

4) Dr. Benham is surprised that I should congratulate Claparède for having worked out the vascular supply of the clitellum.

I did so because Horst and other writers had doubted the accuracy of Claparède's account.

5) Dr. Benham states: — »Mr. Cole [gives] a theory of his own as to the passage of the spermatozoa from one worm to another: a theory founded on no firm basis of fact but on »probabilities«.

I really do not know what this means. I have no theory on this subject. My remarks were merely a criticism of **other** theories. May I suggest that Dr. Benham be good enough to read my paper? (If Dr. Benham has got mixed up again, and is speaking of the formation of the cocoon, my actual words are: — »I can add nothing to the little already known«; »my idea is«; »what we must expect to find«.)

6) Dr. Benham refers to my »explanation« of the tubercula pubertatis.

My actual words are: — »Both these conjectures [i. e. conjectures respecting the function of the tubercula] are improbable, and the tubercula pubertatis must for the present remain a puzzle.«

I think these quotations show that what Dr. Benham was careful enough to label »A criticism« might very fitly have been included among the »Personal-Notizen«.

Edinburgh, May 22nd 1894.

2. Preliminary Note on the Eye of the Leech.

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eingeg. 30. Mai 1894.

In a recent paper (Beiträge zur Kenntnis des Hirudineen-Auges, in: Zool. Jahrbücher, Bd. 5. Abth. f. Morph. p. 552. 1892), Dr. B. L. Maier, a pupil of Prof. Bütschli, calls attention to an interesting feature in the innervation of the Hirudinian eye. He finds that the nerve going to the eye divides at the base of that organ into two branches, the larger perforating the pigment cup and passing as an axial cylinder through the center of the eye, giving off branches to the visual cells as it passes. The other smaller branch passes outside the pigment cup on the incomplete side, and innervates the clear cells lying above and crowding beyond the pigment layer.

Prof. Whitman, in a paper published in the Journal of Morphology in 1889, states that in the eye of *Clepsine* there are two kinds of cells, the clear cells and what he calls the »tactile cells«, which he considers homologous with the tactile cells of the serial sense organs. These two kinds of cells are innervated by two branches of the

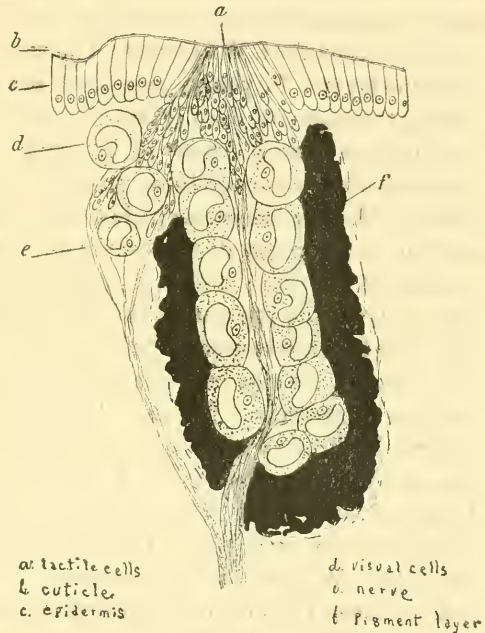
optic nerve, the one terminating in the visual or clear cells, the other in the tactile cells lying above and in front of the visual cells. In a later paper («A Sketch of the Structure and Development of the Eye of *Clepsine*», Zool. Jahrb., Bd. 6), Prof. Whitman says: »If the optic branch, which is extremely short in *Clepsine*, should separate from the main nerve just behind and below the eye, and enter the base of the eye, instead of passing to the front, as it now does, we should have the relations shown in Maier's figure. This resemblance would be essentially complete, if the tactile cells were changed into visual cells. It seems to me most probable that this is precisely what has happened in the history of the *Hirudo* eye.

This accounts for the fact that the upper anterior part of the eye is not covered by pigment, and for the further fact that the visual cells in this region are often spread out rather loosely in front of the proper eye cylinder. It is this surplus of cells that I should regard as that homologue of the tactile elements in the *Clepsine* eye.«

This supposed homology of structure of nerve and tactile cells in *Clepsine* and *Hirudo*, led Prof. Whitman to assign the subject of the development

of the *Hirudo* eye to me as a problem for the summer's work at the Marine Biological Laboratory at Wood's Holl, in 1893.

Before beginning the study of the development of the eye of *Macrobdella*, which among American leeches, is most nearly related to the European medicinal leech, I studied the adult eye of *Clepsine* and *Macrobdella*. Almost the first sections of *Macrobdella* revealed the two kinds of cells found in the eye of *Clepsine*, namely: tactile and visual cells. I then obtained specimens of *Aulostomum*, the Swedish medicinal leech *Hirudo medicinalis*, and a new species, found by Prof. Whitman, near Worcester, Mass., and in all specimens found tactile and visual cells in the adult eye. In other respects the eye follows



very closely the description given by Maier and other writers. The visual cells, called by various writers, »Glaskörper«, »Glaskörperkugeln«, and »lichtpercipierende Zellen«, are arranged in a single layer around the axial nerve-fibers. The symmetry of this arrangement is broken at the upper end on one side by a multiplication of the visual cells, so that the layer there may be two or three cells thick. A point not mentioned by Maier is the fact that in the anterior eyes this multiplication of clear cells takes place at the upper anterior side, while in the posterior eyes the upper posterior side contains the surplus cells. The visual cells contain a large crescentic or horse-shoe shaped vacuole surrounded by a layer of protoplasm, in the most thickened part of which the small nucleus is placed, as first pointed out by Prof. Whitman. The visual cells are surrounded by the pigment layer. In young specimens with completely developed eyes, having the pigment decolorized by hardening in picro-sulphuric acid, the pigment layer is found to be made up of a single layer of small quadrangular cells containing small, not very distinct nuclei, centrally placed. Outside the pigment layer is a layer of connective tissue. The position of the pigment cup leaves an opening at the upper part of the eye and at one side, and it is at this opening that the tactile cells are found. Over the top and at the side of the pigment cup, the epidermal cells become elongated to two or three times their normal length. Their nuclei are smaller than those of the clear cells and situated at the base of the cells. These cells are the homologues of the cells discovered by Prof. Whitman in *Clepsine* and *Nepheleis*, and probably possess the same sense hairs. I have sectioned a few specimens of the Japanese land leech *Haemadipsa japonica* and find elongated tactile cells above the clear cells. They are much longer and more numerous than Prof. Whitman's drawing of the land leech would indicate, and are more symmetrically arranged than in *Macrobdella*. The arrangement of visual cells is perfectly symmetrical, as shown by Prof. Whitman. I have not thus far been able to discover any loose or over crowded arrangement of visual cells. In Prof. Whitman's drawing of the land leech, the nerve is represented as entering at the side and not the base of the eye, as shown by Maier. I find the nerve in both positions in *Macrobdella* and *Aulostomum*, but have not decided whether it is peculiar to anterior or posterior eyes. The nerve of the eye in all specimens examined has two branches as indicated by Maier.

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