

of many rapidly succeeding impressions, then tints are graded into one another at the edges, and we lose the power of distinguishing detail.

I can give, fortunately, a case in point. My eyes are affected with a small amount of astigmatism. It does not affect general vision for ordinary purposes, nor, of course, the definition of single lines; but, when I use appropriate lenses, the whole scene becomes brighter and more cheerful, and I see details. The bark of a tree is a perfectly different object with and without them. With them it is like a good photograph; without them, like many pictures. Formerly, in addition to the cylindrical surface, I required a slight spherical concave, and I was disposed to place the increased general brilliancy of the view mainly to the reduction of size, but I now use plano-cylindrical lenses for distant vision, and it is evident that the brilliancy is solely due to the better definition.

I would, lastly, suggest for Lord Rayleigh's consideration the question whether the change of focus of his eyes in faint light is not partly, at all events, due to change in the colour of the light. I know that there is such a change with me, but I have long had reason to believe that colour affects my vision.

J. F. TENNANT

37, Hamilton Road, Ealing, W., February 7

THOSE who have compared Lord Rayleigh's letter in NATURE of February 12 with that of Mr. Brudenell Carter on February 26 will have observed an inconsistency occasioned by a slip of the pen.

The latter says: "The commonly accepted standard of normal vision is deciphering letters the parts of which subtend visual angles of one minute. . . ." Also, Prof. McKendrick states that "The smallest visual angle in which two distinct points may be observed is 60 seconds."

According to Lord Rayleigh, however, "A double star cannot be fairly resolved unless its components subtend an angle exceeding that subtended by the wave-length of light at a distance equal to the aperture. If we take the aperture of the eye as $\frac{1}{5}$ th inch, and the wave-length of light as $\frac{1}{40,000}$ th inch, this angle is found to be about two minutes." In the case of a small angle the aperture divided by the distance is approximately equal to the arc divided by the radius or to the circular measure of the angle. Hence in the present case we have $\frac{\frac{1}{40,000}\text{th inch}}{\frac{1}{5}\text{th inch}} =$

$\frac{1}{8000}$ radian or $\frac{206,265}{8000} = 25.8$ seconds nearly, instead of the two minutes accidentally stated by Lord Rayleigh.

This minimum value seems to show some mistake in Ehrenberg's experiments on vision, and is about half of that found by Helmholtz for the best of twelve observers.

March 10

SYDNEY LUPTON

[Mr. Lupton is quite right. By a stupid blunder I said about two minutes, when I should have said about half a minute.—RAYLEIGH.]

THERE is a defect of eyesight common among the natives of India known as "rātandhi," lit. "night blindness." Persons affected with this have either ordinary powers of vision by daylight, or else powers so little less than ordinary as to feel no inconvenience, so that usually no defect is noticeable; whilst in feeble twilight their sight fails in the most extraordinary way, and in the dusk they become (in bad cases) practically blind. Of course there are all degrees of this affection; but the strongly-marked cases alone are likely to attract attention.

By medical men in India this affection is said to occur most among men living on a low diet (chiefly of cereals), and the usual palliative treatment is to prescribe a meat diet.

This affection is rarely noticeable among Europeans in India, though I have sometimes noticed marked differences of clearness of sight among them also amounting to slight "night-blindness." Lord Rayleigh's case of short-sightedness in twilight and in the dusk seems to be a mild case of this sort (see NATURE, February 12, p. 340).

ALLAN CUNNINGHAM

The Pupil of the Eyes during Emotion

ALTHOUGH further observations are required, there seems to be a more or less general assent as to the influence of the emotions on the pupils of the eyes. Mr. Clark, in his letter to your journal (vol. xxxi. p. 433), has rightly quoted Gratiolet, who

says that in sudden astonishment or fear the whole system becomes paralysed, and at the same time the pupils dilated. In anger, on the other hand, when the whole body is roused into action, the pupils become contracted: "Les pupilles sont énormément dilatées dans l'épouvanté, tandis qu'elles sont toujours contractées dans le colère." This was, however, said many years before by the celebrated Harvey, who, in his discourse on the circulation of the blood, written in 1628, says: "In anger the eyes are fiery, and the pupils contracted" ("Ira rubent oculi, constringitur pupilla").

I should myself think that a narrow pupil evinces a more active mental state, as it is this condition which is present when the eye is accommodated to regard with attention a near object, whilst, on the other hand, when gazing out into distance, the pupils are wider, and the mental mood is more passive and contemplative.

In my parrot the size of the pupil is a very excellent measure of its frame of mind. When angry the pupil becomes minutely contracted, whereas when the bird is sympathetic and amiable the pupils become as widely dilated. Balzac, with other novelists, have depicted the state of the pupils when describing the various emotions and passions. The former in portraying a saintly woman kneeling before the altar, says: "The pupil of the eye, endued with great contractility, appeared then to expand and draw back the blue of the iris until it formed no more than a narrow circle. What force was that arising in the depths of the soul which so enlarged the pupils in full daylight and obscured the azure of those celestial eyes?" Darwin speaks doubtfully, but rightly demands more observations on the subject.

SAMUEL WILKS

Grosvenor Street, March

Auroræ

AFTER a long and remarkable absence of aurora, which, from a letter in your columns of February 19 (p. 360) does not appear to have been confined to these more southerly latitudes, we were favoured last evening with a beautiful, though somewhat transient display. It was about 9.25 p.m. when I first noticed a long band or belt of light above the northern horizon. At first it was ill-defined, with little change of position, but in about twenty minutes it became more luminous and the characteristic streamers suddenly made their appearance, shooting upwards, sometimes from above, sometimes from below the belt of light, which for a few seconds changed into a double arch. Some of these streamers rose as distinct columns, showing the usual prismatic hues, one in particular being noticeable as traversing the inverted W of Cassiopeia, another forming a fan-like terminus to the luminous region, but all confined to a low altitude, bounded on the north-west by Perseus, and on the north-east by Vega, then rising. It may be well to observe that on the same day (the 15th) a large sun-spot had just reached the central meridian, and was beginning to show signs of great disturbance.

E. BROWN

Further Barton, Cirencester, March 16

Injuries caused by Lightning in Venezuela

IN answer to Mr. von Dancelman's inquiry as to the use of lightning-rods and the frequency of accidents from lightning in the tropics (NATURE, December 11, 1884, p. 127), I beg leave to offer the following information referring to Venezuela, where I have been residing ever since 1862:—

Thunderstorms are very frequent during the rainy season. They break out generally in the afternoon, about the time of the daily maximum of heat, whilst they are extremely rare in the morning (I only witnessed one case) and during the night. Statistics of accidents do not exist, nor are there many lightning-rods in use (in Caracas about half a dozen). But there are certain regions where the former are far from being uncommon, as, for instance, the country around the Lake of Valencia and the plains or llanos to the north of the Orinoco. In these a considerable number of cattle are killed by lightning every year, and I know also of several cases where houses were destroyed and people killed. The herds of cattle crowd together as soon as a thunderstorm begins, and the animals remain during the whole time with their heads down to the ground, thus avoiding instinctively that their pointed horns should act as lightning-conductors.

In the neighbourhood of Maracay, at the eastern end of the Lake of Valencia, accidents occur almost every year. A very