

unites with a corresponding portion from the canal of the opposite side, and thus forms the temporal commissure; the trunk portion runs backwards from the outer end of the commissure to terminate on a level with the end of the vertebral column, after making a characteristic bend above the lower lobe of the caudal fin.

The precommissural part receives two branches of the lateralis nerve, and gives off five tubules. The temporal commissure receives sixteen branches (eight from each lateralis nerve) and gives off sixteen tubules; while the trunk or main part of the lateral canal receives numerous branches from the lateralis nerve as it passes backwards along the trunk and tail.

The paper concludes by referring to the views held as to the function of the sensory canals, and to some of the modifications of the sensory canals found in Elasmobranchs.

Amongst other things it is pointed out that in some cases e. g. *Heptanchus*, the greater extent of the lateral canal is represented by a furrow; while in other cases, e. g. *Alopias*, the canal system is more elaborate than in *Laemargus*, the lateral and other canals giving off numerous long branching tubules; and that while in the comparatively inactive Torpedoes the canal system is feebly developed — the ventral canals being either absent or in a vestigial condition, — in the active Myliobatidae it reaches an enormous development, partly by the folding of the canals, but chiefly by the dichotomous division of both the dorsal and ventral tubules.

3. The lateral sense organs of Elasmobranchs. II. The sensory canals of the common Skate, *Raia batis*.

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In this paper it is pointed out that the lateral sense organs of the Skate consist of 1) Sensory Canals, 2) Ampullary Canals, and 3) Sensory Follicles.

The sensory canals, the only structures dealt with in detail, have the same general arrangements and are related to the same nerves as in *Laemargus*; the supra-orbital, infra-orbital and hyo-mandibular canals being related to the superficial ophthalmic, buccal and hyo-mandibular divisions of the facial respectively, and the lateral canal to the lateralis division of the vagus. But while the canals of *Raia*

¹ Abstract of a paper communicated to the Edinburgh Royal Society. December 1891.

generally agree with those of *Laemargus*, one of them, — the hyo-mandibular — presents in *Raia* a remarkable extension over both aspects of the greatly expanded pectoral fin. By this extension of the hyo-mandibular (which is found in the shark-like rays as well as in the greatly specialized Torpedoes), the skates and rays can be readily distinguished from the sharks.

The supra-orbital canal, beginning in connection with the infra-orbital and lateral canals, proceeds forwards to the tip of the snout which it pierces, and then runs backwards and outwards, to terminate by opening into the infra-orbital canal, after forming a long prenasal loop. The dorsal part of the canal gives off twenty-three tubules — arranged in three separate groups — and receives thirty-six nerves, twenty of which reach the rostral part of the canal, which has no direct communication with the surface. The ventral part opens to the surface by twenty-two very short tubules, and receives thirty-six nerves, which, like those for the dorsal part, come from the superficial ophthalmic division of the facial.

The infra-orbital canal, beginning like the supra-orbital at the anterior end of the lateral canal, runs outwards and forwards external to the eye, pierces the snout and then runs backwards; and, after communicating with the supra-orbital and hyomandibular, runs outwards behind the nasal capsule to meet its fellow of the opposite side in front of the mouth. Leaving its fellow, it runs forwards to again unite with it at the tip of the snout. The dorsal part gives off a large tubule as it bends forwards under the eye, and twelve tubules, four of which open into a dorsal extension of the hyomandibular canal. The ventral part opens to the surface by thirty-seven tubules, the majority of which are extremely short, owing to the canal being partly embedded in the skin.

The dorsal part of the canal receives in all twenty-five branches; while the ventral part receives sixty-six branches from the buccal nerve, some of the branches springing from the main trunk, some from the inner and some from the outer divisions of the buccal division of the facial.

The hyomandibular canals bear in their extent a relation to the greatly expanded pectoral fins. Beginning in front connection with the infra-orbital, each canal runs backwards, beyond and external to the branchial clefts, to form a well-marked ventral loop, the outer limb of which passes to the dorsal surface; and after expanding, runs backwards to open into the long scapular offshoot from the lateral canal. From the ventral portion of the hyomandibular canal only fourteen tubules spring, the dorsal part has four of the infra-orbital tubules

opening into it anteriorly, and thirty-nine tubules springing from it as it proceeds backwards. The anterior part of the hyomandibular canal, the ventral loop and the dorsal extension are all supplied with branches from the hyomandibular nerve, some of which leave the nerve before it enters the large hyomandibular group of ampullae; while others leave the nerve after it enters the ampullary capsule. Exclusive of the loop, there are about twenty branches reaching the ventral part of the canal, and over fifty the dorsal extension.

The mandibular portion of the hyomandibular canal is not in connection with the horizontal part; but the two mandibular portions meet and blend in the middle line. From the mandibular commissure thirty-nine tubules spring; and each half receives thirteen branches from the mandibular branch of the hyomandibular nerve.

The lateral canal consists of the trunk, commissural and precommissural portions. The precommissural portion continuous with the infra-orbital, runs back to the outer end of the temporal commissure; the commissural portions run inwards behind the auditory pores, to meet and blend in the middle line, the trunk portion runs backwards from the end of the commissure to the end of the vertebral column, giving off two branches — a scapular and a post-scapular — on the way.

The precommissural and commissural portions give off no tubules, the trunk portion in front of the scapular branch gives off eleven tubules, and behind the post-scapular offshoot tubules are regularly given off from the canal as it proceeds backwards — one for each segment. Twenty-six tubules spring from the scapular branch, and twenty from the post-scapular branch of the trunk canal. The precommissural, commissural and the part of the trunk canal in front of the shoulder girdle are supplied by a special branch which springs from the lateralis nerve immediately beyond its ganglion. Two branches spring from the lateralis in the region of the shoulder girdle, to supply the scapular and post-scapular offshoots, and the part of the main canal in the vicinity of their origin. Thirty twigs enter the scapular and twenty-four the post-scapular branches of the main canal. The trunk canal, as it proceeds backwards from the region of the shoulder girdle, is perforated by a branch from the lateralis nerve opposite each of the tubules by which it opens to the exterior, the length of the nerves gradually diminishing from before backwards.

The paper concludes with a short account of the histology of the sensory canals, and of their sense organs (nerve hillocks), and a short reference to the sensory follicles — the spalt-papillen discovered by Fritsch.

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