

Citation:

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Anatomy. — "*The arrangement of the motor nuclei in Chimaera monstrosa compared with other fishes*" By C. U. ARIËNS KAPPERS.
(Communicated by Prof. L. BOLK).

(Communicated in the meeting of February 24, 1912).

Examining the oblongata in different orders of fishes great differences are found in the topographic relations of the motor nuclei. On the other hand there is a striking resemblance in the arrangement of those nuclei within the limits of an order. Cyclostomi show principal differences in this respect if compared with the Selachii, and the oblongata of the latter is again very different from that in Teleosts. Recently DROOGLEEVER FORTUYN¹⁾ found that Ganoids (*Amia Calva*) are again different from both.

These observations add to establish more differences between classes and orders drawing the lines of limitation sharper.

In the end of last and the beginning of this year I had a chance to examine a specimen of the order of Holocephali. This seemed important to me because the animal (*Chimaera monstrosa*) represents a separate order and because in several respects its brain stands in between that of the Selachii and Teleostei.

I wanted to know: 1. If the arrangement of the motor nuclei in the oblongata of *Chimaera* revealed such characteristics as should be expected in a separate order; 2. if these characteristics stand in between those of the Selachii and Teleostei.

Although I did not expect a great difference in the internal structure of the oblongata with the Selachian type, on account of the striking macroscopical resemblance between this oblongata and the Selachian, my studies gave very interesting results, which proved on one hand that also on account of the arrangement of the motor nuclei in the oblongata *Chimaera* deserves a special place in the classification of vertebrates and that on the other hand it stands in between the Selachian and Teleostean type.

The facts are these:

The selachii have only a dorsal oculomotor nucleus; HUEB²⁾. A real ventral nucleus as in Cyclostomes or in Teleosts and Ganoids (*Amia Calva*, DROOGLEEVER FORTUYN) is not present. In this respect *Chimaera* resembles the selachii. The IVth nucleus has the same features in Selachii, Holocephali and Teleostii.

¹⁾ Notiz über den Eintritt der motorischen Nerven-wurzeln in die Medulla Oblongata und die Lage der motorischen Kerne bei *Amia calva*. Folia Neurobiologica Bnd. VI, 1912, Heft I.

²⁾ Notes on the trochlear and oculomotor nuclei and roots in the lower vertebrates. Proceedings of the Koninkl. Akademie v. Wetenschappen te Amsterdam, March 23, 1911 p. 897.

Also the Vth nucleus of Chimaera has a great resemblance with the dorsal Vth nucleus of Teleostei, as it is found in Lophius e.g.

The position of the VI cells in Chimaera stands in between the location found in most Selachii and the one found in the Teleosts in so far as they have a less dorsal position than in the former and a less ventral position than in the latter. Division into two groups as is frequently found in the latter does however not occur. The nucleus is very diffuse, its cells are rather scattered.

The position resembles very much the one found in *Amia Calva* by DROOGLEEVER FORTUYN (l.c.)

As I have already pointed out formerly ¹⁾ the roots of the VIth nucleus in Chimaera come much nearer the VIIth root as is generally found in sharks. Also in this respect Chimaera approaches the Teleosts. Not however in the number of rootlets which is *even more* than in many sharks (6 or 7).

The most interesting topography is however exhibited by the VII nucleus.

Whereas in all Sharks the VIIth nucleus forms a continuous row of cells with the IXth and Xth root entrance, and keeping a dorsal place, we found very regularly two facialis nuclei in Teleosts, one, more frontal between the level of the VIIth and IXth roots, containing also the IX cells (as has been equally found by TELLO ²⁾) and another one caudally from the IXth root entrance, remaining continuous with the X cells ³⁾ and keeping a more dorsal position than the VII—IX cellgroup.

Chimaera exhibits a structure of the VII system, which has its own special features, but in some respects resembles the Teleostean character.

As in Teleosts there are two VIIth nuclei in Chimaera, of which one is located between the level of the VII and IX root, without being connected however with IX cells and not exhibiting any ventro-lateral shifting as the VII—IX nucleus in Teleosts generally does.

¹⁾ The migration of the bulbar Vth, VIth, and VIIth nucleus in the series of vertebrates and the differences in the course of their root fibers.

Verhandeling v. d. Kon. Akad. v. Wetensch. te Amsterdam (Tweede sectie) No 16, 1910.

²⁾ Contribucion al Conocimiento del encefalo de los Teleosteos: Losnucleos bulbares.

10, 20 fascicolo, tomo VII 1909. Trabajos del laboratorio de investigaciones biologicas de la Universidad de Madrid, p. 8 and 9.

³⁾ Only in *Gadus* also this VII nucleus was isolated from the X cells. Concerning *Lophius* I refer to my paper in these Proc. 1910.

The posterior VII nucleus lies behind the IX rootlevel and in about the middle of the bulb, being entirely separated from the vagus nucleus. It is several times larger than the anterior nucleus. The real vagus nucleus contains no VII elements. In so far as a certain resemblance with *Gadus* and *Lophius* is present as in those animals the vagus nucleus is also free from VII elements. Specially *Lophius* offers a point of resemblance as the posterior VII nucleus has a more ventral position than the anterior VII nucleus in this animal. It seemed probable to me that the posterior VII nucleus of *Chimaera* contains at the same time the IX root to its origin with certainty. The caudal part of the posterior VII nucleus is however a pure VII nucleus again, the facialroot entering this nucleus in its frontal and in its caudal part.

In so far the resemblance with the Teleosts is greater than one would say at the first glance, because the sequence of cells in the whole visceral system of this region in *Chimaera* is VII—IX—VII—X, just as in Teleosts, whereas in Selachii the primitive arrangement is kept: VII—IX—X, being in harmony with the arrangement and sequence of roots. The difference with the Teleostean topography would consequently be only this that in Teleosts the IX nucleus is combined with the anterior VII nucleus, whereas in *Chimaera*, it is combined with the posterior VII nucleus.

Concerning the reason of the difference between Selachii and Holocephali no definite opinion can be given at present. It may be that it has to do with the innervation of the operculum, but we may not forget that *Amia* has also an operculum and that the Selachian arrangement is kept there. Few words suffice for the arrangement of the vagus column. Besides its freedom from facial cells its structure and length is the same as in the Teleosts. The vagal cell column in Fishes offers generally very few differences.

The spino-occipital system remains. Its cells have a more dorsal place in Selachii than in Teleosts and so they have in *Chimaera*. The cellcolumn is poorly developed in that animal reminding of the scattered spino-occipital cells of *Amia*.

In *Chimaera* a more considerable overlapping of the vagus-column and the spino-occipital column is found than in sharks or Teleosts.

At last I may mention that the topography of the large reticular cells in *Chimaera* is about the same as has been described by VAN HOËVELL in the Selachii.¹⁾ In the caudal part of the oblongata

¹⁾ Remarks on the reticular cells of the oblongata in different vertebrates. Proceedings of the Kon. Akad. v. Wetensch. te Amsterdam. April 20, 1911, p. 1048—1049.

a large nucleus magnocellularis inferior is found, in the raphe extending laterad underneath the fasciculus, longitudinalis dorsalis in form of "guirlande". More frontally in the region of the octavus, V and in front of the Vth, hardly any reticular cells are found in the raphe, the greater part being scattered in the lateral parts of the oblongata, forming the nucleus reticularis medius (octavus-region) and nucleus reticularis superius (praetrigeminal region). The last contain hardly central elements in contrary to the Reptilian, and specially avian and mammalian nucl. retic. superius, which is clearly divided into a dorso-central (nucl. centralis) and a ventrolateral (n. vëntro-lat.) group.

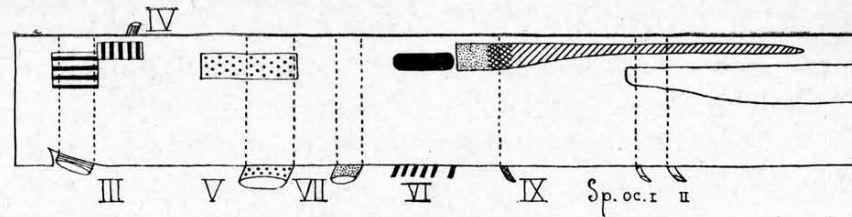
Summarizing my results I may conclude: 1. that Chimaera also on account of the topography of the motor root cells in the oblongata and midbrain has a special place amongst the orders of fishes;

2. that it resembles in some points the Selachian in other the Teleostean type, as has also been found in the forebrain of this animal by CARPENTER and myself¹⁾.

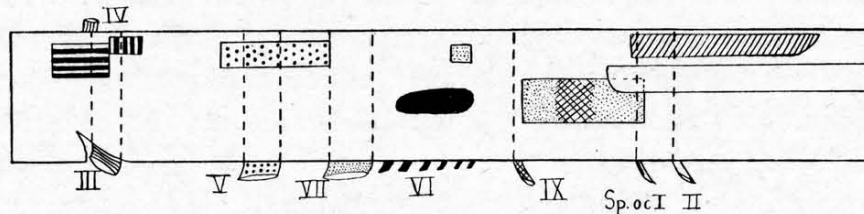
The number of data which show that the nervous system of Chimaera in many respects stands in between that of Selachii and Teleostei, and sometimes reminds more of the Teleostean than the Selachian type is enlarged by an interesting remark made by Prof. G. RETZIUS (Das Gehörorgan der Wirbeltiere Teil I, 1881: Das Gehörorgan von Chimaera monstrosa) who says "in sehr interessanter Weise bildet das Gehörorgan der Holocephalen d. h. der Chimaera ein Uebergangsstadium zu dem der Plagiostomen, ein Verbindungsglied zwischen ihm und den anderen Fischen". In a letter which I received from Prof. RETZIUS in December 1908 he writes "In letzten Sommer bekam ich ein ganz grosses Exemplar von Chimaera und machte mir neue Präparate vom Gehörorgan, welche sehr gut gelangen. Es ist wirklich merkwürdig zu sehen, wie nahe das Organ steht an dem der Teleostier als an dem der Selachier".

It results from all this that my researches on the nervous system of this animal give a further illustration of the interesting results of the Swedish anatomist as also several somatic features of the Holocephali prove their transitory character between the Plagiostomi and Teleosts.

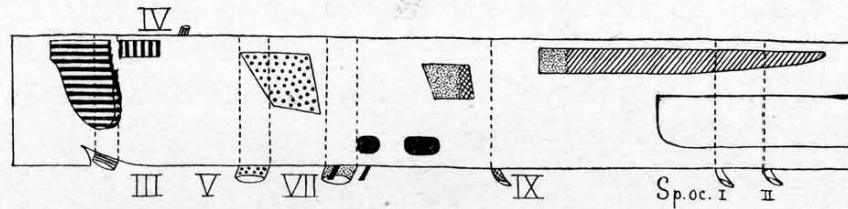
¹⁾ Das Gehirn von Chimaera monstrosa, Folia Neurobiologica Bnd V, Heft 2.



HEXANCHUS


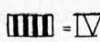


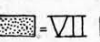





CHIMAERA



COTTUS

EXPLANATION:

 = III
  = IV
  = V
  = VI
  = VII
  = VIII
  = IX
  = Sp. oc. I

Topographic relation of the motor nuclei of midbrain and bulb in regard to the roots of the III, IV, V, VI, VII, IX and Spino-occipital nerves in a shark (*Hexanchus*) Holocephal (*Chimaera*) and a Teleost (*Cottus*).

Astronomy. — *Provisional results from calculations about the terms in the longitude of the moon with a period of nearly an anomalistic month, according to the meridian observations made at Greenwich*". By J. E. DE VOS VAN STEENWIJK. (Communicated by Dr. E. F. VAN DE SANDE BAKHUYZEN).

(Communicated in the meeting of March 30, 1912).

In 1903 Prof. E. F. VAN DE SANDE BAKHUYZEN had come to the conclusion that theory and observation did not perfectly agree about the so called Jovian evection in the longitude of the moon; nor had he been able to find in the observed places indications of another inequality of the same kind caused by Venus and the Earth ¹⁾.

¹⁾ Proc. Acad. Amsterdam 6, 1903 pp. 370 et seq. and 412 et seq.