Mitt. Geol.-Paläont. Inst. Univ. Hamburg	Heft 83	S. 129-162	Hamburg, September 1999

Micromorph gastropoda from the Middle Devonian (Givetian) limestone of the Sötenich Syncline (Eifel)

DORIS HEIDELBERGER, Oberursel & KLAUS BANDEL, Hamburg *)

With 46 figures

Contents

Abstract 129
Zusammenfassung 129
1. Introduction 130
2. Systematic descriptions 131
Acknowledgements 158
References 158

Abstract

Micromorph gastropods of the Rhenish Middle Devonian (Scheid horizon, Cürten strata, Early Givetian) originating from the quarry „Am Wachtberg" near Sötenich (Sötenich syncline, Eifel, western Germany) belong to 12 genera, 6 of which are new, with 18 species described and figured (new genera: *Archaeosphera*, *Nerrhena*, *Urftia*, *Kallispira*, *Soetenichia*, *Sinistriconcha*; new species: *Buechelia horizontalis*, *Lukesispira frydai*, *Nerrhena reticulata*, *Urftia convexa*, *Kallispira varistriata*, *Kallispira latostriata*, *Alaskazygopleura eifelia*, *Straparollus, planiformis*, *Nodeuomphalus leunissi*, *Sinistriconcha lierli*). These species are classified according to the taxonomic concept suggested by BANDEL (1997). The protoconchs of 12 species are shown for the first time, among them the openly coiled one of Middle Devonian species of the Euomphalomorpha and of a species of the Peruneloidea.

Zusammenfassung

Aus dem Steinbruch „Am Wachtberg" bei Sötenich (Sötenicher Mulde, Eifel) werden mikromorphe Gastropoden des Rheinischen Mitteldevons (Scheid-Horizont, Cürten-Schichten, Unteres Givetium) beschrieben und abgebildet. Es handelt sich dabei um 18 Arten aus 12 Gattungen, wovon 6 Gattungen neu aufgestellt wurden (*Archaeosphera*, *Nerrhena*, *Urftia*, *Kallispira*, *Sötenichia*, *Sinistriconcha*). Die 10 neuen Arten sind (*Büchelia horizontalis*, *Lukesispira frydai*, *Nerrhena reticulata*, *Urftia convexa*, *Kallispira varistriata*, *Kallispira latostriata*, *Alaskazygopleura eifelia*, *Straparollus, planiformis*, *Nodeuomphalus leunissi*, *Sinistriconcha lierli*). Sie werden dem taxonomischen Konzept von BANDEL (1997) zugeordnet. Von 12 Arten werden erstmals Protoconche

*) Author's addresses: Prof. Dr. KLAUS BANDEL, Geologisch-Paläontologisches Institut und Museum der Universität, Bundesstrasse 55, 20146 Hamburg, Germany; DR. DORIS HEIDELBERGER, Kapellenstraße 8-10, 61440 Oberursel, Germany.

descriptions and definitions by KIRCHNER (1915) (inventory numbers therefore „KIRCHNER 1-23").

The two other localities described by KIRCHNER besides the quarry „Am Wachtberg"-„Girzenberg" and „south of Sötenich" - are nowadays no longer accessible.

S t r a t i g r a p h i c a l r a n g e : Due to the availability of numerous stratigraphical analyses, the strata occurring in the Sötenich Syncline allow an exact chronological ranging (PAULUS, 1961). Moreover, STRUVE (1963) presented a model of the facies relations which are present within the syncline. The studied material can, therefore, be placed within the „Scheid" horizon of „Cürten" strata of the early Givetian. This horizon formed next to fully marine reefoid deposits that had received the terms „Knollen-Blockriff"-Fazies or „Rübenriff" in the terminology of STRUVE (BECKER, 1969: 249; pers. communication).

Introduction to the systematic discussion

Protoconchs of different Vetigastropoda SALVINI-PLAWEN, 1980 are illustrated and, for the first time, also from Middle Devonian species belonging to the Euomphalomorpha BANDEL & FRÝDA, 1998, the Peruneloidea FRÝDA & BANDEL, 1997, and the Cycloneritimorpha BANDEL & FRÝDA, 1999.

For a critical examination of Devonian protoconchs only data regarding shape and size of the shell are available. As is usual among the early ontogenetic shells of fossils from this time, the transition from protoconch to the teleoconch and the fine structure of ornamentation on the embryonic whorls are not preserved. So a description like „smooth whorls" could sometimes hide segments of larval shell and shell portions that originally had some kind of delicate ornament which may not have been preserved.

Gastropod specimens of Devonian genera in Sötenich are in general smaller in size than related specimens from other Middle Devonian localities, both regarding teleoconchs and protoconchs. This may be due to effects of the facies, but may also be due to the shell having been transported from their actual living environment to a more quiet depositional environment, effecting only light shells. The comparison of early ontogenetic whorls demonstrates quite clearly that features of the teleoconchs alone are not sufficient to establish a systematic classification of Paleozoic gastropods. Unfortunately, the quantity of material with preserved juvenile whorls is rather small. Nevertheless, the locality „Wachtberg" appears to be the most suitable in Germany for studies concerned with the early whorls of middle Devonian gastropods, whereas records of protoconchs from other known localities like Paffrath just east of Cologne (FRÝDA, 1998) and in the southern „Rheinisches Schiefergebirge" (HEIDELBERGER 1999) of nearly the same stratigraphical range are very rare.

2. Systematic Paleontology

Class Gastropoda CUVIER, 1797

Subclass Archaeogastropoda THIELE, 1925

D i a g n o s i s : The protoconch consists of less than one whorl followed directly by the teleoconch (BANDEL, 1982).

D i s c u s s i o n : Protoconch characters, if preserved, usually allow the identification of the subclass of Paleozoic Gastropoda even though in current systematic it is mainly based on anatomical features. The subclass Archaeogastropoda consists of at least two dif-

ferent orders, the Docoglossa TROSCHEL, 1856 (= Patellogastropoda), that have not been found yet without doubt in Paleozoic times (BANDEL & GELDMACHER, 1996), and the Vetigastropoda SALVINI-PLAWEN, 1980 that are known from the early Ordovician onwards. The later order comprises probably also extinct groups like the Stylogastropoda FRÝDA & BANDEL, 1997, while the former order apparently represents the most primitive gastropods among living species (HASZPRUNAR, 1993).

Order Vetigastropoda SALVINI-PLAWEN, 1980

D e s c r i p t i o n : The shells show the protoconch of archaeogastropoda (BANDEL, 1982). At the time being it is difficult or impossible to relate Paleozoic species and genera with recent ones. Only „Selenimorph groups" (with slit and selenizone) and „Trochomorph groups" (without slit and selenizone) can here be differentiated. Modern groups are commonly based more on anatomic features than on external features of the shell (SALVINI-PLAWEN & HASZPRUNAR, 1987; HASZPRUNAR, 1988; HICKMAN & MCLEAN, 1990; PONDER & LINDBERG, 1997), so that comparison with fossils is still problematic, especially regarding Paleozoic species.

1. Selenimorpha

We follow the concept of BANDEL & FRÝDA (1996) and BANDEL & GELDMACHER (1996) summarizing gastropods with slit and selenizone, a protoconch of archaeogastropod-type, and an often nacreous inner shell layer in selenimorph groups. These are ordered in accordance with morphological aspects, but without expressed taxonomic validity as long as no certain phylogenetic relationship can be proved within separate genera.

Selenimorph group *Buechelia.*

The apex is flat, the base is conical. The selenizone lies on the adapical periphery. KNIGHT et al. (1960) placed the genus *Buechelia* to the family Raphistomidae KOKEN, 1896, subfamily Raphistominae KOKEN, 1896.

The selenimorph group *Buechelia* comprises the Ordovician *Raphistoma* HALL, 1847, which has a short slit (according to KNIGHT, 1941), the Ordovician genus *Scalites* EMMONS, 1842, and the genera *Denayella* BLODGETT & JOHNSON, 1992, and *Arizonella* STOYANOV, 1948.

Genus *Buechelia* SCHLÜTER, 1894

D i a g n o s i s : The shell is dextrally coiled and its upper surface is nearly flat or slightly raised. The periphery is sharply angular with the selenizone bordering its upper portion. The base is conical, the columella continues into a short channel, and the aperture is nearly triangular. A thick callus (inductura) covers the columellar lip that is sometimes twisted at the shell axis.

The type species *Buechelia goldfussi* SCHLÜTER, 1894 is preserved in the collection of the Geological-Palaeontological Institute and Museum, University of Bonn. A specimen with preserved selenizone was found in the collection of the „Preußische Geologische Landesanstalt" in Berlin (Nr. Gr. A 66. Nr. 5), now in the Museum of Natural Sciences in Berlin.

L o c u s t y p i c u s : Hebborn near Bergisch Gladbach.

S t r a t i g r a p h i c a l r a n g e : Middle Devonian (Givetian).

D i s c u s s i o n : The classification of *Buechelia* within the family Raphistomidae KOKEN, 1896, subfamily Raphistominae KOKEN, 1896 of the Pleurotomarioidea (KNIGHT et al., 1960) had been uncertain because neither the protoconch nor the structure of the shell were known. Its classification within the Archaeogastropoda had been probable. The preserved protoconch from Sötenich confirms this placement among the Vetigastropoda. But this new security regarding *Buechelia* and its place among the archaeogastropods provides no safety regarding the position and composition of the Raphistomidae. Here no protoconch of any other member of the family is known. The usual bad preservation of the selenizone in German species of *Buechelia* makes it difficult to compare with the Eifelian *Buechelia nodosa* BLODGETT, 1992 from Alaska (FRÝDA, 1998).

Buechelia horizontalis n. sp.

(figs. 1, 2)

H o l o t y p e : The figured specimen, coll. HEIDELBERGER, Senckenberg Museum, SMF, XII/ 3452.

D e r i v a t i o n o m i n i s : Named according to the nearly horizontal apical surface.

D i a g n o s i s : The features of the genus apply to the species. The upper surface of the shell is horizontal, and the sutures are only distinguished as narrow lines. A somewhat nodose protruding band on the upper edge of the apical surface represents the selenizone. The shell base is convex with the inner lip having a short prolongation. The umbilicus is not preserved.

D e s c r i p t i o n : The shell is small (3 mm high and 6,4 mm wide) with an oval cross-section when seen perpendicular to the axis of coiling of the shell. The spire is not elevated. Whorls are triangular in cross-section with lateral surfaces at first nearly vertical, later weakly convex. The upper surface is absolutely plane (pleural angle 180°) to slightly concave. The four recognisable whorls embrace each other and their upper diameter doubles with every new whorl. The sutures are only barely visible and there is no ornamentation preserved. The outer lip of the aperture is well rounded and little oblique, while the columellar lip is short and only little thickened. The protoconch corresponds to the archaeogastropod-type and measures 0,27 mm in diameter.

L o c a l i t y : Sötenich (2 specimens).

D i s c u s s i o n : Even though not well preserved the protoconch is unquestionably visible. A classification of the genus *Buechelia* within the Archaeogastropoda can, thus, be assured. The form of the outer lip is never completely preserved on any of the availabe specimens, nor is the slit. *Buechelia horizontalis* differs from *Buechelia goldfussi* by having a smaller shell and a more plane apical surface. This later feature applies even though in *B. goldfussi* one can find transitions between more or less elevated forms. But the apical surface of *Buechelia goldfussi* is never that flat. From *Euomphalus Bronnii* GOLDFUSS, 1844 of the Eifel *B. horizontalis* is distinguished by the absence of an umbilicus and the faint prolongation of the inner lip. From the Givetian *B. tyrrellii* (WHITEAVES 1891, p.314, Pl.41, figs.5, 5a, 6,6a,b) of Manitoba *B. horizontalis* differs in having the selenizone above the periphery.

Selenimorph Group *Neilsonia*

The shells are relatively high-spired with a selenizone on the periphery and an ornamentation of collabral elements. The protoconch is of the archaeogastropod-type.

This group unites the genera *Neilsonia* THOMAS, 1940 (early Carboniferous), *Peruvispira* CHRONIC, 1949 (Permian) and *Lukesispira* FRÝDA, 1998 (Devonian).

Genus *Lukesispira* FRÝDA, 1998

D i a g n o s i s : The small shells are turbiniform and have a flattened apex formed by the planispirally coiled first whorl of the teleoconch succeeding the embryonic whorl of archaeogastropod-type. The selenizone is very broad, with well marked and regularly wide spaced lunulae and is bordered by sharp spiral carinae. It starts at a wide sinus of the outer lip and its position is median. The cross-section of the whorls is rounded. The ornamentation consists of regularly rounded collabral elements. The type species is *Lukesispira pulchra* FRÝDA, 1998.

S t r a t i g r a p h i c a l r a n g e : Early and Middle Devonian.

D i s c u s s i o n : The genus *Lukesispira* differs from the genus *Peruvispira* by the higher position and the flatness of the selenizone as well as by the prominent formation of collabral elements. It is distinguished from the genus *Neilsonia* by the never nodose ornamentation with distinct collabral elements and the more rounded profile of the whorls. The genus *Lukesispira* is distinguished by a flat apex from the members of the selenimorph group *Mourlonia*, e.g. the genera *Mourlonia* KONINCK, 1883 and *Ptychomphalina* FISCHER, 1885.

Lukesispira frydai n. sp.

(figs. 3-5)

D e r i v a t i o n o m i n i s : Named in honor of our friend JIRI FRÝDA who contributed very much to the knowledge of Devonian gastropods.

D i a g n o s i s : The features of the genus apply. The whorl profile is steep above the selenizone, only little convex, with flat apex. The broad selenizone lies on the periphery just below mid-whorl. Ornament consists of strong and crescent collabral elements.

D e s c r i p t i o n : The shell is small (1,6 mm high and 1,8 mm wide) and turbiniform with a flat apex and a pleural angle of 105°. It consists of three visible whorls, that in profile form a little shoulder and then curve convexly and obliquely towards the selenizone, below it is convex forming a gentle angulation with the flattened base. The selenizone lies slightly below mid-whorl, is somewhat depressed, and relatively broad. It measures 0,19 mm on the last whorl which amounts to one fifth of the whorl's height. Ornament of the selenizone consists of broadly spaced, strong lunulae curving backwards, and margins are accompanied by strong carinae of which the apical one forms the periphery. Ornament of the whorls consists of strong, crescent ribs above the selenizone and weaker radial ones below it. Whorl sutures are deep and distinct. The aperture is relatively wide and lies below the spire. Its outer lip at first is gently oblique with a broad sinus that generates the selenizone while the columellar lip is elongated and somewhat thickened. The protoconch is about 0,2 mm wide and the selenizone initiates within the first whorl of the teleoconch.

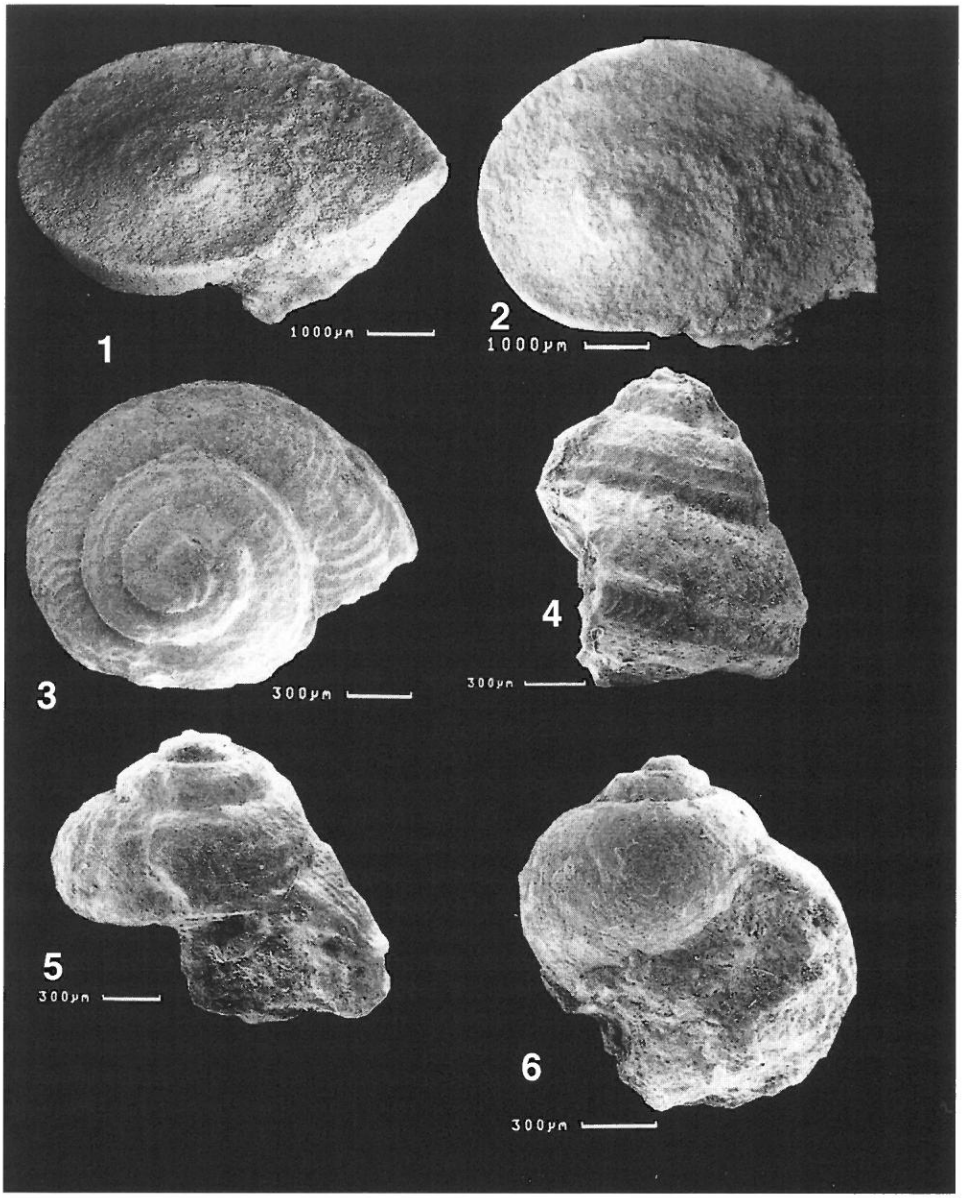


Fig. 1: *Buechelia horizontalis* n. sp., apical view, oblique from above, holotype. **Fig. 2:** Apical view, the same shell as on fig. 1. **Fig. 3:** *Lukesispira frydai* n. sp., apical view , holotype. **Fig. 4:** *Lukesispira frýdai*, lateral view with well preserved selenizone, the same shell as on fig. 3. **Fig. 5:** Apertural view of *Lukesispira fryai*, same shell as on fig. 3. **Fig. 6:** *Archaeosphera wachtbergi* (KIRCHNER, 1915), lateral view.

Holotype: The figured specimen, coll. HEIDELBERGER, Senckenberg Museum, SMF XII/ 3454.

Locality: Sötenich (1 specimen).

Discussion: The protoconch of the single specimen is damaged. Nevertheless, a classification to the genus *Lukesispira* is possible because of the characteristic teleoconch features. *Lukesispira frydai* differs from *Lukesispira pulchra* FRÝDA, 1998 of the Lower Devonian by having a wider pleural angle, a lower selenizone and a more flattened base.

2. Trochomorpha

According to BANDEL & GELDMACHER (1996) the group Trochomorpha includes conispiral gastropods without slit and selenizone, a slowly increasing diameter, anomphalous or phaneromphalous base, and a rounded aperture perpendicular or oblique to shell axis. Generally, an organic or calcitic operculum is present (but rarely preserved in fossils). The protoconch is of archaeogastropod-type. Within this definition all recent species of the Trochoidea in the sense of HICKMAN & MCLEAN (1990) could be united (but for them we have more information, so their classification can be carried out in a better way) and all fossil species without slit and selenizone, but with an archaeogastropod protoconch (which can not easily be placed close to any well defined modern taxon).

Trochomorph Group „*Holopea*"

Diagnosis: The shells are turbiniform, smooth, have a circular aperture and a moderately deep umbilicus.

FRÝDA (1998: 83) based this group on the genus *Holopea* HALL, 1847, in which many species of different ages from the Ordovician to the Carboniferous are described usually without a clear differenciation (Type species: *Holopea symmetrica* HALL, 1847 from the Ordovician of North America), and on the genus *Krasopea* HORNÝ, 1992 from the Lower Devonian of Bohemia. The genera *Archaeosphera* n. gen. and *Sylvestria* n. gen. (HEIDELBERGER, 1999) from the Middle Devonian of the Eifel are also to be included here.

Genus *Archaeosphera* n. gen.

Derivatio nominis: Free combination according to its classification within the Archaeogastropoda and the spherical form of the shell.

Diagnosis: The dextrally coiled shell of turbiniform shape has a strongly convex cross-section and a narrow and deep umbilicus. Its ornament consists of many very fine growth lines. The type species is *Straparollus Wachtbergi* KIRCHNER, 1915, deposited in the Geological-Paleontological Institute and Museum of the University at Bonn, collection DOHM; number: KIRCHNER 3

Stratum typicum: Middle Devonian (Givetian).

Discussion: KIRCHNER (1915: 212) placed this species into the genus *Straparollus* MONTFORT, 1810. Its protoconch is without doubt of archaeogastropod-type, even if the external shape of the teleoconch resembles that of a *Straparollus*, but only regarding the very general shell form. Actually *Straparollus* has a flat early ontogenetic shell portion and

becomes rounded only in later part of the teleoconch (BANDEL & FRÝDA 1998). In contrast to the new genus *Sylvestria* (type species *Sylvestria* (=*Turbo*) *Sötenichensis* KIRCHNER, 1915; HEIDELBERGER in prep.) there is no concave depression present in the whorl profile.

Archaeosphera wachtbergi (KIRCHNER, 1915)

(figs. 6, 7)

1915 *Straparollus Wachtbergi* KIRCHNER, p. 212, Pl.2, fig.3.

H o l o t y p e : The specimen described by KIRCHNER (see type species)

D e s c r i p t i o n : The spherical, turbiniform shell measures 6 mm in height and 9 mm in width with a pleural angle of about 90°. Its apex is elevated and four strongly convex whorls can be distinguished. Their diameter increases regularly, so that every whorl is twice as wide as the preceding one at equivalent position. The sutures are deeply impressed. The umbilicus in the convexly rounded base is narrow, funnel-shaped, and deep. The aperture is slightly oblique, of circular outline, and holostomous. The shell is thin, and ornament consists of many, very fine growth lines which are bent slightly backwards. The protoconch is big (about 0,2 mm) and of rounded shape.

L o c u s t y p i c u s : Wachtberg (Sötenich, Eifel)

L o c a l i t y : Wachtberg (1 specimen, coll. Heidelberger, Senckenberg Museum, SMF XII/ 3444)

D i s c u s s i o n : *Archaeosphera wachtbergi* differs from *Archaeosphera wachtbergi* var. *lithoides* (KIRCHNER) by its smaller size, the less flattened shape and the distinct, but flat apex. In the specimen illustrated by us, the aperture is not totally preserved but it adds to the information available from the holotype.

Archaeosphera minima (KIRCHNER, 1915)

(figs. 8, 9)

1915 *Straparollus minimus* KIRCHNER, p. 213, Pl..2, fig.5.

H o l o t y p e : The specimen described by KIRCHNER, (Geological-Palaeontological Institute and Museum University of Bonn, coll. DOHM; no. KIRCHNER) 5 is 2 mm high, 1-4 mm wide.

D i a g n o s i s : The rotelliform shell is very small and has a nearly flat apex. The protoconch is typical of archaeogastropods. The umbilicus is moderately wide and deep.

D e s c r i p t i o n : The lens-like shell is 0,83 mm high and 1,26 mm wide with a pleural angle of 155°. The apex is flat. The spire consists of two whorls with a flatly convex surface, curving more convexly to the umbilicus at the periphery and forming a moderately deep and narrow, funnel-shaped umbilicus. The sutures are very flat. There is no ornamentation perceptible. The width of protoconch is about 0,2 mm. It is somewhat pointed in its initial portion and corresponds to the shape commonly found among archaeogastropods.

L o c u s t y p i c u s : Wachtberg (Sötenich).

L o c a l i t y : Wachtberg (1 specimen, coll. HEIDELBERGER, Senckenberg Museum, SMF XII/ 3443).

D i s c u s s i o n : In the juvenile shell the aperture is not well preserved. The general shape resembles that of the early Carboniferous *Platyschisma* MCCOY, 1844, but the diameter of the whorls increases more rapidly in *Archaeospera minima* than is the case in *Platyschisma brevis* (YOO, 1994) or *Platyschisma vitrea* (YOO, 1994) of Australia. A sinus in the outer lip is also lacking in *Archaeosphera minima.*

3. Order Stylogastropoda FRÝDA & BANDEL, 1997

D i a g n o s i s : The slender turriform shell is high-spired and has a protoconch of archaeogastropod-type of less than one, relatively large whorl. It is usually laterally folded and never succeeded by a larval shell. Genera like *Katoptychia* PERNER 1907, *Stylonema* PERNER, 1907, *Palaeozygopleura* (*Palaeozygopleura*) HORNÝ, 1955, *Palaeozygopleura* (*Palaeozyga*) HORNÝ, 1955 and *Palaeozygopleura* (*Bohemozyga*) FRÝDA, 1998 are included.

D i s c u s s i o n : It can not yet be proved whether members of the genus *Loxonema* should be included within the Stylogastropoda, since the protoconch of the type species of *Loxonema* is still unknown. Very similar species from the early Devonian are representatives of the Stylogastropoda (FRÝDA & BANDEL, 1997). But from different evaluations of so called „Loxonematoidea" in their classical composition, it can be concluded that they form an artificial group (BANDEL, 1991).

Superfamily Loxonematoidea ? KOKEN, 1889

Family Palaeozygopleuridae HORNÝ, 1955 (emended by KNIGHT et al., 1960)

Genus *Palaeozygopleura* HORNÝ, 1955

D i a g n o s i s : The dextrally coiled shell is high-spired, shows the typical protoconch of the Archaeogastropoda (FRÝDA & BANDEL, 1997), and an ornamentation of strong and collabral costae.

D i s c u s s i o n : HORNÝ (1955) established the three subgenera *Palaeozygopleura* (*Palaeozygopleura*), *P.* (*Palaeozyga*), and *P.* (*Bojozyga*). FRÝDA (1998) adds another subgenus, but at the same time discusses the character of transition in these forms. The specimens found in Sötenich show a segment of more than one whorl without ornamentation. This corresponds to the definition of *Palaeozygopleura* as it was extended by HOARE (1980).

Palaeozygopleura retrostriata (KIRCHNER, 1915)

(figs. 13, 14)

1915 *Loxonema retrostriatum* KIRCHNER, p. 250, Pl.2, fig.20.
1998 *Palaeozygopleura* (*Rheinozyga) retrostriatum* FRÝDA, p. 120, Pl.20, figs.12, 13.

H o l o t y p e : *Loxonema retrostriatum* KIRCHNER, 1915 is deposited in the Geological-Palaeontological Institute and Museum, University of Bonn, coll. DOHM, no. KIRCHNER 18.

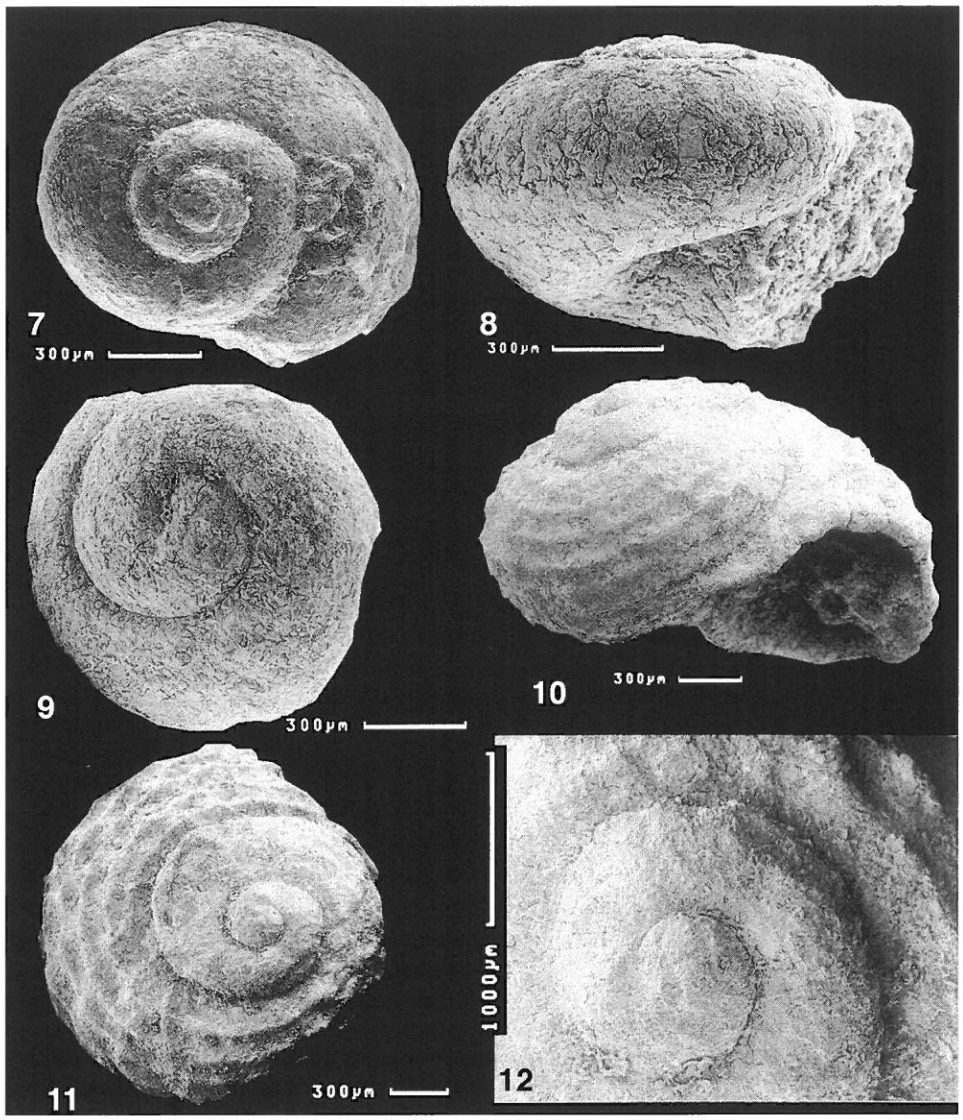


Fig. 7: Apical view of *Archaeosphera wachtbergi*, same shell as in fig. 6. **Fig. 8:** *Archaeopshera minima* (KIRCHNER, 1915), lateral view. **Fig. 9:** Apical view with protoconch of *Archaeopshera minima* (KIRCHNER, 1915), same shell as on fig. 8. **Fig. 10:** *Nerrhena aequistriata* (KIRCHNER, 1915), apertural view; holotype. **Fig. 11:** *Nerrhena aequistriata* (KIRCHNER, 1915), apical view, same shell as on fig. 10. **Fig. 12:** *Nerrhena aequistriata* (KIRCHNER, 1915), detail of the well preserved protoconch, same shell as on fig. 10.

Diagnosis: The shell is conical with rounded whorls. It is covered by prominent, dense, vertical to slightly oblique costae. Sometimes very fine spiral threads are visible. The ornamentation consists of prominent orthocline to slightly opisthocyrt collabral costae. The whorl profile is convex.

Description: The holotype with nine preserved whorls measures 8 mm in height, 3 mm in width. The figured specimen with six preserved whorls is 2,2 mm high and 1,14 mm wide, its pleural angle amounts to 45°. In shape the whorls are spherically convex, with their maximum diameter at about mid-whorl. Sutures are deep, rectangular and slightly oblique to the shell axis. The inner lip is somewhat elongated and the outer lip is not preserved. An umbilicus is lacking. The protoconch is simple, flat with an apical diameter of 0,16 mm and diameter of the initial whorl larger than 0,2 mm. The first two whorls are smooth. The ornamentation consists of 30 straight to slightly bent, prominent costae on each whorl, starting on the third whorl. The distance between the costae is twice as large as their diameter.

Material: 4 specimens; The figured specimen is deposited in the Senckenberg Museum, SMF XII/ 3457.

Discussion: *Palaeozygopleura retrostriata* resembles the genus *Alaskazygopleura* BLODGETT, 1992 in ornamentation, but is always more slender and the aperture is simple (FRÝDA, 1998). The inner lip is never twisted. The here described specimen represents a juvenile shell. It resembles *Loxonema Kaupii* GOLDFUSS, 1844, but the fine reticulate pattern described by GOLDFUSS and KIRCHNER for *L. Kaupii* is not perceptible on *Palaeozygopleura retrostriata* (KIRCHNER, 1915). From *Loxonema costatum* SANDBERGER & SANDBERGER, 1850-56 *Palaeozygopleura retrostriata* is distinguished by only slightly bent costae and a more slender form.

Genus *Urftia* n. gen.

Derivatio nominis: Named according to the river Urft near Sötenich.

Diagnosis: The high-spired shell is smooth. The protoconch shows a small apical diameter (0,1 mm) and an initial whorl of about 0,2 mm.

Discussion: The genus so far is represented by only one certain species (*Urftia convexa* n. sp.), which resembles the genus *Loxonema* in its general shape, but has a more simple and straight growth line pattern. No protoconch is known of *Loxonema* up to now. Perhaps both genera are synonyms, which can only be verified or falsified by further investigations carried out on the type material of *Loxonema* which is based on a Silurian species. If, in contrast, any larval shell can be proved, the classification of *Urftia* within the Caenogastropoda which show a similar small embryonic shell, must be considered. The genus *Urftia* also resembles the genus *Stylonema* PERNER, 1907, which has a larger protoconch of the archaeogastropod-type (FRÝDA & BANDEL, 1997). *Urftia* differs from the new genus *Kallispira* by the lack of ornamentation and the more regular increase of whorl diameter.

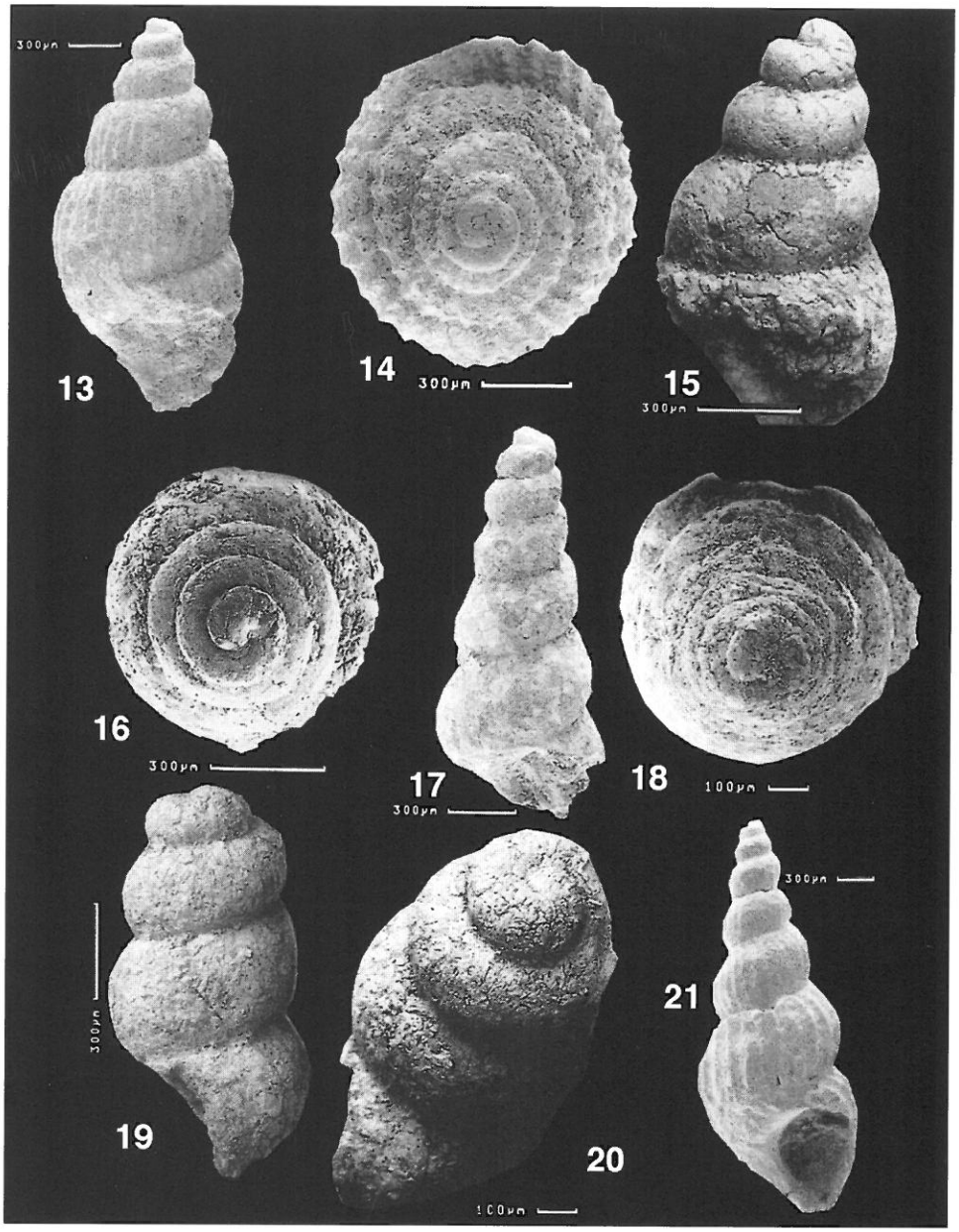


Fig. 13: *Palaeozygopleura retrostriata* (KIRCHNER, 1915), lateral view. **Fig. 14:** Apical view with protoconch of *Palaeozygopleura retrostriata* (KIRCHNER, 1915), same shell as on fig. 13. **Fig. 15:** *Urftia convexa* n. sp., lateral view; holotype. **Fig. 16:** *Urftia convexa* n. sp., the same shell as on fig. 15, apical view with protoconch. **Fig. 17:** *Urftia convexa* n. sp., lateral view of a paratype. **Fig. 18:** The same shell as on fig. 17, apical view with protoconch. **Fig. 19:** *Urftia* indet., lateral view of the apical region. **Fig. 20:** *Urftia* indet., the same shell as on fig. 19, oblique from above with protoconch. **Fig. 21:** *Kallispira varistriata* n. sp., apertural view; holotype.

Urftia convexa n. sp.

(figs. 15-18)

H o l o t y p e : Specimen of *Urftia convexa* illustrated on, figs.15, 16 (SMF XII/ 3446).

D e r i v a t i o n o m i n i s : Named according to the convex whorls of this species.

D i a g n o s i s : The features of the genus apply. The shell is very small with spherical smooth whorls separated from each other by distinct sutures.

D e s c r i p t i o n : The shell with seven spherically convex whorls is 1,67 mm high and 0,71 mm wide with a pleural angle of 25°. Maximal whorl width is somewhat above medium height. The sutures are distinct and deep. The inner lip of the aperture is slightly elongated below. The base is anomphalous. The shell is smooth with apparently straight, indistinct growth lines. The protoconch measures about 0.2 mm with apical diameter of 0,1 mm, and is attached in inclined position to the apex.

P a r a t y p e : Specimen figured on figs.17, 18 (SMF XII/ 3456).

L o c a l i t y : Wachtberg (3 specimens).

D i s c u s s i o n : *Urftia convexa* differs from 19 species placed by PERNER in the subgenus *Loxonema* (*Stylonema*) by its smaller size. It differs from a Devonian *Stylonema* described by FRÝDA (1998) by the spherical cross-section of the whorls and the distinct sutures. The protoconch is not totally plane, but its coiling axis differs from that of the teleoconch so that is points obliquely upwards out of the centre, as is the case in the elongated archaeogastropods of the genus *Eucycloscala* COSSMANN, 1895 from the late Triassic of the Dolomites (BANDEL 1993).

Urftia sp.

(figs. 19, 20).

D e s c r i p t i o n : Only 3.5 strongly convex whorls are preserved of this shell that has its maximum width in mid-whorl height. The increase of width in every whorl is only slight. Only fine collabral lines can be recognised as ornament. The protoconch measures about 0,2 mm (initial whorl) and has an apical diameter of 0,09 mm. In contrast to *Urftia convexa* the protoconch is oriented flatly on the apex of the shell.

T y p e : Figured specimen, coll. HEIDELBERGER, Senckenberg Mus., SMF XII/ 3448.

D i s c u s s i o n : The shell represents a juvenile individual and cannot be connected to a fully grown teleoconch, because only few whorls are preserved.

Genus *Kallispira* n. gen.

T y p e s p e c i e s : The illustrated specimen of *Kallispira varistriata*

D e r i v a t i o n o m i n i s : Free combination of high-spired shell (spira) with the name of the community of Kall (Eifel) next to Sötenich.

D i a g n o s i s : The ornamentation of the slender turriform teleoconch consists of strong collabral costae. The aperture is drop-shaped, and the protoconch simple, rounded with about 0,15 mm diameter in the initial whorl.

D i s c u s s i o n : *Kallispira* resembles *Palaeozygopleura* in general shape, but differs regarding the regular costae in its ornament, the very slender shell shape and the small simple protoconch.

Kallispira varistriata n. sp.

(figs. 21, 22)

H o l o t y p e : The illustrated specimen of *Kallispira varistriata,* coll. HEIDELBERGER, Senckenberg Museum, SMF XII/ 3438.

D e r i v a t i o n o m i n i s : Named according to the collabral costae (striata) that differ in number in each whorl (vari-).

D i a g n o s i s : The ornamentation is formed by broadly spaced, strong collabral costae bent slightly backwards. Their number diminishes with shell growth while the spaces between them increase with growth.

D e s c r i p t i o n : The high-spired shell is 3,2 mm high and 1,2 mm wide with a pleural angle of 35°. In the studied specimen it consists of nine well rounded whorls. The sutures are deep and slightly oblique to shell axis. The aperture is drop-shaped, pointed below with a channel-like elongation on the basal spire. The first whorls are smooth, on the lower ones 20 - 30 backwards bent costae are discernible on each whorl. The maximum curvature lies slightly above mid-whorl. The costae sometimes continue across the different whorls, but this is not necessarily so. The smooth and simple protoconch measures 0,15 mm in diameter (first whorl).

L o c a l i t y : Wachtberg (4 specimens).

D i s c u s s i o n : *Kallispira varistriata* differs from *Loxonema spiraglobosum* KIRCHNER, 1915 (p. 252 f., Pl.2, fig.23), originating from the „Girzenberg" near Sötenich, by the lack of nodulose costae and reticulate pattern formed by spiral lines. Besides having a larger protoconch, *Palaeozygopleura retrostriata* possesses finer costae and *Loxonema arduum* KIRCHNER, 1915 has a whorl profile which is more flattened. *Loxonema obliqui-arcuatum* SANDBERGER & SANDBERGER, 1850 (p. 231, Pl.26, fig.12) of the *Spirifer* limestone near Niederlahnstein (Lower Devonian) has a more conical shape, *Loxonema Roemeri* KAYSER in the description of WHIDBORNE (1891, p. 172, Pl.17, figs.18,19) has stronger and more slightly bent costae. *Holopella tenuisulcata* Sandberger & Sandberger (1850-56, p. 228, Pl.26, fig.8) shows more and finer costae which have wider spaces between them.

Kallispira latostriata n. sp.

(fig. 23)

H o l o t y p e : The illustrated specimen of *Kallispira latostriata,* coll. HEIDELBERGER, Senckenberg Museum, SMF XII/ 3458.

D e r i v a t i o n o m i n i s : Named according to the broad spaces (lat. latus) between the collabral costae on the basal whorls.

D i a g n o s i s : The ornamentation is formed by broadly spaced, strong collabral costae which are only slightly bent backwards.

D e s c r i p t i o n : The high-spired shell with nine evenly rounded whorls is 4, 8 mm high and 1,6 mm wide. The first four whorls appear smooth, on the five following whorls strong collabral costae are discernible, whose intervals are much broader than they measure in width. Each whorl shows 14 costae which are continuous across the deep sutures on the different whorls.

L o c a l i t y : Wachtberg (4 specimens).

D i s c u s s i o n : *Kallispira latostriata* differs by the very broad spaces and the equal number of costae per whorl from *Kallispira varistriata.*

Genus *Alaskazygopleura* BLODGETT, 1992

D e s c r i p t i o n : According to BLODGETT (1992, p. 159, Pl.12, figs.14 - 23; Pl.13, figs.1 - 8), the dextrally coiled shell is moderately to high-spired with prominent collabral elements on all whorls. The costae are sigmoidal on the last whorl and a weak sinus lies on the upper third of the whorl and the outer lip. The inner lip is turned over and forms a strong inductural margin. The type species is *Alaskazygopleura crassicostata* BLODGETT, 1992 from the Devonian of Alaska.

D i s c u s s i o n : Members of the family Pseudozygopleuridae KNIGHT, 1960 are safely recognizable only if their typical protoconch is preserved (NÜTZEL, 1998). Here the prominent collabral ornamentation of the larval shell does not start before the second whorl, which is normally swollen, and continues to the fourth whorl, where it usually changes to the characteristic ornamentation of the teleoconch. In the Palaeozygopleuridae the embryonic whorl consists of an usually large protoconch of the archaeogastropod type with about one smooth whorl (FRÝDA & BANDEL 1997). Since protoconchs are not known in many of the genera of these taxa, their systematic place is commonly not quite sure.

BLODGETT (1992) suggested that his new genus *Alaskazygopleura* may belong in the family Pseudozygopleuridae where similar shell shapes are to be found. But he also noted resemblance with the family Palaeozygopleuridae HORNÝ, 1955 with members usually having more slender shell shape than is found in *Alaskazygopleura.* At the same time BLODGETT emphasized the resemblance of his genus with *Devonozyga* HORNÝ, 1955, which represents a palaeozygopleurid genus.

Protoconchs of the pseudozygopleurid caenogastropods have been proven to occur only since early Carboniferous time (YOO, 1994; BANDEL, 1993; NÜTZEL, 1998), so it is less probable that *Alaskazygopleura* represents a member of the Pseudozygopleuridae, but rather represents a member of the Palaeozygopleuridae with convergent teleoconch shape.

Alaskazygopleura eifelia n. sp.

(fig. 24)

H o l o t y p e : The illustrated specimen of *Alaskazygopleura eifelia,* coll. HEIDELBERGER, Senckenberg Museum, SMF XII/3441.

D e r i v a t i o n o m i n i s : Named according to the Eifel mountains which represent the type area of this species.

D i a g n o s i s : The definition of the genus applies to this small sized species. The last whorl is much higher than all others and of convex outline. The ornamentation consists of strong, bent costae on every whorl of the teleoconch.

D e s c r i p t i o n : A shell with 7,4 mm in height and 4,3 mm in width consists of six whorls. The last whorl curves convexly to the spire and, with 5,3 mm height, it occupies more than two thirds of the total shell height. Whorls of the spire have their maximum curvature in the upper third, below they are only slightly convex to nearly plane. The pleural angle amounts to 50°. The suture of the last whorl is flat and little depressed, at the other whorls it is distinct and rectangular. The base is convexly anomphalous. The large aperture (4 mm high and 2,6 mm wide) forms an acute angle posteriorly and is rounded anteriorly.

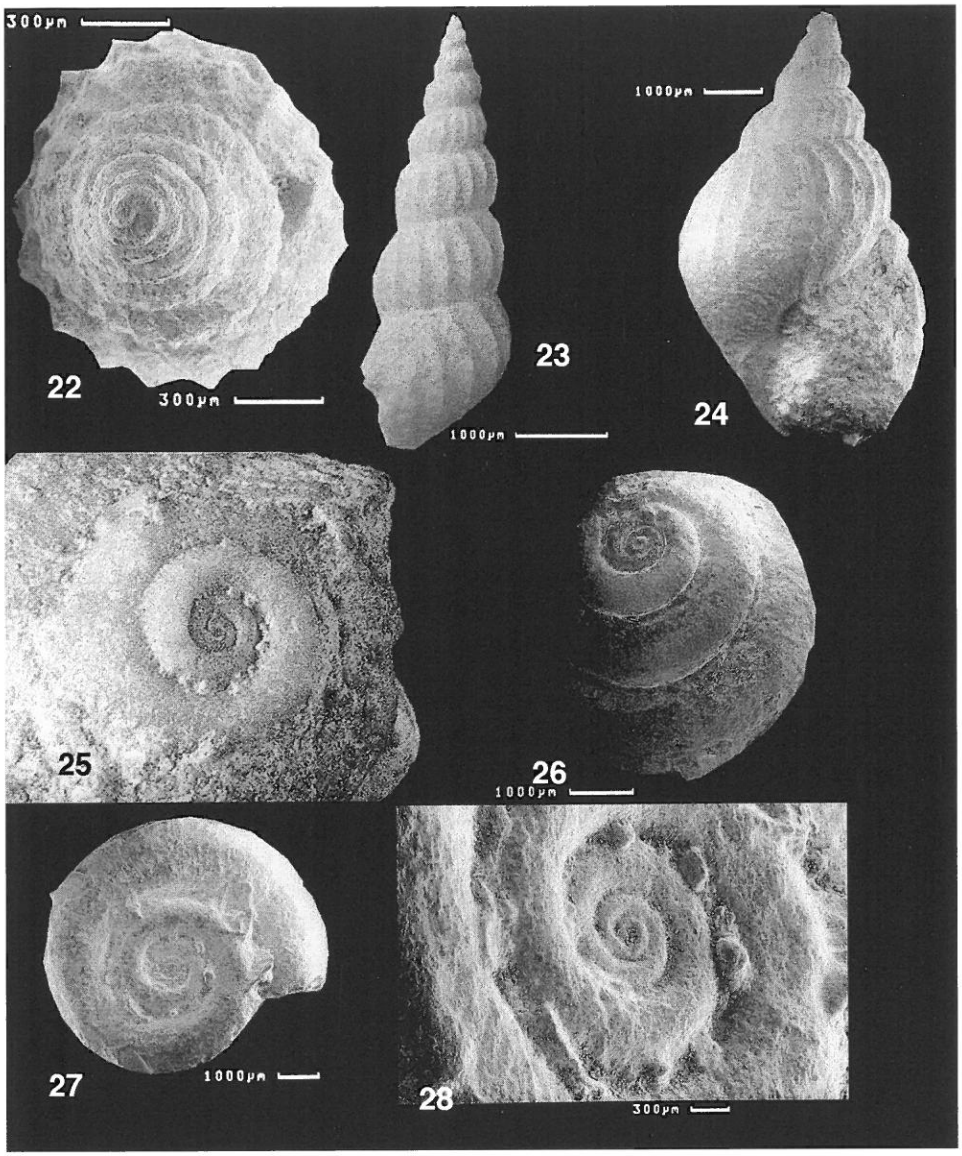


Fig. 22: *Kallispira varistriata* n. sp., the same shell as on fig. 21, apical view with protoconch. **Fig. 23:** *Kallispira latostriata* n. sp., lateral view, holotype. **Fig. 24:** *Alaskazygopleura eifelia* n. sp., lateral view, holotype. **Fig. 25:** *Straparollus devonoaltus* nov. nom. (= *Straparollus altus* KIRCHNER, 1915), apical view, 3 mm in diameter. **Fig. 26:** *Straparollus devonoaltus* nov. nom. (= *Straparollus altus* KIRCHNER, 1915), apical view oblique from above, another specimen. **Fig. 27:** *Straparollus planiformis* n. sp., apical view, holotype. **Fig. 28:** *Straparollus planiformis* n. sp., the same shell as on fig. 27, oblique from above, detail of agglutination in the sutures.

The outer lip has a small sinus in its posterior third. The inner lip is not thickened and forms an angle of 45° with the shell axis, while the outer lip is oriented parallel to it. The ornamentation on the first whorls consists of prosocyrt blunt costae whose intervals are much broader than their diameter. On the last whorl, the costae are bent backwards in a wide, flat bow.

Locus typicus: Sötenich (Eifel) (16 adult, 8 juvenile specimens).

Discussion: *Alaskazygopleura eifelia* differs from *Alaskazygopleura crassicostata* by its smaller dimensions, a shorter spire, a proportionally larger last whorl, and barely sigmoidal costae. The protoconch remains to be discovered. *Alaskazygopleura eifelia* is distinguished from *Loxonema incurvelineatum* KIRCHNER (1915, Pl.2, fig.17) by the sigmoidal costae of the later which strongly bent forwards. *A. eifelia* differs from *Loxonema paucicostatum* KIRCHNER (1915, Pl.2, fig.18) by the lack of shoulders. *A. eifelia* resembles *Macrochilina* (sensu lato) as described by KIRCHNER (1915) in its external form. He described eight species of *Macrochilina* from Sötenich (*M. arculata* SCHLOTHEIM, *M. imbricata* SOWERBY, *M. subimbricata* ORBIGNY, *M. elongata* PHILLIPS, *M. elevata* WHIDBORNE, *M. ejecta* WHIDBORNE, *M. ventricosa* GOLDFUSS, *M. ovata* F.A. ROEMER), but figured none of them. According to his descriptions none of them fits with *Alaskazygopleura eifelia*, because they either represent forms without ornamentation (*M. imbricata*, *M. subimbricata*, *M. elongata*, *M. elevata*, *M. ejecta*, *M. ventricosa*, *M. ovata*) or have a distinct shoulder (*M. arculata*). *Alaskazygopleura* sp. described by KAUFHOLD (1994) has more bent costae.

Subclass Neritimorpha GOLIKOV & STAROBOGATOV, 1975

Superorder Cycloneritimorpha BANDEL & FRÝDA, 1999

Definition according to BANDEL & FRÝDA (1999): Members of the subclass Neritimorpha with a strongly convolute larval shell of more than one whorl (BANDEL (1982, 1992, 1997) and features of teleoconch as described by HASZPRUNAR (1988, 1993).

Genus *Nerrhena* n. gen.

Type species: *Turbo aequistriata* (KIRCHNER, 1915) is deposited in the Geological-Palaeontological Institute and Museum, University of Bonn, coll. DOHM; no. KIRCHNER 11.

Derivatio nominis: This genus is named according to its placement within the Neritimorpha. (Ner-) and the type area of its occurrence, the Rhenish Slate-Mountains (Rheinisches Schiefergebirge).

Diagnosis: The shell is turbiniform with strongly convex whorls and no umbilicus. Ornamentation consists of equidistant spiral and collabral elements. The protoconch is large and smooth and consists of two whorls.

Discussion: *Nerrhena* is distinguished by having a short spire, a spherical shell shape, and by the presence of collabral elements in its ornament. In the most similar *Rhabdotocochlis* KNIGHT the periphery of the whorl is below mid-whorl and not in median position as it is the case in *Nerrhena*, and the aperture is much smaller in relation to the spire.

Nerrhena reticulata n. sp.

(figs. 10-12)

Holotype: The here figured specimen, coll. HEIDELBERGER, Senckenberg Museum, SMF XII/ 3449.

Derivatio nominis: Named for its reticulate, rhomb-shaped pattern of ornamentation.

Diagnosis: The features of the genus apply. The ornamentation consists of strongly spiral and collabral elements.

Description: The turbiniform shell measures 1,8 mm in height and 1,83 mm in width with a pleural angle of 100°. The specimen consists of three convex whorls and a gently elevated apex. Whorls have step-like shoulders, and sutures are distinct and rectangular in shape. There is no umbilicus in the convex base. The aperture is nearly as wide as the diameter of the last whorl and slightly oblique to the shell axis. The outer lip begins at mid-whorl of the preceding whorl, is holostomous, and expands in lower and outer direction. The inner lip is short, somewhat enlarged, and also oblique to the axis. The first two whorls are smooth and ornamentation starts on the second whorl. Ornament on the last whorl consists of eight equidistant, strong carinae. These are crossed by obliquely, backwards directed, strong, equidistant collabral costae forming a typical rhomboid pattern with the spiral ribs.

Locality: Wachtberg (Sötenich), 1 specimen.

Discussion: *Nerrhena reticulata* is more flattened and wider than *Nerrhena aequistriata* (KIRCHNER, 1915), its apex is only moderately elevated and the spiral and collabral elements are of equal size. It differs from *„Turbo" multistriatus* (KIRCHNER) by a convex cross-section of the whorls and by a different ornamentation. FRÝDA (1998) discussed the classification of *Nerrhena* (="*Turbo*") *aequistriatus* (KIRCHNER) placing it with a new selenimorph taxon. Our specimen probably represents a not fully grown juvenile shell.

Subclass Euomphalomorpha BANDEL & FRÝDA, 1998

Description: The dextrally coiled shells are discoidal to slightly trochiform, the spire may also be plane. The umbilicus is always wide and open. Normally, the whorls show a round to oval cross-section, but they can also carry up to two keels. The cyrtocone protoconch is always openly coiled and shows a distinct central gap.

Discussion: The protoconchs found with genera of this group differ from all others actually known. Therefore BANDEL & FRÝDA (1998) placed genera of the family Euomphalidae with these typical features into the subclass Euomphalomorpha, in contrast to their former placement in the Archaeogastropoda (e.g. KNIGHT et al., 1960). The early whorls, and thus the shell composed during early ontogeny, differ fundamentally among the members of these two subclasses of the Gastropoda. Moreover, the shell structure of the genus *Euomphalus* consists of an external calcitic and an aragonitic internal layer (BATTEN, 1984), which according to BANDEL & FRÝDA (1998) has a precursor structure which can be found in modern species in transition to the nacreous as well as to the crossed lamellar structure. The group may have first appeared in Late Cambrian with the genus *Euomphalopsis* (WEBERS et al,. 1992) and could range up to late Triassic (BANDEL, 1988, 1997). It had reliable representatives that lived from Ordovician to Permian time.

Superfamily Euomphaloidea KONINCK, 1881

Family Euomphalidae KONINCK, 1881

D e s c r i p t i o n : The definition of the subclass applies. The shell is initially planispirally to depressed discoidally coiled. The teleoconch may be discoidally or trochispirally coiled. Whorls may only touch each other slightly or are even detached from each other. The protoconch is egg-shaped, of about 0,1 to 0,2 mm in width and 0,3 mm in length. It forms an openly coiled half whorl that leaves a central gap.

Genus *Straparollus* MONTFORT, 1810

D e s c r i p t i o n : The definition of the family applies. The shell is dextrally coiled, discoidal to lowly trochispiral with generally flattened apex. Whorl cross-section is oval to round and increases very slowly in diameter with distinct sutures. The aperture is holostomous and coherent. The base and the lower part of the whorls are well rounded, and the first 2 - 3 whorls are coiled in a plane. The ornamentation consists of very fine growth lines. The type species is *Straparollus dionysii* MONTFORT, 1810 (early Carboniferous, Belgium).

D i s c u s s i o n : Since teleoconchs of *Straparollus* and *Euomphalus* can clearly be differentiated, they represent two different genera belonging to the same family (WENZ, 1938, confirmed by BANDEL & FRÝDA, 1998 and contrasting the opinion of KNIGHT et al., 1960). COSSMANN (1915) suggested that the two genera belong to different families, even though KONINCK (1881) had demonstrated that they are connected to each other by transitional species. KAYSER (1889) suggested that the ability of agglutination of objects to the shell as is present in *Straparollus laevis* (ARCHIAC & VERNEUIL, 1842) warrants the erection of an own genus - *Philoxene* KAYSER, 1889- , but KOKEN (1889) and HOLZAPFEL (1895) expressed different opinions. While WENZ (1938) listed *Philoxene* as independent genus, KNIGHT et al. (1960) only admitted the status of a subgenus.

Straparollus devonoaltus nov. nom. (KIRCHNER, 1915)

(figs. 25, 26)

1915 *Euomphalus altus* KIRCHNER, p.215, Pl.2, fig. 6.

H o l o t y p e : The specimen described by KIRCHNER (1915) is deposited in the Geological-Palaeontological Institute, University of Bonn; coll. DOHM; no: KIRCHNER 6.

D e r i v a t i o n o m i n i s : The species name „altus" proposed by KIRCHNER must be changed, because KONINCK (1881, p.124, Pl.14, figs.31,32) had used the same name for a Carboniferous species, which is not the same (see below). So it is named according to its Devonian age.

D i a g n o s i s : The whorls are situated one upon another forming an elevated spire. The whorl diameter increases very slowly with deep and wide umbilicus, that is funnel-shaped and open to the apex.

D e s c r i p t i o n : The newly collected shell is 3 - 5 mm high and 4 - 5 mm wide and forms a blunt spire. It consists of five circular whorls. There is no ornamentation discernible except fine, radial growth lines. The protoconch forms a plane with the first whorls; it is openly coiled and shows a central gap. The holotype is 8 mm high and 8 mm wide, trochiform with a pleural angle of 60°. Three circular whorls are preserved, the presumed flat apex is lacking. The diameter of the whorls increases very slowly, and whorls are shifted for about

the width of half a whorl against each other. The sutures are distinct and deep. The umbilicus is deep and funnel-shaped. The aperture is holostomous and slightly oblique to shell axis. The ornamentation consists of fine growth lines.

Locus typicus: Girzenberg near Sötenich.

New material is from locality Wachtberg, Sötenich (2 specimens; SMF 3459 and coll. HEIDELBERGER).

Discussion: KONINCK (1881, p. 124, pl. 14, fig. 31, 32) described *Straparollus altus* from the Carboniferous of Belgium. Even though the Carboniferous species resembles *Straparollus devonoaltus* and can be considered related to it as is *S. turritus* (SANDBERGER & SANDBERGER, 1850-56), *Straparollus altus* KONINCK is higher and shows a greater pleural angle. *Straparollus devonoaltus* differs from *S. turritus* by its smaller dimensions, a more acute pleural angle and more rounded whorls.

Straparollus planiformis n. sp.

(figs. 27, 28, 29)

Holotype: The illustrated specimen, coll. HEIDELBERGER, Senckenberg Museum, SMF XII/ 3440.

Derivatio nominis: Named according to the plane, discoidal form of the teleoconch

Diagnosis: The shell is flatly discoidal and has whorls with rounded diameter which are not shifted against each other. The protoconch is typically openly coiled and whorls of the teleoconch only barely touch each other.

Description: The dextrally coiled shell with 2 mm height measures 5 - 7 mm in diameter. The rounded whorls are oval in section and form a plane with their upper surfaces. Whorl diameter doubles within successive whorls. There is a slight shoulder at upper whorl edge and the base is also less rounded than the flanks, forming a plane as well. It curves sharply, nearly vertically into the wide umbilicus which shows every whorl. The sutures are very distinct, since the whorls only touch at a very narrow, median edge. The aperture is rounded, simple, thin, and shows a slight, concave sinus on the upper part. The inner lip is slightly bent inwards, but never thickened. Ornament consists only of very fine, straight, dense growth lines on the upper and lower surfaces. Between the sutures of the upper surface small, regularly spaced agglutinated stones or fragments of shells may be present. The protoconch is openly coiled, measures less than 0,1 mm at its apical end and forms an open, dextrally coiled hook of more than 0,3 mm width.

Material: 4 specimens from Wachtberg.

Discussion: *Straparollus planiformis* is distinguished from *Straparollus laevis* (ARCHIAC & VERNEUIL, 1842) and *Euomphalus planorbis* ARCHIAC & VERNEUIL, 1842 (p.363, Pl.33, figs.7, 7a) by its absolutely plane apical surface. Agglutinations on the apical surface between the sutures may be present or absent, in the same way as is the case in *Straparollus laevis*. The initial shell cap of the protoconch is rather small.

Genus *Nodeuomphalus* BANDEL & FRÝDA, 1998

Description: The dextrally coiled shell is discoidal and shows a more or less distinct keel on the apical surface. Because of this, it is pentagonal in cross-section. The base is ornamented by nodes or large radial folds. The type species is *Nodeuomphalus*

labadyei (ARCHIAC & VERNEUIL, 1842) that is deposited at the Centre des Sciences de la Terre, Lyon 1; number: EM 31565.

Stratigraphical range: Middle Devonian (Givetian).

Discussion: *Nodeuomphalus* differs from *Straparollus* by the possession of an upper keel and a different cross-section, from *Euomphalus* additionally by the typical basal ornamentation with radial folds.

Nodeuomphalus labadyei (ARCHIAC & VERNEUIL, 1842)

(figs. 30-34)

Synonomy see BANDEL & FRÝDA (1998).

Description: The discoidal shell consisting of five whorls is 5 - 7 mm high and 11 - 16 mm wide, has a depressed or slightly elevated apex and a sharp, vertical keel that is always on the outer edge of the whorls. The first two whorls are slightly depressed, afterwards they are distinctly trochispirally coiled. Whorl diameter doubles with each successive whorl of the spire. The sutures are flat, vertical and distinct between the first whorls, later become deeper, because the whorls are shifted against each other. On the base of the last whorl 24 radial, cuneiform, wide folds can be recognised, but they may not be distinguished on all whorls. Only on the last two whorls the apical keel is well marked. The umbilicus is very wide with all whorls visible. The sutures are distinct, and each whorl touches the preceding one only slightly, they are never embracing. The cross-section can be crescent to slightly rhomboid. Besides the upper keel, radial blunt folds are present on the base. The aperture is pentagonal. The protoconch is openly coiled. The initial portion is egg-shaped with an apical width of 0,1 mm. There is a distinct, open central gap with a diameter of 0,06 mm. After 1,5 whorls the protoconch ends against the teleoconch indicated by the presence of a fine, irregular seam at the apical and basal surface and by the whorls getting in touch with each other at the periphery and below mid-whorl.

Locus typicus: Paffrath.

Additional material from the locality Sötenich with 10 specimens of which 5 are juvenile shells. The figured specimens are deposited in the Senckenberg Museum, Frankfurt/M, SMF XII/ 3436, 3439.

Discussion: The holotype of *Nodeuomphalus labadyei* is not well preserved and measures 7 mm in height, 16 mm in width with a pleural angle of 140°. Since only its last two whorls are recognizable, the species is now much better known. *N. labadyei* differs from *N. leunissi* particularly in the position of the apical keel at the outer edge and from *Euomphalus nodosus* SOWERBY by the form and number of the basal folds. *Nodeuomphalus paffrathianus* BANDEL & FRÝDA, 1998 differs in its height and has a more trochispirally coiled shell shape.

Nodeuomphalus leunissi n. sp.

(figs. 35-37)

Holotype: The illustrated specimen, coll. HEIDELBERGER, Senckenberg Museum, SMF XII/ 3455.

Derivatio nominis: Named for Robert LEUNISSEN whose material from Sötenich contributes to our knowledge of these Givetian gastropods.

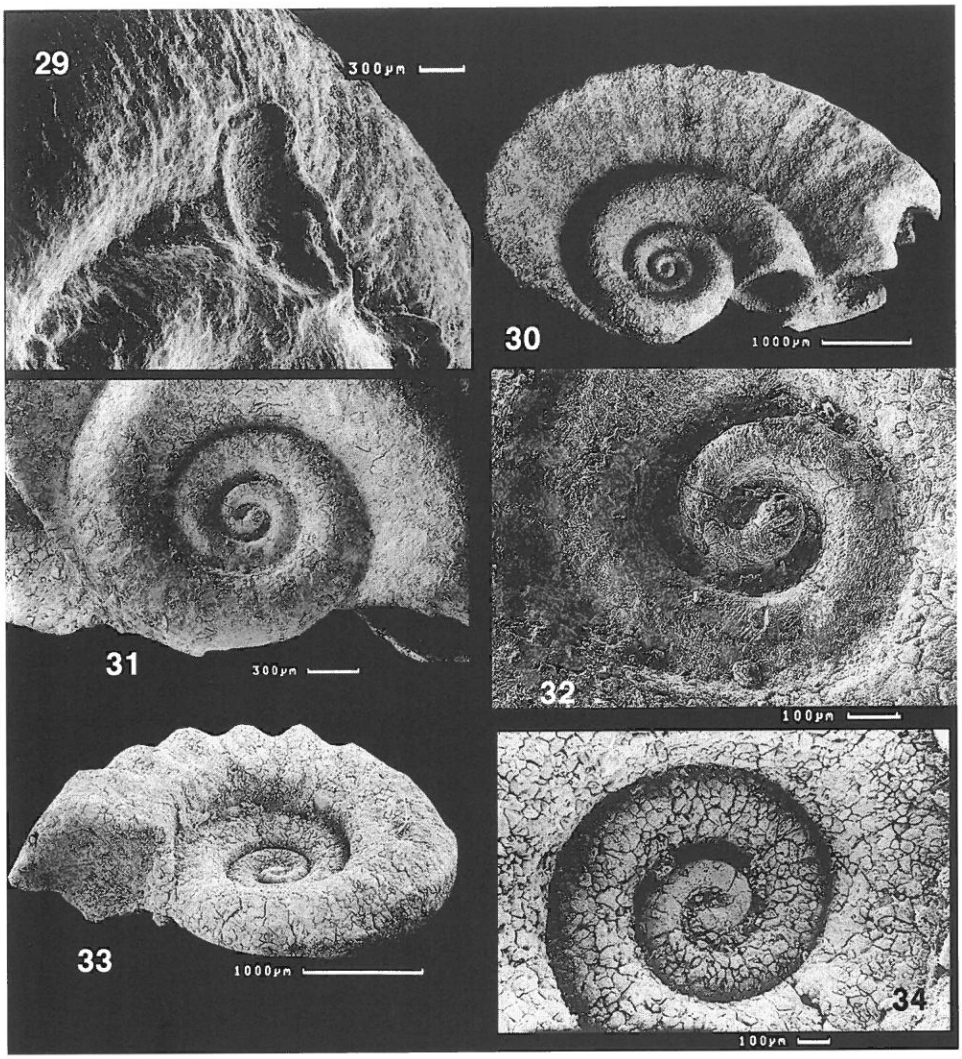


Fig. 29: *Straparollus planiformis* n. sp., the same shell as on fig. 27, detail of agglutinated material. **Fig. 30:** *Nodeuomphalus labadyei* (ARCHIAC & VERNEUIL, 1842), apical view, oblique, SMF XII/ 3439. **Fig. 31:** *Nodeuomphalus labadyei* (ARCHIAC & VERNEUIL, 1842), same shell as on fig. 30, apical view, detail. **Fig. 32:** *Nodeuomphalus labadyei* (ARCHIAC & VERNEUIL, 1842), same shell as on fig. 30, apical view, detail of the protoconch. **Fig. 33:** *Nodeuomphalus labadyei* (ARCHIAC & VERNEUIL, 1842), other specimen, SMF XII/ 3436, basal view, oblique. **Fig. 34:** *Nodeuomphalus labadyei* (ARCHIAC & VERNEUIL, 1842), the same shell as on fig. 33, detail of the openly coiled protoconch, basal view.

D i a g n o s i s : The shell is very flat and planispirally coiled. The apical keel is weakly rounded and lies exactly in the middle of the apical whorl surface. Sharp folds on the base radiate in a straight way.

D e s c r i p t i o n : The shell looks like a flat, rounded disc which with five whorls is 4 mm high and 12 mm wide. Whorls are planispirally arranged and increase regularly in diameter. The first two whorls are evenly rounded and only the apical surface of the last two whorls is divided by a median keel forming two weakly oblique flanks of nearly the same size. The periphery is formed by a small, rounded edge. The base is convexly rounded with the umbilicus widely open exposing all whorls of the spire. Whorls only touch each other along a narrow edge and the sutures are, thus, wide and distinct. The apical roof-like surface is crossed by many fine growth lines which are slightly bend next to the keel. The base of the last two whorl is ornamented by numerous strong, rounded and only slightly curving folds with interspaces of the same width and fine radial growth lines. The aperture occupies the total shell height with the upper part of the outer lip circular and curving obliquely below. The protoconch is openly coiled with 0,1 mm wide initial cap and a central gap. Whorls touch each other after 1,5 whorls.

T y p e l o c a l i t y : Sötenich (3 specimens).

D i s c u s s i o n : *Nodeuomphalus leunissi* differs from *N. labadyei* and *N. paffrathianus* by its more flattened, rounded form, the position of the keel at mid-surface and the nearly straight direction of the basal folds. *N. leunissi* differs from *Euomphalus Schnurii* ARCHIAC & VERNEUIL, 1842, *Euomphalus Archiaci* GOLDFUSS, 1844 and *Euomphalus articulatus* GOLDFUSS, 1844, all of which also occur in the Eifel area, by the presence of basal folds.

Euomphalus sp.

(figs. 38-40)

D e s c r i p t i o n of a micromorph shell: The shell is trochiform and shows an oval diameter of about 3,1 mm (perpendicular line 2,3 mm). The protoconch is flat, only slightly openly coiled (the central gap measures 0,03 mm in diameter) and measures 0,13 mm in apical diameter. The apex is depressed. The first three whorls are sinistrally coiled, and only the last half whorl coils dextrally. The coiling axis is always the same. The cross-section of the whorls is oval and with longer axis horizontally, the whorls only touch at the periphery. The sutures are distinct and deep. The umbilicus is open and wide. An ornamentation is not discernible.

M a t e r i a l : One specimen from Wachtberg; coll. HEIDELBERGER, Senckenberg Museum, SMF XII/ 3460.

R e m a r k s : The protoconch of this species is much more coiled than in species of the genera *Nodeuomphalus* or *Straparollus*. It has a greater diameter and touches the following whorls earlier, moreover the central gap is smaller. How this species looks when it is fully grown is not known.

Superfamily Peruneloidea FRÝDA & BANDEL, 1997

FRÝDA & BANDEL (1997) emended the Peruneloidea for gastropods that bear an openly and almost planispirally coiled protoconch with dextral cyrtoconic initial portion measuring less than or about 0,1 mm in diameter followed by a smooth more or less openly coiled

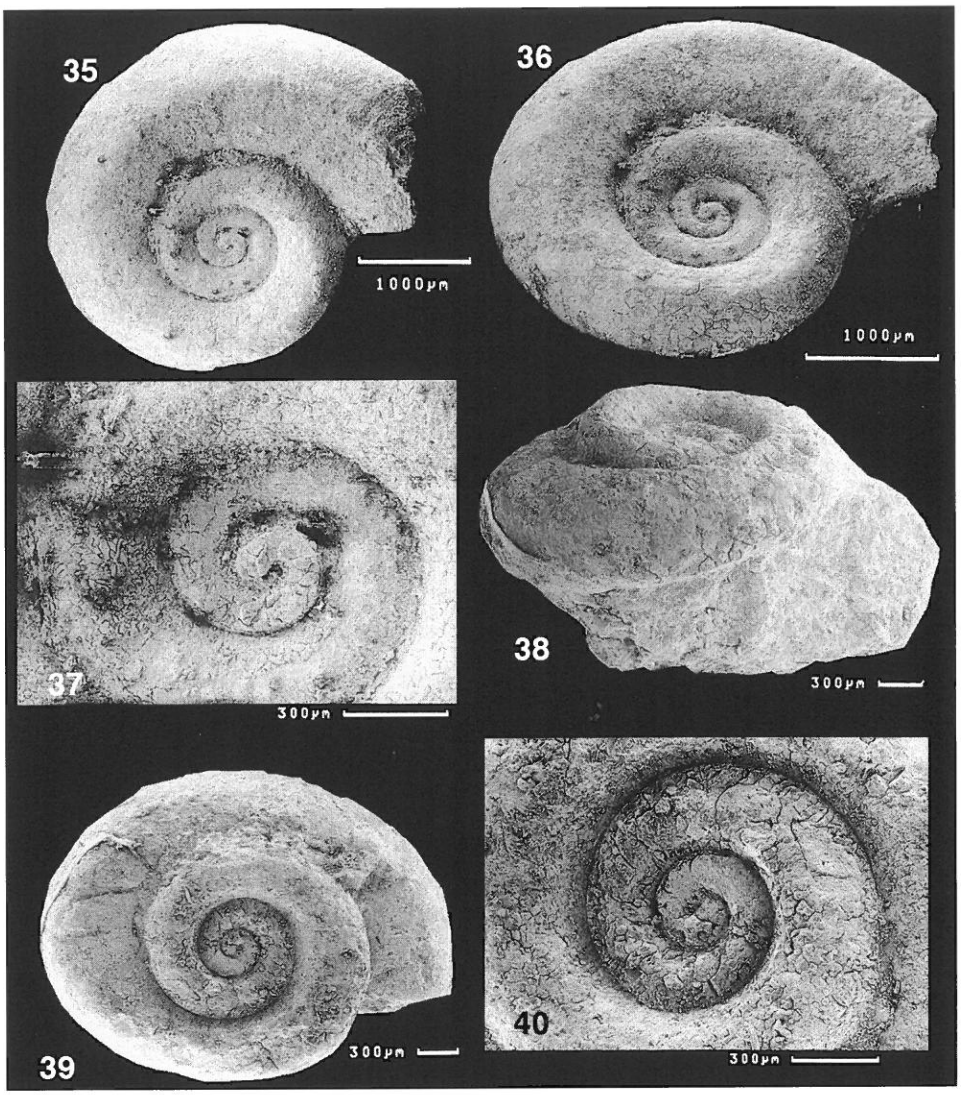


Fig. 35: *Nodeuomphalus leunissi* n. sp. , apical view. **Fig. 36:** *Nodeuomphalus leunissi* n. sp., the same shell as on fig. 35, oblique from above. **Fig. 37:** *Nodeuomphalus leunissi* n. sp., the same shell as on fig. 35, detail of the protoconch, apical view. **Fig. 38:** *Euomphalus* sp., problematic micromorph shell, lateral view. **Fig. 39:** The same shell as on fig. 38, apical view. **Fig. 40:** The same shell as on fig. 38, detail of the protoconch, apical view

larval portion. The teleoconchs of this group are smooth or ornamented by collabral ribs. The classification in relation to other taxa is still open as is the higher taxonomic position. The teleoconch connected to these protoconchs suggests that they may be stem group representatives of the Caenogastropoda and, perhaps, also the Heterostropha (BANDEL 1997). The here described peruneloid species placed in the new genus *Soetenichia* whould have been placed with the superfamily Subulitoidea LINDSTRÖM, 1884 whose taxonomic position is also open. *Soetenichia* n. gen. resemble the Subulitoidea in general shape and its protoconch is formed by an openly coiled shell with very small initial portion. Placement within the Peruneloidea is justified, since the superfamily Subulitoidea is artificial (according to BANDEL 1997, FRÝDA & BANDEL 1997) in the sense that it unites shells with archaeogastropod-type and perunelomorph-type protoconchs in the Devonian and holds true caenogastropods in the Carboniferous. BANDEL & FRÝDA (1998) documented that Euomphalomorpha and Peruneloidea differ in regard to the dimensions of their protoconchs, but also regarding teleoconch shape. Both groups show protoconchs with openly coiled first whorls as do the Cyrtoneritimorpha among the suspected stem group representatives of the Neritimorpha (BANDEL & FRÝDA 1999). These openly coiled protoconchs found among apparently unrelated Devonian gastropods differ only little in size and shape. Those of the Euomphalomorpha are usually larger and more plump in shape than those of the other two. The protoconch of the Peruneloidea is more trochispirally coiled in its early portion than that of the Cyrtoneritimorpha, but both are about of the same dimension.

Genus *Soetenichia* n. gen.

T y p e s p e c i e s : *Loxonema girzenbergense* KIRCHNER is deposited in the Geological-Palaeontological Institute, University of Bonn, coll. DOHM; no: KIRCHNER 23.

D e r i v a t i o n o m i n i s : Named according to the type locality, Sötenich in the Eifel.

D i a g n o s i s : The shell is conical with a very small hook-like protoconch. The diameter of the central gap of the protconch is minute. The subulitiform teleoconch is smooth or ornamented only with very fine growth lines.

S t r a t i g r a p h i c a l r a n g e : Middle Devonian (Givetian)

Soetenichia girzenbergense (KIRCHNER, 1915)

(figs. 41-43)

1915 *Loxonema Girzenbergense* KIRCHNER, p. 254, Pl.2, fig. 25.

H o l o t y p e : *Loxonema girzenbergense* KIRCHNER, see type species. The protoconch is preserved on the newly collected specimens (SMF XII/ 3434, 3445).

D i a g n o s i s : Because of monotypy see that of genus.

D e s c r i p t i o n : The conical shell of the holotype is 3 mm high, 2 mm wide with a pleural angle about 55° to 60°. It consists of four preserved, slightly convex whorls that are higher than wide. In succeeding whorls the height doubles whereas the width increases more slowly. The distinct, but shallow sutures are perpendicular to the shell axis. The aperture is egg-shaped and occupies about one third of the total height. Its outer lip is oblique and the inner lip short and sharp. The base is gently convex. The protoconch starts as a very small, funnel-shaped tube with a very narrow apical portion (apical diameter of 0,025 mm)

for a length of about 0,06 mm. After this initial cup dextral coiling begins forming about one planispiral whorl with a central gap of about 0,04 mm width and 0,07 mm length. On the trochispiral teleoconch an ornament of very fine somewhat sinuous growth lines can be present.

Locus typicus: Sötenich.

Locality: Sötenich (7 specimens).

Discussion: The small dimensions of the protoconch distinguishes *Soetenichia* from all other species of the Peruneloidea described up to now (BANDEL & FRÝDA 1997). The aperture differs from that of *Macrochilina*- or *Strobeus*-like forms of the subulitids. Growth lines are not always present or preserved.

Suborder ? Mimospirina DZIK (1983)

Discussion: The classification of the sinistrally coiled forms with a large smooth protoconch and a conical teleoconch is still discussed (WÄNGBERG-ERIKSSON 1979, DZIK, 1983). While DZIK (1983) united the families Onychochilidae KOKEN, 1925 and Clisospiridae MILLER, 1889 as suborder Mimospirina within the Gastropoda and thus followed WENZ (1938), other scientists like LINSLEY & KIER (1984) interpreted them as untorted mollusks. They suggested the taxon Paragastropoda to include them jointly with other „gastropods" of unknown origin.

Family Clisospiridae S. A. MILLER, 1889

Diagnosis: The shell is flatly to moderately conical and dextrally or sinistrally coiled.

Subfamily Clisospirinae S. A. MILLER, 1889

Diagnosis: The shell is sinistrally coiled and has a smooth, large protoconch.

Genus *Sinistriconcha* n. gen.

Type species: *Sinistriconcha lierli* n. sp

Derivatio nominis: Named according to the sinistrally coiled shell (concha).

Diagnosis: The sinistrally coiled shell is conical with a simple protoconch and a vertical aperture. An ornamentation is lacking.

Stratigraphical range: Middle Devonian (Givetian).

Discussion: The species found in Sötenich cannot be compared to other known forms and is distinguished by its smooth and flat protoconch from members of also sinistrally coiled superfamily Cirroidea COSSMANN, 1916 (emended by BANDEL, 1993), which show a dextrally coiled protoconch and a sinistrally or planispirally coiled teleoconch. The new genus *Sinistriconcha* is therefore placed within the still discussed and somewhat problematic family Clisospiridae, even though it is realized, that the dimensions of the protoconch differ.

Sinistriconcha lierli n. sp.

(figs. 44-46)

H o l o t y p e : The specimen illustrated on figs.44, 45; coll. HEIDELBERGER, Senckenberg Museum, SMF XII/ 3451.

D e r i v a t i o n o m i n i s : Named for Hans Jürgen LIERL (Hamburg) who also collected and provided us with specimen of this new species.

D i a g n o s i s : The features of the genus apply (because of monotypy).

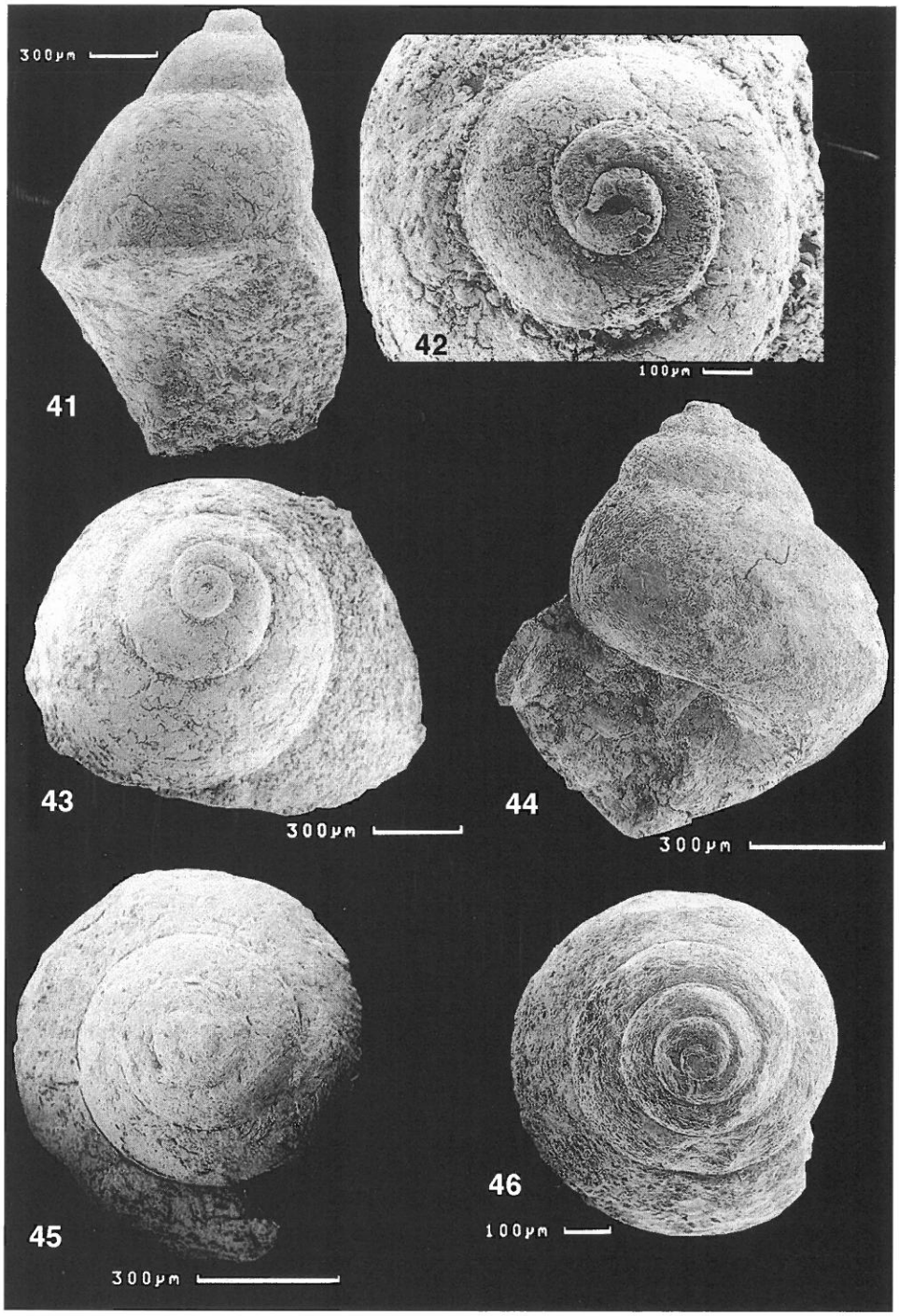
D e s c r i p t i o n : The conical, sinistrally coiled shell is 0,98 mm high and 0,85 mm wide with a pleural angle of 70°. It consists of 4,5 convexly formed whorls, whose diameter increase only slowly. Whorls are oriented obliquely to shell axis as are also the shallow sutures. The periphery of the whorls is somewhat submedian. The outer lip of the aperture is not preserved, the inner lip is broadly flattened and excavated. The protoconch is smooth, flat and narrowly coiled and has an initial diameter of 0,084 mm and a width of the first whorl a little less than 0,1 mm.

Dimensions of a paratype (illustrated fig. 46; SMF XII/ 3437): height: 1,16 mm, width: 0,76 mm, diameter of the protoconch: 0,76 mm

L o c a l i t y : Wachtberg (3 specimens).

D i s c u s s i o n : In contrast to the protoconchs of the Clisospirinae described by Wängberg-ERIKSSON (1979) and DZIK (1983) the protoconchs found in Sötenich are very small. So the classification within the Clisospirinae must be justified by further studies. A similarly small sinistral gastropod with a more pupoid shell shape but similar dimensions of the protoconch has been described as *Onychochilus minutissimus* from the early Carboniferous of Australia by YOO (1988). Both species seems to have been small and remained so during their life-time, since there is no specimen existing with larger dimensions. Of *Sinistriconcha lierli* we have numerous individuals from another locality of the same age and facies, and these are of similar small size.

Fig. 41: *Soetenichia girzenbergense* (KIRCHNER, 1915), lateral view, SMF XII/ 3434. **Fig. 42:** The same shell as on fig. 41, detail of the protoconch, apical view. **Fig. 43:** *Soetenichia girzenbergense* (KIRCHNER, 1915), apical view of a paratype, SMF XII/ 3445. **Fig. 44:** *Sinistriconcha lierli* n. sp., lateral view. **Fig. 45:** *Sinistriconcha lierli* n. sp., the same shell as on fig. 44, apical view with protoconch. **Fig. 46:** *Sinistriconcha lierli* n. sp., apical view of a paratype.


300µm
41
42
100µm
43
300µm
44
300µm
45
300µm
46
100µm

Acknowledgement

We greatly thank to the Wülfrather Zement GmbH & Co. KG., Werk Sötenich for their permission to inspect the quarry at Sötenich, Prof. Dr. G. Becker (Senckenberg, Frankfurt/M) for references and his stratigraphical informations, Dr. Sander (Universität Bonn, collection Dohm) and Dr. A. Prieur (Centre des Sciences de la Terre, Lyon 1, collection Verneuil) for the provision of the collections, Dr. M. Amler (Marburg) for literature, Dr. K. Eiserhardt for making SEM photos, D. Baldus (Fotostudio Baldus, Oberursel) for preparing the plates, Dr. J. Frýda (Prag) for his critical correction, E. Zwiener for language correction, G. Sterrmann und K. Heidelberger for their help in collecting and preparing the studied material.schaft (Selbstverlag): 25 - 47, München.

References

Archiac, E.J.A. de & Verneuil, E. P. de (1841): Note sur le genre *Murchisonia*.-Bulletin de la société géologique de France **12**: 154 - 160, Paris.

- (1842): Memoir on the fossils of the older deposits in the Rhenish Provinces -preceded by a general survey of the fauna of the Palaeozoic rocks, and followed by a tabular list of the organic remains of the Devonian System in Europe. - Transactions of the Geological Society 2nd ser., **6**: 303 - 410, London, Paris.

Bandel, K (1981): Struktur der Molluskenschale im Hinblick auf ihre Funktion.- Paläontologische Kursbücher, Band 1: Funktionsmorphologie, in: Reif, W.-E. (Hrsg.). Paläontologische Gesell

- (1982): Morphologie und Bildung der frühontogenetischen Schale bei conchiferen Mollusken. - Facies **7**, 198 p., Erlangen.
- (1988): Repräsentieren die Euomphaloidea eine natürliche Einheit der Gastropoden?. - Mitt. Geol.-Paläont. Inst. Univ. Hamburg **67**: 1 - 33, Hamburg.
- (1991): Über triassische "Loxonematoidea" und ihre Beziehungen zu rezenten und paläozoischen Schnecken. - Paläontologische Zeitung, **65** (3/4): 239 - 268, Stuttgart
- (1993): Trochomorpha (Archaeogastropoda) aus den St.-Cassian-Schichten (Dolomiten, Mittlere Trias). - Annalen des naturhistorischen Museums in Wien, Ser. **A 95**. Band 1991: 1 - 99, Wien.
- (1997): Higher classification and pattern of evolution of the Gastropoda. - Cour. Forsch.-Inst. Senckenberg **201**: 57 - 81, 1 fig., 3 pl., Frankfurt/M.

Bandel K. & Frýda J. (1998): The systematic position of the Euomphalidae (Gastropoda). - Senckenbergiana lethaea **78** (1/2): 103-131, 1 fig., 5 pl.; Frankfurt/M.

- (1999 in press): Notes on the evolution and higher classification of the subclass Neritimorpha (Gastropoda) with the description of some new taxa. - Geologia et Palaeontologia, Marburg.

Bandel, K.& Geldmacher, W. (1996): The structure of the shell of *Patella crenata* connected with suggestions to the classification and evolution of the Archaeogastropoda. - Freiberger Forschungshefte, C **464**: 1 - 71; Freiberg.

Batten, R. L. (1984): The calcitic wall in the Paleozoic families Euomphalidae and Platyceratidae (Archaeogastropoda).- Journal of Paleontology **58**: 1186 - 1192, Tulsa.

Becker G.(1969): Ostracoda aus dem Mitteldevon der Sötenicher Mulde (N-Eifel). Biostratigraphie, Paläökologie und taxonomische Bemerkungen. - Senckenbergiana lethaea, **50** (2/3): 239-271, 3 Fig., 5 Tab., 1 pl..; Frankfurt am Main.

Blodgett, R.B. (1992): Taxonomy and palaeobiologeographic affinities of an early Middle Devonian (Eifelian) gastropod faunule from the Livengood quadrangle, east-central Alaska. - Palaeontographica Abt. A, **221**:125 - 168, Stuttgart.

Coen-Aubert, M. & Lutte, B.-P. (1990): Massive rugose corals from the Middle Devonian of the North Eifel Hills (Rheinisches Schiefergebirge, West Germany). - Geologica et Palaeontologica, 24: 17-39, 2 Fig., 1 Tab., 5 pl.; Marburg.

COSSMANN, M. (1915): Essais de paléoconchyologie comparée, **10e** livr.; Paris.
DZIK, J. (1983): Larval development and relationships of Mimospirina; a presumably hyperstrophic Ordovician gastropod. - Geologiska Förentingens i Stockholm Förhandlingar **104**: 231 - 239; Stockholm.
- (1994): Evolution of 'small shelly fossils' assemblages of the Early Paleozoic. - Acta Palaeontologica Polonica **39**, 3: 247-313, Warschau.
FRÝDA , J. & BANDEL, K (1997): New Early Devonian gastropods from the *Plectonotus* (*Boucotonotus*) - *Palaeozygopleura* Community in the Prague Basin (Bohemia). - Mitteilungen des Geologisch-Paläontologischen Instituts the Universität Hamburg **80**: 1 - 57, Hamburg
FRÝDA , J. (1998): New data on Paleozoic gastropods. Taxonomy and paleobiology of Devonian gastropods from Bohemia and the Rheinische Schiefergebirge. - Unpublished PH.D thesis at the University of Hamburg.
GOLDFUSS A. (1841 - 44): Petrefacta Germaniae et ea, quae in museo universitatis regiae borussicae Fridericiae Wilhelminae Rhenanae servatur et alia quaecunque in museis Hoeninghausiano, Muensteriano aliisque exstant, iconibus et descriptionibus illustrata. Abbildungen and Beschreibungen der Petrefacten Deutschlands und der angränzenden Länder, unter Mitwirkung des Herrn Grafen Georg zu MÜNSTER. Dritter Theil.: 1 - 128 and pl. 166 - 199, Düsseldorf.
GOLIKOV, A. N. & STAROBOGATOV, Y. I. (1975): Systematics of prosobranch gastropods.- Malacologia **15** (1): 185 - 232, Ann Arbor.
HASZPRUNAR, G. (1985): The Heterobranchia - a new concept of the phylogeny of the higher Gastropoda. - Zeitschrift für zoologische Systematik und Evolutionsforschung **23**: 15 - 37, Hamburg and Berlin.
- (1988): On the origin and evolution of major gastropod groups, with special reference to the Streptoneura.- J. of Molluscan Studies 54: 367 - 441, London.
- (1993): The Archaeogastropoda - A clade, a grade or what else? - American Malacological Bulletin **10**(2): 165 - 177, Houston.
HEIDELBERGER , D. (1999): Mitteldevonische (Givetium) Gastropoda (Mollusca) aus dem Rheinischen Schiefergebirge (Lahngebiet; Sötenicher Mulde). - Dissertation an der Universität Hamburg
HICKMAN, C. S. & MCLEAN, J.H. (1990): Systematic revision and suprageneric classification of trochacean gastropods. - Science Series No. **35**, Natural History Museum of Los Angeles County, 169 p., Los Angeles.
HOARE, R.D. (1980): New Pennsylvanian gastropods from Ohio.- J. of Paleontology **54** (5): 1035 - 1040; Tulsa.
HORNY, R. (1955): Palaeozygopleuridae, nov. fam. (Gastropoda), ze stredoceskeho Devonianu.- Sbornik Ustredniho Ustavu geologickeho, Od paleont. **20**: 17-143, Prag.
- (1992): New Lower Devonian Gastropoda and Tergomya (Mollusca) of Bohemia.- Casopis Národního Muzea, Rada prírodvedná, **1 - 4**: 99 - 110, Praha.
HOLZAPFEL, E. (1895): Das Obere Mitteldevon (Schichten mit *Stringocephalus Burtini* and *Maeneceras terebratum*) im Rheinischen Gebirge. - Abhandlungen der Königlich Preussischen geologischen Landesanstalt N. F., **16**, 460 p.; 19 pl., Berlin.
JHAVERI, R.B. (1969): Unterdevonische Gastropoden aus den Karnischen Alpen. - Palaeontographica Abt. A., **133** (4 - 6): 146 - 176, Stuttgart.
KAUFHOLD, B.(1994): Mittel- und oberdevonische Gastropoden aus der Bergisch Gladbach - Paffrather Mulde. - Unpublished PH.D. thesis at the University of Köln, 177 p.; Bonn, (Mikropress GmbH)
KAYSER, E. (1889): Ueber einige neue und wenig gekannte Versteinerungen des rheinischen Devon. - Zeitschrift der Deutschen Geologischen Gesellschaft, **41**: 288 - 296, pl. 13 - 14, Berlin.
KIRCHNER, H. S. (1915): Mitteldevonische Gastropoden von Sötenich in der Eifel. - Verhandlungen des Naturhistorischen Vereins der preußischen Rheinlande und Westfalen, **71**: 189 - 261, pl. II; Bonn.
KNIGHT, J.B. (1933): The gastropods of the St. Louis, Missouri, Pennsylvanian outlier: V. The Trocho-Turbinidae.- J. of Pal., Vol. 7, No. 1: 30 - 58, pl. 8 - 12; Tulsa.
- (1941): Paleozoic gastropod type species.- Bulletin of the Geological Society of America, Spec.

Paper: **32**, 510 p., 96 pl., New York.

KNIGHT, J. B.; COX, L. R.; MYRA, A.; BATTEN, R. L.; YOCHELSON, E. L. & ROBERSON, R. (1960): Systematic descriptions (Archaeogastropoda). - 169 - 324. Treatise on Invertebrate Paleontology (MOORE, R.C. Ed.), Part I, Mollusca 1.- 351 S., Lawrence, Kansas (Geological Society of America, New York, and University Kansas Press).

KOKEN, E. (1889) : Ueber die Entwicklung der Gastropoden vom Cambrium bis zur Trias.- Neues Jahrbuch für Mineralogie, Geologie und Paläontologie.: 305 - 484, pl. 10 - 14, Stuttgart

- (1896): Die Leitfossilien, ein Handbuch für den Unterricht und das Bestimmen von Versteinerungen.- 848 p., Leipzig.

KONINCK, L.. de (1881): Faune du calcaire carbonifère de la Belgique. - 3ième partie: Gastéropodes.- Annales du musée royal d'histoire naturelle de Belgique, série paléontologique, **6**: 170 p., 21 pl., Brüssel.

LINSLEY, R. M. & KIER, W.M. (1984): The Paragastropoda: a proposal for a new class of Paleozoic Mollusca.- Malacologia **25**(1): 241 - 254, Ann Arbor.P

LINSLEY R. M. & YOCHELSON, E.L. (1973): Devonian carrier shells (Euomphalidae) from North America and Germany.- Geological Survey Prof.Pap. **824**: 1 - 23 and pl. 1 - 6, Washington

LUTTE, B.-P. (1984): Rugose Korallen aus dem Mitteldevon (Givetium) der Sötenicher Mulde (Rheinisches Schiefergebirge, Nord-Eifel). - Münstersche Forsch. Geol. Paläont., **61**: 175-243, 12 Fig., 2 Tab., 9 pl.; Münster.

- (1993): Zur stratigraphischen Verteilung tabulater Korallen im Mittel-Devon der Sötenicher Mulde (Rheinisches Schiefergebirge, Nord-Eifel). - Geologica et Palaeontologica, **27**: 55-71, 2 Fig., 2 Tab., 2 pl.; Marburg.

LUTTE, B.-P. & OEKENTHORP, K. (1988): Rugose Korallen aus der Cürten-Formation (Givetium) der Sötenicher Mulde (Rheinisches Schiefergebirge, Nord-Eifel). - N. Jb. Geol. Paläont., Abh., **176** (2): 213-243, 4 Fig., 1 Tab.; Stuttgart.

NÜTZEL, A. (1998): Über die Stammesgeschichte der Ptenoglossa (Gastropoda).- Berliner geowissenschaftliche Abhandlungen, Reihe E, Band **26**; 215 S., 34 Taf.; Berlin.

PAECKELMANN, W. (1922): Der mitteldevonische Massenkalk des Bergischen Landes.- Abhandlungen der Preußischen Geologischen Landesanstalt, N.F., **91**, 112 p., Berlin.

PERNER, J. (1907): Gastéropodes. II. Pleurotomaridae etc; Ctenobranchia. in: Barrande, J.: Système silurien du centre de la Bohème. 1´ere partie: Recherches paléontologiques. Vol. **IV**: 380 p., pl. 90 - 175, Prag

PHILIPS, J. (1841): Figures and descriptions of the Palaeozoic fossils of Cornwall, Devonian and West Somerset; observed in the course of the ordnance geological survey of that district. - 231 S., pl. I - LX, London . (LONGMAN, BROWN, GREEN, & LONGMANS).

ROEMER, C. F. (1876): Lethaea geognostica oder Beschreibung und Abbildung der für die Gebirgs-Formationen bezeichnendsten Versteinerungen. I. Theil: Lethaea palaeozoica. - 323 S., pl. 26 - 32, Stuttgart.

SALVINI-PLAWEN, L. v. (1980): A reconsideration of systematics in the Mollusca (Phylogeny and higher classification).- Malacologia **19** (2): 249 - 278, Ann Arbor.

SALVINI-PLAWEN, L. v. & HASZPRUNAR, G. (1987): The Vetigastropoda and the systematics of streptoneurous Gastropoda (Mollusca).- Journal of Zoology, **A 211**: 747- 770, London.

SANDERBERGER & SANDERBERGER, G. & F. (1850 - 1855): Die Versteinerungen des Rheinischen Schichtensystems in Nassau.- 564 p., Wiesbaden (Kreidel und Niedner, Verlagshandlung)

SCHLOTHEIM, E. F. von (1820): Die Petrefactenkunde auf ihrem jetzigen Standpunkte durch die Beschreibung seiner Collection versteinerter and fossiler Überreste des Thier- und Pflanzenreichs der Vorwelt. - 1 - 436, Gotha.

- (1822, 1823): Nachträge 1. Teil. - 1 - 100; Nachträge 2. Teil, Gotha.

SCHLÜTER, C. A. J. (1894): Über einige neue Fossilien des rheinischen Devon.- Verhandlungen des naturhistorischen Vereins der preussischen Rheinlande, Westfalens und des Regierungs-Bezirks Osnabrück. **51**. Jahrgang: 63 - 69, Bonn.

WÄNGBERG-ERIKSSON K. (1979): Macluritacean gastropods from the Ordovician and Silurian of Sweden. - Sveriges Geologiska Undersokning C, **753**: 1 - 33, Stockholm.

WEBERS, G.F., POJETA, J.Jr. & YOCHELSON, E.L. (1992): Cambrian Mollusca from the Minaret Formation, Ellsworth Mountains, West Antarctica. - Geol. Soc. of America, Memoir **170**: 181 - 248, Boulder.

WENZ, W. (1938-1960): Gastropoda, Teil 1: Allgemeiner Teil und Prosobranchia (in SCHINDEWOLF O. H. (Hrsg.): Handbuch der Paläozoologie, Bd. **6**, 1639 p., Berlin (Verlag Gebrüder Borntträger).

WHIDBORNE, G. F. (1891): A monograph of the Devonian fauna of the south of England. Part III: The fauna of the limestones of Lummaton, Wolborough, Chircombe Bridge, and Chudleigh.- Palaeontological Society Monographs,: 155 - 250, pl. 16 - 24, London.
(1892): ibid., Part **IV**: 251 - 344, pl. 25 - 31, London.

WHITEAVES, J.F. (1885-98): Contributions to Canadian Palaeontology. Vol. 1, 6. The Fossils of the Devonian rocks of the islands, shores or immediate vicinity of Lakes Manitoba and Winnepogosis.- 255 - 342, Ottawa.

YOCHELSON, (1956): Euomphalacea, Trochonematacea, Pseudophoracea, Anomphalacea, Craspedostomatacea, and Platyceratacea, Permian Gastropoda of the southwestern United States. - Bulletin of the American Museum of Natural History **110**: 173 - 275.

YOO, E. K. (1988): Early Carboniferous Mollusca from Gundy, Upper Hunter, New South Wales. - Records of the Australian Museum **40**: 233-264, Sydney.

- (1994): Early Carboniferous Gastropoda from the Tamworth Belt, New South Wales, Australia. - Records of the Australian Museum **46**: 63 - 120, Sydney.