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# Upper Carboniferous and Permian mesolobid chonetacean brachiopods of Karavanke Mountains (Yugoslavia) and Carnian Alps (Italy)

## Zgornjekarbonski in permijski mezolobidni honetacejski brahiopodi v Karavankah (Jugoslavija) in Karnijskih Alpah (Italija)

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### Abstract

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In the preface the definition of terms mesolobid and mesolobidity is given. In Gzhelian of the Karavanke Mountains two distinct forms of ribbed mesolobid chonetacean brachiopods were found in stratigraphically the same beds. This fact gives evidence for parallel evolution of two ribbed mesolobid chonetacean stocks. One of them is genus *Paramesolobus* Afanasjeva, 1975, the other *Capillomesolobus* n. gen. Both genera are also present in the same beds of Kasimovian of the Carnian Alps. The stratigraphical distribution of mesolobid chonetacean genera and species on world scale is given. Paleobiogeography and migration of genus *Capillomesolobus* is outlined. New taxa are Capillomesolobinae n. subfam., *Capillomesolobus karavankensis* n. gen., n. sp. (Karavanke Mountains, Gzhelian), *C. pontebbanus* n. gen., n. sp. (Carnian Alps, Corona Formation, Kasimovian) and *C. heritschi* n. gen., n. sp. (Karavanke Mountains, Trogkofel beds, Sakmarian or Artinskian).

### Kratka vsebina

Uvodoma je podana definicija izrazov mezolobiden in mezolobidnost. V Karavankah sta bili v stratigrafsko istih gželijskih plasteh najdeni dve obliki rebrastih mezolobidnih honetacejskih brahiopodov. To kaže na vzporeden razvoj dveh rebrastih mezolobidnih honetacejskih vej. Ena od teh je rod *Paramesolobus* Afanasjeva, 1975, druga rod *Capillomesolobus* n. gen. Oba rodova sta bila najdena tudi v stratigrafsko istih plasteh v kasimoviju Karnijskih Alp. Podana je stratigrafska porazdelitev mezolobidnih honetacejskih rodov in vrst v svetovnem merilu. Kratko je podana paleobiogeografija rodu *Capillomesolobus*. Novi taksoni so Capillomesolobinae n. subfam., *Capillomesolobus karavankensis* n. gen., n. sp. (Karavanke, gželij), *C. pontebbanus* n. gen., n. sp. (Karnijske Alpe, formacija Corona, kasimovij) in *C. heritschi* n. gen., n. sp. (Karavanke, trogkofelske plasti, sakmarij in artinskij).

## Introduction

Among the chonetacean brachiopods (superfamily Chonetacea) of Upper Carboniferous and Permian of the Karavanke Mountains (Slovenia) the chonetacean forms with ventral median lobe in median sulcus were also found. It was realised that they belong to two genera. Both genera were also identified in the Upper Carboniferous of the Carnian Alps. Thus Karavanke and Carnian Alps are thought to be the important areas for study of the mesolobid chonetacean brachiopods.

In the present paper the morphological terms "mesolobid" and "mesolobidity" are used for those Carboniferous and Permian chonetacean brachiopods in which in the middle of the ventral median sulcus the median lobe or fold is present.

## Investigations of mesolobid chonetacean forms on generic level

The first described mesolobid chonetacean brachiopod species was *Chonetes mesolobus* Norwood et Pratten, 1855 from Pennsylvanian of USA. The presence of median lobe in ventral median sulcus of chonetacean brachiopod was thus recognised on the species level. On generic level this was done with erection of genus *Mesolobus* Dunbar et Condra, 1932. Type species for genus *Mesolobus* was *Chonetes mesolobus* Norwood et Pratten which was originally described and illustrated as capillate species. Weller et McGehee then (1933, 109) pointed out that in the area from which the material of Norwood and Pratten was derived, there was no capillate form of genus *Mesolobus*, but only the smooth one. Because of it Weller et McGehee proposed that capillate specimens of *Mesolobus* are placed in species *Mesolobus striatus* Weller et McGehee, 1933, and that smooth species *Mesolobus mesolobus lioderma* Dunbar et Condra, 1932 is the type species of genus *Mesolobus*. Hoare (1964, 315) thought that the exterior of *Mesolobus mesolobus decipiens* Dunbar et Condra, 1932 is more similar to the original *Chonetes mesolobus* Norwood et Pratten than the variety lioderma. He proposed the specimen of variety *decipiens* for the neotype of *Mesolobus mesolobus*. This application was approved by the International Commission on Zoological Nomenclature. Thus genus *Mesolobus* was typically smooth. It was logically to place the ribbed mesolobid chonetacean forms in another genus. In this way Afanasjeva (1975, 101) erected the genus *Paramesolobus*. She placed in this genus also the North American ribbed mesolobid chonetacean species. But Afanasjeva (1975, 103) and earlier Ivanov et Ivanova (1936, 21) noted that the mesolobid chonetacean forms from the Russian Platform are larger and with stronger ribs than the North American Pennsylvanian species.

The material from the Upper Carboniferous of the Karavanke Mountains and the Carnian Alps revealed two distinct ribbed mesolobid chonetacean forms in the same beds. One of these is genus *Paramesolobus* Afanasjeva, 1975. The other forms, which is smaller and with finer ribs than the first is *Capillomesolobus* n. gen. These facts give evidence for parallel evolution of two ribbed mesolobid chonetacean stocks (Pecar, 1986, 137) differing not only on the generic but probably also on the subfamily level. The process of generic designation of the mesolobid chonetacean brachiopods is outlined on fig. 1.

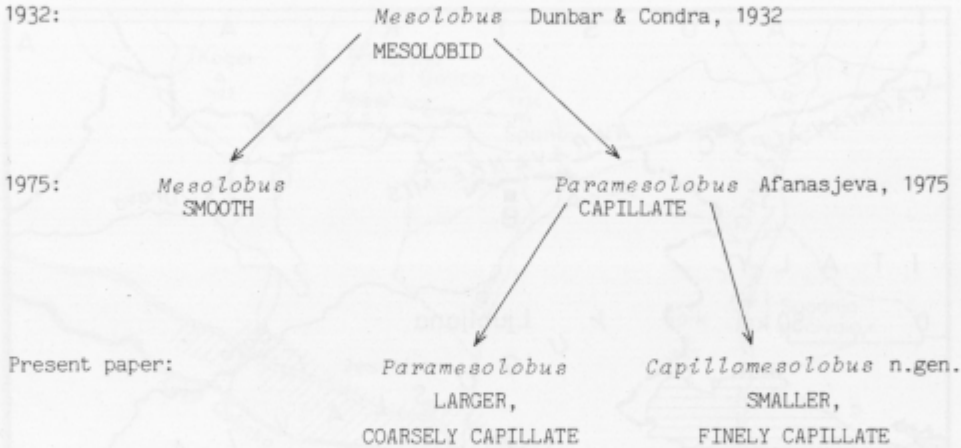



Fig. 1. The development of the generic designation of mesolobid chonetacean brachiopods

Sl. 1. Razvoj rodovne opredelitve mezolobidnih honetacejskih brahiopodov

**Previous investigations of mesolobid chonetacean brachiopods in Carnian Alps, Karavanke Mountains and in nearby countries**

Schellwien (1892, 29, 30) described from the Upper Carboniferous of the Carnian Alps two species now placed in genus *Paramesolobus*; these were *Chonetes lobatus* and *Chonetes latesinuatus*. Later Schellwien (1898, 360) gave to the species *C. lobatus* the new name *C. sinuosus* because the name *lobatus* was preoccupied by *C. lobatus* Grünewaldt, 1860. Gortani (1905, 538) described from the Carnian Alps subspecies *Chonetes moelleri carnicus*. In the Lower Permian Trogkofel beds of the Karavanke Mountains the mesolobid chonetacean was identified (Schellwien, 1900, 38) as *Chonetes sinuosus*. Later Heritsch (1938, 103) ascribed this form to a new species, but he did not name it formally. Heritsch (1931, 10) found *Chonetes latesinuatus* in the Upper Carboniferous of the Karavanke Mountains. This species was described also from the Upper Carboniferous of Croatia (Kostić-Podgorska, 1949, 79) and Hungary (Rakusz, 1932, 59).

**Localities, stratigraphy and age**

The localities 1 to 5 are in the Karavanke Mountains (Slovenia, northwest Yugoslavia), the locality 6 in the Carnian Alps (northeast Italy: figs. 2, 3).

**Locality** 1. Spodnja počivala. Long known fossil locality, situated in Javorniški rovt, about 1.8 km to the north of the village of Javornik (the suburb of the town of Jesenice), 0.55 km N 62° E of the mountain Špik 967 m. The locality is situated about 100 m along the water pipeline, above the lower crossing of the latter with the road from Javornik to Javorniški rovt. Dark-grey to black shale contains rich marine fauna. In intercalated marly shale *Rugosofusulina alpina antiqua* (Schellwien) and *Archaeolithophyllum missouriensum* Johnson were found indicating the Gzhelian age (Ramovš, 1971, 1389; Hahn et al.,


Fig. 2. Location map of the brachiopod collecting sites

Sl. 2. Položajna skica brahiopodnih najdišč

1977, 138). First paleontological contributions from this locality were those of Heritsch (1919, 1931) and of Rakovec (1931). Later Ramovš with co-authors made several paleontological articles from this locality (Hahn G. et al,, 1977).

**Locality 2.** Planina pod Golico. At the third pillar of the cableway to Španov vrh. About 2.5 km to the north of the town of Jesenice, 1.15 km S 85°E of the mountain Kogel 1122 m. A small outcrop was discovered by J. Bedič, it is about 2 m to the north of the pillar. The brownish, partially weathered shale is thought to be of the Upper Carboniferous age, probably Gzhelian.

**Locality 3.** Planina pod Golico. Near the fifth pillar of the cableway to Španov vrh. This secondary occurence is about 250 m to the east of the locality 2 and topographically some tens of m higher. The age of the dark-grey shale with numerous sponges is supposed to be the same as for locality 2.

**Locality 4.** Planina pod Golico. Between the sixth and seventh pillar of the cableway to Španov vrh. Secondary occurrence, about 100 m to the east of locality 3 and some tens of m topographically higher. The lithology is the same and the age is supposed to be the same as for locality 3.

It must be mentioned that detailed stratigraphy of localities 1 to 4 is unknown, because the beds are not well exposed.

**Locality 5.** Dolžanova soteska (= Dolžan Gorge). Classical locality of the Trogkofel Limestone in Karavanke Mountains. About 2.7 km to the northeast of town of Tržič, 1.07 km S 69°E from mountain Samuha 1172 m. The road from Tržič to Jelendol, about 100 m farther of the second road curve after the road tunnel, on the east side of the road. Rose-red, reddish and greyish reef limestone in the abandoned quarry is extending as rocky wall along the road, it is rich in brachiopods and other fossils. This reef limestone is preliminarily named Unit B in the present paper. Grey shale (preliminarily named Unit A) is underlying and the bedded limestone (preliminarily named Unit C) is overlying. Above

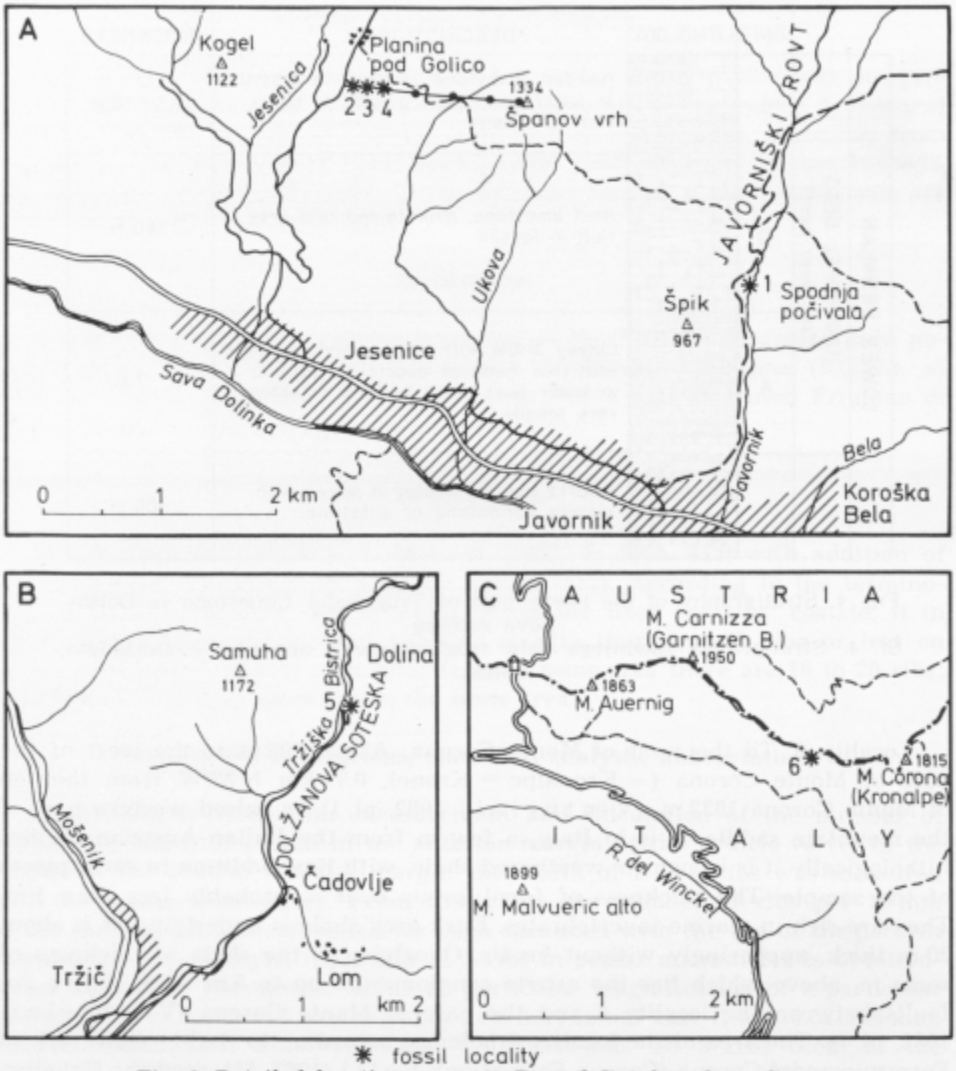



Fig. 3. Detailed location maps A, B, and C, taken from fig. 2
Sl. 3. Podrobnejše položajne skice A, B in C, vzete iz sl. 2

Unit C occurs probably another unit of reef limestone of similar colour as Unit B. The lower part of the Trogkofel Limestone in Dolžanova soteska is briefly stratigraphicaly outlined on fig. 4. This division is based partly on earlier stratigraphycal statements (Teller, 1903; Ramovš, 1961) and on personal observations. Among foraminifers *Pseudofusulina rakoveci* Ramovš et Kochansky-Devidé and *Robustoschwagerina schellwieni* (Hanzava) are present in the Trogkofel Limestone (Ramovš, 1978, 121). The age is considered to be Sakmarian (Waterhouse, 1976, 82; Leven, 1980, pl. 3) or Artinskian (Buser, 1979, 20). Schellwien (1900) described the brachiopods from this locality.

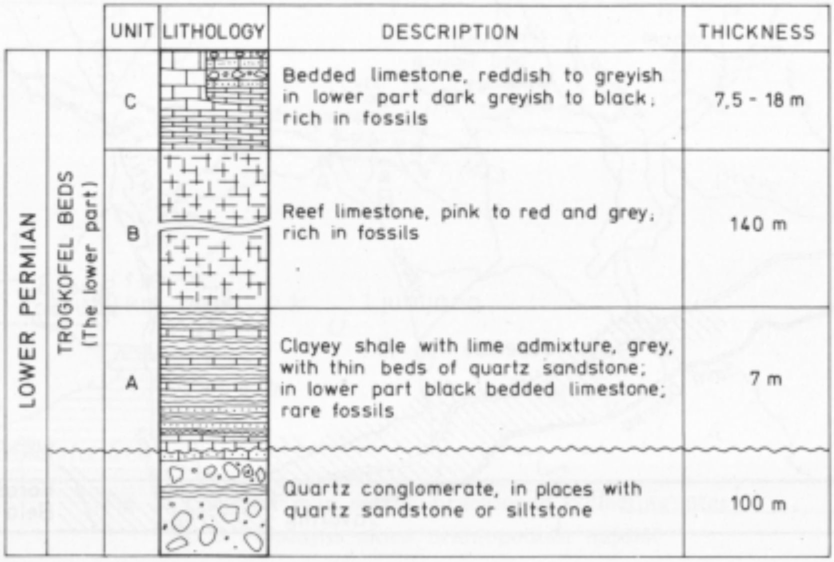



Fig. 4. Stratigraphy of the lower part of Trogokofel Limestone in Dolžanova soteska

Sl. 4. Stratigrafija spodnjega dela trogkofelskega apnenca v Dolžanovi soteski

**Locality 6.** Tó the west of Monte Corona. About 200 m to the west of the base of Monte Corona (= Kronalpe = Krone), 0.74 km N 83°W from the top of Monte Corona 1832 m (V e n t u r i n i , 1982, pl, 1), in raised western part of the mountain saddle. It is in Italy, a few m from the Italian-Austrian border. Lithologically it is brownish, weathered shale, with lime addition in some pieces of the sample. The thickness of fossiliferous beds is probably less than 1 m. They are rich in marine invertebrates. Dark grey shale is underlying, it is about 20 m thick, appearingly without fossils. Overlying is the shale of thickness of some m, above which lies the quartz conglomerate up to 5 m thick. There are faults between the locality 6 and the base of Monte Corona (V e n t u r i n i , 1982, pl. 1). The area of the locality 6 belongs, according to S e l l i (1963, 51), to Formazione del Corona (Corona Formation). S e l l i (1963, 51) cited the Gzhelian age for this formation. F r a n c a v i l l a (1974, 93) ascribed Stephanian A (probably its upper part) or Stephanian B age to the land flora of his locality 119, which belongs to Corona Formation in the vicinity of the present locality 6. V e n t u r i n i et al. (1982, 311) designated the age of Corona Formation as Stephanian B which is corresponding with Kasimovian (R o t a i , 1978, 11). During the field work in 1985 it was not possible to find the S c h e l l w i e n ' s (1892, 8) bed 6 of his Krone section: from this important bed he described among others the mesolobid brachiopod species *Chonetes sinuosus* Schellwien, 1898. It is possible that the locality 6 is very near to S c h e l l w i e n ' s bed 6 of his Krone section both geographically (the horizontal distance to some 200 m) and stratigraphically.

### Preservation of brachiopods

In the Upper Carboniferous localities 1 to 4 and 6 the brachiopods are preserved mainly as moulds, rarely as shells. Numerous biota (mostly bryozoans) are found on the moulds of Upper Carboniferous brachiopods, especially from locality 2. This means that biota lived inside shell structure of brachiopods, perhaps after brachiopod death. In the Permian locality 5 the brachiopods are preserved as shells and as moulds.

### Collections

Brachiopods figured herein are reposited at the Katedra za geologijo in paleontologijo, Univerza Edvarda Kardelja v Ljubljani, Ljubljana (KGPL), at Tehniški muzej Železarne Jesenice, Jesenice (TMJ), and at Museo Friulano di Storia Naturale, Udine (GPU).

### Terminology

It was used that of Muir-Wood (1962, 7; 1965, 412) with addition of terminology of Cooper et Grant (1975, 1212). According to the terminology of Muir-Wood the following terms are used for ribs: costate, if in the middle part of the ventral anterior margin there are 15 ribs or less on 10 mm of the shell width; costellate, if in the same area there are 16 to 25 ribs; capillate, if 26 ribs or more are in the same area.

### Measurements, diagrams, statistical analysis, abbreviations

Explication is needed for measurement and calculation of the number of ribs at the width of 10 mm in the anterior margin of the pedicle valve. In the middle of the ventral anterior margin the width of 2 to 4 ribs was measured with the ocular micrometer. From this value the number of ribs per 10 mm of the shell width was calculated for each specimen with the use of the percent calculation. For example, the width of 3 ribs in ocular micrometer is 34 micrometer units. The micrometer value of particular magnification of a particular microscope was measured and calculated earlier; in our case it was 0.031746 mm. Further calculation: $34 \,.\, 0.031746\ \mathrm{mm} = 1.079364\ \mathrm{mm}$. So 3 ribs occur at the width of 1.079364 mm; with percent calculation we get $3 : 1.079364 = X : 10$, $X = 27.7$ ribs. The chonetacean specimen is capillate, because it has more than 25 ribs per 10 mm of the ventral anterior margin. It is suitable to prepare the table of already calculated data for particular microscope magnification, from which we can get the result at a glance. In the mentioned example the width of 3 ribs is 34 micrometer units, and it can be read from the table that it corresponds to 27.7 ribs per 10 mm of shell width.

The number of ribs per 10 mm of shell width is useful for quick quantitative description of ribs of chonetacean brachiopods, which can be costate, costellate or capillate. It is useful even for specimens with the whole width less than 10 mm. In the present paper it is thought that the exact method of rib measuring with ocular micrometer is quicker than the counting of the number of ribs on the whole specimen and more exact than the counting of ribs on 1, 2 or 5 mm of the shell width. Many times it is impossible to measure the entire number of ribs on ventral valve because they are not all preserved, but it is usually possible to measure 2 to 4 ribs in the middle of the ventral anterior margin. On the other hand the weak point of this parameter in the present paper is the absence of correlation between it and the shell length.

In the present paper the independent variable (on the X axis) is the length of the ventral valve. For each diagram the correlation coefficient (r) for specimens of the particular locality was calculated if the number of specimens was sufficent. When r was significant ($P < 0.05$) the regression line was calculated too (Spiegel, 1975, 263, 270).

In diagrams the following abbreviations are used:

L length of the ventral valve
W maximal width of the valve
Nr 10 number of ribs per 10 mm of the width, measured in the ventral anterior margin
Nr total number of ribs of ventral anterior margin.

## Systematic paleontology

Class **Articulata** Huxley, 1869
Order **Strophomenida** Öpik, 1934
Suborder **Chonetidina** Muir-Wood, 1955
Superfamily Chonetacea Bronn, 1862
Family Rugosochonetidae Muir-Wood, 1962

Diagnosis of this family is provided by Hoover (1981, 49) and Archbold (1892, 2).

### Capillomesolobinae n. subfam.

Diagnosis: Small, capillate or smooth Rugosochonetidae with ventral median sulcus, in which the median lobe is present or absent.

Genera assigned to subfamily: *Capillomesolobus* n. gen. *Mesolobus* Dunbar et Condra, 1932. *Tenuichonetes* Jing et Hu, 1978. New undescribed genus, typified by *Neochonetes unbonoplicatus*, figured by Barkhatova, 1964, from the Sakmarian Nenets Beds, Sula River, Northern Timan Mountains (Archbold, 1982, 2) possibly also belongs to this subfamily.

Discussion and phylogenesis: Capillomesolobinae n. subfam. differs from other subfamilies of family Rugosochonetidae by usual presence of ventral median lobe in ventral median sulcus. Material in the present paper reveals that the presence or absence of mesolobidity is somewhat variable intraspecifically.

Genera *Capillomesolobus*, *Mesolobus* and *Tenuichonetes* are thought to have phylogenetic connection, in which *Capillomesolobus* has starting-point position (fig. 5). This genus appeared in Pennsylvanian (Atokan), probably it descended of genus *Neochonetes* (Sutherland et Harlow, 1973, 31), it lived until Upper Permian (Punjabian). It was a cosmopolitan genus. From genus *Capillomesolobus* derived the endemic North American Pennsylvanian smooth genus *Mesolobus* and the likewise endemic Chinese Middle Permian

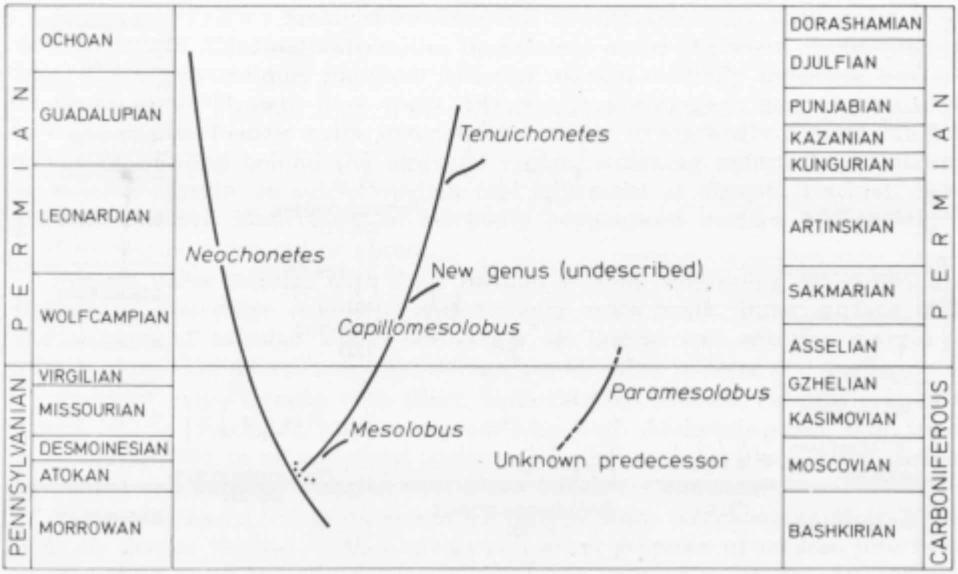



Fig. 5. The inferred phylogeny of mesolobid chonetacean brachiopods

Sl. 5. Domnevna filogeneza mezolobidnih honetacejskih brahiopodov

capillate genus *Tenuichonetes*. In all these three genera the basic morphological characteristics are finely capillate or smooth shell and ventral median lobe in ventral median sulcus (mesolobidity). The possibility that *Tenuichonetes* evolved from either *Mesolobus* or *Paramesolobus* was stated earlier by Archbold (1982, 6). In the present paper it is thought that it possibly evolved from *Capillomesolobus*. Genus *Tenuichonetes* has also plications or lobes on lateral parts of the shell. In the original description of the type species of genus *Tenuichonetes* (*Chonetes tenuiliratus* Chao, 1928) there is neither a description of mesolobidity nor it can be reliably seen on plate. Mesolobidity of *T. tenuiliratus* was described by Jing et Hu (1978, 125) and of *T. plicatiformis* described and figured by Lee (1962, 486). The morphology of the fourth possible, undescribed genus of this subfamily, typified by *Neochonetes unbonoplicatus*, is peculiar: ventral median sulcus in posterior part changes anteriorly to a swollen fold, separated from the lateral flanks of the valve by a valley on either side (Archbold, 1982, 2).

The material from Upper Carboniferous of Karavanke Mountains and Carnian Alps shows clearly the difference between finely ribbed mesolobid chonetacean stock (genus *Capillomesolobus*) and coarsely ribbed stock whose representatives are also larger (genus *Paramesolobus*). Both genera are present in Karavanke Mountains and in Carnian Alps in the same beds; this fact gives the first doubtless evidence for two ribbed mesolobid chonetacean stocks (Pecar, 1986, 137) with parallel evolution. Because of the striking difference between *Paramesolobus* and *Capillomesolobus* they are separated on the subfamily level in the present paper. It is possible that their mesolobidity is a phenomenon of convergence. The predecessor of *Paramesolobus* is unknown.

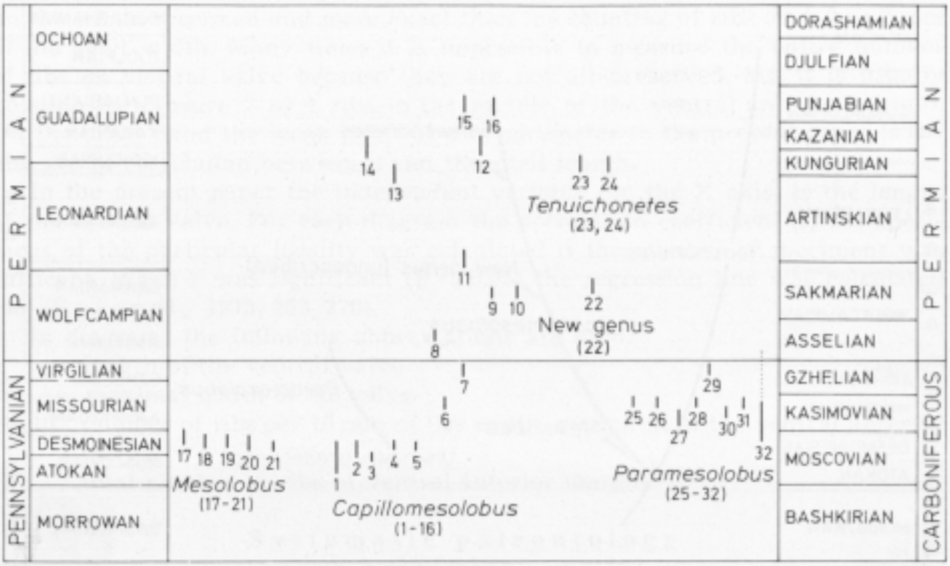



Fig. 6. Stratigraphic distribution of mesolobid chonetacean brachiopods on the world scale

Sl. 6. Stratigrafska porazdelitev mezolobidnih honetacijskih brahiopodov v svetovnem merilu

Genus *Capillomesolobus* n. gen.: 1 *C. striatus* (Weller & McGehee), 2 *C. inflexus* (Girty), 3 *C. depressus* (Stevens), 4 *C. obsoletus* (Sturgeon & Hoare), 5 *C. profundus* (Sutherland & Harlow), 6 C. *pontebbanus* n. sp., 7 C. *karavankensis* n. sp., 8 *Capillomesolobus* sp. (Gobbett, 1963, 120), 9 *Capillomesolobus* sp. (Yanagida, 1967, 86), 10 *Capillomesolobus* sp. (Nakamura, 1959, 205), 11 *C. heritschi* n. sp., 12 *Capillomesolobus* (?) sp. (Tazawa, 1976, 184), 13 *C. permianus* (Cooper & Grant), 14 *Capillomesolobus* sp. (Coogan, 1960, 291), 15 C. (?) *lissarensis* (Diener), 16 *Capillomesolobus* sp. (Hayasaka, 1925, 93), Genus *Mesolobus* Dunbar & Condra, 1932: 17 *M. mesolobus* (Norwood & Pratten), 18 *M. lioderma* (Dunbar & Condra), 19 *M. euampygus* (Girty), 20 *M. rochellensis* R. H. King, 21 *M. indistinctus* Stevens. New genus, undescribed (typified by *Neochonetes unbonoplicatus*, figured by Barkhatova, 1964, cited by Archbold, 1982, 2): 22. Genus *Tenuichonetes* Jing & Hu, 1978; 23 *T. tenuiliratus* (Chao), 24 *T. plicatiformis* (Lee). Genus *Paramesolobus* Afanasjeva, 1975: 25 *P. sinuosus* (Schellwien), 26 *P. latesinuatus* (Schellwien), 27 *P. carnicus* (Gortani), 28 *Paramesolobus* sp. 1 (present paper), 29 *Paramesolobus* sp. 2 (present paper), 30 *P. ivanovae* (Afanasjeva), 31 *P. luganicus* Aisenverg, 32 *P. miaokouensis* (Chao)

Stratigraphical distribution of species of Capillomesolobinae n. subfam. and of genus *Paramesolobus* is shown on fig. 6. Of great assistance for elaborating this figure were the data of Afanasjeva (1978) and Archbold (1982).

*Capillomesolobus* n. gen.

1986 New genus A — Pecar, p. 137.

Type species: *Capillomesolobus karavankensis* n. sp.

Etymology: Capillus (lat.) = hair, because of capillate shell surface; mesolobus, because of morphological similarity with genus *Mesolobus*.

Diagnosis: Small, finelly capillate Rugosochonetidae with ventral median sulcus in which median lobe is present or absent.

Description: Small, subrectangular to subtrapezoidal, shell width larger than length. Cardinal extremities moderately acute angled to obtuse-angled. Lateral margins oblique, rounded. Anterior margin medially indented. Surface finely capillate. Growth lines weak. Hinge spines divergent, near right-angled to right-angled. Pedicle valve exterior moderately to markedly convex. Median sulcus originating behind the umbonal region, widening anteriorly, extending to anterior margin. In sulcus median fold is present or absent. Brachial valve exterior concave. Moderately to markedly pronounced median fold in which median sulcus is present or absent.

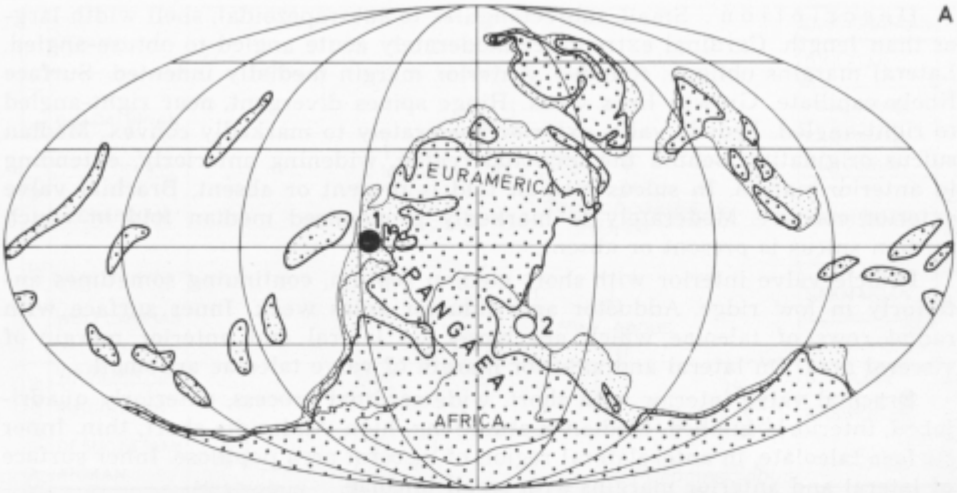
Pedicle valve interior with short median septum, continuing sometimes anteriorly in low ridge. Adductor and diductor scars weak. Inner surface with radial rows of taleolae which are larger on lateral and anterior margin of visceral area. On lateral and anterior margin of valve taleolae are small.

Brachial valve interior with short, wide cardinal process, exteriorly quadrilobed, interiorly bilobed. Median septum long, high. Anderidia short, thin. Inner surface taleolate, in anterolateral region of visceral area papillose. Inner surface of lateral and anterior margins with small taleolae.

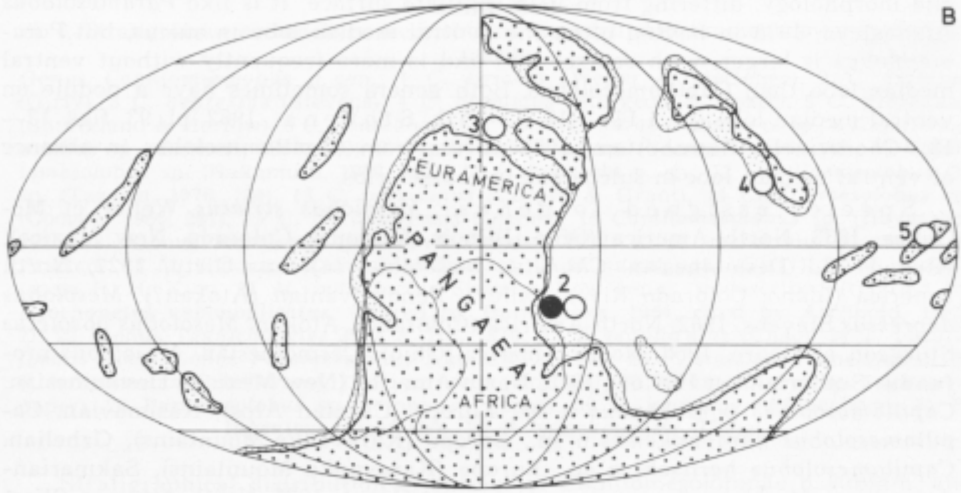
Comparison: *Capillomesolobus* differs from *Neochonetes* Muir-Wood, 1962 by deeper ventral median sulcus and usual presence of median lobe in it. It resembles much the smooth genus *Mesolobus* Dunbar et Condra, 1932 in size and morphology, differing from it in capillate surface. It is like *Paramesolobus* Afanasjeva, 1975 in having often the ventral median lobe in sulcus, but *Paramesolobus* is larger, with coarser ribs and is more frequently without ventral median lobe than *Capillomesolobus*. Both genera sometimes have a nodule on ventral median lobe (pl. 1.14—1.15, 5.5—5.6; Stevens, 1962, pl. 93, figs. 12—13). *Chonetinella* Ramsbottom, 1952 differs from *Capillomesolobus* in absence of ventral median lobe in sulcus and in coarser ribs.

Species assigned to genus: *Mesolobus striatus* Weller et McGehee, 1933, North America (Ohio, Illinois, Missouri, Colorado, New Mexico), Atokan and Desmoinesian. *Chonetes mesolobus inflexus* Girty, 1927, North America (Idaho, Colorado River Valley), Pennsylvanian (Atokan?). *Mesolobus depressus* Stevens, 1962, North America (Colorado), Atokan. *Mesolobus obsoletus* Sturgeon et Hoare, 1968, North America (Ohio), Desmoinesian. *Mesolobus profundus* Sutherland et Harlow, 1973, North America (New Mexico), Desmoinesian. *Capillomesolobus pontebbanus* n. sp., Europe (Carnian Alps), Kasimovian. *Capillomesolobus karavankensis* n. sp., Europe (Karavanke Mountains), Gzhelian. *Capillomesolobus heritschi* n. sp., Europe (Karavanke Mountains), Sakmarian-Artinskian. *Mesolobus? permianus* Cooper et Grant, 1975, North America (West Texas), Upper Leonardian. *?Chonetes lissarensis* Diener, 1897, Himalaya, Punjabian.

Specifically undetermined statements of genus *Capillomesolobus: Mesolobus?* sp., Gobbett, 1963, 120, Svalbard (Spitzbergen), Asselian?. *Mesolobus mesolobus* (Norwood et Pratten), Nakamura, 1959, 205, Japan (Honshu), Sakmarian. *Chonetes* cf. *C. latesinuatus* Schellwien, Yanagida, 1967, 86, Indochina (Thailand), Sakmarian. *Mesolobus sinuosus* (Schellwien), Tazawa, 1976, 184, Japan (Honshu), Kazanian?. *Chonetinella* cf. *C. sinuosa* Schellwien, Coogan, 1960, 291, North America (California), Lower Guadalupian. *Chonetes sinuosus* Schellwien, Hayasaka, 1925, 93, Japan (Honshu), Punjabian.




Capillomesolobus in Moscovian (Atokan and Desmoinesian)
Capillomesolobus in Kasimovian and Gzhelian




Capillomesolobus in Kasimovian and Gzhelian
Capillomesolobus in Lower Permian

P a l e o b i o g r a p h y a n d m i g r a t i o n : In beds of Atokan age in New Mexico two species of *Neochonetes* with intermediate characters between *Neochonetes* and *Capillomesolobus* (the evolution of ventral median lobe) were described (S u t h e r l a n d et H a r l o w , 1973, 26, 27). One of these species, *N. whitei*, is stratigraphically the possible predecessor of *Capillomesolobus*. The oldest known species of genus *Capillomesolobus*, *C. striatus* (Weller et McGehee,

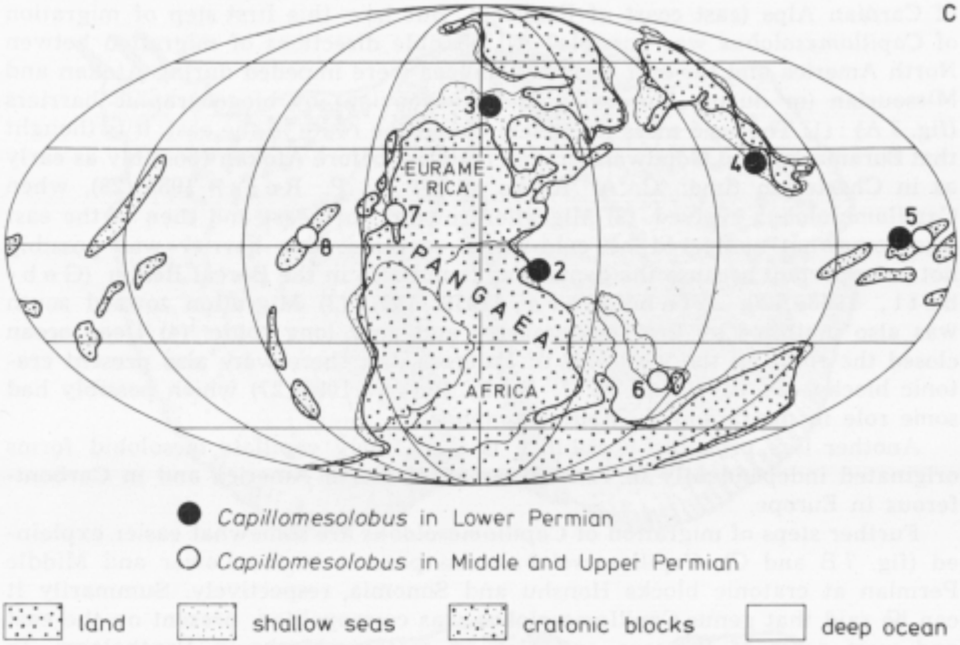



Fig. 7. Paleobiogeography of the genus *Capillomesolobus*
1 North America (USA), 2 North Africa (the possible Upper Paleozoic position of present Karavanke Mountains and Carnian Alps), 3 Svalbard (Spitzbergen), 4 Indochina. 5 Central Japan (Honshu), 6 Nepal, 7 West Texas, 8 North California (cratonic block Sonomia)

*A:* 1 *C. striatus, C. infletus, C. depressus, C. obsoletus, C. profundus;* 2 *C. pontebbanus C. karavankensis. B*: 2 (●) *C. pontebbanus, C. karavankensis;* 2 (○) *C. heritschi;* 3 *Capillomesolobus* sp. (Gobbett, 1963, 120); 4 *Capillomesolobus* sp. (Yanagida, 1967, 86); 5 *Capillomesolobus* sp. (Nakamura, 1959, 205). *C:* 2 *C. heritschi;* 3 *Capillomesolobus* sp. (Gobbett, 1963, 120); 4 *Capillomesolobus* sp. (Yanagida, 1967, 86); 5 (●) *Capillomesolobus* sp. (Nakamura, 1959, 205); 5 (○) *Capillomesolobus* sp. (Tazawa, 1976, 184); 6 *C.* (?) *lissarensis;* 7 *C. permianus:* 8 *Capillomesolobus* sp. (Coogan, 1960, 291). Maps (Mollweide projection) are modified from Scotese et al. (1979) with addition of data from C. A. Ross et J. R. P. Ross (1985)

Sl. 7. Paleobiogeografija rodu *Capillomesolobus*
1 Severna Amerika (ZDA), 2 severna Afrika (možni zgornjepaleozojski položaj sedanjih Karavank in Karnijskih Alp), 3 Svalbard (Spitzbergi), 4 Indokina, 5 osrednja Japonska (Honshu), 6 Nepal, 7 zahodni Texas, 8 severna Kalifornija (kratonski blok Sonomia). Karte (Mollweidova projekcija) so spremenjene po Scotese et al. (1979) z dodatkom podatkov iz C. A. Ross et J. R. P. Ross (1985)

1933) and *C. inflexus* (Girty, 1927), are from Atokan of North America (fig. 5). On base of these data it can be concluded that genus *Capillomesolobus* originated in Atokan in North America. It became temporarily extinct there in Upper Desmoinesian (Upper Moscovian). The oldest locality of *Capillomesolobus* outside North America is in the Carnian Alps where *C. pontebbanus* n. sp. is present in Kasimovian. So it can be supposed that *Capillomesolobus* migrated from the area of its origin in North America (west coast of Pangaea) to the area of Carnian Alps (east coast of Pangaea). But how this first step of migration of *Capillomesolobus* was possible? All possible directions of migration betwen North America and the east coast of Pangaea were impeded during Atokan and Missourian (or during Moscovian and Kasimovian) by biogeographic barriers (fig. 7 A) : (1) The land mass (Pangaea) closed the route to the east; it is thought that Euramerica and Gondwana joined together before Atokan (possibly as early as in Chesterian time; C. A. Ross et J. R. P. Ross, 1985, 28), when *Capillomesolobus* evolved. (2) Migration toward northeast and then to the east was somewhat hampered by cold-water currents; this barrier was possibly not so important because the genus was found also in the Boreal Realm (Gobbett, 1963, 120; Afanasjeva, 1978, 105). (3) Migration toward south was also inhibited by low temperatures and very long route. (4) Deep ocean closed the route on the west side of Pangaea, but there were also present cratonic blocks (C. A. Ross et J. R. P. Ross, 1985, 27) which possibly had some role in migration of *Capillomesolobus*.

Another less probable possibility is that finely capillate mesolobid forms originated independently in Pennsylvanian of North America and in Carboniferous in Europe.

Further steps of migration of *Capillomesolobus* are somewhat easier explained (fig. 7 B and C). *Capillomesolobus* was present in the Lower and Middle Permian at cratonic blocks Honshu and Sonomia, respectively. Summarily it can be said that genus *Capillomesolobus* was cosmopolitan, present on the east and west coast of Pangaea and also on cratonic blocks in Panthalassa. In comparison with it the genus *Paramesolobus* was restricted both biogeographically (to the east coast of Pangaea) and stratigraphically (to Upper Carboniferus and posibly to lower part of Lower Permian). Thus the separation of mesolobid chonetacean genera *Capillomesolobus, Mesolobus* and *Paramesolobus* has important biostratigraphic and paleobiogeographic implications.

### *Capillomesolobus karavankensis* n. sp.

Pl. 1.1—1.25; fig. 8 A, B; fig. 9 A, B, C

1986 New genus A sp. 1 — Pecar, p. 137, 138, pl. 1, figs. 23—28.

Etymology: *Karavankensis* — after Karavanke Mountains, the area of the localities of this species.

Types: Holotype: TMJ 1274. Paratypes: KGPL 5356, TMJ 1219, 1212, 1282, KGPL 5411, TMJ 1278.

Type locality, type horizon and age: Spodnja počivala (locality 1), Karavanke Mountains. Dark-grey to black shale. Gzhelian.

Localities and material: Locality 1, Gzhelian, 15 specimens (2 conjoined valves, 9 pedicle valves, 5 brachial valves). Locality 2, Gzhelian, 23 specimens (12 pedicle valves, 11 brachial valves). Locality 3, Gzhelian, 1 specimen (pedicle valve).

Diagnosis: Medium size *Capillomesolobus* with moderately expressed ventral median lobe and moderately pronounced ventral lateral plications.

Description: Medium size for genus, subrectangular to subtrapezoidal, shell width greater than length, widest shortly before hinge or at hinge. Cardinal extremities moderately acute-angled to obtuse-angled, ears moderately

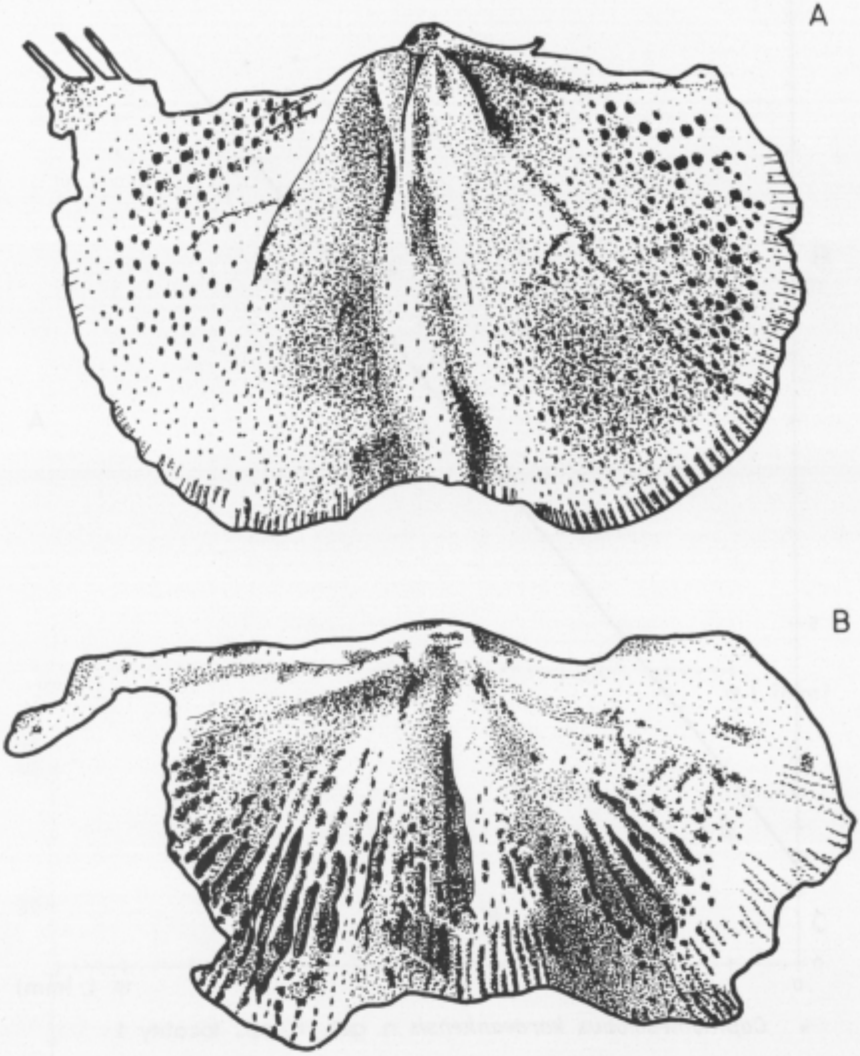
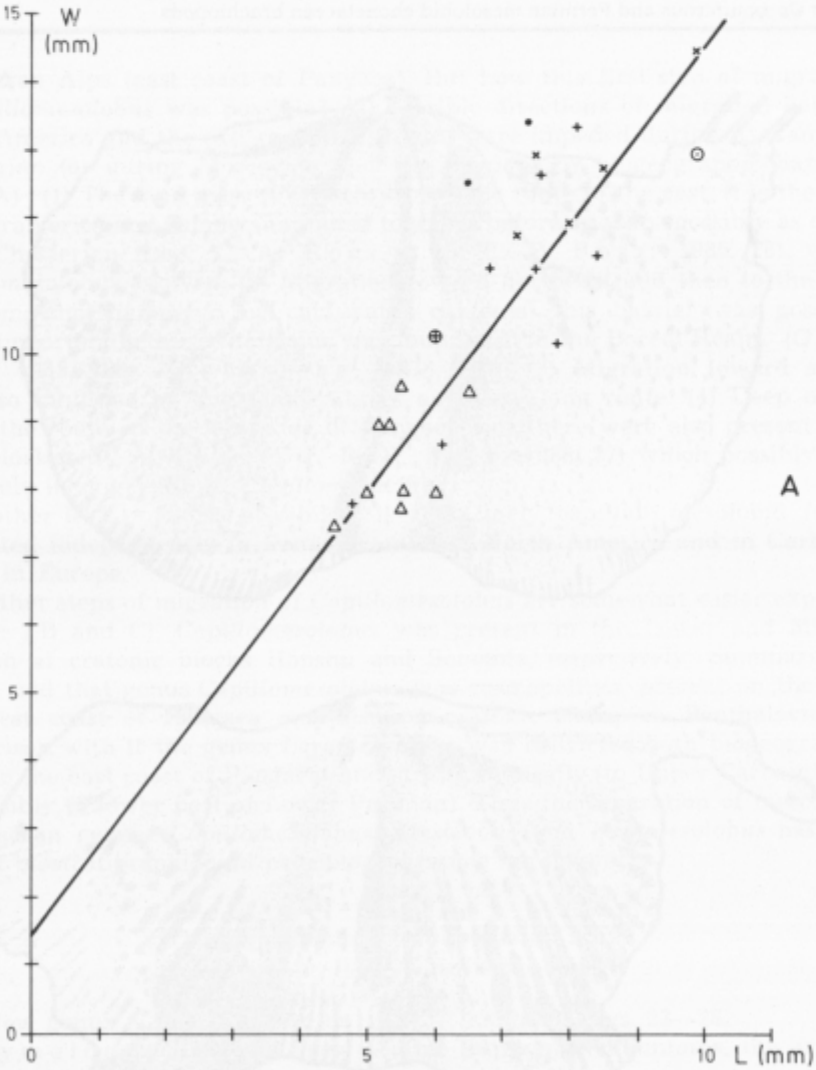



Fig. 8. *Capillomesolobus karavankensis* n. gen., n. sp.
*A* pedicle valve, mould of interior × 8. 1, TMJ 1274, locality 1, Karavanke Mountains, Gzhelian; *B* brachial valve, mould of interior × 8. 2, TMJ 1224/1, locality 2, Karavanke Mountains, Gzhelian

Sl. 8. *Capillomesolobus karavankensis* n. gen, n. sp.
*A* pecljeva lupina, odtis notranjosti × 8. 1, TMJ 1274, najdišče 1, Karavanke, gželij; *B* ramenska lupina, odtis notranjosti × 8. 2, TMJ 1224/1, najdišče 2, Karavanke, gželij




× *Capillomesolobus karavankensis* n. gen., n. sp., locality 1

• *Capillomesolobus karavankensis* n. gen., n. sp., locality 2

⊙ *Capillomesolobus karavankensis* n. gen., n. sp., locality 3

△ *Capillomesolobus pontebbanus* n. gen., n. sp., locality 6

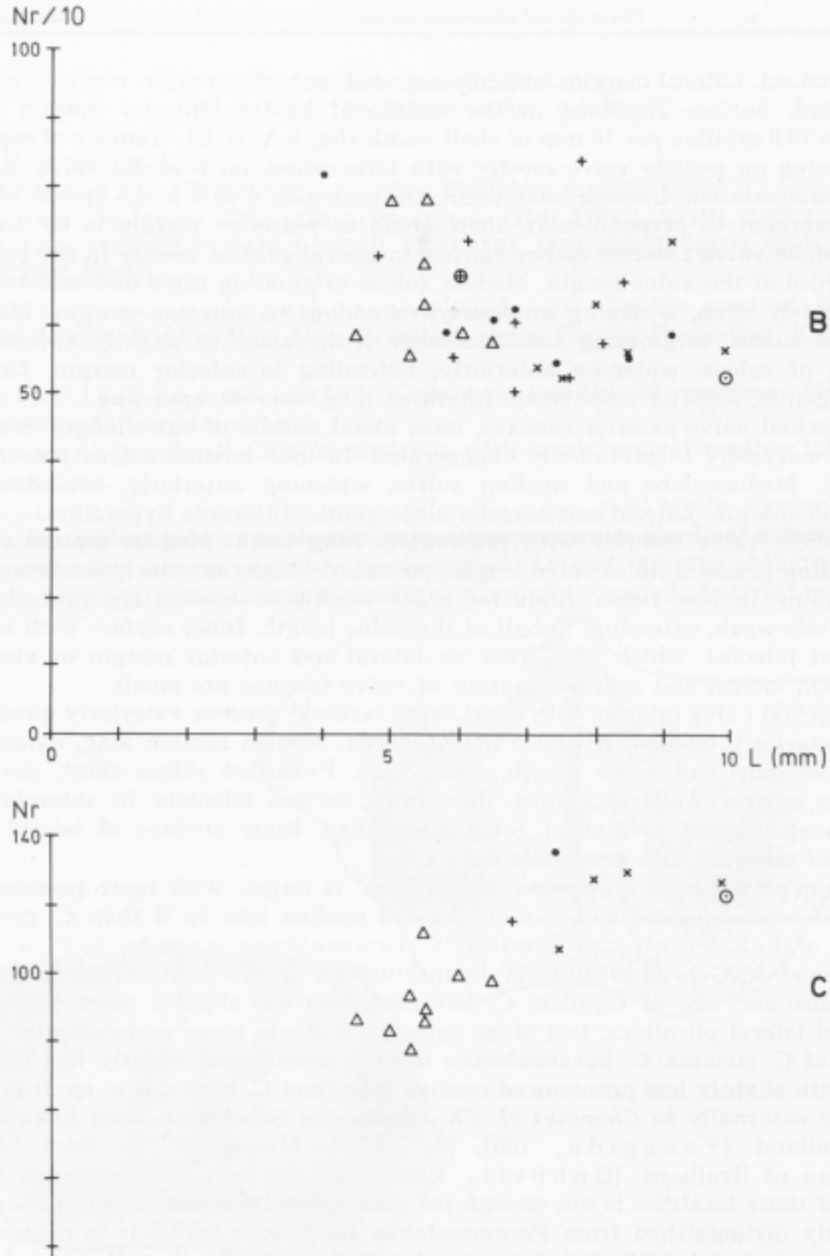
\+ *Capillomesolobus heritschi* n. gen., n. sp., locality 5 (pink reef limestone)

⊕ *Capillomesolobus heritschi* n. gen., n. sp., locality 5 (unit C)

Fig. 9. Diagrams of the genus *Capillomesolobus*

*A* length against maximal width; *B* length against number of ribs on 10 mm of width at ventral anterior margin; *C* length against total number of ribs at ventral anterior margin

At A the regression line for (+) is $W = 1.49 + 1.31\,L$, $r = +0.82$, $P < 0{,}02$




Sl. 9. Diagrami rodu *Capillomesolobus*

*A* dolžina proti največji širini; *B* dolžina proti številu reber na 10 mm širine sprednjega robu pecljeve lupine; *C* dolžina proti celotnemu številu reber sprednjega robu pecljeve lupine

Pri A je regresijska premica za (+) $W = 1.49 + 1.31\,L$, $r = +0.82$, $P < 0.02$

pronounced. Lateral margins oblique, rounded, anterior margin medialy widely indented. Surface capillate, in the middle of ventral anterior margin from 52.8 to 73.0 capillae per 10 mm of shell width (fig. 9 A, B, C). Number of capillae increasing on pedicle valve mostly with bifurcation, on brachial valve mostly with intercalation. Growth lines weak. On each side 4 to 5 hinge spines, which are divergent to perpendicular, their angle to posterior margin is 65° to 90°.

Pedicle valve exterior rather convex in lateral profile, mostly in the prosterior third of the valve length. Median sulcus originating after umbonal region, moderately deep, widening anteriorly, extending to anterior margin. Median fold in sulcus, originating simultaneously with sulcus or slightly anterior to origin of sulcus, widening anteriorly, extending to anterior margin. Lateral slope gentle, anterior slope steep. Interarea long, narrow, apsacline.

Brachial valve exterior concave, most about middle of valve length. Median lobe moderately to profoundly exaggerated. In lobe median sulcus present or absent. Median lobe and median sulcus widening anteriorly, extending to anterior margin. Lateral and anterior slope gentle. Interarea hypercline.

Pedicle valve interior with moderately long teeth. Median septum short, extending to one sixth of valve length, posteriorly high, anteriorly lowering and continuing in low ridge. Adductor scars weakly to moderately pronounced. Diductors weak, extending to half of the valve length. Inner surface with radial rows of taleolae, which are larger on lateral and anterior margin of visceral area. On lateral and anterior margin of valve taleolae are small.

Brachial valve interior with short, wide cardinal process, exteriorly quadrilobed, interiorly bilobed. Alveolus not observed. Median septum long, extending to three fourth of valve length, wide, high. Prosocket ridges short, narrow, sockets narrow. Anderidia short, thin. Inner surface taleolate, in anterolateral region of visceral area short rows of papillae. Inner surface of lateral and anterior margins with small taleolae.

C o m p a r i s o n : *C. karavankensis* n. sp. is larger, with more pronounced ventral median sulcus and more expressed median lobe in it than *C. pontebbanus* n. sp. Exteriorly and interiorly *C. karavankensis* is similar to *C. striatus* (Weller et McGehee, 1933) from Pennsylvanian of North America, including shell size and size of capillae; *C. karavankensis* has slightly more expressed ventral lateral plications, less hinge spines, which are more perpendicular than those of *C. striatus*. *C. karavankensis* is very similar but slightly less convex and with slightly less pronounced median lobe than *C. heritschi* n. sp. It is also similar externally to *Chonetes* cf. *Ch. latesinuata* Schellwien from Sakmarian of Thailand (Y a n a g i d a , 1967, 86) and to *Mesolobus?* sp. from Lower Permian of Svalbard (G o b b e t t , 1963, 120), but only one specimen from each of those localities is not enough for efficient comparison. *C. karavankensis* is easily distinguished from *Paramesolobus* sp. 2 with which it is present in the same beds (pl. 1.24); it is larger and with coarser ribs than *Paramesolobus* sp. 2.

O c c u r r e n c e : Karavanke Mountains, Gzhelian.

*Capillomesolobus pontebbanus* n. sp.
Pl. 2.1—2.25; fig. 9 A, B C; fig. 10 A, B

1986 Pecar, p. 137.

Etymology: *Pontebbanus* — after Pontebba, nearby town.

Types: Holotype GPU 1778/1. Paratypes: GPU 1779/1, KGPL 5403/1, GPU 1777/1, 1782, 1783, KGPL 5416/1, 5420/1, GPU 1781, 1784, KGPL 5402/2, GPU 1785, 1786, KGPL 5422/1.

Type locality, type horizon and age: To the west of Monte Corona (locality 6,), Carnian Alps. Brownish shale, Corona Formation. Kasimovian.

Localities and material: Only type locality, 79 specimens (46 pedicle valves, 33 brachial valves).

Diagnosis: Small *Capillomesolobus* with weak ventral median lobe in median sulcus.

Description: Small for genus, subrectangular, shell width greater than length, the widest part at or shortly before hinge margin. Cardinal extremities from moderately obtuse-angled to acute-angled. Lateral margins oblique, moderately rounded, anterolateral extremities narrowly rounded. Anterior margin

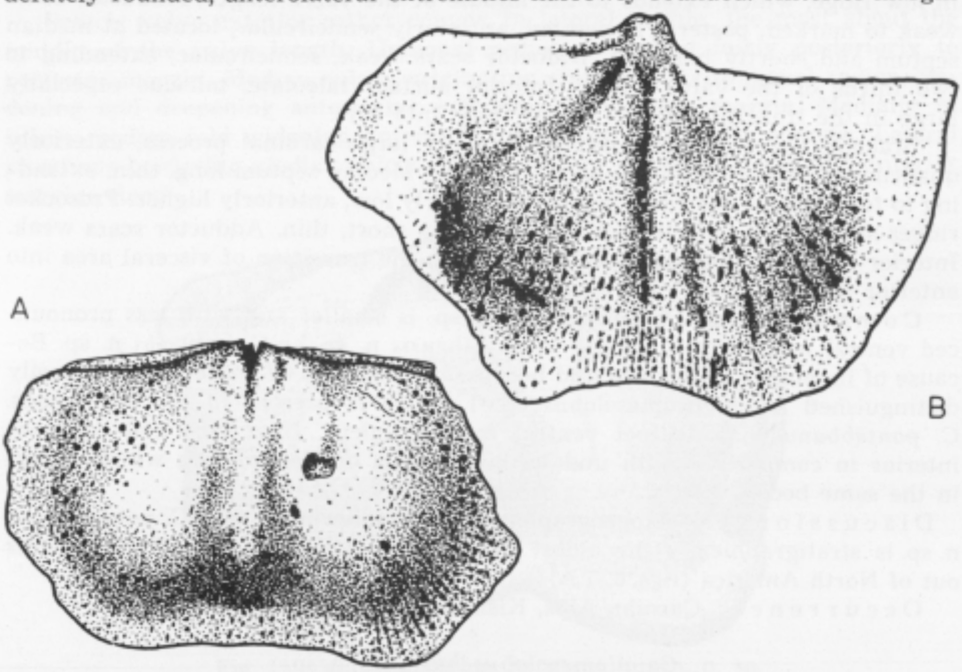



Fig. 10. *Capillomesolobus pontebbanus* n. gen., n. sp.
*A* pedicle valve, mould of interior × 9.0, GPU 1779/1, locality 6, Carnian Alps, Corona Formation, Kasimovian; *B* brachial valve, mould of interior × 8.9, GPU 1785, the same locality as for *A*

Sl. 10. *Capillomesolobus pontebbanus* n. gen., n. sp.
*A* pecljeva lupina, odtis notranjosti × 9.0, GPU 1779/1, najdišče 6, Karnijske Alpe, formacija Corona, kasimovij; *B* ramenska lupina, odtis notranjosti × 8.9, GPU 1785, isto najdišče kot pri *A*

medially indented. Surface capillate, the number of capillae in the middle of anterior margin of pedicle valve from 55.9 to 79.2 on 10 mm of valve width. On ventral valve capillae increasing in number mostly with bifurcation, on dorsal valve mostly with intercalation. Growth lines weak. Hinge spines at least four on each side, divergent, near right-angled.

Pedicle valve exterior markedly convex in lateral profile, mostly in anterior half of shell length. In anterior profile narrowly convex, most in the middle third of valve width. Umbonal slope steep. Wide, shallow median sulcus originating at about second fifth of shell length, widening anteriorly. In sulcus median lobe present or absent, widening anteriorly, extending to anterior margin. Flanks bounding sulcus forming divergent plications. Lateral slope steep, anterior slope gentle. Interarea long, narrow, anacline to orthocline.

Brachial valve exterior rather concave, mostly on the border between posterior and middle third of valve length. More or less expressed median lobe, widening anteriorly, medially in lobe, sulcus present or absent. Anterior and lateral slope moderately steep. Interarea long, orthocline.

Pedicle valve interior with little hinge teeths. Median septum short, extending to one fifth of valve length, narrow, high, continuing anteriorly sometimes in low ridge, which extends to the middle of the valve length. Adductor scars weak to marked, posteriorly pointed, anteriorly semicircular, located at median septum and shortly before it. Diductor scars weak, semicircular, extending to two thirds of the valve length. Interior surface taleolate, taleolae especially large in the transition of the lateral slope into ears.

Brachial valve interior with moderatelly large cardinal process, exteriorly quadrilobed. Alveolus small, conical, shallow. Median septum long, thin, extending to four fifth of the valve length, posteriorly low, anteriorly higher. Prosocket ridges short, thin, sockets shallow. Anderidia short, thin. Adductor scars weak. Interior taleolate, taleolae especially large in the transition of visceral area into anterior margin.

Comparision: *C. pontebbanus* n. sp. is smaller and with less pronounced ventral median lobe than *C. karavankensis* n. sp. or *C. heritschi* n. sp. Because of its much smaller size and because of finer ribs *C. pontebbanus* is easily distinguished from *Paramesolobus* sp. 1 which is present in the same beds. *C. pontebbanus* has distinct ventral median sulcus, finer ribs and different interior in comparison with undescribed species of *Neochonetes* which occurs in the same beds.

Discussion: Paleobiogeographically it is noteworthy that *C. pontebbanus* n. sp. is stratigraphically the oldest known species of genus *Capillomesolobus* out of North America (figs. 6, 7 A).

Occurrence: Carnian Alps, Kisimovian.

*Capillomesolobus heritschi* n. sp.

Pl. 3.1—3.9; fig. 9 A, B, C; fig. 11

1900 *Chonetes sinuosa* Schellwien — Schelwien, p. 38, pl. 9, figs. 17—18.
1938 *Chonetes* n. sp. — Heritsch, p. 103, pl. 7, figs. 6—7.
1986 New genus A sp. 2 — Pecar, p. 137, 138, pl. 1, figs. 29—32.

Etymology: In honor of Austrian geologist Franz Heritsch who recognized this form as new species.

T y p e s : Holotype: KGPL 5358. Paratypes: KGPL 5423, 5424, 5357, 5425.

T y p e l o c a l i t y , t y p e h o r i z o n a n d a g e : Dolžanova soteska (locality 5), Karavanke Mountains. Secondary occurrence of reddish reef limestone, Trogkofel Limestone. Sakmarian or Artinskian.

L o c a l i t i e s a n d m a t e r i a l : Secondary occurrence (the rubbel of the abandoned quarry) of reddish reef limestone in type locality, 18 specimens (5 conjoined valves, 7 pedicle valves, 6 brachial valves). Unit A in locality 5, 1 specimen (pedicle valve). Unit C between two successions of reddish reef limestone in locality 5, 4 specimens (1 conjoined valve, 3 brachial valves).

D i a g n o s i s : Medium size *Capillomesolobus* with well developed, posteriorly extending umbonal region and with pronounced ventral lateral plications.

D e s c r i p t i o n : Medium size for genus, subtrapezoidal to subrectangular shell width greater than length, hinge usually the widest part. Cardinal extremities rectangular to slightly acute-angled, ears not marked. Lateral margins oblique, anterior margin widely indented. Surface capillate, in the middle part of the ventral anterior margin from 50.7 to 84.7 capillae per 10 mm of shell width. In posterolateral regions of brachial valve the lateral parts of capillae turned posteriorly. Hinge spines divergent, their angle to posterior margin is 75° to 85°.

Pedicle valve exterior rather convex in lateral profile, the most about the middle of the valve length. Umbonal region extending fairly posteriorly to posterior margin. Median sulcus originating shortly after umbonal region, widening and deepening anteriorly, extending to anterior margin. Medially in sulcus median fold widening anteriorly, extending to anterior margin. Lateral plications bordering median sulcus rather acutely formed. Lateral and anterior margins steep.

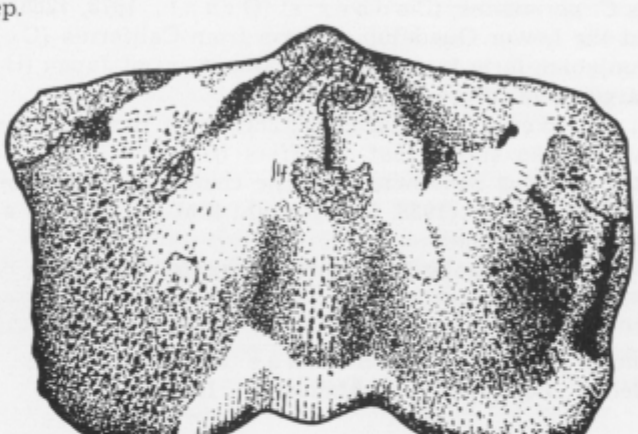


Fig. 11. *Capillomesolobus heritschi* n. gen, n. sp.
Pedicle valve, mould of interior × 8.7, KGPL 5358, locality 5, rosered reef limestone, Karavanke Mountains, Trogkofel Limestone, Sakmarian or Artinskian

Sl. 11. *Capillomesolobus heritschi* n. gen., n. sp.
Pecljeva lupina, odtis notranjosti × 8.7, KGPL 5358, najdišče 5, rožnato rdeči grebenski apnenec, Karavanke, trogkofelski apnenec, sakmarij ali artinskij

Brachial valve exterior concave, most near the middle of valve length. Median fold and median sulcus within it are more or less pronounced, widening anteriorly, extending to anterior margin.

Pedicle valve interior with median septum, which is posteriorly high, anteriorly lowering, continuing to median ridge. Muscle scars weak. Visceral area excavated. Inner surface taleolate, in lateral and anterior parts of visceral area papillose, on lateral and anterior margin finely taleolate.

Brachial valve interior with short, wide cardinal process, interiorly bilobed. Median septum high. Alveolus small, shallow, conical. Prosocket ridges short. Sockets short, wide, shallow. Inner surface taleolate. Papillae in the anterolateral margin of visceral area, in the middle of each half of visceral area a group of papillae.

Other exterior and interior structures were not observed.

Comparison: *C. heritschi* n. sp. is on the average smaller, with more pronounced ventral lateral plications and with stronger umbonal region than *C. karavankensis* n. sp. In the last two mentioned features and more pronounced median fold it differs from *C. pontebbanus* n. sp. Stratigraphically interesting but inefficient is comparison with other Lower Permian forms of the genus *Capillomesolobus* which are represented with only one or a few specimens. The Asselian(?) specimen from Svalbard (Gobbett, 1963, 120) is uncompletely preserved. *C. heritschi* has a deeper median sulcus and more acutely formed lateral plications of the pedicle valve than the specimen from Sakmarian of Thailand (Yanagida, 1967, 86). Rather similar to *C. heritschi* is the form from Sakamatozawa Series (Sakmarian) of Japan (Nakamura, 1959, 205). In comparison with Middle and Upper Permian forms of genus *Capillomesolobus* the species *C. permianus* (Cooper et Grant, 1975, 1266) is similar to *C. heritschi* but the Lower Guadalupian form from California (Cogan, 1960, 291) and the Punjabian form from Kitakami Mountains of Japan (Hayasaka, 1925, 93) are larger and differently formed.

Discussion: Schellwien (1900, 38) which first described this form from Dolžanova soteska stated that it differs from the Upper Carboniferous species *Chonetes sinuosus* Schellwien. But he could not decide for erection of a new species. Heritsch (1938, 103) thought that this form is a new species but he did not name it formally.

Occurrence: Karavanke Mountains, Trogkofel Limestone, Sakmarian or Artinskian.

### Subfamily Rugosochonetinae Muir-Wood, 1962
### Genus *Paramesolobus* Afanasjeva, 1975

Type species: *Paramesolobus ivanovae* Afanasjeva, 1975.

Diagnosis (modified): Medium size, costellate to capillate Rugosochonetidae with ventral median sulcus in which median lobe is present or absent.

Comparison: This genus is larger and with coarser ribs in comparison with *Capillomesolobus* n. gen., but resembles it because of frequent presence of the median lobe in the ventral median sulcus. Genus *Chonetinella* Ramsbottom can be distinguished by the lack of the median lobe in ventral median sulcus, but the number of ribbs per unit of width can be similar.

Species assigned to genus: *Chonetes sinuosus* Schellwien, 1898, Carnian Alps, Spain?, Moscovian-Kasimovian. *Chonetes latesinuatus* Schellwien, 1892, Carnian Alps, Karavanke Mountains, Hungary, Croatia, China, Kasimovian-Gzhelian, Asselian?. *Chonetes latesinuatus miaokouensis* Chao, 1928, China, Spain, Moscovian-Kasimovian, Lower Permian?. *Chonetes moelleri carnicus* Gortani, 1905, Carnian Alps, Kasimovian. *Paramesolobus* sp. 1, Carnian Alps, Kasimovian (present paper). *Paramesolobus* sp. 2, Karavanke Mountains, Gzhelian (present paper). *Paramesolobus ivanovae* Afanasjeva, 1975, Russian Platform, Kasimovian. *Paramesolobus luganicus* Aisenverg, 1895, Donetz Basin, Kasimovian.

*Chonetes latesinuatus tsunyiensis* Huang, 1932 from the Upper Permian of China is poorly known and probably does not belong to genus *Paramesolobus*. Jing et Hu (1978, 126) assigned it to genus *Tenuichonetes* Jing et Hu. The stratigraphical distribution of the species assigned to genus *Paramesolobus* is shown on fig. 5.

Discussion: The fact that the first three known species of genus *Paramesolobus* were described from the Carnian Alps, illustrates the importance of this area for the study of genus *Paramesolobus*. These species are: *Chonetes sinuosus* (described 1892, the name was corrected 1898), *Chonetes latesinuatus* (described 1892) and *Chonetes moelleri carnicus* (described 1905). During the work for the present paper the original Schellwien's (1892) specimens here not available in the museum (Halle, German Democratic Republic) where Schellwien cited their repository. Also during the present work the type locality of *Chonetes sinuosus* in Carnian Alps (bed 6 of the Krone section) was not found. The type localities of other two species in Carnian Alps were not examinated during this work. No original or topotype specimen of *Chonetes latesinuatus* Schellwien, 1892 is available. This species was described from Spiriferenschicht near Monte Carnizza, to the west of Monte Corona. Only two specimens of *Chonetes moelleri carnicus* are now available (Gortani's collection from Monte Pizzul, partially housed in museum in Udine).

It is clear that the revision of species from the Carnian Alps will be significant for the study of *Paramesolobus*. Further field work in this area with collection of topotype material is needed. The present work reveals that at least two species of *Paramesolobus* are present in the Upper Carboniferous of Carnian Alps and Karavanke Mountains. Earlier mentioned fact preclude the definitive identification of species of *Paramesolobus* in the present paper. However, the need of completeness of presentation of mesolobid chonetacean brachiopods of the area and the need of comparation of *Paramesolobus* with *Capillomesolobus* n. gen. make the presentation of data about *Paramesolobus* necessary. The work on this genus is being continued by the author.

### *Paramesolobus* sp. 1

Pl. 3.10—3.21, 4.1—4.12; fig. 12 A, B; fig. 13 A, B, C

1986 Pecar, p. 137.

Locality and material: Locality 6, Corona Formation, Kasimovian, 203 specimens (2 conjoined valves, 124 pedicle valves, 77 brachial valves).

Description: Large for genus, subcircular, shell width greater than length, hinge widest part. Ears moderately large and nearly right-angled. Sides

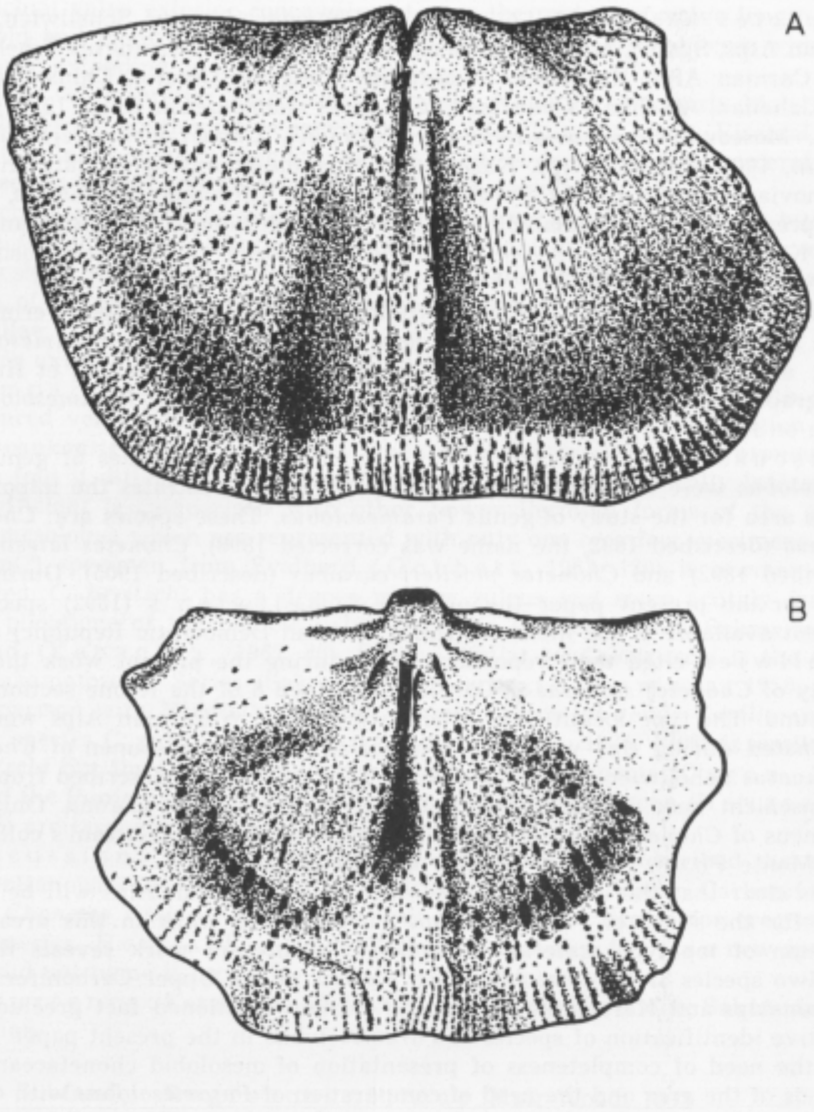



Fig. 12. *Paramesolobus* sp. 1
*A* pedicle valve, mould of interior × 5.3, GPU 1791/1, locality 6, Carnian Alps, Corona Formation, Kasimovian; *B* brachial valve, mould of interior × 5.0, KGPL 5429/1, the same locality as for *A*

Sl. 12. *Paramesolobus* sp. 1
*A* pecljeva lupina, odtis notranjosti × 5.3, GPU 1791/1, najdišče 6, Karnijske Alpe, formacija Corona, kasimovij; *B* ramenska lupina, odtis notranjosti × 5.0, KGPL 5429/1, isto najdišče kot pri *A*

oblique, concave. Anterior margin slightly medially indented. Surface capillate, capillae numbering from 29.7 to 45.2 per 10 mm at the middle of the ventral anterior margin. Number of capillae increasing predominantly with bifurcation on pedicle valve and predominantly with intercalation on brachial valve. Growth lines weak. Posterior margin with at least 5 divergent hinge spines on each side of the beak, they emerge at about 45° to the hinge.

Pedicle valve exterior in lateral profile rather convex, the most convex in posterior two thirds of the valve length. In anterior profile the valve is the most convex in the middle third of width. Umbonal region only slightly extending posteriorly to posterior margin. Median sulcus originating shortly anteriorly to umbo, shallow, widening anteriorly. In median sulcus a weak median fold is present or absent, widening anteriorly. Lateral slope more steep than anterior. Interarea long, narrow, anacline to apsacline. Pseudodeltidium was not seen.

Brachial valve exterior moderately convex, in the lateral profile the most convex on the border between the posterior and middle third of length. Shallow median fold originating slightly anterior to umbo, widening anteriorly. In median fold the median sulcus is present or absent, originating simultaneously as median fold, widening anteriorly. Anterior and lateral slope gentle. Interarea long, narrow, hypercline. Hilidium was not seen.

Pedicle valve interior with short hinge teeth. Median septum short, thin, continuing anteriorly in low median ridge, which sometimes becomes again higher and septum-like anteriorly. Two paramedian ridges can be present in the middle of the valve. Adductor scars moderately expressed. Diductor muscle scars tear-like, extending to two fifths of valve length. Visceral area pronouncedly concave. Interior surface taleolate, taleolae larger on anterolateral border of visceral area and on ears. On lateral and anterior margins taleolae small.

Brachial valve interior with small cardinal process, quadrilobed exteriorly, bilobed interiorly. Alveolus small, shallow, conical. Median septum long, extending to three fifth of valve length, thin, posteriorly low, anteriorly becoming higher and wider, then lowering again. Prosocket ridges moderately long, thin, sockets shallow. Anderidia thin. Adductor scars weak, semicircular. Inner surface taleolate, especially large taleolae in anterolateral parts of visceral area. Only scarce taleolae on ears.

Comparison: *Paramesolobus* sp. 1 is larger than *Paramesolobus* sp. 2, has finer ribs, less distinguished ventral median sulcus and less distinguished ventral median lobe in it. It is likely that *Paramesolobus* sp. 1 is the same species which Schellwien (1892, 29) described as *Chonetes lobatus* and subsequently (Schellwien, 1898, 360) corrected this name to *Chonetes sinuosus*. The lectotype or neotype for this species are not erected in the present paper because neither the original Schellvien's material non the topotype material are available (locality 6 is probably not the same as Schellwien's bed 6 of Krone section). Comparison with *Chonetes moelleri carnicus* Gortani, 1905 (two specimens are reposited in museum in Udine, one of them is figured in Gortani, 1905, pl. 14, fig. 17 a, b) shows that this species might be the same as *Paramesolobus* sp 1, but more material from Gortani's locality will be needed for efficient comparison. *Paramesolobus* sp. 1 is larger and with finer ribs than *P. ivanovae* Afanasjeva, 1975. It is smaller and with finer ribs than

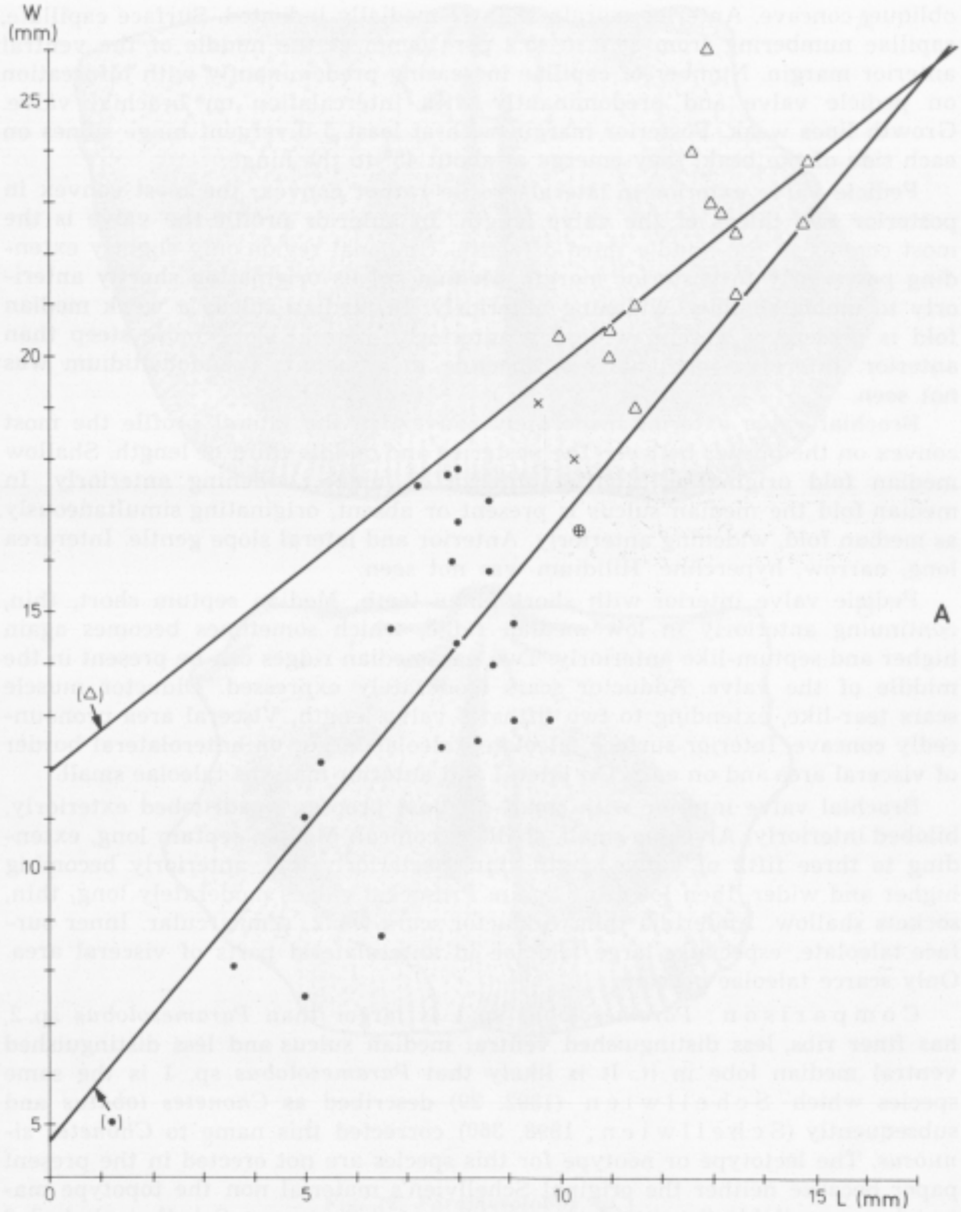
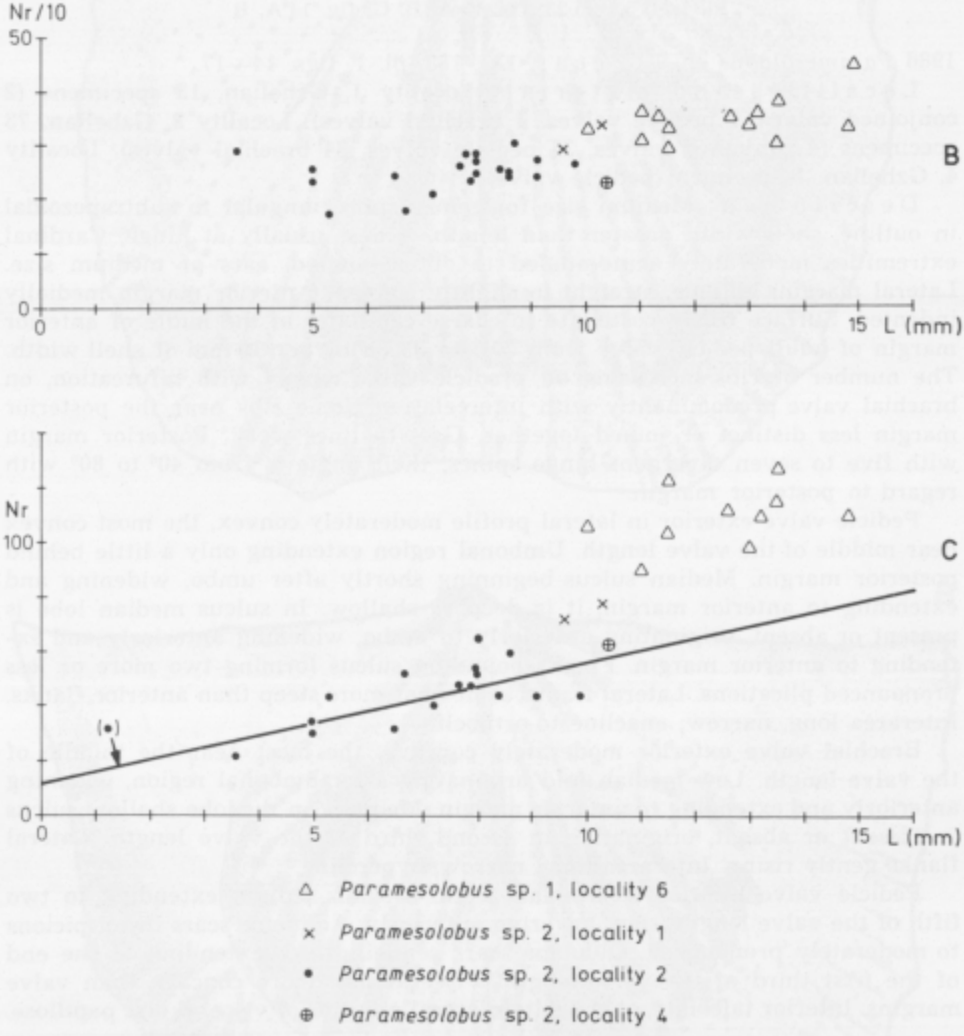



Fig. 13. Diagrams of genus *Paramesolobus*

*A* length against maximal width; *B* length against number of ribs per 10 mm of width et ventral anterior margin; *C* length against total number of ribs at ventral anterior margin

At *A* the regression line for (△) is $W = 11.97 + 0.80\,L$, $r = +0.61$, $P < 0.01$; for (•) is $W = 4.76 + 1.20\,L$, $r = +0.61$, $P < 0.01$. At *C* the regression line for (•) is $Nr = 11.61 + 4.53\,L$, $r = +0.69$, $P < 0.01$




Sl. 13. Diagrami rodu *Paramesolobus*

*A* dolžina proti največji širini; *B* dolžina proti številu reber na 10 mm širine sprednjega robu pecljeve lupine; *C* dolžina proti celotnemu številu reber sprednjega robu pecljeve lupine

Pri *A* je regresijska premica za (△) $W = 11.97 + 0.80\,L$, $r = +0.61$, $P < 0.01$; za (•) je $W = 4.76 + 1.20\,L$, $r = +0.61$, $P < 0.01$. Pri *C* je regresijska premica za (•) $Nr = 11.61 + 4.53\,L$, $r = +0.69$, $P < 0.01$

*P. luganicus* Aisenverg, 1985. It is similar to the Chinese species *Chonetes latesinuatus miaokouensis* Chao, 1928. *Paramesolobus* sp. 1 can be easily distinguished from the also mesolobid, but much smaller and more finely ribbed species *Capillomesolobus pontebbanus* n. sp. with which it is present in the same beds.

*Paramesolobus* sp. 2

Pl. 1.24, 5.1—5.23; fig. 13 A, B, C; fig. 14 A, B

1986 *Paramesolobus* sp. — Pecar, 137, 138, pl. 1, figs. 14—17.

Localities and material: Locality 1, Gzhelian, 13 specimens (2 conjoined valves, 7 pedicle valves, 4 brachial valves). Locality 2, Gzhelian, 73 specimens (4 conjoined valves, 35 pedicle valves, 34 brachial valves). Locality 4, Gzhelian, 1 specimen (pedicle valve).

Description: Medium size for genus, subrectangular to subtrapezoidal in outline, shell width greater than length, widest usually at hinge. Cardinal extremities moderately acute-angled to obtuse-angled, ears of medium size. Lateral margins oblique, straight to slightly convex. Anterior margin medially indented. Surface finely costellate to coarse capillate, in the midle of anterior margin of adult pedicle valve from 20.5 to 33.4 ribs per 10 mm of shell width. The number of ribs increasing on predicle valve mostly with bifurcation, on brachial valve predominantly with intercalation. Some ribs near the posterior margin less distinct or joined together. Growth lines weak. Posterior margin with five to seven divergent hinge spines, their angle is from 40° to 80° with regard to posterior margin.

Pedicle valve exterior in lateral profile moderately convex, the most convex near middle of the valve length. Umbonal region extending only a little behind posterior margin. Median sulcus beginning shortly after umbo, widening and extending to anterior margin, it is deep to shallow. In sulcus median lobe is present or absent, originating anteriorly to umbo, widening anteriorly and extending to anterior margin. Flanks bounding sulcus forming two more or less pronounced plications. Lateral flanks somewhat more steep than anterior flanks. Interarea long, narrow, anacline to orthocline.

Brachial valve exterior moderately concave, the most near the middle of the valve length. Low median fold originating after umbonal region, widening anteriorly and extending to anterior margin. Medially in the lobe shallow sulcus is present or absent, originating in second third of the valve length. Lateral flanks gently rising. Interarea long, narrow, hypercline.

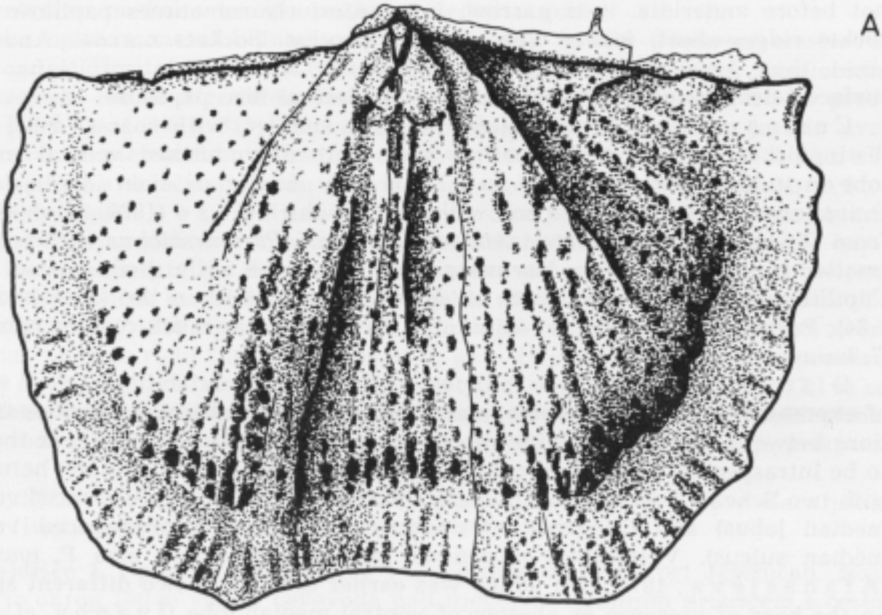
Pedicle valve interior with small teeth. Median septum extending to two fifth of the valve length, thin, lowering anteriorly. Adductor scars inconspicions to moderately pronounced. Diductor scars semielliptical, extending to the end of the first third of the valve length. Visceral disc more concave than valve margins. Interior taleolate, at the anterolateral margins of visceral disc papillose.

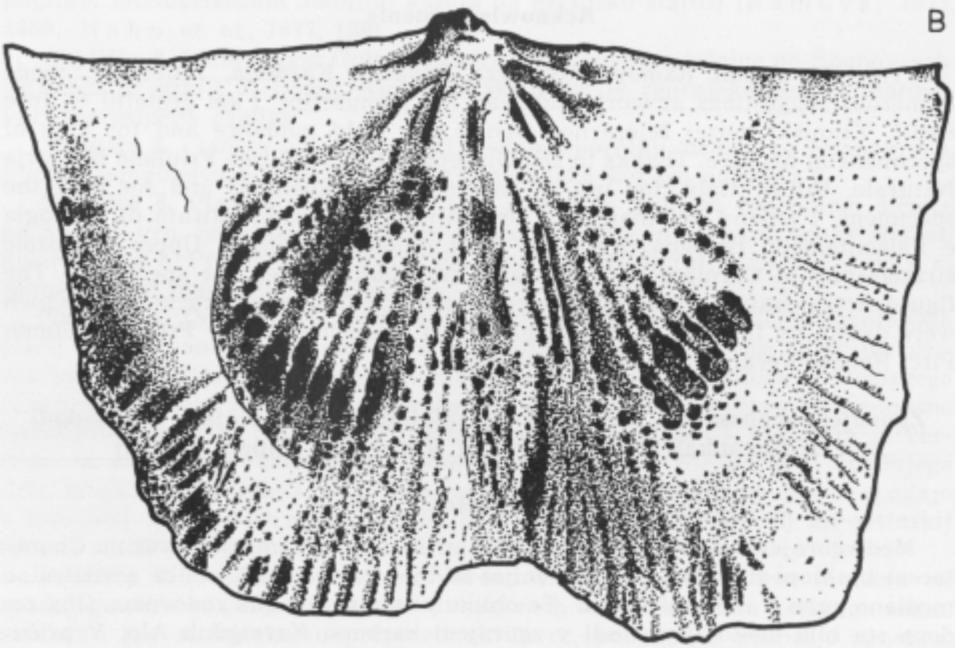
Fig. 14. *Paramesolobus* sp. 2

*A* pedicle valve, mould of interior × 8.7, TMJ 1227/1, locality 2, Karavanke Mountains, Gzhelian; *B* brachial valve, mould of interior × 8.0, TMJ 1222, the same locality as for *A*

Sl. 14. *Paramesolobus* sp. 2

*A* pecljeva lupina, odtis notranjosti × 8.7, TMJ 1227/1, najdišče 2, Karavanke, gželij; *B* ramenska lupina, odtis notranjosti × 8.0, TMJ 1222, isto najdišče kot pri *A*


A


B

Brachial valve interior with short, wide cardinal process, exteriorly quadrilobed, interiorly bilobed. Alveolus small, shallow, conical. Median septum begins not before anderidia, it is narrow, low, anteriorly sometimes papillose. Prosocket ridges short, fusing with cardinal process. Sockets narrow. Anderidia short, thin. Anterior adductors weak, posterior adductors inconspicious. Inner surface taleolate, anterolateral margins of visceral disc papillose.

Comparison: *Paramesolobus* sp. 2 is smaller, with coarser ribs, more distinguished ventral median sulcus and more distinguished ventral median lobe in it than *Paramesolobus* sp. 1. It is very similar or even identical with *P. ivanovae* Afanasjeva, 1975 and with species which Chao (1928, 22) described from China as *Chonetes latesinuatus* Schellwien. *Paramesolobus* sp. 2 is much smaller from *P. luganicus* Aisenverg, 1985. It can be easly distinguished from *Capilllomesolobus karavankensis* n. sp. which is present in the same beds (pl. 1.24); *Paramesolobus* sp. 2 is remarkably larger and has much coarser ribs than *C. karavankensis* n. sp.

Discussion: This species shows a considerable variability of shell width, of expression of ventral median sulcus and of median lobe in it. Various transitions between narrow and wide specimens exist, and this variability is thought to be intraspecific. The statements of Chao (1928, 22) were similar; he united both two Schellwien's species *Chonetes sinuosus* (species with pronounced ventral median lobus) and *Chonetes latesinuatus* (species with pronounced ventral median sulcus). Variability of ventral median lobe shows also *P. ivanovae* (Afanasjeva, 1975, 105) which was earlier divided in two different species on the base of presence or absence of ventral median lobe (Ivanov et Ivanova, 1936, 20, 22).

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## Zgornjekarbonski in permijski mezolobidni honetacejski brahiopodi v Karavankah (Jugoslavija) in Karnijskih Alpah (Italija)

### Povzetek

Med zgornjekarbonskimi in permijskimi honetacejskimi (naddružina Chonetacea) brahiopodi Karavank (Slovenija) so bile najdene tudi oblike z ventralno mediano gubo v mediani brazdi. Te oblike pripadajo dvema rodovoma. Oba rodova sta bila ugotovljena tudi v zgornjem karbonu Karnijskih Alp. V priču-

jočem delu sta morfološka izraza »mezolobidni« in »mezolobidnost« uporabljena za tiste karbonske in permijske honetacejske brahiopode, pri katerih je na sredini ventralne mediane brazde prisotna mediana guba.

Prva opisana mezolobidna honetacejska vrsta je bila *Chonetes mesolobus* Norwood et Pratten, 1855, iz Pennsylvanije ZDA. Prvi izključno mezolobidni honetacejski rod je *Mesolobus* Dunbar et Condra, 1932. Ta rod je bil po predlogu Hoarea (1964, 315) pripoznan kot tipsko gladek. Smotrno je bilo uvrstiti rebraste mezolobidne honetaceje v drug rod, kar je napravila Afanasjeva (1975) z določitvijo rodu *Paramesolobus* Afanasjeva. Po mnenju Afanasjeve spadajo v ta rod tudi severnoameriške pennsylvanijske mezolobidne oblike. Nadaljno delitev rebrastih mezolobidnih honetacijskih oblik pa je omogočil material iz gželija Karavank, v katerem sta v istih plasteh ugotovljeni dve jasno različni mezolobidni rebrasti obliki. Ena od teh je rod *Paramesolobus* Afanasjeva, 1975. Druga oblika, ki je manjša in z znatno drobnejšimi rebri od prve, pripada rodu *Capillomesolobus* n. gen. Ti podatki kažejo na vzporeden razvoj dveh rebrastih mezolobidnih honetacijskih vej (Pecar, 1986, 137), ki se med seboj razlikujeta ne le na nivoju rodu, temveč verjetno tudi poddružine. Potek rodovne opredelitve mezolobidnih honetacijskih brahiopodov je prikazan na sl. 1.

Najdišča 1 do 5 so v Karavankah (Jugoslavija), najdišče 6 je v Karnijskih Alpah (Italija; sl. 2, 3).

**Najdišče 1.** Spodnja počivala. Je v Javorniškem rovtu pri Jesenicah. Najdišče je okrog 100 m vzdolž cevovoda nad njegovim spodnjim križiščem s cesto. V temnem skrilavcu je bogata morska nevretenčarska favna. V vmesnih lapornih plasteh najdeni *Rugosofusulina alpina antiqua* (Schellwien) in *Archaeolithophyllum missouriensum* Johnson kažeta na gželijsko starost (Ramovš, 1971, 1389; Hahn et. al., 1977, 138).

**Najdišče 2.** Planina pod Golico. Pri tretjem oporniku žičnice na Španov vrh. Najdišče je odkril J. Bedič. Rjavkasti skrilavec je zgornjekarbonske starosti, verjetno pripada gželiju.

**Najdišče 3.** Planina pod Golico. Pri petem oporniku žičnice na Španov vrh. Starost temno sivega skrilavca je verjetno enaka kot pri najdišču 2.

**Najdišče 4.** Planina pod Golico. Med šestim in sedmim opornikom žičnice na Španov vrh. Sekundarno najdišče enake litologije in verjetno enake starosti kot najdišče 3. Pripomniti je treba, da podrobna stratigrafija najdišč 1 do 4 ni znana, ker so plasti slabo razgaljene.

**Najdišče 5.** Dolžanova soteska nad Tržičem. Klasično najdišče trogkofelskih plasti v Karavankah, v opuščenem kamnolomu 100 m severno od druge serpentine nad cestnim predorom. Gmota rdečkastega in sivkastega grebenskega apnenca z bogato morsko nevretenčarsko favno je v tem času preliminarno imenovana enota B. Nad njo je plastnati apnenec (enota C), nad njim je verjetno še ena enota rdečkastega grebenskega apnenca. Stratigrafija spodnjega dela trogkofelskih plasti je prikazana na sl. 4. Trogkofelske plasti spadajo v sakmarij (Waterhouse, 1976, 82; Leven, 1980, tab. 3) ali artinskij (Buser, 1979, 20).

**Najdišče 6.** Zahodno od Monte Corona (= Krone). Je 200 m zahodno od spodnjega dela te gore, v nekoliko dvignjenem zahodnem delu gorskega sedla. Litološko gre za rjavkasti, prepereli skrilavec, ponekod s primesjo apnenca.

Najdišče pripada formaciji Corona, starostno gre za kasimovij (V e n t u r i n i et al., 1982, 311).

V diagramih so uporabljene naslednje okrajšave: L = dolžina pecljeve lupine, W = največja širina lupine, Nr 10 = število reber sprednjega robu pecljeve lupine. V nadaljevanju sledi opis novih nadvrstnih taksonov.

**Sistematska paleontologija**

Družina R u g o s o c h o n e t i d a e Muir-Wood, 1962

Capillomesolobinae n. subfam.

D i a g n o z a : Male, kapilatne ali gladke Rugosochonetidae z ventralno mediano brazdo, v kateri je mediana guba prisotna ali odsotna.

R o d o v n i s e s t a v p o d d r u ž i n e : *Capillomesolobus* n. gen. *Mesolobus* Dunbar et Condra, 1932. ?*Tenuichonetes* Jing et Hu, 1978. Novi, neopisani rod, tipiziran z *Neochonetes unbonoplicatus*, upodobljen v B a r k h a t o v i , 1964, iz sakmarijskih plasti Nenets, reka Sula, Severno timansko gorovje (A r c h - b o l d 1982, 2), morda tudi pripada tej poddružini.

R a z p r a v l j a n j e i n f i l o g e n e z a : Capillomesolobinae n. subfam, se razlikuje od ostalih poddružin družine Rugosochonetidae po običajni prisotnosti ventralne mediane gube v ventralni mediani brazdi. Rodovi *Capillomesolobus, Mesolobus* in *Tenuichonetes* so po pričujoči shemi v sorodstvenem odnosu, pri čemer je izhodiščni rod *Capillomesolobus* (sl. 5). Stratigrafsko porazdelitev vrst nove poddružine Capillomesolobinae in rodu *Paramesolobus* je prikazana na sl. 6.

*Capillomesolobus* n. gen.

1986 New genus A — P e c a r , p. 137

T i p s k a v r s t a : *Capillomesolobus karavankensis* n. sp.

E t i m o l o g i j a : Capillus (lat.) = las, zaradi kapilatne površine; mesolobus, zaradi morfološke podobnosti z rodom *Mesolobus*.

D i a g n o z a : Majhne, drobno kapilatne Rugosochonetidae z ventralno mediano brazdo, v kateri je mediana guba prisotna ali odsotna.

O p i s : Majhen, subpravokoten do subtrapezoiden, širina večja od dolžine. Sprednji rob mediano zajeden. Površina drobno kapilatna. Prirastnice šibke. Sklepne bodice divergentne, blizu pravokotnih do pravokotne. Zunanjost pecljeve lupine izbočena. Mediana brazda se navzpred širi. V njej je prisotna ali odsotna mediana guba. Zunanjost ramenske lupine vbočena, v mediani gubi prisotna ali odsotna mediana brazda.

Notranjost pecljeve lupine s kratkim septumom. Mišični odtisi šibki. Notranja površina taleolatna, taleole so večje na lateralnem in sprednjem robu visceralnega predela. Na stranskem in sprednjem robu so taleole majhne.

Notranjost ramenske lupine s kratkim, širokim sklepnim izrastkom, navzven štirirežnjatim, navznoter dvorežnjatim. Mediani septum dolg, visok. Anderidija kratka, tanka. Notranja površina taleolanta, v anterolateralnih delih visceralnega predela papilozna. Notranja površina stranskih robov in sprednjega robu z majhnimi taleolami.

P r i m e r j a v a : *Capillomesolobus* se razlikuje od rodu *Neochonetes* po globlji ventralni mediani brazdi in po običajni prisotnosti mediane gube v njej.

Po obliki je močno podoben rodu *Mesolobus*, od njega se razlikuje po rebrasti površini. *Capillomesolobus* je manjši in ima drobnejša rebra kot *Paramesolobus*.

Paleobiogeografija in migracija: Rod *Capillomesolobus* se je najverjetneje razvil iz rodu *Neochonetes* v atokiju (pennsylvanij) Severne Amerike. Tam je začasno izginil v desmoinesiju. Najstarejše znano izvenameriško nahajališče rodu *Capillomesolobus* je v Karnijskih Alpah, kjer je v kasimoviju ugotovljen *C. pontebbanus* n. sp. Domnevati je torej možno, da se je rod razvil v Severni Ameriki, torej na zahodni obali Pangee. Nato je migriral na vzhodno obalo Pangee, na področje sedanjih Karnijskih Alp in Karavank. Ta prvi del migracije rodu *Capillomesolobus* je zaradi biogeografskih barier težko pojasniti (sl. 7 A).

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## Plate 1 — Tabla 1

*Capillomesolobus karavankensis* n. gen. n. sp.

*1—11, 20, 21, 25* Locality 1, Gzhelian. *1, 2* pedicle valve, mould of exterior × 1 and × 2, paratype KGPL 5356; *3—5* pedicle valve, mould of exterior × 1 and × 2, mould of interior × 2, holotype TMJ 1274; *6—9* pedicle valve, exterior and partial mould of interior, ventral view × 1 and × 2, anterior × 2, side × 2, paratype TMJ 1219; *10, 11* pedicle valve, mould of interior, ventral × 2, side × 2, paratype TMJ 1212; *20* brachial valve, mould of exterior × 2, paratype TMJ 1282; *21* brachial valve, mould of interior × 3,5, paratype KGPL 5411; *25* cardinal process and brachial valve, mould of exterior × 7, paratype TMJ 1278

*12, 13, 18, 19, 22—24* Locality 2, Gzhelian. *12, 13* pedicle valve, mould of exterior × 1 and × 2, KGPL 5412; *18* pedicle valve, mould of interior × 2, KGPL 5414; *19* brachial valve, mould of exterior × 2, KGPL 5415; *22* brachial valve, mould of interior × 2, KGPL 5413; *23* brachial valve, mould of interior × 2, TMJ 1224/1; *24* at left lower corner brachial valve, mould of exterior of the preceding specimen × 2, TMJ 1224/1. At the upper part of 24 is *Paramesolobus* sp. 2, pedicle valve, mould of interior × 2, TMJ 1224/2

*14—17* Locality 3, Gzhelian. Pedicle valve, exterior, ventral view × 1 and × 2, posterior × 2, side × 2, TMJ 1265

*1—11, 20, 21, 25* Najdišče 1, gželij. *1, 2* pecljeva lupina, odtis notranjosti × 1 in × 2, paratip KGPL 5356; *3—5* pecljeva lupina, odtis zunanjosti × 1 in × 2, odtis notranjosti × 2, holotip TMJ 1274; *6—9* pecljeva lupina, zunanjost in delni odtis notranjosti, ventralno × 1 in × 2, sprednje × 2, stransko × 2, paratip TMJ 1219; *10, 11* pecljeva lupina, odtis notranjosti, ventralno × 2, stransko × 2, paratip TMJ 1212; *20* ramenska lupina, odtis zunanjosti × 2, paratip TMJ 1282; *21* ramenska lupina, odtis notranjosti × 3,5, paratip KGPL 5411; *25* sklepni izrastek in ramenska lupina, odtis zunanjosti × 7, paratip TMJ 1278

*12, 13, 18, 19, 22—24* Najdišče 2, gželij. *12, 13* pecljeva lupina, odtis zunanjosti × 1 in × 2, KGPL 5412; *18* pecljeva lupina, odtis notranjosti × 2, KGPL 5414; *19* ramenska lupina, odtis zunanjosti × 2, KGPL 5415; *22* ramenska lupina, odtis notranjosti × 2, KGPL 5413; *23* ramenska lupina, odtis notranjosti × 2, TMJ 1224/1; *24* v levem spodnjem kotu ramenska lupina, odtis zunanjosti predhodnega primerka × 2, TMJ 1224/1. V levem zgornjem kotu 24 je *Paramesolobus* sp. 2, pecljeva lupina, odtis notranjosti × 2, TMJ 1224/2

*14—17* Najdišče 3, gželij. Pecljeva lupina, zunanjost, ventralno × 1 in × 2, zadajšnje × 2, stransko × 2, TMJ 1265

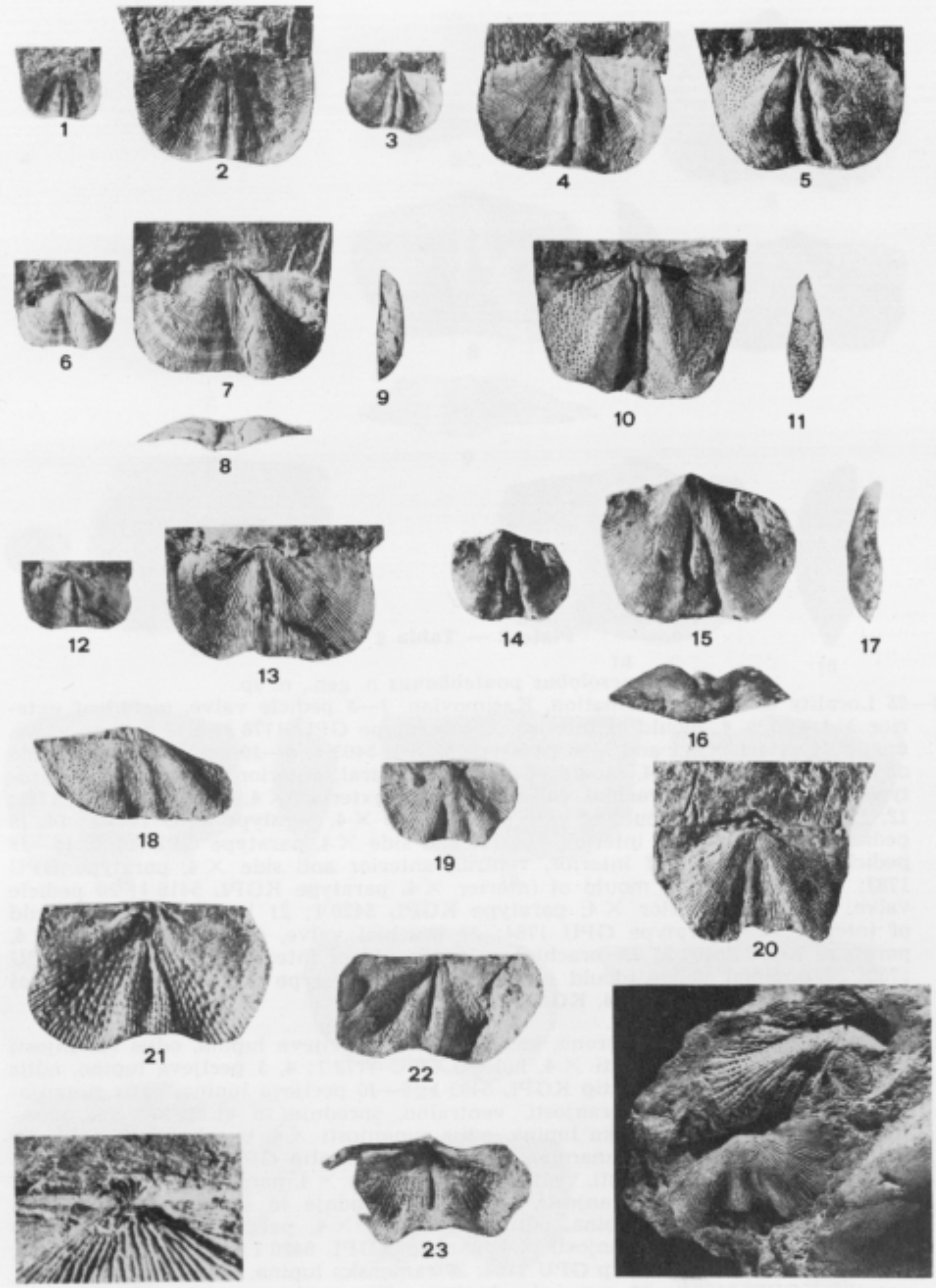
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**Plate 2 — Tabla 2**

*Capillomesolobus pontebbanus* n. gen., n. sp.

*1—25* Locality 6, Corona Formation, Kasimovian. *1—3* pedicle valve, mould of exterior × 1 and × 4, mould of interior × 4, holotype GPU 1778/1; *4, 5* pedicle valve, mould of exterior × 1 and × 4, paratype KGPL 5403/1; *6—10* pedicle valve, mould of exterior × 1 and × 4, mould of interior, ventral, anterior and side × 4, paratype GPU 1779/1; *11* brachial valve, mould of exterior × 4, paratype GPU 1781; *12, 13* pedicle valve, mould of exterior × 1 and × 4, paratype GPU 1777/1; *14, 15* pedicle valve, mould of interior, ventral and side × 4, paratype GPU 1782; *16—18* pedicle valve, mould of interior, ventral, anterior and side × 4, paratype GPU 1783; *19* pedicle valve, mould of interior × 4, paratype KGPL 5416/1; *20* pedicle valve, mould of interior × 4, paratype KGPL 5420/1; *21* brachial valve, mould of interior × 4, paratype GPU 1784; *22* brachial valve, mould of interior × 4, paratype KGPL 5402/2; *23* brachial valve, mould of interior × 4, paratype GPU 1785; *24* brachial valve, mould of interior × 4, paratype GPU 1786; *25* brachial valve, mould of interior × 4, KGPL 5422/1

*1—25* Najdišče 6, formacija Corona, kasimovij. *1—3* pecljeva lupina, odtis zunanjosti × 1 in × 4, odtis notranjosti × 4, holotip GPU 1778/1; *4, 5* pecljeva lupina, odtis zunanjosti × 1 in × 2, paratip KGPL 5403/1; *6—10* pecljeva lupina, odtis zunanjosti × 1 in × 4, odtis notranjosti, ventralno, sprednje in stransko × 4, paratip GPU 1779/1; *11* ramenska lupina, odtis zunanjosti × 4, paratip GPU 1781; *12, 13* pecljeva lupina, odtis zunanjosti × 1 in × 4, paratip GPU 1777/1; *14, 15* pecljeva lupina, odtis notranjosti, ventralno in stransko × 4, paratip GPU 1782; *16—18* pecljeva lupina, odtis notranjosti, ventralno, sprednje in stransko × 4, paratip GPU 1783; *19* pecljeva lupina, odtis notranjosti × 4, paratip KGPL 5416/1; *20* pecljeva lupina, odtis notranjosti × 4, paratip KGPL 5420/1; *21* ramenska lupina, odtis notranjosti × 4, paratip GPU 1784; *22* ramenska lupina, odtis notranjosti × 4, paratip KGPL 5402/2; *23* ramenska lupina, odtis notranjosti × 4, paratip GPU 1785; *24* ramenska lupina, odtis notranjosti × 4, GPU 1786; *25* ramenska lupina, odtis notranjosti × 4, KGPL 5422/1

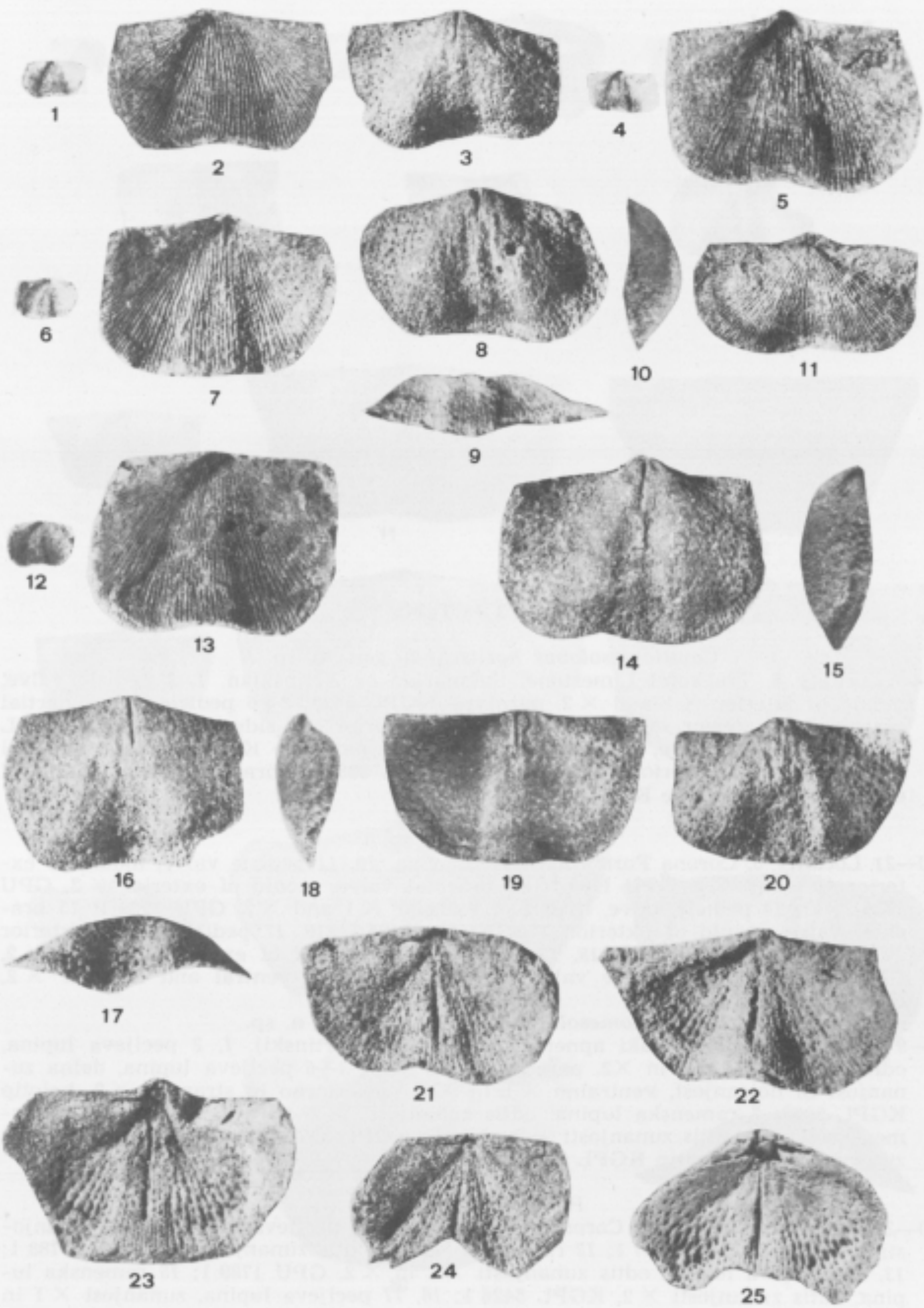
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**Plate 3 — Tabla 3**

*Capillomesolobus heritschi* n. gen., n. sp.

*1—9* Locality 5, Trogkofel Limestone, Sakmarian or Artinskian. *1, 2* pedicle valve, mould of interior × 1 and × 2, paratype KGPL 5423; *3—6* pedicle valve, partial exterior and interior, ventral × 1 and × 2, posterior and side × 2, holotype KGPL 5358; *7* brachial valve, mould of exterior × 2, paratype KGPL 5424; *8* brachial valve, mould of exterior × 2, paratype KGPL 5357; *9* brachial valve, mould of exterior × 2, paratype KGPL 5425

*Paramesolobus* sp. 1

*10—21* Locality 6, Corona Formation, Kasimovian. *10, 11* pedicle valve, mould of exterior × 1 and × 2, GPU 1787 1; *12* brachial valve, mould of exterior × 2, GPU 1788 1; *13, 14* pedicle valve, mould of exterior × 1 and × 2, GPU 1789/1; *15* brachial valve, mould of exterior × 2, KGPL 5426 1; *16, 17* pedicle valve, exterior × 1 and × 2, KGPL 5400; *18, 19* pedicle valve, mould of exterior × 1 and × 2, GPU 1775 1; *20, 21* pedicle valve, mould of interior, ventral and anterior × 2, KGPL 5427 1

*Capillomesolobus heritschi* n. gen., n. sp.

*1—9* Najdišče 5, trogkofelski apnenec, sakmarij ali artinskij. *1, 2* pecljeva lupina, odtis notranjosti × 1 in ×2, paratip KGPL 5423; *3—6* pecljeva lupina, delna zunanjost in notranjost, ventralno × 1 in × 2, posteriorno in stransko × 2, holotip KGPL 5358; *7* ramenska lupina, odtis zunanjosti × 2, paratip KGPL 5424; *8* ramenska lupina, odtis zunanjosti × 2, paratip KGPL 5357; *9* ramenska lupina, odtis zunanjosti × 2, paratip KGPL 5425

*Paramesolobus* sp. 1

*10—21* Najdišče 6, formacija Corona, kasimovij. *10, 11* pecljeva lupina, odtis zunanjosti × 1 in × 2, GPU 1787 1; *12* ramenska lupina, odtis zunanjosti × 2, GPU 1788 1; *13, 14* pecljeva lupina, odtis zunanjosti × 1 in × 2, GPU 1789 1; *15* ramenska lupina, odtis zunanjosti × 2, KGPL 5426 1; *16, 17* pecljeva lupina, zunanjost × 1 in × 2, KGPL 5400; *18, 19* pecljeva lupina, odtis zunanjosti × 1 in × 2, GPU 1775 1; *20, 21* pecljeva lupina, odtis notranjosti, ventralno in sprednje × 2, KGPL 5427 1

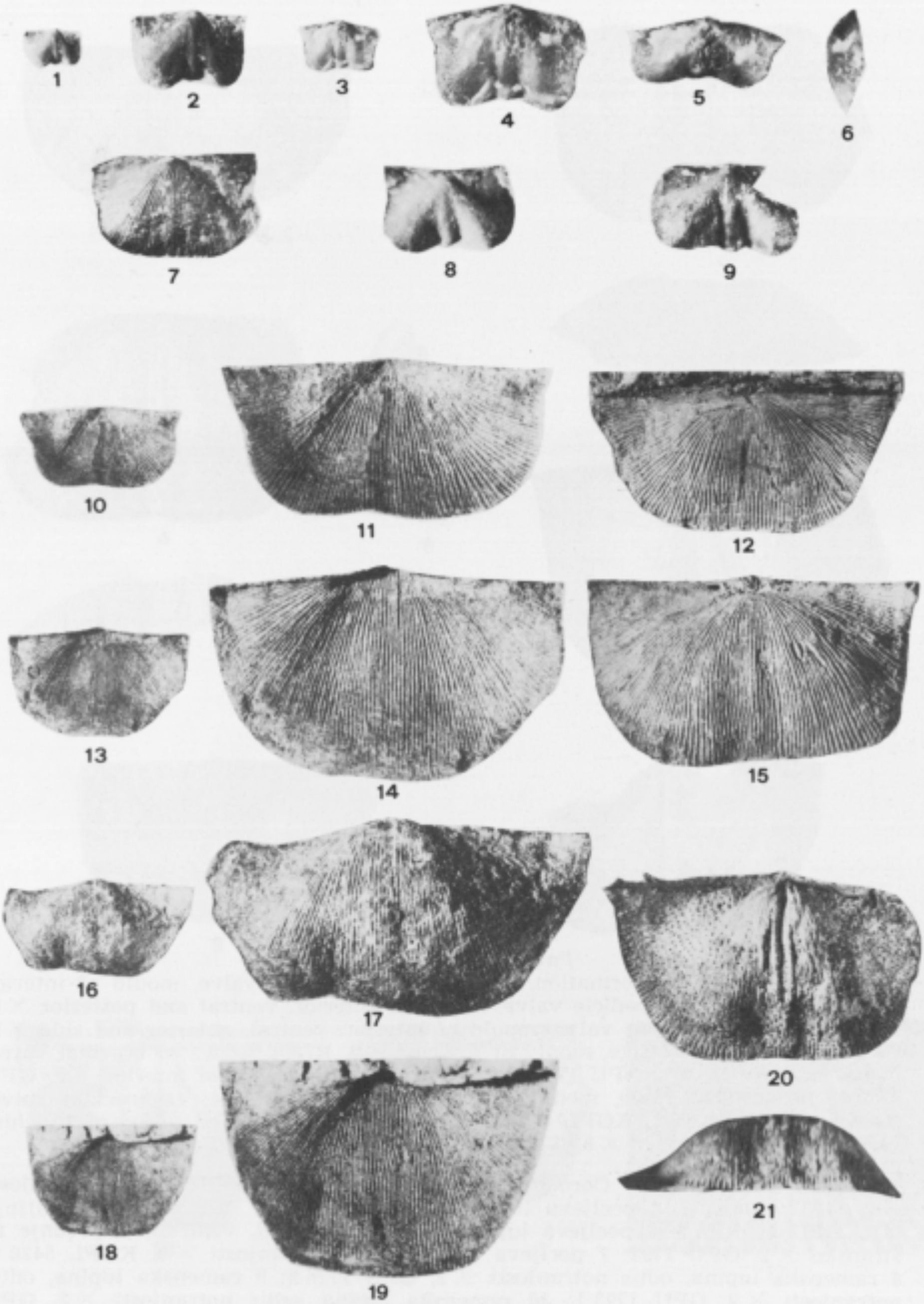
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**Plate 4 — Tabla 4**

*Paramesolobus* sp. 1

*1—12* Locality 6, Corona Formation, Kasimovian. *1* pedicle valve, mould of interior × 2, GPU 1790/1; *2, 3* pedicle valve, mould of interior, ventral and posterior × 2, GPU 1791/1; *4—6* pedicle valve, mould of interior, ventral, anterior and side × 2, GPU 1792; *7* pedicle valve, mould of interior × 2, KGPL 5428/1; *8* brachial valve, mould of interior × 2, GPU 1776/2; *9* brachial valve, mould of interior × 2, GPU 1793/1; *10* brachial valve, mould of interior × 2, GPU 1794; *11* brachial valve, mould of interior × 2, KGPL 5429/1; *12* cardinal process and umbo of brachial valve, mould of exterior × 8, GPU 1795

*1—12* Najdišče 6, formacija Corona, kasimovij. *1* pecljeva lupina, odtis notranjosti × 2, GPU 1790/1; *2, 3* pecljeva lupina, odtis notranjosti, ventralno in zadajšnje × 2, GPU 1791/1; *4—6* pecljeva lupina, odtis notranjosti, ventralno, sprednje in stransko × 2, GPU 1792; *7* pecljeva lupina, odtis notranjosti × 2, KGPL 5428/1; *8* ramenska lupina, odtis notranjosti × 2, GPU 1776/2; *9* ramenska lupina, odtis notranjosti × 2, GPU 1793/1; *10* ramenska lupina, odtis notranjosti × 2, GPU 1794; *11* ramenska lupina, odtis notranjosti, KGPL 5429/1; *12* sklepni izrastek in umbo ramenske lupine, odtis zunanjosti × 8, GPU 1795

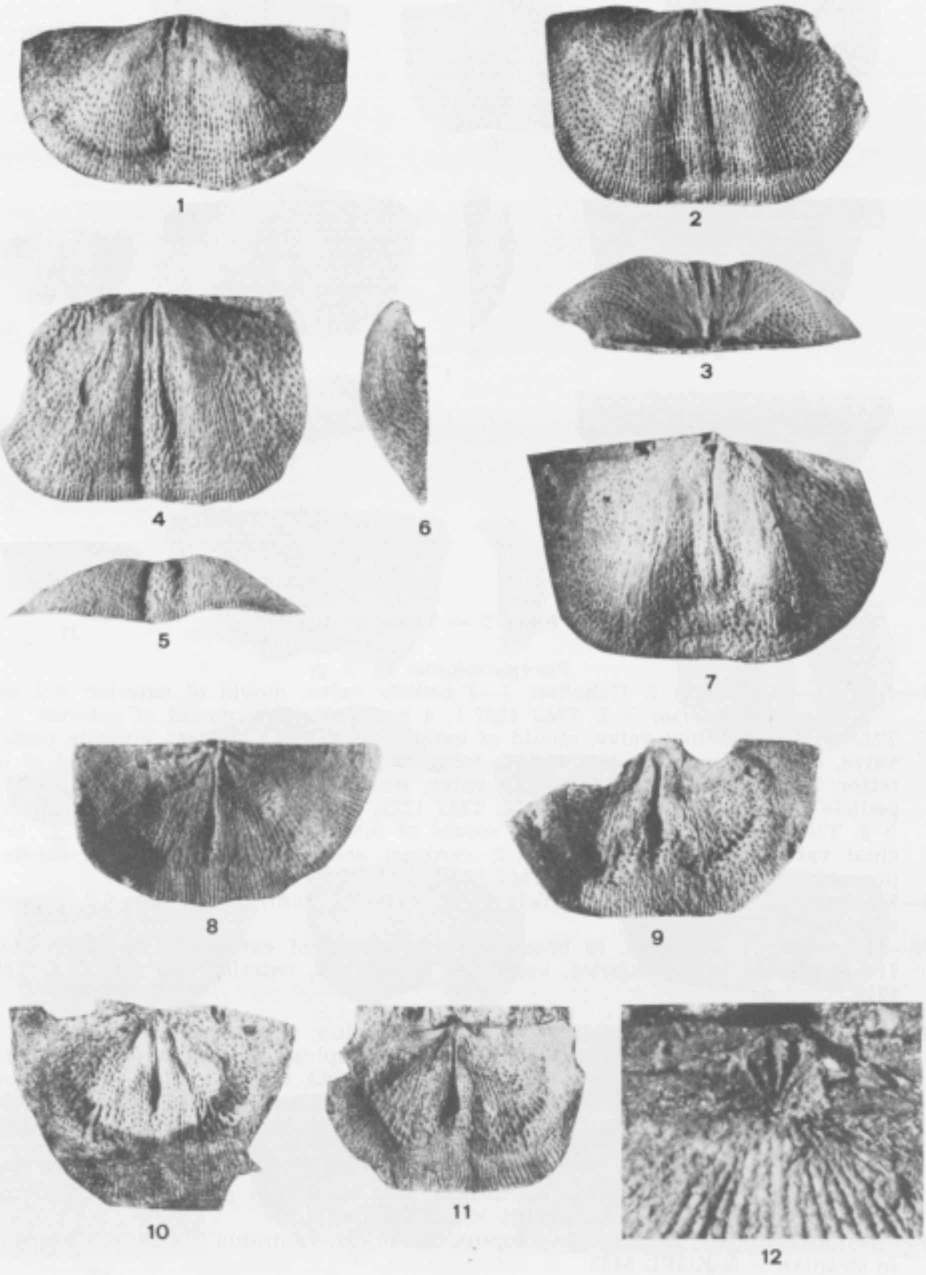
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**Plate 5 — Tabla 5**

*Paramesolobus* sp. 2

*1—4, 9, 15—23* Locality 2, Gzhelian. *1—3* pedicle valve, mould of exterior × 1 and × 2, mould of interior × 2, TMJ 1227 1; *4* brachial valve, mould of exterior × 2, TMJ 1248; *9* brachial valve, mould of exterior × 2, TMJ 1245; *15* juvenile pedicle valve, mould of interior × 2, KGPL 5430; *16* juvenile pedicle valve, mould of interior × 2, KGPL 5431; *17* pedicle valve, mould of interior × 2, TMJ 1242; *18* pedicle valve, mould of interior × 2, TMJ 1223; *19* pedicle valve, mould of interior × 2, TMJ 1252; *20* brachial valve, mould of interior × 2, TMJ 1229; *21, 22* brachial valve, mould of interior × 2, cardinal area × 8, TMJ 1222; *23* cardinal process, mould of exterior × 8, TMJ 1245

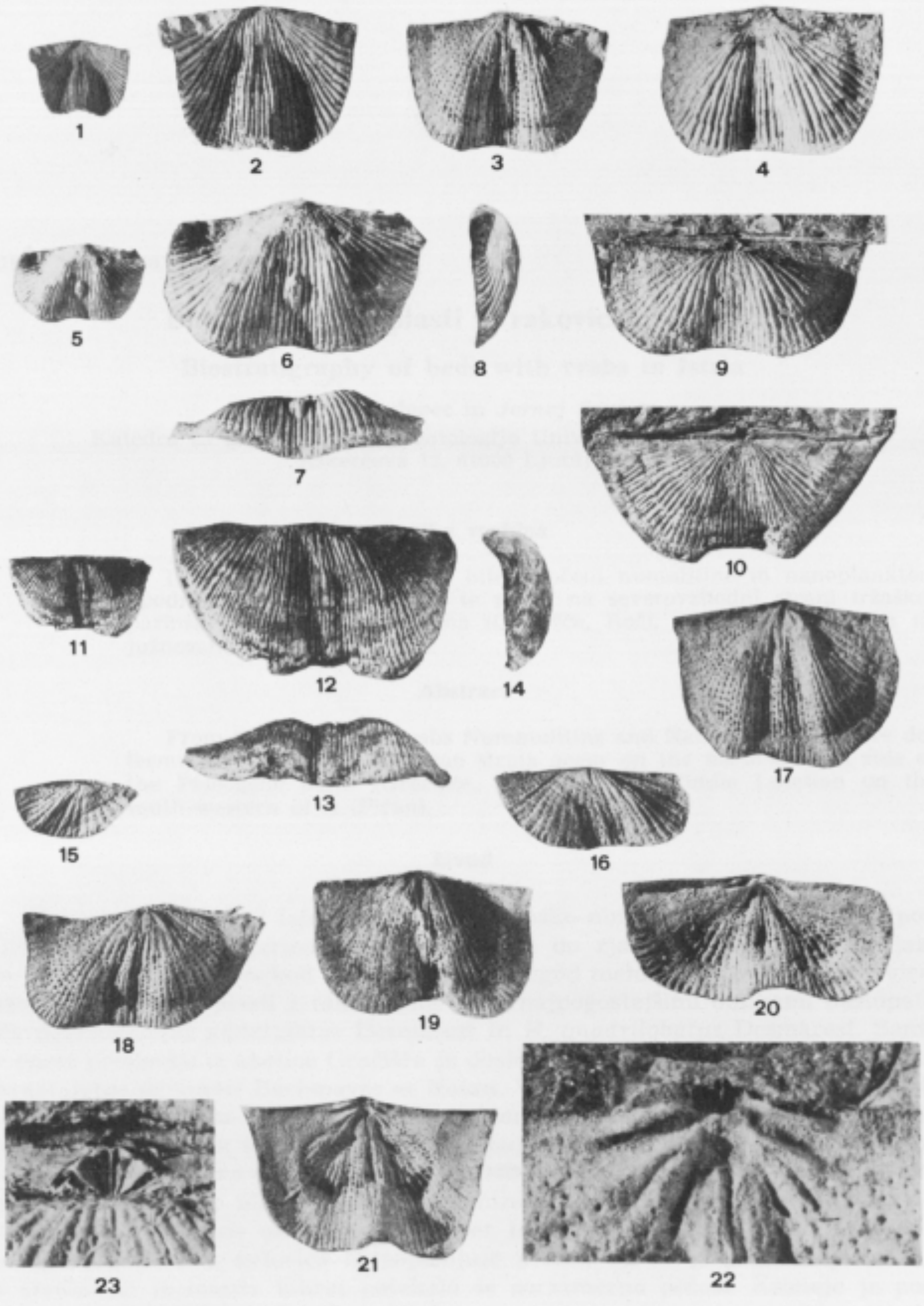
*5—8* Locality 3, Gzhelian. *5—8* pedicle valve, exterior, ventral × 1 and × 2, anterior and side × 2, KGPL 5432

*10—14* Locality 1, Gzhelian. *10* brachial valve, mould of exterior × 2, KGPL 5433; *11—14* pedicle valve, exterior, ventral × 1 and × 2, anterior and side × 2, TMJ 1214

*1—4, 9, 15—23* Najdišče 2, gželij. *1—3* pecljeva lupina, odtis zunanjosti × 1 in × 2, odtis notranjosti × 2, TMJ 1227 1; *4* ramenska lupina, odtis zunanjosti × 2, TMJ 1248; *9* ramenska lupina, odtis zunanjosti × 2, TMJ 1245; *15* mladostna pecljeva lupina, odtis notranjosti × 2, KGPL 5430; *16* mladostna pecljeva lupina, odtis notranjosti × 2, KGPL 5431; *17* pecljeva lupina, odtis notranjosti × 2, TMJ 1242; *18* pecljeva lupina, odtis notranjosti × 2, TMJ 1223; *19* pecljeva lupina, odtis notranjosti × 2, TMJ 1252; *20* ramenska lupina, odtis notranjosti × 2, TMJ 1229; *21, 22* ramenska lupina, odtis notranjosti × 2, kardinalni predel × 8, TMJ 1222; *23* sklepni izrastek, odtis zunanjosti × 8, TMJ 1245

*5—8* Najdišče 3, gželij. *5—8* pecljeva lupina, zunanjost, ventralno × 1 in × 2, sprednje in stransko × 2, KGPL 5432

*10—14* Najdišče 1, gželij. *10* ramenska lupina, odtis zunanjosti × 2, KGPL 5433; *11—14* pecljeva lupina, zunanjost, ventralno × 1 in × 2, sprednje in stransko × 2, TMJ 1214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