Explanation of an Optical Deception in the Appearance of the Spokes of a Wheel seen through vertical Apertures. *By* P. M. Roget, *M.D. F.R.S.* Read December 9, 1824. [*Phil. Trans.* 1825, *p.* 131.]

The optical deception which Dr. Roget describes, takes place when a carriage-wheel, rolling along the ground, is viewed through the intervals of a series of vertical bars, such as those of a palisade, or of a Venetian window-blind. In these circumstances, all the spokes appear curved, those which are situated vertically excepted, the degree of curvature increasing as their position recedes from the vertical, and being a maximum for the horizontal spokes. The convexity of these curved images is always turned downwards, and the direction of their curvature is the same whichever way the wheel be moving.

To determine the influence of variations of circumstances on these phenomena, appeared to Dr. Roget the proper mode of obtaining a clue to their explanation. It results from his experiments, that a certain degree of velocity in the wheel is necessary to produce the deception in question; and if this be communicated to it gradually, the principal effect of *curvature* is observed to come on suddenly, but the *degree* of bending is independent of the velocity of the wheel, and each image appears, during the moment it is viewed, motionless. The number of spokes makes no difference in their degree of curvature. The deception is favoured by the diminution of the interval between the bars, by throwing a strong light on the wheel, and by every circumstance which tends to draw attention from the bars and fix it on the wheel. The number of curved images was found to depend on the ratio of the angles subtended at the eye by the intervals between the bars, and those between the extremities of the spokes; being greater as this ratio was less. If the bars were inclined to the horizon, the phenomena were those of a wheel revolving with a less velocity in a direction perpendicular to their length. Finally, the combination of a progressive with a rotatory motion (whether produced by a real motion of the wheel, the bars, or the spectator,) was found to be essential to the production of the phenomena.

From all these circumstances, the author is led to refer the explanation of the deception in question, to the principle that an impression made by a pencil of rays on the retina, if sufficiently vivid, will remain for a certain time after the cause has ceased. He then explains at length the application of this principle to the case in question, and shows that the apparent form of each spoke will be a curve formed by the continual intersection of the revolving and advancing radius, with the immoveable interval between the bars, referred, not to the plane in which the bars lie, for then it would be a straight line, but by an effort of attention, to the plane of the wheel. The general form of these curves he refers to the class of Quadratrices, and the most remarkable among them is that first discovered by Dinostrates, and known by his name. By varying a certain parameter in the equation of these curves, other forms, having infinite branches and points of contrary flexure, arise; and these

the author has succeeded in rendering visible, by making the wheel revolve on an axle of less than its own diameter; and the appearances being in this, as well as in the foregoing case, perfectly consonant to his theory, he considers the explanation given as quite satisfactory.

Dr. Roget concludes by suggesting the possibility of measuring the duration of the impression of light on the retina by observing the apparent velocity of the visible portion of the spokes.

On a new Photometer, with its application to determine the relative Intensities of Artificial Light, &c. By William Ritchie, *A.M., Rector of the Academy at Tain. Communicated by the President.* Read December 16, 1824. [*Phil. Trans.* 1825, *p.* 141.]

Mr. Ritchie, after a brief exposition of the theoretical views which led him to the construction of his photometer, lays down the following as the principles on which it depends:—

1. That radiant heat does not permeate glass.
2. That light is capable of combining with substances which stop it, and expanding them as heat does.
3. That the intensity of light is in the inverse ratio of the squares of the distance.

The photometer, which he then proceeds to describe, consists of two tin-plate cylinders, broad and shallow, each of which is closed at the one end with tin plate, and at the other with a disk of the thickest plate glass, both made air tight. Each of these cylinders or chambers contains in the middle a diaphragm of black paper, with its black side towards the glass, for the purpose (as he expresses it,) of absorbing the light which penetrates the glass, and instantly converting it into heat. The chambers are then fixed back to back at a little distance from each other, and connected by a bent tube in the form of the letter U, containing a small quantity of a coloured liquid.

This instrument is exposed with its glass faces opposite to two lights to be compared, and their equality is judged of by the liquid in the stem remaining stationary.

Its sensibility is described by the author as such, that a single candle placed 10, 20, or 30 feet from it visibly affects it; while a mass of heated iron affording twenty times the heat has no influence.

The author proposes his photometer as peculiarly well adapted to the measure of the quantity of light given out by gas lights. The solar light he describes as powerful enough to drive the liquid in the stem through 20 or 30 feet of tube. He states himself to have an instrument of this kind now making, with which he hopes to render sensible the effect of the moon's rays. Finally, he explains the difference between his instrument and that of Professor Leslie to consist in this,—that in the latter the difference of temperature between the two balls is the quantity measured; in the former the perfect equality of their temperatures is the essential condition.