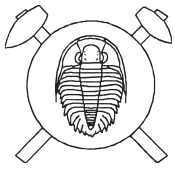
Two new gastropod genera (Porcellioidea, Archaeogastropoda) from the Lower Carboniferous of Belgium



Dva nové gastropodové rody (Porcellioidea, Archaeogastropoda) ze spodního karbonu Belgie (Czech summary)

(2 Figs)

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Two new gastropod genera, *Martinidiscus* gen. nov. (Porcellinae) and *Pauquysia* gen. nov. (Agnesiinae), are described from the Lower Carboniferous of Belgium. Morphology of their juvenile teleoconchs places them into the family Porcelliidae (Porcellioidea, Archaeogastropoda).

Key words: Paleozoic, Carboniferous, Gastropoda, Porcellioidea, new taxa, sinistral heterostrophy

Introduction

During the last 10 years, much new information on early shell ontogeny of the Paleozoic gastropods has been gathered and used for the evaluation of their higher taxonomic positions. These studies have contributed considerably to our knowledge of the evolution of Paleozoic gastropods (see review in Frýda and Rohr 2004). In addition, they have revealed new diagnostic features for some poorly known gastropod groups. The Paleozoic Porcellioidea, which developed sinistrally or planispirally coiled teleoconchs, represent a good example of such a group. The above mentioned studies have also revealed that the generic diversity of the Paleozoic superfamily Porcellioidea was much higher than it was believed. Members of this group can be easily distinguished from other Paleozoic gastropod groups by the ontogenetic change of their shell coiling from dextral to sinistral. Such an unusual shell feature, termed sinistral heterostrophy, has been reported only from two gastropod groups, Heterobranchia and Archaeogastropoda. However, as shown by Frýda and Blodgett (2001, 2004) the heterostrophy found in the Heterobranchia and Archaeogastropoda is not homologous. The Porcellioidea can be thus easily distinguished by this shell feature from other Paleozoic gastropods. Bandel (1993) was the first who used the characteristic change of the shell coiling, which occurred during early shell ontogeny, as a diagnostic feature of the Porcellioidea. According to his interpretation, the Paleozoic Porcelliidae included only five genera (*Porcellia* Léveillé, 1835; *Agnesia* de Koninck, 1883; *Hesperiella* Holzapfel, 1889; *Antitrochus* Whidborne, 1891; and *Coloniacirrus* Bandel, 1993). Later, Frýda (1997) reported the oldest representatives of the Porcelliidae from the Silurian strata of the Prague Basin. These gastropods belonging to the genera *Barrandecirrus* Frýda, 1997, and *Pernericirrus* Frýda, 1997, are hitherto the only Early Paleozoic members of the Porcellioidea. During the last 10 years, most studies of the early shell ontogeny were focused on the Mid Paleozoic gastropods. For this reason, almost all newly described porcellioidean genera come from the Devonian strata. During the last five years, seven additional Devonian genera (*Alaskiella* Frýda and Blodgett, 1998; *Anoriostoma* Farrell, 1992; *Garraspira* Frýda and Farrell, in press, *Koneprusellia* Frýda, 1998; *Krolmusium* Horný, 2002; *Paragnesia* Blodgett and Frýda, 1999, and *Trochagnesia* Heidelberger, 2001) were established as new taxa or recognized to belong to the Porcellioidea. In contrast to the Mid Paleozoic taxa, a majority of the Late Paleozoic Porcellioidea have not been revised for over 100 years. Ongoing studies of the Carboniferous gastropods from western European basins have revealed also a relatively high generic diversity of the Porcellioidea in these faunas. Recently, Bandel and Frýda (2004) described a new Early Carboniferous genus, *Sasakiela*, from Belgium. The present short paper is the second contribution to our knowledge of the Early Carboniferous Porcellioidea from Belgium. A paper with detailed descriptions of all Belgian Carboniferous species belonging to the Porcellioidea as well as the evaluation of their paleogeographical and stratigraphical distributions is in preparation. Both papers are a result of the author's stay at the Institut royal des Sciences naturelles de Belgique, which was supported by the ABC Programme (European Commission – Human Potential Programme). All the herein described specimens are kept in the collection of the Institut royal des Sciences naturelles de Belgique, Bruxelles.

Systematic paleontology

Class G a s t r o p o d a Cuvier, 1797
Subclass A r c h a e o g a s t r o p o d a Thiele, 1925
Order V e t i g a s t r o p o d a Salvini-Plawen, 1980
Superfamily P o r c e l l i o i d e a Koken in Zittel, 1895

D i a g n o s i s : Gastropoda with dextral coiling in the early teleoconch whorls, sinistral or planispiral coiling in the later teleoconch whorls, and characteristic protoconch of the Archaeogastropoda.

Remarks: The extinct superfamily Porcellioidea unites two families, the Mesozoic Cirridae and the Paleozoic Porcelliidae. The oldest members of the Porcelliidae have been reported from Silurian strata (Frýda 1997). The last Cirridae are known from the Late Cretaceous (Kiel and Bandel 2001). Kiel and Frýda (2004) documented the presence of nacreous shell structure in the Late Cretaceous cirrid *Sensuitrochus ferreri* Quintero and Revilla, 1966, and this fact supports a placement of the Cirridae into the order Vetigastropoda.

Family Porcelliidae Koken in Zittel, 1895
Subfamily Porcelliinae Koken in Zittel, 1895

Diagnosis: Porcelliids with planispiral coiled teleoconchs and with selenizone situated around or in the middle of dorsum.
Remarks: The teleoconchs of all hitherto known members of the Porcelliinae bear a selenizone. The position of this shell structure varies slightly in evolutionary older porcelliids. The selenizone is situated around, or in the middle of, dorsum in the Early and Mid Paleozoic Porcelliinae. However, the selenizone of the Late Paleozoic Porcelliinae occurs only in the middle of dorsum.
Genera included: *Barrandecirrus* Frýda, 1997, *Coloniacirrus* Bandel, 1993, *Martinidiscus* gen. nov., *Porcellia (Paraporcellia)* Blodgett and Johnson, 1992, and *Porcellia (Porcellia)* Léveillé, 1835.

***Martinidiscus* gen. nov.**

Type species: *Conchyliolithus Nautilus Ammonites woodwardii* Martin, 1809, from the Carboniferous of England.
Etymology: In honour of W. Martin, who discovered this fossil and described in his *Petrificata Derbiensia*.

Diagnosis: Porcelliid gastropod with a narrow planispiral teleoconch; deltoid aperture in adult teleoconch being the widest in its adaxial part; adaxial and abaxial parts of whorls separated by distinct acute keels, one on upper and one on basal whorl surface; a narrow selenizone in the middle of narrow dorsum; juvenile teleoconch dextrally coiled; shell ornamented by numerous, spirally arranged pustules.
Comparison: *Martinidiscus* gen. nov. differs from the genus *Porcellia* Léveillé, 1835, in its much narrower teleoconch and in the type of its shell ornamentation (Figs 1a–j). Teleoconchs of the type species of *Porcellia*, *Porcellia puzo* Léveillé, 1835, are ornamented on both whorl sides by a series of prominent nodes, which are somewhat lengthened radially (Fig. 1i). The Early Carboniferous *Martinidiscus* gen. nov. differs from the species belonging to the Devonian genus *Coloniacirrus* Bandel, 1993, in the presence of distinct acute keels, separating adaxial and abaxial parts of whorl surface, and in the type of shell ornamentation. The teleoconchs of *Coloniacirrus* species have oval apertures and their shell ornamentation consists of fine sinuous collabral ribs. The species of the Silurian *Barrandecirrus* Frýda, 1997, differ from the *Martinidiscus* gen. nov. in having a rounded aperture and a different shell ornamentation (see Frýda 1997).
Remarks: On his plate 35 (figures 4 and 5), Martin (1809) figured oblique and lateral views of planispirally coiled shells, for which he used the name *Conchyliolithus Nautilus Ammonites woodwardii*. According to de Koninck (1843, 1883) this species is conspecific with his *Porcellia woodwardii* from the Carboniferous of Belgium. Judging from the description and figures of Martin (1809), I agree with de Koninck's interpretation. However, Batten (1966) and Peel (1986) mentioned J. de C. Sowerby (1829) to be the author of the latter species. A more detailed analysis of this problem can be found in Frýda (in prep.).
Species included: Only *Martinidiscus woodwardii* (Martin, 1809).

***Martinidiscus woodwardii* (Martin, 1809)**
Figs 1a–h

Holotype: Shell figured by Martin (1809, plate 35, figures 4 and 5).
Material: Seventeen shells from the Visé (V2) including specimen figured by de Koninck (1883, plate 35, fig. 19).
Occurrence: *Martinidiscus woodwardii* (Martin, 1809) is hitherto known from the Carboniferous strata of England and Belgium.

Description: Disc-shaped, strongly flattened shell with up to 7 whorls; width of the adult narrow teleoconch is about one third of its diameter (Fig. 1h); planispirally coiled teleoconch bears a narrow selenizone situated close to the middle of its dorsum; width of the selenizone is about 2 percent of the width of dorsum (Figs 1a–b, h); deltoid aperture in adult teleoconch being the widest in its adaxial part; adaxial and abaxial parts of whorls separated by distinct acute keels, one on upper and one on basal whorl surfaces (Figs 1c–g); shell ornamented by numerous, spirally arranged pustules (Figs 1a–g); about two whorls of the juvenile teleoconch are dextrally coiled (Fig. 1c).
Remarks: Peel (1986) described muscle scars in the Carboniferous *Martinidiscus woodwardii* (Martin, 1809) from England. This species possessed two muscle scars, which are located at approximately corresponding positions on the upper and basal whorl surfaces. According to this author, similar positions of muscle scars in the latter genus and *Bellerophon* Montfort, 1808, reflect morphological convergence of their shells.

Subfamily Agnesiinae Knight, 1956

Diagnosis: Porcelliids with a sinistrally coiled, trochiform teleoconch and with dextrally coiled initial teleoconch whorls; teleoconch with or without apertural slit.
Remarks: Generic content of the subfamily Agnesiinae was recently summarized by Frýda (1997) and Frýda and Blodgett (1998). The recent revision of the Paleozoic gastropod faunas of Europe and Australia has revealed additional new genera which were placed into the Agnesiinae, five Devonian genera (*Paragnesia* Blodgett and Frýda, 1999, *Trochagnesia* Heidelberger, 2001, *Anorios-*

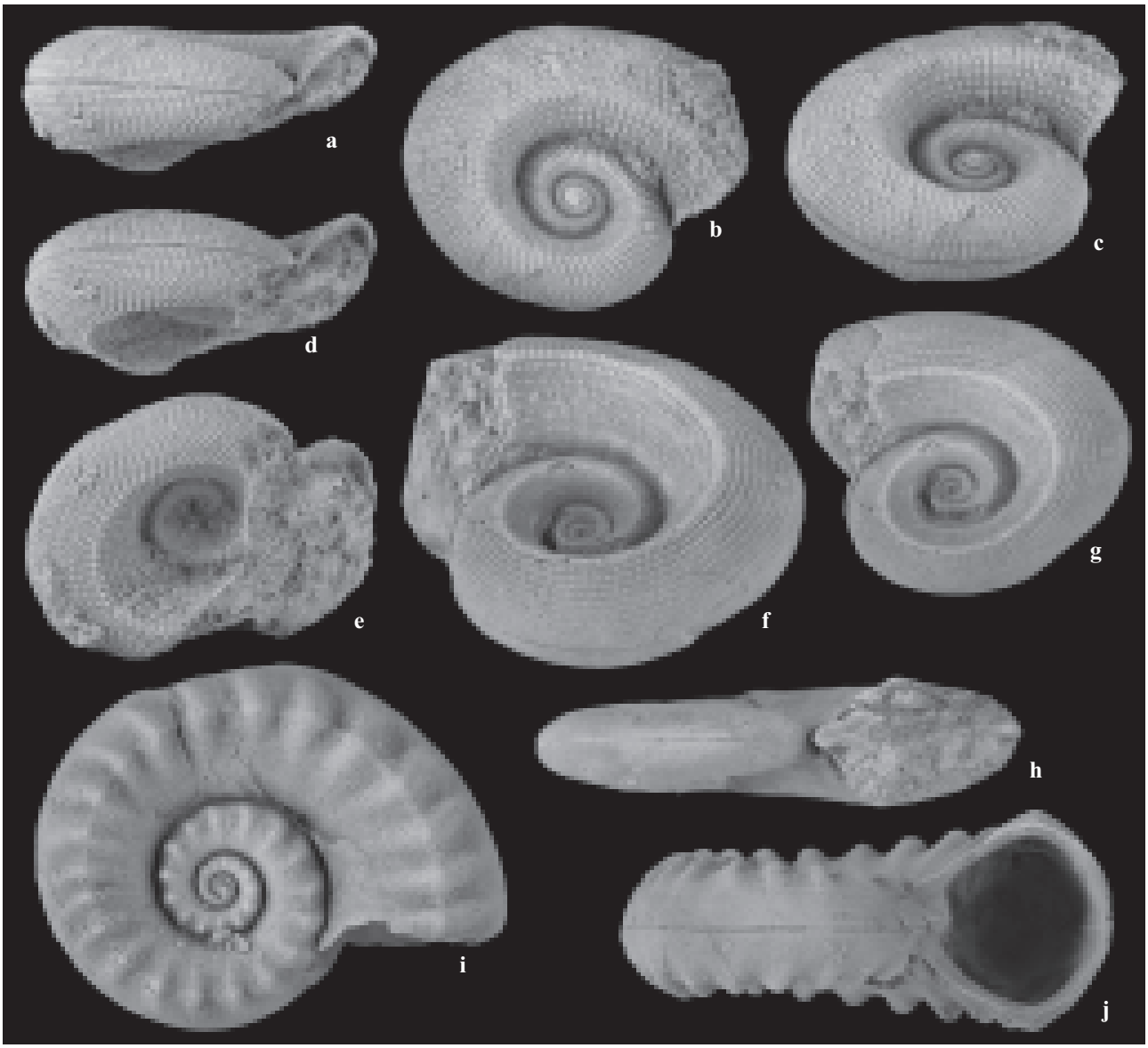

Fig. 1. a–h – *Martinidiscus woodwardii* (Martin, 1809) from the Lower Carboniferous strata of Belgium. a–e, juvenile shell, collection of de Ryckholt, 1063, Visé V2, I.G. 3440; a – dorsal view showing rounded dorsum bearing a narrow selenizone; b, c – apical and oblique views showing dextrally coiled juvenile whorls; d, e – two oblique basal views, all ×5; f, g – oblique basal views showing a keel separating abaxial and adaxial whorl surfaces, slightly deformed shell from the same collection, f – ×2.5, g – ×2; h – apertural view of adult shell figured by de Koninck (1883, plate 35, fig. 19), collection of de Ryckholt, 1063, Visé V2, A-4077, ×2; i–j – *Porcellia puzo* Léveillé, 1835, from the Lower Carboniferous strata of Belgium. This shell was figured by de Koninck (1883, plate 35, figs 26–28), Etage de Tournai, Tournai, A-4078. i – apical view showing shell ornamentation. j – apertural view; both ×1.5.

toma Farrell, 1992, *Krolmusium* Horný, 2002, and *Garraspira* Frýda and Farrell, in press) and one genus from the Lower Carboniferous strata (*Sasakiela* Bandel and Frýda, 2004). A paper with detailed descriptions of all species of the Agnessinae, the analysis of their taxonomic positions as well as the evaluation of their paleogeographical and stratigraphical distributions is in preparation.

The oldest member of the Agnesiinae, *Pernericirrus sinistorsus* (Perner, 1907), was reported from early Upper Silurian strata within the Prague Basin (Frýda 1997). The Agnesiinae reached the highest diversity during the Devonian. The Triassic *Enantiostoma* Koken, 1896, probably represents the youngest and only post-Paleozoic member of the Agnesinae. However, its protoconch morphology is still unknown; therefore, no equivocal evidence exists that any members of the Agnesiinae or Porcelliinae survived the Permian/Triassic extinction event. Genera included: *Agnesia* de Koninck, 1883, *Alaskiella* Frýda and Blodgett, 1998, *Anoriostoma* Farrell, 1992, *Antitrochus* Whidborne, 1891, *Garraspira* Frýda and Farrell, press, *Hesperiella* Holzapfel, 1889, *Koneprusellia* Frýda, 1998, *Krolmusium* Horný, 2002, *Paragnesia* Blodgett and Frýda, 1999, *Pauquysia* gen. nov., *Pernericirrus* Frýda, 1997, *Sasakiela* Bandel and Frýda, 2004, *Trochagnesia* Heidelberger, 2001, and *Enantiostoma* Koken, 1896.

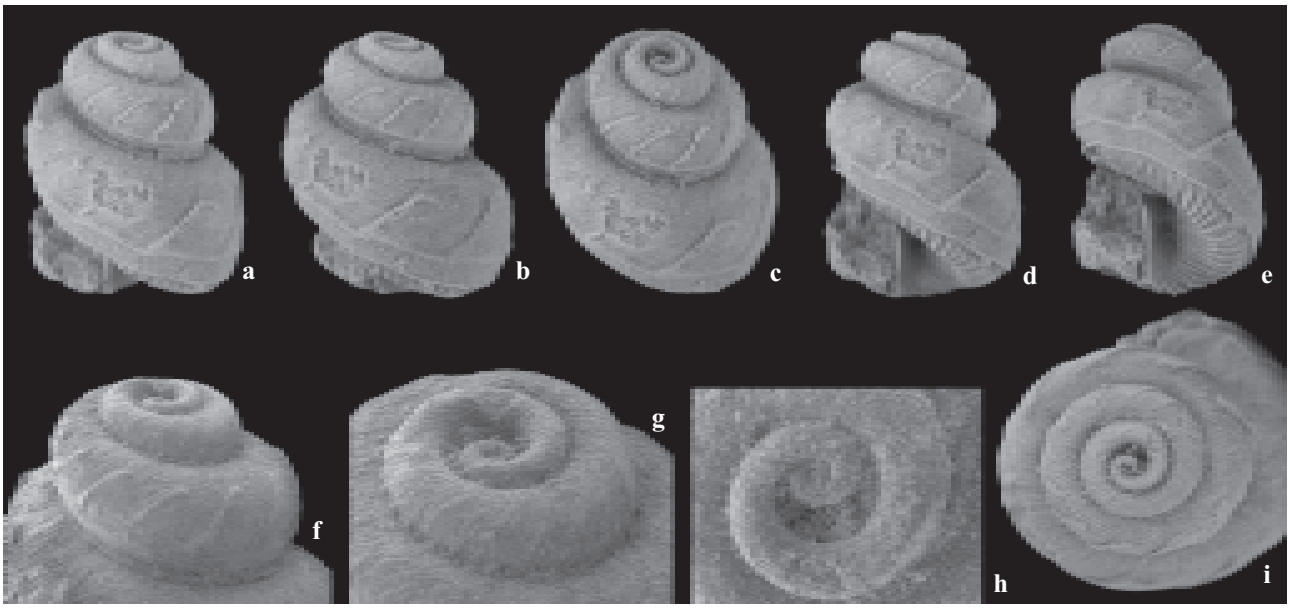

Fig. 2. a–i – Holotype of *Pauquysia discrepans* (de Koninck, 1883) from the Lower Carboniferous strata of Belgium. This shell was figured by de Koninck (1883, plate 33, figs 26–29) and it comes from the Pauquys, Etage de Waulsort, W2a, A-4061; a–c – three different oblique views showing concave shell apex; d–e – lateral and oblique basal views of the same shell showing its wide sellenizone and ornamentation of the shell base, a–e – ×6; f, g – oblique views of the concave shell apex formed by the base of its initial whorls, f – ×10, g – ×19; h – detailed view of the shell apex showing dextrally and closely coiled first teleoconch whorl and openly coiled subsequent whorl, ×22; i – apical view, ×9.

Pauquysia gen. nov.

Type species: *Agnesia discrepans* de Koninck, 1883, from the Early Carboniferous of Belgium.
Etymology: After Pauquys, Belgium, where it was discovered.

Diagnosis: A small member of Agnessiinae with pupiform teleoconch; broad selenizone situated just above impressed suture; concave apex of the sinistral teleoconch formed by the base of initial whorls; initial part of shell (about one whorl) dextrally and closely coiled; second whorl is openly and planispirally coiled; later teleoconch whorls are sinistral; whorl surface above selenizone ornamented by widely spaced, sinuous ribs; narrowly phaneromphalous shell base bears distinct, closely spaced ribs.
Comparison: The presence of an uncoiled initial whorl in *Pauquysia* gen. nov. distinguishes it from all other genera of the Agnesiinae. The only exception is the Early Carboniferous *Sasakiela* Bandel and Frýda, 2004, having the first two whorls openly and planispirally coiled. *Pauquysia* gen. nov. differs from the latter genus in its teleoconch shape and shell ornamentation. The first genus has pupiform teleoconch in contrast to a low trochospiral teleoconch of *Sasakiela*. In addition, teleoconch ornament of *Sasakiela* consists of fine collabral threads.
Species included: Only *Pauquysia discrepans* (de Koninck, 1883).

Pauquysia discrepans (de Koninck, 1883)
Figs 2a–i

Holotype: Shell figured by de Koninck (1883, plate 33, figs 26–29) and here on figure 2.

Material: Three shells from the Pauquys (Etage de Waulsort, W2a) including a holotype figured by de Koninck (1883, plate 33, figs 26–29).
Occurrence: *Pauquysia discrepans* (de Koninck, 1883) is hitherto known only from the Lower Carboniferous strata of Belgium.

Description: Shell small, pupiform, with rounded, strongly convex whorls (Figs 2a–e); concave apex of the sinistral teleoconch is formed by the base of initial whorls; initial part of shell (about one whorl) dextrally and closely coiled; second whorl is openly and planispirally coiled (Figs 2c, f–i); inner diameter of the openly coiled second whorl is about 0.6 mm; later teleoconch whorls are sinistrally coiled (Figs 2a–i); broad selenizone is situated just above the suture; width of the selenizone is about one fifth of the distance of sutures; selenizone flat and bounded by two spiral cords, one on each side (Figs 2d–e); teleoconch whorls between impressed sutures symmetrically arched (Figs 2a–f); shell base rounded and narrowly phaneromphalous; whorl surface above selenizone ornamented by widely spaced, sinuous ribs (Figs 2a–f); rounded shell base bears distinct, numerous, closely spaced ribs (Figs 2d–e).
Remarks: The first whorl of *Pauquysia discrepans* (de Koninck, 1883) is dextrally and closely coiled like those in all other genera of Agnesiinae with the only exception (*Sasakiela* Bandel and Frýda, 2004). However, second whorl of the *Pauquysia discrepans* is openly and planispirally coiled like that in *Sasakiela*. Bandel and Frýda (2004) suggested that a lack of distinct dextral coiling in the early shell whorls of *Sasakiela* is a derived shell feature, which originated probably due to the development of open coiling. Morphology of the early shell

in the *Pauquysia discrepans* (de Koninck, 1883) supports the latter opinion.

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Dva nové gastropodové rody (Porcellioidea, Archaeogastropoda) ze spodního karbonu Belgie (Czech summary)

Dva nové gastropodové rody, *Martinidiscus* gen. nov. (Porcellinae) a *Pauquysia* gen. nov. (Agnesiinae), jsou popsány ze spodního karbonu Belgie. Na základě morfologie juvenilních teleoconch jsou tyto rody umístěny do čeledi Porcelliidae (Porcellioidea, Archaeogastropoda).