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Upper Devonian Brachiopods from Eastern Taurus (Turkey)

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Key words: Brachiopods, Upper Devonian, Gondwana, Cimmerian Belt, Turkey.

Abstract

During a field expedition in Taurus (SE Turkey) in order to study the Lower Palaeozoic series, a small brachiopod fauna was collected in the Kozan area in beds of supposed Silurian age. After closer examination, the age of this fauna is clearly Upper Devonian, probably Lower Frasnian, and this implies a reassessment of the age of the series. This assemblage also shows close affinities with similar North Gondwanan faunas described in Iran and Afghanistan in beds of the same age.

1. INTRODUCTION

The Taurus Mountains are one of the major tectonic units of southern Turkey, and many Palaeozoic outcrops have been recorded in this area, where the succession ranges from Cambrian to Miocene in age with many unconformities. The Devonian series show a regressive tendency following the transgressive sequence of the Silurian (see GEDIK, 1988, for a general overview of the Devonian of Turkey). The studied section is located NE of Kozan, on the road between Kozan and Feke, along the edge of Kilgen Lake, in SE Turkey, eastern part of the Taurids (Fig. 1). From East to West, the succession includes the Ordovician series (Seydisehir Fm., Kozan Fm., Sortepe Fm. and Halevikdere Fm.) followed by Silurian black shales and limestones. The upper part of the latter, consisting of limestones lying unconformably on the rest of the formation and underlying the Mesozoic formations, has yielded a fauna mainly consisting of brachiopods and corals. Although this succession was formerly considered as entirely Silurian, the brachiopod fauna collected in this upper part indicates a Late Devonian age, probably Early Frasnian. The age of the series is thus reassessed on this basis. Only the brachiopods are described here; study of the corals is in progress and they will be described in a future publication.

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2. SYSTEMATIC PALAEONTOLOGY

Note on the terminology

The abbreviations used in the text and tables are the following: L – length measured from the hinge to the anterior commissure; L_t – total length including the beak; W – maximum width; W_h – width of the hinge line; W_s – width of the sulcus or fold at the anterior commissure; H_d and H_v – height (i.e. depth) of the dorsal and ventral valves respectively; H – total height (i.e. thickness) of the shell; Nc_f and Nc_s – number of ribs (or costae) on one flank and sulcus or fold respectively; Nc_p – number of parietal ribs. All measurements are in mm.

The material is housed in the Laboratoire de Paléontologie de Brest, France (numbers LPB).

Order Strophomenida ÖPIK, 1934
Superfamily Strophomenoidea KING, 1846
Family Douvillinidae CASTER, 1939

Genus *Douvillina* OEHLERT, 1887

Type species: *Orthis dutertrei* MURCHISON, 1840, p. 253.

Douvillina sp.
Pl. 1, Fig. 1

Material

One shell fragment showing the ornament; another fragment showing the ventral muscle field. LPB 12400. Kozan section, level PK66 C.

Description

The shell has a low, planar, vertically striated interarea and a denticulate hinge. The delthyrium is triangular, partly filled by the basal thickening of the myophragm.

The ornament is parvicostellate with well marked radial costae separated by wide, flat interspaces bearing fine costellae (2–3 costellae between primary costae), and tending to become stronger anteriorwards. Very fine concentric growth lines are also present on weakly expressed “rugae”.

In the ventral valve, fine radial striae resulting from the alignment of numerous closely spaced small pits occur. They are separated by radial grooves, some of them deeper, mimicking the external ornament. The

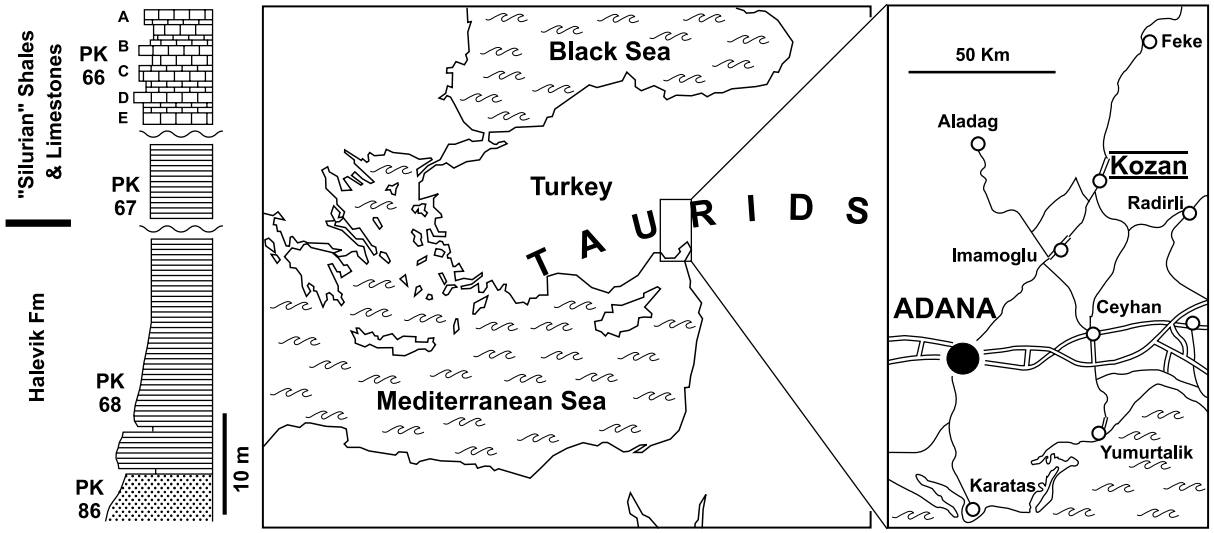

Fig. 1 Location map and lithostratigraphic column of the Kozan section, SE Turkey. The fauna described in this paper was sampled from the top of the series (level PK 66).

muscle field is elevated, giving rise to a transverse, concave platform clearly delimited by an elevated ridge. It is crossed by a strong but relatively low median myophragm that does not run beyond the anterior edge of the muscle field.

Discussion

The internal features and ornament are consistent with an assignment of this species to *Douvillina* OEHLERT, 1887. *D. ferquensis* (RIGAUX, 1872) shows a similar ornament and arrangement of the internal pits related to the external ornament, but it differs in a longer myophragm that crosses the anterior margin of the muscle field. The ornament of some other species (e.g. *D. aronovae* LJASCHENKO, 1952 in LJASCHENKO, 1959) evokes the ornament of the present species, but due to the lack of material, it is difficult to make solid comparisons.

These two species are known in Frasnian successions of Western Europe and the Russian Platform respectively.

Order Productida SARYTCHEVA & SOKOLSKAJA, 1959
Suborder Productidina WAAGEN, 1883
Superfamily Productoidea GRAY, 1840
Family Productellidae, SCHUCHERT, 1929

Genus *Productella* HALL, 1867

Type species: *Productus subaculeatus* MURCHISON, 1840, p. 255.

Productella sp. cf. *subaculeata* (MURCHISON, 1840)
Pl. 1, Figs. 2–5

Material

Four almost complete variably damaged specimens, and two partially exfoliated ventral valves; LPB 12401 – LPB 12402. Kozan section, levels PK66 A and C.

Description

Small to medium size (means: L=18.3 mm; W=21.6 mm; H=8.7 mm), strongly concavo–convex with variable outline (rounded subquadratic to slightly transverse), with a hinge line slightly shorter than maximum width.

The areas are discrete, very low, but distinguishable on most specimens and longitudinally striate; the angle between them varies from 90 to 130°. The delthyrium is broad, low, with no trace of deltidial cover. All the umbos are damaged, except on one specimen that shows no trace of an attachment cicatrix. Chilidium lacking.

The shell bears fine, concentric sinuous growth lines and coarser, sinuous rugae which are stronger on the postero–lateral parts of the shell. The latter are somewhat more conspicuous on the dorsal valve surface. They are generally low except on one specimen where they are well developed on the entire anterior half of the shell on both valves, and particularly well marked on the dorsal one.

The spines, present on the ventral valve only, are long, hollow, numerous, recumbent, and distributed along the rugae in alternate rows resulting in an irregu-

lar staggered implantation. However, due to the irregularity of the rugae, they often appear as randomly distributed, particularly on abraded shells. They can be locally more or less aligned radially, rarely with posterior slightly elongate ridges. No spine was observed on the dorsal valve where they are replaced by small dimples approximately distributed in the same way as spines on the opposite valve.

Due to lack of internal molds, the internal structures were not observed in detail. Nevertheless, two shells, partially exfoliated in their apical part, show a bifid cardinal process with high, divergent lobes and small sockets with short, rounded, slightly internally recurved teeth.

Discussion

The lack of ribs and cicatrix attachment, absence of spines in the dorsal valve, and the presence of teeth plead in favour of an assignment to *Productella* HALL, 1867. The closely related genus *Spinulicosta* NALIVKIN, 1937 shows a tendency to anterior ribbing, which is not the case here, and its spines generally originate from elongate spine bases. *Donalosia* LAZAREV, 1989 presents a similar external aspect, but in *Donalosia* the spines are stronger and more numerous in the postero–lateral region, unlike the present form. *Praewaagenoconcha* SOKOLSKAJA, 1948 has a row of stronger median spines on the ventral valve, and *Eostrophalosia* STAINBROOK, 1943 has spines on the dorsal valve.

Among the species belonging to the genus, *P. subaculeata* (MURCHISON, 1840) seems to be the better receptacle, although the spines are generally described as randomly distributed in this species, which is not exactly the case here, and less numerous (after the original figure in MURCHISON, 1840, pl. 2, fig. 9). As established by BROUSMICHE (1973) the species is highly variable in size, outline and ornament, but the different morphotypes described by this author always show relatively coarser spines than our specimens. We thus maintain this material in open nomenclature although the remaining characters are in good accordance with an assignment to *P. subaculeata*. Among other close species, *P. belanskii* STAINBROOK, 1943 has a row of median stronger spines and elongated spine bases.

P. subaculeata is known in Middle and Upper Devonian series from Europe, Asia, America, and Africa.

Order Rhynchonellida KUHN, 1949

Superfamily Rhynchotrematoidea SCHUCHERT, 1913

Family Trigonirhynchiidae SCHMIDT, 1965

Genus *Cupularostrum* SARTENAER, 1961

Type species: *Cupularostrum recticostatum* SARTENAER, 1961, p. 2.

Cupularostrum? sp.

Material

One complete crushed shell; LPB 12430. Kozan section, level PK66 C.

Description

This relatively large, moderately biconvex shell (L_t=27.5 mm; W=29 mm; H~15 mm) has a subcircular outline. Sulcus and fold are not expressed or weak near the anterior margin that is damaged; the tongue was probably low. The ribs are numerous (Nc~50 over the entire shell), simple, angular, relatively strong, the median ones slightly stronger than lateral ones. The apices are smooth. The interior is unknown.

Discussion

Owing to the lack of information on the interior and the damaged commissure, this specimen is here assigned with doubt to *Cupularostrum* SARTENAER, 1961. It also presents some analogies with *Comiotoechia* LJASCHENKO, 1973 in its general aspect, but is larger, with coarser ribs.

Genus *Rhipidiorhynchus* SARTENAER, 1966a

Type species: *Terebratula livonica* von BUCH, 1834, p. 57.

Rhipidiorhynchus cf. *elburzensis* (GAETANI, 1965)

Pl. 1, Figs. 10–13

Material

Only one crushed but complete specimen; LPB 12403. Kozan section, level PK66 B.

Description

Shell small (L=14 mm; W=14 mm), subquadratic, strongly inequivalve (H_d=8.5 mm; Hv~2.5 mm), with a maximum width located about mid-length. The maximum height is located at the front.

Ventral valve very low and concave (but this may be due to deformation). The beak is well developed, erect. The sulcus is clearly delimited, deep, wide (W_s/W=0.5 at front) with steep flanks, and originates in the posterior part of the valve, not very far from the apex. The tongue is high, trapezoidal.

Dorsal valve very high, convex, with an obviously delimited, high fold, originating in early stages of growth.

Ornament of simple, rounded to subangular ribs, beginning at the apex and bearing very fine concentric growth lines (8 per mm). There are 3 ribs in the sulcus, 2 parietal ribs that do not reach the commissure, and 8–10 lateral ribs on each flank. The ribs on the fold are somewhat stronger than the others. Internal characters are unknown.

Discussion

This species is assigned to the genus *Rhipidiorhynchus* SARTENAER, 1966a on the basis of its ornament beginning at the apex, its sinal formula, the development and shape of the fold/sulcus, the erect beak, etc.

Due to the lack of material, a specific assignment is unsure. This form is close to *R. elburzensis* (GAETANI, 1965) that was identified in the Frasnian of Iran and Afghanistan and differs by its larger size and higher number of lateral ribs (but this is not significant in regard of the number of specimens available here). *R. farsani* BRICE, 1976 is also smaller with a different rib formula. Another closely related species, *R. ferquensis* (GOSSELET, 1887) is also discarded for the same reasons. The latter two are known in Frasnian successions, in Afghanistan and Europe respectively.

Genus *Cyphoterorhynchus* SARTENAER, 1965

Type species: *Uncinulus* (*Uncinulina*) *koraghensis* REED, 1922, p. 40.

Cyphoterorhynchus koraghensis (REED, 1922)

Pl. 1, Figs. 19–23; Table 1

1922 *Uncinulus* (*Uncinula*) *koraghensis* sp. nov. REED, p. 40, pl. 7, figs. 10–22; pl. 8, fig. 1

1971 *Cyphoterorhynchus koraghensis* (REED, 1922) – BRICE, p. 47, pl. 3, figs. 1a–d, 6 a–d; text-fig. 13A (with a comprehensive synonymy).

Material

Seven articulated shells; LPB 12437– LPB 12439. Kozan section, levels PK66 A, C and D.

Description

Shell relatively large (means: L_t=22.3 mm; W=22.2 mm; H=19 mm) (Table 1), strongly dorsi–biconvex with subcircular to slightly transverse outline and vertical or subvertical lateral margins. The maximum height is located at mid-length, occasionally between mid-length and the anterior third of the shell. The sulcus and fold are poorly delimited and weak in the posterior part of the shell. They are also weak in the anterior half. The bottom of the sulcus is slightly convex. The tongue is high, vertical with subtrapezoidal outline. The anterior and lateral commissures are serrate.

The ribs originate at the apex, are relatively strong, rounded to angular, never flattening anteriorly. There are usually 5 to 7 ribs in the sulcus and 1 (rarely 2) parietal rib(s) that invariably disappear anteriorly. Each flank bears 10 to 15 ribs (mean Nc_f=12), the posterolateral ones being very faint.

Table 1 Measurements (in mm) of *Cyphoterorhynchus koraghensis* (REED, 1922) and *C. arpaensis* (ABRAMIAN, 1957) from the Kozan section, near Kilgen Lake, SE Turkey.

Sample	L_t	W	H_d	H_v	Nc_s	Nc_p	Nc_f
C. koraghensis							
LPB 12437	—	—	—	—	4	1	>12
LPB 12438a	25.5	25.5	15	8.5	6	1	10
LPB 12438b	21.5	21.5	12	6	5	1	10–12
LPB 12438c	21.5	24	12	5.5	5	1	10
LPB 12439a	21	20.5	11	7	6	1 (2?)	> 13
LPB 12439b	22	21	13	5.5	7	2	≈15
LPB 12439c	22.5	20.5	13	5.5	7	1–2	14
Means	**22.3**	**22.2**	**12.7**	**6.3**	**≈6**	**≈1**	**≈12**
C. arpaensis							
LPB 12431a	22.5	23	10	5	6	4	13
LPB 12431b	21.5	20	13	5	7–8	2	>18
LPB 12432	22	22	15	5	7	2	>17
LPB 12433a	19.5	20	11	6	7	3	>18
LPB 12433b	17	17	8	4	8	3	>13
LPB 12434a	27	22	12	7	≈9	3	>19
LPB 12434b	19.5	19	12	9	≈8	3	>13
LPB 12435a	25	23.5	14	7	9	2	>16
LPB 12435b	18	18	10	5	7	2	15
LPB 12436a	22	21.5	9	7	9	3	>12
LPB 12436b	16.5	18	8	7	8	3	>13
Means	**21**	**20.4**	**11.1**	**6.1**	**≈8**	**2–3**	**≈16+**

Dorsal interior with septalium; other internal structures unknown.

Discussion

See the discussion of *C. arpaensis* below. The species is known in Frasnian successions of Pakistan (Chitral), Afghanistan, and Iran.

Cyphoterorhynchus arpaensis (ABRAMIAN, 1957)

Pl. 1, Figs. 24–28; Table 1

1957 *Camarotoechia radiata* NAL. (in litt.) var. *arpaensis* var. nov. ABRAMIAN, p. 55, pl. 5, figs. 6 a–r; pl. 6, figs. 4 a–r.

1971 *Cyphoterorhynchus arpaensis* (ABRAMIAN) – BRICE, p. 52, pl. 3, figs. 2 a–c, 4 a–d; text-fig. 14 A (with a comprehensive synonymy).

Material

14 specimens; LPB 12431 – LPB 12436. Kozan section, levels PK66 A, B, C, D.

Description

This species is very similar to the previous one and differs mainly by the shape and number of ribs that are finer, more numerous, less angular and occasionally become flattened anteriorly, with a median groove (visible on two specimens). There are 7 to 9 ribs in the sulcus and 2 or 3 parietal ribs that disappear anteriorly in about 50 percent of the specimens. In one case, there are 4 parietal ribs. The number of lateral ribs is highly variable (13 to more than 19 on each flank) (Table 1). The deltidial plates are low and disjunct.

Ventral interior with short, thick dental plates that converge ventrally. The muscle field is excavated and crossed by a short median myophragm and a few radial grooves. A strong thickening of the shell may be present, reducing the free part of the dental plates.

Dorsal interior with a strong V-shaped septalium with a dorsally convex cover plate. The long, relatively high median septum is thick posteriorly and becomes abruptly thinner anteriorly. Crural bases subcircular in cross-section. The imprint of the anterior and posterior adductor scars is well marked and moderately excavated.

On two specimens the *vascula* are well developed in both valves, particularly the *vascula lateralia*. The *vascula genitalia* are distributed anterolaterally to the muscle field and consist of small tubercles more or less radially oriented and sometimes fused together, in the posterior third of the valve.

Discussion

In this species, as for the species described above, the variability seems very pronounced. It concerns the general shape, more or less transverse, sometimes subcuboid, the number of ribs and their strength, etc. This variability both in *C. koraghensis* and *C. arpaensis* has already been observed in material described in Afghanistan (BRICE, 1971), Iran (SARTENAER, 1966b) or Chitral (REED, 1922). Although the extremes are easily separated, the presence of transitional forms does not make it easy to distinguish the two species by their external aspect; the main criterion consists of the different sinal formulae and number of lateral ribs. Some of the intermediate morphs (with 2 parietal and few lateral ribs) may belong to the subspecies *C. koraghensis interpositus* SARTENAER, 1966b which is a transitional form between the nominal species and *C. arpaensis*.

The two species are assigned here to *Cyphoterorhynchus* SARTENAER, 1965, following the general opinion of the authors in recent literature. Nevertheless, they also show some similarities with the genus *Cupularostrum* SARTENAER, 1961 such as trapezoidal tongue, serrate commissure, distinct dental plates more or less ventrally convergent and relatively long dorsal septum.

C. arpaensis has been described from the Frasnian of Armenia, Transcaucasus, Iran and Afghanistan.

Superfamily Pugnacoidea RZHONSNITSKAJA, 1956

Family Ladogiidae LJASCHENKO, 1973

Genus *Ladogilina* LJASCHENKO, 1973

Type species: *Ladogilina rossica* LJASCHENKO, 1973, p. 38.

Ladogilina sp. 1

Pl.1, Figs. 6–9 ; Table 2

Material

Three almost complete specimens and one crushed specimen; LPB 12426 – LPB 12428. Kozan section, levels PK66 A, B, C.

Description

Shell strongly inequivalve, large (maximum: L=38 mm; W=40 mm) (Table 2), with a rounded subtriangular outline. The apical angle varies from 100 to 110°. The maximum width is located near the anterior third of the shell.

Ventral valve low, more or less flat in transverse section, a very shallow sulcus appearing only at mid-length. At the anterior edge, the tongue is very high and vertically erect, its basis occupying almost the entire width of the shell. The extremity (top) of the tongue is rounded. The beak is short, well marked, with an apparently hypothyrid foramen.

Dorsal valve very high and regularly increasing in height up to the frontal commissure. In transverse section, the valve is regularly rounded (semicircular shape) with a fold becoming expressed only in the anterior third of the shell.

Table 2 Measurements (in mm) of the two species of *Ladogilina* from the Kozan section, near Kilgen Lake, SE Turkey.

Sample	L	W	H_d	H_v	Nc per 5 mm at 1.5 cm from beak	Nc per 5 mm at commissure
***Ladogilina* sp. 1**						
LPB 12426	38	39	20	8	8	4
LPB 12428a	≈30	≈40	15	7	8	5
LPB 12428b	32	34	20	9	8	5
***Ladogilina* sp. 2**						
LPB 12429a	28	31	12	11	11	6
LPB 12429b	28	35	14	10	12	7

The entire shell is covered by numerous fine, rounded, simple ribs beginning at the apex, separated by narrow interspaces and regularly widening anteriorly. There are 8 ribs per 5 mm at 1.5 cm from the beak and 4 to 6 ribs per 5 mm at the antero–lateral commissure.

The dorsal median septum is strong, particularly in its posterior part. It is long, reaching the midlength of the shell.

The ventral interior features are unknown.

Discussion

Despite its subtriangular outline, this species is assigned to *Ladogilina* rather than *Ladogia* after the shape of its tongue (not acute as in *Ladogia*), rounded ribs and the rounded outline in transverse section.

This species is close to *Ladogilina persanica* BRICE, 1999, but differs by its larger size. BRICE (1999 – p. 73) pointed out the existence in Afghanistan (Robat-e-Paï) of a large specimen close to *L. persanica* that "possibly belong[ed] to another species"; this specimen could be conspecific with the present one. *L. rossica* LJASCHENKO, 1973 and *L. simensis* (MARKOWSKY, in ELLERN et al., 1955) are also much smaller than the present species and have somewhat finer ribs (9 to 11 per 0.5 mm at 1.5 cm from the beak).

Ladogilina sp. 2 cf. *L. rossica* LJASCHENKO, 1973

Pl. 1, Figs. 29–33; Table 2

Material

Two complete specimens and 2 incomplete, crushed ones; LPB 12429. Kozan section, level PK66 E.

Description

Shell inequivalve, relatively large, but smaller than *Ladogia* sp. 1 (maximum: L=28 mm; W=31 mm) (Table 2), with a rounded subquadrangular outline. The apical angle is about 110 to 120°. The maximum width is located in the anterior half of the shell.

Ventral valve lower than the dorsal one, rounded in transverse section. Sulcus almost lacking or very shallow, appearing at mid-length. The tongue is widely rounded, not very high. The beak is short with a submesothyrid foramen.

Dorsal valve high and regularly rounded in transverse section. Fold indistinct.

Ribs numerous and fine (11 to 12 per 5 mm at 1.5 cm from the beak and 6 to 8 per 5 mm at the commissure).

The dorsal median septum is thick, particularly in its posterior part and becomes relatively thin anteriorly. It is long, reaching the mid-length of the shell.

The dental plates are short, thin and vertical. The ventral muscle field is poorly impressed and marked by a few, very low radial ridges.

Discussion

This species is close to the former one but differs in its more quadratic outline and its smaller size, although it remains larger than previously known species of the genus. The ventral valve is rounded in cross section, in contrast with *Ladogilina* sp. 1 (where it is flattened); it is also proportionally higher than in *Ladogilina* sp. 1. Furthermore, the ribs are finer and more numerous. This characteristic is reminiscent of both *L. rossica* and *L. simensis* in which the number of costae in 5 mm at 1.5 cm from the beak is around 9 to 11. *Ladogilina* sp. 2 is very close to *L. rossica* in its external aspect and internal features; it differs only by its larger size.

The genus *Ladogilina* is known in Russia (Urals and Timan), Eastern Iran (Kerman Province) and western Afghanistan. All the occurrences are from the Lower Frasnian (Asymmetricus Zone).

Order Atrypida RZHONSNITSKAJA, 1960
Suborder Atrypidina MOORE, 1952
Superfamily Atrypoidea GILL, 1871
Family Atrypidae GILL, 1871

Subgenus *Spinatrypa* (*Spinatrypa*) STAINBROOK, 1951

Type species: *Atrypa hystrix* var. *occidentalis* HALL, 1858, p. 515.

Spinatrypa (*Spinatrypa*) sp. e.g. *S. longispina* (RIGAUX, 1872)

Pl. 1, Figs. 14–18; Table 3

Material

Eight complete specimens and some separate valves; LPB 12404 – LPB 12409. Kozan section, levels PK 66A, B, C, D.

Description

Shell equibiconvex in juvenile growth stages becoming strongly dorsi–biconvex in adult stages (means of dorsal and ventral H respectively 6.9 and 4 mm – Table 3), slightly wider than long (means: L=19.6 mm; W=21.4 mm) with a hinge line shorter than the maximum width. Sulcus and fold absent, only indicated by a slight ondulation of the anterior commissure in adult specimens.

Ventral valve regularly convex; sulcus lacking in juveniles, becoming slightly developed in the immediate vicinity of the anterior commissure in adults. Tongue very low and wide (exceeding 1/2 of shell width). A single gerontic specimen shows a relatively well defined sulcus and tongue. Umbo feebly prominent with a wide submesothyrid foramen. Interarea not developed.

Dorsal valve more convex than the ventral one, regularly postero–anteriorly curved. In transverse section, the valve is strongly convex in its median part, becoming concave in its postero–lateral extremities. The fold is absent.

The ornament consists of coarse ribs (about 7 ribs per 10 mm near the commissure) increasing in number by dichotomy and intercalation. The growth lamellae are long (1 to 2 mm), and their anterior edge is sharply erect (with an angle reaching or exceeding 45°). They are covered with fine concentric growth lines (about 15 per mm). Spines are not preserved *in situ*, but some remains were observed in the sediment covering the external surface of one shell.

Internal features unknown.

Discussion

From the general shape, ornament (ribs and growth lines) and despite the lack of information about its internal morphology, this form is undoubtedly related to the genus *Spinatrypa* STAINBROOK, 1951. Given the relative convexity of the valves (shell rather dorsibiconvex) this form belongs to the subgenus *S.* (*Spinatrypa*). Among the numerous species assigned to the genus, this one is very close to *S. longispina* (RIGAUX, 1872) and differs only by its smaller size. The *S. aspera* group and *S. curvirostra* COPPER, 1967 have stronger, wider and less numerous ribs (4 ribs per 10 mm at the commissure). The adult/gerontic specimens of the present species show some similarities with *Atrypa nefedovae* LJASCHENKO, 1950 in their strongly dorsiconvex profile, but differ by their smaller size and less numerous, coarser ribs.

The only ascertained occurrence of *S. longispina* is in the upper part of the Ferques Formation (Boulonnais, N. France), in the Triangularis Zone (Frasnian). After GODEFROID (1988), the other mentioned occurrences (Belgium and Germany) are dubious or erroneous.

Order Spiriferida WAAGEN, 1883
Suborder Spiriferidina WAAGEN, 1883
Superfamily Cyrtospiriferoidea TERMIER & TERMIER, 1949
Family Cyrtospiriferidae TERMIER & TERMIER, 1949

Genus *Cyrtospirifer* NALIVKIN, 1924 (in FREDERIKS)

Type species: *Spirifer verneuili* MURCHISON, 1840, p. 252.

Cyrtospirifer sp. aff. *C. kermanensis* BRICE, 1999

Pl. 2, Figs. 19–23

Material

Nine more or less complete specimens and 3 ventral valves; LPB 12412 – LPB 12417a. Kozan section, levels PK66 A to E.

Table 3 Measurements (in mm) of *Spinatrypa* sp. cf. *S. longispina* (RIGAUX, 1872) from the Kozan section, near Kilgen Lake, SE Turkey.

Sample	L	W	H_d	H_v	Nc (distance from the beak in mm)					
					(5)	(10)	(15)	(20)	(25)	(40)
LPB 12404a	21.5	25.5	7.5	6.2	19	25	—	—	33	—
LPB 12406a	22	22	7.9	3.5	14?	22?	≈30	≈36	—	—
LPB 12406b	14	15.5	4.6	3	≈18	≈30	30	—	—	—
LPB 12407a	18.5	21.5	3.5		≈14	≈20	27	—	—	—
LPB 12407b	≈11.5	≈13	4	2.5	≈20	≈22	—	—	—	—
LPB 12407c	29.5	31.5	8.9	≈7	18	22	—	≈32	50?	—
LPB 12407d (gerontic)	35.5	36.3	20	≈5	16	24	28	36?	40?	>50
LPB 12408a	12	13	3.5	2	14	21	24	—	—	—
LPB 12408b	12	14.5	2.5	2.5	24	≈40	—	—	—	—
Means	**19.6**	**21.4**	**6.9**	**4**	**≈17**	**≈25**	**≈28**	**≈35**	**≈41**	**—**

Description

Shell small (means: L=12 mm; L_t=16 mm; W=22.3 mm without mucros), transverse with subtrapezoidal outline and slightly sinusoidal lateral commissures. The ventral valve is higher than the dorsal one (means: H_d=5.2 mm; H_v=7.5 mm). The shell is mucronate and the maximum width is thus located at the hinge line. Shells with preserved mucros would probably reach a total width of 30 mm. When the mucros are broken, the cardinal extremities are subangular.

The ventral interarea is low, apsacline, flat on its greater height, becoming abruptly curved in its upper part. It is clearly delimited (sharp angles at the transition to the flanks) with subparallel edges, longitudinally and vertically striated, with finer vertical striation. The delthyrium is triangular and bounded by high, rarely preserved deltidial plates. The beak is strong, overhanging on the area, obscuring the top of the delthyrium in posterior view.

The sulcus is deep, wide (~1/3 W at the anterior margin), and easily delimited by ribs stronger than any adjacent ones. It forms a wide open V-shaped or widely rounded section. The fold is variably expressed, generally low, occasionally not protruding over the flanks, rounded in section. It is always clearly delimited by grooves, obviously deeper than adjacent ones. The tongue is rounded, variably developed, generally low.

The entire shell is ribbed. The ribs on the sulcus/fold are narrower than those on the flanks, particularly in the vicinity of the anterior commissure. The ribs are simple on the flanks (about 20 on each flank), the postero–lateral ones, near mucros, being very faint and poorly expressed. Their number increases by dichotomy (or intercalation?) on the sulcus/fold. These dichotomies/intercalations occur relatively late (on the anterior half of the shell). There are generally 11 ribs (extremes: 10 and 12) on the sulcus/fold.

The micro-ornament consists of fine, closely spaced concentric growth lines (about 7 per mm) and very fine radial capillae bearing densely distributed spine bases.

Interior: the apical part of the shell is variably thickened. The dental plates are long (1/3 L), divergent, almost straight and extrasinal. A well developed delthyrial plate is present. Ctenophoridium present; crural plates apparently lacking or obsolescent. The remaining internal structures have not been observed, due to recrystallization of the shells.

Discussion

The finely costate fold and sulcus, and the wide interarea with acute angles are consistent with assignment to the Cyrtospiriferinae. *Cyrtospirifer* NALIVKIN in FREDERIKS (1924) seems to be the best classification for this species although most of the representatives of this genus show a high, triangular interarea, which is not the case here. The general aspect of our species also recalls *Geminisulcispirifer* SARTENAER, 1982, but the latter has a characteristic median groove on the fold, intrasinal dental plates and bifurcations on lateral ribs. Some specimens of *Sinospirifer sinensis* GRABAU, 1931, particularly those with low interarea, are similar to our species but their mucros are basally wider, their sulcus shallower, the beak less curved and the number of lateral ribs is greater.

Finally the most similar species is *Cyrtospirifer kermanensis* BRICE, 1999, which differs from our species in its shallower, not so sharply limited sulcus and a generally subquadratic outline. *C. archiaci* (MURCHISON, 1840) has a similar number of ribs, grooves bounding the fold and fine mucros, but it is more globose and elongate, with a subquadratic outline. *C. disjunctus* (SOWERBY, 1840) often considered as a synonym of *C. verneuili* (MURCHISON, 1840), shows fine mucros similar to those of our species, a low ventral interarea with subparallel edges and a fold clearly delimited by deep grooves, but it is much larger with a subquadratic outline. *C. echinosus* LJASCHENKO, 1958, is a transverse form with deep fold-bounding grooves, but its mucros are poorly developed, its ribs more numerous (on both flanks and sulcus) and its ventral interarea high and rather triangular. Another species, *C. poljanicus* LJASCHENKO, 1954 in LJASCHENKO (1959) has fine mucros but a shallower, poorly delimited sulcus and corresponding fold.

C. kermanensis has been described from the Frasnian of Iran.

Cyrtospirifer sp. cf. *C. verneuili* (MURCHISON, 1840)

Pl. 2, Figs. 5–7

Material

Two complete, crushed specimens and 1 incomplete ventral valve; LPB 12417c and LPB 12425. Kozan section, levels PK66 A and E.

Description

These poorly preserved specimens are ventribiconvex, relatively large (maximum: L=27 mm, W=40 mm, H=24 mm) with a subquadrangular outline, wider than *Eodmitria* sp. (see description below). The ventral interarea is low (possibly owing to distortion) with a poorly prominent, more or less incurved beak. Cardinal extremities are acute with incipient mucronation. The sulcus and fold are clearly delimited but very shallow/low, almost inconsistent, even in the proximity of the anterior commissure where the tongue is rather low. The sulcus has a flat V-shaped section; the fold has a rounded one. The ornament consists of very fine ribs over the entire shell. There are about 20 ribs on the fold/sulcus, where they increase in number by intercalation, and about 35 ribs on each flank on the larger specimen. They are finer than in *C.* sp. aff. *C. kermanensis* (see above) and similar in size to those of *Eodmitria* sp. (see below), but not flattened on top. The interior is unknown.

Table 4 Measurements (in mm) of *Eodmitria* sp. from the Kozan section, near Kilgen Lake, SE Turkey.

Sample	L	L_t	W	W_h	W_s	H_d	H_v	Nc_f	Nc_s
LPB 12418a	20	25	25	15	≈10	6	10	≈30	≈13
LPB 12418b	23	28	27	18.5	14	9	15	30	20
LPB 12418c	20.5	27	26	12.5	≈12	7	10	33	18
LPB 12419a	24.5	30.5	31	22	14	10	12	34	≈20
LPB 12419b	26.5	32.5	32.5	27	≈14	≈7?	≈12	—	—
LPB 12421a	21	28.5	≈31	21	≈14	—	≈10	32	≈21
LPB 12424a	—	—	31.5	16	—	10	11	35	20–22
LPB 12424b	34	39.5	38.5	23.5	19	11	13	37–38	≈27
LPB 12424c	28	34	33	≈18	15	10	13	≈30	23
LPB 12424d	27	32	≈34	21	15	9	13	37	20–21
LPB 12424e	28	34	34	19	16.5	9	14	>30	21–22
LPB 12424f	20.5	25.5	24.5	17	≈12	8	10	33	19
LPB 12424g	24.5	31.5	≈27	≈18	≈16	≈9	≈12	31	≈26
Means	**24.8**	**30.7**	**30.4**	**19.1**	**14.3**	**8.8**	**11.9**	**≈33**	**≈21**

Discussion

These specimens are assigned to *Cyrtospirifer* but owing to their poor preservation, a specific assignment remains uncertain. They differ from *C.* sp. aff. *C. kermanensis* by their larger size, poorly developed fold and sulcus, fine ribbing and ventral interarea lacking subparallel edges. They differ from *Eodmitria* sp. by their transverse outline, more or less mucronate extremities and relatively coarser, not flattened ribs, but they show some affinities with some unpublished specimens of *Eodmitria* sp. from the lower Frasnian of Ferques (Boulonnais, France) presently under investigation (BRICE, pers. comm., 2004).

Genus *Eodmitria* BRICE, 1982

Type species: *Eodmitria supradisjuncta boloniensis* BRICE, 1982, p. 578.

Eodmitria sp.

Pl. 2, Figs. 8–18; Table 4

Material

12 almost complete specimens and 1 isolated ventral valve; LPB 12417b – LPB 12424. Kozan section, levels PK66 A and C.

Description

Shell medium to large (means: L=24.8 mm; W=30.4 mm), slightly inequivalve (means: H_d=8.8 mm; H_v=11.9 mm) (Table 4), with variable outline: subquadratic weakly elongated, rarely slightly transverse (in adult stage). The maximum width is located around the midlength. The lateral commissures are widely rounded, sometimes becoming slightly concave near the cardinal extremities. The hinge line is very short (mean: W_h=19.1 mm), clearly shorter than the maximum width. Cardinal extremities subangular (widely obtuse angle) with traces of weak mucronation in some specimens.

The ventral interarea is triangular, occasionally abruptly interrupted distally. It is well delimited, short, relatively high, curved and apsacline, with strong vertical striae. The delthyrium is triangular, lined by apparently low deltidial plates and deltidial slots. The beak is prominent, recurved on the interarea.

Sulcus and fold very weak, becoming somewhat better expressed near the anterior commissure where a low, rounded tongue is developed. The sulcus is poorly delimited, the fold better delimited by two lateral grooves deeper and larger than adjacent ones. At the anterior margin, their width reaches or exceeds half of the maximum width (mean W_s=14.3 mm). In transverse section, the sulcus is widely rounded or slightly subangular, particularly in the juvenile stages.

The entire shell is ribbed. The ribs are rounded with a flattened, or even depressed top, and separated by narrow, rounded to subangular interspaces. The ribs are generally simple on the flanks, with a few exceptions, the distal ones being very faint. Their number lies between 30 and 38 per flank. Dichotomies, more rarely trichotomies, occur on the sulcus and fold, where the ribs are finer than the lateral ones. There are 13 to 27 ribs at the anterior edge of the sulcus/fold (mean=20.9).

The microornament consists of very close prominent growth lines (4 to 5 per mm), with irregularly distributed spine bases or pustules.

Ventral interior: the dental plates are thin, straight, relatively long (about 1/4 L), slightly internally convex in section. The delthyrial plate is thin, and relatively long. There is no apical thickening of the shell. Muscle prints were not observed.

Dorsal interior: the cardinal process is striated. The crural bases are long.

Discussion

The general outline of the shell, the weak, ill-defined sulcus and fold, the number of ribs and their shape, the presence of a well developed delthyrial plate, and the presence of crural plates, etc. indicate that this species belongs to *Eodmitria* BRICE, 1982. In the closely related genus *Dichospirifer* BRICE, 1971, the ribs are dichotomous on the entire shell and the delthyrial plate is rudimentary. The closely related genus *Uchtospirifer* LJASCHENKO, 1957 possesses a well developed delthyrial cover and the sulcus and fold are clearly marked. In the original diagnosis, BRICE (1982 – p. 575) indicates that the shell is always mucronate in *Eodmitria*. Nevertheless, some species assigned to the genus since its erection show only a very slight mucronation.

Despite its ressemblance to several species of the genus, the nomenclature of this species remains open because no known species possess this combination of characters. *Eodmitria supradisjuncta* (OBRUTCHEV, 1917) differs from *Eodmitria* sp. in its thick dental and delthyrial plates and a thickened apical region. The subspecies *E. supradisjuncta boloniensis* BRICE, 1982 (type-species of the genus) also shows an apical thickening and has less numerous lateral ribs, a more transverse outline and a more pronounced tendency to mucronation. *E.*? *seminoi* (VERNEUIL, 1850) is also apically thickened, has intra- to subsinal dental plates and lacks crural bases. *E. oblivialis* SARTENAER, 1982 is larger, with a generally longer hinge line, and has stronger, less numerous ribs.

It is possible that this species could be the same as that cited by TCHIHATCHEFF (1854) in the region of Feké (Anti-Taurus) under the name *Spirifer seminoi* VERNEUIL.

The genus *Eodmitria* is known from the Lower Frasnian of Western Europe (Asymmetricus Zone) and the Middle Frasnian from the Russian Platform (Timanicus and Triangularis Zones).

Suborder Delthyridina IVANOVA, 1972
Superfamily Delthyridoidea PHILLIPS, 1841
Family Mucrospiriferidae BOUCOT, 1959

Genus *Eleutherokomma* CRICKMAY, 1950

Type species: *Eleutherokomma hamiltoni* CRICKMAY, 1950, p. 220.

Eleutherokomma hamiltoni? CRICKMAY, 1950

Pl. 2, Figs. 1–4

Material

Three ventral valves and one interior of a ventral valve; LPB 12410 – LPB 12411. Kozan section, levels PK66 B and C.

Description

Transverse shell with subtrapezoidal outline, laterally developing very long mucros. The largest shell is 60 mm wide including mucros (that is about 30 mm without mucros) and 12 mm long. The area is relatively low, strongly apsacline, separated from the flanks by angular edges. The beak is barely prominent. The triangular delthyrium is bordered by low deltidial plates that probably join (?) under the umbo.

The sulcus is wide (W_s=7.5 mm on the above mentioned specimen), shallow, somewhat flared with a rounded section, and bears a faint median ridge.

The ornament consists of 7 lateral rounded ribs per flank, separated by narrow subangular interspaces. The external pair is very faint but the internal pair (bounding sulcus) is clearly stronger than the others. Microornament consists of wavy growth lamellae, the density of which increases anteriorly, and that bear very fine concentric growth lines (8 per mm).

Ventral interior with strong apical thickening embedding the apical structures: delthyrial ridge (rather than true delthyrial plate) and obsolescent dental plates. Teeth short, small, elliptical in outline. No trace of muscle scars observed.

Dorsal valve unknown.

Discussion

After the general aspect of the shell, and particularly the long mucronations, this species can undoubtedly be assigned to *Eleutherokomma* CRICKMAY, 1950. The closest species is *E. hamiltoni* CRICKMAY, 1950, which presents a comparable number of ribs, with sulcus bounding costae stronger than the lateral ones, and very long mucros. It differs in the presence of short dental plates that are partly free and thus visible, due to a less significant shell apical thickening. This variation could result from different environmental conditions. The other species of *Eleutherokomma* with few lateral ribs as in this species, have either short mucros or they are absent.

E. hamiltoni is known from the Lower Frasnian of Canada (lower Asymmetricus Zone).

3. CONCLUSIONS

Despite the fact that the nomenclature of many species described here remains open, due to the few specimens at hand, an estimation of the age can be done with reasonable certainty. At the generic level, this assemblage indicates a Late Devonian age: 4 genera have a Middle–Upper Devonian distribution, 2 are Upper Devonian and 3 are Frasnian (*Douvillina*, *Eodmitria* and *Ladogilina*), one of them (*Ladogilina*) being restricted to the Lower Frasnian. Otherwise, the presence of *Spinatrypa* precludes a Famennian age. This leaves no doubt about a Frasnian age and an Early Frasnian age is probable,

although *Cyphoterorhynchus* is mentioned from the Middle–Upper Frasnian. This is reinforced by an examination at the species level: even if the specific assignments are not definitely stated, all the specific proximities recognized here are with Frasnian species (e.g. *R. elburzensis*, *C. koraghensis*, *S. longispina*, *E. hamiltoni*, *C. kermanensis*, etc.).

The association shows close affinities with those described from Iran and Afghanistan (BRICE, 1971, 1999) and also from the Russian Platform, Timan and Volgo–Uralian areas (LJASCHENKO, 1959, 1973). Several genera are common to these regions, and it is probable that the differences and/or uncertainties at the specific level could be clarified after complementary sampling in Turkey. It is clear that our material is insufficient for a detailed study, but the obvious similarities in the fossil assemblages are troubling if not significant, particularly if we consider some genera with relatively restricted geographic distributions (e.g. *Eleutherokomma* and *Ladogilina*). Resemblances also occur at the morphological level, since several taxa from these different regions share peculiar shell "habitus": highly developed, globose ventral valves (*Ladogia*, *Spinatrypa*), sub-cuboid shells (*Ripidiorhynchus*, *Cyphoterorhynchus* variants reminiscent of *Hypothyridina*) or the contrasted very short/very wide hinged spiriferids (*Eodmitria* vs. *Eleutherokomma*). This morphologic analogy is probably related to similar environmental conditions.

The faunal similarities between Iran, Afghanistan, Pakistan and Armenia during the Upper Devonian have been already underlined by several authors (e.g. BROCK & YAZDI, 2000). The Devonian Turkish fauna indicates that the Taurids (at least the eastern part of the Taurids) should be included in this group of regions constituting the so-called "Cimmerian belt", a suite of terranes located along the North Gondwanan margin. Furthermore, the presence of *Eleutherokomma*, also known in Iran, Mauritania (RACHEBOEUF et al., 2004), northern France and eastern Canada, reinforces the faunal evidence for a narrow oceanic separation between North Gondwana and Euramerica at this time, contrary to some reconstructions based mainly on palaeomagnetic data.

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4. REFERENCES

ABRAMIAN, M.S. (1957): Brakhiopody verkhnefamenskikh i etrenskikh otlojenii iugo-zapadnoi Armenii [*Brachiopods of the Upper Famennian and Etroeungt deposits of SW Armenia* – in Russian].– Izdateltsvo Akademia nauk Armianskoi SSR, Erevan, 142 p.

BRICE, D. (1971): Etude paléontologique et stratigraphique du Dévonien de l'Afghanistan [*Paleontological and stratigraphical study of the Devonian of Afghanistan* – in French].– Notes et Mémoires sur le Moyen Orient, 11, 364 p.

BRICE, D. (1982): *Eodmitria*, genre nouveau de brachiopode *Cyrtospiriferidae* du Frasnien inférieur et moyen [Eodmitria, *a new* Cyrtospiriferidae *brachiopod genus from the lower and middle Frasnian* – in French].– Geobios, 15, 575–581.

BRICE, D. (1999): New Upper Devonian rhynchonellid and spiriferid brachiopod taxa from Eastern Iran (Kerman Province) and Central Iran (Soh Region).– Annales de la Sociéte Géologique du Nord, 7, 2ième Série, 71–78.

BROCK, G.A. & YAZDI, M. (2000): Palaeogeographic affinities of Late Devonian brachiopods from Iran.– In: MAWSON, R., TALENT, J.A. &. LONG, J.A. (eds.): Mid-Palaeozoic Biota and Biogeography. Records of the Western Australian Museum, Supplement 58, 321–334.

BROUSMICHE, C. (1973): Révision des Productellidae (Brachiopodes) du Dévonien de Ferques (Boulonnais, France) [*Revision of the Productellidae (Brachiopods) from the Devonian of Ferques* – in French].– Annales de la Société géologique du Nord, 92/2, 117–136.

BUCH, L. von. (1834): Über Terebrateln, mit einem Versuch, sie zu classificiren und zu beschreiben [*About the Terebratules, with a tentative classification and description* – in German].– Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin, 1833, 21–144.

COPPER, P. (1967): *Spinatrypa* and *Spinatrypina* (Devonian Brachiopoda).– Palaeontology, 10, 489–523.

CRICKMAY, C.H. (1950): Some Devonian Spiriferidae from Alberta.– Journal of Paleontology, 24, 219–225.

ELLERN, S.S., IVANOV, E.E. & KURBANOV, F.Y. (1955): Brakhiopody Devona Tatarskoi ASSR [*Devonian brachiopods of the Tatar ASSR* – in Russian].– In: KRYLOVA, A.K. (ed.): Brakhiopody Devona Volgo–Uralskoi oblasti. VNIGRI. Trudy, 88, 107–145.

FREDERIKS, G.N. (1924): Paleontologicheskie ztoudy. 2: O verkhne-kamennougolnykh spiriferidak Ourala [*Paleontological studies. 2. On Upper Carboniferous spiriferids from Urals* – in Russian].– Geologicheskogo Komiteta, Izvestiya, 38 (1919), 295–324.

GAETANI, M. (1965): Brachiopods and Molluscs from Geirud Formation, Member A (Upper Devonian and Tournaisian).– Rivista Italiana de Paleontologia, 71, 679–770.

GEDIK, I. (1988). A paleogeographic approach to the Devonian of Turkey.– In: Mc MILLAN, N.J., EMBRY, A.F. & GLASS, D.J. (eds.): Devonian of the World. Memoirs of the Canadian Society of Petroleum Geologists, 14/1, 557–567.

GODEFROID, J. (1988): Brachiopodes Atrypida du Dévonien de Ferques (Boulonnais – France) [*Brachiopods Atrypida from the Devonian of Ferques (Boulonnais, France)* – in French].– In: BRICE, D. (ed.): Le Dévonien de Ferques. Bas-Boulonnais (N. France). Biostratigraphie du Paléozoïque, 7, 403–432.

GOSSELET, J. (1887): Note sur quelques Rhynchonelles du terrain Dévonique supérieur [*Note on some Rhynchonellas from the upper Devonian beds* – in French].– Annales de la Société Géologique du Nord, 14, 188–221.

GRABAU, A.W. (1931): Devonian Brachiopoda of China. 1 – Devonian Brachiopoda from Yunnan and other districts in South China.– Palaeontologia Sinica, Serie B, 3/3, 1–752.

HALL, J. (1858): Palaeontology of Iowa.– In: HALL, J. & WHITNEY, J.D. (eds): Report of the Geological Survey of the State of Iowa, Embracing the Results of investigations Made During Portions of the Years 1855, 56 and 57. Vol. 1/2, 473–724, Des Moines.

HALL, J. (1867): Palaeontology of New York.– Vol. 4 (1), Containing descriptions and figures of the fossil Brachiopoda of the Upper Helderberg, Hamilton, Portage and Chemung Groups. 428 p., New York.

LAZAREV, S.S. (1989): Systema devonskikh brakhiopod podotriada Strophalosiidina [*Systematics of Devonian brachiopods of Strophalosiidina suborder* – in Russian].– Paleontologicheskii Zhurnal, 1989, 2, 27–39.

LJASCHENKO, A.I. (1950): Brakhiopody poddomanikovikh otlojenii iujnogo Timana i ik stratigraficheskoi znatchenie [*Brachiopods of the sub-Domanik deposits of south Timan and their stratigraphic significance* – in Russian].– Fondia IGN SSSR (unavailable).

LJASCHENKO, A.I. (1957): Novyi rod devonskikh brakhiopod: *Uchtospirifer* [*A new genus of Devonian brachiopods:* Uchtospirifer – in Russian].– Akademiia nauk SSSR, Doklady, 117/5, 885–888.

LJASCHENKO, A.I. (1958): Brakhiopody Nijnefranskikh otlojenii tsentralnoi chasti Russkoi Platformi [*Brachiopods of Lower Frasnian deposits of the central part of the Russian Platform* – in Russian].– VNIGRNI, Gosgeolizdat, Trudy, 9, 105–157.

LJASCHENKO, A.I. (1959): Atlas brakhiopod i stratigraphiia Devonskikh otlojenii tsentralnikh oblastei Russkoi Platformi [*Atlas of brachiopods and stratigraphy of the Devonian deposits of the central region of the Russian Platform* – in Russian].– Ministerstvo Geologii i Okrania NEDR SSSR (VNIGII), 451 p.

LJASCHENKO, A.I. (1973): Brakhiopody i stratigraphiia Nijnefranskikh otlojenii iujnogo Timana i Volgo–Uralskoi neftegazonosnoi provintsii [*Brachiopods and stratigraphy of Lower Frasnian deposits of the south Timan and Volga–Ural oil–gas bearing province* – in Russian].– Ministerstvo Geologii SSSR, Trudy, 134, 1–279.

MURCHISON, R.I. (1840): Description de quelques unes des coquilles fossiles les plus abondantes dans les couches dévoniennes du Bas Boulonnais [*Description of some more numerous fossil shells in the Devonian layers of the Bas Boulonnais* – in French].– Bulletin de la Société géologique de France, 1ière Série, 11, 250–257.

NALIVKIN, D.V. (1937): Brakhiopody verkhnego i srednego Devona i nijnego Karbona Severo–Vostochnogo Kazakhstana [*Brachiopoda of the Upper and Middle Devonian and Lower Carboniferous of Northeastern Kazakhstan* – in Russian].– Tsentral'nyi Nauchno–Issledovatel'skii Geologo–Razvedochnyi Institut (TSNIGRI), Trudy, 99, 1–200.

OBRUTCHEV, S.V. (1917): Voronejskii Devon i gruppa *Spirifer verneuili* MURCH [*The Devonian of Voronej and the group of* Spirifer verneuili *MURCH* – in Russian].– Zapiski Geologicheskogo otdelenii obchtchestva liobitelei–estestvoznaia Antropologii i etnografii, 5, 21–60.

OEHLERT, D.P. (1887): Appendice: Brachiopodes; notions sur l'anatomie et la physiologie des brachiopodes [*Appendice: Brachiopods; elements on the anatomy and physiology of brachiopods* – in French].– In: FISCHER, H. (ed.): Manuel de Conchyliologie et de Paléontologie conchyliologique ou histoire naturelle des Mollusques vivants et fossiles, 11, 1189–1334.

RACHEBOEUF, P.R., GOURVENNEC, R., DEYNOUX, M. & BRICE, D. (2004): The Devonian of the Hodh area (Islamic Republic of Mauritania): Paleontology, stratigraphy and paleobiogeographic implications.– Journal of Paleontology, 78, 98–110.

REED, F.R.C. (1922): Devonian fossils from Chitral and the Pamirs.– Memoirs of the Geological Survey of India, Paleontologia Indica, 6/2, 1–134.

RIGAUX, E. (1872): Notes pour servir à la géologie du Boulonnais. 1. Description de quelques Brachiopodes du terrain Dévonien de Ferques [*Notes to serve about the geology of the Boulonnais. 1. Description of some brachiopods from the Devonian beds of Ferques* – in French].– Mémoires de la Société académique de l'arrondissement de Boulogne sur Mer, 5, 16 p.

SARTENAER, P. (1961): Etude nouvelle, en deux parties, du genre *Camarotoechia* HALL & CLARKE, 1893. Deuxième partie: *Cupularostrum recticostatum* n.gen., n.sp. [*New study, in two parts, of the genus* Camarotoechia *HALL and CLARKE, 1893. Second part:* Cupularostrum recticostatum *n.gen., n.sp.* – in French].– Bulletin de l'Institut royal des Sciences naturelles de Belgique, 37/25, 1–15.

SARTENAER, P. (1965): Rhynchonelloidea de Shogran et Kuragh (Chitral) [*Rhynchonelloidea from Shogran et Kuragh (Chitral)* – in French].– Italian Expeditions to the Karakorum (K2) and Hindu Kush, Scientific Reports, 4, Paleontology, 1, 55–66. Brill, Leiden.

SARTENAER, P. (1966a): *Ripidiorhynchus*, nouveau genre de brachiopode rhynchonellide du Frasnien [Ripidiorhynchus, *a new Frasnian rhynchonellid brachiopod genus* – in French].– Bulletin de l'Institut royal des Sciences naturelles de Belgique, 42/30, 1–15.

SARTENAER, P. (1966b): Frasnian Rhynchonellids from the Ozbak–Kuh and Tabas regions (East Iran).– Geological Survey of Iran, Reports, 6, 25–53.

SARTENAER, P. (1982): The presence and significance of *Spirifer bisinus*, *S. malaisi*, *S. supradisjunctus*, and *S. seminoi* in early Frasnian beds of Western Europe.– In: SARTENAER, P. (ed.): Papers on the Frasnian–Givetian Boundary, 122–196.

SOKOLSKAJA, A.N. (1948): Evolutsiia roda *Productella* Hall i smezhnykh s nim form v Paleozoe podmoskovnoi kotloviny [*Evolution of the genus* Productella *Hall and related forms in the Paleozoic of the Moscow region* – in Russian].– Akademiia nauk SSSR, Paleontologicheskii Institut, Trudy, 14/3, 1–168.

SOWERBY, J. de C. (1840): On the physical structure and older stratified deposits of Devonshire.– In: SEDGWICK,

A. & MURCHISON, R.I. (eds.): On the distribution and classification of the older or Paleozoic deposits of the North of Germany and Belgium and their comparison with formations of the same age in British isles. Transactions of the Geological Society of London, 2nd series, 5/3, 633–703.

STAINBROOK, M.A. (1943): Strophomenacea of the Cedar Valley limestone of Iowa.– Journal of Paleontology, 17, 39–59.

STAINBROOK, M.A. (1951): Substitution for the pre-occupied brachiopod name *Hystricina*.– Journal of the Washington Academy of Sciences, 41, 196.

TCHIHATCHEFF, P. (1854): Dépôts paléozoïques de la Cappadoce et du Bosphore [*Paleozoic deposits of the Cappadocia and Bosphorus* – in French].– Bulletin de la Société Géologique de France, 2ième Série, 11, 402–416.

VERNEUIL, E. de (1850): Notice sur la collection de roches recueillie en Asie par feu Hommaire de Hell, et sur les divers travaux exécutés pendant le cours de son voyage (In: VIQUESNEL, M.) [*Notice on the rock collection sampled in Asia by the late Hommaire de Hell, and on various studies realized during the course of his trip* – in French].– Bulletin de la Société Géologique de France, 2ième Série, 7, 491–514.

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PLATE 1

Fig. 1 *Douvillina* sp. Level PK66C. Interior of ventral valve, x2, LPB 12400.

Figs. 2–5 *Productella* sp. cf. *P. subaculeata* (MURCHISON, 1840). Level PK66C. Dorsal, ventral, posterior and lateral views, x1.5, LPB 12402.

Figs. 6–9 *Ladogilina* sp. 1. Level PK66A. Ventral, dorsal, posterior and lateral views, x1, LPB 12426.

Figs. 10–13 *Ripidiorhynchus* sp. cf. *R. elburzensis* (GAETANI, 1965). Level PK66B. Lateral, dorsal, anterior and ventral views, x1.5, LPB 12403.

Figs. 14–18 *Spinatrypa (Spinatrypa)* sp. e.g. *S. longispina* (RIGAUX, 1872). Level PK66C. Dorsal, ventral, anterior, posterior and lateral views, x1, LPB 12407.

Figs. 19–23 *Cyphoterorhynchus koraghensis* (REED, 1922). Level PK66C. Dorsal, ventral, anterior, posterior and lateral views, x1, LPB 12438.

Figs. 24–28 *Cyphoterorhynchus arpaensis* (ABRAMIAN, 1957). Level PK66C. Dorsal, ventral, anterior, posterior and lateral views, x1, LPB 12435.

Figs. 29–33 *Ladogilina* sp. 2 cf. *L. rossica* LJASCHENKO, 1973. Level PK66E. 29–32: Dorsal, ventral, anterior and posterior views, x1, LPB 12429a; 33: posterior view of internal mould, x1.5, LPB 12429d.

All specimens are from the Kozan section (Kilgen Lake, Eastern Taurus, Central Turkey).

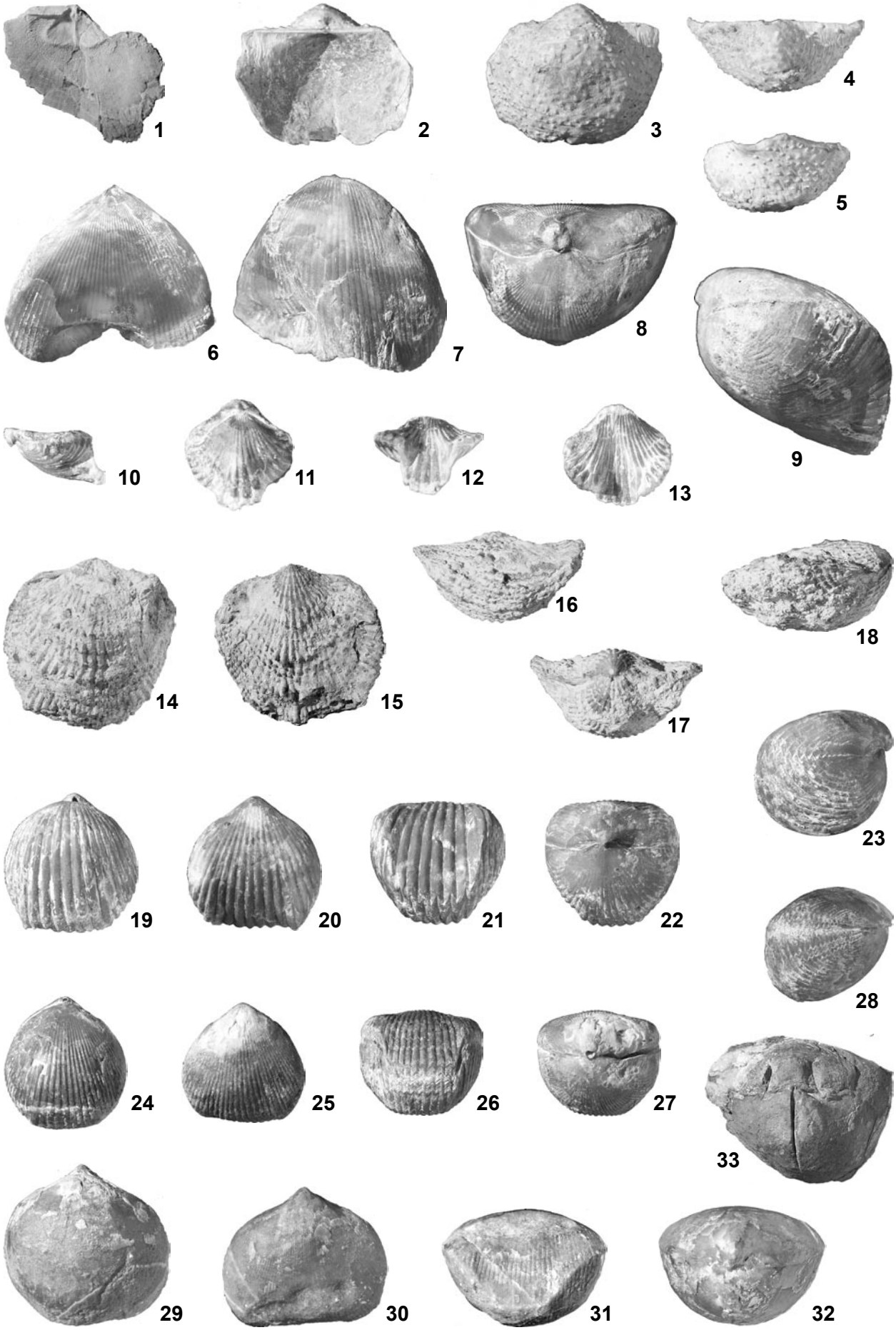
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PLATE 2

Figs. 1–4 *Eleutherokomma hamiltoni*? CRICKMAY, 1950. Level PK66C. 1–3: ventral, anterior and lateral views, LPB 12411a; 4: interior of ventral valve, LPB 12411c.

Figs. 5–7 *Cyrtospirifer* sp. cf. *C.verneuili* (MURCHISON, 1840). Level PK66E. 5–6: dorsal and ventral views; 7: microornament (x10), LPB 12417c.

Figs. 8–12 *Eodmitria* sp. Level PK66A. Dorsal, ventral, anterior, posterior and lateral views, LPB 12418b.

Fig. 13 *Eodmitria* sp. Level PK66A. Microornament (x10). LPB 12422.

Figs. 14–18 *Eodmitria* sp. Level PK66C. Anterior, dorsal, ventral, posterior and lateral views, LPB 12424.

Figs. 19–23 *Cyrtospirifer* sp. aff. *C. kermanensis* BRICE, 1999. Level PK66C. Dorsal, lateral, ventral, anterior and posterior views, LPB 12415.

All specimens are from the Kozan section (Kilgen Lake, Eastern Taurus, Central Turkey) and x1.5, unless otherwise indicated.


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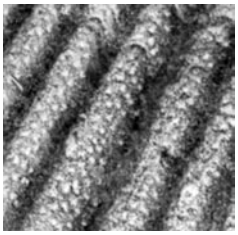
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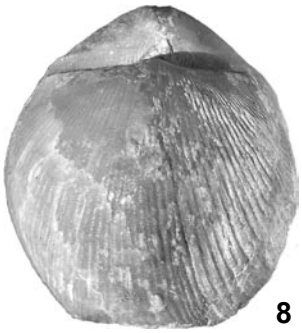
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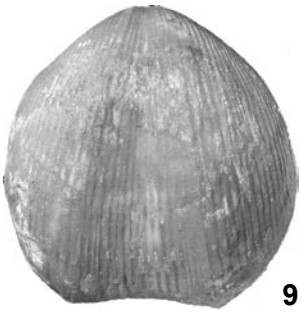
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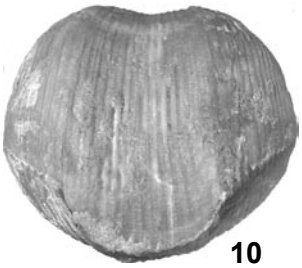
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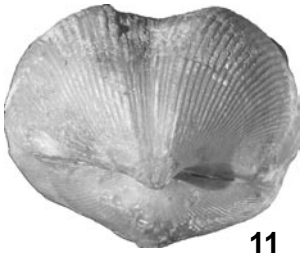
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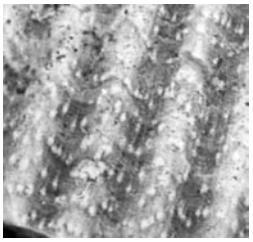
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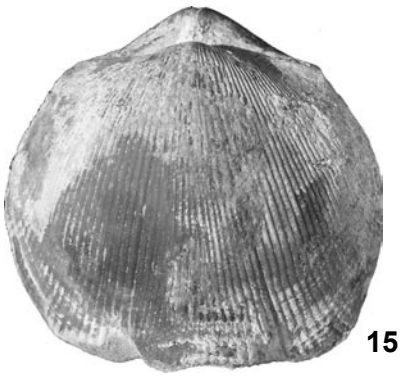
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