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New records of Dasycladales (green algae) from the Aptian-Albian Langshan Formation of Tibet

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ABSTRACT
Little is known about the microflora of the shallow-marine carbonates of the Aptian-Albian Langshan Formation of Tibet. From two sections, the species *Similiclypeina langshanensis* sp. nov., *Morelletpora turgida* (Radoičić, 1975 non 1965), *Salpingoporella* sp., *Bakalovaella xizangensis* (Mu, 1986) comb. nov., and *Bakalovaella elitzae* (Bakalova) are described. The Aptian and Albian age of the studied sections is evidenced by the occurrence of orbitolinid foraminifera. Like the non-orbitolinid benthic foraminifera, the Tibetan Lower Cretaceous Dasycladales also display poorly diversified assemblages compared to western and central Neotethys time-equivalent occurrences (Urgonian-type carbonates).

KEY WORDS
Dasycladales,
calcareous algae,
taxonomy,
biostratigraphy,
Lower Cretaceous,
China,
new combination,
new species.

RÉSUMÉ
Nouvelles données sur les Dasycladales (algues vertes) de la Formation Langshan Aptien-Albien du Tibet.
On sait peu de choses sur la microflore des carbonates marins peu profonds de la formation aptienne-albienne de Langshan au Tibet. Les espèces *Similiclypeina langshanensis* sp. nov, *Morelletpora turgida* (Radoičić, 1975 non 1965), *Salpingoporella* sp., *Bakalovaella xizangensis* (Mu, 1986) comb. nov. et *Bakalovaella elitzae* (Bakalova) sont décrites à partir de deux sections. L'âge aptien et albien des sections étudiées est attesté par la présence de foraminifères orbitolinidés. Comme les foraminifères benthiques non orbitolinidés, les Dasycladales du Crétacé inférieur tibétain présentent également des assemblages peu diversifiés par rapport aux occurrences équivalentes dans l'ouest et le centre de la Néotéthys (carbonates de type urgonien).

MOTS CLÉS
Dasycladales,
algues calcaires,
taxonomie,
biostratigraphie,
Crétacé inférieur,
Chine,
combinaison nouvelle,
nouvelle espèce.

INTRODUCTION

The lower to mid-Cretaceous Langshan Formation of the Lhasa Block, Tibet, is long known for its richness in Orbitolinidae (larger benthic foraminifera; Douvillé 1916; Fossa-Mancini 1928; Cotter 1929; Cherchi & Schroeder 1980; Zhang 1982, 1986, 1994; Marcoux *et al.* 1987; Baud *et al.* 1994; Rao *et al.* 2015; Boudagher-Fadel *et al.* 2017; Schlagintweit & Le Coze 2023; Fig. 1). The diversity of the accompanying other benthic foraminifers as well as green algae is comparably poor and still insufficiently known. In his 1986 paper, Mu stated they were "*the first record of marine calcareous algal flora of Lower Cretaceous in China*" referring to records from the Tibetan Langshan Formation. From this formation, two new species were described as *Cylindroporella chayuensis* Mu, 1982 and *Heteroporella xizangensis* Mu, 1986. In the present contribution we report on new finds of dasycladalean algae from two sections of the Langshan Formation from the northern Lhasa Terrane of Tibet, referred to the upper lower Aptian and Albian. The taxonomic descriptions include a new combination and one new species introduced as *Similiclypeina langshanensis* sp. nov.

GEOLOGICAL SETTING

Several tectonic units or blocks comprise the Tibetan plateau. Sothwards, the tectonic units are the Kunlun, Songpan-Ganzi, Qiangtang, Lhasa, and Himalaya terranes (e.g. Yin & Harrison 2000; Fig. 2A, B). Studied sections are located in the northern part of Lhasa terrane, bounded by the Bangong-Nujiang suture zone. The Lhasa terrane represents the last terrane accreted to Eurasia until its collision with the northward drifting India (Zhu *et al.* 2011). The Langshan Formation of the Lower Cretaceous is mainly composed of shallow marine carbonates, and restricted (with some exceptions) to the northern part of the central and especially the northern subterranes (Lai *et al.* 2019; Fig. 2C). The algal-bearing carbonates are herein reported in the Langshan Formation from two sections: the Roma Chambo section and the Mendang section.

Roma Chambo section

The studied section crops out west of Roma Chambo, about 15 km SW of the lake Dong Co in the Gerze county, Xizang. The coordinates of the section base are *c.* 32°04'42"N, 84°31'34"E, and encompasses the First Member of the Langshan Formation with a thickness of over 80 m that has been assigned to the lower-upper Aptian transition based on larger benthic foraminifera (orbitolinids: e.g. praeorbitolinids; Schlagintweit & Li 2024; Figs 3; 4A, B, D). The uppermost part of the section is assumed to comprise the upper Aptian. Here, *Bakalovaella elitzae* (Bakalova) (very rare) and *Similiclypeina langshanensis* sp. nov. (frequent) have been observed in micritic inner platform/ramp depositional settings (wackestones, packstones, floatstones) often associated with rudists (Fig. 5A, B). Dasycladales, almost exclusively *Similiclypeina langshanensis* sp. nov., and orbitolinids are present throughout the whole section. Other biogenic content of these carbonates includes rudists, other foraminifers and accessory bacinellid-textures (or fabrics). Besides orbitolinids, other benthic foraminifers include common small miliolids, representatives of *Vercorsella-Cuneolina*, and a few indeterminable cyclamminids.

Mendang section

Samples were collected from the central part of the Langshan Mountain, *c.* 7 km southeast of Mendang Township, Baigoin County (GPS: 31°20'52.65"N, 89°47'1.87"E). This section occupies the upper part (Third Member?) of the Langshan Formation and can be referred to the upper Aptian based on *Mesorbitolina tibetica* (Cotter) and to the lower-middle Albian relying on *Mesorbitolina subconcava* (Leymerie), *M. birmanica* (Sahni), and *Palorbitolinoides hedini* Cherchi & Schroeder (Fig. 4C, E-J, L). Other benthic foraminifers include vercorsellids-cuneolinids, pseudocyclamminids, and *Daxia* cf. *cenomana* Cuvillier & Szakall (Fig. 4K-U). A typical microfacies includes orbitolinid floatstones with Dasycladales such as *Morelletpora turgida* (Radoičić) (Fig. 5D). The Elianellacean alga *Marinella lugeoni* Pfender (see Granier & Dias-Brito 2016) is also present and may be found fixed to the tests of orbitolinids (Fig. 5C). *Morelletpora turgida* is also observed in algal packstones with elongated, almost cylindrical segments (Fig. 5E). In contrast to the Roma Chambo section, the sampling campaign conducted at the Mendang section does not include a detailed log.

MATERIAL

Roma Chambo section

The present study is based on 55 thin-sections of carbonate rocks. They are deposited with the original sample numbers 21LMC-37F to 21LMC-81 in the collection of the School of Earth Sciences and Engineering, China.

Mendang section

The carbonate rock samples have been taken in 2018. For this study, 33 samples were taken for thin-section preparation labeled 14PM to 71PM. They are stored at the School of Earth Sciences and Resources, China University of Geosciences in Beijing.

Abbreviations

D	outer thallus diameter;
d	inner thallus diameter;
dfl	diameter of fertile laterals;
dsl base	proximal diameter of sterile laterals;
dsl distal	distal diameter of sterile laterals;
h	vertical spacing of the verticils
l	length primary laterals;
p	diameter primary laterals;
w	number of laterals per verticil.

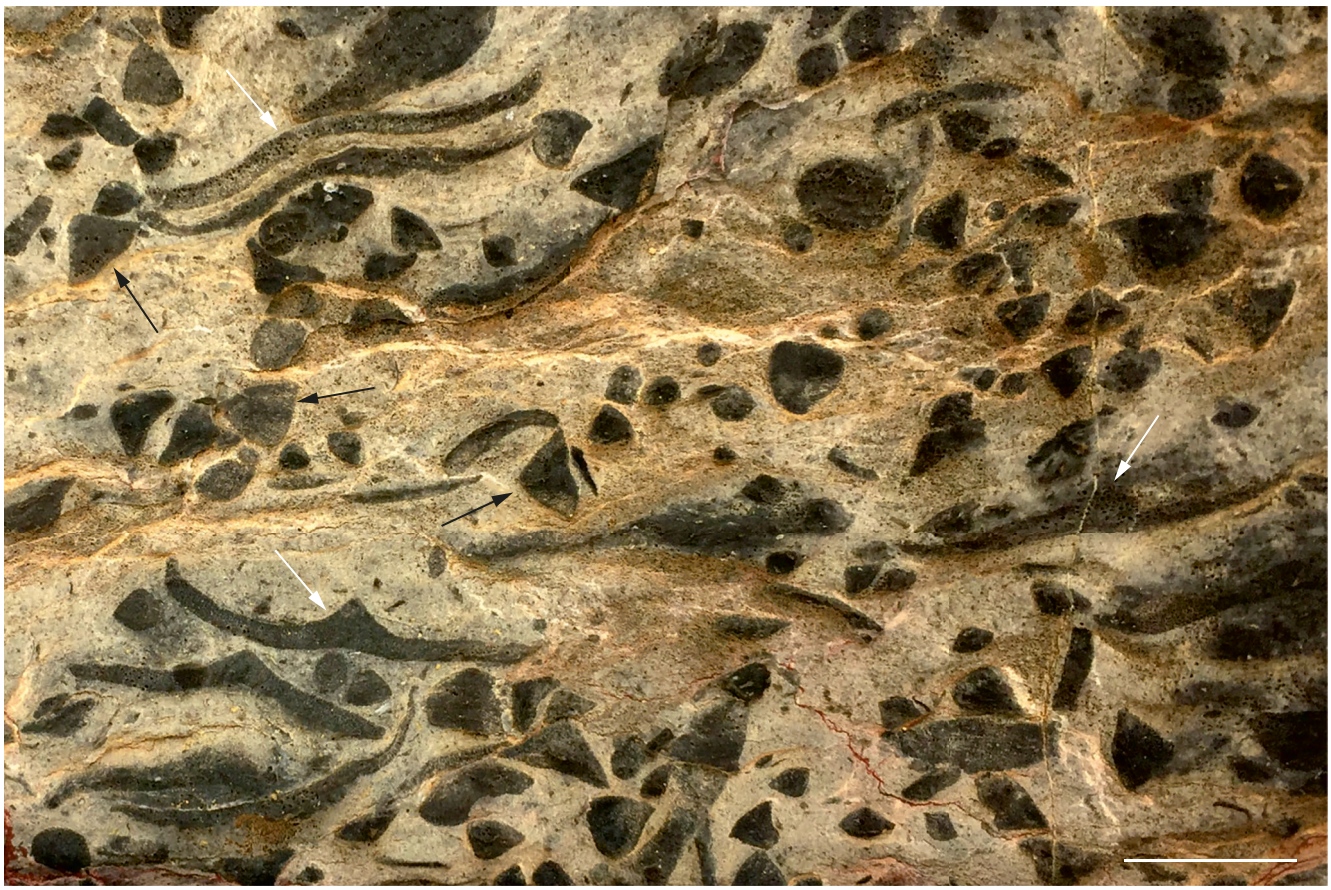

FIG. 1. — Weathered rock surface of the Langshan Formation of the Mendang section with abundant orbitolinids. In the example shown, there is a mixture of high-conical (**black arrows**) and low-conical (**white arrows**) tests, so-called reflexed conico-concave type *sensu* Henson (1948: fig. 12k, l). Scale bar: 1 cm.

TABLE 1. — Biometric data of *Similiclypeina langshanensis* sp. nov. (in mm except d/D and w). Abbreviations: **D**, outer thallus diameter; **d**, inner thallus diameter; **h**, vertical spacing of the verticils; **l**, length primary laterals; **Lmax**, maximum observed thallus length; **p**, diameter primary laterals; **w**, number of laterals per verticil.

Sample	D	d	d/D	l	p	w	h	Lmax
38F1	0.74	0.17	0.23	0.33	0.08	7 (?8)	–	–
38F1	0.59	0.13	0.22	0.32	0.06	–	0.08	-
38F1	1.09	0.27	0.25	0.40	0.11	–	–	–
38F1	0.57	0.11	0.19	0.20	0.07	–	0.08	–
38F1	0.43	0.11	0.26	0.17	0.04	–	–	–
38F1	0.16	0.05	0.31	0.09	0.03	–	–	–
38F1	0.50	0.14	0.28	0.19	–	10	–	–
38F1	0.45	0.13	0.29	0.24	0.06	6 (?7)	–	–
38F2	0.50	0.22	0.44	0.15	0.05	9	–	–
38F2	0.53	0.21	0.40	–	0.06	–	–	–
38F2	0.62	0.15	0.24	0.24	0.06	8	–	–
38F2	0.45	0.13	0.30	0.15	0.05	8	–	–
42F2	0.88	0.20	0.22	0.33	0.07	10	–	–
47F2	0.81	0.19	0.23	0.45	0.09	–	0.09	–
48F1	0.38	0.10	0.27	0.15	0.06	8	–	–
66F1	0.67	0.19	0.28	0.27	0.09	–	0.15	2.23
70F1	–	–	–	–	0.09	–	0.09	–
71F1	1.43	0.34	0.24	0.57	0.09	–	–	–
74F1	–	–	–	–	0.05	–	0.14	0.88
74F2	0.52	0.27	0.51	0.18	0.06	–	0.09	1.70
n	18	18	18	17	19	8	7	3
Min.	0.16	0.05	0.19	0.09	0.03	6 (?7)	0.08	–
Max.	1.43	0.34	0.51	0.57	0.11	10	0.15	2.23
mean	0.62	0.17	0.29	0.26	0.06	–	0.10	–

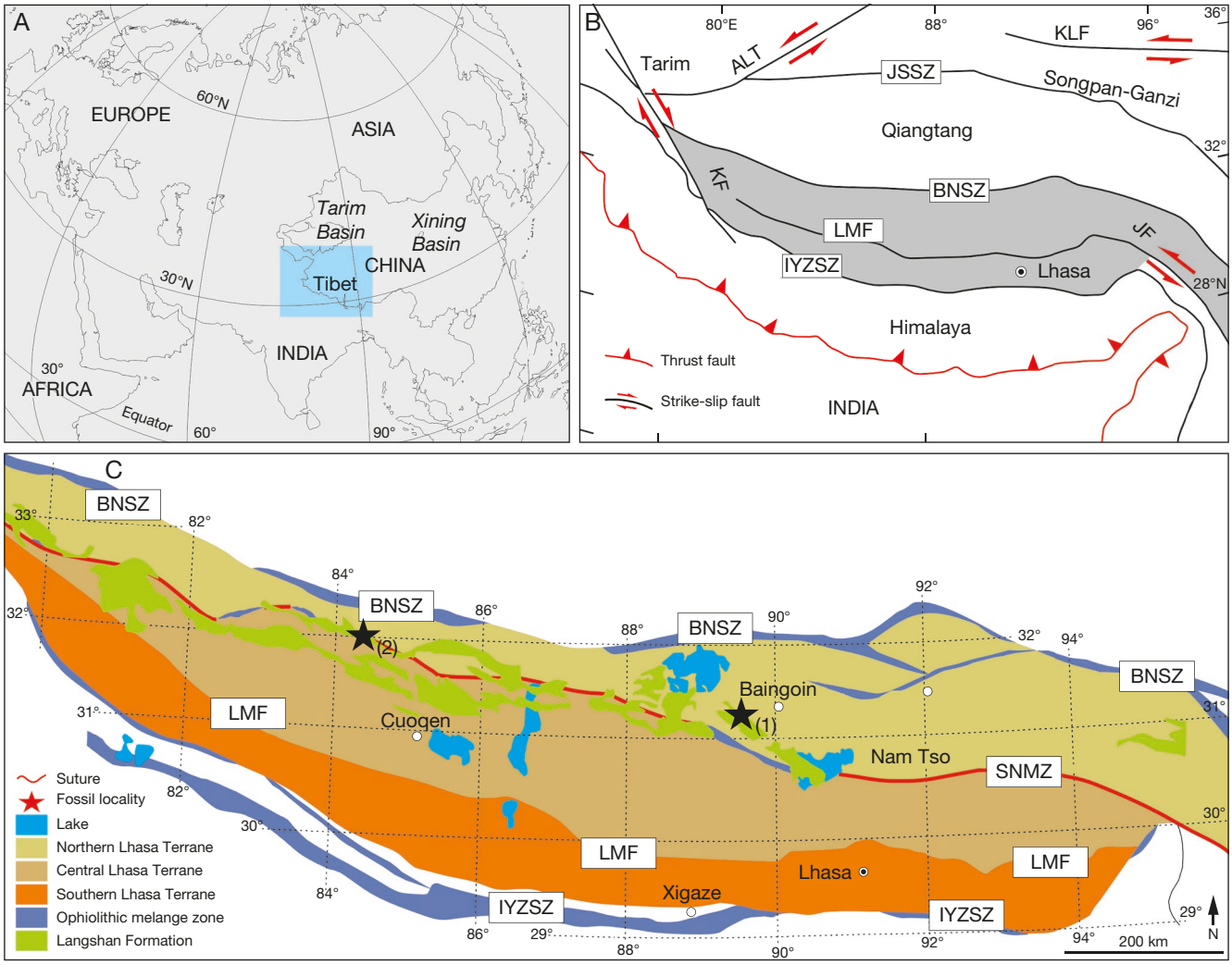

FIG. 2. — **A**, Location of Tibet shown on a large-scale map of Eurasia modified from Bosboom *et al.* (2011); **B**, tectonic map to show the Lhasa Terrane position in Tibet modified from Pan *et al.* (2004); **C**, geological map showing the distribution of the Langshan Formation in the north Lhasa Terrane (modified from Zhu *et al.* 2008): **1**, Mendang section; **2**, Roma Chambo section (Schlagintweit & Li 2024). Abbreviations: **ALT**, Altyn Tagh fault; **BNSZ**, Bangong-Nujiang suture zone; **IYZSZ**, Indus-Yarlung-Zangbo suture; **JF**, Jiali fault; **JSSZ**, Jinshajiang suture zone; **KF**, Karakoram fault; **KLF**, Kunlun fault; **LMF**, Luobadui-Milashan fault; **SNMZ**, Shiquanhe-Namco Ophiolite Mélange Zone.

SYSTEMATIC PALAEONTOLOGY

The suprageneric classification of the Dasycladales is adopted from Granier & Bucur *in* Granier *et al.* (2013).

Order DASYCLADALES Pascher, 1931
Family POLYPHYSACEAE Kützing, 1841
Tribe Clypeineae (Elliott, 1968) Bassoullet, Bernier, Deloffre, Génot, Jaffrezo & Vachard, 1979

Genus *Similiclypeina* Bucur, 1993

TYPE SPECIES. — *Similiclypeina conradi* Bucur, 1993, designated by original description.

REMARKS

The genus diagnosis by Bucur (1993: 105) is as follows: "Thallus made up of overlapping whorls of primary ramifications. Ramifications slightly tilted with respect to the axial cavity, welded at their proximal part and, usually, loose at their distal end. Overlapping whorls touching one another, partly welded into a more or less compact calcareous sheath". Some species that were doubtfully attributed to the genus *Clypeina* Michelin, namely *Clypeina alrawii* Radoičić, 1978, and *Clypeina somalica* Conrad, Peybernès & Masse, 1983 have been transferred to the genus *Similyclypeina*, along with the creation of the new species, *Similiclypeina conradi* (see Bucur 1993). For discussion on the taxonomy of *Similiclypeina* Bucur, 1993 and the close (synonymous?) genus *Piriferella* Sokač, 1996, see Bucur (2000), Conrad *et al.* (2009), Bucur *et al.* (2000, 2021), and Granier (2013). This controversial taxonomic issue however is not influencing the

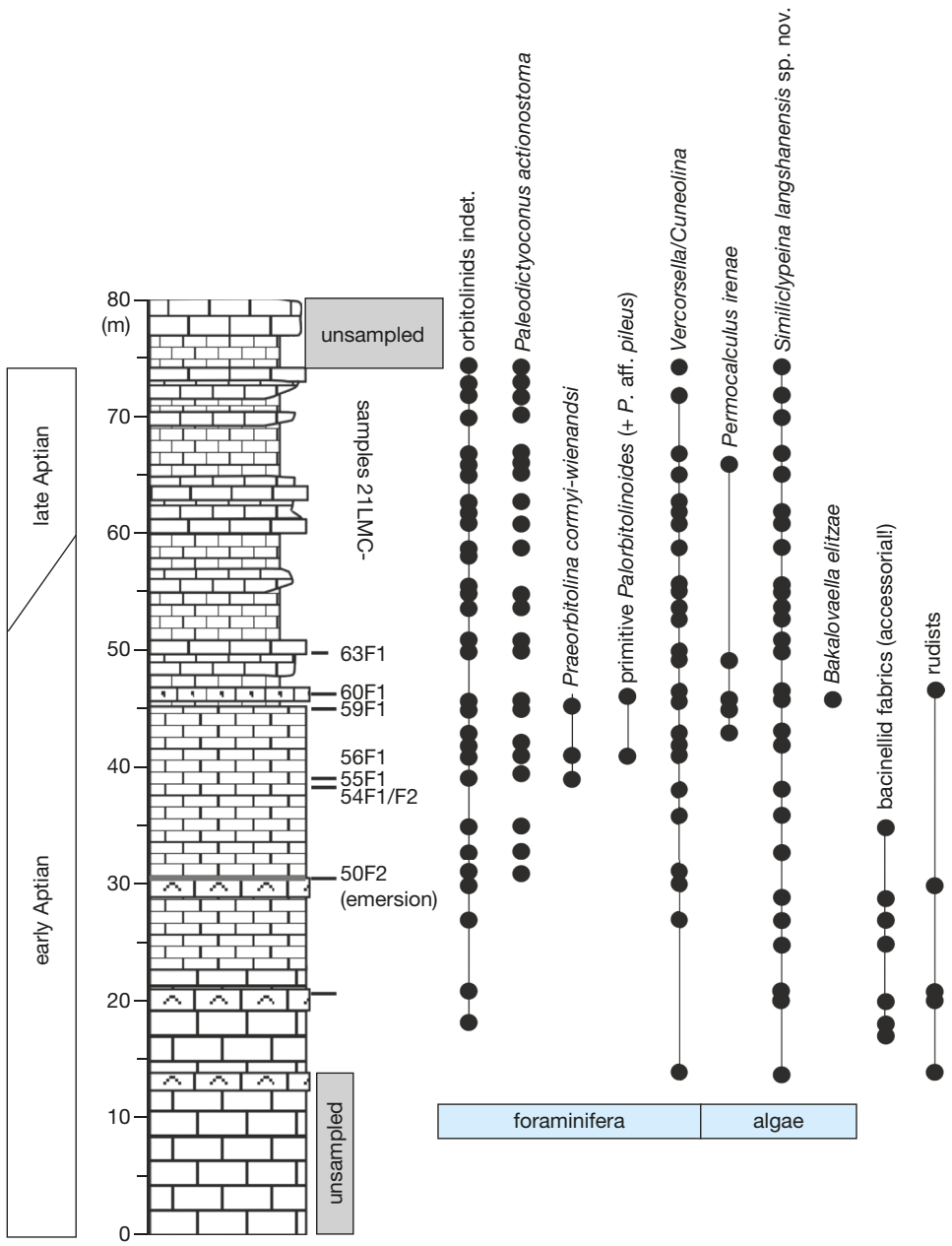

FIG. 3. — Log of the Roma Chambo section with distribution of microfossils (foraminifera, algae) and some other biota (rudists, bacinellid fabrics) (modified from Schlagintweit & Li 2024).

present generic assignment of the Tibetan alga as, if both genera are identical, *Similiclypeina* would then have priority.

Similiclypeina langshanensis sp. nov.
(Figs 5A, B; 6; 7)

TYPE MATERIAL. — **Tibet** • Northern Lhasa Terrane, Roma Chambo section. The section crops out along the eastern side of the Roma Chambo river, about 15 km SW of the Lake Dong Co in the Gerze county, Tibet (China). The coordinates of the section base are *c.* 32°04'42"N, 84°31'34"E, and encompasses a part of the Langshan Formation with a thickness of 80 m that can be assigned to the Aptian. Holotype: longitudinal thallus section illustrated in Figure 7E; thin-section 21LMC-66F1 stored at the School of Earth Sciences and Resources, China University of Geosciences in Nanjing.

ETYMOLOGY. — The species name refers to the Lower-mid Cretaceous Langshan Formation cropping out in the Lhasa Terrane of Tibet.

TYPE LOCALITY AND AGE. — Tibet, northern Lhasa Terrane, Roma Chambo section (Figs 1; 2), late early (*Praeorbitolina cormyi* biozone of Schroeder *et al.* 2010) to early late Aptian.

OCCURRENCE AND STRATIGRAPHY. — The species is widely distributed in the Roma Chambo section spanning an interval from the late early Aptian (*Praeorbitolina* biozone) and parts of the late Aptian.

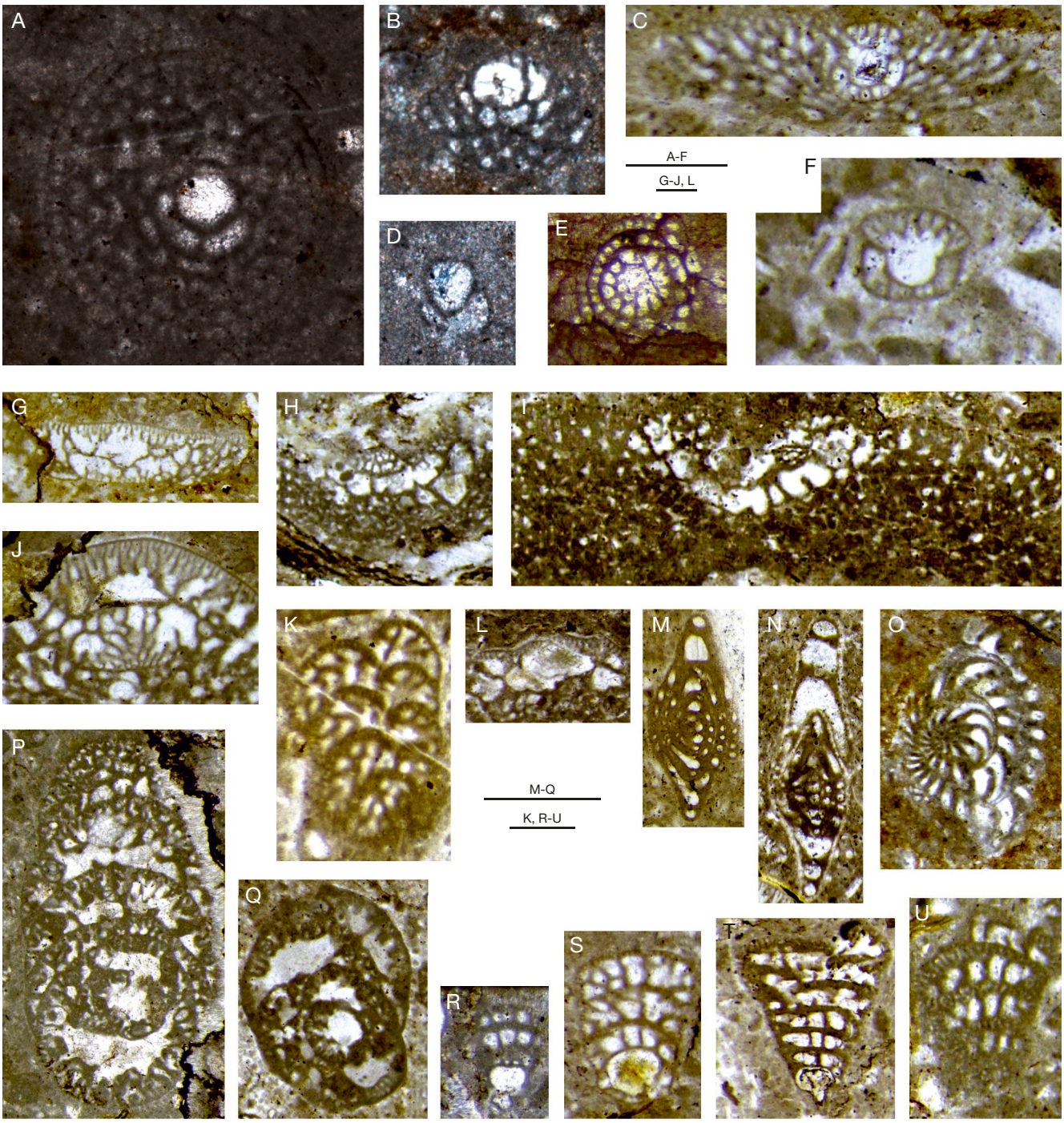

Fig. 4. — Orbitolinids and other benthic foraminifera from the Aptian-Albian Langshan Formation of the Roma Chambo section (**A**, **B**, **D**) and Medong section (**C**, **E**-**U**). **A**, **D**, *Praeorbitolina cormyi* Schroeder; Slightly oblique transverse section and isolated embryo in axial section, thin-section 21LMC-56F1; **B**, *Praeorbitolina wienandsi* Schroeder; slightly oblique axial section; thin-section 21LMC-56F1; **C**, *Mesorbitolina tibetica* (Cotter); Axial section; thin-section 17PM; **E**, **F**, *Mesorbitolina texana* (Roemer); transverse section and isolated embryo in axial section; thin-sections 31PM and 17PM; **G**, *Mesorbitolina subconcava* (Leymerie); axial section of a juvenile specimen; thin-section 19PM; **H**, **I**, **L**, *Palorbitolinides hedini* Cherchi & Schroeder: **H**, oblique section; **I**, **L**, axial sections; **H**, **L**, thin-sections 18PM; **I**, 16PM; **J**, *Mesorbitolina birmanica* (Erman); thin-section 16PM; ; **K**, **R**-**U**, *Cuneolina*? *sliteri* Arnaud-Vanneau & Premoli Silva; different sections showing canaliculated wall (best seen in **U**); **R**, thin-sections 31PM; **S**, **T**, 21PM (**S**, **T**); **U**, 33PM; **M**-**O**, *Daxia* cf. *cenomana* Cuvillier & Szagall; Oblique axial section, subaxial section, and oblique equatorial section; thin-sections 33PM, 20PM, 17PM; **P**, **Q**, *Pseudocyclammina*? sp.; Oblique section of an uncoiling specimen, slightly oblique equatorial section; thin-sections 16PM. Scale bars: A-F, G-K, L, R-U, 0.20 mm; M-Q, 1 mm.

Diagnosis. — Species of *Similiclypeina* with relatively thick calcareous skeleton exhibiting spinose outer appearance, rather low ratio inner-outer diameter and tilted uncompressed tubular branches.

Dimensions. — See Table 1.

Description

Thallus medium-sized, and cylindrical with verticils of primary laterals. Laterals tilted towards the main axis and arranged in quincunxes. The calcification consists of sparry calcite, is

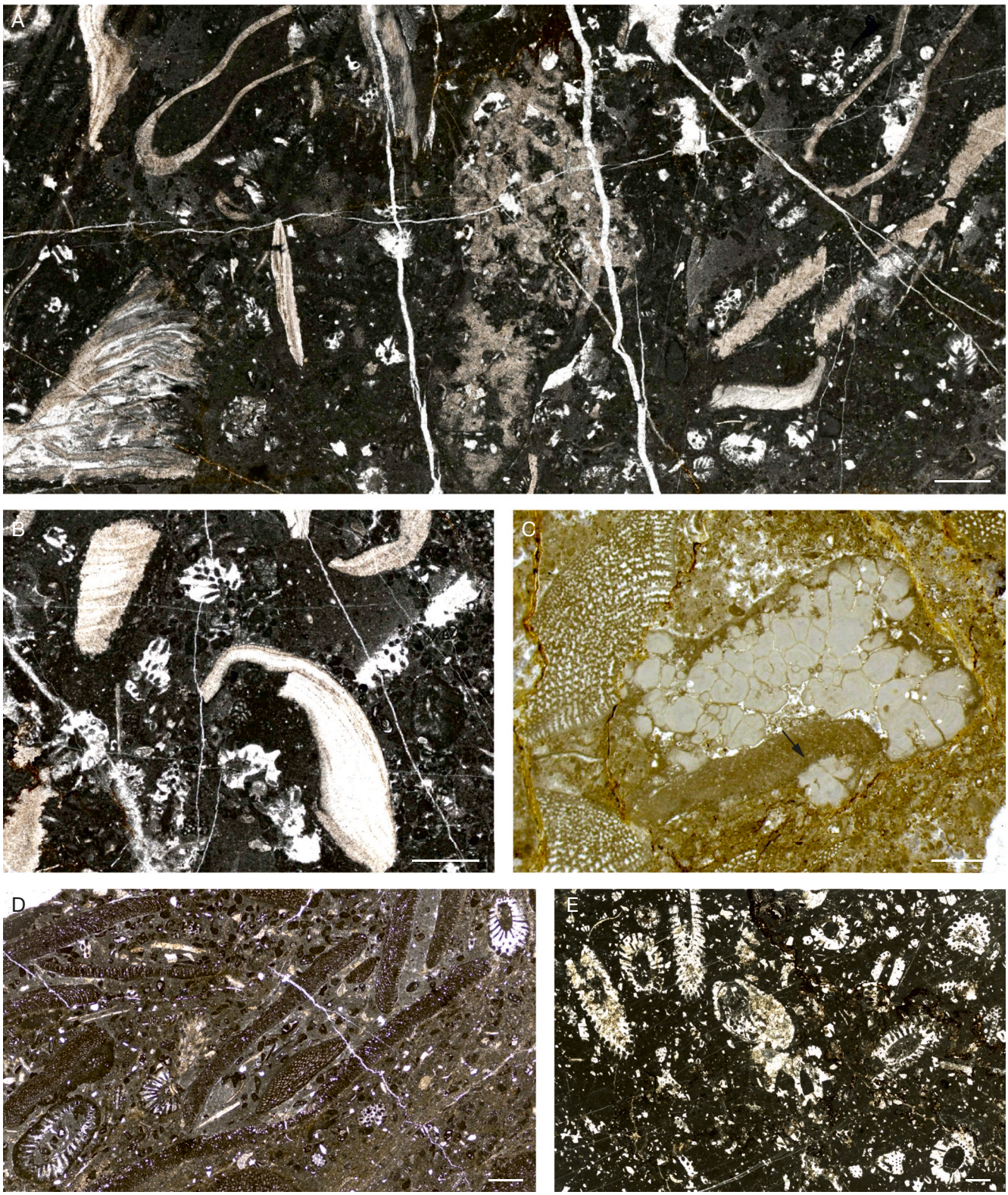

FIG. 5. — Microfacies of algal-bearing samples of the Aptian-Albian Langshan Formation: **A**, **B**, rudist floatstone with *Similiclypeina langshanensis* sp. nov., thin-sections 38F1 and -F2, Roma Chambo section; **C**, packstone with orbitolinids a thallus of *Marinella lugeoni* Pfender, an Elianellacean alga using foraminifer test as a substrate for fixation (**black arrow**); thin-section 15-4, Mendang section; **D**, orbitolinid floatstone with *Morelletpora turgida* (Radoičić); thin-section 22-1, Mendang section; **E**, wackestone with elongated segments of *Morelletpora turgida* (Radoičić); thin-section 64PM, Roma Chambo section. Scale bars: 1 mm.

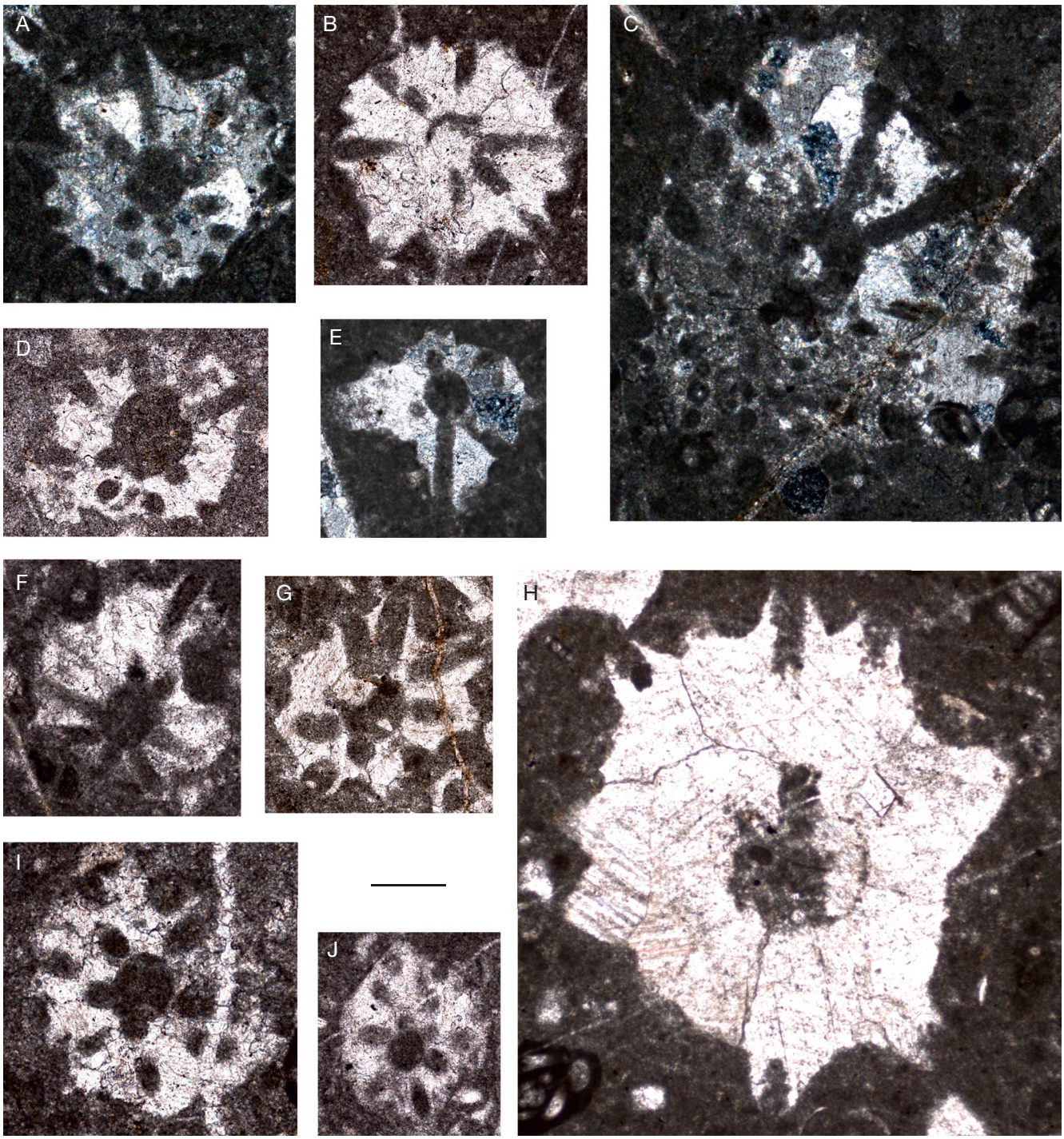

Fig. 6. — *Similiclypeina langshanensis* sp. nov. from the Aptian Langshan Formation of the Roma Chambo section: **A**, **C**, **D**, **G**, **I**, **J**, oblique sections; **B**, **E**, **F**, **H**, partly oblique transverse sections. Samples: 21LMC-38F1 (A, C, E); –38F2 (B, D, I); –46F2 (F); –72F1 (G, H); –48F1 (J). Scale bar: 0.20 mm.

variable, and often displays a thick envelope around the main axis resulting in a low d/D ratio (e.g. Fig. 6B, H). Mostly the elongated tubular (uncompressed) laterals (phloiophorous type), 6 to 10 per vertical, are straight and directed away from the main axis, sometimes (top part of thallus?) bending upwards (Fig. 7F). Along their length, the laterals only slightly widen. The verticils are rather close-set; the individual calcareous coating of the laterals results in a spinose appearance at the distal endings (Fig. 6A). In these cases, the calcified wall shows a slight concave depression at the thallus surface between the laterals. Transverse sections of the laterals as shown in tangential thallus sections are always rounded. The inner surface (axial cavity) is smooth and well delimited.

Comparisons

The main feature that in our opinion justifies the separation of *Similiclypeina langshanensis* sp. nov. from allied taxa are the shape of the laterals. In *Similiclypeina somalica* (Conrad,

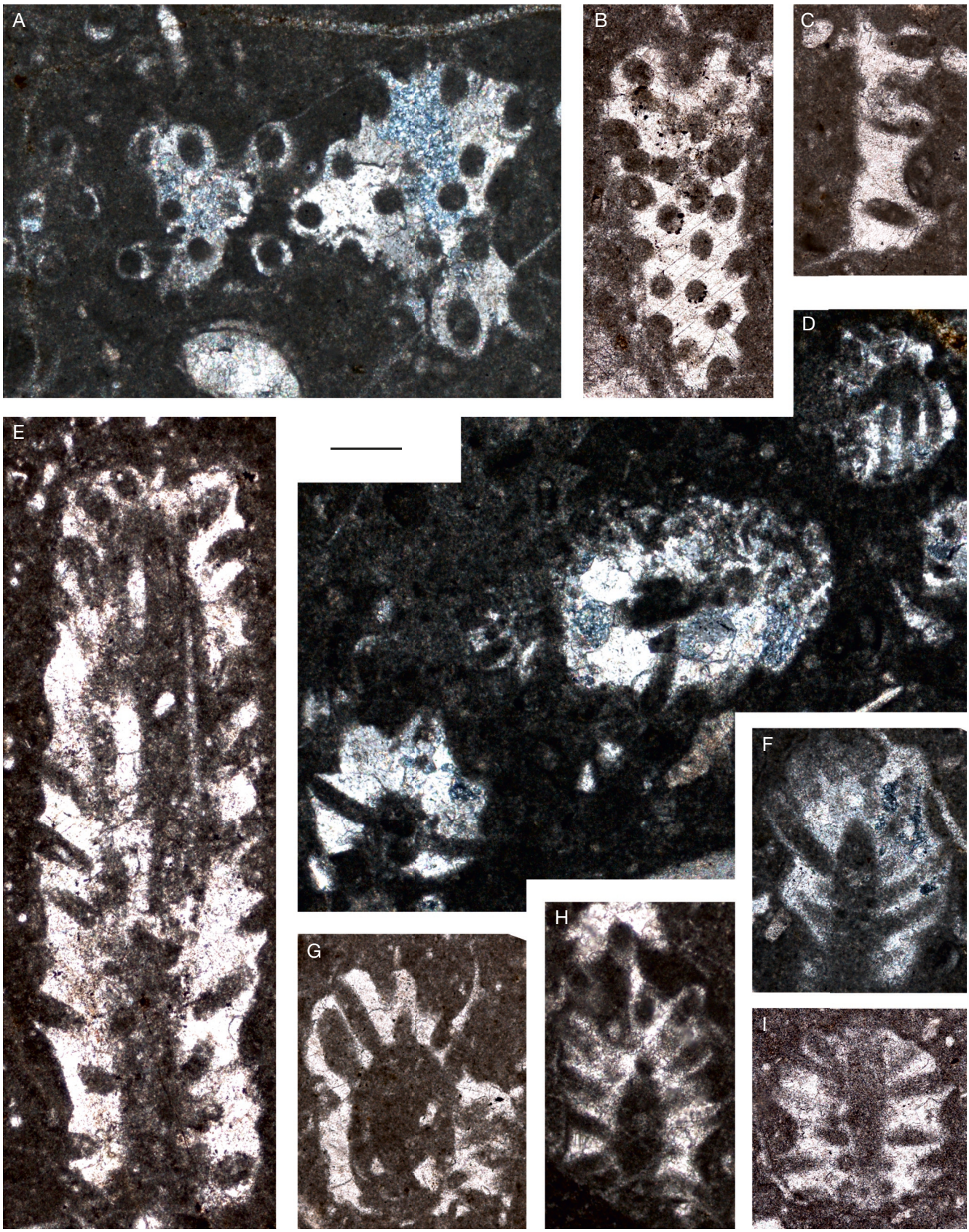

FIG. 7. — *Similiclypeina langshanensis* sp. nov. from the Aptian Langshan Formation of the Roma Chambo section: **A**, **B,** tangential sections; **C**, **E**, **F**, **I**, longitudinal sections. **F** refers to the top part of the thallus; **D**, **G**, **H**, oblique sections. Samples: 21LMC-38F1 (A, D, F); –38F2 (I); –70F1 (B, G); –71F2 (C); –66F1 (E); –47F1 (H). Scale bar: 0.20 mm.

TABLE 2. — Biometric data of *Similiclypeina langshanensis* sp. nov. and taxa used for comparison (in mm except d/D and w). Abbreviations: **D**, outer thallus diameter; **d**, inner thallus diameter; **h**, vertical spacing of the verticils; **l**, length primary laterals; **p**, diameter primary laterals; **w**, number of laterals per verticil.

	***Similiclypeina conradii* Bucur, 1993**	***S. somalica* Conrad, Peybernès & Masse, 1983**	***S. langshanensis* sp. nov.**	***Salpingoporella verrucosa* Sokač, 1996**	***Piriferella spinosa* Sokač, 1996**
D	0.51-1.16 (0.98)	0.47-0.80	0.16-1.43 (0.62)	0.38-0.72 (0.44-0.64)	0.48-0.87
d	0.16-0.47 (0.34)	0.30-0.42	0.05-0.34 (0.17)	0.2-0.32 (0.24-0.30)	0.20-0.34
d/D	0.21-0.51 (0.36)	0.36-0.59	0.15-0.51 (0.29)	0.34-0.59 (0.40-0.50)	0.34-0.50
l	0.25-0.54 (0.38)	0.16-0.32	0.09-0.45 (0.26)	0.12-0.20	0.22-0.34
p	0.14-0.23 (0.17)	*c.* 0.04	0.03-0.11 (0.06)	0.06-0.10	0.10-0.19
w	8-9	6-7	6-10	6-8	7-8
h	0.09-0.12	*c.* 0.23	0.08-0.15 (0.10)	0.14-0.24	0.10-0.14
Tilted laterals	yes	No (or only slightly)	yes	yes	yes

TABLE 3. — Biometric data of *Bakalovaella xizangensis* (Mu) comb. nov. (in mm except d/D). Data from Mu (1986, holotype, and paratypes) compared to specimens studied herein. Abbreviations: **D**, outer thallus diameter; **d**, inner thallus diameter; **dfl**, diameter fertile laterals; **dsl**, diameter of sterile laterals; **h**, vertical spacing of the verticils; **l**, length primary laterals.

	L	**D**	**d**	**d/D**	**dsl base**	**dsl distal**	**dfl**	**h**
holotype	3.34	1.67	0.55	0.33	0.054-0.087	0.19-0.28	0.19-0.24	0.21-0.30
paratype	1.67	0.48	–	–	0.043-0.065	0.024	0.15-0.24	0.17-0.26
paratype	–	–	–	–	0.047-0.087	0.26	0.19	0.30
Sample 22	–	1.22	0.46	0.37	0.045	–	0.18	0.19
Sample 22	–	1.20	0.40	0.33	–	–	–	–
Sample 22	–	1.12	0.39	0.35	–	–	0.22	0.23

Peybernès & Masse), the laterals are directed almost perpendicular to the main axis and egg-shaped (Fig. 8A, B). The laterals of the type-species *S. conradi* Conrad typically are flattened vertically at their proximal parts and continuously decrease in diameter outwards (Fig. 8E, F). In addition, the diameter of the laterals is larger in *S. conradi* (Table 2). In *Piriferella spinosa* Sokač, the laterals are similar to *S. somalica* (Fig. 8C, D). The laterals of *S. langshanensis* sp. nov. attain a length almost double than that reported from *S. verrucosa* Sokač and also the vertical spacing is distinctly lower (Fig. 8G, H; Table 2). For other differences in biometric parameters see Table 2.

Family DASYCLADACEAE (Kützing, 1841)

Genus *Bakalovaella* Bucur, 1993

TYPE SPECIES. — *Bakalovaella elitzae* (Bakalova) Bucur, 1993 [basionym: *Cylindroporella elitzae* Bakalova, 1971].

Bakalovaella xizangensis (Mu, 1986), comb. nov. (Fig. 9A-E, H)

Heteroporella xizangensis Mu, *Bulletin of Nanjing Institute of Geology and Paleontology, Academia Sinica* 10: 97, pl. 4, figs 1, 4-6 (Mu 1986).

STRATIGRAPHY. — Mu (1986) reported *Heteroporella xizangensis* from the northern slope of Langshan Mountain in the Duoba District, Baingoin County. The type-level is indicated as belonging to the lower part of the Langshan Formation containing *Morelletpora turgida* (Radoičić) and *Palorbitolina lenticularis* (Blumenbach) indicating an early Aptian age.

DESCRIPTION

The alga has a cylindrical thallus with a main axis that corresponds to about ⅓ of the total diameter (Fig. 9H). Sterile laterals and fertile whorls are arranged perpendicularly towards the axis in an alternating manner. In the last third (towards the algal surface), the fertile ampullae are touching each other (vertically and horizontally) appearing as a contiguous undulating micritic bands between the levels of sterile laterals (Fig. 9C). The fertile ampullae are inflated with a flattened distal end thereby occupying the space between the sterile laterals almost completely.. The inner surface of the main axis is smooth.

REMARKS

Heteroporella xizangensis Mu was originally described as belonging to *Heteroporella* Praturlon, 1967. Mu (1986) designated one holotype (PB 10994, pl. 4 [wrongly indicated as pl. VI = 6], fig. 1) and two paratypes (PB 10995, pl. 4, fig. 4 and PB 10696, pl. 4, fig. 5). Although validly described, it has neither been included in the critical literature inventory of species (Granier & Deloffre 1993; Bucur 1999) nor the taxonomic revision of the genus *Heteroporella* and its "species" (Granier *et al.* 1994). This led to the reduction of the inventory of the genus *Heteroporella* to its type-species *H. lepina* Praturlon, while all other species previously described as belonging to it were assigned to other genera. *Heteroporella xizangensis* Mu is herewith assigned to the genus *Bakalovaella* Bucur, 1993. This genus is characterized by thalli bearing alternating sterile and fertile whorls that are connected to the former that exhibit a distal widening to form a cortex (see also Granier & Bucur 2019). *Bakalovaella xizangensis* has been observed only in the Mendang section (upper Aptian-middle Albian).

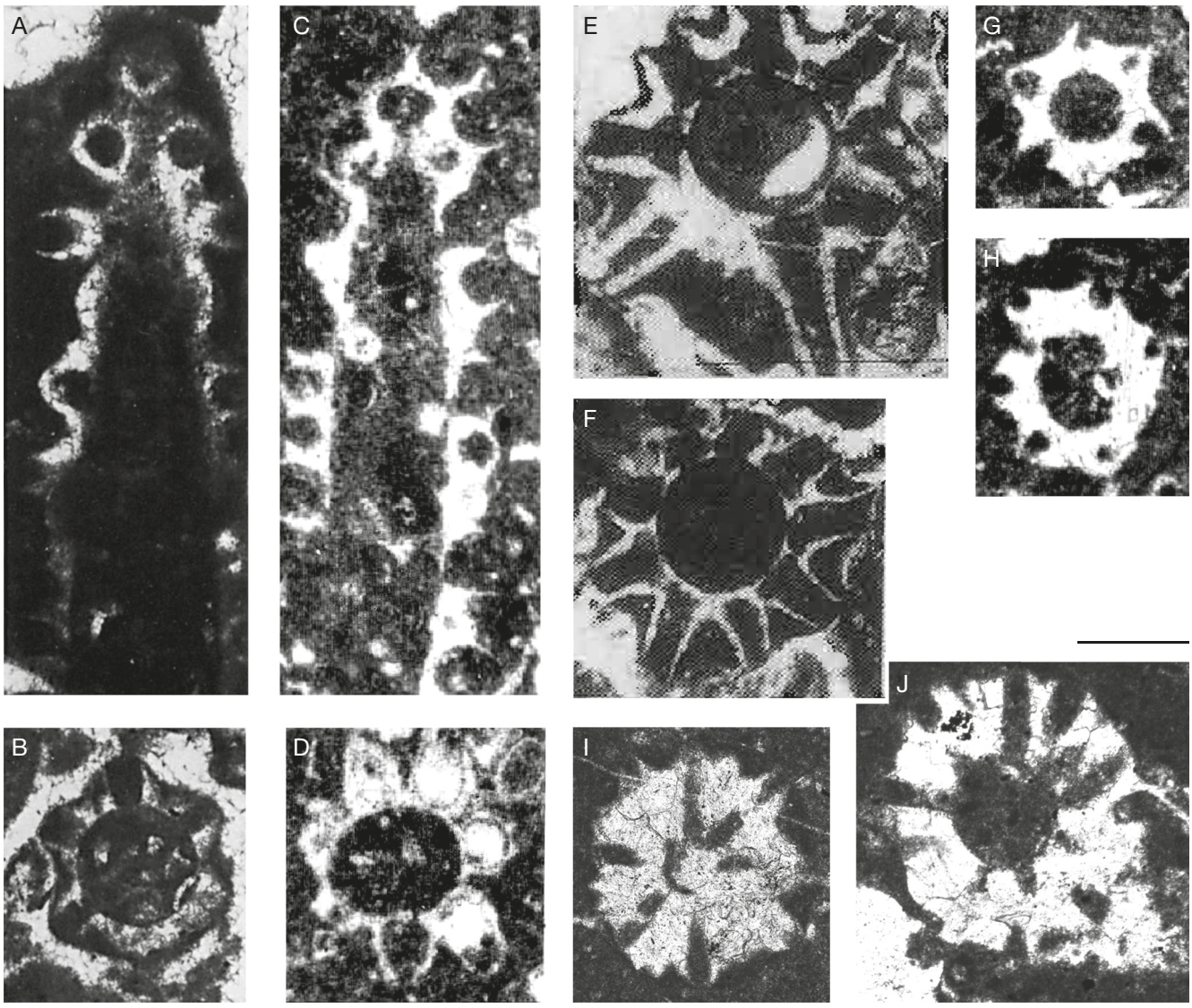

Fig. 8. — Lower Cretaceous (Barremian-Aptian) taxa compared to *Similiclypeina langshanensis* sp. nov.: **A**, **B**, *Clypeina somalica* Conrad *et al.* (synonym of *Holosporella somalica* acc. to Granier 1992; *Similiclypeina somalica* acc. to Bucur 1993; *Piriferella somalica* acc. to Sokač 1996), longitudinal (**A**) and transverse (**B**) sections; **C**, **D**, *Piriferella spinosa* Sokač (from Sokač 1996: pl. 21, figs 1, 10), longitudinal (**C**) and transverse (**D**) sections; **E**, **F**, *Similiclypeina conradi* Bucur (from Bucur 1993: pl. 2, figs 23, 18), slightly oblique transverse sections; **G**, **H**, *Salpingoporella verrucosa* Sokač (synonym of *Piriferella spinosa* acc. to Conrad *et al.*, 2009), transverse sections, slightly oblique in **H**; **I**, **J**, *Similiclypeina langshanensis* sp. nov., slightly oblique transverse sections. Scale bar: 0.30 mm.

Comparisons

Bakalovaella elitzae (Bakalova) (Barremian-Aptian of Bulgaria), another species of the genus that may be associated to *B. xizangensis*, is much smaller and displays almost spherical fertile ampullae (Fig. 9I, J). *Bakalovaella benizarensis* (Fourcade *et al. ex* Jaffrezo *in* Bassoullet *et al.* 1978 (Barremian of Spain) represents a small-sized species (mean D: 0.60 mm to 0.85 mm) with six subspherical ampullae per vertical and a reduced vertical spacing (h: 0.13-0.18). *Bakalovaella deloffrei* Granier & Bucur, 2019 (Hauterivian of western France) represents another small representative of the genus (mean D: *c.* 0.70 mm) displaying a subcylindrical main axis bearing deeply imbricated verticils of 5 to 8 laterals each. *Bakalovaella filipovici* (Radoičić, 2006) (Cenomanian-Turonian of Kosovo) represents a species with a comparably narrow main axis (d: 0.075-0.177 mm) and subspherical fertile ampullae.

Bakalovaella elitzae (Bakalova, 1971)
(Fig. 9I, J)

Cylindroporella elitzae Bakalova, *Bulletin of the Geological Institute, Bulgarian Academy of Sciences – Committee of Geology (Series Paleontology)* 20: 126, pl. 3 (Bakalova 1971). — *Bakalovaella elitzae* (Bakalova) Bucur, *Revista Española de Micropaleontologia* 25 (1): 100, pl. 7 (Bucur 1993); *Carnets de Géologie* 23 (9): 168-169, pl. 5, figs W-X, pl. 6, figs A-C, E-F. (Granier *et al.* 2023). — *Montiella*? *elitzae* (Bakalova) Taherpour Khalil Abad, Conrad, Aryaei & Ashouri, *Carnets de Géologie 2010/05 (CG2010_A05)*: 6, fig. 8a-d (Taherpour Khalil Abad *et al.* 2010); *Facies* 58: 616, fig. 8a-p (Bucur *et al.* 2012).

Remarks

Bakalovaella elitzae is relatively rare in the Langshan Formation and has been observed in both sections studied. In the Mendang section it may co-occur with *B. xizangensis* in the

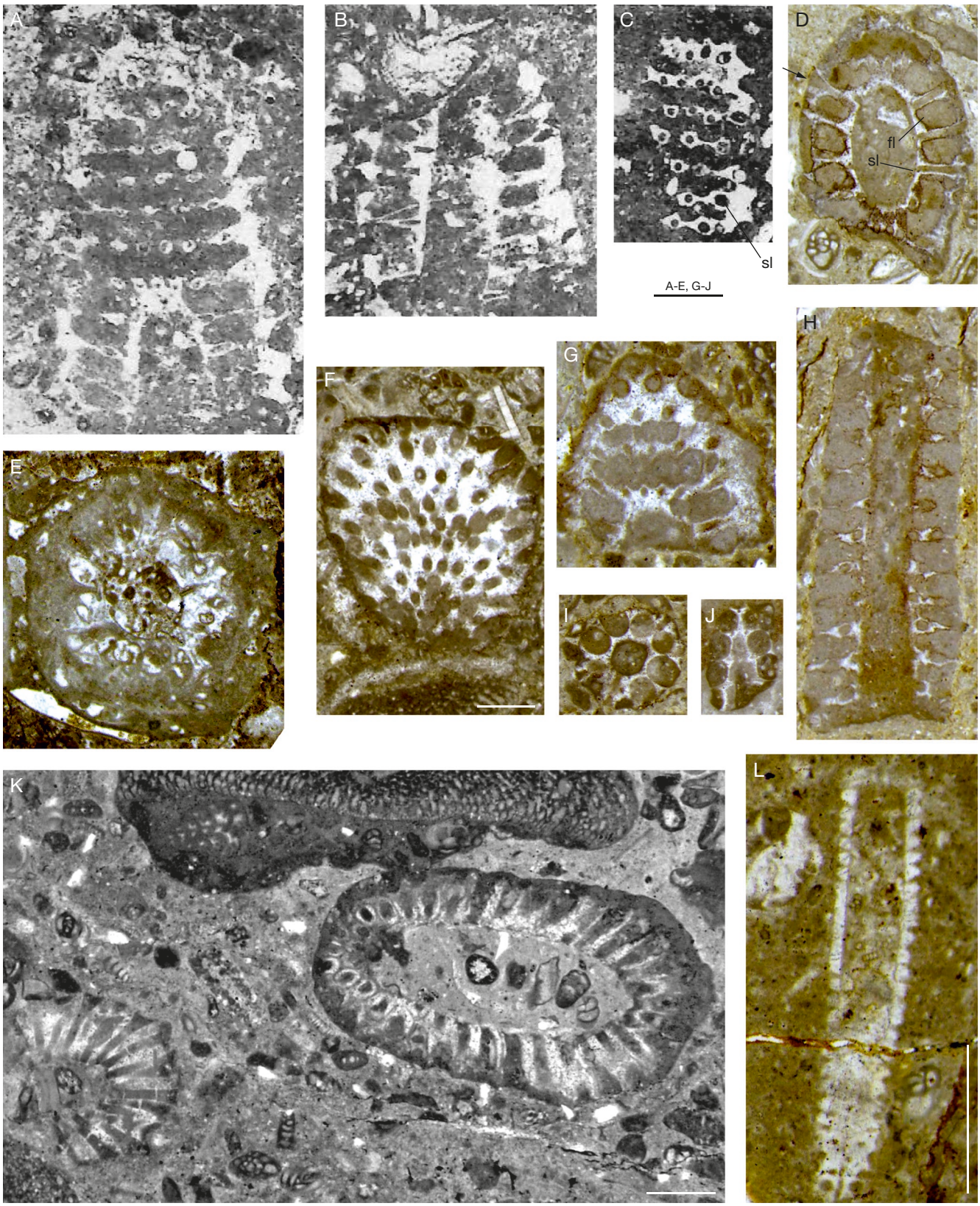

FIG. 9. — Dasycladales from the late Aptian-Albian Langshan Formation of Langshan Mountain (**A**-**C**) and the Mendang section (**D**-**L**): **A**-**E**, **G**, *Bakalovaella xizangensis* (Mu) comb. nov. (from Mu 1986: pl. 4 (incorrectly indicated therein as pl. 6), figs 1, 5, 4): **A**, tangential oblique section; **B**, **H**, longitudinal sections; **C**, tangential section; **D**, **E**, **G**, oblique sections. Note the distal widening of the sterile laterals (**arrow** in **D**); **F**, **K**, *Morelletpora turgida* (Radoičić); tangential-oblique section and different sections mostly longitudinal-oblique; **I**, **J**, *Bakalovaella elitzae* (Bakalova): transverse section and oblique section. Note the much smaller size and the subspherical shape of the fertile ampullae compared to *B. xizangensis*; **L**, *Salpingoporella* sp.; longitudinal section. Abbreviations: **fl**, fertile lateral; **sl**, sterile lateral. Samples: 22-4 (D, F, G); 22-1 (H, L); 22-2 (I, J); 17-1 (K). Scale bars: 0.50 mm.

same samples. For a detailed description of the species see Bucur (1993), Taherpour Khalil Abad *et al.* (2010), and Bucur *et al.* (2012) which includes a tentative thallus reconstruction.

Genus *Salpingoporella* Pia *in* Trauth, 1918

TYPE SPECIES. — *Salpingoporella muehlbergii* (Lorenz, 1902) Pia *in* Trauth (1918) [basionym: *Diplopora muehlbergii* Lorenz, 1902].

Salpingoporella sp.
(Fig. 9K)

REMARKS
One longitudinal section (L = 1.62 mm) of a small-sized cylindrical thallus (D = 0.29 mm) with first order laterals of phloiophorous type (distal pore diameter 0.04 mm) observed in the Mendang section and treated in open nomenclature. The main axis (d = 0.19 mm) is relatively large and makes up about 0.655 of the total diameter. The vertical spacing is 0.05 mm.

Family TRIPLOPORELLACEAE Pia, 1920
sensu Berger & Kaever (1992)
Genus *Morelletpora* Varma, 1950

Morelletpora turgida (Radoičić, 1975 non 1965)
Barattolo, 2002
(Figs 5E, F; 9F, K)

Salpingoporella turgida (Radoičić) Radoičić, 1975, *Bulletin scientifique du Conseil des Académies des Sciences et des Arts de la R.S.F. de Yougoslavie*, Section A, *Sciences naturelles, techniques et médicales* 20 (9-10): pl. 1, fig. 2A *in* Radoičić, 1965 (Radoičić 1975); *Bulletin of Nanjing Institute of Geology and Paleontology, Academia Sinica* 10: 89, pl. 4, figs 2, 3, 7 (Mu 1986). — *Salpingoporella*? *turgida* (Radoičić) Carras, Conrad & Radoičić 2006, *Revue de Paléobiologie* 25: 489, pl. 11, figs 1-5 (reproducing figs 1, 2a of pl. 1, fig. 3 of pl. 2 and figs 2, 3 of pl. 3 from Radoičić 1965) (Carras *et al.* 2006).

Pianella turgida Radoičić, *Geološki vjesnik* 18: 195, pl. 1, figs 1, 2, pl. 2, figs 1-4, pl. 3, figs 1-3, pl. 4, figs 1-4 (Radoičić 1965), *nomen nudum*. — *Morelletpora turgida* (Radoičić) Barattolo, 2002, *Research Advances in Calcareous Algae and Microbial Carbonates*: 25 (Barattolo 2002); *Cretaceous Research* 58: 171, figs 4-10 (Bucur *et al.* 2016).

OCCURRENCES. — Roma Chambo section and Mendang section; Aptian and Albian.

REMARKS
Morelletpora turgida represents a rather common species in the upper Aptian-Albian parts of the Langshan Formation, often dispersed with individual thallus fragments in orbitolinid-rich facies (Fig. 5D). Here the typical barrel-shaped isolated segments prevail. Packstones with abundant thallus fragments and are orbitolinids characterized by more elongated, almost cylindrical segments (Fig. 5F).

DISCUSSION

Compared to other occurrences of Lower Cretaceous shallow-water carbonates in the western Neotethys such as southern France, Spain, Italy or Croatia, the algal assemblages of the Tibetan Langshan Formation are less diverse (e.g. Luperto Sinni & Masse 1993; Masse 1993; Sokač 1996; Bucur 2011). One reason for the seemingly reduced Tibetan diversity might be the more homogeneous facies distribution and the lack of typical high-energy shoal deposits that, for example in southern France, contain a variety of facies-sensitive species (e.g. Conrad 1970; Bucur 2011; Granier 2013). Another reason might be that the occurrences in the western Neotethys are simply more easily accessible than the Tibetan mountain ranges and therefore better studied. Therefore, one may assume that more species remain to be discovered from the Langshan Formation. Along with the reduced diversity of benthic foraminifers one might furthermore speculate about more less favourable palaeoecological conditions, a topic however beyond the scope of the present contribution.

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