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 stereoscopical observation. The question therefore suggested itself, whether we had not here to deal with real stereoscopy? The answer to this question is an affirmative. Brücke[3] 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 stereoscopical 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 demonstrated 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.

[1] Donders. *Wetensch. bijbladen. Med. Gasth. v. Ooglijders*, 1868.
[2] W. Einthoven, "Stéreoscopie dépendant d'une différence de couleur." *Archives Néerlandaises*. t. 20.
[3] Vorlesungen über Physiologie Wien, 1884, 3 Aufl. B. 2, S. 95.

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

the influence of ice sheets on the geographical distribution of plants. Prof. Thomas Meehan, the father of the latter, in a "Catalogue of Plants collected in July, 1883, during an Excursion along the Pacific Coast in South-eastern Alaska,"[1] had given reasons for believing that plants did not merely advance in the wake of retreating glaciers, or push into growth from material brought down in their advance, but that when caught under the mass of flowing ice, would remain for an indefinite period, retaining vitality, and push again into growth when the ice retreated. Prof. Meehan was led to this conclusion from finding no annual plants among those collected in the immediate wake of retreating glaciers in Alaska, while the actual number of species of perennials collected in such locations would be as great as if much time had been given for a floral advance. He had but little opportunity for actual observation as to the plants brought down with the earth carried on the ice, but so far as this went only *Epilobium latifolium* and *Dryas octopetela* were found in this condition, and scarcely any plants were observed on recently deposited moraines. These and some other facts led to the hypothesis that the plants were not migratory, but had held their position through the whole icy period.

These facts were supported by the determination of the existence of much the same flora in isolated spots of land recently bared by the névé of the inland ice, as grow away from the margins of the ice sheet, while the finding of living willow trunks, grass, and perennial plants of many years' growth close to the edges of retreating glaciers, seem to place the point beyond any reasonable doubt, especially when, after careful survey, through the construction and positions of the glaciers, there was the absolute certainty that the plants could not have been deposited by lateral, medial, or terminal moraines, though they might have been by ground moraines—a circumstance which would settle Prof. Meehan's position affirmatively beyond dispute, since the ground moraines are borne under the flowing ice rivers. Abundant vegetation was also found in nunataks—peaks of land projecting above the glaciers or ice cap—but little significance was placed on this circumstance, since all such nunataks visited were within a reasonably close proximity to the main land masses, and the vegetation might readily have sprung from seeds blown there by the winds or brought by mud on the feet of birds. But the demonstration of aged living plants in the other situations named must have a strong bearing on the discussions involved as to the influence of the ice age on the distribution of plants over the surface of the earth.

The abundance of lichens is characteristic of the flora of Greenland. Rocks supposed from a distance to be naturally coloured are found on closer inspection to derive their hue from a complete investiture of some lichen. In this particular the crimson cliffs, beginning at Cape York and extending many miles northward, are a conspicuous example. These cliffs, rising sheer from the water's edge to heights of from seventeen hundred to two thousand feet or more, though of grey granite, show no spot of the intrinsic colour even on being nearly approached, but present a uniform red appearance over their whole surface from a large orange red lichen which covers them.

In view of Schwendener's theory that lichens are but symbiotic forms of algæ and fungi, it is to be regretted that the probably rich fields afforded by the latter named great families in this region have yet to be investigated.

Mosses are even more abundant than lichens. They grow in such vast quantities in spots, that their light or dark greens are visible often for some miles away, brightening the otherwise bleak shores wonderfully. Their persistence in growth under apparently adverse circumstances is also remarkable. No obstacle save the sea seems sufficient to stop their progress. Even dead glaciers have been and are being buried under the steady march of these cryptogamous plants. Mosses fulfil the same duty in Greenland that other forms of plant life perform in more favoured climes, and the amount of rich vegetable matter being deposited by them may be of great value in the future of that great arctic island.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Rev. Bartholomew Price, Master of Pembroke College, has been added to the electors to the Savillian Chair of Astronomy on the present occasion.

SIR HENRY HOWORTH, F.R.S., has had the honorary degree of D.C.L. conferred upon him by Durham University.

OXFORD has conferred the degree of M.A. upon Dr. W. B. Benham, Aldrichian Demonstrator.

MR. W. FISHER, late Conservator of Forests in the North-West Provinces of India, has been appointed Assistant Professor of Forestry at Cooper's Hill.

SCIENTIFIC SERIALS.

American Journal of Science, June.—Electro-chemical effects due to magnetisation, by George Owen Squier.—Nikitin on the quaternary deposits of Russia and their relations to prehistoric man, by A. A. Wright. A summary of the views laid before the International Congress of Archæology in Moscow, 1892, by the Russian geologist, Mr. S. Nikitin, regarding the palæolithic and neolithic epochs in European Russia, and their coincidence with the geological divisions of pleistocene and modern.—Rigidity not to be relied upon in estimating the earth's age, by Osmond Fisher. A criticism of Mr. Clarence King's estimate of the probable age of the earth on the ground of its assumed rigidity not being an established fact. The argument derived from tidal action is fully discussed. Had the solid part of the earth so little rigidity as to allow it to yield in its own figure very nearly as much as if it were fluid, there would be very nearly nothing of what we call tides—that is to say, rise and fall of the sea relatively to the land—but sea and land together would rise or fall a few feet every twelve lunar hours. This would be the case if the geological hypothesis of a thin crust were true. This is the argument for tidal rigidity as enunciated by Kelvin. But this does not take into account the horizontal motion of the water. It rests upon the equilibrium theory of tides as against the canal theory. The latter has been symbolically worked out by Prof. G. H. Darwin. If the earth's interior be assumed to be a liquid of small viscosity, the bodily tide at its equilibrium value will have a height of $1\frac{3}{4}$ feet. This will diminish the hydrodynamical tide by not more than a fifth of its value, and it is quite possible that the tides we actually experience may be tides thus diminished by the fluidity of the earth's interior.—On the treatment of barium sulphate in analysis, by J. I. Phinney. The author shows that alkaline chlorides contaminate barium sulphate thrown down in the presence of an excess of sulphuric acid, and that the process of purifying by hydrochloric acid is inefficient. The only good method for purification is either to fuse, according to Fresenius, with sodium carbonate, extracting and reprecipitating as sulphate, or to evaporate from solution in concentrated sulphuric acid according to Mar.—On the nature of certain solutions and on a new means of investigating them, by M. Carey Lea. The solutions in question are those of sulphates which were tested for free sulphuric acid by a solution of iodoquinia, a very delicate and trustworthy test. Solutions of heavy metallic sulphates, with the exception of ferrous sulphate, contain no free acid. All sesquisulphates examined were dissociated in solution. So were acid salts and alums, with the exception of chrome alum.—Also papers by Messrs. Fairbanks, Moses, Penfield, Johnson, and Pupin.

Bulletin of the New York Mathematical Society, vol. ii. No. 8 [May, 1893, New York]. This number opens (pp. 175–178), with a review by Miss C. A. Scott of Prof. W. B. Smith's "Introductory Modern Geometry of Point, Ray, and Circle" (see NATURE, vol. xlvii. p. 532). We endorse her closing remarks that the usefulness of the book would be greatly increased if he were to translate his work into ordinary mathematical English.—Prof. Echols contributes an interesting note, biographical and otherwise, entitled Wronski's expansion (pp. 178–184). The expansion was presented by Höené Wronski in 1810, to the French Academy of Sciences, and is as follows:—$f(x)=a_0+a_1\omega_1+a_2\omega_2+\ldots$ *ad infinitum*, where $f(x)$, ω_1, ω_2,...are arbitrary functions of x, and a_0, a_1,...are independent of x. The law of formation of the coefficients he calls "la loi suprême."—Dr. Cole, in a note on the substitution groups of 6, 7, and 8 letters (pp. 184–190), furnishes a list of over forty omitted groups supplementary to the lists given by Messrs. Askwith and Cayley in vol. xxiv. of the *Quarterly Journal of Mathematics*.—The *Mathematical Bibliography*, by A. Ziwet (pp. 190–192) gives in some detail an account of the new *Revue Semestrielle des Publications Mathématiques*, &c., issued by the Mathematical Society of

[1] Proceedings of the Academy of Natural Sciences of Philadelphia, 1884.