

# Restatement of the Late Tournaisian *Spirifer tornacensis* de Koninck, 1883 on the base of the original collection

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## Abstract

The original collection of *Spirifer tornacensis* de KONINCK, 1883b is composed of the seven specimens of the type series plus two specimens added by de KONINCK in 1887. Lithographs of five specimens were published in 1883b, and again in 1887 together with those of two more specimens.

In spite of intensive search, one of the specimens of the type series, unfortunately chosen as lectotype, has not been found in the collection bought from de KONINCK in 1878 by the Musée royal d'Histoire naturelle in Brussels. Therefore, a neotype has been designated in accordance with the ICZN rules.

The long overdue re-examination of the original specimens and their new description resulted in the assignment of the specimens of the type series to a new genus, *Atylephorus*. One of the two hypotypes of 1887 belongs to this genus, but the other is here assigned to *Unispirifer* CAMPBELL, 1957.

*Atylephorus tornacensis* is considered herein to be a geographically (Tournaisis in western Belgium) and stratigraphically (late Tournaisian) restricted species. It follows that all forms under the species name outside the type area are not likely to belong to it.

**Key-words:** spiriferids - brachiopods - *Atylephorus* - late Tournaisian - Belgium.

## Résumé

La collection originale de *Spirifer tornacensis* de KONINCK, 1883b se compose de sept spécimens de la série-type et de deux spécimens ajoutés par de KONINCK en 1887. Des lithographies de cinq spécimens ont été publiées en 1883b et à nouveau en 1887 avec celles de deux spécimens supplémentaires.

Malgré des recherches intensives, un des spécimens de la série-type, malheureusement choisi comme lectotype, n'a pas été trouvé dans la collection achetée à de KONINCK, en 1878, par le Musée royal d'Histoire naturelle à Bruxelles. En conséquence, un néotype a été désigné en conformité avec le CINZ.

Le réexamen trop longtemps différé des spécimens originaux et leur description nouvelle ont conduit à attribuer les spécimens de la série-type à un genre nouveau, *Atylephorus*. Un des deux hypotypes de 1887 appartient aussi à ce genre, tandis que l'autre est assigné par les auteurs à *Unispirifer* CAMPBELL, 1957.

*Atylephorus tornacensis* est considérée dans ce travail comme une espèce à répartition géographique (le Tournaisis dans la partie occidentale de la Belgique) et à extension stratigraphique (Tournaisien Supérieur) restreintes. Il en résulte que toutes les formes identifiées sous ce nom en dehors de la région-type n'appartiennent vraisemblablement pas à l'espèce.

**Mots-clefs:** Spiriférides - Brachiopodes - *Atylephorus* - Tournaisien Supérieur - Belgique.

## Introduction

Our knowledge of some early Carboniferous spiriferids, such as *Spirifer bisulcatus* SOWERBY, 1825, *Spirifera clathrata* MCCOY, 1844, *Spirifer konincki* DOUGLAS, 1909, *S. subcinctus* de KONINCK, 1883b, *S. suavis* de KONINCK, 1887, *S. Tornacensis* de KONINCK, 1883b, etc., is still either unclear or imprecise. This is the main reason why these long established western European species have been declared present in many regions of the world, where they are also often referred to as ex. gr., cf., aff.. The revision of these species is long overdue.

This paper deals with the ubiquitous *S. tornacensis*, originally found and described in the late Tournaisian of Belgium. Like *Conchylolithus Anomites (striatus)* MARTIN, 1809 for Viséan spiriferids, it has become, in the course of time, more and more of a 'catch-all-name' for transversely elongated Tournaisian spiriferids in and outside the type area; most of the quotations found in the literature, as well as uncritical synonymy lists, have to be considered with caution and reservation. *S. tornacensis* stayed in the genus *Spirifer* SOWERBY, 1816 until 1950, when it was for the first time assigned to the genus *Cyrtospirifer* FREDERIKS, 1924; later, although still commonly included in the genus *Spirifer*, attributions to the genera *Unispirifer* CAMPBELL, 1957, *Fusella* MCCOY, 1844, and *Imbrexia* NALIVKIN, 1937 are found in the literature from 1957, 1959, and 1971 on, respectively. These generic assignments were not based on examination of de KONINCK's specimens because, for one hundred and thirteen years, the original material has not been subjected to revision, and has even been sometimes declared lost.

de KONINCK (1883b, p. 373, p. 381, pp. 386-388, pl. XIII, figs. 1-9) established *Spirifer tornacensis* for transversely elongated and sometimes large spiriferids occurring together with another spiriferid he erroneously assigned to *S. cinctus* KEYSERLING, 1846. These specimens were recovered from the **calcschiste de Tournai** near the town of Tournai (Hainault, Belgium). He originally illustrated five specimens and these specimens were re-illustrated by de KONINCK (1887, pl. 25, figs. 5-10, 12, 13) together with two new ones (pl. 25, figs. 1-4, 11) on

Name	Catalogue number	Figured		Status	Stratigraphical position	w mm	l lpv/lpvu (lbv/lbv u)	t mm	hpa mm	Number of costae		
		For the first time	In the present paper							On each flank bvl bvr pvl pvr (bifurcations)	Median fold sulcus	Per 5mm near the anterior margin
<i>Atylephorus tornacensis</i> (de KONINCK, 1883b)	Old number (New number)											
	/ (a 4292)	1883, XIII, 1, 2 1887, 25, 7, 8	X	Lectotype (large; complete)	Allain Ls. (Tn3a1sup) or Providence Ls. (Tn3a2) or Pont-à-Rieu Ls. (Tn3b1) or lower part of Vaulx and Chercq Ls. (Tn3b2)							
	AV 6071 (a 4293)	1883, XIII, 3-5 1887, 25, 9, 10	3, 27-34 5, 66, 70	Paralectotype (large; complete)	Allain Ls. (Tn 3a 1sup) probably	53,6	31,5/45 (28,6/35)	20,7	6	>22(3) >24(3) >24(3) >25(2)	6 9	3,5
	AV 6070 (a 4294)	1883, XIII, 6, 7 1887, 25, 5, 6	1, 1-8 5, 63, 67	Neotype (very large; complete)	Uppermost (8m) Pont-à-Rieu Ls. (Tn3b1)	74*	51/75 (44,4/59)	36,6	10	25(8) >31(10) 33(9) 28(7)	9 11	2,5-3
	AV6074 (a 4295)	1883, XIII, 8 1887, 25, 13pp	4, 42-45 5, 71	Paralectotype (small; pv interior)		37,2	23,5/31	~9	4	/ / >20(4) ~ 20(1)	/ 7	4
	a 5580b	1887, 25, 13pp	4, 46, 50-52 5, 73	Paralectotype (small; pv interior)		29,8	22/28	~9	~4	>18(0) >15(1)	/ 7	3,5-4
	a 5580c	X	4, 47-49 5, 72	Paralectotype (small; pv interior)		33	20/28	~9,5	5	>14(1) >16(2)	/ 9	4,5-5
	AV6072 (a 4296)	1883, XIII, 9 1887, 25, 12	3, 35-41	Paralectotype (large; mold almost complete)	Uppermost Allain Ls. (Tn3a1sup) or lower part of Vaulx and Chercq Ls. (Tn3b2)	56,5	deformed specimen					
	AV 6069 (a 5579)	1887, 25, 1-4	2, 11-19 5, 64, 68	Hypotype (very large; complete)	Uppermost (8m) Pont-à-Rieu Ls. (Tn 3b 1)	77,7	46/66 (39,3/54)	31	>7	>29(2) >27(5) >26(4) >26(2)	9(10) 10(12)	2,5-3,5
	a 10438	X	4, 53-58 5, 65, 69	Topotype (very large; almost complete)		81**	42/63 40,7/55	30,3		>34(3) >24(4) >24(4) >34(2)	10 11	3,5
<i>Unispirifer</i> sp.	AV 6073 (a 5580a)	1887, 25, 11	2, 20-26 5, 74, 75	Hypotype (small; complete)	Uppermost Allain Ls. (Tn3a1sup) or lower part of Vaulx and Chercq Ls. (Tn3b2) or Vignobles Ls. (Tn3b2)	29,2	19,5/32 (16/20)	15	3	>11(1) >11(1) >11(0) >12(0)	6 7	5

\* two times left half (in ventral view)

\*\* two times right half (in ventral view)

Fig. 1 — Condensed information on the original material [seven specimens of the type series + two hypotypes (identified by the founder of the species = autohyles)] of *Atylephorus tornacensis* (de KONINCK, 1883b), and on one specimen of this species recently collected in the **Carrière du Milieu** near the town of Tournai.

w = width; l = length; t = thickness; hpa = height of area of pedicle valve; bvl = brachial valve left; bvr = brachial valve right; pvl = pedicle valve left; pvr = pedicle valve right; u = unrolled.



the occasion of the repetition of the description (pp. 110-111) of the species. Two more specimens are present in de KONINCK's original material, which is thus composed of nine specimens, of which the present nomenclatorial status is given on Fig. 1. Unfortunately, one specimen [pl. XIII, figs. 1, 2 (1883b) = pl. 25, figs. 7, 8 (1887)] is not to be found in the collection bought from de KONINCK in 1878 by the Musée royal d'Histoire naturelle à Bruxelles; problems connected with this specimen will be discussed further. Eight specimens belong to a new genus, and will be described as *Atylephorus tornacensis*. The ninth specimen [AV6073 = I.R.Sc.N.B. n°a5580a = Pl. 2, Figs. 20-25, Pl. 5, Figs. 74, 75 = pl. 25, fig. 11 in de KONINCK (1887)] belongs to the genus *Unispirifer*; it is part of the original material, but is not a specimen of the type series. Thus, we are dealing with two genera and two species in the original material, but the specimens of the type series are representatives of one genus and one species only.

de KONINCK's drawings are exceptionally accurate, making it easy to recognize the specimens in the collection. In order to prove this point copies in facsimile of the original lithographs are given on Plates 1-4 together with photographs, which will make good for the obvious deficiencies of the figures of 1883b and 1887. As a matter of fact, these figures were somewhat "embellished", and, more important, lateral and frontal views were only given for three and one specimen respectively, and apical views never. Thus, various characters, such as the relative convexity of the valves, the incurvation of the ventral beak and of the ventral interarea, the height of fold, etc., could not be evaluated. Moreover, photographs have been made of the specimens that were not illustrated by de KONINCK.

Part of de KONINCK's collection (4400 specimens from Belgium and abroad), including most, if not all, of the original material of *S. tornacensis*, was bought by the Musée royal d'Histoire naturelle in Brussels (today: Belgian Royal Institute of Natural Sciences), where it is deposited under the general inventory number IG 4090. This acquisition occurred on January 7, 1878, i.e. before the description of *S. tornacensis* took place. Although housed for more than a century in this institution, it is only for the last thirty years that the original material of *S. tornacensis* has been reexamined by some scientists. LEBEDEV (1929, p. 241, p. 250, p. 251, footnote 5) visited the institution, but it seems that he only had a quick look at the show-cases.

Discussing all the forms referred to *S. tornacensis* in the world is far beyond the scope of this paper, our aim being to establish the systematical position and the stratigraphical range of the original material of the species. Still, some attention will be devoted to Belgian specimens identified as *S. tornacensis* outside the type area.

### Stratigraphical position and geographical location of the original material of *Spirifer tornacensis*

During the period in which his major works were published, de

KONINCK consistently accepted the following threefold division of the Belgian Lower Carboniferous:

#### Étage III de Visé (= étage supérieur)

= Viséan (= upper stage)

#### Étage II de Waulsort (= étage moyen)

= Waulsortian (= middle stage)

#### Étage I de Tournai (= étage inférieur)

= Tournaisian (= lower stage)

At various times he proposed a correlation between these **Étages** and the six **Assises** (**Assises I, II, III, IV, V, VI**) introduced by DUPONT (1863); de KONINCK even published (1878, p. 8) DUPONT's "Échelle stratigraphique du calcaire carbonifère de la Belgique". As a matter of fact de KONINCK relied completely on DUPONT for stratigraphical information. This is the only reason why these correlations are mentioned. They will not be developed further, because DUPONT's **Assises** were rejected by most geologists; their author, who progressively modified their definition, considered them more as facies than lithostratigraphical units, and thought erroneously that either of them could be absent ("théorie des lacunes") in various sections of the Dinant Basin. de KONINCK (1883b, p. 381, p. 388; 1887, p. 111) considers *Spirifer tornacensis* as characteristic of the **étage inférieur du calcaire carbonifère** or as very abundant in the **calcschiste de Tournai**, this being one of the various expressions used by de KONINCK in his publications between 1842 and 1887 to designate the **étage inférieur (étage I) du calcaire carbonifère**. MORTELMANS & BOURGUIGNON were right when they wrote (1954, p. 221) about de KONINCK: "Quant aux recherches paléontologiques de L. de KONINCK elles n'ont que très rarement tenu compte du niveau stratigraphique des fossiles étudiés et sont, de ce fait, à peu près inutilisables pour le stratigraphe"; this was also the opinion of DEMANET (1958, p. 11): "s'il fut un maître en paléontologie, [il] n'avait rien du stratigraphe". In spite of these justified opinions, the stratigraphical information given by de KONINCK was acceptable of the day, and the name *tornacensis* could not have been more appropriate, because it covered altogether the level and the area in which the species was found. As a matter of fact, the original material may derive from anywhere in the rock column exposed in those days, i.e. a sequence of 146.75 m beginning with the **Calcaire d'Allain** (=Tn3a1sup) and ending with the **Calcaire Inférieur de Calonne** (=Tn3c1) (see Figure 2). Still, on the base of what we know about the location of the great number of quarries in operation in the city of Tournai and its immediate surroundings and about the beds from which the highly estimated building stone "pierre de Tournai" was won, it is possible to determine a more restricted range for the original material of *Spirifer tornacensis*.

de DORLODOT (1909a, p. 160) already stressed the point that "Ce sont les assises 2 [Calcaire d'Allain], 3 [Calcaire d'Yvoir], 4 [Petit-granit] et 5 [Calcaire de Vaulx] qui ont fourni les fossiles de la faune tournaisienne de Tournai" in the Tournaisian. But the most precious information pertinent to the subject have been gathered by MORTELMANS & BOURGUIGNON, who wrote (1954, p. 250) about the **Calcaire de Pont-à-Rieu** (=Tn3b): "Elle [the "veine de la Providence", which is the lower vein of the two recognized in the **Calcaire de Pont-à-Rieu**] se termine par les "bancs à moules" véritables lumachelles à brachiopodes.....c'est des "bancs à moules" et des bancs immédiatement supérieurs que provient la majeure partie des fossiles de Tournai existant dans les musées du monde entier". Mentioning again the **Calcaire de Pont-à-Rieu**, MORTELMANS (1969, pp. 25-26) repeated this observation: "Ces calcaires organodétritiques à crinoïdes et bryozoaires renfer-



ment une faune d'une très grande richesse et variété. Une part considérable de la "faune de Tournai" provient de ces niveaux". Similar investigations carried out by DEMANET (1958, p. 124, pp. 139-140) brought him to conclude that the Tournaisian collections from the Tournais chiefly included faunas deriving from the [sous-] assises supérieures de l'étage tournaisien [calcaire d'Allain = upper part of Tn2c (but, for most authors, it is either the upper part of Tn3a, e.g. MORTELMANS & BOURGUIGNON, 1954, pp. 250-251, or the middle part of Tn3a, e.g. MORTELMANS, 1969, p. 21, 1973, p. 143, p. 179), calcaire de la Providence = Tn3a (but, for most authors, it is either the lower part of Tn3b, e.g. MORTELMANS & BOURGUIGNON, 1954, pp. 250-251, or the upper part of Tn3a, e.g. MORTELMANS, 1969, p. 21, 1973, p. 143, p. 179), and, chiefly, calcaire de Première = Tn3b (but, for most authors, it is either the upper part of Tn3b, e.g. MORTELMANS & BOURGUIGNON, 1954, pp. 250-251, or the lower part of Tn3b, e.g. MORTELMANS, 1969, p. 21, 1973, p. 143, p. 179)]. This means that the original material may derive from 91.95 m of rocks [Calcaire d'Allain (29.4 m) + Calcaire de la Providence (40.9 m) + Calcaire de Pont-à-Rieu (21.65 m)], and, eventually, from around 100 m of rocks, if we add the lower part of the Calcaire de Vaulx et de Chercq (32.75 m), which cannot be disregarded. It is in these beds that the fauna, known in the literature under the name "Tournai fauna" (see Figure 2), has been collected; this appropriate expression covers most of the species ever collected by de KONINCK and described by him from 1878 to 1887. This is even more so if one bears in mind that all quarries and outcrops available at the time of de KONINCK's active life were located in the town of Tournai and within a distance of 7 km E, SE and S of this town (see CAMERMAN, 1944, pl. II; DEMANET, 1958, map between p. 116 and 117).

Thus the lack of good stratigraphical information advocated by various authors, including MORTELMANS, who wrote (1973, p. 141) about: "l'absence totale de localisation des récoltes paléontologiques anciennes", must be considerably tempered. We can even go a step further. On account of special and typical conditions of preservation it is very often possible to determine quite exactly the position of a specimen in the lithostratigraphic succession in the area. MORTELMANS & BOURGUIGNON (1954, pp. 224-232) and DEMANET (1958, p. 124, p. 140) have drawn attention to the particular state of preservation of the components of the "Tournai fauna" at various levels (solution pockets), but the most precious clues (colour, epifauna, etc...) were given to one of us by the late professor MORTELMANS (personal communication to PLODOWSKI on september 1974), whose experience of the geology of the Tournai area was without parallel. With the help of all this information, the stratigraphic position of the nine specimens forming the original material has been defined.

Nowadays, only few quarries are still in operation. In the carrière du Milieu, located 4 km SW of the town of Tournai, a few specimens were recently collected in the uppermost eight metres of the Calcaire de Pont-à-Rieu (= Tn3b1); one of them (I.R.Sc.N.B. n°a10438) has been photographed (Pl. 4, Figs. 53-58; Pl. 5, Figs. 65, 69) in order to show its striking resemblance to the original specimens.

### The type series (1883b) of *Spirifer tornacensis* + the specimens figured for the first time in 1887

The status of the original material (1883b + 1887) of *Spirifer tornacensis* (the type series of 1883b + the specimens figured

for the first time in 1887) is as follows (arranged in the sequence of the original figures):

*Holotype*. No holotype was designated by de KONINCK.

*Lectotype*. I.R.Sc.N.B.n°a4292. pl. XIII, figs. 1, 2 in de KONINCK, 1883b = pl. 25, figs. 7, 8 in de KONINCK, 1887. BUBLICHENKO (1976, p. 113) designated as the lectotype the specimen de KONINCK (1883b, pl. XIII, figs. 1, 2) figured in first position. Large and complete specimen, considered as a "normal young specimen" by de KONINCK (1887, explanation of figures). In spite of extensive search, this specimen could not be located in the collection bought in 1878 by the Musée royal d'Histoire naturelle in Brussels. Therefore, contrary to the other specimens of the original material, it is impossible to give it a position in the regional lithostratigraphical sequence. It can derive from anywhere in the about 100 m thick following sequence: Calcaire d'Allain (=Tn3alsup), Calcaire de la Providence (=Tn3a2), Calcaire de Pont-à-Rieu (=Tn3b1), and the lower part of the Calcaire de Vaulx et de Chercq (=Tn3b2).

In the same publication (1976), BUBLICHENKO also designated as the lectotype of other spiriferid species established by de KONINCK the specimen figured in first position by this author. He probably believed that a priority was attached to the specimens figured first. BUBLICHENKO did neither see the original material, nor bother to inquire about its existence, and, thus, about its availability in the Belgian Royal Institute of Natural Sciences, in Brussels. In doing so he completely ignored the ICZN Recommendations on: marking of important individuals, deposition in museums, labelling of name-bearing types, publication of information on labels, institutional responsibility, verification of locality, and type localities. The ignorance of the type series led BUBLICHENKO (1976, p. 112) to be inconsistent in skipping, in the synonymy of *Imbrexia tornacensis*, the figures 5, 6, 9, 10 of plate 25 of 1887, although they are equivalent to the figures 3-7 of plate XII of 1883b, which are included in the synonymy.

Once a lectotype has been chosen, all other specimens of the type series become paralectotypes according to Articles 72 (a)(iii), 73 (b)(ii) and 74 (a)(IV) of the ICZN (1985).

*Paralectotype*, old number: AV6071, new number: I.R.Sc.N.B. n°a4293. Pl. 3, Figs. 27-31, Pl. 5, Figs. 66, 70 = pl. XIII, figs. 3-5 in de KONINCK, 1883b = pl. 25, figs. 9, 10 in de KONINCK, 1887. Large complete specimen, considered as a "younger specimen of the variety" of figures 5, 6 by de KONINCK (1887, explanation of figures), and deriving probably from the Calcaire d'Allain (=Tn3alsup).

*Neotype*, old number: AV6070, new number: I.R.Sc.N.B. n°a4294. Pl. 1, Figs. 1-6, Pl. 5, Figs. 63, 67 = pl. XIII, figs. 6, 7 in de KONINCK, 1883b = pl. 25, figs. 5, 6 in de KONINCK, 1887. Very large and complete specimen, considered as an adult specimen of a "less laterally sharp-pointed variety with somewhat thicker and less numerous costae" by de KONINCK (1883b, explanation of figures; 1887, explanation of figures), and deriving from the uppermost eight metres of the Calcaire de Pont-à-Rieu (=Tn3b1).

On account of the lack of either holotype or lectotype, it is necessary to designate a neotype in conformity with Article 75 of the ICZN (1985), which permits the designation of a neotype only in connection of revisory work in exceptional circumstances, when it is necessary in the interest of stability of nomenclature. We feel that this applies to the present case. The neotype is chosen amongst the specimens of the type series (in this case, amongst the paralectotypes), i.e. the specimen figured by de KONINCK (1883b, pl. XIII, figs. 6, 7 = 1887, pl. 25,



figs. 5, 6; Pl. 1, Figs. 1-6 in the present paper). The neotype is a complete and adult specimen, and the only one in the type series showing the micro-ornament. The **Calcaire de Pont-à-Rieu** [=Tn3b1 (21.65 m) = lower part of Tn3b = lower part of the middle Upper Tournaisian (Tn3b = 54.4 m) according to MORTMANS, 1973, p. 143, p. 179 = *Polygnathus communis carina* Zone according to GROESSENS, 1974, p. 138]. The **Calcaire de Pont-à-Rieu** outcrops in the surroundings of the town of Tournai, for instance in the **carrière du Milieu**. These have to be considered as the type area and the *stratum typicum* of *Spirifer tornacensis*.

*Paralectotype*, old number: AV6074, new number: I.R.Sc.N.B. n°a4295. Pl. 4, Figs. 42-44, Pl. 5, Fig. 71 = pl. XIII, fig. 8 in de KONINCK, 1883b = partly pl. 25, fig. 13 in de KONINCK, 1887. Pedicle valve of a small specimen (showing the interior), considered as a young specimen by de KONINCK (1883b, explanation of figure; 1887, explanation of figure), and deriving from the uppermost eight metres of the **Calcaire de Pont-à-Rieu** (=Tn3b1).

The specimens of *Spirifer tornacensis* figured in 1887 included those already figured in 1883b with, eventually, the following exception. As a matter of fact, pl. 25, fig. 13 (1887) resembles pl. XIII, fig. 8 (1883b) in the contour of the valve, but differs in the aspect of the muscle field, which matches the muscle field of one (I.R.Sc.N.B. n°a5580b) of the two specimens found in the same box (see below) as the present paralectotype, but the contour of the valve of this specimen is different. Therefore, we believe that the specimen of pl. 25, fig. 13 (1887) is the specimen already figured in 1883b, but its muscle field has been re-drawn and replaced by the muscle field of specimen I.R.Sc.N.B. n°a5580b, which is figured in this paper (Pl. 4, Figs. 50-52, Pl. 5, Fig. 73).

*Paralectotypes*, numbers I.R.Sc.N.B. n°a5580b, a5580c. Pl. 4, Figs. 50-52, Pl. 5, Fig. 73 and Pl. 4, Figs. 47-49, Pl. 5, Fig. 72. Pedicle valves of two small specimens (showing interiors) found in the same box as the paralectotype I.R.Sc.N.B. n°a4295, and deriving from the uppermost eight metres of the **Calcaire de Pont-à-Rieu** (=Tn3b1). These two specimens are considered as paralectotypes in accordance with Recommendation 72B of the ICZN (1985).

*Paralectotype*, old number: AV6072, new number: I.R.Sc.N.B. n°a4296. Pl. 3, Figs. 35-40 = pl. XIII, fig. 9 in de KONINCK, 1883b = pl. 25, fig. 12 in de KONINCK, 1887. Large and almost complete specimen, partly preserved as an internal mold, considered as a middle-sized specimen by de KONINCK (1883b, explanation of figure), and deriving from the uppermost part of the **Calcaire d'Allain** (=Tn3a1sup) or the lower part of the **Calcaire de Vault et de Chercq** (=Tn3b2).

Hypotype (identified by the founder of the species = autohyle), old number: AV6069, new number: I.R.Sc.N.B. n°a5579. Pl. 2, Figs. 11-15, Pl. 5, Figs. 64, 68 = pl. 25, figs. 1-4 in de KONINCK, 1887. Very large and complete specimen, considered as an adult specimen by de KONINCK (explanation of plate), and deriving from uppermost eight metres of the **Calcaire de Pont-à-Rieu** (=Tn3b1).

Hypotype (identified by the founder of the species = autohyle), old number: AV6073, new number: I.R.Sc.N.B. n°a5580a. Pl. 2, Figs., 1887/20-25, Pl. 5, Figs. 74, 75 = pl. 25, fig. 11 in de KONINCK, 1887. Small and complete specimen, considered as a "still younger specimen" by de KONINCK (explanation of plate), and deriving from the uppermost part of the **Calcaire**

**d'Allain** (=Tn3a1sup) or from the lower part of the **Calcaire de Vault et de Chercq** (=Tn3b2) or from the **Calcaire des Vignobles** considered nowadays as the youngest development of the **Calcaire de Vault et de Chercq**.

### *Spirifer tornacensis* in the type area and forms identified as *Spirifer tornacensis* in other parts of Belgium

#### SPRIFER TORNACENSIS IN THE TYPE AREA

Family Spiriferidae KING, 1846

Subfamily Prospirinae CARTER, 1974

Genus *Atylephorus* n. gen.

Type species *Spirifer tornacensis* de KONINCK, 1883b

#### DERIVATIO NOMINIS

$\alpha$  (Greek) = privative prefix;  $\tau\acute{\upsilon}\lambda\eta\phi\acute{o}\rho\acute{o}\varsigma$ ,  $\acute{o}\varsigma$ ,  $\acute{o}\nu$  (Greek, adjective) = carrying a fold; alludes to the fold not rising above the flanks or only slightly near anterior commissure.

#### DIAGNOSIS

Large to very large Prospirinae, ventri-biconvex, width exceeding length, hinge line megathyrid, mucronate; ventral interarea apsacline, very weakly concave, with subparallel borders and with denticulate hinge line; sulcus narrow, very shallow, weakly defined, costate; fold narrow, not rising above the flanks or only slightly near anterior commissure, but delimited throughout by distinct fold-bounding grooves, costate; ornament consisting of somewhat flattened costae with narrow intercostal grooves, irregularly spaced growth varices, and fine growth lines and capillae; lateral costae numerous, those near the sulcus and fold bifurcating frequently, number of bifurcations considerably differing on both sides of fold and sulcus, costae on outer parts of flanks simple; pedicle valve interior with stout, diverging dental plates and adminicula, short delthyrial plate embedded in thick apical callosity filling in the apical cavities.

#### SPECIES ASSIGNED TO THE GENUS

Only the type species is assigned to the genus.

#### COMPARISONS

Only two genera show some analogy to the new genus: *Spirifer* SOWERBY, 1816 of late Viséan age, to which the species was originally assigned, and, especially, *Unispirifer* CAMPBELL, 1957 of middle-late Tournaisian to early Viséan age, in which CAMPBELL (1957, p. 67, p. 68) included *Spirifer tornacensis*.

As it was customary at that time, de KONINCK placed the late Tournaisian species of Tournai in the genus *Spirifer*, which was originally established to incorporate all brachiopods with a spiriferid brachidium. Nowadays this genus must be restricted to species close to the type species, *S. striatus* (MARTIN, 1809), i.e. to large late Viséan forms characterized by: numerous bifurcated costae; lateral costae often in bundles; well-developed fold



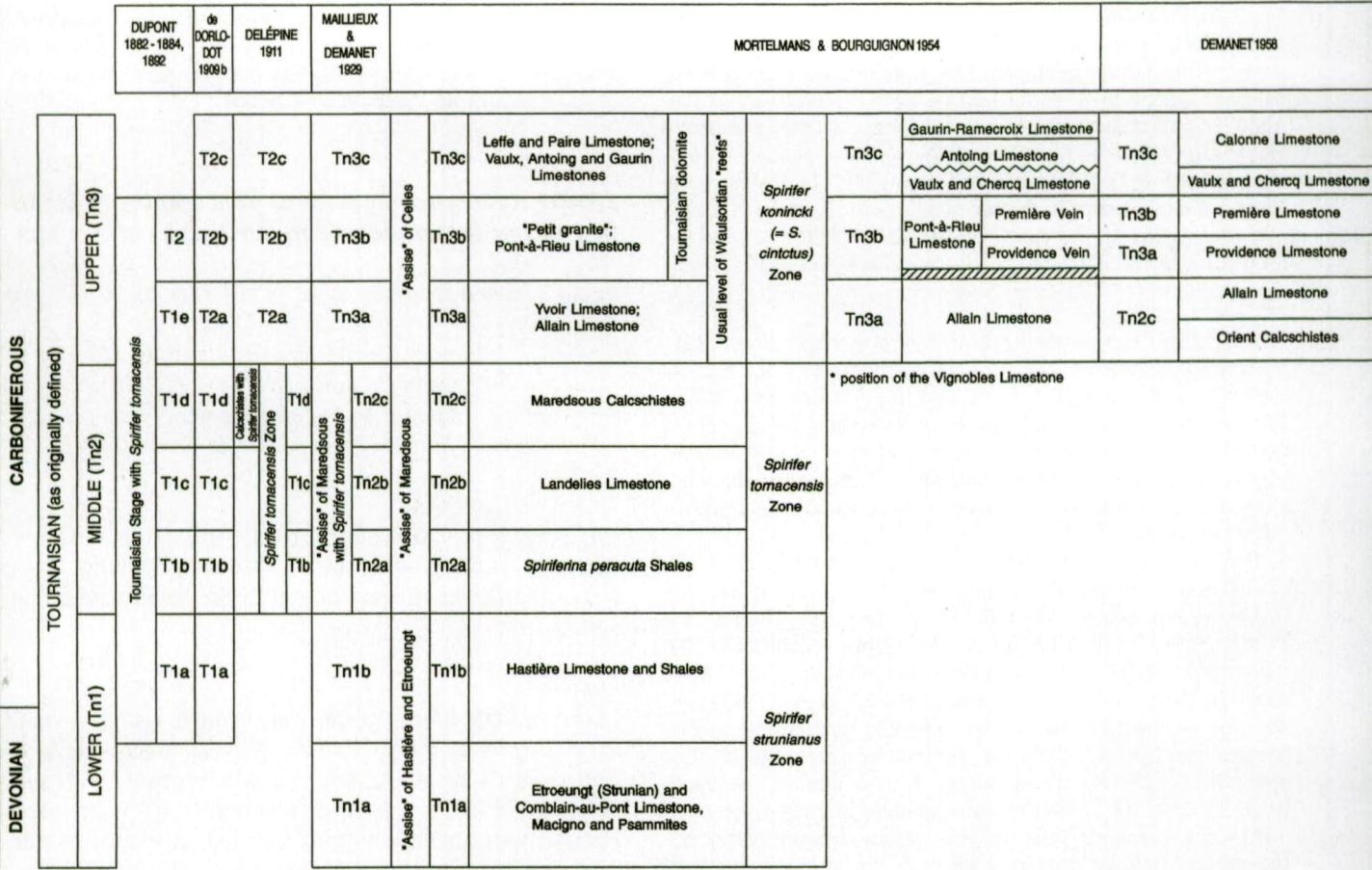


Fig. 2 — The central part of the figure is composed of five columns (from MORTELMANS & BOURGUIGNON 1954 to MORTELMANS 1969) indicating (in the middle) the upper Tournaisian lithostratigraphical units at various times in the Tournai area, and (left and right) correlations with the Tournaisian of the Dinant Synclinorium. The left part of the figure refers to subdivisions of the Tournaisian in use during the time *Spirifer tornacensis* de KONINCK, 1883b and the rocks containing it were abundantly discussed in the literature. The right part of the figure contains some world-wide chronostratigraphical and biostratigraphical units. It is the result of a careful compilation and interpretation of recent literature, in which there are both conflicting views and contradictions. Therefore, this part of the figure must be considered as an attempt.

and sulcus; and a complicated median costation pattern. *Atylephorus tornacensis* does not fit in this pattern, and, thus, its assignment to the genus *Spirifer* has to be disregarded. *Spirifer* also has a larger size, more strongly marked and higher costae, lacks deep fold-bounding grooves, has much more numerous bifurcations, and an anteriorly spreading fold. It must be noted that the original description of *S. striatus* is unbelievably general, and may apply to everything and to anything, and that its internal characters are still poorly known. The closest affinities exist with *Unispirifer* CAMPBELL, 1957, of which the type species, *Spirifer striatoconvolutus* DUN & BENSON, 1920, according to the founder of the genus (1957, p. 71), "has been found [in Watts (Babbins-boon) in northern New South Wales] in rocks of the middle and upper portions of the Lower Burindi Group which are thought to represent the Middle and Upper Tournaisian". These rocks, in Watts, are considered as part of the Merlewood Formation and given an early

Visean age by ROBERTS (1975, table I, p. 5, fig. 3, p. 12) and by ROBERTS *et al.* (1993, fig. 5, p. 360). *Unispirifer* differs by: smaller size; fewer median costae with fewer bifurcations, and, thus, a simpler costation pattern in sulcus and fold; fewer lateral costae with fewer bifurcations (2 to 10 on each flank in *Atylephorus*; 1, 2, exceptionally 3 in *Unispirifer*), which mostly occupy a more or less symmetrical position on both flanks; higher and more rounded costae; sulcus clearly separated from flanks by sulcus-bounding costae along its entire length; fold rising above flanks and clearly defined by bounding grooves, which are much broader and deeper than the furrows. Pl. 4, Fig. 59 shows the fine striation on the cast of a brachial valve of *U. striatoconvolutus*; this character, which is rarely to be seen, is part of the definition of the genus *Unispirifer* and was not illustrated by CAMPBELL. The following three genera, to which the species has sometimes been assigned, have very little in common with the new genus: the Frasnian (middle and late)-Famennian (early and middle) *Cyrtospirifer* NALIVKIN







observé de dessin réticulé”, “l’absence de dessin réticulé”. As a matter of fact, the lack of capillae is one of the characteristic features of *Imbrexia*, although CARTER (1974, p. 687) recognized weak capillae on the type species of the genus, *Spirifer imbrex* HALL, 1858. The original material of the Belgian species being silicified, the micro-ornament is mostly destroyed, but specimens that underwent a lesser silicification, as, for example, the neotype (Pl. 1, Fig. 6), show that radial capillae are present. Still, *Imbrexia* is distinguishable by: highly rounded costae, of which most bifurcate on the flanks; strongly developed fold and sulcus with a somewhat V-shaped section; regularly spaced imbricate to subimbricate growth lamellae.

Finally, we wish to write a few words about two genera also belonging to the subfamily Prospirinae (see CARTER *et al.*, 1994, p. 343): the middle and late Tournaisian genus *Prospira* MAXWELL, 1954, and the late Famennian genus *Parallelora* CARTER, 1974, of which *Mariona* NALIVKIN, 1975 (*in* GARAN’ *et al.*) is a younger objective synonym. Although these genera are very different from the new genus, they have been mentioned several times in connection with species unduly assigned to the Belgian species.

*Prospira*, with type species *P. typa* MAXWELL, 1954, is a small and fusiform genus, which can further be easily separated by: fewer and stronger costae; simple lateral costae; an obsolete or very simple costation on both fold and sulcus; very strong sulcus-bounding costae and fold-bounding grooves extending along the entire length of sulcus and fold.

*Parallelora*, with type species *Spirifer marionensis* SHUMARD, 1855, shares the following features with *Atylephorus*: similar internal structures; a ventral interarea with parallel borders; and bifurcations of lateral costae restricted to an area close to fold and sulcus. It differs in having: a smaller size; much stronger and less numerous lateral costae; a simpler costation pattern both on fold and sulcus; well defined sulcus and fold; strong sulcus-bounding costae and fold-bounding grooves extending along the entire length of sulcus and fold.

*Atylephorus tornacensis* (de KONINCK, 1883b)

Plate 1, Figures 1-10; Plate 2, Figures 11-19;  
Plate 3, Figures 27-41; Plate 4, Figures 42-58;  
Plate 5, Figures 60-73

1883b *Spirifer Tornacensis*, L.G. de Koninck - de KONINCK, p. 373, p. 379, p. 381, pp. 386-388, pl. XIII, figs. 1-9;

1887 *Spirifer tornacensis*, L.-G. de Koninck - de KONINCK, pp. 110-111, pl. 25, figs. 1-10, 12, 13 [non fig. 11 = *Unispirifer* sp.]

Remark

*Spirifer tornacensis* has been mentioned a few times in the literature as a *nomen nudum* before it became a valid taxon:

1) by MOURLON (1881, p. 45) in *Assise I* in the “Liste des fossiles du calcaire carbonifère. D’après les travaux de Mon-

sieur de KONINCK et les recherches stratigraphiques de Monsieur É. DUPONT” under the following designation: “*Spirifer tornacensis*, de K. (S. Mosquensis, Fisch., S. Sowerbyi, de Kon.)” with reference to “de Kon. Descript., 1842-44, pl. 16, fig. 1; p. 252” as the author “ayant servi à la détermination”. At this reference de KONINCK only described and figured *S. Sowerbyi* (FISCHER de WALDHEIM, 1825);

2) by DUPONT (*in* DUPONT & MOURLON, 1882, p. 17) as “Calschistes à *Spirifer tornacensis* (T1d = assise des Écaus-sines) in the Eau-à-Larvaux section N of Ciney;

3) by DUPONT (*in* DUPONT, MOURLON & PURVES, 1883, p. 38) as “calschistes à *Spirifer tornacensis*, T1d” 1.5 km W of the castle of Amas near Clavier;

4) by DUPONT (*in* DUPONT & MOURLON, 1883, p. 26, p. 33) in two outcrops near Dinant: Falmignoul in the “Calschistes noirs, T1d”, and “Calschistes noirs et marbre noir à *Spirifer tornacensis*, T1d” in Froide-veaux on the right bank of the Meuse river;

5) by de KONINCK (1883a, p. 253), but he describes the species a few pages further (1883b, pp. 386-388) in the same Bulletin. There is nothing strange in these quotations, because the taxon was “in the wind” before it was described in 1883b. de KONINCK advertised it quite openly. On one hand his contacts with DUPONT were very close (see above; both scientists made reference to it in various publications), and, on the other hand, he already sold in 1878 part of his collection to the Musée royal d’Histoire naturelle in Brussels.

DIAGNOSIS

As for the genus.

DESCRIPTION

Size large to very large. Transversely elongated, mucronate, with cardinal margin equivalent to greatest width of shell. Hinge line denticulate. Contour in ventral view, without the mucronations, is about semi-circular. Mucronations forming high ridges sharply separating flanks from interareas; this means that shoulders of the pedicle valve are clearly shaping the interareas, of which the borders tend to be subparallel. In juvenile specimens there are no mucronations, and posterior margin is brachythyrid, becoming progressively megathyrid, and finally mucronate in adult specimens. Cardinal extremities are compressed and separated from flanks by a concave flexure. Shell is unequally biconvex with pedicle valve only slightly thicker (deeper) than the brachial valve (tpv/tbv = 51-54/49-46). Flanks moderately convex, sloping evenly towards the antero-lateral margins.

Very shallow sulcus originating at beak, narrow on its entire length, and its maximum width at the front is 1/4 to 1/5th of width of shell. Sulcus is not clearly marked; it is only clearly defined near the beak, and in its anterior part it passes progressively to the flanks. Sulcus-bounding costae do not differ from the others. Very low tongue with slightly curved top. Ventral beak sharp, not inflated, moderately to strongly incurved, slightly overhanging the interarea, and passing to the flanks through concave shoulders. Large open delthyrium, slightly wider than high, with angle of about 80° near the beak; stegidial plates have been observed along the lateral borders and in the apical angles. Ventral interarea apsacline, moder-



ately high, with subparallel borders; it is weakly concave (it is only more concave in juvenile stages). Growth lines in the interarea are parallel to hinge line, while irregular and sinuous growth traces of denticles are perpendicular to it.

Dorsal beak small, weakly inflated, not overhanging the interarea. Narrow fold rising slightly above flanks only in the anterior third or half of the valve. Fold is separated from the flanks on its entire length by grooves slightly broader and deeper than furrows. Wide and open notothyrium. Low, anacline, and very slightly concave dorsal interarea with subparallel borders, and more or less perpendicular to ventral interarea.

**DIMENSIONS:** width is by far the largest dimension. Maximum convexity of both valves posterior to mid-length. Measurements are shown on Figure 1.

**ORNAMENT:** moderately strong flatly rounded costae becoming broad anteriorly: 6 to 7 costae per 10 mm at the anterior margin of the shell near sulcus and fold. Costae are separated from each other by much narrower (two times and more) furrows, and never form bundles.

Lateral costae numerous: >20 to 34 on each flank. Bifurcations common, numbering 2 to 10 on each flank, those close to sulcus and fold bifurcating frequently. Costation pattern somewhat asymmetrical, because the number and the position of bifurcations always differ considerably from one flank to another. Costae simple in the lateral parts of flanks, becoming obsolete on the cardinal extremities. Costae are slightly sloping in transverse sections.

Number of costae on fold and sulcus between 6 and 12. Costation pattern of sulcus consisting normally of a median and two pairs of lateral costae bifurcating successively from the sulcus-bounding costae. Between the costae resulting from the median bifurcation there is sometimes a median costa of second order. A bifurcation of the first lateral costa and the appearance of a third lateral costa, often restricted to one side, renders the costation pattern asymmetrical. Costation of fold begins with a median and one pair of lateral costae. The median costa bifurcates at least once, the resulting costae mostly bifurcating again; between the two bifurcations there is a median costa of second order. The lateral pair generally only bifurcates once, and a possible second bifurcation is restricted to one side and renders the costation pattern asymmetrical.

Micro-ornament of closely spaced growth lines and fine radial capillae resulting in a somewhat reticulate pattern. Imbricating growth varices are irregularly spaced, and more closely near commissure.

**INTERNAL CHARACTERS:** posterior part of pedicle valve thickened by secondary shell material. The apical cavities are thus largely closed, embedding completely or for the major part the delthyrial plate, the dental plates and the adminicula in the apical callosity (Pl. 5, Figs. 60-62). Stout and convergent dental plates and stout divergent

adminicula. Both dental plates and adminicula are strongly divergent in anterior direction. Adminicula extend on the floor of the valve as ridges enclosing the posterior part of the muscle field. Short delthyrial plate, usually completely embedded in callus, and, thus, observable in polished sections, although often obscured by silicification. Sharply marked muscle field with longitudinally subrhombic outline, sharp-pointed anteriorly and bilobate posteriorly, deeply impressed posteriorly, slightly rising above the floor of the shell anteriorly. Long and narrow adductors with low median myophragm extending the whole length of the muscle field; they are enclosed by diductor scars bearing sometimes irregular radially arranged ridges. Adjustor field smooth, generally raised above the rest of the muscle field. Ovarian pits and pallial markings are observed in some specimens.

Dorsal muscle field with long myophragm almost reaching mid-length. Spiral cones with more than 20 whorls. Other dorsal characters unknown.

#### DISCUSSION AND COMPARISONS

*Atylephorus tornacensis* is characterized by its large size, irregularly bifurcated costae on those parts of the flanks adjacent to fold and sulcus, and especially the almost complete absence of an elevated fold. The specimen figured by de KONINCK (1887, pl. 25, fig. 11) is excluded from *Atylephorus tornacensis*, of which it is not a juvenile specimen. It differs from that species in having a strong fold and a costation on the flanks which lacks the characteristic irregular bifurcations; instead, all lateral costae are simple with the exception of the first costa adjacent to the fold which is invariably bifurcate. This constant costation pattern is shared with a group of small Upper Tournaisian spiriferids such as *Unispirifer ventricosus* (de KONINCK, 1887), *U. pentagonus* (de KONINCK, 1887), and several still undescribed species. Moreover, *U. ventricosus* which has a weak fold like *Atylephorus tornacensis*, differs from it by its much smaller size, and the proportionally coarser costae. As far as *U. pentagonus* is concerned, it has a very small size, a globular shape, a subpentagonal outline, a more strongly developed fold, and somewhat coarser costae.

The Visean (V1b or V2a) species *Spirifera clathrata* MCCOY, 1844, which has often been considered as closely related to *Atylephorus tornacensis* (e.g. VAUGHAN, 1915, pp. 41-42), is a poorly known species. On the label of a very badly preserved pedicle valve from Lisnapaste, Ballintra, NW Ireland, and deposited in the National Museum in Dublin, "Pres. by Sir R. Griffith, ? Type" is written. As most of MCCOY's species are based on material from the Griffith Collection, this annotation could be considered correct, but comparison with MCCOY's drawing excludes this possibility. Anyhow, this specimen has nothing in common with the Belgian species on account of its external shape, its smaller size, and its very irregular costation. Some topotypes identified as *Spirifer clathratus* MCCOY, and deposited in the Trinity College in Dublin (TCD 14916), bear very little resemblance to *Atylephorus tornacensis*, and no comparison is needed.



VAUGHAN (1903, pp. 125-126, pl. 2, fig. 3) described some specimens from the Carboniferous Limestone series of the Bristol area as a mutation of the "Group of *Spirifer bisulcatus*, Sow.", Mutation B<sup>1</sup> (= *Spirifer* aff. *clathratus*, McCoy), of which he made later (VAUGHAN, 1905, p. 300) a variety; he stated (VAUGHAN, 1903, p. 126, footnote 1): "The relationship of this mutation to *Spirifer tornacensis*, de Kon, is, for the present, deferred". This mutation is by far closer to *Atylephorus tornacensis* than MCCOY's species. It differs in having a more rounded outline, finer and more rounded costae, and, according to VAUGHAN (1903, p. 124), a prominent fold.

The middle Tournaisian *Spirifer pinskeyensis* GARWOOD, 1912 of Cumbria (north-west England), although considered by its founder (p. 570) as "bearing considerable resemblance to *S. aff. clathratus* (M'Coy) Vaughan", has nothing to do with *Atylephorus tornacensis*, because of its much smaller size, its simple lateral costae, with the exception of the first costa adjacent to the fold, and its completely different costation of fold and sulcus.

de KONINCK (1881, p. 56, footnote 1; 1883a, p. 253, footnote 1; 1883b, p. 373, p. 379, p. 381, p. 387; 1887, p. 109, p. 110) recognized that he had mistaken *Spirifer tornacensis* in his previous publications for *Spirifer Mosquensis* (FISCHER de WALDHEIM, 1825) and *S. cinctus* KEYSERLING, 1846, of which he considered it (p. 387) to be a variety.

#### DISTRIBUTION

*Atylephorus tornacensis* is a very abundant species as emphasized by de KONINCK in various publications (1878, p. 6 under the name *Spirifer mosquensis*; 1881, p. 58; 1883a, p. 253; 1883b, p. 381, p. 387; 1887, p. 110). It is only known with certainty in the town of Tournai and in its immediate surroundings from the **Calcaire d'Allain** (Tn3a1sup) to the lower part of the **Calcaire de Vaulx et de Chercq** (Tn3b2), i.e. from the upper part of the lower Upper Tournaisian to the middle Upper Tournaisian. Thus, the species does not range into the upper (Tn3c) Upper Tournaisian.

#### *Unispirifer* sp.

Plate 2, Figures 20-26; Plate 5, Figures 74,75

1887 *Spirifer tornacensis*, L.- G. de Koninck - de KONINCK, pl. 25, fig. 11 (cet. excl. = *Atylephorus tornacensis*)

#### DESCRIPTION

Size small, transversely elongated, with subrhombic outline in ventral view. Cardinal margin equivalent to greatest width of shell; growth lines showing existence of short mucronations which have broken off. Cardinal extremities somewhat depressed. Shell unequally biconvex, the pedicle valve being slightly thicker (deeper) than the brachial one (tpv/tbv ~ 5/4). Commissure uniplicate.

Sulcus originating at beak, narrow, shallow, with rounded cross-section, well defined only in posterior

third, passing anteriorly imperceptibly to the flanks. Sulcus-bounding costae not differing from others. Short tongue with parabolic outline. Ventral beak small, pointed, not inflated, strongly incurved, overhanging the interarea, with concave shoulders. Ventral interarea apsacline, triangular in outline, moderately concave. Few growth lines parallel to hinge line and numerous irregular growth traces of denticles perpendicular to it. Delthyrium wide, triangular, as wide as high, open; no trace of delthyrial covering observed.

Fold narrow, rising considerably above flanks on its entire length, rounded in cross-sections. Fold-bounding grooves posteriorly slightly deeper and broader than intercostal furrows. Dorsal beak tiny, blunt, not overhanging interarea. Dorsal interarea low, slightly concave, anacline.

ORNAMENT: costae moderately strong, flatly rounded, becoming broad anteriorly, separated from each other by much narrower intercostal furrows, simple on flanks with exception of the first costa on both sides of the fold, which is bifurcate. On flanks 11-12 distinguishable costae, others becoming obsolete on ears. Sulcus with a simple median costa and two pairs of lateral costae bifurcating successively from the sulcus-bounding costae. Fold with a median costa and one pair of lateral costae, each of which bifurcating once, totaling 6 costae. Micro-ornament preserved on the right dorsal flank near the anterior margin, consisting of concentric growth lines only, no radial elements discernible. Elsewhere micro-ornament destroyed by concentric silicification structures.

#### DISCUSSION AND COMPARISON

See comparison with *Atylephorus tornacensis* under the description of that species.

Some small and not yet described spiriferids from the Upper Tournaisian of Belgium, as well as *Spirifer ventricosus* de KONINCK, 1887 and *S. pentagonus* de KONINCK, 1887, show the same costation pattern as *Unispirifer* sp. *Spirifer ventricosus* differs, however, in being more globular, in having a flat fold only very slightly elevated near the anterior margin, and strongly developed sulcus-bounding grooves, which, over their entire length, are much deeper and broader than the other intercostal furrows. *S. pentagonus* is smaller, has a pentagonal outline, a lower fold, and more strongly developed sulcus-bounding grooves over their entire length.

Most specimens from eastern Europe and Asia described as *tornacensis* resemble much more *Unispirifer* sp. than *Atylephorus tornacensis*. A detailed discussion of these forms is beyond the scope of this paper.

#### BELGIAN FORMS IDENTIFIED AS *SPIRIFER TORNACENSIS* OUTSIDE THE TYPE AREA

The large collections of the Belgian Royal Institute of Natural Sciences, as well as those made by one of us (G.P.) during several field seasons outside the type area, show that all forms from outside the type region identi-



fied as *Spirifer tornacensis* in the Strunian, and in the Lower, Middle, and Upper Tournaisian, do not belong to this species.

On account of a too broad concept of the species, many forms were included in it although they differ, chiefly, by: smaller size; greater or smaller l/w ratio; fold rising well above the flanks; strong to very strong fold-bounding grooves; well marked sulcus; simpler costation pattern on fold and sulcus; simple lateral costae; and, rarely, a more complex lateral costation consisting of several successive bifurcations or even fasciculations. Each of these characters may be present alone or in combination with one or more of the others. In short, we are dealing with a very heterogeneous ensemble including several genera and species.

Besides the countless *S. tornacensis* groups found in the literature, the misidentifications just mentioned lead

to the proliferation, outside the type area, of stratigraphical terms, such as: **Étage tournaisien à *Spirifer tornacensis***, *S. tornacensis* time, zones, horizons, beds, **assises** (e.g. **Assise de Maredsous à *S. tornacensis***). Moreover, the definition of most of these terms changed in the course of time.

### Acknowledgments

The authors are indebted to J. L. CARTER, Carnegie Museum of Natural History, Pittsburgh, USA, and to M. LEGRAND, "Université Michel de Montaigne", Bordeaux, France, for critical reading of the manuscript and for valuable suggestions that helped to improve the paper. They are also grateful to K. S. W. CAMPBELL, The Australian National University, Canberra, for sending to each of them, topotypes of *Unispirifer striatoconvolutus* (DUN & BENSON, 1920), the type species of the genus *Unispirifer* CAMPBELL, 1957.

### References

- BRUNTON, C.H.C. & RISSONÉ, A., 1976. *Fusella* M'Coy 1844, a problematic brachiopod genus from the Lower Carboniferous. *Bulletin of the British Museum (Natural History), Geology, Miscellanea*, 27 (4): 275-284.
- BUBLICHENKO, N.L., 1971. Brachiopody nizhnego karbona Rudnogo Altaya (Tarkhanskaya svita). Institut Geologicheskikh Nauk im. K.I. Satpaeva. Akademiya Nauk Kazakhskoi SSR. "Nauka", 189 pp. Alma-Ata.
- BUBLICHENKO, N.L., 1976. Brachiopody nizhnego karbona Rudnogo Altaya (svity Bukhtarminskaya, Ul'binskaya, Pravoloktevskaya). Institut Geologicheskikh Nauk im. K. I. Satpaeva. Akademiya Nauk Kazakhskoi SSR. "Nauka", 211 pp. Alma-Ata.
- CAMERMAN, C., 1944. La pierre de Tournai. Son gisement, sa structure et ses propriétés, son emploi actuel. *Mémoires de la Société belge de Géologie, de Paléontologie et d'Hydrologie*, 1: 115 pp.
- CAMPBELL, K. S. W., 1957. A Lower Carboniferous brachiopod-coral fauna from New South Wales. *Journal of Paleontology*, 31 (1): 34-98.
- CARTER, J. L., 1974. New genera of spiriferid and brachythyrid brachiopods. *Journal of Paleontology*, 48 (4): 674-696.
- CARTER, J.L., JOHNSON, J.G., GOURVENNEC, R. & HOU, H.-f., 1994. A revised classification of the spiriferid brachiopods. *Annals of Carnegie Museum*, 63(4): 327-374.
- de DORLODOT, H., 1909a. Les faunes du Dinantien et leur signification stratigraphique. *Bulletin de la Société belge de Géologie, de Paléontologie et d'Hydrologie, Mémoires*, 23: 153-174.
- de DORLODOT, H., 1909b. Description succincte des assises du Calcaire carbonifère de la Belgique et de leurs principaux faciès lithologiques. *Bulletin de la Société belge de Géologie, de Paléontologie et d'Hydrologie, Mémoires*, 23: 175-193.
- de KONINCK, L.G., 1878. La faune du calcaire carbonifère de la Belgique. Première partie: Poissons et genre Nautil. *Annales du Musée royal d'Histoire naturelle de Belgique*, 2: 152 pp., 31 pls.
- de KONINCK, L.G., 1881. Sur quelques Céphalopodes nouveaux du calcaire carbonifère de l'Irlande. *Annales de la Société géologique de Belgique, Mémoires*, 9: 50-60.
- de KONINCK, L.G., 1883a. Notice sur la distribution géologique des fossiles carbonifères de la Belgique. *Bulletin du Musée royal d'Histoire naturelle de Belgique*, 2: 253-285.
- de KONINCK, L.G., 1883b. Sur le *Spirifer Mosquensis* et sur ses affinités avec quelques autres espèces du même genre. *Bulletin du Musée royal d'Histoire naturelle de Belgique*, 2: 371-395.
- de KONINCK, L.G., 1887. La faune du calcaire carbonifère de la Belgique. Sixième partie: Brachiopodes. *Annales du Musée royal d'Histoire naturelle de Belgique*, 14: 154 pp., 37 pls.
- DELÉPINE, G., 1911. Recherches sur le calcaire carbonifère de la Belgique. *Mémoires et travaux publiés par des professeurs des Facultés catholiques de Lille*: 419 pp.
- DEMANET, F., 1958. Contribution à l'étude du Dinantien de la Belgique. *Mémoires de l'Institut royal des Sciences naturelles de Belgique*, 141: 152 pp.
- DOUGLAS, J.A., 1909. The Carboniferous Limestone of County Clare (Ireland). *Quarterly Journal of the Geological Society of London*, 65 (4, 260): 538-586.
- DUN, W.S. & BENSON, W.N., 1920. Section B. - Palaeontology. In: BENSON, W.N., DUN, W.S. & BROWNE, W.R., The geology and petrology of the Great Serpentine Belt of New South Wales, Part IX.- The geology, palaeontology and petrography of the Currabubula District, with notes on adjacent regions. *Proceedings of the Linnean Society of New South Wales*, B, 45 (3, 179): 337-363.
- DUPONT, É., 1863. Le calcaire carbonifère de la vallée de la Meuse. *Bulletin de la Société géologique de France*, 20 (1862-1863): 849-857.
- DUPONT, É., 1892. In: CUVELIER, M., Compte-rendu d'une excursion dans le Calcaire carbonifère à Pierre-Pétru, près d'Hastière, et aux Fossés, sur la Lesse. *Bulletin de la Société belge de Géologie, de Paléontologie et d'Hydrologie, Procès-Verbaux*, 6 (1892-1893): 122-139.
- DUPONT, É. & MOURLON, M., 1882. Explication de la feuille de



- Ciney. Service de la Carte géologique du Royaume. Musée royal d'Histoire naturelle de Belgique, 66 pp. Bruxelles.
- DUPONT, É. & MOURLON, M., 1883. Explication de la feuille de Dinant. Service de la Carte géologique du Royaume. Musée royal d'Histoire naturelle de Belgique, 152 pp. Bruxelles.
- DUPONT, É., MOURLON, M. & PURVES, J.-C., 1883. Explication de la feuille de Clavier. Service de la Carte géologique du Royaume. Musée royal d'Histoire naturelle de Belgique, 69 pp. Bruxelles.
- DUPONT, É., MOURLON, M. & PURVES, J.-C., 1884. Explication de la feuille de Modave. Service de la Carte géologique du Royaume. Musée royal d'Histoire naturelle de Belgique, 69 pp. Bruxelles.
- FISCHER de WALDHEIM, G., 1825. Notice sur la Choristite, genre de coquilles bivalves fossiles, du Gouvernement de Moscou. Programme d'invitation à la séance publique de la Société Impériale des Naturalistes: 5-11. Moscou.
- FREDERIKS, G., 1924. O verkhne-kamennougol'nykh spiriferidakh Urala. *Izvestiya Geologicheskogo Komiteta*, 38 (1919) (3): 295-324.
- GARAN', I.M., GUSEVA, S.N., DEVINGTAL', V.V., DONAKOVA, L.M., ENOKYAN, N.V., KALASHNIKOV, N.V., LAPINA, N.N., MIKHAYLOVA, E.N., NALIVKIN, D.V., SEMIKHATOVA, S.V., STEPANOV, D.L., STEPANOVA, G.A., SHESTAKOVA, M.F., 1975. Brachiopoda (Brakhiopody). In: STEPANOV, D.L. (ed.), *Paleontologicheskii Atlas kamennougol'nykh otlozheniy Urala. Trudy VNIGRI*, 383: 154-203.
- GARWOOD, E.J., 1912. The Lower Carboniferous succession in the north-west of England. *Quarterly Journal of the Geological Society of London*, 68 (4, 272): 449-586.
- GEORGE, T.N., 1954. Pre-Seminulan Main Limestone of the Avonian Series in Breconshire. *Quarterly Journal of the Geological Society of London*, 110 (3, 439): 283-322.
- GROESSENS, E., 1974. Distribution de Conodontes dans le Dinantien de la Belgique. Preliminary range chart of conodont biozonation in the Belgian Dinantian. In: International Symposium on Belgian micropaleontological limits from Emsian to Viséan, Namur, September 1st to 10th, 1974. *Publication N° 17*, 193 pp.
- HALL, J. & WHITNEY, J.D., 1858. Report on the Geological Survey of the State of Iowa: embracing the results of investigations made during portions of the years 1855, 56 & 57, volume I, part II: Palaeontology: 473-724.
- KEYSERLING, A., 1846. Geognostische Beobachtungen. Wissenschaftliche Beobachtungen auf einer Reise in das Petschora-Land im Jahre 1843: 149-406. St. Petersburg.
- LEBEDEV, N., 1929. Spiriferidae aus dem Karbon des Donetzbeckens und einiger anderer Gebiete von Russland. *Zeitschrift der deutschen geologischen Gesellschaft*, 81 (6): 241-278.
- LEGRAND, R., MAMET, B. & MORTELMANS, G., 1966. Sur la stratigraphie du Tournaisien de Tournai et de Leuze. Problèmes de l'étage Tournaisien dans sa localité-type. *Bulletin de la Société belge de Géologie, de Paléontologie et d'Hydrologie*, 74 (1965) (2 & 3): 140-188.
- MAILLIEUX, E. & DEMANET, F., 1929. L'échelle stratigraphique des terrains primaires de la Belgique. *Bulletin de la Société belge de Géologie, de Paléontologie et d'Hydrologie*, 38 (1928-1929): 124-131.
- MARTIN, W., 1809. Petrificata derbiensia; or, figures and descriptions of Petrifications collected in Derbyshire, 52 pls., 41 pp. London, Edinburgh, Dublin, Buxton.
- MAXWELL, W.G.H., 1954. Upper Palaeozoic formations in the Mount Morgan District - Faunas. *Papers of the Department of Geology of the University of Queensland*, 4 (5): 69 pp.
- MCCOY, F., 1844. A synopsis of the characters of the Carboniferous limestone fossils of Ireland, 207 pp. Dublin.
- MORTELMANS, G., 1963. Les calcaires de Tournai. In: DELMER, A., LEGRAND, R., MAMET, B. & MORTELMANS, G., *Le Dinantien du Hainaut occidental. Excursion I-J. Étude du Calcaire Carbonifère du Hainaut*. 6e Congrès International de Sédimentologie, Belgique et Pays-Bas: 1-21.
- MORTELMANS, G., 1969. L'étage tournaisien dans sa localité-type. Sixième Congrès International de Stratigraphie et de Géologie du Carbonifère, Sheffield, 11-16 septembre 1967, 1: 19-43.
- MORTELMANS, G., 1973. Évolution paléocéologique et sédimentologique du Calcaire de Tournai: quelques lignes directrices. *Bulletin de la Société belge de Géologie, de Paléontologie et d'Hydrologie*, 82 (1): 141-180.
- MORTELMANS, G. & BOURGUIGNON, P., 1954. Chapitre VI. Le Dinantien. In: FOURMARIER, P. (direct.), *Prodrome d'une description géologique de la Belgique*: 217-321.
- MOURLON, M., 1881. *Géologie de la Belgique*, 2: 392 pp. Paris, Berlin, Bruxelles.
- NALIVKIN, D.V., 1937. Brachiopoda of the Upper and Middle Devonian and Lower Carboniferous of north-eastern Kazakhstan. *Transactions of the Central Geological and Prospecting Institute*, 99: 200 pp.
- PHILLIPS, J., 1836. Illustrations of the geology of Yorkshire. Part II: The Mountain limestone district, VII: 194-253. London.
- ROBERTS, J., 1975. Early Carboniferous brachiopod zones of eastern Australia. *Journal of the Geological Society of Australia*, 22 (1): 1-31.
- ROBERTS, J., JONES, P.J. & JENKINS, T.B.H., 1993. Revised correlations for Carboniferous marine invertebrate zones of eastern Australia. *Alcheringa*, 17 (4): 353-376.
- SHUMARD, B.F., 1855. Geological section on the Mississippi River from St. Louis to Commerce. *Annual Report of the Missouri Geological Survey*, 1-2: 139-208.
- SOWERBY, J., 1815-1818. The mineral conchology of Great Britain or coloured figures and descriptions of those remains of testaceous animals or shells, which have been preserved at various times and depths in the earth, 2: 1-235, pl. 103-203. London.
- SOWERBY, J. de C., 1823-1825. The mineral conchology of Great Britain or coloured figures and descriptions of those remains of testaceous animals or shells, which have been preserved at various times and depths in the earth, 5: 1-168, pl. 408-503. London.
- VAUGHAN, A., 1903. Notes on the Corals and Brachiopods obtained from the Avon section and preserved in the Stoddart Collection. *Proceedings of the Bristol Naturalists' Society*, N.S., 10 (1902) (2): 90-134.
- VAUGHAN, A., 1905. The palaeontological sequence in the Carboniferous Limestone of the Bristol area. *Quarterly Journal of the Geological Society of London*, 61 (2, 242): 181-307.
- VAUGHAN, A., 1915. Correlation of Dinantian and Avonian. *Quarterly Journal of the Geological Society of London*, 71 (1, 281): 1-52.
- WATERHOUSE, J.B., 1970. The Lower Carboniferous brachiopod genus *Fusella* M'Coy 1844. *Life Sciences Occasional Papers. Royal Ontario Museum*, 15: 12 pp.



WATERHOUSE, J.B. & GUPTA, V.J., 1978. Early Carboniferous brachiopods from the Syringothyris Limestone and Fenestella Shales of Kashmir. *Contributions to Himalayan Geology*, 1: 106-146.

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Typescript submitted July 1, 1995

Revised typescript received December 1, 1995.

### Explanation of Plates

#### PLATE 1

All figures are natural size unless otherwise stated

- Figs. 1-8 — *Atylephorus tornacensis* (de KONINCK, 1883b). Neotype, I.R.Sc.N.B.n°a4294 (old number: AV6070). 1-5: ventral, dorsal, frontal, apical and lateral views; 6: micro-ornament (x 5); 7,8: pl. XIII, figs. 6,7 *in de KONINCK, 1883b* = pl. 25, figs. 5,6 *in de KONINCK, 1887*.
- Figs. 9, 10 — *Atylephorus tornacensis* (de KONINCK, 1883b). Lectotype, I.R.Sc.N.B.n°a4292. 9: pl. XIII, fig. 2 *in de KONINCK, 1883b* = pl. 25, fig. 8 *in de KONINCK, 1887*; 10: pl. XIII, fig. 1 *in de KONINCK, 1883b* = pl. 25, fig. 7 *in de KONINCK, 1887*.

#### PLATE 2

All figures are natural size unless otherwise stated

- Figs. 11-19 — *Atylephorus tornacensis* (de KONINCK, 1883b). Hypotype I.R.Sc.N.B.n°a5579 (old number: AV6069). 11-15: ventral, dorsal, frontal, apical and lateral views; 16-19: pl. 25, figs. 2, 1, 4, 3 *in de KONINCK, 1887*.
- Figs. 20-26 — *Unispirifer* sp. Hypotype of *Atylephorus tornacensis* (de KONINCK, 1883b), I.R.Sc.N.B.n°a5580a (old number: AV6073). 20-24: ventral, dorsal, frontal, apical and lateral views; 25: micro-ornament (x 5); 26: pl. 25, fig. 11 *in de KONINCK, 1887* as *Spirifer tornacensis*.

#### PLATE 3

All figures are natural size

- Figs. 27-34 — *Atylephorus tornacensis* (de KONINCK, 1883b). Paralectotype, I.R.Sc.N.B.n°a4293 (old number: AV6071). 27-31: ventral, dorsal, frontal, apical and lateral views; 32,33: pl. XIII, figs. 3,4 *in de KONINCK, 1883b* = pl. 25, figs. 10,9 *in de KONINCK, 1887*; 34: pl. XIII, fig. 5 *in de KONINCK, 1883b*.
- Figs. 35-41 — *Atylephorus tornacensis* (de KONINCK, 1883b). Paralectotype, I.R.Sc.N.B.n°a4296 (old number: AV6072). 35-39: dorsal, ventral, lateral, frontal and apical views; 40: latex mold of the ventral muscle field; 41: pl. XIII, fig. 9 *in de KONINCK, 1883b* = pl. 25, fig. 12 *in de KONINCK, 1887*.



## PLATE 4

All figures are natural size unless otherwise stated

- Figs. 42-45 — *Atylephorus tornacensis* (de KONINCK, 1883b). Paralectotype, I.R.Sc.N.B.n°a4295 (old number: AV6074). 42-44: ventral, apical and internal views of a pedicle valve. 45: pl. XIII, fig. 8 in de KONINCK, 1883b = partly (see comments in text) pl. 25, fig. 13 in de KONINCK, 1887.
- Figs. 46, 50-52 — *Atylephorus tornacensis* (de KONINCK, 1883b). Paralectotype, I.R.Sc.N.B.n°a5580b. 46: pl. 25, fig. 13 in de KONINCK, 1887 (see comments in text); 50-52: ventral, apical and internal views of a pedicle valve.
- Figs. 47-49 — *Atylephorus tornacensis* (de KONINCK, 1883b). Paralectotype, I.R.Sc.N.B.n°a5580c. Ventral, apical and internal views of a pedicle valve.
- Figs. 53-58 — *Atylephorus tornacensis* (de KONINCK, 1883b). Topotype, I.R.Sc.N.B.n°a10438. **Carrière du Milieu** located at 4 km SW of the town of Tournai, uppermost eight metres of the **Calcaire de Pont-à-Rieu** (= Tn3b1). Collector: Plodowski, G., 1974. 53-57: ventral, dorsal, frontal, apical and lateral views; 58: micro-ornament (x 6). Remark: a further dorsal view of a topotype is illustrated in VAUGHAN, 1915, pl. VI, fig. 4.
- Fig. 59 — *Unispirifer striatoconvolutus* (DUN & BENSON, 1920). Topotype, I.R.Sc.N.B.n°a10440. Watts, Babbinsboon, northern New South Wales, Australia. Collector: Campbell, K.S.W., 1955. Remainder of micro-ornament on the cast of a brachial valve (x 8).

## PLATE 5

- Figs. 60-62 — *Atylephorus tornacensis* (de KONINCK, 1883b). Topotype, I.R.Sc.N.B.n°a10439. **Carrière du Milieu** located at 4 km SW of the town of Tournai, uppermost eight metres of the **Calcaire de Pont-à-Rieu** (= Tn3b1). Collector: Plodowski, G., 1974. Camera lucida drawings of transverse serial sections in the apical region of the pedicle valve. Distance in mm of the sections forward of the beak: 3.5, 5 and 6.5 mm.
- Figs. 63-73 — *Atylephorus tornacensis* (de KONINCK, 1883b). Costation on sulcus and fold. 63 (sulcus), 67 (fold): Neotype, I.R.Sc.N.B.n°a4294 (old number: AV6070); 64 (sulcus), 68 (fold): Hypotype, I.R.Sc.N.B.n°a5579 (old number: AV6069); 65 (sulcus), 69 (fold): Topotype, I.R.Sc.N.B.n°a10438; 66 (sulcus), 70 (fold): Paralectotype, I.R.Sc.N.B.n°a4293 (old number: A6071); 71 (sulcus): Paralectotype, I.R.Sc.N.B.n°a4295 (old number: A6074); 72 (sulcus): Paralectotype, I.R.Sc.N.B.n°a5580c; 73 (sulcus): Paralectotype, I.R.Sc.N.B.n°a5580b.
- Figs. 74, 75 — *Unispirifer* sp. Hypotype of *Atylephorus tornacensis* (de KONINCK, 1883b), I.R.Sc.N.B.n°a5580a (old number: AV6073). Costation on sulcus (74) and fold (75).



Plate 1.

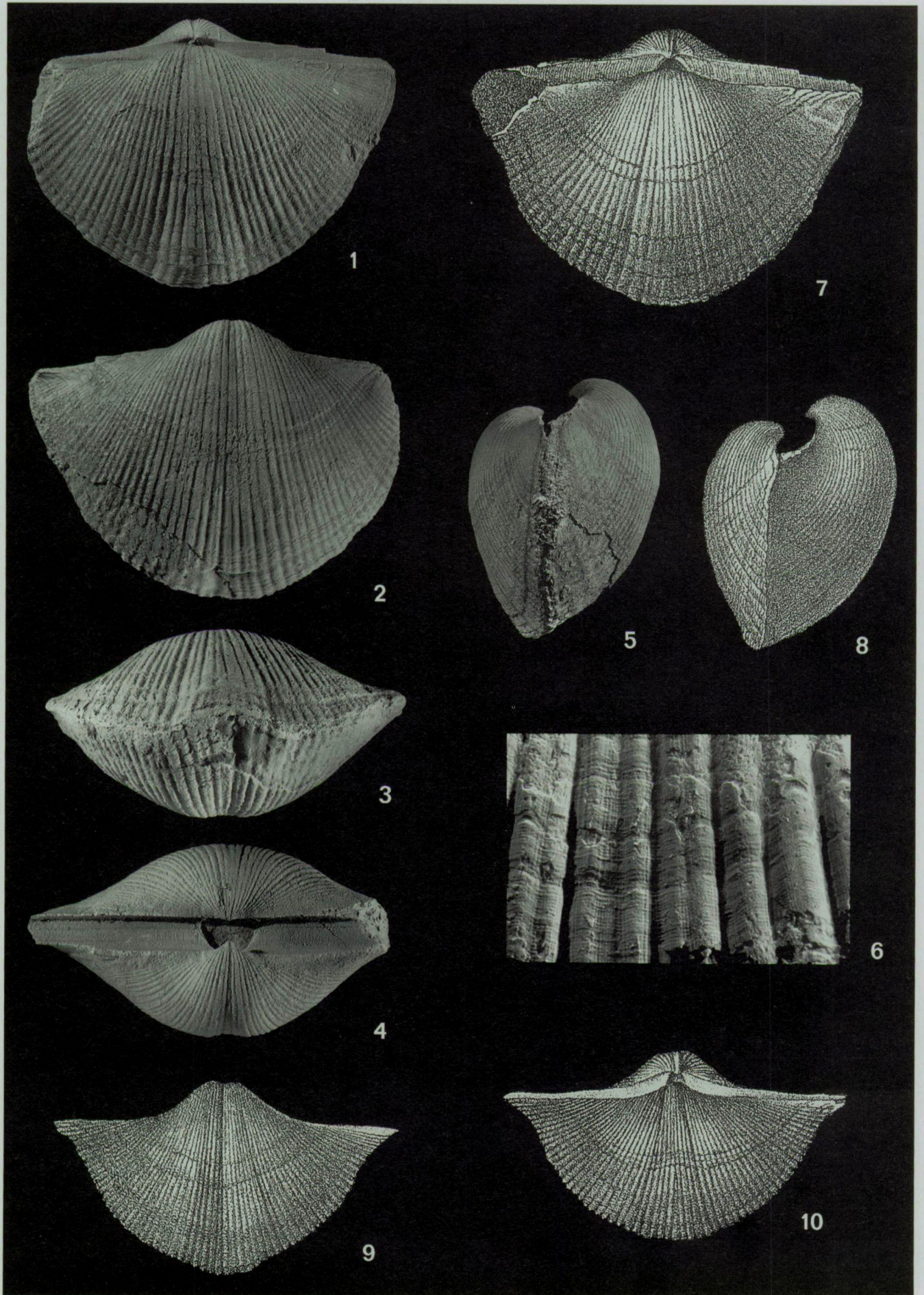




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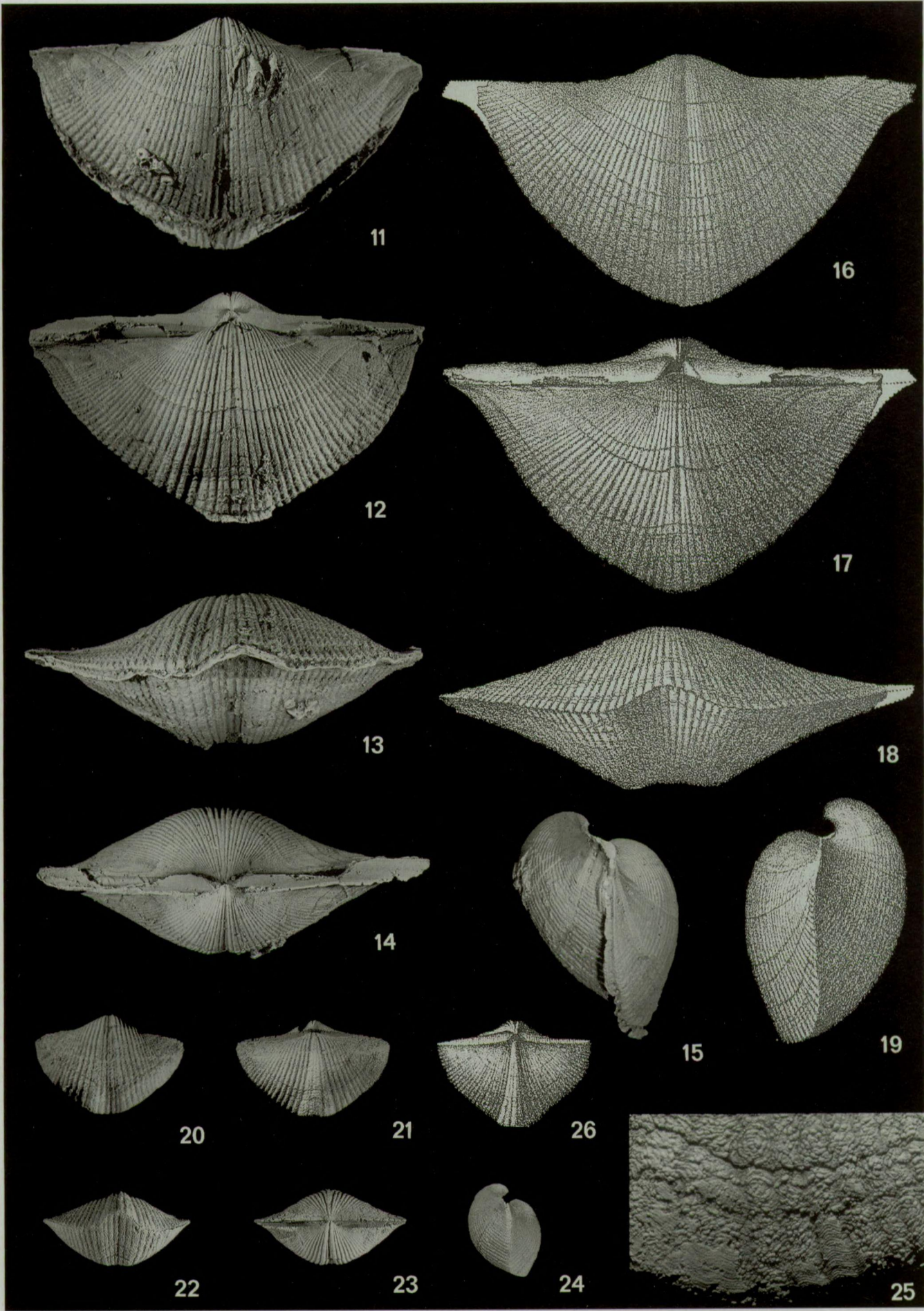




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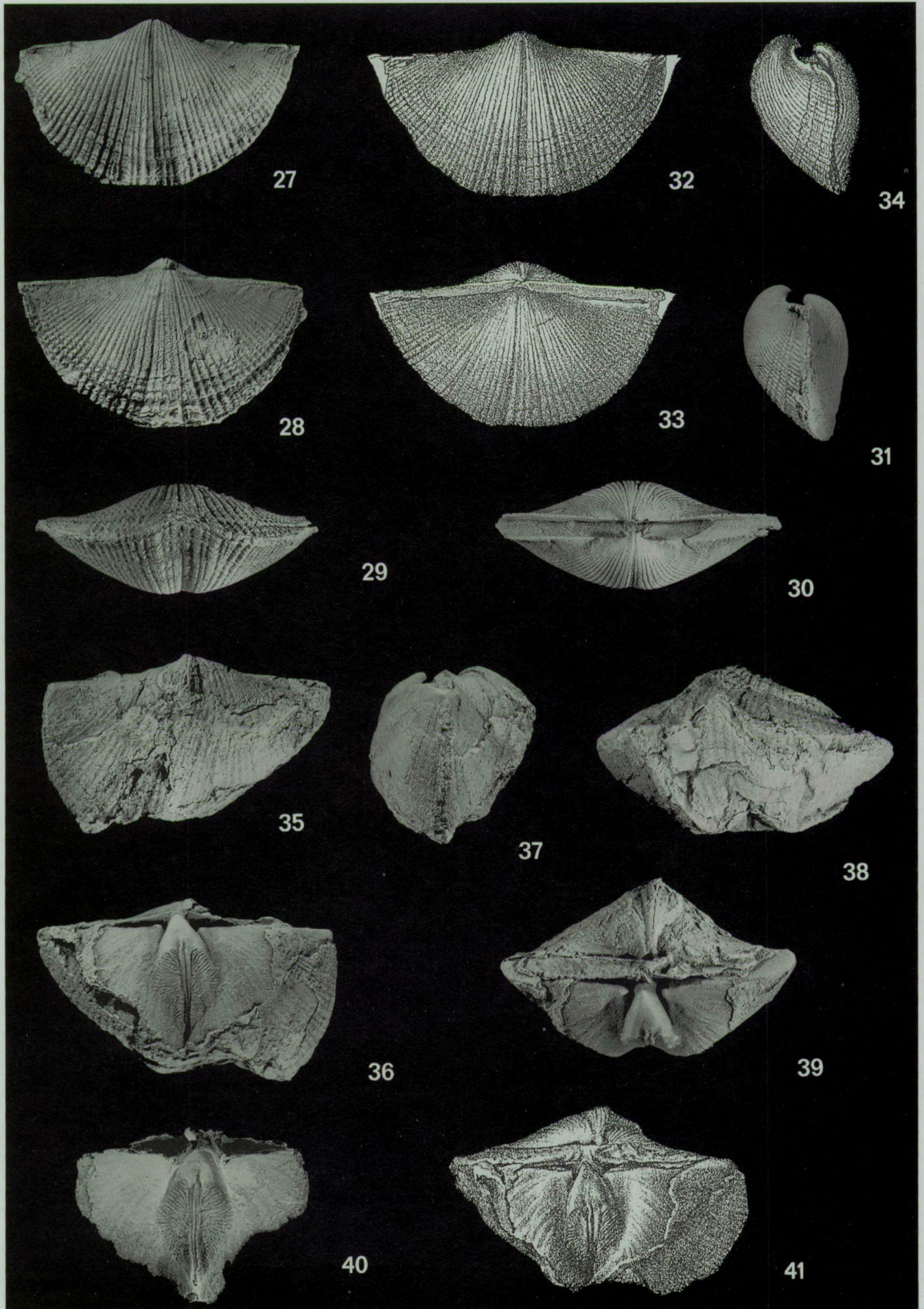




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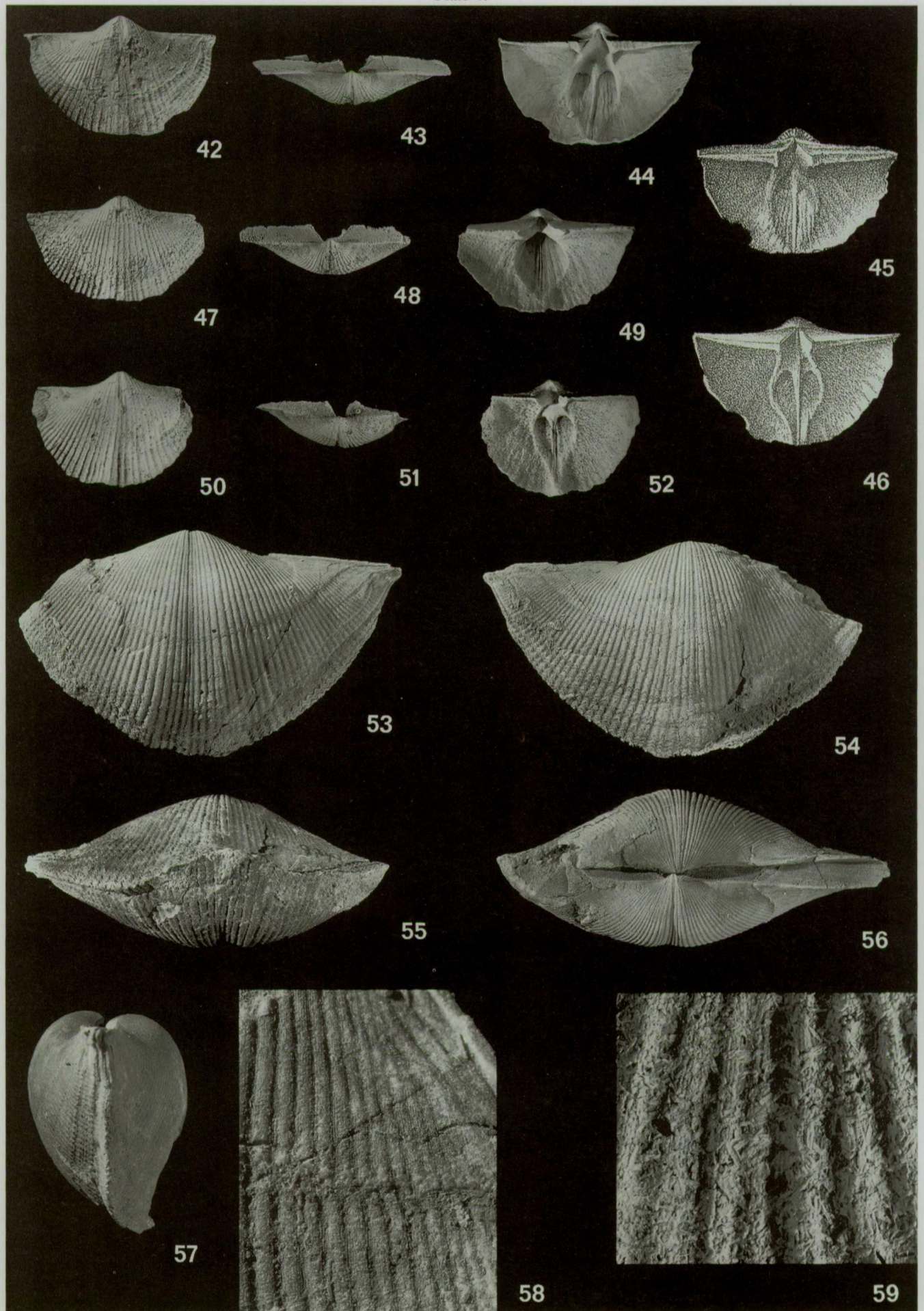




Plate 5.



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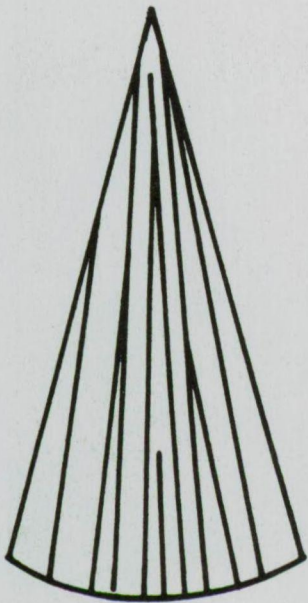
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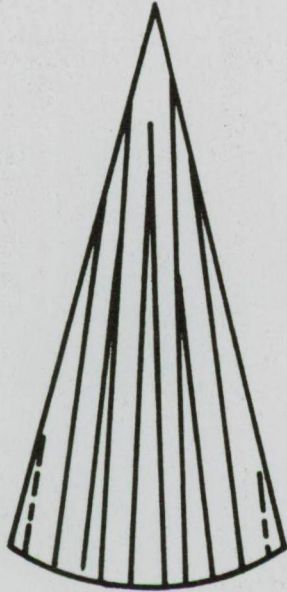


6,5 mm

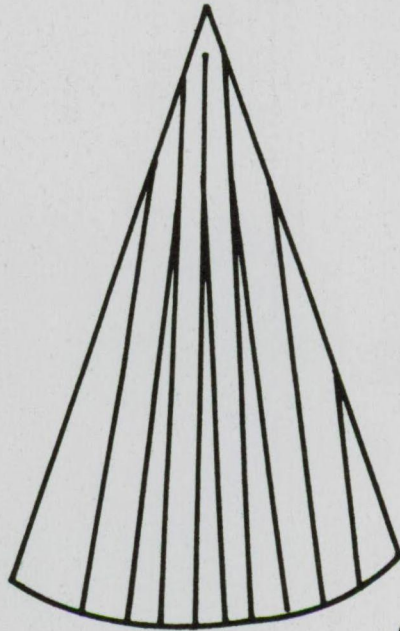
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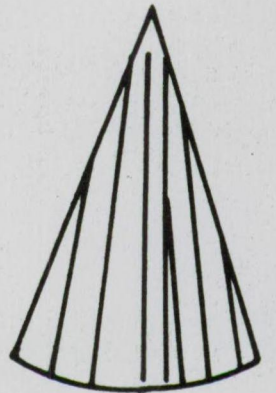
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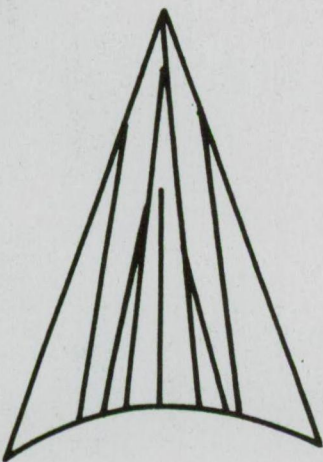
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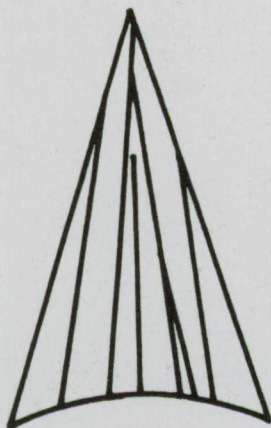
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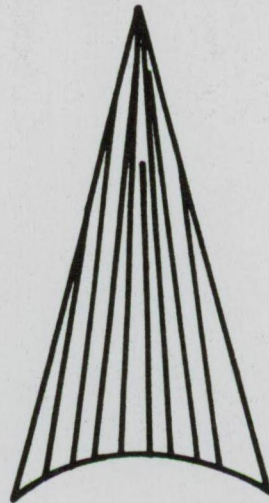
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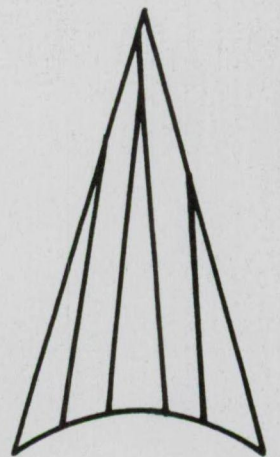
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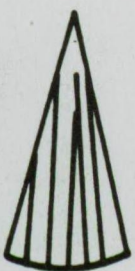
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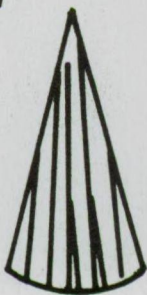
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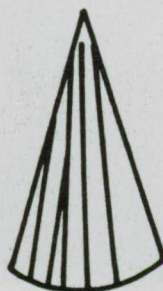
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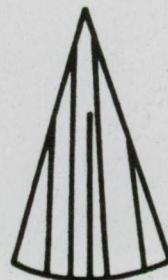
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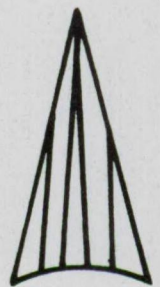
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