

The Frasnian Pentamerida and Atrypida (Brachiopoda) from the Reichle quarry (Eifel, Germany)

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Abstract

The authors describe the pentamerid and atrypid brachiopods collected mainly on the north side of the access road to the Reichle quarry ('Ooser Plattenkalk'; Wallersheim-Loch, Eifel, Germany). The pentamerid brachiopods are rare and questionably assigned to the genus *Neometabolita* GODEFROID, 1974. The atrypid brachiopods belong to the genera and subgenera *Costatrypa* COPPER, 1973, *Spinatrypa* (Exatrypa) COPPER, 1967, *Iowatrypa* COPPER, 1973 and *Desquamatia* (Desquamatia) ALEKSEEVA, 1960. The atrypid fauna collected on the north side of the access road to the Reichle quarry is very close to the one present in the Neuville Formation (Frasnian, *Palmatolepis rhenana* conodont Zone) on the southern border of the Dinant Synclinorium (Belgium).

Key-words: Brachiopods. Pentamerida. Atrypida. Frasnian. Eifel. Germany.

Résumé

Les auteurs décrivent les brachiopodes pentameridés et atrypidés récoltés principalement sur le côté nord du chemin d'accès à la carrière Reichle ('Ooser Plattenkalk'; Wallersheim-Loch, Eifel, Allemagne). Les pentameridés sont rares et attribués avec doute au genre *Neometabolita* GODEFROID, 1974. Les atrypidés appartiennent aux genres et sous-genres *Costatrypa* COPPER, 1973, *Spinatrypa* (Exatrypa) COPPER, 1967, *Iowatrypa* COPPER, 1973 et *Desquamatia* (Desquamatia) ALEKSEEVA, 1960. La faune d'atrypidés récoltée sur le côté nord du chemin d'accès à la carrière Reichle est très proche de celle présente dans la Formation de Neuville (Frasnien, Zone des conodontes à *Palmatolepis rhenana*) sur le bord sud du Synclinorium de Dinant (Belgique).

Mots-clefs: Brachiopodes. Pentamerida. Atrypida. Frasnien. Eifel. Allemagne.

Kurzfassung

Die Autoren beschreiben die pentameriden und atrypiden Brachiopoden, die vorwiegend auf der N-Seite des Zufahrweges zum Steinbruch Reichle (Ooser Plattenkalk; Wallersheim-Loch, Prüm Mulde, Eifel, Deutschland) gesammelt wurden. Die pentameriden Brachiopoden sind verhältnismässig selten und gehören wahrscheinlich zur der Gat-

tung *Neometabolita* GODEFROID, 1974. Die atrypiden Brachiopoden gehören zu den Gattungen und Untergattungen *Costatrypa* COPPER, 1973, *Spinatrypa* (Exatrypa) COPPER, 1967, *Iowatrypa* COPPER, 1973 und *Desquamatia* (Desquamatia) ALEKSEEVA, 1960. Die Atrypa-Fauna von der N-Seite des Zufahrweges zum Steinbruch Reichle steht der Atrypa-Fauna der Neuville Formation (Frasnium, *Palmatolepis rhenana*-Conodontzone) vom Südrand der Dinant-Mulde sehr nahe.

Schlüsselwörter: Brachiopoden. Pentamerida. Atrypida. Frasnium. Eifel. Deutschland.

Introduction

The Reichle quarry is situated about 1.4 km WSW of the village of Wallersheim-Loch in the Prüm Syncline (Eifel, Germany) (Fig. 1). In February 1976, one of us (J.H.) and his father discovered a highly fossiliferous layer in the exposures along the access road to the quarry and collected there year after year a rich invertebrate fauna including numerous corals, brachiopods, crinoids, bivalves, gastropods and cephalopods. The main fossiliferous layer, made up of marls and marly limestones, is about 1-1.5 m thick and located on the north side of the access road, close to the entrance of the quarry. Fossils (brachiopods and crinoids) are particularly abundant in a thin level of grey marls of variable thickness (2-6 cm) at the base of the layer. In 1982, A. and J. Hauser notified the Forschungsinstitut Senckenberg of this important fossil locality. In 1987, a team of this Institution (R. Birenheide, W. Struve, R. Werner) carried out the geological survey of the outcrops. Trenches were dug along the access road and additional palaeontological samples were collected.

Up to now, a detailed stratigraphic study of the outcrops has never been published. According to the short report and description of WERNER (1988, p. 350) and BIRENHEIDE (1991, pp. 40-42) the fossiliferous layer belongs to the 'Ooser Plattenkalk' and overlays the 'Wallersheimer Dolomit' mined in the quarry (STRUVE, 1990, pp. 271-272).

The knowledge of the fauna collected at the Reichle quarry is still incomplete. STRUVE (1988, p. 348, fig. 4a-e; 1990, p. 272) points out the occurrence of *Hypothyridina* sp. aff. *cuboides*. BIRENHEIDE (1991, p. 42) draws the list

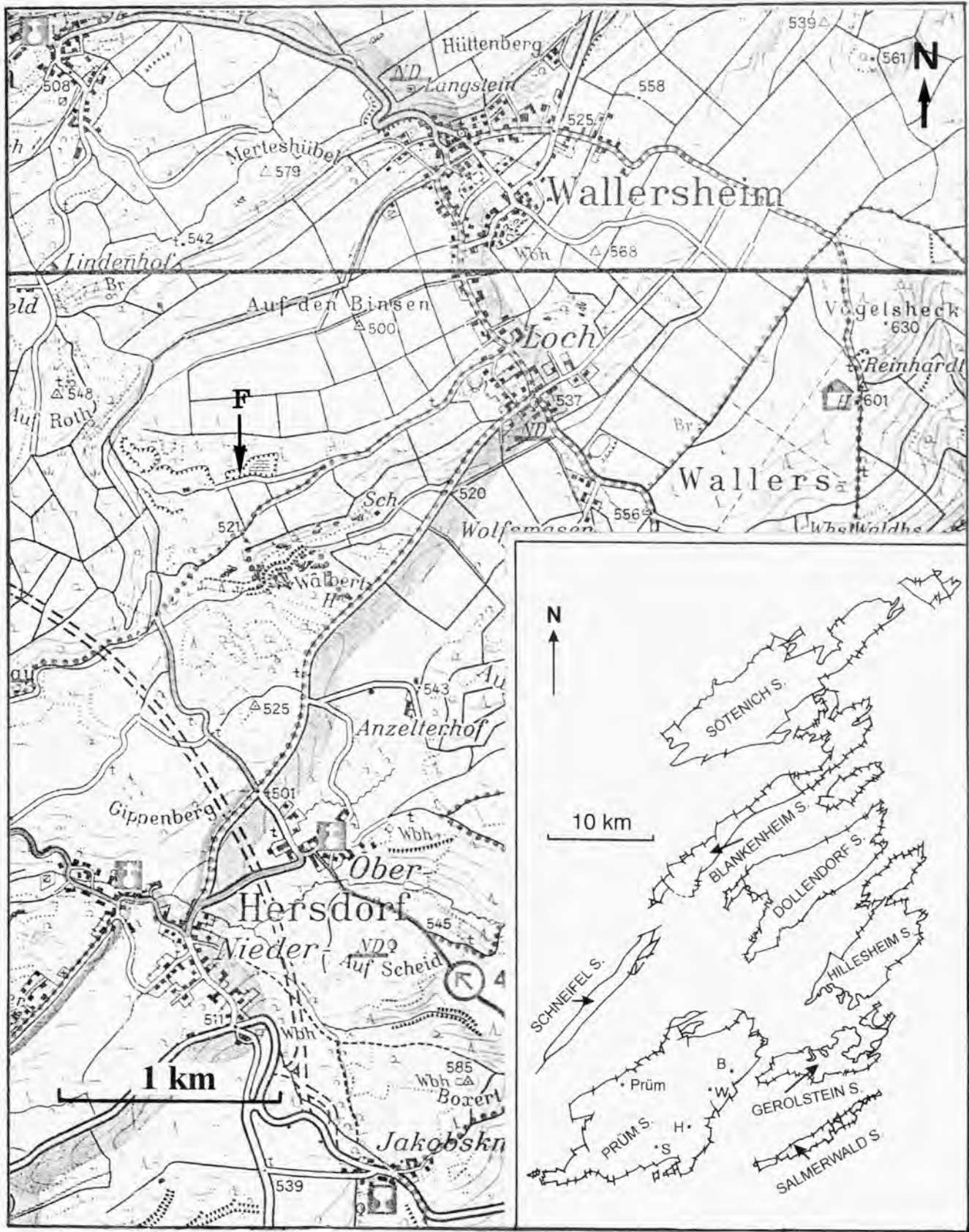


Fig. 1 — Map showing the fossiliferous layer (F) in the access road to the Reichle quarry. Lower right: Schematic geological map of the Eifel Synclines (from STRUVE, 1982, fig. 1). B = Büdesheim; H = Heisdorf; S = Schöneken; W = Wollersheim.

of the species present in the coral fauna at the top of the "Wallerseimer Dolomit" and in the "Ooser Plattenkalk" without specifying if these species have been collected at the Reichle quarry. GRUNT & RACKI (1998, pp. 370-372, figs. 7, 8) erect the new species *Pachyplaxoides postgyralea* based on the holotype from the Reichle quarry. HAUSER (2002) describes the crinoid fauna. Concerning the conodont fauna and according to ZIEGLER (written communication, August 15, 1994), the fossiliferous layer belongs to the Early and Late *rhenana* Zones (see also GRUNT & RACKI, 1998, p. 370, type horizon of *P. postgyralea*).

In this paper we describe the gypidulid and atrypid brachiopods, based on 114 specimens. Most of them were collected by A. and J. Hauser, the others by the above-mentioned "Senckenberg team". The material is stored in the collections of the Forschungsinstitut Senckenberg at Frankfurt am Main (SMF 65888-66001).

Systematic palaeontology

Order Pentamerida SCHUCHERT & COOPER, 1931
 Suborder Pentameridina SCHUCHERT & COOPER, 1931
 Superfamily Pentameroidea M'COY, 1844
 Family Pentameridae M'COY, 1844
 Subfamily Gypidulinae SCHUCHERT & LEVENE, 1929

Genus *Neometabolipa* GODEFROID, 1974

TYPE SPECIES: *Neometabolipa duponti* GODEFROID, 1974

Neometabolipa? sp.
 Figure 2

DESCRIPTION

External characters

General characters

The strongly ventribiconvex shell is wider than long with the hinge line shorter than the width. In ventral view, the outline is roughly rounded pentagonal. The anterior commissure is sulcate.

Pedicle valve

The valve is about two times wider than thick, and strongly and irregularly arched in posterior view, with the median part corresponding to the fold clearly distinct from the lateral ones. The fold originates just posteriorly to the mid-length and becomes sharper from the mid-length anteriorly. The width of the fold at the anterior margin corresponds to 60%-67% of the width of the shell. The strongly inflated umbo extends markedly posteriorly to the hinge line. The well exposed, concave interarea, apsacline at its base, has rounded lateral margins. The delthyrium is open. The incurved beak does not overhang the dorsal umbo.

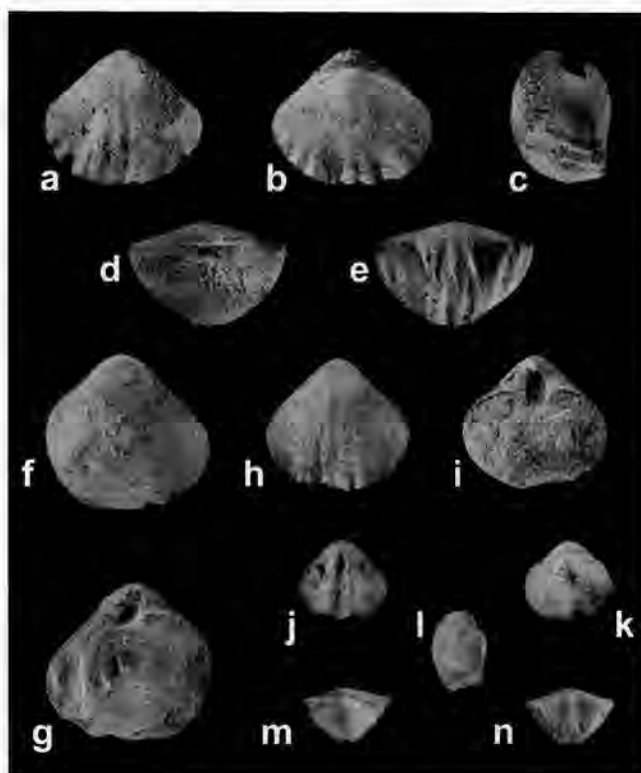


Fig. 2 — *Neometabolipa*? sp. a-e: SMF 65888, ventral, dorsal, lateral, posterior and anterior views. f, g: SMF 65889, exterior and interior of a pedicle valve. h, i: SMF 65890, exterior and interior of a pedicle valve. j-n: SMF 65891, ventral, dorsal, lateral, posterior and anterior views. x1.

Brachial valve

The width is 5.5-6 times the thickness. In posterior view, the median part of the upper surface of the valve is broadly rounded and the $\pm$ plane lateral parts form a low angle with the commissural plane. The sulcus is well defined on the anterior half of the valve. The distinctly developed tongue, about two times wider than high, has a $\pm$ subtrapezoidal general outline (without taking into account the indentations resulting from the ribs).

Ornamentation

The ribs are simple and coarse, with a subtriangular to $\pm$ rounded section, separated by interspaces seemingly of the same types. On three specimens, four and five ribs are present on the fold (three in the sulcus of a single complete adult shell). There are three or four ribs per flanks. The smallest specimen (Fig. 2j-n) displays two ribs on the fold, one in the sulcus and none on the flanks. Two poorly preserved pedicle valves are entirely smooth.

Dimensions

The dimensions of the largest specimen are: length: 17 mm; width: 20 mm; thickness: 13.1 mm. The pedicle valve is 2.9 (large shell) and 2.5 (small shell) times thicker than the brachial valve.

Internal morphology

Except a septalium in two isolated pedicle valves (Fig. 2g, i) the internal structures have not been observed.

REMARKS

As a result of dolomitization, the internal structures cannot be studied with enough accuracy by means of serial sections. Consequently an unquestioned genus assignment is not possible. The specimens are questionably assigned to the genus *Neometabolipa* on the basis of the accompanying atrypid genus *Iowatrypa* and by comparison with the gypidulid and atrypid faunas of Belgium where, as presently known, only *Neometabolipa* occurs with *Iowatrypa*.

MATERIAL

Two complete shells (of which one is a juvenile specimen) and 4 pedicle valves (SMF 65888-65893).

Order Atrypida RZHONSNITSKAYA, 1960

Suborder Atrypidina MOORE, 1952

Superfamily Atrypoidea GILL, 1871

Family Atrypidae GILL, 1871

Subfamily Atrypinae GILL, 1871

Genus *Costatrypa* COPPER, 1973

TYPE SPECIES: *Atrypa varicostata* STAINBROOK, 1945

Costatrypa cf. *varicostata* (STAINBROOK, 1945)

Plate 1, Figures 16-25; Figure 3 *partim*

cf. 1935 *Atrypa*, n. sp. - STAINBROOK, pl. 83, figs. 3, 4.

cf. 1945 *Atrypa varicostata* STAINBROOK, n. sp. - STAINBROOK, pp. 47, 49, pl. 5, figs. 13-17.

cf. 1948 *Atrypa variacostata* (sic) STAINBROOK - STAINBROOK, p. 776, pl. 2, figs. 44-47.

cf. 1973 *Atryparia* (*Costatrypa*) *varicostata* (STAINBROOK, 1945) - COPPER, p. 494, pl. 2, figs. 9-15.

cf. 1982 *Costatrypa varicostata* (STAINBROOK) - COOPER & DUTRO, pp. 88-89, pl. 23, figs. 7-31.

cf. 1998 *Costatrypa varicostata* (STAINBROOK, 1945) - DAY & COPPER, pp. 179-180, fig. 19.

DESCRIPTION

External characters

General characters

The shell is strongly dorsibiconvex and wider than long. In ventral view, the outline is $\pm$ rounded pentagonal: shoulder lines concave, lateral margins gently convex and $\pm$ subparallel, anterior margin only weakly excavated by the sulcus. The cardinal angles are obtuse and the anterior commissure uniplicate.

Pedicle valve

The width/thickness ratio varies from 3.2 to 4.7. In posterior view, the valve has the outline of a low triangle with a broadly rounded top. The shallow sulcus is limited

to the anterior third or fourth of the valve and not sharply delimited laterally except close to the anterior margin. The width of the sulcus at the anterior margin is 60%-68(70?)% of the shell width. The tongue is generally well developed (in some specimens, its distal part is oriented nearly perpendicular to the commissural plane) and 1.7 to 3 times wider than high. There is no visible interarea. The strongly incurved beak is in contact with the brachial umbo (adpressed beak) and pierced by a foramen.

Brachial valve

The valve is thick (width/thickness ratio of 2.1-2.6) and, in some adult specimens, roughly hemispheric in posterior view. In lateral profile, the curvature of the valve is greater posteriorly than anteriorly. The upper surface of the valve is slightly concave on both sides of the very inflated umbo. The fold is weakly developed and not well delimited close to the anterior margin.

Ornamentation

The poorly preserved ornamentation seems to be composed of undulose ribs and growth lamellae not deflected at their free edge. No frills were observed. The ribs increase in number by bifurcation (and intercalation?); rather coarse in the posterior half of the valve, they become finer anteriorly. There are about 10 ribs on 1 cm in the median sector of the pedicle valve at 10 mm (unrolled length) of the beak; 14-15 ribs at 14 mm; 17 ribs at 19 mm. The maximum distance between the free edge of two succeeding growth lamellae is about 1 mm; the growth lamellae are more crowded anteriorly in the region close to the shell margins.

Dimensions (Fig. 3 *partim*)

Internal characters

The dolomitization conceals or has partly destroyed the internal structures of the sectioned specimen.

REMARKS

By their ornamentation and their more or less globose form, these specimens are very close to the holotype of *Costatrypa varicostata* illustrated by STAINBROOK (1945, pl. 5, figs. 13-15) and COPPER, (1973, pl. 2, figs. 12-15). They differ in their smaller size (Fig. 3), their slightly different outline (with a different shoulder angle) and their less pronounced fold. For these reasons and although all these differences may represent intraspecific variations, the German specimens are at present attributed to *Costatrypa* cf. *varicostata*.

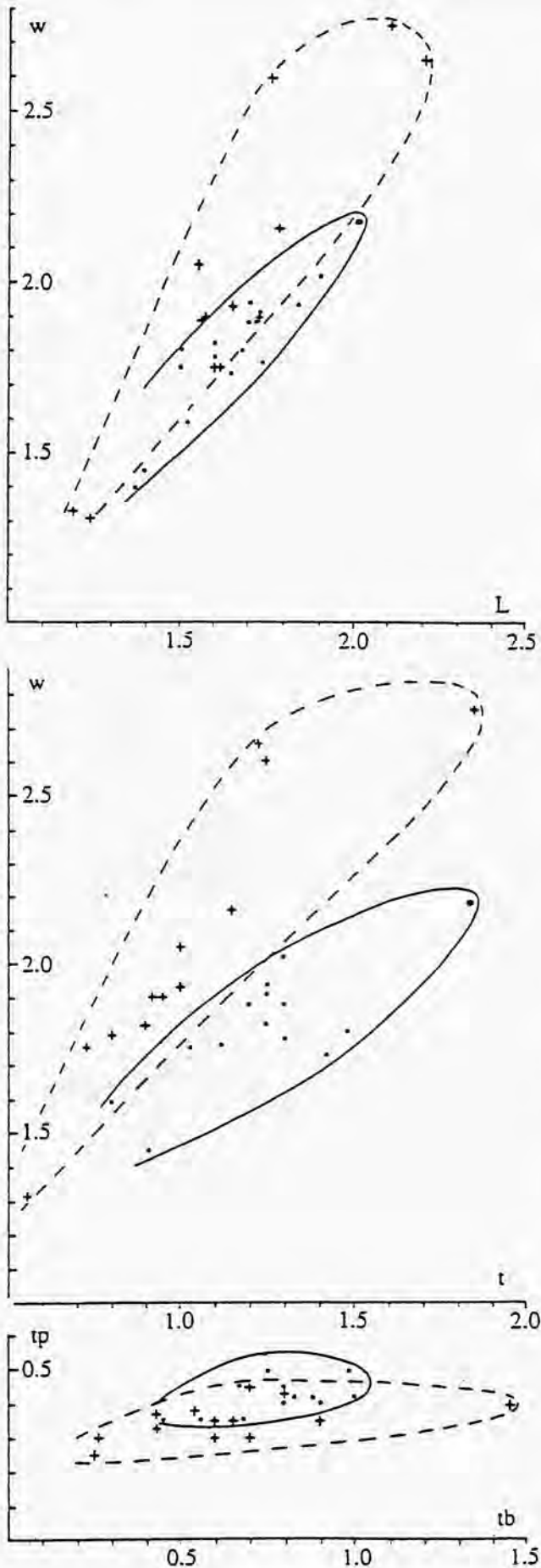
MATERIAL

24 specimens in rather satisfactory state of preservation (SMF 65894-65917).

Costatrypa variabilis (GODEFROID, 1970)

Plate 1, Figures 26-55; Figures 3 *partim*, 4, 5

1970 *Atryparia?* *variabilis* n. sp. - GODEFROID, pp. 98-104, pl. 5, fig. 3; figs. 6-10.



1998 *Costatrypa variabilis* (GODEFROID, 1970) - GODEFROID, pp. 110-111, figs. 4, 5 (*partim*).

1998 *Costatrypa variabilis* (GODEFROID, 1970) - GODEFROID & HELSEN, p. 245, fig. 3.

DESCRIPTION

External morphology

General characters

The dorsibiconvex and wider than long shell displays a $\pm$ straight hinge line and strongly concave shoulder lines forming a posterior margin with a median part, corresponding to the umbo, clearly isolated from the lateral parts more or less oriented in a parallel direction to the hinge line. In ventral view, the anterior and lateral margins are rounded except for the median part of the anterior margin, which is variably excavated by the sulcus. The cardinal angles are obtuse and the anterior commissure uniplicate.

Pedicle valve

The valve is (4.8?)5 to 7.8 times wider than thick and unevenly convex with only the median part regularly well arched posteriorly. The sulcus, present in the anterior half, is shallow and not sharply delimited except close the anterior margin of large shells where the limits are more evident though not sharp. At the anterior margin, the width of the sulcus corresponds to 55%-65% of the width of the shell. On the large specimens, the high tongue has a semi-elliptical or rounded subtrapezoidal outline and a distal part oriented $\pm$ perpendicularly to the commissural plane or pushed posteriorly (Pl. 1, Fig. 38); in other specimens, the tongue is less developed, present as a low undulation of the anterior commissure (Pl. 1, Figs. 45, 50). The tongue is 1.8 to 4 times wider than high. There is no visible interarea. The strongly incurved beak is in contact with the brachial umbo and pierced by a foramen.

Brachial valve

The valve is 3 to 5.4 times wider than thick [one specimen (Pl. 1, Figs. 36-40) has a thick brachial valve, with a width/thickness ratio of 1.5]. The maximum thickness of the valve is located a little anteriorly of the mid-length; from this point, the upper surface of the valve, curves regularly and slopes toward the anterior commissure. The upper surface of the valve is slightly concave near the posterolateral extremities. The very low, not sharply delimited fold originates at about the anterior third of the length; there is no fold on medium- or small-sized shells.



Fig. 3 — *Costatrypa* cf. *varicostata* (STAINBROOK, 1945) and *Costatrypa variabilis* (GODEFROID, 1970). Scatter diagrams plotting width(w)/length(L), width(w)/thickness(t) and thickness of the pedicle valve(tp)/thickness of the brachial valve(tb); dots = *C. cf. varicostata*; circle = holotype of *C. varicostata* (according to STAINBROOK, 1945, p. 47); crosses = *C. variabilis*.

Ornamentation

The ribs (not very well preserved) are $\pm$ undulose. At the anterior margin, their number varies from 9 to 10 per 1 cm in the median part of most specimens (Pl. 1, Figs. 26-40) and from 12 to 14 per 1 cm on less abundant, more finely ribbed forms (Pl. 1, Figs. 41-50). There are 1 to 2 growth lamellae per 1 mm medially, but in places, and not only near the commissures, the growth lamellae are more crowded. The frills are well developed. The ribs are wider and shallower on the frills than on the shell (Pl. 1, Fig. 31).

*Dimensions (Fig. 3 partim)**Internal characters (Fig. 4)**Pedicle valve*

A thick pedicle layer is developed. Dental plates and lateral cavities are lacking, but thick dental supports without visible cavities are present.

Brachial valve

Only the disjunct jugal processes and the jugal plates have been observed.

REMARKS

A specimen (Fig. 5) displays traces of damage and repair in the anteromedian part of the shell. The injury is displayed by a narrow and elongate space in the median part of the two valves, by the incomplete development of a rib and by the convergence of two adjacent ribs. The space resulting from the injury was progressively constricted by the junction of the parts of the mantle lateral to the damage, involving the convergence of the ribs bounding the undamaged zone.

MATERIAL

40 specimens of which 15 are well preserved and the others incomplete (SMF 65918-65957).

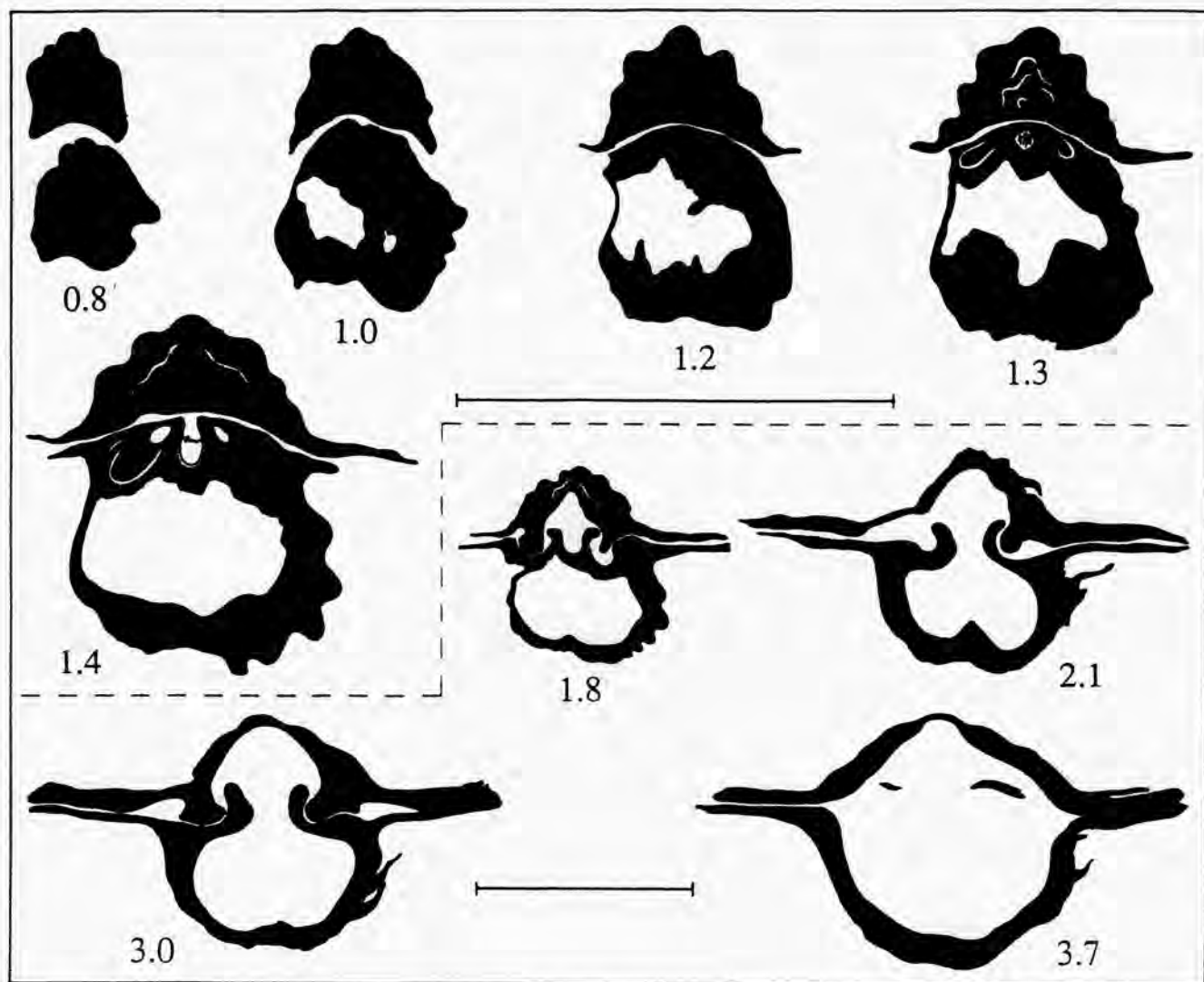


Fig. 4 — *Costatrypa variabilis* (GODEFROID, 1970). SMF 65924. Transverse serial sections. Numbers refer to distances in mm from the top of the ventral umbó. Scale bars = 1 cm.

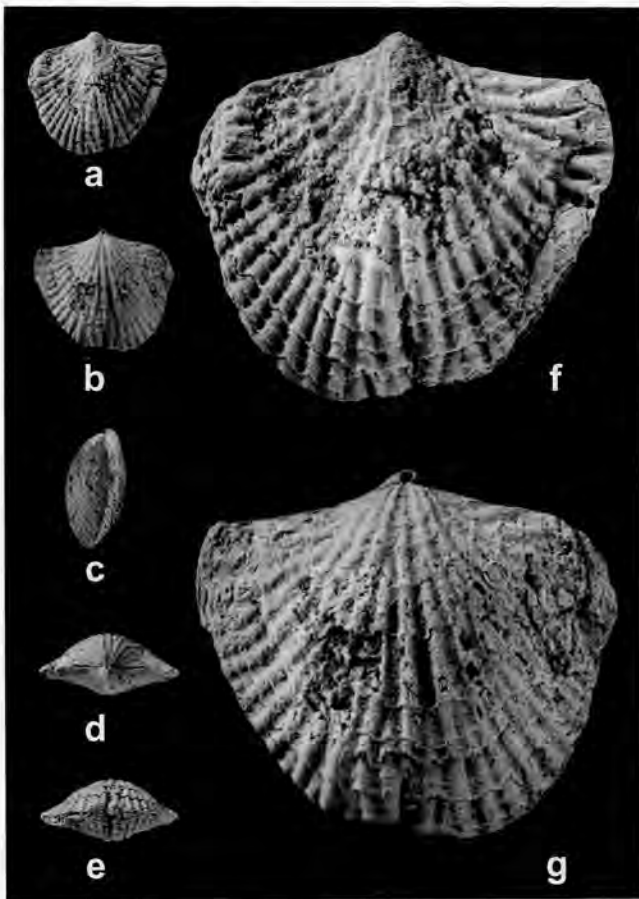


Fig. 5 — *Costatrypa variabilis* (GODEFROID, 1970). SMF 65925. Specimen with traces of damage and shell repair. a, f: ventral views; b, g: dorsal views; c-e: lateral, posterior and anterior views. a-e: natural size; f, g: x3.

Subfamily Spinatrypinae COPPER, 1978

Genus *Spinatrypina* RZHONSNITSKAYA, 1964

TYPE SPECIES: *Spinatrypina margaritoides* RZHONSNITSKAYA, 1964

Subgenus *Spinatrypina (Exatrypa)* COPPER, 1967

TYPE SPECIES: *Terebratulites explanatus* VON SCHLOTHEIM, 1820

Spinatrypina (Exatrypa) sp. 1

Figure 6

DESCRIPTION

External characters

General characters

The flattish, more or less lenticular shell is $\pm$ equibiconvex and $\pm$ as wide as long (width: 13.1 mm and 13.2 mm;

length: 12.8 mm and 13.0 mm). The hinge line equals in value to 77%-80% of the width of the shell. In ventral view, the anterior and lateral margins are well rounded and the shoulder lines concave. The apical and shoulder angles vary respectively between 104° - 106° and 121° - 122° . The anterior commissure is straight.

Pedicle valve

The valve is about four times wider than thick; in posterior view, the upper surface of the valve is $\pm$ regularly arched or rounded subtriangular. Sulcus and tongue are lacking. The interarea is clearly exposed, triangular, slightly concave, $\pm$ orthocline with a submesothyridid foramen and a delthyrium partially closed by deltidial plates.

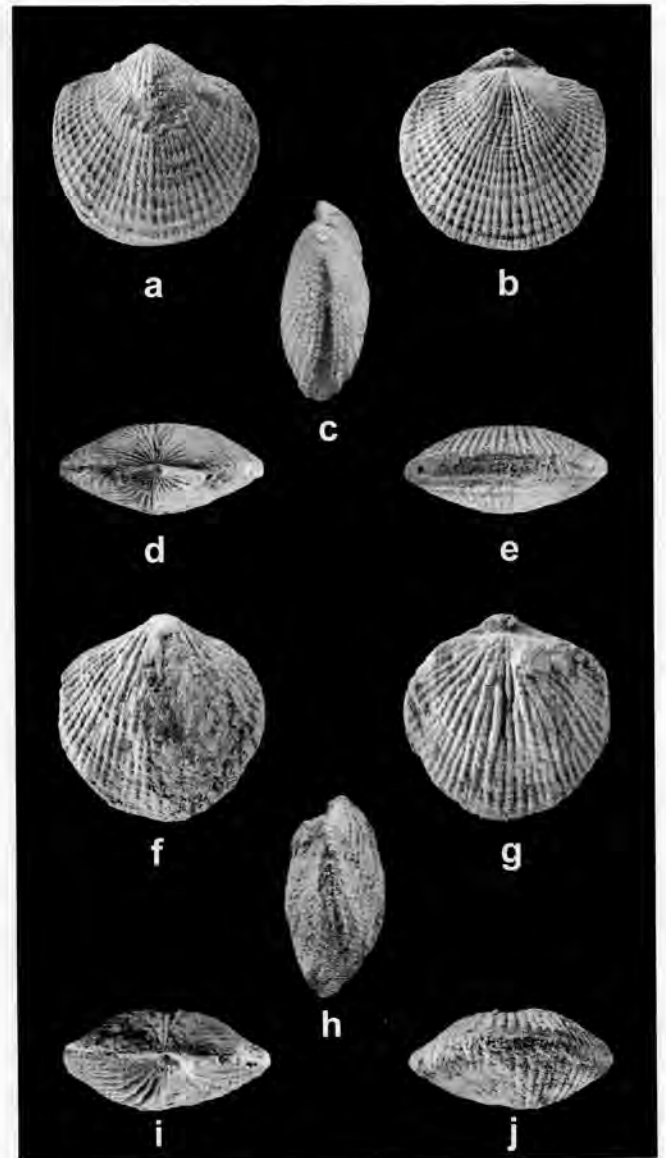


Fig. 6 — *Spinatrypina (Exatrypa)* sp. 1. a-e: SMF 65958, ventral, dorsal, lateral, posterior and anterior views. f-j: SMF 65959, ventral, dorsal, lateral, posterior and anterior views. x2.

Brachial valve

The valve is about four times wider than thick (width/thickness: 3.8 and 4.1), $\pm$ regularly convex transversely and longitudinally except in its posterolateral parts where the upper surface of the valve is concave. There is no fold. In its posterior part, the valve displays a shallow and narrow median depression, ending posterior to the mid-length.

Ornamentation

The fine tubular ribs (17 to 20 ribs on 1 cm in the median part of the anterior margin) increase by bifurcation on the pedicle valve, by bifurcation and intercalation on the brachial valve. The growth lamellae are regularly spaced and slightly upturned; their length does not exceed 1 mm.

Internal characters

Unknown.

REMARKS

These finely ribbed shells are similar to *Spinatrypina* (*Exatrypa*?) *tubaecostatoides* RZHONSNITSKAYA, 1975 but the scarcity of the material (only two specimens, SMF 65958, 65959) does not permit a definitive comparison and identification.

Spinatrypina (*Exatrypa*) sp. 2

Figure 7

DESCRIPTION

*External characters**General characters*

The shell width is nearly equal to the length (width: 16.2 mm and 17.5 mm; length: 16.0 mm and 17.2 mm), equibiconvex, with a lenticular profile and, in ventral view, well rounded anterior and lateral margins. The apical and shoulder angles vary between 105° - 107° and 130° - 135° respectively. The shoulder lines are clearly concave to indented and the anterior commissure slightly uniplicate.

Pedicle valve

The valve is low (width/thickness: 4-4.4), in posterior view regularly arched. The sulcus is poorly developed, expressed as a flattening of the upper surface of the valve near the anterior commissure. The tongue is very low and not sharply delimited laterally. The interarea is triangular, $\pm$ orthocline, weakly concave, with a mesothyridid to submesothyridid foramen and with the delthyrium closed by deltidial plates.

Brachial valve

The curvature of the upper surface of the valve is reversed in the posterolateral regions where it becomes concave. There is no fold.

Ornamentation

There are 10-11 tubular ribs on 1 cm at 1 cm (unrolled length) from the beaks. Only bifurcations of ribs have

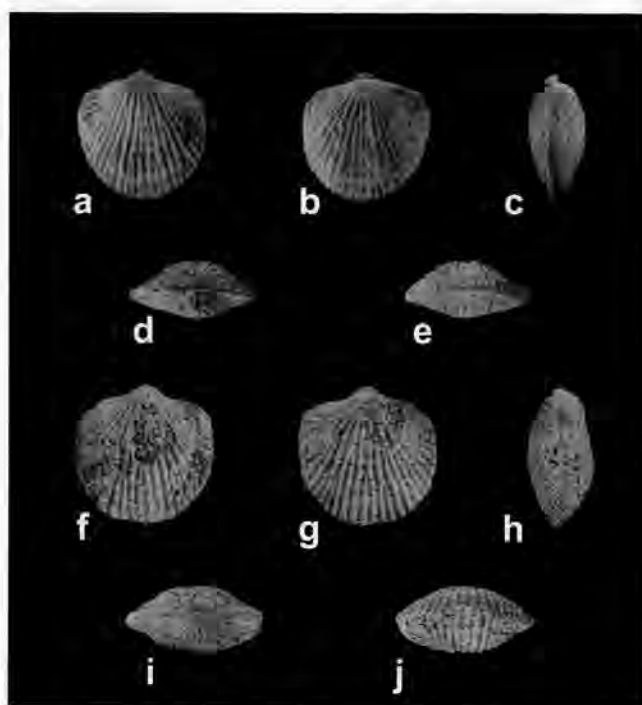


Fig. 7 — *Spinatrypa* (*Exatrypa*) sp. 2. a-c: SMF 65960, ventral, dorsal, lateral, posterior and anterior views. f-j: SMF 65961, ventral, dorsal, lateral, posterior and anterior views, $\times 1$.

been observed. The width of the numerous, slightly upturned growth lamellae vary between ± 0.5 mm-1 mm.

Internal characters

Unknown

REMARKS

S. (E.) sp. 2 is marked off from *S. (E.)* sp. 1 by its coarser ribs, its more open shoulder angle and its slightly uniplicate anterior commissure.

S. (E.) sp. 2 is represented by only two specimens (SMF 65960, 65961).

Spinatrypina (*Exatrypa*) sp. indet.

Figure 8

REMARK

Six small spinatrypinid shells (SMF 65962-65967) were collected in the Reichle quarry. It seems likely that they represent immature specimens and they cannot be related to a known species. Their more transverse outline and coarser ribs distinguish them from *S. (E.)* sp. 1 and *S. (E.)* sp. 2.

Subfamily Invertininae COPPER & CHEN, 1995

Genus *Iowatrypa* COPPER, 1973

TYPE SPECIES: *Atrypa owenensis* WEBSTER, 1921

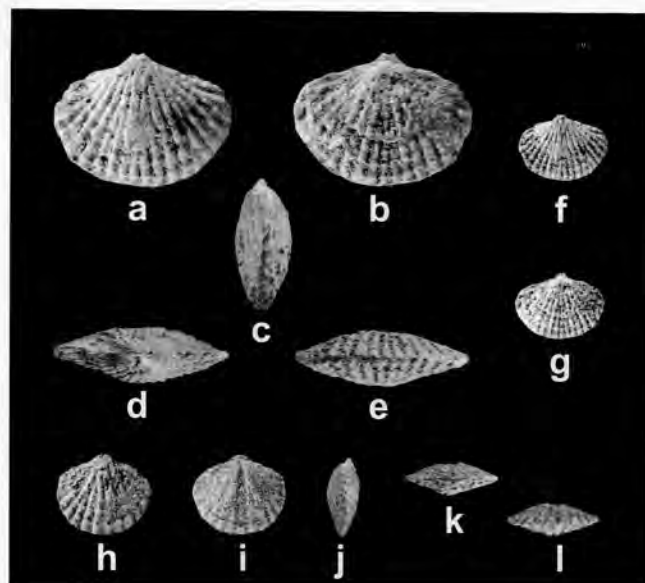


Fig. 8 — *Spinatrypa* (*Exatrypa*) sp. indet. a-g: SMF 65962, ventral (a, f), dorsal (b, g), lateral (c), posterior (d) and anterior (e) views. h-l: SMF 65963, ventral, dorsal, lateral, posterior and anterior views. a-e: x2; f-l: x1.

Iowatrypa aff. *circuitionis* GODEFROID & HELSEN, 1998
Figure 9a-j, Table 1

aff. 1998 *Iowatrypa circuitionis* sp. n. - GODEFROID & HELSEN, pp. 249-252, figs. 5B, 6A-P, 7.

DESCRIPTION

External characters

General characters

The small, weakly ventribiconvex and slightly wider than long shell has a hinge line shorter than the width. In ventral view, the anterior and lateral margins are evenly rounded, and the shoulder lines clearly concave to indented. The cardinal angles are obtuse and the anterior commissure weakly uniplicate.

Pedicle valve

The valve is 2.6 to 3.6 times wider than thick; in posterior view, strongly and $\pm$ regularly convex; lateral profile more arched posteriorly than anteriorly. The sulcus is

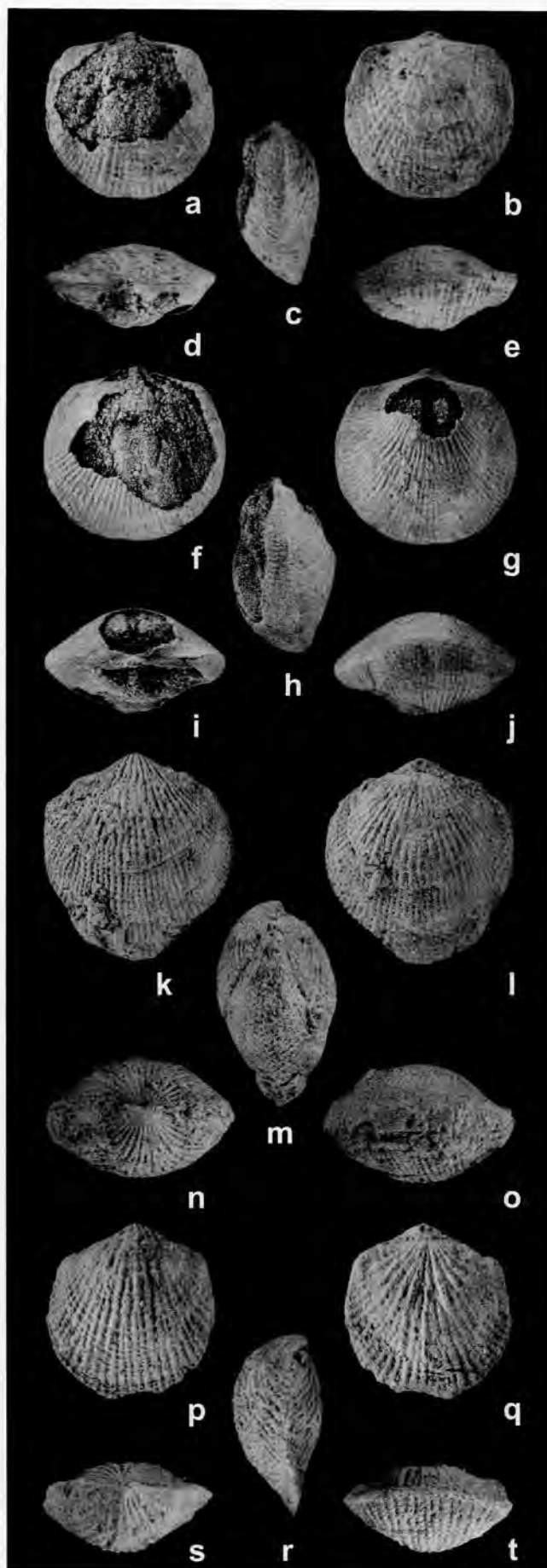


Fig. 9 — a-j: *Iowatrypa* aff. *circuitionis* GODEFROID & HELSEN, 1998. a-e: SMF 65968, f-j: SMF 65969. k-t: *Iowatrypa* cf. *rara* COOPER & DUTRO, 1982. k-o: SMF 65981, p-t: SMF 65982. a, f, k, p: ventral views; b, g, l, q: dorsal views; c, h, m, r: lateral views; d, i, n, s: posterior views; e, j, o, t: anterior views. x2.

absent or very weakly developed in the form of a flattening of the upper surface of the valve close to the anterior commissure. The tongue is low, broadly rounded and not sharply delimited laterally from the remaining part of the commissure (the best developed tongue is 3.7 times wider than high and its width corresponds to 71% of the shell width), or very low, reduced to a weak undulation of the median part of the anterior commissure. The beak, pierced by a foramen (the state of preservation of the specimens does not allow precise description) and strongly recurved above the dorsal valve, is in contact or almost so with the brachial umbo. Interarea and delthyrium are not visible.

Brachial valve

The valve is 3.6 to 4.8 (5.2?) times wider than thick, ± regularly arched in posterior view with a convex lateral profile (convexity greatest anteriorly). The upper surface of the valve is slightly concave near the cardinal extremities. The largest specimen has a very low, poorly defined fold in the anterior third of the valve.

Ornamentation

The imbricate ornamentation is composed of fine ribs (about 20-24 ribs on 1 cm at the anterior margin), interrupted by closely spaced growth lamellae (± 2 lamellae on 1 mm in the median part of the valves) that become crowded along the anterior and lateral commissures

Dimensions (Table 1)

The width/length ratio varies from 1.03 to 1.14. The

pedicle valve is ± 1.1-1.5(2?) times thicker than the brachial valve. The length of the hinge line equals 70%-85% of the width of the shell.

Internal characters

Observed on some partly broken pedicle valves, the ventral muscle field is located on a raised platform. The wall of the ventral valve anterior to the muscle platform becomes thinner medially.

REMARKS

The specimens display the outline and the fine ribs of *I. circuitionis*. They are however distinguishable from this species by their proportionally thinner ventribiconvex profile, slightly larger size, and better developed tongue in some specimens. Moreover, their ribs although fine are not so fine as those of *I. circuitionis* [22-24 ribs on 1 cm at the front margin and 24-26(28) in *I. circuitionis*].

The Reichle quarry specimens are separable from *I. cf. circuitionis* (in GODEFROID & HELSEN, 1998, p. 252, fig. 6Q-U) by their different outlines.

They differ from the equibiconvex to slightly ventribiconvex *Waiotrypa? pluvia* GODEFROID & HELSEN, 1998 by their different outlines.

Though the German specimens could belong to a new species, we presently prefer to refer them to *lowatrypa* aff. *circuitionis*.

MATERIAL

13 poorly preserved specimens, most with only partially preserved shell (SMF 65968-65980).

Specimen SMF	Dimensions (cm)					apical angle	shoulder angle
	l.	w.	t.	tp.	tb.		
65973	1.45	1.58	/	/	0.45	/	/
65969	1.36	1.43	(0.82)	(0.42)	0.40	/	/
65974	1.31	1.35	/	/	0.40	/	/
65968	1.29	1.34	0.67	0.37	0.30	110°	138°
65970	1.25	1.33	0.89	0.52	0.37	110°	135°
65972	1.20	1.30	0.66	0.36	0.30	122°	139°
65971	1.18	1.35	0.78	0.41	0.37	114°	138°
65975	1.13	1.25	0.68	0.38	0.30	/	/
65976	1.04	1.05	0.65	0.38	0.27	112°	136°
65977	0.76	0.80	0.43	0.23	0.20	111°	134°

Table 1 — Abbreviations: l. = length; w. = width; t. = thickness; tp. = thickness of the pedicle valve; tb. = thickness of the brachial valve. Measurements in parentheses are taken on damaged specimen.

Iowatrypa cf. *rara* COOPER & DUTRO, 1982
Figure 9k-t

cf. 1982 *Iowatrypa rara* new species - COOPER & DUTRO, p. 89, pl. 24, figs. 15-29.

REMARKS
Two well preserved specimens (SMF 65981-65982) are characterized by their elongate outline and well developed slightly curved interarea with submesothyridid foramen and partly conjunct deltidial plates. Their outlines are close to *I. rara* COPPER & DUTRO, 1982 from which they are distinguished by having moderately curved interarea.

Subfamily Variatrypinae COPPER, 1978
Genus *Desquamatia* ALEKSEEVA, 1960

TYPE SPECIES: *Desquamatia khavae* ALEKSEEVA, 1960
Subgenus *Desquamatia (Desquamatia)* ALEKSEEVA, 1960

Desquamatia (Desquamatia) alticoliformis
RZHONSNITSKAYA, 1975
Plate 1, Figures 1-15; Figure 10; Table 2

- 1975 *Desquamatia (Desquamatia) alticoliformis* sp. nov. - RZHONSNITSKAYA, pp. 131-133, pl. 28, figs. 10-13; fig. 41.
1998 *Desquamatia (Desquamatia) alticoliformis* RZHONSNITSKAYA, 1975 - RZHONSNITSKAYA *et al.*, pp. 316-319, figs. 8-10, 11A-F.
1998 *Desquamatia alticoliformis* RZHONSNITSKAYA, 1975 - GODEFROID & HELSEN, p. 255, figs. 10A, 11A-G, 12.
1998 *Desquamatia (Desquamatia) alticoliformis* RZHONSNITSKAYA, 1975 - RACKI & BALINSKI, p. 290, fig. 14.

DESCRIPTION

External characters

General characters

The moderately dorsibiconvex, wider than long shell has

a hinge line shorter than the width. In ventral view, the outline, except the posterior margin, is roughly elliptical and the shoulder lines gently to markedly concave. The cardinal angles are obtuse and the anterior commissure uniplicate.

Pedicle valve
The pedicle valve is 4.3 to 4.9 times wider than thick. In posterior view, the median part of the valve is broadly and regularly arched and its lateral parts are ± plane, gently inclined on the commissural plane.

The sulcus is only very weakly developed close to the anterior margin, very shallow, not sharply delimited laterally and not excavating the anterior margin of the shell. The width of the sulcus at the anterior margin corresponds to ± 63%-68% of the width of the shell. The tongue has a ± semi-elliptical outline, with lateral boundaries passing progressively to the anterolateral commissures (Pl. 1, Figs. 10, 15) or is only weakly developed as a low undulation of the median part of the anterior commissure (Pl. 1, Fig. 5). The tongue is about 3 times wider than high when well developed (measurements taken on two specimens only!)

The interarea is well-exposed, triangular, apsacline, slightly curved, with quite sharp lateral edges. Hollow deltidial plates (Fig. 10, 0.9-1.0) close partly the delthyrium. The foramen is submesothyridid to mesothyridid. The beak does not overhang the dorsal umbo.

Brachial valve
The valve is 2.8 to 3.8 times wider than thick, ± regularly convex in posterior view and with a lateral profile displaying a curvature more accentuated posteriorly than anteriorly. The upper surface of the valve becomes slightly concave near the cardinal extremities. There is no fold except for a very low and vaguely delimited elevation at the anterior commissure of one specimen only.

Ornamentation
The ribs are very fine: 20-22 ribs on 1 cm at the anterior margin of the largest shells, increasing in number by bifurcations and intercalations (intercalations more fre-

Specimen SMF	Dimensions (cm)					shoulder angle	apical angle
	l.	w.	t.	tp.	tb.		
65985	1.74	(1.80)	(1.03)	(0.43)	(0.60)	105°	132°
65984	1.72	1.92	1.12	0.44	0.68	112°	137°
65988	(1.70)	2.05	1.06	0.44	0.62	/	/
65983	1.45	1.68	0.93	0.39	0.54	112°	139°
65987	1.42	1.57	0.73	0.32	0.41	/	/

Table 2 — For abbreviations see Table 1.

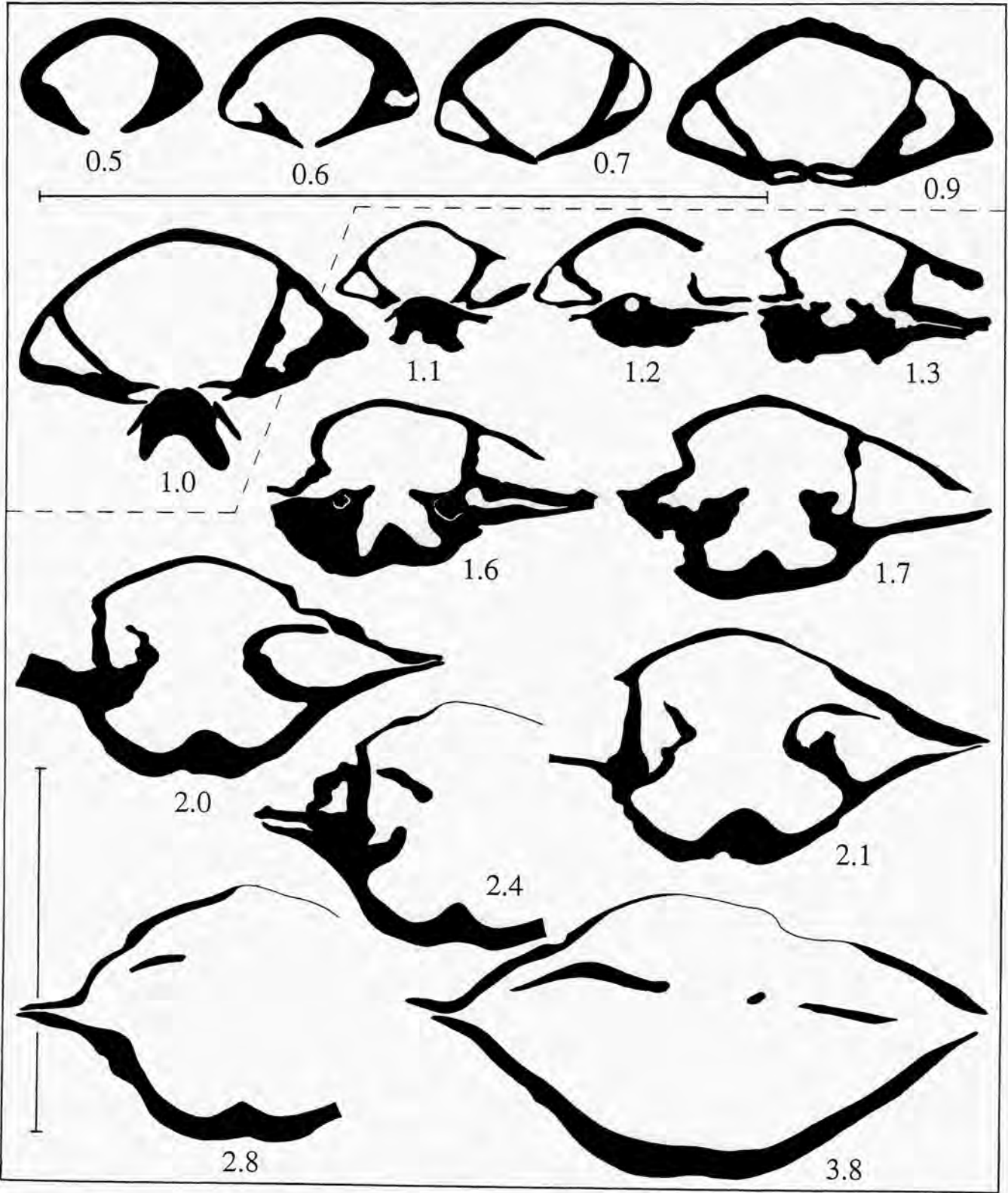


Fig. 10 — *Desquamatia (Desquamatia) alticoliformis* RZHONSNITSKAYA, 1975. SMF 65986. Transverse serial sections. Numbers refer to distances in mm from the top of the ventral umbo. Scale bar = 1 cm.

quent on the brachial valve). Growth lamellae are present but very badly preserved, adhering to the shell all along their length. Their width varies from ± 1 to 1.5 mm in the median part of the valve (except on the region close to the anterior commissure where the growth lamellae seem to be more crowded). Frills have not been observed.

Dimensions (Table 2)

The width/length ratio equals 1.1-1.2. The brachial valve is 1.3-1.5 times thicker than the pedicle valve. The width is located at about the mid-length. The hinge line corresponds to 68%-73% of the shell width.

Internal characters (Fig. 10)

In the pedicle valve, no pedicle collar or pedicle layer have been observed. The dental lamellae seem relatively thin and well individualized. The lateral cavities are wide.

In the brachial valve, disjunct jugal processes and jugal plates are present.

The other characteristics are not clearly observable in the poor serial sections (specimen dolomitized).

MATERIAL

12 shells (SMF 65983-65994) in rather satisfactory state of preservation and 3 small sized specimens (SMF 65995-65997) considered as young shells.

Comparison with the Frasnian faunas of Belgium

Gypidulid brachiopods of the Reichle quarry are only indirectly and questionably assigned to the genus *Neometabolipa*, therefore no comparison can be based on them.

A tentative correlation of the atrypid yielding layer of the Reichle quarry with Frasnian formations cropping out

on the southern border of the Dinant Synclinorium can be proposed.

The here considered Belgian lithological units are, from oldest to youngest, the Grands Breux, Neuville and Matagne Formations (see BOULVAIN *et al.*, 1999, pp. 50-60, 74-79).

On the southern border of the Dinant Synclinorium, species of *Iowatrypa* are present in the Neuville Formation (GODEFROID & HELSEN, 1998, fig. 19). At present, representatives of the genus have not been recovered from the underlying Grands Breux Formation, or in the overlying fine and dark shales of the Matagne Formation which marks the extinction of the Atrypida (see GODEFROID & HELSEN, 1998, pp. 267-268).

Among the two species of *Costatrypa* characterizing the fossiliferous layer of the Reichle quarry, only *C. variabilis* is present on the southern border of the Dinant Synclinorium. There the species occurs in the upper part of the Grands Breux Formation, in the Neuville Formation and in the lower 3-4 metres of the Matagne Formation.

Desquamatia (*Desquamatia*) *alticoliformis* occurs in the upper part of the Grands Breux Formation and in the Neuville Formation.

The only Belgian unit in which *C. variabilis*, *D. (D.) alticoliformis* and *Iowatrypa* species occur together is the Neuville Formation. On that basis we can reasonably consider that the atrypid bearing layer of the Reichle quarry is equivalent to a part of the Neuville Formation (*Pa. rhenana* conodont Zone) (see BULTYNCK *et al.*, 1998, p. 61, fig. 2; BOULVAIN *et al.*, 1999, fig. BIO 10).

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Explanation of Plate 1

All figures are natural size.

Figs. 1-15 — *Desquamatia (Desquamatia) alticoliformis* RZHONSNITSKAYA, 1975. 1-5: SMF 65983; 6-10: SMF 65984; 11-15: SMF 65985.

Figs. 16-25 — *Costatrypa* cf. *varicostata* (STAINBROOK, 1945). 16-20: SMF 65894; 21-25: SMF 65895.

Figs. 26-55 — *Costatrypa variabilis* (GODEFROID, 1970). 26-30: SMF 65918; 31-35: SMF 65919; 36-40: SMF 65920; 41-45: SMF 65921; 46-50: SMF 65922; 51-55: SMF 65923.

1, 6, 11, 16, 21, 26, 31, 36, 41, 46, 51: ventral views;
2, 7, 12, 17, 22, 27, 32, 37, 42, 47, 52: dorsal views;
3, 8, 13, 18, 23, 28, 33, 38, 43, 48, 53: lateral views;
4, 9, 14, 19, 24, 29, 34, 39, 44, 49, 54: posterior views;
5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55: anterior views.

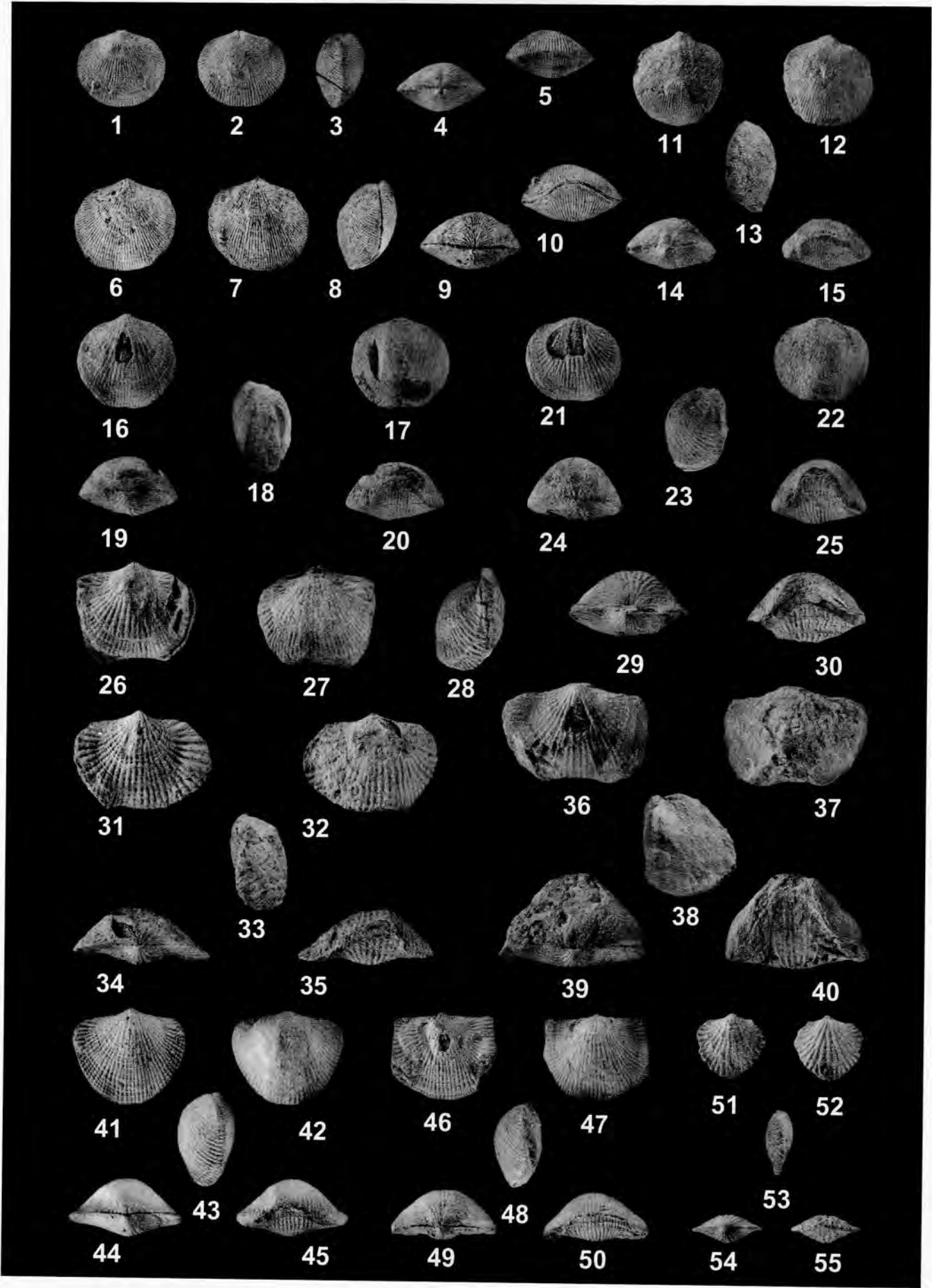


PLATE I.