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Parallelepipedorhynchus, a new late Frasnian rhynchonellide (brachiopod) from the Dinant Basin, Belgium, and Parallelepipedorhynchidae n. fam.

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Abstract

Parallelepipedorhynchus trapezoides n.gen., n.sp. is erected for late Frasnian specimens from the southern flank of the Dinant Basin, Belgium, previously referred to *Hypothyridina cuboides*. It is designated the type for the new rhynchonellide family Parallelepipedorhynchidae. Most references to the occurrence of *Terebratula*, *Rhynchonella*, *Hypothyris*, *Hypothyridina cuboides* are incorrect. The stratigraphic implications of these misidentifications are discussed in detail.

Key words: Parallelepipedorhynchidae, *Parallelepipedorhynchus*, rhynchonellids, brachiopods, late Frasnian, Belgium.

Résumé

Parallelepipedorhynchus trapezoides n.gen., n.sp. est fondé pour une espèce du Frasnien supérieur du bord méridional du Bassin de Dinant, Belgique, connue précédemment sous le nom d'*Hypothyridina cuboides*. Le genre est désigné comme type de la nouvelle famille Parallelepipedorhynchidae. La plupart des références à *Terebratula*, *Rhynchonella*, *Hypothyris*, *Hypothyridina cuboides* sont erronées. Les implications stratigraphiques qui en découlent sont discutées en détail.

Mots-clefs: Parallelepipedorhynchidae, *Parallelepipedorhynchus*, Rhynchonellides, Brachiopodes, Frasnien supérieur, Belgique.

Introduction

There have been many reports of the occurrences of *Hypothyridina cuboides* (J. de C. SOWERBY, 1840) in the Dinant Basin, all now known to be incorrect (in the following discussion, such records are referred to simply as ''*cuboides*''). In a manuscript list de Koninck in 1841 was the first to mention ''*cuboides*'' from two Belgian localities Chimay and Visé. This list was quoted by D'ARCHIAC & DE VERNEUIL (1842, footnote 2, p. 11, p. 308) and incorporated by them in the table on p. 393 as *Atrypa cuboïdes*. DE KONINCK (1844, pp. 285-287, 621, 628, pl. XIX, figs. 3a-e) described the material collected from ''le calcaire et le schiste dévoniens de Chimay'' and the ''calcaire carbonifère de Visé'' as *Terebratula cuboïdes*. No locality is indicated for the two figured specimens. One (figs. 3a-c) is an adult specimen illustrating the ''*cuboides*'' commonly accepted by Belgian and foreign geologists as the characteristic fossil of the Frasnian in its type area; it is also the most abundant form, especially on the southern flank of the Dinant Basin, where Chimay is located.

The other specimen (figs. 3d,e) was considered by DE KONINCK to be a juvenile. The occurrence of ''*cuboides*'' in the Carboniferous of the Visé Massif was dismissed by HORION (1860, p. 58, foot-note 1, p. 59) and GOSSELET (1861, foot-note 2, p. 20), but maintained by DE VERNEUIL (1847, p. 697), and KAYSER (1871a, p. 364; 1871b, pp. 504, 515). I believe that DE KONINCK's specimen is not a juvenile, but one of the various ''*cuboides*'' from the Frasnian of Belgium, but the possibility that it could be a Carboniferous taxon cannot be completely dismissed. DE KONINCK's description covers more than one taxon; therefore the description of some external characters by SCHNUR (1851, p. 4), who received from DE KONINCK some adult specimens from Chimay, is a valuable contribution to the eventual identification of the Chimay species.

In mentioning *Terebratula cuboides* near Couvin in the ''Iberger Kalk'', corresponding to the limestones of Elbingerode and Grund (Harz Mountains, Germany), Brilon (Sauerland, Germany), Hope (South Devon, England), and Tully (New York, USA), ROEMER (1850, pp. VI-VII; 1851, pp. 87-88) was the first to suggest a specifically Frasnian age for Belgian ''*cuboides*''. A profusion of stratigraphic terms was introduced by GOSSELET (1860) for part or all of the Devonian segment in the southern part of the Dinant Basin, which includes strata of late Givetian, Frasnian, and early Famennian age: ''calcaire(s) à *Terebratula cuboides*'', ''couches à *T. cuboides* et schistes de Famenne'', ''schistes à *Spirifer Verneuili* et *Terebratula cuboides*'', ''couches à *T. cuboides*'', ''schistes à *T cuboides*'', ''assise à *T. cuboides*'', ''étage à *T. cuboides*'', ''schiste de Famenne et calcaire à *T. cuboides*'', ''schistes de Famenne (comprenant les couches à *T. cuboides*'', ''schistes et calcaire

à *T. cuboides*''. Most of them were adopted unchanged or with slight modifications by many geologists, while GOSSELET carried on improving and refining his own terminology.

The concept of a Middle Frasnian (''Frasnien Moyen'' = F2 or Fr2) valid only for the southern part of the Dinant Basin was developed by MAILLIEUX (1910-1942), who indiscriminately placed ''*cuboides*'' in the genera *Rhynchonella*, *Rhynchonella* (*Hypothyris*), *Hypothyris*, and *Hypothyridina* in various combinations with: ''faune(s) à..., ''assise à...'', ''assise moyenne à...'', ''couches à...'', and ''Frasnien moyen à...''. From then on the expression ''F2 - Assise de Frasnes à *Hypothyridina cuboides*'' prevailed in Belgian literature, this Frasnian subdivision being the one generally referred to in the type area at least, as variously *cuboides* or *Cuboides* zone, fauna, stage, beds, and ''Schichten''.

The concept of a Middle Frasnian implied the acceptance of a Lower Frasnian (''Frasnien inférieur'' = F1 or Fr1; ''Assise de Fromelennes'' since MAILLIEUX, 1921, p. 16; 1922, p. 16), and an Upper Frasnian (''Frasnien supérieur'' = F3 or Fr3; ''Assise de Matagne'' of GOSSELET 1888 and subsequently).

As indicated by SARTENAER & ERRERA (*in* ERRERA *et al.*,1972), the establishment of the ''Assise de Fromelennes'' drew to an end the historical mistake that started to emerge 59 years before, i.e. the transfer of the upper part of the Givetian (''calcaire de Givet'' or ''calcaire à Stringocéphales'') to the Frasnian. This shift, first suggested by DEWALQUE (*in* DUPONT, 1863, pp. 875, 877) was accepted by GOSSELET after initial reluctance (see GOSSELET *in* DUPONT, 1863, pp. 876-877; SARTENAER & ERRERA *in* ERRERA *et al.*, 1972, fig. 2, pp. 13-16), embraced by MAILLIEUX (1910-1942) and his followers (LECOMPTE, 1960-1970, and his students), and formalized by the Geological Council of Belgium (1952) as the lowest ''assise'' of the Frasnian.

This lowering of the base of the Frasnian rested on the following observations:

1) The recognition (since DEWALQUE, 1868, pp. 65, 66) of an ''assise mince de schiste'' (or ''banc de schiste'' or ''étroit ruban schisteux'') at the base of the upper part of the Givet Limestone.

2) The first appearance of *Spirifer Verneuili* MURCHISON, 1840 (now *Cyrtospirifer verneuili*), considered to be an Upper Devonian species (since GOSSELET, 1871, pp. 293-294 on the base of information received from DUPONT) – the presence of *Spirifer Verneuili* in the upper part of the Givet Limestone without further precision had already been mentioned by GOSSELET, 1863, p. 171).

3) The presence of *Spirifer tenticulum* DE VERNEUIL *in* MURCHISON *et al.*, 1845 (now *Tenticospirifer tenticulum*) in the shale layer mentioned above (MAILLIEUX, 1914, p. 71: ''F1a1. Schistes à *Spirifer tenticulum*'' and later ''F1a – Zone des schistes à *S. tenticulum*'').

4) The presence of *S. tenticulum* in the whole of F1 (F1a + F1b + F1c) (recorded by MAILLIEUX, 1910, pp. 221, 225, who named it later (1914, p. 71) ''F1. – Assise inférieure [du Frasnien] à *S. tenticulum*'').

Identifications of both *Cyrtospirifer verneuili* and *Tenticospirifer tenticulum* in either the lower part or all of F1 are incorrect. Moreover, *T. tenticulum* is not present in any Frasnian subdivision in Belgium or France. It has long been known that *Stringocephalus burtini* (DEFRANCE *in* DE BLAINVILLE, 1824) occurred in F1a, the lower part of the ''Assise de Fromelennes'' (see BONTE & RICOUR, 1949a, pp. 26, 30, 35, but this was not known to MAILLIEUX during his active life, and its significance was underevaluated by LECOMPTE (1960, p. 56; 1967, p. 50; 1970, p. 27), and COEN & COEN-AUBERT (1971, pp. 5-6, 15-16, 18, and plate). This coupled with the errors in identifications of *Cyrtospirifer verneuili* and *Tenticospirifer tenticulum* noted above has been the source of considerable confusion not only in the Belgian literature, but also in papers on successions outside the type area of both the Givetian and Frasnian. For example BOUCOT *et al.* (1966, p. 1356), who reviewed the world distribution of the genus *Stringocephalus* DEFRANCE *in* DE BLAINVILLE, 1825, accepted the Frasnian age of the ''Assise de Fromelennes'' notwithstanding the presence in it of *S. burtini*, thus making it the only Frasnian example in the world of the genus *Stringocephalus*.

In order to resolve the then-prevailing confusion, I organized on October 30, 1971, a Belgo-French colloquium held in the Belgian Royal Institute of Natural Sciences, Brussels (the participants are listed by SARTENAER & ERRERA *in* ERRERA *et al.*, 1972, p. 34). It was unanimously decided at the colloquium to accept as the definition of the Givet Limestone that of GOSSELET (1871) and further advocated by BONTE & RICOUR (1949a, 1949b, 1949c, 1950, 1951), the French geologists who studied the Givet Limestone in its type locality. This decision was first approved by the Belgian National Commission for Devonian Stratigraphy (under my chairmanship), and then by the Geological Council of Belgium (documents 1, 1971 and 7, 1972, not published). This decision, confirmed by subsequent studies based on conodonts, received an international endorsement when the Givetian/Frasnian stage boundary, proposed by the SDS (Subcommission on Devonian Stratigraphy) in 1985, was ratified by the ICS (International Commission on Stratigraphy) and the 28th International Gological Congress in WASHINGTON (1989).

HOUSE (*in* HOUSE *et al.*, 2000, pp. 53-57), ignored the Belgo-French colloquium mentioned above and criticized this general acceptance in a chapter entitled ''Prehistory, ratification and posthistory – a cautionary tale''. In spite of his opinion (p. 56) that ''critical personalisation is unhelpful'', HOUSE's criticism bordered on the personal when I was referred to (on p. 64): ''It should be mentioned that during the SDS discussions one member regularly insisted that Belgians drew the base of the Frasnian at the top, rather than the base of the Assise de Fromelennes, but this was a personal opinion''. Reality is that the ''dismemberment of the Belgian subdivision of the Frasnian into F1, F2 and F3 division'' deplored by HOUSE (p. 56), put an end to an historical mistake parallel to another one related to the same Givetian/Frasnian stage

boundary on the other side of the Atlantic Ocean. In New York State HOUSE regularly opposed COOPER's assignment of the Tully Limestone to the Givetian (Hamilton) based on brachiopods, an assignment that was later confirmed by conodonts (KLAPPER & ZIEGLER, 1967, fig.1, p. 71, pp. 72, 79). This controversy was discussed by SARTENAER (2003, p. 41). Although some philosophical consideration should be given to HOUSE's (p. 56) statement "how elusive is the hope for clarity and permanence in chronostratigraphic nomenclature", a decision resulting from long and open discussions within the geological community should not be brushed aside, but must be given preference.

In summary, there is no Lower Frasnian F1, and the previous Middle Frasnian F2 concept covers the whole Frasnian except the "Assise de Matagne" (F3), this "assise" corresponding to the uppermost part of the Frasnian.

"*Hypothyridina cuboides*" has been recorded from all levels of the Frasnian of the southern border of the Dinant Basin, i.e. in F2a to F2j and F3 in the terminology commonly in use when the study of the Frasnian reached its peak, and that SARTENAER (1974a) suggested be abandoned. It has also been cited in Belgium from the central part and on the northern flank of the Dinant Basin, the southern and northern flanks of the Namur Basin, and the Vesdre Massif.

SARTENAER (2003, p. 36) noted that the cuboidal outline of "*H. cuboides*" has been the one unifying factor that brought together under that single name various species and genera from the type area of the Frasnian and also from other regions of the world. This means that the various reported "*H. cuboides*" are not only different from one region to another, but within each of these regions. It is clearly stated by SAVAGE in the most recent Treatise (2002, p. 1028): "Shape is an important generic feature, notwithstanding the frequency of homeomorphs. The genera *Pleurocornu*, *Hypothyridina*, *Lessinirhynchia*, and many others have a sufficiently distinct shape that initial diagnosis is unlikely to be reversed by investigation of interior features, although such investigation is always necessary". Unfortunately, until now the internal features of *Hypothyridina cuboides* have not been investigated.

The badly needed revision of "*Hypothyridina cuboides*" from the type area of the Frasnian is in progress (SARTENAER, 2003, p. 43). The species described in the present paper is identified as *H.cuboides* in the literature and collections of the Belgian Royal Institute of Natural Sciences, Brussels, but is now known to belong to neither the species nor the genus.

Parallelepipedorhynchidae n. fam.

TYPE GENUS
Parallelepipedorhynchus n. gen.

DIAGNOSIS
Shell of medium- to medium-large-size and subparallelepipedic outline with long ventral interarea and hinge line; apical angle very wide. Sulcus moderately shallow, fold very low, costae simple, few in number, rarely dividing, start at some distance from beaks; median grooves, spine-like projections, *squamae* and *glottae* absent. Hinge plate divided, crura short raduliform, cardinal process absent. Dental plates, septum and septalium absent.

GENERIC COMPOSITION
Parallelepipedorhynchus n. gen. is the sole known genus.

REMARKS
The diagnostic combination of characters allows separation of the new family from all known families, and in particular from the Hypothyridinidae RZHONSNITSKAYA, 1956.

As noted in SARTENAER (2003, pp. 35-36), *Hypothyridina cuboides*, type species of *Hypothyridina* BUCKMAN, 1906, in turn the type genus of the family Hypothyridinidae, is represented by a single specimen, the internal characters of which are obviously unknown. This means that the family is very poorly founded.

The definition of the family by RZHONSNITSKAYA (1958, p. 113) is: "Rhynchonellaceans with radial costae, plicate or almost smooth. Sulcus in ventral, fold in dorsal valve. Divided hinge plate; septalium and cardinal process absent; dental plates developed, more rarely absent; dorsal septum commonly absent". RZHONSNITSKAYA (1956, p. 125) assigned three new subfamilies to the family, Ancistrorhynchinae, Pugnaxinae, and Hypothyridininae, the latter with the following diagnosis: "Hypothyridinides with flat costae, commonly with longitudinal grooves on costae near the anterior commissure. Crura relatively short."

The taxonomic position of *Hypothyridina* and supposedly related genera is unstable. Only to mention the last treatises, SCHMIDT (1965, pp. H563-H570) discarded the Hypothyridinidae, and assigned the Hypothyridininae RZHONSNITSKAYA, 1956 and three other subfamilies to the family Uncinulidae RZHONSNITSKAYA, 1956. SAVAGE (1996, pp. 252-253; 2002, pp. 1092-1131) retained the Hypothyridinidae, and combined it with seven other families in the superfamily Uncinuloidea RZHONSNITSKAYA, 1956. Before a satisfactory classification of the rhynchonellides can be reached, it has always been my contention that many new observations and discoveries will be needed. Given that we do not know the internal structure of *Hypothyridina*, it is not surprising that genera have been added to or removed from the Hypothyridinidae on the basis of external morphology, and important hypothyridinide internal structures have been ignored or given lesser importance (compare the original family definition with those in the two Treatises, HAVLÍCEK, 1961, pp. 22, 33; DROT, 1964, p. 27). Thus the dental plates are said to be well developed, or absent, or weak, septum and septalium absent or rudimentary, cardinal process absent or present, and so on.

SARTENAER (2003, p. 31), took a conservative approach in erecting the new genus *Tullypothyridina* prior to deal-

ing with the problems associated with the concept of the Hypothyridinidae, and assigned the genus to that family. Once new collections from South Devon finally provide information on the interior of *Hypothyridina cuboides* this, little more than a guess, could prove either correct or incorrect.

The new family Parallelepipedorhynchidae cannot be assigned to the superfamily Uncinuloidea as that is defined by SAVAGE (1996, p. 252; 2002, p. 1092).

Parallelepipedorhynchus n.gen.

DERIVATIO NOMINIS

Τὸ παραλληλεπίπεδον (Greek, neuter) = parallelepiped; *τὸ ῥυγχος* (Greek, neuter) = beak; the name draws attention to the shape of the type species of the genus.

TYPE AND ONLY SPECIES

Parallelepipedorhynchus trapezoides n.gen., n.sp.

DIAGNOSTIC FEATURES

Shell of medium- to medium-large-size, outline a dorsibiconvex subparallelepiped, contour subtrapezoidal in ventral view, very wide; greatest thickness and width posterior to mid-length. Hinge line and ventral interarea long, apical angle very wide. Sulcus, fold, and costae start anterior to beaks; fold very low, forming low generally transverse-rectangular tongue. Top of tongue lower, sometimes considerably, than the maximum shell thickness. Median costae few. Costae dividing or intercalated only rarely; parietal costae usual; costae marginally without median grooves or spine-like projections. Shell thick posteriorly. Dorsal internal structures thin; hinge plate divided, crura short, raduliform, crural appendices elongated; no cardinal process. Dental plates, septum, septalium absent.

DESCRIPTION

Shell medium- to medium-large-size, profile gibbous, strongly dorsibiconvex (length slightly greater than thickness, sometimes nearly equal, dorsal valve 2-3 times thickness of ventral valve); ventral valve thickest at 1/4-1/3 shell length, dorsal valve thickest anterior to mid-length. Shell outline transverse (length about 3/4 width) rounded trapezoid, with marked anteromedian reentrant, greatest width posterior to mid-length. Cardinal margin wide (slightly shorter than shell width, cardinal extremities rounded, slightly flattened, sticking out. Anterior and lateral commissures sharp, slightly, sometimes almost not, undulated by the costae. Lateral parts of the anterior commissure at right or slightly obtuse angle to the lateral commissures. Very wide and slightly variable apical angle and angle of the cardinal commissure. Ventral beak slightly to strongly incurved; umbo low, broad, evenly curved. Dorsal beak small; umbo broad, strongly swollen, extends posteriorly beyond ventral umbo. Ventral interarea long, low, concave, defined by faint beak ridges; no deltidial plates seen. Sulcus and fold well marked, start at the anterior border of the umbonal regions. Sulcus narrow, only moderately deep and well delineated towards margin; bottom flat, extended dorsally as moderately high to high tongue with subrectangular outline, tending to become vertical in its uppermost part. Top of tongue slightly posterior to shell length, and lower than maximum shell thickness. Fold is mostly clearly defined but remains low throughout; top flat to gently convex. In transverse profile, dorsal valve high, semi-elliptical, outer flanks deflected ventrally to be almost vertical near commissure; ventral valve low, most strongly curved medially, flanks very gently convex. Costae well marked, low, angular, absent from umbos and cardinal margins. Median costae few, coarser than lateral costae. Parietal costae generally present. No divisions, with the exception of the dorsal external median and the ventral internal lateral costae that are often divided. Intercalated median costae sometimes present. No spine-like projections and accommodating grooves developed.

Shell thick posteriorly. Teeth stout, short, cyrtomatodont, directed dorsolaterally, not supported by dental plates. Dorsal internal structures delicate; no cardinal process or septum; hinge plate divided, outer hinge plates thin, passing without sign of crural bases into elongated appendices; crura short, raduliform, oval in section; crura and crural appendices remain close together.

COMPARISON

The late Givetian genus *Tullypothyridina* and *Parallelepipedorhynchus* exhibit some similar features: the strongly dorsibiconvex profile; the contour of valves in transverse section; the sharp commissure slightly or almost not deflected by the costae; the lateral commissures located low; the strongly inflated dorsal umbo extending posterior to the ventral umbo; a very low fold; the presence of parietal costae; length and thickness nearly equal; a divided hinge plate; short raduliform crura remaining close to each other; the absence of a septum and a septalium.

Many characters make *Parallelepipedorhynchus* distinct from *Tullypothyridina*: a commonly slightly larger size; a subparallelepipedic outline; a trapezoidal contour in ventral view; sulcus, fold, and costae starting at some distance from the beaks; a slightly deeper sulcus; a generally lower, elongated, and transversely rectangular tongue; the top of tongue located lower; a long ventral interarea; less abrupt dorsal flanks; angular and slightly higher median and lateral costae; a generally lower number of median and lateral costae of equal width; the occasional presence of a division of either the dorsal external median or the ventral internal lateral costae; wider furrows; the absence of median grooves on the costae near the commissure and of spine-like projections; the maximum shell width located posterior to mid-length; the top of dorsal valve, and thus the maximum shell thickness, located considerably posterior to front; a long hinge line slightly shorter than shell width; wider apical angle and angle of the cardinal commissure; a thicker posterior part of shell; the absence of dental plates and cardinal process; thinner outer hinge plates.

For reasons mentioned above it is only possible to compare the external characters of *Parallelepipedorhynchus* with the late Givetian holotype of *Hypothyridina cuboides* from South Devon. They have some characters in common, e.g. size, strongly dorsibiconvex shape, a very low fold, a strongly inflated dorsal umbo extending beyond the ventral umbo; a sharp commissure barely deflected by the costae; lateral commissures located low, and the presence of parietal costae.

Parallelepipedorhynchus differs from the holotype of *Hypothyridina cuboides* in its parallelepipedic outline, the subtrapezoidal contour and long cardinal margin, and the maximum shell width being clearly posterior to mid-length (in the holotype of *H. cuboides* it is near mid-length); flanks not as close to vertical; a slightly deeper and narrower sulcus at front; a lower, elongated, generally transversely rectangular tongue, its upper part never recurved posteriorly; the top of tongue located lower; a long ventral interarea; fewer, higher, wider, more angular costae both medially and laterally (14 median and 21 lateral on the holotype of *H. cuboides*); wider furrows; rare divided costae; width being by far the greatest dimension; maximum shell thickness considerably posterior to anterior margin; a wider apical angle; a wider angle of the cardinal commissure (126° on the holotype of *H. cuboides*).

Parallelepipedorhynchus trapezoides n.gen., n.sp.
(Plate 1, Figures 1-25; Text-fig. 1)

All specimens are deposited in the collections of the Royal Belgian Institute of Natural Sciences with registration numbers prefixed IRScNBa

DERIVATIO NOMINIS

Τραπεζοειδής, ής, ές (Greek, adjective) = trapezoidal; the name draws attention to the subtrapezoidal outline of the shell.

TYPES, LOCUS TYPICUS, AND STRATUM TYPICUM

All types but one (paratype J) come from Boussu-en-Fagne near Frasnes (2.7 km to the E) and Couvin (3.3 km to the SE) on the southern flank of the Dinant Basin; they are in good state of preservation.

Holotype, IRScNBa12168 (Pl. 1, Figs. 11-15); paratypes A, IRScNBa12169 (Pl. 1, Figs. 1-5), B, IRScNBa12170 (Pl. 1, Figs. 6-10), C, IRScNBa12171 (Pl. 1, Figs. 16-20), D, IRScNBa12172 (Pl. 1, Figs. 21-25), F, IRScNBa12174 (Fig. 1B), G, IRScNBa12175. Collector: V. Ebbighausen, 1970. Paratypes E, IRScNBa12173 (Fig. 1A), H, IRScNBa12176. Collector: R. Walter, 1980. Holotype and paratypes A-H have been collected from locality 95a, an outcrop along strike from the "F2j" reef of the abandoned cemetery quarry ("Carrière du Cimetière"), 200 m E of that quarry, below a short stretch of road ending abruptly at the verge of a wood.

Paratype I, IRScNBa12177. Cemetery quarry ("Carrière du Cimetière"). Late Frasnian "F2j" reef. Locality: Couvin 6158. Purchased in 1914 when the quarry was still in operation, and identified by Maillieux as *Hypothyridina cuboides*.

Paratype J, IRScNBa12178. Locality BM-2002-80. Railway cutting on the Charleroi-Couvin line NE of Les Valisettes farm and SW of the village of Neuville. Between 7.05 and 7.5 m above the tip of a "F2j" reef (see further details below). Collector: B. Mottequin, 2002. The specimen is in good state of preservation.

OTHER MATERIAL

One fragmentary dorsal valve, collected by R. Walter, 1980 from the same outcrop as the holotype.

DESCRIPTION

This refers only to specific characters in need of further elaboration.

Beginning of sulcus between 30 and 47 per cent of shell length or between 28 and 38 per cent of the unrolled length of ventral valve. Width of sulcus at front between 44 and 60 per cent (mostly between 44 and 52 per cent) of shell width. Top of tongue located lower than the highest

Table 1 — Measurements of ten specimens; figures in parentheses estimates. Abbreviations: l = length; w = width; t = thickness; vv = ventral valve; dv = dorsal valve.

in mm	Paratype A	Paratype E	Paratype I	Paratype G	Paratype F	Holotype	Paratype C	Paratype B	Paratype H	Paratype D
l	21.1	20.4	20.1	19.1	19.1	18.7	18.6	18.5	18.1	15.9
w	25.6	25.9	25	26	(23.9)	24.2	23.4	24.6	25.8	21.6
lvv unrolled	32	?	30	29	27.8	29.5	29.5	28.5	29.5	26
t	20.3	18.7	18.5	16.4	17.7	19.3	18.4	18	18.3	16.3
tvv	6.6	6.9	6.5	5.8	5.9	6.8	6.6	6.5	6	6.3
tdv	13.7	11.8	12	10.6	11.8	12.5	11.8	11.5	12.3	10
l/w	0.82	0.79	0.80	0.74	(0.80)	0.77	0.78	0.75	0.70	0.74
t/w	0.79	0.72	0.74	0.63	(0.74)	0.80	0.79	0.73	0.71	0.75
t/l	0.96	0.92	0.92	0.86	0.93	1.03	0.99	0.97	1.01	1.03
apical angle	145°	(140°)	147°	151°	(151°)	150°	147°	151°	159°	(150°)
angle of the cardinal commissure	154°	(152°)	158°	162°	164°	170°	158°	165°	169°	160°

part of the shell, i.e. between 14 and 33 per cent of the shell thickness. Length of ventral interarea mostly between 50 and 62 per cent of shell length.

Measurements of ten specimens, of which five have been photographed and two serially sectioned, are given on Table 1.

Thickness of dorsal valve between 55 and 67 per cent (mostly 63 to 67 per cent) of shell thickness. Maximum thickness of ventral valve located between 24 and 38 per cent of the shell length anterior to the ventral beak. Maximum thickness of dorsal valve, and thus of shell, between 46 and 58 per cent of shell length anterior to the ventral beak. Maximum shell width between 31 and 45 per cent of shell length anterior to the ventral beak. Width of hinge line between 78 and 90 per cent of shell width. Apical angle generally between 140° and 159° (mostly 145° to 151°), and the angle of the cardinal commissure between 152° and 170°(mostly 158° to 170°).

The general costal formula in median, parietal, and lateral categories derived from at least 75 per cent of the specimens is: (4 to 5 / 3 to 4); (1 – 0 / 1 – 0) to (2 – 1 / 2 – 1); (12 to 16 / 13 to 17). The ratios of costae are given in Table 2. One parietal costa is generally present on one or both flanks of sulcus and fold. Parietal costae usually reach the commissure; they may be adventitious, but mostly result from the division of a ventral internal lateral or a dorsal external median costa. In the latter case the parietal costa is sometimes almost at level with the median costae, and cannot be called parietal; it is then more appropriate to speak of a division of the dorsal external median costa. Width of median costae at front varies between 2 and 3 mm.

Transverse serial sections of two specimens (paratype E, IRScNBa12173 and F, IRScNBa12174) are shown in Figure 1.

Table 2 — *Parallelepipedorhynchus trapezoides* n.gen., n. sp. Number of median, parietal, and lateral costae.

Median costae		Parietal costae		Lateral costae	
Number of costae	Number of specimens	Number of costae	Number of specimens	Number of costae	Number of specimens
4/3	2	0	1	9/10	1
5/4	8	0-1/0-1	1	12/13	2
6/5	1	1-0/1-0	1	13/14	4
7/6	1	1-?/1-?	1	14/15	2
		1-1/1-1	7	16/17	1
		2-1/2-1	1	?	1

Stratigraphic position and geographic location
(Text-figs. 2, 3)

The material described in the present paper comes from two localities 9 km apart: in and near the cemetery quarry at Boussu-en-Fagne on the southern flank of the Dinant Basin (eleven specimens), and the railroad cut SW of the village of Neuville in the Philippeville Massif (one specimen).

"F2j" reefs on the southern flank of the Dinant Basin and in the Philippeville Massif are known in literature variously as "calcaire rouge", "marbre rouge", "calcaire rouge massif", "calcaire rouge à *Acervularia*", "(petit) récif de calcaire rouge", "(petit) récif de marbre rouge", "masse de marbre rouge", "récif F2j", "petit récif F2j", "récif à *Acervularia*", "bioherme F2j". The age of these reefs ranges from the late Early to the early Late *Palmatolepis rhenana* conodont Zone.

Cemetery quarry at Boussu-en-Fagne

The stratigraphic succession exposed in the cemetery quarry ("Carrière du Cimetière") has often been described in the literature, e.g. Maillieux [1913a, pp. 123-124; 1913b, pp. 61-62; 1914, figs. 5B, 6B, p. 86, p. 87, pl. IV, fig. 2 (photograph)], Lecompte [1960, pp. 70-71, fig. 11, p. 70, pl. VII, fig. 1 (photograph); 1963, pp. 26-27, fig. 23, p. 27], Waterlot (1972, fig. 27).

Railway cutting SW of Neuville

On May 5, 1973 the Belgian Geological Society (see "Bulletin de la Société géologique de Belgique", 1974, 83 (1), p. 3) organized an excursion in the Frasnian type area. On this occasion I distributed a section drawn from a new railway cutting on the Charleroi-Couvin line, NE of Les Valisettes farm and SW of the village of Neuville, known at that time as "tranchée de la nouvelle ligne du chemin de fer à Neuville". This section was studied by me during the Spring 1971 shortly after completion of the cutting. Since then the section, not to mention various short references to it, has repeatedly been illustrated (both as profile and stratigraphic column) in the literature: Mouravieff (1974, p. 7), Tsien (1975, fig. 25, p. 33), Coen (1978, fig. 3, p. 28), Coen-Aubert [1982 (separate figure)], Boulvain *et al.* (1993, pp. 20-21, fig. 6, p. 26, pp. 27-28), Bultynck *et al.* (1998, figs. 10-13, pp. 37-40), Boulvain, Coen & Coen-Aubert *in* Boulvain *et al.* (1999, pp. 78-82), and Bultynck *et al.* (2001, pp. 27-29).

Tsien (1975) included in the Neuville Fm. the strata between the F2h reef and the Matagne shales (F3), i.e. F2ij plus a few layers erroneously assigned to the Matagne shales. The Neuville Fm., as originally defined by Tsien (1974, p. 31) corresponds to the Neuville Fm. as newly defined plus the lower part of the Valisettes Fm. (see Fig. 3). In their discussion (p. 34) of the section distributed by me in 1973 it is stated by mistake by Bultynck *et al.* (1998, p. 34) that the section was published in Sartenaer (1974b).

The upper half (45 out of 94 m) of what is now called Les Valisettes Fm. is composed, according to Sartenaer (1973, see above), of purplish-blue and light green shales, alternating with numerous limestone beds changing upwards to aligned limestone nodules and lenses with 10 m of shales at the top. This upper half of the Les Valisettes Fm. is developed between 316 and 438.2 m from SW to NE on the eastern flank of the railway cutting. The measured section extends from a point 4.8 m NE of a private railway crossing, and extends 405.65 m to the km 103.2 marker. The single specimen from this section was collected near the top of the Les Valisettes Fm., between 399.5 and 400.5 m, i.e. 3 to 3.45 m below the shales at the top of the formation, and 13.8 to 14.25 m below the Matagne Shales. It is also 7.05 to 7.5 m above a massive bed noted by me in 1973 outcropping between 372 and 374 m and considered to be the tip of an "F2j" reef. In terms of conodont zonation, the specimen was found in the middle part of the Late *Palmatolepis rhenana* Zone. "F2j" reefs are common in the area, and in particular in another railway cutting 240 m further NE, studied by Bouckaert *et al.* (1970, p. 5, pls. 3-5), while work was still in progress.

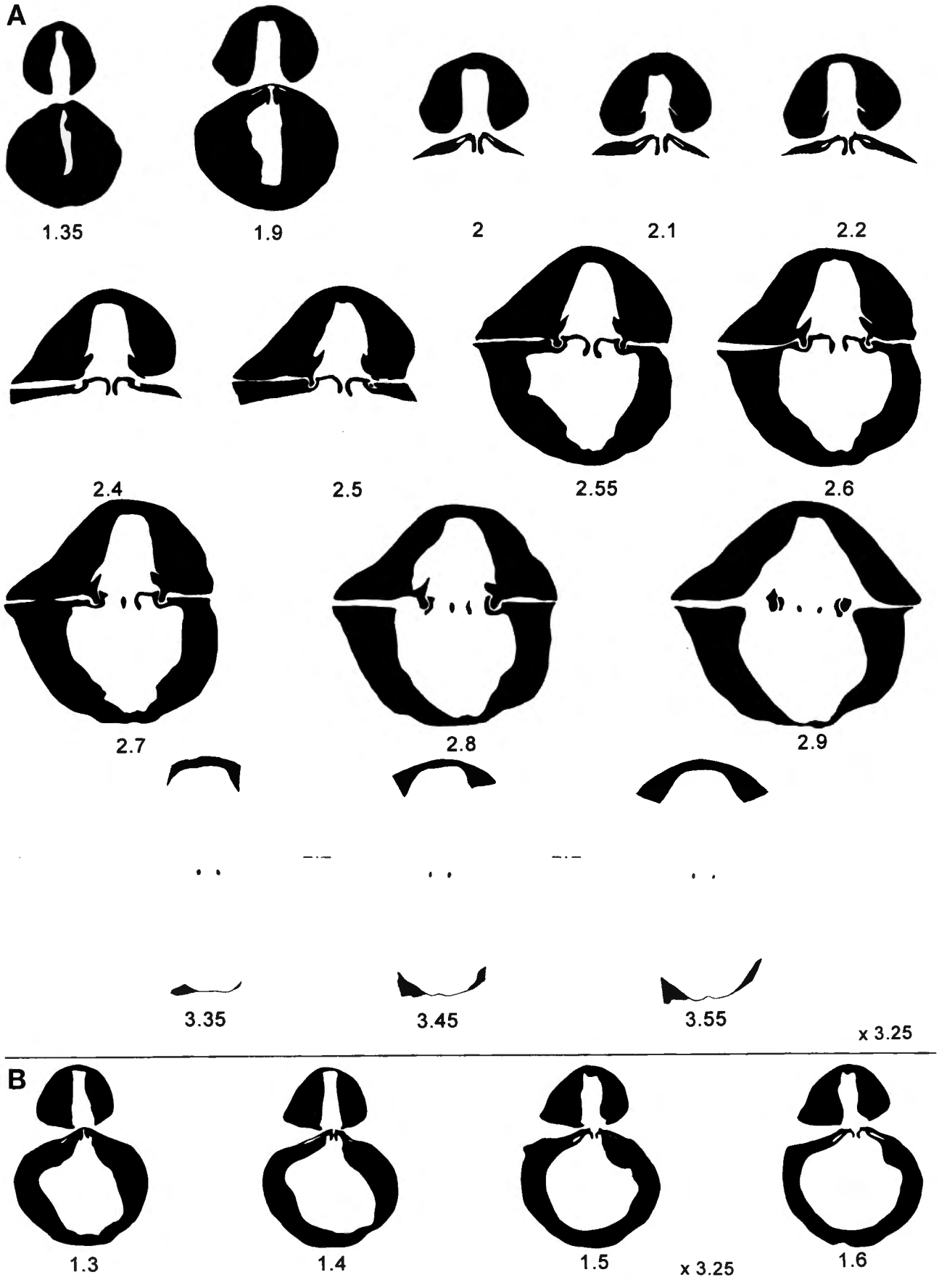


Fig. 1 — *Parallelepipedorhynchus trapezoides* n. gen., n.sp. Transverse serial sections; figures are xx mm from dorsal umbo.
A – Paratype E, IRScNBa12173. Measurements: length = 19.5 mm; width = 25 mm; thickness = 18.7 mm.
B – Paratype F, IRScNBa12174. Measurements: length = 18.4 mm; width = 24.2 mm; thickness = 16.9 mm.

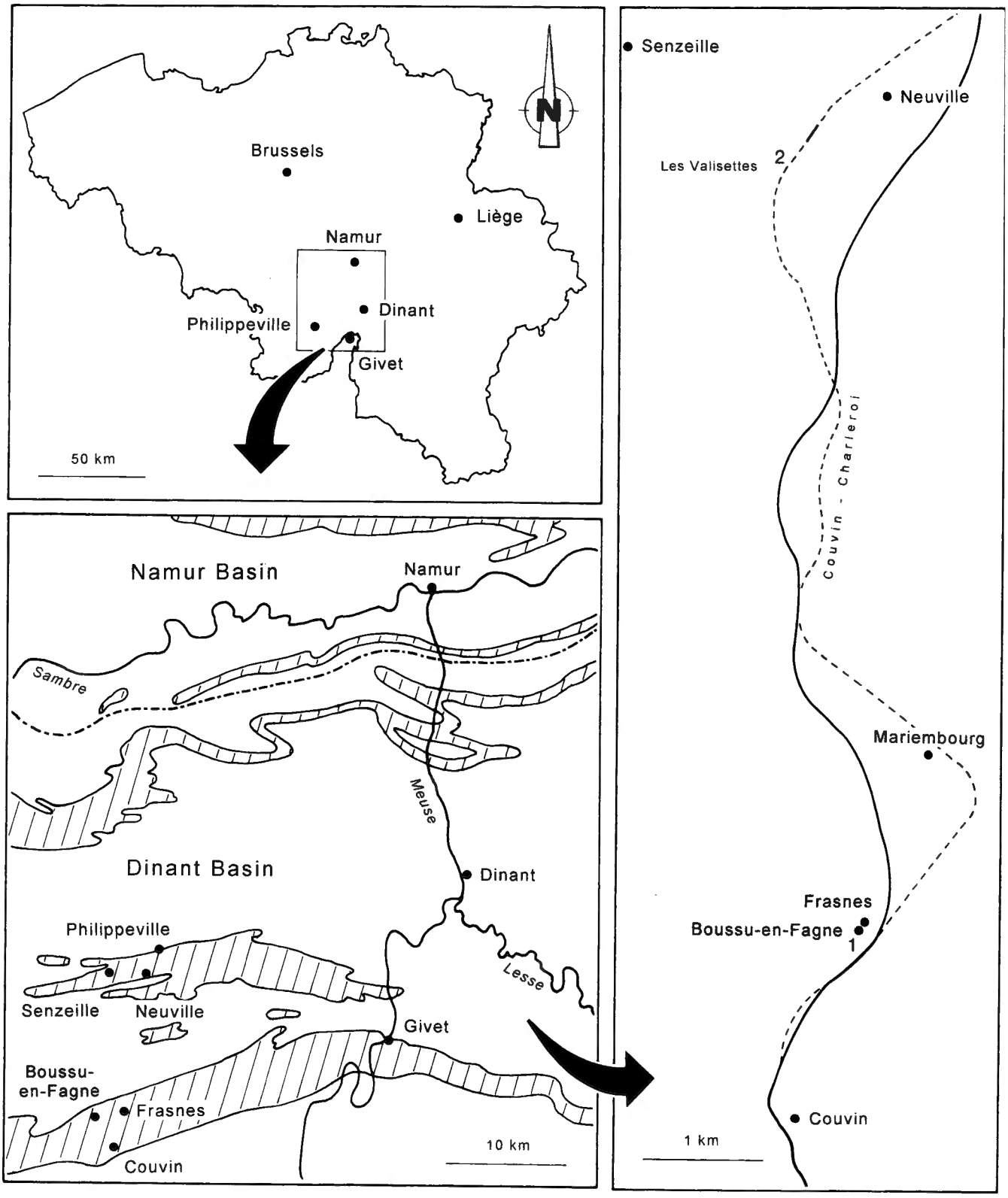
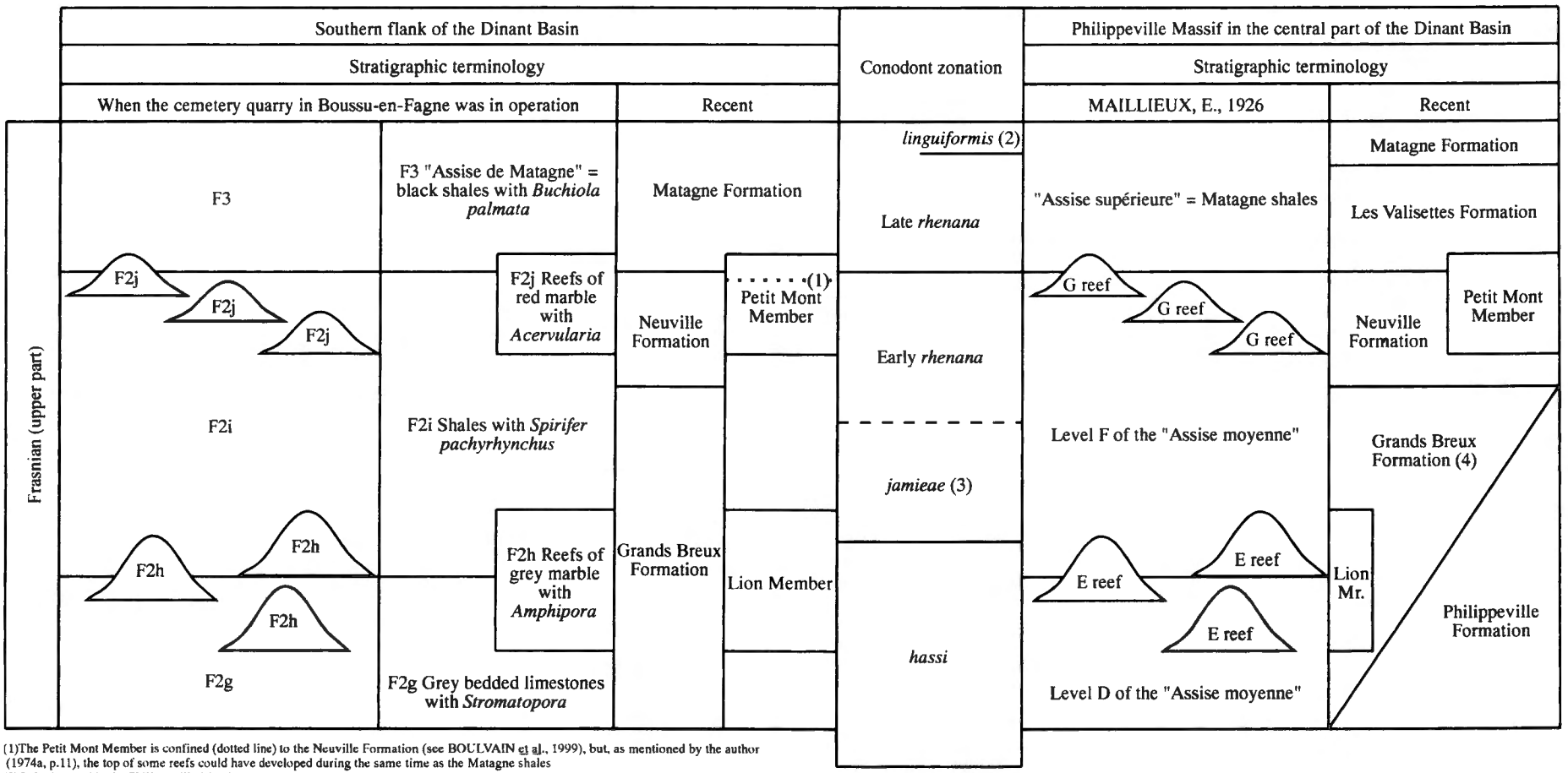


Fig. 2 — Collecting localities of *Parallelepipedorhynchus trapezoides* n.gen., n. sp. on the southern flank of the Dinant Basin (1, in the village of Boussu-en-Fagne W of the road Charleroi-Couvin), and in the Philippeville Massif (2, railway cutting on the line Charleroi-Couvin).



(1)The Petit Mont Member is confined (dotted line) to the Neuville Formation (see BOULVAIN et al., 1999), but, as mentioned by the author (1974a, p.11), the top of some reefs could have developed during the same time as the Matagne shales
(2)Only detected in the Philippeville Massif
(3)Not detected in the Philippeville Massif
(4)In the southeastern part of the Philippeville Massif the terminology used on the southern flank of the Dinant Basin is applied

Fig. 3 — Past and present stratigraphic subdivisions of the upper Frasnian sequence on the southern flank of the Dinant Basin and in the Philippeville Massif.

In terms of MAILLIEUX's (1926, p. 96) description, the "G reefs" contain the same fauna as the *Spirifer pachyrhynchus* Zone (F2i) on the southern flank of the Dinant Basin. MAILLIEUX added that probably most of these reefs ceased in the Matagne Shales ("probablement les plus nombreux ont terminé leur enlisement par les schistes de Matagne"). In this he confirmed (on p. 94) DELHAYE's (1908, pp. B243-B244) observations on the stratigraphic position of the reefs ("entièrement compris au milieu de ces schistes [schistes à *S. pachyrhynchus*], ou bien en partie, voire même entièrement, semble-t-il, au sein des schistes de Matagne" (see Fig. 3).

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Explanation of Plate 1

Parallelepipedorhynchus trapezoides n.gen., n.sp.

Figs. 1-5 — Paratype A, IRScNBa12169. Ventral, dorsal, anterior, posterior, and lateral views (× 1.5). Costal formula: (6 / 5); (1 – 1 / 1 – 1); (13 / 14).

Figs. 6-10 — Paratype B, IRScNBa12170. Ventral, dorsal, anterior, posterior, and lateral views (× 1.5). Costal formula: (5 / 4); (1 – 1 / 1 – 1); (13 / 14) .

Figs. 11-15 — Holotype, IRScNBa12168. Ventral, dorsal, anterior, posterior, and lateral views (× 1.5). Costal formula: (5 / 4); (1 – 1 / 1 – 1); (12 / 13).

Figs. 16-20 — Paratype C, IRScNBa12171. Ventral, dorsal, anterior, posterior, and lateral views (× 1.5). Costal formula:(5 / 4); (1 – 0 / 1 – 0); (13 / 14).

Figs. 21-25 — Paratype D, IRScNBa12172. 21-23, 25: ventral, dorsal, anterior, and lateral views (× 1.5); 24: posterior view (× 1); Costal formula: (5 / 4); 0; (9 / 10).

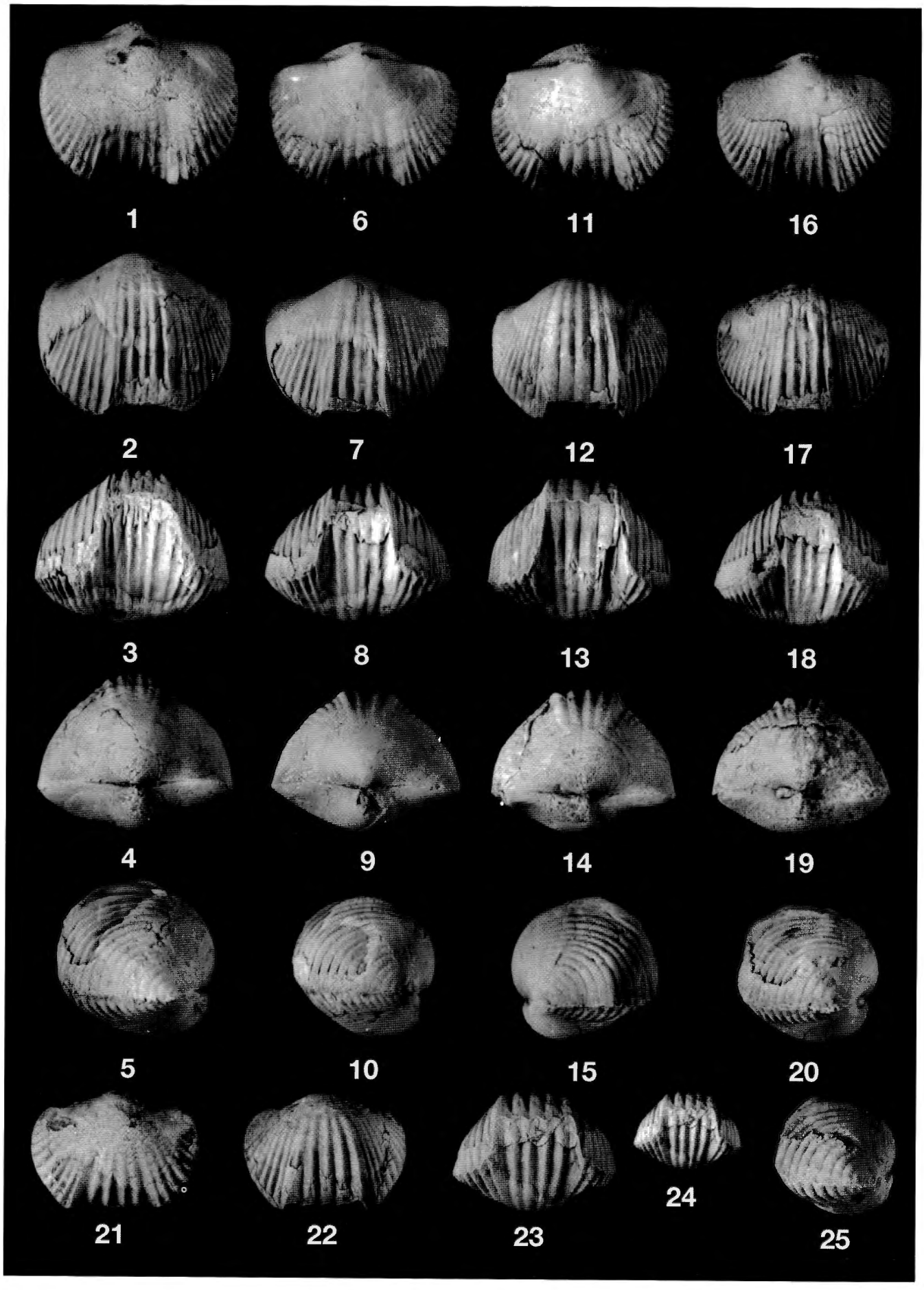

PLATE 1