

glowing-point; again a dark interval follows, shorter than the first, and behind it a long strip with a dark core and very faintly bright edges; as one traces backwards, the edges appear to close in together gradually, so that, after about two inches, the dark core has collapsed, as it were, and the edges have come together to form a narrow and well-defined thread of a mauve tinge; this gradually dies away as we go further back along the trail, and by the time that the glowing-point has travelled over the whole curve once, it has nearly disappeared.

Secondly, let the figure of eight be as large as can be described in a rectangle 8 inches by 4. Here the phenomena are quite different. It now seems as if the dark intervals at either end of the ghost as described above were absent, and the ghost itself were drawn out into a streak which follows *immediately* upon the glowing-point. Its colour is now yellow-green. This gradually narrows to extinction as one traces the trail backwards, and is the positive after-image in its various stages. More probably this streak has no connection with the true *ghost*; but is quite distinct from it, whilst the ghost no longer appears, when the point moves with greater velocity. In fact, there is probably a limiting velocity of the glowing-point, beyond which the ghost is not formed. This coincides with Mr. Bidwell's observations as to the rate of rotation of the vacuum-tube. As the yellow streak disappears narrowing, one sees a faint blue haze on either side, separated from it by an interval of darkness. When one has traced backwards so far that the streak has vanished, one sees what was above described as a strip with dark core and faint blue or mauve edges. The edges close in and form a distinct mauve thread, which gradually dies out.

It is very beautiful to see the ghostly trail hanging before one; and, by suitable movement of the glowing point, one may fill the space, as it were, with a maze of wreathing lines. Perhaps the most striking part of the phenomenon, regarded from an æsthetical standpoint, is the *depth* of the figures so produced: one realises in the form of the trail that the glowing-point has been moving, not in one plane, but in space; and one sees that some parts are nearer than others. After a time the glowing-point seems to be forgotten, and the trail is the only thing observed. The position of the trail appears to change with any change in the state of accommodation of the eye; if the trail goes away from one the eye attempts to follow it, and exaggerates the movement. If there is any irregularity in the curve, as may often be the case from want of proper co-ordination of muscles—especially if the moving arm is at all subject to rheumatism—it is revealed in a terribly truthful manner by the trail.

A systematic investigation of the subject would, I think, be very valuable as throwing light upon the processes in the retina.

Both Prof. Young ("whatever the true explanation may turn out to be, the phenomenon at least suggests the idea of a *reflection of the nervous impulse* at the nerve extremities, as if the intense impression upon the retina, after being the first time propagated to the brain, were then reflected, returned to the retina, and, travelling again from the retina to the brain, renewed the sensation") and Mr. Bidwell ("the series of phenomena seem to be due to an affection of the optic nerve which is of an oscillatory character," &c.) appear to incline to what I may call a *physical* view of the phenomena. The phenomena appear to me to point to some *chemical* action on the retina, and to depend in a great measure on the *rate* at which this action goes on. It would be of great interest to consider the phenomena in connection with Hering's theory of colour sensation; according to it these sensations are due to changes in a certain substance, in such a way that changes of a destructive or dissimilative character give rise to the sensations of white, red, and yellow, whilst those of a constructive or assimilative kind produce the sensations of black, green, and blue ("Zur Lehre vom Lichtsinne," Wien, 1878). It may be that this work has been already done; if so I must crave the indulgence of those who have made the subject a special study.

H. FRANK NEWALL

Crowthorne, Wokingham, May 18

"Speed" and "Velocity"

SOME of your "general" readers, like myself, may wish to see the distinction between "velocity" and "speed" more easily defined than by a reference to the calculus of quaternions, to which I believe the term "tensor" appertains.

"Speed" is not in the index to the new edition of Part II. of

Thomson and Tait. Maxwell, at p. 26 of "Matter and Motion," says, "The rate or speed of the motion is called the velocity of the particle." Tate, in his "Properties of Matter," p. 52, writes about "water of motion; i.e. *Speeds*." It seems thus:—

- (1) Rate of motion is velocity (Maxwell)
- (2) Speed of motion is velocity
- (3) Rate of motion is speed (Tate).

From (1) and (3) it appears as if velocity and speed must be the same, as indeed (2) seems to assert. But we are told this is not the case. Cannot the distinction between the two be made more generally intelligible than by saying that "speed" is the "tensor" of velocity.

SENEX

[When Maxwell introduced to junior students the *Diagram of Velocities*, he made velocity include the *direction* of motion as well as the mere *rate* of motion (i.e. speed).—ED.]

The Male Sole is not Unknown

IN last week's issue of NATURE is what is said to be an abstract of a paper read at the Society of Arts by Prof. Ray Lankester, in aid of a proposed marine laboratory, and, passing over what he stated generally requires elucidation, he gives one example of *what is not known among fishes*, and which in the first instance will be investigated at Plymouth. He is made to say "at present absolutely nothing is known as to the spawning of the sole—the male fish is not even recognised."

In times gone by the plaice was asserted to have ascended from a shrimp, but this, I think, is the first time that the existence of the male sole has been declined recognition. Omitting references to others, I will merely draw attention to the fact that in my collection of British fishes in spirit at the "Great International Fisheries Exhibition," and which is now deposited in the Economic Museum at South Kensington, is a fine example of the male sole, with the milt quite ripe.

I must apologise for pointing out the foregoing, but were such an error left unnoticed in a scientific paper, some practical fisherman will possibly direct attention to it, as the comparative rarity of the male to the female sole has been frequently observed upon in our weekly sporting journals during the last few years.

Cheltenham, May 23

FRANCIS DAY

The Aurora of March 15, 1885

NATURE for March 26 (p. 479) contains an account of a fine aurora observed at Christiania, Sweden, on March 15, by Prof. Sophus Tromholt. I would call attention to the fact that an aurora (a very unusual phenomenon at this place) was visible here on the evening of March 15. It was first seen at about 7 p.m.

At the above time several streamers were noticed ascending somewhat east of north: after a short interval these died leaving a white nebulous cloud of light at an altitude of about 10° near a point some 10° or 15° east of north. Shortly afterwards streamers appeared ascending some 10° or 15° west of north; these presently disappeared, leaving a mass of light similar to that left in the east of north. Several times feebler streamers made their appearance west of north. The rays did not attain a greater height than some 20° , and by 8 $\frac{1}{2}$ h. all was quiet, save an auroral glow along the horizon some few degrees east of north, which remained throughout the night. I have thought this might be interesting in connection with the Christiania aurora.

Longitude west of Washington = oh. 39m. 0 \cdot 68s.
Latitude = +36h. 8m. 58 \cdot 25s.

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Catalogue of Fossil Mammalia in the British Museum. Part I.

IN reply to Mr. Lydekker's comments on the review of his work (NATURE, vol. xxxi. p. 597) I am glad to find that the author repudiates the Owenian system and its errors, though his recognition of the three upper premolars in *Vespertilio* as corresponding, respectively, to *pms.* 2, 3, and 4 of the typical series of four, and the minute anterior upper premolar of *Rhinolophus* as *p.* 3, added to the strange absence of any note on the presence of exceptions to the supposed rule that the premolars decrease in number by reduction from the anterior extremity of the series