

Two new atrypid brachiopod species from the late Frasnian of Belgium

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Abstract

Two new species of atrypid brachiopods from the late Frasnian Lambermont and Barvaux formations of Belgium are described (south-east border of the Dinant Synclinorium and Vesdre Nappe), *Iowatrypa ultima* n. sp. and *Spinatrypa (Spinatrypa) lambermontensis* n. sp. These species rank among the last representatives of the order Atrypida in the Ardennes (Upper *Palmatolepis rhenana* Zone).

Key-words: Brachiopods. Atrypida. Late Frasnian. Systematic palaeontology.

Résumé

Deux nouvelles espèces de brachiopodes atrypidés des Formations de Lambermont et de Barvaux (Frasnien terminal de Belgique) sont décrites (bord sud-est du Synclinorium de Dinant et Nappe de la Vesdre), *Iowatrypa ultima* n. sp. et *Spinatrypa (Spinatrypa) lambermontensis* n. sp. Ces espèces comptent parmi les derniers représentants de l'ordre des Atrypida en Ardennes (Zone supérieure à *Palmatolepis rhenana*).

Mots-clés: Brachiopodes. Atrypida. Frasnien terminal. Paléontologie systématique.

Introduction

The Frasnian/Famennian boundary corresponds to one of the five Phanerozoic extinctions (RAUP & SEPKOSKI, 1982), which is characterized, among the brachiopods, by the disappearance of the orders Atrypida and Pentamerida, but also by important losses in the orders Orthida and Strophomenida (JOHNSON, 1979, p. 299). Nevertheless, several authors pointed out the presence of atrypid brachiopods in the *Palmatolepis triangularis* Zone, as MIZENS *et al.* (2000, p. 83) in South Urals.

This paper deals partially with the atrypids of the Frasnian Lambermont and Barvaux formations. The Lambermont Formation is developed in the Vesdre Nappe, southern border of the Namur Synclinorium and

northern border of the Dinant Synclinorium. The Barvaux Formation is developed mainly along the south-eastern border of the Dinant Synclinorium and in the eastern part of the southern border of this synclinorium (BULTYNCK & DEJONGHE, 2002, pp. 56-57).

All figured and/ or measured specimens are stored at the Royal Belgian Institute for Natural Sciences at Brussels, where they are registered under the numbers IRScNB a11948-a11970.

Stratigraphy

LITHOSTRATIGRAPHICAL UNITS AND BIOSTRATIGRAPHY

The Lambermont Formation (Upper *Palmatolepis rhenana* - *Palmatolepis triangularis* Zones) has been described by LALOUX & GHYSEL (1999) who distinguish several units in the stratotype (Lambermont section, Vesdre Nappe). Its thickness varies between 50 to 100 m in the Vesdre Nappe. After LALOUX & GHYSEL (1999, p. 98), the base of the formation corresponds to the top of the Lower *Palmatolepis rhenana* Zone, but according to GOUWY & BULTYNCK (2000, figs. 16-17), the formation starts in the Upper *Palmatolepis rhenana* Zone. The Frasnian part of the formation is essentially argillaceous with some limestone beds. In the stratotype, the middle part of the formation is characterized by the third biostrome with *Phillipsastrea* of COEN-AUBERT (1974, p. 21) consisting of argillaceous, nodular limestones and calcareous shales with a biostromal bed with numerous massive rugose corals. This level is absent in the Hony section (northern border of the Dinant Synclinorium). At Lambermont, the studied atrypids have been collected in the green to grey shales with some limestone nodules, comprised between the Aisemont Formation and the third biostrome (unit 1 of LALOUX & GHYSEL) and in the base of the third biostrome (unit 2).

The Barvaux Formation, which corresponds to the "Schistes de Barvaux" (GOSSELET, 1880), has been introduced by COEN (1999) and is characterized by purplish to green shales with some sandy layers and nodules. Its thickness attains more or less 90 m in the type area. The

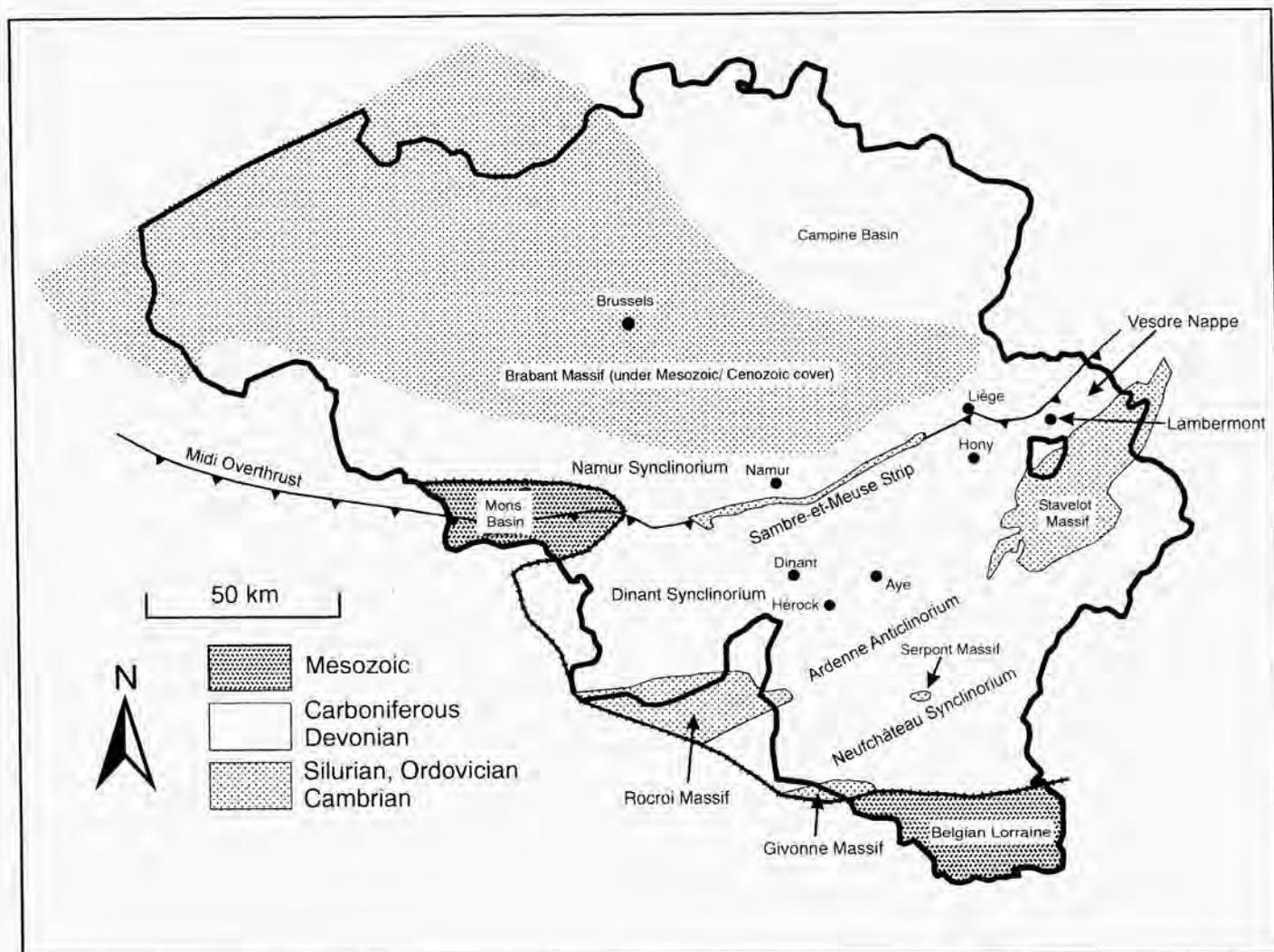


Fig. 1 — Schematic geological map of Belgium with location of the fossiliferous localities.

cyrtospiriferid brachiopods dominate the fauna and, in some levels, attain large sizes. In terms of conodont zones, the formation extends from the Upper *rhenana* to the Lower *triangularis* Zone (BULTYNCK & DEJONGHE, 2002, p. 56).

OUTCROPS (Fig. 1)

Topographic map 1:25000 Houyet – Rochefort 59/1-2

Outcrop BM-2001-4: The outcrop is located along the road from Dinant to Neufchâteau (N40), between km 15.100 and km 15.200, to the north-east of Hérock [grid references (Belgian Lambert system): X = 198.773; Y = 97.339]. It has been described by COEN (1999, p. 62) and exposes about 10 m of green shales which belong to the Barvaux Formation with some levels containing nodules.

Topographic map 1:25000 Aye – Marche-en-Famenne 54/7-8

Outcrop BM-2002-3: The outcrop is located in the in-

dustrial zone of Aye and south of the road from Namur to Marche-en-Famenne (N4) [grid references: X = 216.031; Y = 103.339]. It poorly exposes some meters of green to purplish nodular shales of the Barvaux Formation. The tectonic setting of the outcrop is unclear but the contact between the Barvaux Formation and the Famenne Group (*sensu* THOREZ & DREESEN, 1986, fig. 2) is similarly faulted.

Topographic map 1:25000 Taviers – Esneux 49/1-2

Outcrop BM-2001-2: The outcrop is located in the northern railway cutting, north-east of the railway station of Hony [grid references: X = 235.455; Y = 137.350]. It has been described previously by BOUCKAERT & THOREZ (1966), VANGUESTAINE *et al.* (1983, pp. 138-143; figs. 5-7) and SANDBERG *et al.* (1988b, pp. 278, 280-283; figs. 8-9; table 2). The beds studied here belong to the Frasnian part of the Lambermont Formation (more or less 72 m, leaving aside faults).

Topographic map 1:25000 Fléron – Verviers 42/7-8
Outcrop BM-2002-1: The outcrop is located along the western access road to the motorway Verviers-Prüm at Lambermont [grid references: X = 254.339; Y = 143.564]. It exposes the Aisemont, Lambermont and Hodimont formations, but only the Frasnian part of the Lambermont Formation has been studied. It has been described previously by VANGUESTAINE *et al.* (1983, pp. 145-147; fig. 8), SANDBERG *et al.* (1988a) and LALOUX & GHYSEL (1999).

Systematic palaeontology

Abbreviations: L – length of the pedicle valve; W – width of the shell; Tb – thickness of the brachial valve; Tp – thickness of the pedicle valve; Ulb – Unrolled length of the brachial valve; Ulp – Unrolled length of the pedicle valve; R-5, R-10, R-15 – number of ribs per 5 mm from the top of the pedicle valve, respectively. The ratios put between brackets are less frequent.

Order Atrypida RZHONSNITSKAYA, 1960
Suborder Atrypidina MOORE, 1952
Superfamily Atrypoidea GILL, 1871
Family Atrypidae GILL, 1871
Subfamily Pseudogruenewaldtiinae RZHONSNITSKAYA,
YUDINA & SOKIRAN, 1997

Genus *Iowatrypa* COPPER, 1973

TYPE SPECIES

Atrypa owenensis WEBSTER, 1921

Iowatrypa ultima n. sp.

Plate 1, Figures 1-5; Figures 2A, 3; Tables 1-2

DERIVATIO NOMINIS

Ultimus, a, um (Latin, adjective): last. Allusion to the fact that it is probably one of the last species of the Pseudogruenewaldtiinae in the Ardennes.

TYPES

Holotype: IRScNB a11948 (Pl. 1, Fig. 1 a-e); Paratypes H: IRScNB a11956; I: IRScNB a11957; outcrop BM-2001-4, fossiliferous bed located at 15km134.

Paratypes A: IRScNB a11949 (Pl. 1, Fig. 2 a-e); B: IRScNB a11950 (Pl. 1, Fig. 3 a-e); C: IRScNB a 11951 (Pl. 1, Fig. 4 a-e); D: IRScNB a11952 (Pl. 1, Fig. 5 a-e); E: IRScNB a11953; F: IRScNB a11954; G: IRScNB a11955; H: IRScNB a11956; I: IRScNB a11957; J: IRScNB a11958 (Fig. 4); outcrop BM-2002-3, fossiliferous bed located between 4.6 - 4.8 m from the northwest extremity of the Marche-en-Famenne forest counter parking.

LOCUS TYPICUS

Outcrop BM-2001-4, along the road from Dinant to

Neufchâteau at km 15.134. Grid references (Belgian Lambert system): X = 198.773; Y = 97.339.

STRATUM TYPICUM

Upper part of the Barvaux Formation (late Frasnian).

MATERIAL

10 of the 187 specimens examined are in good state of preservation, 15 satisfactory, and 28 poor; 134 specimens are fragmental. Some cyrtospiriferids, *Athyris* sp., *Schizozophoria* sp. and rugose corals have been also collected with *Iowatrypa ultima* n. sp. at its locus typicus.

DIAGNOSIS

A generally wider than long (W/L: 0.91-1.14), ventribiconvex to dorsibiconvex (Tp/Tb: (0.69) 0.95-1.53) species of *Iowatrypa* with a rounded subquadratic to semi-elliptic outline (maximum W = 23.45 mm; maximum L = 21.3 mm; maximum T = 14.2 mm). Sulcus and fold absent. Rectimarginate to slightly uniplicate anterior commissure.

DESCRIPTION

External characters

General characters

The shell is generally wider than long (W/L: 0.91-1.14) and ventribiconvex to dorsibiconvex [Tp/Tb: (0.69) 0.95-1.53]. The outline is rounded subquadratic to semi-elliptic. The cardinal extremities are rounded. The hinge line is shorter than the maximal width. The anterior commissure is rectimarginate or slightly uniplicate.

Pedicle valve

The valve is moderately inflated (W/Tp: 3-4.5; L/Tp: 2.9-4.24) and in lateral view, the upper surface of the valve is evenly convex (L/Ulp: 0.71-0.88). In posterior view, the upper surface of the valve is slightly carinate or dome-shaped. The flanks slope moderately to strongly towards the lateral commissures. The umbo is generally prominent and the posterolateral areas are sometimes flattened. There is no sulcus. The tongue is absent (rectimarginate anterior commissure) or represented by a poorly defined undulation. The interarea is orthocline and deltidial plates close the delthyrium except the submesothyridid foramen. The beak is suberect to erect. The shoulder lines display three different aspects: indented, concave or sub-rectilinear. The shoulder angle varies between 117°-143°; the apical angle between 111°-132°.

Brachial valve

The outline is semi-elliptic to subquadratic. The valve is more or less regularly convex longitudinally as well as transversally (W/Tb: 3.30-5.09; L/Tp: 2.62-4.89; L/Ulb: 0.87-1.02). Nevertheless, the top of the valve is sometimes slightly flattened in posterior view. The posterolateral areas occasionally have a concave upper surface.

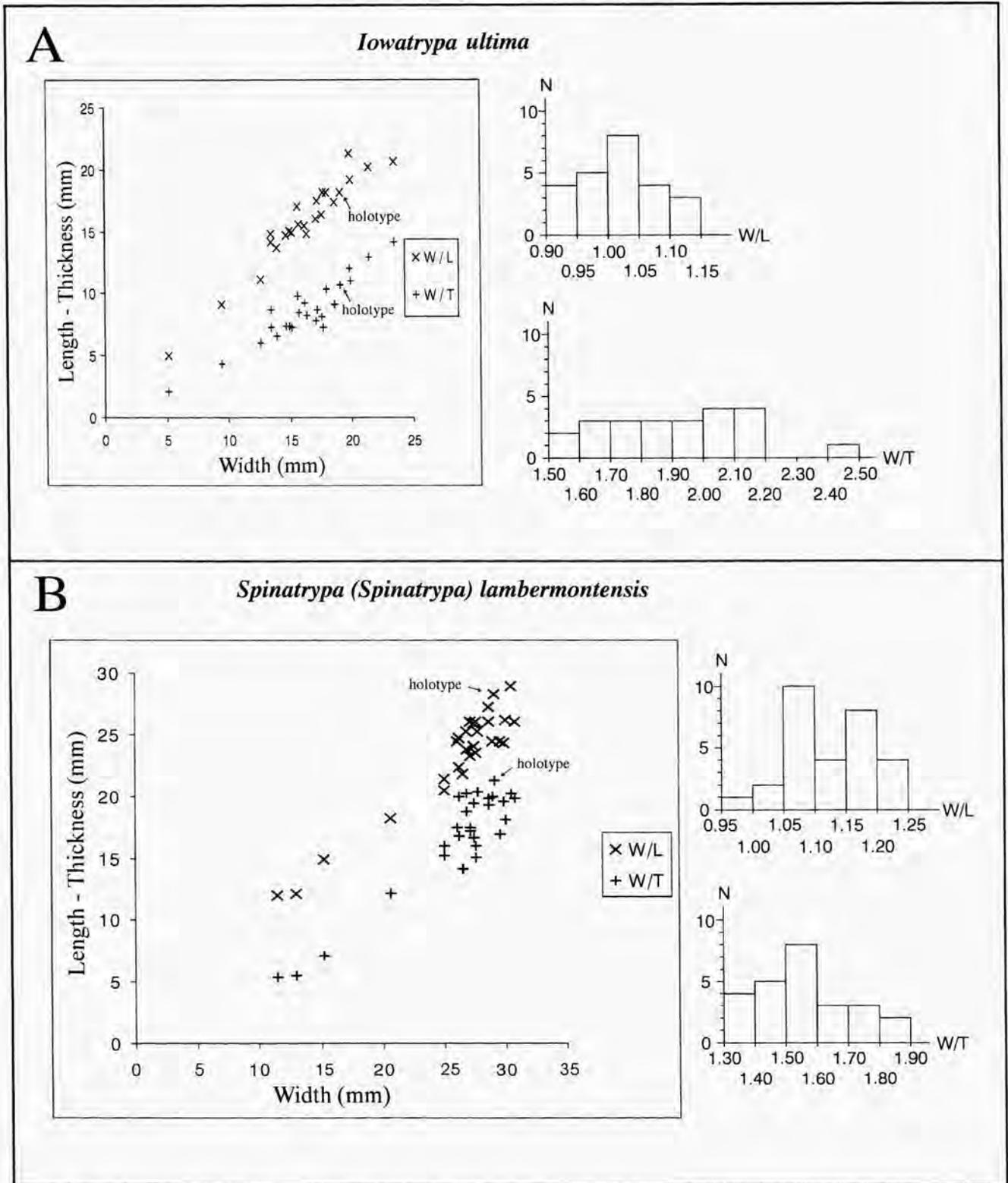


Fig. 2A — *Iowatrypa ultima* n. sp.

Scatter diagram plotting width/length and width/ thickness; frequency diagrams.

Fig. 2B — *Spinatrypa (Spinatrypa) lambermontensis* n. sp.

Scatter diagram plotting width/length and width/ thickness; frequency diagrams.

Table 1

<i>Iowatrypa ultima</i> n. sp.		
Distances in mm from the top of the ventral umbo or from the hinge line (brachial valve)	Number of ribs per 5 mm (8 specimens)	
	Pedicle valve	Brachial valve
5	8.5-10	8.5-12
10	9-10	7.5-10
15	8-10.5	9-11
20	11	8-9

Ornamentation (Table 1)

Radial ribs increase principally by bifurcation and more rarely by intercalation on the pedicle valve; on the brachial valve, they increase principally by intercalation and more rarely by bifurcation; 8-11 ribs per 5mm at 15 mm from the beak of the pedicle valve. The growth lamellae with an average spacing of about 1 mm in the central part of the shell are more closely spaced near the commissures. There are also microlines on the best-preserved specimens.

Dimensions (Fig. 2A, table 2)

Internal characters (Fig. 3)

Pedicle valve

The valve thickens with deposits of prismatic calcite in the apical and the middle parts. There is no pedicle collar. The dental nuclei disappear anteriorly to give rise to solid teeth.

Brachial valve

The muscle platform is raised, with a notothyrial pit in its posterior part and progressively sloping downward in anterior direction. The cardinal process has not been observed in the notothyrial pit. The internal crests of the dental sockets give rise to the crural bases leading to fibrous crura, laterally oriented. A slight median ridge divides the muscle field. Jugal processes and the spirillum have not been observed.

DISCUSSION

The new species is assigned to the genus *Iowatrypa* COPPER, 1973 though some internal characters have not been observed in the sectioned specimen (jugal processes, jugal plates and spiralia).

From *Spinatrypa? nebulosa* YUDINA, 1997 [species assigned with doubt to *Iowatrypa* by RZHONSNIKAYA *et al.* (1998, p. 33)], *I. ultima* differs by a smaller size, a finer ribbing (R-5 = 8.5-10 versus R-5 = 5) and a less developed tongue.

The new species differs from *Iowatrypa nalivkini*

Table 2

<i>Iowatrypa ultima</i> n. sp.							
Specimen	Dimensions in mm						
	W	L	Ulp	Ulb	T	Tp	Tb
Holotype	19.0	18.2	25	20	10.7	6.1	4.6
Paratype A	(15.7)	(15.6)	20	15.5	8.6	5.2	3.4
Paratype B	13.4	14.2	18	15	7.3	4.2	3.1
Paratype C	23.4	(20.6)	/	/	14.2	7.15	7.10
Paratype D	19.8	21.3	30	23	12	6.6	5.4
Paratype E	(14.9)	15.1	19	15	7.3	4	3.3
Paratype F	17.1	16.1	19	16.5	7.8	3.8	4
Paratype G	17.3	16.3	19	15	8.1	4.6	3.5
Paratype H	16.2	14.8	(20)	(16)	8.3	5.1	3.2
Paratype I (juvenile)	9.4	9.2	11	9	4.4	2.3	2.1

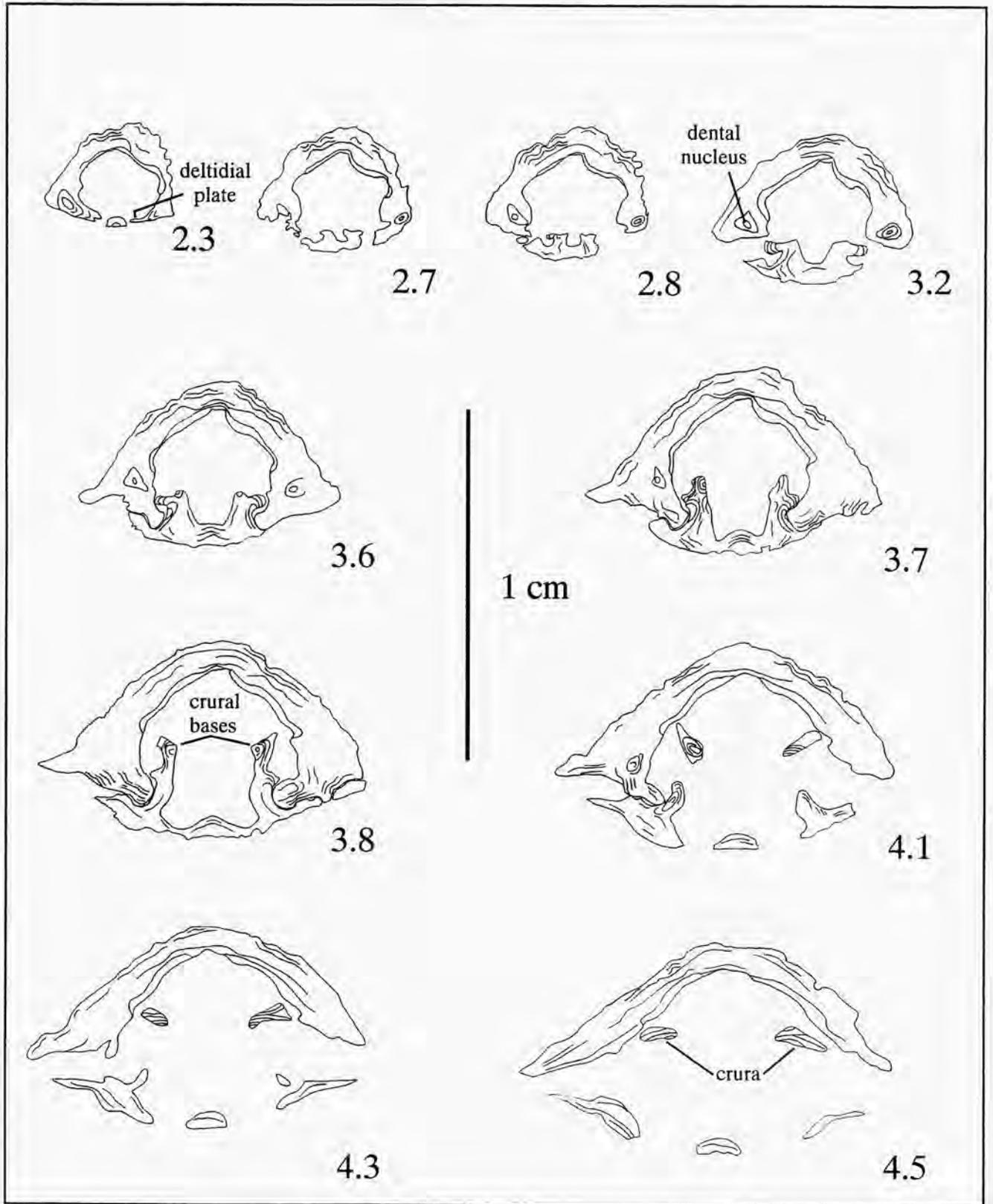


Fig. 3 — *Iowatrypa ultima* n. sp. Paratype J. Specimen IRScNB a11958. Distances are in mm from the top of the ventral umbo.

RZHONSNITSKAYA & SOKIRAN (in RZHONSNITSKAYA *et al.*, 1998, pp. 330-333; figs. 23A-T) by a larger size, a finer ribbing (R-10 = 9-10 versus R-10 = 6-8) and the absence of ears, sulcus and fold.

From *I. magna* (LYASCHENKO, 1973), *I. ultima* is easily separable by its finer ribs (R-15 = 8-10.5 versus R-15 = 5-7) and its smaller size.

I. ultima is distinguished from *I. markovskii* (LYASCHENKO, 1959) by the absence of a median groove on the brachial valve and a slightly coarser ornamentation (R-15 = 8-10.5 versus R-15 = 10-11).

I. ultima differs from *I. americana* (STAINBROOK, 1945) by its larger size, its less developed tongue and the absence of sulcus at the pedicle valve and fold at the brachial valve.

STRATIGRAPHIC RANGE AND GEOGRAPHIC DISTRIBUTION (Fig. 6)

The species is present in the Dinant Synclinorium (BM-2001-2 (Fig. 6); BM-2001-4; BM-2002-3) and in the Vesdre Nappe [BM-2002-1 (Fig. 6)]. It is known from the Lambermont and the Barvaux formations. In the locus typicus, the species seems to be restricted at 0.6 m above a nodular level which has yielded a colony of *Frechastrea pentagona pentagona* (GOLDFUSS, 1826). This latter species indicates the third stratigraphically significant coral association of COEN *et al.* (1977) in the upper part of the Frasnian in Belgium.

Subfamily Spinatrypinae COPPER, 1978

Genus *Spinatrypa* STAINBROOK, 1951

Spinatrypa (Spinatrypa) STAINBROOK, 1951

TYPE SPECIES

Atrypa hystrix var. *occidentalis* HALL, 1858

Spinatrypa (Spinatrypa) lambermontensis n. sp.
Plate 1, Figures 6-7; Figures 2B, 4, 5 a-o; Table 3

DERIVATIO NOMINIS

Allusion to the village of Lambermont, the locus typicus.

TYPES

Holotype: IRScNB a11959 (Fig. 5 a-e); Paratypes A: IRScNB a11960 (Fig. 5 f-j); B: IRScNB a11961 (Fig. 5 k-o); C: IRScNB a11962 (Pl. 1, Fig. 6 a-e); D: IRScNB a11963 (Pl. 1, Fig. 7 a-e); E: IRScNB a11964; F: IRScNB a11965; G: IRScNB a11966; H: IRScNB a11967; I: IRScNB a11968; J: IRScNB a11969 (Fig. 4); outcrop BM-2002-1, bed 2.

LOCUS TYPICUS

BM-2002-1, western access road to the motorway Verriers-Prüm at Lambermont. Grid references (Belgian Lambert system): X = 254.339; Y = 143.564.

STRATUM TYPICUM

Lower part of the Lambermont Formation (late Frasnian) [unit 1 of LALOUX & GHYSEL, 1999].

MATERIAL

10 of the 61 specimens examined are in good state of preservation, 25 satisfactory, and 12 poor; 12 specimens are fragmental. Cyrtospiriferids and productellids have been collected along with *S. (S.) lambermontensis* n. sp. at the locus typicus.

DIAGNOSIS

A dorsibiconvex (Tb/Tp: 1.48-3.39), equidimensional to slightly wider than long (W/L: 1.01-1.23) species of *Spinatrypa (Spinatrypa)* [maximum W = 30.8 mm; maximum L = 28.9 mm; maximum T = 21.3 mm]. Rounded to subelliptic outline. Anterior commissure strongly uniplicate. Sulcus and fold present on some specimens.

DESCRIPTION

External characters

General characters

The shell is medium-sized, slightly wider than long (W/L: 1.01-1.23) and dorsibiconvex at adult growth stages (Tb/Tp: 1.48-3.39). The outline is rounded to subelliptic. The hinge line is shorter than the maximal width. The juvenile forms are ventribiconvex (Tb/Tp: 0.57-0.83). The lateral commissure is straight and the frontal commissure is strongly uniplicate. Low fold and sulcus are present in some specimens.

Pedicle valve

The valve is moderately inflated to inflated (W/Tp: 3.62-7.70; L/Tp: 3.31-6.53). In posterior view, the upper surface of the valve is regularly convex; the flanks slope gently to moderately towards the lateral commissures. In some cases, only the postero-central area of the valve is convex and, the anterior and lateral areas are flattened. In lateral view, the upper surface of the valve is regularly arched. Some specimens have a shallow and poorly defined sulcus, which appears near the front. The tongue is moderately high and corresponds to an undulation on the anterior commissure, or the tongue is high, frequently nearly semi-elliptic and more or less perpendicular to the commissural plane. There is no visible interarea; the beak is hypercline, in contact with the dorsal umbo and pierced by a transapical foramen. The deltidial plates are joined near the apex. The umbo is moderately prominent and shoulder lines are indented. The shoulders angle varies between 121°-141° (150°?); the apical angle between 106°-134°.

Brachial valve

The valve is inflated and its maximal thickness is situated at about the mid-length, never at the front. In apical view, the valve is regularly convex with the flanks generally

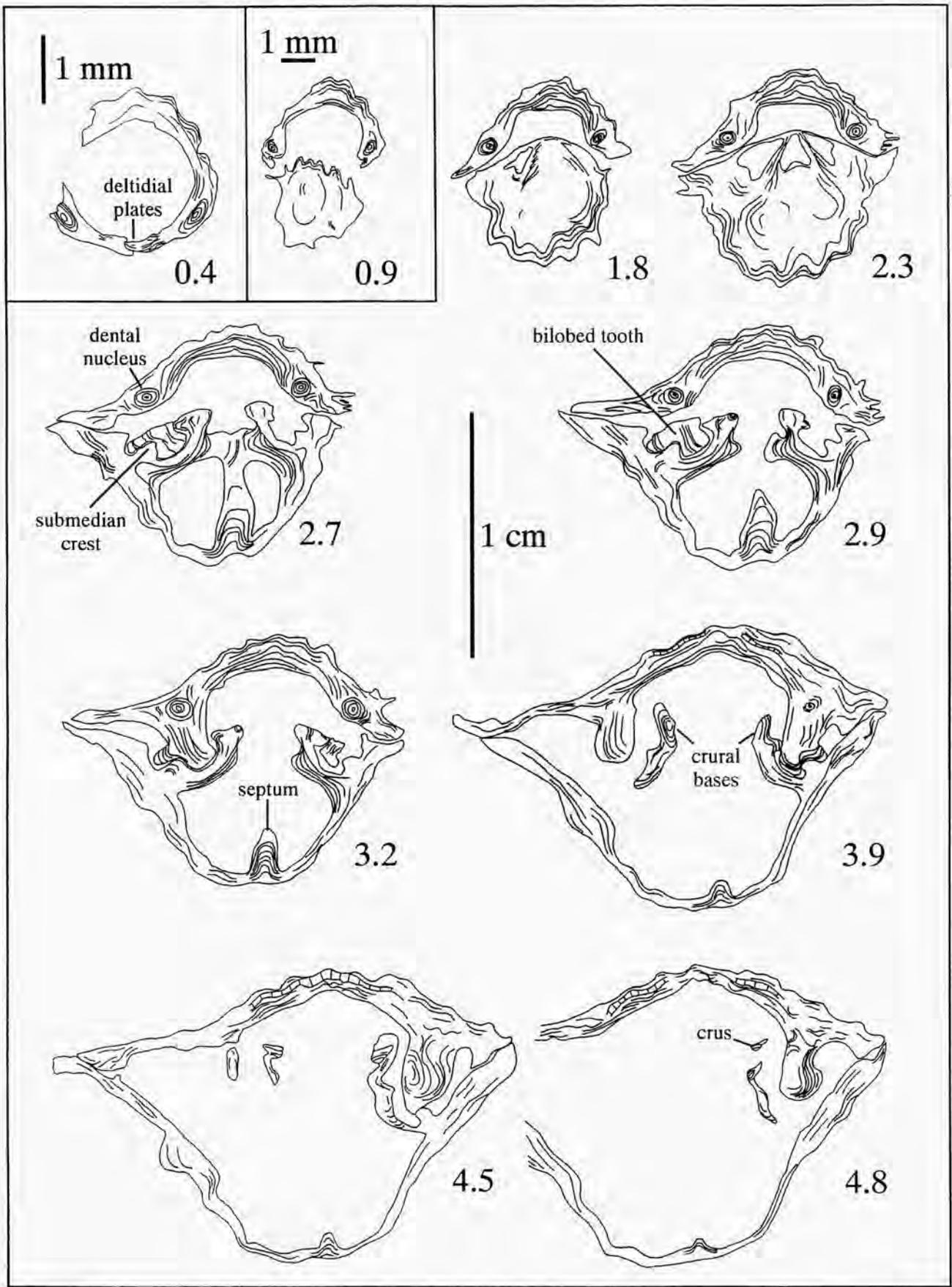


Fig. 4 — *Spinatrypa (Spinatrypa) lambermontensis* n. sp. Paratype J. Specimen IRScNB a1 1969. Distances are in mm from the top of the ventral umbo.

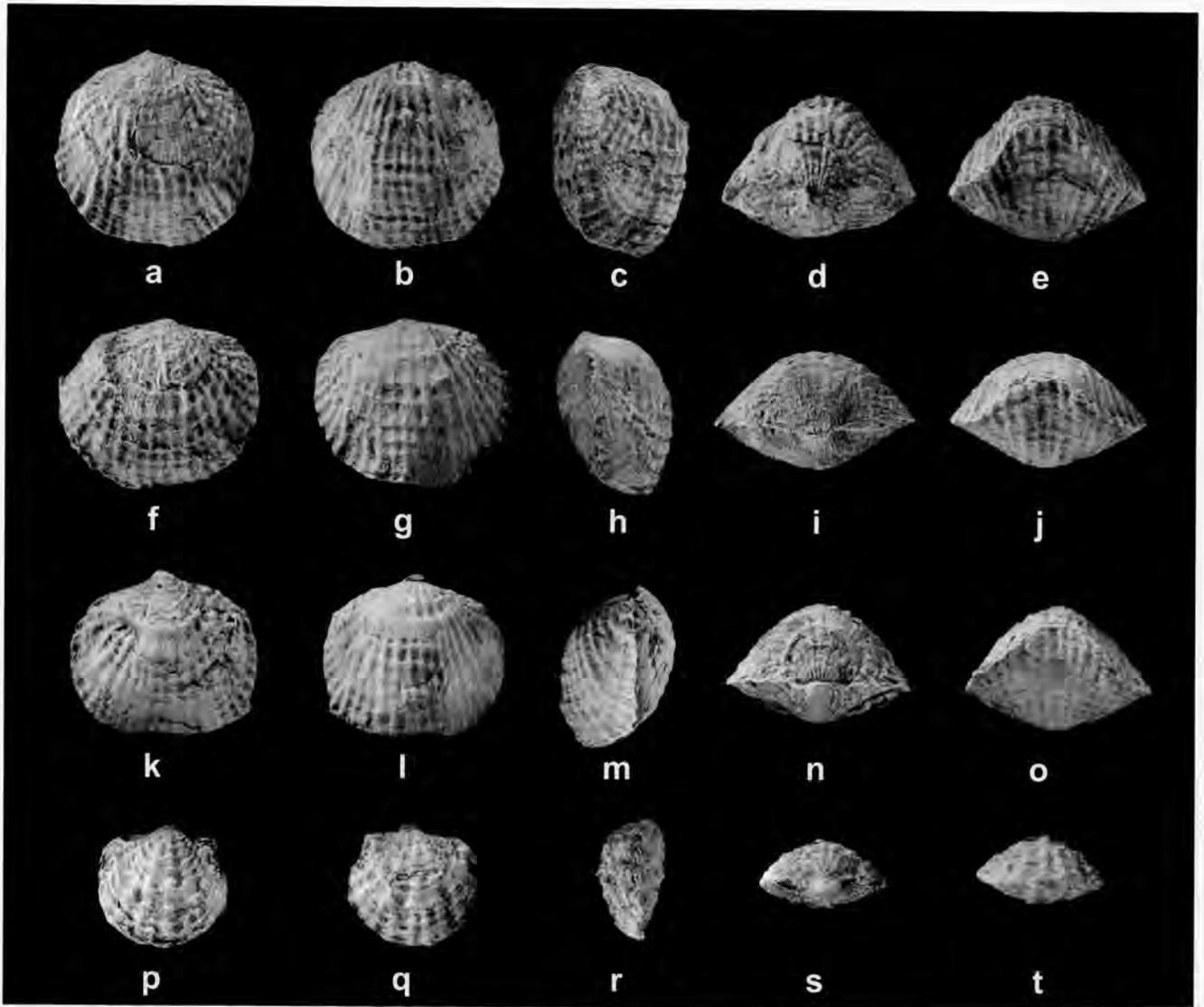


Fig. 5 — *Spinatrypa (Spinatrypa) lambermontensis* n. sp. a-e: Holotype, specimen IRScNB a11959; f-j: Paratype A, specimen IRScNB a11960; k-o: Paratype B, specimen IRScNB a11961. Natural size. Lambermont, BM-2002-1, bed 2. *Spinatrypa (Spinatrypa)* sp. p-t: specimen IRScNB a11970. Natural size. Hony, BM-2001-2, bed 13. 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.

sloping strongly towards the lateral commissure. Some specimens have a more or less defined fold, which appears at about the mid-length of the valve or more anteriorly.

Ornamentation

At 15 mm from the beak of the pedicle valve, there are between 5-7 undulose ribs per cm and at the front, their number oscillate between 5-6 per cm. They increase principally by bifurcation. In the plane of symmetry, the distance between the concentric growth lamellae varies between 1.5-3.0 mm in the best-preserved specimens. They are more closely spaced near the commissure. Spines (rarely preserved) originate at the intersection between the ribs and the growth lamellae.

Dimensions (Fig. 2B, Table 3)

Internal characters (Fig. 4)

Pedicle valve

Thick plates support the bilobed teeth with well-developed dental nuclei at their base. The central apical cavity is free.

Brachial valve

A median septum is present in the posterior part of the valve. The dental sockets are divided by a submedian crest. The crura are more or less orientated parallel to the commissure. Jugal processes and the spiralium have not been observed.

Table 3

<i>Spinatrypa (Spinatrypa) lambermontensis</i> n. sp.							
Specimen	Dimensions in mm						
	W	L	Ulp	Ulb	T	Tp	Tb
Holotype	29.1	28.3	37	39	21.3	7.4	13.9
Paratype A	29.5	24.4	33	31	16.9	5.7	11.2
Paratype B	27.2	23.2	33	30	17.2	6.9	10.3
Paratype C	20.7	18.2	31	24	12.2	5.5	6.7
Paratype D	26.8	23.8	33	34	18.8	7.1	11.7
Paratype E	25.1	21.4	30	28	16.0	5.7	10.3
Paratype F	26.1	24.5	29	31	17.4	4.0	13.4
Paratype G	28.6	27.2	36	36	19.8	4.8	15
Paratype H	28.6	26.1	38	32	19.3	5.7	13.6
Paratype I	11.5	12	13	12	5.5	3	2.5

DISCUSSION

Spinatrypa (S.) lambermontensis is unquestionably close to the North American species *S. (S.) planosulcata* (WEBSTER, 1888) as figured by DAY & COPPER (1998, pp. 185-187, figs. 22-23). Nevertheless, it differs by its larger size, a more inflated brachial valve, a slightly coarser ornamentation (5-7 ribs/10 mm at 15 mm from the beak of the pedicle valve versus 6-8/10 mm in *S. (S.) planosulcata*) and a greater distance between the growth lamellae (1.5-3.0 mm versus 1.0-1.7 mm in the North American species).

STRATIGRAPHIC RANGE AND GEOGRAPHIC DISTRIBUTION (Fig. 6)

S. (S.) lambermontensis species is known in the Lambermont Formation [Vesdre Nappe (BM-2002-1) and in the northern border of the Dinant Synclinorium (BM-2001-2)]. The presence of this species in the Barvaux Formation is probable, but needs confirmation because collected material is insufficient.

Spinatrypa (Spinatrypa) sp.

Figures 5 p-t, 6

Two dorsibiconvex specimens [a badly preserved adult form and a juvenile form (W: 19.1 mm; L: 17.9 mm; T: 10.6 mm)] differ from *S. (S.) lambermontensis* n. sp. by their coarser and more undulose ribs. They increase by intercalation and bifurcation oscillating between 4 to 5/cm at 15 mm from the ventral beak. The available material does not allow a more accurate determination,

nevertheless these specimens are similar to North-American species *S. (S.) trulla* (STAINBROOK, 1945) and *S. (S.) rockfordensis* (FENTON & FENTON, 1924).

Spinatrypa (S.) sp. is present in the Lambermont Formation (BM-2001-2; Fig. 6).

Remark

Another species of atrypid brachiopod, which belongs to *Costatrypa* COPPER, 1973, and maybe another species of *Radiatrypa* COPPER, 1978 are also present in the Lambermont Formation but there is a lack of well preserved and abundant material (Fig. 6).

Conclusions

This article is only a first step in description of atrypid brachiopods from the Lambermont and Barvaux formations (Upper *P. rhenana* Zone). It is difficult to precise the extension of the atrypid brachiopods in the Barvaux Formation because the outcrops never completely expose the formation. *I. ultima* is present in the Barvaux and the Lambermont formations. At its locus typicus (Barvaux Formation), the species seems to be restricted above a level which has yielded a colony of *Frechastraea pentagona pentagona* (GOLDFUSS, 1826), one of the most characteristic coral species of the third biostrome with *Phillipsastrea* of COEN-AUBERT (1974, p. 21) which is well developed in the stratotype of the Lambermont Formation

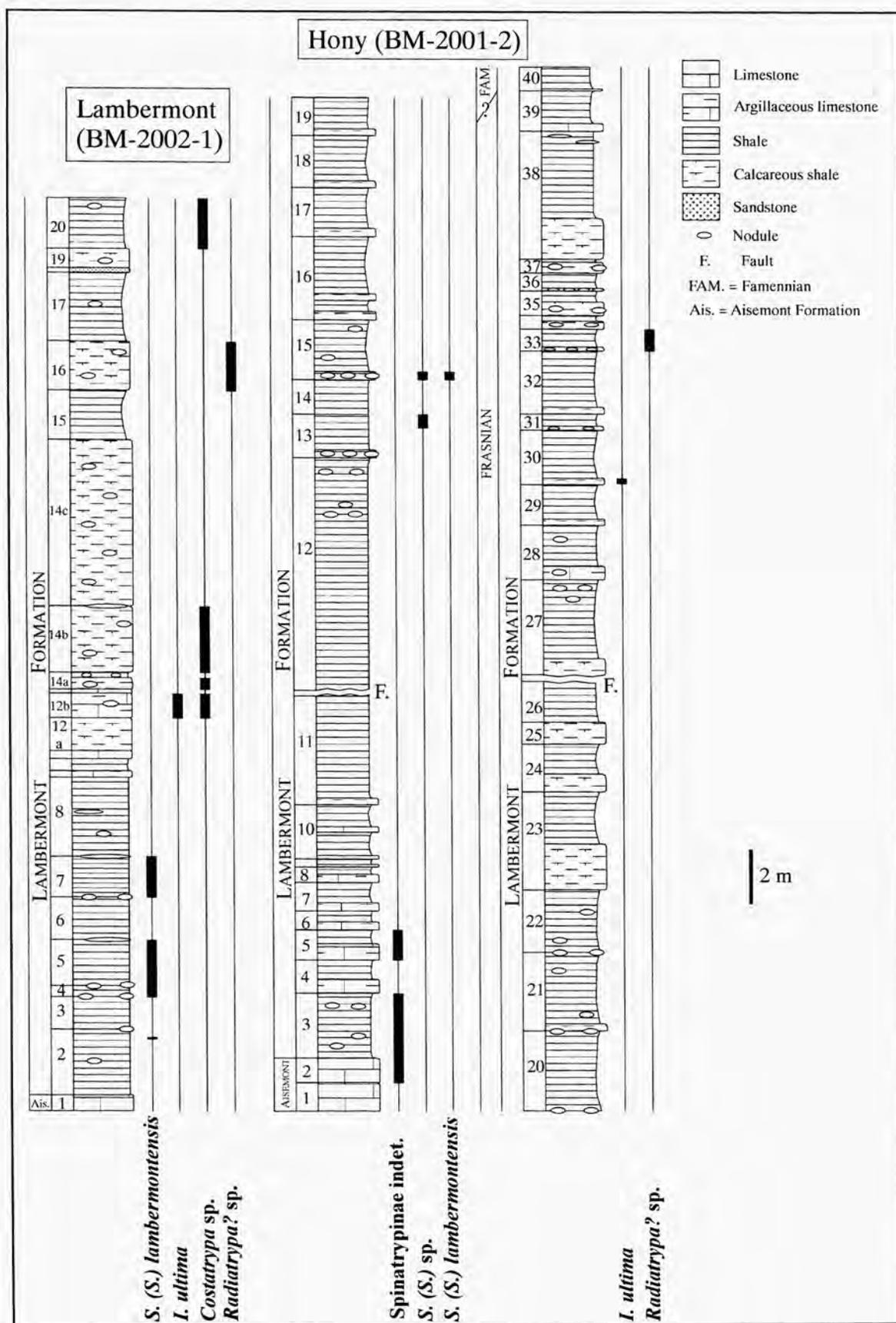


Fig. 6 — Distribution of *Iowatrypa ultima* n. sp., *Spinatrypa (Spinatrypa) lambermontensis* n. sp., *Costatrypa* sp. and *Radiatrypa?* sp. in the outcrops BM-2002-1 (Lambermont; beds 1 to 10 logged in the southern flank of the anticline and beds 11 to 20 logged in the northern flank of the same anticline) and BM-2001-2 (Hony, logged in collaboration with E. POTY).

and where *I. ultima* has been also collected. Therefore *I. ultima* allows us to locate the third biostrome in the Barvaux Formation, a facies where the characteristic rugose corals are less abundant. In the Lambermont Formation, *S. (S.) lambermontensis* is present between the top of the Aisemont Formation and the third biostrome with *Phillipsastrea*. Some *Spinatrypa* which are close to *S. (S.) lambermontensis* have been collected in the Barvaux Formation, and precede the apparition of *I. ultima*.

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Explanation of Plate 1

PLATE 1

All specimens are figured at magnification x 1.5. Photos Wilfried MISEUR.

a: ventral view; b: dorsal view; c: lateral view; d: posterior view, e: anterior view.

Iowatrypa ultima n. sp.

Fig. 1 a-e — Holotype, specimen IRScNB a11948. Hérock, outcrop BM-2001-4.

Fig. 2 a-e — Paratype A, specimen IRScNB a11949. Aye, outcrop BM-2002-3.

Fig. 3 a-e — Paratype B, specimen IRScNB a11950. Same locality.

Fig. 4 a-e — Paratype C, specimen IRScNB a11951. Same locality.

Fig. 5 a-e — Paratype D, specimen IRScNB a11952. Same locality.

Spinatrypa (Spinatrypa) lambermontensis n. sp.

Fig. 6 a-e — Paratype C, specimen IRScNB a11962. Lambermont, outcrop BM-2002-1, bed 2.

Fig. 7 a-e — Paratype D, specimen IRScNB a11963. Same locality.

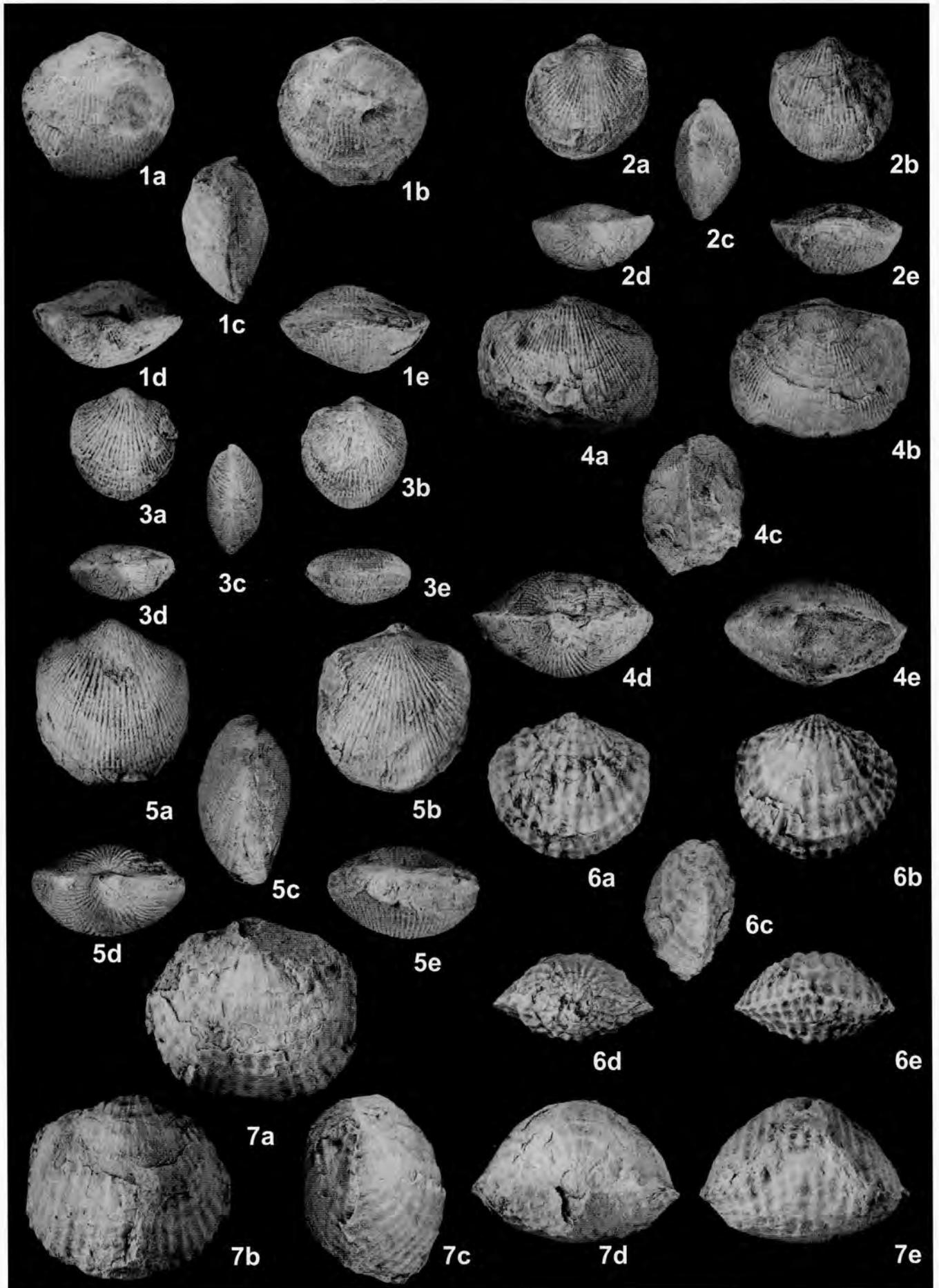


PLATE 1