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This paper is intended to be supplementary to the paper by the same title presented at the 1927 meeting of the Iowa Academy of Science by Smiley, Ingram and Blagg.

Davidson (1918) and Daniel (1922) in their treatment of the structures of the parietal fossa in Heptanchus do not refer to the work of previous investigators other than Howes (1883). Scarpa (1789) seems to be the first to recognize this depression as a feature of importance, although Geoffroy (1778) figures it indistinctly in Raia and describes two apertures, an anterior smaller and a posterior larger, that are without doubt the foramen of the endolymphatic duct and the fenestra ovalis of Scarpa respectively. Geoffroy suggests that these openings may serve as the inlets of sound vibrations. Scarpa figures and mentions in Raia a groove on the inner wall of the vestibule of the ear, at the top of which is the fenestra. This groove is called the tympanum by Howes (1883) and the fenestral furrow by Daniel. Scarpa shows the characteristic relation of the posterior semicircular canal to the fenestra and to the groove. He does not designate the parietal fossa by a distinct name. In *Catulus caniculus* (*Squalus catulus* L.) he finds a fenestra in the fossa closed by a membrane, essentially as in the rays, but the fenestrae are closer together. As he denies that the endolymphatic duct communicates with the exterior he consequently finds no endolymphatic sac in the fossa, nor does he distinguish the foramen through which the endolymphatic duct passes. Weber (1820) was apparently the first to see a pair of small muscles in the fossa. I have not had access to this paper of Weber. Breschet (1838) gives excellent figures of the fossa in Raia and shows the endolymphatic sac ("canal ascendens") with the attached endolymphatic muscle; also the fenestra ovalis and the foramen of the endolymphatic duct. He suggests that the endolymphatic muscle serves to compress the endolymphatic sac. In opposition to Scarpa Breschet shows plainly that the sacculus of the ear is in free communication with the exterior through the endolymphatic duct and sac. To Hasse (1873) are due the terms ductus endolymphaticus and saccus endolymphaticus. Retzius (1878) proved beyond question that the sacculus of the Plagiostome ear is in free communication with the exterior through the endolymphatic duct, the latter opening by a minute pore on the top of the head. Retzius also (1881) showed the muscle of the endolymphatic duct not only in the rays (Raia), but also, as Breschet had failed to do, in the true sharks (*Squalus acanthias*).

I have found the endolymphatic sac and its attached muscle present in the following genera: Carcharinus, Cephaloscyllium (Catulus), Galeorhinus, Heptanchus, Heterodontus, Mustelus, Rhina, Squalus, Triakis, Myliobatis, Platyrhinoidis, Pteroplatea, Raia, Rhinobatus, Urolophus and Zapteryx. We may therefore consider them present in all Plagiostomes.

As to the presence in the parietal fossa of Elasmobranchs of a structure analogous in function to a tympanic membrane, as Daniel believes, there is room for differences of opinion. But the facts compel one to deny that there is a membrane stretched across the fossa, just beneath the skin, its tension regulated by a pair of small muscles, as Daniel concludes for Heptanchus. This pair of small muscles is invariably inserted on the endolymphatic sacs. It is true that usually a membrane closes the fenestra (fenestra ovalis of Scarpa) in the bottom of the fossa. But a definite fenestral membrane forming a part of the wall of the fossa does not always exist. In many instances, as in Cephaloscyllium, Galeus, Mustelus, Rhina and Squalus, the membranous wall of the posterior semicircular canal closes the fenestra, and not a distinct fenestral membrane. In Mustelus and Urolophus there is a fenestral membrane and in addition the posterior semicircular canal wall also blocks the fenestral passage. A fenestral membrane is usually present in the rays. One is also found in Triakis among the true sharks. A distinct fenestra is lacking in Heterodontus and Pteroplatea and probably is combined with the foramen of the endolymphatic duct. In Zapteryx there is certainly a union of the fenestra with the foramen of the endolymphatic duct. In Myliobatis the fenestra is completely covered by the anterior extension of the trunk muscles. In the rays the fossa is shallow and in Myliobatis is essentially nonexistent, the endolymphatic sac and its muscle being flattened out between the skin and the skull.

Daniel states that in the fossa of preserved specimens of Heptanchus occur many granules, coagulations of the original fluid of the fossa. These I find are confined to the endolymphatic sac and duct and the latter's continuation into the sacculus and do not occur in the fossa itself. Daniel notes also that sand grains are reported to be found in the sacculus of adult Squatina (Rhina). In the endolymphatic sac of adult *Squalus acanthias* I have found siliceous as well as calcareous grains filling the sac, these sand grains extending down into the sacculus. So abundant is the sand in the adult Squalus that it is well nigh impossible to cut sections of the endolymphatic sac. In advanced embryos of Squatina taken from the oviduct of the parent I have invariably found sand grains in the endolymphatic sac and thence on into the sacculus. But when one considers free communications of the oviducts with the cloaca in this form, and the possibility of free movements of the embryos about in the oviducts, it is not strange that sand should find its way far up the oviduct and easily enter the large endolymphatic ducts of the embryos, for the oviduct in Squatina is little more than a brood sac. In general the endolymphatic sacs of elasmobranch embryos do not contain concretions or sand grains, nor are the latter objects invariably present in the ear of the adult forms.

I see no good reason for opposing the view of Daniel that a functional "tympanic membrane" exists in the parietal fossa of Elasmobranchs, but it is not a constant structure. It is not present in all forms; it is variously situated and constituted. I am not able to find it in Heptanchus, unless it be the wall of the posterior semicircular canal.

LITERATURE CITED

BRESCHET, M. G. 1838. Recherches anatomiques et physiologiques sur l'organe de l'ouie des poissons. Acad. d. Sci. Savans Etrangers, T. V.

DANIEL, J. F. 1922. The Elasmobranch Fishes. Berkeley, Calif.

DAVIDSON, P. 1918. The Musculature of *Hèptanchus maculatus*. Univ. Calif. Pub. (Zool.), 18.

GEOFFROY, E. L. 1778 (1780). Abhandlungen von dem Gehörwerkzeuge des Menschen, der Amphibien und Fische. Leipzig, 1780. Translation from the French: "Dissertation sur l'organe de l'ouie de l'homme, des reptiles et poissons" Amsterdam, 1778.

HASSE, C. 1873a. Die Lymphbahnen des inneren Ohres der Wirbelthiere. Anat. Stud., Bd. I, Nr. XIX.

1873b. Die vergleichende Morphologie und Histologie des hautigen Gehörorganes der Wirbelthiere. Suppl. z. d. Anat. Stud., Bd. I.

HOWES, G. B. 1883. On presence of a tympanum in genus Raia. Jour. Anat. Physiol., 17.

LUTHER, A. 1909. Untersuchungen über die vom N. trigeminus innervierte Muskulatur der Selachier (Haie und Rochen) uter Berücksichtigung ihrer Beziehungen zu benachbarten Organen. Acta Soc. Sci. Fenn., T. 36, Nr. 3.

RETZIUS, G. 1878. Zur Kenntniss von dem membranösen Gehörlabyrinth bei den Knorpelfischen. Archiv. Anat. u. Physiol., Anat. Abt.

1881 Das Gehörogan der Wirbelthiere. Stockholm.

SCARPA, A. 1789 (1800). Anatomische Untersuchungen des Gehörs und Geruchs. Nurnberg, 1800. Translation from the Latin: "Anatomicae disquisitiones de auditu et olfactu." Ticini, 1789.

SMILEY, R. E., INGRAM, W. R., and BLAGG, E. M. 1927. The organs of the parietal fossa in Elasmobranchs. Proc. Iowa Acad. Sci., vol. 34, 1927.