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NEW BRACHIOPOD FAUNAS FROM THE MIDDLE JURASSIC OF ZANSKAR (LADAKH, INDIA)

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Key-words: Biostratigraphy, Systematic Paleontology, *Brachiopoda: Rynchonellida* and *Terebratulida*, Middle Jurassic, Himalaya, India.

Riassunto. Durante una spedizione geologica in Zanskar (Himalaya occidentale, Ladakh, India) sono state misurate in dettaglio diverse sezioni stratigrafiche riguardanti il Giurassico Medio della Falda Zumlung. In alcune di esse sono stati raccolti abbondanti Brachiopodi e rari Ammoniti, in particolare nei Laptal Beds e nella Ferruginous Oolite Formation, unità solitamente povere di fossili. Per quanto riguarda i Brachiopodi, molte delle specie sono risultate nuove per la regione himalayana, essendo tipiche del margine settentrionale della Tetide. Una specie, *Ivanoviella gaetanii* sp. n., è stata istituita su materiale proveniente dalla Ferruginous Oolite Formation. La presenza di numerosi fossili ha permesso un'ampia discussione sull'età delle unità.

Nonostante qualche discrepanza tra la distribuzione conosciuta dei Brachiopodi e quella degli Ammoniti, si è confermata l'età batoniana dei Laptal Beds. Maggiori problemi sono sorti per la datazione della Ferruginous Oolite Formation; essa è stata considerata riferibile al ?Batoniano, Calloviano Inferiore-Oxfordiano, anche se con la probabile presenza di lacune, come d'altra parte segnalato in altre aree dell'Himalaya.

Abstract. Several detailed stratigraphical sections have been measured in the Middle Jurassic of the Zanskar region (Western Himalaya, Ladakh, India). Along six sections in the Laptal Beds and in the Ferruginous Oolite Formation, a rich brachiopod fauna, associated with a few ammonites, has been collected. Most of the brachiopod species are new for the Himalayan region, been so far typical of the Northern Tethys margin. A species, *Ivanoviella gaetanii* sp. n., is erected on material from the Ferruginous Oolite Formation. The age of the lithostratigraphic units yielding fossils is discussed from both brachiopods and ammonites: though little discrepancies are present between the inferred age of brachiopods and ammonites, a Bathonian age for the Laptal Beds and a ?Bathonian, Early Callovian to Oxfordian age for the Ferruginous Oolite Formation is established.

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Introduction.

During the 1987 Italian Geological expedition to Zanskar (Western Himalaya), a group of four geologists travelled on a geologically mostly unknown area (Fig. 1). Aim of their work was the Jurassic and Cretaceous sequence of the area, mainly comprised in the Zumlung Nappe (Baud et al., 1982; Gaetani et al., 1986). Several detailed Middle Jurassic stratigraphical sections have been measured (Tintori, 1990; Jadoul, pers. comm.) and rich brachiopod and ammonite faunas have been meanwhile collected by one of us (AT) in the Laptal Beds (Heim & Gansser, 1939), in the Ferruginous Oolite Formation (Krishna, 1983; Jadoul et al., 1985) and in the Spiti Shales (Stoliczka, 1866).

Brachiopods were found only in the topmost part of the Laptal Beds and in the Ferruginous Oolite Formation, sometimes associated with a few ammonites. The Spiti

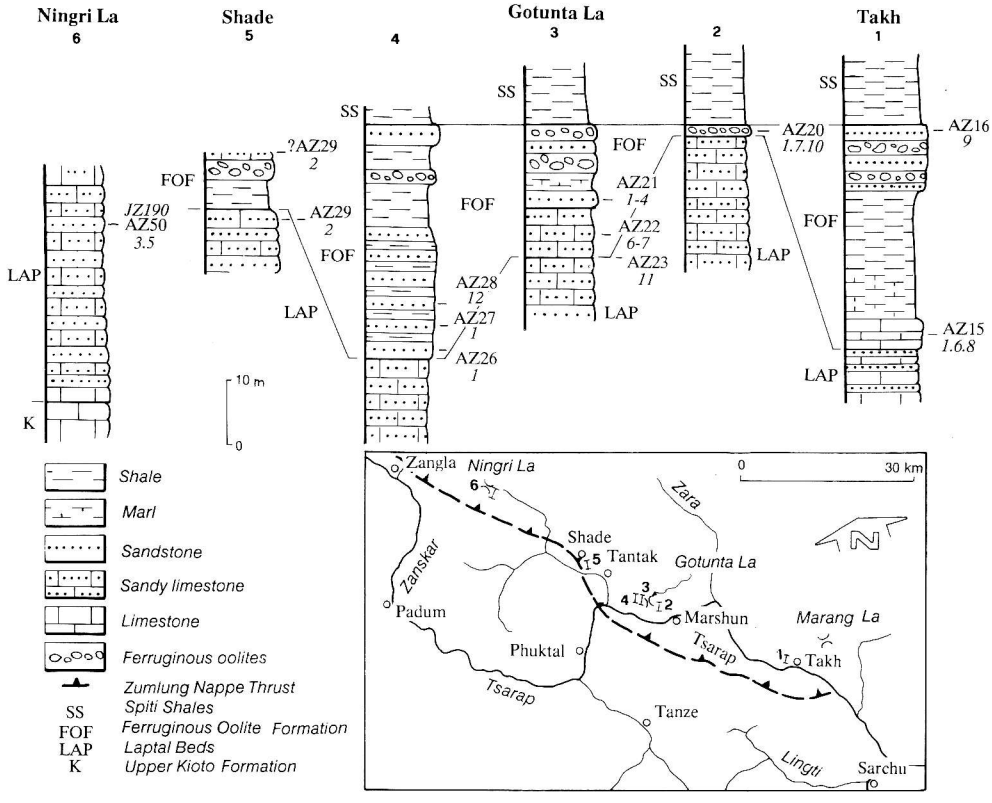


Fig. 1 - Places of the measured sections (1-6). Stratigraphic position and paleontological content *(1-12)* of the fossiliferous samples:
1) Ivanoviella; 2) Somalirhynchia; 3) Daghanirhynchia; 4) Septaliphoria; 5) Holcothyris; 6) Dorsoplicathyris; 7) Zeilleria; 8) Hecticoceras (Chanasia) and *Indosphinctes (Elamites); 9) Dhosaites; 10) Oxycerites* and *Hecticoceras (Prohecticoceras); 11) Macrocephalites* s.l.; *12) Choffatia.*

Shales yielded only ammonites. A preliminary determination of the latter [*Hecticoceras (Prohecticoceras), Oxycerites, Choffatia, Hecticoceras (Chanasia), Macrocephalites*], made by one of us (AT), suggests that the age of the lower Ferruginous Oolite Formation is around the boundary between Bathonian and Callovian or in the Early Callovian. The same levels have been proved to be of similar age in Eastern Himalaya and Tibet (Westermann & Wang, 1988; Krishna, 1983; Cariou et al., 1990).

The Middle Jurassic sequences from the different tectonic units of the Zanskar area appear quite different: in the Zangla Nappe (Jadoul et al., 1985) no brachiopods have been found in the Ferruginous Oolite Formation, and ammonites point to Early-Middle Callovian; Bathonian fossils are absent. The Laptal Beds are not found; perhaps most of the Bathonian is missing like in Southern Tibet (Westermann & Wang, 1988). In the Zumlung Nappe the sedimentation has been more continuous and the Laptal Beds record the passage from the underlying Kioto Limestone (of early Middle Jurassic age in its topmost part; Jadoul, pers. comm.) to the Ferruginous Oolite Formation. This fact confirms that more basinal conditions occurred towards the North.

Alméras and Benigni are responsible for brachiopod identification and description. Tintori collected the specimens and made the preliminary identification of the ammonites.

The studied material and the figured specimens are kept in the collections of the Dipartimento di Scienze della Terra, Museo di Paleontologia, Milano, and the referred numbers are these of the collections.

Age of the units according to the faunas.

The age assignments are still tentative, because brachiopods and ammonites give sometimes slightly different ages. Six fossiliferous sections have been measured (Fig. 1). Their detailed description is in progress (Jadoul, in prep.).

a) Laptal Beds. Only one section has been measured in the Laptal Beds, near the Nigri La: the sample AZ50 (1) contains brachiopods, namely *Holcothyris angulata* and *Daghanirhynchia daghaniensis*. The first species indicates an Early Bathonian age (Pamir, Turkmenia, Crimea, Northern Caucasus, China, Morocco, Western Algeria, French Southern Jura) or even a Bathonian post-Zigzag age (Central Saudi Arabia). The second species is Bathonian post-Zigzag. In Saudi Arabia and in Eastern Africa (Somalia, Ethiopia) it exists as soon as the Bathonian post-Zigzag, but its acme occurs in the Middle Callovian (Coronatum Zone).

One more section possibly crossed the Laptal Beds near Shade; there *Somalirhynchia africana* has been collected in the level AZ29. However, because of very strong tec-

(1) Sample AZ50 has been collected from the detritus of the bed JZ190, that yielded only a few specimens.

tonics, the precise stratigraphic position of the sample AZ29 is not known. It is also possible that the sample comes from layers of the upper part of the Ferruginous Oolite Formation (Jadoul, pers. comm.). The occurrence of this species is puzzling because it would indicate at least the Middle Callovian, which seems to be too young for the Laptal Beds.

b) Ferruginous Oolite Formation. Four sections yield fossils also from the Ferruginous Oolite Formation, one near Takh and the other three around the Gotunta La (Fig. 1). In the Takh section, the sample AZ15 yields *Ivanoviella gaetanii* sp. n., *Dorsoplicathyris* (?) aff. *kabardinensis* (Moisseev), *Kutchithyris* aff. *pyroidea* (Kitchin) (1) in Prosorovskaya, 1968, together with ammonites of late Early Callovian such as *Indosphinctes (Elamites) calloviensis* and *Hecticoceras (Chanasia)* cf. *pseudochanasiensis*. The uppermost bed surface of the unit (AZ16) yields several *Dhosaites* of large size. This latter genus indicates the base of the Late Oxfordian.

In the first Gotunta La section, the sample AZ20 yields *Ivanoviella gaetanii* sp. n., *Zeilleria rostellata* Kitchin as well as ammonites such as *Oxycerites* sp. ind. and *Hecticoceras (Prohecticoceras)* cf. *crassum* Elmi, 1967, this latter species indicating the topmost Middle Bathonian.

In the second Gotunta La section there are (top to the bottom): sample AZ21 with *Ivanoviella gaetanii* sp. n. and *Septaliphoria zacharlensis* Prosorovskaya; sample AZ22 with *Dorsoplicathyris* (?) aff. *kabardinensis* (Moisseev) and *Zeilleria rostellata* Kitchin; sample AZ23 with a macrocephalid ammonite, the latter indicating an Early Callovian age.

In the last Gotunta La section only *Ivanoviella gaetanii* sp. n. has been found among brachiopods (samples AZ26 and AZ27). Just above these samples a few specimens of *Choffatia* cf. *prorsicostata* (Siemiradzki, 1894) have been found (sample AZ28), again of topmost Early Callovian age.

In conclusion, except for *Holcothyris angulata* and *Zeilleria rostellata*, the brachiopod faunas indicate an Early-Middle Callovian age while the ammonites of the same levels are Early Callovian. These brachiopod species have been collected only on the Tethyan northern margin before this finding. Actually, the species described in the present paper are mostly new finds in the Tethyan southern margin, so that their age span is possibly wider than so far known.

We would like also to remark that *Holcothyris angulata* has been already described by Alméras & Gupta (1986) from the area in question. In that paper, in fact, the specimens are told to come from the Laptal Beds of the Chharap Valley, which is only a different spelling of our Tsarap Valley. Since serious doubts have been recently raised about Gupta's field work (Talent et al., 1988; Talent, 1989), we must say that no Laptal Beds outcrops are found all the way the carriage road Manali-Leh follows the Tsarap

(1) Owing to the poor preservation of these specimens, they have not been described.

Valley. The first section (the Takh one) is about two days walk from the point where the road leaves the Tsarap Valley. As far as we know, no other geological expedition had previously travelled along our itinerary further than the carriage road. It has also worth adding that Gupta's fauna is monospecific and restricted to the Laptal Beds. On the contrary, the overlying Ferruginous Oolite Formation has proved to be much more fossiliferous and (both in the Laptal Beds and in the Ferruginous Oolite Formation) at least two brachiopod species are generally found together with a few ammonites. *Holcothyris angulata* has been found during our expedition in only one of the many studied sections, the farthest one from the Tsarap Valley, together with predominant *Daghanirhynchia.* Thus we wander whether specimens sent to one of us (Y.A.) by Gupta have been actually collected elsewhere, for instance in the Kachchh region.

Paleontological descriptions

The undermentioned symbols correspond to biometric characteristics examined with their ratios:

N = number of specimens referred to each sample (or to each species);
L, W and T = length, width and thickness of the shells;
W/L = relationship of the width to the length;
T/L = relationship of the thickness to the length;
Tb = thickness of the brachial valve;
Tp = thickness of the pedicle valve;
L'/L = location of the maximum width to the beak.

In Rhynchonellids:
Ws = width of the median pedicle sulcus;
Ds = depth of the median pedicle sulcus;
Ds/Ws = relationship of the depth of the median pedicle sulcus to its width;
Ws/W = relationship of the sulcus width to the shell width;
As = location of the first appearance of the median pedicle sulcus (length from the beak);
Ns = number of costae on the pedicle sulcus;
Nb = number of costae on the median dorsal fold;
Nvb = total number of costae on the brachial valve.

In Terebratulids:
p = height of the uniplication;
d = width of the uniplication;
p/d = relationship of the height of uniplication to its width.

Phylum **Brachiopoda**

Family *Rhynchonellidae* Gray, 1848

Subfamily *Rhynchonellinae* Gray, 1848

Genus *Ivanoviella* Makridin, 1955

Type-species: *Ivanoviella alemanica* (non Rollier) in Makridin (1964), p. 140, pl. 5, fig. 3-6 (= *Ivanoviella gaetanii* sp. n.).

There is a nomenclatural problem about *Ivanoviella*. Makridin [1955, p. 83 (*nomen vanum*); 1960, p. 254 and 1964, p. 133] created and described its new genus *Ivanoviella* with *Rhynchonella alemanica* Rollier (1917, p. 151) as type-species. We find again this proposition in the American Invertebrate Treatise (Ager, 1965, p. 611). But the species studied and figured by Makridin under the name *Ivanoviella alemanica* (1964, p. 140, pl. 5, fig. 3-6) is not the true Rollier's species (see Laurin, 1984, p. 361 and in this paper the paragraph remarks about *Ivanoviella gaetanii* sp. n.). It is another species, for which we propose the name of *Ivanoviella gaetanii* sp. n. So, the type-species of *Ivanoviella* becomes *I. gaetanii* sp. n.

Ivanoviella gaetanii sp. n.

Pl. 20, fig. 1-9; Text-fig. 2-4

1955 *Rhynchonella (Cyclothyris) alemanica* - Gerassimov, p. 179, pl. 43, fig. 16, 17.
1964 *Ivanoviella alemanica* - Makridin, p. 140, pl. 5, fig. 3-6.

Derivatio nominis. In homage to Professor M. Gaetani, Università di Milano.
Locus typicus. Takh (AZ15).
Stratum typicum. Ferruginous Oolite Formation of Callovian age.
Holotype. Specimen n. 6568, Pl. 20, fig. 1.
Paratypes. 50 well preserved shells have been measured; they come from samples AZ15 (n. 6569), AZ20 (n. 6570), AZ21 (n. 6571), AZ26 (n. 6572) and AZ27 (n. 6573). 26 other specimens are in poor state of preservation.

Diagnosis. Uniplicate and cynocephalous shells of 8 up to 15 mm in length, with a rounded subpentagonal outline. Hypothyrid, beak sharp, suberect to erect. Elliptical foramen. Disjunct deltidial plates. Smooth stage in the beak and umbonal regions. 8 to 17 thin, sharp costae, 2 to 7 of which are developed on the median brachial fold.

Hinge-teeth well developed with small denticula. Hinge-plates horizontal. Shallow V-shaped septalium. Crura radulifer.

Description.

External characters. Shells with a symmetrical rounded subpentagonal outline, between 8 and 15 mm in length, longer than wide (Pl. 20, fig. 2, 3) or wider than long (Pl. 20, fig. 4, 5), the mean of ratio W/L counted on 50 specimens is 1.07. The young shells have a subcircular outline, they are regularly and slightly biconvex, and show a maximum width and a maximum thickness towards the middle of valves (Pl. 20, fig. 6). Then, during ontogenesis, the maximum width displaces towards the anterior margin (0,52 up to 0.77 of the length).

The pedicle valve is flattened; its sulcus takes rise between 6 and 10.5 mm below the umbo, i.e. between 0.55 and 0.75 of the length from the beak. The brachial valve, firstly of an average convexity, is anteriorly raised with the development of a high me-

dian fold. So, its maximum thickness is located about the anterior margin and the shells show a cynocephalous aspect in lateral view. Higher or lower rounded uniplication according to the thickness of shells, with ventrally divergent borders of the anterior deflexion. The lengthened lappet of sulcus curves again towards the brachial valve forming an obtuse angle, close to a right angle.

Small, sharp beak, with lateral beak-ridges, more often suberect, sometimes erect, always very overhanging above the dorsal umbo. Elliptical, rarely circular foramen. Disjunct deltidial plates.

The ornamentation consists of 8-17 thin, sharp costae (Pl. 20, fig. 4, 5, 7) which become a little coarser and more rounded when the number of ribs is smaller (Pl. 20, fig. 8, 9). In the same time, we observe 2 to 7 costae on the median dorsal fold. According to the shells, the ornamentation begins between 5 and 10 mm below the umbo. The beak and umbonal regions present a smooth stage.

	N	L	W	T	W/L
Az 15	5	12.9 (12.0-14.7)	14.7 (12.8-15.8)	10.8 (9.7-12.2)	1.14 (1.05-1.24)
Az 20	24	11.2 (8.8-14.8)	12.0 (9.0-16.1)	8.4 (5.0-10.5)	1.07 (0.92-1.23)
Az 21	10	11.9 (9.8-14.2)	12.6 (10.7-15.5)	9.3 (7.0-11.8)	1.06 (0.99-1.13)
Az 26	7	11.4 (10.6-13.1)	12.0 (9.6-13.2)	10.0 (9.2-13.0)	1.05 (0.84-1.18)
Az 27	4	13.0 (11.8-14.5)	13.5 (12.0-15.0)	9.9 (8.3-11.0)	1.04 (0.87-1.17)
Total	50	11.7 (8.8-14.8)	12.5 (9.0-16.1)	9.2 (5.0-13.0)	1.07 (0.84-1.24)
		T/L	**L'/L**	**As**	
Az 15	5	0.84 (0.79-0.92)	0.66 (0.52-0.73)	0.65 (0.61-0.71)	
Az 20	24	0.75 (0.57-1.02)	0.70 (0.57-0.76)	0.65 (0.53-0.73)	
Az 21	10	0.78 (0.71-1.02)	0.66 (0.56-0.72)	0.63 (0.57-0.69)	
Az 26	7	0.88 (0.70-1.19)	0.71 (0.66-0.77)	0.66 (0.60-0.80)	
Az 27	4	0.75 (0.70-0.81)	0.70 (0.65-0.74)	0.65 (0.59-0.69)	
Total	50	0.78 (0.57-1.19)	0.69 (0.52-0.77)	0.65 (0.53-0.80)	
		Ws	**Ds**	**Ds/Ws**	**Ws/W**
Az 15	5	10.3 (8.8-11.8)	8.6 (7.8- 9.0)	0.83 (0.74-1.00)	0.70 (0.63-0.76)
Az 20	24	8.8 (6.7-10.9)	6.9 (2.8-10.0)	0.78 (0.42-1.11)	0.73 (0.61-0.79)
Az 21	10	8.9 (7.5-10.4)	7.4 (5.2- 9.7)	0.84 (0.69-1.14)	0.70 (0.64-0.80)
Az 26	7	8.6 (7.0-10.0)	8.6 (6.5-13.2)	1.00 (0.68-1.32)	0.72 (0.62-0.85)
Az 27	4	10.2 (9.2-11.7)	7.8 (6.8- 9.2)	0.77 (0.75-0.79)	0.75 (0.71-0.78)
Total	50	9.0 (6.7-11.8)	7.5 (2.8-13.2)	0.83 (0.42-1.32)	0.73 (0.61-0.85)
		Ns	**Nb**	**Nvb**	
Az 15	5	6.0 (5 - 7)	5.0 (4 - 6)	13.2 (11 - 15)	
Az 20	24	4.8 (3 - 7)	3.8 (2 - 6)	11.5 (8 - 16)	
Az 21	10	5.3 (4 - 8)	4.3 (3 - 7)	11.4 (9 - 17)	
Az 26	7	4.7 (4 - 5)	3.7 (3 - 4)	10.6 (9 - 14)	
Az 27	4	4.5 (4 - 5)	3.5 (3 - 4)	8.5 (8 - 9)	
Total	50	5.0 (3 - 8)	4.0 (2 - 7)	11.3 (8 - 17)	

Fig. 2 - Means and variation intervals of shell dimensions in *Ivanoviella gaetanii* sp. n. For symbols, see p. 431.

Variability. The allied means of dimensions, the same dimensions variability (Fig. 2) show that the different samples collected in several sections constitute a single species. Because of these allied means of dimensions (particularly the length of shells), we can utilize the graphic of T/L in function of W/L to express the morphological dispersion. The outlines circumscribing the morphological dispersion in the different samples

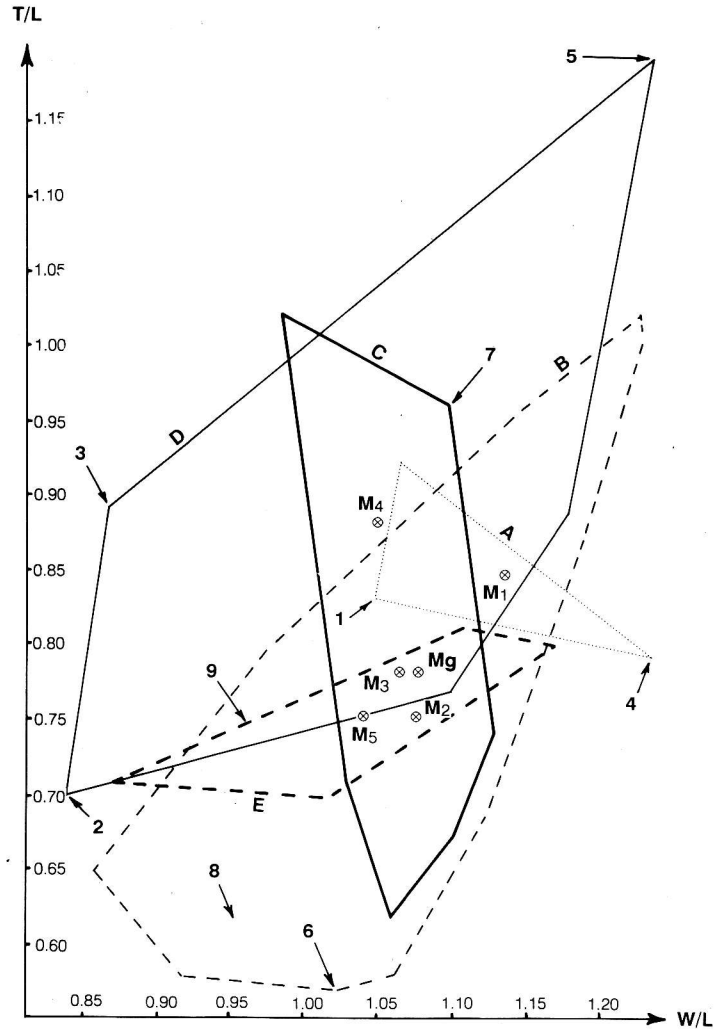


Fig. 3 - The dispersion graphic of T/L in function of W/L in the different samples of *Ivanoviella gaetanii* sp. n.
The perimeters A, B, C, D and E circumscribe the morphological variability in the five samples AZ15, AZ20, AZ21, AZ26 and AZ27. M1, M2, M3, M4, M5 situate the means T/L and W/L in the same samples. Mg corresponds to means of T/L and W/L in all the samples. The points 1 to 9 situate the shells figured in Plate 20, fig. 1-9, in the morphological dispersion of *I. gaetanii* sp. n.

present a common superposable part (Fig. 3). Because of the asymmetry of the samples (some include only a few shells), we cannot consider these results as statistical ones.

We must notice the marginal situation of shell (Pl. 20, fig. 5), with a T/L ratio equal to 1.19 while the other thicker specimens have a T/L ratio equal to 1.02 only (Fig. 2, 3). This shell shows also the highest uniplication.

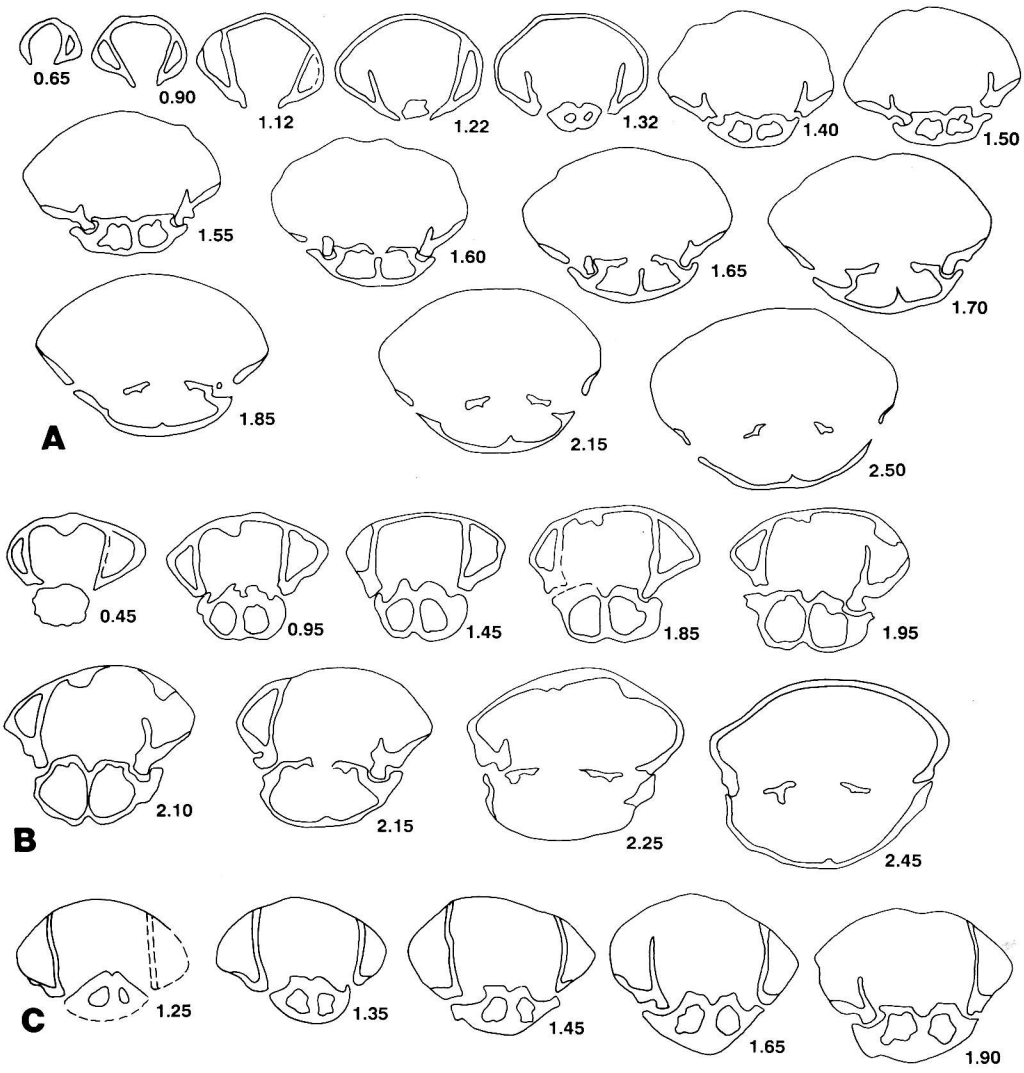


Fig. 4 - Serial transverse sections through the posterior part of shell in *Ivanoviella gaetanii* sp. n. A) more flattened shell with linguiform extension on the anterior commissure: L=12.5 mm, W=12.8 mm, T=5.8 mm, specimen n. 6571/9; B) uniplicate morph: L=12.1 mm, W=12.1 mm, T=6.6 mm, specimen n. 6571/4; C) wide form with a trilobate outline; W=14.1 mm, T=7.3 mm, specimen n. 6570/6. All specimens x 2.5.

Internal characters (Fig. 4). Pedicle valve. The dental lamellae are parallel or divergent ventrally and delimitate a subrectangular delthyrial cavity. The lateral umbonal cavities are wide and subtriangular in cross-section. The hinge-teeth are well-developed with small denticula.

Brachial valve. The hinge-plates are horizontal and separated by a wide, shallow V-shaped septalium. This latter is supported by a median septum which is reduced to a short ridge. Crural bases appear to be well developed and the crura are of radulifer type.

Biometric characteristics:

Dimensions of the figured specimens (in mm) (Pl. 20, fig. 1-9):

N	L	W	T	W/L	T/L	Ws	Ds	Nvb	Nb
6568	13.2	13.9	11.0	1.05	0.83	8.8	9.8	13	4
6572/1	13.1	11.0	9.2	0.84	0.70	8.2	8.1	9	3
6572/2	11.2	9.6	10.0	0.86	0.89	8.2	7.5	10	4
6569/1	12.6	15.6	10.0	1.24	0.79	11.8	8.8	14	6
6572/3	10.9	15.0	13.0	1.24	1.19	10.0	13.2	14	4
6570/1	8.8	9.0	5.0	1.02	0.57	6.7	2.8	11	4
6571/1	11.5	12.7	11.0	1.10	0.96	8.5	9.3	17	7
6570/2	10.1	9.6	6.5	0.95	0.64	7.4	3.8	8	3
6570/3	12.0	11.5	9.0	0.96	0.75	8.0	7.2	10	2

Means and variation intervals of the different samples (see Fig. 2).
The variation intervals are deduced from the different measures of shells. They are not statistical values.

Remarks.

Ivanoviella gaetanii sp. n. is very close to *Ivanoviella personata* (v. Buch) from the Middle Callovian of russian platform (regions of Moscow, Riazan and Kouibichev) figured by Makridin (1964, pl. 4, fig. 16, 17; pl. 5, fig. 1, 2). Nevertheless, this last species shows a smooth stage developed on the two-thirds or on the three-fourths of the length of valves, the ornamentation is only present on the anterior margin of shells; moreover, the beak is also slightly larger and a slightly more incurved, at least in some specimens. On the contrary, *I. gaetanii* sp. n. is absolutely identical in its morphology, its small sharp beak, the aspect of its ornamentation, the number of costae, the position of the beginning of costae, to *Ivanoviella alemanica* (non Rollier) described and figured by Makridin (1964, pl. 5, fig. 3-6). The differences with the true *alemanica* (Rollier) justify the creation of our new species. It exists also in the Middle Callovian of the russian platform where it is particularly abundant in the Moscow syneclisis. It is slightly more scarce in the south-eastern part of the same platform, in the north-western margins of Donetz, in Crimea and in Northern Caucasus.

Laurin (1984, p. 361) excluded it from the synonymy of the true *alemanica* (Rollier) which he attributed to another genus, *Rhynchonelloidella* Muir-Wood. According to

Makridin (1964), *Rhynchonelloidella* and *Ivanoviella* are two allied genera, which differ in the characters of deltidial plates, dental lamellae and crura. When comparing our Fig. 4 and Laurin (1984) fig. 103, 104, we can distinguish *R. alemanica* (Rollier) with the sinuous drawing of dental lamellae, shorter cardinal plates, a very slightly developed and short septalium (on the contrary of *I. gaetanii* sp. n.), often obliterated by callus deposits, also by calcarifer crura. At least, the long smooth stage on the posterior parts of valves (costae are present about 1-2 mm from the apex in *R. alemanica*) constitutes a main feature allowing to distinguish at first sight *Ivanoviella* from *Rhynchonelloidella.*

Rhynchonella (Cyclothyris) alemanica figured by Gerassimov (1955, p. 179, pl. 43, fig. 16, 17) is identical to *Ivanoviella alemanica* (non Rollier) in Makridin (1964, p. 140, pl. 5, fig. 3-6) for which we create *I. gaetanii* sp. n.

Stratigraphical and geographical distributions.

Early Callovian (upper part) and Middle Callovian: russian platform, Crimea, Northern Caucasus (Gerassimov, 1955 and Makridin, 1964).

Subfamily *Tetrarhynchiinae* Ager, 1965

Genus *Somalirhynchia* Weir, 1925

Type-species: *Somalirhynchia africana* Weir, 1925

Somalirhynchia africana Weir, 1925

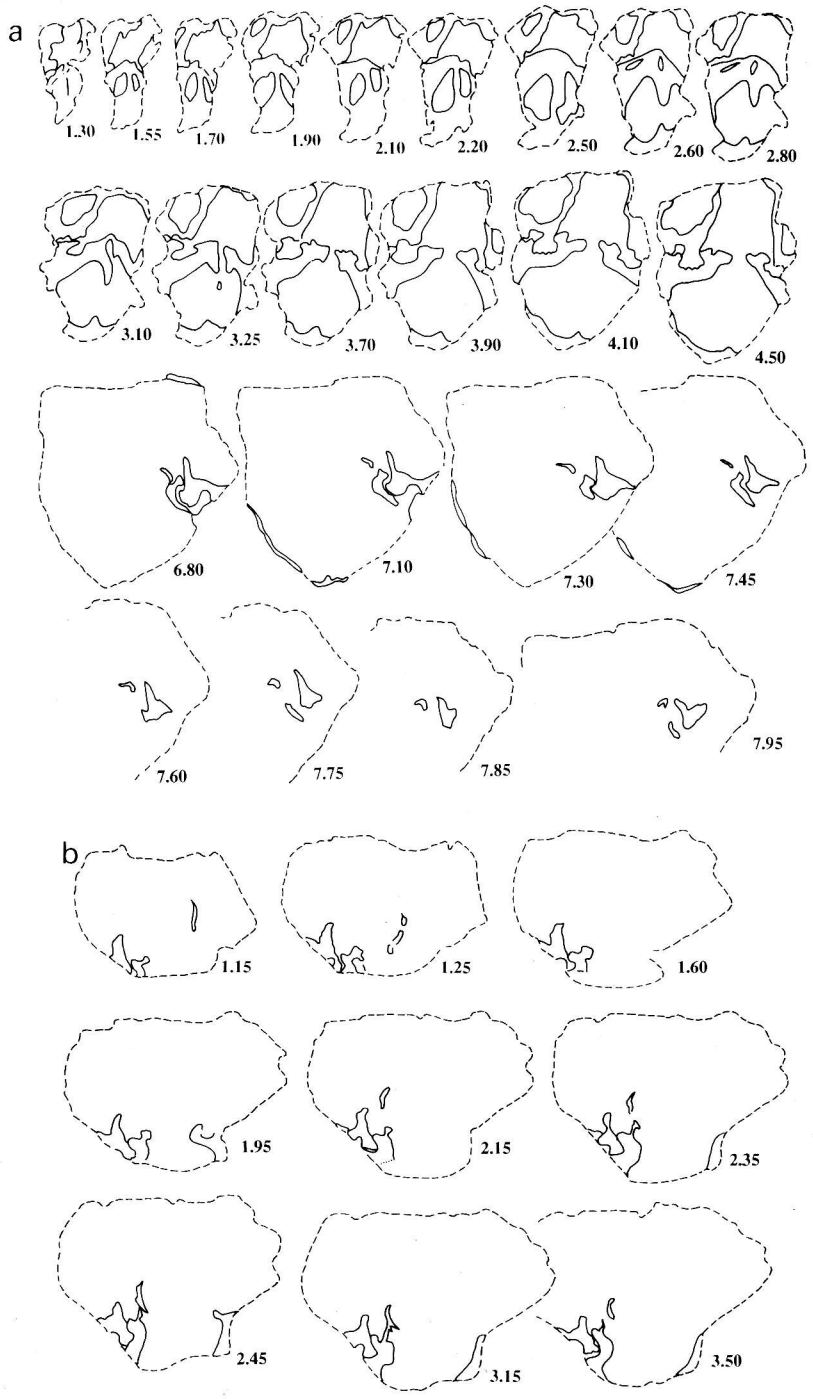
Text-fig. 5

1925 *Somalirhynchia africana* Weir, p. 80, pl. 12, fig. 20-23.
1929 *Somalirhynchia africana* - Weir, p. 39, pl. 4, fig. 7-11.
1930 *Somalirhynchia africana* - Weir, p. 78.
1931 *Somalirhynchia africana* - Diaz-Romero, p. 9, pl. 1, fig. 3, 4.
1932 *Rhynchonella (Somalirhynchia) africana* - Stefanini, p. 113, pl. 5, fig. 9, 10; pl. 6, fig. 1-4.
1935 *Somalirhynchia africana* - Muir-Wood, p. 94, pl. 10, fig. 7; text-fig. 7, 8.
1949 *Somalirhynchia africana* - Colivicchi, p. 108.
1967 *Somalirhynchia* cf. *africana* Dubar, p. 30, pl. 2, fig. 5.
1971 *Somalirhynchia africana* - Jordan, p. 153, pl. 21, fig. 4.
1974 *Somalirhynchia africana* - Abbate et al., p. 439, pl. 39, fig. 4.
1977 *Somalirhynchia* cf. *africana* Ager & Walley, fig. 6 (p. 94).
1987 *Somalirhynchia africana* - Peybernès et al., p. 1454, pl. 1, fig. 1, 2.
1989 *Somalirhynchia* sp. Ben Ismail et al., p. 357.

Material. 23 poorly preserved specimens of great size, often crushed, and 7 young shells, two of which are well preserved. Upper part of Laptal Beds. Sample AZ29 (n. 6558).

Description.

External characters. These 23 great-sized shells, of about 30 up to 40 mm in length, can be undoubtfully attributed to *Somalirhynchia africana.* We find again the globular morphology, the rounded subpentagonal outline, the slightly incurved beak, the rounded and more or less high uniplication with poorly defined dorsal fold and ven-


a
1.30
1.55
1.70
1.90
2.10
2.20
2.50
2.60
2.80
3.10
3.25
3.70
3.90
4.10
4.50
6.80
7.10
7.30
7.45
7.60
7.75
7.85
7.95
b
1.15
1.25
1.60
1.95
2.15
2.35
2.45
3.15
3.50

tral sulcus and the ornamentation consisting in coarse, rounded costae. We have recently observed all these characters in Morocco, in the Id-Bou-Addi Formation of the Essaouira basin (Amsittene Djebel) and in the Ouanamane Formation of the Agadir basin (Oued Tizgui, Izi Izwarn, Tamarout) (Peybernès et al., 1987), and also in the Southern Tunisia (Ben Ismail et al., 1989). Seven specimens, two of which are well preserved, of 12 up to 20 mm in length, with circular outline, slightly convex valves (T/L = 0.47), erect beak, very slightly uniplicate anterior commissure, ornamented with about 20 fine costae, are young specimens of the same species, which we can also find again in moroccan populations (especially in the Izi Izwarn locality).

Internal characters (Fig. 5). The poor state of preservation has not allowed the complete examination of the internal features.

Pedicle valve. The large, subrectangular in cross-section delthyrial cavity is bounded by strong dental lamellae and presents a short median septum. The lateral umbonal cavities are wide, semicircular in outline. The hinge-teeth are strong and crenulated, with laterally developed denticula.

Brachial valve. The septalium is present while the short median septum is reduced to a low ridge. The inner and outer socket-ridges are both well developed and delimitate deep, crenulated dental sockets.

Remarks.

The synonymy is restricted to references that we consider as really attributed to *S. africana*. So, we exclude from it some references given by Weir (1929) and Abbate et al. (1974), some of which are also contradictory. The morphology of these last cited and figured forms generally does not agree with that of the true *S. africana*. This is the case of the shells from Harar (Eastern Africa) described by Jaboli (1952, p. 18, pl. 2, fig. 2, 4, 5). Their age is also younger (Lusitanian or Oxfordian instead of Callovian).

We wonder why the weathered shell figured by Jaboli (1952, pl. 2, fig. 2) is considered as *S. africana* by Abbate et al. (1974) and why the shells, pl. 2, fig. 4, 5, showing an identical morphology, are not. We also must remark a mistake in Abbate et al. (1974) about Weir's references (the reversal of 1925 and 1929 references).

Stratigraphical and geographical distributions.

According to Ager & Walley (1977), *Somalirhynchia* is a Late Callovian-Oxfordian genus. Nevertheless, two species at least are mentioned in the Middle Callovian: *S. nobile* (d'Orbigny) in Pakistan (Fatmi, 1972) and *S. africana* in Morocco (Peybernès et al., 1987). The generally approved age of *S. africana* is more recent: Oxfordian of Somalia,

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Fig. 5 - Serial transverse sections through the posterior part of the shell in *Somalirhynchia africana* Weir, 1925. Laptal Beds. Sample AZ29 (specimens a: n. 6558/3; b: n. 6558/4). Umbonal area missing in both specimens. x 2.5.

Ethiopia, Dancalia, Kenya (Mombasa) and Syria. In Essaouira and Agadir basins, in Morocco, *S. africana* is collected with *Bihenithyris barringtoni* Muir-Wood and *Flabellothyris dichotoma* Kitchin, which are dated at Middle Callovian, Coronatum Zone, in Central Saudi Arabia (Alméras, 1987). Oxfordian age is also given by Dubar (1967) to *S.* cf. *africana* in the Southern Tunisia. Effectively, in Tunisia, the beds with *Somalirhynchia* are located just above levels with *Pachyerymnoceras* and *Daghanirhynchia daghaniensis* Muir-Wood of Middle Callovian (Ben Ismail et al., 1989). In these conditions the presence of *S. africana* in the topmost part of the Laptal Beds near Shade (AZ29) makes the upper part of these Formation younger (Middle Callovian instead of Bathonian post-Zigzag).

Subfamily *Cyclothyridinae* Makridin, 1955

Genus *Daghanirhynchia* Muir-Wood, 1935

Type-species: *Daghanirhynchia daghaniensis* Muir-Wood, 1935

Daghanirhynchia daghaniensis Muir-Wood, 1935

Pl. 21, fig. 1-7; Text-fig. 6, 7

1915 *Rhynchonella orbignyi* - Douvillé, p. 65, pl. 7, fig. 20-24.
pars 1925 *Somalirhynchia subversabilis* - Weir, p. 82, pl. 11, fig. 29-31.
pars 1929 *Cymatorhynchia* (?) *quadriplicata* - Weir, p. 41, pl. 4, fig. 13.
1931 *Cymatorhynchia* (?) *quadriplicata* - Diaz-Romero, p. 14, pl. 1, fig. 11, 12.
1935 *Daghanirhynchia daghaniensis* Muir-Wood, p. 83, pl. 8, fig. 5; text-fig. 4-6.
1952 *Rhynchonella (Daghanirhynchia) daghaniensis* - Jaboli, p. 23, pl. 3, fig. 4.
1968 *Daghanirhynchia daghaniensis platiloba* - Ficcarelli, p. 26, pl. 2, fig. 4.
1970 *Daghanirhynchia daghaniensis* - Nazer, p. 54, pl. 4, fig. 2-4; pl. 5, fig. 1, 2.
pars 1972 *Daghanirhynchia subversabilis* - Ficcarelli, p. 134, pl. 19 and 20 only; (non pl. 21, fig. 1-3 = *Daghanirhynchia subversabilis* Weir).
? 1985 *Cymatorhynchia schardti* - Sulser, p. 608, pl. 1-3; pl. 4, fig. 1, 3.
1987 *Daghanirhynchia daghaniensis* - Alméras, p. 179, pl. 3, fig. 11-17.
1988 *Daghanirhynchia daghaniensis* - Alméras & Moulan, p. 159, pl. 14, fig. 15.

Holotype. Specimen from the Callovian, Daghani section, Somalia (British Somaliland) figured in Muir-Wood (1935, pl. 8, fig. 5), preserved in the British Museum (Nat. Hist.) collections (B 85.408) (original designation: Muir-Wood, 1935).

Material. 43 measured shells, 19 other specimens. Samples AZ50 (58 shells, n. 6559) and JZ190 (4 shells, n. 6560).

Description.

External characters. The studied material includes shells of 9.8 up to 21.7 mm in length (Pl. 21, fig. 2 and 3) with a rounded pentagonal outline. The width is generally greater than the length and the widest point is located on the anterior half of the valves (L'/L = 0.70).

The pedicle valve is posteriorly flattened or moderately convex on a distance of 6 to 15 mm below the umbo; it is anteriorly sunk with a well developed median sulcus which increases in width and depth towards the anterior margin. The brachial valve is considerably more convex than the pedicle one. This convexity, already well marked

posteriorly, increases much towards the front. So, the shells show a trigonal profile in lateral view. The anterior commissure is medianly and highly uniplicate. An asymmetrical drawing of the uniplication can be observed in 8 well preserved specimens. The ventral sulcus and the dorsal fold in opposite stage occur between the middle of shells and 0.8 of their length from the beak. The sulcus is wide and deep while the prominent dorsal fold, generally not well delimitated, progressively passes to the lateral parts of the shell. The specimen, Pl. 21, fig. 1, represents the averaged form of the studied sample. Some unusually wide shells (Pl. 21, fig. 5) show a trilobate outline. The shells are flattened in the young stages (Pl. 21, fig. 2, 6).

The beak is acute, without lateral beak-ridges; it is more often suberect, sometimes erect in the adult or gerontic stages. It is always very much overhanging the brachial umbo. Foramen elliptical, scarcely circular. The deltidial plates are always disjunct (Fig. 6). The palintrope is narrow and flattened.

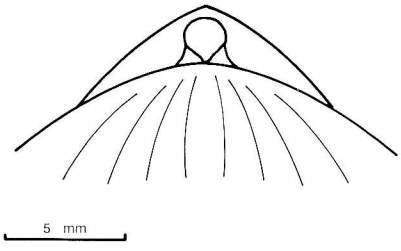
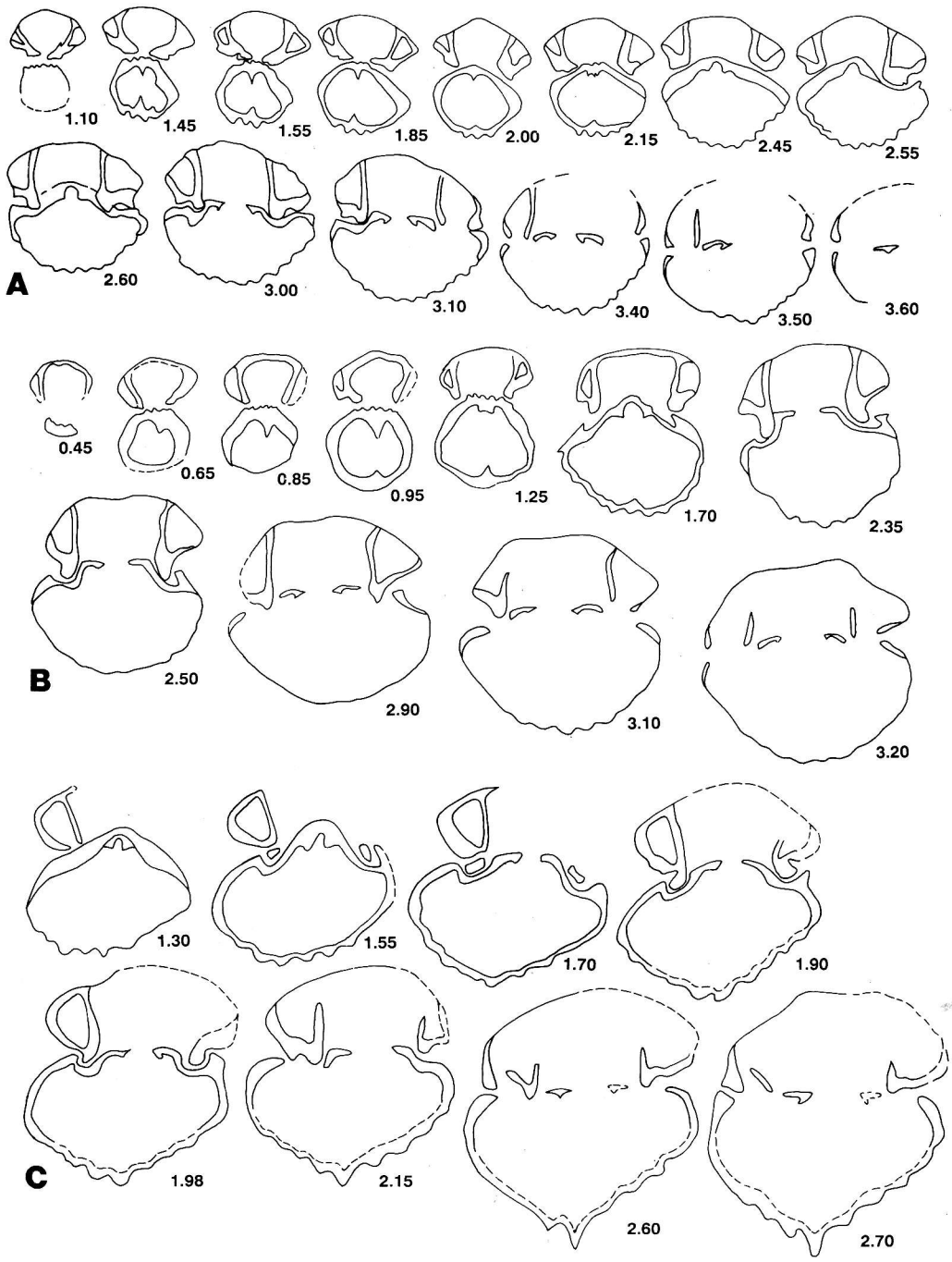


Fig. 6 - Beak and foramen characters in *Daghanirhynchia daghaniensis* Muir-Wood.

The ornamentation consists of 9-15 strong angular costae, with 2-5 on the fold and 1-4 in the sulcus. The specimens with 4 costae on the fold are the most frequent (22 shells/ 43). The studied material comprises 10 shells with 3 costae on the fold and 10 shells with 5 costae; the fold of one shell bears 2 costae only. There is no smooth stage on the posterior parts of shells. The costae are gently curved on the lateral slopes and they do not bifurcate.

Internal characters (Fig. 7). Pedicle valve. The delthyrial cavity is wide, quadrate in cross-section. The dental lamellae, delimitating the cavity, tend initially to diverge ventrally and then get progressively parallel; they support massive hinge-teeth and short, sharp denticula are developed laterally. The lateral umbonal cavities are well-developed, subcircular in outline.

Brachial valve. There is no cardinal process, but the posterior end of the brachial valve does not protrude into the delthyrial cavity. The hinge-plates arch ventrally and are not clearly demarcated from the inner socket-ridges, which are poorly developed. Outer socket-ridges are small but clearly marked. The median septum is short and ridge-like, and splits away at an early stage from short septalial plates. Crural bases arise dorsally at the distal ends of the hinge plates. Crura are not distinctly observable, but are probably of radulifer type.


A
1.10
1.45
1.55
1.85
2.00
2.15
2.45
2.55
2.60
3.00
3.10
3.40
3.50
3.60
B
0.45
0.65
0.85
0.95
1.25
1.70
2.35
2.50
2.90
3.10
3.20
C
1.30
1.55
1.70
1.90
1.98
2.15
2.60
2.70

Biometric characteristics:

Dimensions of the figured specimens (in mm) (Pl. 21, fig. 1-7):

N	L	W	T	W/L	T/L	Ws	Ds	Nvb	Nb
6559/1	19.7	21.5	16.0	1.09	0.81	15.0	13.0	11	4
6559/2	9.8	10.8	6.7	1.10	0.68	7.0	5.0	14	4
6560/1	21.7	21.7	16.0	1.00	0.74	16.2	14.0	13	5
6559/3	15.1	15.0	10.0	0.99	0.66	10.7	7.0	12	3
6559/4	18.3	25.7	16.2	1.40	0.88	17.3	13.7	14	5
6559/5	16.5	17.7	9.0	1.07	0.54	10.2	6.5	13	4
6559/6	19.5	21.5	22.2	1.10	1.14	15 ?	18.5 ?	12 ?	4

Means and variation intervals:

L = 17.4 (9.8 - 21.7)
W = 19.0 (10.0 - 26.0)
T = 13.3 (6.5 - 22.8)
W/L = 1.10 (0.92 - 1.40)
T/L = 0.76 (0.49 - 1.23)
L'/L = 0.69 (0.61 - 0.81)
As = 0.69 (0.53 - 0.80)
Ws = 12.2 (4.5 - 17.3)
Ds = 10.4 (1.7 - 21.0)
Ds/Ws = 0.84 (0.38 - 1.36)
Ws/W = 0.64 (0.47 - 0.80)
Nvb = 12.8 (9 - 15)
Nb = 4 (2 - 5)

Remarks.

In the synonymy of *D. daghaniensis* the first four references (Douvillé, 1915; Weir, 1925; Weir, 1929; Diaz-Romero, 1931) are these given and discussed by Muir-Wood in her original description (1935). We agree with her opinion; so supplementary comments are not necessary.

The morphological characters which allow to distinguish *D. daghaniensis* from *D. subversabilis* (Weir) have been mentioned in Alméras (1987).

"*Rhynchonella*" *schardti* Haas from the *Mytilus* Beds of Switzerland (Alpes

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Fig. 7 - Serial transverse sections through the posterior part of the shell in *Daghanirhynchia daghaniensis* Muir-Wood. Laptal Beds. Sample AZ50. A) L=16.5 mm, W=17.8 mm, T=14.6 mm, specimen n. 6559/9; B) L=20.0 mm, W=23.6 mm, T=15.2 mm, specimen n. 6559/14; C) asymmetrical shell of remarkable size, specimen n. 6559/20. All specimens x 2.5.

Vaudoises and Alpes Bernoises) is a very similar species with its trilobate morphology and its deep and wide ventral sulcus; nevertheless its shells have a greater average-size. Its internal characters studied by Sulser (1985) who has doubtfully attributed it to the genus *Cymatorhynchia* Buckman, are not very different from those of *D. daghaniensis.*

The same remark can be expressed about the internal characters of *Formosarhynchia dumortieri* (Szajnocha) observed by Wisniewska-Zelichowska (1978, fig. 11) on polish shells from the Late Bajocian of Czestochowa. *F. dumortieri* differs from *D. daghaniensis* in having a massive and slightly incurved beak, a shallow ventral sulcus and a not very high dorsal fold; its shells are biconvex and the thickest point is located in the middle of the valves rather than on the anterior margin like in *D. daghaniensis. F. dumortieri* from the Early Bathonian of the French "bordure vivaro-cévenole" and of Western Algeria (Alméras & Elmi, 1984), *D. subversabilis* from beds with *Tulites, Micromphalites* and *Dhrumaites* of the Central Saudi Arabia (Alméras, 1987) and some *Burmirhynchia termierae* Rousselle from Early Bathonian of the Moroccan folded Middle-Atlas show very similar morphologies.

A greater gibbosity of shells can be observed in *D. subversabilis.*

Stratigraphical and geographical distribution.

Bathonian of Sinaï, Maghara Mountains (Douvillé, 1915). Somalia: Bihin Limestone of Idah Kabeita and Bihendula (Bathonian-Callovian) (Weir, 1925). Jubaland: Daua Limestone (basal beds) of Muddo Erri (Bathonian) (Weir, 1929).

Callovian of Central Dancalia (Diaz-Romero, 1931), Sinaï, Syria, Ethiopia (Harar) (Jaboli, 1952), Northern Somalia (Migiurtinia) (Ficcarelli, 1972).

The Bathonian-Callovian age of *D. daghaniensis* has been sustained by recent studies on brachiopods from Central Saudi Arabia (Alméras, 1987).

Moreover, Late Bathonian of Southern France (Provence) (Alméras & Moulan, 1988).

Genus *Septaliphoria* Leidhold, 1921

Type-species: *Rhynchonella arduennensis* Oppel, 1857

Septaliphoria zacharlensis Prosorovskaya, 1971

Pl. 20, fig. 10, 11; Text-fig. 8

1971 *Septaliphoria zacharlensis* Prosorovskaya, p. 91, pl. 1, fig. 1.

Holotype. Shell from the Middle Callovian of Zakharli (Kouguitang) figured in Prosorovskaya, 1971, pl. 1, fig. 1.

Material. 6 measured shells. Ferruginous Oolite Formation. Sample AZ21 (n. 6562).

Description.

External characters. Shells of 17 up to 28.5 mm in length, with a rhomboidal outline. While young specimens, 17-20 mm in length, slightly uniplicate, have a subcircular outline (W/L = 0.97 to 0.99), the anterior margin lengthens and gets narrow during

ontogenesis (Pl. 20, fig. 11). The greatest width is located between the middle of valves and the anterior two-thirds of their length.

The pedicle valve is twice or three times lesser convex than the brachial one. Slightly convex or flattened on its posterior half, it sinks between 12 and 15 mm under the umbo (i.e. between 0.50 and 0.72 of the length from the beak) with a wide sulcus, not well delimitated laterally, which increases towards the anterior margin, but remains shallow. The brachial valve regularly becomes inflated towards the anterior margin; here the thickness is maximum and there is a rounded to square median dorsal fold of average height, conspicuous and well delimitated from the lateral parts of shell. High and narrow arched anterior commissure. The ventral sulcus gets the shape of an almost quadrangular lappet. The posteriorly rectilinear lateral commissures, regularly and strongly rise again towards the brachial valve near the anterior margin.

The small beak, suberect in the young stage (Pl. 20, fig. 10), becomes slightly more massive and erect in the adult stage (Pl. 20, fig. 11). Elliptical foramen, disjunct or just

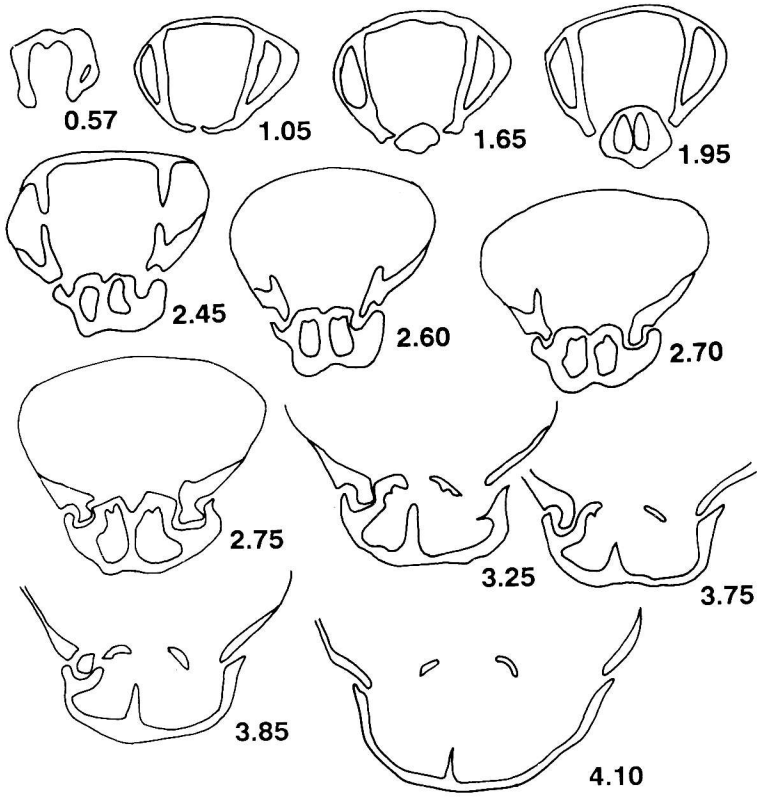


Fig. 8 - Serial transverse sections through the posterior part of the shell in *Septaliphoria zacharlensis* Prosorovskaya. Ferruginous Oolite Formation. Sample AZ21. L=24.9 mm, W=19.8 mm, T=13.0 mm, specimen n. 6562/9. x 2.5.

conjunct deltidial plates. The valves are ribbed with 19 to 26 narrow and sharp costae, 5 or 6 of which are located on the wide and shallow ventral sulcus.

Internal characters (Fig. 8). Pedicle valve. The delthyrial cavity, with short septum, is large, roughly quadrate, delimitated by strong dental lamellae which initially diverge ventrally and afterwards become subparallel. The lateral umbonal cavities are wide, semicircular to triangular in outline. The hinge-teeth are straight prolongations of the dental plates and are massive. Short, sharp denticula are developed laterally. Presence of disjunct deltidial plates.

Brachial valve. The hinge-plates are convex ventrally and separated by deep, V-shaped septalium, with distinct septalial plates. These are supported by the median septum which is reduced to a ridge for most of its length. It is visible through the test on the posterior half of the brachial valve on the specimen, Pl. 20, fig. 11. The inner and the outer socket-ridges are well-developed and circumscribe a deep dental socket. There are small, sharp crural bases developed dorsally. The crura of radulifer type are strong, concave dorsally.

Biometric characteristics:

Dimensions of the figured specimens (in mm) (Pl. 20, fig. 10, 11):

N	L	W	T	W/L	T/L	Nvb
6562/1	21.2	19.0	9.4	0.90	0.44	22
6562/2	28.5	24.5	16.7	0.86	0.58	24

Means and variation intervals:

L = 23.0 (17.1 - 28.5)
W = 20.1 (16.9 - 24.5)
T = 12.6 (9.6 - 16.7)
W/L = 0.89 (0.80 - 0.99)
T/L = 0.54 (0.44 - 0.59)
Nvb = 23 costae (19 - 26)

Remarks.

The morphology and the internal characters (compare Fig. 8 in this work and Prosorovskaya, 1971, fig. 1) agree very well with those figured by Prosorovskaya. The differences concern a lower number of costae as in the population of Kouguitang (19-26 costae instead of 32-34 costae), where the lateral umbonal cavities are reduced owing to callus thickening of the shells.

Stratigraphical and geographical distributions.

Middle Callovian of Kouguitang (Aïribaba, Zakharli, Karangakoul) (Prosorovskaya, 1971).

Family *Terebratulidae* Gray, 1840
Subfamily *Terebratulinae* Gray, 1840
Genus *Holcothyris* Buckman, 1915
Type-species: *Holcothyris angulata* Buckman, 1917

Holcothyris angulata Buckman, 1917

Pl. 21, fig. 8-11; Text-fig. 9-11

1917 *Holcothyris angulata* Buckman, p. 192, pl. 10, fig. 1-4.
1940 *Holcothyris angulata* - Sahni, p. 10, pl. 2, fig. 16, 17.
1940 *Holcothyris angulata* var. *depressa* Sahni, p. 11, pl. 1, fig. 17, 18.
1940 *Holcothyris angulata* var. *areolata* Sahni, p. 11, text-fig. 8.
1967 *Holcothyris angulata* - Ovcharenko, p. 27.
1971 *Holcothyris angulata* - Alméras, p. 334, pl. 58, fig. 7-12; pl. 59 A-B.
1982 *Arceythyris* (?) *chharapensis* Gupta & Michalik, p. 83, pl. 1, fig. 1-4.
1986 *Holcothyris angulata* - Alméras & Gupta, p. 419, pl. 1, fig. 1-9; pl. 2, fig. 1-4.
1987 *Holcothyris angulata* - Yang & Shi, p. 36, pl. 1, fig. 1-3.

Holotype. Shell from the Namyau Beds of Pangwoleng (Burma), with a sulciplicate anterior commissure, figured in Buckman, 1917, pl. 10, fig. 1a-c, then in Muir-Wood, 1965, fig. 642, 2a-c (designation: Alméras, 1971).

Material. 16 measured shells. 8 other specimens. Laptal Beds. Sample AZ50 (n. 6561).

Description.

External characters. Average-sized shells (L = 26.5 mm) with a rounded subpentagonal outline; the greatest width is located around the middle of valves. Generally, the width is slightly smaller than the length (W/L = 0.88). The shells have a modest thickness (T/L = 0.54), the brachial valve being slightly less convex than the pedicle one (Tb/T = 0.40). The young rectimarginate specimens possess a subcircular outline (Pl. 21, fig. 8). The rectimarginate stage can last up to 25 mm in length, then the lateral commissures begin to rise again anteriorly, drawing a large curve towards the brachial valve. Between 18 and 25 mm in length, a sulciplication appears on the anterior margin; it increases with the growth of shells. The median dorsal sulcus is wide and shallow (p/d = 0.17 to 0.34) (Pl. 21, fig. 9, 10), and it is bordered by two rounded lateral folds developed only on the anterior third of the valve (Pl. 21, fig. 10). The corresponding sulci on pedicle valve are not clearly defined or are lacking and in these cases the pedicle valve remains regularly and slightly convex in its anterior part. We have numbered 3 rectimarginate specimens, 12 sulciplications and one sulciplicate-paraplicate anterior commissure (Pl. 21, fig. 11).

The large beak, erect to slightly incurved, comes into contact with the dorsal umbo, except for the specimen, Pl. 21, fig. 10, where it is lengthened and very much overhanging the dorsal umbo. Relatively large foramen, circular, permesothyrid between two short and rounded lateral ridges or sometimes not clearly defined.

Internal characters (Fig. 9). Pedicle valve. The delthyrial cavity is deep and semicircular. The hinge-teeth are narrow, elongated in outline. Short denticula are developed laterally.

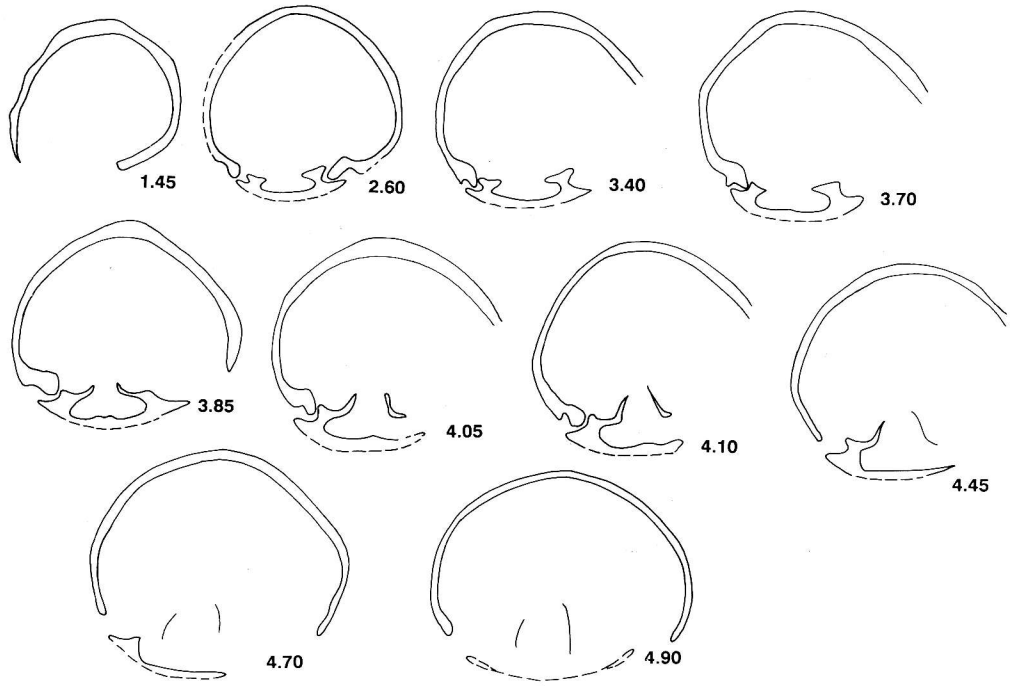


Fig. 9 - Serial transverse sections through the posterior part of the shell in *Holcothyris angulata* Buckman. Laptal Beds. Sample AZ50. L=24.6 mm, W=20.9 mm, T=13.9 mm, specimen n. 6561/7. x 2.5.

Brachial valve. The hinge-plates are practically horizontal, fine, tapering and clearly demarcated from the inner, well developed socket-ridges. Outer socket-ridges are small, sharp and poorly developed. Crural bases are virgate. The dorsal median septum is extremely short.

Biometric characteristics:

Dimensions of the figured specimens (in mm) (Pl. 21, fig. 8-11):

N	L	W	T	W/L	T/L	p	d	p/d
6561/1	21.0	20.2	10.5	0.96	0.50	-	-	-
6561/2	26.7	23.0	14.9	0.86	0.56	1.7	9.6	0.18
6561/3	29.2	23.7	17.2	0.81	0.59	2.8	11.2	0.25
6561/4	33 ?	27.8	20.0	0.84	0.61	3.5	10.4	0.34

Means and variation intervals: see Fig. 10.

Remarks.

The description above agrees with the morphology and the ontogeny of *Holcothyris angulata* from the Early Bathonian of Chharap Valley (India) (Alméras & Gupta,

1986). The variability of the two samples is narrowly superposed (Fig. 11; see also means and variation intervals, Fig. 10). We can remark the shallowness of the dorsal sulcus in the studied material: p/d = 0.22 (0.17-0.34) instead of 0.37 (0.22-0.60 and up to 0.82 in the specimen figured by Alméras & Gupta, pl. 1, fig. 5). This seems to be due to the smaller number of shells above 27 mm in length in the studied population. The de-

	Studied Sample Az 50	Chharap Valley
N	16	68
L	26.5 (21.0-33.0)	25.0 (15.8-35.7)
W	23.4 (20.2-27.8)	22.4 (13.8-32.7)
T	14.3 (10.5-20.0)	12.7 (7.3-24.0)
W/L	0.88 (0.81-0.96)	0.89 (0.74-1.00)
T/L	0.54 (0.45-0.62)	0.52 (0.43-0.67)
T/W	0.61 (0.49-0.72)	0.58 (0.45-0.74)
p	2.1 (1.4 - 3.5)	3.4 (1.4-10.2)
d	9.9 (8.8-11.2)	9.0 (5.1-14.2)
p/d	0.22 (0.17-0.34)	0.37 (0.22-0.82)

Fig. 10 - Means and variation intervals of shell dimensions in *Holcothyris angulata* Buckman, Laptal Beds, sample AZ50. Comparison with population of the same species collected in Laptal Beds of Chharap Valley, Himachal Pradesh (India) (see Alméras & Gupta, 1986).

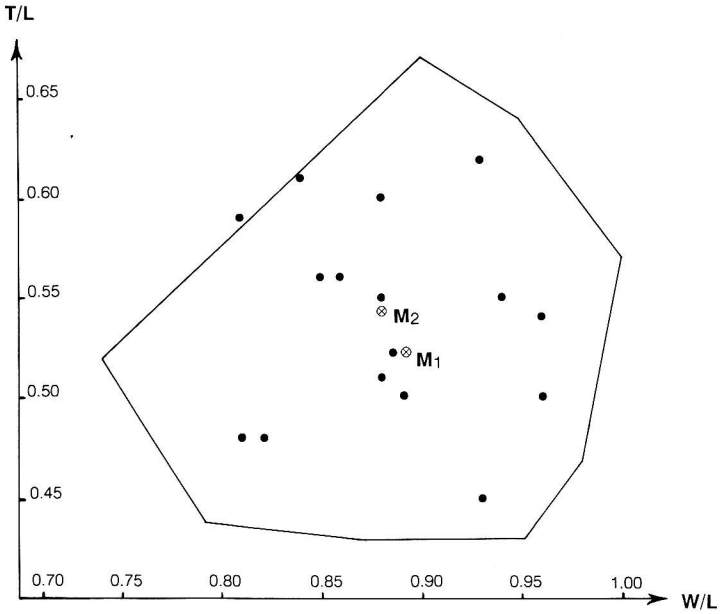


Fig. 11 - Variability of shell dimensions in *Holcothyris angulata* Buckman from Laptal Beds, sample AZ50 (dots). The perimeter circumscribes the variability of the same species from Chharap Valley (Gupta's material). M1 and M2 are locations of W/L and T/L means respectively in Chharap Valley and in sample AZ50.

scribed species is also present in Ksour Mountains (El Harchaia in Western Algeria) (see Alméras & Gupta, 1986, pl. 2, fig. 1-4).

We find again the already observed internal characters (see Alméras & Gupta, 1986, fig. 2), especially the lack of cardinal process and umbonal cavity, the cardinal plates very low above the brachial valve, the narrow and elongated cardinal teeth.

The incomplete and slightly twisted specimen (Pl. 21, fig. 11), with about 30 mm in length and with the same maximum thickness as in the studied sample, is the only shell showing a sulciplicate-paraplicate anterior commissure, with an acute and deep median dorsal sulcus. So, its morphology is very close to that of *Kutchithyris acutiplicata* (Kitchin) and, particularly, to that of the well preserved shell from Chharap Valley, Himachal Pradesh (India), figured by Alméras & Gupta, 1986, pl. 1, fig. 5.

Finally, we must recall the doubtful origin of the indian material sent to one of us (Y.A.) by Gupta (see above).

Stratigraphical and geographical distributions.

China, Burma, Pamir, Turkmenia, Crimea, Northern Caucasus, France, ? England dealing with the northern margin of Tethys. India, Saudi Arabia, Sinaï, Eastern Africa, Maghreb for the southern margin of Tethys.

Stratigraphical distribution: Early Bathonian, sometimes Bathonian post-Zigzag (Saudi Arabia). For details, see Alméras & Gupta, 1986, pp. 423-426. To this distribution, we must add Early Bathonian of Northern Xizang-Southern Qinghai (China) (Yang & Shi, 1987).

Genus *Dorsoplicathyris* Alméras, 1971

Type-species: *Terebratula dorsoplicata* Deslongchamps, 1856

Dorsoplicathyris (?) aff. **kabardinensis** (Moisseev, 1934)

Pl. 20, fig. 13, 14

Holotype. Specimen from the Middle Callovian of Northern Caucasus, preserved in GGM coll. Moisseev, n. 2238/3808, figured in Moisseev (1934), pl. 10, fig. 25-28.

Material. 2 shells, sample AZ15 (n. 6563) and 3 specimens poorly preserved, sample AZ22 (n. 6564). Ferruginous Oolite Formation.

Description.

External characters. Frequently poorly preserved large shells, 30 up to 50 mm in length, showing a very elongated oval outline (W/L = 0.53 to 0.66). The smallest specimen (L = 30 mm) has a less elongated outline (W/L = 0.70). The maximum width and thickness are located towards the middle of valves. Regularly and slightly convex valves (T/L = 0.38 to 0.52); the pedicle valve is slightly thicker than the brachial one. A specimen of 42 mm in length is as thick as wide (22 mm). Rectilinear lateral commissures, rectimarginate anterior commissure.

Large, erect beak, without lateral beak-ridges or with rounded and short lateral

ridges. The small trapezoidal symphytium is partially exposed. Circular foramen relatively large.

Biometric characteristics:

Dimensions of the figured specimens (in mm), (Pl. 20, fig. 13, 14):

N	L	W	T	W/L	T/L
6563/1	50.4	33.4	19.0	0.66	0.38
6563/2	39.2	24.8	18.8	0.63	0.48

Remarks.

Because of their rectilinear lateral commissures and their rectimarginate anterior commissure, the Ladakh shells are close to *kabardinensis* Moisseev, where the curved lateral commissures are regularly raised again towards the brachial valve near the anterior margin (see Moisseev, 1934, pl. 10, fig. 25-28; pl. 11, fig. 1-4; Prosorovskaya, 1962, pl. 11, fig. 2; Prosorovskaya, 1968, pl. 10, fig. 1, 2). Moreover, *kabardinensis* has an episinuate anterior commissure and the brachial valve is ornamented by two rounded and short folds disunited by a wide and shallow median sulcus. This sulcus can be completely missing in some shells (Prosorovskaya, 1968).

Prosorovskaya (1968) has erroneously referred *kabardinensis* to the aalenian genus *Loboidothyris* Buckman. Its morphology, anterior morphogenesis, and internal characters described (but not figured) by Prosorovskaya, allow to assign the species to the callovian genus *Dorsoplicathyris* Alméras, 1971.

Stratigraphical and geographical distributions.

Middle Callovian of Northern Caucasus (Moisseev, 1934). Middle-Late Callovian of Turkmenia, Touarkyr, Cekishan, Kouguitang (Prosorovskaya, 1962, 1968).

Family *Zeilleriidae* Rollier, 1919

In the American Invertebrate Treatise (1965), the family *Zeilleriidae* is attributed to Allan, 1940. In fact, the name *Zeilleriidae* was created by Rollier (1919, p. 279; anterior rule). See also Delance, 1974 (p. 68).

Genus *Zeilleria* Bayle, 1878

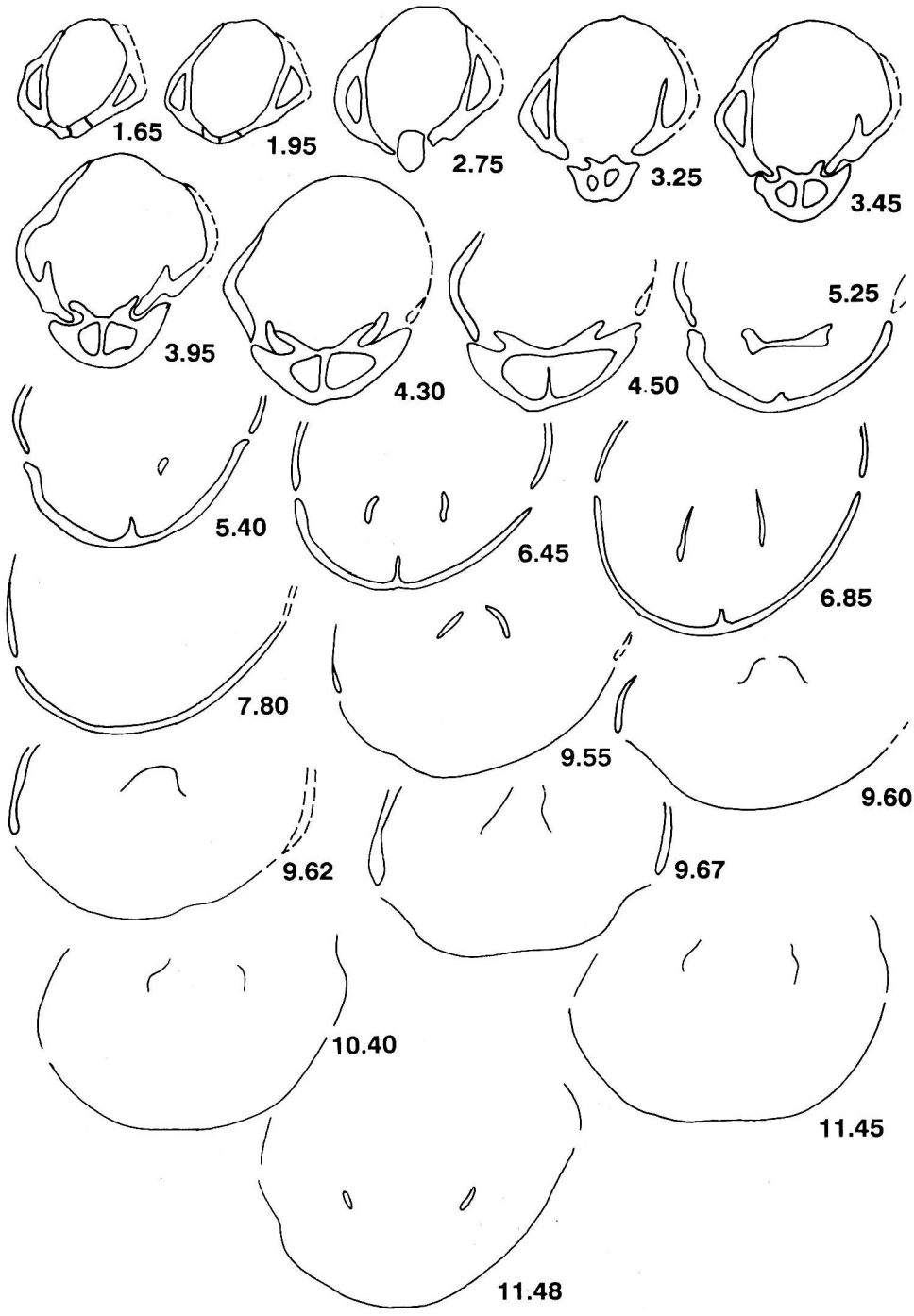
Type-species: *Terebratula cornuta* J. de C. Sowerby, 1824

Zeilleria rostellata Kitchin, 1900

Pl. 20, fig. 12; Text-fig. 12

1900 *Zeilleria rostellata* Kitchin, p. 42, pl. 9, fig. 5-7.

Material. 12 ex. from sample AZ20 (n. 6565); 2 ex. from sample AZ22 (n. 6566). Ferruginous Oolite Formation.


1.65
1.95
2.75
3.25
3.45
3.95
4.30
4.50
5.25
5.40
6.45
6.85
7.80
9.55
9.60
9.62
9.67
10.40
11.45
11.48

Description.

External characters. Zeilleriids of 16 up to 24.5 mm in length, with an elongated oval outline, longer than broad, with a rounded narrow frontal margin. The juvenile shells of less than 20 mm in length are broader (W/L = 0.80 to 0.86), then the outline lengthens during ontogenesis (W/L = 0.62 to 0.74). The maximum width and thickness occur about half of the shells. The valves are equally and not very convex (T/L = 0.45). The lateral commissures are perfectly straight lines when viewed from the side. The valve margins approach one another according to a moderate sharp angle. The anterior commissure is always rectimarginate, without fold or sulcus on the valves.

The beak with long and sharply developed lateral ridges is suberect to erect. It is delimitated from the dorsal umbo by conjunct high deltidial plates and broad areas. The extremity of the beak is frequently worn; in few cases we observe a small foramen of circular or perhaps slightly elliptical shape. The specimen, Pl. 20, fig. 12, shows a median dorsal septum visible through the test, which extends for at least one-third of the length of the valve.

Internal characters (Fig. 12). Pedicle valve. The delthyrial cavity is large and rectangular between slender and almost parallel dental lamellae. The lateral umbonal cavities are triangular in cross-section. The deltidial plates are very distinctive and conjunct. The hinge-teeth are strong and elongated; small, poorly-developed denticula are present.

Brachial valve. The dorsal median septum is high and supports fused hinge-plates the section of which appears slightly convex ventrally. Deep dental sockets are delimitated by a well-developed inner socket-ridge. Septalium is broad, medianly horizontal, U-shaped. Long loop of zeilleriid type is composed of two narrow descending branches and two ascending branches which are linked by a transverse band in their terminal part.

Biometric characteristics:

Dimensions of the figured specimen (in mm) (Pl. 20, fig. 12):

N	L	W	T	W/L	T/L
6565/1	20.4	14.1	8.8	0.69	0.43

Means and variation intervals:

L = 19.9 (16.3 - 24.5)
W = 15.0 (13.3 - 18.0)
T = 8.9 (6.2 - 12.6)
W/L = 0.76 (0.62 - 0.86)
T/L = 0.45 (0.38 - 0.51)

Fig. 12 - Serial transverse sections through the posterior part of the shell in *Zeilleria rostellata* Kitchin. Ferruginous Oolite Formation. Sample AZ20. L=21.3 mm, W=13.5 mm. Specimen n. 6565/3; x 3.5.

Stratigraphical and geographical distributions.

Kachchh, Western India. Dhosa Oolite, Upper beds of the Chari Group (Kitchin, 1900, p. 78). The Chari Group has a Callovian-Oxfordian age according to Krishna & Westermann (1985). The Dhosa Oolite is dated as Late Callovian-Early Oxfordian (Intern. Stratigraphical Lexic, p. 95).

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PLATE 20

Fig. 1 to 9 - *Ivanoviella gaetanii* sp. n. Ferruginous Oolite Formation.

Fig. 1 - Holotype. Average specimen with its dimensions. Sample AZ15; n. 6568.

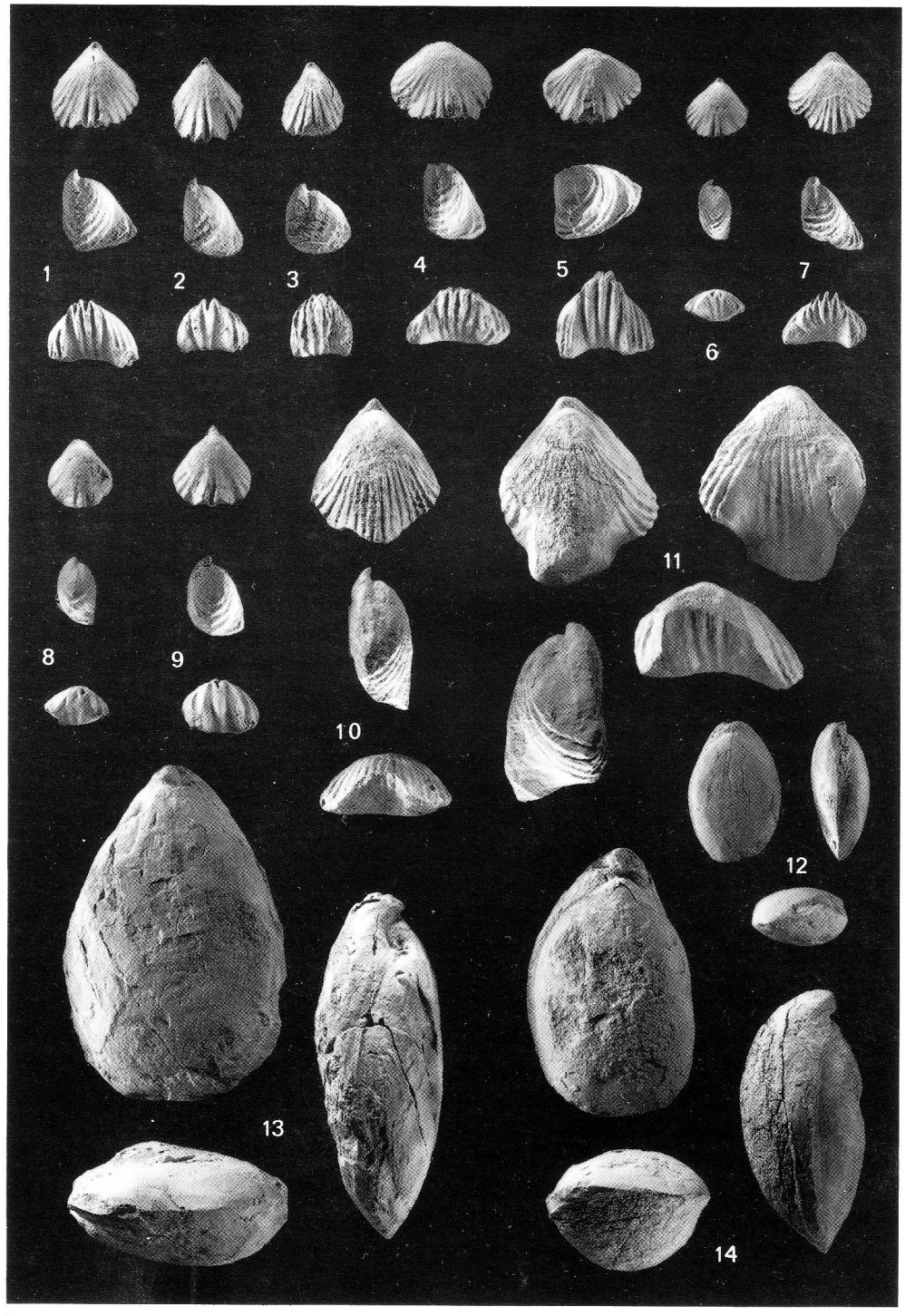
Fig. 2, 3 - Narrow shells (W/L = 0.84 and 0.86), with a few number of costae (Nvb = 9 and 10), of variable thickness (T/L = 0.70 and 0.89). Sample AZ26; n. 6572/1 and 6572/2.

Fig. 4 - The widest specimen (W/L = 1.24) with an average thickness (T/L = 1.79). Sample AZ15; n. 6569/1.
Fig. 5 - The thickest shell (T/L = 1.19) showing the highest uniplication (Ds/Ws = 1.32). Sample AZ26; n. 6572/3.
Fig. 6 - The thinnest shell (T/L = 0.57) of small size (L = 8.8 mm) showing the lowest uniplication (Ds/Ws = 0.42). Sample AZ20; n. 6570/1.
Fig. 7 - Shell with the greatest number of costae (Nvb = 17; 7 costae on the median dorsal fold). Sample AZ21; n. 6571/1.
Fig. 8 - Specimen with a few number of costae (Nvb = 8; 3 costae on the median dorsal fold). Sample AZ20; n. 6570/2.
Fig. 9 - Well preserved shell with averaged length and thickness; its width is smaller than the mean value. Only two costae on the median dorsal fold. sample AZ20; n. 6570/3.
Fig. 10, 11 - *Septaliphoria zacharlensis* Prosorovskaya. Ferruginous Oolite Formation. Sample AZ21; n. 6562/1 and 6562/2.
Fig. 12 - *Zeilleria rostellata* Kitchin. Average-sized specimen. Ferruginous Oolite Formation. Sample AZ20; n. 6565/1.
Fig. 13, 14 - *Dorsoplicathyris* (?) aff. *kabardinensis* (Moisseev). Ferruginous Oolite Formation. Sample AZ15; n. 6563/1 and 6563/2.

All the shells of Plates 20 and 21 are figured in natural size (x1) and are represented in dorsal, lateral and anterior views.

PLATE 21

Fig. 1 to 7 - *Daghanirhynchia daghaniensis* Muir-Wood. Laptal Beds. Sample AZ50, excepted fig. 3 (sample JZ190).
Fig. 1 - Averaged specimen with its dimensions and its ornamentation; n. 6559/1.
Fig. 2 - The smallest specimen (L = 9.8 mm); n. 6559/2.
Fig. 3 - The largest specimen (L = 21.7 mm); n. 6560/1.
Fig. 4 - A narrow specimen (with that of fig. 3) (W/L = 0.99); n. 6559/3.
Fig. 5 - The widest specimen of the studied sample, showing a trilobate aspect (W/L = 1.40); n. 6559/4.
Fig. 6 - One of the most flattened shells (T/L = 0.54); n. 6559/5.
Fig. 7 - The thickest shell (T/L = 1.14); n. 6559/6.
Fig. 8 - 11 - *Holcothyris angulata* Buckman. Laptal Beds. Sample AZ50.
Fig. 8 - Young rectimarginate shell with a subcircular outline; n. 6561/1.
Fig. 9 - Sulciplicate shell of average-size; n. 6561/2.
Fig. 10 - One of the largest sulciplicate shells (L = 29.2 mm), with a long erect beak overhanging the dorsal umbo; n. 6561/3.
Fig. 11 - The largest shell (L = about 33 mm) with a sulciplicate-paraplicate anterior commissure. Median dorsal sulcus relatively deep. Morphology of *Kutchithyris acutiplicata* Kitchin; n. 6561/4.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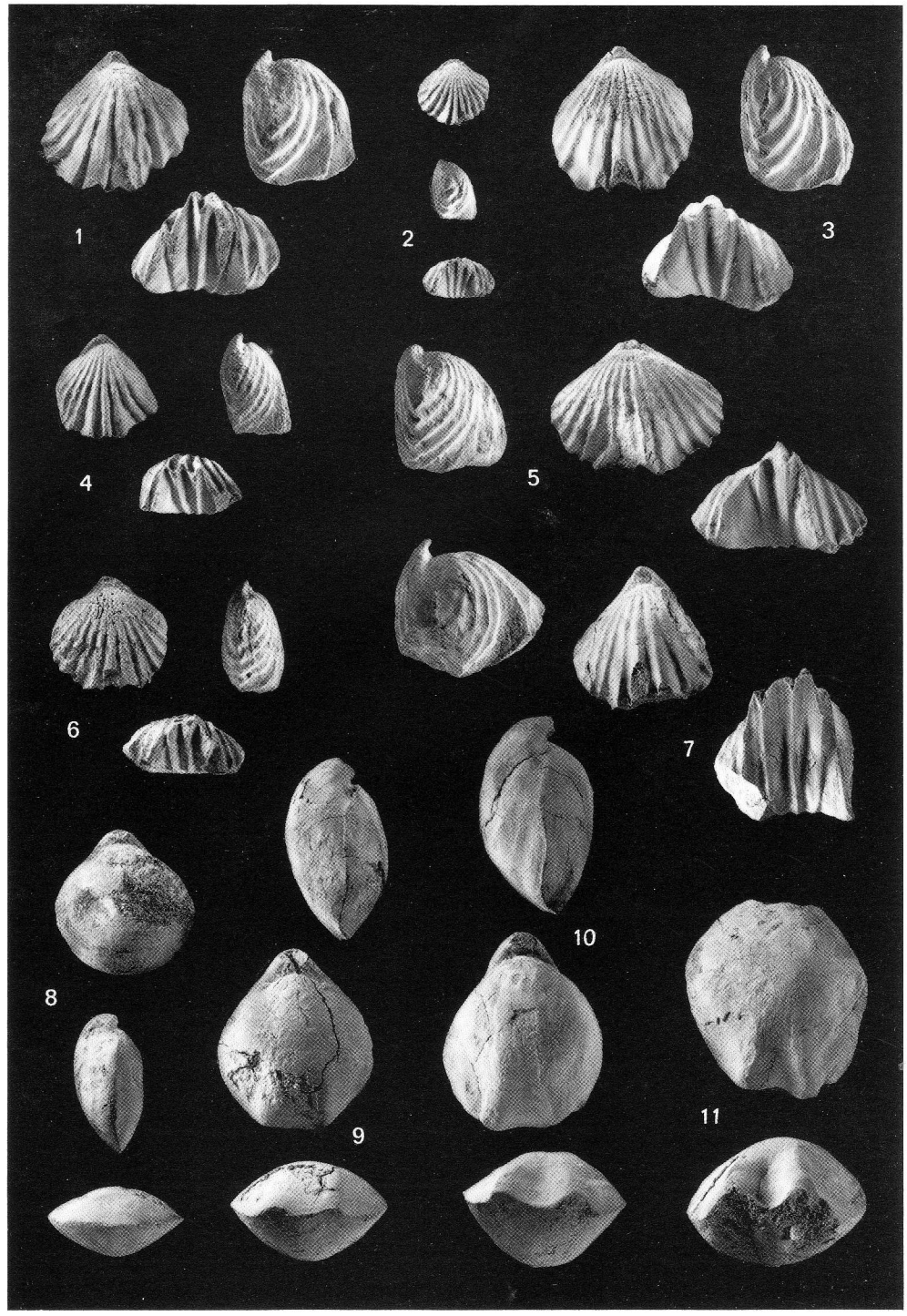
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