Proceedings of the Iowa Academy of Science

Volume 17 | Annual Issue

Article 31

1910

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Recommended Citation

Norris, H. W. (1910) "The Cranial Nerves of *Siren lacertina*," *Proceedings of the Iowa Academy of Science*, 17(1), 223-226.

Available at: <https://scholarworks.uni.edu/pias/vol17/iss1/31>

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THE CRANIAL NERVES OF *SIREN LACERTINA*.

BY H. W. NORRIS.

In this preliminary account of the cranial nerves of *Siren* little reference will be made to the characteristic urodele features, but the descriptions will deal chiefly with those characters that have a special significance in *Siren*.

For our knowledge of the cranial nerves of *Siren* we are indebted to the researches of Fischer (1864), H. H. Wilder (1891) and Druener (1904).

The olfactory nerve in *Siren* is double. A posterior series of rootlets gives rise to a trunk supplying the anterior nasal epithelium and Jacobson's organ; an anterior series of rootlets innervates the posterior nasal epithelium; the two series in origin and distribution are distinct, no observable anastomosing between the two olfactory trunks taking place.

The optic and eye-muscle nerves are of the usual form found in urodele amphibians, all being imperfectly developed in consequence of the rudimentary condition of the eyes.

Of the anastomoses between the fifth and seventh nerves found in other Urodela the following occur in *Siren*: 1. General cutaneous fibers from the gasserian ganglion unite with the ramus ophthalmicus superficialis (lateral line) to form a supra-orbital trunk. 2. An infra-orbital trunk is formed by the union of general cutaneous fibers from the gasserian ganglion with the ramus buccalis VII (lateral line). A branch of the infra-orbital trunk, containing both lateral line and general cutaneous fibers, combines with a branch of the ramus ophthalmicus profundus V (general cutaneous fibers) to form a nerve that sends its lateral line fibers to innervate the anterior portion of the infra-orbital series of neuromasts and its general cutaneous component to form an anastomosis with the ramus palatinus VII. 3. The palatinus-ophthalmicus anastomosis at first sight seems to be peculiar, but is found to fall into line with that described in *Amblystoma* (Coghill) and *Amphiuma* (Norris). 4. The anastomosis between the alveolaris VII and a branch of the ramus mandibularis V, that seems to be characteristic of the Urodela, occurs in *Siren* to the extent only that the two branches in question pass a

short distance in contact with each other, without any exchange of fibers.

From the dorsal edge of the dorsal lateral line ganglion of the seventh nerve there passes posteriorly a branch that anastomoses with the rami supra-temporalis and auricularis X. No such anastomosis has been reported in any other amphibian. It is very suggestive of the condition found in the Cyclostomata, where a branch of the lateral line component of the seventh nerve joins the ninth and tenth nerves.

As has been noticed by previous writers the ramus palatinus and alveolaris VII of *Siren* arise from the ganglion by a common trunk, from which there is given off posteriorly a nerve called by Wilder the posterior palatine. This latter nerve passes in part to the pharyngeal region, but a part of it anastomoses with the ramus pretrematicus IX forming Jacobson's commissure.

The lateral line constituents of the seventh nerve have in general the characteristic distribution.

The discovery in *Siren* by Druener of a levator arcuus hyoidei muscle, which he believes to be innervated by a branch of the ramus jugularis, is confirmed.

The ninth and tenth nerve ganglia are nearly distinct from each other. The ramus communicans carries from the tenth to the seventh nerve general cutaneous fibers only.

Pretrematic rami of five branchial nerves are found, but only three post-trematic rami. The various branches of the tenth nerve show a marked tendency toward an early departure from the main trunk; hence the diffuse character of a large part of the nerve as described and figured by Wilder and others. Motor components of the posttrematic rami of the first and second branchial nerves unite and innervate the ceratohyoideus internus muscle. The ramus intestinalis recurrens is entirely motor. The sensory constituents usually found in this nerve in other Urodela leave the vagus ganglion as a distinct nerve united with other sensory fibers that form the fourth and fifth pretrematic nerves. The name, ramus sensorius recurrens X, is suggested for this nerve after the pretrematic and other pharyngeal branches are given off.

The occurrence of persistent gills in *Siren* necessitates some special innervation of the branchial region. From the ninth or first branchial nerve a small general cutaneous component goes to the skin over the first branchial arch. From the second branchial nerve (vagus I) the levator branchiae 1 and depressor branchiae 1 and 2 muscles are innervated. It also sends general cutaneous branches to the first and second gills. From the third branchial nerve (vagus II) the levator branchiae 2 and 3 and depressor branchiae 3 muscles are innervated. From the same nerve are given off general cutaneous branches to the third gill.

The hypoglossal nerve is formed from branches of the first and second spinal nerves as Druener has stated.

A comparative study of the morphogenesis of the sympathetic nervous system in birds and mammals reveals certain points of difference which evidently have phylogenetic significance. Two pairs of sympathetic trunks arise in the course of ontogeny in birds, while in mammals a single pair of sympathetic trunks is developed. In the early stages in mammals the prevertebral plexuses show their greatest development in the region of the suprarenals. In the early stages in birds, these plexuses show their greatest development in the sacral region. This character in birds is obviously correlated with the enormous development of the ganglion of Remak which has no counterpart in mammals. The pulmonary plexuses in mammals arise from cells which migrate from the vagi along the walls of the bronchi. In birds cells wander from the slender branches of the vagi, lying along the walls of the oesophagus, directly into the anlagen of the pulmonary plexuses. In mammals the anlagen of the cardiac plexus arise in the angle between the aorta and the pulmonary artery. In birds the anlagen of the cardiac plexus arise in the atrial septum. These morphogenetic differences, doubtless, indicate that the sympathetic system has departed more widely from the original type in birds than in mammals.

A study of the development of the sympathetic system in birds, as well as in mammals, warrants the conclusion that the nervous system is a unit of which the sympathetic system is a part homologous with the other functional divisions. The morphogenetic differences above pointed out in the development of the sympathetic system in birds and mammals obviously indicate specializations in certain directions which have arisen in response to the peculiar conditions of the vegetative functions.

SUMMARY.

1. The primary sympathetic trunks in the chick arise during the fourth day of incubation, as a pair of cell-columns lying along the dorso-lateral surfaces of the aorta. The anlagen of the secondary sympathetic trunks arise about the beginning of the sixth day, as ganglionic enlargements on the median sides of the spinal nerves. These ganglionic enlargements are at first independent of each other, but become connected later by longitudinal commissures. The primary sympathetic trunks reach their maximum development during the course of the sixth day and then give way to the secondary sympathetic trunks. These observations do not differ essentially from those of His, Jr.

2. The prevertebral plexuses arise from cells which migrate ventrally from the primary sympathetic trunks.

3. The ganglion of Remak arises as an oval cell-column lying in the mesentery just dorsal to the rectum. It is composed of cells which migrate ventrally from the hypogastric plexus.

4. Cells migrate from the neural tube and the spinal ganglia along the spinal nerves. Some of these cells deviate from the course of the spinal nerves and give rise to the sympathetic trunks.

5. The vagal sympathetic plexuses: viz., the cardiac plexus and the sympathetic plexuses in the walls of the visceral organs arise from cells which migrate from the hind-brain and the vagus ganglia along the fibers of the vagi. The myenteric and the submucous plexuses in the posterior region of the intestine probably receive some cells from the ganglion of Remak.

6. The cells which migrate from the neural tube and the cerebro-spinal ganglia are the "indifferent" cells and the "neuroblasts" of Schaper. Therefore, they are homologous with the cells giving rise to the neurones and the neuroglia cells in the central nervous system, and the sympathetic neurones are homologous with the efferent and afferent components of the other functional divisions of the peripheral nervous system.

7. Morphogenetic differences obviously indicate that the sympathetic system has departed more widely from the original type in birds than in mammals.