SALINITY CHANGES RECORDED BY OSTRACODA ASSEMBLAGES FOUND IN PANNONIAN SEDIMENTS IN THE WESTERN MARGIN OF THE DANUBE BASIN

VARIATIONS DE LA SALINITÉ DÉTERMINÉES PAR ÉTUDE DES ASSOCIATIONS D'OSTRACODES PANNONIENS SUR LA MARGE OCCIDENTALE DU BASSIN DU DANUBE

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Sur la marge occidentale du Bassin du Danube (Bassin Pannonien), 42 espèces d'Ostracodes ont été déterminées dans les sédiments pannoniens. On peut distinguer trois associations correspondant à des indices de salinité différents. Ces associations alternent régulièrement dans le profil reflétant les oscillations climatiques. Une espèce nouvelle est décrite: *Candona (Pseudocandona) adriana* n.sp.

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Mots-clés : Ostracoda, Bassin du Danube, Miocène supérieur, Pannonien, Paléoécologie.

ABSTRACT

Sediments of the western part of the Danube basin (part of the Pannonian basin) yielded 42 Ostracoda species which may be divided into three different assemblages characterized by different salinity of the environment where they lived. The assemblages are alternating regularly in the strata sequence. This feature indicates climatic changes in the time of sedimentation. A new species is described: *Candona (Pseudocandona) adriana* n.sp.

Keywords: Ostracoda, Danube basin, Upper Miocene, Pannonian, Palaeoecology, Salinity changes, Ostracoda assemblages.

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INTRODUCTION

The town of Pezinok is situated about 15 km NNE from Bratislava, the capital of Slovakia, on the east part of the Malé Karpaty Mts. The loam pit is situated on a city margin, 500 m on the east from railway station (Fig. 1). The first geological data about loam pit of the brick-kiln in Pezinok were collected by HORUSITZKY (1907). Pannonian age of the sediments was determined by CÍLEK (1960). Palaeoclimatic conditions were defined on the basis of Mollusca and flora studies performed by HOLEC *et al.* (1987). They suggest cooling in Pannonian compared to the Badenian and Sarmatian. The sediments were deposited in varying environment of the shallow lake with gradually decreasing salinity (KANTOR *et al.*, 1986). The detailed analysis of the ecological conditions during sedimentation of the rock sequence outcroped in the loam pit required sampling of each layer in the studied profile.

1. — METHODS

Approximately 1 kg sample was steeped into solution of H_2O_2. Fractions >0.2, 0.2-0.09 and <0.09 mm were separated by sieves. The fraction >0.2 mm was evaluated further because the fraction 0.2 - 0.09 mm contained only juvenile Ostracoda forms. Only adult individuals grouped into an assemblage serve for ecological assessments.

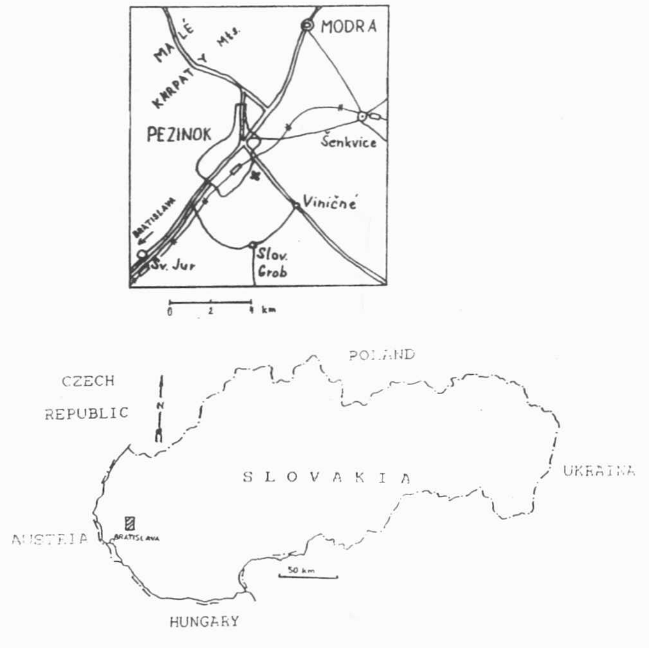

FIGURE 1

Geographic position of the Pezinok locality. The loam pit is indicated by a cross.

Position de la localité Pezinok. Fosse d'argile est marquée par la croix.

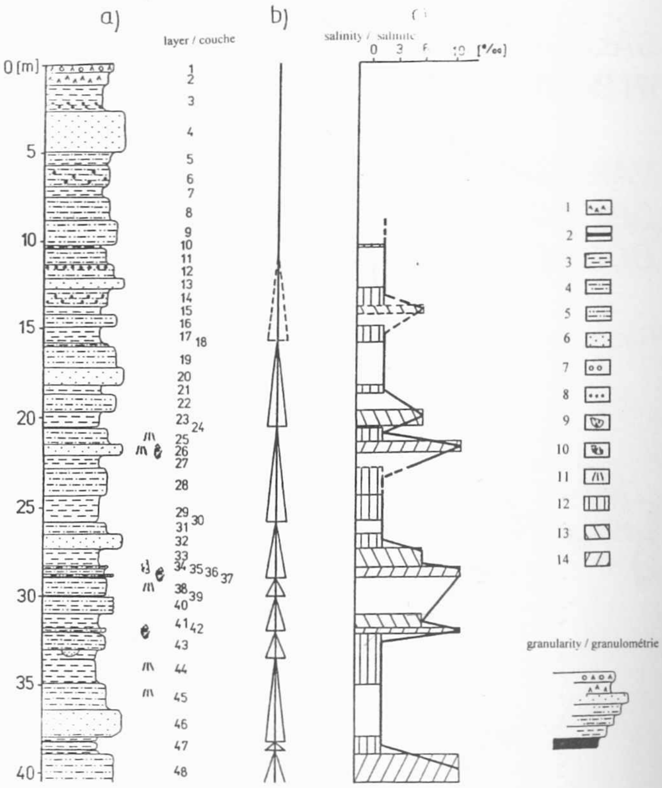

FIGURE 2

Profile of the loam pit in Pezinok:
a) lithological profile (modified after FORDINÁL, 1986),
b) paralic sedimentation cycles at the margin of the Pannonian lake,
c) distribution of the Ostracoda assemblages with indication of the salinity changes.
1. loam, 2. humodyl, 3. clay, 4. sandy clay, 5. clayey sand, 6. sand, 7. pebbles, 8. calcareous concretions, 9. Bivalvia, 10. Gastropoda, 11. rhizolits, 12. assemblage of fresh-water Ostracoda, 13. assemblage with *Candona (Caspiolla) praebalcanica*, 14. assemblage of the species of the genus *Cyprideis*.

Coupe de la fosse argile près de la ville Pezinok
a) coupe litologique (d'aprés FORDINÁL, 1986, adapté),
b) cycles de la sédimentation paralique autour de la bordure du Lac Pannonien,
c) distribution des associations d'Ostracodes dans la coupe comparée avec la courbe de la salinité.
1. argile, 2. lignite, 3. argile, 4. argile sableuse, 5. sable argileux, 6. sable, 7. galets, 8. concrétions calcaires, 9. Bivalves, 10. Gastéropodes, 11. rhizolites, 12. association d'Ostracodes d'eau douce, 13. association avec Candona (Caspiolla) praebalcanica, *14. association des espèces du genera* Cyprideis.

Comparison of the samples similarity of locality was done according to the Sorensen's coefficient of associations. Similarity dendrogram was obtained by the program NCLAS and the complete-linkage method. The method is very often used in ecology (Jedlicka, oral communication, JONGMAN *et al.*, 1995) and this method is very suitable.

2. — FAUNISTIC ANALYSIS

The rock sequence in the profile of Pezinok loam pit (Fig. 2a) comprises 48 layers. The Ostracoda fauna was recorded in 22 of them. Numbers of specimens vary in layers, some of them being rich in fossils, others having only scarce fauna. Using JIRÍCEK's procedure (1985) we determined the age of the sediments as Pannonian (zone E) as we found the species *Candona (Caspiolla) praebalcanica* KRSTIC, *Cyprideis heterostigma* (REUSS), *Hemicytheria reniformis* (REUSS), *Hemicytheria brunnensis* (REUSS) and *Candona (Pontoniella) multipora* (POKORNY). Biofacial analysis of the Ostracoda assemblages as well as applied similarity dendrogram (Fig. 3) allowed to distinguish three types of assemblages.

Assemblage of the species of genus *Cyprideis*

It is represented by species *Cyprideis seminulum* (REUSS), *Cyprideis alberti* KOLLMANN, *Cyprideis heterostigma* (REUSS), *Cypria abbreviata* (REUSS), *Cypria dorsoconcava* KRSTIC, *Amplocypris recta* (REUSS), *Hemicytheria brunnensis* (REUSS), *Hemicytheria reniformis* (REUSS). Higher diversity of the samples 35 and 36+37 enabled to distinguish two subtypes with 20 % similarity.

Assemblage with *Candona (Caspiolla) praebalcanica*

The assemblage is dominated by the species *C. (C.) praebalcanica* KRSTIC that at least 68 % of the individuals represents in each fauna-rich layer. It has two subtypes with similarity of 16 % resulting from small number of individuals.

Assemblage of fresh-water Ostracoda

It comprises species *Candona (Candona) candida* (O.F. MÜLLER), *C. (C.)* sp. 1, *C. (C.)* sp. juv., *Cyclocypris* cf. *laevis* (O.F. MÜLLER), *C. (Psedocandona) adriana* n.sp., *Darwinula stevensoni* (BRADY & ROBERTSON), *Ilyocypris gibba* RAMDOHR, *Leptocythere lacunosa* (REUSS), *Paralimnocythere* sp. Single samples have 0 % similarity caused by very small number of individuals and species.

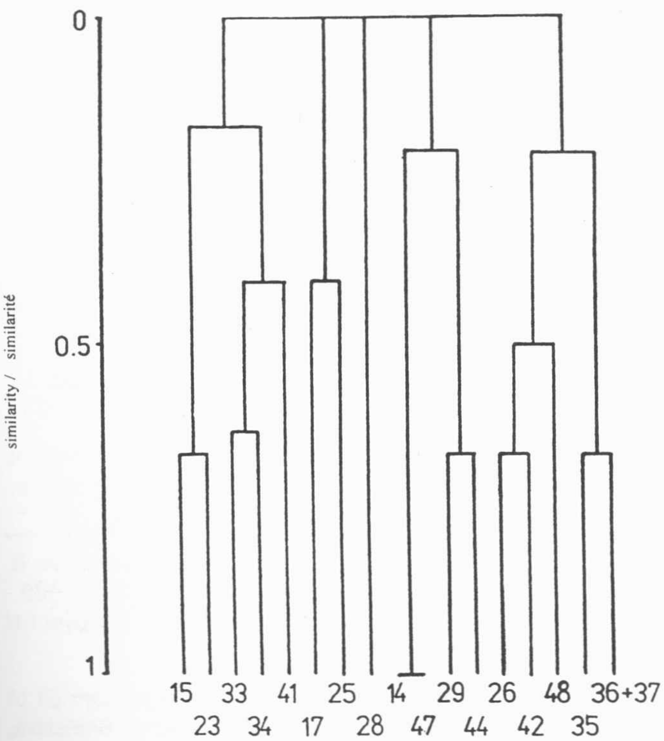

FIGURE 3

Similarity dendrogram of the Ostracoda assemblages.
Dendrogramme de la similarité des associations d'Ostracodes.

The basic physical factors that influence spatial distribution of Ostracoda include depth of water, substratum, temperature and salinity (VAN MORKHOVEN, 1962).

A direct evidence permitting not to consider water deth to be such a factor in the Pezinok loam pit (tens of meters) is the presence of humodyl beds, rhizolits (stigmaria soils), paralic character of sedimentation (Fig. 2b), findings of terrestria Gastropoda (*Limax* sp.), turtles (? *Nicoria* sp.) (swamp turtle, HOLEC, oral communication), analysis of palynological spectrum (HOLEC *et al.*, 1986) and Mollusca fauna (FORDINÁL, 1986), indirectly also study of heavy minerals its their source region corresponds to the crystalline complexes of the Malé Karpaty Mts. The water level oscillation may have reached up to 10 m.

Substratum - sediments with Ostracoda fossils are almost identical, sandy clays to clayey sands. The assemblages were found in all the layers - from clays to sands.

No temperature dependence has been proved for the species *Candona (Caspiolla)* and *Cyprideis* as well as for other species of the locality. The species *Candona (Candona) candida, Cyclocypris* cf. *laevis* and *Ilyocypris gibba* are the only exception as they inhabit preferably cold waters. Their presence indicates temperature decrease during sedimentation of layers. The assemblage of fresh-water Ostracoda was found there (LOTTIG, 1955 ex. DEVOTO, 1965, VAN MORKHOVEN, 1962, DEVOTO, 1965, RYBECKY, 1986, ROHLE, 1994).

The last factor is salinity. It plays decisive role in explanation of vertical cyclic changes in Ostracoda assemblages character.

The assemblage of fresh-water Ostracoda contains species inhabiting infrahalinne (0.0 - 0.5 ‰) to oligohalinne (0.5 - 3 ‰) environments. Presence of *Bithynia* sp., *Limax* sp. as well as palynological analysis of the layer No. 25 that shows the occurrence of fresh-water plankton and water fern (VAN MORKHOVEN, 1962, DEVOTO, 1965, HOLEC *et al.*, 1986, GRIFFITHS & BUTLIN, 1994, RÜHLE, 1994) support this estimation.

The typical species of the genus *Cyprideis, Cyprideis torosa* (JONES) is strongly euryhalinne. It lives in meso- to hypersaline waters. VAN HARTEN (1990) designated this species as a anomohaline one. We are taking in consideration environments meso- to pliohaline (more than 5-9 ‰) environment. Brown or mostly black colouring of the valves is caused by impregnation of pyrite. Larger amount of pyrite in samples documents reduction condition during sedimentation.

The group with *Candona (Caspiolla) praebalcanica* contains maximum of 32 % of the species of the first or second assemblages. It represents a transitional type with estimated salinity of 4 - 7 ‰ (miohaline environment).

3. — CAUSES OF SALINITY CHANGES

Fig. 2c shows cyclic alternation of the above-mentioned assemblages. DODD & STANTON (1981) say: "Cyclic changes in the distribution of assemblages are due to cyclic changes of the physical factors of the environment," and moreover: "Temporal changes in biota or an assemblage may be described as changes in morphology of single taxa or changes in taxonomical composition or diversity."

Sediments of the loam pit were deposited at the margin of the Pannonian lake. This is reflected by paralic character of sedimentation and synsedimentary tectonics. However, occurrence of the assemblages does not correspond to the division into the parasequences based on the lignite seams (Fig. 2), *i.e.*, the strata sequence records two different processes. The first one is oscillation of water level of the Pannonian lake, the second one is salinity fluctuation. The salinity changes caused by greater or smaller input of fresh water during wetter or drier periods (FISCHER *et al.*, 1990) due to changes of perihelion length (avg. 19 - 23 Ka) or obliquity (avg. 41 Ka). It seems the profile registers the Milankovitchís cycle but the distribution of the assemblages in the profile does not allow to determine its order.

4. — SYSTEMATIC PART

Order Podocopida MÜLLER, 1894
Family Cyprididae BAIRD, 1850
Subfamily Candoninae KAUFMANN, 1900
Genus *Candona* BAIRD, 1845
Subgenus *Pseudocandona* KAUFMANN, 1900

Candona (Pseudocandona) adriana n.sp.
(Pl. 1, fig. 5; Pl. 2, fig. 7,8; Pl. 3, fig. 1-6)

Holotype: left female valve

Paratype: right and left female valve

Locus typicus: loam pit of the brick-kiln in Pezinok, Slovakia.

Stratum typicum: Pannonian, zone E

Derivatio nominis: according to the female name Adriana.

Description: Shape elongated. Female: LV - A oval, D straight, P oval with the largest curvature under CP, V straight, slightly concave in CV, the greatest width in C. RV - A oval, AD oblique, D straight, slightly dipping to P, P oval with the largest curvature in the PV area, V arcuate, most concave in CV. The greates width in the centre. Male narrower, PD oblique.

Surface slightly pitty to smooth, the left valve superimposes over the right one. Adont hinge, marginal zone and inner lamella narrow, in V almost merging, width of the lamella in A a little smaller than that of the marginal zone, width of the lamella in P only a third of the marginal zone width, marginal pore canals in A, P numerous, straight and short, in V not as numerous as in A and P.

Dimensions: Holotype LV female length - 0.57 mm height - 0.32 mm
Paratype LV female length - 0.56 mm height - 0.30 m
PV female length - 0.57 mm height - 0.32 mm

Stratigraphic range: Pannonian, zone E, Danube basin.

Relationships: The species resembles *Candona (Pseudocandona)* sp. III. POKORNY (POKORNY, 1944) The two species differ in shape of A and P. The new species differs from *Candona (Psedocandona) pokornyi* JIRÍCEK in pitty surface (JIRÍCEK, 1985)

Material: 139 adult individuals, males are very rare.

Occurrence and ecology: The species occurs in the freshwater Ostracod assemblage characteristic for fresh- to oligohalinne waters.

5. — CONCLUSIONS

Three different independent Ostracoda assemblages were found in the profile of the loam pit in Pezinok. Each of them occurs in environment with different salinity. They are the assemblage of the genus *Cyprideis* that inhabited waters with 10 ‰ salinity, the assemblage with *Candona (Caspiolla) praebalcanica* that inhabited less halinne waters (appr. 6 ‰) and the assemblage of fresh-water Ostracoda - fresh - and oligohalinne waters (0.0 - 3.0 ‰). The salinity changes were caused by climatic changes, namely by changes of the perihelion length or obliquity. A newly described species *Candona (Pseudocandona) adriana* n.sp. was found in freshwater and oligohalinne environment.

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PLATE
PLANCHE 1

Fig.1. — *Paralimnocythere* sp., LV, outside, 108 x.
Paralimnocythere *sp., VG, vue latérale externe, 108 x.*

2. — *Candona (Candona)* sp. 1., RV, outside, 69 x.
Candona (Candona) *sp. 1., VD, vue latérale externe, 69 x.*

3. — *Cyclocypris* cf. *laevis* (O.F. MÜLLER), LV, outside, 131 x.
Cyclocypris *cf.* laevis *(O.F. MÜLLER), VG, vue latérale externe, 131 x.*

4. — *Candona (Candona)* sp. 2., RV, outside, juvenile, 62 x.
Candona (Candona) *sp. 2., VD, vue latérale externe, juvénile, 62 x.*

5. — *Candona (Pseudocandona) adriana* n. sp., LV, female, holotypus, 112 x.
Candona (Pseudocandona) adriana *n. sp., VG, femelle, holotype, 112 x.*

6. — *Darwinula stevensoni* (BRADY & ROBERTSON), RV, outside, 89 x.
Darwinula stevensoni *(BRADY & ROBERTSON), VD, vue latérale externe, 89 x.*

7. — *Candona (Caspiolla) praebalcanica* KRSTIC, LV, outside, 69 x.
Candona (Caspiolla) praebalcanica *KRSTIC, VG, vue latérale externe, 69 x.*

8. — *Ilyocypris gibba* (RAMDOHR), RV, outside, juvenile, 73 x.
Ilyocypris gibba *(RAMDOHR), VD, vue latérale externe, juvénile, 73 x.*

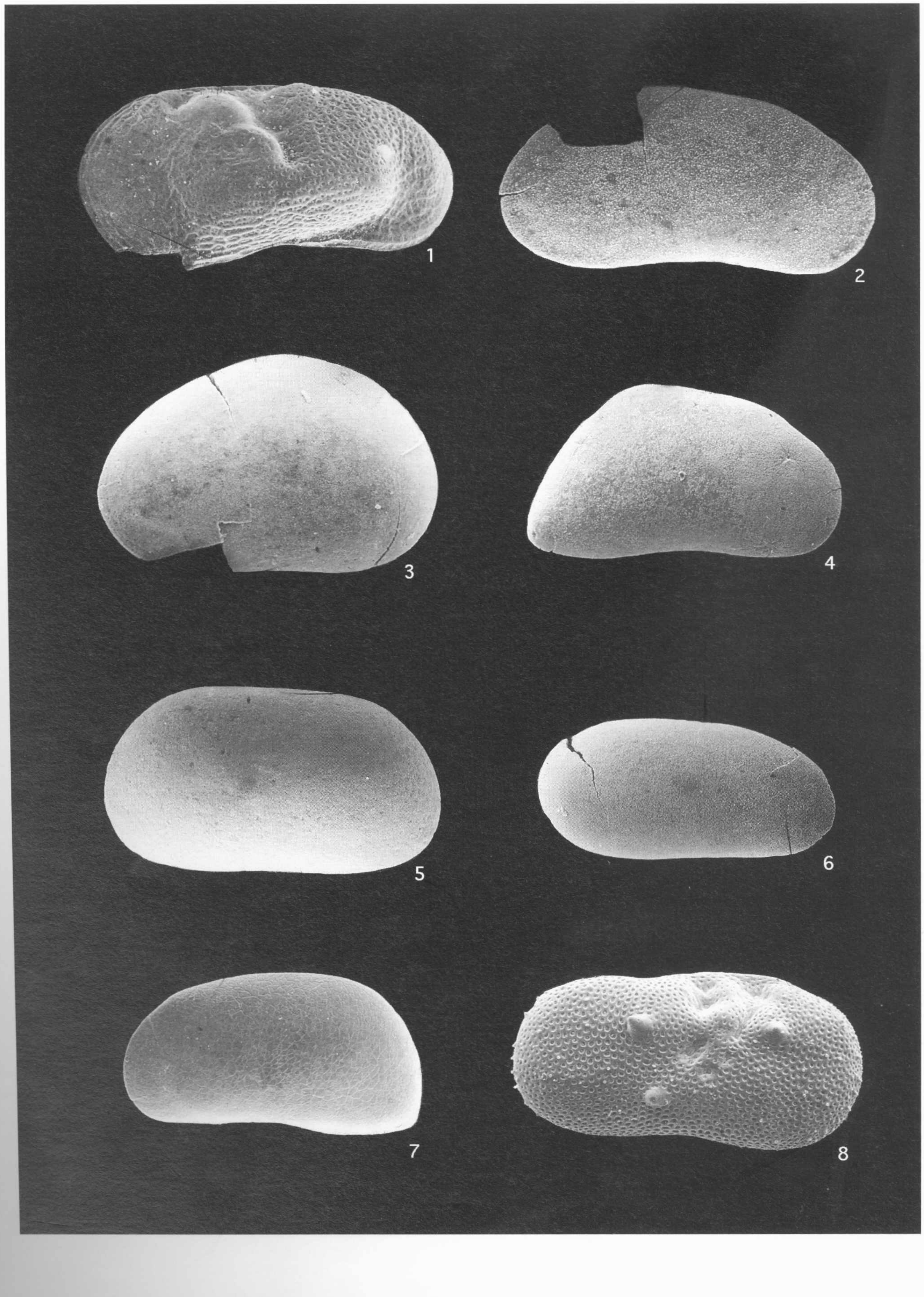


PLATE
PLANCHE 2

Fig.1. — *Cyprideis seminulum* (Reuss), RV, outside, 77 x.
Cyprideis seminulum *(Reuss), VD, vue latérale externe, 77 x.*

2. — *Candona (Caspiolla) praebalcanica* Krstic, RV, outside, 69 x.
Candona (Caspiolla) praebalcanica *Krstic, VD, vue latérale externe, 69 x.*

3. — *Cyprideis regularis* Jirícek, RV, outside, 65 x.
Cyprideis regularis *Jirícek, VD, vue latérale externe, 65 x.*

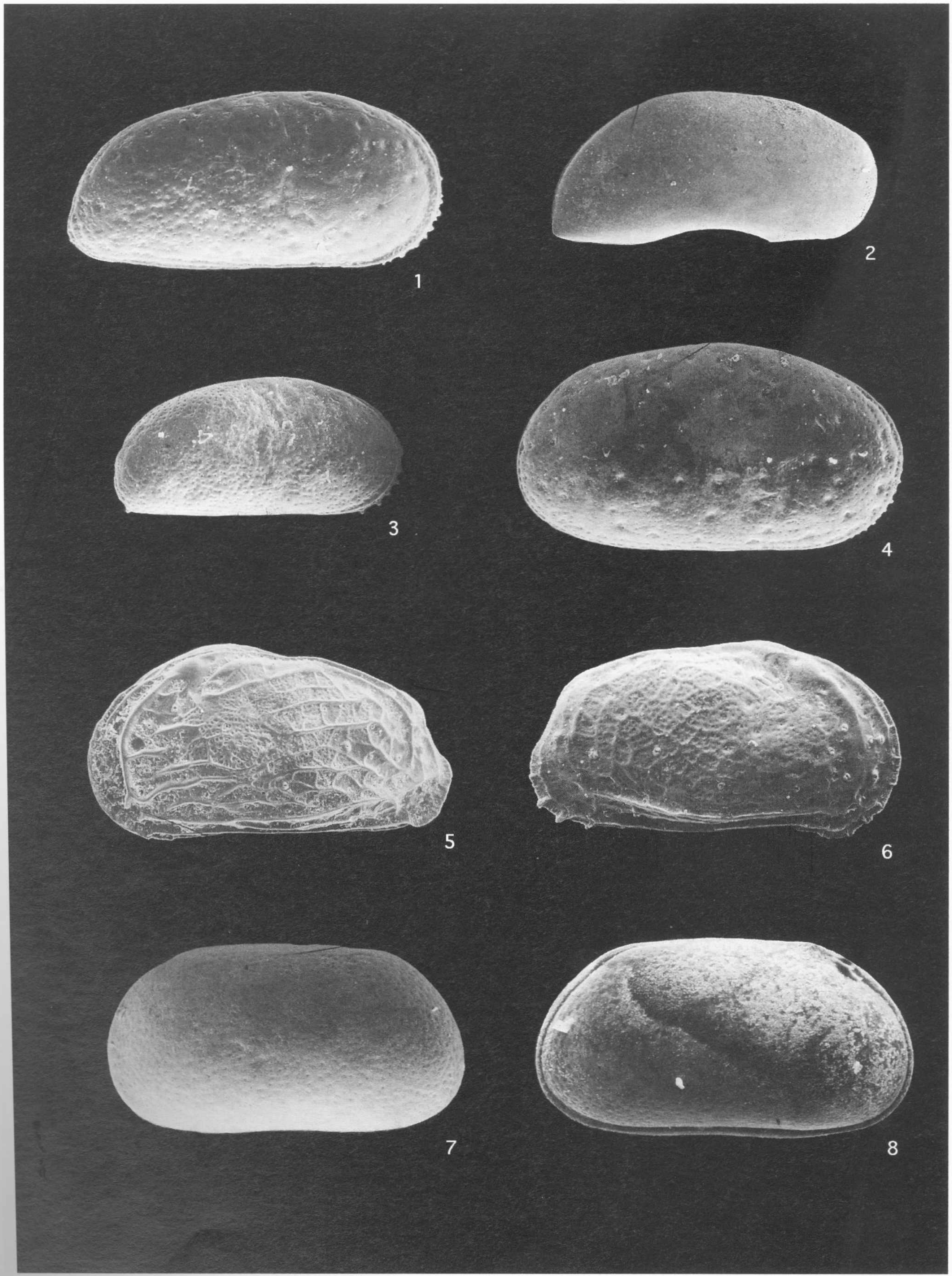
4. — *Cyprideis alberti* Kollmann, RV, outside, 96 x.
Cyprideis alberti *Kollmann, VD, vue latérale externe, 96 x.*

5. — *Tyrrhenocythere pezinokensis* Jirícek, LV, outside, 81 x.
Tyrrhenocythere pezinokensis *Jirícek, VG, vue latérale externe, 81 x.*

6. — *Hemicytheria brunnensis* (Reuss), RV, outside, 77 x.
Hemicytheria brunnensis *(Reuss), VD, vue latérale externe, 77 x.*

7. — *Candona (Pseudocandona) adriana* n. sp., LV, outside, female, paratypus, 115 x.
Candona (Pseudocandona) adriana *n. sp., VG, vue latérale externe, femelle, paratype, 115 x.*

8. — *Candona (Pseudocandona) adriana* n. sp., RV, outside, male, paratypus, 115 x.
Candona (Pseudocandona) adriana *n. sp., VD, vue latérale externe, mâle, paratype, 115 x.*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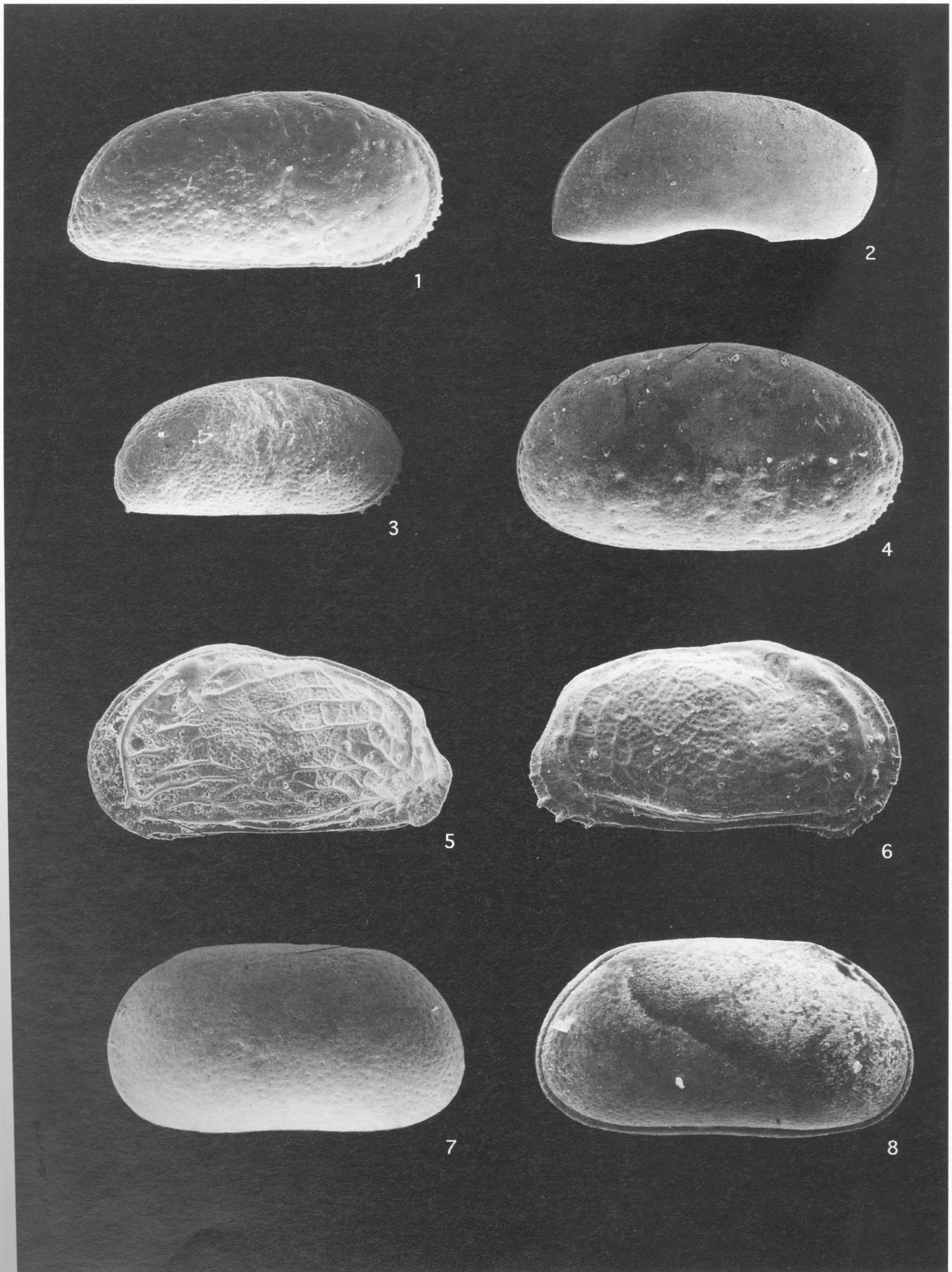
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PLATE
PLANCHE 3

Fig. 1-6. — *Candona (Pseudocandona) adriana* n. sp.

1. — LV., inside, female, holotypus, posterior, 190 x.
VG, vue latérale interne, femelle, holotype, partie postérieure, 190 x.

2. — LV, outside, female, holotypus, central muscle scarce field, 137 x.
VG, vue latérale externe, femelle, holotype, empreintes des muscles adducteurs, 137 x.

3. — LV, inside, female, holotypus, anterior, 190 x.
VG, vue latérale interne, femelle, holotype, partie antérieure, 190 x.

4. — RV, inside, 108 x.
VD, vue latérale interne, 108 x.

5. — Dorsal view, 119 x.
Vue dorsale, 119 x.

6. — Ventral view, 112 x.
Vue ventrale, 112 x.