temp. 46°F.

A pilot ballon ascent at 5 p.m. at Croydon gives upper winds as follows :—

Height.	*Wind. Direction.*	*Wind. Velocity.*
Ft.	°	*m.p.h.*
Surface	260	8
1,000	260	10
2,000	260	10
3,000	270	9
4,000	270	11
5,000	250	27
6,000	225	25

From the pilot balloon ascent it is evident that there was a quite solid westerly current extending from the surface to 4,000 feet and above this a backing and freshening of the wind, the velocity increasing from 10 to 25m.p.h. It is also worth noting the change of temperature about the same level indicated at Duxford, the temperature decreasing from the surface (69°F.), to 5,700 feet (40°F.), where it ceases to fall and begins to increase. The inversion extends from 5,700 to 6,370 feet, above this height the temperature begins to fall again with increase of height. From 3,200 to 4,700 feet there was at Duxford a layer of broken strato-cumulus clouds and at 4,700 feet the haze top was reached.

The weather map for 1 p.m. G.M.T. on the same day shows a feeble ridge of high pressure over southeast England and an advancing occlusion, the occlusion running in a northwesterly direction from the Scilly Islands to the Wash and southern Scandinavia. The passage eastwards of this occlusion caused slight rain in the London area when it passed on the following morning, this being the first rain for ten days. The map here reproduced shows the wind and weather with the clouds in the southeast mentioned in detail. At 4 p.m. G.M.T. Croydon reported cumulus clouds, 2/10 of the sky being covered. J. CRICHTON.

Arctic Ice and British Weather

For many years meteorologists have played with the idea that the weather secrets of temperate latitudes are to be sought in the frozen north. The theory of action centres suggested a mechanism by which polar ice may influence seasonal changes, and the development of the theory of the polar front showed how Arctic conditions could dominate day to day changes. After lying almost dormant for many years, the idea has lately begun to find expression in both practical and theoretical researches. Professor W. H. Hobbs' expedition to Greenland, which had for one of its principal objects the establishment of a station on the inland ice, is one example of the practical side, and another is the recent trans-Arctic flight of Captain Sir George Wilkins, whose programme included the search for sites on which permanent meteorological stations could be established. On the theoretical side reference has been made in a previous number of the *Meteorological Magazine** to the work of W. Wiese, but this is naturally concerned more with the weather of Russia than with that of western Europe.

A statistical investigation of the influence of Arctic ice on the pressure distribution over western Europe which has recently been published as a *Geophysical Memoir*† shows that the matter is sufficiently complicated, the influence varying with the season

**Vol.* 61, 1926, *p.* 29.

†The influence of Arctic ice on the subsequent distribution of pressure over the eastern North Atlantic and western Europe. By C. E. P. Brooks and Winifred A. Quennell. *London. Meteor. Office. Geophys. Memoirs No.* 41.

in a way which suggests that it is due to a combination of several factors, some acting in one direction, some in another. As a result, the correlation coefficients obtained, while sometimes appreciable, are never high, though they are sufficiently confirmed by various checks to show that they are real.

The area dealt with in the Arctic is divided into four parts, the neighbourhood of Iceland and the Greenland, Barents and Kara Seas. The ice conditions in these areas in spring and summer are known mainly from the annual survey of the Danish Meteorological Institute‡, and these ice figures were correlated with quarterly means of pressure at nine selected stations covering an area from Jacobshavn (Greenland) and Vardö (Norway) in the north to Ponta Delgada in the south and Berlin in the east. As a result, three relationships were found, the first two of which were suspected before, while the third appears to be not only new, but surprising :—

(1) When there is much ice in the Arctic, pressure in spring and summer tends to be above normal in the north-west (Jacobshavn, Stykkisholm and Thorshavn) and below normal in the south-west (Ponta Delgada).

(2) When there is much ice in the Arctic in the spring and summer, pressure in the following late autumn and winter (November to January) tends to be below normal over the British Isles and northern France.

(3) Similar effects tend to recur annually at northern stations for about four years following abnormal ice years. (See figure 1.)

The memoir in question is concerned more with the presentation of facts than with the discussion of their causes, but the third result was sufficiently curious to arouse speculation. It must first be remarked that there are two chief ways in which Arctic ice may affect the distribution of pressure. In the first place ice and ice-cold water cool the air above, and since cold air is heavy, the presence of a large cold area tends to raise the barometric pressure in its neighbourhood. On the other hand, the Icelandic low is generally regarded as intimately related to the general circulation of the atmosphere, so that when this circulation is vigorous, pressure at Stykkisholm is below normal. The atmospheric circulation is in turn related to the temperature difference between poles and equator, so that much ice in the Arctic, by increasing this temperature difference, should lower the pressure at Stykkisholm. Thus there are two opposing tendencies, one towards a higher pressure and the other towards a lower pressure at Stykkisholm in years of much Arctic ice, and it may well be that the first tendency prevails at one season, the second at another. Let us see how they may operate.

‡Isforholdene i de Arktiske Have. *Copenhagen, Dansk Meteor. Institut.*

Dealing first with the tendency for much ice to raise pressure, it appears that the relatively small amounts of ice which appear off Iceland in spring and early summer are not likely themselves to have a great effect. It is when they begin to melt and to cover the surface of the northernmost Atlantic with a thin sheet of cold thaw water, that we should expect the effect to be most noticeable. The greater part of the break up of ice from the East Greenland Current takes place in summer, and it is in this season that we should look for the greatest tendency for much Arctic ice to raise pressure near Stykkisholm. On the other hand, we should expect the effect on the general atmospheric circulation to be greatest in January to March, when the ice in the Arctic basin itself is most solid and extensive. Moreover

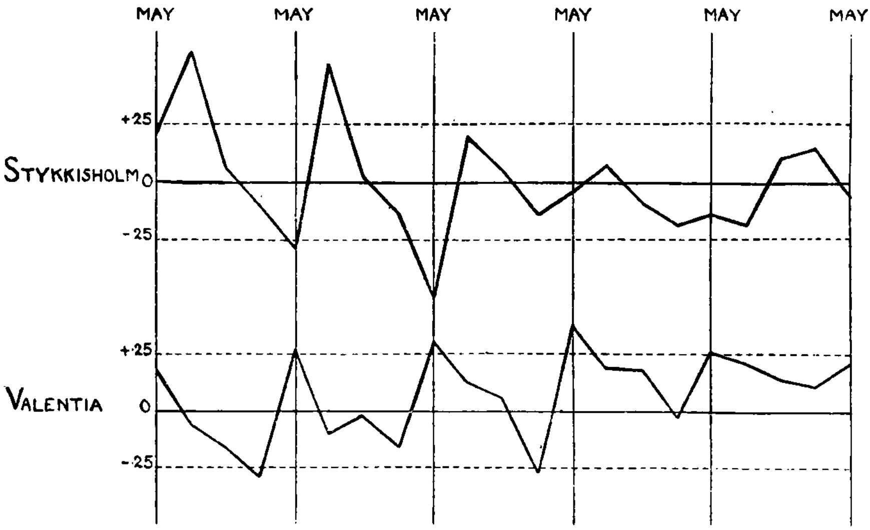


Fig. 1.—CORRELATION COEFFICIENTS; ICE INDEX FIGURES AND THE QUARTERLY PRESSURE DURING THE FOLLOWING FIVE YEARS.

the Icelandic low is intense in winter, feeble in summer, and for both these reasons we may anticipate that the tendency for much Arctic ice to lower pressure over Iceland will be greatest in winter.

We come next to the recurrence of similar tendencies at the same season in several successive years. That this is real is shown by figure 1, reproduced from the original memoir, showing the correlation coefficients between an " ice index " figure obtained by combining the ice data from the Greenland, Barents and Kara Seas, and the quarterly pressures at Stykkisholm and Valentia during the following five years. It is not until the fourth or fifth year that the regular recurrence of positive and negative coefficients breaks down. There can be little doubt that this recurrence is due to the persistence of the main mass of Palæocrystic ice, of which the variable ice areas in the outlying seas are merely the fringes. The Palæocrystic ice is believed to form mainly to the north of Siberia, whence it drifts slowly across the Arctic Ocean, part of it finally reaching the East Greenland Current. The passage across the Arctic takes about four years, so that if a large amount of ice is formed north of Siberia in any one year, we may look for its effects during the following four years. Each summer it sheds some ice from its fringes, and the thaw water brings high pressure to Iceland, while each winter it strengthens the atmospheric circulation and deepens the Icelandic low.

The tendency to low pressure at Valentia which recurs each autumn after much Arctic ice may be tentatively attributed to storminess resulting from the introduction of streams and patches of cold thaw water into the warm Gulf Stream Drift of the North Atlantic. The same phenomenon is observed, though less definitely, in the winter following a year with much ice off Newfoundland, an effect which is also investigated in the memoir, but with the Newfoundland ice there is very little if any recurrence in the second year. C. E. P. BROOKS.

Expedition of the *Marion*

The United States Coast Guard ship *Marion*, which sailed from Boston on July 12th, on an oceanographical expedition to Baffin Bay and the west coast of Greenland, as described in the *Meteorological Magazine* for September (p. 191), returned to harbour in New London, Conn., on September 18th after a very successful voyage. The full scientific results are naturally not yet available, but such great progress has been made that it is already possible to indicate the main conclusions. The first is the discovery of a surface layer of abnormally warm sea water—five degrees warmer than normal—100 metres thick covering an area of 100,000 square miles. This great heat reservoir must have far-reaching climatic effects, and supports the assertion frequently made that the Arctic climate has recently undergone a great temporary amelioration. Another interesting discovery is that the temperature and salinity of the bottom water in the trough between Greenland and Labrador—2.6°C. and 34.90 parts per 1,000—shows that this water cannot be derived from ice melting on the surface, but suggests that it is derived by creeping along the bottom of the Antarctic.* No fewer than 2,100 "echo" soundings were made, and have resulted in greatly improved knowledge of the bathymetry of the region, while about 2,000 measurements of temperature and salinity were taken. Meteorological observations were carried on hourly throughout the cruise.

*See *Meteorological Magazine*, 62, 1927, p. 173.

Course of Training for Observers

The unusually large number of 24 people attended this course at Kew Observatory on September 24th, 25th and 26th. Monday and the morning of Tuesday were spent in discussing meteorological instruments, the taking of observations, and filling-up of returns. Tuesday afternoon was occupied with a demonstration of the adjustment of a sunshine recorder (including concentricity of the sphere and bowl). On Wednesday morning Mr. Corless explained the new tables for computing accumulated temperature to the fourteen crop-weather observers, while the eight observers from health resorts each constructed a synoptic chart on form 2204 from British data telephoned from Kingsway. Later in the morning Dr. Whipple conducted the whole party round the Observatory. The course ended at noon on that day.

E. V. NEWNHAM.

Agricultural Meteorological Conference

The conference of agriculturists and "crop-weather" observers for the purpose of reading and discussing papers on agricultural meteorology, which is held annually under the auspices of the Ministry of Agriculture and the Meteorological Office, took place on September 27th and 28th at South Kensington.

Sir Napier Shaw, whose comments from the Chair have added greatly to the instructiveness of previous conferences, was unfortunately prevented by illness from being present, and Sir Thomas Middleton presided. The opening paper by Dr. C. E. P. Brooks dealt with the "Historical Climatology of England and Wales," and discussed the variations in the climate of Great Britain from the close of the Ice Age to the present day. The remainder of Thursday was devoted to the relations between weather conditions and crops, papers being read by Mr. T. W. Fagan of Aberystwyth, Mr. J. H. Blackaby, Oxford, Mr. M. C. Vyvyan, East Malling, Mr. L. N. Staniland, Long Ashton, and Mr. A. H. Lees.

The papers on Friday dealt with the relations between weather and soils, and opened with a valuable symposium on "Meteorological Conditions and Drainage from the Soil," by Dr. B. A. Keen, Rothamsted, Mr. H. D. Welsh, Craibstone, and Prof. G. W. Robinson, Bangor. Papers followed by Mr. F. Tutin, Long Ashton, Dr. E. McKenzie Taylor, Cambridge (on "Soil Temperatures in Egypt"), Prof. R. T. Leiper, of the Institute of Agricultural Parasitology ("The Influence of Meteorological Conditions on the spread of Parasitic Worms"), Prof. Dr. E. Handchin (late of Rothamsted), and Dr. W. F. Bewley, Cheshunt. The conference was well attended and many speakers took part in the discussions.

Errata

We regret that the words "Reproduced by the courtesy of Mr. G. A. Clarke" were omitted beneath the photograph of Cirro-cumulus cloud at Aberdeen, published in the September number of the magazine.

September 1927, page 186, line 29 *for* "At Barnstaple we had an extraordinary storm on August 24th at 4 pm." *read* "At Gunn, Goodleigh, North Devon on August 28th there was an extraordinary storm at 4 p.m. (summer time)." Major H. Sandford Claye informs us that there was no hail at Barnstaple some five miles away. Line 40 *for* "H. Sandford Clay" *read* "H. Sandford Claye."

The Weather of September, 1928

The most notable feature of the weather of the month was the excess of sunshine experienced over the whole country. In England and eastern Ireland the deficiency in the rainfall was also very marked. The month opened with calm anticyclonic weather over the whole country and these conditions were maintained over east and southeast England until the 9th. During this time the highest temperatures of the month were recorded (85°F. at Camden Square on the 8th, 83°F. at Greenwich on the 4th, 5th and 8th and at Tottenham on the 8th, and 82°F. at Hull on the 5th), and many hours of bright sunshine were experienced, over 12hrs. per day being recorded on several days at many places, while Hastings and Bath had 12.6hrs. each on the 4th. Meanwhile further north secondaries to a main depression over Iceland caused rain on the 3rd, 4th and 5th in the north and west; 1.95in. fell at Delphi (Mayo) on the 4th, 1.89in. at Borrowdale on the 3rd and 1.09 at Inverness on the 5th. An interval of fair weather followed, but low pressure westward of Ireland caused a renewal of unsettled weather with local gales on the 7th. This spread over the whole country on the 9th, thus temporarily interrupting the fine weather of the south. Thunderstorms accompanied by moderately heavy rain were experienced at many places on this day; 2.35in. fell at L.Llydaw (Snowdon), 1.22in. at Mallaranny; and 0.58in. at Kew. Subsequently pressure became high and another period of anticyclonic weather with much sunshine and high day temperatures was enjoyed over practically the whole country. These settled conditions persisted in the south and east with little change until the 19th, when the anticyclone began to move further north and temperature fell though the weather continued generally fair and sunny until the 27th. There was slight local rain at times, however, during this period, with a heavy fall in the north on the 16th and 17th (2.00in. at Borrowdale on the 17th) and another smaller one in the south on the 24th. From the evening of the 27th until the

29th rain was experienced in most parts of England and Ireland, but in Scotland the rain only lasted one night and fair weather occurred on the 28th, 29th and 30th. On this last day conditions were also fair but with cold northerly winds over the whole country. During the latter part of the month much mist and fog was experienced in the early mornings and several ground frosts were recorded. The lowest grass minimum temperature for the month was 22°F. at Dumfries on the 29th, and the lowest screen minimum 29°F. at Fort Augustus and Dundee on the 29th and at Markree Castle (Sligo) on the 23rd and 26th. The sunshine total for the month at Kew, 200hrs., which was 55hrs. in excess of the normal, was the highest September total there since 1911. The total of 197hrs. at Falmouth was 34hrs. above normal, that of 157hrs. at Liverpool 29hrs. above normal, that of 147hrs. at Aberdeen 23hrs. above normal. Totals in Ireland and at Stornoway were also above normal, but not to such a marked degre.

Pressure was above normal over Spain and from the Baltic, Germany and north Italy across the North Atlantic and Iceland to Newfoundland and Bermuda, the greatest excess being about 7mb. in Jämtland (Sweden). Pressure was below normal in a narrow belt extending from south Italy across the Pyrenees to Portugal and the Azores, and also at Spitsbergen and Jan Mayen. Temperature and rainfall were both above normal at Spitsbergen, northern Norway and Portugal, and deficient in central and western Europe. At Zürich the rainfall was as much as 1.75in. below normal. In Sweden, temperature was normal and rainfall deficient in the north, while in the south temperature was below normal and rainfall generally near the average.

A thunderstorm accompanied by waterspouts caused much damage in northern Jutland and the western coast of Sweden on the 11th. In Switzerland the spell of fine weather which had lasted since about the 3rd was abruptly ended on the 16th, when snow fell on the Alps down to 6,000ft., and on the 22nd a thunderstorm which caused much damage to the crops in Canton Ticino was followed by a considerable drop in the temperature. After a long hot summer, unseasonable cold occurred about the 25th in northern and central Italy and round Trieste, and snow fell abundantly on the central Appennines. Heavy rain occurred in central and western Spain on the 27th, and at the end of the month snow fell heavily in the Rhineland and destructive storms occurred in Portugal. On the 30th a gale on the Belgian coasts was followed by floods.

A severe storm on the 2nd wrought havoc in Lahore, and on the 4th, owing to the heavy rains in Kashmir, the banks of the

Jhelum River burst at several points between Srinagar and Jhelum. Floods resulted and most of the crowded roads were blocked. In a severe blizzard which followed the continuous rain 66 of the pilgrims to the Amaranth Sacred Caves were killed. In the Bombay Presidency the heavy rain between the 14th and 20th was very favourable to the cultivators, but in Allahabad, Agra, Jhansi and Meerut districts the agricultural outlook on the 21st was grave owing to the failure of the rains. Abnormal rains in Japan at the beginning of the month have caused fears for the rice crop. On the 14th and 15th, a typhoon which passed close by Hangchow, Chinkiang and Nanking caused much damage along the coast near Shanghai. It was followed by heavy rain, as a result of which Shanghai was badly flooded.

A hurricane swept across the West Indies and Florida from the 13th to 18th causing much loss of life and great material damage. It passed across the Leeward Islands from Dominica to Porto Rico on the 13th. At San Juan (Porto Rico) the anemometer at the Weather Bureau registered 132m.p.h. before it was blown away. From here the hurricane, which was travelling about 300 miles per day, passed westnorthwestwards across the Bahamas to Florida, where it struck the coast from Miami to Jupiter Inlet on the 16th. Thence it passed to Tampa and turned northeast across southeast Georgia, where, however, its force was greatly diminished. The heavy rain in Vera Cruz, Mexico, during the last week of the month caused serious flooding and the gales damaged the crops. Two typhoons swept across Porto Alegre, Brazil, during the month, one about the 6th and the other about the 20th.

Heavy rain at the beginning and end of the month considerably improved the wheat crop in Victoria, Australia. The total rainfall for the month was, however, below normal in nearly all parts of Australia except Tasmania.

The special message from Brazil states that the rainfall distribution was irregular in the northern and southern regions with 0.35in. and 0.43in. of rain above normal respectively, but that the rainfall was scarce in the central regions, being 1.73in. below normal. Six anticyclones passed across the country, and in the south rainstorms produced floods. The crops generally were in good condition except that they were suffering, in the north-east from lack of rain, and in Rio Grande do Sul from the rainstorms. Pressure at Rio de Janeiro was 1.4mb. above normal and temperature 1.3°F. above normal.

Rainfall, September, 1928—General Distribution

England and Wales ...	47	per cent. of the average 1881-1915.
Scotland	110	
Ireland	92	
British Isles	73	

Rainfall: September, 1928: England and Wales

Co.	Station	In.	Per-cent of Av.	Co.	Station	In.	Per-cent. of Av.
Lond .	Camden Square	·69	38	*Leics* .	Thornton Reservoir	·82	45
Sur .	Reigate, The Knowle	·74	38	,, .	Belvoir Castle	·46	25
Kent .	Tenterden, Ashenden	·60	28	*Rut* .	Ridlington	·67	...
,, .	Folkestone, Boro. San.	·62	...	*Linc* .	Boston, Skirbeck	·24	14
,, .	Margate, Cliftonville	·66	33	,, .	Lincoln, Sessions House	·19	12
,, .	Sevenoaks, Speldhurst	·75	...	,, .	Skegness, Marine Gdns	·62	34
Sus .	Patching Farm	·61	25	,, .	Louth, Westgate	·43	21
,, .	Brighton, Old Steyne	·93	45	,, .	Brigg, Wrawby St.	·28	...
,,	Tottingworth Park	·48	20	*Notts* .	Worksop, Hodsock	·21	14
Hants .	Ventnor, Roy. Nat. Hos.	1·03	42	*Derby* .	Derby	·82	50
,, .	Fordingbridge, Oaklnds	2·15	100	,, .	Buxton, Devon Hos.	·79	24
,, .	Ovington Rectory	1·41	62	*Ches* .	Runcorn, Weston Pt.	1·23	46
,, .	Sherborne St. John	1·74	85	,, .	Nantwich, Dorfold Hall	·90	...
Berks .	Wellington College	1·03	56	*Lancs* .	Manchester, Whit. Pk.	1·01	42
,, .	Newbury, Greenham	1·66	82	,, .	Stonyhurst College	1·65	43
Herts .	Benington House	·83	46	,, .	Southport, Hesketh Pk	1·31	48
Bucks .	High Wycombe	1·10	58	,, .	Lancaster, Strathspey	2·44	...
Oxf .	Oxford, Mag. College	·70	42	*Yorks* .	Wath-upon-Dearne	·30	19
Nor .	Pitsford, Sedgebrook	·69	38	,, .	Bradford, Lister Pk.	·48	23
,, .	Oundle	·62	...	,, .	Oughtershaw Hall	2·15	...
Beds .	Woburn, Crawley Mill	·70	39	,, .	Wetherby, Ribston H.	·64	36
Cam .	Cambridge, Bot. Gdns.	·60	37	,, .	Hull, Pearson Park	·27	16
Essex .	Chelmsford, County Lab	·75	44	,, .	Holme-on-Spalding	·24	...
,, .	Lexden, Hill House	·65	...	,, .	West Witton, Ivy Ho.	·31	...
Suff .	Hawkedon Rectory	·81	42	,, .	Felixkirk, Mt. St. John	·46	25
,, .	Haughley House	·35	...	,, .	Pickering, Hungate	·35	...
Norf .	Beccles, Geldeston	...	...	,, .	Scarborough	·38	49
,, .	Norwich, Eaton	1·05	49	,, .	Middlesbrough	·53	32
,, .	Blakeney	·74	40	,, .	Baldersdale, Hury Res.	·73	...
,, .	Little Dunham	·56	24	*Durh* .	Ushaw College	1·00	50
Wilts .	Devizes, Highclere	1·60	78	*Nor* .	Newcastle, Town Moor	·93	46
,, .	Bishops Cannings	1·49	68	,, .	Bellingham, Highgreen	1·60	...
Dor .	Evershot, Melbury Ho.	2·15	81	,, .	Lilburn Tower Gdns.	1·15	...
,, .	Creech Grange	2·43	...	*Cumb* .	Geltsdale	2·29	...
,, .	Shaftesbury, Abbey Ho.	2·15	88	,, .	Carlisle, Scaleby Hall	1·85	69
Devon .	Plymouth, The Hoe	2·00	78	,, .	Borrowdale, Rosthwaite	6·69	...
,, .	Polapit Tamar	2·10	75	,, .	Keswick, High Hill	3·56	...
,, .	Ashburton, Druid Ho.	2·07	67	*Glam* .	Cardiff, Ely P. Stn.	·89	29
,, .	Cullompton	1·20	53	,, .	Treherbert, Tynywaun	2·33	...
,, .	Sidmouth, Sidmount	1·37	60	*Carm* .	Carmarthen Friary	1·59	46
,, .	Filleigh, Castle Hill	1·42	...	,, .	Llanwrda, Dolaucothy	1·96	48
,, .	Barnstaple. N. Dev. Ath.	1·40	52	*Pemb* .	Haverfordwest, School	1·90	53
Corn .	Redruth, Trewirgie	1·74	56	*Card* .	Aberystwyth	2·15	...
,, .	Penzance, Morrab Gdn.	1·72	59	,, .	Cardigan, County Sch.	1·34	...
,, .	St. Austell, Trevarna	2·50	78	*Brec* .	Crickhowell, Talymaes	2·00	...
Soms .	Chewton Mendip	1·73	56	*Rad* .	Birm W. W. Tyrmynydd	1·80	47
,, .	Long Ashton	1·18	...	*Mont* .	Lake Vyrnwy	1·98	56
,, .	Street, Hind Hayes	1·29	...	*Denb* .	Llangynhafal	3·25	...
Glos. .	Cirencester, Gwynfa	·83	38	*Mer* .	Dolgelly, Bryntirion	1·81	42
Here .	Ross, Birchlea	1·05	55	*Carn* .	Llandudno	1·28	56
,, .	Ledbury, Underdown	·92	48	,, .	Snowdon, L. Llydaw 9	5·69	...
Salop .	Church Stretton	1·49	73	*Ang* .	Holyhead, Salt Island	1·51	56
,, .	Shifnal, Hatton Grange	1·16	60	,, .	Lligwy	1·55	...
Worc .	Ombersley, Holt Lock	·79	45	*Isle of Man*			
,, .	Blockley, Upton Wold	·81	39		Douglas, Boro' Cem.	2·63	80
War .	Farnborough	·96	45	*Guernsey*			
,, .	Birminghm, Edgbaston	·65	36		St. Peter P't. Grange Rd.	1·56	60

Rainfall: September, 1928: Scotland and Ireland

Co.	Station	In.	Per-cent of Av.	Co.	Station	In.	Per-cent. of Av.
Wigt .	Stoneykirk, Ardwell Ho	2·12	76	*Suth* .	Loch More, Achfary ...	4·69	82
,, .	Pt. William, Monreith	1·89	...	*Caith* .	Wick	2·39	96
Kirk .	Carsphairn, Shiel.	4·21	...	*Ork* .	Pomona, Deerness	2·22	77
,, .	Dumfries, Cargen	2·84	97	*Shet* .	Lerwick	2·52	84
Dumf.	Eskdalemuir Obs.	4·37	118	*Cork* .	Caheragh Rectory	2·73	...
Roxb .	Branxholm	2·04	91	,, .	Dunmanway Rectory...	3·69	90
Selk .	Ettrick Manse	3·76	...	,, .	Ballinacurra	2·17	86
Peeb .	West Linton	3·22	...	,, .	Glanmire, Lota Lo. ...	2·45	87
Berk .	Marchmont House	1·51	63	*Kerry*.	Valentia Obsy.	4·70	114
Hadd.	North Berwick Res. ...	2·25	108	,, .	Gearahameen	5·90	...
Midl .	Edinburgh, Roy. Obs.	2·17	115	,, .	Killarney Asylum	3·53	99
Ayr .	Kilmarnock, Agric. C.	4·00	131	,, .	Darrynane Abbey	2·98	84
,, .	Girvan, Pinmore	3·15	82	*Wat* .	Waterford, Brook Lo...	1·49	54
Renf .	Glasgow, Queen's Pk. .	2·81	101	*Tip* .	Nenagh, Cas. Lough...	1·83	65
,, .	Greenock, Prospect H.	5·79	122	,, .	Roscrea, Timoney Park	1·55	...
Bute .	Rothesay, Ardencraig.	4·79	118	,, .	Cashel, Ballinamona...	2·06	84
,, .	Dougarie Lodge	3·64	...	*Lim* .	Foynes, Coolnanes	2·13	74
Arg .	Ardgour House	7·55	...	,, .	Castleconnel Rec.	1·83	...
,, .	Manse of Glenorchy ...	6·88	...	*Clare* .	Inagh, Mount Callan...	5·37	...
,, .	Oban	5·11	...	,, .	Broadford, Hurdlest'n.	2·81	...
,, .	Poltalloch	4.12	90	*Wexf*.	Newtownbarry	1·16	...
,, .	Inveraray Castle...	7·34	114	,, .	Gorey, Courtown Ho ..	·75	30
,, .	Islay, Eallabus ...	5·05	121	*Kilk* .	Kilkenny Castle	1·52	66
,, .	Mull, Benmore	...	...	*Wic* .	Rathnew, Clonmannon	·99	...
,, .	Tiree	3·52	...	*Carl* .	Hacketstown Rectory..	1·30	46
Kinr .	Loch Leven Sluice	3·80	148	*QCo* .	Blandsfort House	1·86	68
Perth .	Loch Dhu	6·20	108	,, .	Mountmellick	2·04	...
,, .	Balquhidder, Stronvar	4·84	...	*KCo* .	Birr Castle	1·55	68
,, .	Crieff, Strathearn Hyd.	3·67	128	*Dubl* .	Dublin, FitzWm. Sq...	·94	49
,, .	Blair Castle Gardens ...	3·75	158	,, .	Balbriggan, Ardgillan.	1·21	59
,, .	Dalnaspidal Lodge ...	4·54	97	*Me'th* .	Beauparc, St. Cloud...	1·89	...
Forf .	Kettins School	2·61	131	,, .	Kells, Headfort	2·79	105
,, .	Dundee, E. Necropolis	2·52	121	*W.M* .	Moate, Coolatore	2·15	...
,, .	Pearsie House	2·97	...	,, .	Mullingar, Belvedere..	2·26	85
,, .	Montrose, Sunnyside...	2·67	134	*Long* .	Castle Forbes Gdns.	2·96	103
Aber .	Braemar, Bank ...	3·82	152	*Gal* .	Ballynahinch Castle ...	6·73	141
,, .	Logie Coldstone Sch....	3·30	142	,, .	Galway, Grammar Sch.	5·27	...
,, .	Aberdeen, King's Coll.	2·66	120	*Mayo* .	Mallaranny	7·73	...
,, .	Fyvie Castle	3·19	...	,, .	Westport House	4·37	123
Mor .	Gordon Castle	3·55	142	,, .	Delphi Lodge	10·78	...
,, .	Grantown-on-Spey ...	3·99	161	*Sligo* .	Markree Obsy.	3·82	114
Na .	Nairn, Delnies	2·98	135	*Cav'n*.	Belturbet, Cloverhill...	2·16	87
Inv .	Kingussie, The Birches	3·28	...	*Ferm* .	Enniskillen, Portora...	4·38	...
,, .	Loch Quoich, Loan ...	8·10	...	*Arm* .	Armagh Obsy	2·11	86
,, .	Glenquoich	9·13	106	*Down*.	Fofanny Reservoir	2·87	...
,, .	Inverness, Culduthel R.	3·07	...	,, .	Seaforde	2·43	88
,, .	Arisaig, Faire-na-Squir	3·50	...	,, .	Donaghadee, C. Stn ...	2·42	101
,, .	Fort William	6·28	...	,, .	Banbridge, Milltown...	2·42	98
,, .	Skye, Dunvegan	4·99	...	*Antr* .	Belfast, Cavehill Rd ...	2·41	...
R & C.	Alness, Ardross Cas. ...	2·71	93	,, .	Glenarm Castle	3·33	...
,, .	Ullapool	3·07	...	,, .	Ballymena, Harryville	3·21	103
,, .	Torridon, Bendamph...	5·79	83	*Lon* .	Londonderry, Creggan	5·27	160
,, .	Achnashellach	6·12	...	*Tyr* .	Donaghmore	2·93	...
,, .	Stornoway	3·03	77	,, .	Omagh, Edenfel	5·13	168
Suth .	Lairg	1·57	...	*Don* .	Malin Head	3·97	151
,, .	Tongue	2·57	81	,, .	Dunfanaghy	4·62	...
,, .	Melvich	2·82	101	,, .	Killybegs, Rockmount.	5·23	114

Climatological Table for the British Empire, March, 1928.

STATIONS	PRESSURE: Mean of Day M.S.L. (mb.)	PRESSURE: Diff. from Normal (mb.)	TEMPERATURE: Absolute Max. (° F.)	TEMPERATURE: Absolute Min. (° F.)	TEMPERATURE: Mean Values Max. (° F.)	TEMPERATURE: Mean Values Min. (° F.)	TEMPERATURE: Mean Values ½ max. and min. (° F.)	TEMPERATURE: Mean Values Diff. from Normal (° F.)	TEMPERATURE: Mean Wet Bulb (° F.)	Relative Humidity (%)	Mean Cloud Am'nt (0—10)	PRECIPITATION: Am'nt (in.)	PRECIPITATION: Diff. from Normal (in.)	PRECIPITATION: Days	BRIGHT SUNSHINE: Hours per day	BRIGHT SUNSHINE: Percentage of possible
London, Kew Obsy.	1009·2	— 5·2	74	32	55·2	40·8	48·0	+ 0·7	42·1	84	7·5	1·41	— 0·04	11	4·4	32
Gibraltar	1014·1	— 2·4	71	51	66·4	54·1	60·3	— 0·7	53·0	80	5·2	1·71	— 0·97	12	..	..
Malta	1012·2	— 1·8	80	50	67·8	56·0	61·9	+ 1·0	56·8	80	6·3	2·61	+ 1·75	7	8·4	64
St. Helena	1011·6	+ 1·4	70	58	67·0	60·2	63·6	— 2·2	60·7	93	8·4	2·60	— 1·27	20	..	..
Sierra Leone	1011·3	+ 0·5	93	71	88·2	75·2	81·7	— 0·7	76·4	75	6·7	2·65	— 1·41	8	..	..
Lagos, Nigeria	1008·5	— 1·3	89	70	87·6	76·9	82·3	— 0·2	77·8	79	7·3	6·96	+ 1·21	14	..	..
Kaduna, Nigeria	1014·3	+ 3·6	99	..	94·3	..	..	..	74·1	85	..	2·08	— 1·21	5	..	..
Zomba, Nyasaland	1012·9	+ 0·4	84	56	78·1	61·7	69·9	+ 0·6	..	76	6·0	4·70	+ 1·04	10	..	..
Salisbury, Rhodesia	1012·7	— 0·1	83	44	77·3	53·3	65·3	— 0·4	57·9	61	3·0	0·52	— 0·47	6	8·8	75
Cape Town	1018·6	+ 2·3	95	43	74·3	54·6	64·5	+ 1·3	56·0	84	5·2	0·69	— 1·23	4	..	..
Johannesburg	1017·9	+ 1·4	79	43	72·0	51·5	61·7	+ 1·9	52·4	62	2·4	1·93	+ 0·19	6	8·8	77
Mauritius	1013·8	— 0·2	84	66	81·5	71·4	76·5	+ 0·7	73·6	77	6·2	5·34	+ 0·87	23	7·8	67
Bloemfontein	..	..	82	41	74·0	49·0	61·5	+ 0·7	53·0	70	2·8	1·11	— 1·02	5	..	..
Calcutta, Alipore Obsy.	1006·6	— 0·3	105	67	95·9	75·7	85·8	+ 0·1	76·1	80	3·6	3·20	+ 1·31	6*	..	..
Bombay	1008·0	— 0·8	94	75	90·8	77·7	84·3	+ 1·2	76·7	75	2·7	0·00	— 0·05	0*	..	..
Madras	1007·3	— 1·1	106	74	94·0	78·2	86·1	+ 0·8	78·5	74	4·6	0·06	— 0·47	1*	..	..
Colombo, Ceylon	1008·8	— 0·3	89	72	87·2	76·1	81·7	— 0·9	78·2	77	7·8	8·99	+ 0·69	19	6·5	53
Hongkong	1012·4	— 0·3	86	60	75·5	67·8	71·7	+ 0·9	67·2	78	7·7	4·11	— 1·19	10	4·3	34
Sandakan	..	..	90	72	88·8	75·4	82·1	— 0·2	77·5	82	..	7·94	+ 3·87	11	..	..
Sydney	1017·1	— 1·4	85	54	74·7	60·9	67·8	+ 3·1	62·3	77	5·3	4·86	— 0·71	16	6·4	57
Melbourne	1018·2	— 1·2	84	41	71·5	52·4	61·9	+ 2·4	56·5	70	5·5	0·87	— 1·38	9	6·7	60
Adelaide	1018·3	— 1·7	90	47	76·7	57·7	67·2	+ 3·3	57·8	54	4·8	1·07	— 0·68	8	7·3	66
Perth, W. Australia	1017·0	— 1·5	96	48	76·9	57·4	67·1	+ 0·5	60·2	61	5·4	0·89	— 0·69	8	7·2	64
Coolgardie	1016·1	— 2·4	96	43	80·8	53·1	66·9	+ 1·8	57·3	54	2·5	0·36	— 0·59	2	..	..
Brisbane	1016·3	— 1·3	88	56	79·5	63·7	71·6	+ 1·3	65·8	75	5·2	14·89	+ 11·30	16	6·2	54
Hobart, Tasmania	1015·3	+ 0·8	78	43	65·6	52·0	58·8	+ 3·7	51·9	67	6·6	4·27	+ 2·38	13	5·4	50
Wellington, N.Z.	1019·4	+ 1·3	73	43	64·9	54·1	59·5	+ 2·6	56·1	75	6·6	5·82	+ 1·94	10	4·5	41
Suva, Fiji	1011·6	+ 1·0	86	72	82·7	74·2	78·5	— 0·2	76·0	88	8·2	17·10	+ 5·82	27	3·5	30
Apia, Samoa	1010·4	+ 0.5	88	72	86·1	75·5	80·8	+ 1·9	78·6	82	5·5	11.29	+ 1·05	21	5·9	50
Kingston, Jamaica	1013·9	— 0·2	90	67	85·6	70·3	77·9	— 0·5	69·8	80	2·3	0·88	— 0·36	4	7·3	58
Grenada, W.I.	1010·0	— 2·4	90	72	86·0	74·3	80·1	+ 1·2	73·8	72	4·6	1·65	— 0·63	10	..	..
Toronto	1012·7	— 2·8	71	23	49·9	33·4	41·7	+ 0·3	36·1	70	4·9	2·58	+ 0·18	12	6·5	49
Winnipeg	1015·0	— 2·0	76	6	43·6	24·5	34·1	— 3·7	..	..	4·9	1·20	— 0·29	9	7·4	54
St. John, N.B.	1012·5	— 1·1	54	21	45·7	31·7	38·7	— 0·3	34·4	68	5·8	3·38	— 0·13	13	5·5	41
Victoria, B.C.	1015·2	— 2·1	64	35	54·8	42·3	48·5	+ 0·8	44·2	72	6·0	1·36	— 0·37	18	6·1	45

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

CORRIGENDA.—June 1928, pages 126 and 127. Malta, precipitation, amount and diff. from normal, December 1927, *for* "5·69in., + 1·98in. *read* 6·69, + 2·98in." and Year 1927, *for* "14·93in.— 4·93in, *read* 15·93in. — 3·93in."