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Retirement of Sir Napier Shaw, Sc.D., LL.D., F.R.S.

THE retirement of Sir Napier Shaw from the Directorship of the Meteorological Office, on the completion of the third term of his appointment, will be received with regret by all who have been associated with meteorological work in this country and abroad. Sir Napier's connection with the Office has extended over 40 years, for it began in 1879, when, at the request of the Meteorological Council, he undertook an experimental comparison of the various methods of determining the hygrometric state of the air, the results of which were published in the *Philosophical Transactions* of the Royal Society in 1888. In 1897 he was appointed a member of the Meteorological Council to fill the vacancy caused by the death of Mr. E. J. Stone, F.R.S. In 1900 he succeeded the late Dr. R. H. Scott as Secretary to the Council. From that date the work of the Office has been carried on under his immediate supervision, and the present eminence to which the Office has attained is due in no small measure to his personal initiative and "drive."

In 1905 the direction of the Office became vested in the Meteorological Committee appointed by the Treasury, with Sir Napier as Director and Chairman of Committee. Busy

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years followed. The planning of the new office building at South Kensington occupied much time and thought. It was to be no mere office, but a centre for meteorological and geophysical research, with ample library accommodation and a museum in which the results obtained might be adequately displayed. The building was completed in 1910, and the transfer from Victoria Street was accomplished in the summer and autumn of that year. The educational side of the Office work benefited immediately and parties of students and teachers visiting the establishment to acquire at first-hand a knowledge of meteorological practice were frequently met with at the Office.

The transfer to the Meteorological Committee of responsibility for the work of the Observatories at Kew and Eskdalemuir in 1910 further widened the scope of office work and increased the duties and responsibilities of the Director. The Office ceased to be a purely meteorological institution and became the official centre for carrying out geophysical investigations, terrestrial magnetism, atmospheric electricity and seismology.

In the purely meteorological sphere, in addition to extending the work of the forecast service and of the stations and observatories directly under the jurisdiction of the Office, Sir Napier was ever anxious to bring the large number of voluntary observers into relation with the Office in order to render their work readily available for the public good. He devoted much time and thought to devising arrangements for supervising such voluntary work and directing it along useful lines. The publication of summaries of approved observations in the *Monthly Weather Report* was the chief means adopted for attaining this end, and the Report came to be regarded as an index of the material available in the Office for " keeping the public memory of the weather."

The twenty years of Sir Napier's control of the Office have witnessed a rapid development of upper air research in this and other countries, and it became necessary to see that the Office took its proper share in this pioneer work. The spending of the available funds in a manner to secure the best results was no easy task. Sir Napier was fortunate in having the assistance of Mr. W. H. Dines, F.R.S., in this part of his work. He was singularly happy in devising arrangements under which Mr. Dines was enabled to carry on his individual work at Pyrton Hill, and subsequently at Benson, and bring it into close co-operation with the work of the Office. He was equally fortunate in securing co-operation between the Office and institutions like the upper air observatory of the University of Manchester or the private observatory of Capt. C. J. P. Cave, of Ditcham Park.

In international meteorological work Sir Napier was also called upon to play a large part. He became a member of the International Meteorological Committee soon after his appointment as Secretary to the Meteorological Council, and on the retirement of M. Mascart he was elected President of the Committee at the meeting held in Paris in 1907. From that time onwards he was constantly called upon to deal with questions of international co-operation between the meteorological services of different countries.

It had been Sir Napier's often expressed intention to resign from the Directorship in 1915 in order that he might have leisure to devote himself to furthering the academic side of meteorology, but the outbreak of war put all idea of resignation out of question, as it soon became clear that the national emergency would make great demands on the Office. Limitation of space makes it impossible to detail the steps which led to the formation of the separate meteorological services established by the Army, Navy and Air Force, but the Office organisation had to supply the essential information for all these, and to supply or undertake the training of a large part of the personnel required. The demands were not only for weather forecasts, but for help in the applications of meteorology to gunnery, aircraft construction and navigation, and numerous other subjects. The work of directing the Office operations became more than one man could accomplish, and arrangements were made, with the consent of the War Office, for Colonel H. G. Lyons to undertake the administration of the Office, leaving Sir Napier free to devote himself to the scientific problems which he was eminently fitted to solve. Among other things the need of an advanced text-book of meteorology for the training of expert personnel became acutely felt, and Sir Napier met that demand by compiling the *Manual of Meteorology*, of which Part IV., dealing with the relation of wind to the distribution of pressure, was issued early in 1919. The first three parts are still to come.

Some months after the signing of the armistice Colonel Lyons relinquished his temporary position as administrative head of the Office and the full responsibility once more devolved upon Sir Napier. During the months that have intervened the control of the Office has passed to the Air Ministry and Sir Napier has had to carry through the unification under a single control of the independent services established during the war. Another important step in the unification of meteorological work in this country also occurred at this time, namely, the transfer to the Office of responsibility for the work of the British Rainfall Organisation, which took place during the summer of 1919.

We are glad to learn that Sir Napier's retirement from the Directorship does not involve his complete dissociation from active meteorological work at South Kensington. He has undertaken the duties of the Professorship of Meteorology at the Imperial College of Science and Technology in connection with the School of Aviation recently established there in association with the University of London, and as such will, with the courtesy of the Air Ministry, retain the use of a room in the building which he was instrumental in calling into being. The good wishes of all will go with Sir Napier in his new work.

OFFICIAL NOTICES.

The Meteorological Office.

THE retirement of Sir Napier Shaw, Sc.D., LL.D., F.R.S., from the Directorship of the Meteorological Office took place on September 6th. The Air Council have appointed Dr. George C. Simpson, F.R.S., to succeed him. Dr. Simpson is best known to meteorologists by his theory of thunderstorms and by his work as meteorologist and physicist to the Scott South Polar Expedition, which was discussed by Dr. H. R. Mill in our July number. He has held an appointment on the staff of the Indian Meteorological Department since 1906.

The unification of the National Meteorological Services was completed on August 12th, 1920, on which date the special meteorological service established during the war at the Admiralty was incorporated with the Meteorological Office. The Air Ministry has thus become responsible for all branches of official meteorological work.

An official meteorological station for the local distribution of meteorological information has been opened at Cattewater, Plymouth. Mr. C. D. Stewart, B.Sc., has been placed in charge.

Summer Time Act.

PUBLIC clocks are to resume Greenwich Time as from 3 a.m. (summer time) on September 27th. Observers are requested to indicate the standard of time on their returns for the months of September and October.

Issue of Meteorological Reports by Wireless.

On August 16th, 1920, the following revised time-table for the issue of synoptic reports came into force :—

Reports from Air Ministry Wireless Station have been issued at 3 h. 15 m., 8 h. 45 m. and 20 h. 15 m. G.M.T. on a wave length of 1,400 m. (C.W.).

Reports from Aberdeen Wireless Station have been issued at 2 h. 30 m., 8 h. 30 m., 14h. 30 m., and 19 h. 30 m. G.M.T. on a wave length of 3,300 m.

From September 1st, the form of these reports has been modified and the information supplied has been made more complete. Particulars of the code now in use will be found in the revised copy of M.O. Form 2621, copies of which may be obtained on application.

Official Publications.

Professional Notes No. 10. *Methods of Computation for Pilot Balloon Ascents.* By J. S. Dines, M.A. Price 8*d.* net.—In this pamphlet, which was first issued as a typewritten memorandum, Mr. J. S. Dines summarises the various systems of computation in use for the reduction of pilot balloon observations. The note is divided into three parts, viz.: Part I., Single Theodolite Method; Part II., Double Theodolite Method; and Part III., Balloon Tail Method. The publication is likely to prove useful to those who are interested in pilot balloon work.

Professional Notes No. 11. *On the Ground Day Visibility at Cranwell, Lincolnshire.* By Capt. W. H. Pick, B.Sc. Price 6*d.* net.—The observations utilised in this note cover a period of 68 days, February 1st to April 8th, 1920. The scope of the note is to investigate the relationship, if any, of visibility during day time to pressure distribution, wind direction and wind force. In spite of the difficulty of basing satisfactory generalisations on so short a record, Capt. Pick brings out some interesting points. He finds that at Cranwell visibility is best with winds from the SW. quadrant and worst with winds from the SE. quadrant. While investigating the relation of wind force to visibility he finds that the mean visibility is considerably improved with wind speeds above 12 mi/hr. "with a possible exception in the case of winds" from SE. by S. to SSE. Capt. Pick has also made an attempt to correlate visibility with isobaric distributions. It is remarkable that straight isobars across the British Isles are accompanied by high mean visibility at Cranwell. It would be interesting to know if this is generally the case at other stations.

A Conference at Bergen.

An Extract from the Report by Sir NAPIER SHAW, Sc.D , LL.D., F.R.S.

ON the invitation of Professor V. Bjerknes, Director of Section B. of the Geophysical Institute, Bergen, a delegation of the Meteorological Office visited Bergen for the purpose of inspecting new methods of forecasting which have been developed by the meteorological staff of the Institute under the direction of Professor Bjerknes. The Geophysical Institute consists of two sections, viz., A., the Oceanographical Section, under Professor Helland-Hansen, who is also the Director-General of the Institute, and B., the Meteorological Section, under Professor Bjerknes.

The invitation had the practical support of the Bergen Steamship Company and the Bergen-America Line on account of the interest of those companies in the development of meteorological methods with a view to forecasting for North Sea steamers and ocean liners. The companies observe for the Institute at 8 h. 14 h. and 20 h. Norwegian time, and transmit their observations by wireless telegraphy for incorporation with other data on the regular maps.

The invitation was extended to four or more representatives of the Meteorological Office. The delegation consisted of Sir Napier Shaw, Director, Colonel L. F. Blandy, Controller of Communications, with Major A. H. R. Goldie, Mr. L. F. Richardson and Captain C. K. M. Douglas. The delegation left London on July 17th for Newcastle and landed at Bergen on the morning of July 19th.

The members of the staff of the Bergen Institute who took part in the proceedings, besides Professors Bjerknes and Helland-Hansen, were Mr. J. Bjerknes, Mr. B. Björkdal and Mr. Rossby, who are in charge of forecasts, Mr. Fjeten, who is in charge of instruments. Professor Hesselberg, Director of the Norwegian Meteorological Service, came from Christiania, and Mr. Bergeron, a former assistant at Bergen and now in the Hydrographic-Meteorological Bureau of Stockholm, came with his colleague, Mr. Calwagen, from Stockholm. Dr. Jakobsen, a Danish oceanographer, was also present with Professor Helland-Hansen, and Mr. Jon Eyporsson, who is in training for the Meteorological Service of Iceland.

The ordinary daily programme of business was to meet in a lecture-room of the Bergen Museum in the morning (which lasts till 15 h.) for the discussion of scientific questions, and later in the afternoon to visit the Institute to inspect the working charts for the day and to consider as a committee the administrative aspects of the questions raised. This plan was followed on July 20th to 24th inclusive and July 27th to 30th. Proceedings commenced with a lecture, followed by discussion, and the reading and discussion of supplementary papers.

The projects which the visit was designed to develop have arisen out of a discovery by the Bergen Institute, principally by Messrs. Solberg, J. Bjerknes and Bergeron, that the phenomena of the weather of the Northern Hemisphere are largely dependent upon the surface of junction of polar and equatorial air which can be detected at the earth's surface as a line of discontinuity in the conditions of pressure, temperature, wind-direction and force, humidity and visibility. The line of discontinuity passes through the centres of cyclones and connects the centre of one cyclone with those of the preceding and succeeding ones by a line which can be identified somewhere in the westerly current lying on the south side of the line of centres of cyclones. It may possibly be as far south as the margin of the permanent Atlantic anticyclone, and it may even be carried round with the north-east trade to the southern margin of the anticyclone. The polar air is identified at the surface as being cold, dry, very transparent, and often blowing from some easterly point, and the equatorial air as relatively warm, moist, with poor visibility, and always blowing from some westerly point.

The surface of demarcation between these two types of air is called the "polar front," which is divided into the "steering surface" or "anaphalanx" from the front margin of the cyclone to its centre, the intermediate section between the margin of successive cyclones, the "squall surface" or "kataphalanx" from the centre to the rear margin. Attempts to identify the line in which the polar front cuts the earth's surface on the detailed maps of Western Norway have apparently been generally successful, and its extension over Western Europe and ultimately round the earth is obviously a practical proposition. The complete front must be regarded as a surface of irregular shape extending from the line marked out at the earth's surface obliquely upward to a considerable, but at present unknown, height. The Bergen investigators set no limit below the stratosphere (say 33,000 feet). *A priori* we should regard it as belonging to the peculiar juxtaposition of relatively warm and cold air which is inevitable at the surface, but not to be expected in the upper layers; observations in aeroplanes have, however, been adduced in support of the Bergen views. They associate most of the phenomena of cyclones with different parts of the polar front, and in particular on all their maps they set out definite rain areas in connection with the anaphalanx and the kataphalanx, the two parts of the front that meet in a cyclonic centre; and they use the two parts of the line in which the front cuts the surface (provisionally called the steering line and the squall line) as axes meeting in the cyclone-centre: to one or other of which they refer all the the weather incidental to the passage of the cyclonic depression. The sector of the cyclone within the angle between the anaphalanx and kataphalanx they call the "warm" sector of equatorial air, and endow it with showery possibilities but not continuous rain.

Moreover, they find that the one part of the polar front the kataphalanx may encroach to such an extent on the warm sector as to reach the steering line or surface line of the anaphalanx and ultimately overlap it; thus it will cut off an isolated patch of the equatorial air, upon which the warm sector of the cyclone depends for its existence, and will bring about the "death" of the cyclone.

As to the nature and origin of cyclones, Professor Bjerknes, relying upon a proposition of Helmholtz that in consequence of the rotation of the earth the surface of separation at a discontinuity between polar air (or air moving eastward) would not be vertical, but would tend to become parallel to the earth's axis of rotation and therefore inclined to the vertical anywhere except at the pole, is developing a theory of the motion of air in a cyclonic depression as the result of wave motion, different in character on either side of the polar front and advancing in the inclined surface of separation which forms the front.

In consequence of these developments the Bergen meteorologists have come to consider that a new step in advance in practical meteorology is possible, and indeed almost certain, if attention is concentrated upon this new feature, viz., the polar front.

The more serious business of the meeting was interrupted for the 25th and 26th July for an excursion, on the invitation of Professor Helland-Hansen, to Väring Voss, at the head of the Hardanger Fjord, which was reached partly by rail, partly by motor over remarkable roads, and partly by the motor ship *Armauer-Hansen*, a craft belonging to the Oceanographical Section of the Geophysical Institute for the purpose of investigation of the fjords and the ocean. This afforded an opportunity of inspecting the methods of investigation of physical oceanography.

Meteorology at the British Association Meeting at Cardiff.

THERE was very little sign of activity in meteorology in the programme of papers prepared for the meeting of the British Association at Cardiff this year. The working part of the meeting was confined to the four days Tuesday, 24th August to Friday, 27th, and since the last meeting of a sub-section for Cosmical Physics the expansion of subjects belonging to Section A. has been more marked than ever, so that no place is likely to be obtained for meteorological subjects in the time-table unless meteorologists prepare for it betimes.

The programmes of Section A., Mathematics and Physics, showed the Report of the Seismology Committee by Professor H. H. Turner, F.R.S., and Mr. J. J. Shaw, which mentioned the transfer of Dr. Milne's organisation to Oxford and was still more notable for an interesting examination of the travel of microseisms by Mr. Shaw. There was also a paper by Professor S. Chapman upon Terrestrial Magnetism, Auroræ, Solar Disturbance and the Upper Atmosphere, a further development of the subject so well set out in the recent paper before the Royal Meteorological Society. A Report of the Committee on Tides was presented by Professor Proudman and Dr. Doodson. In Section B. (Chemistry) Dr. J. S. Owens gave an account of the recent work of the Committee on Atmospheric Pollution in the investigation of the acid impurities of the atmosphere, and in Section E. (Geography) Dr. E. C. Gee, of the Ministry of Agriculture and Fisheries, discussed the movements of the sea.

It has been customary for many years, since the time of Mr. Symons and Dr. Buchan, for meteorologists who are present at this Association to meet at breakfast or luncheon, and in recent years, since the operations of the Meteorological Office have included the geophysical work of the Observatories at Richmond and Eskdalemuir, representatives of the geophysical subjects Terrestrial Magnetism, Seismology, Hydrography, and Physical Oceanography have associated themselves with the meteorologists.

Accordingly it was possible to get together a company of twenty-three at the Dorothy Café in Cardiff for a meteorological and seismological luncheon on Thursday, August 26th. The company included Sir Napier and Lady Shaw, Sir Richard Gregory, Professor, Mrs., and Miss Turner, Dr. Walford (Cardiff), Mr. Wilson Fox (Falmouth), Dr. J. S. and

Mrs. Owens, Dr. W. Mansergh Varley (Technical College, Brighton), Professor Proudman and Dr. Doodson (Liverpool), Rev. M. Evanson, Mr. A. Borns, Mr. W. E. Brain, Mr. C. G. Barton, Mr. Wilfred Hall, Mr. J. J. Shaw, Mr. J. Jackson (Royal Observatory) and Mrs. Jackson, the Misses Bellamy (Oxford).

After luncheon Sir Napier Shaw thanked the members of the party for maintaining the traditional assembly of those interested in geophysical studies, and referred to the widening circle of activity. He cited the work done in seismology, in the study of atmospheric pollution, and the institution of a new establishment for the study of tidal phenomena in connection with the University of Liverpool. He also referred to the long service of Mr. Wilson Fox to meteorology and magnetism at Falmouth, and to the local observatory at Cardiff in the control of Dr. Walford.

Professor Turner spoke appreciatively of the useful work on meteorology which had been carried on for so long by Mr. Wilson Fox at Falmouth. His work constituted a link with the past, and it was only right that his labours should be recognised by them. Professor Turner was very pleased indeed to welcome to that table Professor Proudman and Dr. Doodson, who were doing excellent work on tidal analysis and prediction at Liverpool. They represented one of those branches of cosmical physics which were not adequately cared for by any scientific institution, and therefore one to which the British Association was always willing to lend a helping hand. In the past those wishing to obtain information about tides had applied to such men as Lord Kelvin and Sir George Darwin, and it was very pleasing to him that the work was again being carried on vigorously. A proposal to send out a new *Challenger* expedition for scientific observations of the sea was being pressed forward by several sections of the British Association. This was a question in which Section A. was closely interested, and such branches of science as were represented at the table could be properly included amongst those which would benefit from such an expedition. Professor Duffield, who was unable to be present, was urging the claims of the Committee for the Determination of Gravity at Sea. Continued experiments at sea were required.

Mr. Wilson Lloyd Fox, of Falmouth, after thanking Sir Napier Shaw and Professor Turner for their kind references to him, remarked that he was a Delegate to the Corresponding Societies on behalf of the Royal Cornwall Polytechnic Society of Falmouth for the Advancement of Science and Art, whose career commenced in 1833. Since its early infancy, it had fostered the science of meteorology, and tables had continuously appeared in the Annual Reports. At one period it printed the returns from some half-dozen localities in the county. The observatory was started as one of the seven principal meteorological observatories of Great Britain, and was equipped with self-recording photographic and other instruments. Latterly, under the guiding hand of Sir Napier Shaw, it became one of the "Weather Stations" of the Meteorological Office, furnished with the latest patterns of instruments for observing pressure, clouds and the higher atmosphere, besides sending 1 a.m. observations to the Office. It might not be out of place to recall that one of its early secretaries was the Mr. Jordan who had the distinction of inventing the self-recording instruments, diagrams of which appear in one of the early reports of the Society. During the meeting of the Corresponding Societies at the British Association meeting at Bournemouth last year, Mr. Salter read a paper on "Rainfall" in which he advocated setting up stations in the numerous districts in which they were conspicuous by their absence. Mr. Pearse Jenkin, of Redruth, had previously taken the matter up and initiated the formation of a "Rainfall Association of Cornwall." His efforts had been warmly supported by the Polytechnic Society. Several new stations had been started, and it was hoped the example would be followed by other voluntary observers.

Professor Proudman said: "I wish to thank Sir Napier Shaw and Professor Turner for their kind references to the efforts of Dr. Doodson and myself in Liverpool. Perhaps they do not realise that the existence of our Institute is due to the British Association. There is no institution, of any nationality, whether Government or not, with which progress in our knowledge of the tides is associated to such an extent as it is with the British Association. The very first grant which it made in aid of research was one of £20 in 1834, for the reduction of tidal observations. This was made to Lubbock, and in subsequent years he received many others, as did also Whewell. When Thomson (Lord Kelvin) conceived the idea of harmonic analysis he immediately placed its development in the hands of the Association, which spent £1,000 on the work. Kelvin's work was continued by Sir George Darwin, again with assistance from the Association, and when the names of Lubbock, Whewell, Kelvin and Darwin are removed from the list of pioneers in work on actual tides, those that remain are of secondary importance. Some years ago the Geodetic Committee of the Association asked Professor Lamb for a report on the present state of the subject of tides. Lamb collected material from all parts of the British Dominions and asked me to examine it. This I did, and it proved to be a revelation. The subject called most urgently for nothing less than a large institute to make an organised attack on its many problems and to clear away some of the uncertainty which everywhere prevails. I managed to secure the interest of a prominent Liverpool shipowner, and was provided with just enough money to enlist the great abilities of Dr. Doodson on full-time work. Shortly after, the British Association came to our aid and gave us £150 (bringing the total amount they have spent on tidal research to about £2,500) with which to engage a full-time computer. In Section A., to-morrow, Dr. Doodson will show some of the results of our first year's work. On all sides we have received expressions of good will and we are very grateful."

Dr. J. S. Owens drew attention to the gradual recognition of the importance of measurements of atmospheric pollution by dust, both from the meteorological point of view and from that of the ventilating engineer and the preservation of public health. He pointed out that the question of visibility, which is of such vital importance in connection with aerial navigation, is intimately connected with that of atmospheric pollution by dust. From the public health point of view it was important to remember that for practical purposes gaseous impurities in the atmosphere were harmless, whereas all transmissible diseases were carried by solid particles. The time was, therefore, probably coming when so much attention would not be paid to the quantity of carbon-dioxide in the air, and the suspended impurities would receive the consideration due to their importance.

Dr. Walford, Medical Officer of Health for Cardiff, spoke of the part taken by Sir Napier Shaw, not only in the founding of their small observatory, but also in the efforts he made to have the work recognised by the University. More support was required to run the station as it deserved. Besides meteorological instruments, they had a seismograph and telescope.

Earthquakes.

A TELEGRAM from Ilfracombe, dated September 3rd, records two shocks, believed to be seismic, at 23 h. 50 m. on September 2nd and 1 h. on September 3rd. The Superintendent of Eskdalemuir Observatory reported an earthquake at 5 h. 55 m. 50 s. on September 7th. The epicentre was distant 1,510 km., probably in the region of Iceland.

Correspondence.

To the *Editors, "Meteorological Magazine."*

Visibility on Cloudy Nights.

CAPTAIN W. H. Pick's stimulating article under the above title in the August number of this magazine calls for serious consideration on account both of the importance and also the very complex nature of the subject. Perhaps on this account I may be allowed to raise one or two points, which the article suggests, in the hope that they may contribute to the development of the method.

Firstly, night visibility requires definition but is presumably concerned with that of a standard light. In effect, Captain Pick's method seems to be to take a feeble standard on a small scale and then to pass to a larger scale proportionally. Now the grease spot and paper are near enough to form a finite image on the retina of the eye and accordingly, in perfectly clear air, the *apparent* brightness would be independent of the distance, and is only reduced in practice by the failure of the air to transmit all the light, and then by an exponential law. A distant light, however, is viewed as a point, and there is an additional decrease in apparent brightness following the inverse square law. There is not, therefore, strict proportionality between the two cases. However, to some extent this is a consequence of definition.

Secondly, the *intrinsic* brightness of the grease spot (and paper) for a fixed distance (d) of the candle is not standard, but each may be expected to vary as $e^{-\mu d}$, where μ depends on the state of transparency of the air between the candle and the paper. The *apparent* brightness then varies as $e^{-\mu (x+d)}$, so that it appears that one should consider $(x + d)$ rather than x or, better, should bring the candle up close to the paper and secure in some other way the advantages which accrue from having it at a distance. If on two occasions the spot becomes indistinguishable at distances x_1 and x_2, it would not seem unreasonable to assume $\frac{x_1 + d}{x_2 + d} = \frac{\mu_2}{\mu_1}$; and if the definition of the corresponding visibilities v_1 and v_2 makes $\frac{v_1}{v_2} = \frac{\mu_2}{\mu_1}$, then proportionality between the small and large scale cases is obtained. The reason for the presence of the squares in the equation of the original article is by no means self-evident.

However, lastly, as one recedes from the paper, the apparent brightness of the grease spot and paper decrease in the same proportion, and thus the ratio of their difference to either of them remains constant. Now, according to Weber, the smallest perceptible increment in the brightness of an object is proportional to the brightness itself, so that if the grease-spot is distinguishable from the paper at the outset it should remain so, and one would not predict its vanishing until the paper no longer appears to transmit any light. It would therefore be very interesting to know if this is the case in practice with a person of normal vision.

M. A. GIBLETT.

West Hampstead, 28th August, 1920.

VISIBILITY is so important an element in the modern development of meteorology that any method of estimating it under unfavourable conditions deserves close attention. The device described by Capt. W. H. Pick in the August number of this magazine is therefore worthy of careful consideration by meteorologists in general and observers in particular. There are, however, one or two points connected with it upon which discussion would be profitable.

To begin with, there is the purely philosophical question as to what is really meant by "visibility" at night. Put baldly, Capt. Pick seeks to determine the transparency of a small sample of air and thereby to arrive at the distance of visibility supposing the surrounding gloom to be suddenly replaced by broad daylight. So long as we bear in mind that this is all that can be achieved by any estimate of "visibility" on a dark night, and that the term cannot be regarded as having any other meaning whatever, we need have no quarrel with Capt. Pick's use of the term. To follow up this side issue would, however, lead us rather far afield.

I have not tried Capt. Pick's method myself, but I suppose it will be safe to assume that for a given "visibility" there *is* a point at which a normal person would find the grease-spot indistinguishable from the surrounding paper. But why should it become indistinguishable? It is easy to understand why the grease-spot becomes invisible when properly adjusted in the ordinary photometric use of Bunsen's device, that is to say, when the sum of the transmitted and reflected light is the same for grease-spot and surrounding paper, but as used by Capt Pick the conditions are fundamentally different. In the latter case, unless I have completely misunderstood the method, we are concerned only with the difference between the light transmitted by the spot and surrounding paper. One would have thought that so long as anything could be seen at all the grease-spot would appear brighter than the plain paper. A physical explanation of the phenomenon would be highly desirable.

Capt. Pick's method of calibration is also somewhat puzzling. In the example given $x^2/40^2 = 7000^2/16{,}000^2$; there is no obvious reason for the squaring of each quantity. It amounts to assuming that the hypothetical visibility is proportional to the "distance of indistinguishability," which seems reasonable enough, though a rigorous proof would be desirable before using it as a basis of calibration.

E. G. BILHAM.

Twickenham, 27th August, 1920.

A Fog Bank at Malta.

ON July 9th a phenomenon was noticed in this Island which for the time and the season at which it took place is to be considered as a rare occurrence. For the last four days a persistent SE. wind was blowing with its usual accompaniment of high temperature and damp air. A maximum temperature of 91·4° F. was recorded on the 6th.

At 11 h. a bank of fog was seen advancing from the West, and by 11 h. 15 m. it had reached the N. and NW. part of the Island. What I noticed about it was that from a light blue colour this cloud of fog changed to a smoky white when it reached the land and where it rested on the buildings; it looked as if dense smoke was coming from the same. By 12 h. the bank was dissipated.

The wind, which at 8 h. was blowing SSE., Force 1, changed to NW. at 11 h., kept blowing in this direction for some time, then it started veering, and by 15 h. it was again blowing SE. No special fluctuations were noticed at the time in the barometer or the microbarograph.

D. THOS. AGIUS.

R.A.F. Meteorological Headquarters, University, Malta, 11th July, 1920.

Black Rain in Devonshire.

I NOTICE in the *Meteorological Magazine* for August a letter describing a fall of black rain in Devonshire. It would be of the utmost interest if Mr. Horner could give us some information as to the cause of the blackness. Was it due to soot carried from some industrial area, or to some other cause?

J. S. OWENS.

Advisory Committee on Atmospheric Pollution,
47, Victoria Street, S.W.1, 2nd September, 1920.

High Pilot Balloon Ascents at Valencia Observatory.

An unusually high pilot balloon ascent was made at Valencia Observatory on June 3rd, 1920, when a white balloon, weighing 36 grammes, was followed for 143 minutes with one theodolite and finally lost to view in the distance. The rate of ascent on the usual formula was 152·5 metres per minute, giving a final theoretical height of 21·8 kilometres, with a horizontal trajectory of 67·2 kilometres. It is, of course, impossible to assert that these were the real values. There was, however, no evidence that any leak had developed in the balloon, since the angular elevation, though falling more rapidly during the last 20 minutes, did not do so at a steadily increasing rate, and up to the 130th minute the computed velocities did not show any particular general increase. Also the nature of the results did not suggest that the balloon had ceased to rise.

It seems then to be clear that the stratosphere was penetrated to a considerable distance. It is, therefore, more interesting to notice that the velocity and direction of the wind in different layers of the stratosphere were by no means constant or uniform in their variation.

Variations took place which could not be accounted for by errors in the setting or reading of the theodolite, they were too consistent in every way. The general range of velocity above 11 kilometres was from 6 to 19 m./s., and of direction between 90° and 155° from North. In general, direction and velocity changed together, the most notable cases occurring at 15 kilometres, where, through about 500 metres height, a wind of 6 m./s. from 155° was sandwiched between two of 9–10 m./s. from 95°. Other erratic variations were observed at about 21 kilometres.

Another ascent on June 4th under similar conditions reached 17·2 kilometres and showed effects of a like nature, the most pronounced being a rise in velocity from 15 m./s. on either side to about 22 m./s. over a layer 1 kilometre thick at 16 kilometres.

Vertical currents are unthinkable in such lofty regions, so that there seems to be no doubt that the above cases were genuine and that layers of air from ½ to 1 kilometre thick in the stratosphere may be travelling with velocities differing widely both in magnitude and direction from those above and below them.

L. H. G. Dines.

Valencia Observatory, Cahirciveen.

Hay transported by a Whirlwind.

A SOMEWHAT curious phenomenon occurred here about 5.30 p.m. on Saturday, July 31st. It rained hay over the whole of Stone, and to my own knowledge as far as Moddershall, over two miles away. A good many of the wisps which fell were larger than dinner plates, all were soaked through being in a cloud, and everyone agrees that the hay seemed to fall from a great height. The hay was accompanied by a whirling wind which knocked over an umpire on the cricket ground.

I have tried to give you certain facts, and avoid the many rumours which are flying round the town.

H. MALCOLM FRASER.

Alleyne's Grammar School, Stone, Staffs, 4th August, 1920.

Weather Lore.

I SHOULD be much obliged if any of your readers would send me any weather sayings current in the district in which they live. I particularly desire to know the effect of approaching bad weather on birds, animals, insects and flowers. If anyone can help, will they please send to address below.

B. BROTHERTON.

St. George's Boys' School, Worcester, 6th Sept., 1920.

Geostrophic Wind over London; October, 1881–1915.

FREQUENCY OF STRENGTH AND DIRECTION.

Estimates based on the D.W.R. charts (8*h.*, 1881–1908; 7*h.*, 1909–1915).

Direction.	5 m/s. 11 mi/hr.	10 m/s. 22 mi/hr.	15 m/s. 33 mi/hr.	20 m/s. 44 mi/hr.	Over 20 m/s. Over 44 mi/hr.	Total Frequency of Direction.
N.	20	29	27	10	12	98
NE.	10	17	19	4	2	52
E.	12	16	27	11	4	70
SE.	21	28	19	7	5	80
S.	41	40	26	13	9	129
SW.	33	46	58	27	10	174
W.	18	44	62	36	23	183
NW.	18	34	32	18	9	111
Total Frequency of Strength	173	254	270	126	74	897*

* Indeterminate—188.

NOTES AND QUERIES.

Weekly Weather Report.

APPENDIX I., First Quarter 1920, giving District values for Rainfall, Mean Temperature and Sunshine has recently been issued and contains some new features. There is a separate table giving temperatures in degrees absolute above 200 a in addition to the old table giving corresponding information in degrees Fahrenheit. In the case of rainfall, amounts are expressed in millimetres, and not in inches as hitherto. No change has been made in the sunshine table.

A Canadian Eden.

AN illustrated pamphlet entitled "The Climate of Victoria," issued by the Victoria and Island Development Association, British Columbia, introduces us to one of Nature's favoured regions. In the same latitude as Jersey it has more sunshine and less rainfall. Its summers are cool and its winters are so mild that it is termed "The Evergreen City," and withal it is free from fogs. These advantages have induced the Dominion Government to make Victoria the site of the new Dominion Astrophysical Observatory, which is under Dr. J. S. Plaskett. The Meteorological Observatory is under the direction of Mr. F. Napier Denison.

Relation of Temperature to Solar Radiation.

AN interesting account of his researches concerning the relation of temperature to solar radiation has been received from Mr. A. H. Wallis, C.E. If there are places on the surface of the sun which are ordinarily brighter than normal places in the same latitude, the solar radiation will be greatest when most of these are on the side of the sun nearest the earth. Thus a periodic variation in the solar radiation will be produced, depending on the period of the sun's synodic rotation, 27·33 days. The author has divided up four years' temperature observations at Mafeking into 27·33-day batches and averaged the results for corresponding days in all the batches, thus finding the part of the temperature variation that could be attributed to such changes in radiation. The resulting curve has two main maxima in a period, one strikingly sharp and the other smoother, and it seems that the range of the variation thus caused is about a third of that of the actual variation. Thus a notable part of the observed temperature irregularities may have been accounted for.—H. J.

Review.

Some Broader Aspects of Rain Intensities in Relation to Sewer Design. By R. E. Horton. Reprinted from *Municipal and County Engineering*, June–July, 1919. Albany, N.Y. Size $11\frac{1}{2} \times 7$, pp. 12. Numerous diagrams.

Mr. Horton has devoted so much skilled attention to the study of high rainfall intensities in the United States that a generalized epitome of his views is welcome. The subject is approached largely from the economic side as affecting the design of sewers, in which respect it is of course of paramount importance, but it is not lacking in scientific interest.

The author clearly recognises the fact that rainfalls of the highest intensity are almost invariably associated with thunderstorms; he regards the latter as of convectional origin as a rule, though also liable to occur in conjunction with cyclonic storms. The characteristics of thunderstorm rain in any case are so distinct from those of other types of rain as to require separate study. Nearly all high rainfall intensities occur in the summer, since apart from the relative frequency of thunderstorms winter cyclonic rains differ in some essential respects from those of summer. We note with interest that in the United States the proportion of excessively intense rains which occur in conjunction with thunderstorms increases with the altitude. So far as the British Isles are concerned we have always found that in the hilly districts of the west, both summer thunderstorms and intense rainfalls are comparatively rare. The difficulty of defining both phenomena and their extremely local nature render statistical comparisons somewhat fallacious.

The physical processes of thunderstorm rain are explained on the convectional hypothesis, the intense rain being largely due to suspension and sudden release of the condensed drops. An important argument is put forward that since during convectional action the precipitation must be drawn almost entirely from local sources, there is an approximately ascertainable limit to the possible amount of rainfall, which does not exist in the case of cyclonic or more especially of orographical rainfall. In other words, although thunderstorm rain is likely to be heavier than that of other kinds while it lasts, larger amounts may fall during non-thunderstorm rains if sufficiently long continued. In this connection it is of interest to note that the two most remarkable daily rainfalls ever recorded in England, those of August 25th–26th, 1912, at Norwich, and of June 28th, 1917, at Bruton, were essentially cyclonic. In both these rains the rate of fall was approximately one inch per hour, an extremely high rate for cyclonic rain, but low compared with severe thunderstorm rain. In the extraordinary orographic rain at Baguio, Philippine Islands, on July 14th–17th, 1911, when 88·2 inches of rain fell in four days, the average rate of rainfall during the 20 hours of most intense fall was about 2 inches per hour, though for short intervals it rose to 3 inches, and once to 4 inches per hour, a rate fully comparable with high thunderstorm rates, but exceeded in the British Isles for all periods up to 30 minutes on a considerable number of occasions. It is notable that the limit of maximum rain intensity, due to storage suspension, does not appear to vary greatly in amount even between places having widely different annual rainfalls and thunderstorm frequencies. Throughout most of the eastern United States it seems to correspond with an intensity of 10–12 inches per hour for a period of five minutes.* The characteristic of thunderstorm rain is its lack of constancy, the high rate seldom being maintained for any great length of time. At New York during 45 years only 4 per cent. of rains exceeded 30 minutes in duration.

Speaking broadly, the author finds that thunderstorms and excessively heavy rains vary in frequency, and occur under the same conditions, as high values of the annual, or more precisely the summer, rainfall. They are most common in tropical latitudes and decrease towards the poles owing to decreased temperature, and their occurrence is mainly limited to the summer months. They usually decrease proceeding inland from the coast as the moisture content of the air decreases. Whilst these statements are undoubtedly true in their broadest sense, they must not be applied too narrowly, and, except in a limited degree, do not hold good in Western Europe. In England intense rainfalls are probably commonest in the Fen District, where the annual rainfall is least. Further, it is found that in the United States the greatest daily maximum rainfalls and the greatest intensities for short periods usually occur in years having the highest total rainfall. In a region where the bulk of the rain is orographical this is certainly not the case.

Mr. Horton shows so extensive a knowledge of this intricate and difficult subject that we hope he will be induced to extend his purview to include the British Isles, and make use of very large collection of statistical material published annually in *British Rainfall.* C. S.

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* For the British Isles the actual observed limit is 15 inches per hour for five minutes at Preston on August 10th, 1893.

Obituary.

Sir Joseph Norman Lockyer, K.C.B., LL.D., D.Sc., F.R.S.

(Born at Rugby May 17th, 1836; died at Salcombe Regis, Sidmouth, August 16th, 1920.)

THE death of Sir Norman Lockyer on August 16th marks the end of the career not only of a famous astronomer and exponent of the physics of the sun, but also of a keen meteorologist whose claim to fame in that department of natural knowledge will increase as time goes on and "the thoughts of men are widened with the process of the suns." In science he began as an amateur, for he was educated at various private schools which had no laboratories in those days, and at the age of twenty-one he received an appointment at the War Office. After eight years' experience, in 1865 he was entrusted with the duty of editing the Army regulations. By 1868 he had become so famous as an astronomer, in conjunction with the French astronomer Janssen, by certain spectroscopic researches on the sun, that a medal was struck in honour of the two men. Two years afterwards he left the War Office to become secretary of the Duke of Devonshire's Royal Commission on Scientific Instruction and the Advancement of Science; in 1875 he was transferred to the Science and Art Department, and in 1885 became director of an Observatory for the Study of Solar Physics established at South Kensington.

It was the study of solar physics that brought him into relation with meteorology. Certain indications of relationship between the frequency of sunspots and the phenomena of the Earth's atmosphere had been brought forward by Charles Chambers as regards Indian rainfall, and by Charles Meldrum as regards the frequency of tropical revolving storms in the region of the Mauritius. The relations were sufficiently marked to make further investigation practically imperative, but not sufficiently so to be put into practice forthwith. To develop the relationship into practical utility required on the one hand the study of the sun, and on the other hand the study of the meteorology of the Earth as a whole. The case for this co-operative study was set out by Sir Norman Lockyer at a meeting of the International Metereological Committee at Southport in 1903, when that Committee met simultaneously with the BritishAssociation, of which Lockyer was then President. His memorandum will be found in the Official Report of the meeting of the Committee at Southport. It was this economic importance of correlation of solar and terrestrial changes, particularly in relation to Indian rainfall and famines, which formed the justification of the maintenance of a solar physics observatory out of public funds; and during Sir Norman Lockyer's tenure of the office of Director the two sides of the obligation were regarded. The meteorological side involved the study of the meteorology of the globe as a whole, and the prosecution of that study required the co-operation of meteorologists all over the world. The work of compilation and discussion was entrusted mainly to Dr. W. J. S. Lockyer, Sir Norman's youngest son, and to their activity we owe a number of volumes on the distribution of pressure and rainfall over the globe, the barometric see-saw, the meteorology of Australia, and the circulation of air in the Southern hemisphere.

When the Solar Physics Observatory was removed to Cambridge, much to Sir Norman's chagrin, the original purpose of exploring the connection between solar and terrestrial changes was no longer made a primary object, and the study of the sun for its own sake was admitted as a legitimate object of the expenditure of public money. The study of meteorology in relation to the sun became specialized as the physics of the Earth's atmosphere, and the Meteorological Office had to take up the duty of compiling observations to exhibit the meteorology of the globe as a whole. The work in this direction is exemplified by the publication of the *Réseau Mondial*, of which the volumes for 1911, 1912 and 1913 have already appeared, indirectly owing to Sir Norman's initiative.

For many years, until his removal to Sidmouth, Sir Norman Lockyer's home in Penywern Road, South Kensington, was a rendezvous for those who were interested in science. Each year invitations were issued to a weekly assembly in the evening, and many meteorologists have enjoyed his hospitality. His wide influence as Editor of *Nature* made these gatherings of more than ordinary interest, and the absence of any continuance of that kind of assembly will be recognised by many as one of the ways in which the world of science is the poorer by Sir Norman's departure.

NAPIER SHAW.

Weather in the British Isles: August 1920.

LIKE June and July, August was characterised by dull, cool weather and a general absence of any really hot days, a prominent feature of the month's weather being the few occasions on which the maximum temperature touched or exceeded the normal. At most stations, moreover, the mean temperature was lower than that of the two months which preceded it; a result largely due to the unusually low temperatures which occurred during several of the nights. The minimum temperatures recorded at some of the stations on the 20th, although equalled, have never been lower in August in records extending in some instances over more than forty years. At Eskdalemuir there were seven occasions, and at Benson six, when the minimum temperature fell below 43° F. Ground frosts, moreover, although not very severe, were experienced at an abnormally large number of stations.

A striking feature of the month was the erratic way in which the sunshine was distributed on many occasions. Thus during the week which ended on the 14th the percentage of the possible sunshine at Rhayader, in Central Wales, was only 5 and at Crathes (Kincardineshire) only 9, but in Guernsey it was as high as 73. During the week ended on the 21st, large differences were again recorded, the percentage at Gordon Castle being only 15, compared with 42 at Dundee; 14 at Norwich, compared with 28 at Yarmouth and 38 at Southend; and 28 at Southampton, but 52 at St. Leonards. During the following week the percentage in Guernsey was 54, but locally at Malin Head and Castlebay it was as low as 8 and 10 respectively.

Between the 10th and 16th, and again from the 20th to the close of the month, anticyclonic conditions predominated, and during these two periods many stations had no rain. At places however, heavy precipitation occurred on the 4th and 17th. At 7 h. on the former day a depression was shown on the weather map over the north-west coast of the British Isles, which as it passed eastwards caused continuous rain in several localities, 52 mm. falling at Holyhead, 30 mm. at Pembroke, 117 mm. at Beddgelert, and 26 mm. at Eskdalemuir. Another depression passed eastwards across the British Isles on the 17th, its passage being associated with exceptionally heavy falls of rain in Scotland, Ireland, and the north of England, 77 mm. falling at West Linton (Pentland Hills), 66 mm. at Glasgow, 79 mm. at Paisley, 72 mm. at Egremont and Leith, 71 mm. at Renfrew, 49 mm. at Eskdalemuir, and 47 mm. at Malin Head. At the rear of a depression centred over Denmark on the 20th, the temperature in parts of Scotland did not rise above 52° F., and 54° F. in the north of England, and remained as low as 58° F. even in Cornwall. Similar conditions prevailed on the 21st; some very low temperatures were also recorded on the 30th and 31st, the temperature at Kew Observatory at 13 h. on the 30th being only 53° F., compared with 72° F. at the same hour at Akureyi in northern Iceland.

The thunderstorms of August, which mainly occurred during the early part of the month, were less frequent and much less widespread than those of June and July. Strong winds were infrequent and gales were rare. At Tenbury, on the 12th, there was a time of pitch black darkness with heavy rain and hail, the latter the size of marbles. On the same day at Birmingham, when 23 mm. of rain fell, there was loss of life and much damage caused by floods.

The total rainfall for the month was nearly everywhere deficient, especially in England, where several areas in the Midlands had less than 25 mm. Practically the whole of England had less than half the average, and in Wales the rainfall was generally below the average in spite of the heavy rain on the 4th. The fall was also deficient in Ireland, but was almost everywhere in excess of 50 mm. In Scotland the rainfall was considerably heavier, particularly in the valleys of the Forth and Clyde, where more than 130 mm. fell widely. The general rainfall expressed as a percentage of the average was:—England and Wales, 59; Scotland, 85; Ireland, 62; British Isles, 68.

In London (Camden Square) the mean temperature was 59·1° F., or 3·3° below the average; a lower mean temperature was only reached on three occasions in August since observations were commenced in 1858. The duration of rainfall was 27·8 hours. Evaporation, 2·00 in.

Weather Abroad: August 1920.

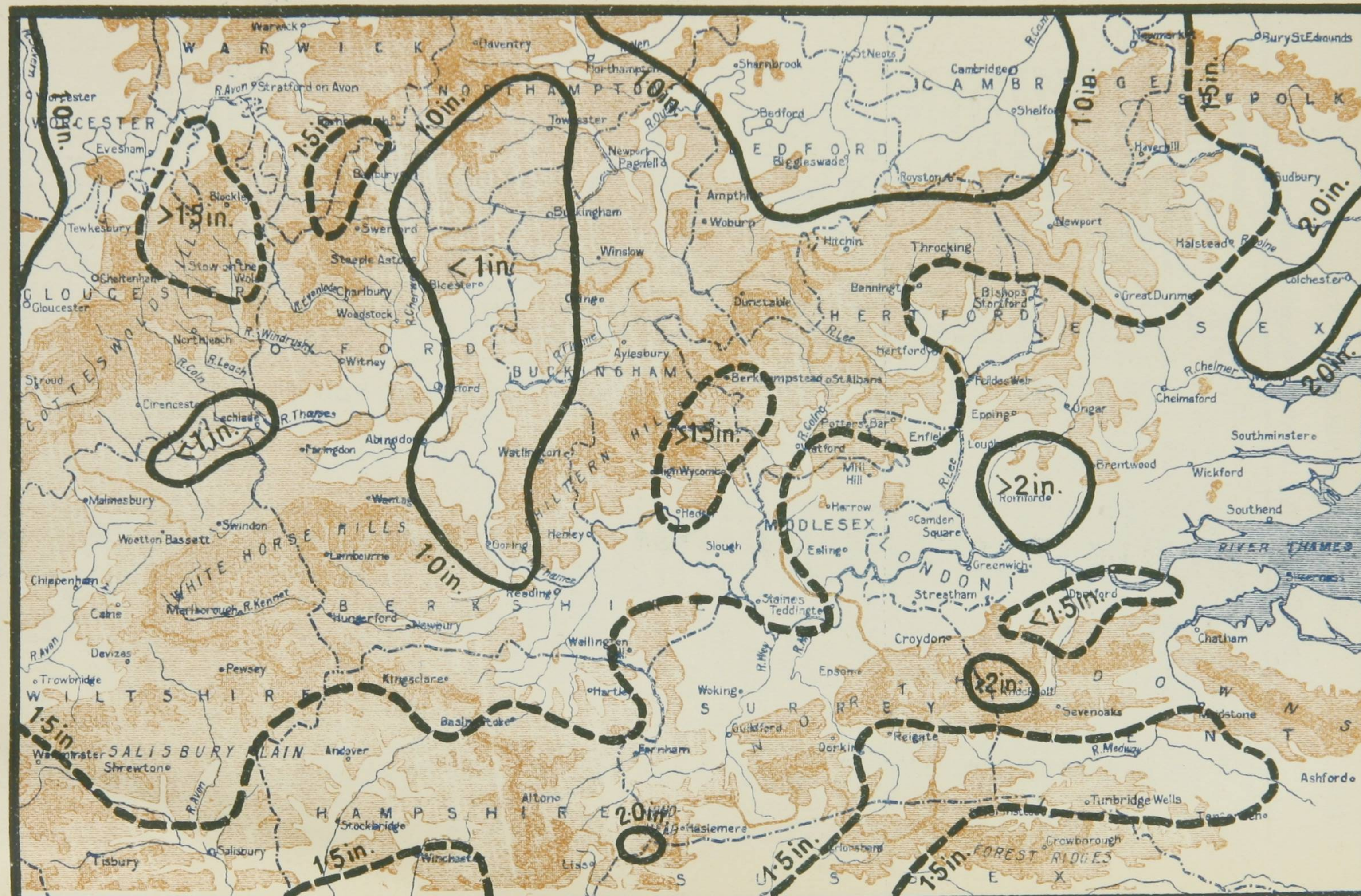
During the first part of the month a series of depressions and their secondaries moving in from the Atlantic caused very unsettled weather in North-west Europe. Local thunderstorms and heavy falls of rain occurred

(*Continued on* p. 188.)

Rainfall Table for August 1920.

STATION.	COUNTY.	Aver. 1875—1909.	1920.		Per cent. of Av.	Max. in 24 hrs.		No. of Rain Days.
		in.	in.	mm.		in.	Date.	
Camden Square	*London*	2·39	1·75	44	73	·82	18	7
Tenterden (View Tower)	*Kent*	2·42	1·58	40	65	·99	18	5
Arundel (Patching)	*Sussex*	2·52	1·29	33	51	·70	18	5
Fordingbridge (Oaklands)	*Hampshire*	2·76	1·62	41	59	·41	18	7
Oxford (Magdalen College)	*Oxfordshire*	2·44	1·05	27	43	·45	4	8
Wellingborough	*Northampton*	2·36	·84	21	36	·24	4	8
Hawkedon Rectory	*Suffolk*	2·30	1·61	41	70	·46	22	14
Norwich (Eaton)	*Norfolk*	2·52	2·07	53	82	·40	19	13
Launceston (Polapit Tamar)	*Devon*	3·17	1·59	40	50	·63	4	11
Lyme Regis (Rousdon)	"	2·84	1·34	34	47	·58	4	5
Ross (Birchlea)	*Herefordshire*	2·90	·87	22	30	·29	4	9
Church Stretton (Wolstaston)	*Shropshire*	3·43	·98	25	29	·29	4	12
Boston (Black Sluice)	*Lincoln*	2·39	1·72	44	72	·57	19	11
Worksop (Hodsock Priory)	*Nottingham*	2·55	·65	16	25	·28	4	10
Mickleover Manor	*Derbyshire*	2·80	1·05	27	37	·45	4	10
Southport (Hesketh Park)	*Lancashire*	3·73	1·49	38	40	·80	4	12
Wetherby (Ribston Hall)	*York, W. R.*	2·78	1·66	42	60	·59	4	7
Hull (Pearson Park)	*" E. R.*	3·05	1·25	32	41	·46	4	7
Newcastle (Town Moor)	*North'land*	3·20	1·90	48	59	·86	4	11
Borrowdale (Seathwaite)	*Cumberland*	11·47	8·70	221	76	..	..	..
Cardiff (Ely)	*Glamorgan*	4·54	2·73	69	60	1·73	4	15
Haverfordwest (Portfield)	*Pembroke*	4·21	3·71	94	88	2·03	4	13
Aberystwyth (Gogerddan)	*Cardigan*	4·88	2·66	68	55	1·07	4	..
Llandudno	*Carnarvon*	3·16	3·39	86	107	1·14	18	15
Dumfries (Cargen)	*Kirkcudbrt.*	4·23	4·02	102	95	1·40	4	16
Marchmont House	*Berwick*	3·54	3·56	90	101	1·73	17	..
Girvan (Pinmore)	*Ayr*	4·54	4·48	114	99	·96	17	19
Glasgow (Queen's Park)	*Renfrew*	3·62	4·85	123	134	2·30	17	15
Islay (Eallabus)	*Argyll*	4·49	4·43	112	101	1·18	17	18
Mull (Quinish)	"	5·00	3·45	88	69	·93	16	18
Loch Dhu	*Perth*	6·70	7·30	185	109	2·15	17	13
Dundee (Eastern Necropolis)	*Forfar*	3·34	4·22	107	126	1·47	17	13
Braemar	*Aberdeen*	3·63	3·05	78	84	·90	19	13
Aberdeen (Cranford)	"	3·07	2·06	52	67	·76	17	10
Gordon Castle	*Moray*	3·29	2·30	58	70	·58	16	14
Drumnadrochit	*Inverness*	3·11	2·57	65	83	·67	6	18
Fort William	"	6·15	5·75	146	93	1·55	16	18
Loch Torridon (Bendamph)	*Ross*	6·61	3·76	96	57	1·24	16	10
Stornoway	"	3·82	2·25	57	59	·41	2	17
Dunrobin Castle	*Sutherland*	2·71	·82	21	30	·20	3	10
Wick	*Caithness*	2·73	·95	24	35	·23	2	16
Glanmire (Lota Lodge)	*Cork*	3·83	2·58	66	67	·73	7	15
Killarney (District Asylum)	*Kerry*	4·57	2·01	51	43	·57	7	14
Waterford (Brook Lodge)	*Waterford*	3·73	2·69	68	72	·91	7	9
Nenagh (Castle Lough)	*Tipperary*	4·04	2·13	54	53	·59	7	17
Ennistymon House	*Clare*	5·01	2·71	69	54	·70	11	17
Gorey (Courtown House)	*Wexford*	3·31	2·97	75	90	1·01	4	9
Abbey Leix (Blandsfort)	*Queen's Co.*	3·94	2·61	66	66	·75	7	14
Dublin (FitzWilliam Square)	*Dublin*	3·08	1·52	39	49	·39	4	15
Mullingar (Belvedere)	*Westmeath*	4·00	1·95	50	49	·45	8	14
Woodlawn	*Galway*	4·62	2·51	64	54	·43	17	21
Crossmolina (Enniscoe)	*Mayo*	4·68	2·86	73	61	·79	7	18
Collooney (Markree Obsy.)	*Sligo*	4·30	2·85	72	66	·41	2	18
Seaforde	*Down*	3·64	1·99	50	55	·48	7	13
Ballymena (Harryville)	*Antrim*	4·18	2·86	73	68	·69	7	16
Omagh (Edenfel)	*Tyrone*	4·22	3·55	90	84	·87	31	20

THAMES VALLEY RAINFALL, AUGUST 1920.



ALTITUDE SCALE

Below 250 feet	250 to 500 feet	500 to 1000 feet	Above 1000 feet

SCALE OF MILES

0 5 10 15 20

H.M.Stationery Office Press Kingsway, W.C.2.

P.S. 5544/197. 105/P.35. 1250. 9/20.

Supplementary Rainfall, August 1920.

Div.	STATION.	RAIN. in.	RAIN. mm.
II.	Ramsgate	2·07	53
"	Sevenoaks, Speldhurst	1·80	46
"	Hailsham Vicarage	1·78	45
"	Totland Bay, Aston	1·03	26
"	Ashley, Old Manor Ho.	1·61	41
"	Grayshott	2·03	51
"	Ufton Nervet	1·43	36
III.	Harrow Weald, Hill Ho.	1·77	45
"	Pitsford, Sedgebrook	·95	24
"	Chatteris, The Priory	1·06	27
IV.	Elsenham, Gaunts End	1·22	31
"	Lexden, Hill House	2·18	55
"	Aylsham, Rippon Hall	1·98	50
"	Swaffham	1·33	34
V.	Devizes, Highclere	1·23	31
"	Weymouth	1·55	39
"	Ashburton, Druid Ho.	1·70	43
"	Cullompton	1·35	34
"	Hartland Abbey	2·73	69
"	St. Austell, Trevarna	1·30	33
"	North Cadbury Rec.	1·60	41
"	Cutcombe, Wheddon Cr.	1·97	50
VI.	Clifton, Stoke Bishop	1·98	50
"	Ledbury, Underdown	·79	20
"	Shifnal, Hatton Grange	1·17	30
"	Ashbourne, Mayfield	1·28	32
"	Barnt Green, Upwood	1·87	48
"	Blockley, Upton Wold	1·92	49
VII.	Grantham, Saltersford	..	..
"	Louth, Westgate	1·71	43
"	Mansfield, West Bank	·94	24
VIII.	Nantwich, Dorfold Hall	1·44	37
"	Bolton, Queen's Park	2·55	65
"	Lancaster, Strathspey	2·24	57
IX.	Wath-upon-Dearne	1·12	28
"	Bradford, Lister Park	1·68	43
"	West Witton	1·42	36
"	Scarborough, Scalby	2·99	76
"	Ingleby Greenhow	2·45	62
"	Mickleton	1·20	30
X.	Bellingham	1·90	48
"	Ilderton, Lilburn	3·25	82
"	Orton	3·73	95
XI.	Llanfrechfa Grange	1·60	41
"	Treherbert, Tyn-y-waun	5·52	140
"	Carmarthen Friary	3·56	90
"	Fishguard	3·59	91
"	Lampeter, Falcondale	3·60	91
"	Abergwngy	2·55	65
"	Crickhowell, Talymaes	8·00	203
"	Sennybridge	1·82	46
"	Lake Vyrnwy	2·75	70
"	Llangynhafal, P. Drâw	2·05	52
"	Dolgelly, Bryntirion	3·17	80
"	Lligwy	4·16	106
XII.	Stoneykirk, Ardwell Ho.	3·40	86
"	Whithorn, Cutroach	2·92	74
"	Carsphairn, Shiel	5·31	135
XII.	Langholm, Drove Rd.	4·18	106
XIII.	Selkirk, Hangingshaw	3·14	80
"	North Berwick Res.	4·34	110
"	Edinburgh, Royal Ob.	5·33	135
XIV.	Biggar	5·74	146
"	Leadhills	6·22	158
"	Maybole, Knockdon	4·11	104
XV.	Rothesay	5·34	136
"	Oban	3·66	93
"	Inveraray Castle	1·89	48
"	Holy Loch, Ardnadam	8·56	217
XVI.	Loch Venachar	6·80	173
"	Glenquey Reservoir	6·10	155
"	Loch Rannoch, Dall	3·62	92
"	Coupar Angus	3·15	80
"	Montrose Asylum	1·96	50
XVII.	Balmoral Castle	3·44	87
"	Fyvie Castle	2·17	55
"	Peterhead, Forehill	2·92	74
"	Grantown-on-Spey	2·92	74
XVIII.	Cluny Castle	2·80	71
"	Loch Quoich, Loan	9·26	235
"	Skye, Dunvegan	3·58	91
"	Fortrose	2·08	53
"	Ardross Castle	2·36	60
"	Glencarron Lodge	3·77	96
XIX.	Tongue Manse	2·43	62
"	Melvich Schoolhouse	1·14	29
"	Loch More, Achfary	3·89	99
XX.	Dunmanway Rectory	3·33	85
"	Mitchelstown Castle	2·72	69
"	Gearahameen	2·40	61
"	Darrynane Abbey	2·24	57
"	Clonmel, Bruce Villa	2·90	74
"	Cashel, Ballinamona	2·08	53
"	Roscrea, Timoney Pk.	2·28	58
"	Foynes	1·98	50
"	Broadford, Hurdlesto'n	2·40	61
XXI.	Kilkenny Castle	2·12	54
"	Rathnew, Clonmannon	1·79	46
"	Hacketstown Rectory	3·52	89
"	Ballycumber, Moorock	2·45	62
"	Balbriggan, Ardgillan	1·98	50
"	Drogheda	2·24	57
"	Athlone, Twyford	2·74	70
"	Castle Forbes Gdns.	2·31	59
XXII.	Ballynahinch Castle	4·14	105
"	Westport House	3·95	100
XXIII.	Enniskillen, Portora	..	..
"	Cootehill, Dartrey	..	..
"	Armagh Observatory	1·92	49
"	Warrenpoint	2·63	67
"	Belfast, Cave Hill Rd.	2·57	65
"	Glenarm Castle	1·93	49
"	Londonderry, Creggan	2·98	76
"	Sion Mills	2·73	69
"	Milford, The Manse	2·72	69
"	Killybegs, Rockmount	3·40	86

Erratum.—In July Armagh should read 2·99 in. or 76 mm.

Climatological Table for the

STATIONS	PRESSURE: Mean of Day M.S.L. (mb.)	PRESSURE: Diff. from Normal (mb.)	TEMPERATURE Absolute: Max. (° F.)	Absolute: Date	Absolute: Min. (° F.)	Absolute: Date	Mean Values: Max. (° F.)	Mean Values: Min. (° F.)	Mean Values: ½ max. and min. (° F.)	Mean Values: Diff. from Normal (° F.)
London, Kew Observatory	1013·8	0·0	66	30	29	9	54·1	39·0	46·6	+4·2
Gibraltar	1021·1	+5·3	71	23	37	11	62·5	49·6	56·1	−1·4
Malta	..	..	..	..	..	..	..	..	..	..
Sierra Leone	1011·4	+0·5	99	7	70	24	89·3	73·9	81·6	−1·0
Lagos, Nigeria	1011·8	+2·4	99	24	71	22	89·3	77·6	83·5	+0·6
Kaduna, Nigeria	1012·9	+4·8	100	19, 20	55	5	93·6	62·7	78·1	−3·6
Zomba, Nyasaland	1010·7	+1·0	86	2	60	28,29,31	79·1	64·9	72·0	+1·3
Cape Town	..	..	96	19	50	25	79·5	57·4	68·5	+0·3
Johannesburg	..	..	83	15	41	27	73·0	53·0	63·0	−0·3
Mauritius	1013·1	+1·1	86	11	65	5	83·5	71·6	77·5	−0·5
Bloemfontein	..	..	83	10	38	27	74·0	52·1	63·1	−4·3
Calcutta, Alipore Obsy.	1009·4	−0·5	96	21	61	7	88·8	71·7	80·3	+0·2
Bombay	1009·9	−0·8	91	25	71	2	87·4	74·3	80·9	+1·4
Madras	..	..	92	30	70	21	89·9	73·7	81·8	+0·8
Colombo, Ceylon	1010·1	+0·1	93	26	73	1, 3, 7,	88·4	74·3	81·3	−0·7
Hong Kong	1016·6	+0·8	80	11	51	4	66·7	59·3	63·0	−0·3
Sydney	1017·5	+1·3	82	5	51	19	75·1	59·7	67·4	−1·8
Melbourne	1017·7	+0·9	98	13	46	10	73·4	53·8	63·6	−0·9
Adelaide	1018·7	+1·7	105	14	47	22	80·9	58·2	69·5	−0·4
Perth, West Australia	1015·5	+0·1	104	23	47	30	81·6	61·5	71·5	+0·7
Coolgardie	1015·0	+0·2	104	9	46	14	86·0	59·9	72·9	+1·2
Brisbane	1016·2	+2·1	90	7	57	18	81·6	64·6	73·1	−1·3
Hobart, Tasmania	1013·2	−0·9	88	13	41	18	68·5	49·9	59·2	−0·2
Wellington, N.Z.	1016·2	−0·8	76	19	45	26	67·3	54·9	61·1	+0·4
Suva, Fiji	..	..	..	..	..	..	..	..	..	..
Kingston, Jamaica	..	..	90	10	65	21	87·0	69·3	78·1	+1·0
Grenada, W.I.	1013·5	+0·6	85	30	69	8	82·8	71·6	77·2	−0·5
Toronto	1014·1	−2·9	66	26	− 1	2	43·1	24·6	33·9	+5·0
Fredericton, N.B.	..	..	65	24, 25	−19	2	39·0	15·2	27·1	+1·5
St. John, N.B.	1011·2	−3·0	58	25	− 9	2	37·8	22·1	29·9	+1·5
Victoria, B.C.	1012·0	−3·8	59	20	32	31	49·6	38·2	43·9	+0·7

LONDON, KEW OBSERVATORY.—6 fogs. 2 days of snow; mean speed of wind 8·5 mi/hr.

GIBRALTAR.—3 fogs, 3 gales.

SIERRA LEONE.—Prevailing wind direction S.W.

MAURITIUS.—Prevailing wind direction E; mean speed, 7·5 mi/hr.

British Empire, March 1920.

TEMPERATURE Absolute Max. in Sun °F.	TEMPERATURE Absolute Min. on Grass °F.	Relative Humidity %	Mean Cloud Am'nt 0–10	PRECIPITATION Amount in.	PRECIPITATION Amount mm.	PRECIPITATION Diff. from Normal mm.	PRECIPITATION Days	BRIGHT SUNSHINE Hours per day	BRIGHT SUNSHINE Percentage of possible	STATIONS
118	17	76	6·1	1·17	30	– 13	14	4·1	35	London, Kew Observatory.
138	32	77	4·1	1·96	50	– 72	10	..	..	Gibraltar.
..	..	..	..	..	..	..	..	..	..	Malta.
..	..	65	2·3	0·00	0	– 28	0	..	..	Sierra Leone.
163	55	71	6·2	3·78	96	0	6	..	..	Lagos, Nigeria.
..	..	40	1·0	0·00	0	– 10	0	..	..	Kaduna, Nigeria.
..	..	90	9·2	21·78	553	+343	23	..	..	Zomba, Nyasaland.
..	..	65	2·6	0·16	4	– 20	4	..	..	Cape Town.
..	..	76	5·0	4·40	112	+ 5	10	7·6	62	Johannesburg.
..	60	78	6·1	8·98	228	– 10	27	8·4	69	Mauritius.
..	..	73	3·9	5·99	152	+ 51	10	..	..	Bloemfontein.
..	57	55	3·6	6·27	159	+127	5	..	..	Calcutta, Alipore Obsy.
..	..	77	1·9	0·00	0	– 1	0	..	..	Bombay.
157	67	73	2·1	0·00	0	– 5	0	..	..	Madras.
161	68	76	6·3	5·95	151	+ 39	13	..	..	Colombo, Ceylon.
..	..	84	9·0	1·39	35	– 41	8	2·7	22	Hong Kong.
137	45	66	4·1	1·49	38	– 93	13	..	..	Sydney.
147	37	59	5·5	1·08	27	– 28	11	..	..	Melbourne.
157	36	44	3·6	1·44	37	+ 10	3	..	..	Adelaide.
165	40	56	3·5	1·63	41	+ 23	6	..	..	Perth, West Australia.
164	44	35	4·3	0·52	13	– 6	5	..	..	Coolgardie.
146	53	62	4·1	1·80	46	–106	7	..	..	Brisbane.
141	34	69	6·1	1·78	45	+ 3	17	..	..	Hobart, Tasmania.
140	34	73	4·5	2·13	54	– 29	7	8·2	67	Wellington, N.Z.
..	..		..	..	..	..	..	..	..	Suva, Fiji.
..	..	80	3·0	0·34	9	– 17	7	..	..	Kingston, Jamaica.
137	..	71	4·3	2·51	64	– 6	17	..	..	Grenada, W.I.
104	–11	63	4·7	2·31	59	– 8	10	..	..	Toronto.
..	..	..	..	2·99	76	– 44	13	..	..	Fredericton, N.B.
..	..	72	5·6	8·04	204	+ 89	15	..	..	St. John, N.B.
119	23	80	6·7	2·28	58	– 7	18	..	..	Victoria, B.C.

BLOEMFONTEIN.—Coolest March yet experienced.

COLOMBO, CEYLON.—Wind direction variable; mean speed, 3·7 mi/hr.; 14 thunderstorms.

HONG KONG.—Prevailing wind direction E; mean speed, 15·1 mi/hr.; 1 thunderstorm, 11 fogs.

GRENADA.—Prevailing wind direction E.

at various places, 66 mm. of rain falling at Hernosand (Sweden) during the 24 hours ending 7 a.m. on the 7th. During this period the Azores were under the influence of an anticyclone with extensions over southern Europe. On the 9th the temperature reached 95° F. at Madrid. About this date the Azores anticyclone moved up in a northerly direction and by the 11th was centred over the British Isles. It afterwards moved SW. and remained off the SW. coasts of the British Isles for some days, but by the 17th it had retreated to the Azores again. High temperatures were recorded in the south of France during this period, the temperature at Perpignan reaching 101° F. on the 16th. With the retreat of the anticyclone, further depressions moved in from the Atlantic, one of which crossed the British Isles on the 17th–18th to the North Sea, and after remaining in the vicinity of the southern North Sea and Denmark for some days, moved eastward, where it remained over Germany and Poland until the end of the month. On the 20th, 48 mm. of rain fell at Saerna (Sweden) and 43 mm. at Lugano (Switzerland).

The Azores anticyclone again spread northward on the 18th, and remained off the west and south-west coasts of the British Isles until the 25th, when it moved up over the British Isles. By the 28th it was centred over the Färoe Islands, and by the 31st over the Gulf of Bothnia. This northern movement of the anticyclone caused a considerable improvement in the weather of Northern and North-western Europe during the last days of the month.

In Italy and the Eastern Mediterranean the weather continued for the most part fine and warm throughout the month. A temperature of 108° F. was reached at Cairo on the 17th, and again on the 27th, while on the latter date 106° F. was recorded at Alexandria.

On the 9th and 10th, New York and the North-Eastern States experienced temperatures above the normal. On the former day 100° F. in the shade was registered at Oneco, Connecticut, this being the highest temperature experienced there for 40 years. The hot weather was associated with an extensive area of high pressure occupying the Western Atlantic, but although this maintained itself for nearly three weeks, temperatures were normal the greater part of the time. There had been no previous hot periods this summer.

A message from Bombay, dated August 9th, stated that there had been abnormal rainfall accompanied by unprecedented floods in the region of the new industrial town of Jamshedpur, near Bombay. The low-lying parts of the town were under water and over 100 persons perished. On the whole, however, the monsoon in India was poor; at Bombay Observatory only 35 inches of rain fell from June to August, compared with a ten-year average of 55 inches in the same period. In some sections rain was badly needed, especially in Berar, the Bombay Presidency and the Western Deccan. Good rain, however, fell throughout the area affected by the long drought in the Eastern Deccan and Haidarabad. In the southern part of the latter province it exceeded the normal. The naturally rainy province of Assam also had heavier rain than usual. The condition of the cotton crop was poor on the whole owing to the dry weather, but Indian meteorologists were of opinion that there was no cause for anxiety.

In Australia extraordinary cold was experienced in Victoria, snow falling as far north as Albury, on the River Murray, where it had not been seen for 20 years. Good general rains were again registered over Victoria and New South Wales. South Australia is anticipating a record harvest.

There were very serious floods in portions of the Japanese islands of Kyushu and Shikoka, many whole towns and villages being overwhelmed. The casualties are believed to be enormous.

During a recent storm the collapse of a mountain top in the Philippines buried a village of Igorot Malays under hundreds of feet of earth and caused the loss of 70 lives.