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II. Wissenschaftliche Mittheilungen.

1. On the Organ of Jacobson in Ophidia.

By Prof. R. Ramsay Wright, Toronto.

In his recent paper on the Lachrymal Duct in *Tropidonotus* Born¹ offers a new interpretation of the cellular columns which form the greater part of the thickness of the roof of Jacobson's Organ. — He regards them as »die zellige Ausfüllungsmasse einfacher Drüsen von birnförmiger Configuration, die dicht an einander gedrängt die ganze Schleimhaut durchsetzen«, while Leydig on the other hand believed the cells composing the columns to be largely of ganglionic nature. —

A recent study of Jacobson's Organ in the common Garter-Snake — *Eutaenia sirtalis* (Baird & Girard) — induces me to believe that the older explanation is nearer the truth, and recalls some points of histological detail described by Klein for the Rabbit and Guinea-pig².

The material at my disposal consisted of a series of sections of an embryo-head 6mm in length, and a series from the adult both made by Mr. A. B. Macallum who will shortly publish an account of the nasal region in *Eutaenia*³ — I also made a second series from the adult to control the observations recorded below.

Structure of the Olfactory Epithelium in the Nasal Cavity.

Immediately within the cartilaginous nasal capsule lies the mucosa in which the following structures are to be observed: 1) branched tubes of Bowman, 2) olfactory nerve-bundles, 3) pigment-cells, 4) capillaries which surround the glands and form a plexus on which, with the intervention of a distinct basement-membrane, the Neuroepithelium rests. The average height of the Neuroepithelium

¹ Morpholog. Jahrb. 8. Bd. 2. Heft.

² Quart. Journ. Micr. Soc. Vol. XXI.

³ In a forthcoming Fasciculus of the 'Proceedings of the Canadian Institute', Toronto.

on the roof of the nasal cavity is 90μ , of which 28μ belongs to a superficial stratum formed by the cylindrical bodies of the ordinary epithelial cells (exclusive of their deep processes) and the intervening superficial processes of the olfactory cells⁴, while the remainder of the height is occupied by a deep or nuclear stratum formed by the numerous (8 or 9) layers of olfactory cells⁵.

Structure of the lining membrane of Jacobson's Organ.

a. The Roof. Immediately within the osseous capsule which the Vomer forms for Jacobson's Organ lies a somewhat scanty mucosa which is largely occupied by olfactory nerve-bundles: it is more richly pigmented than the corresponding layer in the nasal cavity, its blood-vessels are of larger calibre, and it is destitute of Bowman's glands. Most of the elements of the mucosa are continued inwards towards the lumen of Jacobson's Organ between its cellular columns, which are thus isolated from each other by pigmentary connective-tissue and capillary vessels. Very few of the olfactory nerve-fibres appear to run in the partitions thus formed, the bundles entering the outer ends of the cellular columns almost entirely. The capillaries arrived at the deep surface of the Neuro-Epithelium form there a plexus, the polygonal meshes of which are occupied by the inner ends of the cellular columns. This plexus obviously corresponds to that on which the neuro-epithelium 'in the nasal cavity rests, both there is no intervening basement membrane for a reason which will be presently apparent. The neuro-epithelium (inside the plexus) is only 33μ high, and the greater part of this belongs to the superficial stratum (as defined above) while only one or two layers of cells corresponding to the nuclear stratum are to be detected. These latter cells however, differ in form, according as they stand opposite a node or a mesh in the capillary plexus: in the former case they are shorter, and their deep processes are bent in such a manner as to pass round the vessel, in the latter case they are more fusiform, and they retain this shape for three or four layers while passing through the mesh into the corresponding cellular column. With the exception of these spindle-shaped cells which form their inner ends the cellular columns are formed entirely of cells

⁴ Although the cilia in the ordinary mucous membrane of the Nasal Cavity, and those on the floor of Jacobson's Organ are well preserved in my preparations, I am unable to speak definitely of the structures outside the Memb. lim. olfact. either in the nasal cavity or in Jacobson's Organ.

⁵ Hoffmann (Chelonia p. 228) hesitates to describe the deeper cells of this stratum as olfactory cells. On the other hand Klein (l. c. p. 565) and Retzius (Arch. Anat. Phys. 1880. I.) appear to have established in layers quite as thick that the superficial processes of the deepest cells do reach the surface. I have not convinced myself that such is the case here, and am inclined to doubt its possibility in the organ of Jacobson (vide infra).

completely resembling those of the nuclear stratum in the olfactory epithelium of the nasal cavity; i. e. they possess rounded nuclei ($6-7 \mu \times 5 \mu$) surrounded with very scanty protoplasm prolonged into processes at either end. The highest columns measure about 300μ .

β . The Floor. The following structures may be traced from roof to floor:

1) the layer of ordinary cylindrical epithelial cells, which are now only 15μ high, and bear short cilia: between the bases of these are wedged small rounded cells forming rarely more than one layer; these rest on

2) the capillary plexus, which is directly continuous with that mentioned above: the rest of the mucosa is occupied by

3) the abundant pigment cells, which spread out at junction of roof and floor to surround the cellular columns in the mode described above.

Structure of the parts in the embryo examined.

The following points are worthy of remark. The neuro-epithelium in the nasal cavity is as high as in the adult, but the glands of Bowman are not yet developed. The highest of the cellular columns in Jacobson's Organ are from $150-180 \mu$, while the neuro-epithelium (inside the capillary plexus) is from $56-67 \mu$ high, of which 28μ still belongs to the superficial stratum. The nuclear stratum (inside the plexus) is thus much higher in the embryo than in the adult, while the cellular columns are not yet so high, and are separated by a somewhat more abundant mucosa.

From the above data I conclude that the cellular columns in the roof of Jacobson's Organ are outgrowths of the nuclear stratum of its neuro-epithelium, the polygonal form of which has been determined by the meshes of the capillary plexus through which the outgrowths have taken place, and that in the course of development more and more of the cells of the nuclear stratum have been pushed outside the boundary formed by the capillary plexus, till eventually little but the superficial stratum is left inside that boundary.

The cellular columns push before them the basement membrane, only traces of which (opposite the nodes in the plexus) are to be found in its original position inside the plexus.

I have purposely used the term 'nuclear stratum' rather than 'layer of olfactory cells', because I doubt whether the superficial processes of the cells in the deeper layers ever do reach the surface, and thus fulfil the definition of an olfactory cell. On the other hand their deep

processes are unquestionably in connection with the fibres of the olfactory nerve, as many places in my preparations show. Fresh material will be required to elucidate the course of the superficial processes of these cells: it is possible that they may only indirectly reach the surface through the medium of those more superficial cells with longer nuclei which are undoubtedly 'olfactory', in which case the deeper cells would have to be interpreted as ganglion-cells formed in the course of the olfactory fibres to the true olfactory cells⁶. However this may be settled, I think there is no doubt of the identity in structure of the deeper parts of the nuclear stratum in the nasal olfactory epithelium and the cellular columns of the Organ of Jacobson.

The following arguments appear to favour the above conclusion:

1) Reichel⁷ has already called attention to the late development of all glandular structures in the head of the *Ophidia*. In the embryo examined neither Müller's lateral nasal gland, nor Bowman's glands, nor the palatine crypts are developed; the superior labial gland is just beginning to be formed while the outgrowths of the neuro-epithelium of Jacobson's Organ are already formed at a much earlier stage. (v. Born, l. c.).

2) Klein has pointed out that the great thickness of the neuro-epithelium on the median wall of Jacobson's Organ in the Rabbit and Guinea-pig is due to the increased number of layers of 'sensory' cells which may even extend out in small groups into the mucosa. Both in this respect and in the fact that the olfactory nerve is entirely distributed to it, the median wall of Jacobson's Organ in the Mammalia corresponds to its roof in the Reptilia.

3) In anterior and posterior frontal sections through Jacobson's Organ, where the cellular columns are cut across, I have failed to find any indication of a lumen, and indeed the protoplasm surrounding the cells is so scanty that it would be impossible to ascribe a secretory function to the cells at either of the stages examined. That they possess such merely at an earlier stage is abundantly disproved by the fact that the columns only attain their full size in the adult⁸.

⁶ Wiedersheim (Lehrbuch der vergl. Anat. p. 355) copies a diagram from Merkel according to which all the fibres of the higher sense-nerves pass through a ganglion-cell before entering their proper terminal cells. Perhaps this is not intended to include the olfactory nerve-endings, for I do not remember to have seen other than a direct communication between olfactory nerve fibres and olfactory cells suggested. I cannot refer to Merkel's work at present.

⁷ Morphol. Jahrb. 8. Bd. 1. Hft.

⁸ I have considered the possibility of the cellular columns being glands of the sort figured by Hoffmann from the olfactory epithelium of *Sphargis* and *Chelone* (l. c. T. XXXIV, Fig. 8) the cavities of which are filled by a cellular mass. These

4) Jacobson's Organ receives a very large share of the olfactory nerve-bundles. It would be difficult to account for this, were the cellular columns functionless glands; while the explanation of their nature offered above is in harmony with what we know of Jacobson's Organ in the Mammalia, and points to the conclusion that it is a highly specialised portion of the olfactory epithelium.

April, 1883.

2. Contribuzione alla fisiologia degli spermatozoidi.

Nota di Enrico Stassano.

In molte fecondazioni artificiali incrociate fra varie specie di echini ho osservato talune cose interessanti sopra un' attività speciale che posseggono gli spermatozoidi.

Le varie fasi della segmentazione nelle uova degli echini, fecondate da individui dell' istessa specie, non si manifestano contemporaneamente. In alcune specie la segmentazione in due si manifesta, per esempio, circa un ora e mezzo dopo che si è praticata la fecondazione, mentre le uova d' un' altra specie di echini cominciano a vedersi segmentate due ore, tre ore e quattro ore dopo.

Nelle fecondazioni incrociate s' osserva invece che gli spermatozoidi comunicano alle uova la particolarità di accelerare o di ritardare le fasi della segmentazione, secondo che le uova della loro specie si segmentano più presto o più tardi dopo che le hanno fecondate.

Dal giornale delle esperienze trascrivo la seguente pagina che mostra chiaramente come procedono le cose.

»Il 17 Marzo, alle 10 del mattino, fò la fecondazione artificiale »fra quattro specie di echini: l'*Arbacia pustulosa*, l'*Echinocardium cordatum*, l'*Echinus microtuberculatus* e lo *Sphaerechinus granularis*. Gli »spermatozoidi di ognuna di queste specie si fanno fecondare contemporaneamente in diversi bicchieri, le uova delle quattro specie.

»Alle 12^h m. le uova dell' *Echinocardium* fecondate dagli spermatozoidi dell' istessa specie, presentano la segmentazione in due. Le »uova del *microtuberculatus* e dell' *Arbacia* fecondate dall' *Echinocardium* cominciano a presentare contemporaneamente qualche segmentazione in due.

»Alle 12^h 15' le uova dell' *Echinocardium* fecondate dall' *Arbacia*, »dal *microtuberculatus* e dallo *Sphaerechinus* presentano appena gli orli »irregolari.

however are possessed of very distinct ducts, and walls lined with cylindrical epithelium, whereas the parietal and central cells of the cellular columns of Jacobson's Organ are identical.

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