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The Upper Famennian Rhynchonellid genus *Planovatirostrum* SARTENAER, 1970 from Africa, China, Europe and the USSR

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Abstract

The type species of the genus *Planovatirostrum, P. planoovale* (NALIVKIN, 1937), and thus, the genus, is redefined on the base of a new and rich collection made in northern Xinjiang, at about 175 km from its type locality in northeastern Kazakhstan. A world-wide Upper Famennian *Planovatirostrum* Zone is proposed. It is based on species of the genus found in China, Czechoslovakia, Germany, Morocco, Poland, and the USSR.
Key-words : *Planovatirostrum* - Rhynchonellid - Famennian - China - World.

Résumé

L'espèce-type du genre *Planovatirostrum, P. planoovale* (NALIVKIN, 1937). et donc le genre, sont redéfinis grâce à une nouvelle et abondante collection faite dans le Xinjiang septentrional, à environ 175 km de la localité-type dans le nord-est du Kazakhstan. Une Zone à *Planovatirostrum* d'âge famennien supérieur est proposée à l'échelle mondiale. Elle est fondée sur des espèces du genre trouvées en Allemagne, en Chine, au Maroc, en Pologne, en Tchécoslovaquie et en URSS.
Mots-clefs : *Planovatirostrum* - Rhynchonellide - Famennien - Chine - Monde.

摘　要

根据中国、捷克、德国、摩洛哥、波兰和苏联发现的资料，本文提出一个上法门阶 世界分布的 *Planovatirostrum* 带。同时根据在距离典型产地哈萨克斯坦约175 km之新疆北部采集到的大量新资料，对该属的模式种 *P. planoovale* (NALIVKIN, 1937) 进行了重新修订。
关键词：*Planovatirostrum* 一小嘴贝一法门阶一中国一世界

I. - Introduction

In 1985, the Xinjiang Stratigraphical Investigation Team of the Nanjing Institute of Geology and Palaeontology of the Academia Sinica collected abundant Devonian fossils in the Junggar Basin. The Basin is situated in the northern part of the Xinjiang Autonomous Region of the northwestern part of the People's Republic of China. Representatives of the genus *Planovatirostrum* SARTENAER, 1970 were found in the Hoboksar area (Figure 1) of the western Junggar Basin, and are critically important for dating because of little information from other fossils. The additional taxonomic and biostratigraphic data allow us to reassess and consolidate knowledge of the genus almost twenty years after its proposal.

The type species, *P. planoovale* (NALIVKIN, 1937), is based on a single specimen collected by G.Z. MEDOEV in 1929. Because its internal characters have, of course, not been examined, recognition of the species has been difficult outside its type locality and usually incorrect. *P. planoovale* herein is described from Hoboksar, only 175 km from the type locality of *P. planoovale,* Mount Alchagyr in the Ulenty District of northeastern Kazakhstan. Paradoxically, knowledge of the middle Asiatic species, first discovered in the USSR, will be consolidated with the help of abundant Chinese material which allows vital transverse serial sections to be made for investigating the internal characters.

II. - Restatement of the genus *Planovatirostrum* SARTENAER, 1970

1. - *Species and forms assigned to the genus when first established*

a. - WHAT WE KNEW IN 1970

When the genus was introduced with a late, and possibly middle, Famennian age, the following species were assigned : ① *Liorhynchus plano-ovalis* NALIVKIN, 1937, the type species, from the upper part of the *sulcifer* beds of Kazakhstan — the single original specimen was assigned to the *sulcifer* beds without any further precision —, these beds corresponding to the lower part of the Upper Famennian, and from the Kurgandzhar beds, i.e. the upper part of the Upper Famennian, of the Mugodzhary Mountains; ② specimens called *Pseudoleiorhynchus undulatus* (TERMIER & TERMIER, 1950) by DROT (1964, pl. 23, figs. 8a-c, 9a-c) from the ammonoid zone doIV of the Dra Plains and the Ma'der of pre-Sahara Morocco; ③ and, with reservations, some Russian forms mistakenly called *Liorhyn-*

chus ursus NALIVKIN, 1947, species from the *Prolobites* and *Leiorhynchus ursus* Zone, corresponding to the middle Famennian or to the lower part of the Upper Famennian in the Mugodzhary Mountains, the Soviet Arctic region, and the Ural Mountains.

b. - WHAT WE KNOW IN 1989

Planovatirostrum planoovale appeared to be widely distributed in central and eastern Kazakhstan and in the southern Mugodzhary Mountains. However, now we must question the inclusion in the species and sometimes in the genus of various forms described and figures under this name in the *sulcifer* beds of the southwestern part of the Karaganda Basin in central Kazakhstan by SIMORIN (1956, as *Leiorhynchus planoovalis*) in the *sulcifer* beds of the northern part of the region around the Balkhash Lake in central Kazakhstan and in the Kurgandzhar beds of the southern Mugodzhary Mountains in western Kazakhstan by ROZMAN (1962, as *Pseudoleiorhynchus planoovalis*), and in the Munar beds (= upper part of the *sulcifer* horizon) of central Kazakhstan by MARTYNOVA (*in* LITVINOVICH *et al.*, 1975, as *Trifidorostellum planoovalis*). SIMORIN (1956, p. 249), and ROZMAN (1962, p. 129) both had commented that the costation in the specimens of their collections was generally different from that of the holotype, and WEYER (1972, p. 94) referred to "*Pseudoleiorhynchus planoovalis* (NALIVKIN, 1937) (sensu ROZMAN, 1962)". DROT (1964, p. 172) also indicated some major differences between Moroccan representatives of the genus (*Pseudoleiorhynchus undulatus*) and the forms described as *P. planoovalis* by ROZMAN (1962). Finally, the founder of the species, NALIVKIN, did not recognize it in the Mugodzhary Mountains collections, where he identified *Liorhynchus numismalis* according to ROZMAN (1960, p. 48; 1962, p. 49).

We draw the following conclusions : *Planovatirostrum planoovale* is probably present in central and western Kazakhstan, but another species of the genus probably also is present; specimens identified as *P. planoovale* in that area may represent more than one genus; a new description of *P. planoovale* is needed. The literature suggests that *P. planoovale* is found in the upper part of the *sulcifer* beds, i.e. in the upper part (IV) of the *Platyclymenia*-Stufe and the major part of the *Clymenia*-Stufe (V) of the ammonoid succession or in the upper part of the *Palmatolepis trachytera* Zone, the *P. postera* Zone, and the Lower *P. expansa* Zone in the conodont succession.

Outside Kazakhstan the species has also been mentioned in upper Famennian strata encountered in two borings of the eastern part of the Russian Platform (*in* LIACHENKO *et al.*, 1970, p. 181).

Further west, there are incorrect identifications of *Planovatirostrum planoovale* In Poland and in the Democratic Republic of Germany; on account of the poor definition of the species, these errors are easy to understand. The specimens from the Wola Quarry in the Holy Cross Mountains have been figured by BIERNAT & RACKI (1986, pl. 40. figs. 1a,b,d, 2a,b,d, 3a-d), and by BIERNAT (1988, Fig. 2, p. 330, pl. 1 = p. 331, figs. 1a,b = pl. 40, figs. 3a,d *in* BIERNAT & RACKI, 1986) in beds of Famennian (?doIII to do IV or *Palmatolepis trachytera* Zone) age. *Planovatirostrum* cf. *planoovale* mentioned and figured by WEYER (1979, p. 99, p. 103, pl. 4, fig. 13) from Bohlen (Mauxion railway station), on the southern border of the city of Saalfeld in Thuringia is the form described and figured by RICHTER (1848, p. 30, pl. V, figs. 153-159) as *Terebratula* sp. It was assigned to *Planovatirostrum richteri* (OPPENHEIMER, 1916) by WEYER (1986), who figured (pl. I, right column, fig. 4) a second specimen from the Gossitz-Felsen-Süd near Fischersdorf south of Saalfeld. We do not agree with the assignment of these specimens from the lower part (the level with *Kalloclymenia subarmata*) of the *Wocklumeria*-Stufe (VI) to *Planovatirostrum richteri*.

Besides the two specimens of *Pseudoleiorhynchus undulatus* from north of Kheneg-Aftès, Morocco, and from the right bank of the oued Akka figured by DROT (1964, pl. 23, figs. 8a-c, 9a-c), that were included in *Planovatirostrum* by SARTENAER (1970), other specimens of the species have been mentioned by DROT (1964, p. 169) not only at other localities in the Dra Plains, but also from the Ma'der (Arho-n-Kou, and north of Arho-n-Kou). DROT (1964, p. 169) gave a "Famennien (zones IV essentiellement et V)" age to these specimens, but the "Famennien (zone V)" age is due to her specimen from Fezzou in the Ma'der, which does not belong to the genus, as indicated by SARTENAER (1967, p. 2; 1970, p. 17). Extensive sampling by SARTENAER in 1984 in the Ma'der allows assignment doIV to doV age to this species, which will be described as a new species, in a forthcoming paper, jointly written by SARTENAER & DROT, and which includes all the specimens, with the exception of the lectotype, previously mentioned under the name *Pseudoleiorhynchus undulatus*. It will be stressed in that paper that the specimens from the doIV are shorter than the specimens from the doV.

BIERNAT & RACKI (1986, p. 101, pl. 40, figs. 5a-d) described and figured one specimen of ?*Planovatirostrum* cf. *undulatum* collected in the Wola Quarry in the Holy Cross Mountains in a bed of Famennian (?doIII to doIV) age. This specimen was mentioned and figured again among the rhynchonellids of the *Palmatolepis trachytera* Zone as *?P.* cf. *undulatum* or *P.* sp. by BIERNAT (1988, p. 328, Fig. 2, p. 330, pl. 1 = p. 331, figs. 5a-d).

As far as *Liorhynchus ursus* is concerned, we can only repeat what one of us (P.S.) wrote in 1970 (p. 17) : "some forms called *Liorhynchus ursus* NALIVKIN, D.V., 1947 could belong to the genus *Planovatirostrum*". This does not mean that the species itself can be assigned to the genus *Planovatirostrum* as was done by BEIRNAT (1988, p. 329 as *P. ursus*, Fig. 2, p. 330 as *?P. ursus*).

2. - *Species and forms assigned to the genus after 1970*

Terebratula subcurvata von MÜNSTER, 1840 from Elbersreuth in Upper Franconia has nothing to do with the genus *Planovatirostum*. OPPENHEIMER (1916, p. 6, pp. 35-36, pl. I, figs. 13a,b) gave the name *Terebratula Richteri* to a species from Moravia, in the synonymy of which he placed *T. subcurvata* described under this name by RICHTER (1856,

p. 29, pl. I, figs. 37-39). Consequently, since SCHMIDT (1924, p. 145, p. 161, p. 162), forms with the name *Leiorhynchus subcurvatus* (RICHTER, 1856 *non* MÜNSTER, 1840) or similar designations have been reported in the Subzones and Zones toVα to toVβ, to VI of the Sauerland and the Kellerwald. von GAERTNER (1931, p. 150) following SCHMIDT (1924, p. 145), placed *Rhynchonella acuminata* var. *platyloba* SOW, described by GORTANI (1907, pp. 206-207, pl. I (VI), figs. 6a-d) from the Carnic Alps in the synonymy of *Liorhynchus subcurvata* RICHTER (non MSTR.), and indicated the presence of *Leiorhynchus subcurvata* RICHT. in the Subzone to Vα ("kann es sich schon um Vα handeln. Sicher is dies keineswegs") of the central Carnic Alps. The Moravian species, from the Upper Famennian (zone V for one of the two outcrops mentioned, zone V or VI for the other), was assigned by HAVLÍČEK (1979, pp. 96-97, pl. II, figs. 1-5, fig. 6 *in textu* p. 96) to the genus *Planovatirostrum,* and later recognized in Thuringia by BARTZSCH & WEYER (1986, pl. I, fig. 4), who included in it what WEYER (1979, p. 99, p. 103, pl. 4, fig. 13) had previously called *P.* cf. *planoovale* (*see* above). WEYER (1979, p. 103, pl. 4, fig. 14), and BARTZSCH & WEYER (1986, pl. I, right column, fig. 5) figured *P. fibrosissimum* (TIETZE, 1870) from the "untere *Wocklumeria*-Stufe" in the high valley of the River Mühl at Bornleite (Bohlen section) near Obernitz south of Saalfeld in Thuringia. This species, discovered by TIETZE (1870, p. 148, pl. XVII, figs. 38, 38a) in the "Clymenienkalk" of Ebersdorf near Neurode in the Glatz county of Thuringia, probably belongs to *Pugnaria* BIERNAT & RACKI, 1986.
BRICE & DROT (*in* BRICE *et al.,* 1984, p. 447, p. 450, p. 451) mentioned *Planovatirostrum* sp. of very likely doIV age (without excluding totally a doV age) in the "Boutonnière d'Immouzer du Kandar", south of Fès, south of the Rif in Morocco and believed that the genus seemed also present in the Oued Aricha in central Morocco, *fide* a lost specimen figured by G. and H. TERMIER (1950, p. 198, p. 199, pl. 99, fig. 25).

III. - Chinese outcrops of *Planovatirostrum planoovale* (NALIVKIN, 1937)

The well developed and well exposed Upper Devonian of the western Junggar Basin is subdivided into an upper Hongguleleng Formation of Famennian age and a lower Zhulumute Formation of Frasnian age (*see* HOU *et al.,* 1979; LIAO & CAI, 1987; XU *et al.,* in press).
The Hongguleleng Formation is 230-300 m thick and can be subdivided into three parts. (1) The lower part, about 100 m thick, consists of thin and medium-bedded limestone, argillaceous limestone and marls containing a great number of brachiopods, corals and acritarchs (namely the *Goungjunspirifer sinicus* - *« Ptychomaletoechia »* sp., *Nalivkinella profunda* - *Tabulophyllum postnormale* and *Cymatiosphaera perimembrana* - *Stellinium comptum* Assemblages), spores (*Archaeozonotriletes variabilis* NAUMOVA, *Camptotriletes prionotus* HIGGS, *Corystisporites* sp., etc...), and some conodonts (*Polygnathus homoirregularis*

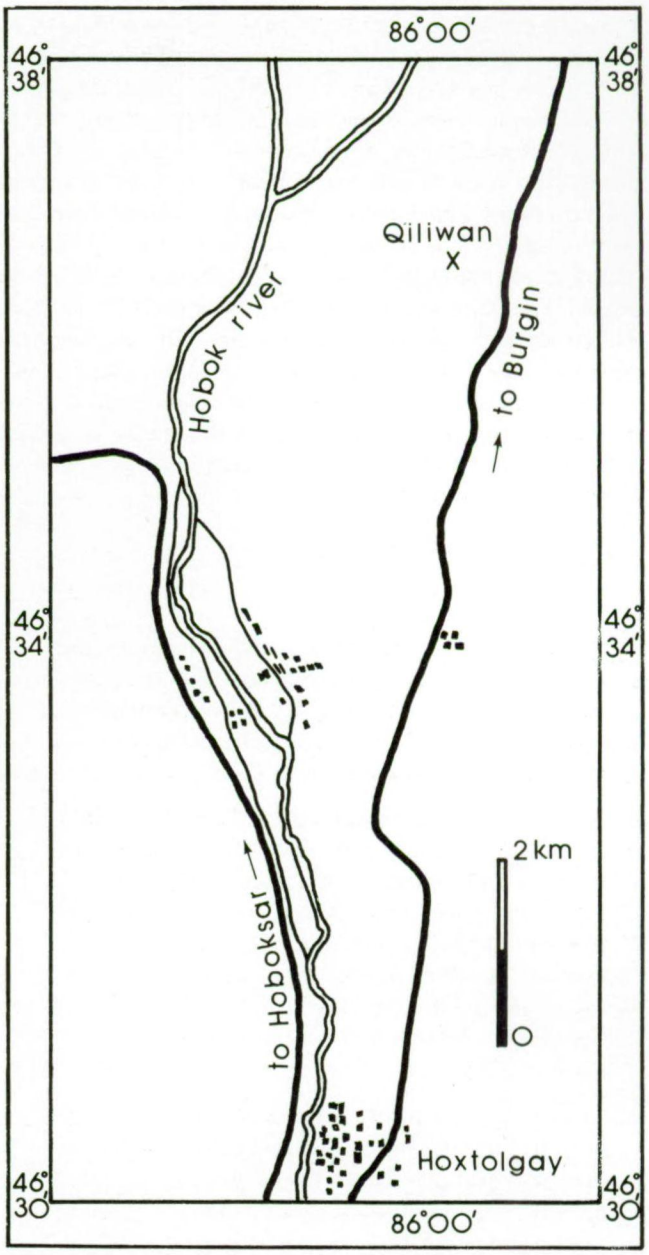

Figure 1. – *Hoxtolgay area in the western Junggar Basin, northern part of the Xinjiang Autonomous Region, northwest China. The Qiliwan section is located at 10 km north of Hoxtolgay.*

ZIEGLER, and *Palmatolepis glabra* ULRICH & BASSLER). The conodonts indicate correlation with an interval corresponding to the Famennian *Palmatolepis rhomboidea* to *Polygnathus styriacus* Zones, and thus, a doII to doV age according to WANG (*in* XU *et al.,* in press). (2) The middle part is probably more than 100 m thick, and is composed of variegated siliceous shale and silty mudstone, yielding rare trilobites (*Phacops* sp.), brachiopods (*Productella* sp., *Cyrtospirifer* sp.), and bivalves, but, in the Qiliwan section, a rich brachiopod and coral fauna is found at the base (*see* below). (3) The upper part is about 30 m thick and consists of brown-yellow calcareous or silty mudstone and marls with abundant brachiopods (*Mesoplica* sp., *Leioproductus*

sp., « *Mucrospirifer* » sp.), solitary corals (*Cyathocarinia xinjiangensis* LIAO & CAI, *Metriophyllum omhaense* LIAO & CAI, *M. curviseptatum* LIAO & CAI), and conodonts (*Polygnathus communis* BRANSON & MEHL, *Protognathodus collinsoni* ZIEGLER, *P. meischneri* ZIEGLER. The conodonts allow approximate assignment to an interval corresponding to the Famennian *Bispathodus costatus* Zone and the *Protognathodus* Fauna, and thus to a VI to top Famennian age according to WANG (*in* XU, TSAI, LIAO & LU, in press). The Zhulumute Formation is about 800 m thick and consists of volcanic sandstone and silty conglomerate with the plant *Lepidodendropsis* cf. *theodori* ZAL.

The lower (units 1 and 2) and middle (units 3 and 4) parts of the Hongguleleng Formation are summarily described as follows in the Qiliwan section located 10 km north of Hoxtolgay (*see* Fig. 1) :

Overlying strata : Volcanic rocks.

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4. Variegated siliceous and silty shale (Field number AEj 565) containing brachiopods (« *Tenticospirifer* » sp., *Cyrtospirifer* sp., *Athyris* sp., *Productella* sp.), and corals (*Amplexus tobeiensis* LIAO & CAI, *Honggulasma sinense* LIAO & CAI) . . . . . 18 m

3. Variegated calcareous and silty shale (Field number AEj 564) yielding abundant brachiopods (*Planovatirostrum planoovale* mainly, plus *Schizophoria* sp., *Athyris* sp., « *Mucrospirifer* » sp.), and solitary corals (*Gorizdronia sinensis* LIAO & CAI, *Guerichiphyllum sinense* LIAO & CAI, *Honggulasma sinense* LIAO & CAI, *Nalivkinella profunda* SOSHKINA, *Tabulophyllum postnormale* LIAO & CAI) . . . . . 22 m

2. Thin-bedded to medium-bedded yellow grey and grey argillaceous limestones and marls (Field number AEj 563) containing many brachiopods, most of them very large (*Goungjunspirifer honggelelenensis* ZHANG, F.M., *G. sinicus* ZHANG, F.M., *G.* sp., *Cyrtospirifer fusiformis* ZHANG, F.M., *C. regularis* ZHANG, F.M., *C.* sp., *Schizophoria* sp., *Athyris* sp., « *Mucrospirifer* » sp. . . . . 32 m

1. Thin-bedded greyish limestone intercalated with medium-bedded limestone and some marls (Field number AEj 562) containing many poorly-preserved brachiopods (many « *Mucrospirifer* » sp., some *Cyrtospirifer* sp., and a few *Goungjunspirifer* sp.) . . . . . 94 m

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Underlying strata : Zhulumute Formation consisting of thick-bedded yellow-grey sandstone and silty conglomerate (Field number AEj 561).

Abundant *Planovatirostrum planoovale* are found in the base (unit 3) of the middle part.

Planovatirostrum planoovale, which is abundant in the Qiliwan section, is often rare or absent in other sections around Hoboksar.

IV. - New description of *Planovatirostrum planoovale* (NALIVKIN, 1937)

(Plate 1, Figures 1a-e, 2a-e, 3a-e, 4a-e; Plate 2, Figures 5a-e, 6a-e, 7a-e, 8a-e, 9a-e, 10a-e. 11a-e)

Remarks

For reasons mentioned above, descriptions given by SIMORIN (1956, pp. 248-250, pl. XXII, figs. 1-30), ROZMAN (1962, pp. 127-129, figs. 33, 34, p. 128, 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), and MARTYNOVA (*in* LITVINOVICH *et al.*, 1975, pp. 74-75, pl. XXI, figs. 1a,b,v, 2a,b,v) are suspect. Therefore, we are left with the following original description of NALIVKIN (1937, English text, p. 147) :

"Large very flat, more wide than long oval form with smooth sides and large, flat median plications.

Characteristic features : 1. Large, extremely flat transverse oval shell. 2. Extremely small, recurved apex. 3. Smooth sides and flat median plication. 4. Slightly developed indistinctly defined sinus and elevation."

This too brief description based on the external characters of a single specimen gives altogether an insufficient and very approximate idea of the species. Moreover, the absence of lateral costae, the presence of a flat median plication, the slightly developed and poorly marked sulcus and fold are exceptional characters as is the high number $(\frac{6}{5})$ of median costae.

Hypotypes

The following hypotypes have been deposited in the Nanjing Institute of Geology and Palaeontology :

A, 112131 (Pl. 1, figs. 1a-e); B, 112132 (Pl. 1, figs. 2a-e); C, 112133 (Pl. 1, figs. 3a-e); D, 112134 (Pl. 1, figs. 4a-e); E, 112135 (Pl. 2, figs. 5a-e); F, 112136 (Pl. 2, figs. 6a-e); G, 112137 (Pl. 2, figs. 7a-e); H, 112138 (Pl. 2, figs. 8a-e); I, 112139 (Pl. 2, figs. 9a-e); J, 112140 (Pl. 2, figs. 10a-e); K, 112141 (Pl. 2, figs. 11a-e); L, 112142 (Figure 2). Plaster casts of hypotype L were taken before grinding; a cast as well as the remainder of this specimen are deposited in the Institute.

Additional plaster casts of the above hypotypes are deposited in the Royal Institute of Natural Sciences of Belgium under the number IG 27515.

Material - State of preservation

Ninety-four specimens have been studied. Most of them are in satisfactory state of preservation.

Description

GENERAL EXTERNAL CHARACTERS

Medium to large size. Flat. Uniplicate to slightly sulciplicate. Valves low, equally covex, and subequally high. Transversely suboval contour in ventral and dorsal views, slightly modified by the projection of the ventral beak; in cardinal and frontal views the contour has the shape of a

biconvex lense. Commissure sharp, sticking out, clearly indented by the costae. In about half the specimens, the frontal commissure is marked by a slight depression affecting the fold. Cardinal line almost straight. Postero-lateral margins concave near the commissures.

PEDICLE VALVE

On account of the small thickness of the valve, flanks slope gently from the umbonal region, which has a slight relief; they are flat to slightly convex. Although very shallow and starting imperceptibly, the sulcus is nevertheless well marked and clearly separated from the flanks. Bottom of sulcus flat, exceptionally slightly convex. Sulcus beginning at a variable distance, sometimes a great distance, from the beak : 33 to 63 % of the shell-length, most of the values varying from 44 to 56 %, or 31 to 60 % of the unrolled length of the valve, most of the values varying from 42 to 55 %. The sulcus starts with a width of 42 to 55 % of its width at the front; it widens rapidly and reaches its greatest width (58 to 71 % of shell-width, most of the values varying from 63 to 68 %) at the junction of the frontal and lateral commissures. Tongue wide, very shallow, trapezoidal, with sharp borders, standing out clearly; its top always lower than the top of the shell (about 14 to 37 % lower than point of maximum shell thickness). Beak small, flat, erect to slightly incurved, overhanging the cardinal line, often almost in contact with the dorsal umbonal region. Beak with a small circular foramen. Interarea shallow and wide — between 37 and 49 % of shell-width — clearly separated from the flanks. Deltidial plates not observed in transverse serial sections.

BRACHIAL VALVE

Shallow, slightly and uniformly convex. Although it is very low, the fold is well marked and clearly separated from the flanks; it begins at a variable distance, sometimes a great distance, from the beak, and is wide at the front. Fold anteriorly depressed in almost half of the specimens. This depression generally affects the whole part of the fold located between the external costae; in rare extreme cases the depression is so deep that the frontal commissure could almost be described as sulciplicate. Sometimes there is a corresponding slight swelling in the sulcus.

ORNAMENT

General formula, which is, a grouping of at least 75 % of the specimens in median, parietal, and lateral categories, is $\frac{3–5}{2–4}$; 0; $\frac{1–3}{2–4}$.

Numbers of median and lateral costae are a follows :

Median			Lateral		
Number of costae	Number of specimens	Percentage	Number of costae	Number of specimens	Percentage
$\frac{3}{2}$	7	8.15 %	0	9	15.8 %
$\frac{4}{3}$	52	60.45 %	$\frac{1}{2}$	2	3.5 %
$\frac{5}{4}$	20	23.25 %	$\frac{2}{3}$	20	35.1 %
$\frac{6}{5}$	7	8.15 %	$\frac{3}{4}$	22	38.6 %
			$\frac{4}{5}$	4	7 %
	86	100 %		57	100 %

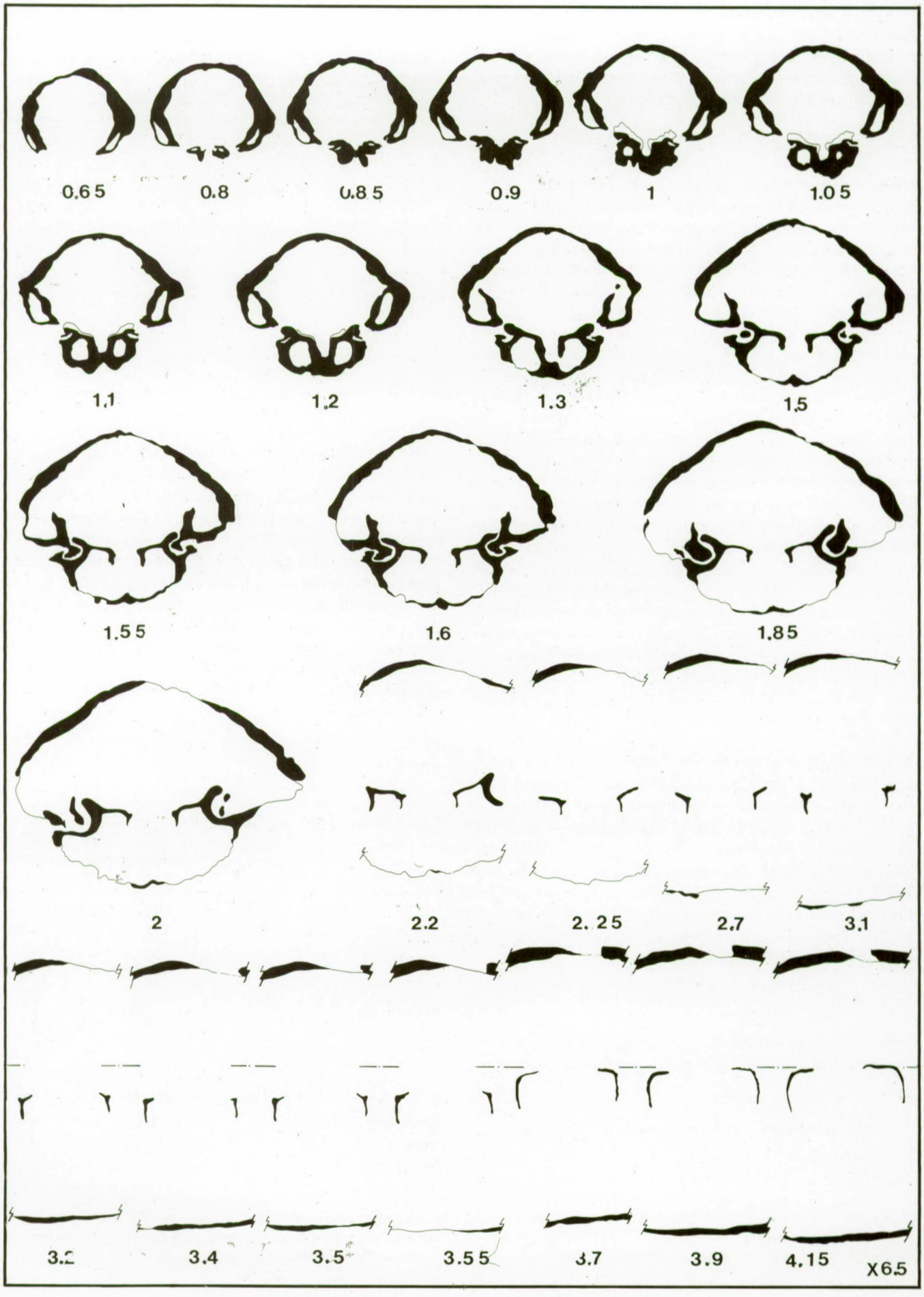
Costae few, strongly marked, relatively regular, angular with often rounded tops, high in comparison with the small shell-thickness. Width of castae at front generally varies between 2 and 4 mm, but may reach 5 mm. Median costae begin some distance from the beaks, somewhat posterior to the beginning of sulcus and fold; divisions and intercalations have been observed in 20 % of the specimens. Lateral costae, which are only exceptionally absent, may begin in the umbonal region, but generally are restricted to the anterior half, even the anterior third, of flanks; their length decreases from the internal one to the external one. One divided lateral costa has been observed. Parietal costae exceptional.

DIMENSIONS

Measurements of six photographed specimens :

in mm	Hypotype A	Hypotype E	Hypotype B	Hypotype C	Hypotype F	Hypotype D
l	25.5	24.2	24.1	24	23.2	23
w	33.9	30.7	34.6	34.1	30	31.7
lpv unrolled	29	28	28.5	29.5	27.5	28.5
t	11.1	10	10.7	10.7	9.8	10.9
tpv	5.2	4.8	5.2	5.2	4.6	5.4
tbv	5.9	5.2	5.5	5.5	5.2	5.5
l/w	0.75	0.79	0.70	0.70	0.77	0.73
t/w	0.33	0.33	0.31	0.31	0.33	0.34
t/l	0.44	0.41	0.44	0.45	0.42	0.47
apical angle	146°	?	133°	142°	134°	140°
angle of the cardinal commissure	153°	?	(136°)	(147°)	136°	145°

l = length; t = thickness; w = width; bv = brachial valve; pv = pedicle valve. Measurements shown in parentheses indicate a reasonable estimate on a damaged specimen.


0.65
0.8
0.85
0.9
1
1.05
1.1
1.2
1.3
1.5
1.55
1.6
1.85
2
2.2
2.25
2.7
3.1
3.2
3.4
3.5
3.55
3.7
3.9
4.15
X6.5

Top of pedicle valve located posteriorly varying from 22 to 44 % of the shell-length or from 25 to 42 % of the unrolled length of the valve. The greatest thickness of the brachial valve is never at the frontal commissure, but generally located at a very variable point between 40 and 65 % of the shell-length; from this point the valve curves gently anteriorly.
Width is always clearly the greatest dimension. Maximum width occurs anteriorly at a point between 50 and 59 % of the shell-length.
Great apical angle varying between 131° and 146°, most of the values varying from 138° to 145°. Angle of cardinal commissure 136° to 153°.

INTERNAL CHARACTERS

Shell moderately thick in the apical region.
Dental plates short, more or less thin; they diverge in their posterior part, and become parallel or converge anteriorly. In transverse serial sections the dental plates are buttresses touching the bottom of the valve around the middle of the thickness of the valve; they delimit small and wide umbonal cavities, and become rapidly detached from the bottom of the valve. Teeth small, wide, and strong.
No septum, no septalium. Strong crural plates delimiting lateral cavities and resting on a socle on the bottom of the valve; they become detached anteriorly, while the socle continues as a low thickening. Toward the interior the crural plates resolve into crura without passing through distinctly circumscribed crural bases. Hinge plate composed of two strong flat to convex parts inclined toward each other, and extending some distance anteriorly as appendages of the crura. A distinct layer of secondary shell, resting on the hinge plate, is clearly observable in transverse serial sections (Fig. 2). Inner socket ridges of dental sockets low and stretched ventro-laterally. In transverse serial sections the long and slender crura have, in their distal parts, the shape of a hockey-stick of which the two elements grow longer before disappearing; they curve slightly at their distal ends.

Comparisons

P. richteri may be easily separated from *P. planoovale* by : smaller size; fewer, shorter, lower and weaker costae (lateral costae may even be absent); less developed and less well marked sulcus and fold. It must be noted that the presence of dental plates could not be checked in *P. richteri;* HAVLÍČEK (1979, pp. 96-97), who on account of insufficient material, was able to make only poor transverse serial sections, ascribed this, probably correctly, to preservation.
The new species from the Ma'der is a more robust species than *P. planoovale,* has stronger costae, and generally more lateral costae. When the Moroccan species will be fully described, a detailed comparison will be made.

V. - Redefinition of the genus *Planovatirostrum*

The genotype, *Planovatirostrum planoovale,* had been established on the external characters of a single and not excellent specimen. It was to be expected that its unsatisfactory definition would lead to the broadening of the concept of the species, and result in subsequent descriptions encompassing more than one taxon. New and rich collections made at not too far a distance (about 175 km to the east) from the type locality of *P. planoovale* have allowed the authors to examine the internal characters of the species and to redefine it properly, and thus, the genus *Planovatirostrum.*
Here follows a list of corrections and additions to be brought to the original definition of the genus.

Original definition (1970)	Corrections and additions
– Uniplicate	– Uniplicate to slightly sulciplicate
– Ventral beak strongly incurved	– Ventral beak erect to slightly incurved
– Ventral interarea narrow	– Ventral interarea between 37 and 49 % of shell-width (Holotype of type species : 38 %)
– Costae irregular	– Costae relatively regular
– Costae of variable height, generally low, sometimes even not discernible	– Costae relatively high (e.g. the type species), less high or low (e.g. *P. richteri*)
– Median costae often divided or intercalated, starting far from the beaks	– Median costae starting at some distance from the beaks, somewhat posterior to the beginning of sulcus and fold; they are divided or intercalated in 20 % of the specimens of the type species – Parietal costae exceptional
– Greatest thickness of brachial valve located in the posterior half	– Greatest thickness of brachial valve generally located at a variable point between 40 % and 65 % of the shell-length
– Sulcus and fold slightly developed, beginning at a great distance from the beaks	– Sulcus and fold well developed beginning at a variable distance, sometimes a great distance from the beaks. Although very shallow (sulcus) and very low (fold), and beginning

◁ Figure 2. – Planovatirostrum planoovale *(NALIVKIN, 1937). Camera lucida drawings of serial transverse sections; figures are distances in mm of the section forward of the crest of the ventral umbo. Hypotype L, 112142. Measurement : l = 23,7 mm; w = 31 mm; t = 11.3 mm.*

	imperceptibly, sulcus and fold are nevertheless well marked and clearly separated from the flanks
– Shell thick	– Shell moderately thick in the apical region
– Crural plates reaching sometimes the bottom of the valve	– Crural plates reaching always the bottom of the valve
– Septum absent or present as a low and wide ridge on the bottom of the valve	– Crural plates rest on a socle on the bottom of the valve, then become detached anteriorly, while the socle continues as a low thickening
– Weak crural bases	– No distinctly circumscribed crural bases
	– Dental plates are buttresses touching the bottom of the valve around the middle of the thickness of the valve; they become rapidly detached from the bottom of the valve
	– Dental sockets stretched ventro-laterally
	– Crura slender, curving slightly at their distal ends
	– In transverse serial sections, the two elements of the hockey-stick shaped crura grow longer in their distal parts, before disappearing

VI. - Geographic distribution and stratigraphic position of the genus *Planovatirostrum*

Planovatirostrum is found in : the Holy Cross Mountains, Kazakhstan, Kellerwald, Morocco (Central, Dra Plains, Ma'der), Moravia, the Mugodzhary Mountains, the Russian Platform (eastern part), Sauerland, Thuringia, northern Xinjiang.

SARTENAER (1982, p. 132, table 2) reported, according to the literature, the following stratigraphic range for the genus : *Platyclymenia*-Stufe (III-IV), but with uncertainty for its lower part (III), *Clymenia*-Stufe (V), and *Wocklumeria*-Stufe (VI). A doIII age remains uncertain, and even doubtful, because well-established species are younger; thus, the possibility of the genus being already present in the Middle Famennian, as envisaged by SARTENAER (1970, p. 17), seems less and less probable. The doVI occurrence needs confirmation and corroboration.

In conclusion, doIV-V is the most reliable age for the genus *Planovatirostrum*; this means, in the conodont succession, the upper part of the *Palmatolepis trachytera* Zone, the *P. postera* Zone, and the Lower *P. expansa* Zone. It is on this base that the part of the Hongguleleng Formation containing *Planovatirostrum planoovale* has been dated.

VII. - Species attributed to the genus *Planovatirostrum*

In spite of its wide distribution, only two species may be assigned to the genus : *Planovatirostrum planoovale,* the type species from north-eastern Kazakhstan, and *P. richteri* from Moravia. A third well known but yet to be formally established species is the new species from Morocco. Other representatives of the genus have been erroneously identified at the specific level and need to be reevaluated.

VIII. - Conclusions

When the genus *Planovatirostrum* was proposed, together with thirteen other genera, its author stressed (1970, p. 3) its "use in regional stratigraphic studies and in international correlations". This paper demonstrates that, since its recognition, nineteen years ago, the genus has been documented from a wide geographic distribution, but its stratigraphic range has remained restricted. Therefore, we propose a world-wide *Planovatirostrum* range Zone.

References

BARTZSCH, K. & WEYER, D., 1986. Biostratigraphie der Devon/Karbon-Grenze im Bohlen-Profil bei Saalfeld (Thüringen, DDR). *Zeitschrift für geologische Wissenschaften,* 14 (2) : 147-152.

BIERNAT, G., 1988. Famennian brachiopods of the Holy Cross Mountains, Poland. *In* : N.J. MCMILLAN, A.F. EMBRY & D.J. GLASS (Edits.), Devonian of the World, Proceedings of the Second International Symposium on the Devonian System, Calgary, Canada, volume III : Paleontology, Paleoecology and Biostratigraphy : 327-335. Canadian Society of Petroleum Geologists, Calgary.

BIERNAT, G. & RACKI, G., 1986. A rhynchonellid-dominated late Famennian brachiopod assemblage from the Holy Cross Mountains (Poland). *Acta Palaeontologica Polonica,* 31 (1-2) : 85-109.

BRICE, D., CHARRIERE, A., DROT, J. & REGNAULT, S., 1984. Mise en évidence, par les faunes de Brachiopodes, de l'extension des formations dévoniennes dans la boutonnière d'Immouzer du Kandar (Sud de Fès, Maroc). *Annales de la Société Géologique du Nord,* 103 (1983) (4) : 445-458.

DROT, J., 1964. Rhynchonelloidea et Spiriferoidea siluro-dévoniens du Maroc pré-saharien. *Notes et Mémoires du Service Géologique du Maroc,* 178 : 287 pp.

GORTANI, M., 1907. Contribuzioni allo studio del Paleozoico carnico. Parte III. La fauna a climenie del Monte Primosio. *Memorie della Accademia delle Scienze dell'Istituto di Bologna,* serie 6, 4 (1-2) : 201-245.

HAVLÍČEK, V., 1979. Upper Devonian and Lower Tournaisian Rhynchonellida in Czechoslovakia. *Věstník Ústředního Ústavu Geologického,* 54 (2) : 87-101.

HOU, H.-f., XIANG, L.-w., LAI, C.-g. & LIN, B.-y., 1979. Advances in the Palaeozoic stratigraphy of Tianshan-Xingan region. *Acta Stratigraphica Sinica,* 3 (3) : 175-187.

LAIO, W.-h. & CAI, T.-c., 1987. Sequence of Devonian rugose coral assemblages from northern Xinjiang. *Acta Palaeontologica Sinica,* 26 (6) : 689-707.

LIASHENKO, A.I., ARONOVA, S.M., GASSANOVA, I.G., LOTSMAN, O.A., SOKOLOVA, L.I., LIASHENKO, G.P., ARKHANGEL'SKAYA, A.D., BATRUKOVA, L.S., KARPOV, P.A. & PAN'SHINA, L.N., 1970. Stratigrafiya i lithologiya. *In* : A.I. LIASHENKO & I.G. GASSANOVA (Red.), Neftegazonosnye i perspektivnye kompleksy tsentral'nykh i vostochnykh oblastei Russkoi Platformy, tom II : Devonskie otlozheniya Volgo-Ural'skoi neftegazonosnoi oblasti. Trudy Vsesoyuznogo Nauchno-Issledovatel'skogo Geologorazvedochnogo Neftyanogo Institut (VNIGNI), 75 : 21-183.

LITVINOVICH, N.V., AKSENOVA, G.G. & MARTYNOVA, M.V., 1975. Stratigrafiya pogranichnykh otlozhenii devona i karbona. *In* : Fauna pogranichnykh otlozhenii devona i karbona Tsentral'nogo Kazakhstana (Foraminifery, Stromatoporoidei, Tabulyaty, Rugozy, Mshanki, Brakhiopody. *Materialy po Geologii Tsentral'nogo Kazakhstana,* 18 : 8-19.

MARTYNOVA, M.V., 1975. Cf. LITVINOVICH, N.V.

NALIVKIN, D.V., 1937. Brachiopoda of the Upper and Middle Devonian and Lower Carboniferous of North-eastern Kazakhstan. *Trudy Tsentral'nogo Nauchno-Issledovatel'skogo Geologo-Razvedochnogo Instituta (TsNIGRI),* 99 : 200 pp.

OPPENHEIMER, J., 1916. Das Oberdevon von Brünn. *Verhandlungen des Naturforschenden Vereines in Brünn,* 54 : 1-44.

RICHTER, R., 1848. Beitrag zur Paläontologie des Thüringer Waldes. Die Grauwacke des Bohlens und des Pfaffenberges bei Saalfeld. I. Fauna. Dresden, Leipzig, 100 pp.

RICHTER, R., 1856. Erster Theil. *In* : R. RICHTER & F. UNGER, Beitrag zur Paläontologie des Thüringer Waldes : 3-52, Wien.

ROZMAN, Kh.S., 1960. Stratigrafiya famenskikh i nijneturneiskikh otlozhenii Mugodzhar i smezhnykh raionov Urala. *Izvestiya Akademii nauk SSSR, seriya geologicheskaya,* 12 : 42-51.

ROZMAN, Kh.S., 1962. Stratigrafiya i brakhiopody famenskogo yarusa Mugodzhar i smezhnykh raionov. *Trudy Geologicheskogo Instituta, Akademiya nauk SSSR,* 50 : 196 pp.

SARTENAER, P., 1967. De l'importance stratigraphique des Rhynchonelles famenniennes situées sous la Zone à *Ptychomaletoechia omaliusi* (GOSSELET, J., 1877). Quatrième note : *Tenuisinurostrum* n. gen. [*T. crenulatum* (GOSSELET, J., 1877) = espèce-type]. *Bulletin de l'Institut royal des Sciences naturelles de Belgique,* 43 (32) : 24 pp.

SARTENAER, P., 1970. Nouveaux genres Rhynchonellides Brachiopodes) du Paléozoïque. *Bulletin de l'Institut royal des Sciences naturelles de Belgique,* 46 (32) : 32 pp.

SARTENAER, P., 1982. Znachenie rodov rinkhonellid dlya opredeleniya granits otdelov devona. *In* : B.S. SOKOLOV & M.A. RZHONSNITSKAYA (Red.), Biostratigrafiya pogranichnykh otlozhenii nizhnego i srednego devona. Trudy polevoi sessii Mezhdunarodnoi podkomissii po stratigrafii devona. Samarkand, 1978 : 130-133.

SCHMIDT, H., 1924. Zwei Cephalopodenfaunen an der Devon-Carbongrenze im Sauerland. *Jahrbuch der Preussischen Geologischen Landesanstalt zu Berlin* für das Jahr 1923, 44 : 98-171.

SIMORIN, A.M., 1956. Stratigrafiya i brakhiopody Karagandinskogo basseina. Institut Geologicheskikh Nauk. Akademiya Nauk Kazakhskoi SSR, Alma-Ata.

TIETZE, E., 1870. Ueber die devonischen Schichten von Ebersdorf unweit Neurode in der Grafschaft Glatz, eine geognostisch-paläontologische Monographie. *Palaeontographica, Beiträge zur Naturgeschichte der Vorwelt,* 19 : 103-158.

von GAERTNER, H.R., 1931. Geologie der Zentralkarnischen Alpen. *Mathematisch-Naturwissenschaftliche Klasse der Akademie der Wissenschaften in Wien, Denkschriften,* 102 : 113-199.

WEYER, D., 1972. Rozmanaria, ein neues Rhynchonellida-Genus aus dem europäischen Oberfamenne (Brachiopoda, Oberdevon). *Geologie,* 21 (1) : 84-99.

WEYER, D., 1979. Biostratigraphy of the Devonian-Carboniferous Boundary in the German Democratic Republic. *Compte Rendu du 8e Congrès International de Stratigraphie et de Géologie du Carbonifère,* Moscou, 8-13 septembre 1975, 2 : 97-104.

WEYER, D., 1986. Biostratigraphie der Devon/Karbon-Grenze im Bohlen-Profil bei Saalfeld (Thüringen, DDR). *Zeitschrift für geologische Wissenschaften,* 14 (2) : 147-152.

XU, H.-k., TSAI, C.-y., LIAO, W. & LU, L.-c. (in press). Devonian of Junggar, Xinjiang and development of its geological history.

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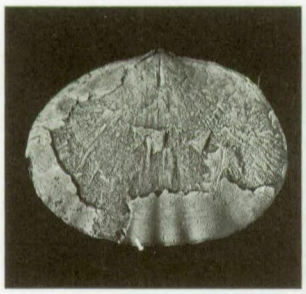

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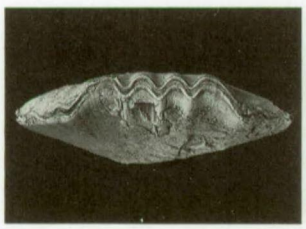

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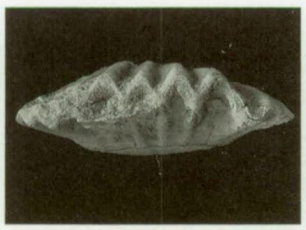

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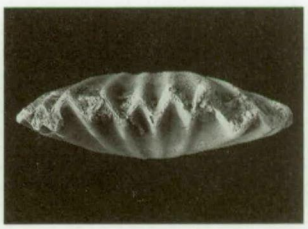

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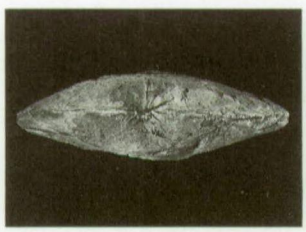

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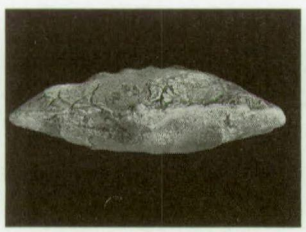

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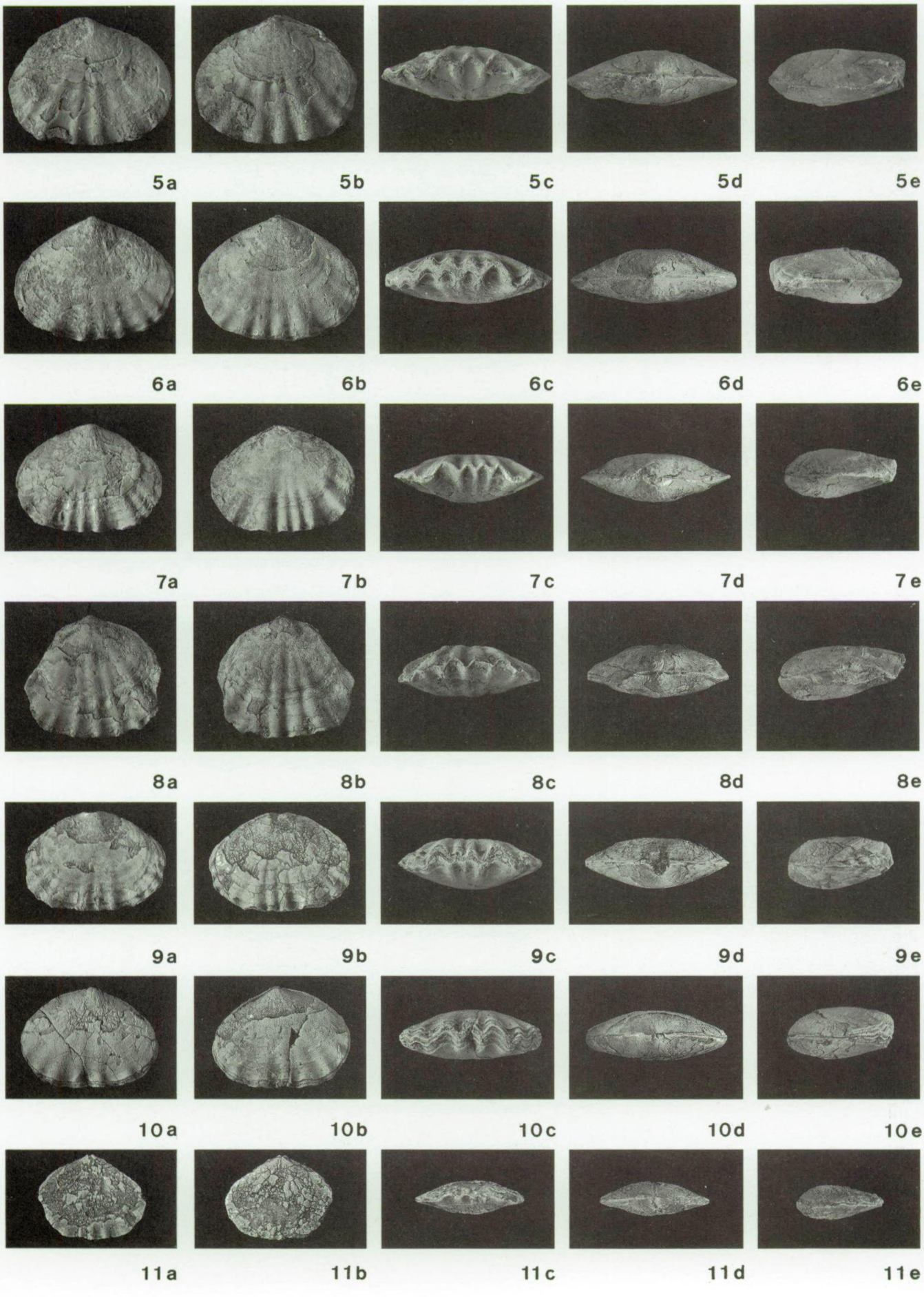

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9a 9b 9c 9d 9e

10a 10b 10c 10d 10e

11a 11b 11c 11d 11e

PLATES 1 AND 2

Planovatirostrum planoovale *(NALIVKIN, 1937)*

All figures are × 1. a = ventral view; b = dorsal view; c = frontal view; d = apical view; e = lateral view.

Figs. 1a-e. – *Hypotype A, 112131. Costal formula :* $\frac{4}{3}$; *0;* $\frac{3}{4}$.

Figs. 2a-e. – *Hypotype B, 112132. Costal formula :* $\frac{5}{4}$; *0;* $\frac{2}{3}$ *and* $\frac{4}{5}$.

Figs. 3a-e. – *Hypotype C, 112133. Costal formula :* $\frac{5}{4}$; *0;* $\frac{3}{4}$.

Figs. 4a-e. – *Hypotype D, 112134. Costal formula :* $\frac{5}{4}$; *0;* $\frac{2}{3}$.

Figs. 5a-e. – *Hypotype E, 112135. Costal formula :* $\frac{3}{2}$; *0;* $\frac{2}{3}$.

Figs. 6a-e. – *Hypotype F, 112136. Costal formula :* $\frac{4}{3}$; *0;* $\frac{2}{3}$.

Figs. 7a-e. – *Hypotype G, 112137. Costal formula :* $\frac{4}{3}$; *0;* $\frac{2}{3}$ *and* $\frac{3}{4}$.

Figs. 8a-e. – *Hypotype H, 112138. Costal formula :* $\frac{5}{4}$; *0; ?.*

Figs. 9a-e. – *Hypotype I, 112139. Costal formula :* $\frac{4}{3}$; *0;* $\frac{3}{4}$ *and* $\frac{4}{5}$.

Figs. 10a-e. – *Hypotype J, 112140. Costal formula :* $\frac{3}{2}$; *0;* $\frac{2}{3}$.

Figs. 11a-e. – *Hypotype K, 112141. Costal formula :* $\frac{4}{3}$; *0; 0.*