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DEVONIAN BRACHIOPODS OF THE TAMESNA BASIN (CENTRAL SAHARA; ALGERIA AND NORTH NIGER). PART 1

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Abstract. The Devonian brachiopod fauna from samples collected by the late Lionel Lessard in the sixties from several sections of the Lower Palaeozoic bordering the Tamesna Basin (Algeria and North Niger, south of the Ahaggar Massif) is described. The fauna is preserved in siliciclastic rocks, often lacking fine morphological details that are necessary for the determination of the fauna. Despite this difficulty, in total 40 taxa have been determined to generic, species or subspecies levels. One new chonetoid genus *Amziella* is defined on newly described species *A. rahirensis*. The new species *Arcuaminetes racheboeufi, Montsenetes pervulgatus*, *Montsenetes* ? *drotae*, *Pustulatia lessardi, Pustulatia tamesnaensis*, *Eleutherokomma mutabilis*, *Mediospirifer rerhohensis* and the new subspecies *Tropidoleptus carinatus titanius* are described. The Pragian age is suggested for the earliest brachiopod association, with maximum spread and diversity of the brachiopod fauna in Late Emsian – Early Eifelian interval. The youngest Devonian brachiopod fauna in the available samples is probably of the Givetian age. The Upper Devonian succession is lagoonal and poorly fossiliferous and precedes the basal marine Carboniferous. The taxonomic composition of fauna indicates an affinity to the Middle Devonian brachiopod faunas of the Eastern Americas Realm. However, in the Upper Pragian and Emsian ages, the influence of the Malvinokaffric Realm is documented by the presence of several genera (*Lomaella*, *Pustulatia, Pleurothyrella, Orbiculoidea*).

■ Brachiopoda, taxonomy, Devonian, Emsian, Eifelian, Tamesna Basin, Algeria, Niger

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Introduction

Devonian fossils of the Tamesna Basin have been known for over forty years but they have never been satisfactorily described. This extensive desert area near Algeria and North Niger borders remains poorly known to present time. The results of the geological mapping of the area have been published by Lionel Lessard (1959, 1961, 1962). He also presented the first more detailed stratigraphical data concerning the Devonian in this area. He recognized the unconformity between the Silurian shales and the transgressive Devonian beds and he also attempted to define the Lower/Middle and Middle/Upper Devonian boundaries in the area, based on lithological and palaeontological data. Since this time, a few other authors have dealt with geology and poor brachiopod fauna (Drot 1986, Racheboeuf 1990b, Herrera et Racheboeuf 2001, Mergl et Massa in print). The original Lessard (1962) stratigraphical data have been called in question, mostly on the data from chonetoid brachiopods (Racheboeuf 1990a, 1990b, Herrera et Racheboeuf 2001).

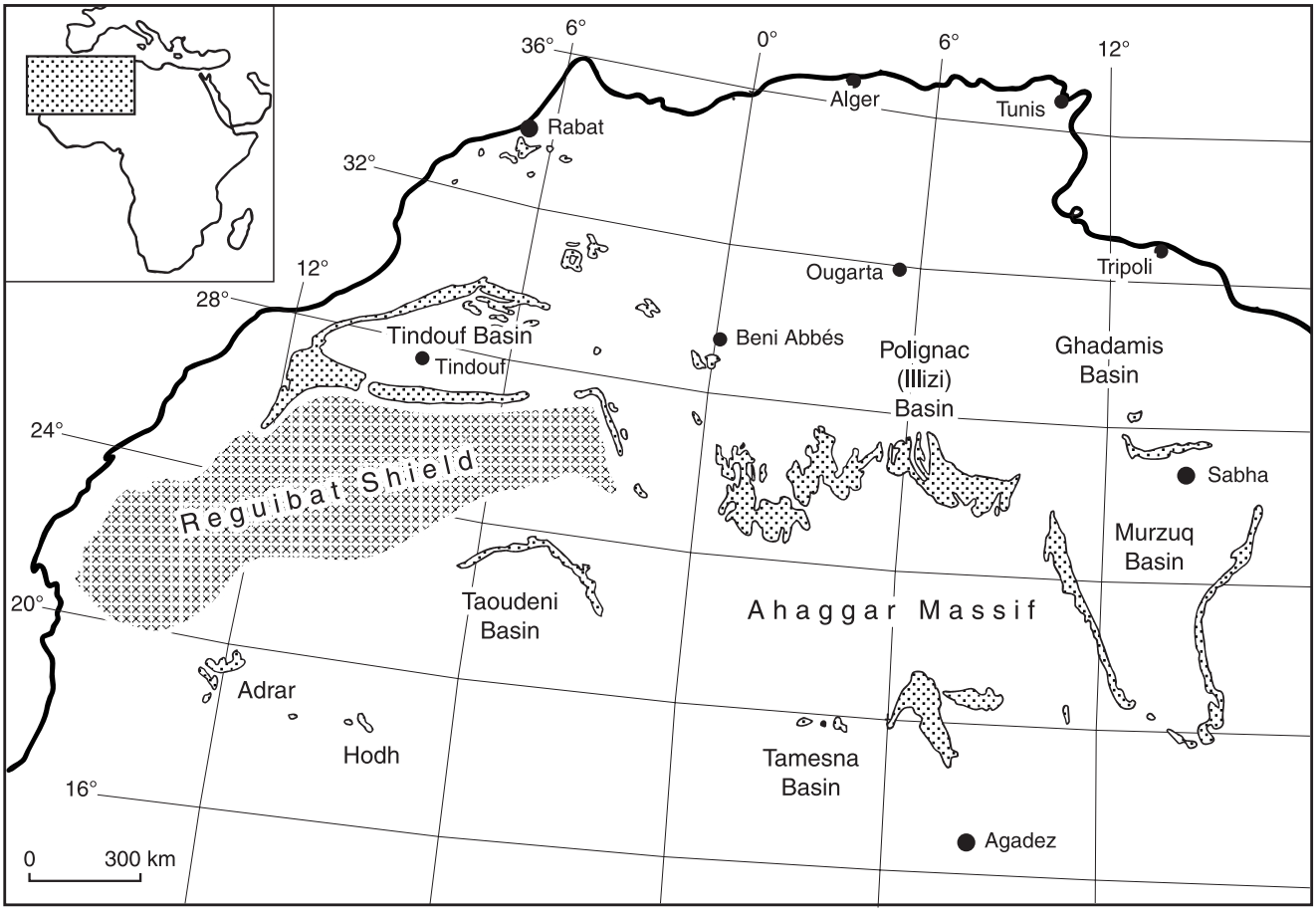
One of the authors (D. M.) strove to bring together the material of the original Lessard's samples and compiled the data of his unpublished reports. The second author (M. M.) described and evaluated the brachiopod fauna of these samples. The attempt to elucidate the geological setting and age of the samples based on brachiopod fauna is the main aim of this report. The paper is divided in two parts. Part 1 presents the taxonomic work of the brachiopod fauna from the surface localities along the north border of the Tamesna Basin.

Part 2 deals with the subsurface brachiopod data from the boreholes drilled in the Tamesna Basin, important non-brachiopod fossils from the surface and subsurface samples, locality data, geological setting, stratigraphy, benthic community ecology and palaeobiogeographic affinity of the fauna. Only a short overview of the geology and stratigraphy is given in Part 1.

Geological setting

The Ténéré du Tamesna Basin, an extensive desert area near Algerian and Nigerian frontiers, is poorly known to present time because of very difficult access. The geological results in this area have been partially published, as far as the Palaeozoic is concerned, roughly between 1960 and 1985 (Lessard et Joulia 1959, Lessard 1959, 1961, 1962, Reboul et al. 1962, Claret et Tempere 1968, Greigertt et Pougnet 1967a, 1967b, Perrodon 1971). Several papers and unpublished reports were mainly devoted to Uranium, Water or Hydrocarbons research works of Bigotte et Obellina (1968), Valsardieu (1970) and Mokkadem (1990).

The Ténéré du Tamesna Basin is located south of the Ahaggar Massif (Text-fig. 1). It is usually mentioned in the



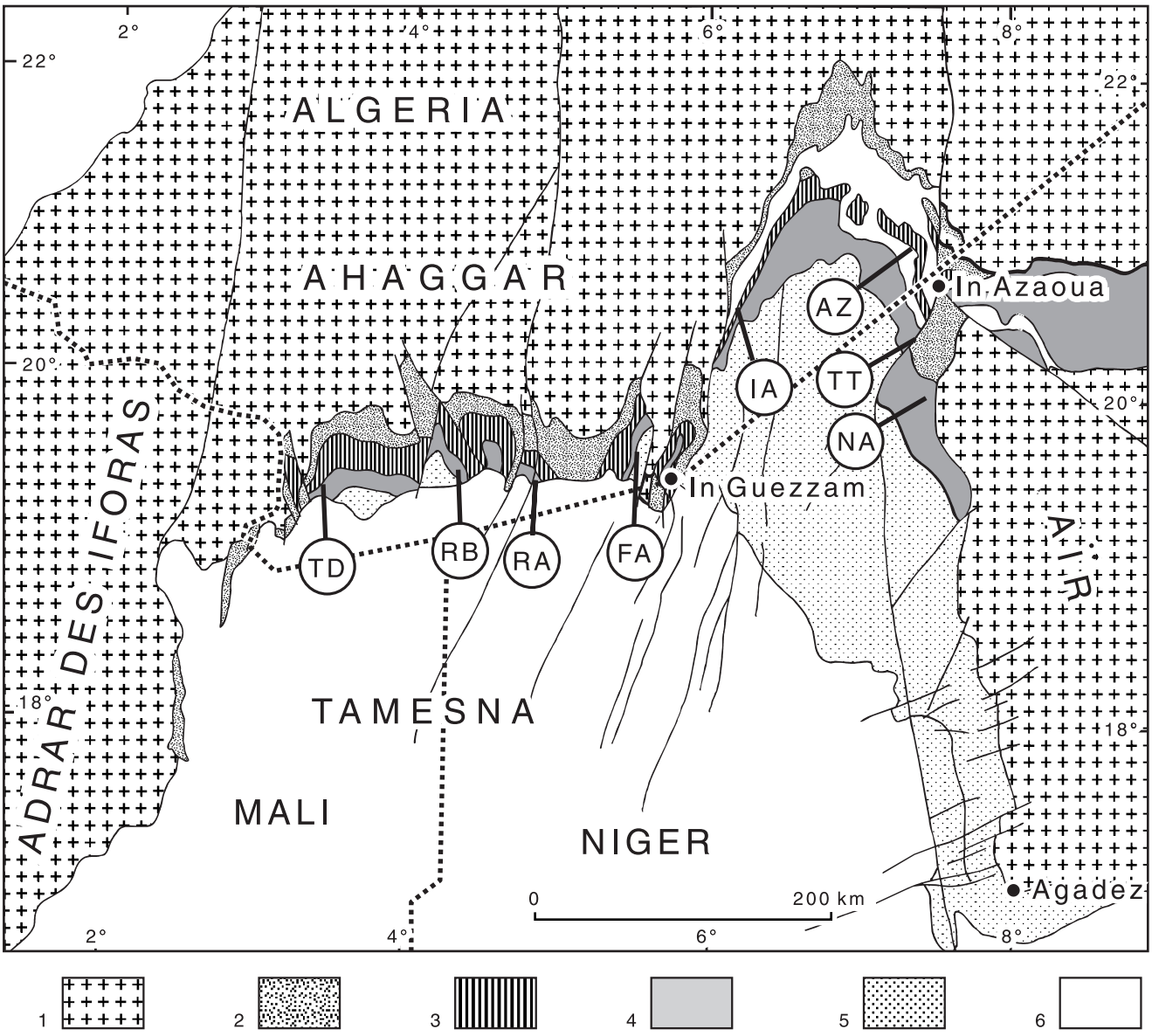
Text-fig. 1. Devonian outcrops in the Saharan platform and NW Africa with location of referred bassins and outcrops (modified after Boucot et al. 1983 and Racheboeuf 2004).

literature as the "Tamesna Basin". The northern part is situated in South Algeria and it is called "Oua-n-Ahaggar Tassili", a local Tuareg name. It is the north margin of the basin widely covering the North Niger (Iullemeden intracratonic Basin). The eastern limit of the Tamesna Basin corresponds with the Precambrian Aïr Massif. The western limit forms the Adrar-des-Iforas Massif, also of the Precambrian age, studied by Karpoff (1960). The north-south In Guezzam Uplift is located in the central part of the basin separating the eastern wide Tin Seririne syncline from the western area, sometimes called Azouak in the literature.

Above the Precambrian of the Ahaggar Massif several formations are known comprising the Cambrian, Ordovician, Silurian, Devonian, and Carboniferous. The total thickness, without the Carboniferous and the Mesozoic, is some 1200–1500 m. A particularly interesting is the comparison between the Palaeozoic outcrops in northern side of the Ahaggar Massif (Tassili-n-Ajjer), the eastern side of the Ahaggar Massif (western flank of the Murzuq-Djado Basin) and the southern margin (Tamesna Basin). They have a great significance for the regional, stratigraphic and palaeogeographic purposes, as they belonged originally to the same "peri-Ahaggarian" area. The selected lithostratigraphy and chronostratigraphy terminology of these units, as used in present work, is given in Text-fig. 3.

The Cambrian and Ordovician units were defined in the Algerian Tassili-n-Ajjer area and refer particularly to the basin contribution (Beuf et al. 1971). According to Lessard et Joulia (1959), the Unit II is considered the Middle and Upper Cambrian in age (equivalent of the Ajjers Formation). The Unit III is of the Lower and Middle Ordovician age (equivalent of the In Tahouite Formation). The Unit IV is of the Upper Ordovician age (equivalent of the Tamadjert Formation). Its diversified marine fauna has been referred by Gatinsky et al. (1966) to the Caradocian and Ashgillian but it has not been described and only approximate faunal list is available. The major unconformities are known north and south of the Ahaggar Massif (Deynoux et al. 1985).

The Silurian was discovered quite early (Kilian 1928). This graptolite-bearing unit is present and mapped in the Oua-n-Ahaggar belt of outcrops (Claret et Tempere 1965). Rapid lateral thickness variations often occur, with ranges from a few meters to almost 250 metres. The thickness variations are related with the important erosion of the Upper Silurian (Caledonian tectonic phase; Bellini et Massa 1981). The age of these Silurian sequences is lower and middle Llandoverian (Deynoux et al. 1985). A revision of the available graptolite collections is in preparation (Štorch et Massa, in prep.). In complete uneroded sections it is possible to recognize equivalents of the "Tanezzuft" and "Acacus" facies,



Text-fig. 2. Geological map of of the north margin of the Tamesna Basin with the sections bearing the Devonian fauna. TD – Toufine and In Debirene section, RB – South Tin Rerhoh Anou n'Bidek section, RA – In Rahir Tin Amzi section, OF – Oued Felaou section, IA – In Ateï Anou Izileg section, TI – Taberia Touaret section, AZ – In Azaoua section, NWA – North West Aïr. 1 – Precambrian, 2 – Cambrian and Ordovician, 3 – Silurian, 4 – Devonian, 5 – Carboniferous, 6 – post-Carboniferous units.

described from the Western Murzuq Basin of South Libya (Massa 1988) and the new name Tin Tarabine Formation is proposed for this succession restricted to the Tamesna Basin.

The lowest sequence of the Devonian lacks marine fossils but it is rich in plant remains and carbonised woods (Idekel Formation). The age of this unit is indistinct but the Lochkovian is probable. In the western part of the Tamesna Basin, in the Oua-n-Ahaggar belt, there the fine grained sandstones and the associated carbonates are commonly fossiliferous (Bazoche et Blain 1961). Trilobites, bivalves, brachiopods and tentaculites were collected from these beds. A Pragian age of this unit (Touaret Formation) seems adequate taking into consideration the previous publications, mainly of Lessard et Joulia (1959). Above this lowest unit, the Emsian, Eifelian, Givetian and Upper Devonian strata were recognized south of the Ahaggar Massif in the Tamesna Basin, preceding the Carboniferous marine cycle (Valsardieu 1970).

Repository

All specimens, including the types and figured ones are part of the Massa and Mergl collection (abbreviation MaMe), housed as a separate part in the palaeontological collection of the Department of Palaeontology of the Museum of West Bohemia, Plzeň, Czech Republic.

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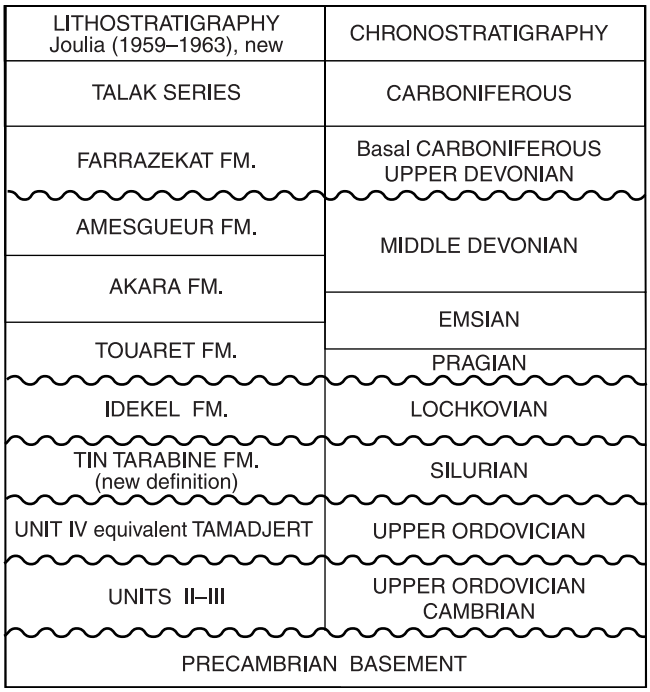
The authors have greatly appreciated the gift of the original documents and sections of the late L. Lessard, made by



Text-fig. 3. Stratigraphy of the Palaeozoic of the Tamesna Basin (after Joulia 1959-1963 and Greigert et Pougnet 1967).

Madame Lessard-Moureaux. They are greatly indebted to P. R. Racheboeuf from Université de Bretagne Occidentale, Brest, France for sending, *pro parte*, the brachiopod material; to A. J. Boucot from the Oregon State University, Corvallis, Oregon, USA for useful comments.

Abbreviations

DvL – length of dorsal valve; DvW – width of dorsal valve; VvL – length of ventral valve; VvW – width of ventral valve; n – number of measured specimens.

Systematic part

Subphylum **Linguliformea** WILLIAMS et al., 1996
Order **Lingulata** GORJANSKY et POPOV, 1985

Superfamily **Discinoidea** GRAY, 1840
Family **Discinidae** GRAY, 1840

Genus ***Roemerella*** HALL et CLARKE, 1890

Type species: *Orbicula grandis* VANUXEM, 1842; Middle Devonian, Hamilton Group; New York, USA.

***Roemerella* ?** sp.

Pl. 5, fig. 1

Material: One external mould of ventral valve in sandstone.

Description: The shell is large, with planar dorsal valve having a weakly concave apical region. The pedicle track is long, narrowly elliptical, with a distinct large listrium. Ornament consists of almost regularly spaced low concentric lamellose rugellae, 0.6 to 0.9 mm apart. Weak growth fila are present in interspaces.

Remarks: This species is poorly known but its weakly concave dorsal valve indicates an affinity to the genus *Roemerella* HALL et CLARKE, 1890. Large discinoids with planar ventral valve are reported but otherwise poorly known in the Lower Devonian. They are characteristic for siliciclastic facies in several parts of the Malvinokaffric Realm (Boucot et al. 2001). Apart of this realm, Kayser (1892) described the large discinoid *Discina siegenensis* KAYSER, 1892 from the Siegenian of Germany. This is similar to the shell from the Tamesna Basin but until recently it was neither revised nor illustrated and the original description and drawings are of a poor quality.

Distribution: Upper Pragian.

Occurrence: Tamesna Basin, Tin Rerhoh area (section 3) (sample H 1079).

Genus ***Orbiculoidea*** D'ORBIGNY, 1847

Type species: *Orbicula forbesii* DAVIDSON, 1848; Silurian, Wenlock; England.

Orbiculoidea sp.

Material: Fourteen complete shells in sandstone.

Remarks: This giant discinoid is described in a separate paper (Mergl et Massa, in print). It represents a new species of the new genus, characteristic by a highly conical dorsal valve and planar ventral valve with a very short pedicle track.

Distribution: Upper Pragian.

Occurrence: Tamesna Basin, In Rahir Tin Amzi section (sample H 1053).

Subphylum **Craniiformea** POPOV et al., 1993
Order **Craniiopsida** GORJANSKY et POPOV, 1985

Superfamily **Craniopsoidea** WILLIAMS, 1963
Family **Craniopsidae** WILLIAMS, 1963

Genus ***Craniops*** HALL, 1859

Type species: ? *Orbicula squamiformis* HALL, 1843; Middle Devonian, Hamilton Group; New York, USA.

Craniops sp.

Pl. 5, fig. 8

Material: Three valves, internal and external moulds, on the same bedding plane of sandstone.

Description: Two associated valves probably belong to the same specimen, the third is of nearly same size. The

shell is 3.5 mm wide, broadly oval with weakly convex dorsal and more convex ventral valve. Exterior is coarsely and distantly lamellose. Interior of the ventral valve has broad elevated brim along posterior and lateral margins. Ventral visceral field is deeply impressed in posterior half of shell, with large oblique crescentic anterior adductors and smaller and less distinct other scars.

Remarks: The genus has broad stratigraphic as well as geographic distributions. It extends from the late Ordovician to early Carboniferous, with the maximum spread in the late Silurian and early Devonian. This is the first report of this genus from the Devonian of North Africa.

Distribution: Upper Emsian.

Occurrence: Tamesna Basin, Tin Rerhoh area (section 5) (sample H 1087).

Subphylum **Rhynchonelliformea** WILLIAMS et al., 1996

Class **Strophomenata** WILLIAMS et al., 1996

Order **Strophomenida** ÖPIK, 1934

Superfamily **Strophomenoidea** KING, 1846

Family **Leptostrophiidae** CASTER, 1939

Genus ***Mesoleptostrophia*** HARPER et BOUCOT, 1978

Type species: *Mesoleptostrophia kartalensis* HARPER et BOUCOT, 1978; Lower Devonian, Emsian; Turkey.

Mesoleptostrophia (M.) explanata (SOWERBY, 1842)

Pl. 1, figs 1–7

cf. 1842 *Leptaena explanata*; SOWERBY, J. B., p. 409, pl. 38, fig. 15.

cf. 1971 *Leptostrophia explanata* (SOWERBY, 1842); Jahnke, p. 55, pl. 3, figs 2, 4, 5 (here older synonymy of the European occurrences).

1983 cf. *Leptostrophia* (*Leptostrophiella*) *explanata* (SOWERBY, 1842); Brice et al., p. 448, pl. 12, fig. 19.

1986 cf. *Leptostrophia* (*Leptostrophiella*) *explanata* (SOWERBY, 1842); Drot, p. 513, pl. 1, figs 17, 18.

Material: Six dorsal and seven ventral valves and numerous fragments, some with original shell but mostly preserved as internal and external moulds in calcareous sandstones.

Description: The shell is planoconvex, very large with the measured width of 96 mm in the largest specimen available, thin-walled relative to shell size, with the maximum width located near or gently anterior to the hinge line. The commissure is rectimarginate. The outlines of several available shells are somewhat irregular, concerning especially the location of maximum width.

The dorsal valve is subcircular, 75–80 % as long as wide, with straight posterior margin, evenly curved anterior and lateral margins and obtuse cardinal extremities. The cardinal process is prominent, with a pair of prominent lobes faced posteroventrally, extending from the short and broad median ridge. The myophore is coarsely lamellose. The adductor scars are large, elongate, extending in 30 % of the valve, bounded anterolaterally by a low ridge. The field is posterolaterally subsided below the densely pustulose shell interior.

The ventral valve is subcircular, about 82 % as long as wide. The hinge line is straight, 85–100 % as wide as the valve. Lateral and anterior margins are evenly curved. The ventral interarea is distinct, low, steeply apsacline, with dense vertical striation that corresponds to numerous denticles along the whole length of the hinge line. There are 12–14 striae and denticles, respectively, per 5 mm. The delthyrium is small, open and narrowly triangular with densely and finely striated bottom of delthyrial chamber. The ventral muscle field is widely triangular, about 40 % wide as the valve. The muscle scars are weakly impressed on the valve floor, being posterolaterally bounded by stout, coarsely pustulose and widely divergent ridges, which subtend about 80° angle between each other. The diductor impressions are partitioned by fine but remarkably high radial ridges of uneven length into narrow lobes. There are about 11–15 distinct lobes apparent in large well-preserved specimens, with smaller, less clearly defined lobes along the anterior periphery of the muscle field. The ventral process is massive, consisting of two short proximally high divergent ridges. The fine myophragm is low, broad and disappears near the midlength of the valve. The adductor scars are minute, contiguous to proximal part of the myophragm.

The shell interior is densely covered by fine pustules that anterolaterally decrease in size.

The ornamentation is parvicostellate, with 8–10 costellae per 5 mm anteromedianly. Concentric ornament consists of fine, slightly wavy growth fila over entire surface. There are no distinct concentric rugellae. The broad band along the shell periphery exhibits distinct internal costellation.

Remarks: The genus *Mesoleptostrophia* HARPER et BOUCOT, 1978 (=*Leptostrophiella* HARPER et BOUCOT, 1978) is known since the Silurian to the Emsian, with closely related species in the different parts of the word. Brice et al. (1983) reported less favourably preserved valves of the genus in North Morocco, and Drot (1986) referred with some uncertainty to the species *M. explanata* a specimen from the sample H 1088 collected by Lionel Lessard in the northern flank of the Tamesna Basin. Stratigraphically younger leptostrophiids of the Upper Emsian and Eifelian ages are currently referred to subgenus *M.* (*Paraleptostrophia*), which is smaller and have posteriorly faced lobes of cardinal process (Cocks et Rong 2000).

The giant species of *Mesoleptostrophia* are especially known from the Lower Emsian. Jahnke (1971) described, figured and discussed the affinity of *Mesoleptostrophia explanata* (SOWERBY, 1842) from the Siegenian and Emsian of Harz, Germany. This author mentioned various taxa that

need modern revision and were formerly incorporated under this species name. Jahnke (1971) noted the probability that during phylogeny of *M. explanata* in Siegenian to Emsian ages the ventral diductors were split by prominent radial ridges. Having taken in account his suggestion, our specimens belong to typical form of *M. explanata* by its large size and numerous radial ridges partitioning the ventral muscle field.

The upper range of the subgenus and the species deserves a discussion. Our specimens have been found in two different fossil associations, probably of different age. The specimens in our samples are never associated with *Paraspirifer* and *Longispina* and only one specimen is associated with chonetoid *Montsenetes pervulgatus* sp. n. This may be explained by the disappearance of the species before the spread of the early Eifelian fauna in the area.

In Spain and Anti-Atlas of Morocco, the species appeared for the first time in the Lower Emsian, extended to the latest Upper Emsian and disappeared before the end of the Lower Devonian (Brice et al. 1983, Pardo et Garcia-Alcalde 1984, Garcia-Alcalde et Truyols 1994, Garcia-Alcalde 1997, 2001). The specimens from Germany are also of the Emsian age (Jahnke 1971, Weddige et al. 1979). The earliest but tentative report of the species is from the Gedinian (Boucot 1960). The species *M. explanata* is never reported from beds of the Eifelian or younger age. As our specimens have the same morphology as the Emsian specimens in Europe, we also suggest their Upper Emsian age. However, because of the associated fauna, some specimens from the Tamesna basin (sample H 884) may be also of the early Eifelian age.

The morphologically similar but stratigraphically younger species *Mesoleptostrophia* (*M.*) *casteri* (BENEDETTO, 1984) is reported from the upper Eifelian of Venezuela. This species represents the youngest report of the genus hitherto known. This species is also associated with a chonetoid *Montsenetes*, represented by the species *M. notius* (BENEDETTO, 1984). The ventral valve of *M. casteri* differs from our specimens by less divergent ridges bounding the ventral muscle field, by coarser radial ridges partitioning the ventral diductor scars, lack of dorsal median ridge and different shape of the cardinal process. These features also distinguish *M. casteri* from European specimens referred to *M. explanata*.

Distribution: The Emsian age of rocks bearing *M. explanata* is suggested, with most reports referred, to the Upper Emsian. The species is usually associated with *Tropidoleptus*, various chonetoids and spiriferoids. However, the large strophomenoid shells are mostly incomplete and may, eventually, belong to more than one species. The differences in associated fauna indicate that *M. explanata* occurs within longer stratigraphical interval, probably from the Emsian to early Eifelian.

Occurrence: Tamesna Basin, Kori-Idemeg – Touaret area (sample H 884), In Ateï section (sample H 1003), In Rahir Tin Amzi section (sample H 1058), Tin Rerhoh area, section 5 (samples H 1086, H 1087).

Order **Productida** SARYTCHEVA et SOKOLSKAYA, 1959
Suborder **Chonetidina** MUIR-WOOD, 1955
Superfamily **Chonetoidea** BRONN, 1862
Family **Anoplidae** MUIR-WOOD, 1962
Subfamily **Caenanoplinae** ARCHBOLD, 1980

Genus ***Arcuaminetes*** BIZZARO, 1995

Type species: *Chonetes scitula* HALL, 1857; Middle Devonian, Givetian; New York, USA.

Arcuaminetes racheboeufi sp. n.

Pl. 3, figs 17–24

Holotype: Ventral valve (MaMe 0183A), figured on pl. 3, figs 17, 21, housed in the Department of Palaeontology of the Museum of West Bohemia, Plzeň, Czech Republic.

Paratype: Dorsal valve (MaMe 0185), figured on pl. 3, fig. 22, housed in the Department of Palaeontology of the Museum of West Bohemia, Plzeň, Czech Republic.

Type horizon: Devonian, Eifelian.

Type locality: Algeria, Tamesna Basin, Tin Rerhoh area, section 5, sample H 1090.

Etymology: After Dr. Patrick Racheboeuf, the famous chonetid brachiopod specialist.

Material: Some twenty-five internal and external moulds, mostly of ventral valves, and numerous fragments preserved in ferruginous sandstone.

Diagnosis: The shell small, thin-shelled; dorsal valve deeply concave, with short median septum and a pair of longer accessory septa; ventral valve deeply convex, with strong myophragm extending into low median ridge toward anterior margin; ventral muscle field weakly impressed.

Description: The shell is small, in maximum 9 mm wide, thin shelled, strongly concavo-convex.

The dorsal valve is deeply concave, deepest at midlength, widest in posterior third, with evenly curved margins. The dorsal interarea is very low, hypercline. The cardinal process is ventrally bilobed, short, supported by a short, low median ridge. The shallow cardinal process pit is present. The median ridge is short, becoming indistinct from shell midlength. Dental sockets are large, bordered anteriorly by short and small socket ridges. Anderidia are short and weakly divergent. Accessory septa are well-developed, each with a distinct radial row of coarse endospines. Several similar radial rows of prominent and toward commissure larger endospines are located more laterally. Three radial rows of endospines are intercalated between the accessory septa.

The ventral valve is broadly oval, with maximum width in posterior third. The valve is strongly convex, weakly depressed posterolaterally, with maximum depth in posterior fourth. The VvW/VvL is 1.35 (range: 1.25 to 1.42; n = 12). Cardinal extremities are rectangular in small to medium

sized specimens becoming obtuse in large shells. The ventral interarea is low, apsacline to almost orthocline. Spines are orthomorph oblique, known only in their proximal parts. Three strongly posteriorly convergent canals (inner apertures of hollow spines) penetrate the shell on each side of the ventral umbo. The inner three pairs of apertures are arranged in short intervals, the fourth pair of apertures is situated in much longer distance from the umbo. Teeth are massive, triangular, and widely divergent. The myophragm is thick posteriorly, anteriorly it continues to low, rounded median ridge nearly toward anterior commissure. The dorsal edge of the myophragm is sharply acute. The ventral muscle field is weakly impressed, with undivided diductor scars and small, weakly impressed semielliptical adductor scars in posterior three-fourth of the valve. Almost whole interior shows traces of external costellation that become coarse along the commissure. Radial rows of endospines are short and finer than in dorsal valve, restricted into narrow band along margins.

Ventral valve exterior bears some 40 costellae, half of them extending from the umbo. Costellae are rounded, separated by shallow rounded interspaces. New costellae originate mostly by bifurcation in the ventral valve. The ornament of the dorsal valve is similar but new costellae originate by implantation. There are 6 to 7 costellae per 2 mm anteriorly.

Comparison: This species is referred to *Arcuaminetes* BIZZARO, 1995 although the type species is less convex and has different ornament of the ventral valve, with the new costellae mostly originating by intercalation. In the new species the costellae of the ventral valve originate by bifurcation. The conformity of the new species with the species *A. scitulus* (HALL, 1857) concerns the presence of three radial rows of endospines between accessory septa. Although the shell of *A. racheboeufi* sp. n. is much smaller than of other chonetoids in the area, the high convexity, clearly impressed muscle scars and upper size limit (8.5 – 9.0 mm width) of the available shells indicate the maturity of the preserved individuals. This difference indicates a different age from specimens *A.* ? *deynouxi* RACHEBOEUF et al., 2004 described from the Givetian of Libya and Mauritania (Havlíček et Röhlich 1987, Mergl et Massa 1992, Racheboeuf et al. 2004). By size and convexity, the species is also similar to other coenanoplines, especially to *Caplinoplia* HAVLÍČEK et RACHEBOEUF, 1979 but this genus has more clearly developed two pairs of accessory septa and its ornament is coarser. Small specimens of *Devonochonetes* ? sp. from suggested Givetian Akara Formation of the Air Massif (North Niger) (Boucot et al. 1983) may belong to the same or related species. It differs from similar *Montsenetes pervulgatus* sp. n. of the Eifelian age by smaller size, less convex ventral valve and weaker myophragm in the ventral valve.

Distribution: Eifelian.

Occurrence: Tamesna Basin, Tin Rerhoh area, section 5 (sample H 1090).

anopliid indet.

Pl. 4, fig. 22

Material: Two dorsal valves in sandstone.

Remarks: Poorly preserved internal moulds show distinct, high accessory septa and absence of median septum in weakly concave dorsal valve. Although the material is not determined in generic level, the presence of an anopliid is noteworthy.

Distribution: Givetian.

Occurrence: Tamesna Basin, In Ateï section (samples H 820 and H 1006).

Genus ***Plicanoplia*** BOUCOT et HARPER, 1968

Type species: *Chonetes fornacula* DUNBAR, 1920; Lower Devonian, Emsian; Tennessee, USA.

Plicanoplia sp.

Pl. 5, fig. 14

Material: Two internal moulds of ventral valves in sandstone.

Remarks: Two poorly preserved shells have features characteristic for the genus: small size, subtrigonal outline, extreme convexity of ventral valve and a few weak costae. It is most similar to *P. fornacula* (DUNBAR, 1920) by small size and subtrigonal outline. However, other details of morphology remain unknown and thus generic attribution of these valves remains tentative. The genus ranges from the Pragian to Emsian; in Venezuela it ranges into the Upper Emsian (Benedetto 1984).

Distribution: Upper Emsian.

Occurrence: Tamesna Basin, Tin Rerhoh area, section 5 (sample H 1087).

Family **Eodevonariidae** SOKOLSKAYA, 1960

Genus ***Lomaella*** HERRERA, 1995

Type species: *Lomaella primoris* HERRERA, 1995; Lower Devonian, Pragian; Argentina.

Lomaella amziensis HERRERA et RACHEBOEUF, 2001

Pl. 2, figs 13, 14, 16–18

1990a *Loreleiella* sp.; Racheboeuf, p. 320.
2001 *Lomaella amziensis* nov. sp.; Herrera et Racheboeuf, p. 499, figs 7 and 8: 1–10.

Material: Six ventral valves and three dorsal valves preserved as internal and external moulds in fine sandstone and several fragments of shells showing details of morphology in calcareous sandstone.

Remarks: This species was described in detail by Herrera et Racheboeuf (2001), with description based and ma-

terial figured from the sample H 1052. They also reported its range extended to some 60 m higher beds (sample H 1057). These authors suggested only the late Emsian age of the beds bearing the species. However, the species is known from two distinct fossil associations. The older brachiopod association near the base of the Devonian succession (sample H 1052) yielded dominant spiriferoid *Filispirifer merzakhsaiensis* JANSEN, 2001 that indicates the Pragian age. The younger occurrences of *Lomaella amziensis* are from samples H 1086 and H 1087, in the association with a large chonetoid *Montsenetes* (?) *drotae* sp. n., small *Plebejochonetes* sp., spinocyrtiid *Subcuspidella* and strophomenoid *Mesoleptostrophia*, indicating a younger, probably Upper Emsian age. Thye fragmentary state of preservation of *Lomaella* from younger beds does not allow satisfactory comparison with the specimens from sample H 1052 and these younger shells may even represent another species. The whole range of *L. amziensis* from the Tamesna Basin is roughly the same as the known occurrence of the genus in South America. According to Herrera (1995), *Lomaella* extends from the late Pragian in the Argentine Precordillera to the Upper Emsian of Bolivia.

Distribution: Upper Pragian to Upper Emsian.

Occurrence: Tamesna Basin, In Rahir Tin Amzi section (samples H 1052, H 1086, H 1087).

Family **Chonetidae** BRONN, 1862
Subfamily **Chonetinae** BRONN, 1862

Genus ***Plebejochonetes*** BOUCOT et HARPER, 1968

Type species: *Chonetes plebeja* SCHNUR, 1854; Lower Devonian, Emsian; Germany.

Plebejochonetes sp.

Pl. 5, figs 10, 11

Material: Two internal and two external moulds of ventral valves in sandstone.

Description: Shell is small, 8 mm wide, broadly semielliptical, widest at midlength, with obtuse cardinal extremities. The valve is moderate convex. Ventral interior bears high and short myophragm. Ornament of ventral valve consists of about 15 simple costae, with posterolateral costae crossing the posterior margin and only some five to six costae extending from the umbo. Spines have not been observed in our material.

Remarks: The origin of posterolateral costae is an important feature of the genus. Therefore, although poorly preserved, the available shells are referred to *Plebejochonetes* BOUCOT et HARPER, 1968. By size and coarse ornament our specimens are most similar to *P. moniellensis* GARCIA-ALCALDE et RACHEBOEUF, 1978 from the Upper Emsian of the Cantabrian Mountains, Spain.

Distribution: Upper Emsian.

Occurrence: Tamesna Basin, In Rahir Tin Amzi (sample H 1057).

Genus ***Amziella*** gen. n.

Type species: *Amziella rahirensis* sp. n.; Lower Devonian, Pragian; Algeria.

Etymology: After the type area of the type species in In Rahir Tin Amzi.

Species referred: *Amziella rahirensis* sp. n.; Upper Pragian; Algeria. ? *Plicanoplia* sp.; Early Emsian, Talacasto Formation, Argentina.

Diagnosis: The shell is moderately concavo-convex, medium sized, with shortly alate ventral valve; radial ornamentation of subangular costae originating from beak except of a few lateral costae originating above the posterior margin; costae rarely branching by bifurcation in ventral valve and weakly widen anteriorly; ventral interarea almost orthocline, dorsal interarea almost catacline, very low; hinge teeth large, directed anterolaterally; myophragm short, distinct; dorsal interior with short septum supporting ventrally bilobate cardinal process; fused endospines form a pair of accessory septa; cardinal process pit shallow; anderidia short, weakly divergent; interiors with prominent radial rows of large endospines.

Comparison: The new genus is similar to *Plebejochonetes* BOUCOT et HARPER, 1968 from which it is probably derived. The common features of *Plebejochonetes* and the new genus comprise lateral costae crossing the posterior margin of the valves, dichotoming ventral costae, deeply bilobed cardinal process and short dorsal median septum (Boucot et Harper 1968). The new genus is distinct by alate cardinal extremities in adult specimens, coarser ornament of high subangular costae and coarsely spinose interior with endospines arranged into discrete radial rows. Genus *Plebejochonetes* is represented by several species in the Emsian of southwest Europe. Among them the Spanish species *P. collensis* GARCIA-ALCALDE et RACHEBOEUF, 1978 differs by finer radial ornament and a weak ventral myophragm. The species *P. moniellensis* GARCIA-ALCALDE et RACHEBOEUF, 1978 has a less distinct internal costation and much finer internal endospines. The morphologically nearest species is *P. buchoti* (RENAUD, 1942) from the Lower Emsian of the Armorican Massif. It has rather coarse costation but its costae are rounded and, apart from the flanks, the new costae are added mostly by intercalation. The anopliid genus *Arcuaminetes* BIZZARO, 1995 has similar shell morphology as the new genus but its external ornament is weaker, it has low cardinal process and the ventral valve is not alate. The size of the new genus is also larger, unusual for anopliides.

The poorly known species *Plicanoplia* sp. from the early Emsian (Talacasto Formation) of Argentina may belong to a new genus (Herrera 1995). It has comparatively coarse ornament but is smaller and its interior is poorly known.

Amziella rahirensis sp. n.

Pl. 2, figs 1–12

Holotype: Ventral valve (MaMe 0011A), figured on pl. 2, fig. 10, housed in the Department of Palaeontology of the Museum of West Bohemia, Plzeň, Czech Republic.

Paratype: Dorsal valve (MaMe 0062), figured on pl. 2, fig. 9, housed in the Department of Palaeontology of the Museum of West Bohemia, Plzeň, Czech Republic.

Type horizon: Lower Devonian, Upper Pragian.

Type locality: Algeria, Tamesna Basin, In Rahir Tin Amzi section, sample H 1052.

Etymology: After the type area.

Material: Twelve dorsal valves, fifteen ventral valves and many fragments, often poorly preserved in fine sandstone.

Diagnosis: Shell of medium size, coarsely costellate with prominent subangular costae originating at the apex and above the posterior margin; hinge line shortly alate; shell interior with discrete radial rows of coarse endospines.

Description: The shell is moderately concavo-convex, rectimarginate, medium sized and thin-walled. The largest preserved specimen attains 14 mm width but the average shell size is smaller, ranging from 10 to 12 mm. Maximum width is at the hinge line, which is extended into short but distinct ears.

The dorsal valve is moderately concave, with a flattened posterior disc. DvW/DvL is 1.42 (range: 1.33 to 1.50; n = 8). The dorsal interarea is very low, almost catacline, with notothyrium filled by the cardinal process. The cardinal process is ventrally distinctly bilobed but details of its posteriorly faced myophore remain unknown. The median septum is low and coarse, extending to midlength anteriorly, laterally with a pair of weakly divergent, higher accessory septa of fused endospines. The anderidia are short, low and stout, diverging anteriorly in 45–50° angle. The dental sockets are large, deep, anteriorly bordered by stout inner socket ridges which diverge each other in 150° angle. Outer socket ridges are united with the hinge line. The visceral area is distinct in large specimens as a large, semicircular and gently elevated platform, extending anteriorly to two-thirds of the valve length. Endospines are very coarse, inclined anteromedianly, arranged in simple radial rows.

The ventral valve is about 80 % as long as wide, VvW/VvL is 1.34 (range: 1.25 to 1.47; n = 8). Anterior and lateral margins are evenly curved. The valve is strongly arched in a lateral profile and strongly convex in a transverse profile. Cardinal extremities are slightly depressed. The beak is short. The ventral interarea is low, apsacline, a small delthyrium is widely triangular and apically closed by a small, highly convex pseudodeltidium. There are coarse canal apertures on each side of the umbo, converging posteriorly, three to four on each side. Spines are cyrtomorph intraversed. The ventral valve interior has stout teeth and lacks distinctly bordered visceral area. The median septum is clearly defined posteriorly but weak anteriorly, in the posterior third it is flanked by narrow and weak semielliptical adductor scars. Diductor scars are indistinct. Coarse endospines are arranged in simple radial rows in the extravisceral area.

The shell exterior is covered by coarse subangular costae of uniform size, anteriorly regularly extending in size, originating at the apex and above the posterior margin. The new costae on ventral valve originate mostly by asymmetrical bifurcation, only rarely by an implantation. They rapidly reach the same size as the primary costae. There are 28–30 costae distinct from the umbo, with 5 to 6 costae per 5 mm anteromedianly. The large shells have 37 to 40 costae.

Distribution: The species is a dominant element in samples from the lowest transgressive fossiliferous beds of the Devonian succession in four localities. These beds are a good stratigraphical marker. The Upper Pragian age is suggested.

Occurrence: Tamesna Basin, In Rahir Tin Amzi section (sample H 1052), Tin Rerhoh area, sections 2 and 5 (samples H 1074, H 1076, H 1085).

Subfamily **Devonochonetinae** MUIR-WOOD, 1962

Genus ***Devonochonetes*** MUIR-WOOD, 1962

Type species: *Chonetes coronatus* HALL, 1857; Middle Devonian, Hamilton Group; New York, USA.

Devonochonetes cf. ***salemi*** MERGL et MASSA, 1992

Pl. 4, figs 12–14

Material: Four dorsal valves, six ventral valves, and numerous fragments preserved as internal and external moulds in sandstone.

Description: The shell is large, 20 mm wide in the largest specimen, moderate concavo-convex, widest at hinge line, rather thin-shelled.

The dorsal valve is slightly concave, with rectangular to broadly angular cardinal extremities. The dorsal interarea is hypercline, low. The notothyrium is filled with the cardinal process. The valve is weakly convex or almost flat in the posterior half. The cardinal process is moderately high, with posteriorly faced quadrilobate myophore. The process continues anteriorly into the low and short median ridge, which disappears posterior to the shell midlength.

The ventral valve is broadly oval, with evenly rounded lateral and less rounded anterior commissure. VvW/VvL is 1.38 (range: 1.28 to 1.48; n = 3). The valve is moderately convex in a lateral profile and evenly convex in transverse profile with depressed cardinal extremities. The ventral interarea is anacline to almost orthocline, low, with a small delthyrium. The umbo is short. Spines are orthomorph oblique but known only after their broken bases, rapidly curved dorsally. The ventral muscle field is weakly impressed, divided by a short and low myophragm. Visceral area is distinctly bordered by a low edge on valve floor. Inner costellation is distinct along the periphery in the extravisceral area.

Ornamentation consists of fine, high and rounded costellae of uniform size, separated by deep subangular interspaces. New costellae originate by bifurcation in the ventral valve and by intercalation in the dorsal valve. There are 5 costellae per 2 mm anteromedianly. Surface of flattened

cardinal extremities is without costellation, with only weak concentric growth lines.

Remarks: The species *D.* cf. *salemi* MERGL et MASSA, 1992 is similar by moderate concavo-convex profile, weak myophragm and poorly impressed ventral muscle field and weak median ridge in dorsal interior and by cardinal extremities without radial ornament to the typical specimens of *D. salemi* MERGL et MASSA, 1992 from the Givetian-Frasnian transition of the Ghadamis Basin. There are not distinct differences between Libyan and our specimens apart of less transverse outline and a more prominent inner costellation of *D. salemi*.

The species is also similar to the type species *D. coronatus* (HALL, 1857) from the Middle Devonian of New York, USA by a transverse outline, moderate convex ventral and weakly concave dorsal valves but there are significant differences. In *D.* cf. *salemi* the radial ornament is absent in cardinal extremities and the maximum width is at the hinge line. Stratigraphically earlier and morphologically similar chonetids in the Tamesna Basin are referred to *Montsenetes* RACHEBOEUF, 1992 but both newly described species (*M. pervulgatus* sp. n. and *M.* ? *drotae* sp. n.) are more convex and their maximum width is more anterior, the cardinal extremities being always obtuse. The number of costellae per 2 mm anteriorly is also different in *D.* cf. *salemi* and in both species of *Montsenetes*.

Distribution: Givetian.

Occurrence: Tamesna Basin, In Ateï (samples H 820 and H 1006).

Genus ***Longispina*** COOPER, 1942

Type species: *Chonetes emmetensis* WINCHELL, 1866; Middle Devonian; Hamilton Group; New York, USA.

Longispina sp.

Pl. 4, figs 15–21

Material: Two dorsal and three ventral valves, preserved as internal and external moulds in ferruginous sandstone.

Description: The shell is small, 6.5 mm wide, with maximum width at hinge line, strongly concavo-convex, thin-shelled.

The dorsal valve is deeply concave, widest at the hinge line. Its interior is unknown. The ventral valve is semicircular (VvW/VvL is 1.3), with regularly curved margins. Cardinal extremities are rectangular. The shell is strongly convex, with depressed posterolateral edges. The ventral interarea is rather high, nearly orthocline. Teeth are small, anterolaterally supported by short and widely divergent ridges. The myophragm is high, short and not exceeding one-third of the valve length. The ventral muscle field is poorly impressed. Spines are orthomorph parallel, but their number and arrangements is unknown because only spine bases (pl. 4, figs 19, 20) have been observed. Exterior bears some 16–18 simple, undivided, rounded costae, evenly widening anteriorly and decreasing in size laterally, becoming obscure near cardinal extremities. Anteromedianly there are 3–4 costae per 2 mm.

Remarks: The genus is known from the Eifelian to Givetian of North and South America, Europe and northwestern Africa (Garcia-Alcalde et Racheboeuf 1978, Benedetto 1984, Racheboeuf 1990a, Racheboeuf et Feldman 1990, Racheboeuf et Isaacson 1993, Brice et al. 1994). Our specimens are most similar by coarse costellation to *Longispina mucronata* (HALL, 1843) from the Eifelian of New York, USA but it differs by mucronate cardinal extremities and less numerous costae. A specimen similar to our species has recently been described from a suggested Givetian strata of Hodh area of Mauritania (Racheboeuf et al. 2004). The presence of *Longispina* in our material indicates the post-Emsian age.

In the studied area, small strongly convex shells which are referred to this genus are known from two samples. In sample H 1405 several ventral valves are known, two with spines preserved. In sample H 1404 similarly shaped but poorly preserved one ventral valve without spines is known. In both samples the associated devonochonetine *Montsenetes pervulgatus* sp. n. and a spiriferoid *Eleutherokomma* support suggested the Eifelian age of the samples.

Distribution: Eifelian.

Occurrence: Tamesna Basin, Oued Felaou area (samples H 1404, H 1405).

Genus ***Montsenetes*** RACHEBOEUF, 1992

Type species: *Devonochonetes notius* BENEDETTO, 1984; Middle Devonian, Eifelian; Venezuela.

Montsenetes pervulgatus sp. n.

Pl. 3, figs 1–16

1983 *Devonochonetes* ? sp.; Boucot, Massa et Perry; p. 112, pl. 3, figs 28–33.

Holotype: Ventral valve (MaMe 0120), figured on pl. 3, figs 1, 5, housed in the Department of Palaeontology of the Museum of West Bohemia, Plzeň, Czech Republic.

Type horizon: Devonian, Eifelian.

Type locality: Algeria, Tamesna Basin, In Ate_ section, sample H 1017.

Etymology: *pervulgatus* (Lat.) – allusion to the abundance of the species.

Material: Several tens of specimens in various state of preservation.

Diagnosis: Large, thick-shelled and strongly concavo-convex *Montsenetes* with transverse shell outline, moderate-sized ventral myophragm, weak and short dorsal median septum, short anderidia and evenly and coarsely costellate shell.

Description: Shell is large, thick-shelled, in maximum 25 mm wide, strongly concavo-convex, thick-walled. Anterior commissure is rectimarginate to very weakly

unisulcate in gerontic specimens. The shell shape considerably changes with ontogeny. Small to medium sized ventral valves are moderately convex. In adult specimens the ventral valve becomes strongly convex, with subsequent growth dorsally directed.

The dorsal valve is deeply concave, with flattened cardinal extremities, broadly semielliptical, with maximum depth at midlength. The DvW/DvL is 1.43 (range: 1.20 to 1.77; n = 6). The dorsal interarea is low, hypercline, with small notothyrium closed by small chilidium and the posterior face of the cardinal process. The cardinal process is large, quadrilobed, with high, thin inner pair of lobes and about half-sized lateral lobes. The myophores are very high, faced posteriorly. The cardinal process is supported by a low and proximally thick median ridge, which becomes anteriorly thinner and higher. The ridge disappears at about shell midlength. Dental sockets are small, deep, bordered posteriorly by small outer socket ridges. Inner socket ridges are obsolete, short, diverging anteriorly in about 90–100° from each other. Anderidia are short, thin, diverging at about 40° from each other. Two rows of coarse endospines fused together to form ridges similar to accessory septa are developed from shell midlength. Five weak radial rows of endospines are intercalated between the anterior parts of these rows of endospines. Dorsal muscle field is weakly impressed, with shallow triangular imprints of anterior adductor between the median ridge and anderidia.

The ventral valve is broadly semielliptical, rectimarginate, with obtuse cardinal extremities. The VvW/VvL is 1.28 (range: 1.12 to 1.50 in juvenile shell; n = 21). Hinge line is some 90–95 % of the width. The maximum width is located in posterior one-third to one-fourth. Transverse profile is strongly and evenly convex, with steeply sloping flanks and evenly convex axial part. Only small corners near cardinal extremities are depressed. Lateral profile is strongly convex, with the maximum height at midlength. Margins are evenly rounded. The commissure is rectimarginate. The ventral umbo is directed posteriorly to posterodorsally in small shells. In large shells it is directed dorsally to even weakly anterodorsally, slightly overhanging the posterior margin. The ventral interarea is low, orthocline in small shells but well anacline in large shells, with a weakly concave profile. Its surface bears fine growth lines. The delthyrium is apically closed by a small pseudodeltidium. Spines are fine and short, cyrtomorph intraversed to cyrtomorph geniculated, with various incline toward the commissure plane. Unfortunately, only their proximal parts are usually preserved. Their direction may be different even in the same shell, with spines rapidly, just above the hinge line inverted posterodorsally to spines of cyrtomorph inverted type. The spines extend in irregular, gradually increasing distance from the umbo in both sides of the shell, numbering three to (?) five on each side in largest shells. The first (preserved) spine (1') appears some 1.3 mm from the umbo with the next spines in various distances (2' = 2.3 mm, 3' = 5.5 mm, 4' = 7.3 mm; 1 = 2.3 mm, 2 = 4.0 mm, 3 = unpreserved; specimen MaMe 0016).

Ventral interior has a rather small, short and widely divergent teeth. Adductor muscle scar field is semielliptical, rather small, with longer, narrower and deeply impressed posterior pair, and smaller, triangular anterior pair (pl. 3, fig. 10). The adductor muscle field is divided by a strong, acute and long myophragm, which diminishes anteriorly and continues as a low median ridge nearly to anterior margin. Diductor muscle scars are large, flabellate, with several radially arranged lobes that extend over shell midlength. The ventral visceral area is large, occupying over 80 % of valve length, bordered by a weak edge. Extravisceral shell interior is covered by regularly arranged internal radial costellation intercalated by short rows of endospines. The visceral area is almost smooth.

Ventral valve exterior is coarsely costellate, with rounded costellae of uniform size, separated by narrow and deep interspaces. Some 10–12 costellae extend from the umbo, the new costellae originate exclusively by bifurcation; two new costellae rapidly attain the same size as the primary costella. The symmetric bifurcation is common at the same growth line, especially during earlier growth periods. Ornament of the dorsal valve consists of subangular costellae of uniform size, separated by wider, rounded interspaces. The costellae are of uniform size, with new ones originating by intercalation, commonly near the same growth line. There are some 10–12 costellae extending from the umbo, and 3–4 costellae per 2 mm anteriorly. The large shells bear 60–65 distinct costellae. The costellation is developed over all surface of the valve except of smooth depressed small corners near the cardinal extremities. Concentric ornament is not present. However, inside the shell wall the concentric wavy lines are present. These lines are distinct in partly exfoliated shell and probably are weakly expressed on internal shell surface, judging after some excellently preserved internal moulds.

Remarks: New species is similar to the type species *Montsenetes notius* (BENEDETTO, 1984) from the Eifelian of Venezuela by costellate ornamentation, shell interior and convexity. These features indicate near affinity of both species. The main difference is a coarser ornament of the new species, with only 11–12 costellae per 5 mm anteriorly while 14–18 costellae are present in *M. notius*. In *M. notius*, the ventral median ridge is longer and more prominent. The species *M. boliviensis* RACHEBOEUF, 1992 from the Givetian of Bolivia differs from the new species by coarser costellation, with only 7–9 costellae per 5 mm and by a stronger median ridge on the dorsal interior.

The species *Devonochonetes* ? sp. from the Akara Formation of Air Massif (Boucot et al. 1983) may belong to the new species. This species has the shell of a medium size (up to 25 mm wide), highly convex ventral valve with the same type of ornament and its interior is consistent with the other species of *Montsenetes* RACHBOEUF, 1992. A difficulty represents the age of this species. The Akara Formation is suggested of a Givetian age (Boucot et al. 1983) but the specimens from In Guezzam area are supposed of an Eifelian, even a Late Emsian age. However, the undoubted

Givetian fauna from the Aïr Massif is represented in the younger Amesguer Sandstone by a terebratulid *Rhypidothyris africana* BOUCOT et al., 1983. This species is known from Ghadamis and Murzuq Basins of Libya (Boucot et al. 1983) from beds of a suggested early Givetian or even late Eifelian age. This indicates, that the Akara Formation, or at least its part, might be older, of an Eifelian age.

Distribution: The new species is very abundant; sometimes it is even the commonest brachiopod in the samples. Its shells form low-diversity, almost monospecific accumulations (e.g. samples H 1017, H 358) from valves in various ontogenetic stages. The shells are associated with various fauna, usually with spiriferids *Eleutherokomma, Paraspirifer* and *Pustulatia*. The fauna by the presence of some genera indicates an Eifelian age, probably near to the Emsian/Eifelian boundary. In this respect, the new species is stratigraphically older than other known species of the genus (*M. notius* is from the Upper Eifelian-Lower Givetian, *M. boliviensis* from the Givetian).

Occurrence: Tamesna Basin, Kori-Idemeg – Touaret section (sample H 884), In Ateï section (samples H 1004, H 1006, H 1016, H 1017), In Debirene section (samples H 1106, H 1107), Oued Felaou area (samples H 1404, H 1405).

Montsenetes ? ***drotae*** sp. n.

Pl. 4, figs 1–11

Holotype: Ventral valve (MaMe 0086A), figured on pl. 4, fig. 3, housed in the Department of Palaeontology of the Museum of West Bohemia, Plzeň, Czech Republic.

Paratype: Dorsal valve (MaMe 0032B), figured on pl. 4, fig. 5, housed in the Department of Palaeontology of the Museum of West Bohemia, Plzeň, Czech Republic.

Type horizon: Lower Devonian, Upper Emsian.

Type locality: Algeria, Tamesna Basin, Oued Felaou area, sample H 328.

Etymology: After Dr. Jeaninne Drot, in honour of the late outstanding French palaeontologist.

Material: Ten dorsal valves and eleven ventral valves and numerous fragments preserved in sandstone.

Diagnosis: Large, thick-shelled and moderate concavo-convex *Montsenetes* with transverse shell outline, weak and rounded ventral myophragm, weak and short dorsal median septum, short anderidia and evenly and coarsely costellate shell.

Description: Shell large, thin-shelled relatively to shell size, moderately concavo-convex, transversely oval, in maximum 31 mm wide. Spines were not found in our material. The inner apertures of spines are arranged symmetrically along the posterior margin, two on each side of the large valves.

The dorsal valve is moderately and evenly concave, widest at posterior third, with rectangular to obtuse cardinal extremities. The DvW/DvL is 1.33 (range: 1.31 to 1.69; n = 11). The dorsal interarea is low, hypercline. The notothyrium is wide, apically closed by a chilidium. Cardinal process is large, high, quadrilobate posteriorly, with a posterodorsally faced myophore. Inner lobes of myophore are high and narrow, lateral lobes are much lower, broader. Inner cristae are prominent. Cardinal process is anteriorly supported by a robust base of median ridge that extends into tapering ridge over two-thirds of the valve. Outer socket plates are short and transverse, inner socked ridges are thick, united with the cardinal process, widely diverging anterolaterally. Dental sockets are large and deep. Anderidia are long, strong, diverging anteriorly at 40–50°. Inner surface of the valve is finely costellate along the commissure, with radial rows on uniformly sized small endospines.

The ventral valve is strongly convex, widest at posterior third, with flattened posterolateral parts. The VvW/VvL is 1.38 (range: 1.24 to 1.57; n = 13). Cardinal extremities are obtuse to rectangular, depending on shell size. The valve margins are evenly rounded, slightly less anteromedianly. The ventral interarea is anacline, low and straight, distinct, with fine growth lines. Hinge line is without denticles. The delthyrium is apically closed by a small pseudodeltidium. Spines are orthomorph, regularly spaced, three on each side in medium-sized specimens (the available large specimens have always broken spines). The spines are rapidly but unevenly turned ventrally. Fine thin and widely diverging canals penetrating the shell wall are situated near the ventral umbo, three on each side, not extending into spines. Inner apertures of spines are widely funiculate. The ventral interior has short, ridge-like, obsolete and broadly diverging teeth. The ventral muscle field is large, divided by posteriorly distinct, low and rounded myophragm that becomes finer in its anterior part. The adductor muscle field is semielliptical, located in the posterior third. It is differentiated into parallel, more distinct posterior pair and less distinct, triangular anterior pair that is sometimes divided into two lobes. The diductor scars are weakly impressed, of numerous narrow, radially arranged lobes. Visceral area is large, with evenly rounded and distinctly defined lateral, anterior and anteromedian borders. Only a narrow slit remains between the visceral lobes along the shell axis. Internal costellation is distinct near shell periphery on extravisceral area. It consists of narrow and high costellae, in interspaces with small and high endospines.

Ornament of the ventral valve consists of numerous fine, rounded costellae of uniform size, numbering 4, rarely 5, per 2 mm in anterior margin. Interspaces of similar size are deep. In ventral valve, the new costellae originate mostly by bifurcation, while intercalation is rare and restricted to posterolateral sectors. In the dorsal valve, the intercalation prevails. The large shells bear 90–100 distinct costellae. Concentric ornament is weak, with several concentric growth lines.

Remarks: New species is referred to *Montsenetes*, but its external morphology differs significantly from other species of the genus. It is much larger and less convex than *M. notius* (BENEDETTO, 1984) and *M. pervulgatus* sp. n.

The anterior edge of the visceral area is much better impressed in the new species than in other species of the genus.

Distribution: Upper Emsian.

Occurrence: Tamesna Basin, Oued Felaou area (sample H 328), In Rahir Tin Amzi section (sample H 1057), Tin Rerhoh area, section 5 (sample H 1088), In Ateï section (sample H 1003).

Montsenetes sp.

Pl. 2, fig. 15

Material: One dorsal and three ventral and valves preserved as internal moulds in sandstone.

Remarks: The valves represent another species of *Montsenetes* RACHEBOEUF, 1992. It differs from *M. pervulgatus* sp. n. in having a deeper dorsal valve, a weak ventral myophragm and a finer ornament. The ornament in *M. pervulgatus* is coarser, with 4 costellae per 2 mm anteromedianly, while in *M*. sp. there are 5 to 6 costellae. *Montsenetes* sp. is even smaller, with highly convex ventral valve already in 12 mm wide specimens but in this size, the ventral valves of *M. pervulgatus* are weakly to moderately convex only. *Montsenetes* sp. is surely a new species but due to poor material it is left in open nomenclature. It is noteworthy that the shells are associated with several taxa (*Craniops*, *Salopina*, *Plicanoplia*) unknown from other levels and collecting sites in the area.

Distribution: Upper Emsian.

Occurrence: Tamesna Basin, Tin Rerhoh area, section 5 (sample H 1087).

Subfamily **Notiochonetinae** RACHEBOEUF, 1992

Genus ***Pleurochonetes*** ISAACSON, 1977

Type species: *Chonetes* (*Pleurochonetes*) *lauriata* ISAACSON, 1977; Lower Devonian, Emsian; Bolivia.

Pleurochonetes ? sp.

Pl. 5, fig. 20

Material: Two internal moulds of ventral valves in sandstone.

Descriptions: The valves are large (30 mm width in the largerst valve), weakly convex, with rectangular cardinal extremities. The ventral interarea is very low, apsacline. The delthyrium is small, with a small pseudodeltidium. The large ventral muscle field is weakly impressed, divided by low and long myophragm. The visceral area is distinctly defined. Inner costellation is distinct along the shell periphery, with 4 costellae per 2 mm anteriorly. External ornamentation, spines and the dorsal valve are unknown.

Remarks: The valves differ by a large size, weak convexity and a very low, apsacline interarea from other chonetoids in the Tamesna Basin. The valve morphology is consistent with assignment to Notiochonetinae RACHEBOEUF, 1992, especially to genus *Pleurochonetes* RACHEBOEUF, 1992. However, this determination is tentative and must be confirmed by a new better material collected in the area. The genus *Pleurochonetes* is known from the Emsian (lower Icla Formation) to the Eifelian (upper Icla Formation) of Bolivia (Isaacson 1977, Le Hérisse et al. 1992) and from the Lower Devonian of the Parecis Basin of Brazil (Racheboeuf in Boucot et al. 2001).

Distribution: Emsian ? or Eifelian.

Occurrence: Tamesna Basin, Felaou Area (sample H 1067).

Order **Orthotetida** WAAGEN, 1884
Suborder **Orthotetidina** WAAGEN, 1884

Superfamily **Chilidiopsoidea** BOUCOT, 1959
Family **Chilidiopsidae** BOUCOT, 1959
Subfamily **Chilidiopsinae** BOUCOT, 1959

Genus ***Iridistrophia*** HAVLÍČEK, 1965

Type species: *Orthis umbella* BARRANDE, 1848; Lower Devonian, Lochkovian; Bohemia.

Iridistrophia sp.

Pl. 5, fig. 15

Material: Three external moulds, several fragments.

Description: All specimens are represented by small shells, the most complete fragment is 15 mm wide but fragments indicate a larger shell size, to some 22–25 mm. The ventral valve is weakly convex, the dorsal valve is flat with weak and broad sulcus. Cardinal extremities are almost rectangular. Interiors are unknown. The shell exterior bears fine, acute and high costellae, intercalated by slightly finer secondary costellae. There are some 4–6 costellae per 2 mm anteromedianly.

Remarks: The upper limit of *Iridistrophia* HAVLÍČEK, 1965 is the Emsian after Williams et Brunton (2000). It is in coincidence with the suggested Upper Emsian age of our samples. However, in Libya the genus is reported from the Bir al Quasr Formation (Eifelian) of the Murzuq Basin (Havlíček et Röhlich 1987), but this determination is based on poor specimens and could not be excluded that this species might be referred to another chilidiopsid genus. Our specimens, although fragmentary preserved, are not resupinate and the dorsal valve is flat. Both fragments are near to *I. dendritica* BENEDETTO, 1984 from the Upper Emsian of Venezuela, from which our valves differ by smaller size. Out of several species of the genus in the Pragian to Emsian strata of Argentina (Herrera et al. 1998) the species *I. aliciae* HERRERA et al., 1998 is near to our specimens by size, ornament and shell outline.

Distribution: Upper Emsian.

Occurrence: Tamesna Basin, In Rahir Tin Amzi section (sample H 1058), Tin Rerhoh area, section 5 (sample H 1087).

Class **Rhynchonellata** WILLIAMS et al., 1996
Order **Orthida** SCHUCHERT et COOPER, 1932

Remarks: Orthid brachiopods, apart of the enigmatic genus *Tropidoleptus,* are rare in samples in the Tamesna Basin. Only a few specimens, often incomplete and small sized, have been found. However, they have certain stratigraphical importance and therefore even this poor material is described and figured.

Suborder **Dalmanellidina** MOORE, 1952

Superfamily **Dalmanelloidea** SCHUCHERT, 1913
Family **Rhipidomellidae** SCHUCHERT, 1913
Subfamily **Rhipidomellinae** SCHUCHERT, 1913

Genus ***Rhipidomella*** OEHLERT, 1890

Type species: *Terebratula michelin*i LÉVEILLÉ, 1835; Lower Carboniferous; Belgium.

Rhipidomella ? sp.
Pl. 5, figs 3, 4

Material: One internal mould of dorsal valve and incomplete external mould of ventral valve in calcareous sandstone.

Remarks: Poor material makes the generic assignment of both valves speculative. The dorsal valve (pl. 5, fig. 3) is strongly convex, of circular outline indicating only a small interarea. Internally, there is a prominent median ridge extending anterior to midlength. The genus *Rhipidomella* OEHLERT, 1890 extends from the Eifelian to Upper Permian (Williams et Harper 2000) and our find would be one of the earlier reports of the genus in the area. Le Maïtre (1952b) reported two species of the genus from the Lower Eifelian of Erg Djemel in Algeria but she did not figure these specimens. The genus is common from the Middle Devonian to Tournaisian in Libya and Algeria (Borghi 1939, Havlíček 1984, Mergl et Massa 1992, Brice et Latréche 1998). Unlike our specimen, the cosmopolitan genus *Dalejina* HAVLÍČEK, 1953, which is characteristic for Lower Devonian, lacks the prominent median septum.

Distribution: Upper Emsian.

Occurrence: Tamesna Basin, Tin Rerhoh area, section 5 (sample H 1086).

Superfamily **Enteletoidea** WAAGEN, 1884
Family **Draboviidae** HAVLÍČEK, 1950
Subfamily **Draboviinae** HAVLÍČEK, 1950

Genus ***Salopina*** BOUCOT, 1960

Type species: *Orthis lunata* J. de C. SOWERBY, 1839; Silurian, Ludlow; England.

Salopina sp.
Pl. 5, fig. 2

Material: Two internal moulds of ventral valve and incomplete external mould.

Description: The ventral valve is subcircular, 95 % as long as wide, thin-shelled, one complete valve is 6 mm wide. The valve is strongly convex transversely and axially, with maximum depth in the posterior third. The maximum width is at midlength. The ventral interarea is apsacline, small and low, about less than 70 % of valve width. Dental plates are thin, of moderate length, diverging anteriorly at about 60° angle. The ventral muscle field is weakly impressed, as long as the dental plates. Internal ribbing is of uneven size, with deep interspaces restricted to the shell periphery. Exterior bears fine radial costellae of uneven size.

Remarks: The species is poorly known due to rare material. It is most similar to *Salopina hitchcocki* WALMSLEY et al., 1969 from the Tarratine Formation (Siegenian) of Maine (Walmsley et al. 1969, Boucot 1973). Our specimens differ from *S. hitchcocki* by longer and thinner dental plates but other features are almost identical. The Eifelian species *S. hazardensis* WALMSLEY et al., 1969 from Pennsylvania is smaller, transverse and its dental lamellae are short and medianly curved.

Distribution: Upper Emsian.

Occurrence: Tamesna Basin, Tin Rerhoh area, section 5 (sample H 1087).

Family **Tropidoleptidae** SCHUCHERT, 1896

Genus ***Tropidoleptus*** HALL, 1857

Type species: *Strophomena carinatus* CONRAD, 1839; Middle Devonian, Hamilton Group; New York, USA.

Remarks: As stated by Isaacson et Perry (1977), the genus *Tropidoleptus* HALL, 1857 displays remarkable morphologic uniformity throughout its history from the Siegenian to Frasnian. Apart from the type species, only a few other species or subspecies have been discriminated (Isaacson et Perry 1977, Cooper et Dutro 1982, Boucot et al. 1983,). The genus has an extensive geographical distribution, covering South America, Mexico, North America, North and South Africa and Central and Southwest Europe; its distribution and evolutionary history have been commented by many authors. However, variations of the shell morphology within particular populations (Williams 1913) and only minor morphological changes through its phylogeny make it useless as an index fossil (Isaacson et Perry 1977, Boucot et al. 1983).

In the territory of Northwest Africa and Central Sahara the genus was noted in many localities (Mauritania: Le Maïtre1952a, Sougy 1964, Bitam et al. 1996, Racheboeuf et al. 2004; Algeria: Brice et Latréche 1998; Libya: Borghi 1939, Boucot et al. 1983, Havlíček 1984, Havlíček et Röhlich 1987, Mergl et Massa 1992; Niger: Boucot et al. 1983, Mergl et al. 2001).

Numerous surface samples from the Tamesna Basin yielded *Tropidoleptus* but the shells are often scrapped and poorly preserved. Three morphological groups can be differentiated among our specimens. They probably represent different subspecies or species separated stratigraphically; one of them is described as a new subspecies. The oldest

shells of this genus in the Tamesna Basin have been collected from beds with fauna referred to the Upper Pragian or Pragian/Emsian boundary interval. However, the adult shells of this population are poorly known. Younger sandstone beds, referred to the Upper Emsian, yielded remarkably large specimens and this giant *Tropidoleptus* is described as a separate subspecies. Younger representatives of the genus have been collected near the Emsian/Eifelian boundary and these, as well as the shells in younger succession, are of average size, with width rarely exceeding 20 mm. These shells are referred to the typical subspecies *T. carinatus carinatus* (CONRAD, 1839). No shells in our material display morphology consistent with the formerly described African subspecies *T. carinatus nigerensis* BOUCOT et al. 1983 and *T. carinatus freuloni* BOUCOT et al. 1983 but shells from higher levels, probably of a Givetian age, are very poor. Absence of these two subspecies among the available material is indicative of an earlier, pre-Givetian age of most of the collected specimens from the Tamesna Basin.

Although recently this problematic genus is not referred to orthids (Williams et Harper 2000), present authors retain its original position in the Superfamily Enteletoidea WAAGEN, 1884 by Williams et Wright (1965).

Tropidoleptus carinatus carinatus (CONRAD, 1839)

Pl. 5, figs 16, 17, 19, 22

1986 *Tropidoleptus carinatus* (Conrad, 1839); Drot, p. 513, pl. 1, figs 10, 11.

Material: Some twenty-five valves in various, generally poor state of preservation in sandstones.

Remarks: Specimens from various stratigraphical levels may be referred to typical subspecies *T. carinatus carinatus* (CONRAD, 1839). The size of the specimens does not exceed 25 mm and falls into usual size range of the type subspecies.

The specimens of the Upper Pragian (sample H 1052) age have fine dorsal median septum perfectly developed already in very small individuals (pl. 5, fig. 19). Inner periphery of these small shells bears bundles of delicate radial ridges. Adult specimens are some 20 mm wide and have weakly convex ventral valve devoid of distinct carination.

Specimens from stratigraphically higher beds, referred to the Upper Emsian, Emsian/Eifelian boundary interval and Eifelian have commonly smaller shells, with width about 15 mm. The ventral valve is considerably convex and in some specimens also distinctly carinate. The stratigraphically youngest shells in the Tamesna Basin come from samples H 826 and H 1009, referred to the Givetian.

Distribution: Upper Pragian, Emsian, Eifelian, and Givetian.

Occurrence: Tamesna Basin, Oued Felaou area (samples H 333, H 1405), Kori-Idemeg – Touaret section (sample H 884), In Rahir Tin Amzi section (samples H 1052, H 1057, 1058), Tin Rerhoh area, section 5 (samples H 1086, H 1087, H 1088), In Ateï section (samples H 1004, H 1006, H 1009), Anou Izileg area (H 323), and In Debirene section (samples H 1105, H 1106, H 1107).

Tropidoleptus carinatus titanius subsp. n.

Pl. 6, figs 1–11

Holotype: Complete shell (MaMe 0038), figured on pl. 6, figs 1, 3, housed in the Department of Palaeontology of the Museum of West Bohemia, Plzeň, Czech Republic.

Paratype: Dorsal valve (MaMe 0037), internal mould figured on pl. 6, fig. 11, housed in the Department of Palaeontology of the Museum of West Bohemia, Plzeň, Czech Republic.

Type horizon: Lower Devonian, Upper Emsian.

Type locality: Algeria, Tamesna Basin, In Ateï section, sample H 1003.

Etymology: *titanius* (Lat.) – referring to the giant size of the shell.

Material: One complete shell, five dorsal valves, three ventral valves and numerous fragments preserved in sandstone with carbonatic cement.

Diagnosis: Large, depressed, non-carinate *Tropidoleptus carinatus* with low, short and thin dorsal median septum and low rounded costae.

Description: The shell is very low, planoconvex, weakly unisulcate, rather thick-walled, with cardinal extremity obtuse and never mucronate. The size is unusual and very large for the genus, with the width exceeding 50 mm (the largest specimen examined attains 56 mm width). The shell wall is densely exopunctate.

The dorsal valve is transversely oval, with hinge line 65–70 % of the maximum width. The lateral margins are evenly rounded, the anterior margin is only weakly curved. The valve is almost flat, with a broad and shallow sulcus apparent from valve midlength. The interarea is low, anacline, with the notothyrium closed by a high convex transversely striated chilidium. The dental sockets are deeply excavated into shell wall, widely diverging and shoaling anteriorly. Their bottom is coarsely crenulated, with 5–6 transverse ridges. Outer socket ridges are thin, inner socket ridges are high, massive, united with moderately divergent short crural bases. The notothyrial platform is long and narrow, anteriorly supported by a low and broad proximal part of the median septum. The septum anteriorly extends into tapering, low and acute myophragm, which continues towards 60–70 % of the valve length. The cardinal process is undivided, posteroventrally faced, with ventral face divided by deep transverse slit into shorter posterior and longer anterior lobes. The bottom of slit has subaxially two deeper pits. Muscle scars are weakly impressed, with apparent posterior adductors situated in front of the notothyrial platform. Anterior adductors are large, triangular, situated at the centre of the valve.

The ventral valve is gently and evenly convex in a transverse profile and weakly and unevenly convex in a lateral profile, with the maximum convexity and depth in the posterior third. The low fold is apparent from shell midlength. The ventral beak is short, obtuse. The interarea is low, al-

most orthocline, with fine transverse striation. The broadly triangular delthyrium is covered apically by long convex delthydial plate. The valve beak is short, curved. Teeth are large, faced dorsolaterally, supported by low, broadly divergent dental plates, which laterally bound an extensive ventral muscle field. The muscle field is weakly impressed, large, wider than long, with transversely striated surface. The field is axially divided by a weak myophragm.

The ornament of large shells consists of low and rounded costae of uniform size, slightly decreasing in size laterally, slowly widening during growth and separated by shallow rounded interspaces of similar size. However, the smaller specimens to 10 mm length have high, distinctly rounded costae in median and submedian sectors. The median costa on the ventral valve is weakly coarser and separated by narrower interspaces from lateral costae, which decrease in size laterally. Cardinal extremities are almost smooth. The shells have 23–25 costae. Internal costation is weak and obscured by secondary deposits in large shells. Fine internal radial striation along shell periphery, which is common feature in other subspecies of the genus, is weak in *T. carinatus titanius*. Fine pustules cover flattened peripheral rim of large shells, especially in the bottom of interspaces. Concentric ornament is weak, restricted to several uneven short growth lamellae or coarser growth lines near periphery of large shells.

Remarks: *Tropidoleptus carinatus titanius* subsp. n. differs from other subspecies and species of the genus by the large size. While other subspecies or species (*T. carinatus freuloni* BOUCOT et al., 1983, *T. carinatus nigerensis* BOUCOT et al., 1983, *T. carinatus rhenana* FRECH, 1897, *T. platys* COOPER et DUTRO, 1982) are 20 to 30 mm wide in average, the shells of *T. carinatus titanius* are 50 mm wide or even larger as can be assumed from the associated shell fragments. There are limited exact data about the size of other subspecies. The maximum width noted by Isaacson et Perry (1977) are less than 35 mm, in paper Isaacson et Chlupáč (1984) even less than 27 mm. All described specimens from Bolivia, where the species is typical element in the Emsian brachiopod fauna, are less than 27 mm wide (Isaacson 1977a). Also specimens of *T. carinatus* from the Hamilton Group (Givetian) of New York, USA are smaller (Williams 1913). In addition, a comparatively small and low median ridge of *T. carinatus titanius* distinguishes it from other subspecies of the genus. Only *T. carinatus freuloni* almost lacks the median septum but there are other differences between these subspecies, mainly in stronger myophragm, deeper impression of adductors and prominent internal radial striation of *T. carinatus freuloni*. Specimens from the Hamilton Group of New York (Williams 1913) and the Silica Shale of Ohio have higher and more prominent dorsal median septum, *T. carinatus rhenana* from the Lower Emsian of Germany differs by coarser costation and distinctly bilobed cardinal process. The coarser median costae on shell exterior that is developed in specimens from various worldwide sites (cf. Isaacson et Perry 1977: pl. 1, figs 17, 23; pl. 3, figs 13, 26; pl. 4, fig. 20) are weaker in *T. carinatus titanius*. The currently described *Tropidoleptus* sp. from Hodh area of Mauritania (Racheboeuf et al. 2004) is smaller and belongs to another subspecies.

Distribution: Upper Emsian.

Occurrence: Tamesna Basin, In Ateï section (sample H 1003), Oued Felaou area (sample H 328), Tin Rerhoh area, section 5 (sample H 1087).

Order **Rhynchonellida** KUHN, 1949

Superfamily **Rhynchotrematoidea** SCHUCHERT, 1913

Family **Trigonirhynchiidae** SCHMIDT, 1965

Subfamily **Trigonirhynchiinae** SCHMIDT, 1965

Genus ***Trigonirhynchia*** COOPER, 1942

Type species: *Uncinulina fallaciosa* BAYLE, 1878; Lower Devonian; France.

Trigonirhynchia sp.

Pl. 5, fig. 12

Material: Three incomplete ventral valves.

Description: Assumed from the fragments, the shell is some 12–14 mm wide, coarsely costate with short and stout dental sockets and short and weakly impressed ventral muscle field. The costae are rounded, originating at the beak. Ventral sulcus is distinct from midlength, extending into long serrate tongue. Ventral shell has six rounded costae in shallow sulcus and five lateral costae in each flank. Concentric ornament consists of fine growth lines.

Remarks: Poor material does not allow accurate generic determination but nature of the costae and the outline of the tongue indicate affinity to *Trigonirhynchia* COOPER, 1942. This genus occurs in the Pragian and Emsian (Brice et al. 2000). The species seems to be rather similar to the type species *T. fallaciosa* (BAYLE, 1878), but its size and ornament are similar also to *T. occidens* (WALCOTT, 1884) from the Emsian (*Eurekaspirifer pinyonensis* Zone) of Nevada (Johnson 1970).

Distribution: Upper Pragian.

Occurrence: Tamesna Basin, In Rahir Tin Amzi section (sample H 1052).

Genus ***Stenorhynchia*** BRICE, 1981

Type species: *Terebratula nympha* BARRANDE, 1847; Lower Devonian, Pragian; Barrandian, Bohemia.

Stenorhynchia ? sp.

Pl. 5, figs 5–7, 9

Material: Three incomplete external moulds and one internal mould of dorsal valves, one ventral valve.

Description: The available fragments of a small rhynchonellid have low dorsal sulcus distinct from the umbo. Costae are prominent from the beak, simple, angular, separated by deep angular interspaces. Flanks bear slightly curved asymmetrical costae of comparable size. The dorsal valve interior has distinct strong median septum. The ventral valve is subpentagonal, with the erected beak and shallow sulcus. The shell has some 16 costae, out of which four are in the dorsal fold.

Remarks: It is impossible to make an accurate determination of these fragments. However, they indicate the presence of a small rhynchotrematoid in benthic communities. The shape of our shells is most similar to small specimens of *Stenorhynchia nympha* (BARRANDE, 1847) reported from many sites in Europe and North Africa (Havlíček 1961, Brice 1981). Small specimen of *S. nympha* from the Upper Emsian of Morocco figured by Drot (1964; pl. 19, fig. 6) has less curved lateral costae. The fragments also show similarity to *Cupularostrum* sp. reported by Boucot et Johnson (1968) from the Emsian (Bois Blanc Formation) of New York, USA.

Distribution: Upper Emsian.

Occurrence: Tamesna Basin, In Rahir Tin Amzi section (samples H 1057, H 1058), In Ateï section (sample H 1003), In Debirene section (sample H 1108).

Superfamily **Camarotoechioidea** SCHUCHERT, 1929
Family **Leiorhynchidae** STAINBROOK, 1945
Subfamily **Leiorhynchinae** STAINBROOK, 1945

Genus ***Leiorhynchus*** HALL, 1860

Type species: *Orthis quadracostata* VANUXEM, 1842; Middle Devonian, Givetian; New York, USA.

Leiorhynchus ? sp.
Pl. 5, fig. 13

Material: One poorly preserved external mould in siltstone.

Remarks: Although poorly preserved, elongate rounded outline, weak radial plications in a midsector of the ventral valve and smooth flanks indicate leiorhynchid affinity of the shell. It is the only report of the camarotoechioids brachiopod in the material from the Devonian outcrops of the Tamesna Basin, unlike other North African basins with the Middle and Upper Devonian succession. However, a subsurface data indicate the presence of other leiorhynchids in the Tamesna Basin (Part 2).

Distribution: The Givetian or even younger age of the sample is suggested.

Occurrence: Tamesna Basin; Kori-Idemeg – Touaret area (sample H 888).

Order **Athyridida** BOUCOT, JOHNSON et STATON, 1964
Suborder **Athyrididina** BOUCOT, JOHNSON et STATON, 1964

Superfamily **Athyridoidea** DAVIDSON, 1881
Family **Athyrididae** DAVIDSON, 1881
Subfamily **Athyridinae** DAVIDSON, 1881

Genus ***Athyris*** M'COY, 1888

Type species: *Terebratula concentrica* VON BUCH, 1834; Middle Devonian, Eifelian; Germany.

Athyris sp.
Pl. 5, figs 18, 21

Material: Two internal moulds and one external mould of ventral valves.

Description: The ventral valve has rounded subpentagonal outline and is slightly wider than long (VvL/VvW = 0.90; n = 2) with maximum width at midlength. The larger shell is 26 mm wide. Posterolateral margins are almost straight, lateral margins are strongly curved. Anterolateral margin is weakly curved. The anterior margin is truncated. The valve is evenly convex in lateral and transverse profiles. The sulcus is narrow, shallow, distinct from about midlength. It extends into long, rounded tongue, occupying some 50 % of the shell width.

Dental plates are distinct, short, subparallel, with the bases slightly converging anteriorly and ventrally. The ventral muscle field is clearly defined, with long, narrowly triangular, subparallel diductor scars, flabellate along the anterior margins. Adductor scars are narrow, parallel, encircled by diductors. The muscle field is long, extending over the shell midlength.

Shell exterior bears thin concentric lines of uniform size, of which a few extend into short lamellae. There are some 10–12 lines per 5 mm anteromedianly.

Comparison: Athyridids are rare in our material and apart from the figured specimens, only a small fragment of ventral valve has been found in another sample (H 1087). Outline, convexity and external ornament of the shells from the Tamesna Basin are consistent with the attribution to *Athyris* M'COY, 1888. Shells are similar to the type species *A. concentrica* VON BUCH, 1834 as newly defined by Alvarez et al. (1996) but our species differs by transversely strongly convex ventral valve and bigger shell. The Spanish Emsian species *Athyris campomanesi* (DE VERNEUIL et D'ARCHIAC, 1845) is less transverse, with shorter ventral tongue and has distinct radial plications that are absent in *A.* sp. The species *Athyris* cf. *cora* HALL, 1857 from the Eifelian of Venezuela (Benedetto 1984) differs by much smaller size, weaker concentric ornament and weak ventral tongue. Le Maître (1952b) reported some athyridids from western Algeria, among others also *A. concentrica*. The figured shell

(Le Maïtre 1952b; pl. 19, figs 41, 42) differs from our specimens by smaller size and more distinct sulcus. In Central Sahara, poorly preserved athyridids were also reported by Havlíček et Röhlich (1987) and Mergl et Massa (1992) from the Eifelian of Libya (Ghadamis and Murzuq basins). These Libyan athyridids are much transverse with a deeper ventral sulcus and their morphology is more consistent with a subgenus *Alvarezites* STRUVE, 1992.

Distribution: Upper Emsian to Lower Eifelian.

Occurrence: Tamesna Basin, Tin Rerhoh area, section 5 (sample H 1087), In Debirene section (sample H 1106).

Order **Spiriferida** WAAGEN, 1883
Suborder **Spiriferidina** WAAGEN, 1883

Superfamily **Ambocoelioidea** GEORGE, 1931
Family **Ambocoelidae** GEORGE, 1931

Genus ***Pustulatia*** COOPER, 1956

Type species: *Vitulina pustulosa* Hall, 1860; Middle Devonian, Hamilton Group; New York, USA.

Remarks: The genus has typical pustulose microornament, which is lacking in the externally similar Lower Devonian genus *Plicoplasia* BOUCOT, 1959. Other differences in these homoeomorphous genera concern of the myophragm and the median septum, which are poor in *Pustulatia* COOPER, 1956. The presence of *Pustulatia* in the Upper Pragian of the Tamesna Basin indicates that the origin of the genus could be sought outside of North America. The genus has more likely a Gondwanan origin. It is known from the Emsian and early Eifelian, possibly also the Givetian from Niger, South Africa, Bolivia, and Brazil. *Pustulatia* is also reported from Argentina Precordillera from beds already of the Emsian age (Herrera 1995). The famous occurrence on *Pustulatia pustulosa* (HALL, 1860) in the Hamilton Group (New York, USA) represents the latest member in the evolutionary history of the genus. The occurrence of *P. pustulosa* in the Hamilton Group of New York associates with the elements having also other than North American origin (e.g. *Tropidoleptus*).

Pustulatia lessardi sp. n.
Pl. 7, figs 1–12, 15

Holotype: Dorsal valve (MaMe 0052B), figured on pl. 7, fig. 5, housed in the Department of Palaeontology of the Museum of West Bohemia, Plzeň, Czech Republic.

Paratype: Ventral valve (MaMe 0050H), figured on pl. 7, fig. 11, housed in the Department of Palaeontology of the Museum of West Bohemia, Plzeň, Czech Republic.

Type horizon: Lower Devonian, Upper Pragian.

Type locality: Algeria, Tamesna Basin, In Rahir section, sample H 1052.

Etymology: After Dr. Lionel Lessard, the famous French geologist.

Material: Six dorsal valves, eight ventral valves, numerous valves of juvenile specimens and several fragments with microornament preserved in fine sandstone.

Diagnosis: *Pustulatia* with broad dorsal sulcus and weak ventral median plications, with cardinal process with small ctenophoridium of about seven plates; lateral plications weak and rapidly decreasing in size, distinct from midlength; ventral myophragm absent.

Description: The shell is small, planoconvex, weakly sulcate, thin-shelled, transversely oval, with width maximum at or posterior to midlength. The shell width attains some 9.0 mm in large specimens. Lateral margins are evenly curved, frontal margin has a weak emargination.

The dorsal valve is flat, with rounded cardinal extremities. DvW/DvL ratio is about 135 %. The dorsal interarea is anacline, low but clearly defined. The shallow and broad sulcus is distinct from valve midlength. The dental sockets are deep, triangular, supported by triangular, moderately divergent (at about 65°) inner socket plates. The crural bases are poorly defined, attached to surface of weakly defined triangular notothyrial platform. The platform is low, broad and long, unsupported by a median ridge. The ctenophoridium is small, faced posteroventrally, of seven vertical radially arranged plates.

The ventral valve is high, with broad and shallow sulcus. The plications bounding the sulcus are much more prominent than the lateral plications. The delthyrium is large, open. The bottom of delthyrial chamber is highly raised above adjacent valve floor. Teeth are large and robust in relation to shell size, unsupported by dental plates. The ventral muscle field is poorly impressed, with large paired diductors and much smaller, posteromedianly situated scars of adductors. The myophragm is absent.

The ornament consists of low rounded plications, four in each flank, rapidly diminishing in size laterally. The lateral plications become distinct from shell midlength, being obscure near shell beaks. The bottom of ventral sulcus bears weaker but distinct median plication. The dorsal sulcus has correspondingly sized median interspace between the pair of plications. Microornament consists of almost regularly spaced radial fila with regular rows of fine elongate pustules. There are seven to ten fila on plications bounding the sulcus. Concentric ornament consists of a few, low, distinct growth lamellae. Growth fila are unevenly sized, distinct between lamellae along the shell margin of large shells.

Remarks: This new species is the stratigraphically earliest species of the genus in our samples from the Tamesna Basin, and probably also the earliest known representative of the genus yet recorded. The species differs from the stratigraphically subsequent species *Pustulatia tamesnaensis* sp. n. in the same area by a broader sulcus having a low median plication in the ventral valve, by the lateral plications distinct from the shell midlength, and by rapidly reduced size of lateral plications. The dorsal valve of *P. lessardi* sp. n. is flat, while that of *P. tamesnaensis* sp. n. is moderately convex. The new species differs from the speci-

men found in the Taoudeni Basin by Villemur et Drot (1957) and referred to *P. pustulosa* (HALL, 1860) by a distinctly broader dorsal sulcus and uneven size of plications. The presence of *P. pustulosa* in the Tamesna Basin was commented by Le Maïtre (1961). She noted the occurrence of *P. pustulosa* in three different levels, from Siegenian to upper Emsian, but without any description or illustrations of these specimens. It is probable that her determination was approximate and comprised two currently described species. The typical *Pustulatia pustulosa* (HALL, 1860) from the Middle Devonian (Hamilton Group; upper Eifelian and Givetian) of New York, USA differs by even narrower dorsal sulcus, distinct dorsal myophragm and median ridge, and coarser and more numerous lateral plications.

The genus *Pustulatia* is reported, apart from the classical Middle Devonian occurrence in New York of USA, from Brazil (Rathbun 1874), Bolivia and Argentina (Thomas 1905, Isaacson 1977b, 1993), and South Africa (Reed 1903). Two species, the stratigraphically earlier (Emsian and early to mid-Eifelian) species *P. curupira* (RATHBUN, 1874) and the latter (late mid-Eifelian) species *P. branisi* ISAACSON, 1977, are known from Bolivia. However, their stratigraphical range may be younger, as suggested by Racheboeuf et al. (1993a, 1993b). The earlier *P. curupira* differs from the new species by more transverse outline, almost rectangular cardinal extremities, narrower sulcus and coarser plications. An important difference concerns the cardinal process. While in *P. curupira* and *P. branisi* the cardinal processes are large, bilobate proximally and quadrilobate distally, in the new species the cardinal process is low, with a chevron-like arrangements of high ctenophoridial plates.

Distribution: Upper Pragian.

Occurrence: Tamesna Basin, In Rahir Tin Amzi section (sample H 1052), Tin Rerhoh area, section 5 (sample H 1085).

Pustulatia tamesnaensis sp. n.

Pl. 7, figs 13, 14, 16–22

Holotype: Dorsal valve (MaMe 0128), figured on pl. 7, figs 13, 16, 17 housed in the Department of Palaeontology of the Museum of West Bohemia, Plzeň, Czech Republic.

Paratype: Ventral valve (MaMe 0127C), figured on pl. 21, figs 21, 22 housed in the Department of Palaeontology of the Museum of West Bohemia, Plzeň, Czech Republic.

Type horizon: Middle Devonian, Eifelian.

Type locality: Algeria, Tamesna Basin, In Debirene section, sample H 1107.

Etymology: After the studied area.

Material: Five dorsal valves, five ventral valves and several fragments preserved as internal and external moulds in sandstone.

Diagnosis: *Pustulatia* with convex dorsal valve, narrow dorsal sulcus without ventral median plication; inner socket ridges broadly divergent; strong plications distinct from the umbones.

Description: The shell is ventribiconvex, weakly unisulcate, thin-shelled, transversely oval, 9.0 mm wide in the largest known specimen.

The dorsal valve is moderately convex, widest in the posterior third, with a shallow, rather narrow sulcus. The dorsal interarea is very low, anacline. Cardinal extremities are rounded. Dental sockets are long, narrow, deep and broadly divergent. The dental sockets are bound by broadly divergent (at about 130°) inner socket ridges. The cardinal process is raised, without distinct ctenophoridial blades. The notothyrial platform is distinctly raised, short, supported by a short median ridge.

The ventral valve is highly convex in lateral view, subcarinate in transverse profile. The ventral sulcus is shallow and narrow. The delthyrium is open. Teeth are large, robust, unsupported by dental plates. The ventral interarea is small, catacline. Muscle scars are not impressed in the available shells.

External ornament consists of distinct plications originating at umbones. Sulcus-bounding plications are stronger than the lateral plications. There are five plications on each flank of the ventral valve and four plications on each flank of the dorsal valve. The median plication in dorsal sulcus is well developed, originating at beak and is slightly smaller than sulcus-bounding plications. Concentric ornament is not preserved. Microornament of radial rows of elongate pustules is poorly preserved.

Remarks: The species differs from *P. lessardi* sp. n. by a narrower dorsal sulcus and more prominent lateral plications distinct already from umbones, by shorter and more divergent inner socket ridges and by convex dorsal valve, which is flat in *P. lessardi*. The species *P. pustulosa* (HALL, 1860) has the sulcus-bounding plications only weakly coarser than other lateral plications and the median plication in sulcus evenly widens anteriorly. In the new species, the sulcus bounding plications are much stronger than other lateral plications, leaving the median plication nearly evenly wide from the shell midlength. The new species has also more rounded outline and less distinct dorsal myophragm than *P. pustulosa*. The species is similar to *P. curupira* (RATHBUN, 1874) but the South American species is more transverse, having narrower and deeper sulcus. The specimen referred to *P. pustulosa* (HALL, 1860) by Villemur et Drot (1957) from the Taoudeni Basin cannot be referred to *P. tamesnaensis*. The specimens from the Taoudeni Basin differ by a broader dorsal sulcus with a pair of weak median plications, while the latter has only a single undivided median plication. In addition, the new species has coarser plications than the specimen figured by Villemur et Drot (1957).

Distribution: This species is a common element in samples referred to the Eifelian, associated among others with the spiriferids *Paraspirifer*, *Eleutherokomma* and a chonetoid *Montsenetes pervulgatus* sp. n. but it occurs already in beds of the suggested Upper Emsian age.

Occurrence: Tamesna Basin, In Debirene section (sample H 1107), Oued Felaou area (sample H 333), Tin Rerhoh area, section 5 (samples H 1087, H 1090).

Suborder **Delthyridina** IVANOVA, 1972

Superfamily **Delthyridoidea** PHILLIPS, 1841
Family **Hysterolitidae** TERMIER et TERMIER, 1949
Subfamily **Hysterolitinae** TERMIER et TERMIER, 1949

Genus ***Filispirifer*** JANSEN, 2001

Type species: *Filispirifer merzakhsaiensis* Jansen, 2001; Lower Devonian, Pragian; Morocco.

Filispirifer merzakhsaiensis JANSEN, 2001
Pl. 8, figs 3–17

Synonymy: See Jansen (2001).

Material: Seventeen ventral and five dorsal valves preserved as internal and external moulds in fine sandstone.

Description. The shell is biconvex, strongly uniplicate, some 40 mm wide in the largest specimens, with the hinge line extended into short mucronations. The shell wall is thickened, especially in the posterior of the ventral valve.

The dorsal valve is almost semicircular, 50 % as long as wide, subcarinate, with prominent fold. The flanks are weakly convex, passing laterally into flattened mucronations. Lateral profile of the valve is considerably convex, with the maximum depth in midlength. The dorsal interarea is very low, anacline, with widely triangular notothyrium. The dorsal valve interior lacks the notothyrial platform. The ctenophoridium rests at the posterior concavity of the umbonal chamber. The ctenophoridium is deeply concave in transverse profile and consists of 22 to 30 high vertical lamellae. Dental sockets are short and rather small. The crura are short and massive. Posterior adductor scars are small and weakly impressed in the posterior fourth of the valve. Anterior adductors are located at the centre of the valve and are deeply impressed, having transversely striated surface. The scars are separated from each other by a prominent median septum.

The ventral valve is transverse, strongly convex, with convex flanks and depressed mucronations. The sulcus is deep, rounded, extending into prominent long tongue. The ventral interarea is high, apsacline, slightly concave in lateral profile. The delthyrium is triangular, bordered by stout bases of large teeth. The ventral valve interior undergoes distinct changes during growth. The distinct, short and broadly divergent dental plates of juvenile specimens are almost completely sealed in gerontic shells. The ventral muscle field is posteriorly deeply impressed into the valve floor but anteriorly remains shallower and is bordered by a low raised ridge. The surface of the muscle field is posteriorly halved by a short fine myophragm, which anteriorly separates the parallel elongate adductor scars. Posteriorly, the myophragm becomes thickened and passes into massive vertical septum inside the umbonal chamber. The muscle scars impressions are distinctly striated (pl. 8, figs 10, 13).

Internal plication is distinct, commonly with 6 or 7 plications but only 4 to 5 plications remains distinct in the gerontic specimens.

External ornament consists of seven to ten distinct rounded and undivided lateral plications. Their size rapidly decreases laterally. The fold and sulcus are smooth. Fine concentric ornament is obscure, but several coarse, often imbricating growth lamellae are anteriorly developed. The lamellae are well defined internally by thickening of the valve. The microornament is unknown.

Remarks: The morphology and ontogeny of this species was widely discussed by Jansen (2001). Although the microornament of our specimens is unknown, the shell morphology is identical with *A. merzakhsaiensis* JANSEN, 2001. In coincidence with specimens from Morocco, our specimens lack the notothyrial platform, have deeply impressed ventral muscle field and the exterior with fewer plications but they are slightly smaller than in the specimens described by Jansen (2001). The stratigraphically younger species *Filispirifer fallax* (GIEBEL, 1858) is larger and has distinct notothyrial platform. The species *Filispirifer fallax* is reported from the early Lower Emsian in several sites in Germany and Spain. The species *F. merzakhsaiensis* is stratigraphically earlier, restricted to the Middle and Upper Siegenian of Morocco. Nearly identical specimens are reported also in various parts of West Europe (Jansen 2001).

Distribution: Upper Pragian.

Occurrence: Tamesna Basin, In Rahir Tin Amzi section (sample H 1052), Tin Rerhoh area, section (sample H 1080).

Genus **Hysterolites** SCHLOTHEIM, 1820

Type species: *Hysterolites hystericus* SCHOLTHEIM, 1820; Lower Devonian, Siegenian, Germany.

Hysterolites hystericus SCHLOTHEIM, 1820
Pl. 8, figs 1, 2

1963 *Hysterolites (Hysterolites) hystericus* SCHLOTHEIM, 1820; Solle, p. 174 (here complete older synonymy).

1989 *Hysterolites hystericus* SCHLOTHEIM, 1820; Gourvennec, p. 111, pl. 9, figs 11–29 (here synonymy after 1963).

Material: One dorsal valve, one ventral valve and several shell fragments in fine sandstone.

Description: The shell is strongly transverse, thin-shelled, ventri-biconvex, with acute extremities, about 30 mm wide.

The dorsal valve is weakly convex, with anacline interarea and wide notothyrium filled by cardinal process. The triangular ctenophoridium form some 10 to15 lamellae. The dental sockets are deep and widely divergent. The crural

plates are distinctly developed, the extending crura are widely divergent. The muscle scars are indistinct. The median septum is weak.

The ventral valve has a deep sulcus. The ventral interarea is steeply apsacline and slightly curved. The ventral muscle field is weakly impressed, with distinct myophragm, posterolaterally bounded by extrasinal, basally long and evenly thick dental plates. The shell ornament consists of high subangular costae, 11–12 on each flank.

Remarks: Our specimens are nearly identical by the size and internal morphology with the specimens from West and Central Europe (Solle 1963, Vandercammen 1963, Gourvennec 1989) as inferred from our limited material. The genus *Hysterolites* SCHLOTHEIM, 1820 is widespread in the Pragian and probably extends to the Lower Emsian (Gourvennec 1989).

Distribution: The species is associated with *Filispirifer merzakhsaiensis* JANSEN, 2001 but it is rare in both samples. The Upper Pragian age is probable.

Occurrence: Tamesna Basin, In Rahir Tin Amzi section (sample H 1052) and Tin Rerhoh area, section 3 (sample H 1080).

Genus ***Arduspirifer*** MITTMEYER, 1972

Type species: *Spirifer arduennensis* SCHNUR, 1853; Lower Devonian, Emsian; Germany.

Remarks: A revised diagnosis of the genus has been recently given by Jansen (2001). This author also critically revised the taxa referred by various authors to this genus and presented precise data about the distribution of the genus in Germany, Belgium, France, Spain, and Morocco. The genus appeared in the Middle Siegenian and extended into the Lower Eifelian. In Morocco, the genus is known from the Upper Siegenian to early Upper Emsian (Jansen 2001). Our limited material from the Tamesna Basin falls into variability range of only one species of the suggested Upper Emsian age.

Arduspirifer cf. ***mosellanus*** (SOLLE, 1953)

Pl. 9, figs 1–9

1952a *Acrospirifer speciosus speciosus* AUCT.; Le Maître, p. 334, pl. 2, figs 4–9.

1952b *Acrospirifer speciosus speciosus* AUCTORUM; Le Maître, p. 126, pl. 15, figs 16–18.

cf. 1953 *Hysterolites (Acrospirifer) mosellanus* n. sp.; Solle, p. 83, pl. 8, figs 119–123, pls. 9–11, pl. 12, figs 176–178.

1964 *Acrospirifer mosellanus mosellanus* SOLLE, 1953; Drot, p. 54.

1964 *Acrospirifer mosellanus* cf. *mosellanus* SOLLE, 1953; Drot, p. 54.

1964 *Acrospirifer mosellanus* cf. *steiningeri* SOLLE, 1953; Drot, p. 54.

1964 *Acrospirifer* cf. *mosellanus steiningeri* SOLLE, 1953; Drot, p. 54.

1986 *Arduspirifer* sp. gr. *mosellanus* (SOLLE, 1953); Drot, p. 513, pl. 1, figs 1–4, 7.

Material: External mould of a complete shell, six internal moulds of ventral valves, six external moulds and several fragments.

Description: The shell is 35–40 mm wide, slightly dorsi-biconvex, with posteriorly strongly thickened shell in adult specimens.

Dorsal valve is moderately convex, with narrow fold slightly broader than bordering plications. Dorsal interior is unknown.

The ventral valve is broadly semielliptical, 40–50 % as long as wide but may be significantly longer with age (pl. 9, fig. 5), with the maximum width at the hinge line. The beak is prominent. Anterior and lateral margins are evenly curved, anterior margin is without prominent emargination. Cardinal extremities are acute, sometimes with weak and short mucronations. The valve is moderately convex in lateral profile and moderately and weakly arched in transverse profile with arched flanks. The sulcus is shallow, only slightly wider than interspaces between plications, with rounded bottom. The sulcus extends into short rounded tongue. The ventral interarea is apsacline, remarkably low, weakly concave in lateral profile with a wide open delthyrium. Surface of interarea is smooth. The ventral valve interior has large teeth, in small specimens supported by very short dental plates, which subtend 80–85° angle between each other. The adult specimens have the ventral muscle field completely subdued into thick posterior shell wall and the dental plates are obsolete. The ventral muscle field is large, broadly oval, halved by a weak and broad median ridge.

Ornament consists of coarse, low rounded plications. Their height rapidly decreases laterally. There are 6 to 7 lateral plications in large ventral valves, but the most lateral ones are already poorly defined. Internally, there are 4 to 6 distinct plications. Interspaces are narrower than plications, with rounded bottom. Concentric ornament is weak, with several short lamellae along the periphery of large shells. Microornament consists of concentric rows of microspines. There are two concentric rows of microspines per 1 mm, with 6 to 7 microspines per 1 mm in a row.

Remarks: The presence of *Arduspirifer* MITTMEYER, 1972 in the area has been reported by Drot (1986). She figured four specimens, detail of its microornamentation, and suggested the Upper Emsian age. Our specimens from the same sample H 1088 and also from the probably corresponding level (sample H 1058) are similar to the specimens referred by Solle (1953) to *A. mosellanus moselanus* SOLLE, 1953. Our specimens have less extended hinge line than the specimens from Germany, especially the subspecies *A. mosellanus gracilis* (SOLLE, 1953) and *A. mosellanus steiningeri* (SOLLE, 1953) (= probably subjective synonyms of *A. mosellanus mosellanus*). This species is a characteristic younger member of the evolutionary lineage of the genus *Arduspirifer*. The species is known from the Upper Emsian in Germany (Solle 1953), France (Heddebaut 1981) and Celtiberia (Carls et al. 1972, Carls 1988). It is known, apart from the already mentioned paper of Drot (1986), probably also in Algeria and Mauritania (Le

Maïtre1952a, 1952b; p. 126, *Acrospirifer speciosus speciosus* SCHNUR, 1853). Our specimens are externally similar also to the species *Arduspirifer supraspeciosus* (LOTZE, 1928) from the Eifelian of Germany and Belgium (Solle 1953, Vandercammen 1963) but our specimens are less transverse and lack distinct dental plates present in the German specimens. Our specimens can be compared with other members of the *A. intermedius* evolutionary lineage (Solle 1953). Their shared morphology, with few low rounded plications and narrow sulcus, indicates a late Emsian or early Eifelian age of the specimens from Tamesna Basin.

Age: Upper Emsian to Lower Eifelian.

Occurrence: Tamesna Basin, In Rahir Tin Amzi (sample H 1058), Tin Rerhoh area, section 5 (sample H 1088).

Subfamily **Paraspiriferinae** PITRAT, 1965

Genus ***Paraspirifer*** WEDEKIND, 1926

Type species: *Spirifer cultrijugatus* F. ROEMER, 1844; Lower Devonian, Emsian; Germany.

Paraspirifer aff. ***cultrijugatus*** (ROEMER, 1844)

Pl. 9, figs 10–19

1952a *Spirifer* (*Paraspirifer*) *cultrijugatus* (F. ROEMER): Le Maïtre, p. 335.

Material: One incomplete shell, two ventral valves, one external mould of ventral valve and an incomplete internal mould of a dorsal valve.

Description. The shell is large, slightly transverse, of bilobate outline, widest in anterior third, dorsi-biconvex, highly uniplicate, with moderately thick shell. The maximum shell width estimated from incomplete shells is 58 mm.

The dorsal valve is highly carinate, with feebly convex and steeply sloping flanks. In transverse profile the flanks subtend 100° angle. The fold is prominent, subangular, with rounded crest. There is only a weak angle between the side of fold and the adjacent flank. The dorsal interarea is very low, anacline. The notothyrium is open. The shell interior is poorly known, with internal ribbing distinct only near the anterior commissure.

The ventral valve is strongly convex, with significantly arched flanks in the transverse profile. The valve is deepest at the posterior third. The hinge line occupies about 80 % of the shell width. The interarea is rather small, apsacline, strongly curved. The delthyrium is open. The sulcus is deep, with straight slopes and rounded bottom, evenly and significantly expanding anteriorly at about 25–28° angle. It occupies 40–45 % of shell width at anterior margin. The tongue is short, triangular with rounded apex. Interior is known only in small specimens. The dental plates are short, thin, widely divergent. Muscle scars are deeply impressed in large specimens but very weak in small individuals.

Ornament consists of asymmetrical radial plications distinct from the beak. The plications dichotomously divide into two slender ribs at about midlength, separated by shallow interspaces. Only four to five plications adjacent to fold and sulcus, respectively, bifurcate, the remaining lateral plications remain undivided. Each flat side of the fold and sulcus, respectively, has weakly defined radial bands separated by obscure interspaces from the axial part of the fold and sulcus. There are 15 plications distinct from the beaks, in total some 20 along the anterior margin of large shells.

Remarks: The poor preservation and lack of complete shells make determination of particular specimens difficult. By shell shape, the species shows distinct affinity to *P. cultrijugatus* (ROEMER, 1844). Both our specimens and the typical specimens of *P. cultrijugatus cultrijugatus* (ROEMER, 1844) from Belgium and Germany (Vandercammen 1963, Solle 1971) have an acute fold and angular to subangular bottom on the ventral sulcus. Our species differs only by less acute bottom of the ventral sulcus but it still remains less rounded than in the European species *P. cultrijugatus frechi* SOLLE, 1971, *P. praecursor* SOLLE, 1971, and *P. curvatissimus* SOLLE, 1971. By morphology, our specimens fall into the *cultrijugatus* group of the European paraspiriferinids (Solle 1971), which are characteristic for the late Upper Emsian and early Eifelian time.

A close affinity of the Saharan species to the American representatives of the genus was suggested by earlier authors (Racheboeuf 1990a, 1990b). However, the American paraspiriferinids of which revision has been published by Godefroid et Fagestrom (1983) can be differentiated from our specimens. The species *P. conradi* GODEFROID et FAGESTROM, 1983 and *P. clarkei* GODEFROID et FAGESTROM, 1983 differ by rounded folds and sulcus. *P. bownockeri* (STERWARD, 1927) differs by earlier dichotomy of plications. *P. halli* GODEFROID et FAGESTROM, 1983 and *P. acuminatus* (CONRAD, 1839) are most similar to our specimens. The latter has less numerous lateral plications, its fold is less acute, flanks of the dorsal valve are more convex and its fold is narrower than in our specimens. *P. halli* is the most similar of all North American species but it is more globose and its shell is more transverse. Poorly preserved paraspiriferinids (*P.* aff. *cultrijugatus*, *P.* aff. *P. acuminatus*, and *P.* ? sp.) are known from early to late Eifelian of Venezuela (Benedetto 1984) and these taxa need a revision.

In northwest Africa the genus is known north as well as south of the Reguibat Shield (Le Maïtre, 1952a, 1952b, Drot 1964) and its stratigraphical significance has repeatedly been discussed by Racheboeuf (1990a, 1990b). Although a mere presence of the genus can indicate at least the late Upper Emsian to Givetian age, the species of the *P. cultrijugatus* group are restricted to the Upper Emsian and Lower Eifelian in Europe and the morphologically similar North American species *P. acuminatus* and *P. halli* are of the Eifelian age (Onondaga Limestone, Jeffersonville Limestone). Our specimens differ from specimens of *P. cultrijugatus* figured by Le Maïtre (1952a; pl. 14, figs 1–6) and Drot (1964; pl. 4, fig. 5) by a subangular fold and they cannot be re-

ferred to the same species. These previously described African species are similar to the subspecies *P. cultrijugatus frechi* SOLLE, 1971 or to younger American species with long and rounded fold (e.g. *P. clarkei*). Consequently, the stratigraphical extension of the genus in Central Sahara can take longer interval, with few discrete species. However, the morphology of our specimens from the Tamesna Basin is uniform and falls into the morphology of the earliest members of the genus. Therefore, the late Upper Emsian or early Lower Eifelian age is suggested.

Distribution: Late Upper Emsian to Lower Eifelian.

Occurrence: Tamesna Basin, Tin Rerhoh area, section 5 (sample H 1090), In Debirene section (samples H 1105, 1106), In Ateï section (sample H 1017).

Family **Mucrospiriferidae** BOUCOT, 1959
Subfamily **Mucrospiriferinae** BOUCOT, 1959

Genus ***Eleutherokomma*** CRICKMAY, 1950

Type species: *Eleutherokomma hamiltoni* CRICKMAY, 1950; Upper Devonian, Givetian; USA.

Eleutherokomma mutabilis sp. n.

Pl. 10, figs 1–19

? 1964 *Acrospirifer arduennensis arduennensis* (SCHNUR, 1853); Drot, p. 50.

? 1964 *Acrospirifer* cf. *mosellanus mosellanus* SOLLE, 1953; Drot, p. 54.

Holotype: Complete shell valve (MaMe 0125), figured on pl. 10, figs 15, 18, housed in the Department of Palaeontology of the Museum of West Bohemia, Plzeň, Czech Republic.

Type horizon: Middle Devonian, Eifelian.

Type locality: Algeria, Tamesna Basin, In Ateï section, sample H 1017.

Etymology: *mutábilis* (Lat.) – allusion to the variation of the mucronation length.

Material: Six complete specimens, eight dorsal and eighteen ventral valves and numerous fragments in sandstone.

Diagnosis: Unequally biconvex, large *Eleutherokomma* with smooth sulcus, with six to eleven lateral ribs and mucronations of variable length, posteriorly thickened interior of ventral valve with prominent pitted pad; short, posteriorly thick dental plates; prominent apical pad in ventral umbonal chamber and distinctly impressed ventral and dorsal muscle fields; crural plates absent in adult specimens; concentric ornament of densely spaced short lamellae.

Description: The shell is unequally biconvex to almost plano-convex, in maximum 50 mm wide, rather thick-shelled in adults, with uniplicate commissure. The shell outline is broadly semicircular to subtrapezoidal. Maximum width is at the hinge line.

The dorsal valve is strongly transverse, some 30 % as long as wide (without mucronations). Mucronations are robust, short to very long but invariably present. However, their length significantly fluctuates and sometimes there are differences in their length also between the left and right side of the same specimen. The mucronations extend laterally into evenly wide extensions, with low striated catacline posterior face and nearly smooth and flat anterior face. The anteromedian shell margins are gently curved, with a shallow emargination at the edge of the fold. Small dorsal valves are nearly flat, but the valves of adults become weakly arched in lateral profile, with a tendency to geniculation along the anterior periphery of gerontic specimens. This geniculation is commonly formed by overlapping short growth lamellae and internally is marked by a step-like shell floor. Transverse profile at midlength of the valve is weakly convex, with somewhat flattened cardinal extremities. The fold is prominent, bald, high, rounded, regularly but weakly expanding anteriorly, bordered by deep interspaces. However, in single specimens (sample H 884), the median groove, slightly asymmetrical to the shell axis has been found. The dorsal interarea is low, anacline, with broadly triangular notothyrium, which is almost entirely filled by small, widely triangular, slightly raised ctenophoridium of a crescentic outline. The ctenophoridium consists of 20–22 high, weakly diverging plates of uniform size. The notothyrial platform is short and thick, highly raised above valve floor, supported by very short and low median ridge. Short and thick crural bases extend anteriorly with 90–100° angle from each other, but they are distinct only in small individuals. Dental sockets are narrowly triangular, rapidly deepening laterally and bordered by thin and high inner socket ridges. A thin myophragm extending towards midlength of the valve is distinct in small individuals, generally becoming obscure in large specimens but its strength is variable. Muscle scars are deeply impressed, with subtriangular posterior adductor scars onto the second and third plications. The anterior pair of adductors is situated on the top and slopes of the fold at about valve midlength. The anterior adductors scars are divided into a narrower and longer elliptical posterior pair and a shorter, subcircular anterior pair. The internal plication is distinct over the whole internal surface except for the gerontic specimens having posteromedianly thick and deeply pitted pad.

The ventral valve is strongly convex in a lateral profile, some 25 to 30 % as deep as long, with the maximum depth at midlength. The flanks are gently convex, extending into lateral extension bordering anterior edge of mucronations. This extension is of variable length, making an angle subdued by mucronation and the lateral margins strongly varying. The point of inflexion lies immediately before the hinge line, the lateral margins are weakly to moderately curved. The sulcus is prominent, deep, with rounded bottom, extended dorsally into a short, semielliptical tongue. The ventral interarea is high, apsacline, strongly concave in the lateral profile, with prominent transverse striation along the whole length. The delthyrium is open. Teeth are strong, directed almost laterally. The dental plates are distinctly extrasinal, diverging at 60–70° degrees from each other.

Dental plates are always clearly developed, short, located between the second and third lateral plications. Young specimens have thin dental plates but their bases become strongly thickened in adults, leaving only acute vertical edges anteriorly. The gerontic specimens have stout bases of dental plates, especially on inner sides, leaving only narrow and deep delthyrial chamber. The shell floor between proximal parts of dental plates is remarkably thick. This pad posteriorly borders the muscle field and extends axially as a short ridge between adductor scars. The ventral muscle field is poorly impressed in young specimens. In adults the field becomes posteriorly deeply impressed and subdued below valve floor but its anterior border remains weakly defined. The field is broadly triangular, anteriorly bisected by thin low myophragm. The adductor scars are small, long, narrowly elliptical. The accessory diductors are deeply impressed. The main diductors are less clearly impressed, with radially striated surface in anteromedian parts. Posteromedian floor of the large valve is strongly thickened, with deeply pitted surface.

Ornament on the flanks of the dorsal valve generally consists of 9 to 11 straight subangular plications, regularly expanding during growth. Some specimens have only six plications and their number may significantly vary among individuals. Lateral plications rapidly decrease in size, with thin and short plications near the cardinal extremity. The subangular interspaces are narrower than the plications. All plications extend from the umbones. Concentric ornament consists of short low lamellae, evenly distinct along the whole length and distinct also on shell surface of cardinal extremities behind the most lateral plication. Lamellae are arranged in 0.6 to 1.0 mm long intervals, with shorter distance along periphery of large shells, where they commonly overlap. Radial microornament was not observed.

Remarks: The genus *Eleutherokomma* is characteristic spiriferid in the Givetian and Frasnian succession of the North American fauna (Crickmay 1950). It is also known from France (Brice 1988), Belgium (Mailleaux 1940), Poland (Baliński 1979), Afghanistan (Brice 1971) and China (Su 1976). Recently, the new species of the genus has been described from the beds of the Upper Givetian to Lower Frasnian age in Hodh area of Mauritania (Racheboeuf et al. 2004). A detailed comparison of formerly described species with the species from Mauritania has been given by Racheboeuf et al. (2004) and their conclusions are in a great part valid also for the new species. Unlike the North American species, the new species has bald fold and sulcus (except for a single, probably malformed shell from sample H 884; pl. 10, fig. 19), and the number of lateral plications is smaller.

The new species is morphologically closest to *E. monodi* RACHEBOEUF et al., 2004 from Mauritania. Unlike the specimens of *E. monodi*, the new species differs by few characters that look stable within the otherwise broad phenotypic variability. The muscle scars of the new species are more clearly defined in both valves. A prominent pitted pad in posterior of the ventral valve is unknown in *E. monodi*. Plications and interspaces of the new species are higher and subangular, compared with the rounded plication of *E. monodi*. However, some specimens of *A. mutabilis* (sample H 333) also have low rounded plications separated by shallow interspaces. This is better considered to be the result of shell abrasion because these specimens also lack concentric lamellose ornament. Rounded plications of *E. monodi* are probably primary because based on the data of Racheboeuf et al. (2004), the shells show minimum transport and fine concentric ornament is preserved on these rounded plications. The remarkable morphological variation of *E. mutabilis* concerns the number of plications, corresponding outline and length of mucronations. Length of mucronations cannot be used for specific determination because our specimens have both very long, ridge-like mucronations (as described in *E. monodi*) to short mucronations and some specimens lack any mucronations at all. Similar variation of mucronation length is known in other spiriferids (e. g. *Mediospirifer spinosum* BENEDETTO, 1984 or *Mucrospirifer hastatus* MERGL et MASSA, 1992) and therefore their length is not a reliable diagnostic feature. Even the length of mucronations on the left and right side of the same specimen may be different (pl. 10, fig. 7).

Although other species of *Eleutherokomma* are of the Givetian or Frasnian age, the beds bearing the new species are referred to the Eifelian. The species *E. mutabilis* is associated with the species *Paraspirifer* aff. *cultrijugatus* (ROEMER, 1844) and also other fauna (chonetoids, *Mesoleptostrophia*) indicates an earlier age than suggested in North American and other species. Concluded from the morphological similarity of both species, the Upper Givetian *E. monodi* is probably a descendant of *E. mutabilis*. However, it is worth noting that *Eleutherokomma* is unknown in the presumed Givetian succession of the Illizi Basin of east Algeria (Brice et Latréche 1998), and in the Givetian of the Ghadamis and Murzuq Basins (Mergl et Massa 1992). The mucrospiriferinids are represented there by several species of *Mucrospirifer* GRABAU, 1931 invariably with the median rib in the sulcus.

Distribution: Eifelian.

Occurrence: Tamesna Basin, Oued Felaou area (samples H 332, H 333, H 1404, H 1405), In Ateï section (samples H 1016, H 1017), and In Debirene section (samples H 1105, H 1106, H 1107).

Superfamily **Cyrtospiriferoidea** TERMIER et TERMIER, 1949
Family **Spinocyrtiidae** IVANOVA, 1959
Subfamily **Spinocyrtiinae** IVANOVA, 1959

Genus ***Mediospirifer*** BUBLICHENKO, 1956

Type species: *Delthyris medialis* HALL 1843; Middle Devonian, Hamilton Group; New York, USA.

Mediospirifer rerhohensis sp. n.

Pl. 11, figs 1–21

Holotype: Dorsal valve (MaMe 0191), figured on pl. 11, figs 13, 16, 17, 19, housed in the Department of Palaeontology of the Museum of West Bohemia, Plzeň, Czech Republic.

Paratype: Ventral valve (MaMe 0192), figured on pl. 11, fig. 2, housed in the Department of Palaeontology of the Museum of West Bohemia, Plzeň, Czech Republic.

Type horizon: Middle Devonian, Eifelian.

Type locality: Algeria, Tamesna Basin, Tin Rerhoh area, section 5, sample H 1090.

Etymology: After the type locality.

Material: Five ventral and four dorsal valves and many fragments preserved as internal and external moulds in sandstone.

Diagnosis: *Mediospirifer* with 17–18 low plications on each flank and short mucronations at the hinge line, with high dorsal fold, short tongue and subcarinate dorsal valve; ventral interarea strongly curved; delthyrial plate long, undivided; dental plates weakly divergent, long.

Description: The shell is large (the maximum width is estimated 45–50 mm; based on fragments), subequally biconvex, with highly uniplicate commissure and hinge line extended into short mucronations. The shell wall is strongly thickened posteriorly but thin anteriorly.

The dorsal valve is semicircular in outline, with a shallow, angular emargination in anterior margin. Anterolateral and lateral margins are evenly rounded. Transverse profile of the valve is subcarinate, with high fold and gently arched flanks. The valve is highly and evenly convex in the lateral profile. The dorsal interarea is very low, almost orthocline. Dental sockets are narrow, deepening and strongly expanding anterolaterally, widely diverging from each other. The ctenophoridium is small, transversely rhomboidal, deeply concave, with some 20 high thin plates. It rests on a low, short but clearly defined notothyrial platform. Crural bases are thick, diverging at 100° from each other. The adductor scars are deeply impressed in the posterior third of the valve. The anterior adductor scars rest on the bottom and the slopes of the fold and have coarsely striated surface. Median septum is absent, only weak short myophragm extends from the notothyrial platform between the anterior adductors. The imprints of posterior adductors are weakly impressed laterally to the fold. Their surface bears irregular oblique wrinkles. The dorsal valve interior shows weakly impressed plications.

The ventral valve is semicircular in outline, with evenly curved lateral margins. The umbo is strongly curved, directed almost dorsally in large specimens. The valve is highly convex in transverse profile with remarkably arched flanks. Lateral profile is moderately convex. The maximum depth lies at posterior one-third. The interarea is remarkably high, steeply apsacline, strongly concave in lateral profile. Its surface bears fine transverse lines. The delthyrium is triangular, approximately as high as wide, with a distinct, flat and thin delthyrial plate. Its dorsal edge is slightly concave and the surface bears fine growth lines. The delthyrial chamber is deep. The sulcus is deep, subangular, with rounded bottom. The sulcus extends into moderate long, rounded, dorsally directed tongue. Dental plates are extrasinal, thin, high, slightly thickened posteriorly in large shells. They rest almost perpendicularly at the valve floor and their bases slightly diverge anteriorly, more in large than in small shells. The plates are weakly thickened in large individuals. Teeth are large. The ventral muscle field is weakly impressed anteriorly, with poorly defined borders, posteriorly halved by a low and short myophragm.

The ornament consists of simple, low, rounded, straight plications, separated by narrow angular interspaces. Plications regularly widen toward commissure. Each flank bears 17 to 18 plications in large shells, all gradually decreasing in size. Even the most lateral plications, already on cardinal extremities, are distinct along the whole length. Concentric fine lamellose ornament is distinct on surface of large shells. Radial microornament has not been discovered even in the best preserved specimens and its absence is probably primary.

Remarks: Although there are numerous specimens, the material is highly fragmentary. It allows description but for an illustration the material is poor. The species is referred to *Mediospirifer* BUBLICHENKO, 1956 because of the general shell shape, presence of the delthyrial plate, lack of radial microornament and widely spaced short growth lamellae but differs from all thedescribed species by numerous features. *Mediospirifer* is mostly American genus with range from the Eifelian to Givetian (Hall 1843, Benedetto 1984). The species *M. spinosum* BENEDETTO, 1984 from the late Eifelian of Venezuela differs from the new species by shorter dental plates, wider ventral muscle field, longer mucronations and less numerous lateral plications. Stratigraphically younger specimens from Venezuela, by Benedetto (1984) referred to North American species *M. audaculus* (CONRAD, 1842) are similar to the new species by less transverse shell, higher number of lateral plications, and narrower sulcus and fold. The main difference between these species is general absence of mucronations at the hinge line and more anteriorly divergent dental plates of *M. audaculus*.

The genus is known from the Eifelian (upper part of the Bir al Qasr Formation) of the Murzuq Basin in Libya. Havlíček et Röhlich (1987) described and figured mostly broken shells referred to *M*. cf. *audaculus* (CONRAD, 1842). These shells, however, differ from our species by less convex flanks of ventral valve, more widely divergent dental plates and higher number of lateral plications that are narrower and higher.

Of the spinocyrtiids described from the Givetian of the Ghadamis Basin (Mergl et Massa 1992), only *Spinocyrtia* sp. A has similar subparalell dental plates and rounded high fold and deep sulcus.

The new species is known from samples H 1090, H 1105, H 1106 and H 333. Numerous specimens from the first sample are mostly fragmentary and preserved as internal and external moulds in medium grained weathered sandstone. These shells have slightly weaker plications that differ from plications of the shells from other samples but despite this difference, all specimens are referred to the same species. Only the specimen from the sample H 1105 has preserved fine lamellose microornament.

Distribution: Lower Eifelian.

Occurrence: Tamesna Basin, Oued Felaou area (sample H 333), Tin Rerhoh area, section 5 (sample H 1090), In Debirene section (samples H 1105, H 1106).

Genus ***Subcuspidella*** MITTMEYER, 1965

Type species: *Spirifer subcuspidatus* SCHNUR, 1851; Lower Devonian, Emsian; Germany.

Subcuspidella cf. ***subcuspidata*** (SCHNUR, 1851)

Pl. 12, figs 1–8

1952b ? *Spirifer* (*Hysterolites*) *subcuspidatus* SCHNUR; Le Maître, p. 121, pl. 15, fig. 38.
1986 *Subcuspidella* ? sp.; Drot, p. 513, pl. 1, figs 5, 6.

Material: Two dorsal valves and twelve, mostly incomplete ventral valves preserved as internal and external moulds in sandstone.

Description: The shell is large, at least 50–55 mm wide, ventri-biconvex, widest at the hinge line. The dorsal valve is broadly triangular, with acute cardinal extremities, without distinct mucronations. Smaller specimens are more transverse than the adult ones, in which DvL/DvW is about 0.60. The anterior margin is slightly emarginate, lateral margins are weakly curved anteromedianly, laterally becoming straight. The valve is gently convex in transverse profile and slightly convex in lateral profile, with maximum depth at the posterior third. The interarea is almost orthocline, low, with fine transverse striation. The fold is narrowly triangular, expanding anteriorly, depressed along its axis, bordered by deep, slightly divergent and curved interspaces. The notothyrial platform is high, short, unsupported by a median ridge. The dental sockets are moderately divergent, deep, short, rapidly expanding anterolaterally. The cardinal process is unknown. Crural bases are divergent, thick and short. Adductor scars are weakly impressed laterally to the fold. Internal plications are more distinct anteriorly, posteriorly obscured by shell deposits.

The ventral valve is hemipyramidal in small specimens with a remarkably high, catacline to almost procline interarea. The sulcus is deep, with flattened bottom, anteriorly extending into moderately long roundly triangular tongue. The interarea of large valves is steeply apsacline, strongly curved apically but weakly curved along the hinge line. The delthyrium is narrowly triangular, with sides enclosing 30° angle. Its apical third is closed by slightly depressed triangular delthyrial plate. Ventral interior shows broadly divergent, extrasinal, short and posteriorly obsolete dental plates, resting at bottoms of third lateral plications. Their bases extend to one-third of the valve. The ventral muscle field is large, weakly impressed, extending into shell midlength. The diductors are weakly bordered from resting valve floor, the adductor impressions are narrow, running along shell axis. The posterolateral floor is never sealed with shells deposits.

Each flank bears about 20 subangular, high and narrow plications, separated by deep interspaces. The sizes of the plications regularly decrease laterally and regularly increase towards the shell periphery. The coarser concentric ornament consists of short growth lamellae, commonly overlapping, arranged in few concentric bands. The bands are internally marked by strong concentric bands that make prominent ridge in lateral shell profile. Fine concentric ornament consists of growth fila of uneven size.

Remarks: In North Africa, the genus was already reported by Le Maître (1952) from Algeria but this determination was questioned by Gourvennec (in Boumendjel et al. 1997). Drot (1986) referred to *Subcuspidella* MITTMEYER 1965 a few poorly preserved specimens from the Upper Emsian sandstones of the Tamesna Basin. The new material is much more similar to the type species and the specimens determined as *S.* cf. *subcuspidata* (SCHNUR, 1851) by Godefroid (2001) from the Upper Emsian of Belgium. The genus is known only from the Emsian of Germany (Mittmeyer 1972), Belgium (Vandercammen 1963, Godefroid 2001, Godefroid et al. 2002) and France (Drot 1962). Its occurrences in other regions of Europe (Carls 1969, Gourvennec 1989) and reports of another age were subsequently questioned by Godefroid (2001). It is worth to note that some of our small sized specimens are remarkably similar, mostly by transverse outline and apsacline ventral interarea, to *Tenuicostella* MITTMEYER et GEIB, 1967. This genus is restricted to the Pragian and Lower Emsian and it is by some authors considered synonymous to *Subcuspidella* (Racheboeuf et al. 2004). However, the procline ventral interarea of other small specimens and the weak convexity of the ventral valve make the attribution of our specimens to *Subcuspidella* probable.

Distribution: Upper Emsian.

Occurrence: Tamesna Basin, In Ateï section (sample H 1003), In Rahir Tin Amzi section (samples H 1057, H 1058), Tin Rerhoh area, section 5 (sample H 1088).

Tenuicostella MITTMEYER et GIEB, 1967

Type species: *Spirifer subcuspidatus* var. *tenuicosta* SCUPIN, 1900; Lower Devonian, Emsian; Germany.

Tenuicostella ? sp.

Pl. 12, figs 9–15

1986 *Brachyspirifer* ? sp.; Drot, p. 513, pl. 1, figs 9, 16.
1986 *Tenuicostella* ? sp.; Drot, p. 513, pl. 1, fig. 8.

Material: Five ventral and one dorsal valve preserved as internal and external moulds in sandstone.

Description: The shell is large, with width 45 to 50

mm, ventri-biconvex, transverse, about 50–60 % as long as wide, moderately thick.

The dorsal valve is moderately convex with semicircular shell outline.

The ventral valve is depressed hemipyramidal, of widely reverse trapezoidal outline, widest at hinge line. Cardinal extremities are narrowly acute in young individuals, during the growth the angle rapidly increases. The interarea is apsacline, high, strongly curved. The delthyrium is highly triangular, apically with thick delthyrial plate. Transverse profile of the valve is subcarinate, the flanks are steeply sloping almost straight or weakly arched. The sulcus is broad, deep, bald, extending dorsally into long semielliptical tongue and occupying some 25–30 % of shell width at the commissure. Dental plates are broadly divergent, extrasinal, subtending about 90–100° from each other, even in the juvenile individuals. The dental plates are posteriorly very thick, with obsolete inner sides meeting in a delthyrial chamber but their anterior edges are thin, acute and resting almost perpendicularly at valve floor. The ventral muscle field is large, 70 % as long and some 35–40 % as wide as the valve, weakly impressed, anteriorly weakly bordered and laterally bounded by low, medianly converging ridges. The adductor scars are narrow, long, the diductor impressions are large, with distinct radial and oblique wrinkles. Inner plication is distinct only along periphery of large valves, being obsolete by shells deposits in most internal surface. In small valves, however, the internal plication is distinct over the entire shell floor.

Exterior bears low rounded plications separated by deep and narrow interspaces. Lateral plications rapidly decrease in size extremities. Each flank bears some 16 to 20 plications. Concentric ornament consists of growth lamellae of various strength. Some lamellae produce prominent edges on shell surface, internally being marked by prominent thickening of the shell and step-like edge.

Remarks: Although the microornament is unknown, the species is surely a spinocyrtiid due to the presence of a prominent delthyrial plate and general shell morphology. However, its taxonomic position is ambiguous. Its morphology is similar especially to *Tenuicostella* MITTMEYER et GIED, 1967 but this genus is restricted to the Pragian and Lower Emsian and is substituted by *Subcuspidella* MITTMEYER, 1965 in the Upper Emsian in German and Belgium Devonian sucession. The genus *Spinocyrtia* FREDERICKS, 1916 comprises species with the larger subglobose shells with prominent microornament that are present in the Middle and Upper Devonian. Our specimens are by wide and long dental plates and broadly triangular shell similar to the ventral valve of "*Spinocyrtia*" sp. (Boucot et al. 1983; p. 120, pl. 4, figs 1–6) from the Akara Formation. Although the Givetian age of these shells has been suggested, the earlier Eifelian age consistent with our material cannot be excluded. The shells from the Tamesna Basin differ from spinocyrtiid described from the Ghadamis Basin (Boucot et al. 1983, Mergl et Massa 1992) by a coarser plication, longer dental plates and absence of a myophragm in the dorsal valve. Therefore, the generic position of *Tenuicostella* ? sp. is unclear and needs further study.

Distribution: Late Upper Emsian and Eifelian.

Occurrence: Tamesna Basin, Oued Felaou area (sample H 333), In Rahir Tin Amzi section (sample H 1058), Tin Rerhoh area, section 5 (sample H 1088), In Debirene section (sample H 1106).

Genus **Spinocyrtia** FREDERIKS, 1916

Type species: *Delthyris granulosa* CONRAD, 1839; Middle Devonian, Hamilton Group; New York, USA.

Spinocyrtia sp.

Pl. 10, fig. 20

Material: Two dorsal valves preserved as internal and external moulds in sandstone.

Description: The shell is some 36 mm wide, semielliptical, with extended cardinal extremities. The valve has evenly convex lateral profile, with weakly arched flanks. The sulcus is prominent, deep, bald, with sides subtending 20° angle. Ornamentation consists of some 20 high and rounded plication on each flank. Concentric ornamentation consists of weak, densely spaced growth fila, forming short lamellae in surface of the sulcus.

Remarks: The insufficient material makes the generic affinity of both valves unclear. Both valves are similar to spinocyrtiids but from the type species *S. granulosa* (CONRAD, 1839) they differ by narrower sulcus and lack of short mucronations at cardinal extremities. The North American species *S. parvigranulata* EHLERS et WRIGHT, 1955 has similarly shaped dorsal valves of young specimens.

Distribution: Givetian.

Occurrence: Tamesna Basin, In Ateï section (samples H 820, H 1006).

Order **Terebratulida** WAAGEN, 1883
Suborder **Centronellidina** STEHLI, 1965
Superfamily **Stringocephaloidea** KING, 1850
Family **Rhipidothyrididae** CLOUD, 1942
Subfamily **Rhipidothyridinae** CLOUD, 1942

Genus ***Rhipidothyris*** COOPER et WILLIAMS, 1935

Type species: *Rhipidothyris plicata* COOPER et WILLIAMS, 1935; Middle Devonian, Givetian; New York, USA.

Remarks: The genus *Rhipidothyris* COOPER et WILLIAMS, 1935 is known from the Eifelian and Givetian of Bolivia, Europe, Libya, China, South Africa and North America (Wang et al. 1987, Isaacson 1993, Boucot et Wilson 1994). The genus commonly occurs in monospecific communities in shallow subtidal positions, with fossilized shells often in articulated conditions. Our occurrences of

Rhipidothyris in east margin of the Tamesna Basin are similar, with highly articulated specimens in fine sandstone beds generally without any other brachiopod fauna.

Rhipidothyris africana BOUCOT, MASSA et PERRY, 1983

Pl. 13, figs 4–12

1983 *Rhipidothyris africana* new species; Boucot et al., p. 117, pl. 3, figs 1–27.
1984 *Rhipidothyris ensicostata* sp. n.; Havlíček, p. 59, figs 16, 17.
1987 *Rhipidothyris ensicostata* HAVLÍČEK; Havlíček et Röhlich, p. 163, pl. 1, figs 14–18.
1992 *Rhipidothyris africana* BOUCOT, MASSA and PERRY, 1983; Mergl et Massa, p. 95, pl. 25, figs 1–15.
2000 *Rhipidothyris ensicostata* HAVLÍČEK, 1984; Mergl et Massa, pl. 1, figs 5, 6.

Material: Some fifty specimens, mainly articulated, preserved as internal moulds and external moulds in fine-grained sandstone.

Description: The shell is biconvex, thin-shelled, with shell wall only 0.1 mm thick in the midlength, 12–14 mm wide in adult specimens. The anterior margin is rectimarginate and strongly crenulate. The shell structure is exopunctate, evidenced by well-preserved limonitic infillings of exopunctae in external moulds.

The dorsal valve is subcircular, widest at the midlength, with evenly curved margins, moderate convex in transverse and lateral profiles. The maximum depth is at the valve midlength. The dorsal interior has narrow, widely divergent dental sockets. Inner socket ridges are subhorizontal, flat and wide, distinctly bordered from outer hinge plates. Outer hinge plates are narrower, longer, and clearly concave in the transverse profile. The imperforate cardinal plate has a shallow septalium that is basally and anteriorly supported by a thin and long median septum, which may extend nearly to midlength of the valve. The crura anteriorly extend from the subhorizontal inner hinge plates but were always broken in the studied specimens. The dorsal muscle field is not impressed.

The ventral valve is subpyriform in outline, with curved, pointed apex. The pedicle foramen is submesothyridid, circular, with distinct pedicle collar. Deltidial plates are discrete. The dental plates are very thin, long, moderately divergent anteriorly and resting perpendicularly on the valve floor. The ventral muscle field is not impressed in any specimens available.

The shell bears coarse straight ribs, all extending from the umbo; exceptionally the new and weaker rib may appear by an implantation. The ribs are subangular, about half as high as wide, divided by deep, subangular interspaces of identic size. There are 14 to 18 ribs on the exterior of the large valves. The rib size rapidly and regularly decreases posterolaterally. The concentric ornamentation is restricted to fine growth lines. The lines are coarser and more densely spaced along the anterior periphery of the large valves, forming short lamellae.

Remarks: The shells are similar to specimens described and figured from the Devonian basins on the territory of southwest Libya (Ghadamis and Murzuq Basins) and the Tamesna Basin, Aïr Massif, Niger (Boucot et al. 1983, Havlíček et Röhlich 1987, Mergl et Massa 1992). Great morphological variability of this species, especially the number of ribs on specimens from the same bed, indicates that species *R. ensicostata* HAVLÍČEK, 1984 can be referred to the species *R. africana* BOUCOT et al., 1983. The specimens from the Tamesna Basin cannot be safely differentiated from the specimens from the type locality (Givetian, Idri section, northern flank of the Murzuq Basin: Boucot et al. 1983) although the ribbing is generally coarser and lateral ribs are more curved in the specimens from the Tamesna Basin. The uniformity of shell morphology in particular localities and beds may be explained by phenotypic variability of the local populations. The stratigraphical range comprises the Givetian (? Lower to Middle) but after Havlíček (1984) the species appears already in the Eifelian (Bir al Qasr Formation of the Murzuq Basin, Libya).

The species is known also from the Amesgueur Sandstone, some 150 m thick unit of the suggested late Middle and Upper Devonian age of the Aïr Massif of northeast Niger.

The species *Rhipidothyris africana* is strongly reminiscent and may be considered homoeomorphous to *Derbyina* CLARKE, 1913 (family Mutationellidae CLOUD, 1942). Both genera have few coarse, subangular ribs on the shell exterior. The differences lie in dorsal valve interior, with discrete hinge plates not united into the septalium-like structure developed in *Derbyina*. Other species referred to *Rhipidothyris* have much finer ornamentation, often with rounded costae (Cooper et Williams 1935, Cloud 1942, Johnson 1971, McKellar 1966, Isaacson 1993, Boucot et Theron 2001). Therefore, we consider that the species *Rhipidothyris africana* is only loosely related to the group of roundly and weakly costate *Rhipidothyris* and may represent a separate genus.

Distribution: Upper Eifelian or early Givetian.

Occurrence: Tamesna Basin, In Ateï area (?) (sample H 355) and area west of the Aïr Massif (sample G 1000).

Rhipidothyris ? sp.

Pl. 13, figs 1–3, 13

Material: Two ventral valves and a single dorsal valve, preserved in fine-grained sandstone. Some forty poorly preserved external moulds and shell fragments may belong to the same species.

Description: The shell is minute, 8 mm wide, ventribiconvex. The dorsal valve is subcircular, with flattened median sector and 12 strong rounded plications. The dorsal interior has a thin and long median septum.

The ventral valve is elongate-oval, strongly convex, with coarse rounded costae. Two median plications are coarser and separated by wider interspaces from lateral plications, forming an incipient fold. The dental plates are thin and gently divergent.

Remarks: This species is referred to *Rhipidothyris*

COOPER et WILLIAMS, 1935 although it is also similar to *Cydimia* CHATTERTON, 1973 because of few rounded plications instead of subangular or angular ribs of the latter genus. *Cydimia* is an Upper Emsian genus from Australia (Chatterton 1973).

Two rocks samples with shells are labelled H 355. The first is ferruginous sandstone with poorly preserved external and internal moulds of disarticulated specimens that have size and ornamentation characteristic for the species *R. africana* BOUCOT et al., 1983. The second slab of almost identical sandstone has the bedding plane covered by poorly preserved external moulds of smaller, more elongate and convex shells that have less distinct costation and are very similar to the shells in sample H 1009. These smaller shells may belong to *R.* sp. but it cannot be excluded that these shells are worn small shells of *R. africana*.

Distribution: Late Eifelian ? and Givetian.

Occurrence: Tamesna Basin, In Ateï section (samples H 1009), In Ateï area (?) (sample H 355).

Subfamily **Globithyridinae** CLOUD, 1942

Genus ***Globithyris*** CLOUD, 1942

Type species: *Rensselaeria callida* CLARKE, 1907; Lower Devonian, Emsian; Maine, USA.

Globithyris orchas (HAVLÍČEK, 1984)

Pl. 14, figs 1–8

1984 *Rhipidothyris orchas* sp. n; Havlíček, p. 58, figs 14, 15.

? 1984 *Globithyris* sp.; Alvarez et Boucot in Boucot et al., p. 1199, fig. 1 A–P.

1987 *Rhipidothyris orchas* HAVLÍČEK; Havlíček et Röhlich, p. 163, pl. 2, figs 3–6.

1992 *Rhipidothyris orchas* HAVLÍČEK, 1984; Mergl et Massa, p. 96, pl. 25, figs 16, 17.

Material. Two conjoined shells, one dorsal and three ventral valves.

Description: The shell is large, equally biconvex, thin-walled, with obscure plicate and finely serrate anterior commissure, 23–26 mm wide in adult specimens.

The dorsal valve is transversely oval, with evenly curved margins except for the less curved anterolateral part. The valve is regularly and moderately convex in the transverse profile, with the deepest part in the posterior third and lesser convexity anteriorly. The maximum depth equals to 20 %, the length equals to 80 % of the valve width. The dorsal valve interior shows very thin median septum that anteriorly extends to one-third of the valve. Dental sockets are small, long and widely diverging. The cardinal plate is unknown.

The ventral valve is broadly and roundly rhomboidal in the outline, with a prominent umbo. The palintrope is distinct, high, anacline and weakly curved. The nature of the pedicle foramen is unknown. The valve is widest posterior to midlength, with rounded cardinal extremities. The hinge line occupies 30–40 % of the valve width. The valve is evenly convex in the transverse profile, and moderately convex in the lateral profile with the maximum of convexity posteriorly. The depth maximum lies between the posterior one-third to one-fourth of the valve. The dental plates are thin and short, weakly divergent anteriorly, never obsolete, resting almost perpendicularly on the valve floor. The ventral muscle field is poorly impressed with a weak myophragm posteriorly in the umbonal chamber.

The shell ornamentation consists of uniform rounded costae, all extending from the umbo. The costae gradually grow anteriorly and regularly diminish laterally to become obscure posterolaterally. The costae are separated by narrower, deep interspaces. There are 50–55 costae in large shells, numbering 4–5 per 5 mm anteromedianly. The large valves have one or two strong concentric lamellae situated anteromedianly.

Remarks: As the type specimen of the species *Rhipidothyris orchas* from the Bir al Qasr Formation (Eifelian of the Murzuq Basin, Libya; Havlíček 1984) has similar ornamentation and convexity, the specimens from the Tamesna Basin are referred to the same species although the holotype is somewhat smaller. The shape of the cardinalia and the pedicle foramen of the holotype as well as of our specimens are essentially unknown, other characters of the shells warrant their attribution to *Globithyris* CLOUD, 1942. The species *G. callida* (CLARKE, 1907) from the Lower Devonian (Tomhegan Formation) of Northern Maine (Boucot 1973) has coarser ornamentation, its outline is more elongate and the crural plates are larger compared with the delicate cardinalia of the species from the Tamesna Basin. The species *G. diania* (CLARKE, 1907) has distinctly coarser ornamentation and more erected ventral umbo.

Remarkably similar are two articulated specimens of *Globithyris* sp. from the Hammamiat member of the Jauf Formation (earlier Emsian age) of Saudi Arabia (Boucot et al. 1989). These specimens have been recognized among fossils from a bryozoan thicket with dominant athyridid brachiopod *Sulcathyris ? arabica* ALVAREZ et BOUCOT, 1984. The globithyridid shells have similar size, convexity and ornamentation as the specimens from the Tamesna Basin. The stratigraphic range of African globithyridid biofacies comprises early Emsian to Eifelian. Some athyridid brachiopods (*Anathyris*, *Sulcathyris*) have similar extension indicating the similar environmental requirements. Athyrids are known from Saudi Arabia (Boucot 1984, Boucot et al. 1989) and the Ghadames Basin of Libya (Mergl et Massa 1992). Although Isaacson (1974) referred to *Globithyris* several specimens from the Emsian of Bolivia, they were later described as the new species of another genus (*Rhipidothyris ava* ISAACSON, 1993) and their age has been re-evaluated (Racheboeuf et al. 1993).

The globithyridid biofacies ranges from the Siegenian to Lower Emsian (Boucot 1963, 1975). The biofacies commonly occurs in a nearshore, shallow subtidal position, probably in quiet waters. Globithyridids commonly form monospecific aggregations of shells. Our sample shows the similar taphonomy. Several shells are complete and other

fauna is restricted (*Tropidoleptus*). The geographic extension of the globithyridid biofacies is very broad and comprises northern Appalachians, Rheinische Schiefergebirge, Ardenne (Boucot 1963, Jux 1981), Saudi Arabia (Boucot 1984) and Australia (McKellar 1966). If the Libyan species *G. orchas* (Bir al Quasr Formation, Eifelian, Murzuq Basin of south Libya; Havlíček et Röhlich 1987), the Saudi Arabian species *G*. sp. (Alvarez et Boucot in Boucot et al. 1984), and the specimens from the Tamesna Basin actually belong to the same taxon, then the extent of the globithyridid biofacies of the Emsian and Eifelian ages is remarkable, covering the space from Western Sahara to North Arabian Peninsula. In addition, Boucot et al. (1995) briefly discussed the systematic position of a weakly costate globithyridid from Libya and referred *Neoglobithyris* HAVLÍČEK, 1984 to genus *Globithyris*. This extends the vertical extension of the globithyridid biofacies into the Frasnian. The patchy distribution of localities with globithyridid biofacies confirms specific ecological requirements of these terebratuloids.

Distribution: Emsian to Lower Eifelian age. A small fragment of the ventral valve (pl. 14, fig. 5), which may belong to the same or related species, is known in the Upper Pragian.

Occurrence: Tamesna Basin, In Rahir Tin Amzi section (sample H 1052), Anou Izileg area (sample H 823).

Family **Mutationellidae** CLOUD, 1942

Genus ***Pleurothyrella*** BOUCOT, CASTER, IVES et TALENT, 1963

Pleurothyrella cf. ***knodi*** CLARKE, 1913

Pl. 13, figs 14–16

Material: One poorly preserved shell.

Description: Shell is large, weakly ventri biconvex, rectimarginate, broadly subpentagonal in outline with maximum width in the posterior third, 35 to 40 mm long (apex is broken). Ornament consists of 60 to 70 simple, straight and rounded costellae, gradually diminishing laterally and crossed by three prominent concentric lamellae. The dorsal valve interior has a weak median ridge.

Remarks: Although the shell interior is almost unknown, the shell size, shape and ornament are identical with the illustrated specimen of *P. knodi* CLARKE, 1913 from Bolivia (Boucot et al. 1963). The species originally described from Bolivia, has been by other authors later identified in Guinea-Bissau of West Africa (Drot et Villeneuve 1985) and more recently, almost identical shells were reported in the Parecis Basin of Brazil (Boucot et al. 2001). The presence of *Pleurothyrella* cf. *knodi* in the Upper Pragian to Lower Emsian of the Tamesna Basin is of extraordinary palaeogeographic importance, indicating the extension of the Malvinokaffric Realm brachiopod fauna as far as to Central Sahara.

Distribution: Upper Pragian to Lower Emsian.

Occurrence: Tamesna Basin, In Rahir Tin Amzi section (sample H 1053).

Family **Centronellidae** WAAGEN, 1882
Subfamily **Amphigeniinae** CLOUD, 1942

Genus ***Amphigenia*** HALL, 1867

Type species: *Pentamerus elongata* VANUXEM, 1842; Middle Devonian, Eifelian; New York, USA.

Amphigenia cf. ***elongata*** (VANUXEM, 1842)

Pl. 14, figs 9–13, 15

1966 *Amphigenia* aff. *elongata* (VANUXEM, 1842); Drot, p. 373.
1986 *Amphigenia* cf. *elongata* (VANUXEM, 1842); Drot, p. 513, pl. 1, figs 12–15.

Material: Complete large dorsal valve and four small fragments of ventral and dorsal valves in sandstone.

Description: The dorsal valve is very large (77 mm long), elongate-oval, with weakly truncate anterior margin and convergent anterolateral margins. The maximum width lies slightly posterior to midlength. The valve is strongly convex, with almost geniculate posterolateral margins and a less convex central part. The anterior commissure is rectimarginate. The cardinal plate and crural plates are united into a massive, sessile, block-like structure that is posteriorly perforated. The anterior slope of the block extends into a pair of closely adjacent crural plates with parallel, anteriorly extended bases bordering a weak myophragm. The ventral surface of the block is posterolaterally flat and anteromedianly weakly concave. The cardinal process is absent. Anterolateral edges of the block are acute and probably deeply excavated (this is obscured by preservation.). The dental sockets are large, deep, diverging at approximately 100°, with high and long socket ridges. The right canal of weakly divergent vascula media is poorly impressed (Pl. 14, fig. 9) on the worn surface of the internal mould.

Two fragments belong to small, about 10 mm long (based on two fragments) ventral valves (Pl. 14, fig. 10). The ventral valve interior shows narrow anteriorly tapering spondylium resting directly on the valve floor. The third fragment belongs to a larger subcarinate ventral valve with a long and strong median septum (Pl. 14, fig. 15). Its deeply V-shaped spondylium is raised, at least anteriorly, above the valve floor.

Remarks: The centre of distribution of *Amphigenia* HALL, 1867 lies in the Eastern America Realm (Boucot et Wilson 1994). The ranges of formerly described species cover the Upper Emsian to Eifelian (Esopus Formation and Kanouse Sandstone; Boucot 1959), with the earlier "small" and later "large" *Amphigenia* (Boucot et Wilson 1994). Apart from North America, this genus has been reported from late Emsian and Early Eifelian of Venezuela (Benedetto 1984), from Brazil (Boucot 1959) and from two sites in the western and southern Sahara. It is known from the

southeast border of the Taoudeni Basin (Drot 1966) and from the Tamesna Basin (Drot 1986). The specimens from the Tamesna basin, figured by Drot (1986) probably belong to young individuals because all are about half size of our large specimen. Three newly figured fragments derive from the same sample (H 1088; collection of Lionel Lessard) as the shells figured by Drot (1986).

As noted by Boucot (1959) the foramen perforating the cardinal plate may be closed in large specimens. This is apparent also in our large dorsal valve. Our specimens are by the large size most similar to *A. elongata* (VANUXEM, 1842). Other species *A. chikasawensis* BOUCOT 1959, *A. preparva* BOUCOT, 1959 and *A. curta* (MEEK et WORTHEN 1968) from New York, USA, are generally smaller and differ by morphology of the ventral valves and shell convexity. Because of the fragmentary preservation of our ventral valves, it is difficult to compare reliably the Tamesna specimens with the American species. It seems likely that the species from Tamesna Basin (Drot, 1986; pl, 1, figs 12–14) has high and strong ventral septum and a raised spondylium similar to *A. elongata*. This distinguishes the African species from the earlier "small" *Amphigenia* in the suggested *Amphigenia* phylogeny of New York, USA (Boucot et Wilson 1994) and indicates the Middle Devonian age. The Middle Devonian "large" *Amphigenia* has the spondylium well supported by median septum. Therefore, the latest Emsian or earliest Eifelian age of our *Amphigenia*-bearing samples is suggested. This age is confirmed by other brachiopods, mainly spiriferids.

The late Emsian or early Eifelian occurrence of *Amphigenia* strongly supports the North American affinity of the brachiopod fauna in the Tamesna basin.

Distribution: Upper Emsian to early Eifelian.

Localities: Tamesna Basin, In Rahir Tin Amzi section (sample H 1058), Tin Rerhoh area, section 5 (sample H 1088).

Subfamily **Eurythyridinae** CLOUD, 1942

Genus ***Eurythyris*** CLOUD, 1942

Type species: *Oriskania lucerna* SCHUCHERT, 1913; Lower Devonian, Pragian; Maryland; USA.

Eurythyris ? sp.

Pl. 14, fig. 14

Material: External mould of the dorsal valve in sandstone.

Description: The dorsal valve is 20 mm wide, 110 % as long as wide, subpentagonal in outline, almost flat becoming convex from the anterior one-fourth. The shell is smooth, without any sign of radial ornament.

Remarks: Is it impossible to make exact determination from the material but the presence of a terebratulid in the sample H 1052 is noteworthy. The flat dorsal valve is strongly similar to the valve of *Eurythyris lucerna* (SCHUCHERT, 1913) from the Oriskany Sandstone of Maryland, USA. However, the lateral margins are not introverted; therefore it cannot be not excluded that the shell belongs to a different genus.

Distribution: Upper Pragian.

Occurrence: Tamesna Basin, In Rahir Tin Amzi section (sample H 1052).

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Explanation to the plates

All photos by M. M.

PLATE 1

Mesoleptostrophia (M.) explanata (SOWERBY, 1842)

Age and localities: Emsian to Eifelian; Tamesna Basin, In Rahir Tin Amzi section (1, 6), In Ateï section (2, 4), Kori-Idemeg – Touaret section (3), and Tin Rerhoh section (5, 7).

1, 6. Dorsal valve, internal mould and latex cast of interior; sample H 1058; MaMe 0048, × 1.2, × 1.7.

2. Ventral valves, internal moulds; sample H 1003; MaMe 0043A and MaMe 0043B, × 1.1.
3. Ventral valve, internal mould; sample H 884; MaMe 0047, × 1.1.
4. Ventral valve, detail of interarea, internal mould; sample H 1003; MaMe 0039, × 6.0.
5. Dorsal valve, internal mould; sample H 1087; MaMe 0024A, × 2.0.
7. Ventral valve with original shell, interior; sample H 1086; MaMe 0014, × 1.1.

PLATE 2

Amziella rahirensis sp. n.

Age and locality: Upper Pragian; Tamesna Basin, In Rahir Tin Amzi section.

1. Dorsal valve, internal mould; sample H 1052; MaMe 0011C, × 3.5.
2. Ventral valve, internal mould; sample H 1052; MaMe 0026B, × 3.5.
3. Ventral valve, internal mould; sample H 1052; MaMe 0074, × 3.5.
4. Ventral valve, internal mould; sample H 1052; MaMe 0049, × 3.5.
5. Dorsal valve, internal mould; sample H 1052; MaMe 0026F, × 3.5.
6. Dorsal valve, internal mould; sample H 1052; MaMe 0026E, × 3.5.
7. Dorsal valve, external mould; sample H 1052; MaMe 0026C, × 3.5.
8. Ventral valve, internal mould; sample H 1052; MaMe 0070, × 3.5.
9. Paratype, dorsal valve, internal mould; sample H 1052; MaMe 0062, × 6.0.
10. Holotype, ventral valve, internal mould; sample H 1052; MaMe 0011A, × 3.5.
11. Ventral valve, internal mould; sample H 1052; MaMe 0026D, × 3.5.
12. Dorsal valve, latex cast internal mould showing median septum, anderidia and cardinal process with shallow cardinal pit; sample H 1052; MaMe 00050B, × 6.0.

Lomaella amziensis HERRERA et RACHEBOEUF, 2001

Age and locality: Upper Pragian and Emsian; Tamesna Basin, In Rahir Tin Amzi section.

13. Ventral valve, internal mould; sample H 1052; MaMe 0023, × 2.0.
14. Incomplete dorsal valve, internal mould; sample H 1052; MaMe 0022A, × 2.0.
16. Incomplete dorsal valve; sample H 1086; MaMe 0015, × 2.0.
17. Ventral valve, internal mould; sample H 1052; MaMe 0031, × 2.0.
18. Ventral valve, latex cast of external mould; sample H 1052; MaMe 0050A, × 2.0.

Montsenetes sp.

Age and locality: Emsian; Tamesna Basin, Tin Rerhoh section.

15. Ventral valve, internal mould; sample H 1087; MaMe 0024B, × 4.0.

PLATE 3

Monsenetes pervulgatus sp. n.

Age and localities: Eifelian; Tamesna Basin, In Ateï section (1–9, 13, 16), and Kori-Idemeg – Touaret area (10–12, 14, 15).

1, 5. Holotype, ventral valve in ventral and anterior views; sample H 1017; MaMe 0120, both × 2.0.
2, 6. Ventral valve in ventral and oblique views; sample H 1017; MaMe 0121, both × 2.0.
3. Ventral valve, latex cast of exterior; sample H 826; MaMe 152C, × 2.0.
4. Dorsal valve, latex cast of exterior with cardinal process; the same level as sample H 826; MaMe 0178, × 2.0.
7, 8. Two dorsal valves, latex casts of interior with cardinal process and detail of left valve; sample H 1018; MaMe 0153A and MaMe 0153C, × 2.0 and × 5.0.
9. Complete shell showing interareas, sample H 358; MaMe 0186, × 2.0.
10. Ventral valve, internal mould; sample H 884; MaMe 0044A, × 2.0.
11, 14. Ventral valve, internal mould in ventral and posterior views; sample H 884; MaMe 0044B, × 2.0 and × 3.8.
12. Dorsal valve, latex cast of exterior; sample H 826; MaMe 0152B, × 2.0.
13. Ventral valve, internal mould; sample H 1004; MaMe 0145, × 2.0.
15. Detail of spines on left side, latex cast of ventral valve exterior; sample H 884; MaMe 0154, × 7.0.
16. Detail of spines on right side, latex cast of ventral valve exterior; sample H 1018; MaMe 0153B, × 7.0.

Arcuaminetes racheboeufi sp. n.

Age and locality: Eifelian; Tamesna Basin, Tin Rerhoh section.

17, 21. Holotype, ventral valve, internal mould in ventral and posterior views; sample H 1090; MaMe 0183A, × 6.0.
18. Ventral valve, internal mould; sample H 1090; MaMe 0183B, × 6.0.
19. Ventral valve, latex cast of exterior; sample H 1090; MaMe 0179, × 6.0.
20, 24. Ventral valve, latex cast of exterior in dorsal and posterior views; sample H 1090; MaMe 0183C, × 6.0.
22. Paratype, dorsal valve, internal mould; sample H 1090; MaMe 0185, × 6.0.
23. Dorsal valve, internal mould; sample H 1090; MaMe 0184, × 6.0.

PLATE 4

Monsenetes ? *drotae* sp. n.

Age and localities: Emsian; Tamesna Basin, In Ateï section (1, 2), In Rahir Tin Amzi section (4, 8), and Oued Felaou area (3, 5–7, 10, 11).

1. Ventral valve, internal mould; sample H 1003; MaMe 0042A, × 2.2.
2. Ventral valve, internal mould; sample H 1003; MaMe 0042B, × 2.2.
3. Holotype, ventral valve, internal mould; sample H 328; MaMe 0086A, × 2.0.
4. Dorsal valve, latex cast of cardinal process; sample H 1057; MaMe 0025, × 5.0.
5. Paratype, dorsal valve, interior with cardinal process, anderidia and median septum; sample H 328; MaMe 0032B, × 2.0.
6, 9. Ventral valve, exterior in ventral and anterior views; sample H 328; MaMe 0086B, both × 2.0.
7. Ventral valve, internal mould; sample H 328; MaMe 0030, × 2.0.
8. Dorsal valve, latex cast of interior; sample H 1057; MaMe 0027, × 2.3.
10. Ventral valve, interior; sample H 328; MaMe 0029A, × 2.3.
11. Dorsal valve, exterior; sample H 328; MaMe 0029B, × 2.3.

Devonochonetes cf. *salemi* MERGL et MASSA, 1992

Age and locality: Givetian; Tamesna Basin, In Ateï section.

12. Ventral valve, internal mould; sample H 820; MaMe 0083, × 2.0.
13. Ventral valve, latex cast of exterior; sample H 1006; MaMe 0073A, × 2.0.
14. Dentral valve, exterior; sample H 820; MaMe 0082, × 2.0.

Longispina sp.

Age and locality: Eifelian; Tamesna Basin, Oued Felaou area.

15, 21. Ventral valve, internal mould in ventral and oblique views; sample H 1405; MaMe 0135, both × 5.5.
16. Ventral valve, internal mould; sample H 1405; MaMe 0130, × 5.5.
17. Ventral valve, internal mould; sample H 1405; MaMe 0134A, × 5.5.
18. Dorsal valve, external mould; sample H 1405; MaMe 0133, × 5.5.
19. Ventral valve showing spines, internal mould; sample H 1405; MaMe 0180, × 5.5.
20. Ventral valve showing spines, internal mould; sample H 1405; MaMe 0134B, × 5.5.

anopliid sp.

Age and locality: Givetian; Tamesna Basin, In Ateï section.

22. Dorsal valve, internal mould; sample H 1006; MaMe 0073B, × 5.5.

PLATE 5

Roemerella sp.
Age and locality: Upper Pragian; Tamesna Basin, Tin Rerhoh section.

1. Ventral valve, internal mould; sample H 1079; MaMe 0046, × 1.6.

Salopina sp.
Age and locality: Emsian; Tamesna Basin, Tin Rerhoh section.

2. Ventral valve, internal mould; sample H 1087; MaMe 0024D, × 5.5.

Rhipidomella sp.
Age and locality: Emsian; Tamesna Basin, Tin Rerhoh section.

3. Dorsal valve, internal mould; sample H 1086; MaMe 0098, × 2.0.
4. Ventral valve, latex cast of exterior; sample H 1086; MaMe 0013, × 3.0.

Stenorhynchia ? sp.
Age and localities: Emsian; Tamesna Basin, In Ateï section (5), In Rahir Tin Amzi section (6, 9), and Tin Rerhoh section (7).

5. Dorsal valve, latex cast of exterior; sample H 1003; MaMe 0182, × 4.5.
6. Dorsal valve, latex cast of exterior; sample H 1058; MaMe 0167B, × 4.5.
7. Ventral valve, exterior; sample H 1088; MaMe 0090, × 4.5.
9. Dorsal valve, internal mould; sample H 1057; MaMe 0181, × 4.5.

Craniops sp.
Age and locality: Emsian; Tamesna Basin, Tin Rerhoh section.

8. External mould and ventral valve, internal mould; sample H 1087; MaMe 0024C, × 5.5.

Plebejochonetes sp.
Age and locality: Emsian; Tamesna Basin, In Rahir Tin Amzi section.

10. Ventral valve, internal mould; sample H 1057; MaMe 0028A, × 5.5.
11. Ventral valve, latex cast of exterior; sample H 1057; MaMe 0028B, × 5.5.

Trigonorhynchia sp.
Age and locality: Upper Pragian; Tamesna Basin, In Rahir Tin Amzi section.

12. Incomplete ventral valve, internal mould; sample H 1052; MaMe 0026A, × 3.5.

Leiorhynchus ? sp.
Age and locality: Givetian; Tamesna Basin, Kori Idemeg-Touaret section.

13. Ventral valve, latex cast of exterior; sample H 888; MaMe 0102, × 3.5.

Plicanoplia sp.
Age and locality: Emsian; Tamesna Basin, Tin Rerhoh section.

14. Ventral valve, internal mould; sample H 1087; MaMe 0024H, × 6.0.

Iridistrophia sp.
Age and locality: Emsian; Tamesna Basin, In Rahir Tin Amzi section.

10. Dorsal valve, latex cast of exterior; sample H 1058; MaMe 0165C, × 5.0.

Tropidoleptus carinatus carinatus (CONRAD, 1839)
Age and localities: Upper Pragian to Givetian; Tamesna Basin, In Ateï section (16), Oued Felaou area (17), In Rahir Tin Amzi section (19), and In Debirene section (22).

16. Ventral valve, internal mould; sample H 1009; MaMe 0017, × 2.0.
17. Ventral valve, internal mould; sample H 823; MaMe 0101, × 2.5.
19. Ventral valve, internal mould; sample H 1052; MaMe 0052A, × 5.5.
22. Ventral valve, internal mould; sample H 1106; MaMe 0140C, × 1.5.

Athyris sp.
Age and locality: Eifelian, In Debirene section.

18, 21. Ventral valve, internal mould in ventral and anterior views; sample H 1106; MaMe 0140A, both × 2.0.

Pleurochonetes sp.
Age and locality: Emsian, Oued Felaou area.

20. Ventral valve, internal mould; sample H 1067; MaMe 0018, × 1.7.

PLATE 6

Tropidoleptus carinatus titanius subsp. n.
Age and localities: Emsian; Tamesna Basin, In Ateï section (1–6, 9–11), Oued Felaou area (7), and Tin Rerhoh section (8).

1, 3. Holotype. complete shell, internal mould with part of original shell; sample H 1003; MaMe 0038, × 1.5.
2. Ventral valve, internal mould with part of original shell; sample H 1003; MaMe 0036, × 1.5.
4. Dorsal valve, external mould with part of original shell; sample H 1003; MaMe 0034A, × 1.5.
5. Ventral valve, internal mould with part of original shell; sample H 1003; MaMe 0035, × 1.5.
6. Ventral valve, internal mould showing shell with external ornament; sample H 1003; MaMe 0034B, × 1.5.
7. Ventral valve, exterior; sample H 328; MaMe 0032A, × 2.0.
8. Ventral valve, internal mould; sample H 1087; MaMe 0024E, × 1.8.
9. Small ventral valve, internal mould; sample H 1003; MaMe 0043C, × 1.5.
10. Small ventral valve, internal mould; sample H 1003; MaMe 0043D, × 1.5.
11. Paratype, dorsal valve, internal mould; sample H 1003; MaMe 0037, × 1.8.

PLATE 7

Pustulatia lessardi sp. n.
Age and locality: Upper Pragian; Tamesna Basin, In Rahir Tin Amzi section.

1. Ventral valve, latex cast of exterior; sample H 1052; MaMe 0026B, × 6.0.
2. Dorsal valve, latex cast of exterior; sample H 1052; MaMe 0050F, × 6.0.
3. Dorsal valve, latex cast of exterior; sample H 1052; MaMe 0050G, × 6.0.
4. Dorsal valve, latex cast of exterior; sample H 1052; MaMe 0026G, × 6.0.
5. Holotype, dorsal valve, internal mould; sample H 1052; MaMe 0052B, × 6.0.
6. Dorsal valve, internal mould; sample H 1052; MaMe 0050E, × 6.0.
7, 12. Ventral valve, internal mould in oblique and ventral views; sample H 1052; MaMe 0050C, both × 6.0.
8. Ventral valve, latex cast of exterior; sample H 1052; MaMe 0011B, × 6.0.
9. Small ventral valve, internal mould; sample H 1052; MaMe 075, × 6.0.
10. Ventral valve, internal mould; sample H 1052; MaMe 0022B, × 6.0.
11. Paratype, ventral valve, internal mould; sample H 1052; MaMe 0050H, × 6.0.
15. Dorsal valve, internal mould; sample H 1052; MaMe 0050D, × 6.0.

Pustulatia tamesnaensis sp. n.

Age and localities: Emsian to Eifelian; Tamesna Basin, In Debirene section (13, 14, 16, 20–22), and Tin Rerhoh section (18, 19).

13, 16, 17. Holotype, dorsal valve, internal mould, latex cast of exterior and external mould, sample H 1107; MaMe 0128, all × 6.0.

14. Dorsal valve, latex cast of interior; sample H 1107; MaMe 0127A, × 6.0.

18. Small ventral valve, internal mould; sample H 1087; MaMe 0024F, × 6.0.

19. Small ventral valve, latex cast of exterior; sample H 1087; MaMe 0024G, × 6.0.

20. Ventral valve, latex cast of exterior; sample H 1107; MaMe 0127B, × 6.0.

21, 22. Paratype, ventral valve, internal mould and latex cast of exterior; sample H 1107; MaMe 0127C, both × 6.0.

PLATE 8

Hysterolites hystericus SCHLOTHEIM, 1820

Age and localities: Upper Pragian; Tamesna Basin, In Rahir Tin Amzi section (1), and Tin Rerhoh section (2).

1. Dorsal valve, internal mould; sample H 1052; MaMe 0053, × 4.0.

2. Ventral valve, internal mould; sample H 1080; MaMe 0139, × 1.7.

Filispirifer merzakhsaiensis JANSEN, 2001

Age and localities: Upper Pragian; Tamesna Basin, In Rahir Tin Amzi section (3, 8–17), and Tin Rerhoh section (4–7).

3. Ventral valve, internal mould; sample H 1052; MaMe 0069A, × 1.7.

4. Ventral valve, internal mould; sample H 1080; MaMe 0137, × 1.7.

5. Ventral valve, internal mould; sample H 1080; MaMe 0136, × 1.7.

6. Ventral valve, internal mould; sample H 1080; MaMe 0138, × 1.7.

7. Ventral valve, internal mould; sample H 1080; MaMe 0132, × 1.7.

8. Ventral valve, internal mould; sample H 1052; MaMe 0026H, × 1.7.

9, 14. Dorsal valve, internal mould; sample H 1052; MaMe 0060, × 2.5, × 4.0.

10, 13. Dorsal valve, internal mould and details of cardinalia; sample H 1052; MaMe 0069B, × 1.7, × 3.0.

11. Ventral valve, internal mould; sample H 1052; MaMe 0076, × 1.7.

12. Ventral valve, internal mould; sample H 1052; MaMe 0026I, × 1.7.

15, 16. Dorsal valve, internal mould and details of cardinalia; sample H 1052; MaMe 0064, × 1.7, × 3.0.

17. Ventral valve, external mould; sample H 1052; MaMe 0065, × 1.7.

PLATE 9

Arduspirifer cf. *mosellanus* (SOLLE, 1953)

Age and localities: Emsian; Tamesna Basin, In Rahir Tin Amzi section (1–3, 5–8), and Tin Rerhoh section (4).

1. Small ventral valve, internal mould; sample H 1058; MaMe 163, × 1.7.

2. Ventral valve, internal mould; sample H 1058; MaMe 0165a, × 1.7.

3. Ventral valve, internal mould; sample H 1058; MaMe 0166b, × 1.7.

4. Dorsal valve, latex cast of exterior; sample H 1088; MaMe 0092B, × 2.5.

5. Ventral valve, latex cast of exterior; sample H 1058; MaMe 0164A, × 1.7.

6, 7, 9. Complete shell valve, latex cast of ventral valve exterior, posterior view and deatil of microornament in external mould; sample H 1058; MaMe 0166A, × 1.7, × 9.0, × 1.7.

8. Incomplete ventral and dorsal valves, internal moulds; sample H 1058; MaMe 0165B, × 1.7.

Paraspirifer aff. *cultrijugatus* (ROEMER, 1844)

Age and localities: Eifelian; Tamesna Basin, In Ateï section (10, 13, 14, 17, 18), Tin Rerhoh section (11, 12), and In Debirene section (15, 16, 19).

10, 18. Ventral valve, posterior and ventral views; sample H 1017; MaMe 0124, both × 1.3.

11, 12. Ventral valve, internal mould in ventral and anterior views; sample H 1090; MaMe 0126, both × 1.3.

13, 17. Incomplete shell, dorsal and anterior views; sample H 1017; MaMe 0122, both × 1.3.

14. Ventral valve, anterior view; sample H 1016; MaMe 0131, × 1.3.

15, 19. Ventral valve, latex cast of exterior and detail of microornament; sample H 1105; MaMe 0129, × 1.3, × 9.0.

16. Small ventral valve, latex cast of exterior; sample H 1106; MaMe 0141, × 1.3.

PLATE 10

Eleutherokomma mutabilis sp. n.

Age and localities: Eifelian; Tamesna Basin, Oued Felaou area (1–5, 8, 9, 12–14, 17), In Ateï section (7, 15, 18), Tin Rerhoh section (16), In Debirene section (10, 11) and Kori-Idemeg – Touaret area (19).

1. Ventral valve, internal mould; aequivalent of sample H 333; MaMe 0150, × 1.7.

2, 5. Ventral valve, internal mould and latex cast of exterior; sample H 333; MaMe 0149A, both × 1.7.

3, 8. Ventral valve, latex cast of interior and internal mould; sample H 333; MaMe 0149B, × 1.4, × 1.7.

4. Ventral valve, internal mould; sample H 333; MaMe 0151B, × 1.7.

6. Dorsal valve, latex cast of exterior; sample H 828; MaMe 0152A, × 1.7.

7. Dorsal valve with uneven mucronations, internal mould; sample H 1004; MaMe 0144, × 1.7.

9. Dorsal valve, internal mould; sample H 1404; MaMe 0146A, × 1.8.

10, 11. Small dorsal valve, internal mould and latex cast of exterior; sample H 1106; MaMe 0140B, both × 1.7.

12. Ventral valve, anteriior view to internal mould; sample H 333; MaMe 0151A, × 1.7.

13. Dorsal valve, internal mould; sample H 1404; MaMe 0147, × 1.8.

14. Dorsal valve, internal mould showing details of cardinalia; sample H 1404; MaMe 0146B, × 3.0.

15, 18. Holotype, complete shell,, dorsal valve and anterior view; sample H 1017; MaMe 0125, both × 1.7.

16. Ventral valve, internal mould; sample H 1090; MaMe 0148, × 1.7.

17. Dorsal valve, internal mould showing muscle field; sample H 1404; MaMe 0200, × 3.0.

19. Ventral valve with median sulcus in dorsal fold, probably the same species, internal mould; sample H 884; MaMe 0045, × 1.7.

Spinocyrtia sp.

Age and locality: Givetian; Tamesna Basin, In Ateï section.

20. Dorsal valve, internal; sample H 820; MaMe 0077, × 1.3.

PLATE 11

Mediospirifer rerhohensis sp. n.

Age and localities: Eifelian; Tamesna Basin, Tin Rerhoh section (1–6, 8, 10, 12, 13, 15–21), Oued Felaou area (7, 11, 14), and In Debirene section (9).

1. Ventral valve, latex cast of exterior; sample H 1090; MaMe 0174, × 1.7.

2. Paratype, ventral valve, latex cast of exterior; sample H 1090; MaMe 0192, × 1.7.

3. Ventral valve, latex cast of interarea; sample H 1090; MaMe 0173, × 1.7.

4. Ventral valve, latex cast of interarea; sample H 1090; MaMe 0193, × 1.7.

5. Dorsal valve, latex cast of exterior; sample H 1090; MaMe 0188, × 1.7.
6, 10. Ventral valve, latex cast of exterior in ventral and anterior views; sample H 1090; MaMe 0170, both × 1.7.
7. Incomplete ventral valve, internal mould; sample H 333; MaMe 0151D, × 1.7.
8, 15. Dorsal valve, internal mould; sample H 1090; MaMe 0189, both × 1.7.
9. Dorsal valve, latex cast of exterior; sample H 1105; MaMe 0143, × 1.7.
11, 14. Ventral valve, internal mould in ventral and anterior views; sample H 333; MaMe 0151C, both × 1.7.
12. Ventral valve, latex cast of exterior; sample H 1090; MaMe 0190, × 1.7.
13, 16, 17, 19. Holotype, dorsal valve, internal mould in dorsal, posterior and posterodorsal views, and detail of ctenophoridium; sample H 1090; MaMe 0191, × 1.7, × 1.7, × 1.7, × 6.5.
18, 21. Dorsal valve, internal mould in anterior and dorsal views; sample H 1090; MaMe 0187, both × 1.7.
20. Dorsal valve, internal mould showing muscle scars; sample H 1090; MaMe 0186, × 1.5.

PLATE 12

Subcuspidella cf. *subcuspidata* (SCHNUR, 1851)
Age and localities: Emsian; Tamesna Basin, Tin Rerhoh section (1–3, 5, 6, 8), and In Rahir Tin Amzi section (4, 7).

1. Ventral valve, internal mould; sample H 1088; MaMe 0094, × 2.0.
2, 5. Ventral valve, latex cast of exterior and ventral interarea; sample H 1088; MaMe 0171, × 2.0, × 2.0.
3, 6. Ventral valve, latex cast of exterior and ventral interarea; sample H 1088; MaMe 0095, × 2.0, × 2.0.
4. Dorsal valve, latex cast of exterior; sample H 1058; MaMe 0164B, × 2.0.
7. Dorsal valve, latex cast of exterior; sample H 1057; MaMe 0168, × 2.0.
8. Dorsal valve, internal mould; sample H 1088; MaMe 0096, × 2.0.

Tenuicostella ? sp.
Age and localities: Emsian to Eifelian; Tamesna Basin, In Debirene section (9–12, 15), Tin Rerhoh section (13), and In Rahir Tin Amzi section (14).

9, 12. Ventral valve, internal mould and latex cast of exterior; sample H 1106; MaMe 0140D, both × 1.5.
10, 15. Ventral valve, internal mould in anterior and ventral views; sample H 1106; MaMe 0091, both × 1.5.
11. Small ventral valve, internal mould; sample H 1106; MaMe 0142, × 1.5.
13. Ventral valve, internal mould; sample H 1088; MaMe 0172, × 1.5.
14. Dorsal valve, internal mould; sample H 1058; MaMe 0167A, × 1.2.

PLATE 13

Rhipidothyris ? sp.
Age and locality: Givetian; Tamesna Basin, In Ateï section (1–3, 13)

1. Ventral valve, latex cast of exterior; sample H 355; MaMe 0019, × 2.5.
2. Ventral valve, internal mould; sample H 1009; MaMe 0016A, × 2.5.
3. Ventral valve, internal mould; sample H 1009; MaMe 0016B, × 2.5.
13. Bedding plane of sandstone with external and internal moulds of *Rhipidothyris* ? sp; sample H 355, MaMe 0019, × 1.5.

Rhipidothyris africana BOUCOT, MASSA et PERRY, 1983
Age and localities: Givetian; Tamesna Basin, area W to the Air Massif (4–8, 10–12), and In Ateï section (9).

4. Complete shells, external moulds showing pedicle foramen; sample G 1000; MaMe 0113A (left) and MaMe 0113D, × 3.5.
5, 10. Ventral valve, latex cast of external mould showing exopunctation, and latex cast of four complete shells; sample G 1000; MaMe 0113C, × 9.0, × 3.5.
6. Ventral valve, internal mould showing dental plates; sample G 1000; MaMe 0114, × 3.5.
7. Dorsal valve, internal mould showing dental plates; sample G 1000; MaMe 0113B, × 3.5.
8. Dorsal valve, internal mould showing crural plates; sample G 1000; MaMe 0118, × 3.5.
9. Bedding plane of sandstone with external and internal moulds of *Rhipidothyris africana* BOUCOT et al. 1983; sample H 355, MaMe 0111, × 1.5.
11. Dorsal valve of complete shell, internal mould; sample G 1000; MaMe 0116, × 3.5.
12. Ventral valve of complete shell, internal mould; sample G 1000; MaMe 0117, × 3.5.

Pleurothyrella cf. *knodi* (CLARKE, 1913)
Age and locality: Upper Pragian; Tamesna Basin, In Rahir Tin Amzi section.

14–16. Complete shell, internal mould in anterior, ventral and dorsal views; sample H 1053; MaMe 0119, × 1.3.

PLATE 14

Globithyris orchas (HAVLÍČEK, 1984)
Age and localities: Pragian; Tamesna Basin, Anou Izileg area (1–4, 6–8), and In Rahir Tin Amzi section (5).

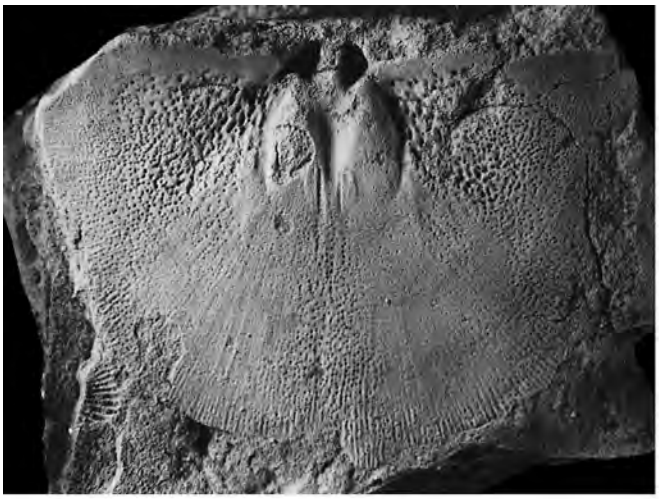
1. Dorsal valve, internal mould; sample H 823; MaMe 0104, × 2.0.
2, 4. Complete shell valve, internal mould in ventral and anterior views; sample H 823; MaMe 0108, × 2.0.
3, 6. Ventral valve, internal mould in lateral and ventral views; sample H 823; MaMe 0106, × 2.0.
5. Incomplete ventral valve, internal mould; sample H 1052; MaMe 0063, × 7.5.
7, 8. Ventral valve, internal mould in ventral and posterior views; sample H 823; MaMe 0112, × 2.0.

Amphigenia cf. *elongata* (VANUXEM, 1842)
Age and localities: Emsian; Tamesna Basin, In Rahir Tin Amzi section (9, 12, 13), and Tin Rerhoh section (10, 11, 15).

9, 12, 13. Dorsal valve, internal mould, in dorsal and posterodorsal views and latex cast of cardinalia (12); sample H 1058; MaMe 0160, × 0.8, × 2.5, × 1.0.
10. Incomplete small ventral valve, internal mould; sample H 1088; MaMe 0092A, × 3.5.
11. Incomplete small dorsal valve, internal mould; sample H 1088; MaMe 0093A, × 3.5.
15. Incomplete ventral valve, internal mould; sample H 1088; MaMe 0099, × 1.5.

Etymothyris sp.
Age and locality: Upper Pragian; Tamesna Basin, In Rahir Tin Amzi section.

14. Dorsal valve, latex cast of exterior; sample H 1052; MaMe 0161, × 1.7.



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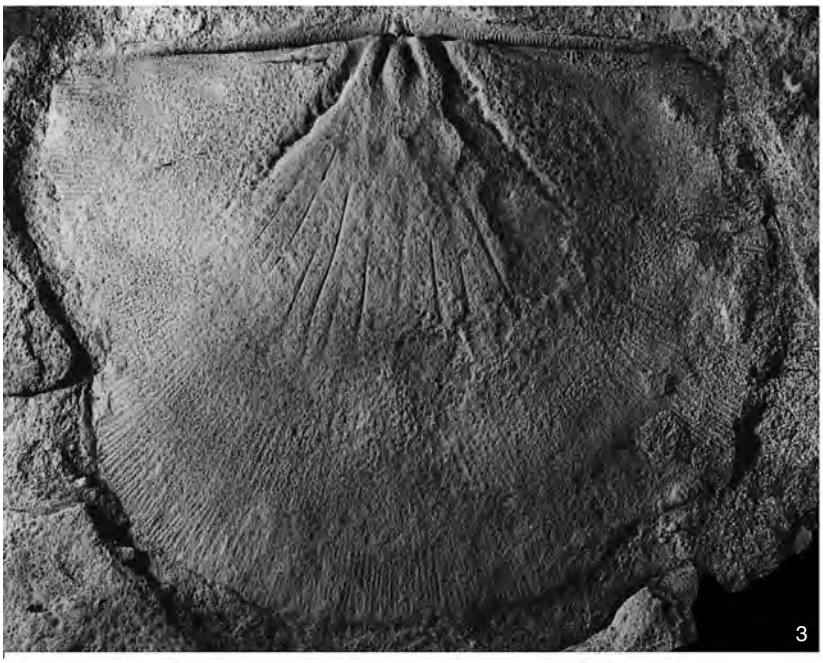

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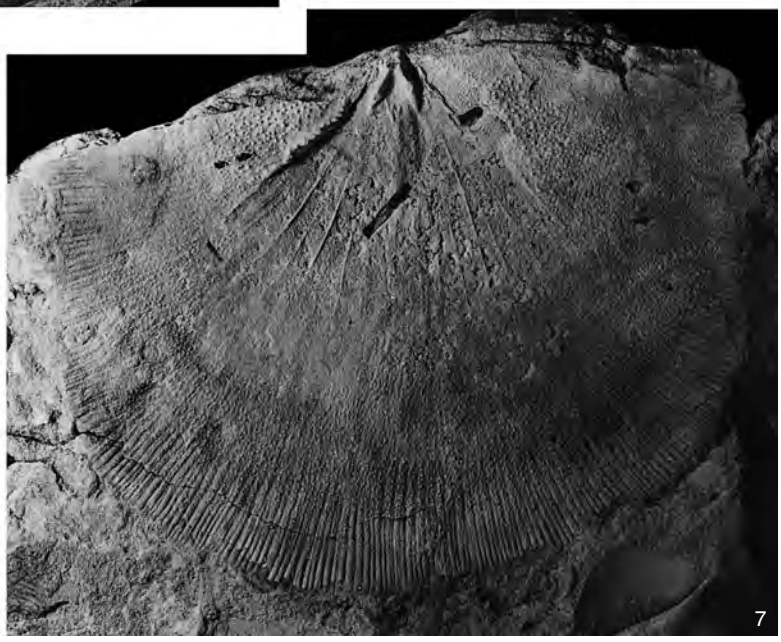

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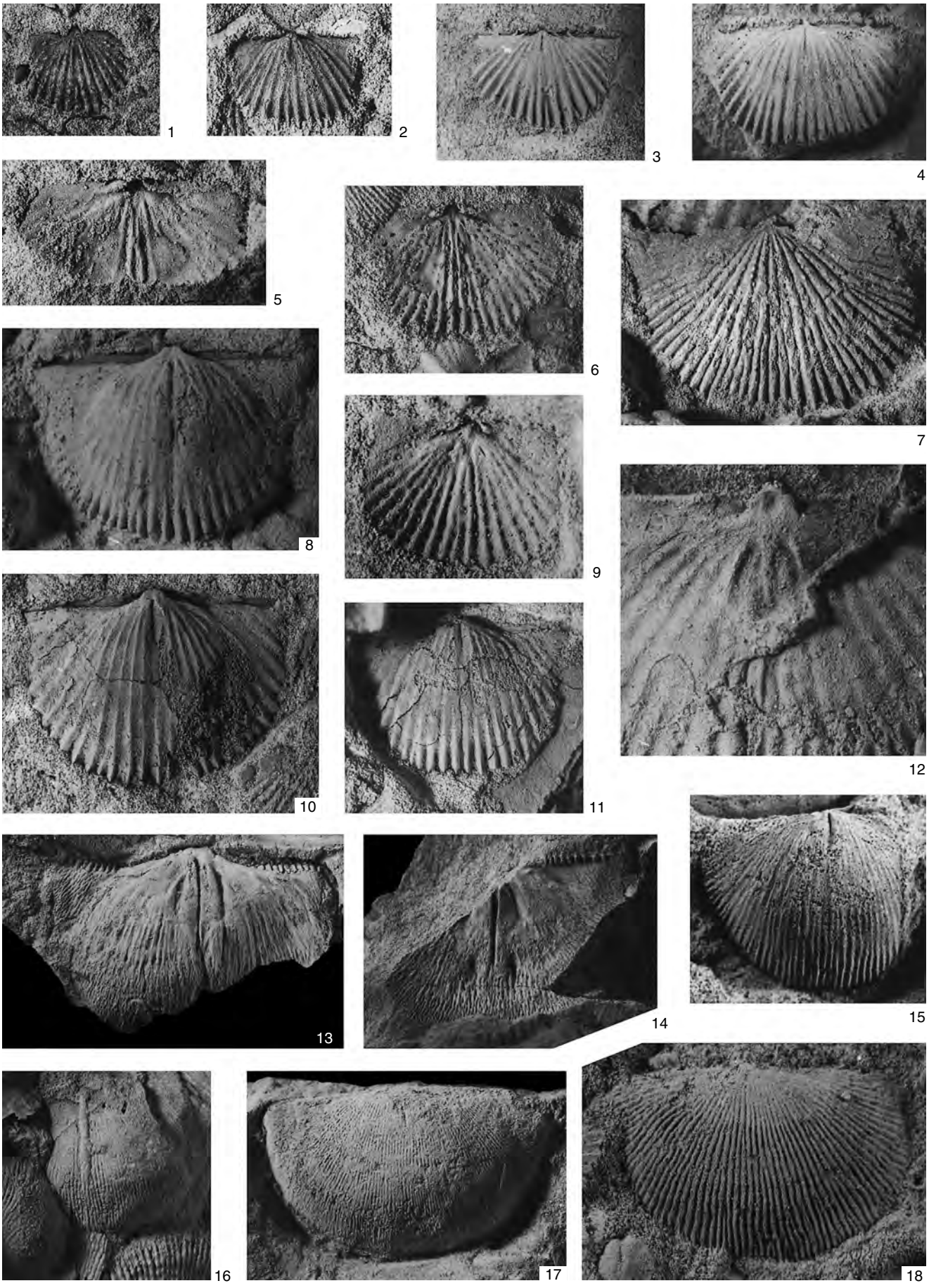

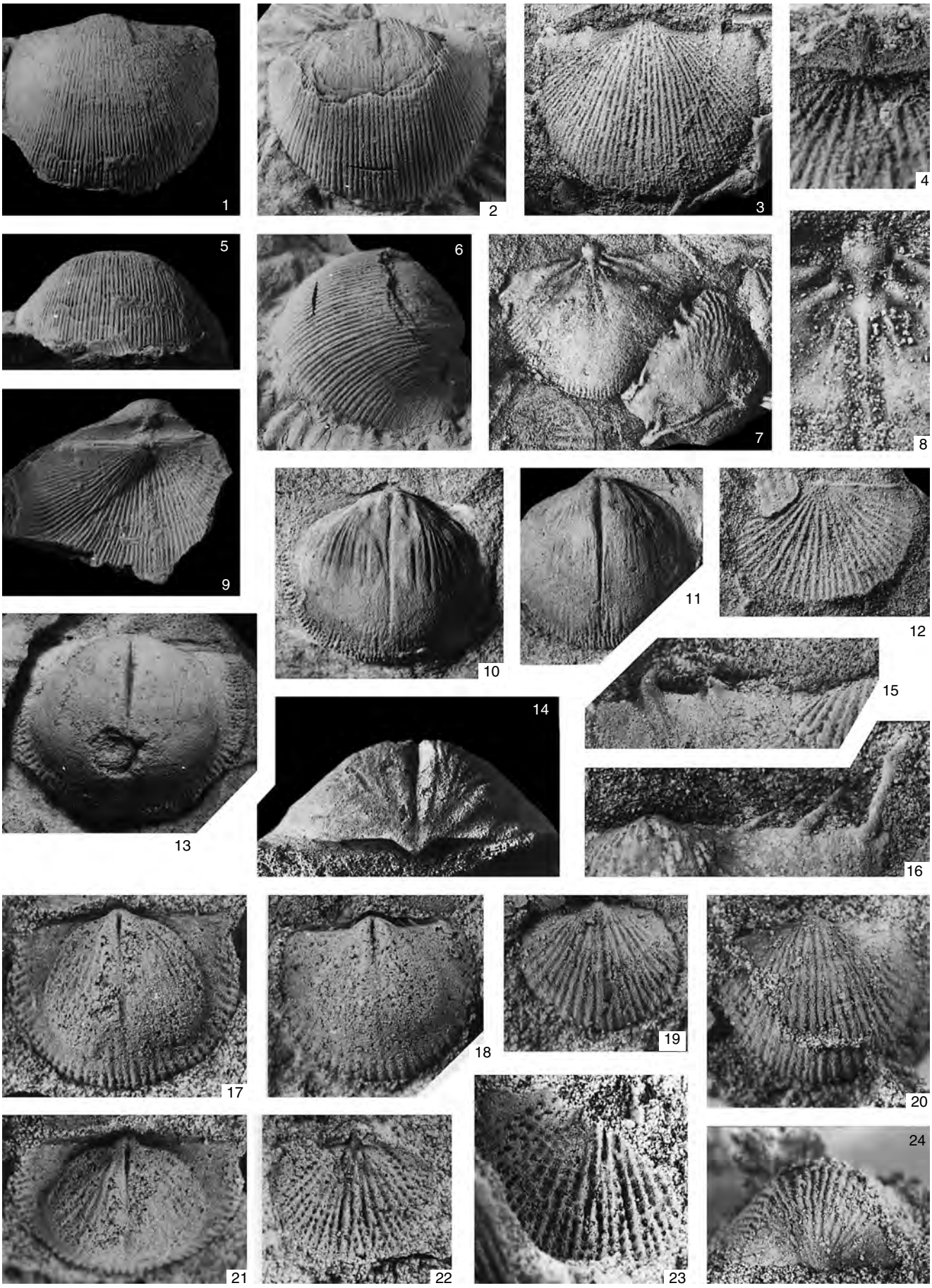
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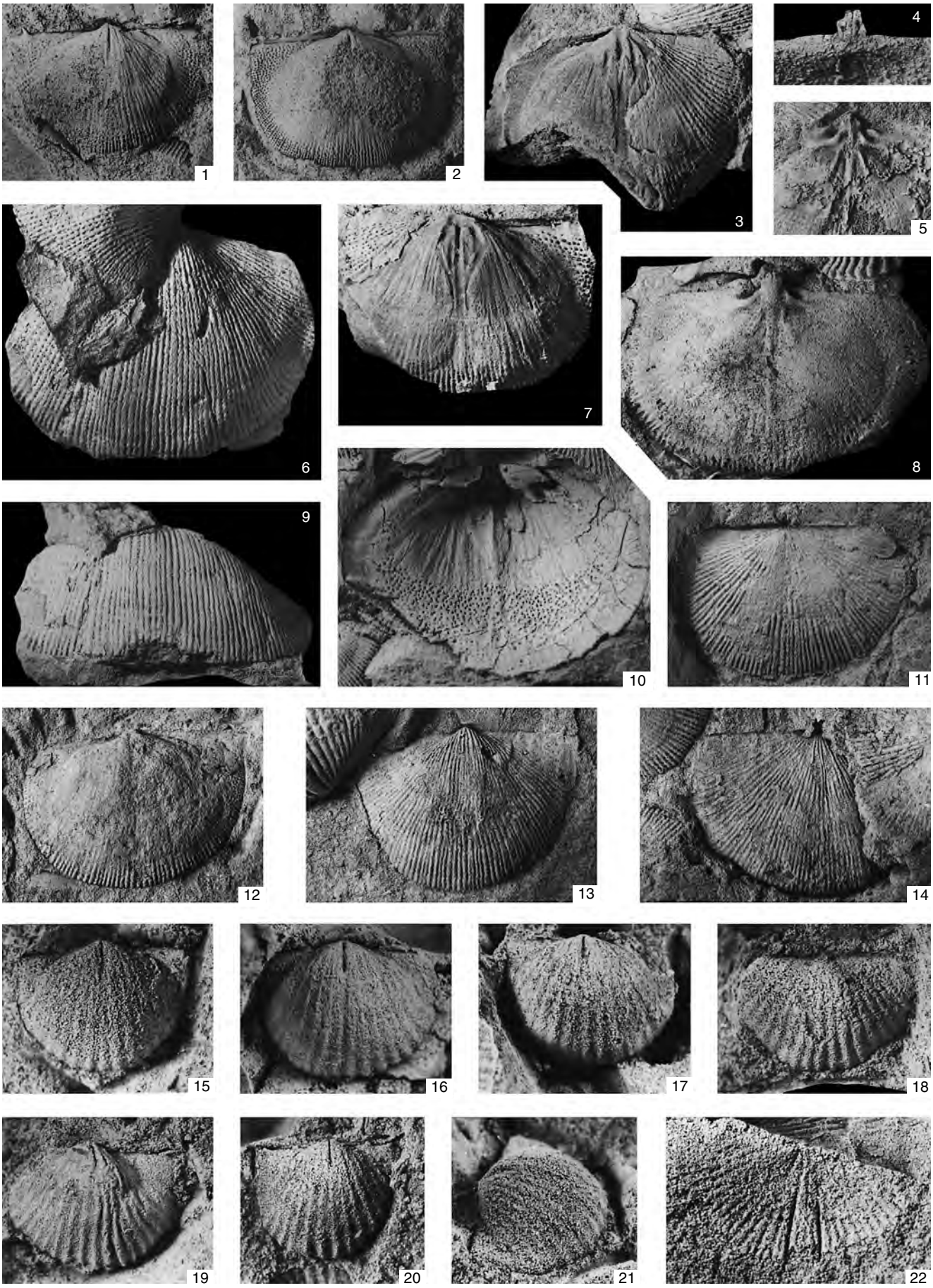
Plate 4

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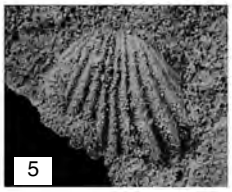
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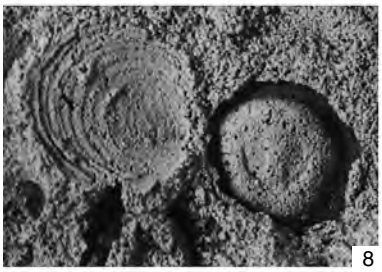
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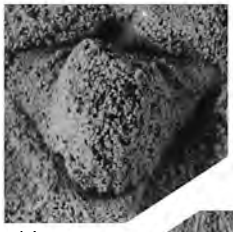
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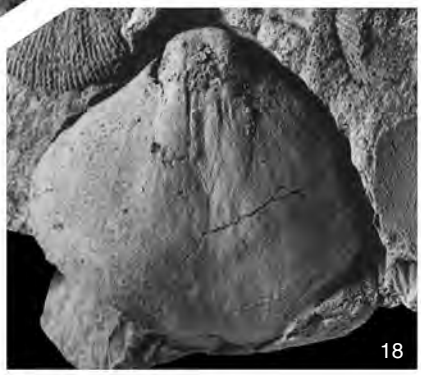
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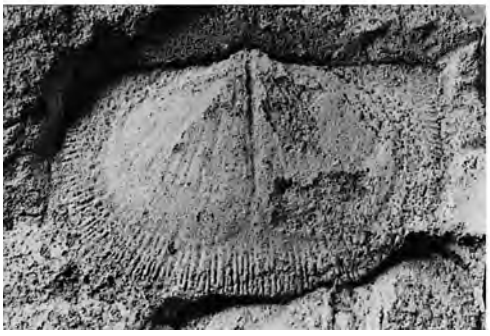
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Plate 6


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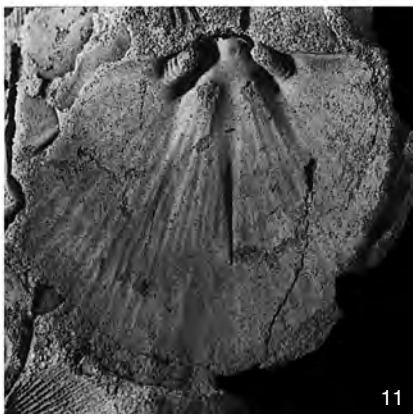
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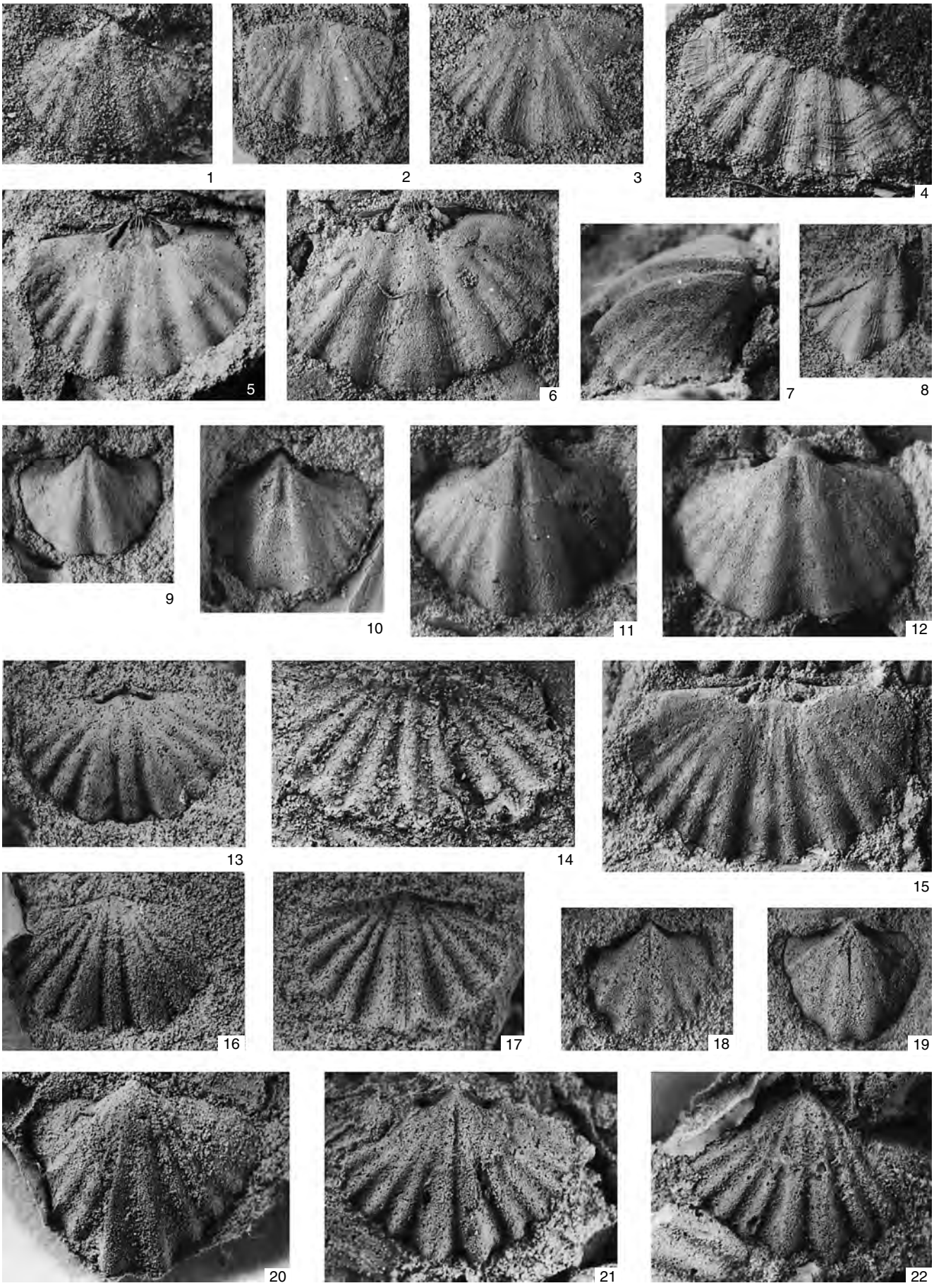
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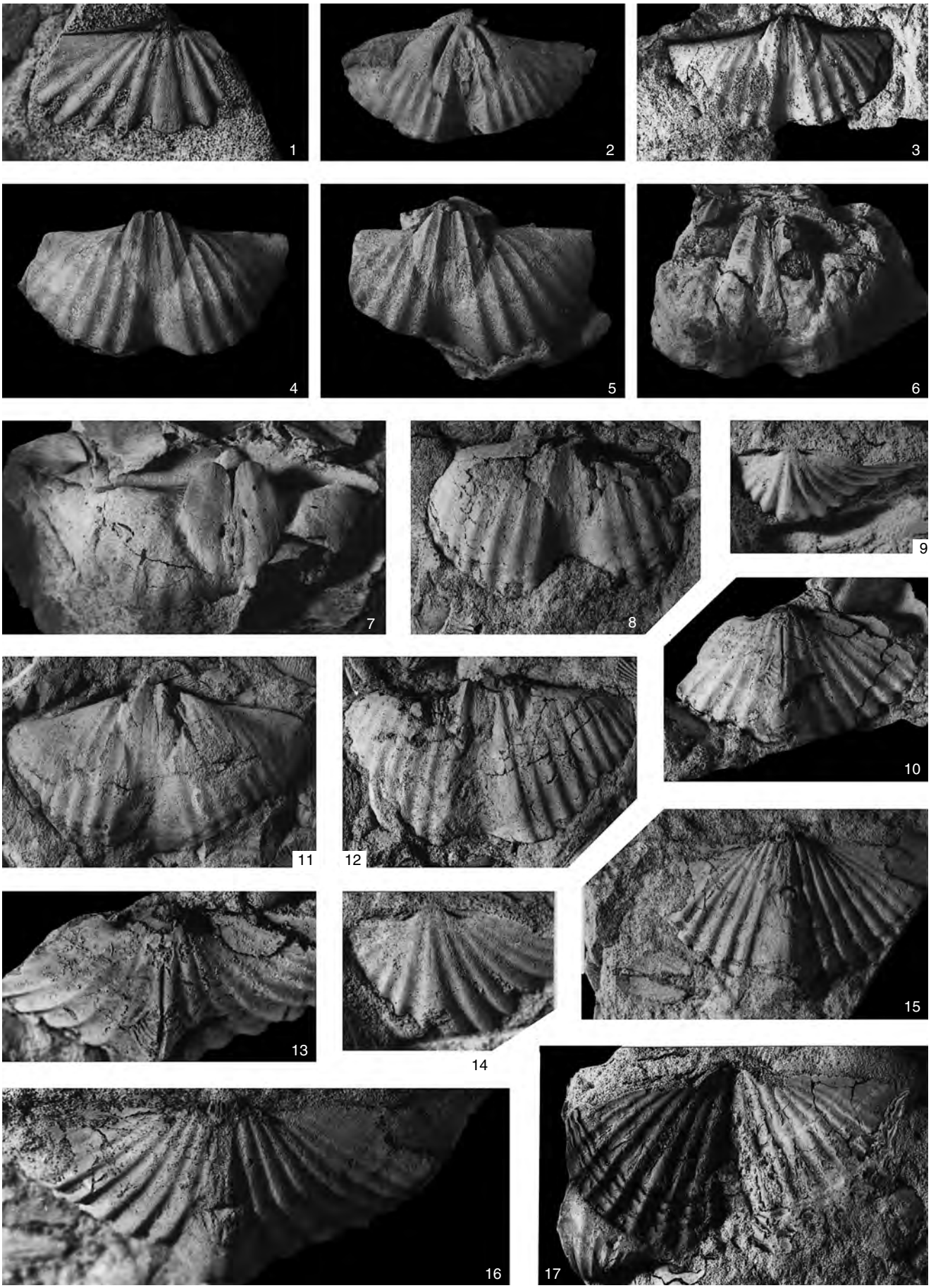
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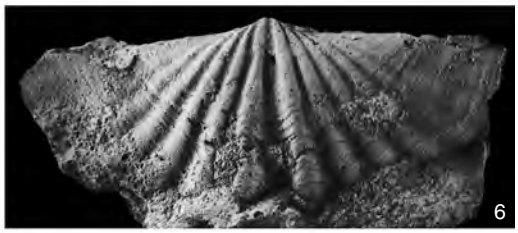
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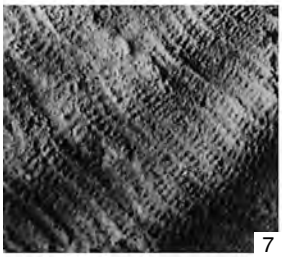
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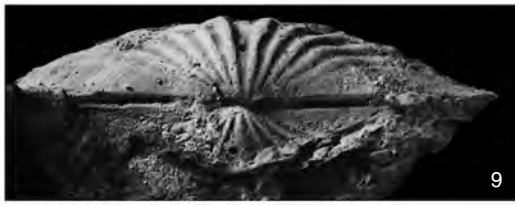
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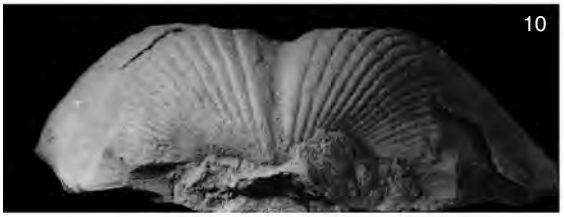
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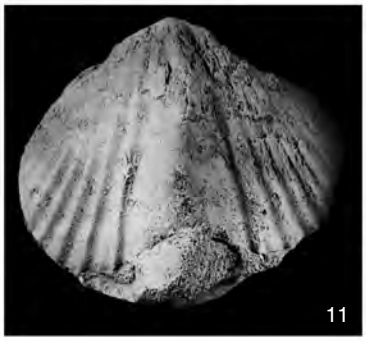
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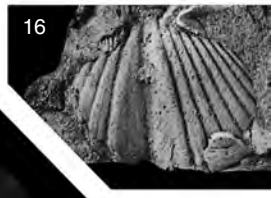
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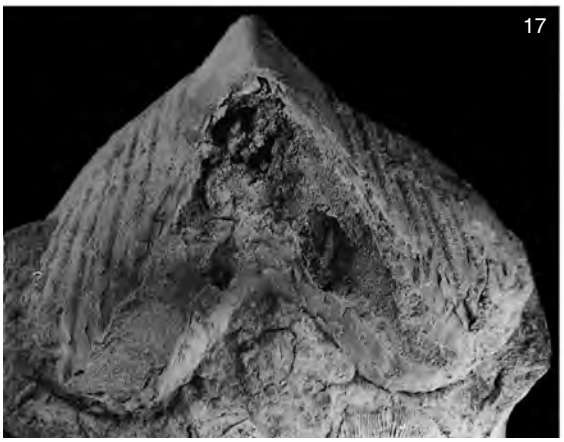
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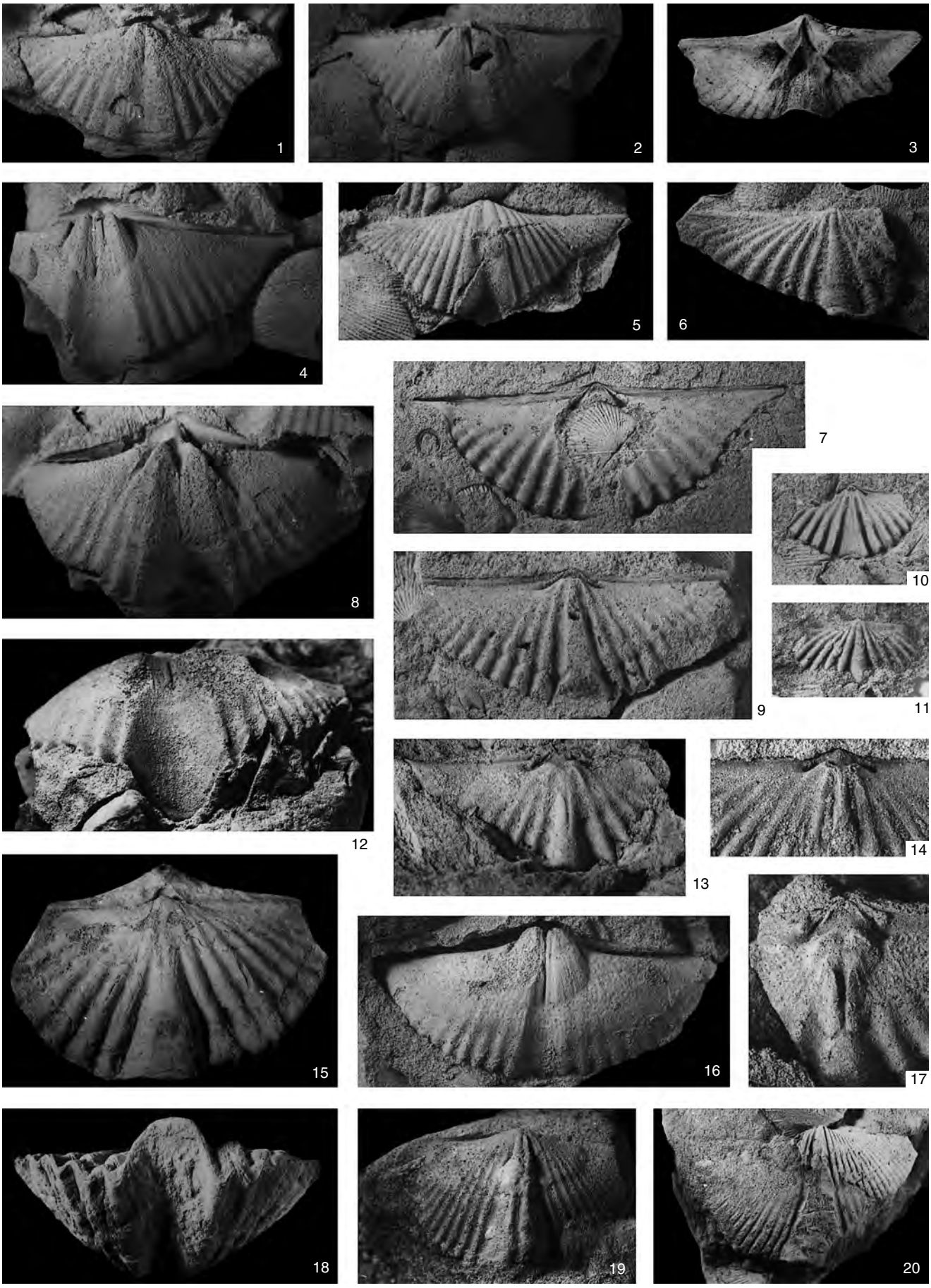
Plate 10



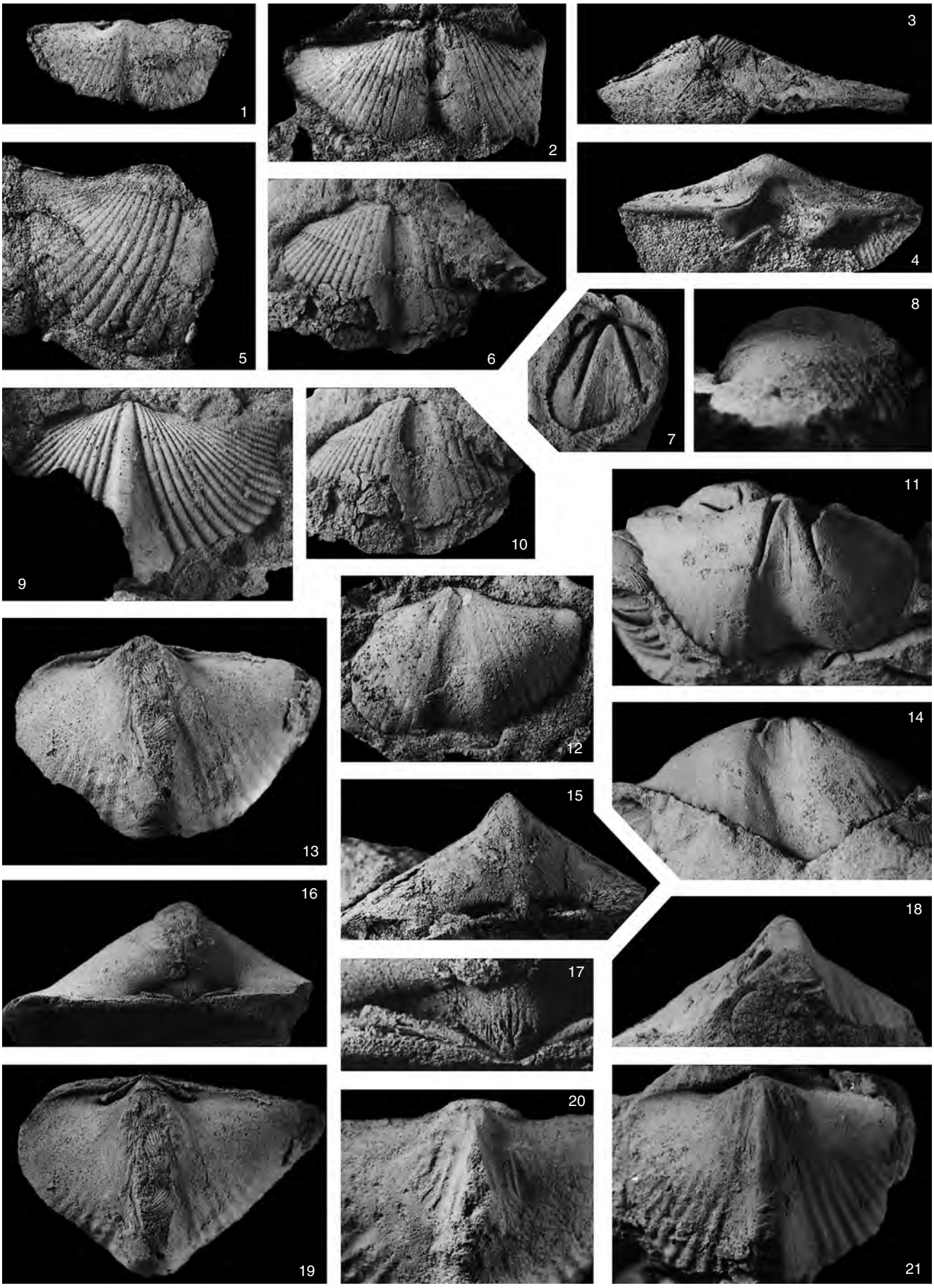

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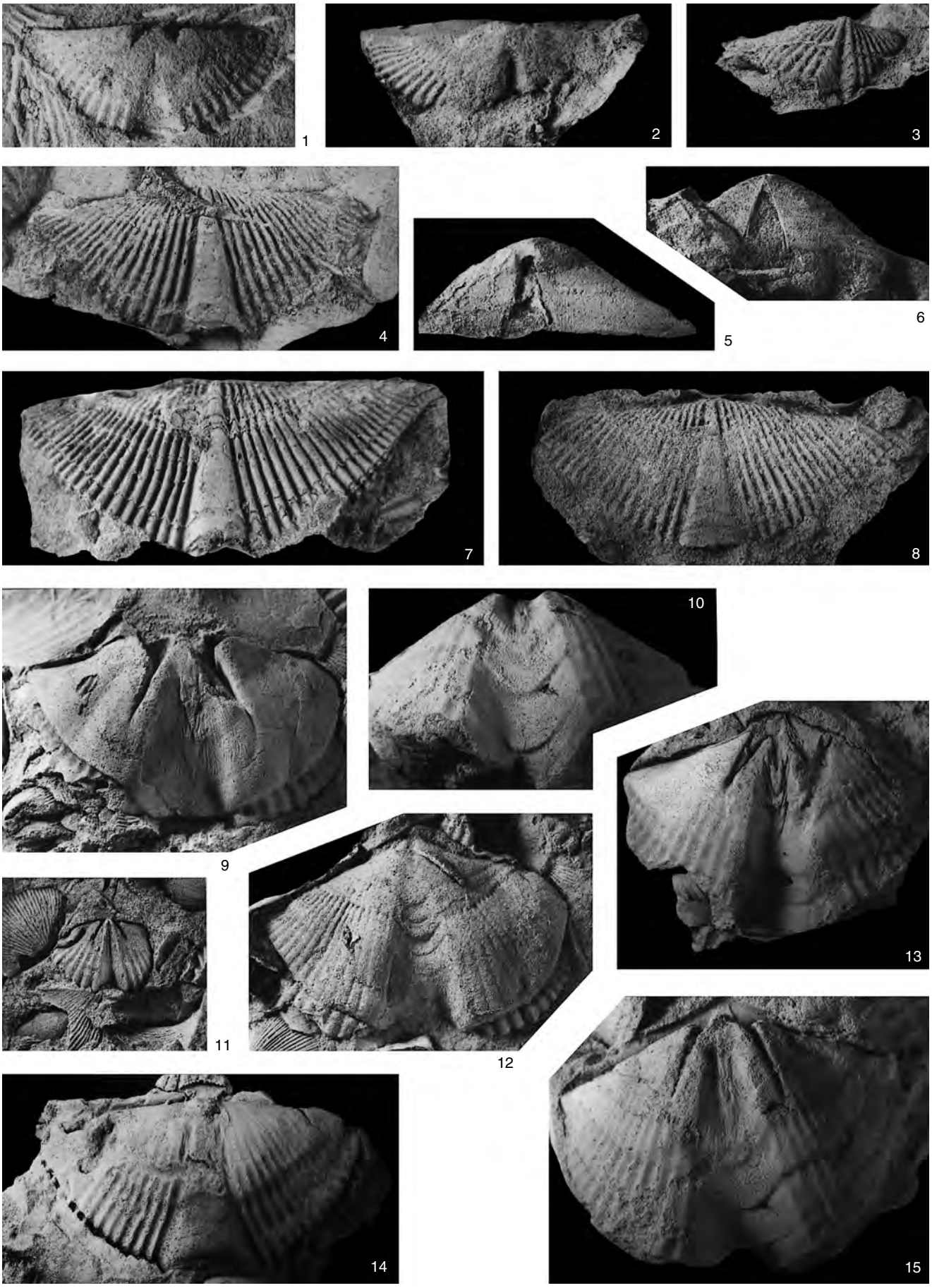
Plate 12



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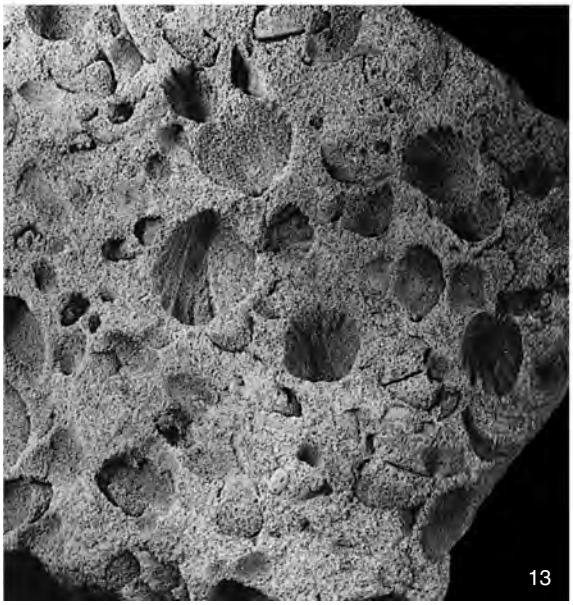

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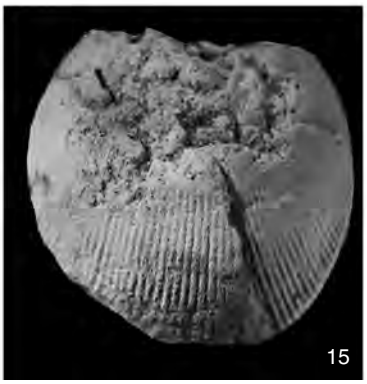

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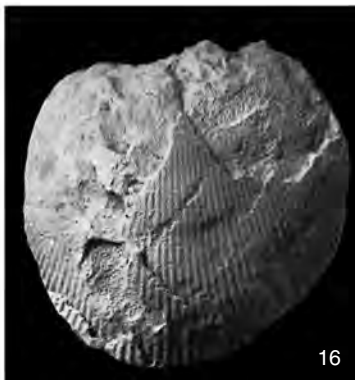

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Plate 14


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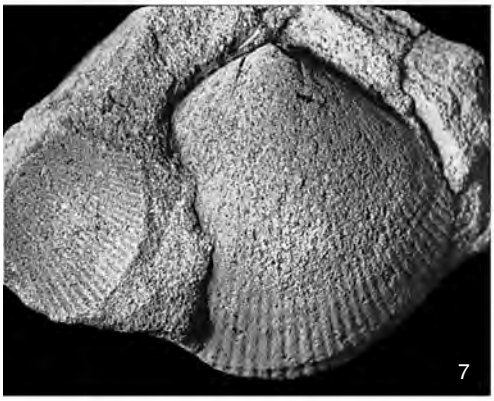
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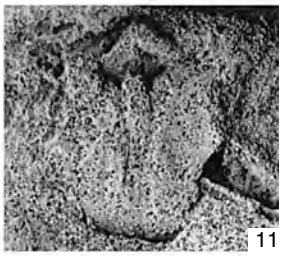
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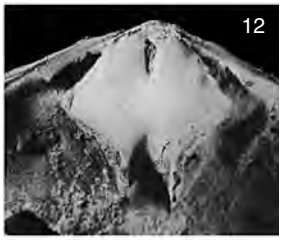
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