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On the structure of the retina in man

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alea, Cleodora, Tiedemannia, and *Pneumodermon.* In all, with the exception of *Pneumodermon,* the development of which has been described by Müller (Monatsbericht der Kön. Akad. der Wiss. zu Berlin, October 1852), and by Kölliker and Gegenbaur (Zeitschrift für Zoologie, Bd. iv.), an oval embryo is formed, furnished with membranous ciliated lobes (*velum*) and a shell (even in *Firola*). In the Pteropoda this *velum* is persistent, and becomes transformed into the finlike lateral appendages of these animals. In the Heteropoda, on the contrary, it gradually disappears as the animal acquires its characteristic form. The velum of the Heteropoda and Pteropoda corresponds exactly with that of the Gasteropoda, from which it follows that the lateral lobes or fins of the Pteropoda, which are only an ulterior metamorphosis of the velum, cannot be compared with the foot of the Gasteropoda, as was Cuvier's opinion.

2. Lastly, the author has ascertained that in many Mollusca the generative organs contain both eggs and spermatozoa. The excretory canal of these organs is not double, or furnished with two semi-canals, as was supposed by Meckel, but contains at once eggs and spermatozoa: this was shown by H. Müller of Wurzburg to be the case in *Phyllirhoë.—Comptes Rendus,* Sept. 26, 1853, p. 493.

TEETH OF TESTACELLUS AND GLANDINA.

M. Moquin-Tandon, in the 'Journal de Conchyliologie' (ii. 125), describes the teeth of *Testacellus,* and among other particulars states that the animal has no horny jaws, a retractile proboscis, and is carnivorous.

M. Morelet (in vol. iii. pp. 27 & 257) and M. Raymond (in vol. iv. p. 14 of the same Journal) describe the animal of two species of *Glandina* from America and Africa as having nearly similar teeth, a retractile proboscis without a horny jaw, and the same carnivorous appetite. The latter author considers *Testacellus* as "a *Glandina* with a rudimentary shell." Dr. Wyman described and figured the teeth of *Glandina* in the 'Boston Journal of Natural History,' showing them to be of a conical form.

I intended, in my paper on the Teeth of Pulmonata in the last Number, to have observed, that the illustrations of that paper were kindly drawn by Mr. S. P. Woodward from the well-mounted specimens of Messrs. Cocken and Wilton. The examination of the large series of mounted specimens belonging to these gentlemen and other microscopists, has been very useful to me in these researches, as showing the uniformity and permanence of the characters afforded by the teeth, and sometimes of drawing my attention to peculiarities of form, and inducing me to examine the teeth of the animal they were said to be taken from.—JOHN EDWARD GRAY.

On the Structure of the Retina in Man. By Profs. KÖLLIKER and H. MÜLLER.

The retina is composed of different layers—viz. 1. the layer of cylinders and cones; 2. that of nucleiform bodies; 3. the layer of

gray substance; 4. the expansion of the optic nerve; and 5. the limiting membrane.

Leaving the latter membrane out of the question, we will commence with the layer of the optic nerve. The most remarkable fact to be noticed here, is that according to a discovery of M. Kölliker, the expansion of the optic nerve is interrupted at the *macula lutea*, so that at that place there does not exist the smallest trace of a layer of nervous fibres. In all other parts of the retina the nervous fibres form a very thick and uninterrupted layer at the bottom of the eye; except that at the margins of the *macula lutea* they are lost in a layer of nervous cells, which here form the most internal layer of the retina, and are only covered by the limiting membrane. These cells form a very thick layer in this place, as in a vertical section of the retina, from nine to twelve series of cells placed one behind the other may be seen; these cells possess the characters of the other cells of the retina, which will be referred to hereafter.

With respect to one of the most important questions, the termination of the nervous fibres of the retina, the observations of M. Kölliker upon the human retina show that these fibres are in direct communication with the nervous cells. These cells, which are entirely absent at the entrance of the optic nerve, are all provided with from one to six processes, exactly resembling those found in the nervous cells of the brain and ganglions; these, ramifying several times, are continuous with the true nervous fibres of the expansion of the optic nerve, so that these fibres take their rise in the nervous cells of the retina. The discovery of this important fact is due to the Marquis A. Corti, of Turin, who ascertained it, first, about three years ago in the ruminants and afterwards in the elephant, in which animal the origins of the optic fibres are presented with unparalleled distinctness and beauty. We have verified the facts ascertained by M. Corti on the human retina, and think we may say that in man, as in the other mammalia, there are terminations of the nervous fibres in the cells of the retina. As to free terminations, we have never found them, and we are inclined to believe that, although admitted by several authors, they have no existence in fact.

Next to the nervous fibres and cells, the parts most worthy our attention are the cylinders and cones. The former have been well described by Hannover; but the cones of the retina of man and mammalia have not been sufficiently seen by any observer. The cones are pyriform or conical bodies, three or four times the thickness of the cylinders, but not half their length, situated in the interior of the layer of cylinders. The cones, which on their outer slender portion bear a prolongation resembling a short cylinder, are less numerous than the cylinders; they are tolerably regular in their arrangement. At the position of the *macula lutea*, as observed by Henle, there are no cylinders, whilst the cones are very numerous and form an uninterrupted layer.

One of the facts most worthy attention is, that from the internal portion of each cone and from each cylinder a fibre proceeds, which, after traversing all the layers of the retina, loses itself on the inner

surface of the limiting membrane. This has also been ascertained by Müller to be the case with animals. These fibres, which are all in relation with the nucleiform bodies, of which, as already pointed out by Bowman, there are two layers in the human retina, form a peculiar system of the retina, and are named by us the *radiating fibres*. The principal facts which we have ascertained respecting these fibres, which have hitherto remained unknown, are as follows: every cone at its inner portion is in connexion with an enlarged body containing a nucleus, which is situated in the outer layer of nucleiform bodies; and from this enlarged body, which may be regarded as a cell, a fibre arises, which attains the inner layer of the nucleiform bodies and there becomes connected with one of these, which are only small cells containing a large nucleus; this fibre then traverses the nervous cells and fibres, and at length attaches itself by its extremity, which is inflated and sometimes ramified, to the limiting membrane.

Radiating fibres, exactly resembling these, but finer, also rise from the inner portion of the cylinders, become connected with those nucleiform bodies in the two layers which are not fixed to the fibres proceeding from the cones, and terminate in the same manner at the limiting membrane; it is to be observed, however, that from three to six of the fibres proceeding from the cylinders unite during their passage through the inner layers of the retina so as to form a single fibre, which renders the radiating fibres less numerous in the inner layers. These radiating fibres, like the nervous fibres of the retina, are very delicate, but they never form varicosities, and may thus be distinguished from the true nervous fibres.

Such are the principal facts which we have ascertained with respect to the anatomy of the human retina, and from these physiology may derive certain conclusions of indubitable interest. We establish, in the first place, that it is not by the nervous fibres of the retina that light is perceived, because, on the one hand, that part of the retina which is most sensible to light and which offers the most perfect visual perception, the *macula lutea*, does not exhibit the least trace of the layer of nervous fibres, whilst, on the other hand, the nervous fibres exist in great number at that point where the retina is totally deficient in sensibility. This settled, there only remain the nervous cells of the retina, the nucleiform bodies, and the cones and cylinders, which can be considered as organs of sensation. For our own parts, we should be inclined to regard the nervous cells as fulfilling this function, as it has been shown, both by Corti and ourselves, that the nervous fibres of the optic nerve are continuous with these cells; we are, nevertheless, compelled to lay aside this supposition, as in all parts of the retina which possess the faculty of perception, these cells form several series (ten or twelve) laid one upon another, and it is impossible to admit that we could receive exact and distinct visual impressions, if each ray of light influenced at once ten or twelve cells. The same reason leads us to think that it is not by means of the nucleiform bodies that we receive the impression of light, so that only the cones and cylinders remain for our purpose. We are led to form the opinion that these curious organs, with which physiology has hitherto

been puzzled what to do, are truly the parts destined to receive the impression of light, and we at the same time think that their arrangement side by side in the manner of a mosaic, and their small diameter, are all favourable for rendering the visual sensations as exact as possible. We do not, however, wish to insist too strongly upon this hypothesis, as we have been unable to discover any connexion between the cones and cylinders and the nervous fibres and cells of the retina. We suppose that such a connexion exists, but we have found it impossible to prove it distinctly. All that we have seen is,—

1. That all the nervous cells possess one or two processes, which, proceeding from their external portion, lose themselves in the inner layer of nucleiform bodies; and,

2. That the nucleiform bodies of this layer have generally one or two processes besides the two which are continuous with the radiating fibres mentioned above.

It may be, as indeed we suppose, that these latter fibres are in direct communication with the external prolongations of the nervous cells, so that sensations originating in the cylinders and cones would be transmitted by the radiating fibres to the nervous cells, and thence to the fibres of the expansion of the optic nerve, which would thus become only a means of communication between the organs which perceive the light (the cones, cylinders and nervous cells) and the brain.

In any case, even should our hypothesis of the function of the cylinders and cones be proved false by subsequent discoveries, it will always be certain that the fibres of the optic nerve are not directly acted upon by the light, and that we must seek for the organ of the direct sensation of light in the nervous cells of the retina, whether these cells be directly affected by the luminous rays or by the medium of the cones and cylinders. We admit that the layer of nervous cells in the retina is a true ganglion, or if it be preferred a true nervous centre. We attribute to it the function of the perception of light, and believe that the optic nerve serves merely to transmit the sensations from this centre to the organ of intelligence and consciousness.—*Comptes Rendus*, 26th September, 1853, p. 488.

Discovery in the Human Body of a Substance giving the same Chemical Reactions as Cellulose. By M. Virchow.

M. Purkinje has described some peculiar corpuscles from the human brain, formed of concentric layers and of a structure analogous to that of starch grains. These amylaceous bodies have since been found in several parts, especially in the superficial layers of the walls of the cerebral ventricles and in the spinal cord. Some observers have supposed that it was this substance that constituted the *acervulus cerebri*.

In investigating the microchemical properties of these corpuscles, the origin of which is unknown, I was much surprised to find, that on the addition of watery solution of iodine a bluish tint made its appearance, contrasting strongly with the yellow coloration of the neighbouring parts. The addition of hydrated sulphuric acid to the object immediately produced that bright violet colour so especially characteristic of vegetable cellulose. The repetition of the experi-