

for the most part the inherited tendencies of cell growth acquired as legacy from the canal organs of the surface." Among important topics which the author ignores, and upon which we could have wished his opinion, are Chatin's alleged discovery of all intermediate stages between the rod-bearing and ciliated cells of the Batrachian auditory epithelium, and the views of Engelmann, Chun, and Yves Delage, arising from the experimental study of the otoliths in Ctenophora, Mollusca, and Crustacea. The latter are by no means reconcilable with the author's bold assertion that "the functions of the otoliths are entirely unknown." In dealing with the "chalk-sacs" of the amphibia, the author remarks (p. 21) that their "morphological as well as physiological significance" is still unknown. He ignores the fact that Lenhossek has shown them to be tubular glands and named them; and this is very remarkable, as, while he makes no mention of that author's paper, he acknowledges one by Coggi, in which it receives ample recognition. G. B. H.

PERSPECTIVE AND COLOUR.

IN *Brain*, Parts LXI. and LXII., which have just been published, occurs an interesting article by Prof. Einthoven (of Leyden) on the production of shadow and perspective effects by difference of colour. The following is an account of the phenomena:—

Difference of colour may, under certain circumstances, be the cause of an apparent difference in distance.¹ To observe the phenomenon, it is only necessary to glue different coloured figures, such as letters of blue and of red paper, to a screen of black velvet and to look at them from a suitable distance. In the experiment about to be described, Roman capital letters of about eight by four centimeters were used, the screen being placed at about three meters distance from the observer.²

Under these conditions it appeared, both to Prof. Einthoven and to others who he interrogated, that the red letters were nearer than the blue. Obviously, the phenomenon might be explained by difference in accommodation. In order to see the red letters distinctly, a greater amount of accommodation is necessary than in focussing the blue ones, and the greater sense of effort might account for the notion of the red letters being nearer. This accommodation hypothesis, plausible as it seems, cannot however be accepted as a satisfactory explanation of the phenomenon. Several observations tell against it, notably this: that there are about as many persons who see the blue letters before the red, as there are those who see red before blue. In the second place, the apparent difference in distance—so distinct to binocular vision—disappears almost wholly with the closure of one eye. Looked at with one eye only, and for some length of time, the letters appeared to be lying in the same plane, but each time that the other eye was opened the difference in distance obtruded itself irresistibly.

The amount of difference remains constant, and can be estimated with considerable accuracy, in the same way as in making a stereoscopic observation. The question therefore suggested itself, whether we had not here to deal with real stereoscopy? The answer to this question is an affirmative. Brücke³ has shown by means of a simple experiment that the retinal images of differently coloured points are shifted with respect to one another. Looking with one eye at a narrow vertical strip on a black background, the upper and lower thirds of the strip being red and the middle third blue, Brücke observed that the blue part deviated to one side, the two red parts to the other side. By covering either eye alternately, a deviation of the blue and red parts in opposite directions will be observed; and, on both eyes being used, the notion of a difference in distance is proved by the combination of the two images in such a way that the parts that deviate to the nasal side constitute the nearer image; the parts that deviate to the temporal side, the further image. The stereoscopic effect is, however, more distinct and convincing with the coloured letters than with the strip used by Brücke.

The cause of the relative removal of the differently coloured images lies in the eccentricity of the pupil, as may be demon-

strated experimentally. The pupils may be made highly eccentric by covering them partially. Partial covering on the nasal side is equivalent to a removal of the pupil to the temporal side, and conversely, covering the temporal side is equivalent to removal to the nasal side. With a nasal eccentric pupil a shifting of the differently coloured images in one direction will be observed; with a temporal eccentric pupil the shifting will be in the other direction.

The effect of an artificial eccentricity of the pupil is surprising when both eyes are used. Anyone who sees the red letters before the blue has only to cover his pupils symmetrically on the temporal side, when he will observe the red letters retreat and soon appear to be behind the blue. On covering his pupils symmetrically on the nasal side, the red letters come forward more and more, and seem at last (experimenting at a distance of four or five meters) to remain several decimeters in front of the blue. A person who sees the blue letters before the red, has only to cover his pupils on the nasal side, when he will observe that the distances change, the red coming forward and the blue shrinking back.

Lately, however, Dr. A. D. Waller has found that on repeating the experiment with a seemingly slight modification, he obtained the same effects with one eye alone. He used as a test object rings of blue paper on a red ground, or of red paper on a blue ground, and found that the nasal pupil of the left eye gives the same appearance of circular trenches or hillocks as does the temporal pupil of the right eye.

This observation has been the motive to a more thorough study of the phenomenon.

On looking with the right eye and a temporal pupil at red rings on a blue paper, the rings appear as circular hillocks when the paper is held to the left, and also sloping in that direction. One seems to be looking against the dark edges of a thick red ring fixed upon the blue paper. With a nasal pupil the red rings appear as circular trenches.

The phenomenon is the more striking in proportion to the purity of the colours used. The pupil must be made sufficiently eccentric and in a suitable direction by means of a black screen that covers it from one side, or better still, by means of a stenopæic apparatus. The pupil must not be too narrow, and the whole eye should be wide open and well-directed, so as to avoid any partial covering by the nose, eyelid, or lashes. Lastly, it is not desirable to keep the eccentricity of the pupil constant for more than a brief period. For if one stares at the rings a long time with unmoved pupils, all appreciation of distance is lost, as in so many cases where only one eye is used, and the rings may even seem to lie in a plane that intersects the plane of the blue paper perpendicularly. If, on the contrary, one shifts the screen or the stenopæic apparatus now and then the rings appear to rise and sink, and, under the above-mentioned conditions the rising will be with temporal pupil, the sinking with nasal pupil, and in a way almost as striking as if they were seen stereoscopically.

Prof. Einthoven proves mathematically that the explanation of the phenomenon is found in the appearance of shadows.

THE FLORA OF GREENLAND.

IN 1891 Dr. William H. Burk accompanied, as botanist, the party which escorted Lieut. Peary to his winter quarters in McCormick Bay. A number of plants were collected and taken to America, but they had barely been determined before an expedition was organised to search for Lieut. Peary, and Mr. William G. Meehan was appointed botanist to it. This was just a year ago. Mr. Meehan was also fortunate enough to obtain specimens, and a catalogue of the plants collected in both cases was communicated to the Academy of Natural Sciences of Philadelphia on April 11. Some idea as to the character of the catalogue will be obtained from the following introduction to it:—

The range of territory covered by Dr. Burk and Mr. Meehan was between about latitude 63° and above 78° or between Godthaab and Littleton Island.

As nearly the whole collection was repeated by each collector, it may be taken as a fairly complete flora of that portion of the territory of Greenland.

Before starting in their respective journeys, both Dr. Burk and Mr. Meehan were instructed to examine as far as possible

¹ Donders. *Wetensch. bijbladen. Med. Gasth. v. Ooglijders*, 1868.
² W. Einthoven, "Stéréoscopie dépendant d'une différence de couleur." *Archives Néerlandaises*, t. 20.

³ Vorlesungen über Physiologie Wien, 1884, 3 Aufl. B. 2, S. 95.