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Osteological revision of the genus *Phoxinus* RAF., sensu BĂNĂRESCU 1964, with description of a new genus, *Parchrosomus* gen.n. (Pisces, Cyprinidae)

[With 88 text-figures and 2 plates]

INTRODUCTION

Representatives of the genus *Phoxinus* sensu BĂNĂRESCU, 1964 are small fishes spread all over the northern Eurasia and North America, and by many authors recognised as belonging to different genera: *Phoxinus* RAFINESQUE 1820, *Chrosomus* RAFINESQUE 1820, *Pfrittle* JORDAN 1924 and *Moroco* JORDAN and HUBBS 1925.

The definition of the genus *Phoxinus* was based on the European *Cyprinus phoxinus* LINNAEUS 1758. BERG, 1906 names four species from the territory of Russia: *Ph. phoxinus* (LINNAEUS), *Ph. perennurus* (PALLAS), *Ph. czekanowskii* DYBOWSKI and *Ph. lagowskii* DYBOWSKI. At the same time BERG has stressed the fact that the type-species — *Ph. phoxinus* — differs markedly from the other mentioned above species. Yet, taking into consideration the topography of the dorsal fin, identic in all above mentioned species (the dorsal fin is set well behind the front of the pelvics), he does not assign them to different genera. However, to stress their differences BERG, 1932 and 1949: 572–574 has restricted the fishes on the genus *Phoxinus* to two subgenera: *Phoxinus* s. str. (type *Ph. phoxinus*) and *Gila*¹ (= *Rhynchoocypris*, type: *Rhynchoocypris variegata* GÜNTHER

The genus *Gila*, in the light of the osteological study of UYENO, 1960 and the author's observations, comprises a large group of species living in America, which are more related to the representatives of the genus *Leuciscus* than to the genus *Phoxinus*.

1889). To the former subgenus belong the forms having a terete, fusiform body, big, dark spots ranging in one row on the side of the body up to the caudal fin, and subterminal mouth. The latter subgenus comprises the forms whose body is laterally compressed, the back and the sides covered with small, dark spots, and having terminal mouth. To this subgenus BERG included *Ph. percnurus*, *Ph. czekanowskii* and *Ph. lagowskii*.

JORDAN and HUBBS, 1925 when investigating the fishes from Japan established a new genus — *Moroco* — basing on the type species *Pseudaspius bergi* JORDAN and METZ 1913. This species is according to BERG, 1949 : 583 a synonym of *Rhynchocypris variegata* and of *Phoxinus lagowskii oxycephalus* (SAUVAGE et DABRY 1874). NIKOLSKIJ, 1956 : 153 discussed critically the subspecific status of *Ph. lagowskii oxycephalus* and recognised them as an ecological form of *Ph. lagowskii* only. In accordance with the conception of JORDAN and HUBBS, 1925 and the point of view of BERG, 1949 : 583 the author of this paper thinks to be right, basing on the detailed osteological study, to recognise the group of species: *Ph. lagowskii*, *Ph. percnurus*, *Ph. czekanowskii* as constituting the distinct genus *Moroco* JORDAN and HUBBS 1925. The generic name *Moroco* has recently been employed in Japan by UCHIDA, 1939; OKADA, 1960; NAKAMURA, 1969 in relation to the mentioned above species.

Out of the Europe, according to BERG, 1912 : 194, lives in North America *Phoxinus neogaeus* COPE 1869, a form related to the European *Ph. phoxinus*. JORDAN, 1924 has questioned the close relation of *Ph. neogaeus* with the form of the Old World genus *Phoxinus*, and has established for it a new genus — *Pfrille*. BAILEY, 1951 has lumped *Pfrille neogaea* in the genus *Chrosomus* RAFINESQUE 1820, however in 1970 he has included it to the genus *Phoxinus*. BĂNĂRESCU, 1964 has recognised the genera: *Pfrille*, *Chrosomus* and *Moroco* as synonyms of the genus *Phoxinus*.

Up to the present the American authors have shared a controversial opinion on the systematics of *Ph. neogaeus* = *Pfrille neogaea*. MCPHAIL and LINDSEY, 1970 : 252 say: "we follow JORDAN, 1924 in considering *neogaeus* to be of uncertain affinity, best placed by itself in the genus *Pfrille*". On the contrary SCOTT and CROSSMAN, 1973 placed it into the genus *Chrosomus*. Having analysed different point of view concerning the systematic status of this species the last mentioned authors express their idea as follow: "Whatever the decision, the closeness of the relationship of *Chrosomus eos* and *neogaeus* can surely be denied".

It is the aim of this work to elucidate the rightness basing on the skull osteology: 1. elimination of *Ph. percnurus* and its related forms from the genus *Phoxinus* and transfer them to the genus *Moroco*, 2. to prove the distinct character of the genus *Chrosomus* in comparison with the genus *Phoxinus*, 3. to interpret the systematic position of *Pfrille neogaea*, 4. to discuss the systematic differences in the representatives of the genus *Chrosomus*, and necessity to create a separate genus *Parchrosomus* basing on the type species *Chrosomus oreas* COPE 1868.

MATERIAL AND METHOD

The osteological study have been carried on:

- Phoxinus phoxinus*, 12 specimens from the Dunajec R. (tributary of Vistula R.) and from Czarna Hańcza R. (tributary of Nemen R.) Poland.
- Moroco percunurus* (= *Ph. percunurus*), 12 specimens from small bodies of water near Warszawa and Bydgoszcz, Poland; 5 specimens from Jana system River, Siberia.
- Moroco lagowskii* (= *Ph. lagowskii*), 2 specimens from the Zeja River (Amur R. tributary), and 5 specimens from Korea.
- Moroco lagowskii oxycephalus* (= *Ph. lagowskii oxycephalus*), 2 specimens from the Amur R. basin.
- Moroco czekanowskii* (= *Ph. czekanowskii*), 2 specimens from the Uganda River (Amur R. tributary).
- Pfrille neogaea* (= *Chrosomus neogaeus*), 12 specimens from small, weedy lakes, Ont. Sudbury Distr., Canada.
- Chrosomus eos*, 12 specimens, Ont. Leeds County, Small Creek Hwy 42, Athess Drainage St. Lawrence R.
- Chrosomus erythrogaster*, 8 specimens from Willey Fork of North Fork of Fishing Creek, West Virginia, USA.
- Chrosomus oreas*, 4 specimens from Back Creek at Poages Mill, Roanoko County, USA.

The material have been preserved in alcohol or in formalin, and for osteological study stained with alizarin. The greatest attention has been done to the bones of the skull, and among them to the lacrimal, supraorbital, urohyal, the pharyngeal process of the basioccipital, operculum, maxillary, dentary.

ACKNOWLEDGMENTS

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OSTEOLOGY

Dorsal view of the cranium

The supraethmoid lies at the front of the surface of the head. Its anterior part is largely fused with the anterodorsal part of the underlying ethmoid. The shape of the supraethmoid is not at all constant within the species, nevertheless the general structure is markedly different in particular species discussed in this paper. Usually it is a thin, transparent bone more or less concave along its mesial axis. In *Ph. phoxinus* this concavity is deep and thus the lateral portion of the bone becomes wing-like. Anteriorly it is bent downward, and its anterior edge is moderately incised medially and laterally projects as a pair

of very small parallel processes. Posteriorly the supraethmoid gradually becomes narrower and its posterior edge is usually dentated. In this species the bone is longer than broad (Fig. 1). In *Moroco percunurus* the mesial concavity is very deep anteriorly and posteriorly the bone gradually grows to an almost flat plate. Its anterior edge is bent downward forming a pair of lateral processes.

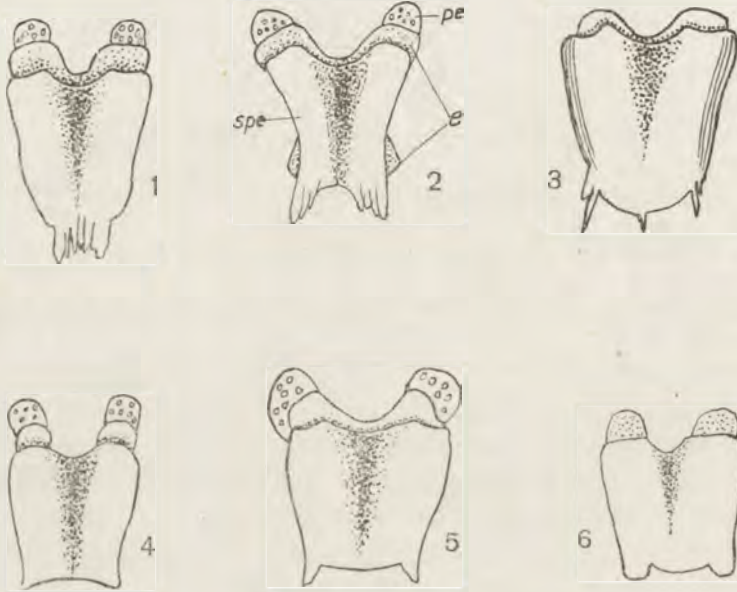


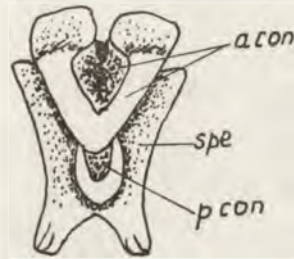
Fig. 1-6. Dorsal view of the ethmoid. 1 - *Phoxinus phoxinus*, 2 - *Moroco percunurus*, 3 - *Pfrille neogaea*, 4 - *Chrosomus erythrogaster*, 5 - *Ch. eos*, 6 - *Ch. oreas*; e - ethmoid, pe - preethmoid, spe - supraethmoid.

The posterior edge is laterally deeply dentated (Fig. 2). The bone is longer than broad, with lateral edges slightly incised. The supraethmoid of *M. lagowskii* is very similar to that of *M. percunurus*. In *Pfrille neogaea* the supraethmoid is a little longer than broad, and its posterior edge bears a moderately long denticle laterally and a small one mesially (Fig. 2, 3). In the three representatives of the genus *Chrosomus* the lateral edges of the supraethmoid are usually slightly rounded, and the posterior edge is laterally supplied with a variously shaped process. In *Ch. erythrogaster* the process is scarcely marked, in *Ch. eos* it is tapered, and in *Ch. oreas* it is blunt (Fig. 4, 5, 6).

The ethmoid of the investigated species is in comparison with the supraethmoid a strongly built bone of a complicated structure. It is composed of two portions: the anterior and the posterior (both called conus here). The anterior conus, when observed from the ventral side, has a V-like form and thick walls. The walls enclose a deep groove opened anteriorly by a narrow incision. The posterior conus is generally smaller than the anterior one, and

is partly covered by it. Its walls enclose a funnel-like pit with its apex trended anteriorly. In *Ph. phoxinus* this portion is markedly smaller than the anterior one, and the opening to the funnel is of oval form, surrounded by thick walls. The pit is not very deep, sometimes scarcely marked. In *Moroco percnurus*, *M. lagowskii*, *Pfrille neogaea* and in the species of the genus *Chrosomus* the opening to the funnel-like pits is nearly round, and the pit is voluminous and deep (Fig. 7).

Fig. 7. Ventral view of the ethmoid of *Moroco percnurus*; acon — anterior conus, pcon — posterior conus, spe — supraethmoid.



The preethmoid is present in all investigated species (Fig. 8). It is mostly of cartilaginous consistence, with one or two centra of ossification. A part of it is pushed between the lateral projection of the vomer and the ethmoid. The outstanding portion of the preethmoid fits laterally to the anterodorsal facet of the palatin, and anterodorsally to it attaches the anterodorsal part of the maxillary.

The frontal is the largest paired bone forming the roof of the cranium. Anteriorly the frontal joins the supraethmoid, laterally each frontal partially covers the lateral ethmoid, posteriorly it overlies the anterior margin of the parietal. Posterolaterally the frontal joins the sphenotic. The ventral surface of each frontal is transversed by a shallow furrow. Dorsolaterally each frontal bears the greatest part of the supraorbital sensory canal, embedded in its surface. Anteriorly this canal continues as the nasal canal, enclosed in a tube-like nasal bone, posteriorly it extends towards the posterior margin of the frontal. Posterolateral portion of the frontal, just above the postorbital process of the sphenotic makes a shallow bend, to constitute a part of the roof of the lateral temporal fossa (Fig. 8).

The supraorbital clings to the lateral edge of each frontal. This bone has a different shape and proportion in the species discussed here. In *Moroco percnurus* it is very large and crescent-like, it extends beyond the half length of the frontal edge. In *M. lagowskii* and *M. czekanowskii* it is very similar to that of *M. percnurus*. In *Ph. phoxinus* the supraorbital is very small, situated in a deep incision of the frontal, and is almost round (Fig. 9). The shape and proportion of this bone are real generic characteristics for the genera: *Phoxinus* and *Moroco*. In *Pfrille neogaea* and in the three species of the genus *Chrosomus* the supraorbital is small and crescent-like, never extending beyond half the length of the frontal edge (Fig. 10, 11).

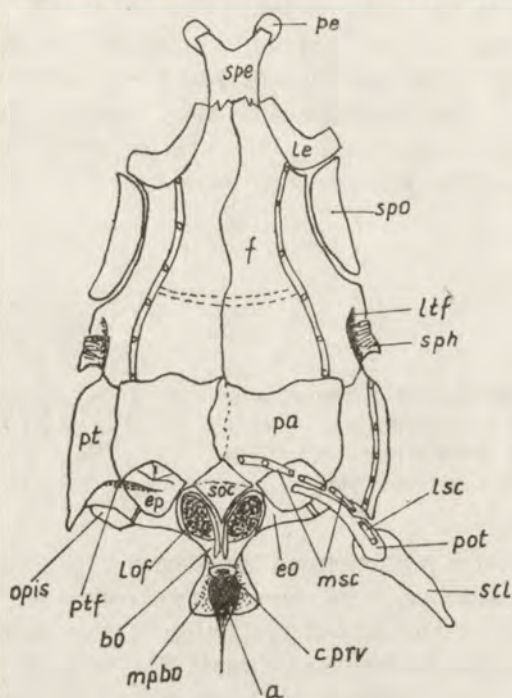


Fig. 8. Cranium of *Moroco percunurus*, dorsal view; a – canal for aorta in basioccipital, oprv – centrum of proatlas vertebra, eo – exoccipital, ep – epiotic, f – frontal, le – lateral ethmoid, lof – lateral occipital foramen, ltf – lateral temporal fossa, lsc – lateral extrascapular, mpbo – masticatory plate of the basioccipital, msc – medial extrascapular (post-parietal), opis – opistotic (intercalary), pa – parietal, pe – preethmoid, pt – pterotic, ptf – posttemporal fossa, pot – posttemporal fused with the lateral extrascapular, scl – supracleithrum, spe – supraethmoid, soc – supraoccipital, sph – sphenotic, spo – supraorbital.

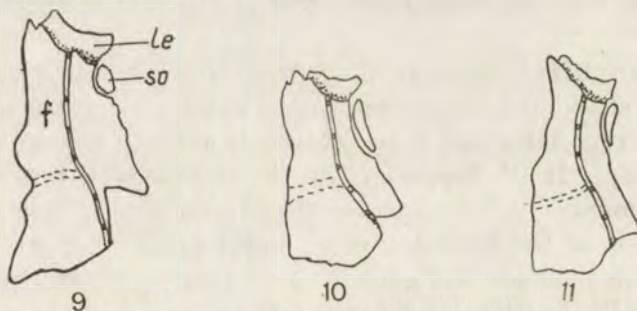


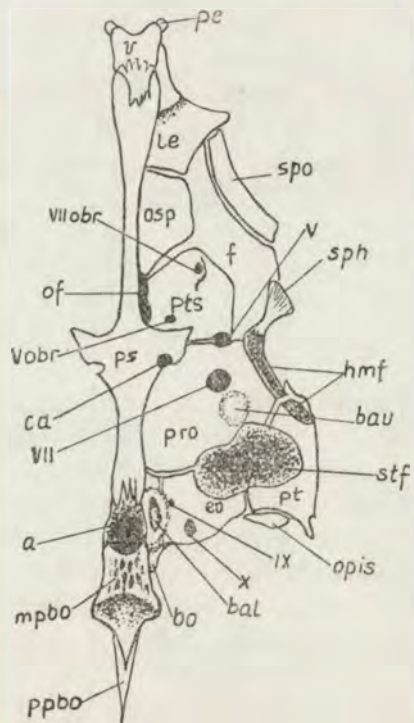
Fig. 9–11. Shape and proportion of the supraorbital. 9 – *Phoxinus phoxinus*, 10 – *Pfrille neogaea*, 11 – *Chrosomus oreas*; f – frontal, le – lateral ethmoid, so – supraorbital.

The sphenotic is a paired bone situated laterally at the margin of the cranium. Anteriorly it is partly overlaid by the frontal, and only a portion of it — the broad ledge — (postorbital process sensu HARRINGTON, 1955) is visible on the outside. In all American species here discussed a small, dorsal portion of the sphenotic intervenes between the frontal and the pterotic. As it concerned *Ph. phoxinus* and *Moroco percnurus* the frontal and the pterotic come into direct contact in most cases, and only sporadically the mentioned bones are separated by the sphenotic. The ventral edge of the sphenotic forms anterior part of the facet for the hyomandibular (Fig. 12).

The parietal is a paired, flat bone of an almost square shape, covering the posterodorsal region of the cranium. In the midline the right parietal overlaps the left margin of its mate.

The pterotic is a paired bone, lying laterally to the parietal, along its lateral surface runs a sensory canal (dermopterotic canal sensu WEITZMAN, 1962; supratemporal-intertemporal canal sensu HARRINGTON, 1955; temporal sensory canal sensu RAMASWAMI, 1955). Posteriorly the dermopterotic canal joins the extrascapular canal and proceeds backward in the posttemporal bone. The anterior, upper surface of the pterotic constitutes the continuation of the lateral temporal fossa. The inner surface of the pterotic encloses the semicircular canal, and forms the vault of the subtemporal fossa.

Fig. 12. Cranium of *Moroco percnurus*, ventral view; a — canal for aorta in basioccipital with the otolith asteriscus, bal — bulla acustica lagenaris, bau — bulla acustica utricularis with the otolith lapillus, bo — basioccipital, ca — foramen for carotid artery, eo — exoccipital, f — frontal, hmf — hyomandibular facet, le — lateral ethmoid, mpbo — masticatory plate of the basioccipital, of — optic foramen, opis — opisthotic, osp — orbitosphenoid, pe — preethmoid, ppbo — pharyngeal process of the basioccipital, pro — prootic, ps — parasphenoid, pt — pterotic, pts — pterosphenoid (pleurosphenoid), sph — sphenotic, spo — supraorbital, stf — subtemporal fossa, v — vomer, V — foramen for the trigeminal nerve, VII — foramen for the facial nerve, Vobr — foramen for the ophthalmic branch of the trigeminal nerve, VIIobr — foramen for the ophthalmic branch of the facial nerve, IX — foramen for the glossopharyngeal nerve, X — foramen for the vagus nerve.



The epiotic is a paired bone, lying on the posterodorsal edge of the cranium, and laterally to the supraoccipital. Its ventral surface takes part in forming the subtemporal fossa. The dorsolateral surface of the epiotic extends horizontally to a lamella-like projection which joins the similar lamella of the pterotic, and together form the roof of the posttemporal fossa (REGAN, 1911) well expressed in *Moroco percenurus* and *Ph. phoxinus* (Fig. 8). The lamella-like projections are very feebly expressed in *Pfrille neogaea*, and in three representatives of the genus *Chrosomus*, that is why the posttemporal fossa in these species is hardly visible. In this case my observations agrees with that of RAMASWAMI, 1955: 234 who says "I have noticed the fossa (posttemporal fossa) in all the genera studied by me". Quite a different opinion has been expressed by ROBERTS, 1973: 384 "In *Cyprinidae* it is absent".

The unpaired supraoccipital bone forms the posterior medial roof of the cranium, it is very similar in all investigated species. It contacts with the parietals, the epiotics and the exoccipitals.

The paired exoccipital bones form the posterolateral part of the cranium. The exoccipital is dorsally bordered by the supraoccipital and the epiotic, dorsolaterally by the pterotic, anteroventrally by the prootic, ventrally and posteriorly it lies on the basioccipital. In the posterior wall of the exoccipital there is a big, oval foramen — the lateral occipital foramen (Fig. 8). The mesial, vertical stripe-like parts of these bones meet each other to form a ridge, but ventrally the walls step aside to form the foramen magnum for the nerve cord. The inner, horizontal lamellae of each exoccipital meet in the midline to form the roof of the cavum sinus imparis. On the ventrolateral wall of each exoccipital there are two foramina, the passages for the nerves: glossopharyngeus IX and vagus X. The former, small foramen is located in the anteroventral corner of the exoccipital and the latter, much bigger, lies posteriorly and somewhat dorsally (Fig. 12 IX, X).

The opisthotic (intercalare of BERG, 1940) is a paired, small and flat bone of a somewhat oval shape, the bone lies at the posterior edge of the pterotic, laterally touching the exoccipital.

The extrascapular bones. It is a complex of a superficial, tubular bones. The medial extrascapular of each side is composed of three limbs. The mesial of it is partly fused with the posterior margin of each parietal, the other limbs lie free in one line and parallel to the anterior edge of each posttemporal (Fig. 8). These series of bones enclose the supratemporal lateral-line canal. The canal continues as the so called posttemporal canal in the lateral extrascapular, which is tightly fused with the posttemporal.

The posttemporal is a paired bone, long and flat; fastened by its proximal end to the top of the epiotic. Its distal end is broadened being fused with the lateral extrascapular bone.

Ventral view of the cranium

The vomer is an unpaired, flat and thin bone situated ventrally on the front of the cranium (Fig. 12, 13–20). Its shape is not at all constant within a species. Ventrally it is slightly concave. On its dorsal surface, a more or less expressed crest runs mesially to the posterior end of the bone. In *Moroco percnurus* the crest may be split longitudinally into two lamellae. Anteriorly the vomer contacts with the ethmoid, posteriorly it overlies the parasphenoid, and laterally it sutures with the lateral ethmoid. In *Phoxinus phoxinus*, *M. percnurus* *M. lagowskii* it is anteriorly deeply notched and its lateral projections are well expressed. In *Pfrille neogaea* and in *Ch. oreas* the anterior edge of the vomer is moderately notched. The dorsal surface of each lateral projection is always concave and rests on the inner portion of the preethmoid (Fig. 13–30).

The parasphenoid lies along the ventromesial part of the cranium. Its anterior long portion is a narrow bar, usually somewhat flattened and enlarged in front. Posteriorly this portion extends dorsolaterally to form a sort of bony lamellae, which contact with the correspondent prootic (Fig. 12). The deep incision on the posterior edge of each lamella forms with the opposite margin of the prootic a foramen for the carotic artery. The posterior portion of the parasphenoid is not very long, somewhat enlarged, and its end is usually furcate.

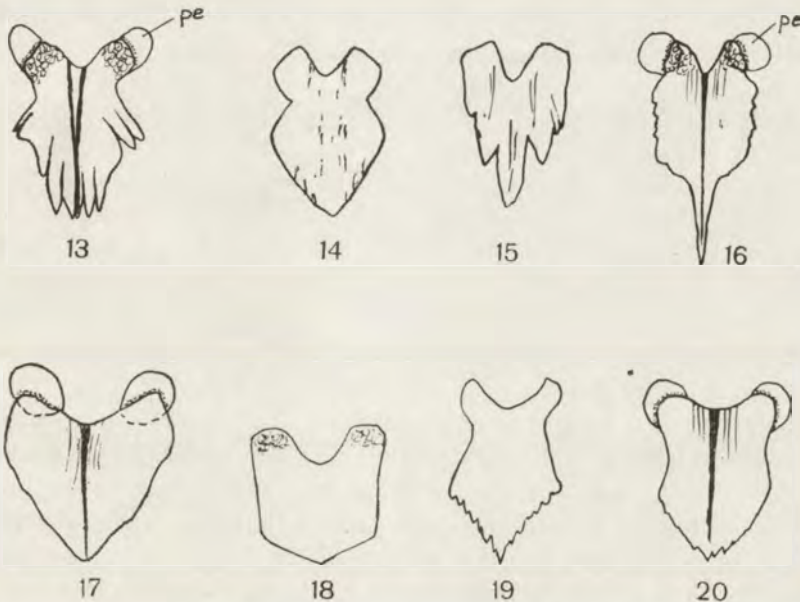


Fig. 13–20. Vomer, ventral view; 13 — *Moroco percnurus*, 14 — *M. lagowskii*, 15 — *M. cze-kanowskii*, 16 — *Phoxinus phoxinus*, 17 — *Pfrille neogaea*, 18 — *Chrosomus erythrogaster*, 19 — *Ch. eos*, 20 — *Ch. oreas*; pe — preethmoid.

Anteriorly the parasphenoid is pushed under the end of the vomer, posteriorly it clings to the ventral wall of the basioccipital. The parasphenoid is very similar in all investigated species.

The orbitosphenoid is an unpaired bone, Y-shaped in cross section. Its upper diverged walls contact with the frontals, anteriorly with the lateral ethmoids and posteriorly with the pterosphenoid. The bone forms the floor of the cranium cavity. The external surface of the lateral walls of the orbitosphenoid is quite smooth in the fishes discussed here, whereas in some other

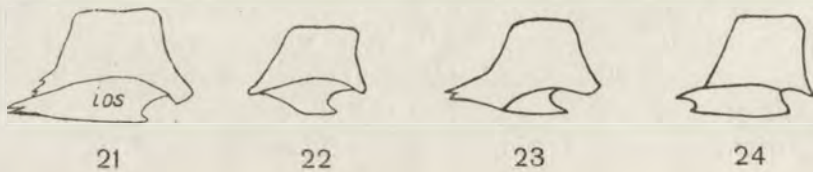


Fig. 21-24. Orbitosphenoid. 21 - *Moroco percunurus*, 22 - *Phoxinus phoxinus*, 23 - *Pfrille neogaea*, 24 - *Chrosomus oreas*; ios - interorbital septum.

genera of the subfamily *Leuciscinae* as in *Gila*, *Leuciscus* or *Rutilus* it is rough or even bears a longitudinal crest. The ventral part of the orbitosphenoid - the interorbital septum - contacts with the anterior portion of the parasphenoid. This element of the orbitosphenoid varies within the species (Fig. 21-24).

The pterosphenoid (pleurosphenoid, alisphenoid) is a paired bone of an almost flat and round form. Each pterosphenoid contacts anteriorly with the orbitosphenoid, posteriorly with the prootic and the parasphenoid, dorsally touches the frontal. The free, mesial edges of both pterosphenoids bound laterally the optic foramen. Three well expressed foramina perforate the bone. Through the anterodorsal foramen passes the ophthalmic branch of the facial nerve - VII obr. The foramen located posteroventrally constitutes a path for the ophthalmic branch of the trigeminal nerve - V obr. The foramen for the trigeminal nerve - V lies on the dorsal portion of the suture joining the pterosphenoid to the prootic (Fig. 12).

The prootic is a paired bone situated on the ventral side of the cranium. It sutures anteriorly with the pterosphenoid, dorsolaterally it contacts with the sphenotic and pterotic, and constitutes the ventral edge of the facet of the hyomandibular fossa. Posteriorly the prootic sutures with the exoccipital and the basioccipital, and forms the anterior wall of the subtemporal fossa. Lateromesially it contacts with the parasphenoid. Here its wall splits longitudinally to form the ventral and dorsal lamellae. Each ventral lamella sutures with the parasphenoid, whereas the dorsal lamellae of the right and left prootic meet in the midline to constitute the roof of the posterior eye-muscle myodome, whereas the parasphenoid forms the bottom of this myodome. On the ventral

surface of the prootic, just anteriorly to the subtemporal fossa, a prominent bulla acustica, and the otolith lapillus enclosed in the utriculus are visible. Anteriorly to the bulla acustica lies the foramen for the facial nerve (Fig. 12).

The unpaired basioccipital forms a part of the otic region of the skull; it is anteriorly sutured with the prootic and ventrally it lies on the end of the parasphenoid, laterally it is joined with the exoccipitals. The construction of the basioccipital is somewhat complicated. We can distinguish two different parts of it. The anterodorsal part, which is limited posteriorly by a concave centrum — the proatlas vertebra — (HARRINGTON, 1955), and the ventro-posterior part — the pharyngeal process. The former part is very similar in all examined species. Its anterior walls are markedly thickened and include the hind end of the eye myodome. At this region the dorsal surface of the basioccipital forms medially the floor of the cavum sinus imparis protected by thin, vertical bones laterally. Here the basioccipital extends laterally to form, on each side a large cavity — the recessus saculi, which encloses the otoliths: asteriscus and sagitta. The convexity formed by the basioccipital and the exoccipital walls, just opposite to the otoliths, is well expressed in the studied fishes, and is termed — bulla acustica lagenaris (Fig. 12).

The posteroventral part of the basioccipital — the pharyngeal process — is situated obliquely to the body axis, and is of composed construction. It is anteriorly flattened dorsoventrally, whereas its posterior portion is an elongated and laterally compressed plate in all investigated species except that of *Chrosomus oreas*. The anterior portion — the masticatory plate — is differently shaped in each species, and thus presents a good specific characteristic (Fig. 25–32). In *Ph. phoxinus* the masticatory plate is short, deeply concave, and wing-like, expanded laterally. Its surface is characteristically bent posteriorly, forming yet another small depression. The lateral wings are well rounded posteriorly. The anterior edge of it is usually incised. In *Pfrittle neogaea* is the masticatory plate much alike that of *Ph. phoxinus*. In *M. percenurus* the masticatory plate is elongated, its surface is posteriorly bent like that of *Ph. phoxinus*, the lateral edges are slightly incised and the posterior angles are rounded. The anterior edge is usually incised, yet it may be convex sporadically or even elongated to small projection mesially. The masticatory plate of *M. lagowskii* and *M. ozekanowskii* do not much differ from that of *M. percenurus*. When comparing the masticatory plate of the representatives of the genus *Chrosomus* we state great likeness between *Ch. erythrogaster* and *Ch. eos*, whereas in *Ch. oreas* this element is markedly different. In the two first the masticatory plate is feebly concave, the lateral edges are moderately rounded and posteriorly slightly incised. In *Ch. oreas* the masticatory plate is rather flat and its lateral rounded edges, gradually approach each other towards its end. The anterior edge of the masticatory plate is in all three species only slightly incised, most often straight or even convex, and sporadically, as in *Ch. oreas*, elongated mesially to a tapered projection (Fig. 33).

From the above we see that the shape of the masticatory plate may be a very important taxonomic feature in uncertain cases as, for instance, in the studied fishes. According to the taxonomic value of the masticatory plate the opinion of MIASKOWSKI, 1960: 138 is as follows: "Meine Untersuchungen zeigten dass kein anderes Artmerkmal so charakteristisch und konstant ist". At the time this author quotes the opinion of HEINKE, 1873: „Kauplatte für die Cypriniden noch charakteristischer ist als der Schlundknochen mit seinen Zähnen”.

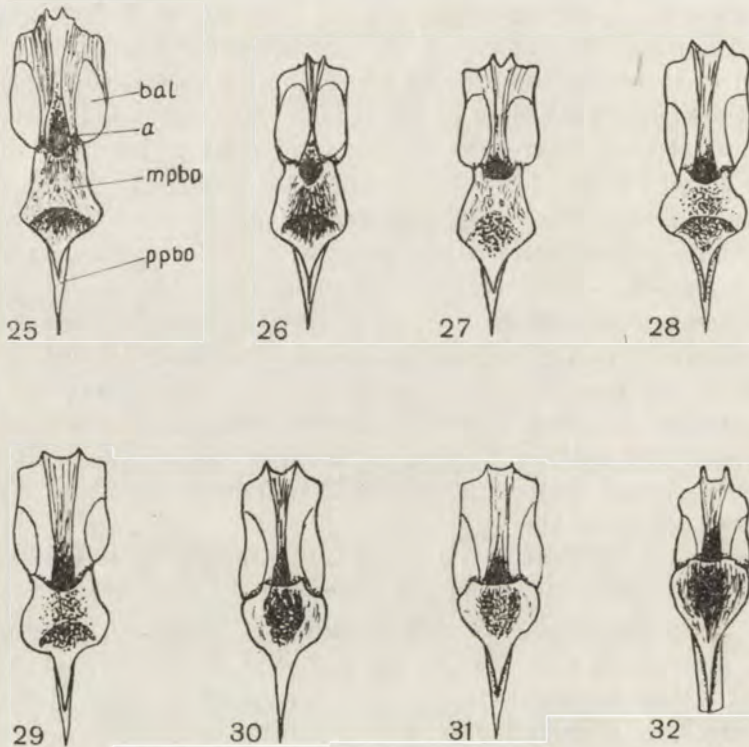


Fig. 25-32. Basioccipital, ventral view. 25 - *Moroco percunurus*, 26 - *M. lagowskii*, 27 - *M. czekanowskii*, 28 - *Phoxinus phoxinus*, 29 - *Pfrille neogaea*, 30 - *Chrosomus erythrogaster*, 31 - *Ch. eos*, 32 - *Ch. oreas*; a - canal for aorta descendens in the basioccipital, bal - bulla acustica lagenaris, mpbo - masticatory plate, ppbo - pharyngeal process of the basioccipital.



Fig. 33. Basioccipital of *Chrosomus oreas*, lateral view. A case of the masticatory plate with the tapered projection.

When comparing the shape of the masticatory plate in the species discussed here, we can distinguish four different pattern of it, and basing on this fact to distinguish four adequate groups of species. The first group constitutes: *M. percnurus*, *M. lagowskii*, *M. czekanowskii*, a related group of Eurasiatic species. To the second group belong *Ph. phoxinus* and *Pfrille neogaea*. The third group includes *Ch. erythrogaster* and *Ch. eos*. The fourth group constitutes *Ch. oreas*.

The elongated posterior portion of the pharyngeal process is in all investigated species, except *Ch. oreas*, much alike each other, being in all cases thin, blade-like plate. In *Ch. oreas* it is dorsally flattened to an uniformly broad plate on which rests mesially the blade-like plate (Fig. 32).

In my opinion the shape of the elements of the pharyngeal process (masticatory plate and the elongated posterior portion) produce not only good specific characteristics but a generic also. This I can state having investigated the masticatory plate of the different species of the polytypic genera: *Abramis* (*A. brama*, *A. ballerus*); *Barbus* (*B. barbus*, *B. petenyi*); *Leuciscus* (*L. leuciscus*, *L. cephalus*, *L. (Idus) idus*) from Poland. In all species of each mentioned genera the masticatory plates are very similar.

Otoliths

As in other Cyprinids there are three pairs of otoliths in the investigated fishes: asteriscus, lapillus, and sagitta. The largest, disk-shaped asteriscus, is situated in the lateral part of the recessus sacculi of the basioccipital, in which it takes vertical position. Its mesial surface is slightly concave in its very center, whereas the opposite surface is convex. The margin of the asteriscus is more or less distinctly dentated, except its small anterior portion (Fig. 34).

The lapillus is a little smaller than the asteriscus and lies in the recessus utriculi of the prootic. It is thick, oval-shaped, sometimes almost round; in general its shape is not as constant as that of the asteriscus.

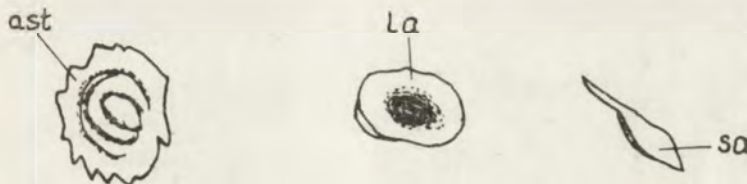


Fig. 34. Otoliths of *Moroco percnurus*; ast — asteriscus, la — lapillus, sa — sagitta.

The slender and very fragile sagitta lies close to the asteriscus, mesially to it, and is situated horizontally. Its anterior portion is markedly broadened and thickened.

All these bones are very similar in the investigated material.

Circumorbitals

The circumorbital complex consists of five suborbitals (infraorbital) the dermosphenotic and one supraorbital. The suborbital SO_1 , known as the lacrimal, calls a special attention because of its shape and topography at the front of the head. In *Ph. phoxinus* the lacrimal takes a rather horizontal position, and it is elongated so that its length is much greater than its height. In the other investigated species the lacrimal takes a rather vertical position, and its height is equal to or somewhat greater than its length (Fig. 35–39). The lacrimal is of a more or less pentagonal shape. Its posterior edge — a —, facing the front margin of the eye and the dorsal edge — b —, facing the nostrils, are slightly concave, and in *Ph. phoxinus* the dorsal edge is markedly long. The anterior edge — c — is somewhat complicated, its outline is always curved so we can distinguish two portions of it: the anterodorsal and the anteroventral ones. The ventral edge — d —, facing the suborbital — SO_2 —, is slightly concave; its dimension is, in general, adapted to the proportion of the front edge of the SO_2 . The suborbital SO_2 is of moderate length, in *Ph. phoxinus* and in *Ch. oreas* it sometimes consists of a tube of the sensory canal only. In the other investigated species SO_2 is larger, especially at its anterior portion. The suborbital SO_3 is the longest bone and visibly broader than the former. The SO_4 is usually shorter than the SO_3 , however, it is an expanded bone, sometimes it may be split into two or even three pieces. The suborbital SO_5

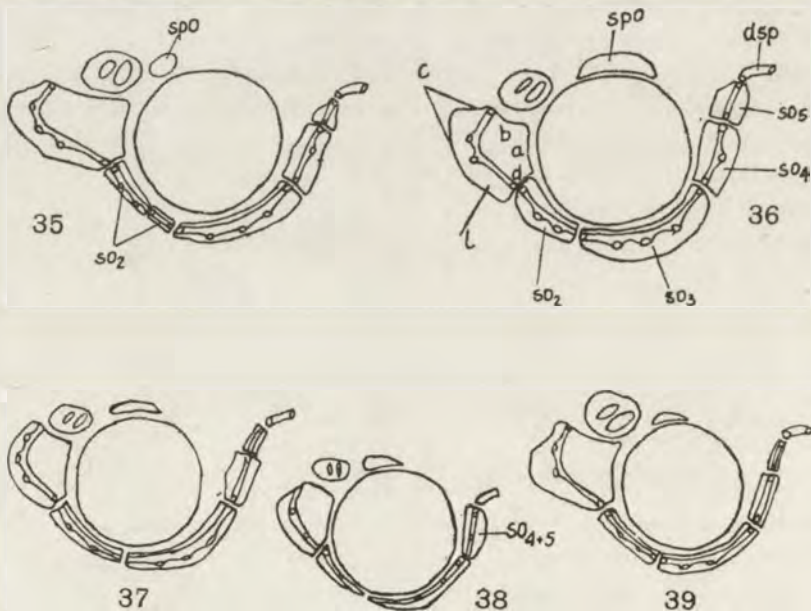


Fig. 35–39. Circumorbital bones. 35 — *Phoxinus phoxinus*, 36 — *Morocco perenurus*, 37 — *Pfrille neogaea*, 38 — *Chrosomus eos*, 39 — *Ch. oreas*; l — lacrimal (so_1): a — posterior edge of the lacrimal, b — dorsal, c — anterior, d — ventral, so_{2-5} suborbitals, spo — supraorbital. dsp — dermosphenotic.

is very variable as it concerned its dimension. In *Ph. phoxinus* and in *Pfrille neogaea* it consists sometimes of a tube containing the sensory canal only; in the other species it is a larger bone with a more or less distinct basal expansion of the ossification. The suborbital $SO_2 - SO_5$ are generally flat, thin bones, very often they are split into pieces, and the bones of the right side may differ from those of the left. The SO_5 may be fused with the SO_4 to form a large bone.

The dermosphenotic consists of a tube containing the sensory canal only, flouting in the cuts, and turned backward to the sensory canal on the pterotic bone.

The supraorbital is in *Ph. phoxinus* very small and almost round, it is situated in a deep incision at the antero-lateral margin of the frontal (Fig. 9). In *Moroco percenurus*, *M. lagowskii* it is crescent-shaped bone, which occupies more than a half of the length of the lateral margin of the frontal (Fig. 8). In *Pfrille neogaea* and in the three species of the genus *Chrosomus* the supra-orbital is crescent-like or oval and of moderate length (Fig. 10, 11).

Oromandibular region

The maxillary differs slightly among the studied species (Fig. 40-45). It is elongated and curved bone, the anterior end of which bears a knob-like condyle on its dorso-inner portion. The knob clings to the anterior surface of the biconcave cartilage disc — the submaxillary. On the inner surface of the maxillary, just below the knob, arises a rod-like process — the rostral

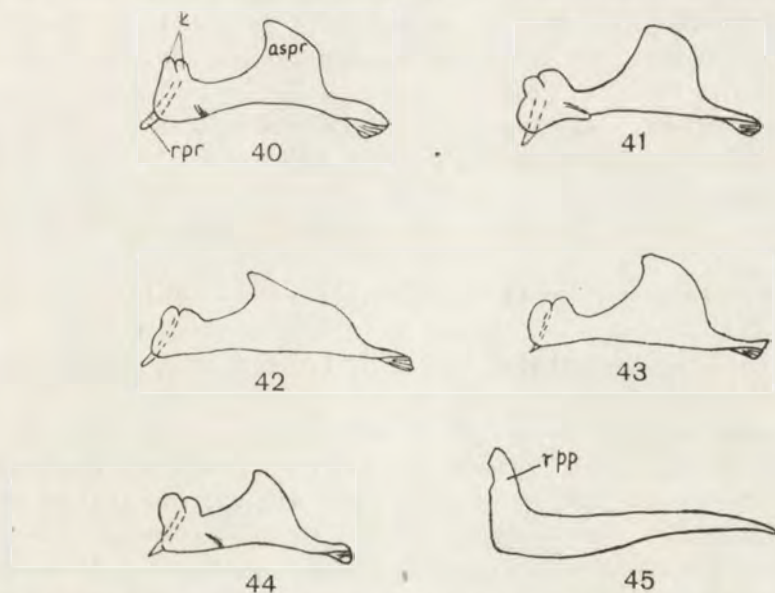


Fig. 40-45. Maxillary and premaxillary, external view. Maxillary of: 40 — *Moroco percenurus*, 41 — *Phoxinus phoxinus*, 42 — *Pfrille neogaea*, 43 — *Chrosomus eos*, 44 — *Ch. oreas*; aspr — ascending process of the maxillary, k — knoblike condyle, rpr — rostral process of the maxillary; Premaxillary of: 45 — *Moroco percenurus*; rpp — rostral process of the premaxillary.

process of RAMASWAMI, 1955b, and runs mesially and downwards. The posterior end of the maxillary is narrow and provides an oval and truncate surface to which the hind end of the premaxillary is attached. Medially the maxillary expands dorsally to form a large process — the ascending process of the maxillary, the shape of which is characteristic specifically in some degree. The anterior margin of this process is, in general, concave when its dorso-posterior margin is variably formed. In *Moroco percnurus* and *Phoxinus phoxinus* the posterior portion of this margin is clearly marked by a sharp bend. In *Chrosomus eos* and *erythrogaster* the ascending process is very similar to that of *Phoxinus phoxinus*. In *Ch. oreas* it is not much expanded, and in *Pfrille neogaea* it is rather short and markedly elongated posteriorly (Fig. 42).

The premaxillary is a paired, thin and flat bone being at its mesial end elevated dorsally to a narrow limb — the rostral process of the premaxillary. The mesial edge of this bone may be quite straight (*Ph. phoxinus*, *Pfrille neogaea*, *Chrosomus*) or it may have a more or less expressed small incision on the dorsal portion of this edge (*Moroco percnurus*) (Fig. 45).

Lower jaw

The number of bones forming each ramus of the mandible is the same in all investigated species. The dentary is the largest bone among them, and its shape shows some specific differences. The anterior portion of it is narrow and curved to form a symphysis with the opposite mate. The ventral margin of this portion is differently outlined in particular species. In *M. percnurus*, *M. lagowskii* and in the three species of the genus *Chrosomus* it has a short curvature anteriorly, whereas in *Ph. phoxinus* and *Pfrille neogaea* this curvature is markedly longer. Backwards the dentary increases to a broad, thin bone, and is supplied by a dorsally ascending process, which is a high plate rounded dorsally. The ascending process takes an almost vertical position in *Ph. phoxinus*, whereas in the other investigated species it is slightly lining backward (Fig. 46–51).

The second great component of the mandible is the angular bone. It lies by its fore and middle portion against the inner, concave surface of the dentary. The angular is an elongated, anteriorly tapered bone, gradually becoming larger backward.

The third component of the mandible consists of elements which are the derivatives of the Meckel's cartilage (Fig. 51). The foremost part of the Meckel's cartilage — mentomeckelian — lies along the inner, anterior portion of the dentary. The rod-like, middle segment of the Meckel's cartilage lies along the anterior, concave portion of the angular. The posterior portion of the cartilage grows to a thick, ossified element — the articular — and is fully fused with the angular bone. Dorsally to the Meckel's cartilage, and in a depression of the angular, lies the coronomeckelian bone.

Posteriorly the angular forms two articular facets, the dorsal facet articulates with the quadrate bone, and the ventral one with the small and thick bone — the retroarticular — which is the posteromost part of the Meckel's cartilage.

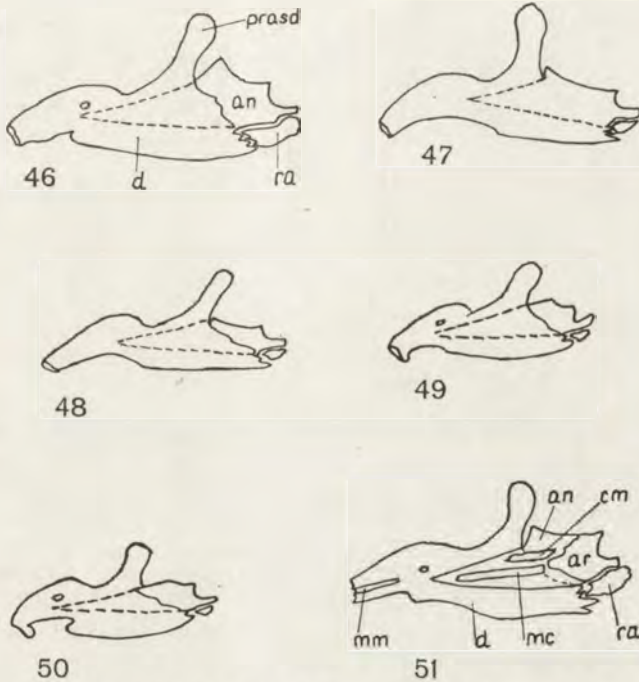


Fig. 46-51. Mandible, external and internal view. External view: 46 — *Moroco percnurus*, 47 — *Phoxinus phoxinus*, 48 — *Pfrille neogaea*, 49 — *Chrosomus eos*, 50 — *Ch. oreas*; an — angular, d — dentary, prasd — processus ascendens of the dentary, re — retroarticular; internal view of: 51 — *Moroco percnurus*; ar — articular, cm — coronomeckelian, mc — Meckel's cartilage, mm — mentomeckelian.

Opercular series

The opercular is the largest bone of the opercular series. It is of a somewhat square shape, smooth, thin and slightly convex externally. The bone is reinforced by two thickenings. The strut-like thickening runs along the anterior margin of the bone, and dorsally passes into the antero-dorsal angle (opercular arm of NELSON, 1949). Below the opercular arm there is a facet for articulation of the hyomandibular condyle. From this place begins the other crest-like thickening which runs posteroventrally on the inner surface of the opercular. The opercular in the fishes discussed here varies insignificantly. In *Ph. phoxinus* the opercular arm is high and thin, in the other species it is short and broad. The dorsal margin is mostly concave, yet in *Moroco percnurus* it is rather oblique.

The posterior margin is in *M. percnurus* almost straight, in the other species more or less incised and in *P. phoxinus* the incision is the deepest. The angle between the dorsal and posterior margins (the auricular process of NELSON, 1949) is more or less round (Fig. 52-55).

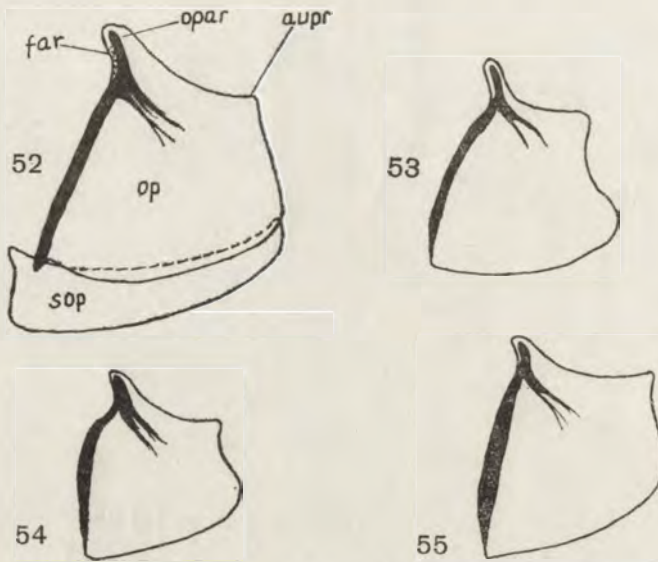


Fig. 52-55. Opercular and subopercular. 52 - *Moroco percnurus*, 53 - *Phoxinus phoxinus*, 54 - *Chrosomus erythrogaster*, 55 - *Ch. oreas*; aupr - auricular process, far - facet for articulation of the hyomandibular, op - opercular, opar - opercular arm, sop - subopercular.

The subopercular shows little specific difference. Its anterodorsal angle and the anterior margin may be variously shaped but this characteristic is not constant even in the same species.

The preopercular and interopercular are very alike within the species here involved, and show no specific difference.

Hyoid arch

The basihyal is an elongated, unpaired bone, and in the material discussed here it differs only slightly. The bone is a little broadened anteriorly and sometimes thickened posteriorly. This broadness is well expressed in *Pfrille neogaea*.

The hypohyals, upper and lower, are strong, deeply grooved bones. Both bones abut laterally to the posterior portion of the basihyal (Fig. 56).

The ceratohyal is a strong bone, grooved in its proximal portion, where it clings to the upper and lower hypohyals.

The epihyal is a thick and trianguloid bone, which articulates with the ceratohyal. The four above discussed paired bones are very alike in the species examined here.

The hyomandibular is a paired, strong bone in which we distinguish the mesial portion much thickened longitudinally and two thinner lateral wings. The anterior wing is usually markedly extended, whereas the posterior one is usually narrow. The former wing is variously shaped even within a species, its margin may be concave, convex or quite straight. The dorsal edge of the bone is thickened to form the anterior and posterior condyles, which attach the bone to the neurocranial facet running in the sphenotic and the pterotic. The posterolateral condyle articulates with the facet of the opercular. The lower thickened portion of the hyomandibular is perforated by an obliquely running canal through which passes the hyomandibular branch of the facial nerve, its external exit is presented by a big oval foramen (Fig. 70–71).

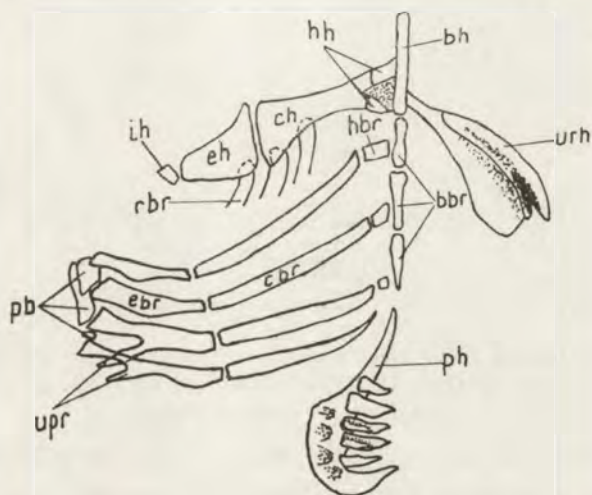


Fig. 56. Hyobranchial apparatus of *Moroco perenurus*, schematic view; bh – basihyal, bbr₁₋₃ – basibranchials (copulae), cbr – ceratobranchial, ch – ceratohyal, ebr – epibranchial, eh – epihyal, hbr – hypobranchial, hh – hypohyal (upper and lower), ih – interhyal, pb – pharyngobranchials, ph – lower pharyngeal bone (fifth ceratobranchial), rbr – branchiostegal rays, upr – uncinat process, urh – urohyal.

The urohyal is an unpaired, elongated bone joined to the ventral hypohyals by strong ligaments (Fig. 56). It lies ventrally to the basibranchials and passes back between the sternohyoid muscles. The bone is composed of two plates: the horizontal plate (wink-like) and a vertical one which raises dorsally along the mesial axis of the horizontal plate (Fig. 56, 57–62). Anteriorly the urohyal is much narrowed, thick and terminating by a pair of rod-like processes, which attach the bone to the hypohyals. The processes are short in *Phoxinus phoxinus* and in *Chrosomus oreas*, they are long in *Moroco perenurus*, and in the other examined species they are of intermediate length. The posterior margin of the horizontal plate is variously outlined, being medially tapered in *Ph. phoxinus*, whereas in all other examined species it is more or less incised.

The shape of the vertical plate is more constant. In *Ph. phoxinus* it is much elongated posteriorly, whereas in *M. percunurus*, *M. lagowskii* it is shorter than the horizontal plate. In the other investigated species it is mostly as long as the horizontal plate or only slightly longer (Fig. 57–62).

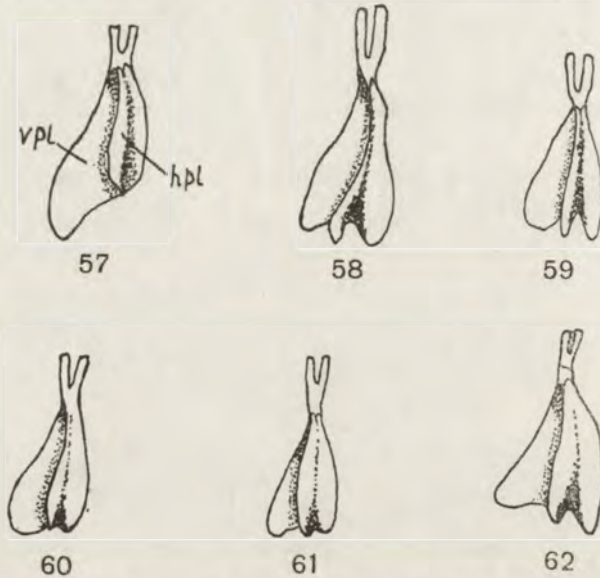


Fig. 57–62. Urohyal, lateral view. 57 – *Phoxinus phoxinus*, 58 – *Moroco percunurus*, 59 – *M. lagowskii*, 60 – *Pfrille neogaea*, 61 – *Chrosomus eos*, 62 – *Ch. oreas*; hpl – horizontal plate, vpl – vertical plate.

Some recent authors attribute a systematic value to the urohyal. KUSAKA, 1974 expressed the idea that the urohyal with its extremely varied shape presents great interest as a characteristic useful in determining families, genera and species. WEITZMAN, 1974: 406 when investigating the fishes of the Stomiatoidei families says: "The shape of the urohyal is characteristic of each genus". When comparing the urohyal of the species here investigated, we state a real difference between that bone in *Ph. phoxinus* and *M. percunurus* only.

Branchial arches

The pattern of the branchial apparatus is similar through the fishes investigated here. It is composed of three unpaired basibranchials, four paired branchial arches, one paired lower pharyngeal bones and the paired pharyngobranchials.

The basibranchials (copulae of RAMASWAMI, 1955) are three, rod-like bones situated in one row, and constituting the axis of the branchial apparatus. In all investigated here species the first basibranchial is the shortest, and the third one is tapered posteriorly. The first and the second are narrowed in the middle of their length (Fig. 56).

The branchial arches 1-3 are composed of three paired elements: next to the basibranchials lie the short hypobranchials, which adjoin the longest bones the ceratobranchials, the third element are the epibranchials. The fourth branchial arch has no hypobranchials. The third and fourth epibranchials bear hook-like processes (uncinate processes, HARRINGTON, 1955).

The pharyngeals represent the fifth pharyngeal arch reduced to the ceratobranchials only, which are strong, modified tooth-bearing bones. The teeth are arranged in one main row in the representatives of the genus *Chrosomus*, and in two rows in other examined species. Traditionally the shape of the bone, the number of rows and the number of teeth in each row are recognised as a good taxonomic characteristic for establishing the genera in the Cyprinid fishes. In the investigated material the shape of the pharyngeals show a great variability within each species, and only slightly differs generically (Fig. 63-69).

For the comparative examination of the shape and particular elements of the pharyngeal I am following the method and terminology of HOROSZEWICZ, 1960. This author has recognized two parts in the pharyngeal: the dorsal and the ventral one. In the dorsal part she distinguishes the upper extremity, upper segment, the lateral segment and the arc-angle (Fig. 63-69). To characterize each element following position of this bone has been accepted: the bone

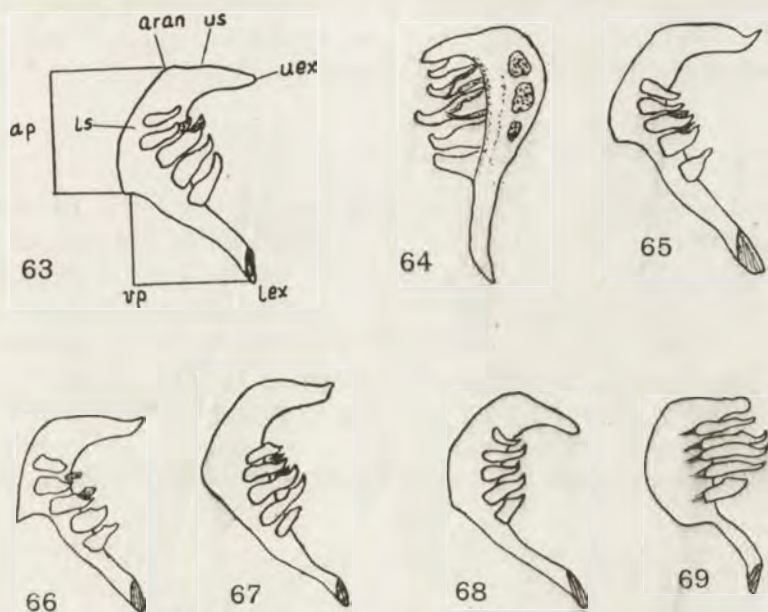


Fig. 63-69. Lower pharyngeal bone. 63 - *Moroco percnurus*, ventral view, 64 - same, dorsal view, 65 - *M. lagowskii*, 66 - *Phoxinus phoxinus*, 67 - *Pfrille neogaea*, 68 - *Chrosomus eos*, 69 - *Ch. oreas*; aran - arc-angle, dp - dorsal part of the lower pharyngeal bone, lex - lower extremity, ls - lateral segment, uex - upper extremity, us - upper segment, vp - ventral part.

was placed on the plotting paper with its upper extremity at the point of the intersection of the horizontal and the vertical line, and its lower extremity on the vertical line (Fig. 63).

The upper extremity may be blunt (*Ch. oreas*), acute (*M. percnurus*), acute and curved externally (*Ph. phoxinus*, *M. lagowskii*), acute and curved internally (*Ch. erythrogaster*, *Ch. eos*).

The upper segment may be marginal or more or less convex against the horizontal line. It may pass gradually into the lateral segment (*Ph. phoxinus*, *M. lagowskii*, *Pfrille*, *Chrosomus*) or its external margin may bend clearly forming a more or less expressed angle, (*M. percnurus*) the arc-angle of HOROSZEWICZ, 1960 or anterior angle of UYENO, 1960.

The lateral segment may pass gradually into the ventral part of the bone (*Pfrille neogaea* Fig. 67), in *Chrosomus oreas* it is rounded and clearly stand apart from the lower part of the pharyngeal (Fig. 69). Some intermediate shape are found in *Moroco percnurus*, *Chrosomus erythrogaster*, *Ch. eos*. In these cases the lateral segment may be slightly incised at the boundary with the ventral part of the pharyngeal, and the incision is sometimes well expressed in *Ph. phoxinus* (Fig. 66).

The anterodorsal surface of the pharyngeals is fully pitted in all investigated species (Fig. 64).

The paired pharyngobranchials consist of two flat bones of different size and a small cartilage element all connected with the epibranchials. The bones attach the branchial apparatus to the parasphenoid.

Teeth

With the exception of the representatives of the genus *Chrosomus* with one row of teeth (5 — 5) all other examined species have two rows of them and the general formula of them is 2.5 — 4.2. In *Ph. phoxinus* the deviation from the general formula is conspicuous. According to STARMACH, 1963 and to KULAMOWICZ and KORKUĆ, 1971 nine different tooth formulae characterize the specimens from Poland. KLIMCZAK-JANIKOWSKA, 1970 found even 12 variants of the formula for the specimens from the Gulf of Finland. In all these cases the teeth are arranged in two rows. BERINKEY, 1968 noted six variations of the tooth formula in a small collection of *Ph. phoxinus* of Yugoslavia, and he stated one specimen missing the minor row of teeth (1.4 — 4.0). *Moroco percnurus*, *M. lagowskii*, *M. czekanowskii* show a rather stable formula: 2.5 — 4.2, sporadically 2.5 — 5.2. The same variability is noted in the species of the genus *Chrosomus* and *Pfrille*. Recently EASTMAN and UNDERHILL, 1973 state comparatively great deviation from the standard formula in *Ch. eos* (8.0%), and in *Ch. erythrogaster* (2.0%) and in *Pfrille neogaea* (1.4%) only.

The teeth are laterally somewhat compressed, the IV and V tooth are markedly expanded, and the latter of them is usually placed on the lower part

of the pharyngeal. The grinding surface is feebly developed and it usually is lacking in the V and sometimes in the IV tooth. The tip of the tooth is slightly hooked.

In the species belonging to the genus *Chrosomus* the teeth are laterally compressed, elongated especially in *Ch. oreas*. The grinding portion of the I-III teeth is comparatively long. It must be stressed that in *Ch. oreas* all teeth are arranged on the upper part of the pharyngeal, whereas in *Ch. erythrogaster* and in *Ch. eos* the fifth tooth is always shifted to the lower part.

Palatoquadrate arch

Most bones consisting this arch differ very little throughout the species involved here. The quadrate bears anteroventrally a condyle to articulate with the angular of the lower jaw. Posteroventrally it is a little incised and much elongated to a narrow and tapered process. The narrow and long symplectic lies along this process. The metapterygoid is a flat, large bone deeply incised on its dorsal margin (*M. percunurus*, *Ph. phoxinus*) and then forming two lamellae. The posterior lamella, contacting with the hyomandibular is always smaller, and that contacting with the quadrate and endopterygoid is in these species a little bigger. In *Pfrille neogaea* and in the species of the genus *Chrosomus* the metapterygoid is not so much incised and the lateral lamellae are poorly

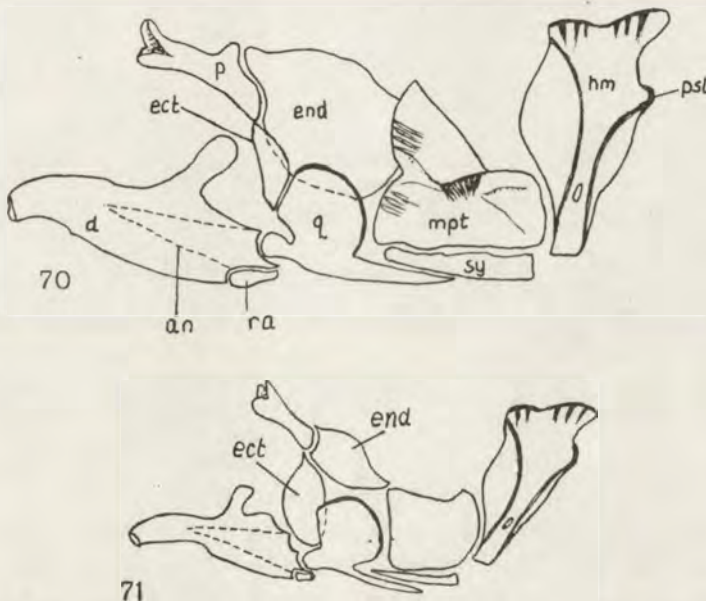


Fig. 70-71. Palatoquadrate arch. 70 - *Moroco percunurus*, 71 - *Chrosomus oreas*; an - angular (articular), d - dentary, ect - ectopterygoid, hm - hyomandibular, mpt - metapterygoid, p - palatine, q - quadrate, ra - retroarticular, sy - symplectic.

marked. The endopterygoid is a large, flat bone of a somewhat pear-like shape, except in *Ch. oreas*, in which it is posteriorly narrowed (Fig. 71). Anteriorly the bone is supplied with a notch to articulate with the palatine. The ectopterygoid is a small bone lying anteriorly to the quadrate and ventrolaterally to the endopterygoid. In *Moroco percunurus* it is of sigmoid shape, in the other examined species it is rather oval (Fig. 70). The palatine is a rod-like bone anteriorly enlarged and ended by three short processes, forming the facets for articulation with the vomer, preethmoid and with the ascending process of the maxillary.

All these bones, in connection with the hyomandibular, form the suspensory mechanism for the lower jaw.

Pectoral girdle

The pectoral girdle comprises eight bones: posttemporal, supracleithrum, cleithrum, scapula, coracoid, mesocoracoid, postcleithrum, and four radii (Fig. 72). The bones show great similarity in all investigated species.

The cleithrum is the greatest bone composed of two well developed wings: the vertical and the horizontal one. The former is a plate of triangular shape tapered dorsally; it is in all examined species shorter than the horizontal one. In *Moroco percunurus* this triangular wing is slender and narrow at its

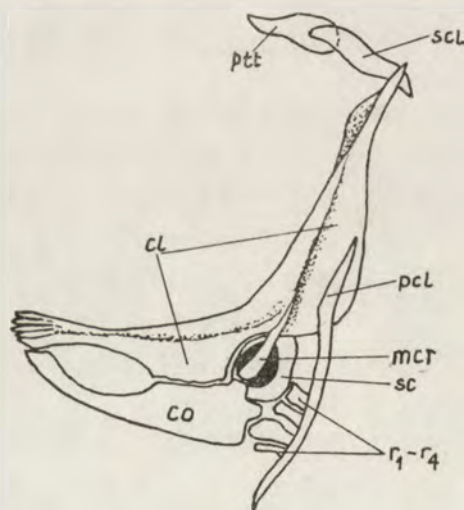


Fig. 72. Pectoral girdle of *Moroco percunurus*, internal view; co - coracoid, cl - cleithrum, mcr - mesocoracoid, pcl - postcleithrum, ptt - posttemporal, sc - scapula, scl - supracleithrum, r₁-r₄ - radials.

base, in *Ph. phoxinus*, *Pfrille neogaea* and in the species of the genus *Chrosomus* it is moderately broad. The horizontal wing is a large plate bent inward and ventrally, its ventral edge is anteriorly curved longitudinally and joined to the coracoid by its rostral and posterior alae.

The coracoid is a thin, flat bone and has the same form in all examined species. Its inner, long edge is deeply incised just opposite the incision of the

cleithrum. The dorsoposterior edge of the coracoid splits into two lamellae, and on its posterior extremity the exterior lamella articulates with the scapula and the inner one with the mesocoracoid.

The scapula is a ring-like bone with thick walls which border the scapular foramen. It articulates with the cleithrum just in the angle between the vertical and horizontal wings, ventrally it joins the coracoid and posteriorly it articulates with the first and second radials.

The mesocoracoid is a small bar-like bone, dorsally it may be enlarged to an oblique plate which clings to the median side of the upright rand of the cleithrum. The opposite end of the bone is thickened and articulates with the coracoid.

The postcleithrum (metacleithrum of SORESCU, 1968) is a long spine-like, and curved bone, clinging to the interior edge of the vertical wing of the cleithrum.

The supraclithrum is a long flat bone, which lies on the upper tapered process of the cleithrum. Its dorsal part is overlapped by the posterior, expanded portion of the posttemporal, the opposite end of which is fastened to the top of the epiotic.

Four radials are present, from which the first and the second articulate with the scapula.

Pelvic girdle

The pelvic girdle of each side consists of one bone only — the basipterygium (pelvic bone of WEITZMAN, 1962). The long, anterior portion of this bone is thin, flat and deeply forked, the posterior portion is thick and extends medially to form a well expressed, medial process (SEWERTZOFF, 1934), and the latter extends posteriorly to the ischiae process (WEITZMAN, 1962).

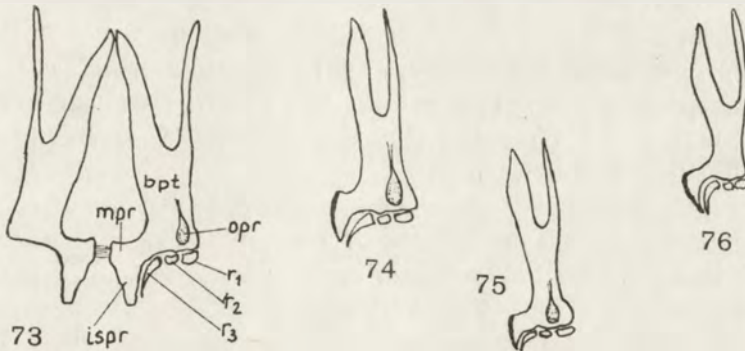


Fig. 73-76. Pelvic girdle, ventral view. 73 — *Moroco percnurus*, 74 — *Phoxinus phoxinus*, 75 — *Pfrille neogaea*, 76 — *Chrosomus erythrogaster*; bpt — basipterygium, ispr — ischiae process, mpr — medial process, opr — oval process, r_1 - r_3 — radials.

The mesial arm of the forked portion is large and flate, whereas the lateral arm is narrow, rod-like. Both arm may be of the same length (*Ph. phoxinus*), or the lateral one may be a little longer as it is in all other investigated species (Fig. 73-76). The depth of the forked portion is the greatest in *Moroco percnurus*, extending somewhat beyond the half length of the basipterygium, in the other species it is of about half the length of this bone.

The most characteristic of the basipterygium is the shape of the ischiac process. In all species, except *M. percnurus* it is short, triangular-shaped and tapered at its end. In *M. percnurus* it is comparatively long, rectangle-shaped and obtuse at its end (Fig. 73).

On the ventral side of the posterior portion of the basipterygium an osseous knob, (processus ovalis of SEWERTZOFF, 1934) is well expressed in all examined species.

There are three radial bones (pterygiophores) joined to the posterior edge of the basipterygium. The biggest of them is the radial (metapterygium of SEWERTZOFF, 1934); it is falciform-shaped, tapered caudally, enlarged and grooved on its anterior edge. The radials $2-3$ are small bones, composed of two walls joined along their posterior edges and open anteriorly, where they tightly clasp the posterior edge of the basipterygium.

Weberian apparatus

In the professional literature there exist numerous and controversial opinions (MÜLLER, 1853; BRIDGE and HADDON, 1893; CHRANILOV, 1927; RAMASWAMI, 1955; NIAZI, 1967; ROSEN and GREENWOOD, 1970; MAHY, 1975b) on the origin and the terminology of the elements of the Weberian apparatus.

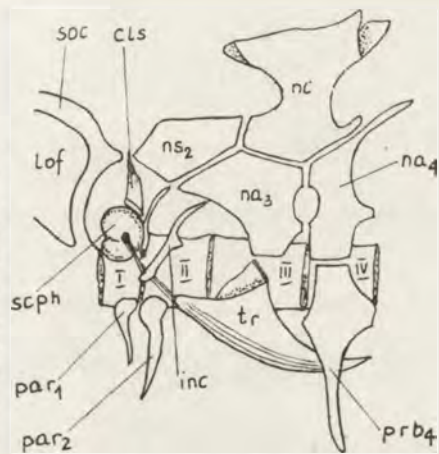
Recently a new bony element of the Weberian apparatus is mentioned by MAHY, 1975b in accordance with investigated by him *Chrosomus neogaeus* = *Pfrille neogaea*. The bone lies in the anterior part of the Weberian apparatus in vicinity of the claustrum, and MAHY regards it as — the neural arc of the second vertebra, $NEUR_2$ —. This element have never been seen in the cyprinid fishes as *Cyprinus carpio* (CHRANILOV, 1927), *Notropis cornatus* (RAMASWAMI, 1955) in the representatives of the genus *Gila* (UYENO, 1961) and in four species of *Barbus* (NIAZI, 1967). When investigating my material, including *Pfrille neogaea*, I did not find this bone.

Analysing the structure and origin of particular elements of the Weberian apparatus of the species examined here, I am following the terminology of CHRANILOV, 1927; NIAZI, 1967; ROSEN and GREENWOOD, 1970 partly.

Part sustentaculum. The first four vertebrae, which constitute the Weberian apparatus are amphicoelous in the investigated species. The second and the third vertebrae are free from each other; this feature is typical to the representatives of the subfamily *Leuiscinae*, a primitive group of the family *Cyprinidae*.

The first centrum is the shortest and bears ventrolaterally a small well ossified parapophyses (transverse process of CHRANILOV, 1927; dorsal rib of RAMASWAMI, 1955 and NIAZI, 1967; parapophyses of BERG, 1940; UYENO, 1960; ROSEN and GREENWOOD, 1970). The centrum has neither a neural arch nor a neural spine. The former has been transformed into the scaphium (CHRANILOV, 1927; ROSEN and GREENWOOD, 1970). The neural spine has been, according to CHRANILOV, 1927, transformed into the claustrum. Yet recently ROSEN and GREENWOOD, 1970 have proved that the claustrum has been formed by supraneural elements, independently from the elements of the first vertebra. This opinion is shared by MAHY, 1975b.

Fig. 77. Weberian apparatus of *Moroco perenurus*, schematic view; cls – claustrum, inc – intercalarium, lof – lateral occipital foramen, na₃ – third neural arch, na₄ – fourth neural arch, nc – neural complex, ns – neural spine of the second vertebrae, par₁₋₂ – parapophysis of the first and second vertebrae. prb₄ – fourth pleural rib, scph – scaphium, soc – supraorbital, tr – tripus, I-IV – vertebrae.



The second centrum is somewhat longer and its parapophyses are stronger in comparison with those of the first vertebra. Its neural arches are transformed into the intercalaria following the opinion of MÜLLER, 1853; CHRANILOV, 1927; ROSEN and GREENWOOD, 1970. The saddle-like bone which is removed dorsally from the second centrum I recognise as the neural spine of the second vertebra – ns₂ following the terminology of CHRANILOV, 1927; RAMASWAMI, 1955 and NIAZI, 1967. Quite another opinion concerning the name of this bone has MAHY, 1975b. He designates the bone as the neural spine of the first vertebra, NS₁ – and interprets its origin from the elements placed on the potential zone for the formation of the first and the second neural spine.

The third centrum is the largest one, it has no parapophyses, which have been transformed into the tripus (ROSEN and GREENWOOD, 1970). The neural arches of the centrum – na₃ (neural pedicle – 3rd NP of NIAZI, 1967) fit by their root in the dorsal pit of the centrum, dorsally the neural arches become markedly broad, and extend anteriorly for over half the length of the second centrum. Above its posterior portion raises a large bone, which I have called following Niazi, 1927 – neural complex – nc (neural spine of the third vertebra –

nsp₃ of CHRANILOV, 1927, BERG, 1940; NS23 of RAMASWAMI; 1955; supra-neural — SN₂ of MAHY, 1975b). Ventrally the neural complex consists of two walls which dorsally meet each other at the sagittal level to form a common portion — the stem, then the stem splits dorsally into two lamellar walls — spinae bifidae (CHRANILOV, 1927).

This part of the neural spine shows great variability within the species. In *Ph. phoxinus* and in *Pfrille neogaea* it is markedly elongated anteriorly. In *M. percunurus* the spinae bifidae are rather uniformly expanded anteriorly and posteriorly (Fig. 77). As it concerned the species of the genus *Chrosomus* the drawings (Fig. 80–82) present only some variants of this bone.

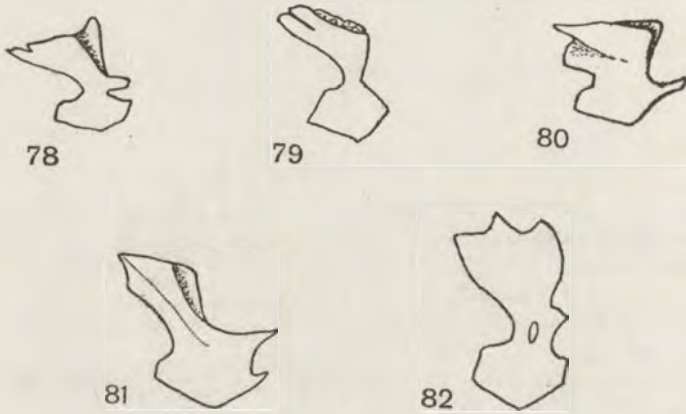


Fig. 78–82. Neural complex. 78 — *Phoxinus phoxinus*, 79 — *Pfrille neogaea*, 80 — *Chrosomus erythrogaster*, 81 — *Ch. eos*, 82 — *Ch. oreas*.

The fourth centrum is of moderate length, with its neural arch and neural spine well developed. Ventrolaterally to each side of the centrum clings the pleural rib as a strong rod-like bone. The enlarged proximal portion turns posteriorly and downwards to form the os suspensorium, a thin flat bone, which spreads vertically beneath the end of the fourth centre. When joined

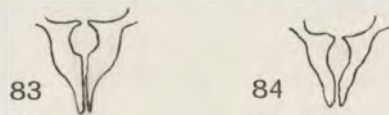


Fig. 83–84. Ossa suspensoria. 83 — *Moroco percunurus*, 84 — *Pfrille neogaea*.

the right and the left os suspensorium have a triangular form tapered ventrally; they are connected mesially by a membranous wall (Fig. 83–84). On the dorsal, enlarged portion of each bone, the mesial margin is markedly notched, and a sort of a foramen is formed, covered also by a membranous wall. In the examined species the foramen mediale is well expressed and differently shaped. In *Ph.*

phoxinus, *M. percunurus*, *Ch. erythrogaster*, *Ch. eos* it is round and of moderate size, in *Pfrittle neogea* and in *Ch. oreas* it is oval and comparatively big. The disjunction of the ossa suspensoria, its tapered end, and well expressed foramen medialis indicate, according to CHRANILOV, 1927 the primitive character of the *Cyprinidae*, and are common to the subfamily *Leuciscinae*.

Part auditivum of the Weberian apparatus consists of four elements: claustrum, scaphium, intercalarium and tripus (Fig. 85, 86). The shape of these bones in the material investigated here is highly similar. The most anterior bone of the Weberian ossicles is the claustrum in which two parts are distinguished. The dorsal part — corpus claustri is usually a triangular crest, the ventral part — the scutellum claustri is concave and cup-like. Dorsally the triangular crest is connected by connective tissue with the anterior edge of the neural spine of the second vertebra, and anteriorly it is attached to the exoccipital above the foramen magnum (Fig. 77, 86).

The scaphium is of a cup-like shape, internally it is divided by a low crest into two unequal portions. In its posteroventral edge the scaphium bears two processes placed almost in the same line. The ascendens process is longer and tapered and it penetrates in the connective tissue between the posterior edge of the neural spine of the second vertebra and the anterior edge of the neural arch of the third vertebra (Fig. 77, 85). The processus articularis, which is short and rounded at its end, fits in the lateral pit of the first centre.

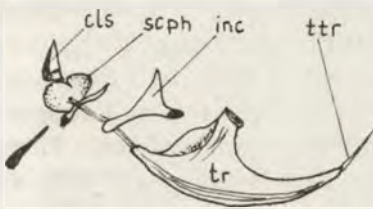


Fig. 85. Weberian ossicles of *Chrosomus oreas*; cls — claustrum, inc — intercalarium, scph — scaphium, tr — tripus, tr — transformator tripi.



Fig. 86. Claustrum of *Moroco percunurus*; ccl — corpus claustri, stcl — scutellum claustri.

The intercalarium is here a three-armed bone situated perpendicularly against the second centre. Its strongest arm — manubrium is rounded at its distal end, and here the bone is connected anteriorly to the protuberance of the scaphium by an interossicular ligament, and posteriorly to the anterior ramus of the tripus. The arm directed anterodorsally — the ascending process — is in all cases tapered and variously elongated. It extends towards the anteroventral edge of the third neural arch. The posteroventral arm — the articulating process — is usually short and rounded on its end. It fits in the articulating depression of the second centre. The intercalarium is the bone among

the ossicles of the Weberian apparatus which shows some specific differences, yet its shape within particular species is not at all stable. In *Ph. phoxinus* and in *Pfrille neogaea* the processus ascendens is long and the processus articularis is short. In *M. percnurus* both processes are comparatively short. In *Ch. oreas* both processes are short. In *Ch. erythrogaster* and *eos* the processus ascendens is a little longer.

The tripus is the largest bone in this complex, and it is very similar in the fishes investigated here. In this bone the following parts are distinguished: the body (central part), the anterior and the posterior arms (Fig. 85). The body is never fenestrated, sculptured only with longitudinal stripes, and it bears a strong median articulating process which fits in the pit of the third centre. The anterior ramus is connected to the manubrium of the intercalarium by an interossicular ligament. The posterior ramus passes directly into the transformer process which extends up to the posterodorsal surface of the os suspensorium, and there it contacts with the swim bladder.

The comparative analysis of the Weberian apparatus in the species discussed here reveal that its taxonomic value seems to be of doubtful usefulness. Some components are similar in all species (claustrum, scaphium, tripus) and the other (neural complex) is very variable within a species.

Discussion

In the light of the osteological and selected morphological data concerning *Ph. phoxinus* (LINNAEUS) and *Ph. percnurus* (PALLAS) I cannot accept the opinion of BERG, 1949 and that of BĂNĂRESCU, 1964 and lump these two form into the genus *Phoxinus*. The differences between these forms are real and support the idea of JORDAN and HUBBS, 1925 to establish a new genus *Moroco*. These authors make the genotype of *Moroco* the species *Pseudaspilus bergi* JORDAN and METZ 1913, which is according to BERG, 1909, 1949 a synonym of *Ph. lagowskii oxycephalus* (SAUVAGE et DABRY, 1974). This form is osteologically closely related to *Ph. percnurus percnurus* (PALLAS). Consequently both above mentioned forms belong to the genus *Moroco*. This point of view has been accepted by recent authors: UCHIDA, 1939; OKADA, 1960; NAKAMURA, 1969 and others.

The generic differences between the species *Ph. phoxinus* and *M. percnurus* are presented below:

Osteological comparison

Phoxinus phoxinus (LINNAEUS)

Lacrimal elongated horizontally, its anterior part is obtuse, triangular-shaped. The length is greater than the height (Pl. II, Fig. 9).

Moroco percnurus (PALLAS)

Lacrimal pentagonally shaped. The length is equal to the height (Pl. II, Fig. 8)

Supraorbital small, ovoid, situated in a deep incision at the anterolateral margin of the frontal (Fig. 9)

Supraethmoid wing-like, concave along its mesial axis, longer than broad, posterior edge usually dentated.

Urohyal with the vertical plate markedly elongated backwards and with comparatively short anterior processes.

Masticatory plate of the pharyngeal process is short and concave, its lateral edges are rounded and broadened posteriorly. A transverse curvature makes the posterior part of its surface deeper (Fig. 28).

The ischiac process short and tapered at its end.

The neural complex of the third vertebra markedly expanded anteriorly (Fig. 78).

The opercular with elongated auricular process and the posterior margin markedly incised (Fig. 53).

Supraorbital big, crescent-shaped, extending more than half the length of the lateral margin of the frontal (Fig. 8).

Supraethmoid wing-like with the posterior edge dentated laterally only.

Urohyal with a short vertical plate and longer anterior processes.

Masticatory plate elongated, its lateral edges slightly incised. The transverse curvature well expressed (Fig. 25).

The ischiac process longer and obtuse at its end.

The neural complex of the third vertebra is broadened and uniformly expanded anteriorly and posteriorly (Fig. 77).

The opercular with short auricular process and with the posterior margin almost straight (Fig. 52).

Morphological comparison

Phoxinus phoxinus (LINNAEUS)

Body elongated, almost terete, on the sides big, dark spots arranged in one horizontal row. The spots may join to form one stripe running from the tip of the snout to the insertion of the caudal fin (Pl. I, Fig. 2).

Head length smaller than the caudal peduncle length.

Pectorals long, rounded, extend beyond the middle of the distance between the pectorals and pelvics, P - V.

Anteroventral distance (from the tip of the snout to the origin of the pelvic) on the average 45.90% of the body length.

Mouth small, subterminal, almost horizontal.

Caudal fin markedly furcate, fin lobes rounded (Pl. I, Fig. 2).

Small and feeble scales cover the back and sides of the body and only a part of the belly. Here they are grouped in three places. A larger group lies across the belly before the pelvics, and the two other groups lie before the pectorals, arranged in 6 to 9 rows, running parallel to the gill opening. These last two groups never.

Moroco perenurus (PALLAS)

Body elongated, laterally compressed numerous small; dark spots scattered on the back and the sides (Pl. I, Fig. 1).

Head length greater than the caudal peduncle length.

Pectorals short, rounded, reaching almost the middle of the distance P - V.

Anteroventral distance on the average 53.30% of the body length.

Mouth small, terminal or slightly subterminal, oblique.

Caudal fin with shallow fork, fin lobes rounded (Pl. I, Fig. 1).

Scales cover all the body, they are slightly imbricated on the back and on the sides, but those on the belly hardly touch each other.

touch each other in the middle line. The first 4 - 5 rows of these scales are characteristically comb-like coalescent.

Breeding males develop prominent, white tubercles on the head, that between the eyes are strong, sharp and regularly arranged. The like tubercles are spread on the comb-like scales in front of the pectorals. The tubercles are minute in the females.

Neither can I accept everything in the opinion of BĂNĂRESCU, 1964 and MAHY, 1975 b, c, who have included the American species *Pfrille neogaea* (following the nomenclature of McPHAIL and LINDSEY, 1970) and *Chrosomus erythrogaster*, *Ch. eos* and *Ch. oreas* to the genus *Phoxinus*. I range these species to three different groups of not equal taxonomic level, accepting the shape of the pharyngeal process as the essential feature for recognizing the different genera. Taking into consideration the above mentioned feature, *Pfrille neogaea* shows the greatest affinity to the Eurasiatic *Phoxinus phoxinus*. This affinity is supported by other common features: biserial pharyngeal teeth 2.5-5.2 or 2.5-4.2, 1.5-4.1, the nuptial tubercles on the comb-like modified scales in the front of the pectoral fins, the shape of the ischiac process of the pelvics, a not complete lateral line, the pectorals extend beyond half the distance between the origin of the pectorals to the origin of the pelvics, a short intestine with one main loop only (Fig. 87). There are some features which differentiate this species from *Ph. phoxinus* (urohyal, supraorbital, lacrimal) as well as a large mouth, extending back to the front margin of the pupil.

The above-mentioned characteristic of *Pfrille neogaea* have confirmed

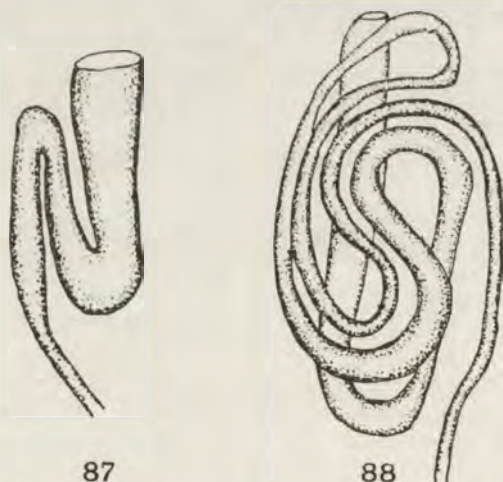


Fig. 87-88. Intestine. 87 - *Phoxinus phoxinus*, 88 - *Parchrosomus oreas*.

me in regarding this American form as one belonging to the genus *Phoxinus*, yet taking into consideration some of its own features to preserve for it the subgeneric status. Therefore its real name should be *Phoxinus (Pfrille) neogaeus* (COPE).

As far as the three representatives of the genus *Chrosomus* are concerned, they are not at all so uniform as it is interpreted by MAHY, 1975c; 636–637. I share the opinion of this author as far as the interrelation between *Ch. erythrogaster* and *Ch. eos*, is concerned excluding *Ch. oreas*. The first two forms are really osteologically and morphologically related, therefore it is reasonable to regard *Ch. eos* as a geographic race (MAHY, 1975c; JORDAN and EVERMAN, 1896).

Chrosomus oreas differs essentially from the above-mentioned two forms in the shape of the whole pharyngeal process (masticatory plate and the posterior elongated part of it) (Fig. 32), and in the shape of the urohyal. Morphologically it differs in the pattern of the longitudinal stripes on the sides of the body, and the presence of dark crossbars on the back (Pl. I, Fig. 3, 4). Its lateral head length is smaller than the maximal body depth, whereas in the two former species the lateral head length is greater than the maximal body depth. Than I think to be right to eliminate this form from the genus *Chrosomus* and to establish for it a new genus *Parchrosomus* gen. n.

Summarising the osteological and morphological differences of the species investigated in this study, I assign them to four different genera as it is shown in the following key.

KEY TO THE GENERA

1. Alimentary canal short (shorter than the body length) with one main loop only (Fig. 87). Teeth in two rows 2.5–5.2. Mouth terminal, or subterminal. Scales small 70–92 in lateral series 2.
- . Alimentary canal long (about twice as long as the body length) with one main loop and two crosswise coils (Fig. 88). Mouth terminal, small. Scales small 67–95 in lateral series 3.
2. Mouth terminal or upper jaw slightly overhanging the lower jaw. Body elongated, laterally compressed, not very high. Small, dark spots scattered on the back and on the sides of the body, or along the sides of the body runs a narrow dark stripe. Lateral line complete, extending to the caudal fin. Pectorals rounded, short, not reaching the middle of the distance P–V. Peritoneum dusky *Moroco* JORDAN and HUBBS, 1925.
- . Mouth small, subterminal, with the maxillary extending to the front margin of the eye, or the mouth greater, maxillary extending beyond the front margin of the eye. Body elongated, stout, almost terete. Big dark spots along the body sides arranged in one row, or one long band extending from the tip of the snout to the caudal fin. Lateral line interrupted or incomplete. Pectorals rounded, extend beyond the middle of the distance P–V. Peritoneum dusky or black *Phoxinus* RAFINESQUE, 1820.

3. Two dark almost parallel bands run horizontally along each side of the body. The upper one begins from the upper angle of the opercular, and extends dorsally to the caudal fin. The lower band, usually broader, extends from the tip of the snout, running across the eye downward and backward, reaches the caudal fin. Body elongated, somewhat compressed (Pl. I, fig. 5). Lateral line incomplete. Lateral head length greater than the maximal body depth. Pectorals somewhat tapered posteriorly. Peritoneum black *Chrosomus* RAFINESQUE, 1820.
- Two dark not horizontal bands along each side of the body. The upper band begins opposite the venter and extends to the middle of the caudal fin. The lower band extends from the tip of the snout, runs through the eye downward and backward, passing at the base of the anal fin. Body elongated, somewhat compressed. Back with dark spots and crossbars (Pl. I, fig. 3). Lateral head length smaller than the maximal body depth. Pectorals rounded, peritoneum dusky . . . *Parchrosomus* **gen. nov.**

Genus *Parchrosomus*, **gen. n.**

Type-species: *Chrosomus oreas* COPE 1868

Body slender, laterally little compressed. Head length, excluding membrane, smaller than maximal body depth. Its length about 24.1% of standard length. Mouth small, terminal, slightly oblique, not reaching the front margin of the eye. Snout slightly overhanging the lower jaw, 32.5% on the average of the length of the head. Dorsal fin distinctly posterior to pelvic fin base. Pectorals extend beyond the half distance between the origin of pectorals and pelvis origin. Caudal fin distinctly forked, lobes rounded. *D* III 7, *A* III 7 usually. Scales small, 79–84 in lateral series. Lateral line incomplete, perforated scales extend, at the very most, to the vertical of the pelvic origin. Two, not horizontal, dark bands, extend on the body side. The upper band begins above the anus, and ends at the caudal base. The lower band extends from the tip of the snout and runs obliquely through the head downward and backward to the anal fin base. The back with dark big spots or crossbars (Pl. I, Fig. 3, 4). Teeth uniserial 5–5, all attached to the lateral segment of the pharyngeal. Posterior end of the pharyngeal process flattened dorsally, not blade-like. Alimentary canal about twice as long as the body length with one main loop and two secondary ones (Fig. 88).

ADDITIONAL REMARKS

Some of the discussed American forms are known for their hybridization under natural conditions of life. LEGENDRE, 1970 has recorded hybrids of *Phoxinus neogaeus* × *Ph. eos* (*Chrosomus eos*) and *Ph. neogaeus* × *Semotilus margarita* in many localities in Quebec (Canada), and he assumes that they are

interfertile to some degree. Basing on this fact, LEGENDRE considers the above mentioned forms to be phylogenetically close, and he suggests to include *Semotilus margarita* into the genus *Phoxinus*.

Chrosomus erythrogaster hybridizes with *Notropis cornutus* (GREENFIELD et al., 1973), with *Clinostomus elongatus* (TRAUTMAN, 1957) as well as with *Campostoma anomalum* and *Clinostomus vandoisulus* (HUBBS and BAILEY, 1952).

Among the Cyprinids under natural conditions of life intergeneric hybrids appear in localities where their natural habitats have been disturbed by the interference of man. Mostly it is due to an extensive agricultural activity, which results in a reduction of the adequate breeding sites, and forces non-related species to spawn over the same nest (HUBBS and MILLER, 1943; HUBBS, 1955; GREENFIELD et al., 1973).

The hybrids *Huso huso* × *Acipenser ruthenus*, obtained artificially in the USSR, appear to be fertile producing the offspring of both sexes. In consequence the hybrids have been introduced for breeding consumption purposes (NIKOL'JUKIN, 1972).

NIKOL'JUKIN, 1972: 31 has expressed his opinion on the intergeneric hybridization of fishes: "It is interesting that in fishes intergeneric hybrids are much more common than interspecific ones. This is explained by the fact that the species of different genera, e.g. the *Cyprinidae*, are more seldom isolated geographically than the species of the same genus. A disturbance of other kinds of isolating mechanisms (ecological, physiological) results in a more frequent occurrence of intergeneric than interspecific hybrids. This peculiar characteristic distinguishes fishes from other groups of animals".

In view of the above cited NIKOL'JUKIN's opinion, hybrids of the mentioned American forms do not prove any close relationship.

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STRESZCZENIE

[Tytuł: Rewizja osteologiczna rodzaju *Phoxinus* RAF., sensu BĂNĂRESCU 1964, oraz opis nowego rodzaju, *Parchrosomus* gen. n.]

Opierając się na analizie morfologicznej i osteologicznej ryb stanowiących rodzaj *Phoxinus* sensu BĂNĂRESCU 1964 i obejmujących oprócz rodzaju *Phoxinus* RAF. także amerykańskie gatunki z rodzaju *Pfrille* i *Chrosomus*, autorka poddaje w wątpliwość słuszność stanowiska tego autora.

Euroazjatyccy przedstawiciele tego rodzaju są zasadniczo od siebie różni zarówno osteologicznie i morfologicznie, jak też ekologicznie. Dlatego autorka proponuje przydzielić je do dwóch rodzajów: *Phoxinus* RAFINESQUE, 1820 i *Moroco* JORDAN et HUBBS, 1925. Typowym gatunkiem pierwszego rodzaju jest *Phoxinus phoxinus* (LINNAEUS, 1758) i formy jemu pokrewne. Do rodzaju *Moroco* autorka zalicza *Moroco percunurus* (PALLAS) = *Phoxinus percunurus* (PALLAS) sensu BERG, 1949 i jemu pokrewne formy występujące głównie na Syberii, Półwyspie Koreańskim, w Japonii i Chinach. Gatunek ten kończy w Polsce zasięg występowania w Europie.

Co się tyczy przedstawicieli rodzajów amerykańskich: *Pfrille* i *Chrosomus*, to autorka widzi pewne pokrewieństwo tylko między *Pfrille* i *Phoxinus*, jednakże podkreśla, że różnice między tymi rodzajami są dostatecznie wyraźne, żeby zatrzymać dla *Pfrille* status podrodzaju: *Phoxinus (Pfrille) neogaeus* COPE.

Przedstawiciele rodzaju *Chrosomus* także nie stanowią dostatecznie jednolitej grupy, przeto autorka wydzieliła *Chrosomus oreas* COPE, 1868 w oddzielny rodzaj *Parchrosomus* gen. n. (patrz klucz na str. 403). W rodzaju *Chrosomus* pozostaje tylko *Ch. erythrogaster* RAFINESQUE, 1820 i jego rasa geograficzna *Ch. erythrogaster eos* (COPE, 1861).

Znane w Ameryce Północnej częste przypadki krzyżowania się *Pfrille neogaea* z *Chrosomus erythrogaster* lub *Ch. eos*, skłoniły niektórych badaczy do uznania tych form za bliskie filogenetycznie. Jednakże, jak wykazują bliższe obserwacje (HUBBS 1943, 1955, GREENFIELD et al. 1973) hybrydy powstają tylko w przypadkach zakłócenia przez człowieka właściwych warunków bytowania wspomnianych gatunków. Intensywne melioracje pociągają za sobą

zmiany charakteru zbiorników wodnych, pozbawiają ryby właściwych tarlisk i zmuszają do przypadkowego kontaktu przedstawicieli różnych rodzajów w czasie rozrodu.

РЕЗЮМЕ

[Заглавие: Ревизия остеологии рода *Phoxinus* RAF. (*Pisces*, *Cyprynidae*) sensu Банареску, 1964, и описание нового рода *Parchrosomus* gen. n.]

На основании анализа морфологического и остеологического строения рыб, составляющих род *Phoxinus* sensu Банареску, 1964, который согласно этому автору охватывает не только номинальный род, но также американские виды из родов *Pfrille* и *Chrosomus*, автор выражает сомнение относительно правильности такой классификации гольянов.

Европейско-азиатские представители этого рода принципиально отличаются друг от друга не только по своей морфологии и остеологии, но также экологически. В связи с этим автор предлагает разбить их на два рода: *Phoxinus* RAFINESGUE, 1820 и *Moroco* JORDAN et HUBBS, 1925. Типовым видом первого является *Phoxinus phoxinus* (Linnaeus, 1758) и родственные ему формы. К роду *Moroco* автор причисляет *Moroco percunurus* (PALLAS) = *Phoxinus percunurus* (PALLAS) sensu BERG, 1949 и родственные ему формы, встречающиеся главным образом в Сибири, на Корейском полуострове, в Японии и в Китае. В Польше проходит западная граница ареала этого вида.

Что касается представителей американских родов *Pfrille* и *Chrosomus*, то автор видит некоторое родство между *Pfrille* и *Phoxinus* но подчеркивает при этом, что различия между этими родами достаточно четкие, чтобы сохранить для *Pfrille* категорию подрода: *Phoxinus (Pfrille) neogaeus* (COPE).

Виды, относящиеся к роду *Chrosomus* также не составляют достаточно однородной группы. В связи с этим автор выделяет *Chrosomus oreas* COPE, 1868 в самостоятельный род *Parchrosomus* gen. n. (см. определитель 403), оставляя в роде *Chrosomus* только *Ch. erythrogaster* RAFINESGUE, 1820 и его географическую расу *Chrosomus erythrogaster eos* (COPE, 1861).

Факт, что в Северной Америке часто бывают случаи скрещивания *Pfrille neogaea* с *Ch. erythrogaster* либо с *Ch. eos* склонил некоторых исследователей к мнению, что эти формы филогенетически близки. Однако, как показали наблюдения (HUBBS 1943; HUBBS 1955; GREENFIELD et al. 1973), гибриды возникают только в случаях нарушений человеком условий среды, свойственных этим видом. Интенсивное мелиорирование влечет за собой изменение характера водоемов, лишает рыб надлежащих нерестилищ и принуждает к случайным контактам во время нереста представителей разных родов.

PLATE I

- Fig. 1. *Moroco percunurus* (PALL.)
Fig. 2. *Phoxinus phoxinus* (L.)
Fig. 3. *Parchrosomus oreas* (COPE)
Fig. 4. *Parchrosomus oreas* (COPE)
Fig. 5. *Chrosomus erythrogaster* (RAF.)
Fig. 6. *Pfrille neogaea* (COPE)

(Phot. T. PŁODOWSKI)

PLATE I

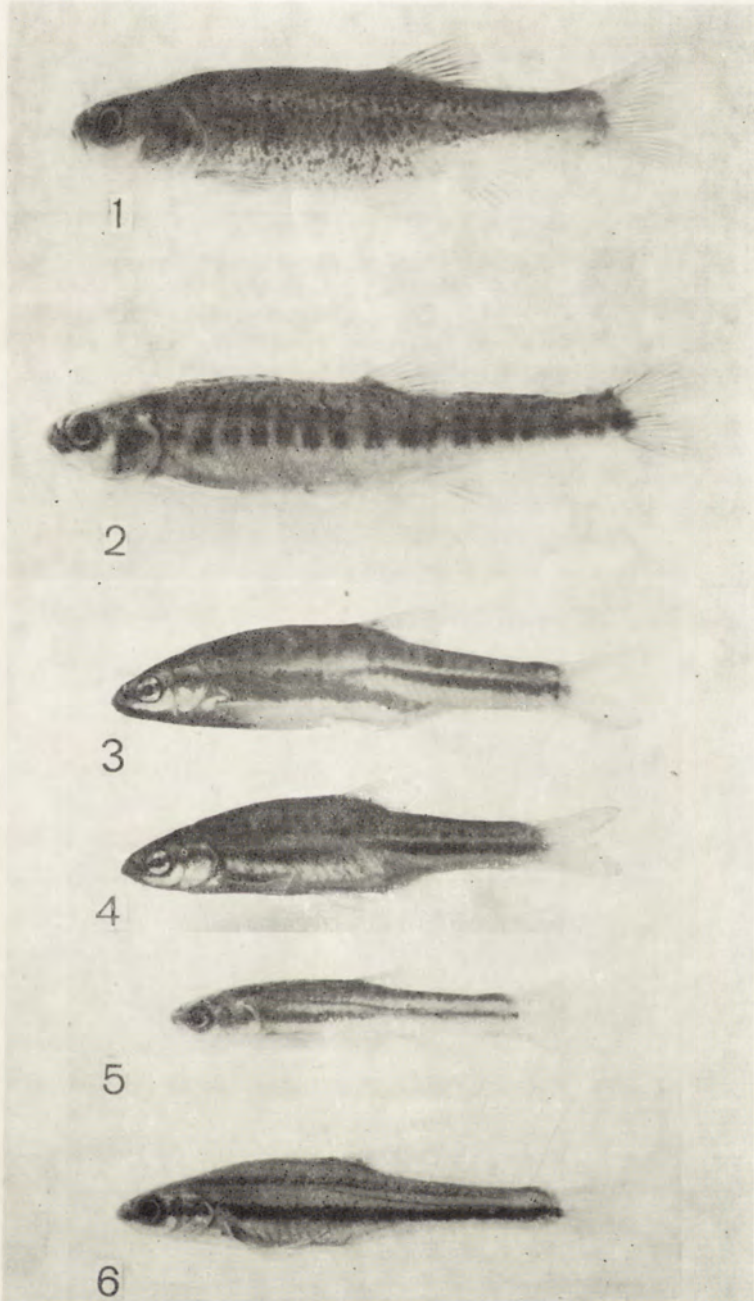
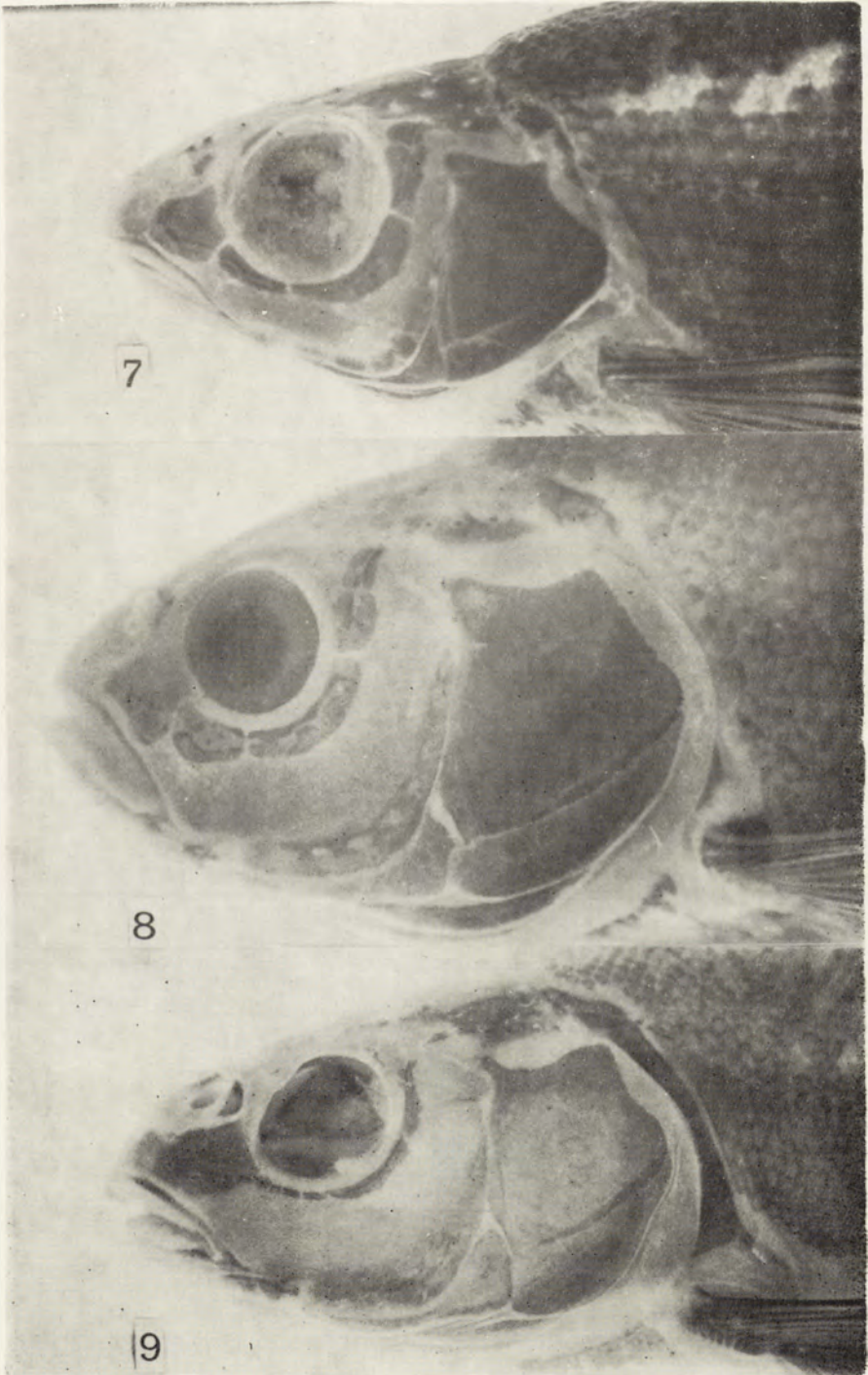


PLATE II

- Fig. 7. *Moroco lagowskii* (DYB.)
Fig. 8. *Moroco percnurus* (PALL.)
Fig. 9. *Phoxinus phoxinus* (L.)

(Phot. T. PŁODOWSKI)

PLATE II



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