

Givetian brachiopods from the Trois-Fontaines Formation at Marenne (Belgium, Dinant Synclinorium)

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GODEFROID, J. & MOTTEQUIN, B., 2005. — Givetian brachiopods from the Trois-Fontaines Formation at Marenne (Belgium, Dinant Synclinorium). *Bulletin de l'Institut royal des Sciences naturelles de Belgique, Sciences de la Terre*, 75: 5-23, 2 pls., 9 figs., 4 tables, Bruxelles-Brussel, March 31, 2005 – ISSN 0374-6291.

Abstract

The brachiopods sampled from the Trois-Fontaines Formation in the Marenne quarry are mainly represented by two species: *Spinatrypina (Spinatrypina) fontis* n. sp. and *Eifyris socia* n. sp. Orthid, rhynchonellid, spiriferid and terebratulid brachiopods are also present but much rarer. Among them a new species, *Bornhardtina equitis* n. sp., is described, the others being only briefly discussed.

Key-words: Brachiopods, Givetian, Belgium.

Résumé

Les brachiopodes récoltés dans la Formation de Trois-Fontaines affleurant dans la carrière de Marenne sont représentés principalement par deux espèces: *Spinatrypina (Spinatrypina) fontis* n. sp. et *Eifyris socia* n. sp. Des brachiopodes orthides, rhynchonellides, spiriférides et térébratulides sont également présents, mais ils sont beaucoup plus rares. Parmi eux, une nouvelle espèce, *Bornhardtina equitis* n. sp., est décrite, les autres étant uniquement brièvement discutées.

Mots-clefs: Brachiopodes, Givetien, Belgique.

Introduction

The Marenne quarry is located north of the village of Marenne, on the southern border of the Dinant Synclinorium (Figs. 1, 2). BARCHY *et al.* (2004, pp. 59-61, figs. 1, 3) described it in detail. The quarried limestones belong to the Givetian Trois-Fontaines Formation (see BULTYNCK *et al.*, 1991, pp. 49-52). The subvertical beds well exposed in the south-eastern wall of the quarry are separated, in the southern part of the latter, from the younger Mont d'Hours Formation (see BULTYNCK *et al.*, *id.*, pp. 55-56, 59) by the fault of Marenne also called faulted zone of Marenne (BARCHY *et al.*, *id.*, fig. 1).

According to BARCHY *et al.* (*id.*) the exposed part of the Trois-Fontaines Formation is about 86 m thick and con-

sisting of five units (thickness of these units from the base to the top: 26 m, 11 m, 23 m, 3.2 m, 23 m) (Fig. 3).

The brachiopods described herein have been collected in the dark, well-bedded and bioclastic limestones with silty and crinoidal levels (unit 1), in the fine, dark coloured, well-bedded limestones (unit 3) and in the crinoidal limestones rich in *Scoliopora* (unit 4).

In units 1 and 3, although some beds are very rich in brachiopods (some of them very large), it is difficult to sample well-preserved material and present the complete inventory of the fauna. On the other hand, in unit 4, spinatrypid and athyrid brachiopods can be collected plentifully, whereas other brachiopods taxa are much scarcer. Only the spinatrypid and athyrid brachiopods and the terebratulid species *Bornhardtina equitis* n. sp. are described herein in detail; other brachiopod taxa are only shortly discussed (only the original references are given).

All the material is stored in the Palaeontological Department of the "Institut royal des Sciences naturelles de Belgique" at Brussels (IRScNB).

Taxonomy

Abbreviations: L: length of the shell; Ld: length of the dorsal valve; W: width of the shell; T: thickness of the shell; Tv: thickness of the ventral valve; Td: thickness of the dorsal valve.

Order Orthida SCHUCHERT & COOPER, 1932
Suborder Dalmanellidina MOORE, 1952
Superfamily Dalmanelloidea SCHUCHERT, 1913
Family Mystrophoridae SCHUCHERT & COOPER, 1931
Subfamily Mystrophorinae SCHUCHERT & COOPER, 1931
Genus *Mystrophora* KAYSER, 1871
TYPE SPECIES: *Orthis areola* QUENSTEDT, 1871

Mystrophora sp.

MATERIAL AND OCCURRENCE

One incomplete ventral valve, two ± complete dorsal valves (IRScNB a12035-a12037) from unit 4 (Fig. 3).

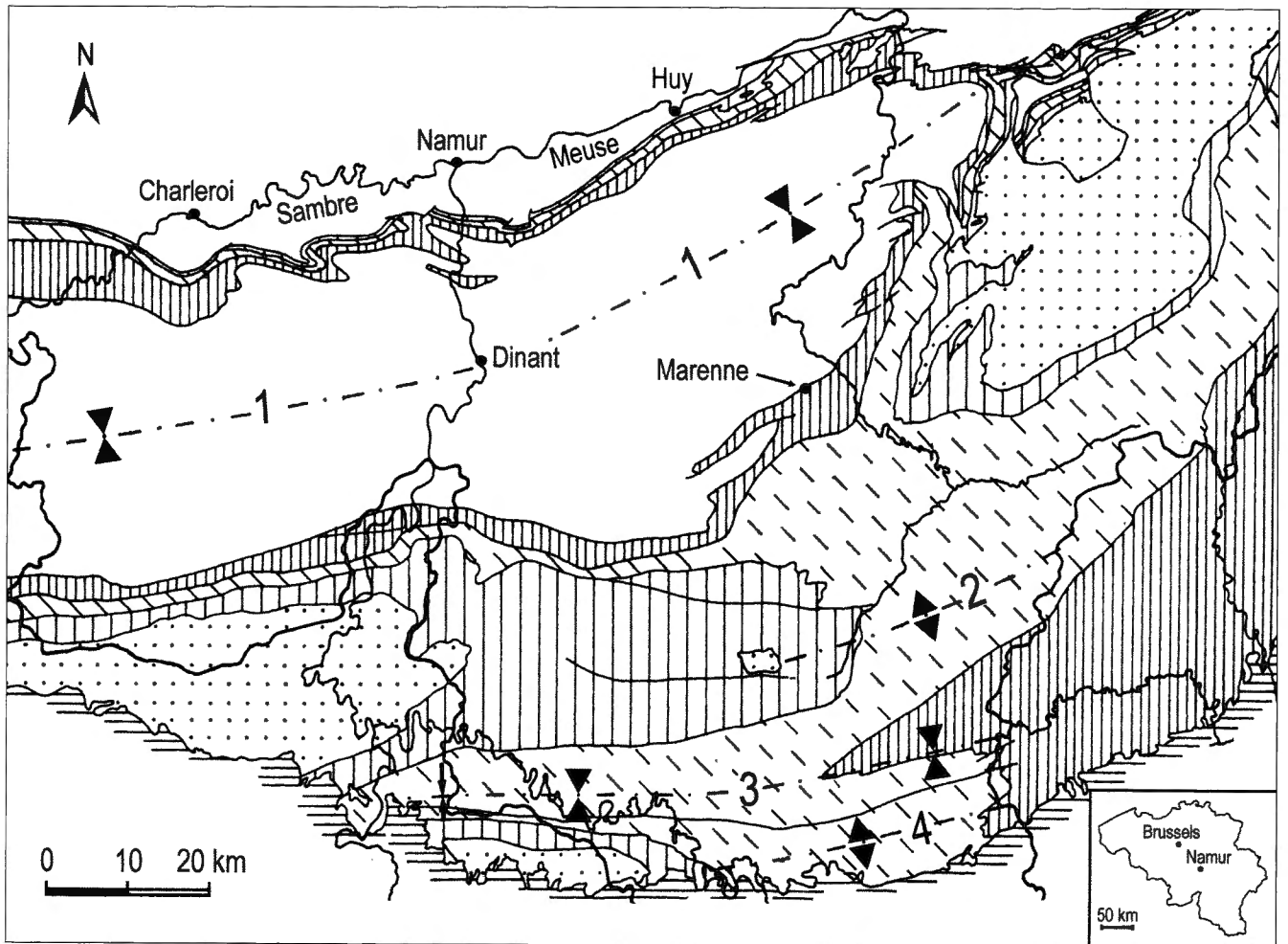


Fig. 1 — Schematic geological map of southern Belgium with location of the village of Marenne.

Symbols: stippling = Cambrian and Cambro-Ordovician massifs; wide vertical hatching = Lochkovian ("Gedinnian") formations; oblique hatching = Pragian ("Siegenian") formations; close vertical hatching = Emsian formations; horizontal hatching = Mesozoic formations [The Gedinnian and Siegenian stages do not correspond exactly to the official ones defined by the IUGS (see BULTYNCK & DEJONGHE *in* GODEFROID *et al.*, 1994, p. 4)]. Abbreviations: 1 = axis of the Dinant Synclinorium; 2 = axis of the Ardenne Anticlinorium; 3 = axis of the Neufchâteau Synclinorium; 4 = axis of the Givonne Anticlinorium.

SHORT DESCRIPTION

Shell large for the genus (dimensions of the largest dorsal valve (IRScNB a12037): W: (19.45) mm; L: 15.2 mm; T: 4.2 mm), transversally oval. Ventral valve relatively high, with a faint sulcus starting at the beak. Interarea well developed, slightly curved, apsacline. Delthyrium open. Internally, short subparallel dental plates.

Dorsal valve moderately convex with an outline more or less like a half an ellipse (wide, straight hinge line) and a relatively narrow sulcus starting a little anteriorly to the dorsal beak. Interarea slightly curved, anacline. Internally, cruralium supported by a low median septum and divided by a low median crest.

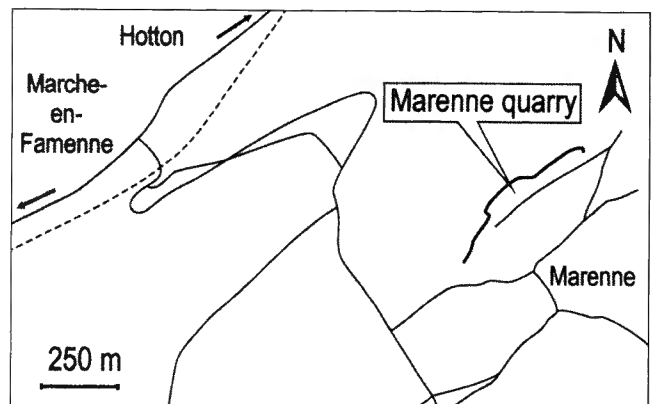


Fig. 2 — Location of the Marenne quarry.

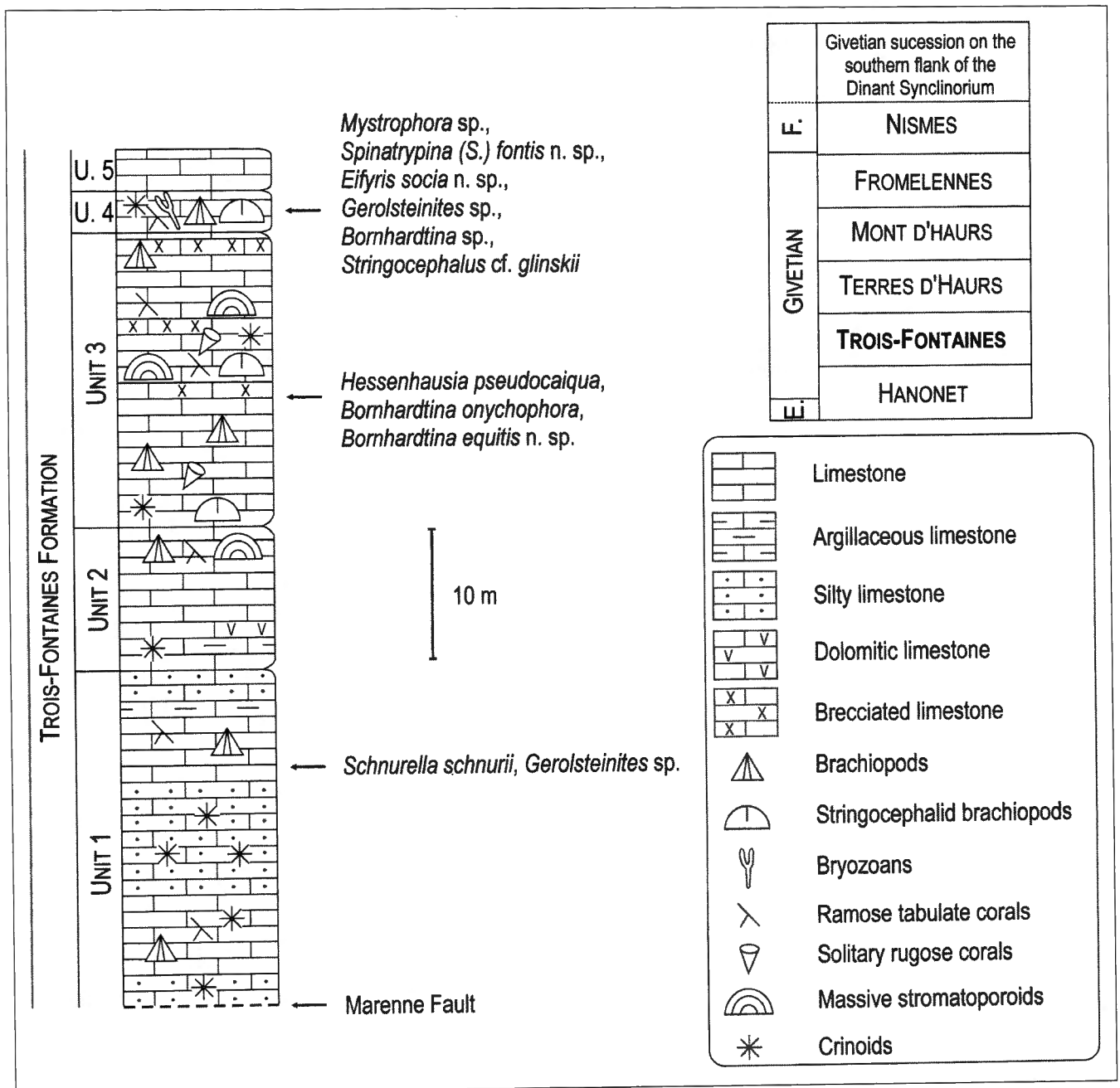


Fig. 3 — Lithostratigraphic column of the Trois-Fontaines Formation at the Marenne quarry (BARCHY *et al.* (2004, fig. 3), modified) with the distribution of the brachiopods. In the units 1 and 3, the localization of the fossiliferous beds is approximate. Only the base of the unit 5 is figured here. Abbreviations: E.: Eifelian; F.: Frasnian.

REMARK

The septum supporting the cruralium in the dorsal valve is rather low and not very high as is the case in *Mystrophora areola* (QUENSTEDT, 1871), type species of the genus.

On the other hand, the shells cannot be assigned to *Skenidium* HALL, 1860 because they do not display the high subpyramidal ventral valve with a free or supported spondylium.

Order Rhynchonellida KUHN, 1949
Superfamily Pugnacoidea RZHONSNITSKAYA, 1956

Family Yunnanellidae RZHONSNITSKAYA, 1959
Subfamily Yunnanellinae RZHONSNITSKAYA, 1959
Genus *Schnurella* SCHMIDT, 1964
TYPE SPECIES: *Terebratula Schnurii* DE VERNEUIL, 1840

Schnurella schnurii (DE VERNEUIL, 1840)
1840 *Terebratula Schnurii* – DE VERNEUIL, pp. 261-262, pl. 3, fig. 2a-d.

MATERIAL AND OCCURRENCE

Twelve fragmentary specimens embedded in the limestone (IRScNB a12038, for the whole lot).

The specimens have been collected by P. Bultynck at a time when the quarry was more reduced and the Marenne fault not as clearly exposed as it is presently. *S. schnurii* comes from beds 11 and 12 in the description of COEN *et al.* (1974, p. 13). These two beds, not yet precisely located in the survey of BARCHY *et al. (id.)*, are situated at about the upper two thirds of unit 1 (Fig. 3).

REMARK

The specimens display the general characteristics of the species: subtriangular outline, ventral valve flat, dorsal valve strongly convex, flanks and front truncated, low costae restricted to the anterior margin, and costellae.

Order Atrypida RZHONSITSKAYA, 1960

Suborder Atrypidina MOORE, 1952

Superfamily Atrypoidea GILL, 1871

Family Atrypidae GILL, 1871

Subfamily Spinatrypinae COPPER, 1978

Genus *Spinatrypina* RZHONSITSKAYA, 1964

Subgenus *Spinatrypina (Spinatrypina)* RZHONSITSKAYA, 1964

TYPE SPECIES: *Spinatrypina margaritoides* RZHONSITSKAYA, 1964

Spinatrypina (Spinatrypina) fontis n. sp.

Plate 1, Figures 1-15; Figures 4-5; Tables 1-2

DERIVATIO NOMINIS

Fons, fontis (Latin): spring ("fontaine" in French). Allusion to the name of the formation (the Trois-Fontaines Formation) in which the species occurs.

TYPES

Holotype: IRScNB a12039 (Pl. 1, Figs. 1-5; Table 1); Paratypes a12040 (Pl. 1, Figs. 6-10; Table 1); IRScNB a12041 (Pl. 1, Figs. 11-15; Table 1); a12042-a12051 (Table 1); a12148 (Fig. 5).

Besides the above-mentioned specimens, the type material includes 198 generally well preserved complete shells and 9 isolated ventral and dorsal valves.

LOCUS TYPICUS

Active quarry at Marenne (near Marche-en-Famenne, province of Luxembourg, Belgium).

STRATUM TYPICUM

Trois-Fontaines Formation, Early Givetian. All the material comes from unit 4 (Fig. 3).

DIAGNOSIS

A species of *Spinatrypina (Spinatrypina)* with a dorsibiconvex profile, a rounded, slightly wider than long outline, relatively fine ribs (42-50 ribs counted at the anterior and lateral margins of adult shells), a transversally irregularly curved ventral valve and concave to indented shoulder lines. Sulcus and fold absent or very weakly developed near the anterior margin.

DESCRIPTION

External characters

General characters

Shell medium sized, dorsibiconvex and slightly transverse (Fig. 4, Table 1). In ventral view, lateral and anterior margins well rounded and shoulder lines concave to indented, very rarely nearly straight. Width of the hinge line corresponding to 73%-88% of the width of the shell. Maximum width located at mid-length. Anterior commissure more or less rectimarginate to moderately uniplicate. Protruding beak.

Ventral valve

Valve moderately thick (W/Tv: 3.5-5.9; L/Tv: 3.2-5.2), with the maximum thickness located at the posterior third of the length. In posterior view, upper surface of the lateral parts of the valve \pm plane and gently inclined to the lateral commissures, median part widely rounded (\pm "tectiform"). Sulcus absent or very shallow, poorly delimited and only present close to the anterior margin; width of the sulcus at the anterior margin corresponding to 46%-63 (70)% of the width of the shell. Tongue, when present, low to very low, poorly delimited laterally, with an outline like a half an ellipse, the best developed tongue being 4.5-5 times wider than high. Shoulder and apical angles varying between 95°-105° and 113°-127° respectively. Small interarea well developed, horizontally striated, curved, slightly apsacline, in some specimens \pm orthocline, clearly delimited by blunt lateral ridges, a little less marked close to the cardinal extremities. Delthyrium partially closed by deltidial plates joined at their base; pedicle opening mesothyrid.

Dorsal valve

Valve wider than long (W/Ld: 1.10-1.25), regularly curved transversely and longitudinally except in the posterolateral regions, which are slightly depressed close to the cardinal extremities. Maximum thickness located at about one-half of the length (W/Td: 2.5-5.9; L/Td: 2.3-4.9). No clearly differentiated fold; on some specimens, a very low and not sharply laterally delimited elevation present close to the anterior margin.

Table 1

Distances (cm) from the beak	Ribs on 1 cm in the median part
1	(9) 11 - 12
1.5	(8) 9 - 11 (13)
2	8 - 9 (11)
2.5	8 - 11

Ornamentation

Ribs tubular, increasing by bifurcation and intercalation. Ribs relatively fine but slightly varying in thickness (Table 1); 42-50 ribs at the anterior and lateral margins. Growth lamellae with their anterior edge slightly up-turned; width of the growth lamellae varying generally between 1-1.5 mm in the median part of the valve, rarely reaching 2 mm in width; growth lamellae often more crowded close to the anterior and antero-lateral margins.

Dimensions (Fig. 4, Table 2)

Internal characters (Fig. 5)

Ventral valve

The relatively thick dental plates support bilobed teeth and separate the large umbonal cavity from the well-developed dental cavities.

Dorsal valve

No traces of cardinal processes have been observed in the notothyrial pit. A median ridge with a central furrow on its crest is located anterior of the notothyrial cavity; it divides the muscle field and is buried in the posterior part of the valve, below the notothyrial floor. The dental sockets are divided by a submedian crest in which the depression separating the dental lobes fits. The internal crests of the dental sockets give rise to the crural bases leading to the feathered crura, laterally oriented and \pm parallel to the commissure plane. The jugal processes, jugal plates and spiralia have not been observed. The prismatic layer is well developed in the posterior part of the valve.

COMPARISONS

From the species assigned to the subgenus *Spinatrypina* (*Exatrypa*) COPPER, 1967a (type species: *Terebratulites explanatus* VON SCHLOTHEIM, 1820 in 1820-1823), *S. (S.) fontis* is separable on the basis of its dorsibiconvex, less flattish profile [exceptionally shells of *S. (S.) fontis* are flattish (Pl. 1, figs. 11-15) but their interarea are not as large as in typical *S. (Exatrypa)*].

The closest species are *S. (S.) soetenica* (STRUVE, 1964) and *S. (S.) girzenensis* COPPER, 1967b from the Middle Devonian of Germany.

By the size and the number of ribs, the Belgian species is very close to *S. (S.) soetenica*. It is distinguishable from the German species by its transversely irregularly curved (\pm "tectiform") ventral valve [the ventral valve of *S. (S.) soetenica* is more regularly curved. STRUVE (1964, p. 530) writes: "... mit mehr gerundetem als (flach) dachförmigen Rücken"] and its clearly concave to indented shoulder lines [shoulder lines nearly straight in *S. (S.) soetenica*].

From *S. (S.) girzenensis*, *S. (S.) fontis* is distinguished by its dorsibiconvex profile and finer ribs. *S. (S.) fontis* is larger and has more numerous ribs than *S. (S.) wotanica* (STRUVE, 1964).

S. (S.) fontis is larger than *Spinatrypina pratorum* GODEFROID, 1988. Its ribs are coarser and do not become finer close to the anterior and lateral margins as is generally the case in *S. pratorum*.

GEOGRAPHIC AND STRATIGRAPHIC DISTRIBUTION

At present the species is only known from the locus typicus and stratum typicum.

Table 2

Specimen IRScNB	Dimensions (cm)					Apical angle	Shoulder angle
	L	W	T	Tv	Td		
a12042	2.63	2.88	1.60	0.80	0.80	103°	120°
a12043	2.37	2.50	1.35	0.55	0.80	104°	126°
Holotype	2.34	2.37	1.50	0.60	0.90	95°	127°
a120444	2.30	2.49	1.40	0.60	0.80	98°	122°
a12040	2.30	2.48	1.49	0.64	0.85	96°	120°
a12041	2.20	2.40	1.00	0.50	0.50	100°	124°
a12045	2.10	2.15	1.30	0.60	0.70	96°	120°
a12046	2.06	2.27	0.96	0.47	0.49	103°	117°
a12047	2.05	2.20	1.34	0.57	0.77	102°	120°
a12048	1.93	2.05	1.10	0.50	0.60	105°	115°
a12049	1.80	1.72	0.97	0.44	0.53	103°	113°
a12050	1.79	1.86	0.90	0.45	0.45	105°	121°
a12051	1.25	1.27	0.65	0.32	0.33	95°	120°

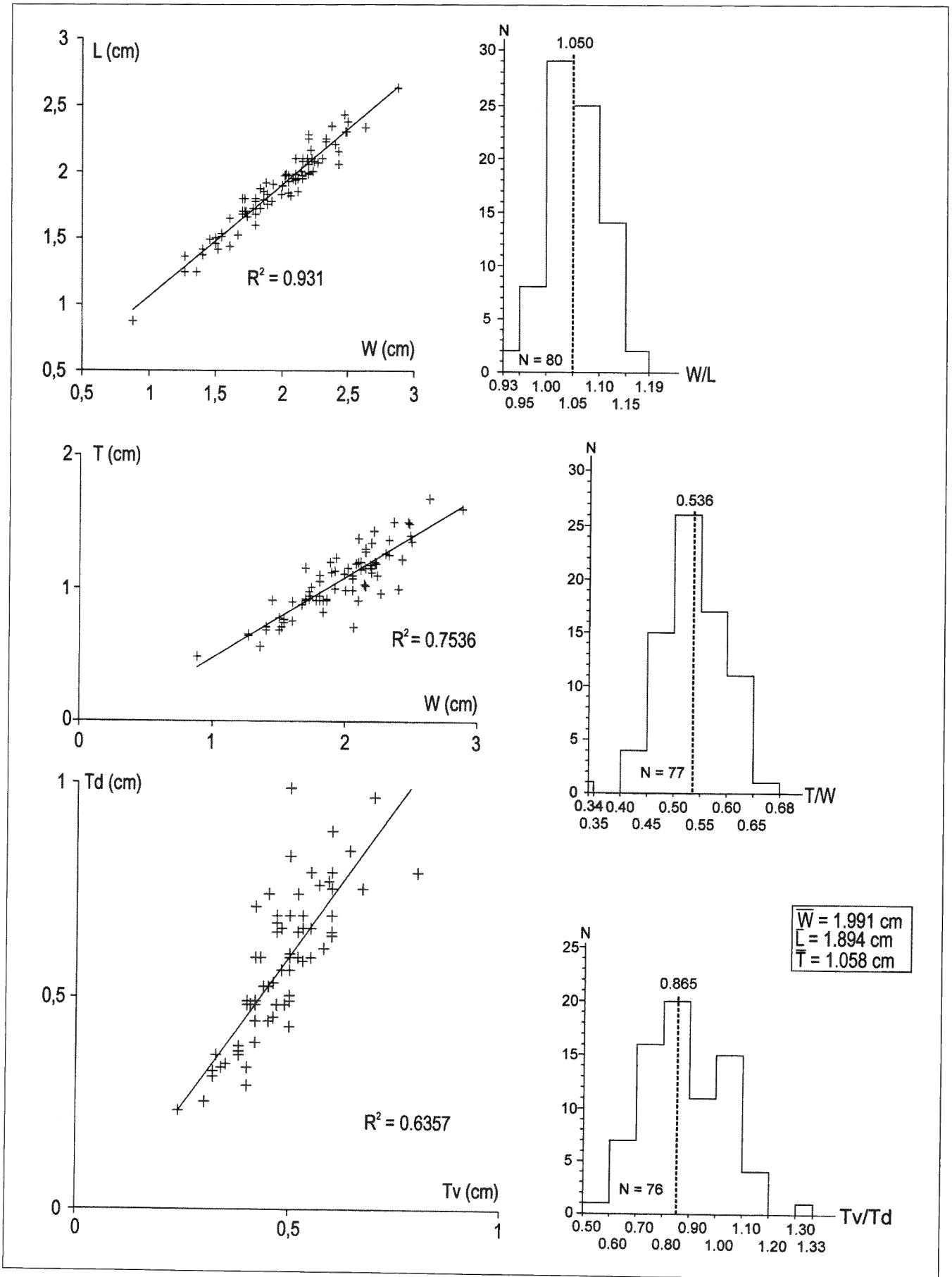


Fig. 4 — *Spinatrypina (Spinatrypina) fontis* n. sp. Scatter diagrams and frequency diagrams.

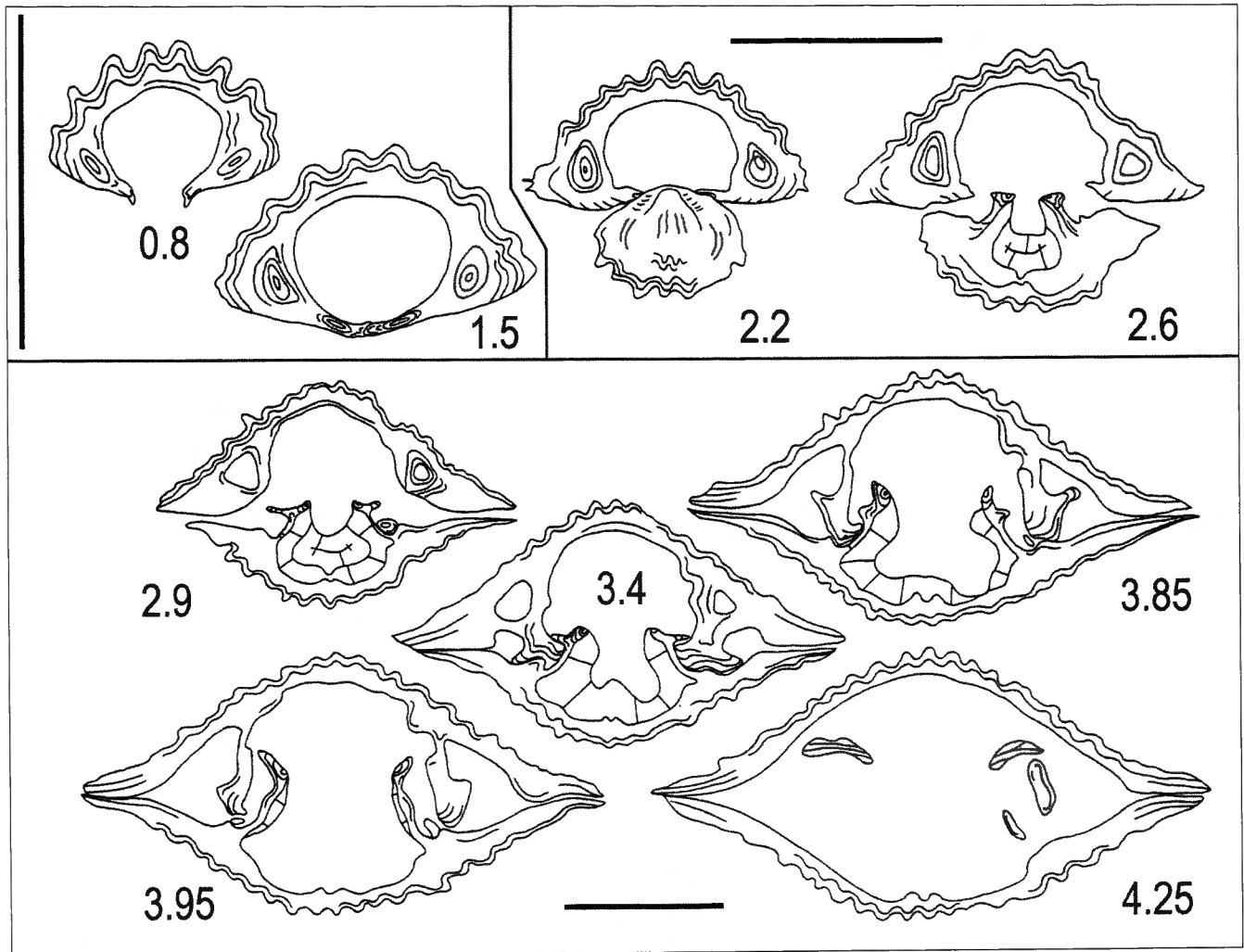


Fig. 5 — *Spinatrypina (Spinatrypina) fontis* n. sp. Specimen IRScNB a12148. Transverse serial sections. Distances are in mm from the top of the ventral umbo. Scale bar = 5 mm.

Order Athyridida BOUCOT, JOHNSON & STATON, 1964
 Suborder Athyrididina BOUCOT, JOHNSON & STATON, 1964
 Superfamily Athyridoidea DAVIDSON, 1881
 Family Athyrididae DAVIDSON, 1881
 Subfamily Athyridinae DAVIDSON, 1881
 Genus *Eifyris* STRUVE, 1992
 TYPE SPECIES: *Terebratula Eifliensis* SCHNUR, 1853

Eifyris socia n. sp.
 Figures 6-8, Table 3

DERIVATIO NOMINIS

Socia, ae (Latin) (noun in apposition): companion. The species is the companion of *Spinatrypina (Spinatrypina) fontis* n. sp.

TYPES

Holotype: IRScNB a12052 (Fig. 6 a-e, Table 3); Para-

types a12054 (Fig. 6 f-j; Table 3); a12053, a12055-
 a12066 (Table 3); a12149 (Fig. 8A); a12150 (Fig. 8B).

Besides the above-mentioned specimens, the type material includes 76 generally well preserved complete shells and ± 20 incomplete specimens.

LOCUS TYPICUS

As for *Spinatrypina (Spinatrypina) fontis* n. sp.

STRATUM TYPICUM

The same as for *S. (S.) fontis* n. sp.

DIAGNOSIS

A species of *Eifyris* with a generally slightly ventribiconvex profile, and a rounded, subpentagonal and generally more or less as wide as long outline. Sulcus well developed but shallow, originating at the posterior quarter or third of the length, with a median furrow. Anterior commissure moderately parasulcate on most specimens.

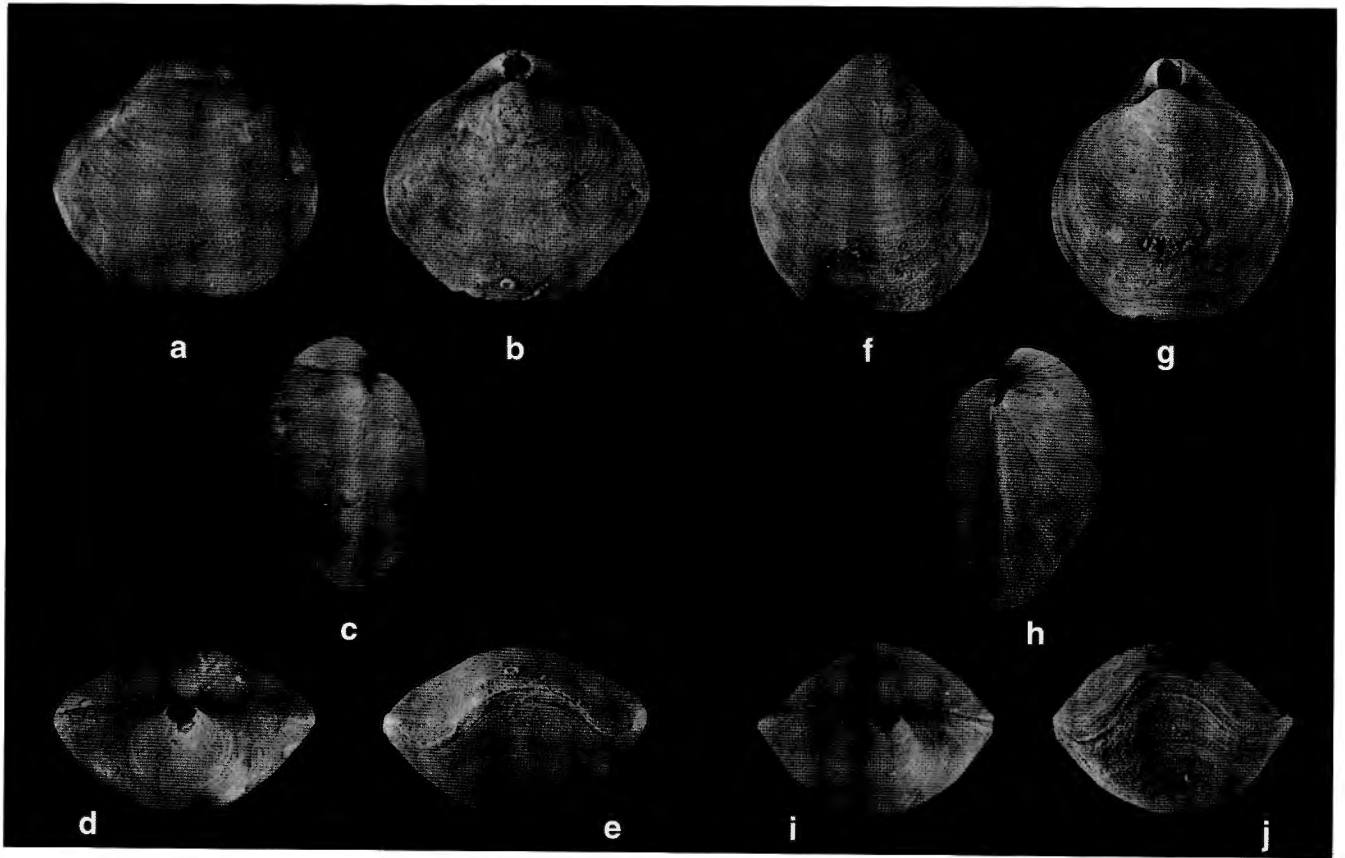


Fig. 6 — *Eifyris socia* n. sp. a-e: holotype IRScNB a12052, ventral, dorsal, lateral, posterior and anterior views; f-j: paratype a12054, ventral, dorsal, lateral, posterior and anterior views. X 2.

Table 3

Specimen IRScNB	Dimensions (cm)					Apical angle	Shoulder angle
	L	W	T	Tv	Td		
a12053	1.80	1.73	1.30	0.70	0.60	=	90°
a12054	1.70	1.57	1.14	0.65	0.49	77°	92°
a12055	1.70	1.43	1.23	0.68	0.55	=	72°
a12056	1.62	1.49	1.12	0.62	0.50	=	88°
a12057	1.57	1.55	1.09	0.54	0.55	77°	83°
a12058	1.48	1.141	1.04	0.61	0.43	=	87°
a12059	1.41	1.34	0.97	0.55	0.42	=	85°
a12060	1.37	1.13	0.92	0.55	0.37	=	83°
a12061	1.80	1.87	1.25	0.65	0.60	90°	/
a12062	1.78	1.83	1.07	0.57	0.50	92°	102°
a12063	1.69	1.71	0.94	0.42	0.52	91°	102°
a12064	1.67	1.76	1.08	0.57	0.51	85°	98°
a12065	1.65	1.68	1.10	0.55	0.55	/	/
Holotype	1.64	1.74	1.15	0.62	0.53	87°	93°
a12066	1.26	1.34	0.84	0.49	0.35	87°	95°

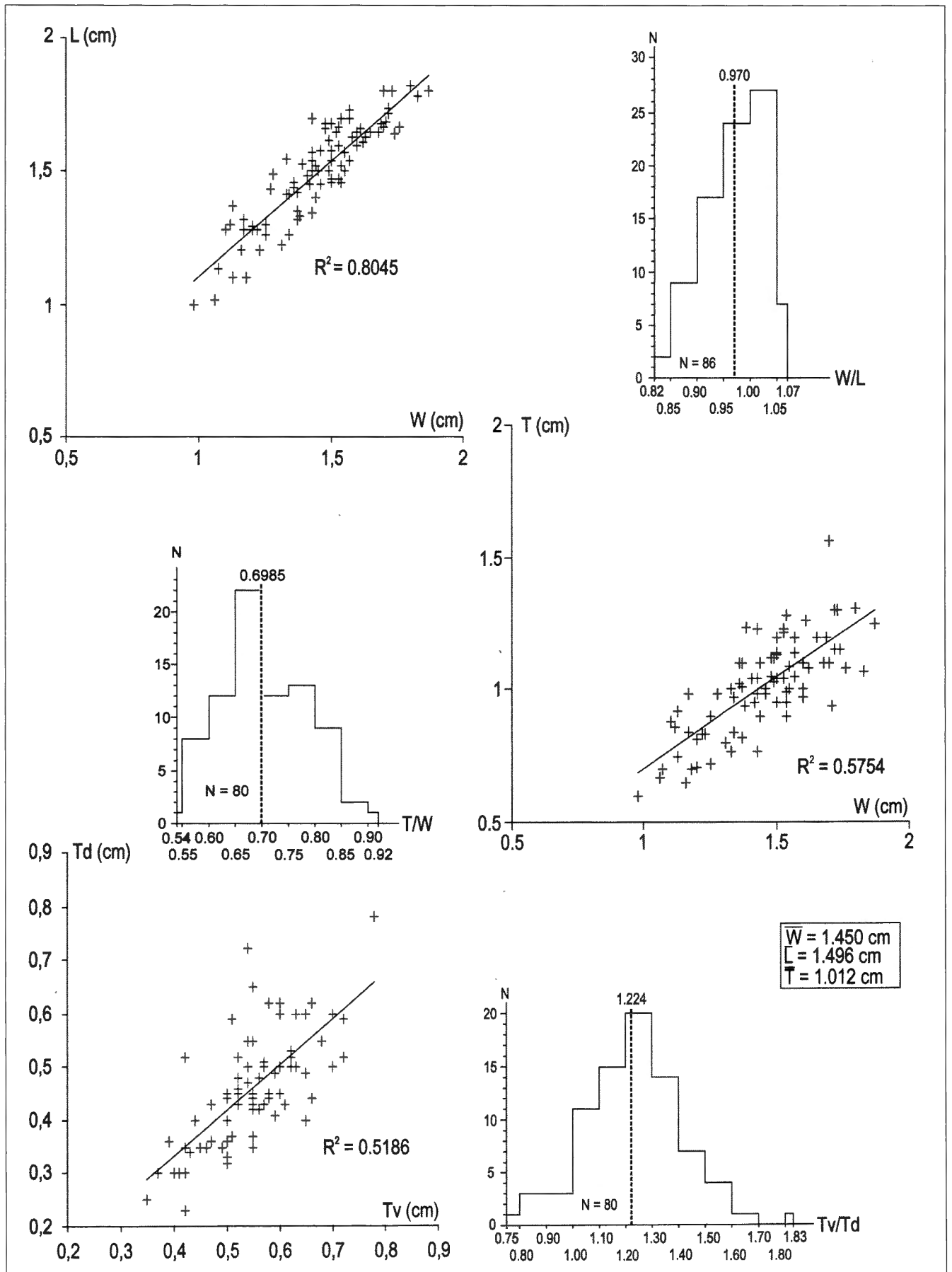


Fig. 7 — *Eifyris socia* n. sp. Scatter diagrams and frequency diagrams.

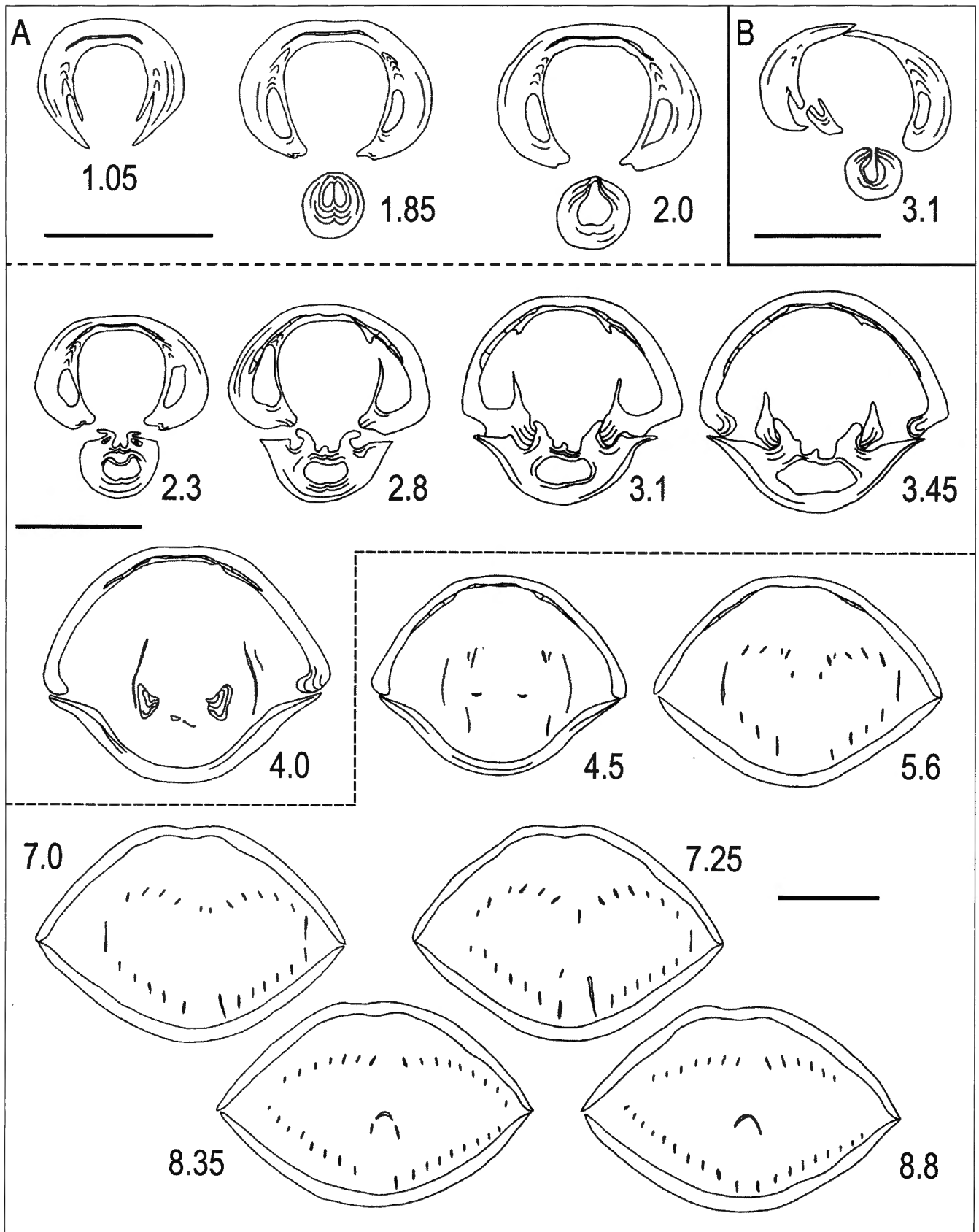


Fig. 8A — *Eifyris socia* n. sp. Specimen IRScNB a12149. Transverse serial sections. Distances are in mm from the top of the ventral umbo. Scale bar = 5 mm.

Fig. 8B — *Eifyris socia* n. sp. Specimen IRScNB a12150. Transverse serial sections. Distance is in mm from the top of the ventral umbo. Scale bar = 5 mm.

DESCRIPTION

External characters

General characters

Shell medium sized, generally moderately ventribiconvex, rarely equi- or dorsibiconvex, as wide as long or a little wider than long or longer than wide (Figs. 6-7, Table 3). Maximum width located a little anteriorly to mid-length. In ventral view, outline rounded subpentagonal: shoulder lines slightly to clearly concave, lateral margins curved and "bracket-shaped", anterior margin generally \pm rectilinear or very slightly excavated by the sulcus. Anterior commissure moderately parasulcate on most specimens, rarely \pm uniplicate.

Ventral valve

Valve thick (W/Tv: 2-3.3; L/Tv: 2.1-3.1) with a well marked and more or less regular transversal convexity. Maximum thickness located at about the posterior third of the length. Sulcus wide and shallow, originating generally at the posterior quarter or third of the length of the valve, in some rare specimens more posteriorly on the umbo, with well rounded lateral boundaries developed on some specimens as very low, rounded and wide lateral "ridges". Bottom of the sulcus with a longitudinal groove well marked on almost all the specimens. At the front margin, width of the sulcus corresponding to (50) 55%-70% of the width of the shell. Tongue variably developed (the best developed tongue about two times wider than high), in some thick, more globose specimens, oriented almost perpendicularly to the commissural plane. Interarea (palintrope) badly defined, curved, delthyrium partly concealed by the incurved ventral beak and the dorsal umbo; foramen wide, rounded to ovate, and mesothyrid to permesothyrid.

Dorsal valve

Valve \pm regularly arched, with a subrounded to subelliptical outline. Maximum thickness located at about mid-length (W/Td: 2.2-4.4; L/Td: 2.1-4.3). Fold poorly developed, low, rounded and limited to the anterior half or third part of the valve.

Ornamentation

Concentric growth lamellae slightly lamellose and rather regularly spaced. Width of the growth lamellae in the central part of the valve rarely exceeding 1 mm.

Dimensions (Fig. 7; Table 3)

Internal characters (Fig. 8)

Ventral valve

The dental plates are thin and well differentiated. They separate a large and subrounded central pedicle cavity from a lateral pair of well-defined apical cavities and support subrectangular teeth.

Dorsal valve

The dental sockets are relatively deep and limited by prominent inner socket ridges and weak outer ridges. Anteriorly, the latter are not differentiated from the valve edges. The cardinal plate with a high median ridge is slightly ventrally concave and apically perforate (Fig. 8B). A low myophragm is present. The jugum is relatively long; the laterally oriented spiral cones comprise at least 9 whorls.

COMPARISONS

From *Eifyris eifliensis*, *E. socia* (the youngest known species of the genus) can be differentiated by its different ventral sulcus (the rounded ridges bounding the sulcus of *E. eifliensis* are much more developed than those visible on some specimens of *E. socia*), and dorsal fold (more developed in *E. eifliensis* than in *E. socia*) as well as by its less parasulcate anterior commissure.

E. socia differs from *Athyris (Eifyris) kirbergensis* STRUVE, 1992 by its subpentagonal outline (the outline of the German species is rounded to rhomb-shaped), its better marked sulcus and fold, and its anterior commissure generally slightly parasulcate [the anterior commissure of *A. (E.) kirbergensis* is uniplicate].

E. socia is very close to *Athyris (Eifyris) lehmenensis* STRUVE, 1992 from which it can be differentiated by its rounded subpentagonal outline [and not rounded or rhomb-shaped as in *A. (E.) lehmenensis*], its less developed, but wider ventral sulcus [at the front, the width of the sulcus of *E. socia* corresponds to (50) 55%-70% of the width of the shell; in *A. (E.) lehmenensis*, the width of the sulcus measured on the figures of the species in ALVAREZ *et al.* (1996, pl. 7, figs. 39, 40) corresponds to 35%-40%] and its anterior commissure generally slightly parasulcate [the anterior commissure of *A. (E.) lehmenensis* is uniplicate or very slightly parasulcate].

E. socia is larger than *Athyris bayeti* RIGAUX, 1908 (compare Table 3 with the dimensions given by BRICE, 1988, p. 351), its sulcus is wider at the front margin and its growth lamellae are less marked. Moreover, *E. socia* is generally ventribiconvex while *A. bayeti* is biconvex.

From *Athyris davidsoni* RIGAUX, 1873 and *A. kaisini* RIGAUX, 1908, *E. socia* is distinguished by its larger size (see dimensions of *A. davidsoni* and *A. kaisini* in BRICE, *id.*, pp. 352, 354) and its different outline.

Athyris oehlerti RIGAUX, 1908 is typically smaller than *E. socia*.

The outline of *E. socia* is rounded subpentagonally whereas *Athyris concentrica purchisoni* BRICE, 1988 is transversally elliptic.

Atrythyris betencourti (RIGAUX, 1892) differs from *E. socia* by its lenticular outline and by its radial, external undulations, similar to those shown the German species included by STRUVE (1965) in *Atrythyris*.

Athyris cingulata FICNER & HAVLIČEK, 1978 is smaller than *E. socia* and strongly parasulcate; *A. mollizonata* FICNER & HAVLIČEK, 1978 is more rounded than *E. socia*. Moreover, both species from Moravia have more lamellose and widely spaced growth lamellae than *E. socia*.

Order Spiriferida WAAGEN, 1883
 Suborder Spiriferidina WAAGEN, 1883
 Superfamily Reticularoidea WAAGEN, 1883
 Family Reticulariidae WAAGEN, 1883
 Subfamily Reticulariinae WAAGEN, 1883
 Genus *Gerolsteinites* STRUVE, 1990
 TYPE SPECIES: *Spirifera Gerolsteinensis* STEININGER, 1853

Gerolsteinites sp.
 Figure 9

MATERIAL AND OCCURRENCE

Four fragmentary ventral and dorsal valves (IRScNB a12067 for the whole lot). Same occurrence as *Schnurella schnurii* (unit 1).

Four complete shells from the level with *Scoliopora* (unit 4): IRScNB a12068A (Fig. 9 a-e), a12068B (Fig. 9 f-j), a12068C-E.

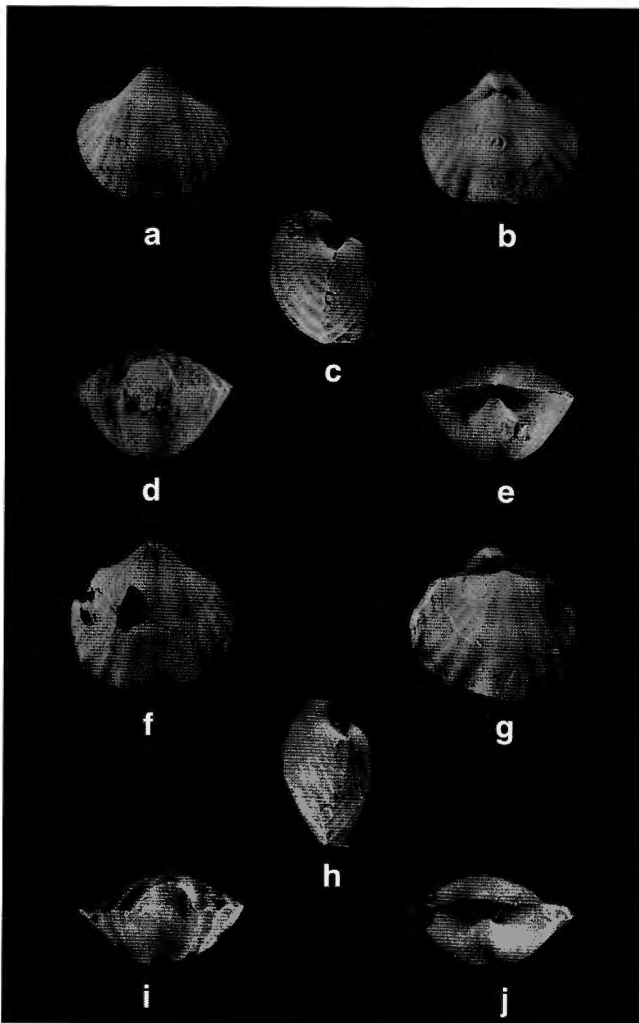


Fig. 9 — *Gerolsteinites* sp. a-e: specimen IRScNB a12068A, ventral, dorsal, lateral, anterior and posterior views; f-j: specimen IRScNB a12068B, ventral, dorsal, lateral, anterior and posterior views. Natural size.

REMARK

These spiriferid brachiopods are provisionally assigned to the genus *Gerolsteinites* STRUVE, 1990 because of their ventribiconvex profile, their low, shallow, rounded sulcus and low, rounded fold, both starting on the umbos as well as their few (7-8) rounded, low, simple costae starting on the umbo or a little more anteriorly. STRUVE (1992, p. 582) distinguished *Gerolsteinites* from *Undispirifer* HAVLÍČEK, 1957 by its more developed sulcus, fold and costae, its ventribiconvex profile (when *Undispirifer* is aequibiconvex), and its higher ventral interarea. These differentiating characters, evident on *Spirifera Gerolsteinensis* STEININGER, 1853, type species of the genus, are however not so clearly marked on our specimens. CARTER *et al.* (1994, p. 354) shortly discuss these characters and conclude that “*Gerolsteinites* at most should have subgeneric rank”.

Our specimens differs from *G. gerolsteinensis* and *G. givefex* (STRUVE, 1981) by their size and ornamentation. They belong likely to two different species but more material is needed for reaching a decision.

Order Terebratulida WAAGEN, 1883
 Suborder Centronellidina STEHLI, 1965
 Superfamily Stringocephaloidea KING, 1850
 Family Stringocephalidae KING, 1850
 Subfamily Newberriinae STRUVE, 1982
 Genus *Hessenhausia* STRUVE, 1982
 TYPE SPECIES: *Rauffia pseudocaiqua* SCHULZ, 1914

Hessenhausia pseudocaiqua (SCHULZ, 1914)

1914 *Rauffia pseudocaiqua* nov. gen., nov. sp. – SCHULZ, pp. 371-374, pl. 7, figs. 7, 8; pl. 9, figs. 1-10.

MATERIAL AND OCCURRENCE

One almost complete shell (IRScNB a12069) and one fragmentary (IRScNB a12070). Coquina beds with numerous terebratulid brachiopods are intercalated in unit 3 (Fig. 3). However, it is difficult to collect complete or nearly complete specimens. At present, only this species and those described below have been recognized in these fossiliferous levels.

SHORT DESCRIPTION

Large, thick shell (L: ± 8.2 cm; W: ± 7 cm, T: ± 5.4 cm), ± aequibiconvex, with an elongate subelliptical outline. Ventral interarea (palintrope) strongly curved; ventral beak ± in contact with the dorsal umbo.

Dorsal valve with a clear median longitudinal depression (sulcus?).

Subfamily Bornhardtinae CLOUD, 1942

Genus *Bornhardtina* SCHULZ, 1914

TYPE SPECIES: “*Bornhardtina uncitoides* SCHULZ, 1914”

Bornhardtina equitis n. sp.

Plate 2, Figures 1-10, Table 4

DERIVATIO NOMINIS

Equis, itis (Latin): knight (“chevalier” in French). The specimens have been collected by E. Chevalier, research worker at the “Université de Liège”.

TYPES

Holotype: IRScNB a12071 (Pl. 2, Figs. 1-5), Paratype IRScNB a12072 (Pl. 2, Figs. 6-10), Paratype IRScNB a12073.

LOCUS TYPICUS

As for *Spinatrypina (Spinatrypina) fontis* n. sp.

STRATUM TYPICUM

Trois-Fontaines Formation, Early Givetian. The holotype and paratypes come from unit 3 (some meters above the base) (Fig. 3).

DIAGNOSIS

A large, wider than long species of *Bornhardtina* with a subtriangular outline in ventral view, a clearly curved palintrope and a dorsal valve with a well marked transversely elliptical outline.

DESCRIPTION

External characters

General characters

Shell large-sized and aequibiconvex to ventribiconvex (Table 4), weakly to moderately asymmetrical, clearly wider than long. Maximum width located between the anterior third and fourth part of the length. In ventral view subtriangular outline with the base of the triangle widely rounded. Anterior commissure rectimarginate to slightly uniplicate (?).

Ventral valve

Valve ± regularly curved transversely and longitudinally. No sulcus but a slight flattening of the anterior half of the median part of the valve. Shoulder lines slightly to clearly concave. Shoulder angle of 93°-95°. Palintrope high, clearly curved, orthocline in its basal part and anacline in its distal part. Delthyrium partly closed by deltidial plates obliquely towards the plane of symmetry. Beak incurved, overhanging the dorsal umbo but not concealing the delthyrium.

Dorsal valve

Typically wider than long and with a well elliptical outline. No fold but a very weakly marked flattening of the anterior half of the median part of the valve.

Ornamentation

Concentric growth lines (some of them could be even slightly lamellose); width of the growth lamellae varying from 1.5 to 3.0 (4.0?) mm.

Dimensions (Table 4)

Internal characters

Not studied.

COMPARISONS

Bornhardtina equitis is close to *B. triangularis* WEDEKIND, 1934 but the new species has a different, wider than long outline and its palintrope and ventral beak are more incurved.

B. equitis is distinguishable from *B. laevis laevis* (MCCOY, 1852) (? = *B. uncitoides* SCHULZ, 1914), *B. ovalis* WEDEKIND, 1934, *B. sulcata* TING, 1936 and *B. laevis ellipsoides* STRUVE, 1982 by its typically wider than long outline and its widely elliptical dorsal valve.

B. equitis differs from *B. onychophora* (SPRIESTERSBACH, 1919) by the same characters as those mentioned above as well as by its less incurved palintrope and ventral beak.

The orientation of the palintrope of *B. equitis* differs completely from the one (bended in ventral direction) of *B. ahuetensis* TING, 1936.

B. equitis is larger than *B. rugosa* TING, 1936 and has no concentric “rugae”.

The outline of *B. equitis* is unlike that of *B. skalensis* BIERNAT, 1953 and its ventral umbo and beak are more developed.

From the Russian species assigned to *Bornhardtina* (*B. langurica*, *B. rhiphaeica*, *B. tarasurica*, *B. rensselandiaformis*) and described by KHODALEVICH & BREIVEL (1972, pp. 159-163), the Belgian species can be differentiated by its size and outline. Moreover, concerning *B. tarasurica*, this species has ventral and dorsal sulci that are absent in *B. equitis*.

The outline of *B. equitis* is unlike that of *B. coulteri* BROWN, 1944 (compare pl. 2, figs. 1, 6 and pl. 4, fig. 7, pl. 5, fig. 3 in BROWN).

Table 4

Specimen IRScNB	Dimensions (cm)					Apical angle	Shoulder angle
	L	W	T	Tv	Td		
Holotype	6.20	7.14	4.60	± 2.30	± 2.30	70°	95°
a12072	6.30	± 7.60	± 3.15	± 1.90	± 1.25	65°	± 93°

Many new species of *Bornhardtina* have been described from the Givetian of China. We cannot compare the new species with all these species because some of the Chinese publications were not accessible. *B. equitis* is clearly distinguishable on the basis of the general shape, outline and/or peculiar characters (curvature of the beak, development of the palintrope, presence of sulcus on both valves) from the following species: *B. (Parabornhardtina) yunnanensis* SUN & HOU, 1964 (in HOU, H.-f. & XIAN, Si-y.), *B. bisulcata* YANG (MS) (in ZHANG *et al.*, 1983, p. 379), *B. burtiniformis* FANG, 1974, *B. convexa* FANG, 1974 (in FANG & CHU), *B. orientalis* WU, 1974 (in YANG, Y., YU, C.-m. & WU, Q.).

Relationships with and differences between *B. equitis* n. sp. and *B. tianshanensis* YANG (MS) (in ZHANG *et al.*, 1983, p. 380), but also *B. speciosa* WANG and *B. dahekouensis* XIAN, both species listed by TALENT *et al.* (2001, pp. 114-115), remain to be clarified and specified.

Bornhardtina onychophora (SPRIESTERSBACH, 1919)

*1919 *Uncites (Bornhardtina) laevis* MCCOY n. var. *onychophora* – SPRIESTERSBACH, pp. 447-454, pl. 26, figs. 1-3, pl. 27, figs. 1, 2.

MATERIAL AND OCCURRENCE

One specimen with partially broken ventral beak (IRScNB a12074), one incomplete specimen (IRScNB a12075) from unit 3 (Fig. 3).

SHORT DESCRIPTION

Shell thick and large (L: ± 7.4 cm; W: ± 6.0 cm; T: ± 4.8 cm). Ventral valve strongly asymmetrical. In ventral view, anterior half with anterior and lateral margins \pm rounded; posterior half roughly subtriangular and asymmetrical. Beak of the most complete specimen broken but, on the basis of the curvature of the remaining part of the umbo, strongly curved and clearly overhanging the dorsal umbo. No ventral sulcus nor dorsal fold.

In the ventral valve, teeth located on the dorsal side of important postero-lateral thickenings of the valve (no individualized dental plates). In the dorsal valve, hinge plates disjunct.

Bornhardtina sp.

MATERIAL AND OCCURRENCE

Three incomplete dorsal valves (IRScNB a12076 for the whole lot) from unit 4 (Fig. 3).

REMARK

These three free dorsal valves display the typical disjunct hinge plates with the inner parts gently bent in dorsomedian direction.

Subfamily Stringocephalinae KING, 1850

Genus *Stringocephalus* DEFRANCE, 1825 (in DE BLAINVILLE)

TYPE SPECIES: *Terebratula Burtini* DEFRANCE, 1825 (in DE BLAINVILLE)

Stringocephalus cf. *glinskii* STRUVE, 1992

cf. 1992 *Stringocephalus glinskii* n. sp. – STRUVE, pp. 593-594.

cf. 2001 *Stringocephalus glinskii* STRUVE, 1992 – THORMANN & WEDDIGE, pl. 7, figs. 51, 52.

MATERIAL AND OCCURRENCE

One complete shell (IRScNB a12077), three broken and disarticulated ventral valves (IRScNB a12078 for the whole lot) from unit 4 (Fig. 3).

REMARK

These specimens (dimensions of the specimen a12077: W: 38 mm; L: 30.9 mm; T: 18.1 mm) are provisionally assigned to *S. glinskii* on the basis of their wider than long outline corresponding in ventral view to a half ellipse topped by a triangle, their widely elliptical dorsal valve and their aequibiconvexity.

Conclusions

First of all it must be noted that the data given on Figure 3 are preliminary and must be refined by further sampling. That is particularly true for the faunas of units 1 and 3. In unit 3 for example, the fossiliferous beds are not rare, but well-preserved specimens are difficult to collect. Studied specimens from that unit were not collected *in situ* but in the debris at the base of the wall of the quarry. Their position in the stratigraphic column is consequently approximate.

At present, three faunas or assemblages have been recognized (from the base to the top):

- Fauna 1: This assemblage recognized in unit 1 includes *Schnurella schnurii* and *Gerolsteinites* sp. Other brachiopods are also present but too fragmentary to be identified with precision; they consist of indeterminate fragments of spinatrypids and reticulariids. Outside de Marenne area, on the southern flank of the Dinant Synclinorium, this assemblage is also present at Couvin (Haine quarry) (BULTYNCK, 1970, p. 50, “*Undispirifer*” *undiferus* = *Gerolsteinites*) and Pondrôme (GODEFROID, 1995, p. 107).
- Fauna 2: It is represented by many terebratulid brachiopods (*Hessenhausia*, *Bornhardtina*) in unit 3. Isolated shells of *Stringocephalus* have not yet been collected and among the numerous sections of brachiopods visible in the fossiliferous beds, none have been identified as *Stringocephalus* on the basis of the presence of large cardinal process and septa in the two valves. However, that absence could be the result from collection failure.
- Fauna 3: The highly diversified and rich association dominated by atrypid and athyrid brachiopods characterizes the level with *Scoliopora* (unit 4). *Stringocephalus* is present.

Acknowledgements

M. COEN-AUBERT helped one of us (J. GODEFROID) to discover the Marenne quarry and its brachiopod fauna. P. BULTYNCK and E. CHE-

VALIER gave us some good brachiopod specimens. The photographs have been perfectly made by W. MISEUR. F. ALVAREZ (Oviedo) and R. GOURVENNEC (Brest) kindly reviewed the manuscript. We thank all these persons whole-heartedly.

References

- ALVAREZ, F., BRUNTON, C.H.C. & STRUVE, W., 1996. On *Athyris* (Brachiopoda) and its type species "*Terebratula*" *concentrica* VON BUCH. *Senckenbergiana lethaea*, **76** (1/2): 65-105.
- BARCY, L., COEN-AUBERT, M., MARION, J.M. & COEN, M., 2004. Mise en évidence de la Faille de Marenne sur la carte géologique Aye – Marche-en-Famenne. *Bulletin de l'Institut royal des Sciences naturelles de Belgique, Sciences de la Terre*, **74**, supplément: 59-71
- BIERNAT, G., 1953. O trzech nowych brachiopodach z tzw. wapienia stringocefalowego Gór Świętokrzyskich. *Acta Geologica Polonica*, **3** (2): 299-324. [in Polish].
- BOUCOT, A.J., JOHNSON, J.G. & STATON R.D., 1964. On some atrypoid, retzioid, and athyridoid Brachiopoda. *Journal of Paleontology*, **38**: 805-822.
- BRICE, D., 1988. Brachiopodes du Dévonien de Ferques (Boulonnais – France). In: BRICE, D. (Editor), Le Dévonien de Ferques, Bas-Boulonnais (N. France). *Biostratigraphie du Paléozoïque*, **7**: 323-395.
- BROWN, I.A., 1944. Stringocephalid Brachiopoda in Eastern Australia. *Journal and Proceedings of the royal Society of New South Wales*, **77** (3): 119-129.
- BULTYNCK, P., 1970. Révision stratigraphique et paléontologique (Brachiopodes et Conodontes) de la coupe type du Couvinien. *Mémoires de l'Institut géologique de l'Université de Louvain*, **26**: 1-152.
- BULTYNCK, P., COEN-AUBERT, M., DEJONGHE, L., GODEFROID, J., HANCE, L., LACROIX, D., PREAT, A., STANIER, P., STEEMANS, P., STREEL, M. & TOURNEUR, F., 1991. Les formations du Dévonien moyen de la Belgique. *Mémoires pour servir à l'Explication des cartes géologiques et minières de la Belgique*, **30**: 1-105.
- CARTER, J.L., JOHNSON, J.G., GOURVENNEC, R. & HOU Hong-Fei, 1994. A revised classification of the spiriferid brachiopods. *Annals of Carnegie Museum*, **63** (4): 327-374.
- CLOUD, P.E., Jr., 1942. Terebratuloid Brachiopoda of the Silurian and Devonian. *Geological Society of America, Special Papers*, **38**: I-XI, 1-182.
- COEN, M., BULTYNCK, P. & PEL, J., 1974. Excursion E. In: BOUCKAERT, J. & STREEL, M. (Editors), Guidebook International Symposium on Belgian micropaleontological limits from Emsian to Viséan, Namur, September 1st to 10th 1974. Geological Survey of Belgium, Brussels, 20 pp.
- COPPER, P., 1967a. Frasnian Atrypidae (Bergisches Land, Germany). *Palaeontographica*, **A**, **126** (3-6): 116-140.
- COPPER, P., 1967b. *Spinatrypa* and *Spinatrypina* (Devonian Brachiopoda). *Palaeontology*, **10** (3): 489-523.
- COPPER, P., 1978. Devonian atrypids from western and northern Canada. In: STELCK, C.R. & CHATTERTON, B.D.E. (Editors), Western and Arctic Canadian Biostratigraphy. *Geological Association of Canada, Special Paper*, **18**: 289-331.
- DAVIDSON, T., 1881. On genera and species of spiral-bearing Brachiopoda from specimens developed by Re. Norman Glass: with notes on the results obtained by Mr. George Maw from extensive washing of the Wenlock and Ludlow shales of Shropshire. *Geological Magazine*, N. S. (II), **8** (1): 1-13.
- DEFRANCE, M.J.L., 1825-27. In: DE BLAINVILLE, H.M.D., Manuel de malacologie et de conchyliologie. Text (1825), pp. I-VIII, 1-647; Atlas (1827), pp. 649-664, 109 pls. Levrault, Paris, Strasbourg.
- FANG, Run-Sen & CHU Xiang-Shui, 1974. Atlas of fossils from Yunnan. Yunnan People's Press, Yunnan, vols. 1-2, 703 pp. [in Chinese].
- FICNER, F. & HAVLÍČEK, V., 1978. Middle Devonian brachiopods from Celechovice, Moravia. *Sbornik geologických věd, Paleontologie*, **21**: 49-106.
- GILL, T., 1871. Arrangement of the families of molluscs prepared for the Smithsonian Institution. *Smithsonian Miscellaneous Collections*, **227**: 1-49.
- GODEFROID, J., 1988. Brachiopodes Atrypida du Dévonien de Ferques (Boulonnais – France). In: BRICE, D. (Editor), Le Dévonien de Ferques, Bas-Boulonnais (N. France). *Biostratigraphie du Paléozoïque*, **7**: 403-434.
- GODEFROID, J., 1995. Les brachiopodes (Pentamerida, Atrypida et Spiriferida) de la fin de l'Eifelien et du début du Givetien à Pondrôme (Belgique, bord sud du Synclinorium de Dinant). *Bulletin de l'Institut royal des Sciences naturelles de Belgique, Sciences de la Terre*, **65**: 69-116.
- GODEFROID, J., BLIECK, A., BULTYNCK, P., DEJONGHE, L., GERRIENNE, P., HANCE, L., MEILLIEZ, F., STANIER, P. & STEEMANS, P., 1994. Les formations du Dévonien inférieur du Massif de la Vesdre, de la Fenêtre de Theux et du Synclinorium de Dinant (Belgique, France). *Mémoires pour servir à l'Explication des Cartes Géologiques et Minières de Belgique*, **38**: 1-144.
- HALL, J., 1860. Observations on genera of Brachiopoda. New York State Cabinet of Natural History, 13th Annual Report; 65-73. Albany.
- HAVLÍČEK, V., 1957. Dalsi nové rody celi di Spiriferidae v ceskem Siluru a Devonu. *Vestník Ustředního ústavu geologického*, **32** (6): 436-440. [in Czech].
- HOU Hong-Fei & XIAN Si-Yuan, 1964. Brachiopod fauna of the Nanpanjiang Limestone of Eastern Yunnan and its geological age. *Acta Palaeontologica Sinica*, **12** (3): 411-425. [in Chinese].
- KAYSER, E., 1871. Die Brachiopoden des Mittel- und Ober-Devon der Eifel. *Zeitschrift der Deutschen Geologischen Gesellschaft*, **23**: 491-647.
- KHOLADEVICH, A.N. & BREIVEL, M.G., 1972. Nadsemeistvo Terebratulacea. In: KHOLADEVICH, A.N. (Editor), Kishchnopolostie i brachiopody zhivetskikh otlozheniy vostochnogo sklona Urala. Ministerstvo Geologii SSSR, Ural'skoe Territorial'koe Geologicheskoe Upravlenie, Isdatel'stvo "NEDRA": 152-170. [in Russian].

- KING, W., 1850. A monograph of the Permian fossils from England. *Palaeontographical Society, Monograph*, **3**: I-XXXVII, 1-258.
- KUHN, O., 1949. Lehrbuch der Paläozoologie. E. Schweizerbart (Editor), Stuttgart, 326 pp.
- McCOY, F., 1852. Description of the British Palaeozoic Fossils in the Geological Museum of the University of Cambridge. J.W. Parker & Son. London. pp. 185-644.
- MOORE, R.C., 1952. Brachiopods. In: MOORE, R.C., LALICKER, C.G. & FISCHER, A.G., Invertebrate fossils, 766 pp. McGraw-Hill, New York.
- QUENSTEDT, F.A., 1871. Brachiopoden. In: Petrefactenkunde Deutschlands, 1, abt. 2: I-IV, 1-748. Leipzig.
- RIGAUX, E., 1873. Notes pour servir à la géologie du Boulonnais. 1. Description de quelques brachiopodes du terrain dévonien de Ferques. *Mémoires de la Société Académique de Boulogne-sur-Mer*, **5**: 1-16.
- RIGAUX, E., 1892. Notice géologique sur le Bas-Boulonnais. *Mémoires de la Société Académique de Boulogne-sur-Mer*, **16**: 5-108.
- RIGAUX, E., 1908. Le Dévonien de Ferques et ses brachiopodes. 33 pp. Deligny Editor. Boulogne-sur-Mer.
- RZHONSNITSKAYA, M.A., 1956. Systematization of Rhynchonellida. In: GUZMAN, E. *et al.* (Editors), Resúmenes de los trabajos presentados. International Geological Congress, Mexico, Report 20: 125-126.
- RZHONSNITSKAYA, M.A., 1959. K sistematike rinkhonellid. *Paleontologicheskii Zhurnal*, 1959 (1): 25-36. [in Russian].
- RZHONSNITSKAYA, M.A., 1960. Otryad Atrypida. In: ORLOV, Y.A. (Editor), *Osnovy Paleontologii*, 7, Mshanki, Brakhiopody, pp. 257-264. Izdatel'stvo Akademii Nauk SSSR, Moskva. [in Russian].
- RZHONSNITSKAYA, M.A., 1964. O devonskikh atripidakh Kuznetskogo Basseyna. *Trudy Vsesoiuznogo Nauchno-issledovatel'skogo Geologicheskogo Instituta (VSEGEI), Novaya seriya*, **93**: 91-112. [in Russian].
- SCHLOTHEIM, E. (VON), 1820-1823. Die Petrefactenkunde auf ihrem jetzigen Standpunkte durch die Beschreibung seiner Sammlung versteinerner und fossiler Überreste des Thier und Pflanzenreichs der Vorwelt erläutert, pp. I-LXII, 1-437. Bekker'schen edit. Gotha.
- SCHMIDT, H., 1964. Neue Gattungen paläozoischer Rhynchonellacea (Brachiopoda). *Senckenbergiana lethaea*, **45** (6): 505-506.
- SCHNUR, J., 1853. Zusammenstellung und Beschreibung sämtlicher im Uebergangsgebirge der Eifel vorkommenden Brachiopoden nebst Abbildungen derselben. *Palaeontographica*, **3**: 169-247.
- SCHUCHERT, C., 1913. Class Brachiopoda. The Lower Devonian deposits of Maryland. Maryland Geological Survey. Baltimore, pp. 290-449.
- SCHUCHERT, C. & COOPER, G.A., 1931. Synopsis of the brachiopod genera of the suborders Orthoidea and Pentamerioidea, with notes on the Telotremata. *American Journal of Science* (5), **22**: 241-251.
- SCHUCHERT, C. & COOPER, G.A., 1932. Brachiopod genera of the suborders Orthoidea and Pentamerioidea. *Memoirs of the Peabody Museum of Natural History*, **4** (1): I-XII, 1-270.
- SCHULZ, E., 1914. Über einige Leitfossilien der Stringocephalenschichten der Eifel. *Verhandlungen des Naturhistorischen Vereins der Preussischen Rheinlande und Westfalens*, **70**: 335-385.
- SPIESTERSBACH, J., 1919. Neue Versteinerungen aus dem Lenneschiefer. *Jahrbuch der Königlich Preussischen Geologischen Landesanstalt*, **38** (1): 434-512.
- STEHLI, F.G., 1965. Paleozoic Terebratulida. In: MOORE, R.C. (Editor), *Treatise on Invertebrate Paleontology*, Part H, Brachiopoda, volume 2: H730-H762.
- STEININGER, J., 1853. Geognostische Beschreibung der Eifel, pp. I-III, 1-144. Lintz, F. (Editor). Trier.
- STRUVE, W., 1964. Erörterung des Alters der Refrath-Schichten und Darstellung einiger devonischer Atrypinae. *Senckenbergiana lethaea*, **45** (6): 523-532.
- STRUVE, W., 1965. *Atrythyris* n. g. und ihre Arten (Athyrididae). *Senckenbergiana lethaea*, **46** (4/6): 217-228.
- STRUVE, W., 1981. Das untergivetische Leit-Fossil *Undispirifer givefex* (Spiriferida/Reticulariidae). *Senckenbergiana lethaea*, **41** (3/6): 437-443.
- STRUVE, W., 1982. Schaltier-Faunen aus dem Devon des Schwarzbach-Tales bei Ratingen, Rheinland. *Senckenbergiana lethaea*, **63** (1/4): 183-283.
- STRUVE, W., 1990. Paläozoologie III. *Courier Forschungsinstitut Senckenberg*, **127**: 251-279.
- STRUVE, W., 1992. Neues zur Stratigraphie und Fauna des rhenotypen Mittel-Devon. *Senckenbergiana lethaea*, **71** (5/6): 503-624.
- TALENT, J.A., GRATSIANOVA, R.T. & YOLKIN, E.A., 2001. Latest Silurian (Pridoli) to middle Devonian (Givetian) of the Asia-Australia hemisphere: rationalization of brachiopod taxa and faunal lists; stratigraphic correlation chart. *Courier Forschungsinstitut Senckenberg*, **236**: 1-221.
- TING, T.H., 1936. Zur Kenntniss der Gattungen *Bornhardtina* SCHULZ und *Stringocephalus* DEF. *Bulletin of the Geological Society of China*, **15** (3): 343-359.
- THORMANN, F. & WEDDIGE, K., 2001. Addendum zu STRUVE, W. (1992), Neues zur Stratigraphie und Fauna des rhenotypen Mittel-Devon. *Senckenbergiana lethaea*, **81** (2): 307-327.
- VERNEUIL, E. (DE), 1840. Sur quelques espèces intéressantes de brachiopodes des terrains anciens. *Bulletin de la Société géologique de France*, série 1, 11: 257-262.
- WAAGEN, W.H., 1883 (1883-1885). Salt Range fossils. Part 4 (2): Brachiopoda. *Memoirs of the geological Survey of India, Palaeontologia Indica*, **13** (1): 329-770.
- WEDEKIND, R., 1934. Kritische Bemerkungen zur Gliederung des Eifler Mitteldevons. *Zeitschrift der Deutschen Geologischen Gesellschaft*, **86**: 19-28.
- WANG Yu, YU Chang-Min & WU Qi, 1974. Advances in the Devonian Biostratigraphy of South China. *Memoirs of Nanking Institute of Geology and Palaeontology*, **6**: 1-45. [in Chinese].
- ZHANG Chuan, ZHANG Zi-Xinn, ZHANG Feng-Ming & WANG Zhi, 1983. Brachiopoda, Late Palaeozoic. In: *Atlas of Palaeontology of Northwest China, Xinjiang Autonomous Region*, Vol. 2, Late Palaeozoic: 262-386. Geological Publishing House, Beijing. [in Chinese].

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Typescript submitted: June 1, 2004
Revised typescript received: November 15, 2004

Explanations of the plates

PLATE 1

All figures are X2.

Spinatrypina (Spinatrypina) fontis n. sp.

Figs. 1-5 — Holotype IRScNB a12039.

Figs. 6-10 — Paratype IRScNB a12040.

Figs. 11-15 — Paratype IRScNB a12041.

1, 6, 11: ventral views; 2, 7, 12: dorsal views; 3, 8, 13: lateral views; 4, 9, 14: posterior views; 5, 10, 15: anterior views.

PLATE 2

All figures are natural size.

Bornhardtina equitis n. sp.

Figs. 1-5 — Holotype IRScNB a12071.

Figs. 6-10 — Paratype IRScNB a12072.

1, 6: ventral views; 2, 7: dorsal views; 3, 8: lateral views; 4, 9: posterior views; 5, 10: anterior views.

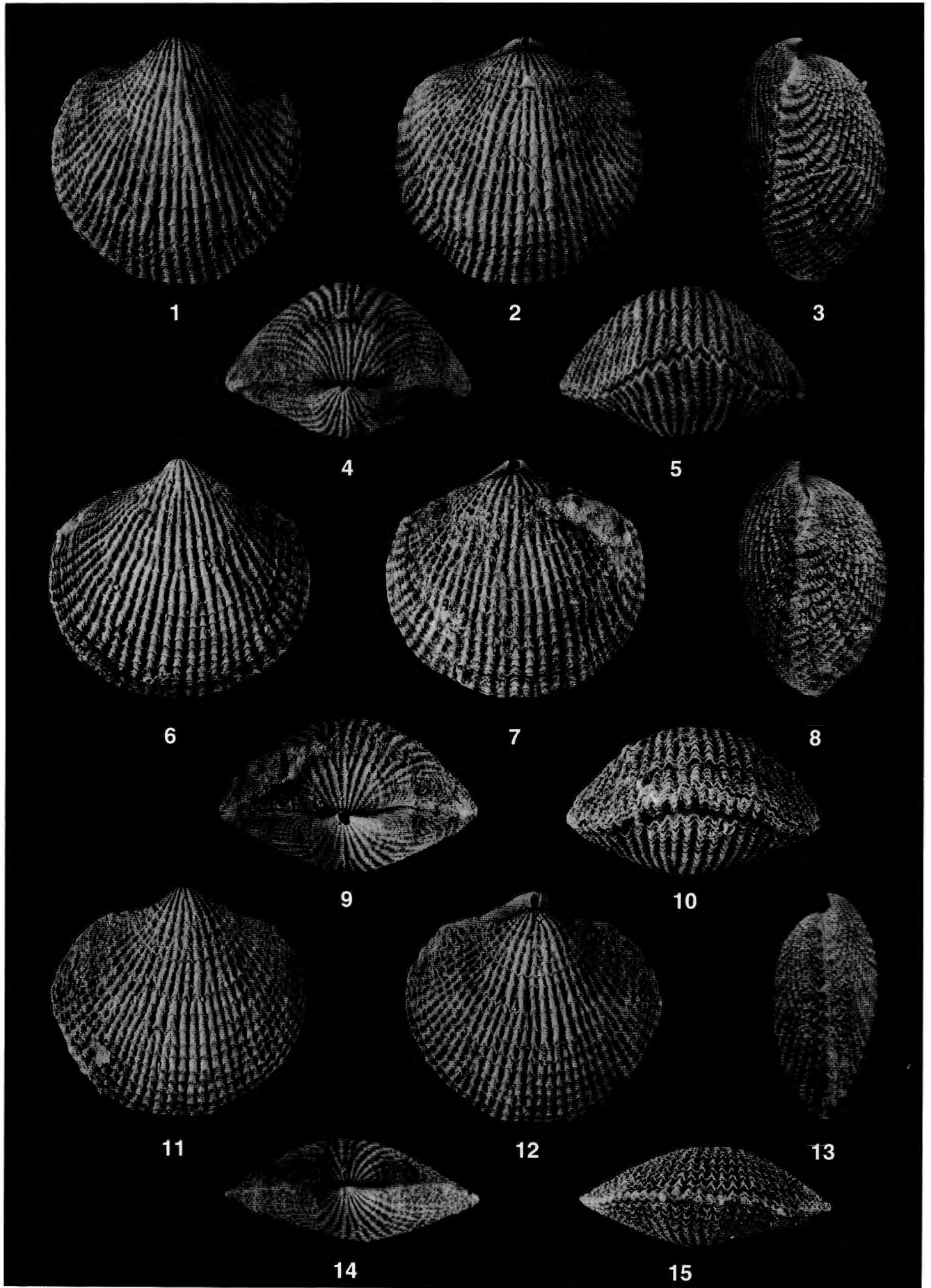


PLATE I

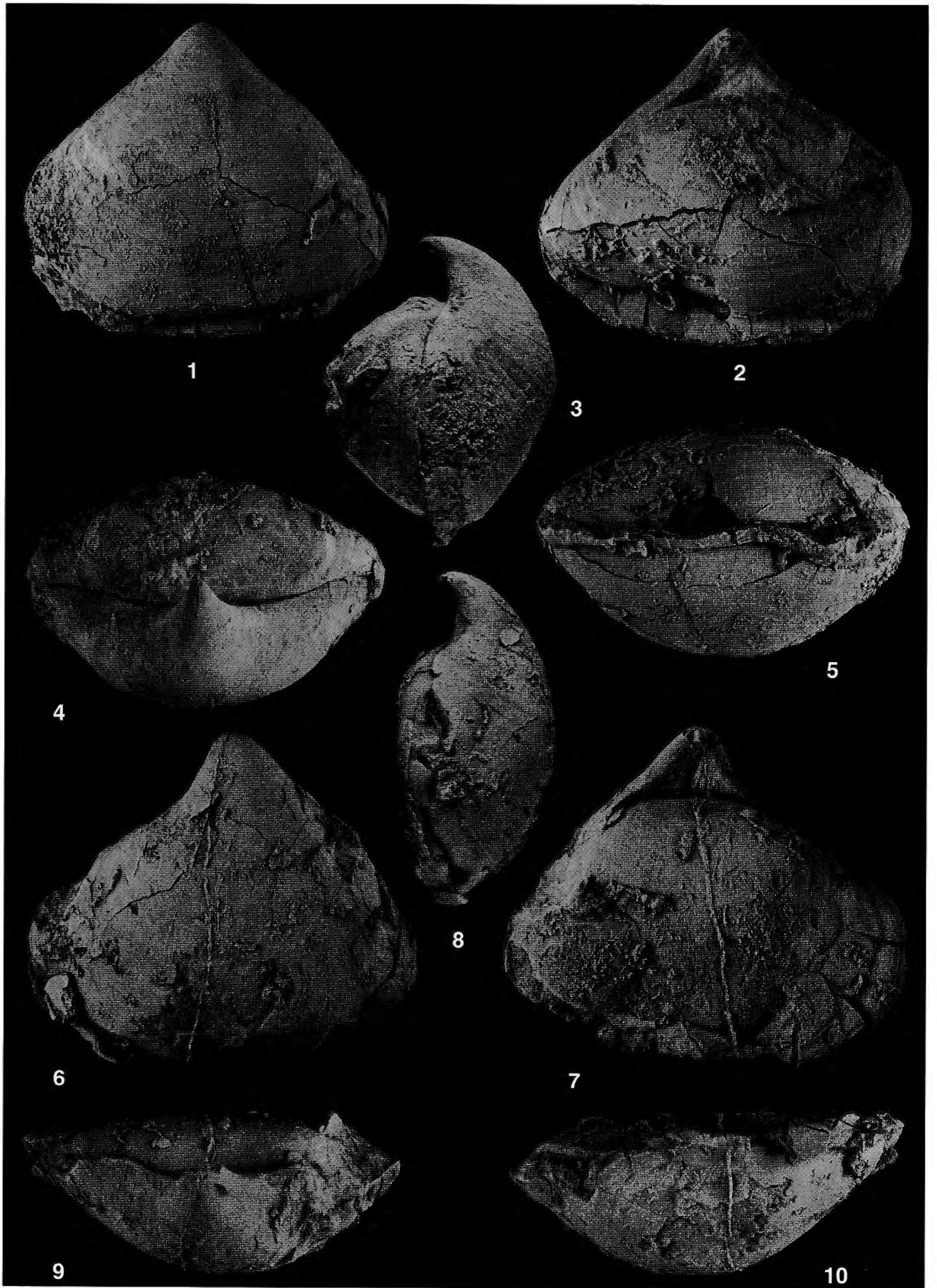


PLATE 2

