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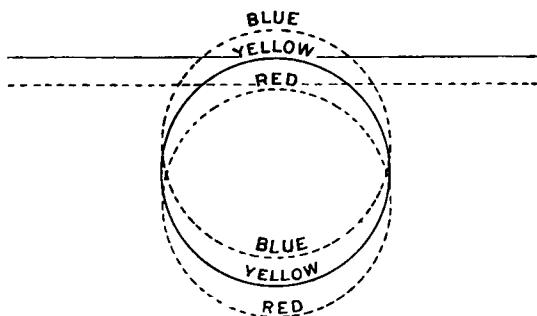
VOL. XLI.

## THE GREEN FLASH ON THE HORIZON.

BY ARTHUR A. RAMBAUT, D.Sc., F.R.S.

(Continued from p. 23.)

EVERY astronomer is familiar with the fact that in a telescope the image of a star observed near the horizon is drawn out into a short spectrum. In the case of an object with a measurable disk, such as the sun or a planet, this effect becomes exceedingly troublesome when accurate measurements are required, even while the object is at a considerable altitude. The images formed by the variously coloured rays are not exactly superposed but fall as is shown in the diagram, in which, for simplicity, only the alternate colours, red, yellow and blue are indicated. It is obvious that, as the sun sinks in the west, the red image will be the first to disappear, then the yellow; and at the moment when the horizon is in the position indicated by the continuous straight line in the figure, it is clear that only blue light can reach the eye. This way of representing the facts also explains why at sunset the tips are the first to become green (when the horizon cuts through the yellow disk as indicated by the dotted line in the diagram), as is generally found to be the case if the flash is well seen with the aid of glasses. In the *Memoirs of the Royal Astronomical Society*, Vol. xlv., p. 121, Sir David Gill draws attention to the effect of this inequality in the observations of Mars made at Ascension in 1877. The same effect was discussed by Airy, in the *Monthly Notices*, R.A.S., Vol. xxix., p. 333, when arranging for the observation of the Transit of Venus in 1874, and he proposed the use of a prism in the eyepiece of the telescope to correct the dispersion.



We have thus in the atmospheric dispersion of light a *vera causa* which must necessarily give rise to something in the nature of a green or blue flash. The only question is whether the dispersive effect is large enough to account for the flashes as actually seen. The following considerations will help us to come to a decision on this point.

Bouguer, in 1729, was the first to notice this atmospheric dispersion. Sir William Herschel, in 1785, and Stephen Lee, in 1815, tried to measure its amount. Robinson found that the image of Vega at its lower culmination at Armagh, when its altitude would have been about  $3^\circ$ , measured  $22''$  in a vertical direction. F. Struve found a similar extension of the image of Fomalhaut at its culmination above the horizon at Dorpat, and concluded that the atmospheric dispersion of the visible spectrum is about  $\frac{1}{100}$ th of the refraction. Airy estimates it at about  $\frac{1}{60}$ th of the refraction. If we consider any two rays, R and R', and if we denote the refractive index of the air for R by  $\mu$ , and that for R' by  $\mu'$ ; then if  $\beta$  denote the coefficient of refraction for R and  $\beta'$  that for R' we have approximately

$$(\beta' - \beta) / \beta = (\mu' - \mu) / (\mu - 1).$$

The difference  $\beta' - \beta$  is the coefficient of dispersion for the two rays. Thus we see that the ratio of the dispersion to the total refraction is given by the expression  $(\mu' - \mu) / (\mu - 1)$ .

If now we take R to be the ray represented by the Fraunhofer line C in the red portion of the solar spectrum, and R' to correspond to the line F in the green-blue, we have

$$\mu = 1.00029383 \text{ and } \mu' = 1.00029685,$$

from which we find that

$$\frac{\mu' - \mu}{\mu - 1} = \frac{302}{29383} = \frac{1}{98} \text{ approximately, thus}$$

agreeing very closely with Struve's estimate. On the other hand, if we had taken the Fraunhofer lines A, in the deep red, and G, in the deep blue, we should have found  $\frac{1}{50}$  as the value of this expression. The true value is probably somewhere between these two extremes, and we cannot be far wrong if we take it to be  $\frac{1}{72}$ .

At the moment when the last red rays of the sun disappear beneath the horizon they are bent through an angle of about  $36'$  by the refraction, the exact amount depending on the condition of the air; but if we adopt the value,  $\frac{1}{72}$ , for the ratio of the dispersion to the refraction, we see that the rays at the other end of the visible spectrum are at the horizon refracted through an angle greater by  $\frac{1}{72}$ nd part than this, *i.e.*, through an angle of  $36'5$ . They will accordingly not wholly disappear until the sun has sunk to this depth beneath the horizon. The absence of the red rays will give a preponderance to the green and blue, so that we should expect a change of tint, passing through green to blue, to last while the sun was passing from a depth of  $36'$  to  $36'30''$  below the horizon. We have there-

fore to find the time occupied by the sun in passing through this angle of  $30''$ , and it is not difficult to show that this time will be shortest if the observer is situated on the equator at the time of either equinox, and will then be equal to 2 seconds. In other latitudes where the sun crosses the horizon obliquely it may last much longer, and in the neighbourhood of the Arctic Circle it is conceivable that at midsummer the sun might pass so close below the horizon at midnight that the red rays would be cut off while the green and blue remained visible, and accordingly a "green flash" be seen, for more than 12 minutes. Farther north, the duration might extend to even greater length. As seen from either pole a prolonged display might be seen about the time of the equinoxes, as the sun passes from one side of the equator to the other; but the rapid movement of the sun in declination at these dates complicates the calculation, and in view of the scarcity of observers in those parts it seems hardly worth while to go more elaborately into the question. The value of 2 seconds found for the minimum duration agrees very well with the actual facts, most observers estimating it from barely 2, to 3 or 4 seconds of time.

With regard to the very pertinent question put by Admiral McClear, in his letter which appeared in this Magazine for January, viz.: "Why should the flash be green?" I would remark that the term "green flash" is from many points of view an unsatisfactory description of the phenomenon. When best seen the colour of the remaining segment of the sun at setting turns, at the very last moment, from green to blue. Many writers have described it as a *blue* flash, not *green* (see the remarks of the late Mr. Cowper Ranyard in *Knowledge*, April, 1889, and Prof. W. H. Pickering's paper in the *Monthly Notices*, both included in the list of references on pp. 21 and 22). Many of the passengers on board the *Durham Castle* described the flash seen over Guardafui on September 27th as blue, and, as already stated, one of the observers of the rising sun, on September 29th, preferred to describe the colour of the very first ray as blue rather than green. The fact that the flash does not appear indigo or violet is accounted for partly by the relative feebleness with which these rays impress the eye compared with the yellow, green and blue rays, and partly by the selective absorption of the atmosphere which cuts down the rays of shorter wave length in a larger proportion than those that are less refrangible. The violet and indigo are thus most reduced.

Professor Michie Smith, in his letter referred to above, questions the adequacy of the refraction theory to account for all the facts. He says, "If the phenomenon were due simply to refraction it would last for only a fraction of a second and the colour would be much more blue than green," and then he calls in the aid of absorption by dust—"water dust or other"—to supplement the refraction. As an effect of this dust-absorption the sun has been seen in India and other places of a pea green colour while still many degrees above the

horizon, an effect which was particularly striking shortly after the great eruption of Krakatoa in 1883, when the Earth's atmosphere was charged with immense masses of finely divided volcanic dust. But, although the effect of dust may perhaps sometimes intensify the blueness, it is, as I have already shown, not necessary to have recourse to this, the atmospheric dispersion alone being sufficient to account for the duration of the flash. The phenomenon is most frequently seen over a sea horizon, while a steady atmosphere and a calm sea appear to be usually associated with its appearance, a state of affairs in which the amount of fine spray—or, to use Prof. Michie Smith's expressive phrase, "water dust," in suspension close to the surface of the sea is a minimum. In this connection the observations described by Mr. Whitmell in the *Journal* of the B.A.A., xii. 289, are to my mind conclusive. He writes, "In the belfry of the Wesleyan Chapel, on the west side of Woodhouse Moor, there are narrow horizontal openings, through which, at certain times, the setting sun can send his rays to an observer at the large band-stand, about 300 yards away. On Saturday, 26th April, between 7 $\frac{1}{4}$  and 7 $\frac{1}{2}$  p.m., I was so exceptionally fortunate as to observe through the openings no fewer than three green and three red flashes. The red ones were seen just as the base of the sun successively revealed itself below each of the upper edges of three of the openings. The green ones were seen just as the top of the sun disappeared behind each of the lower edges of the openings." This is exactly what we should expect to see as the effect of the atmospheric dispersion of the light, but I find it impossible to conceive how *both* green and red flashes could be brought about by the absorption of dust.

These observations of Mr. Whitmell's suggested to me a method of seeing the green and red flashes any morning or evening when the sun is shining in a clear sky. For this purpose it is only necessary to place an opaque diaphragm in the focal plane of the objective of a telescope, so as to screen off one half of the field of view. The edge of the diaphragm should be very sharp and burnished, and should coincide with the diameter of the field. If the diaphragm is placed with its edge horizontal so as to obscure the lower half of the field of view, as projected on a white screen placed behind the eyepiece, then, as the sun sinks behind this artificial horizon line, the last narrow segment, corresponding to the highest point of the sun's limb, will become a vivid blue before disappearance. On the other hand, by rotating the diaphragm through 180° in its own plane so as to obscure the upper half of the field, and allowing the sun's image to emerge from behind it, the first segment, corresponding to the lowest point of the limb, will appear brilliantly red.

On the first occasion on which I had an opportunity of trying the experiment I did so, and though there was a thick haze near the horizon as the sun went down, I was able to exhibit these green and red flashes as often as I pleased. The observations were made

between 5 p.m. and 5.15 p.m., while the sun was sinking from an altitude of  $5^{\circ} 25'$  to one of  $3^{\circ} 12'$  above the horizon.

More recently I have had a diaphragm with a narrow diametral slit, about  $\frac{1}{40}$  of an inch wide, inserted in the focal plane of a small telescope of  $3\frac{1}{4}$  inches aperture. This slit takes the place of the openings in Mr. Whitmell's belfry, and the necessity for rotating the eyepiece is avoided. With this apparatus I have frequently shown the blue and red fringes at the top and bottom of the sun's disk. Unless the air is very unsteady the red fringe at the bottom is always conspicuous when the sun is low, but a haze near the horizon reduces the intensity of the blue-green fringe at the top. This will account for the fact that the "flash" is not more frequently seen in these latitudes. When the sky is free from haze the blue-green fringe is as striking as the red.

This is an observation by which any possessor of a telescope can easily satisfy himself that the flashes are due to atmospheric dispersion of light, and is at least less expensive than building a Wesleyan Chapel with horizontal openings in the belfry.

#### SCOTTISH METEOROLOGICAL SOCIETY.

A MEETING of the Society was held at 5, St. Andrew Square, Edinburgh, on March 12th, at 2.30 p.m., the Hon. Lord McLaren, President of the Society, in the chair.

The report from the Council was adopted, sympathetic reference being made to the faithful services of the late Miss Jessie Hill Buchan.

Dr. J. Halm contributed a paper under the title "The Influence of Atmospheric Temperature Conditions on Astronomical Observations." Experiments by the late Professor Langley had shown that, contrary to the conventional opinion, the definition of telescopic images was much clearer when the air in the neighbourhood of the instrument was agitated than when it was in a state of tranquillity. It was impossible to experiment with the general mass of the atmosphere, but we could note the differences in clearness of definition corresponding to various weather conditions. The blurring of the images was due, of course, to the passage of the light rays through atmospheric layers having different indices of refraction. Thus on theoretical grounds we should expect astronomical seeing to be best when the air was violently stirred by strong convection currents, for it was then that the state of adiabatic equilibrium was most nearly approached in which any given mass of ascending air assumed the exact temperature and density of the masses it successively displaced. On the other hand, seeing should be worst on clear winter nights when terrestrial radiation was most active and a slow sinking movement of the atmosphere disturbed the refrangibility of the successive layers. Experience agreed with theory. Thus Dr. Halm had found during his work in the conti-

mental climate of Strasburg, where the diurnal temperature range was large, that the images were clearest towards sunset on early summer evenings. Gradually as nocturnal radiation became more and more active, the images became blurred. Definition was quite unsatisfactory by two o'clock in the morning and worst about sunrise.

The suggestion was made that climatic and topographic conditions should be taken into account in selecting sites for new astronomical observatories. The slopes or neighbourhood of mountains should afford favourable positions, since there horizontal air currents were deflected upwards, so that the surrounding atmosphere was more or less disturbed and the desirable state of indifferent equilibrium more frequently and readily attained.

Professor Knott made the interesting observation that Sir Isaac Newton in his "Optics" had suggested that mountain summits should be favourable positions for astronomical work on account of the stillness of the atmosphere there! Newton had never dreamt that good definition depended on the commotion of the atmosphere rather than on its tranquillity.

In a paper "On Large Differences of Temperature between Ben Nevis and Fort William," by Mr R. T. Omond, it was pointed out that the average difference of temperature between the two observatories was  $15^{\circ}5$  F. By far the greater number of the hourly differences were somewhere near this value, but there were a few extreme cases ranging from a maximum difference of  $28^{\circ}8$  at 2 a.m. on 19th December, 1890, to a minimum at 9 a.m. on February 19th, 1895, when the summit of the mountain was no less than  $17^{\circ}6$  warmer than the base (Ben Nevis,  $33^{\circ}6$ ; Fort William,  $16^{\circ}0$ ). During a period of thirteen and a-half years there had been only 205 hours at which there was a difference of at least  $25^{\circ}$ . Though the extreme case had occurred on a winter's night, almost all the cases of large differences had been on summer afternoons, invariably with dry air at Fort William and nearly always with strong winds. There had been only three occasions on which a temperature difference of  $25^{\circ}$  or over had continued for more than four consecutive hours. On the other hand, actual inversions of temperature might persist continuously for many hours, or even for two or three days, in succession. The adiabatic rate of change of temperature in the case of dry air corresponded to a temperature difference of about  $24^{\circ}$  in an air column 4,400 feet in height, and the rarity of differences larger than this appeared to indicate that the adiabatic limit was a definite controlling factor in fixing approximately an upper limit to the variations of the difference of temperature between the summit and base of the mountain. That when the adiabatic difference was exceeded the air column was in a state of instability was shown by the fact, already indicated, that the occurrence of very large differences had never been long continued.

Mr. Omond's paper was followed by an interesting discussion, in which Professor Knott, Dr. Halm, Dr. Buchan and Lord McLaren took part.

## METEOROLOGICAL OBSERVATIONS TAKEN DURING 1905 AT BANANI, PEMBA, NEAR ZANZIBAR.

WE are again indebted to Mr. T. P. Newman for particulars of the meteorological observations taken by Mr. Theodore Burt, of the Friends' Industrial Mission at Pemba.

1905.	Mean Max.	Mean Min.	Absolute Max.	Absolute Min.	Rainfall.	Rain Days
					in.	
January .....	83·8	73·7	87·0	72·0	·63	5
February .....	83·8	73·5	87·0	72·0	·23	2
March .....	82·8	73·3	90·0	70·0	12·52	15
April .....	80·0	71·7	88·0	68·5	39·01	25
May .....	79·8	70·6	83·0	69·0	14·44	21
June .....	80·0	69·4	83·0	66·0	6·19	14
July .....	78·2	68·5	81·0	65·0	3·58	15
August .....	78·5	68·2	79·0	66·0	2·35	16
September .....	79·9	69·1	84·0	64·0	3·54	7
October .....	83·5	70·6	87·0	68·0	2·92	8
November .....	84·4	73·3	90·0	71·0	4·98	11
December .....	84·1	73·9	90·5	70·0	10·89	14
Year .....	81·6	71·3	90·5	64·0	101·28	153

Extreme Range of Temperature..... 26·5

Mr. Burt appends to his report the following remarks on the year :—

As will be seen by comparison with the observations recorded in *Symons's Meteorological Magazine* for March, 1905, the past year shows a slight fall in temperature ; this is, no doubt, owing to the unusual amount of cloud which we had. It is interesting to notice the considerable increase in the rainfall—the largest since 1899. I am still of opinion that the light rainfall which we have experienced during the past few years has been abnormal. The autumn (?) rains which usually fall in November were late this year, scarcely getting over before the year closed.

### ROYAL METEOROLOGICAL SOCIETY.

THE monthly meeting of this Society was held on Wednesday evening, March 21st, at the Institution of Civil Engineers, Great George Street, Westminster, Mr. Richard Bentley, President, in the chair.

The following were elected Fellows:—Mr. C. Anthony, junr., M.Inst.C.E., Mr. L. C. W. Bonacina, Miss E. H. Cordner, Capt. R. H. Douglas, Raja Kushal Pal Singh, M.A., Mr. R. H. Rhind, Prof. A. Schuster, F.R.S., Mr. M. Sutton and Mr. W. J. Ware.

This being the "popular" meeting of the session, Dr. H. R. Mill, at the request of the Council, gave a lantern lecture on "South Africa as seen by a Meteorologist." The lecture was illustrated by more than sixty lantern slides from photographs taken by the lecturer during the African wanderings of the British Association in 1905, and bearing some relation to the climate of the countries passed through. While no attempt was made to give an account of the climate of South Africa or a detailed description of the observing stations maintained in the various colonies, a general idea was conveyed, as much in pictures as by words, of the actual condition of things. Travelling in the dry season, the lecturer was naturally impressed with the drought and dust, and had much to say on the importance of systematic irrigation if the natural resources of the country are to be developed to the full. A detailed report here is unnecessary, as a description of the British Association trip has already appeared in this Magazine.

On the motion of the President, seconded by Mr. F. Campbell Bayard, a hearty vote of thanks was accorded to the lecturer.

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## Correspondence.

*To the Editor of Symons's Meteorological Magazine.*

### SNOW ON THE SURREY HILLS.

THE remarkable phenomenon noted by Mr. B. (p. 29) came under my own observation so recently as March 14th, at 1.55 p.m. By that hour the snow fallen in the night *had actually disappeared* from the southern slopes of the North Downs (N.W. of Dorking)—chalk, with patches of tertiary sands on top in parts—but *was still lying* on the northern slopes of Leith Hill, S.W. of the town, which are lower greensand. Another remarkable and most unusual fact is that the sun had been shining for some hours. The northern slopes of the North Downs and southern slopes of Leith Hill were beyond Mr. B.'s vision and mine; but it is safe to say that the answer to the first part of the editorial question is NO.

LOCAL WISEACRE.

*Dorking, March 18th, 1906.*

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IN reply to the question raised by you in your editorial note to my letter in the March number on the localization of snow on the Surrey Hills, on the 24th of February, I have to say that I noticed that



snow was entirely absent from the northern slopes of the portion of the North Downs in question, and that it was present on all sides of the Leith Hill ridge except the western, which I did not see, though at midday the snow had commenced to melt rapidly under the combined influence of warm sunshine and the setting in of a moist south-westerly air current. I have to note, however, that on the morning of the 24th of March I met with an instance of a thaw progressing very slowly on the chalk of the North Downs near Oxted, but very rapidly on the green-sand of the Ide Hill range running parallel to the North Downs between Oxted and Sevenoaks. On the morning of that date the sky was entirely overcast, and the temperature of the air about 36° F.

Though these observations made during February and March on the distribution of snow-covered ground in a few localities in Surrey and Kent have been through force of circumstances fragmentary, they would seem to indicate appreciable differences in the condition of the surface rocks with respect to temperature and humidity.

Two parallel ranges of hills like those in question—the one composed of chalk and covered with thin turf, the other composed of sandstone, with a surface consisting largely of barren heath-land—are obviously far more likely, owing to the different physical constants of chalk and sandstone, to vary in surface temperature at any particular time than two parallel ranges of hills composed of the same kind of rock and productive of the same kind of vegetation. I would strongly urge that some attention be paid to the subject of the permanence of layers of snow over different geological formations by observers in this country while making notes upon future falls of snow, as in this way it may be possible to ascertain definite relationships amid seemingly disconnected phenomena. I find that the subject of soil temperature in connection with snow-covering has been studied in Germany. (*Deutsches Meteorologisches Jahrbuch für 1901*).

The character of the snow-clouds, with respect to crystalline texture, boldness of form, and sharpness of outline, has this month been very beautiful and typical of the early spring. Late in the afternoon of the 24th instant, as I was watching from the summit of Ide Hill the dark rugged masses of cumulo-form clouds delicately underlined with silver or tinged with pink, and the squalls of snow amid ever-varying effects of light and shadow, drift slowly across the richly-wooded weald of Kent, I could not but feel that it is in harsh seasons like the present, when the returning sun must make a fierce struggle with the forces tending to protract the cold, that the spirit of the early spring in the open country in these higher latitudes is most magnificently expressed.

L. C. W. BONACINA.

March 27th, 1906.

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## COLD IN FEBRUARY AND MARCH.

It is a curious fact (perhaps nothing more) that in each case of the last five sunspot maxima, the year following has had both February and March warm. Assuming last year (1905) to be a maximum year, it seemed not unlikely that the two months this year would "follow suit." They have not done so, being both cold. There seems to be good evidence of a general tendency to earlier springs (in our London region, at least) about the time of sunspot maxima. Individual years are of no great account, I take it, in these inquiries. It will be of more interest to see whether groups of (say) five years about and after the present maximum, present an average February-March temperature conforming to past experience.

Another view may be taken. With two big spots on the sun at present (4th April), it may perhaps be doubted whether we have passed the maximum yet.

In a recent letter I referred to the idea of our air temperature going down in consequence of a large quantity of ice melting in the Gulf Stream, and the cooled water reaching our shores after a considerable interval. I would here pursue this idea a little further.

Dr. Meinardus recently gave a table in which the character of each season at Newfoundland (from 1860 to 1902), as regards ice, was expressed numerically according to the scale,  $-2$ ,  $-1$ ,  $0$ ,  $+1$ ,  $+2$ , where  $-2$  indicated *little* ice, and  $+2$  *much* ice.\* I have compared each of these annual numbers (*a*) with the cold at Greenwich in the latter part of the *same* year, and (*b*) with that in the earlier part of the *following* year.

The inquiry into (*a*)—comparison being made in the number of frost days in the later half of the same year—revealed nothing very definite; no special tendency. But in the case of (*b*) there is, I think, something of that nature.

Thus, there were 10 years at Newfoundland with values  $+2$  or  $+1.5$  (much ice), and 8 of these were followed by an *excess* of frost days in the earlier half of the next year at Greenwich, 2 by a deficiency. On the other hand, out of 9 years with values  $-2$  or  $-1.5$ , 7 were followed by *little* frost at Greenwich in the earlier half of the next year, while in 2 there was (slight) excess.

The mean temperature of each of the first three months appears to be marked by this tendency, which is most pronounced in March. Thus, there were in all 19 seasons at Newfoundland with ice in excess of the average, and of these 14 were followed in Greenwich by cold Marches. Similarly of 19 seasons with ice under average, 14 were followed by warm Marches.

Last year (1905) there was much ice in the Newfoundland region, but I am unable to say how precisely it would be characterised in the above scale. Are we to suppose, in view of the figures just given,

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\* A translation of Dr. Meinardus's important paper will be found in the *Quarterly Journal* of the Royal Meteorological Society for January last.

that our recent cold in those two months has been due to an ice-cooled Gulf Stream? The facts seem, at least, to suggest the desirability of further observation of those relations. A timely warning of excessive cold in the early part of the year might possibly be found in the reports of the Newfoundland ice in the previous spring and summer.

ALEX. B. MACDOWALL.

*Southgate, Buxton, 4th April, 1906.*

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### UNUSUAL SKY COLOURS.

YESTERDAY at 7 p.m. the entire canopy of the heavens in Torquay was diffused with a brilliant light green, having slight traces of yellow, N.N.W. on the immediate horizon. This was succeeded by a brilliant ultramarine blue, radiating also from the N.N.W. The entire day and Monday were remarkably bright and clear.

HENRY BEDFORD.

*St. Michael's View, Crown Hill, Torquay, April 4th, 1906.*

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### REVIEWS.

*Cloud Studies.* By ARTHUR W. CLAYDEN, M.A., *Principal of the Royal Albert Memorial College, Exeter.* London: John Murray. 1905. Size 8 x 6. Pp. xiv. + 184; 61 Plates. Price 12s. net.

ONE of the books which is not only worth reading, but worth buying. Mr. Clayden writes shortly, but all he says is fresh, solid and interesting, while the beautifully reproduced photographs of clouds are the finest we have seen. The difficulty of obtaining a clear photograph of a faint white cloud on a deep blue sky is pretty familiar to all who have handled a camera; but the methods of overcoming the difficulty here expounded will be new to most amateurs. Some of Mr. Clayden's finest results, showing the exquisitely minute structure of the faintest and loftiest clouds, were obtained by directing the camera, not towards the cloud itself, but towards the reflection in a mirror of black glass, set at an angle which reduces the intensity of the polarized light of the blue sky while giving full effect to the unpolarized light reflected by the white cloud.

Mr. Clayden executed a series of important cloud measurements for altitude at Exeter by the device of having two cameras at the end of a measured base of 200 yards, each pointed so as to include in the same picture the cloud under observation and the sun. Knowing the date and hour, nothing further is required in order to obtain the height of any part of the cloud above the surface by simple measurement on the plate. The greater part of the book, however, is devoted to a discussion of the minor differences in the

recognized cloud forms, and although at first sight the number of sub-forms strikes one as alarmingly large, the illustrations seem to justify them.

The basis of the classification is that formally adopted by the International Meteorological Committee and embodied in the well-known International Cloud Atlas. Mr. Clayden does not look on this classification with unmixed approval, but with a caution and consideration which cannot be too much praised he refrains from putting forward a new system, trusting that in time the classification will be overhauled by the authoritative body which introduced it. He adds to the classification, however, by suggesting a large number of specific forms of the accepted cloud genera, and he proposes names for these, some of them adopted from Clement Ley, many of which will probably pass into use. He gives, for instance, nine distinct forms of Cirrus, viz., *Cirro-nebula*, *Cirro-filum*, *Cirrus excelsus*, *Cirrus ventosus*, *Cirrus nebulosus*, *Cirrus caudatus*, *Cirrus vittatus*, *Cirrus inconstans*, and finally *Cirrus communis*. The other cloud forms are similarly dealt with.

A very interesting part of the book is the attempt to associate the particular forms of the clouds, and the changes which these forms undergo, with the physical conditions giving rise to them. In this connection the study of the cumulo-nimbus, or thunder cloud, strikes us as particularly happy, while there is a great deal of acute observation and careful reasoning in the short chapter devoted to wave-forms in clouds. The work of Mr. Clayden is a solid contribution to what may be called the vertical exploration of the atmosphere, a direction in which the early years of the twentieth century have already witnessed great progress. Apart from its scientific value, the book will appeal to many who are mere Gallios in meteorology on account of the exquisite beauty of the illustrations.

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*An Introduction to Practical Geography.* By A. T. SIMMONS, B.Sc., and HUGH RICHARDSON, M.A. London: Macmillan & Co. 1905. Size 7 x 4½. Pp. xii. + 380.

A BOOK of admirable intentions very well carried out. It consists largely of a series of exercises in geometrical drawing and calculation adapted to the construction, interpretation and use of maps illustrating all sorts of distributions; but it also contains excellent practice in out-of-door work invaluable to a student of geography. Our readers will probably find the chief interest and utility of the book in its treatment of the diagrammatic representation of variable quantities. More than 100 pages are devoted to Climate, and although this section is well and conscientiously done, a few points present themselves for comment from the point of view of a meteorologist. For instance, on p. 215, the ordinary hours for reading meteorological instruments in this country (9 a.m. and 9 p.m.) are not mentioned, though several quite unusual hours are quoted. We

note with surprise, on p. 225, the use of the extremely objectionable expression, "above or below the equator," when "north or south of the equator" is meant. On p. 232, "Tropical" is inadvertently used in the second table for places all of which lie outside the tropics. On p. 235, the latitude of Ben Nevis as given would sink that mountain and the remains of its observatory in the deep sea. The rain gauge figured on p. 278 is a pattern which should be avoided as it combines the worst defects of two practically obsolete types, while the measuring glass shown beside it can measure only .45 in. These defects are serious in a book for the use of children at school, but after all this is not a heavy list of matters needing amendment in over 100 pages written by authors who are not specialists, and we have pleasure in welcoming and commending the little book.

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*Ueber die räumliche und zeitliche Verteilung des Wärmehalts der unteren Luftschicht*, [On the distribution in space and time of Heat in the lower stratum of the atmosphere.] Von WALTER KNOCHE. *Aus dem Archiv der Deutschen Seewarte xxviii. Jahrgang.* Hamburg: 1905. Size  $11\frac{1}{2} \times 9\frac{1}{2}$ . Pp. 46. Plates.

THE author deals with the distribution of heat, not of temperature, and following von Bezold he uses as an index of the heat in the atmosphere the "equivalent temperature," that is the temperature of the air increased by an amount equivalent to the latent heat present. This thermodynamic treatment throws light on some of the apparent anomalies of the distribution of climate when the actual temperature alone is considered, and the author permits himself to hope that further studies in this direction may yield results of practical value in improved weather forecasts.

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*The Hygiene of the Zones.* By ROBERT DE C. WARD. Reprinted from the Bulletin of the Geographical Society of Philadelphia. Vol. 4. No. 2. January, 1906. Size  $9 \times 6$ . Pp. 28.

AN attempt to give a brief survey of some of the relations between weather and climate and a few of the more important diseases. The author shows by many instances that the influence of climate in the production of disease is by no means so great as was formerly supposed, yet that it acts in many ways, direct and indirect. Hygiene is more than climate, yet climate has to be considered, because it affects our bodily comfort, may depress or exhilarate, may induce to remain indoors inactive or tempt to exercise in the open air. In connection with this paper we are reminded of the Committee of the British Association which is now at work, under the presidency of Sir Lauder Brunton, investigating the relation between climate and disease. Anyone able to afford information on the subject should apply to the Secretary of the Committee, Mr. J. Barcroft, King's College, Cambridge.

*Some Aspects of Meteorology.* By HENRY MELLISH. (*Reprinted from the 53rd Report and Transactions of the Nottingham Naturalists' Society for 1904-05.*) Size  $9 \times 5\frac{1}{2}$ . Pp. 8. Plates.

IN this interesting little paper Mr. Mellish gives a rainfall map of Nottinghamshire based on 30 years' averages, and refers in some detail to several aspects of the problem of the distribution and the destination of rainfall.

## METEOROLOGICAL NEWS AND NOTES.

A COURSE OF FOUR LECTURES ON METEOROLOGY, at the University of London, South Kensington, is announced. The subject is "The Atmospheric Circulation and its relation to Weather," and the lectures will be given at 5 p.m., on May 1st, 8th, 15th, and 24th, 1906, by Dr. W. N. Shaw, Director of the Meteorological Office. The following is a syllabus of the lectures:—

I. Atmospheric currents and the distribution of pressure over the globe. Buys Ballot's law and its dynamical significance. Forces which guide the motion of air. Currents in the upper air as determined by observations of cloud and by calculation of the distribution of pressure.

II. Persistent and periodical winds, tropical revolving storms, cyclonic depressions of middle latitudes and the weather associated with them.

III. The normal general circulation at the surface and in the upper air. Relation of temperature and rainfall to the general circulation and local disturbances.

IV. Variations in the several elements of the circulation from year to year. The relation of wheat crop to rainfall and its meteorological significance. Sequences in seasonal variations, with illustrations from the Meteorology of Indian Ocean and of the Atlantic Ocean. Attempts to identify the law of sequence of meteorological changes.

There is no fee for the lectures, and cards of admission may be obtained on application to the Academic Registrar, Mr. P. J. Hartog, The University of London, South Kensington, S.W.

THE METEOROLOGICAL OFFICE has appointed as Superintendent of the Statistical Branch, Mr. R. G. K. Lempfert, whose duties, we understand, will include the preparation of the Weekly Weather Report, and the Reports for the Registrars General of England and Ireland, which are prepared by the Meteorological Office, as well as the supervision of the Library. As Superintendent of the Instruments Branch Mr. Ernest Gold, a distinguished graduate of the University of Cambridge, has been appointed. Mr. J. A. Curtis succeeds Mr. J. S. Harding as Cashier and Chief Clerk of the Office.

MR. H. E. WOOD, formerly demonstrator in the Physical Laboratory in the University of Manchester, has been appointed Assistant Meteorologist in the Johannesburg Observatory of the Transvaal Government.

THE CAMBRIDGE AND HUNTINGDONSHIRE RAINFALL TABLE has been published monthly for circulation amongst the rainfall observers in those counties for twenty years. Conducted at first by Mr. H. G. Fordham and latterly by Mr. Harold Warren, C.E., it was in danger of lapsing when the last-named gentleman left Cambridge early in the present year. The Editor of "British Rainfall," being unwilling to see any well designed plan for promoting interest in so important a matter as the rainfall of two prominent agricultural counties fall to the ground, offered to continue the Table as part of the work of the British Rainfall Organization, if no volunteer were forthcoming to carry it on. He has been held to his word; and readers of this Magazine in the counties mentioned who would care to have the Table and do not already receive it are invited to communicate with the Editor.

TELEGRAPHIC DELAYS owing to the destruction of posts and wires during gales and snowstorms have frequently been commented on in our winter numbers, and it is a pleasure to be able now to record the completion of an underground telegraph cable for the 400 miles from London to Glasgow which may be depended upon to prevent an absolute suspension of communication from south to north in bad weather. The work, which has been carried out by the Post Office, was costly—the sum of £2,000,000 has been mentioned in the newspapers—but the practicability of long underground cables has been proved, and this is another step towards the emancipation of humanity from the adverse powers of the air.

LONG PERIOD WEATHER FORECASTS have always been viewed by meteorologists in an atmosphere of doubt mingled with hope, and confirmation of the following cutting from one of the many newspapers of March 29th which published it will be awaited with interest:—

NEW YORK, March 28.—At a banquet which was given here yesterday evening by the Maritime Association, Mr. Moore, chief of the Weather Bureau, announced that the Bureau believed it had a basis for forecasting the general character of the weather a month in advance, and that it expected to inaugurate a service of this character within a year.—*Reuter*.

EASTER WEEK frequently presents to the Editor of a monthly publication the alternative of going to press too early, and thereby leaving undone some of his best intentions, or of going to press too late, and losing such character for promptitude as he may possess. We have chosen the former alternative, hence there is no article on the rainfall of the winter six months of 1905-06.

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## TEMPERATURE FOR MARCH, 1906.

STATION.	COUNTY.	Lat. N.	Long. W. [°E.]	Height above Sea. ft.	TEMPERATURE.				No. of Nights at or below 32°	
					Max.		Min.		Shade.	Grass.
					°	Date.	°	Date.		
Camden Square.....	London.....	51 32	0 8	111	65·1	7	27·3	23	9	20
Tenterden.....	Kent.....	51 4	*0 41	190	62·0	7	27·5	24	9	20
Hartley Wintney.....	Hampshire.....	51 18	0 53	222	60·0	7, 18	24·0	23	10	17
Hitchin.....	Hertfordshire.....	51 57	0 17	238	65·0	7	24·0	22	15	...
Winslow (Addington).....	Buckinghamshir.....	51 58	0 53	309	67·0	7	23·0	30	15	20
Bury St. Edmunds (Westley).....	Suffolk.....	52 15	*0 40	226	67·0	7	25·0	13	...	...
Brundall.....	Norfolk.....	52 37	*1 26	66	...	...	...	...	...	...
Alderbury.....	Wiltshire.....	51 2	1 44	263	63·0	7	22·0	22	14	...
Winterbourne Steepleton.....	Dorset.....	50 42	2 31	316	56·2	6	22·7	30	11	15
Torquay (Cary Green).....	Devon.....	50 28	3 32	12	58·5	6	31·6	23	1	21
Polapit Tamar [Launceston].....	„.....	50 40	4 22	315	61·0	17	24·0	29	10	13
Bath.....	Somerset.....	51 23	2 21	67	65·0	17	24·5	30	13	...
Stroud (Upfield).....	Gloucestershire.....	51 44	2 13	226	60·0	6, 7	28·0	25	10	...
Church Stretton (Wooltaston).....	Shropshire.....	52 35	2 48	800	58·0	17	20·0	26	23	...
Bromsgrove (Stoke Reformatory).....	Worcestershire.....	52 19	2 4	225	60·0	8, 17	21·0	29	16	...
Boston.....	Lincolnshire.....	52 58	0 1	25	60·0	6	26·0	14	13	...
Worksop (Hodsock Priory).....	Nottinghamshire.....	53 22	1 5	56	62·9	7	23·7	14	12	19
Derby (Midland Railway).....	Derbyshire.....	52 55	1 28	156	63·0	8	26·0	12	13	...
Bolton (Queen's Park).....	Lancashire.....	53 35	2 28	390	54·5	17	23·8	13	11	19
Wetherby (Ribston Hall).....	Yorkshire, W.R.....	53 59	1 24	130	...	...	...	...	...	...
Arnccliffe Vicarage.....	„.....	54 8	2 6	732	...	...	...	...	...	...
Hull (Pearson Park).....	„ E.R.....	53 45	0 20	6	61·0	6, 7, 17	19·0	14	11	23
Newcastle (Town Moor).....	Northumberland.....	54 59	1 38	201	...	...	...	...	...	...
Borrowdale (Seathwaite).....	Cumberland.....	54 30	3 10	423	50·5	20	17·3	14	10	...
Cardiff (Ely).....	Glamorgan.....	51 29	3 13	53	...	...	...	...	...	...
Haverfordwest (High Street).....	Pembroke.....	51 48	4 58	95	56·2	17	28·3	30	5	19
Aberystwyth (Gogerddan).....	Cardigan.....	52 26	4 1	83	...	...	...	...	...	...
Llandudno.....	Carnarvon.....	53 20	3 50	72	54·0	17	27·0	13	4	...
Cargen [Dumfries].....	Kirkcudbright.....	55 2	3 37	80	54·0	16	17·0	14	9	...
Lilliesleaf (Riddell House).....	Roxburgh.....	55 31	2 46	550	50·0	6 †	10·0	13	14	25
Edinburgh (Royal Observatory).....	Midlothian.....	55 55	3 11	442	54·1	16	19·4	13	10	19
Colmonell (Clachanton).....	Ayr.....	55 8	4 54	140	53·0	6	12·0	13	11	...
Glasgow (Queen's Park).....	Renfrew.....	55 53	4 18	144	55·0	30	14·0	13	13	26
Tighnabruaich.....	Argyll.....	55 55	5 14	50	48·0	20 ‡	20·0	13	18	20
Mull (Quinish).....	„.....	56 36	6 13	35	49·0	31	...	...	...	...
Dundee (Eastern Necropolis).....	Forfar.....	56 28	2 57	199	54·6	30, 31	18·6	14	16	...
Braemar.....	Aberdeen.....	57 0	3 24	1114	...	...	...	...	...	...
Aberdeen (Cranford).....	„.....	57 8	2 7	120	51·0	30, 31	14·0	13	16	...
Cawdor (Budgate).....	Nairn.....	57 31	3 57	250	...	...	...	...	...	...
Invergarry.....	E. Inverness.....	57 4	4 47	130?	...	...	...	...	...	...
Loch Torridon (Bendamph).....	W. Ross.....	57 32	5 32	20	...	...	...	...	...	...
Dunrobin Castle.....	Sutherland.....	57 59	3 56	14	53·0	17	19·5	13	15	...
Castletown.....	Caithness.....	58 35	3 23	100	53·0	16 §	25·0	13	8	18
Killarney (District Asylum).....	Kerry.....	52 4	9 31	178	59·0	17	28·0	26	...	...
Waterford (Brook Lodge).....	Waterford.....	52 15	7 7	104	56·0	15	29·0	3	3	...
Broadford (Hurdlestown).....	Clare.....	52 48	8 38	167	53·0	31	28·0	25	8	...
Carlow (Browne's Hill).....	Carlow.....	52 50	6 53	291	...	...	...	...	...	...
Dublin (Fitz William Square).....	Dublin.....	53 21	6 14	54	59·9	16	31·9	3	3	12
Ballinasloe.....	Galway.....	53 20	8 15	160	60·5	6	22·0	28	14	...
Clifden (Kylmore House).....	„.....	53 32	9 52	105	...	...	...	...	...	...
Crossmolina (Enniscoe).....	Mayo.....	54 4	9 18	74	...	...	...	...	...	...
Seaford.....	Down.....	54 19	5 50	180	55·0	6	20·0	12	8	12
Londonderry (Creggan Res.).....	Londonderry.....	54 59	7 19	320	...	...	...	...	...	...
Omagh (Edenfel).....	Tyrone.....	54 36	7 18	280	54·0	16	20·0	12	8	17



## RAINFALL FOR MARCH, 1906.

RAINFALL OF MONTH.							RAINFALL FROM JAN. 1.				Mean Annual 1870-1899.	STATION.
r. 99.	1906.	Diff. from Av.	% of Av.	Max. in 24 hours.		No. of Days	Aver. 1870-99.	1906.	Diff. from Aver.	% of Av.		
	in.	in.		in.	Date.		in.	in.	in.		in.	
2	1.08	— .54	67	.32	10	17	5.13	6.99	+1.86	136	25.16	Camden Square
9	1.77	— .12	94	.37	10	19	6.10	7.63	+1.53	125	28.36	Tenterden
7	1.50	— .27	85	.29	10	19	6.22	7.79	+1.57	125	27.10	Hartley Wintney
3	1.83	+ .30	120	.29	25	16	4.88	7.00	+2.12	143	24.66	Hitchin
2	1.54	— .08	95	.34	10	19	5.40	7.06	+1.66	131	26.75	Addington
4	2.12	+ .48	129	.26	1	20	4.89	8.15	+3.26	167	25.39	Westley
5	2.16	+ .51	131	.35	24	21	4.81	8.68	+3.87	181	25.40	Brundall
8	.63	— 1.15	35	.14	13	14	6.66	9.06	+2.40	136	29.17	Alderbury
1	1.51	— .90	63	.40	13	11	9.42	14.60	+5.18	155	39.00	Winterbourne Stpltn
5	1.00	— 1.45	41	.27	13	11	8.51	11.02	+2.51	129	35.00	Torquay
1	2.02	— .39	84	.58	1	16	9.12	14.82	+5.70	163	38.85	Polapit Tamar
4	1.69	— .25	87	.45	10	16	6.58	8.04	+1.46	122	30.75	Bath
6	1.53	— .33	82	.40	10	17	6.45	8.05	+1.60	125	29.85	Stroud
1	1.40	— .61	70	.26	7	17	7.09	8.21	+1.12	116	33.04	Woolstaston
6	.82	— .54	60	.23	10	11	4.90	5.87	+ .97	120	24.50	Bromsgrove
6	1.76	+ .40	129	.30	23	18	4.50	6.66	+2.16	148	23.30	Boston
5	1.28	— .27	83	.24	1	16	4.87	6.15	+1.28	126	24.70	Hodsock Priory
9	1.51	+ .02	101	.32	1	17	5.10	7.36	+2.26	144	26.18	Derby
8	3.35	+ .47	116	.78	7	17	8.93	14.34	+5.41	161	42.43	Bolton
5	1.53	— .32	83	.37	24	16	5.37	7.53	+2.16	140	26.96	Ribston Hall
3	6.37	+1.34	127	1.55	7	23	16.10	22.02	+5.92	137	60.96	Arncliffe Vic.
9	1.65	— .14	92	.21	18	17	5.45	5.86	+ .41	108	27.02	Hull
0	1.24	— .86	59	.22	10	15	5.64	4.71	— .93	84	27.99	Newcastle
1	9.38	— 1.13	89	1.56	15	17	36.86	38.65	+1.79	105	132.68	Seathwaite
9	3.12	+ .33	112	1.07	10	15	9.77	14.81	+5.04	152	42.81	Cardiff
3	2.97	— .06	98	1.12	10	16	11.86	14.37	+2.51	121	47.88	Haverfordwest
3	3.81	+ .88	130	1.17	10	15	9.83	15.20	+5.37	155	45.41	Gogerddan
7	3.15	+1.18	160	.88	7	15	6.51	9.97	+3.46	153	30.98	Llandudno
1	2.49	— .52	83	.52	10	12	11.17	9.86	— 1.31	88	43.43	Cargen
0	1.60	— .80	67	.38	11	15	7.41	6.02	— 1.39	81	33.04	Riddell House
	1.97	...	...	.57	11	14	...	6.09	...	...	...	Edinburgh
8	2.62	— .56	82	.58	14	13	11.37	10.35	— 1.02	91	44.85	Colmonell
3	3.53	+1.20	152	1.10	14	9	8.11	11.14	+3.03	137	35.80	Glasgow
6	5.35	+ .99	123	1.59	16	14	14.79	18.74	+3.95	127	57.90	Tighnabruaich
3	2.68	— 1.55	63	.76	16	19	14.58	14.14	— .44	97	57.53	Quinish
12	1.05	— .87	55	.25	11	12	6.12	3.80	— 2.32	62	28.95	Dundee
2	2.96	+ .54	122	...	...	...	8.03	9.46	+1.43	118	36.07	Braemar
3	2.20	— .23	91	.45	11	20	7.18	6.29	— .89	88	33.01	Aberdeen
6	2.92	+ .76	135	.53	16	19	6.16	7.86	+1.70	128	29.37	Cawdor
3	3.30	— 1.53	68	.95	16	6	16.35	18.25	+1.90	112	56.00	Invergarry
8	8.52	+2.14	134	1.75	6	29	21.90	29.72	+7.82	136	86.50	Bendamph
7	2.41	— .06	98	.54	14	12	7.48	11.09	+3.61	148	31.60	Dunrobin Castle
	2.31	...	...	.37	8	26	...	11.55	...	...	...	Castletown
3	2.52	— 1.51	63	.66	11	17	16.04	13.52	— 2.52	84	58.11	Killarney
5	1.81	— .74	71	.45	10	14	9.91	10.36	+ .45	104	39.30	Waterford
7	2.26	+ .09	104	.38	10	15	7.34	10.49	+3.15	143	33.47	Hurdlestown
6	2.56	+ .30	113	.60	10	15	8.02	9.04	+1.02	113	34.44	Carlow
5	1.52	— .33	82	.48	10	17	5.99	7.29	+1.30	122	27.75	Dublin
5	2.58	+ .13	105	.64	10	19	8.42	11.32	+2.90	134	37.04	Ballinasloe
7	3.46	— 2.21	61	.82	10	14	19.61	20.59	+ .98	105	80.23	Kylemore House
5	3.53	— .42	89	.73	10	19	12.96	15.45	+2.49	119	50.50	Enniscoe
6	1.97	— .59	77	.40	1	15	9.16	7.99	— 1.17	87	38.61	Seaforde
6	3.39	+ .33	111	.66	11	20	9.35	13.10	+3.75	140	41.20	Londonderry
7	3.60	+ 1.13	146	.61	14	18	8.30	11.94	+3.64	144	37.85	Omagh

## SUPPLEMENTARY RAINFALL, MARCH, 1906.

Div.	STATION.	Rain. inches	Div.	STATION.	Rain. inches
II.	Abinger Hall .....	1.86	XI.	Rhayader, Tyrmynydd .....	5.61
	Ramsgate, West Cliff Villas .....	1.74		Lake Vyrnwy .....	5.08
	Hailsham .....	1.65		Llangyhanfal, Plás Draw .....	2.38
	Crowborough, Uckfield Lodge .....	2.41		Criccieth, Talarvor .....	2.87
	Osborne, Newbarn Cottage .....	1.36		Llanberis, Pen-y-pass .....	13.50
	Ensforth, Redlands .....	1.32		Lligwy .....	3.03
	Alton, Ashdell .....	1.50		Douglas, Woodville .....	2.31
	Newbury, Welford Park .....	2.02	XII.	Stoneykirk, Ardwell House .....	1.59
III.	Harrow Weald, Hill House .....	1.34		Dalry, The Old Garroch .....	4.73
	Oxford, Magdalen College .....	1.27		Langholm, Drove Road .....	...
	Bloxham Grove .....	1.14		Moniaive, Maxwellton House .....	3.39
	Pitsford, Sedgebrook .....	1.32	XIII.	N. Esk Reservoir [Penicuik] .....	3.35
	Huntingdon, Brampton .....	1.84	XIV.	Maybole, Knockdon Farm .....	3.29
	Wisbech, Bank House .....	1.66		Campbeltown, Witchburn .....	3.15
IV.	Southend Water Works .....	1.11	XV.	Inveraray, Newtown .....	6.28
	Colchester, Lexden .....	1.51		Ballachulish House .....	6.31
	Newport, The Vicarage .....	1.79		Islay, Eallabus .....	3.43
	Rendlesham .....	1.85	XVI.	Dollar Academy .....	3.17
	Swaffham .....	1.74		Loch Leven Sluice .....	2.68
	Blakeney .....	1.53		Balquhider, Stronvar .....	...
V.	Bishops Cannings .....	1.79		Perth, Pitcullen House .....	1.92
	Ashburton, Druid House .....	1.75		Coupar Angus Station .....	1.19
	Okehampton, Oaklands .....	2.79		Blair Atholl .....	2.22
	Hartland Abbey .....	1.67		Montrose, Sunnyside Asylum .....	.33
	Lynmouth, Rock House .....	2.84	XVII.	Alford, Lynturk Manse .....	2.40
	Probus, Lamellyn .....	1.19		Keith Station .....	3.03
	Wellington, The Avenue .....	1.71	XVIII.	N. Uist, Lochmaddy .....	1.61
	North Cadbury Rectory .....	1.54		Alvey Manse .....	2.84
VI.	Clifton, Pembroke Road .....	2.81		Loch Ness, Drumnadrochit .....	3.50
	Moreton-in-Marsh, Longboro' .....	1.52		Glencarron Lodge .....	9.46
	Ros, The Graig .....	1.10		Fearn, Lower Pitkerrie .....	1.56
	Shifnal, Hatton Grange .....	1.26	XIX.	Invershin .....	2.45
	Cheadle, The Heath House .....	2.43		Altnaharra .....	4.16
	Coventry, Kingswood .....	1.37		Bettyhill .....	2.92
VII.	Market Overton .....	1.46		Watten Station .....	1.37
	Market Rasen .....	2.14	XX.	Dunmanway, The Rectory .....	3.15
	Bawtry, Hesley Hall .....	.82		Cork .....	1.16
VIII.	Neston, Hinderton .....	1.83		Darrynane Abbey .....	2.33
	Southport, Hesketh Park .....	2.58		Glenam [Clonmel] .....	2.30
	Chatburn, Middlewood .....	4.27		Ballingarry, Gurteen .....	2.46
	Cartmel, Flookburgh .....	3.95		Milton Malbay .....	3.29
IX.	Langsett Moor, Up. Midhope .....	4.20	XXI.	Gorey, Courtown House .....	1.86
	Scarborough, Scalby .....	2.16		Moynalty, Westland .....	2.16
	Ingleby Greenhow .....	2.11		Athlone, Twyford .....	2.45
	Mickleton .....	2.10		Mullingar, Belvedere .....	1.92
X.	Bardon Mill, Beltingham .....	2.03	XXII.	Woodlawn .....	3.02
	Ewesley, Fallowles .....	...		Westport, Murrisk Abbey .....	3.37
	Ilderton, Lilburn Cottage .....	1.58		Collooney, Markree Obsy .....	3.72
	Keswick, York Bank .....	4.02	XXIII.	Enniskillen, Portora .....	2.58
XI.	Llanfrechfa Grange .....	2.37		Warrenpoint, Summer Hill .....	1.49
	Treherbert, Tyn-y-waun .....	6.34		Banbridge, Milltown .....	1.76
	Carmarthen, The Friary .....	3.03		Belfast, Springfield .....	2.96
	Castle Malgwyn [Llechryd] .....	3.20		Bushmills, Dundarave .....	2.46
	Plynlimon .....	11.20		Stewartstown, The Square .....	2.70
	Tall-y-llyn .....	2.60		Killybegs .....	4.82
	New Radnor, Ednol .....	3.04		Horn Head .....	3.97

## METEOROLOGICAL NOTES ON MARCH, 1906.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Temp. for Temperature; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; TS for Thunderstorm; R for Rain; H for Hail; S for Snow.

LONDON, CAMDEN SQUARE.—The first and last weeks were fine and sunny, but in the intermediate period R or S fell on practically every day in small quantities, with much high wind. The temp. was for the most part somewhat below the normal, but the mean for the month was  $42^{\circ}3$ , or  $0^{\circ}2$  above the average. Duration of sunshine  $99\cdot4^*$  hours, and of R  $43\cdot5$  hours.

CROWBOROUGH.—Variable till 18th and mild on the whole, but wintry weather on 19th with night frosts and continual light S. The month closed calm and mild. Mean temp.  $38^{\circ}1$ , or  $2^{\circ}4$  below the average, and  $5^{\circ}2$  below that of March, 1905. R  $\cdot05$  in. above the average.

BLAKENEY.—On 12th, with a heavy N.E. to N.W. gale, occurred the highest tide since November, 1897. No damage was done here, but at Cley many houses were inundated.

TORQUAY.—Mean temp.  $44^{\circ}2$ , or  $0^{\circ}1$  above the average. Duration of sunshine  $148\cdot3^*$  hours, or  $9\cdot1$  hours above the average, Mean amount of ozone  $5\cdot7$ .

NORTH CADBURY.—Judging by means, a normal March, but in fact most abnormal. Till 18th it was unusually warm, with S.W. wind and R. From 19th to 29th was the coldest period of the whole winter, with N. and N.E. winds and frequent S, but plenty of sunshine.

CLIFTON.—The first week was fine, then R or S fell every day till 16th. The remainder was mostly dry, with slight frosts and keen N.E. winds. R  $\cdot37$  in. above the average.

BOLTON.—Bright and sunny, the duration of sunshine being  $93\cdot7^*$  hours, or  $17\cdot6$  hours above the average. Cold N. and E. winds prevailed.

CARMARTHEN.—The first three weeks were wet and cold, with some H, sleet and S, hindering work on farms and gardens. The latter part was exceptionally cold and dry, with bitter N. and N.E. winds.

GOGERDDAN.—From 1st to 15th was rough and boisterous from W. and N.W., the wind amounting to strong gales at times with R. Cold drying E. and N.E. winds and strong sunshine from 15th to the end.

DOUGLAS.—Very stormy and colder than either January or February, with falls of S and H and slight frosts. A series of strong N.E. and N.W. winds set in on 11th and prevailed throughout the remainder of the month, causing extremely cold weather.

DUMFRIES.—The low temp. and biting E. winds of the latter half greatly checked vegetation, but a better time for sowing the corn crop has hardly ever been experienced.

RIDDELL.—A typical March; it "came in like a lion and went out like a lamb." There was much N. wind, gales, R and S, and everything was disagreeable till the last four days.

INVERARAY.—There was an extraordinary fall of  $2\cdot90$  in. of R on 16th, but it appears to have been local.

COUPAR ANGUS.—Cold after the first week, with N. winds and S, which drifted in places, blocking the roads. R  $\cdot90$  in. below the average.

DRUMADROCHIT.—The coldest and stormiest of the winter months. There was considerable flooding from melting S. R  $\cdot51$  in., and rainy days 6, above the average of 20 years. Aurora borealis on 24th.

DUNMANWAY.—The traditional March; cold and dry, with much N.E. wind and bright sunshine.

CORK.—R less than half the average. The mean temp. of the first 18 days was  $44^{\circ}8$  and of the last 13,  $39^{\circ}6$ .

DARRYNALE ABBEY.—The first half was mild and wet, the second dry and cold, except the last three days. R 70 per cent. of the average.

OMAGH.—The first fortnight was raw and very wet, with frequent H, sleet and S showers, and some sharp night frosts, but the latter part was made up of typical March weather, with strong N.E. winds drying the ground and enabling a large breadth of cereal crops to be sown in excellent order.

\* Campbell-Stokes.

## Climatological Table for the British Empire, October, 1905.

STATIONS.  <i>(Those in italics are South of the Equator.)</i>	Absolute.				Average.				Absolute.		Total Rain.		Aver.	
	Maximum.		Minimum.		Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days.		Cloud.
	Temp.	Date.	Temp.	Date.										
London, Camden Square	61·0	9	27·8	22	53·8	38·7	40·9	85	97·9	23·7	1·40	14	5·9	
Malta.....	82·5	6	56·9	21	73·3	62·2	59·2	80	132·6	51·7	2·94	11	4·7	
Lagos.....	87·0	13a	69·0	16	83·9	73·9	73·9	81	144·0	63·0	5·99	17	7·7	
Cape Town .....	86·8	31	47·1	8	67·5	52·9	52·5	74	...	...	1·42	12	5·1	
Durban, Natal .....	86·9	19	49·5	2	77·2	61·8	...	...	143·3	...	3·87	14	5·7	
Johannesburg .....	87·8	18	35·7	1	78·4	53·8	43·4	49	164·0	33·5	·85	4	1·5	
Mauritius.....	85·1	28	59·1	4	81·5	65·5	63·2	72	150·0	51·2	1·99	18	5·4	
Calcutta.....	90·9	4	68·9	30	87·4	74·9	74·0	81	157·0	63·8	4·78	7	4·8	
Bombay.....	94·7	8	74·9	30	89·7	78·1	75·2	77	141·0	68·0	·20	5	3·6	
Madras.....	93·7	28	66·7	28	88·6	74·9	74·7	84	145·2	62·2	19·65	15	5·3	
Kodaikanal .....	69·0	1	46·4	30	63·4	51·4	48·1	73	143·9	32·6	15·36	18	5·3	
Colombo, Ceylon.....	87·7	5b	72·4	10	85·5	75·1	74·4	86	149·8	71·4	14·81	19	6·1	
Hongkong.....	85·7	19	59·7	21	80·4	72·0	66·3	71	147·1	...	1·83	4	4·9	
Melbourne.....	72·0	10c	36·0	8	59·9	45·5	43·4	77	135·1	28·4	2·57	16	6·9	
Adelaide .....	77·0	5	38·9	20	64·3	46·1	44·0	67	139·0	32·4	2·90	18	5·8	
Coolgardie .....	89·6	20	39·0	11	73·2	47·2	40·4	48	152·0	35·2	·61	5	3·7	
Sydney .....	84·7	6	44·1	9	67·2	50·8	46·8	64	123·8	32·7	2·31	26	5·1	
Wellington .....	64·0	24	41·3	15	59·0	48·3	46·0	76	128·0	36·0	6·17	18	7·0	
Auckland .....	66·5	30	44·0	15	60·8	49·9	48·7	79	136·0	38·0	5·87	21	5·8	
Jamaica, Negril Point..	89·9	24	70·9	18	86·9	73·3	74·6	81	...	...	11·14	10	...	
Trinidad .....	91·0	4	70·0	sev.	88·6	71·7	74·0	82	169·0	67·0	6·94	17	...	
Grenada.....	88·0	7	72·0	20	84·9	75·3	72·7	77	150·0	...	8·73	19	4·4	
Toronto .....	78·0	1	25·2	29	57·4	40·2	43·6	79	97·0	17·5	3·49	10	5·3	
Fredericton ...	72·8	2	16·1	27	55·0	32·2	31·4	55	...	...	·86		3·7	
Winnipeg .....	78·0	8	6·0	24	48·0	28·1	...	...	...	...	1·03	7	5·6	
Victoria, B.C. ....	58·0	5	33·5	19	52·9	42·6	...	82	...	...	2·81	14	5·9	
Dawson .....	48·5	5	-2·8	29	30·2	18·5	...	...	...	...	1·84	14	7·1	

a and 30. b and 29, 30. c and 16.

MALTA.—Mean temp. of air 66°·4, or 2°·9 below average. Mean temp. of sea 73°·0; hourly velocity of wind 10·7, or 1·9 miles above average.

MAURITIUS.—Mean temp. of air 67°·7, of dew point 1°·4, and R 41 in. above averages. Mean hourly velocity of wind 9·3 miles, or 1·7 miles below average.

MADRAS.—Bright sunshine 180·5 hours.

KODAIKANAL.—Bright sunshine 167 hours.

COLOMBO.—Mean temp. of air 79°·9, or 0°·3 below, of dew point 1°·4 above, and R 14 in. above, averages. Mean hourly velocity of wind 6·5 miles, prevailing direction, S.W.

HONGKONG.—Mean temp. of air 75°·9. Mean direction of wind E. by N., and mean hourly velocity 12·4 miles. Bright sunshine 201·7 hours. R 2·90 in. below 20 years' average.

ADELAIDE.—Mean temp. of air 6°·9 below, R 1·17 in. above, average. Bright sunshine 49 hours below average.

SYDNEY.—R 65 in. below, mean temp. 4°·4, and humidity 4·9 below, averages.

WELLINGTON.—Mean temp. of air 0°·8 below, and R 1·90 in. above, averages.

AUCKLAND.—Stormy month, R 2·75 in. above average. Mean temp. much below average

TRINIDAD.—R 6·94, or 1·7 in. above 40 years average.