

# *Tetragonorhynchus*, new late Famennian rhynchonellid genus from Maïder, southern Morocco, and *Tetragonorhynchidae* n. fam.

by Paul SARTENAER

## Abstract

*Tetragonorhynchus* n. gen., type species *T. mrakibensis* n. sp., is described from the late Famennian of Maïder, southern Morocco. The new genus is type of *Tetragonorhynchidae* n. fam.

**Key-words:** *Tetragonorhynchus*, *Tetragonorhynchidae*, rhynchonellid, brachiopod, Famennian, Morocco.

## Résumé

L'auteur décrit *Tetragonorhynchus* n. gen., avec *T. mrakibensis* n. sp. du Famennien supérieur du Maïder, Maroc méridional, comme espèce-type. Le nouveau genre est le genre-type de *Tetragonorhynchidae* n. fam.

**Mots-clefs:** *Tetragonorhynchus*, *Tetragonorhynchidae*, Rhynchonellide, Brachiopode, Famennien, Maroc.

Although a minor element in Devonian deep water facies, rhynchonellids usually occur together with goniatites. The southern Morocco desert, where vegetation is scarce and where outcrops extend for many kilometres, is an ideal place to build up with time decent-sized collections making a study possible and worth while. *Tetragonorhynchus* n. gen. is the first of new stratigraphically restricted genera the author intends to describe in the deep water facies of the Famennian from Tafilelt and Maïder. This genus shows a combination of characters leading to the establishment of a new family.

## Superfamily Rhynchonellacea GRAY, 1848 *Tetragonorhynchidae* n. fam.

### TYPE GENUS

*Tetragonorhynchus* n. gen.

### DIAGNOSIS

Medium-sized, flat, sub-quadrangular to sub-elliptical outline. Ventral sulcus, dorsal fold. Costae few, low, clearly marked, starting at some distance from the beak, occasionally divided. Neither dental plates nor septum; divided hinge plate; bilobate cardinal process.

### COMPOSITION

*Tetragonorhynchus* n. gen. as sole genus so far. The genus *Novaplatirostrum* SARTENAER, 1997 might also belong to the new family, but its cardinal process is different from that of *Tetragonorhynchus* n. gen.

### REMARK

The flatness of the shell combined with the absence of dental plates and septum, and the presence of a cardinal process, allows to separate the new family from all known families.

### *Tetragonorhynchus* n. gen.

#### DERIVATIO NOMINIS

Τετράγωνος, ος, ον (Greek) = quadrangular; τò βύχος (Greek, neuter) = beak. The name draws attention to the characteristic sub-quadrangular contour of the shell.

#### TYPE SPECIES

*Tetragonorhynchus mrakibensis* n. gen., n. sp.

#### DIAGNOSTIC FEATURES

Medium-sized, uniplicate, flatly biconvex, sub-quadrangular to sub-elliptical outline. Wide apical angle. Sulcus, fold, and median costae beginning at some distance from beaks; sulcus shallow, wide. Fold low and commonly marked by a very low median depression. Top of tongue always located lower than top of shell. Few low, well marked, simple and wide median and lateral costae. Shell thick in apical region. Crura of radulifer type; neither dental plates nor septum. Bilobate cardinal process.

#### SPECIES ATTRIBUTED TO THE GENUS

In addition to the type species, the late Famennian species, *Planovatirostrum planoovale* from western Kazakhstan, and *P. richteri* from Moravia, could belong to the new genus.

The present author designated *Liorhynchus plano-ovalis* NALIVKIN, 1937 from northeastern Kazakhstan as the type species of *Planovatirostrum* SARTENAER, 1970

(pp. 16-18), and, based on the Russian literature, he accepted its presence in other parts of Kazakhstan, including the Mugodzhary Mountains. A rich collection made in northern Xinjiang allowed SARTENAER & XU (1989) to redescribe *P. planovalve* and to show for the first time its internal characters. Consequently, they questioned (p. 38) the inclusion in the genus *Planovatiostrum* of various forms attributed to *P. planovalve* in southeastern (Balkhash Lake area), central (southwestern part of the Karaganda Basin), and western (Mugodzhary Mountains) Kazakhstan. The characterization of *Tetragonorhynchus* n. gen. makes it highly probable that some, if not all, the specimens erroneously identified as *Pseudonudirostra planovalvis* (Nal.) by ROZMAN in 1960 (p. 43, p. 47, p. 48, p. 50, fig. 2), and then mistakenly described and figured by her in 1962 as *Pseudoleiorhynchus planovalvis* (Nalivkin, 1937) (p. 47, p. 48, p. 49, p. 70, p. 71, p. 80, p. 82, p. 84, pp. 127-129, pl. XVII, figs. 1a,b,g, 2a,b,g, 3a,b,v,g, 4a,b,g, 5a,b,g, 6a,b,v,g, 7a,g, 8a,b,v,g, 9a,b,v,g, tables 6, 8, 9, 10, 11) belong to it. Any residual reservations in such reassessment are due to the lack of sufficient and clear information on the internal characters of these forms from Kazakhstan; the serial transverse sections given by ROZMAN (1962, figs. 33,34, p. 128) are unsatisfactory, and without handling the material itself the present author cannot investigate the matter further.

The Moravian species *Terebratula Richteri* OPPENHEIMER, 1916, assigned to the genus *Planovatiostrum* by HAVLÍČEK (1979, pp. 96-97, pl. II, figs. 1-5), probably also belongs to the new genus. The species is still poorly known on account of the sparsity of the original material collected at the beginning of the century, the lack of precise stratigraphical information, and the unsatisfactory knowledge of the internal characters. These shortcomings were outlined by SARTENAER & XU (1989, pp. 38-39, p. 43, p. 44), and by SARTENAER (1997, p. 25, p. 26, p. 27, pp. 33-34, table 1).

#### DESCRIPTION

Uniplicate, flat, medium-sized, both valves shallow. Subquadrangular to sub-elliptical in ventral and dorsal views, i.e. rounded cardinal angles and lateral commissures in the form of parentheses. Transverse profile shallowly biconvex. Sulcus and fold beginning at some distance from the beaks. Commissure sharp, and projecting clearly postero-laterally where valve margins are concave. Commissure slightly but clearly indented by median and lateral costae. External median costae on fold slightly higher than median ones when frontal commissure has shallow median depression. Cardinal line long.

Flanks of pedicle valve flat to very slightly convex, sloping gently from an umbonal region almost without relief. Shallow sulcus starting imperceptibly, and thus becoming only clearly separated from flanks in anterior half of valve. Sulcus starting wide, and wide at front. Bottom of sulcus flat to slightly convex. Shallow trapezoidal and well defined tongue; its top always lower,

often considerably lower, than the top of the shell. Upper part of tongue elongated anteriorly. Beak wide, flat, erect to slightly incurved, not or only slightly overhanging the cardinal line. Interarea low, long and clearly separated from flanks. Beak resorbed by a circular foramen. Deltoidal plates have not been observed in serial transverse sections.

Brachial valve slightly and uniformly convex. Fold low, but nevertheless well marked and clearly separated from flanks in the anterior half of the valve. Fold commonly marked on almost its whole length by a very shallow depression affecting the part between the external costae.

Costae moderate in number, clearly marked, relatively regular, low, wide, and angular with rounded top. Median costae begin on a level with the beginning of the sulcus and fold. In only one specimen has a division been observed near the commissure in each of the external median costae. No parietal costae present. When there are more than 2/3 lateral costae, the internal costa on each flank starts around mid-length, while the others decrease in length laterally. When there are 1/2 lateral costae, they are usually mere undulations of the commissure.

Both valves are low, the brachial valve being somewhat deeper than the pedicle valve. Maximum depth of pedicle and brachial valves, and thus maximum thickness of shell, located at mid-length or in the posterior half of the shell. From the top of the brachial valve the valve slopes gently toward the frontal commissure. Maximum width of shell occurs at a point located somewhat anterior to mid-length. Wide apical angle and angle of the cardinal commissure.

Shell thick in the apical region. Neither dental plates nor umbonal cavities. Teeth short and strong. Contour of delthyrial cavity very irregular in serial transverse sections. Short divided hinge plate composed of two slender aliform parts passing progressively and rapidly to the crura with no crural bases to speak of. No septum. Dental sockets narrow; inner socket ridges high and strong. Very short bilobate cardinal process [1.45 mm in the two specimens (paratypes G and H) in which serial transverse sections were made (Figs. 1-3)]; crenulation was observed on paratype H (Fig. 3). Crura short, ventrally curved at their distal end; in serial transverse sections they are boomerang-shaped proximally, duckhead-shaped medially, and stick-shaped distally.

#### COMPARISONS

*Tetragonorhynchus* n. gen. and the latest Famennian (UD



Figures 1,2 - *Tetragonorhynchus mrakibensis* n. gen., n. sp. Camera lucida drawings of serial transverse sections; figures are distances in mm forward of the ventral umbo. Paratype G, IRSNB a10690. Measurements: length = 19.7 mm; width = 25.6 mm; thickness = 9.5 mm.

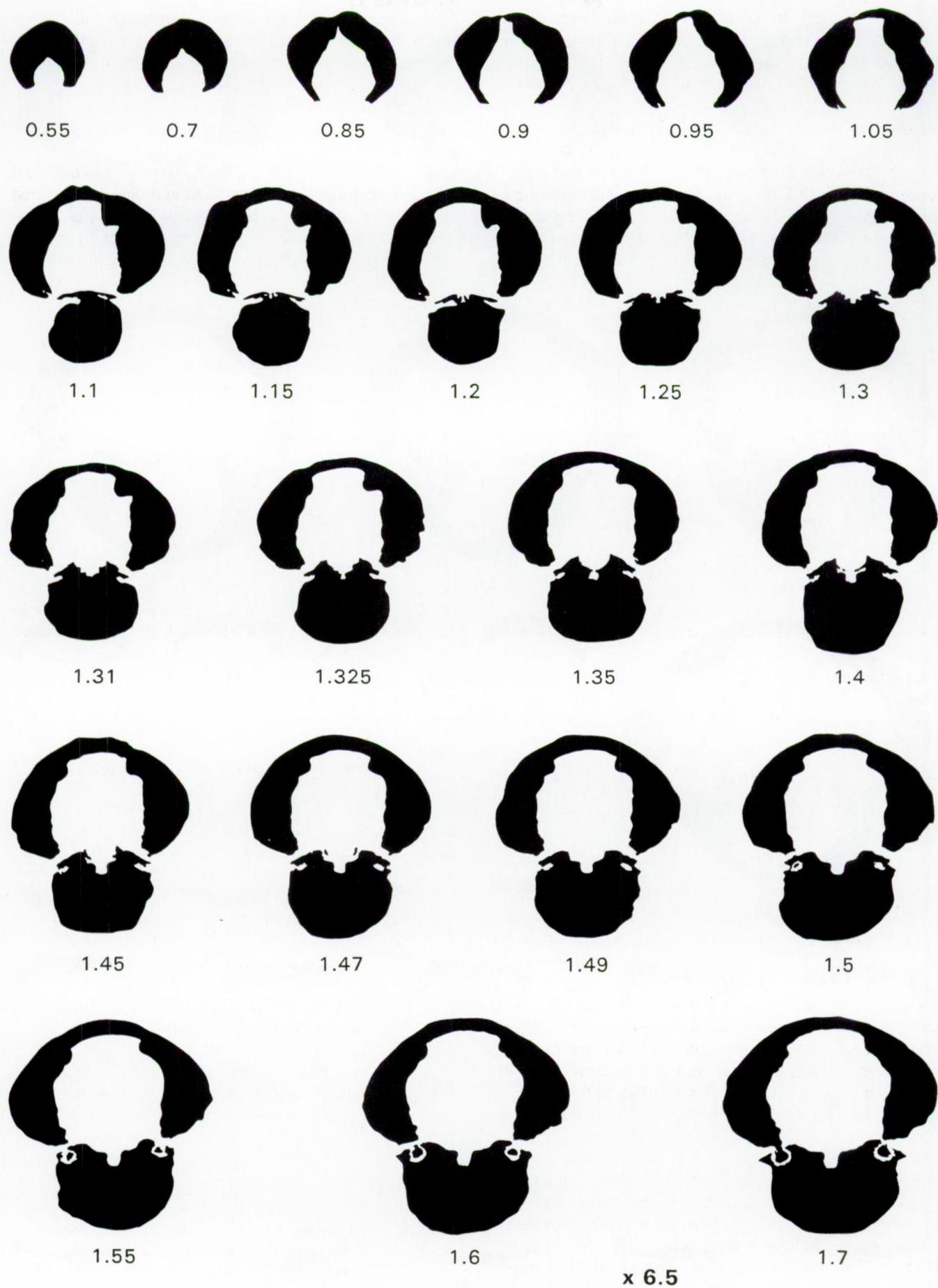


Figure 1

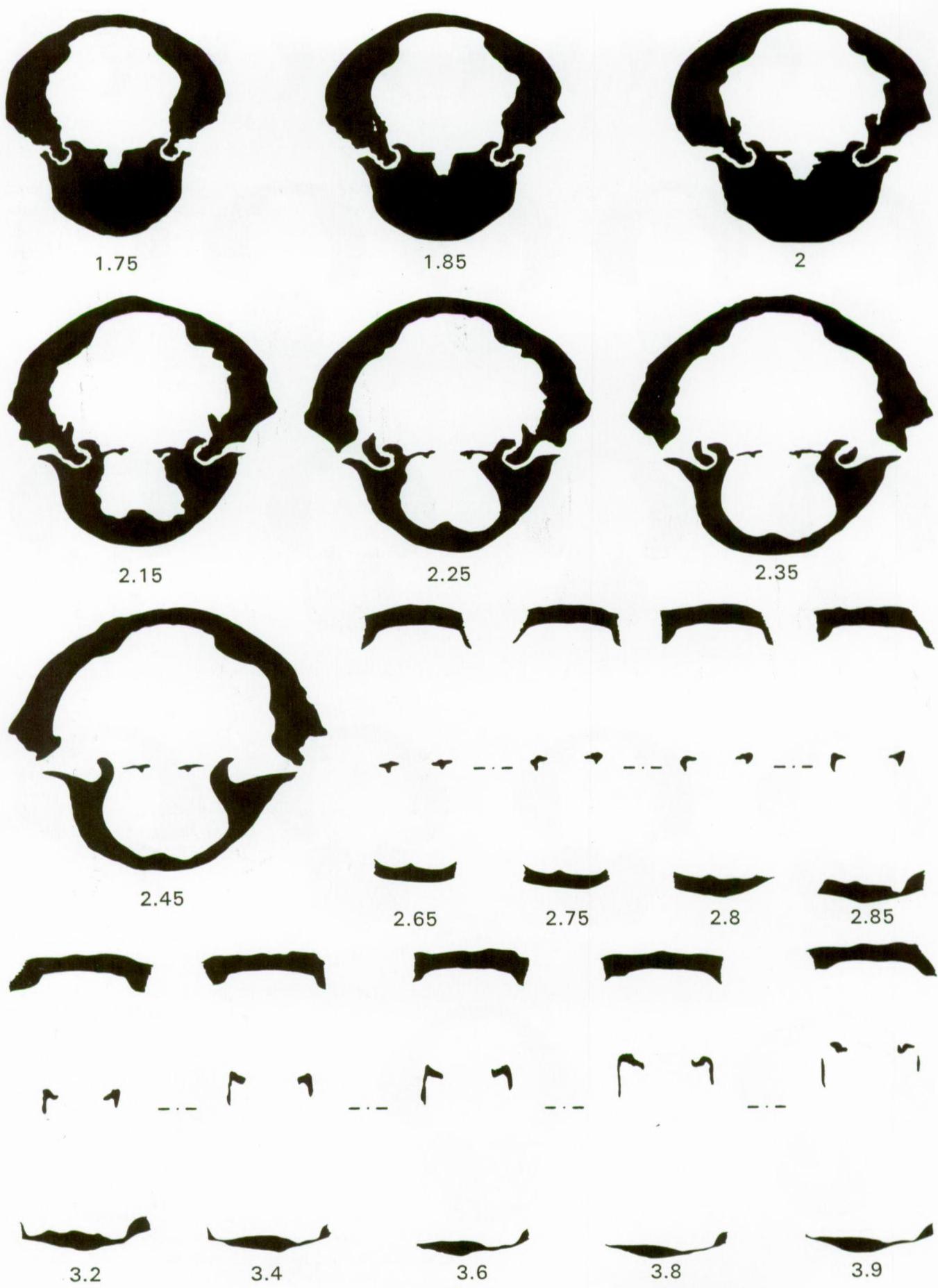
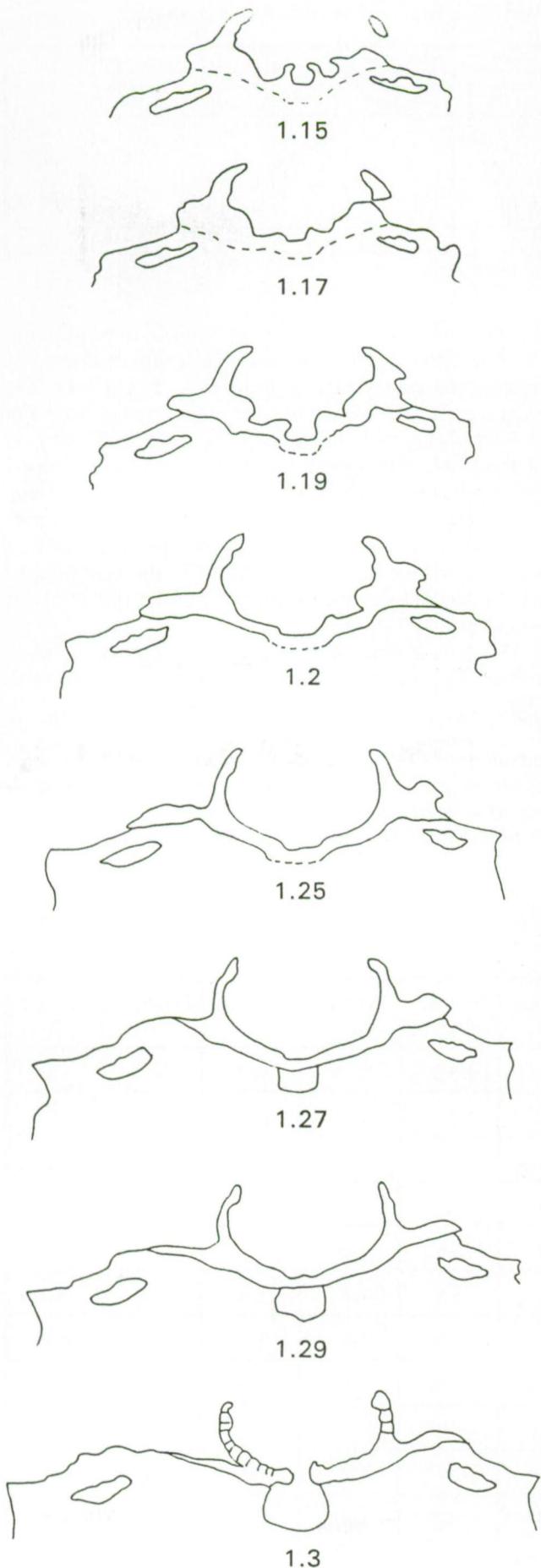


Figure 2



VI A-D) genus *Novaplatirostrum* have many characters in common, e.g.: low slightly and uniformly convex valves; trapezoidal tongue with top always lower than top of shell; moderate number of clearly marked, relatively regular, simple, wide, and low costae; presence of costellae; wide apical angle; absence of dental plates and septum; crura (shape, length); presence of a cardinal process.

*Tetragonorhynchus* n. gen. can easily be separated from *Novaplatirostrum* by: its sub-quadrangular to sub-elliptical outline (in *Novaplatirostrum* the outline is more variable and sometimes distorted); its sulcus, fold, and costae beginning more posteriorly; a median depression more commonly present on the fold; somewhat higher fold, tongue, and costae; a somewhat deeper sulcus; the almost constant presence of lateral costae; a slender hinge plate; a more elaborate cardinal process; the transition between the outer hinge plates and the crura with no crural bases to speak of.

#### *Tetragonorhynchus mrakibensis* n. gen., n. sp.

Plate 1, Figures 1-35, Text-figures 1-3

##### DERIVATIO NOMINIS

Jebel el Mrakib is a ridge 27 km southeast of the village of Fezzou in Maïder, southern Morocco (see BECKER, 1995, fig. 1, p. 609). The most precise stratigraphical age for the species - Famennian UD V-B - is given by the goniatites collected at this locality by R. T. Becker, and V. Ebbighausen.

TYPES (all from Maïder, southern Morocco. Upper Ibaouâne Formation)

Holotype, IRSNB a10687 (Pl. 1, Figs. 6-10), paratype A, IRSNB a10688 (Pl. 1, Figs. 1-5). 2 km southwest of Tizi Ibaouâne at the Aguelmous (Msissi 1/100,000 sheet). Upper part of Famennian UD V. MA-84-7C,D. Collector: P.Sartenaer, 1984.

Paratypes B, MB.B.1121 (Pl. 1, Figs. 11-15), I, MB.B.1126. Rich Bou Kourazia (Fezzou 1/100,000 sheet). Famennian UD V (talus). Locality 154. Collector: R.T.Becker, 1996.

Paratype C, IRSNB a10689 (Pl. 1, Figs. 16-20). Jebel el Mrakib, N 30°46,367', W 04°42,618' (Fezzou 1/100,000 sheet). Level of Famennian UD V. Locality 102b. Collector: V. Ebbighausen, 1996.

Paratypes D, MB.B.1122 (Pl. 1, Figs. 21-25), E, MB.B.1123 (Pl. 1, Figs. 31-35), F, MB.B.1124 (Pl. 1, Figs. 26-30), J, MB.B.1127. Rich el Mbidia at the Aguelmous, N 31°02,145'.

Figure 3 – *Tetragonorhynchus mrakibensis* n. gen., n. sp. Bilobate cardinal process (x26). Camera lucida drawings of serial transverse sections; figures are distances in mm forward of the ventral umbo. Paratype H, MB.B.1125. Crenulation of lobes is clearly seen in the last section. All sections show the dental sockets. The median opening in the last three sections is not part of the structure of the brachial valve; it corresponds to the recess of secondary calcite, recess that can also be observed in sections 13 to 25 in Text-Figs. 1,2.

W 04°43,500' (Fezzou 1/100,000 sheet). Level of Famennian UD V. Locality 123. Collector: R.T. Becker, 1995.

Paratype G, IRSNB a10690 (Text-figs. 1,2). Jebel el Mrakib, N 30°45,410', W 04°42,757' (Fezzou 1/100,000 sheet). Talus above bed R2 of unpublished section (BECKER *et al.*, in prep.), i.e. above Famennian UD V-A. Locality 102a. Collector: V. Ebbighausen, 1996.

Paratypes H, MB.B.1125 (Text-fig. 3), K, MB.B.1128. Jebel el Mrakib, N 30°45,410', W 04°42,757' (Fezzou 1/100,000 sheet). Upper and uppermost parts of bed T, and lower part of bed U of unpublished section (BECKER *et al.*, in prep.), level of Famennian UD V-B. Locality 102a. Collector: R. T. Becker, 1997.

MB.B. = Paläontologisches Museum des Museums für Naturkunde (MFN), Humboldt Universität zu Berlin.

#### LOCUS TYPICUS

2 km southwest of Tizi Ibaouâne at the Aguelmous (Msissi 1/100,000 sheet), Maïder, southern Morocco.

#### STRATUM TYPICUM

Upper part of Famennian UD V in the Upper Ibaouâne Formation.

#### MATERIAL

22 of the 42 specimens examined are in good state of preservation, seven satisfactory, and six poor; seven specimens are fragmental.

#### DESCRIPTION

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

Sulcus beginning at 31 to 60 per cent of the shell

Table 1 – Number of median and lateral costae.

Number of costae	Median costae			Lateral costae		
	Number of specimens	%	Number of costae	Number of specimens	%	
3/2	3	8.5	0	3	10	
4/3	14	40	1/2	9	30	
5/4	15	43	2/3	13	43.5	
6/5	3	8.5	3/4	2	6.5	
			4/5	2	6.5	
			5/6	1	3.5	
	35	100		30	100	

length, most of the values varying from 48 to 60 per cent, or 35 to 58 per cent of the unrolled length of the valve, most of the values varying from 48 to 58 per cent. The sulcus starts with a width of 31 to 66 per cent of the width at front, and reaches its greatest width (58 to 72 per cent of the shell width, most of the values varying from 64 to 72 per cent) at the junction of the frontal and lateral commissures. Top of tongue 10 to 37 per cent lower than point of maximum shell thickness. Length of ventral interarea varying from 55 to 75 per cent of shell width. Median depression on the fold in two-thirds of specimens.

The general costal formula, which is a grouping of at least 75 per cent of the specimens in median, parietal, and lateral categories, is  $\frac{4-5}{3-4}$ ; 0;  $\frac{0-2}{0-3}$ . The ratios of median and lateral costae (in specimens in which such observations were possible) are given in Table 1. Costellae have been observed on two specimens.

Measurements of ten specimens, of which seven have

Table 2 – Measurements (in mm) based on 10 specimens; figures in parentheses are reasonable estimates on damaged specimens. Abbreviations used: l = length; w = width; t = thickness; pv = pedicle valve; bv = brachial valve.

in mm	Paratype I	Paratype K	Paratype B	Paratype A	Holotype	Paratype C	Paratype D	Paratype J	Paratype F	Paratype E
l	21.1	20	19.7	19.6	19.5	18.5	17.9	16.7	16.4	15.4
w	28.9	25.7	25.4	27.2	25.9	25	22.2	22.5	20	20.3
lpv unrolled	25	24	23	22.5	23	21.5	21.5	21	21	18.5
t	(9.8)	9.5	9.6	9.9	9.9	9.1	9.5	8.8	8.4	7.9
tpv	2.9	4.1	4.3	3.5	4.2	3.6	4.6	3.4	3	3.2
tbv	(6.9)	5.4	5.3	6.4	5.7	5.5	4.9	5.4	5.4	4.7
l/w	0.73	0.78	0.78	0.72	0.75	0.74	0.81	0.74	0.82	0.76
t/w	(0.34)	0.37	0.38	0.36	0.38	0.36	0.43	0.39	0.42	0.39
t/l	(0.46)	0.48	0.49	0.51	0.51	0.49	0.53	0.53	0.51	0.51
apical angle	141°	132°	(135°)	138°	138°	(137°)	134°	138°	136°	139°
angle of the commissure	147°	136°	(138°)	142°	142°	(142°)	138°	145°	139°	146°

been photographed, are given on Table 2. Columns 9 and 10 refer to the smallest specimen at disposal.

Top of pedicle valve located posteriorly at a variable point between 13 and 28 per cent of the shell length, and top of brachial valve at a point varying between 16 and 53 per cent of the shell length anterior to the ventral beak. Maximum width occurs at a point between 53 and 64 per cent of the shell length anterior to ventral beak. Apical angle varying from  $132^\circ$  to  $141^\circ$  (most values between  $134^\circ$  and  $138^\circ$ ). Angle of the cardinal commissure varying from  $136^\circ$  to  $147^\circ$ .

Serial transverse sections of two specimens (paratypes G, IRSNB a10690 and H, MB.B.1125) are shown in Text-figures 1-3.

#### GEOGRAPHICAL LOCATION AND STRATIGRAPHICAL POSITION

All specimens have been collected in the Upper Ibaouâne Formation within a restricted area in Maïder, southern Morocco (see BECKER, 1995, fig. 1, p. 609). Localities are, from north to south: Tizi Ibaouâne at the Aguelmous (Msissi 1/100,000 sheet): 4 sp., MA-84-7d,f, Famennian UD V (lower and upper part), collected by P.Sartenaer, 1984; 2 km southwest of Tizi Ibaouâne at the Aguelmous (Msissi 1/100,000 sheet): 14 sp., MA-84-7C,D, upper part of Famennian UD V, collected by P.Sartenaer, 1984; Rich el Mbidia at the Aguelmous (Fezzou 1/100,000 sheet): locality 123, N  $31^\circ 02,145'$ , W  $04^\circ 43,500'$ , Famennian UD V, collected by R.T.Becker (7 sp.), 1995, 1996, and by V. Ebbighausen (3 sp., talus), 1996; Rich Bou Kourazia (Fezzou 1/100,000 sheet): 4 sp., locality 154, Famennian UD V (talus), collected by R.T.Becker, 1996; Jebel el Mrakib (Fezzou 1/100,000 sheet): 7 sp., localities 102a (3 sp., talus) = N  $30^\circ 45,410'$ , W  $04^\circ 42,757'$ , above bed R2 of unpublished section (BECKER *et al.*, in prep.), i.e. above Famennian UD V-A, and 102b (4 sp.) = N  $30^\circ 46,367'$ , W  $04^\circ 42,618'$ , Famennian UD V, collected by V. Ebbighausen between 1990 and 1996, and 3 sp. (102a), upper and uppermost parts of bed T, and lower part of bed U of unpublished section (BECKER *et al.*, in prep.), Famennian UD V-B, collected by R.T. Becker, 1997.

In summary, the age of *Tetragonorhynchus mrakibensis* n. gen., n. sp. is Famennian UD V. In two outcrops [Tizi Ibaouâne and

Jebel el Mrakib (102b)] the species is associated with *Hadyrhyncha meridionalis* SARTENAER, 1998.

#### Stratigraphical range and geographical distribution of the genus *Tetragonorhynchus* n. gen.

Information on the Moroccan species, *T. mrakibensis* n. gen., n. sp., is given above.

Subject to what has been written above on their assignment to the new genus, the stratigraphical range and the locality of the Kazakh form and the Moravian species are as follows.

The form described as *Pseudonudirostra plano-ovalis*, and later revised as *Pseudoleiorhynchus planovalis*, was collected by ROZMAN (1960, 1962) in western Kazakhstan in the Kurgandzhar beds [upper part (*Laevigites* Zone, UD V) of the Upper Famennian] from the Berchogur Depression in the southern Mugodzhary Mountains.

The lectotype of *Terebratula Richteri* comes from the Hady Limestone (Famennian UD V or UD VI) at Hady Hill near Brno in Moravia, where it is associated with *Hadyrhyncha hadiensis* HAVLÍČEK, 1979. Representatives of the two genera - *Tetragonorhynchus mrakibensis* n. gen., n. sp. and *Hadyrhyncha meridionalis* SARTENAER, 1998 - occur together in the late Famennian (UD V) of southern Morocco. This indirectly suggests that the Moravian species could also be of late Famennian (UD V) age.

#### Acknowledgments

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#### Explanation of Plate 1

All figures are natural size

*Tetragonorhynchus mrakibensis* n. gen., n. sp.

- Figs. 1-5 – Paratype A, IRSNB a10688. Ventral, dorsal, frontal, apical, and lateral views. Costal formula: 6/5; 0; 1/2.  
Figs. 6-10 – Holotype, IRSNB a10687. Ventral, dorsal, frontal, apical, and lateral views. Costal formula: 5/4; 0; 2/3.  
Figs. 11-15 – Paratype B, MB.B.1121. Ventral, dorsal, frontal, apical, and lateral views. Costal formula: 6/5; 0; 4/5 and 5/6.  
Figs. 16-20 – Paratype C, IRSNB a10689. Ventral, dorsal, frontal, apical, and lateral views. Costal formula: 4/3; 0; 3/4 and 2/3.  
Figs. 21-25 – Paratype D, MB.B.1122. Ventral, dorsal, frontal, apical, and lateral views. Costal formula: 4/3; 0; 2/3 and 1/2.  
Figs. 26-30 – Paratype F, MB.B.1124. Ventral, dorsal, frontal, apical, and lateral views. Costal formula: 4/3; 0; 1/2 and 2/3.  
Figs. 31-35 – Paratype E, MB.B.1123. Ventral, dorsal, frontal, apical, and lateral views. Costal formula: 4/3; 0; 0.

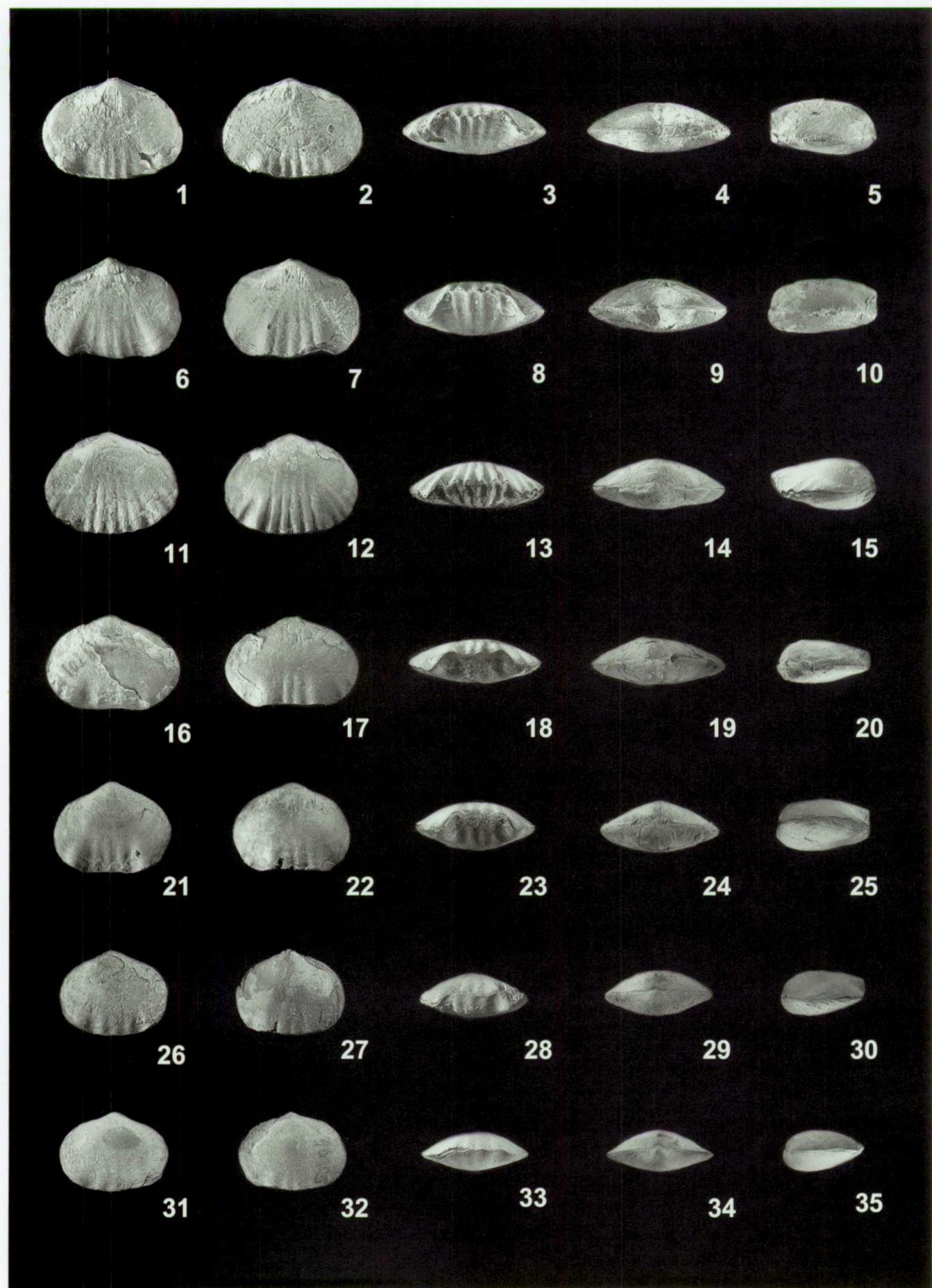


PLATE 1

