system that yields 'fixed carbon' a lower density than that which yields the 'volatile matter'? Is there actually free carbon in colloid solution in the hydrocarbon complex, or are we dealing with a colloidal association of two series of compounds, one of which series yields the major portion of the 'fixed carbon' on the application of heat, whilst the other series yields the major portion of the 'volatile matter'?

In conclusion, one may say that the data to which reference is made in this letter seem to indicate that much valuable information might be obtained from a systematic study of coals as colloid systems; not being myself a student of colloid chemistry, but a geologist with no opportunity for physico-chemical research, I have, therefore, ventured to direct attention to these data and to make some apparently rash suggestions in the hope that they may attract attention to the subject and cause others more competent to undertake the careful research that the preliminary data seem to warrant.

L. L. FERMOR.

Geological Survey of India, Feb. 16.

Light and Sight.

ALL the facts point to the conclusion that vision takes place by stimulation of the cones of the retina through photo-chemical decomposition of the liquid surrounding them which is sensitised by the visual purple. The rods are not percipient elements, but control the visual purple. Helmholtz stated that there was no evidence that the rods were percipient elements. This theory explains numerous facts which are otherwise inexplicable, such, for example, as the change in position in the field of vision of after-images on movement of the eye. Two after-images may combine into one, or a red after-image may go right through a green one. This proves conclusively that the stimulus is liquid.

Apart from the numerous facts against the duplicity theory, which supposes that the rods are percipient elements for perception in a dim light, it will be found that it is supported almost entirely by misstatements, namely, (1) that certain animals have only cones, and others have only rods; (2) that the periphery of the retina is colour-blind; (3) that the eye is totally colour-blind in dark adaptation; (4) that the Purkinje phenomenon and the recurrent image are not found with the fovea. With regard to these I offer the following criticisms:

(1) Though I have examined numerous collections I have never been able to find any animal with only rods or only cones, neither have I found anyone who has seen such a retina. The tortoise is the most quoted; it is stated to have only cones. The rods and cones in the retina of the tortoise are as clearly defined and distinct as in the human retina.

(2) The periphery of the retina is not colour-blind when colours of sufficient intensity are used. The reader can test this for himself with a doctor's red lamp. He will find he can see it as red to the extreme periphery.

(3) In dark adaptation the eye is not totally colour-blind. Further, there is no scotoma or blind area corresponding to the rod-free portion of the macula which is equal to a visual angle of about three degrees.

(4) The Purkinje phenomenon and recurrent image are found with the fovea.

Hess showed not only that the recurrent image was found with the fovea, but also that it was bent outwards at this region as it would be if the visual purple had to flow into the fovea.

F. W. EDRIDGE-GREEN.

London, April 21.

No. 3053, Vol. 121]

PROF. HARTRIDGE's letter in NATURE of April 21 is of interest if only for the reason that it exposes our ignorance of the history of human vision. Apparently those who have studied this problem have not yet established any conclusion which limits the field of speculation. It would scarcely be possible to find suggestions more diverse in character than the three already made in this discussion, and it is doubtless much easier to add to the variety than to demonstrate the impossibility of those already put forward. I do not claim to have shown that Sir John Parsons' suggestion is impossible; having pointed out that an additional link is needed to complete the chain of his argument, I merely venture the opinion that this link is very unlikely to be found.

In his third and fourth paragraphs, Prof. Hartridge attempts to provide this missing link, but since he prefers another theory he is perhaps conscious that something is still wanting. Unfortunately, I find his third paragraph unintelligible, and part of the fourth is so ambiguously worded that it would not be profitable to discuss it. It may, however, be as well to say at once that similarity of the two curves Sir John mentioned is not a factor in the problem; the only point under consideration is the occurrence in the same neighbourhood of the peaks of both curves. Since the distribution of solar energy is known, nothing can be gained by introducing into the discussion such foreign considerations as experimental apparatus.

Many readers of NATURE may like to see reproductions of Prof. Wood's photographs, and read his own explanation of these effects, before deciding whether Prof. Hartridge's assumption that they are faulty and misleading photographs is well founded. They will be found in the *British Journal of Photography* for Aug. 12 and Oct. 28, 1910. If, after reading and inspecting them, Prof. Hartridge has any lingering doubts about the reality of these effects, I suggest that he should himself take corresponding photographs through filters of the types used by Prof. Wood, utilising, of course, the much more convenient plates that are now available.

The explanation of our limited visual sensibility proposed by Prof. Hartridge scarcely seems to me compatible with an evolutionary outlook. The words 'difficulty' and 'absence,' suggesting as they do such questions as 'who found it difficult?' almost carry the discussion into the domain of theology. In any event, it is not a view of which my opinion is likely to interest others.

An inappropriate choice has been made in selecting the visibility of a thin dark line as an illustration of the finer powers of the eye; there is no mystery about the explanation. The phenomenon is independent of resolution, and, despite his penultimate paragraph, I can scarcely think that Prof. Hartridge commits such an error as making the line width a function of the resolving power. What is yet uncertain is how it comes about that the eye can detect want of alignment of two parallel lines when the displacement corresponds to an angle of about one second at the eye, and can discriminate between an outline formed by two perpendicular straight lines meeting in a point and another formed by two perpendicular straight lines joined by a circular arc of a radius so small that the separation of the pointed and rounded contours, if the straight lines were superposed, would be much less than the projection, on the plane containing the lines, of the diameter of a single retinal cone. Does Prof. Hartridge's theory give an adequate explanation of these facts?

Is the eye capable of making these refined judgments without moving in its socket, and can the