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by

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ACADEMY OF THE SOCIALIST REPUBLIC OF
ROMANIAFAUNA OF THE SOCIALIST REPUBLIC OF ROMANIACYCLOSTOMATA AND CHONDRICHTHYES
(CYCLOSTOMES AND SELACHIANS)

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By

Petru Banarescu

(5)

CLASS CYCLOSTOMATAGENERAL SECTIONHISTORY

The cyclostomes have been known since ancient times, although to a lesser degree than fishes in general. Aristotle and Strabo classified them as leeches with gills. Linnaeus (1758) describes two genera - Petromyzon and Myxine - classifying the first as belonging to the heterogeneous group Amphibia Nantes (together with some aberrant fishes) and the second - among the intestinal worms. In 1784, Bloch describes Petromyzon planeri, and in 1816, Oken isolated genus Lampetra¹⁾. Beginning with the 19th century, cyclostomes are definitively placed among fishes. Cuvier created the order Cyclostomata, which he

included together with the ganoids and selachians in the sub-class of the cartilaginous fishes. Muller (1844) separates them into a special sub-class - Marsipobranchii or Cyclostomi - with two orders (Hyperoartia and Hypotreta); although he classifies them as fishes, Muller shows that the differences between cyclostomes and fishes are bigger than those between fishes and mammals. Beginning with Regan (1906), cyclostomes are considered a specific class.

Recent classifications group cyclostomi together with a series of fossil groups, into a separate, special sub-phylum of the vertebrates - Agnatha - (the opposite of vertebrates with jaws - Gnathostomata). Berg (1940), divides the sub-branch Agnatha into five distinct classes, out of which two include the actual forms (Petromyzontes and Myxinoidei) and three include the fossil forms. However, the classification chosen by Fontaine (1958) and Stensio (1958), reunites all the existing and fossil Agnatha into one class - Cyclostomata. This point of view is based especially on the research carried out by Stensio on the fossil vertebrates without jaws (Agnatha); this research showed the phyletic relation between Cephalaspides (Osteostraci)⁽⁶⁾ and Petromyzoniformes and between Pteraspides (Heterostraci) and Myxiniiformes.

Until Muller, authors were aware of only a few species of cyclostomes from the Northern and Western parts of Europe. In the second half of the XIXth century, a series of new species and genera from North America, Eastern Asia, the Caspian

1) (page 1): However, Oken's description is not considered as being valid nomenclaturally.

Sea and Southern hemisphere are described; in 1906, Berg describes genus Caspiomyzon, and in 1911 Regan publishes a revision of all the Petromyzontes (Hyperoartia), describing on this occasion genus Eudontomyzon. Creaser & Hubbs (1922) and Berg (1931) also published revisions of petromyzontes from the Northern hemisphere, while Holly (1933) published a revision of cyclostomes from all over the world.

In the last few years, the systematics of cyclostomi was studied especially by Zanandrea and Vladykov, while Balabai of U.S.S.R. and Hardisty of England dealt firstly with their biology. Their anatomy was studied (after Muller) by numerous researchers among which we must mention the research conducted on the musculature by Tretiakov and Furbringer, on the skeleton by Parker, on the nervous system by Retzius and Saito and finally Keibel's research conducted on the alimentary canal and circulatory system. In the last 35 years, fossil cyclostomes from the Paleozoic Era (Ostracodermii) were the object of some very detailed research, conducted especially by Stensio.

The last synthesis on cyclostomes was published in 1958, in volume XIII of the Treatise on Zoology written by Grassé.

Cyclostomes were found and reported in the Danube's basin by Reisinger (1830), Heckel and Kner (1858) and Herman (1886) under the names of Petromyzon (respectively Lampetra) fluviatilis and planeri; they were also signaled (under the same names) in Yugoslavia (Serbia) by Pancic (1862), in Romania by Antipa (1909) and in Bulgaria by Morov (1931).

In 1911, after revising petromyzons from all over the world, Regan describes the new monotypic genus Eudontomyzon,

after studying exemplaries found in our country in the Sebes (Transylvania); however, ichthyologists from the countries situated in the Danube's basin were not aware of his work for a long time, and they still continued to mention the same West-European species - fluviatilis and planeri - (Vutskits,1913). Vladykov discerns the differences between the cyclostome found in the upper portion of the Tisa (the actual transcarpathian Ukraine) and the actual Lampetra planeri only in 1925, and describes the first one under the name of L.bergi. In 1931, the same author (after taking notice of Regan's work) synonymizes Lampetra bergi with Eudontomyzon danfordi. During the same year, Berg describes Lampetra (E) mariae found in the rivers of the Ukrainian S.S.R., affirming that this species also exists (7) in the upper portion of the Prut (Danube's basin); he did not have any evidence however, and made his statement based on the interpretation of certain data, provided previously by an author. After listing the fishes found in Europe, Berg (1932) affirms that the actual Lampetra planeri is also found in the Danube, but only in its upper course. Drensky reports seeing both Eudontomyzon danfordi and Lampetra planeri in the Osam (an affluent of the Danube in Bulgaria); on the other hand, later on, while studying specimens from the entire basin of the Danube (1935), he maintains that he always noted - only Eudontomyzon danfordi and E. mariae; in 1952, he decided to reconsider his findings affirming that both Eudontomyzon danfordi and Lampetra planeri exist in the lower portion of the Danube and in its affluents in Bulgaria.

Oliva reports finding Eudontomyzon danfordi in 1953, in

the Danube's basin, on Czechoslovakia's territory. Beginning in 1958, Zanandrea started publishing a series of papers on the cyclostomes from the Danube's basin, where he noted the following species: Lampetra planeri (only in the upper course - Austria and Bavaria), Eudontomyzon mariae (in the Bosna, in Yugoslavia), E. danfordi (in Tisa's affluents in Romania, Ukrainian SSR and Czechoslovakia) and a new form - E. danfordi vladykovi² (found in the Danube and its affluents from Czechoslovakia, Austria and Yugoslavia); later on (in 1962) he also reports seeing it in the Arges in Romania. New data, on the same species E.d. vladykovi were published by Holcik (1963) who classifies it as a species. Kux (1965) describes a new species from the Danube's basin (in Slovakia): E. gracilis, which is very similar to E. danfordi, except that it is not a predatory species.

Consequently, up to the present, 5 cyclostomes were sighted - in the Danube's basin: Lampetra planeri, Eudontomyzon danfordi, E. gracilis, E. vladykovi and E. mariae. No recent decisive revisions were made concerning the species from the Danube's basin, in Bulgaria and Yugoslavia (Serbia).

History of Research Conducted in Romania: Cyclostomes, especially Eudontomyzon danfordi, are well known to peasants living in the mountains; as proof, we have the numerous popular names and other ethno-zoological data published by Bacescu (1947). The first report about cyclostomes in our country was

2) The description of this new sub-species was published by Oliva and Zanandrea (1959) and Zanandrea (1959); the first description is considered as being -the original.

carried out by Reisinger (1830), who mentions Petromyzon fluviatilis as being found in the Tisa among other rivers, without specifying any locality. In 1853, Bielz mentions (without description) Ammocoetes branchialis and Petromyzon fluviatilis, and in 1888 he reports on P. fluviatilis and P. planeri being found in many rivers in the basins of Someş, Mureş and Olt (8) (in Transylvania). In 1909, Antipa mentions that he found the last two species in Moldova and Muntenia and even includes a figure of P. fluviatilis, but he describes them according to the writings of foreign authors.

The first truly original study conducted on cyclostomes from our country is that of Regan (1911), who describes genus Eudontomyzon (specifically E. danfordi found in one of the rivers from Transylvania (the Sebes). The existence of this endemism was unknown to the ichthyologists from Romania and the neighbouring countries, - for a long time; in 1939, influenced by Vladykov's work (1931), Chappuis (1939 and 1940) establishes that all the cyclostomes found in the rivers from the Apuseni (Western) Mountains belong to E. danfordi and publishes a detailed study on the biology of this species. Mihail (1962) completes the data furnished by Chappuis regarding the biology of this species. Motas and Angheliescu (1944) point out that Lampetra planeri was found in the Moldavian Bistrita; they also mention - among other things - that E. danfordi may also exist in this river; Ziemiński (1947) also mentions that only L. planeri exists in the rivers of Northern Moldavia. Băcescu (1947) reports that E. danfordi lives in several rivers, including Riul Doamnei (the first report on this species in Muntenia), and also produces biological and ethno-zoological data.

Banarescu (1954) mentions the existence of E. danfordi in many rivers from Transylvania and Banat and also maintains that E.sp. exists in the upper portion of the Bega; Banarescu, Muller and Nalbant (1960), mention the existence of E. vladykovi in the Arges (on the basis of an exemplary determined by Zanandrea) and that of E. danfordi in the Suceava. Grossu, Homei, Barbu and Popescu (1962), after making a revision of the cyclostomes which are found in Romania, noted that E. danfordi the only species from the basin of Tisa, also exists in the Moldavian Bistrita, that E. vladykovi lives in the affluents of Arges and Jiu, and that E. mariae was noticed in the Cibin (an affluent of the Olt); the authors complete the description of E. vladykovi and affirm that the so-called Petromyzon fluviatilis found by Antipa in the Danube, is - in reality - E. vladykovi. Nalbant (1962) found and described a topo-type of E. danfordi from the Sebes, in comparison with E. vladykovi and E. mariae, which were collected by Banarescu from the Bistra Marului (Banat). Banarescu (1965) while dealing with fishes found within limited areas in our country, mentions new localities of E. danfordi and E. mariae.

We must call the attention to the fact (which will be discussed in the systematic part of this paper) that the species found to the South of the Carpathian Mountains, which was identified as Eudontomyzon vladykovi by Zanandrea (1962) and all the contemporary Romanian authors (1960-1968), is - in reality - E. mariae, while the species which was identified (by the same authors) as being E. mariae, is - in fact - E. vladykovi.

EXTERNAL MORPHOLOGY

The body of cyclostomes is elongated, cylindrical in its anterior part and compressed laterally on the posterior side. The anterior region of genus Geotria, widens ventrally, forming a sort of gullet. Actually there is no line to be found between the head and the body.

The anterior extremity of the body is truncated obliquely; the mouth is situated on this portion. The two eyes are also noted on the anterior part. They are invisible in myxinoids, being covered by musculature and skin, while in petromyzons they are - on the contrary - very visible. Behind the eyes the gill openings (branchial orifices) can be seen, 7 oval pairs in petromyzons and 1-14 round pairs in myxinoids situated near the ventral side. The unpaired nasal opening is placed on the dorsal side; it is situated between the eyes in petromyzons, and in myxinoids it is offset anteriorly and surrounded by 2-4 nasal tentacles. The anus is situated posteriorly and ventrally. The paired fins are missing. The unpaired fins are represented in myxinoids through a single fold on the posterior part of the body. In petromyzons, one or two dorsal fins and one caudal fin exist; the caudal fin is also corresponding to the anal fin, since it is extended on the ventral side until it reaches the anus. The two dorsal fins are either placed at a distance from each other (in Eudontomyzon danfordi) or are close together (in E. vladykovi, E. mariae and Lampetra planeri); they can be completely separate or conrescent. The second dorsal fin and the caudal (tail) fin are placed in such a way that they are continuous and it is difficult to tell where one begins and the other finishes.

INTERNAL STRUCTURE

The integument (tegument) of the cyclostomes is composed of epidermis, dermis and hypodermis. The epidermis of myxinioids is formed of several strata of epithelial cells, of which some are sensorial and others belong to three types of glandular cells. The petromyzons have a more complicated multi-stratified epidermis (Fig.1), with a basal stratum formed of prismatic cells thinned at the apical extremity, after which we notice several rows of cells thinned at both extremities; following, are some polyhedric cells and a superficial stratum of calciferous cells (which are secreting mucus) and these are replaced by subjacent polyhedric cells. Among the epithelial cells there are two types of glandular cells: knoblike and granular. The dermis which has a conjunctive nature, contains pigmentary cells. The hypodermis consists of a network of collagenous fibers.

(10)

The axial skeleton is composed of the notochord, perichordal skeleton and cranium.

The notochord is a flexible axis, circular when cut into sections, un-segmented, - which extends from the base of the cranium to the tail and - is surrounded by an internal fibrous sheath and an external elastic one.

Fig.No.1:

Integument in Lampetra fluviatilis.

ep: epidermis;
d: dermis;
sc: sub-cutaneous conjunctive tissue;
fm: muscular fiber
(from: Zoological Treatise).

(Cont. Fig.1):

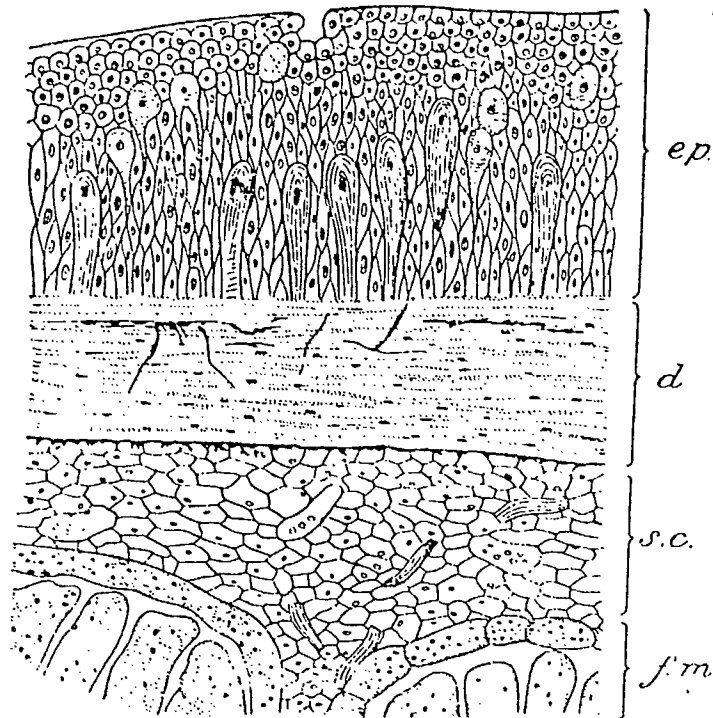


Fig. 1. - Tegumentul la *Lampetra fluviatilis*. ep. - epidermă; d. - dermă; s.c. - țesut conjunctiv subcutanat; f.m. - fibră musculară (din *Traité de Zoologie*).

The perichordal skeleton, is mostly membranous; in petromyzons, cartilaginous portions also appear. This skeleton forms four longitudinal thickenings along the notochord: two dorso-lateral thickenings from which the upper membranous arches which surround the spinal marrow separate, and two latero-ventral thickenings from which the lower membranous arches detach, and whose distribution is somehow the same as that of the ribs in higher vertebrates. In the upper membranous arches of the petromyzons, cartilaginous portions appear, varying in form, which are disposed metamERICALLY and correspond to the body's segments. The perichordal skeleton is probably the homologue of the vertebral (spinal) column in gnathostomous vertebrates; it seems that its poor development in the existing cyclostomes does not

represent a primitive stage but - on the contrary - a regressed condition.

Fig.No.2:

Cephalic skeleton in the larva of Lampetra fluviatilis.

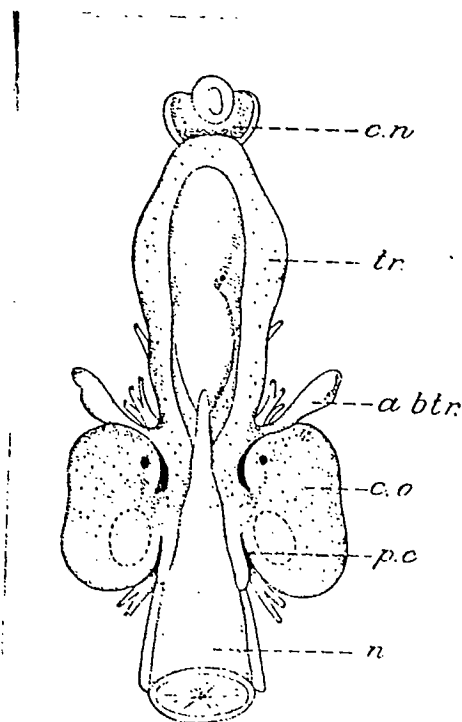


Fig. 2. -- Scheletul cefalic al larvei de *Lampetra fluviatilis*, c.n. -- capsulă nazală; tr. -- trabeculă; a.b.tr. -- apofiză bazitrabeculară; c.o. -- capsulă otică; p.c. -- paracorde; n. -- notocord (după Parker, din *Traité de Zoologie*).

c.n.: nasal capsule;
tr: trabecula;
a.b.tr.: basi-trabecular apophysis;
c.o.: otic capsule;
p.c.: parachordal;
n.: notochord;
(According to Parker, from "Zoological Treatise").

Fig. No. 3:

Neurocranium and splanchnocranium in the larvae of
petromyzons
(laterally)

n: notochord.
(from "Zoological Treatise")

(Cont. Fig. 3):

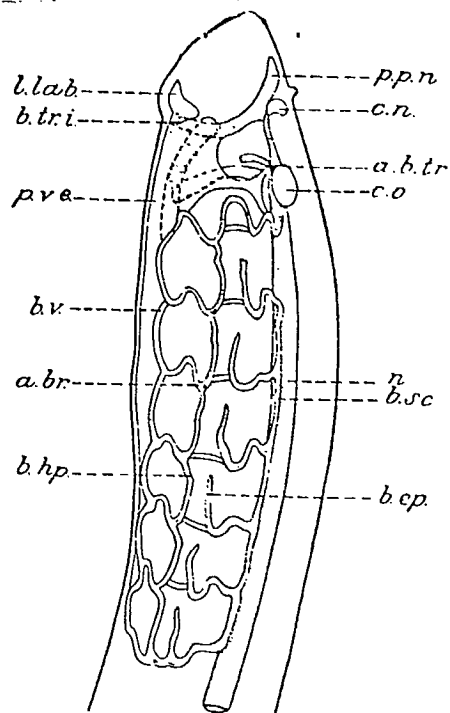


Fig. 3. — Neurocraniul și splanchnocraniul larvelor de petromizonide, lateral; *n*, notocord (din *Traité de Zoologie*).

The cranium of cyclostomes is composed of the neurocranium (which protects the brain and the cephalic sense organs) and the splanchnocranium (skeleton of the stoma (mouth) and gill apparatus).

In the larvae of petromyzons the neurocranium consists of a fibrous sheath which surrounds the brain and a series of cartilaginous parts: a pair of parachordals placed on the sides of the anterior extremity of the notochord, a pair of trabeculae which fuse with the parachordal cartilages (with which they are continuous), a pair of otic capsules which protect the internal ear and an unpaired nasal capsule (Fig. 2).

(12)

The skeleton of the mouth (stoma) in larvae, is composed of several parts: the elastic ventral part (Fig. 3, p.v.e.)

placed directly under the skin and whose anterior margin supports the ventral lip; the internal transversal band (b.tr.i) which strengthens the ventral lip; a pair of labial lobes (l.lab.) which are extensions of the ventral section and which penetrate into the dorsal lip; the pre-nasal plate (p.p.n.) which connects the buccal skeleton to the base of the neurocranium; the basi-trabecular apophysis (a.b.tr.); the nasal capsule (c.n.) and otic capsule (c.o.); a series of skeletal parts of the velum and the elastic medio-ventral band.

The branchial skeleton is composed of 7 branchial arches (a.br.)(placed transversally and having the form of a double S), which are connected between themselves by 4 longitudinal rods: the sub-chordal rod (b.sc.), epitrematic rod (b.ep.), hypotrematic rod (b.hp.) and ventral rod (b.v.); the epitrematic rod is incomplete.

The neurocranium of the adult petromyzons (Fig.4) differs a little from the neurocranium of the larvae: the lateral walls of the cranium appear, as a continuation of the parachordals, as well as an unpaired part between the trabeculae - and a sub-ocular arch; a cartilaginous bridge is also noticed between the auditory capsules.

The skeleton of the mouth in adult petromyzons (Fig.4), differs from that of the larvae, due to the different feeding system: Anteriorly, the annular cartilage is noted (c.i.)(on which two stylets are attached)as well as the medio-ventral cartilage (c.m.v.),(stylets: st.). The anterior dorsal cartilage (c.d.a.) is situated dorsally, and on its sides and behind the annular cartilage, the anterior lateral cartilages are noticed (c.l.a.).

Behind the anterior dorsal cartilage the posterior cartilage is situated (c.d.p.) and on its sides there are two posterior plates (p.l.p.). On the posterior side of the mouth, a circular part exists (velar arch), and the piston of the tongue is supported by a long rod, the cartilage of the piston (c.p.).

The branchial skeleton of the adults, differs from that of larvae, through the appearance of a peri-branchial arch (a.p.b.) on the anterior side, and the appearance of a peri-cardial cartilage (c.p.c.) on the posterior part.

The musculature is metamerized and consists of myomeres separated by connective tissue septa (myosepta). The myomeres are not vertical but have various folds and curves, which differ in the various regions of the body (Fig.5). At the base of the dorsal fin, a special musculature exists. A series of ocular, cephalic muscles of the buccal parts and velum also exist.

The central nervous system includes the spinal marrow and brain (Fig.6), in which the following lobes are discerned: the myelencephalon (rachidian bulb) which equals in size the rest of the brain; the metencephalon (cerebellum) which is reduced; the mesencephalon (midbrain) consisting of a pair of well developed but poorly differentiated optical lobes; the diencephalon (between-brain) on which the hypophysis is attached ventrally; -- dorsally, the pineal body (pineal organ) is connected with it; finally, there is also the telencephalon (anterior brain), which consists of two pairs of visicles: the olfactory lobes, which are more reduced in size, and the olfactory bulbs which are anterior projections of the lobes and are well developed.

Ten pairs of cranial nerves also exist.

Fig. No. 4:

Branchial Skeleton in Lampetra fluviatilis (adult).

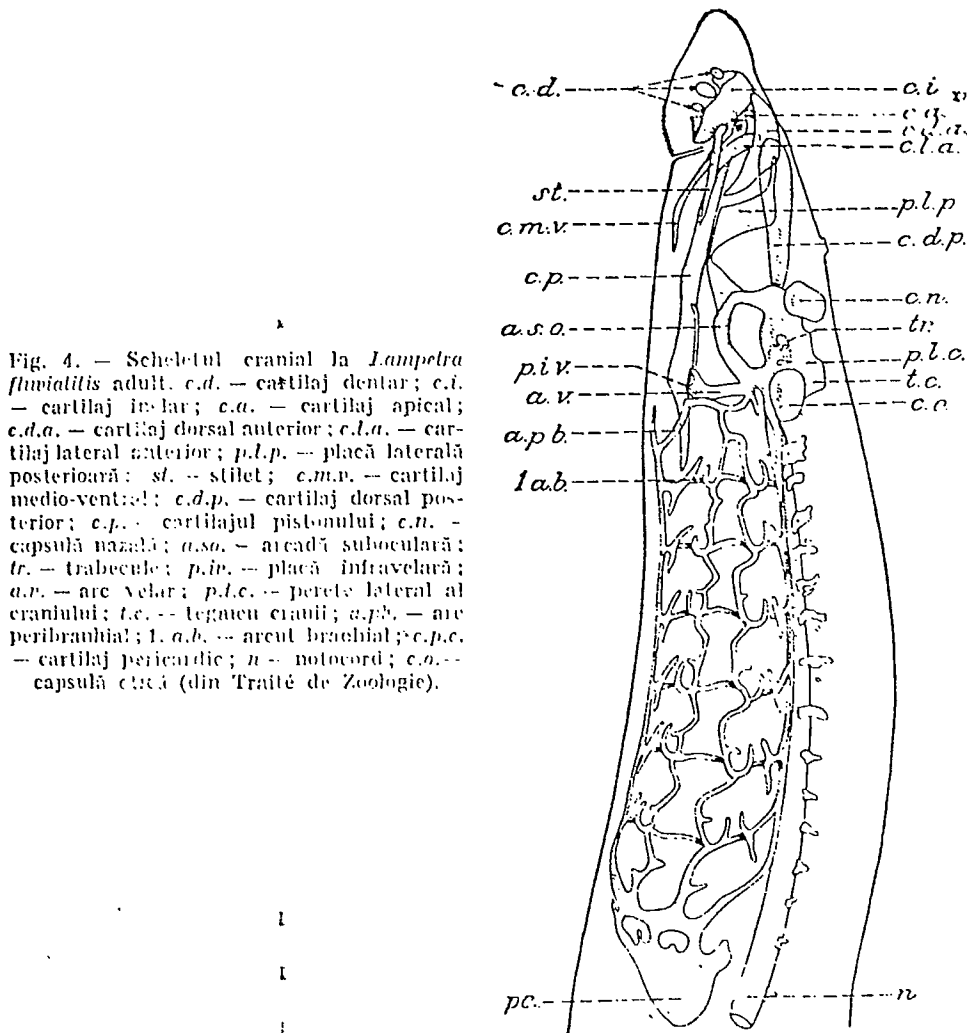


Fig. 4. — Scheletul cranial la *Lampetra fluviatilis* adult. *c.d.* — cartilaj dentar; *c.i.* — cartilaj inelar; *c.a.* — cartilaj apical; *c.d.a.* — cartilaj dorsal anterior; *c.l.a.* — cartilaj lateral anterior; *p.l.p.* — placă laterală posterioară; *st.* — stilet; *c.m.v.* — cartilaj medio-ventral; *c.d.p.* — cartilaj dorsal posterior; *c.p.* — cartilajul pistonului; *c.n.* — capsulă nazală; *a.s.o.* — arcadă suboculară; *tr.* — trabecule; *p.i.v.* — placă infravelară; *a.v.* — arc velar; *p.l.c.* — perete lateral al craniului; *t.c.* — tegmen cranii; *a.p.b.* — arc peribranchial; *1.a.b.* — arc brachial; *c.p.c.* — cartilaj pericardic; *n* — notocord; *c.o.* — capsulă ciliară (din *Traité de Zoologie*).

- c.d.: dental cartilage;
- c.i.: annular cartilage;
- c.a.: apical cartilage;
- c.d.a.: anterior dorsal cartilage;
- c.l.a.: anterior lateral cartilage;
- p.l.p.: posterior lateral plate;
- st.: stylets;
- c.m.v.: medio-ventral cartilage;
- c.d.p.: posterior dorsal cartilage;
- c.p.: cartilage of the piston;
- c.n.: nasal capsule;
- a.s.o.: subocular arch;
- tr.: trabeculae;
- p.i.v.: infravelar plate;
- a.v.: velar arch;
- p.l.c.: lateral wall of the cranium;
- t.c.: tegmen cranii;
- a.p.b.: peri-branchial arch;
- 1.a.b.: branchial arch

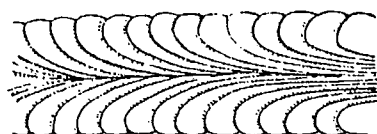
(Cont. Fig.4):

c.p.c.: pericardial cartilage;
n.: notochord;
c.o.: otic capsule.
(From the "Zoological Treatise")

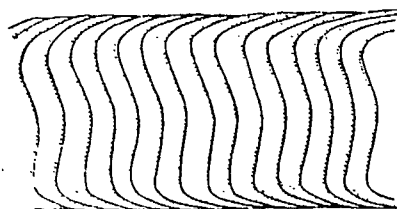
(14)

Fig. No. 5:

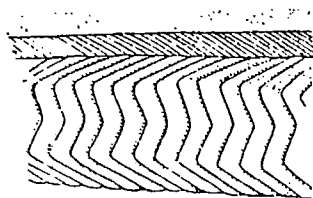
Distribution of the musculature in cyclostomes



A



B



C

Fig. 5. -- Dispoziția musculaturii la ciclostomi. A -- dorsal, înaintea înalțării dorsale; B -- lateral, înaintea dorsalei; C -- lateral, în dreptul dorsalei (din *Traité de Zoologie*).

A: dorsally, behind the dorsal fin;
B: laterally, behind the dorsal fin;
C: laterally, near the dorsal fin.
(From the "Zoological Treatise")

Fig. No. 6:

Brain of the petromyzon

n.: nostril (naris);
v.: valvula;
s.o.: olfactory sac;
n.o.: olfactory nerve;
gl.a.: accessory gland;
b.olf.: olfactory lobe;
o.p.: pineal body (organ);
c.np.: nasopalatine duct;
h.: hypophysis;
g.h.: habenular ganglion
l.o.: optic lobe;

(Cont. Fig.6):

m.s.: spinal marrow;

n.: notochord.

(According to Parker and Haswell, from "Zoological Treatise")

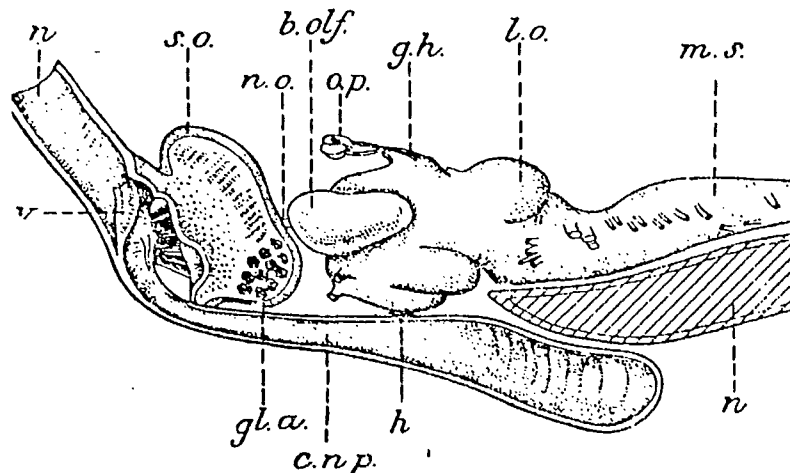


Fig. 6. — Creier de petromizonid. *n* — nară; *v* — valvulă; *s.o.* — sac olfactiv; *n.o.* — nerv olfactiv; *gl.a.* — glandă accesorie; *b.olf.* — lob olfactiv; *o.p.* — organ pineal; *c.n.p.* — canal nazopalatin; *h* — hipofiză; *g.h.* — ganglion habenular; *l.o.* — lob optic; *m.s.* — măduva spinării; *n* — notocord (după Parker și Haswell, din *Traité de Zoologie*).

(15)

The pineal apparatus which seems to be sensitive to light, is situated in a lacuna of the brain, directly under the tegument. It is composed of two vesicles: the pineal body (epiphysis) and the para-pineal body (situated behind the pineal body). Both end with a vesicle with the essential structure of an eye (parietal eye).

Sense Organs: The lateral continuous line, similar to the one found on fishes, is missing in cyclostomes; on the sides of the head, we notice however sensitive formations corresponding to the lateral line and innervated by some of the pairs of cranial nerves (5,7,9 and 10).

The unpaired olfactory organ is well developed and consists of an olfactory sac (the only sensitive part) and a nasopalatine duct. The close relation between the olfactory organ and the hypophysis is a characteristic of the cyclostomes.

The eyes of petromyzons have the general structure of the eyes of higher vertebrates; in the larvae of petromyzons and in myxinoids, the eyes are hidden under the skin.

The ear of the petromyzons (Fig.7) is completely hidden in the auditory capsule (vesicle) and consists of the utriculus (relatively large), the sacculus (reduced), the lagena, two semicircular canals (corresponding to those vertical canals located anteriorly and posteriorly in the higher vertebrates; there is only one canal in myxinoids), two sunken canals and two large ciliated chambers; these chambers constitute the most original part of the ear in cyclostomes.

The Alimentary Canal: The mouth in myxinoids is round and surrounded by two pairs of tentacles. In the larvae of petromyzons (ammocoetes) it has the form of a horseshoe and does not have a tongue or teeth, while in adults, the mouth is circular when the animal is fixed, and oval when it is free. The opening of the mouth is funnel shaped and surrounded by small tentacles. The lingual piston (tongue) is situated at the end of this funnel. A series of horny, toothlike formations exist in the buccal cavity and on the tongue, which function like teeth (but which are not homologues of the vertebrates' teeth) and are named odontoids.

Fig. No. 7:

Diagram of the labyrinth in petromyzons

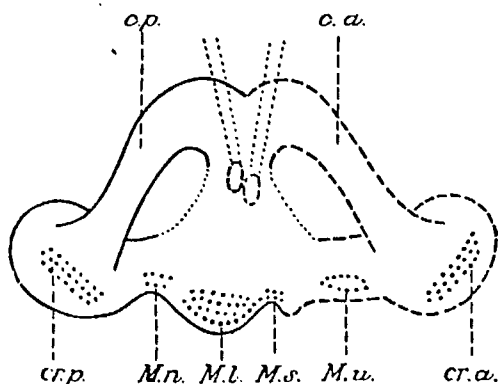


Fig. 7. -- Schema labirintului de petromizonid.
c. p. -- canal posterior; c. a. -- canal anterior;
cr. p. -- creastă posterioară; cr. a. -- creastă anterioară;
M. n., M. l., M. s., M. u. -- macula neglecta, lagenae, saculi, utriculi (după Burlet, din *Traité de Zoologie*).

c.p.: posterior canal;
c.a.: anterior canal;
cr.p.: posterior crest;
cr.a.: anterior crest;
M.n., M.l., M.s., M.u.: Macula neglecta, M. lagenae, M. sacculi, M. utriculi.
(according to Burlet, from "Zoological Treatise")

Their distribution, number and form are the principal criteria used for the classification of the genera and species of (16)

Petromyzonidae. There are three groups of odontoids (Fig.8):

1. The labial odontoids, found on the surface of the buccal infundibulum (often in concentric circles). We distinguish different types of odontoids, according to their position: labial odontoids - internal and external, lateral, upper and lower. The largest and at the same time the most important from the systematic point of view, are the 3 (seldom 4) pairs of internal labial odontoids, situated on the right and left sides of the mouth; and which can have one, two or three points: monocuspids, bicuspids and tricuspids.

2. The buccal odontoids are fused, forming the upper oral plate (supraoral plate) situated before the mouth, and the suboral plate; the suboral plate is equipped with a variable number of pointed or rounded odontoids.

3. The lingual odontoids are fused into three plates: the impar (unpaired) lingual plate whose distribution on the tongue is parallel to the suboral plate, and two paired lingual plates (more reduced in size). The unpaired lingual plate is equipped with numerous odontoids, of which the median odontoid is usually bigger.

Fig. No. 8

Diagram of buccal disk in petromyzons.

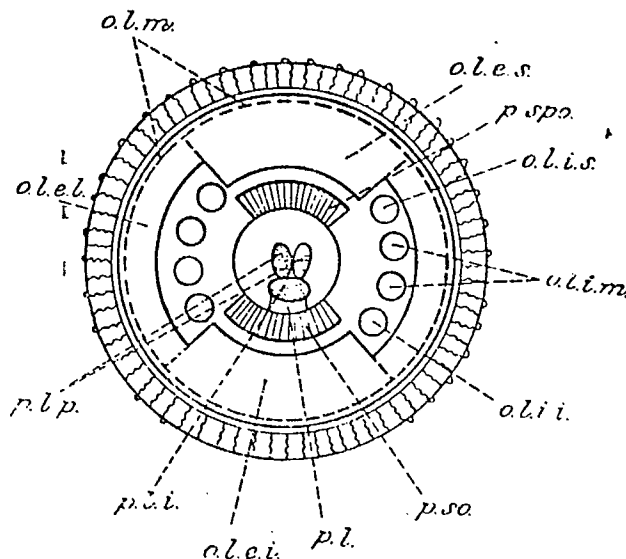


Fig. 8. — Schema discului bucal la petromizonide. *o.l.m.* — odontoizi labiali mediani; *o.l.e.s.*, *o.l.e.l.*, *o.l.e.i.* — odontoizi labiali externi superiori, laterali și inferiori; *o.l.i.s.*, *o.l.i.m.*, *o.l.i.i.* — odontoizi labiali interni superiori, mediani, inferiori; *p.spo.* — placa supraorală; *p.so.* — placa suborală; *p.l.p.* — plăci labiale pare; *p.l.i.* — placă labială impară; *p.l.* — piston lingual (după Holly).

(Cont. Fig.8):

o.l.m.: median labial odontoids;
o.l.e.s., o.l.e.l., o.l.e.i.: upper, lateral, lower external labial
odontoids;
o.l.i.s., o.l.i.m., o.l.i.i.: upper, median, lower internal labial
odontoids;
p.spo.: supra-oral plate;
p.so.: sub-oral plate;
p.l.p.: paired labial plates;
p.l.i.: impar (unpaired) labial plate;
p.l.: lingual piston.
(according to Holly).

(17)

After the buccal cavity, a narrow pharynx is noticed, from which the aqueduct (canal) leading to the respiratory system opens - ventrally, while dorsally, the esophagus can be seen (it is continuous with the rectilinear intestine). The mucous membrane of the intestine is folded, and forms a spiral fold. The intestine narrows considerably in species which do not feed during the adult stage, while after metamorphosis, the esophagus (at least in some of these species) is compressed.

The annexes of the alimentary canal are the salivary glands (existing only in adult petromyzontiformes), the hypobranchial furrow or endostyle (found only in larvae), the liver (which regresses in petromyzontiformes which do not feed after metamorphosis; the gallbladder (gall sac) may disappear in these petromyzons), and the pancreas.

The endocrine glands noticed in cyclostomes are the thymus gland, thyroid gland, suprarenal glands, endocrinal pancreas, epiphysis and the hypophysis.

The Respiratory System: The petromyzontiformes have 7 pairs of branchial sacs; the myxinoids have 5-15 pairs. These sacs communicate on the one hand with the exterior (through the branchial clefts (or gill clefts)), and on the other hand with the alimentary canal; in larvae they communicate with the

pharynx, and in adult petromyzontiformes - with the aqueduct, a sunken canal situated parallel with the esophagus. On the walls of the branchial sacs the branchial lamellae can be seen. The water which was taken in, is eliminated (passing to the exterior) through the branchial openings (clefts), after bathing the branchial lamellae (gills).

The Circulatory System: This system resembles very much that of fishes, since it is almost identical in cyclostomes. The heart, protected by a partially cartilaginous pericardium, is placed ventrally. It consists of a sinus, an atrium, one ventricle and an arterial bulb. The venous blood is pushed from the heart into the ventral aorta, from which a pair of aortic arches extends to each branchial sac. The oxygenated blood is collected from the gills into the dorsal aorta, from which it is carried to the various organs, while the venous blood flows and collects in the veins, which in turn carries it to the heart.

In some of the largest veins several contractile dilations exist, named accessory hearts.

The blood contains a large quantity of chlorides. The red cells (blood cells) are nucleate and contain an iron-binding red respiratory pigment, which, from the chemical point of view, is intermediate between the hemoglobin of vertebrates and erythrocrucorin found in certain groups of invertebrates.

The Excretory System: The kidneys consist of the pronephros, the only functional part in the beginning, and the mesonephros which appears later on. The ureters open through a urogenital papilla, situated in a depression in which the anus also exists.

The Reproductive System is unpaired and ductless. The genital produces fall into the general cavity, penetrate into the urogenital sinus through two pores, and are eliminated (18) through the urogenital orifice, situated at the extremity of the urogenital papilla. In many species, this papilla is more developed in males than in females.

REPRODUCTION AND DEVELOPMENT

At the beginning, some species of myxinoids are inverted and later on, they become unisexual; the petromyzons are unisexual. In some species, the males attach themselves (with the sucker) to the females. There is no coupling organ. It is not known whether the fecundation takes place internally (and whether the spermatozoa (spermatozoids) reach the cloaca) or externally (occurring when the eggs are expelled).

The division of the egg in petromyzons is total, leading to the formation of a very small larva, similar to the adult, but with eyes hidden under the skin, with branchial openings situated in a furrow, with the anterior region compressed laterally, and with a mouth shaped like a horseshoe, without odontoids and horny parts (Fig.9).

Fig. No. 9

Larva of a cyclostome - Eudontomyzon sp. (orig.)

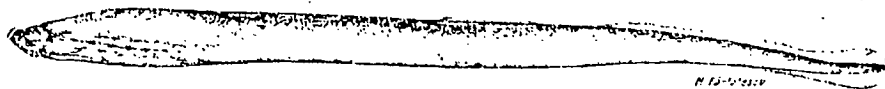


Fig. 9. - Larvã de ciclostom - *Eudontomyzon* sp. (orig.).

During the very long larval life (lasting a few years), the larva grows very much. During metamorphosis, the eyes appear - in

the beginning -, and afterwards, the mouth changes: the two lips fuse, the mouth becomes ovoid and elongated; later on, it widens becoming a large mouth, situated at the bottom of a buccal sucker, surrounded by cirri and equipped with odontoids. The furrow between the branchial openings disappear, and the dorsal fins become individualized and grow in height. At the same time, important modifications of the internal organs take place³. In non-parasitic species which do not feed during the adult stage, the pharynx is not connected to the esophagus anymore.

ECOLOGY

All the myxinoids are marine; some of the petromyzons are anadromous migratories, and others are exclusively fresh-water types. Their reproduction takes place in fresh waters.

The larvae live hidden in ooze and organic detritus,⁽¹⁹⁾ where they feed on detritus, microflora and microfauna.

In some species, metamorphosis takes place in the fall, in others it occurs in the summer; the period of metamorphosis and duration of larval life may vary in one specific species, depending on the latitude: for example, this period in Lampetra planeri varies between 2½ years (in Italy) and 5½ years (in the North of England). After metamorphosis, the animal leaves the ooze and leads a mobile life.

In predatory species (parasites) the adults feed on invertebrates, especially on fishes, adhering to their prey with the help of the sucker; they perforate the skin and consume

3) Among the authors who have clarified the evolution of metamorphosis in cyclostomes, was the Romanian morphologist - Paul Bujor (1891).

the flesh with the help of the odontoids. These species continue to grow after metamorphosis, and have a relatively long life; sexual maturity is reached during a certain period, after metamorphosis. The migratory species Petromyzon marinus and Lampetra fluviatilis (in Europe), belong to the category of predatory species; after metamorphosis, these species descend to the sea, and after reaching sexual maturity, they ascend the rivers (from the sea) to the montane zone, where they reproduce (breeding). During migration they stop feeding and decrease in length and weight. After reproduction they die. The predatory, exclusively freshwater species (in our country: Eudontomyzon danfordi) feed during their entire life-span.

The non-predatory species (in our country: Eudontomyzon mariae and E. vladykovi; in Western Europe: Lampetra planeri) stop feeding after metamorphosis; the alimentary canal atrophies, and the exemplars start reducing their dimensions. Their reproduction takes place a few months after metamorphosis; before reproduction, certain morphological modifications occur (for example, the dorsal fins grow and increase in height). After reproduction they die.

The anadromous species and some exclusively freshwater species (for example Lampetra planeri) migrate for the purpose of breeding (reproduction) by going upstream (ascending rivers). There are indications that E. danfordi might also migrate.

PALEONTOLOGY AND PHYLOGENY

The cyclostomes are closely related with the earliest known vertebrates - the Ostracodermi - which lived from the upper Silurian to the Devonian periods. Unlike the actual existing

forms of cyclostomes, the Ostracoderms had an exoskeleton consisting of either a massive plate - bony armor - or scales. The majority had one well developed or rudimentary fold, on each side of the body, corresponding to the paired limbs (fins) of fishes; the mouth was simpler than that of the cyclostomes, (20) without a tongue or with a rudimentary tongue (excepting the group of anaspids, which had a well developed tongue); the number of branchial slits (clefts) was larger than that found in cyclostomes; in some Ostracoderms, a functional pre-mandibular branchial cleft also existed. However, the Ostracoderms are not considered to be a taxonomic unit but are included together with the cyclostomes; out of the four groups of "ostracodermi", two of them (osteostraci and anaspida) are considered by some authors of being closely related to the petromyzons (petromyzonidae); the third group (heterostraci) is considered to be related to the myxinoids, while the fourth group (Thelodontidae (Thelodonti)) is not too well known, its affinities thus being problematic.

The head and anterior part of the body in osteostracans (Fig.10) were large and flattened dorso-ventrally, and were covered by an ossified armor; the eyes were placed close to each other and were situated on the dorsal part of the head; the dorsal nasal opening was unpaired; the mouth and branchial openings were situated on the ventral side; the branchial apparatus and circulatory system were similar to those of the petromyzons; generally, the cauda was heterocercal.

The anaspids (Fig.11) had an elongated body which was compressed laterally; the eyes were situated on the sides of the head; the cephalic shield was missing; their branchial system was similar to that of the petromyzons, but its branchial openings

were situated on the posterior part of the head; the tail (cauda) was hypocercal (its end pointed down).

The heterostracans - (Fig.12), had a body which was flattened dorso-ventrally and extended by a rostrum; the mouth was placed ventrally; they had widely separated eyes; the nasal opening was probably ventral, similar to that of the myxinoids; the majority had the head and the anterior part of the body covered by a skeletal carapace, differing very much from the shield found in osteostraci (cephalaspids); the cauda was heterocercal; they also had only one gill opening (branchial opening) on each side, similar to those found in myxinoids.

We do not have any knowledge of other fossil forms (from the Devonian period to the present time) which are related to the cyclostomes; however, the great anatomical similarity between the fossil groups mentioned above and those found at the present time, show that the cyclostome type persists since the primary period without showing any important modifications. The existing forms, differ from the fossil forms by missing the external skeleton and having an improved buccal armature.

Although the cyclostomes form - on the whole - an archaic group, the existing species are recent and belong to the present period. This is proven by their strict localization and the concordance between the areas inhabited by the species and the actual hydrography. The fact that in many hydrographic basins there live one predatory and one non-predatory species which are related, influenced many authors in assuming that there is a sympatric ecological process of speciation; generally, the belief is that the non-predatory species derives from the predatory kind. In the best known case, that of the two species

(22)
of Lampetra found in Western Europe, the predatory species L. fluviatilis is an anadromous migrator while the non-predatory species - L. planeri - is sedentary and living in fresh water.

(21)

Fig. No.10

Type of osteostracan - *Aceraspis robusta* (from the "Zoological Treatise")

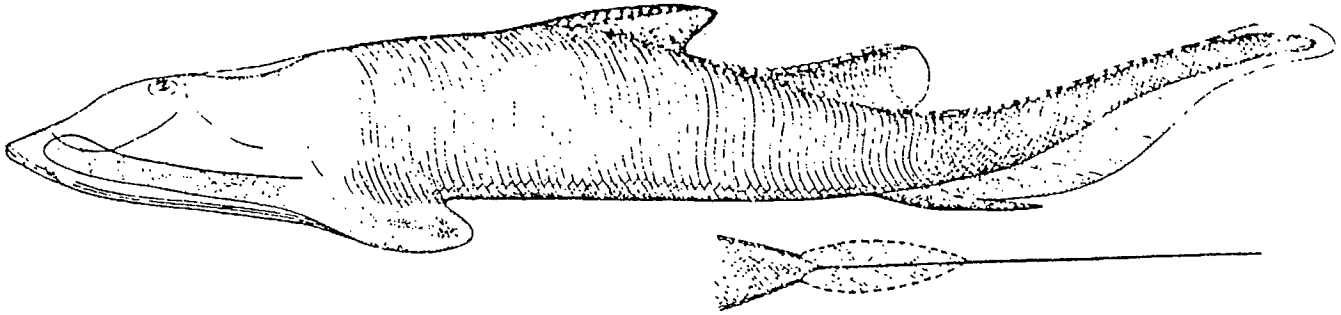


Fig. 10. - Tip de osteostrac - *Aceraspis robusta* (din Traité de Zoologie).

Fig. No.11

Type of anaspid - *Pterolepis nitidus* (from the "Zoological Treatise")

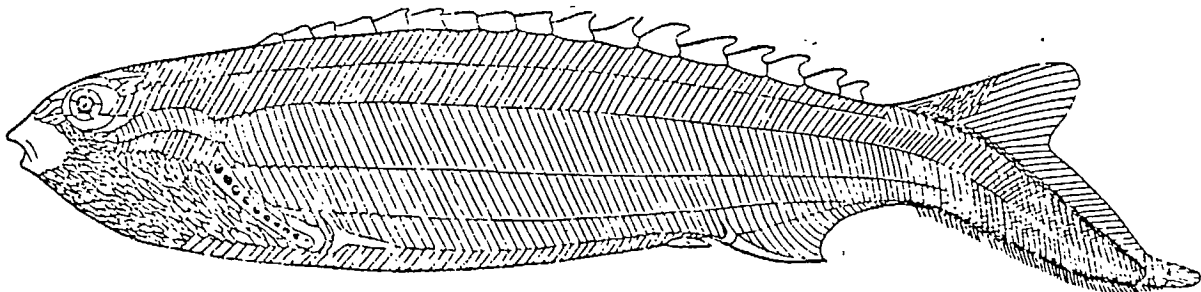


Fig. 11. - Tip de anaspid - *Pterolepis nitidus* (din Traité de Zoologie).

Fig. No.12

Type of heterostracan - *Pteraspis rostrata* (from the "Zoological Treatise")

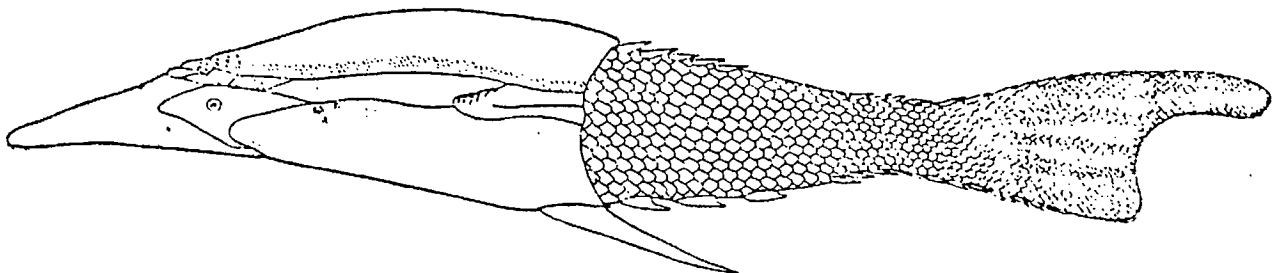


Fig. 12. - Tip de heterostrac - *Pteraspis rostrata* (din Traité de Zoologie).

(22)

The fact that the non-predatory species have mouth (buccal) parts, may indicate that indeed they descend from predatory species. However, we found in the Danube's basin a predatory species (Eudontomyzon danfordi) which lives in Tisa's affluents and the neighboring rivers, as well as two non-predatory species (E.mariae and E.vladykovi) which are more related to each other than to the first species, and which do not exist in Tisa's affluents. This fact shows that in reality, the speciation was geographical rather than ecological. The predatory species does not seem to be primitive but on the contrary, it appears to be a more developed and evelutive species. It replaces the two other species, especially E.vladykovi, in Tisa's basin.

GEOGRAPHICAL DISTRIBUTION

A common zoo-geographical characteristic of both groups of cyclostomes, is the fact that they are distributed in cold waters and to a certain extent in temperate waters, - both in the Northern hemisphere as well as in the Southern hemisphere. They are missing in the tropical zone (Fig.13 and Fig.14). Both groups have therefore a bi-polar distribution, which is explained by the fact that these archaic vertebrates were eliminated by the more modern groups in warm waters, in which the animal world is more abundant and competition is stronger.

Myxinoids are missing in the less saline seas (such as the Caspian Sea, the Baltic Sea, the Black Sea), in the Mediterranean Sea (although they exist in the Adriatic Sea), on the coasts of Iceland and on the coasts of the Arctic Ocean; however, they exist on both coasts of Greenland; in the Southern hemisphere their presence is noticed on the South-African coasts; they do not exist on the coasts of Tasmania and Australia.

Out of the three genera which belong to this order (Myxinoidei), only Paramyxine (with only one species) is endemic, on the coasts of Japan, while the other two genera - Myxine and Bdellostoma - are spread on almost the entire area where myxinoids exist. However, their various species have each a limited distribution: For example, Myxine glutinosa is found on the coasts of Europe, M. limosa and M. atlantica live on the Atlantic littoral of North America, etc..

Some of the petromyzons are anadromous migrators and the others are exclusively freshwater. Exclusively freshwater genera exist, and there are also some freshwater species belonging to certain genera which are more marine than freshwater; the first ones lived a much longer time in fresh water, and their distribution occurred continentally. On the whole, the freshwater petromyzons are peripheric freshwater animals, descending from marine forms⁴.

(24)

(23)

Fig.No.13

Geographical distribution of the cyclostomes

- 1: in interior waters;
- 2: presence of anadromous forms along the littoral;
- 3: genus Caspiomyzon;
- 4: genus Eudontomyzon (orig.).

4): For categories of freshwater fishes, see Pisces - Osteichthyes, in the R.P.R. Fauna, vol. XIII, 1964, p. 165-166.

(Cont. of Fig. 13):

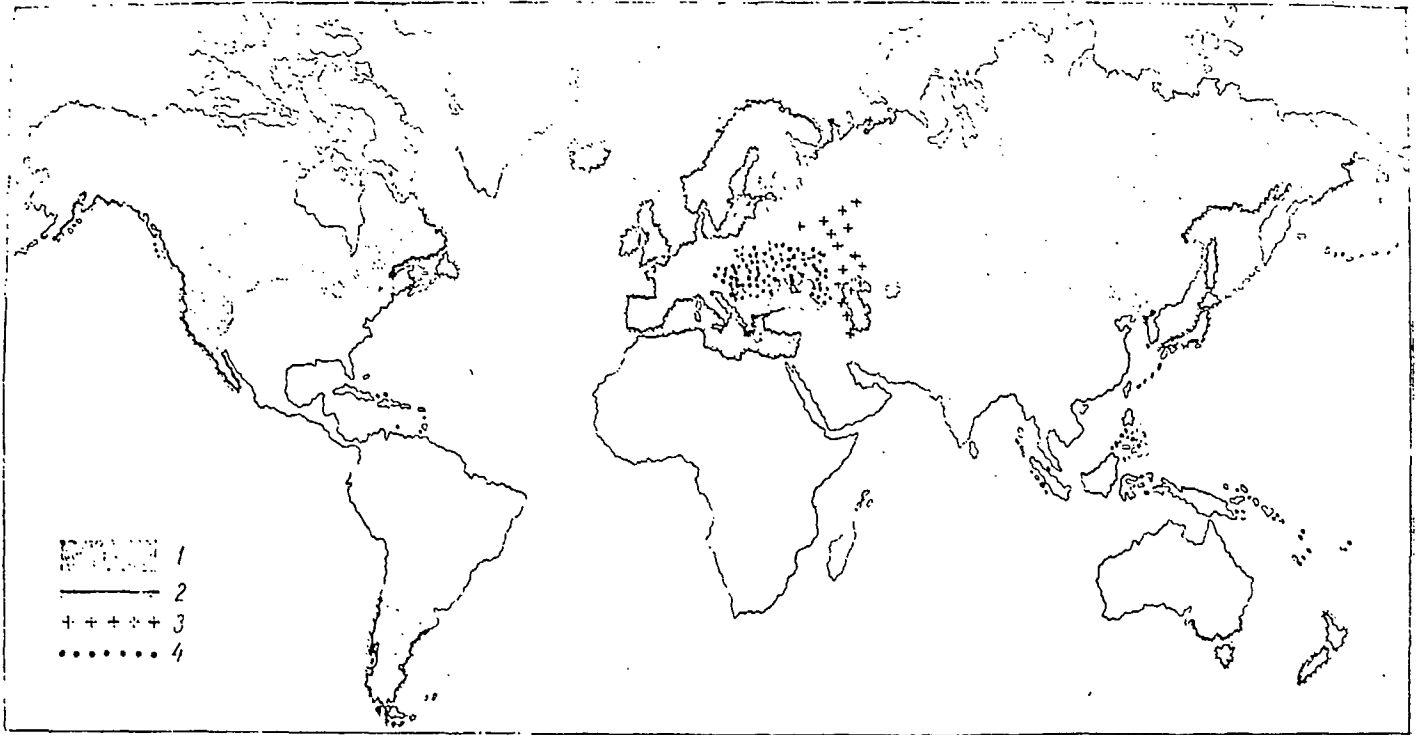


Fig. 13. — Răspândirea geografică a ciclostanilor. 1 — în ape interioare; 2 — prezența formelor anadrome la litoral; 3 — genul *Caspiomyzon*; 4 — genul *Eulantomyzon* (orig.).

(24)
The fact that they do not exist in a large Southern part of North America (although they can be found in the Western part of Mexico), and are also missing in the Aral's basin, is remarkable. Unlike the myxinoids, the petromyzons exist in the Southern hemisphere - in Tasmania and Southern Australia, but are missing in Southern Africa. They are distributed almost exclusively in the holarctic region (in the fresh waters of the Northern hemisphere), - as described in ichthyology (Banareescu, 1960) - missing in certain Southern parts of the region (a large part of North America - Rio Grande, the lower portion of the Mississippi river, Florida -, the North-Western part of Africa, Asia Minor, Aral's basin); their presence (25)
extends beyond the region - only in Eastern Asia, being also

Fig. No. 14

Distribution of cyclostomes in the interior waters of Europe

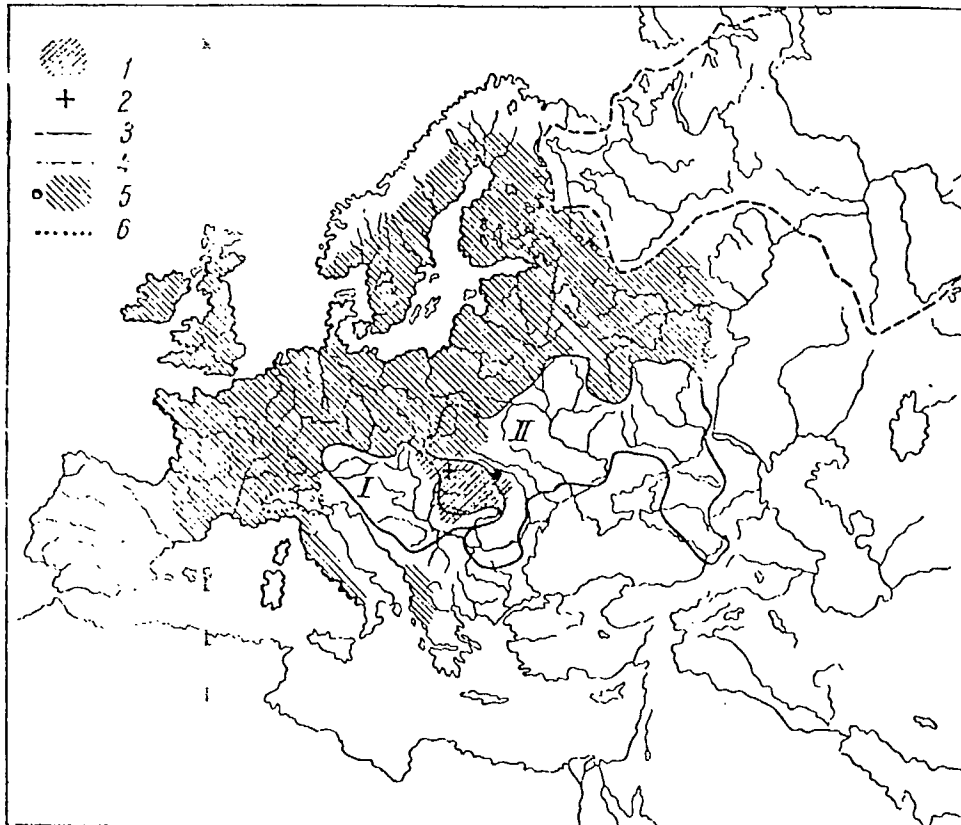


Fig. 14. — Răspândirea ciclostomilor în apele interioare ale Europei. I — *Eudontomyzon olabrykovi*; II — *E. mariae*; 1 — *E. danfordi*; 2 — *B. gracilis*; 3 — *Lampetra fluviatilis*; 4 — *L. japonicu*; 5 — *L. planeri*; 6 — *L. zanandrei* (ovig.).

found in Amur's basin, Korea and Japan.

The petromyzons include 9 genera, out of which 6 live in the Northern hemisphere and 3 exist in the Southern hemisphere.

Three of the 6 Northern genera have only one anadromous species: Petromyzon (on the European and North-American coasts of the Atlantic), Caspiomyzon (in the Caspian Sea), Entosphenus (in the Northern part of the Pacific, on the West-American and East-Asian coasts). The fourth genus, - Lampetra - has three anadromous species (fluviatilis on the North and West European coasts, and sometimes on the North-American coasts); japonica in the White Sea, the Arctic Ocean and the North-Western part of the Pacific; reissneri on the Asian and American coasts of the Northern part of the Pacific), and 5 exclusively freshwater species, out of which 3 are North-American (lamotteni, wilderi, spadicea), and 2 are European (planeri in the Western and Northern part of Europe, the South of Italy, the upper course of the Danube, Siret and Volga, and zanandreai in the Northern part of Italy). The two last genera are exclusively freshwater genera: Ichthyomyzon has 6 species, out of which 3 are predatory and 3 non-predatory (in the Eastern part of North America), while Eudontomyzon which is closely related to Lampetra, has 4 species in the basin of the Black Sea (danfordi, mariae, vladykovi and gracilis) and one species in the Yalu (in Korea) named morii; this genus does not exist in Siberia. The distribution of the above genus (Eudontomyzon) shows an East-West Palearctic discontinuity; certain genera and species of fishes (Misgurnus, Cyprinus carpio, Rhodeus sericeus, etc.) present

a similar discontinuous distribution. This distribution shows that Eudontomyzon originated in Siberia, from where it spread continentally both in Europe and in Eastern Asia; it disappeared from Siberia because of the climatic conditions during the glacial period (ice age).

The 3 Southern genera have anadromous species: Exomegas (a species found in South-America); Geotria (there are two species in South-America, New Zealand and Australia, one in New Zealand and one in Tasmania and New Zealand), and Mordacia (with two species in Chile and one in Australia, Tasmania and Chile).

The last Southern genus forms by itself the sub-family Mordaciinae, and the 8 genera (6 Northern and two Southern) - form the sub-family - Petromyzoninae.

There are 4 species of cyclostomes in Romania, of which 3 belong to the freshwater genus Eudontomyzon while the fourth belongs to genus Lampetra (which has a marine origin). Out of the 3 species of Eudontomyzon, the area where E. mariae lives is the largest: the basins of the Kuban, Don, Nipru and the Danube (the Southern and Eastern part of this last basin). E. vladkovi (a species which was described recently) seems to be (according to the existing data) endemic in the upper and middle basin of the Danube. E. danfordi lives in the most limited (and at the same time the best known) area : Tisa's basin (beginning with Eastern Slovakia), and a few neighboring rivers (close to the basin). Lampetra planeri exists especially in the basin of the Baltic Sea, France, England and Ireland, and also

in the center of Italy and partially in the Western part of the Balkan Peninsula; in the ponto-caspian basin, this species was noticed until now in the upper portion of the Danube (it is assumed that it had reached this river recently, through the affluents of the Rhine) and the upper portion of the Volga (which could have been reached through the affluents of the Neva). The recent finding of this species in the Moldova (in our country), shows that it is widely distributed in the ponto-caspian basin; most probably it also exists in the basins of the Nistru and Prut, as well as in the upper and middle course of the Siret.

As far as their distribution within the framework of the hydrographic network of Romania (Fig.15) is concerned, the best known is the distribution of the species E.danfordi, which is (at the same time) the only species found in great numbers. This species lives in almost all the mountain rivers which are affluents of the Tisa (with the exception of the Barcau and Beghei), in Banat (the Timis, Cerna and probably the Nera), and the Moldavian Bistrita. Up to the present, E. vladykovi was found only in the Bistra Marului (an indirect affluent of the Timis) and in the Cibin. E. mariae is distributed in the mountain rivers of Oltenia and Muntenia (the basins of the Jiu and Arges) where it appears to be the only species, as well as in the Moldova. According to the interpretation given by Grossu, Homei and their collaborators (1962) to the figure and data provided by Antipa (1909), E. mariae may live⁵ or may have lived also in the lower Danube, being the only cyclostome which could reach the plain

5) We already mentioned that the species considered by these four co-authors as being E. vladykovi, is in fact E. mariae.

waters (rivers). Consequently, the Carpathian arc seems to be the limit between the areas inhabited by these species - E. vladykovi (in the West) and E. mariae (to the East of the Carpathian mountains). Up to now, Lampetra planeri was found only in the Moldova and in one locality (Draguseni, District of Suceava).

In our country, two species (E. danfordi and E. vladykovi) were found together in only one river (the Bistra Marului).

We have incomplete information about the distribution of the cyclostomes in Romania and much too little is known about their distribution in Moldova (Moldavia). It is still not known what species live in the Danube's affluents from Yugoslavia (Serbia) and Bulgaria (probably - E. mariae).

(27)

Fig. No. 15

Distribution of the cyclostomes in Romania (orig.).

A: exemplaries which were not identified (as species).

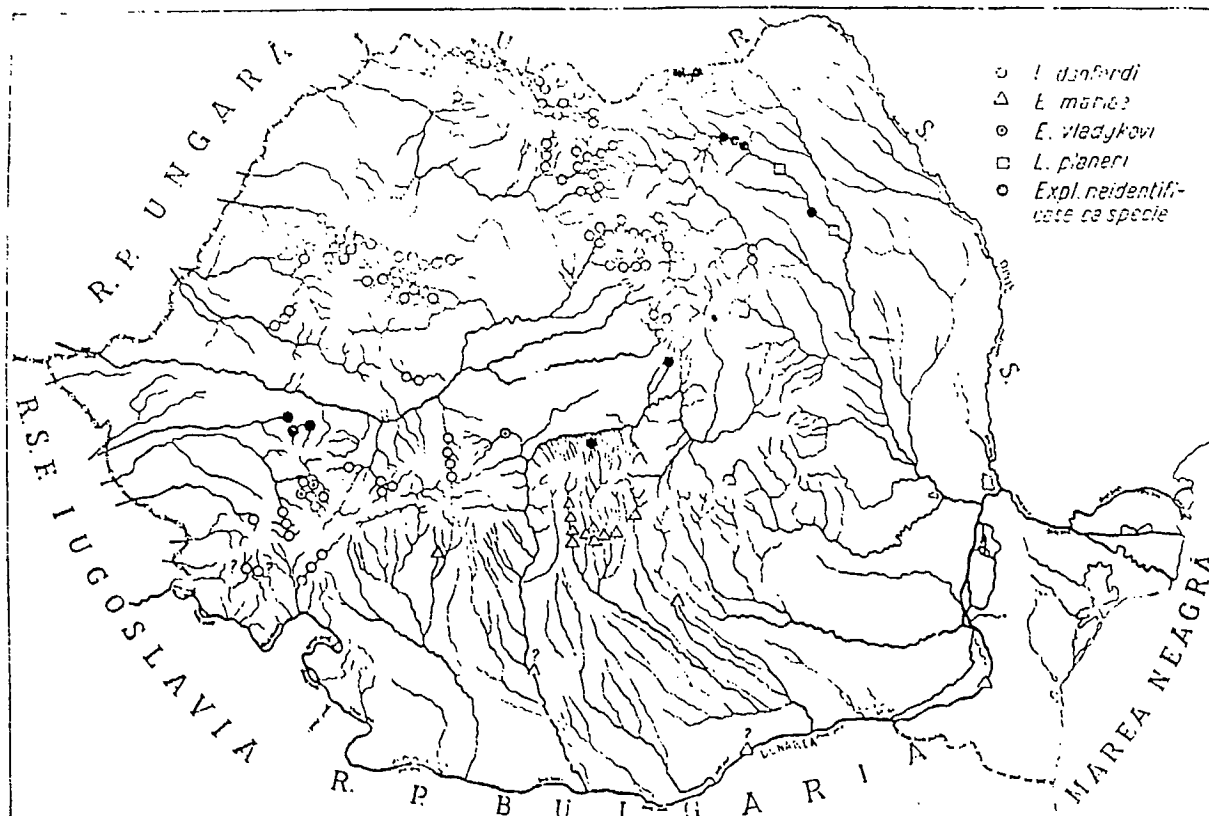


Fig. 15. — Răspândirea ciclostomilor în România (orig.).

ECONOMIC IMPORTANCE

Among the marine petromyzontoid species, Petromyzon marinum is the object of economic (commercial) fishing. The larger and easily found species, are consumed - sometimes - by the natives. In our country, the natives consume cyclostomes (especially E. danfordi which is the most frequently found species) along certain mountain rivers; in other regions they are not consumed.

The predatory species are harmful because they destroy many fishes. In Romania, E. danfordi destroys large quantities of trouts in fish hatcheries where trouts are bred artificially. In natural waters, this species attacks other fish, especially the miller's thumb (Cottus gobio - and in Maramures - C. poecilopus) but seldom the trout and barbel. Therefore, E. danfordi may be considered as either harmful or useful depending on how we consider Cottus gobio (miller's thumb): useful (especially as a nutritive element for the large trouts) or harmful (being a consumer of young trouts (fry) and a rival of trouts).

STUDY AND COLLECTING METHODS

The larvae of cyclostomes can be easily collected from ooze with a dredge or by throwing the ooze on the bank with a shovel. The adults of the predatory species (in our country: E. danfordi) can be easily lured with the help of - bait (recently dead fishes, preferably crushed, entrails of fishes or birds, etc.) attached to the interior of a circular fishing net. It is much more difficult to capture the adults of the non-predatory species; sometimes, they can be caught directly from the clear rivers, where they can be seen in the moderate current, **adhering** (in general) to the rocks with the help of the sucker.

Large quantities may be collected by draining the arm of the river, through the periodical drainages of the barrages which service the small hydro-electric (power) stations, and by draining the millponds.

The fixing of the cyclostomes is done in formalin (4%-5%), which may be neutralized or not; the fixing should be carried out in trays or other large containers, so that the animals would harden in a stretched position. The ulterior preservation of the exemplaries in the museum collections, may be achieved either in a 4-5% solution of formalin or in 70° alcohol.

The identification of the species is accomplished especially through the odontoids. The relative values of the various dimensions of the body which play such a prominent part (29) in the system of classification (systematics) of fishes, have a reduced importance in the identification or classification of the cyclostomes. Only the length (base) and height of the two dorsals (dorsal fins), as well as the distance between them are taxonomic characters; however, they may also vary (in the same species) depending on the level of sexual maturation.

The cyclostomes (larvae and adults) may be bred in aquariums in well oxygenated cold water (under 15°) and without strong and direct light.

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THE SYSTEMATIC PART

CLASS CYCLOSTOMATA

- 1758 *Amphibia nantes* (partim) + *Vermes intestina* (partim) Linnaeus, Syst. Nat., ed. a X-a, p. 230, 650.
1784 *Cartilaginei* (partim) Bloch, Oekon. Naturg. Fische Deutschl., vol. 3, p. 33.
1801 *Dipterygii* (partim) + *Monopterygii* (partim) Bloch & Schneider, Syst. Ichthyol., p. 530, 534.
1806 *Cyclostomi* Duméril, Zool. anal., p. 101.
1835 *Cyclostozeta* J. Müller, Vergl. Anat. Myxinoidea, p. 12.
1838 *Marsipobranchii* (partim) Bonaparte, N. Ann. Bologna, vol. 2, p. 133.
1866 *Marsipobranchia* Heckel, Gen. Morphol., vol. 2, p. CXX.
1880 *Myxichthyes* Huxley, Proc. Zool. Soc. London, vol. 48, p. 660.
1889 *Symphysobranchii* Garman, Mem. Mus. Harvard, vol. 24, p. 339.
1911 *Monorhina* Poche, Arch. Naturg., vol. 77, suppl., p. 110.

These are aquatic vertebrates, with a wholly cartilaginous skeleton and a persistent notochord, no limbs or paired fins, without girdles, with jawless mouths, an unpaired nasal opening, a cranium without an occipital region; the branchial openings resemble a pouch (gill pouches) and are not covered by an opercular apparatus (opercular bones).

The existing forms are grouped into two orders: Petromyzoniformes (Hyperoartia) and Myxiniiformes (Hypotreta), which, according to some authors are sometimes classified as subclasses or suborders⁶. Only the representatives of the first order exist in Romania.

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ORDER PETROMYZONIFORMES

- 1835 *Hyperoartia* Müller, Vergl. Anat. Myxinoidea, p. 13.
1845 *Hyperoartia* Müller, Arch. Naturg., vol. 11, p. 137.
1850 *Lampetrae* Bonaparte, Consp. Syst. Ichthyol.
1866 *Petromyzonida* Haeckel, Gen. Morphol., vol. 2, p. CXXI.
1904 *Petromyzontes* Fürbringer, Morphol. Jahrb., vol. 28, p. 482.
1910 *Petromyzoniformes* Berg, Sistema Ribi, p. 106.
1956 *Petromyzonoidea* Fontaine, in P. Grassé, Traité de Zoologie, t. XIII, fasc. 1, p. 155.

6): According to Stensio's conception which was adapted by other authors as well, the super-order Petromyzonoidea together with the fossil super-orders Osteostraci (with 3 orders) and Anaspida, form the sub-class Cephalaspidomorphi, while the super-order Myxinoidea together with the fossil super-order Heterostraci (with 10 orders) form the sub-class Pteraspidorphi; a third sub-class of cyclostomes, Thelodonti (with 2 super-orders) groups excl. fossil forms

The mouth (with thick lips) is surrounded by numerous cirri, but does not have tentacles and it is adapted to sucking; the infundibulum of the mouth is equipped with numerous horny odontoids. They have one or two dorsals (dorsal fins), 7 pairs of gill pouches and 7 pairs of gill openings. The adults have well developed eyes. The nasal canal opens on the dorsal part of the head and is closed on the posterior side. Development is achieved through metamorphosis; the larvae have rudimentary eyes, hidden under the skin; they do not have odontoids or lingual piston. They are freshwater or migratory animals.

The order is formed of only one family.

FAMILY PETROMYZONIDAE

It has the same characters as the order. Of the two sub-families, Petromyzoninae and Mordaciinae, only the first has representatives in our country; the last one, is composed of only one genus, with 3 species spread in the Southern hemisphere.

SUBFAMILY PETROMYZONINAE

1853 *Petromyzoninae* Gill, Pr. U.S. Nat. Mus., vol. 5, p. 522.

1824 *Petromyzoninae* Rauther, Bronn. Kl. Ordn., vol. 6, Abt. 1, p. 677.

Only one supra-oral horny plate exists. The margin of the buccal infundibulum is fringed and it has papillae at the extremity.

It includes 8 genera, whose enumeration and geographical distribution were indicated in the general part, in the chapter dealing with zoogeography (page 25). Only 4 genera exist in Europe, out of which only two live in the Danube's basin; these two genera can be also found in Romania.

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KEY USED FOR THE PURPOSE OF DETERMINING THE GENERA
OF THE FAMILY PETROMYZONIDAE

- ‡ (2) With external labial odontoids..... EUDONTOMYZON
- 2 (1) Without external labial odontoids..... LAMPETRA

GENUS EUDONTOMYZON Regan, 1911

Ann. Mag. Nat. Hist., ser. 8, vol. 7, p. 200; ^Ftip *Eudontomyzon danfordi* Regan.

A: type

The fact that the two dorsals (dorsal fins) are distinct, adjacent or at some distance from each other, is characteristic. The upper plate is very wide, showing one very hard, generally bifid tooth on each side; rarely, a small median tooth also exists. The infra-oral plate has 5-11 rounded or pointed odontoids; there are 3 or 4 internal labial odontoids on each side; the upper and lower ones are simple or bifid, while the internal odontoids are bifid or trifid; external labial odontoids also exist. The anterior margin of the sublingual plate has 5-19 odontoids, among which the middle one is more developed.

As adults, these forms are exclusively freshwater, non-migratory, predatory or non-predatory.

Observations: This genus differs from genus Lampetra only through the presence of the external labial odontoids. Since the external labial odontoids are reduced in dimensions and number in the non-predatory species - Eudontomyzon mariae and E. vladykovi - many authors consider Eudontomyzon as a sub-genus of Lampetra. However, we think that Eudontomyzon is a distinct genus, especially since in all likelihood it is an ancient freshwater genus, which spread continentally, while Lampetra is a marine genus, whose freshwater species have only lately come into existence.

The genus includes 4 or 5 species: morii existing in

in the Yalu (Korean Peninsula), mariae found in the basins of all the rivers from the North region adjacent to the North Sea, danfordi, vladykovi and gracilis which live in the Danube's basin (although it is doubtful that the last species exists). Only three species exist in Romania.

KEY USED FOR THE PURPOSE OF DETERMINING THE SPECIES OF EUDONTOMYZON

- 1.(2): Numerous external labial radiated odontoids (characterized by radial symmetry); the odontoids of the sub-oral plate are pointed; predatory species.... E. danfordi
- 2.(1): The external labial odontoids are rare and are not disposed in a radial manner; the odontoids of the sub-oral plate are rounded; non-predatory species.....3
- 3.(4): A row of lower labial odontoids exist parallel (36) with the sub-oral plate; the anterior side of the head is not narrowed anteriorly.....E.vladykovi
- 4.(3): Only very rare exemplaries have a row of lower labial odontoids parallel with the sub-oral plate; the anterior part of the head is narrowed anteriorly...E. mariae.

EUDONTOMYZON DANFORDI Regan, 1911

(Eels - Fig. 16 and 17)

- 1830 *Petromyzon fluviatilis* (non Linnaeus), Reisinger, Specimen Ichthyol. Hung., p. 97 (partim); 1853 Bielz, Verh. u. Mitt. Siebenb. Ver. Naturw., vol. 4, p. 185 (partim); 1858 Heckel & Kner, Die Süßwasserfische Östr. Monarchie, p. 377, fig. 202 (partim); 1888 Bielz, *ibidem*, vol. 38, p. 120 (partim); 1909 (?) Antipa, Fauna ihtiolo. a Rom., p. 275 (partim).
- 1853 *Aminocoetes branchialis* (non Linnaeus), Bielz, *ibidem*, p. 185 (partim); (?) 1858 Heckel & Kner, *ibidem*, p. 382, fig. 204 (partim).
- 1858 *Petromyzon planeri* (non Bloch), Heckel & Kner, *ibidem*, p. 380, fig. 203 (partim); 1888 Bielz, *ibidem*, p. 120; 1909 (?) Antipa, *ibidem*, p. 276 (partim).
- 1911 *Eudontomyzon danfordi* Regan, Ann. Mag. Nat. Hist. (S), vol. 7, p. 200; 1954 Bărbărescu, St. și cerc. științ., Cluj, an. IV, nr. 3-4, p. 155, 159; 1962 Grossu, Homci et. colab., Trav. Mus. Hist. Nat. „Gr. Antipa”, vol. 3, p. 255.
- 1925 *Lampetra bergi* Vladykov, Zool. Anz., vol. 64, p. 251.
- 1931 *Lampetra (E.) danfordi* Berg, Ann. Mus. Zool. Leningrad, vol. 32, p. 93, p. 3, fig. 2, 3; 1933 Healy, Das Tierreich, fasc. 59 (*Cyclostomata*), p. 33, fig. 41; 1948 Berg, Ribni proucih vod SSSR, vol. 1, p. 32, fig. 14, 15.

Dimensions: The larvae reach a length of 180 mm.; the metamorphosis occurs within dimensions of 156-176 mm.. The adults have dimensions of 176-260 mm..

The body is relatively compressed laterally, in the anterior region. The height of the body represents a percentage of 5,0-7,7% of the total length ⁷. The two dorsals (dorsal fins) are separated, at some distance from each other; the distance between them represents 2,3-6,8% of the body's length; the base of the first dorsal fin represents 10,5-14,9% and the base of the second dorsal represents 21-27% of the length of the body. The first dorsal fin is short (its height represents 1,3-1,8% of the length of the body) and rounded; the second dorsal fin is taller (its height represents 2,1-3,2% of the body's length), rounded or vaguely triangular. The pre-dorsal space represents 46,6-52,5%, while the pre-anal space represents 66,5-72,5% of the total length. (38)

Fig. No. 16

(37)

Eudontomyzon danfordi (orig.)

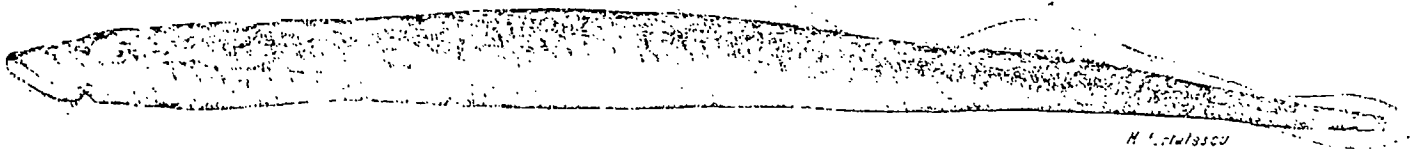


Fig. 16. — *Eudontomyzon danfordi* (orig.).

7): The bio-metric data result from the study of 26 exemplaries found in the Somesul Rece (the Apuseni Mountains) and 11 exemplaries from the Bistra Marului (Banat) which have a length of between 175 and 243 mm..

Fig. No. 17

Eudontomyzon danfordi, the mouth (orig.)

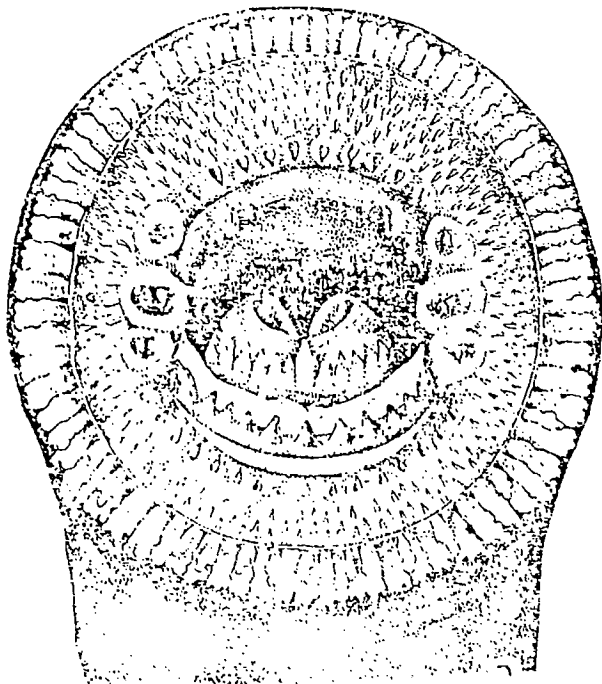


Fig. 17. — *Eudontomyzon danfordi*, gura (orig.).

The head is not narrowed in the anterior region (behind the buccal sucker).⁽³⁸⁾

The buccal sucker has numerous external labial odontoids, disposed in a radial manner; those situated on the lower part of the sucker are disposed in several rows, out of which those from the first row are larger. The sub-oral plate shows 9-11, rarely 12 pointed odontoids, of which the marginal ones are sometimes bifid (out of 24 exemplaries which were studied, we found 5 with 9 odontoids, 13 with 10 odontoids, 5 with 11 odontoids and 1 with 12 odontoids). The supra-oral plate has 2 lateral strong teeth. The sub-lingual plate has one strong median odontoid and 5 or 6 lateral ones, a little more reduced in size. On each side there are 3 labial internal

odontoids, out of which the upper one is (in the majority of cases) simple (monocuspid); however, it is often bicuspid, but in this case the two pointed extremities are close to each other. The middle internal labial odontoid is bicuspid (in one case only, it is tricuspid), the lower one is bicuspid (rarely simple - monocuspid). The two points of the middle internal labial odontoid are separated from one another; that is why the bicuspid character of this odontoid, is much more evident than that of the lower odontoid.

The intermediary stage (immediately after metamorphosis) is different from the adult (stage) through its smaller size (156-202 mm.), undersized dorsal fins and the anterior part of the head narrowed; these characters give these exemplaries an aspect which is similar to that of E. mariae. However, the dentition is like the one found in E. danfordi, although the odontoids are more reduced in size; the odontoids of the sub-oral plate are individualized, without being pointed like those found in adults; the external labial odontoids are small and as numerous - as in adults, while under the sub-oral plate, the lower external labial odontoids from the first row, are considerably larger than those in the following rows.

Colouring: The adults are dark grey with an olive tint, or dark brown with a metallic shine; the ventral side has a yellowish-whitish colour. The larvae are lighter in colour than the adults and the metallic shine is missing.

Ecology: The species lives in mountain rivers, in the same zone as the trout and grayling, seldom in the upper region of the broad snout zone. Its abundance or presence in various rivers and even in the various portions of the same

river is un-equal, depending probably on the presence and abundance of the portions with stagnant water and ooze, in which the larvae develop, and the abundance of food. The eel is frequently found in trout-hatcheries, in the small barrage lakes (or dams) of the small hydro-electric (power) stations, in mill-ponds or reservoirs (or near them) as well as in the vicinity of sawmills.

The larvae live sunk in ooze, especially in ooze mixed with sand or wood sawdust, at a depth of 10-40 cm. (according to Mihail, 1961). The head and branchial region emerge from the ooze; during the night, the whole animal comes out and hunts. The food of the larvae is composed especially of microflora (diatoms, etc.), micro-fauna and detritus. According to Mihail, they may also consume oligochetes, as well as larvae of trichoptera; the same author assumes that they also attack newly hatched young trouts (fry). The small artificial brooks or warm springs created near or on a series of mountain rivers (for example Valea Ierii) in order to offer the young trout favourable conditions in the first few months, are - at the same time - an ideal place for the larvae of the cyclostomes. (39)

There are many contradictions concerning the duration of the larval life. While analyzing the length variations of the larvae of E. danfordi (from the Valea Ierii), Chappuis (1939 and 1940) concluded that the larval life lasts between 4 and $4\frac{1}{2}$ years; at the end of the first summer (respectively the fall), the exemplaries reach 15-45 mm.; after the second summer they are 45-100 mm. long, after the third one their length is between 100-145 mm., and after the fourth summer they reach 145-200 mm..

In winter, growth stops almost completely. In some exemplaries, metamorphosis starts during the fall of the fourth year of life, and in others it begins during the spring of the fifth year.

According to Mihail.(1961), the larvae reach a length of between 12 and 20 mm., and in one year they grow - up to a length of 65-70 mm; according to this author, the larval life may last only 3 years.

Before reaching the adult stage, the larvae pass into an intermediary stage, during which they have eyes, dark colouring, a sucking mouth (sucker), rudimentary odontoids and buccal plates. During this stage, the individuals are usually smaller than the largest larvae, due to the consumption of energy which occurs during metamorphosis. The intermediary stage begins in the fall and lasts until spring; during this time, the animals do not feed and remain hidden in the ooze, beside the larvae.

In the spring, the animal becomes an adult, and starts feeding actively. Its favourite food consists of fishes (alive or recently dead, fishes), remains from slaughter-houses, birds and mammals which were killed and probably some invertebrates. Eels can attack fast swimming fishes (trouts) but more often, they attack almost motionless bottom fishes (especially the miller's thumb, genus Cottus), or slightly wounded fishes. They attach themselves on the skin of the prey, which they perforate with the help of the lingual and oral plates, after which they attack the musculature. Since they have poor eyesight, they orientate themselves by smell while searching for a prey. Usually, after being attacked by an eel, the same fish will be attacked by other eels again. The bodies of fishes which were attacked by an eel, are easily recognized because of the large

round holes produced by the attack. When they are not fixed on a prey, the eels usually remain motionless at the bottom of the river, under rocks or adhered with the buccal sucker to the rocks.

(40)

By feeding themselves in an active manner, the adult eels grow greatly until fall. In winter, feeding stops; Chappuis maintains that the alimentary canal probably regresses during winter. According to Chappuis, the adults do not feed anymore during the second year of life, and they die during summer (June, beginning of July). Maturation of the genital glands is achieved in winter, after which, in the spring of the following year (May-June) when reproduction occurs, the exemplaries travel upstream. Afterwards (according to Mihail), they may live until fall. In any case as adults, they do not live more than two summers.

Economic Importance: In certain regions, eels are consumed by the inhabitants of villages. Fishermen use them occasionally as a living bait. However, since they destroy fishes (sometimes in rather large quantities), eels are considered harmful (pests). They produce the largest damages in the artificial cultures of trouts (hatcheries), especially near feeding places. In the rivers, they rarely attack trouts and other salmonids; other fishes which have a minimum economic value, are attacked more often, particularly the miller's thumb, which by being - to a certain extent - a pest itself, confers a positive role to the eel, in some degree.

Terra Typica: The Sebes (affluent of the Mures, in the South of Transylvania, Romania).

Geographic Distribution: The basin of Tisa and several neighbouring rivers, Czechoslovakia, the Ukrainean S.S.R. (sub-Carpathian Ukraina) and Romania.

In our country, it is frequently found in large numbers in the Viseu (from its source to the river mouth), as well as in all its affluents (Homei, 1963), and also in the Tisa (in the frontier zone); although it has not been seen, it probably exists in the Iza, Sapinta and the Tur.

It has been found in the basin of the Somesul-Mare, in the Anies, Cormaia and the Salauta (information - Dr. Homei), and also in the Transylvanian Bistrita (District of Bistrita-Nasaud), between Colibita and the Bistricioara (the mill) (unpublished data). It was noticed in the basin of the Somesul Mic, in the Somesul Cald - from Giurcuta de Sus (Upper Giurcuta) to the confluence with Somesul Rece, and in its affluents - the Risca and Agirbici (Banarescu and Muller, 1960); in the Somesul Rece it exists from above Racatau up to the confluence with Somesul Cald (Chappuis, 1939); (Banarescu and Muller, 1960); it is rarely found in the Somesul Mic, between Gilau and Cluj (Chappuis, 1939); it is present in the Capus, an affluent of the Somesul Mic, above the village of Capusu Mic (district of Cluj). In the basin of the United Somes it is present only in the Firiza (an affluent of the Lapusul) in the district of Maramures (information: Malecea).

In the Crisul Repede it is relatively seldom found in the region of the districts of Cluj and Bihor and frequently seen in its affluents - Valea Draganului and Valea Iadului (Chappuis, 1939; Banarescu and Muller, 1960); it is missing

in the Barcau. Up to the present, its presence was noticed in the basin of the Crisul Negru only in the Cris near Vascau, and in the Vida and its affluent the Toplita, above (upstream) (41) Lunca Sprie (Dobresti village, district of Bihor); in the basin of the Crisul Alb, it exists only in one stream, the Moneasa, - above Moneasa (district of Arad) (Banarescu, 1954).

It was reported existing in the Mures by Bielz (1888) and Vutskits (1913) under the name of Petromyzon fluviatilis and P. planeri, without any indications regarding the localities. In the upper Mures, the species exists between the Toplita and Deda (unpublished data) & probably also upstream, above Deda; it is also found in several affluents: Toplita (Bielz, 1888), Gudea-Mare, downstream (below) from the trout hatchery, Gudea Unita (United-Gudea) to the (river) mouth, in the Zebrac, as far as its mouth (Jaszfalusi, 1947), Rastolita (Mihalyi, 1954) and in the Bistra (unpublished data); it is present in the upper course of the Lapusna and its affluents (district of Mures) - (information: Dr. A. Pop and Dr. I. Popescu-Gorj). There were no reports about its presence in the Aries; it is frequently seen in large numbers in the Iara (one of its affluents) above Baisoara (Chappuis, 1930 and recent informations); it also exists downstream from Baisoara. It was noticed in the Ampoi by several authors (Csernyi, 1867; Vutskits, 1913) under the name of P. planeri. In the Tirnava-Mare it exists at approximately 20 km. above Odorhei (information: A.G.V.P.S., Odorhei), and also in an affluent, the Sacasau, near Zetea (district of Harghita) (Rotarides, 1944; Mihalyi, 1944). In the Sebes, the

species was found and described by Regan (1911); it exists in a certain region, from the Tau - 1000 m. altitude - downstream, to a point below Sugag - approximately 300 m. altitude - (district of Alba) (information: Radu, also Nalbant, 1962). It is not present in all the affluents of Sebes; it exists only in the Bistra and Prigoana. In the Strei it exists near Hateg, Pui, and upstream; it was also found in the Barbat at its point of discharge into the Strei (mouth), in the Riul Mare and in an affluent of the Riul Mare near Sarmizegetusa (Banarescu, 1954; Bacescu, 1947).

Of course, the species is distributed in many other mountain rivers within the basins of the Somes (Somesul Mare) the Cris and the Mures. It is missing in the Bega, the last affluent of the Tisa.

It is only rarely found in the Timis, between Teregoava and Valisoara (district of Caras-Severin) (Banarescu, 1954) but is frequently noticed in the Bistra Marului, from above Poiana Marului (upstream) to the confluence with Bistra Bantarilor (district of Caras-Severin), as well as in the Sucu and other affluents of the Bistra Marului. It also exists in the Birzava, an affluent of the Timis, near Valiug (district of Caras-Severin).

The species may exist near Bozovici in the Nera and its affluent the Minis. According to some unverified information, certain predatory cyclostomes were found, which seem to be none other than E. danfordi.

It exists in the Cerna, - upstream (above Baile Heraulane) and downstream (below and downstream from Heculane) (information: Mr. Telegut (engineer)).

In the Moldavian Bistrita, it was found near Tarcau (district of Neamt) (Grossu and collaborators, 1962).

EUDONTOMYZON VLADYKOVI OLIVA ET ZANANDREA, 1959

(Fig. 18-20)

- 1858 *Petromyzon fluviatilis* (non Linnaeus), Heckel u. Kner, Die Süßwasserfische Östr. Monarchie, p. 377 (partim).
1858 *Petromyzon planeri* (non Bloch), Heckel u. Kner, *ibidem*, p. 380 (partim).
1959 *Eudontomyzon danfordi vladykovi* Oliva et Zanandrea, Doriana, vol. 2, p. 1-5; 1959 Zanandrea, Arch. Zool. Ital., vol. 44, p. 231.
1963 *Eudontomyzon vladykovi* Holčík, Věstn. Českoslov. Spol. Zool., vol. 27, p. 51-61.
1962 *Eudontomyzon mariae* (non Berg), Grossu, Homei et colab., Trav. Mus. Hist. Nat. „Gr. Antipa”, vol. 2, p. 271, fig. 6 C, 7; 1962 Nalbant, St. prot. epur. apelor, vol. II, p. 17; 1964 Bănărescu, Ocotirea naturii, vol. IX, p. 14, fig. 9.

* : Protection of nature

Dimensions: The adults have a length of between 156 mm. and 201 mm., and during the intermediary stage they measure 170-201 mm; maximum dimensions of the larvae were not determined in our country.

The adults have a taller body than the other species existing in Romania, with a maximum height representing 6,5%-7,5% of the total length of the body; the pre-dorsal space represents 47,5-54,5% and the pre-anal space represents 67-72% of the total length of the body⁸. The two dorsal fins are tall and close to each other; the base of the first dorsal fin represents 11,4-15,9% and its height represents 2,2-2,7% of the length of the body; the base of the second dorsal fin represents 22-29% and its height represents 3,3-4,7% of the length of the body. The body is slightly narrowed towards its anterior part. The uro-genital papilla is strongly developed (more than in the other species).

8): The biometric data come from 11 exemplaries collected from the Bistra Marului (Banat).

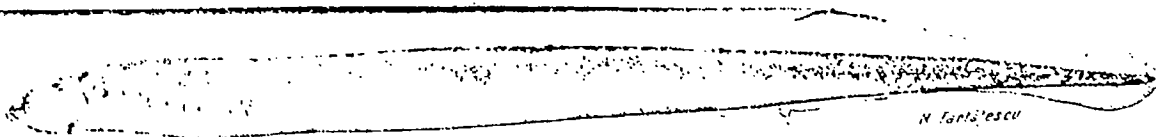
The recently metamorphosed exemplaries which were collected in the fall (intermediary stage), have a thinner body (the height representing 4,9-6,1% of the length), with dorsal fins that are placed at a distance from one another and which are undersized; the base of the first dorsal fin represents 11,2-13,7% and its height represents 1,1-1,4% of the length of the body; the base of the second dorsal fin represents 22,0-27,5% and its height represents 1,4-2,2% of the length of the body. The head is not narrowed in the anterior part, as in E.marinae. The urogenital papilla is not yet differentiated.

The external labial odontoids are scarcer and smaller than in E. danfordi; there is a row of more developed lower labial odontoids, parallel with the sub-oral plate. The upper internal labial odontoids are mono-cuspids (simple), rarely bi-cuspids; the middle ones are always bi-cuspids, the lower ones are usually bi-cuspids, sometimes mono-cuspids. In the only exemplary caught from the Cibin, the middle and upper internal labial odontoids were bi-cuspids, the lower odontoid from the right side was tetra-cuspid, and the one from the left side, was bi-cuspid (according to Grossu, Homei and collaborators, 1962). The supra-oral plate has two lateral points;

(43)

Fig. No.18

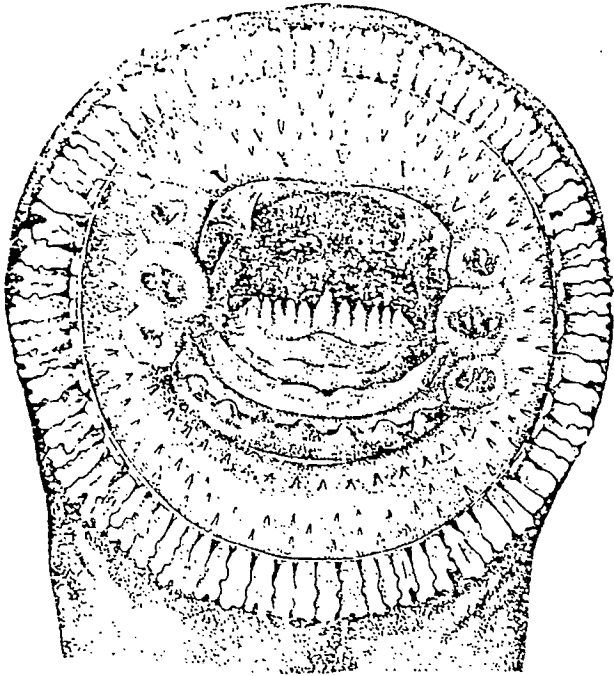
Eudontomyzon vladykovi, adult, Bistra Marului (orig.)



↑
Fig. 18. — *Eudontomyzon vladykovi*, adult, Bistra Mărului (orig.).

Fig. No. 19

Eudontomyzon vladykovi, the mouth (orig.)



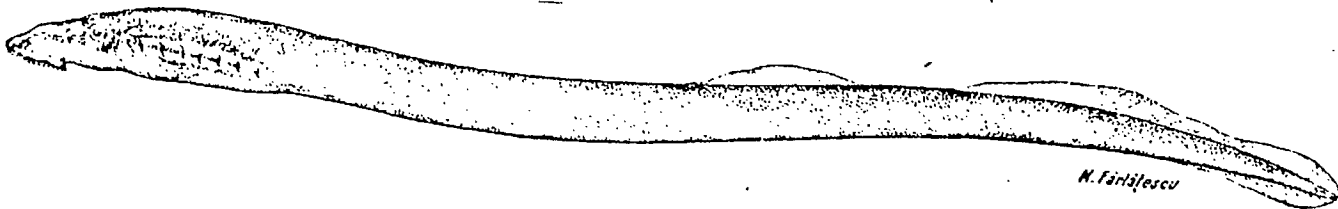
← Fig. 19. — *Eudontomyzon vladykovi*, gura (orig.).

Fig. No. 20

Eudontomyzon vladykovi, semi-adult, in the fall;
Bistra Marului (orig.)

Fig. 20. — *Eudontomyzon vladykovi*, semi-adult, toamna; Bistra
Mărului (orig.).

↓



N. Fărbulescu

(44)

the sub-oral plate has 8,9,10 or 11 well individualized odontoids; however, they are rounder than those in E. danfordi; the exemplary caught in the Cibin, has 7 odontoids. While studying the exemplaries from Bistra Marului, we noted 5 individuals with 8 odontoids, 5 with 9 odontoids, 4 with 10 odontoids and 2 individuals with 11 odontoids. The sub-lingual plate has one large median odontoid, and 3 to 7 small odontoids on each side.

The fall exemplaries (intermediary stage) have incompletely formed odontoids (especially those of the sub-lingual plate); those of the sub-oral plate are very distinct and moderately rounded, similar to those found in adults; the form of these odontoids is the only character which allows us to differentiate the intermediary stage of E. vladykovi from that of E. mariae.

Colouring: The colouring of the adults is dark-grey, with a whitish ventral part.

Ecology: E. vladykovi is a non-predatory species, which lives in mountain waters. We do not have any data on the duration of larval life. Metamorphosis occurs in the fall. The late fall exemplaries have eyes, short dorsal fins placed at a distance from one another, and incompletely developed odontoids; those caught at the beginning of the spring, are completely developed and have tall and fused dorsal fins. The adults do not feed themselves and for that reason, their dimensions reduce from 177-201 mm. (month of May) to 156-191 mm. (the end of the month of June). They lie fixed with the sucker on stones.

It seems that reproduction takes place at the end of the month of June - beginning of July in the Bistra Marului, after which the adults die.

Terra Typica: The Danube near Cilistovo (Czechoslovakia).

Geographic Distribution: It exists throughout the upper and middle basins of the Danube, from Austria to the Carpathian Mountains. The species is not uniformly distributed in this area: it is found in the Danube, throughout the region made up of slopes below the timberline, and having evergreen trees as the characteristic life form (montane zone) up to the region above Bratislava; it is also found in many affluents of the Danube from Austria, Czechoslovakia and most probably the F.R. of Germany; it is missing in Tisa's affluents (with the probable exception of the most Southern affluent of the Tisa, the Bega); it reappears in our country in the South of Transylvania (basin of the Olt) and in Banat (basin of the Timis and probably the basin of the Beghei); it also exists in the upper basin of the Drava and Sava (in Yugoslavia).

In Romania (up to the present), the species was noticed only in the Cibin, (an affluent of the Olt) above Sibiu (Grossu, Homei and collaborators, 1962), and in the Bistra Marului (an indirect affluent of the Timis), between Poiana Marului and Magura (district of Caras-Severin).

Observations: Until now, this species was confused in our rivers with E. mariae, and was mentioned as such by Grossu, Homei and collaborators (1962), Nalbant (1964) and Banarescu (1965). (45)

The first cause of the confusion is the fact that the real E. mariae which was recently captured in our country, was identified by Zanandrea (in Banarescu and collaborators, 1960, and Zanandrea, 1962) as being E. vladykovi; for that reason, when the real E. vladykovi was found by Homei in the Cibin, and

by Banarescu in the Bistra Marului, it was identified as E. mariae by Grossu, Homei and collaborators (1962), by Nalbant (1964) and by Banarescu (1965). The second cause of the confusion, is the fact that the same authors did not pay attention to the principal difference between the two species, - the presence or absence of the row of lower labial odontoids parallel to the sub-oral plate -; at the same time, Grossu, Homei and collaborators, have considered as main difference, the height and distance between the two dorsal fins; this is a character which varies in the real E. mariae, depending upon the stage of sexual maturation.

The comparison of the exemplaries which were found in the Bistra Marului (mistakenly considered - up to the present - to be E. mariae), to para-types of E. vladykovi (placed at our disposal by Dr. Holcik of Bratislava), convinced us that they are indeed the same species, the exemplaries from Banat differing from the para-types only through the larger size, and a belated period of reproduction.

EUDONTOMYZON MARIAE (Berg, 1931)

(Fig. 21-25)

- 1811 Pelromyzon fluviatilis (non Linnaeus), Pallas, Zoogr. Rosso-Asiatica, vol. 3, p. 66 (partim); 1909 Antipa, Fauna ihtiolo. a Rom., p. 275, pl. XXX, fig. 119 (partim: Dunăre).
- 1909 Pelromyzon planeri (non Bloch), Antipa, *ibidem*, p. 276 (partim); 1911 Berg, Fauna Țării Ribi, vol. I, p. 39 (partim; fluviile din nordul Mării Negre); 1952 Dreusky, Rîbete v Bulgaria, p. 21, fig. 4.
- 1931 Loutzkyia (Eudontomyzon) mariae Berg, Ann. Mus. Zool. Leningrad, vol. 91, pl. I, fig. 3, 4; 1933 Holly, Das Tierreich, fasc. 59 (Cyclusomaha), p. 35, fig. 43, 41; 1948 Berg, Ribi presnih vod SSSR, vol. I, p. 33, fig. 16-19.
- 3 1947 Eudontomyzon danfordi (non Regan), Băcescu, p. 96-98 (partim: Rîul Doamnei).
- 1960 Eudontomyzon vladykovi (non Oliva et Zanandrea), Bănarescu, Müller și Nalbant, Com. zool. S.S.N.G., p. 117; 1962 Grossu, Homei, Barbu et Popescu, Trav. Mus. Hist. Nat. „Gr. Antipa”, vol. 3, p. 258, fig. 3, 4; 1962 Zauandrea, Dacia, vol. 3, nr. 128, p. 1-3; 1962 Nalbant, Șt. prot. epur. apelor, vol. II, p. 17, pl. I; 1965 Bănarescu, Oerolirea naturii, t. 9, nr. 1, p. 14, fig. 8.

(Continuation Eudontomyzon mariae):

1. Ichthyological fauna of Romania (partim: the Danube);
 2. Partim: the rivers - to the North of the Black Sea;
 3. Partim: the Riul Doamnei;
Protection and water treatment;
Protection of nature.
-

Dimensions: The adults have a length of 163-214 mm;
the largest larvae reach 230 mm.

(46)

Fig. No. 21

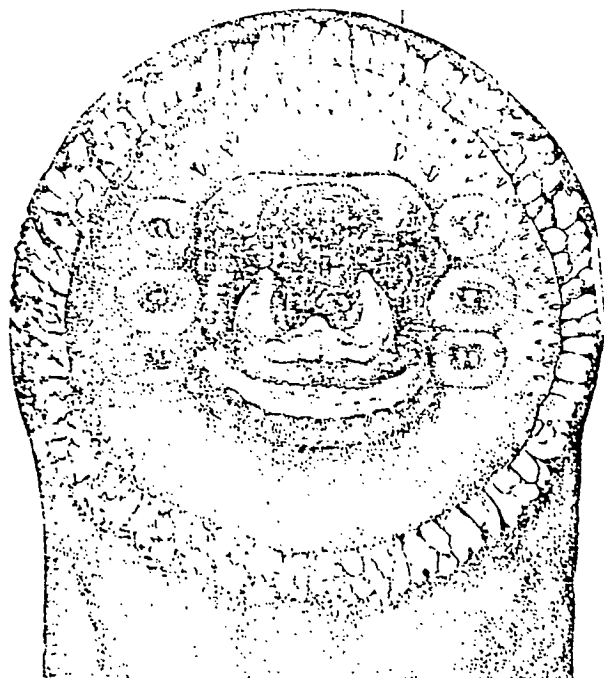
Eudontomyzon mariae, adult (July), the Arges (orig.)



↑
Fig. 21. - Eudontomyzon mariae, adult (iulie), Argeş (orig.).

Fig.No. 22

Eudontomyzon mariae, the mouth (orig.)

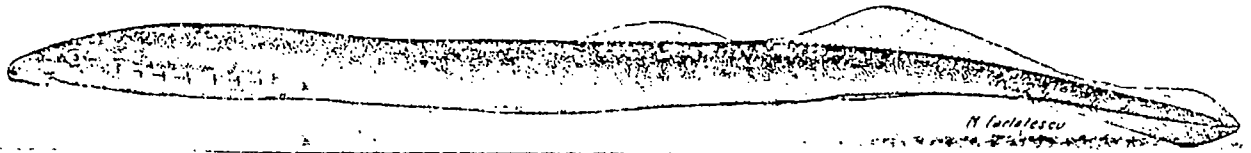


← Fig. 22. - Eudontomyzon mariae, gura (orig.).

Fig. No. 23

Eudontomyzon mariae, (immature adult) (June, the Arges)
(orig.)

Fig. 23. - *Eudontomyzon mariae*, adult imatur (iunic),
Arges (orig.).



(47)

Fig. No. 24

Eudontomyzon mariae, adult (according to Berg)

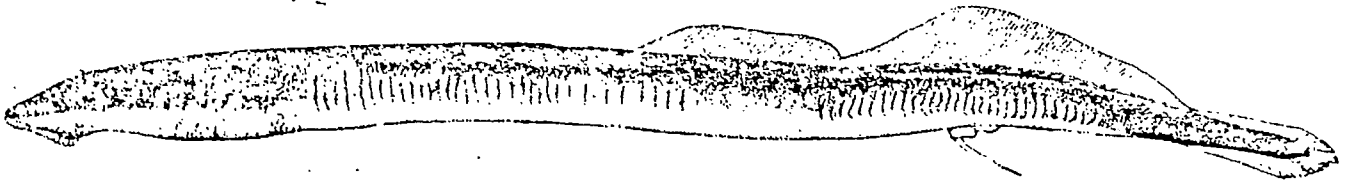
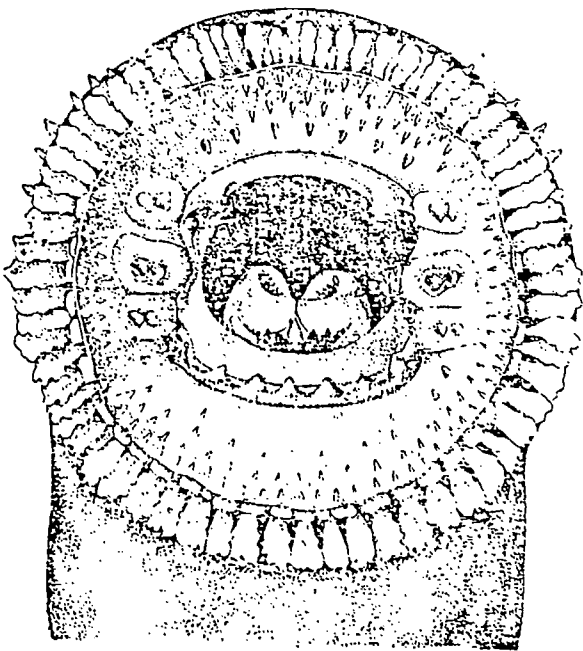


Fig. 24. - *Eudontomyzon mariae*, adult (după Berg).

Fig. No. 25

Eudontomyzon mariae, the mouth (according to Berg)



← Fig. 25. - *Eudontomyzon mariae*, gura (după Berg).

(48)

The body is cylindrical in the anterior region (uncompressed laterally). The height represents 5,3-5,7% of the total length. The two dorsal fins are relatively short and at a distance from each other, until the beginning of the month of June; the base of the first dorsal fin represents 12,4-14,2% , while its height represents 1,6-2,5% from the total length; the base of the second dorsal fin represents 22,3-27%, its height represents 3,0-3,9% while the distance between the two dorsal fins represents 4,1-4,9% of the total length. During the month of June, just before reproduction, the two dorsal fins develop, touch and grow taller; during this stage, the base of the first dorsal fin represents 15,9-16,6% of the total length; the base of the second dorsal represents 25-28%, and their height represents 2,6-3,0% and (respectively) 3,8-4,0% of the total length. the pre-dorsal space represents 46,0-48,0%, and the pre-anal space represents 69,0-72,0% of the total length.

The body is narrower in the anterior side, just behind the buccal sucker.

The external labial odontoids are much scarcer and smaller than those found in E. danfordi; the larger lower external labial odontoids (placed in a parallel direction with the sub-oral plate), exist only in a few exemplaries. In most cases, the upper internal labial odontoids are mono-cuspid, but sometimes they are bi-cuspid; the middle ones are always bi-cuspid, while the lower odontoids are bi-cuspid - and in rare occasions, mono-cuspid. The supra-oral plate has two blunt lateral teeth, and sometimes, also a median pointed tooth. The odontoids of the sub-oral plate, are very poorly individualized, short and rounded, so that it is very difficult to establish

their number; usually, on this plate there are 6-10 odontoids. It is difficult to distinguish the sub-lingual plate; on it, there are normally one very strong, central odontoid and 2-4 small odontoids on each side. The uro-genital papilla is reduced.

Colouring: The adults have a dark brown dorsal part with metallic reflexes; the sides are light brown, and the ventral part has a silvery colour. Some exemplaries are almost black. the branchial region has a yellow-rosy tint. The larvae are brown coloured, and are darker dorsally; in the large larvae, spots (disposed in a mosaical pattern and circled by a white colour) appear.

Ecology: In our country, E. mariae lives like E. danfordi in mountain rivers, namely in the grayling zone, in the upper part of the broad snout zone and probably also in the trout zone. Since Antipa (1909) mentioned that Petromyzon fluviatilis was also found in plain rivers (Olt), as well as in the Danube, it should be assumed that E. mariae reaches occasionally (or used to reach 50-60 years ago) the plain as well. In any case, nowadays the species does not reach the plain rivers, and they could reach the Danube sooner, through the Southern affluents (Bulgaria). In the Ukrainean S.S.R., the species exists in the river situated in the hill zone.

(49)

The larvae live sunk in ooze, in the still portions of the rivers. There are no data on the duration of the larval life. According to Grossu, Homei and collaborators (1962), the one year old larvae may be over 42 mm. long in the spring of the following year, while those which are 2 years old, may reach a length of more than 120 mm.. The female gorads start

developing during the larval stage; the male gonads develop only in adults.

Metamorphosis occurs in the fall; it is possible that some exemplaries undergo metamorphosis only in the winter or the beginning of spring. The odontoids develop only after the appearance of the eyes, during the final phase of metamorphosis. The dorsal fins grow taller and become longer only at the end of the month of June, before reproduction. After metamorphosis, the animals do not feed anymore and for that reason, their dimensions reduce; the largest larvae are 230 mm. long, while the largest adults reach a length of 216 mm. in April; however, in June they are only 163-176 mm. long.

In April the gonads are well developed, but reproduction does not yet take place (contrary to the opinion of Grossu, Hommei and collaborators, 1962); we affirm this because the exemplaries considered by the above mentioned authors as being in the course of reproducing themselves, had dorsal fins which were short and at a distance from each other. During June and July, the dorsal fins grow in height and become closer to each other; shortly after this period, reproduction surely occurs, and after that, the animals die.

Economic Importance: This species does not have an economic importance. Like E. vladykovi and unlike E. danfordi, E. mariae is not a pest.

Terra Typica: Harkov(basin of the Don, the Ukrainean S.S.R.).

Geographical Distribution: It is found in the basins of the lower Danube, the Nistru, Bug, Nipru and the Kuban , and possibly also in Western Trans-Caucasia. In the lower

Danube's basin, the species was definitely identified (up to the present) only in Muntenia and Oltenia. It is most likely that it also exists in Moldova (in our country) and in the Northern part of Bulgaria. It was also found by Zanandrea in the Bosna, (an affluent of the Sava (Yugoslavia)); its presence in this river must be however verified, since it would be more likely to assume that E. vladykovi is the species which lives in that river. Berg believes that the exemplaries sighted and mentioned by Wajgel in 1884 under the name of Petromyzon planeri (from the upper course of the Prut, near Kolomea (Ukrainean - S.S.R.)), may belong to E. mariae; we have doubts about this assumption, since Wajgel maintains that the exemplaries are predatory, while E. mariae does not feed as an adult.

In Romania, the species was positively identified only to the South of the Carpathian Mountains, in the basins of the Jiu and Arges.

In the basin of the Jiu it is known and was found only in the Piriul Galbenu (the Yellow Stream) - an affluent of the Gilort, in the village of Piticu (district of Gorj) (Grossu, Homei and collaborators, 1962), and probably in all the affluents of this river (in Oltenia). In the Arges, it exists between the villages of Albesti and Oesti (district of Arges) (Banarescu and collaborators, 1960) in its affluent the (50) Vilsan, near Musetesti (district of Arges) (Grossu, Homei and collaborators, 1962); in the Riul Doamnei near Domnesti (district of Arges) and in the Bratia near Berevoesti (district of Arges), larvae which belong - without doubt - to this species were found. The exemplaries from the collections of the Museum

of Cimpulung mentioned by Grossu, Homei and collaborators, come from the Riul Tirgului, an affluent of the Arges, situated near this city. In the Dimbovita, the most Eastern affluent of the Arges, it was found near Rucar (district of Arges) (collected and determined by Homei as E. vladykovi). In the Ilfov, a stream & indirect affluent of the Dimbovita, it was found near Nucet (district of Dimbovita) (unpublished data). The exemplaries sighted in the Olt near Slatina, and in the Danube near Giurgiu and Cernavoda by Antipa (1909) and mentioned under the name of Petromyzon fluviatilis, probably also belong to this species.

Observations: This cyclostome which lives in the mountain rivers from Muntenia and Oltenia, was considered until now - as being identical with E. vladykovi from the basin of the upper Danube. We already explained (while describing the previous species) the causes of this confusion. By comparing exemplaries found in the Arges and the Vilsan with those of Harkov (terra typica) (taken from the collections of the Zoological Institute (U.S.S.R. Science Academy) - No. 23 124 -), we noticed a perfect identity: the exemplaries from Harkov have the same narrowed mouth, and the row of lower labial odontoids situated parallel with the sub-oral plate is missing in 27 exemplaries (out of the 28 which were studied); in the basin of Arges, the number of exemplaries in which this row of odontoids exists, is slightly larger. The only differences are the following: in the exemplaries from Harkov, the urogenital papilla is better developed; the odontoids of the sub-oral plate are a little better formed than those existing in the exemplaries which were found in the Arges (but not as developed as in E. vladykovi or (especially) E. danfordi);

a particular difference is the fact that the two dorsal fins are already developed (tall) and are close to each other at the end of the month of April (the exemplaries which were examined were collected between April 24 and May 5); in the exemplaries from the Arges, Vilsan and the basin of the Jiu, the dorsal fins develop (by growing taller and reducing the distance between them) only at the end of the month of June or the beginning of July.

The main distinct character of this species as compared to E. vladykovi is the absence of the external, labial row of odontoids, parallel with the sub-oral plate. According to the actual stage of knowledge and research, the two species are vicarious, the chain of the Carpathian Mountains representing the limit between their areas. The fact that rare exemplaries of E. mariae in which the row of odontoids is present exist, and that these exemplaries appear to be more numerous towards the zone of contact with E. vladykovi suggest the existence of an intergradation, since E. vladykovi could be a sub-species of E. mariae.

GENUS LAMPETRA GRAY, 1851

(51)

Proc. Zool. Soc. London, vol. 19, p. 235; tip Petromyzon fluviatilis Linnaeus.

tip=type

Genus Lampetra differs from genus Eudontomyzon through the absence of the external labial odontoids (exceptionally, in some species rudiments of these odontoids exist, in which case, the odontoids of the supra-oral plate are bifid).

It is a genus with numerous species; some of them are migratory, anadromous species living in the Arctic Ocean, the Atlantic and the Pacific, both in Eurasia as well as in North America; the other species stay in the fresh waters from the basins of the same oceans and the Mediterranean, penetrating (to some extent) into the ponto-caspian basin as well. Solid reasons exist for considering that the freshwater species proceed from the anadromous species and that this is something that happened in relatively recent times. In general, the anadromous species are predatory, while the freshwater species do not feed as adults.

In the basin of the Danube, only one species exists, which also reaches Romania (where it was sighted).

LAMPETRA PLANERI (Bloch, 1784)

(Fig. 26,27)

1781 *Petromyzon planeri* Bloch, Oekon. Naturg. Fische Deutschl., vol. 3, nr. 4, p. 47.

1911 *Lampetra planeri*, Berg, Fauna Rossii, Ribbi, vol. I, p. 39, fig. 11 (partim: bazinal Balticii și Volga superioară); 1933 Holly, Das Tierreich, fasc. 59 (*Cyclostomus*), p. 30, fig. 37, 38; 1946, Berg, Ribbi presnih vod SSSR, vol. I, p. 53, fig. 44-50.

partim: basin of the Baltic Sea and the upper Volga.

It is a small species; the adults, usually have a length of 10-12 cm, and in rare occasions they reach a length of 16 cm..

The mouth is strongly bent downwards. The two dorsal

fins are tall and close to each other; exemplaries with dorsal fins placed at a distance from each other were also sighted, but these specimens were probably not totally mature. The uro-genital papilla is well developed.

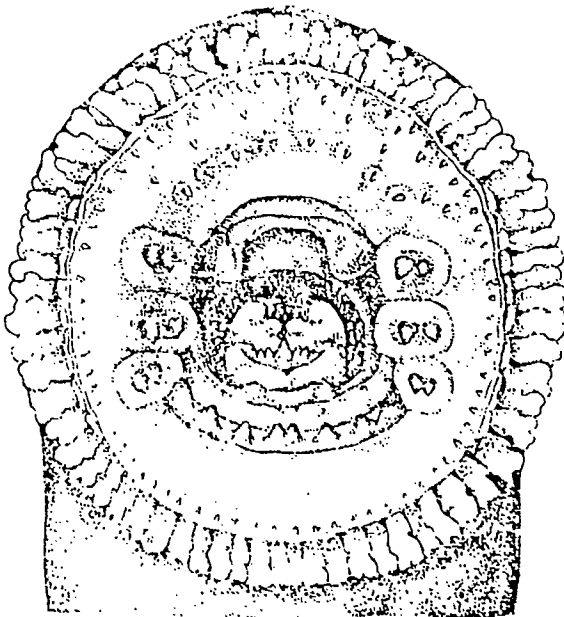
The supra-oral plate is wide, and has one strong, monofid odontoid on each side. The sub-oral plate has 5-9 (usually seven) equally sized, well defined, rounded odontoids. Three internal, labial odontoids exist on each side; the upper and lower ones are bicuspid, while the middle odontoid is tricuspid. A row of marginal, labial odontoids exist around the buccal infundibulum, and also a reduced number of upper labial odontoids. There are no external, labial, lower odontoids. (52)

Fig. No. 26: Lampetra planeri (orig).



↑
Fig. 26. — *Lampetra planeri* (orig.).

Fig. No. 27: Lampetra planeri, the mouth (orig.)



← Fig. 27. — *Lampetra planeri*, gura (orig.).

(53)

Colouring: The upper part has a dark bluish-green color, the sides are yellowish and the ventral part's color is whitish.

Ecology: L. planeri exists both in mountain waters and in plain waters, however, only in those which are relatively cold and well oxygenated. The larvae live in ooze. The adults do not feed. The period of reproduction varies, - depending on the latitude.

Terra typica: The basin of the Weser, near Erfurt (German Democratic Republic).

Geographical Distribution: The species is spread in the basins of the North Sea and the Baltic Sea, in England, France, the centre of Italy, the West region of Danube's basin, the upper course of the Volga, and probably also in the Adriatic versant of the Balkan Peninsula. In the basin of the Danube, it was found only in one river, the Inn and in an affluent of the upper Drava, near Klagenfurt (Austria).

Up to the present, only one exemplary was found in Romania, in the Moldova near Draguseni (district of Suceava) (leg. El. Arion); the species probably reaches Roman as well. It may be quite possible that it also exists in the Siret and Suceava.

OTHER RIVERS FROM OUR COUNTRY WHERE CYCLOSTOMES WERE SIGHTED AND FOUND

The four species of cyclostomes which are known in our country, were also found in other rivers; however, we cannot state precisely which ones, since, either only larvae were found (which cannot be determined), or the reason is that they were sighted by some authors a long time ago, so that their determination cannot be checked (since the exemplaries were not preserved).

If it was mentioned that the species was found in Tisa's basin, then, we can positively affirm that it was E. danfordi; when the basin of Arges was mentioned (for example the Bratia, Riul Doamnei, Riul Tirgului), they probably meant that E. mariae was found; when they wrote about a species being sighted in the basin of Olt (in Transylvania), we are certain that it was E. vladykovi, while in the basin of the Siret, the mentioned species are either E. mariae or Lampetra planeri.

The Bega: Larvae were found between the villages of Curtea and Margina (district of Timis) (Banarescu, 1954, under the name of Eudontomyzon sp.), and also in the Bega Poienilor and Bega Lucanilor above their confluence (upstream). It cannot be E. danfordi, because adults were never found attacking fishes; it may be E. vladykovi which lives in the adjacent basin of the Timis.

Basin of the Olt: Vutskits (1913) mentions seeing retromyzon fluviatilis in the Olt, without indicating the location, while Mihalyi (1954) writes about finding a larva in an affluent of the Olt, near Meresti (district of Harghita), with the name of E. danfordi. Banarescu and Muller (1960) consider that in both cases, the species which was found is E. danfordi, Cyclostomes also existed in the former trout-hatchery near Fagaras, and they still exist in a series of mountain rivers in the districts of Brasov and Sibiu. Because of the fact that only E. vladykovi was sighted in the basin of Olt (in the Cibin) and was mentioned accurately, we assume that the same species is also found in the Olt.

Basin of the Siret: Larvae which were wrongly identified as E. danfordi by Banarescu and collaborators (1960), were found in the Suceava, at its confluence with the Putna (a stream

in the district of Suceava). Larvae were found in the Moldova, between Fintina Mare and Boroaia (district of Suceava) and also near Botesti (district of Neamt), which were also identified as E. danfordi by Banarescu and collaborators (1960). However, no mention was made about cyclostomes attacking fishes in these two rivers, therefore, the species cannot be E. danfordi but one of the non-predatory species, most likely E. mariae or Lampetra planeri. Bacescu (1947) mentioned finding cyclostomes in the Siret, without specifying the species and without indicating the locality.

It is also possible that E. mariae or L. planeri may live in the Moldavian Bistrita, together with E. danfordi.

It is not known whether cyclostomes exist in the basins of the Trotus and the Putna, or in the affluents of the Jiu (Transylvania) and the Olt (in Oltenia). They are also missing in rivers from higher to lower ground, which spring in the plains or hills (the Beregsau, the Vedea and its affluents, Colentina, the rivers between the Siret and the Prut), as well as in the rivers which spring from the sub-Carpathian region, but whose upper course does not have a montane character: the Crasna, the Milcov. The Barcau, the Buzau and its affluents are in all likelihood among the mountain rivers from which the cyclostomes are missing.

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