which, in a great manufacturing country like this, ought certainly not to be the least important of all. H. T. WOOD.

Society of Arts, Aug. 22

The Diurnal Inequalities of the Barometer

LIKE the author of the interesting paper on the daily inequalities of the barometer in NATURE, vol. xiv. p. 314, I am one of those who are waiting for the appearance of the second part of Mr. Buchan's essay on this subject. Perhaps the coming meeting of the British Association at Glasgow may elicit from Mr. Buchan the result of his laborious investigations. I own that I am not only anxious to ascertain if his views coincide with my own,[1] but desire very much to have at my command the thorough discussion of the data for the eighty-six stations which Mr. Buchan has collected.

So far as a correct explanation of the inequalities is concerned, I believe it must be one that can dispense with the lateral movements of the air proposed by Mr. Blanford, and be applicable alike during the calm days of the "doldrums," and during periods of great wind disturbance. It must explain, too, seasonal differences in their amount, and we may infer that what will explain a seasonal difference will probably explain also a geographical difference of the same kind.

In the barometric co-efficients for Calcutta, supplied by Mr. Blanford, the semicircular one U' is nearly twice as great in April as it is in July, and the quadrantal co-efficient U'' is one third greater in March than it is in June. The hour angle u' does not vary so much as it does in this country, and the angle u'' shows its usual very remarkable constancy. In England the co-efficient U'' seems to have a greater proportionate range than at Calcutta. This will be seen by the following monthly means obtained from Mr. Main's discussion of the observations made at the Radcliffe Observatory, Oxford.

Mean Daily Quadrantal Oscillation of the Barometer for each month at Oxford for the sixteen years, 1858-1873 inclusive. In units of ·0001 of an inch :—

March	120	September	120
April	118	October	109
May	101	November	90
June	98	December	92
July	94	January	74
August	108	February	111

The epochs of maximum effect seem here to correspond with the greatest thermometric range rather than with epochs of greatest heat. I think it will also be found in this country that this inequality is as large, if not larger, during continuous strong westerly winds as during quiet anticyclonic periods.

Like Mr. Blanford I was led to this subject by a study of the daily inequalities of the wind. My having arrived at a very different result must be my excuse for pointing out what seem to me to be points of difference between the conditions which he theoretically investigates and those which exist in nature. Mr. Blanford shows that "when a given quantity of heat is employed in heating dry air at the temperature of 80°, it raises its pressure more than seven times as much as when it simply charges it with vapour without altering the temperature." Mr. Blanford very properly premises that this occurs "while the volume remains constant." It is also implied that the volumes of air are of equal tension throughout. But where do these conditions obtain in volumes of the atmosphere? Such a volume, for example, as rests on a square yard, a square mile, or a hundred square miles of the earth's surface. This volume may easily be supposed to remain perfectly constant, while the tension of its parts may vary enormously. No ordinary addition of heat to the base of this volume will increase its total weight or sensibly add to the tension of the air at the surface of the earth. The added heat will alter the relative tension of portions of the lower third or half of the volume, and will be expended in raising to a small extent the centre of gravity of the whole. When this is done, that is, when the dynamical effect of the added heat is completed, the barometer at the base of the volume of the atmosphere will in reality read a little lower, instead of showing the greater tension required by Mr. Blanford's investigation. And this will be the case whether the added heat has expanded dry air only, or has evaporated particles of water already in the atmosphere. In either case I apprehend that during the upward movement of the warm air or of the *lighter* vapour the barometer would read lower than at the moment when the movement was completed.

An elevation of the centre of gravity of the atmosphere equal to two-thirds of a mile, barometer at 30 inches, would reduce the weight of the atmosphere by about the one-hundredth of an inch. The centre of gravity of the air over an elevated station like Leh in Ladakh would have to be raised several miles to produce so large a change of pressure as ·1034 of an inch, the difference between the maximum night and day value of coefficient U' as given by Mr. Blanford—so many miles as, in my opinion, to compel one to look for some other cause for the production of part of the observed effect, and that cause, I believe, will be found in the dynamical one already indicated.

W. W. RUNDELL

[1] On the Diurnal Inequalities of the Barometer and Thermometer. *Quarterly Journal of the Meteorological Society*, Oct., 1874

Visual Phenomena

ALTHOUGH most people are familiar with the appearances which surround, or perhaps I should say form, the image on the retina of a luminous point, their origin, I believe, is not so generally known, and it is not uncommon to hear them ascribed to reflection from the eyelids and eyelashes, which in reality plays no part in their production. There are three distinct phenomena which go to make up the appearance of a luminous point, but they are not generally all visible at once. I will describe them for convenience of reference as phenomena A, B, and C.

(A). The luminous point appears to be surrounded by short rays, seldom more than a degree in length, generally much less, the length depending on the brightness of the point and the size of the pupil at the time.

These rays are what make a bright point look star-shaped (Fig. 1).

(B). Upwards and downwards from the point proceed two bundles of rays, each often 20° or more in length, and inclined to one another at an obtuse angle (Fig. 2).

Fig. 1.

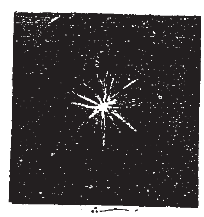
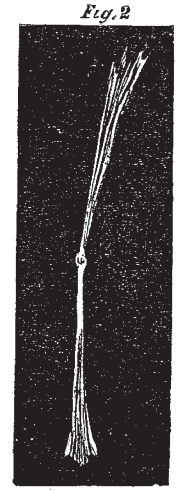


Fig. 2



(C). Coloured rays such as are shown in Fig. 3, which are only seen when the eyelids are nearly closed.

These perhaps it is hardly necessary to say are produced by diffraction through the eyelashes.

(B) is due to refraction through the small band of tears, which is retained by capillarity in the angle between the inner edge of the eyelid and the eye (shown at t and t', Fig. 4), and which acts as a curved prism, although its effect is only visible when the lids are advanced far enough over the cornea to allow light which passes close to them to enter the pupil.

The following simple experiments show that this explanation is the right one.

1. While looking at a bright point so as to see (B), draw down the lower eyelid, the upper bundle of rays will then disappear. This shows that the upper rays are caused by the lower eyelid, and also that as the image on the retina is inverted, the light must take some such course as shown by the dotted lines in Fig. 5. Now in no conceivable way could reflection from the