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A NOTE ON THE FAUNA OF ARTINSKIAN (LOWER PERMIAN) AFFINITY FROM GARHWAL SYNFORM, LESSER HIMALAYA

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ABSTRACT

A sample collection from the Boulder Slate Member, that forms lower part of the Bijni Unit in the Garhwal tectonic set-up, has revealed presence of *Neospirifer fasciger* (Keyserling), *Linoproductus cf. cora* (d'Orbigny), *Waagenoconcha cf. gangetica* (Diener), *Cleiothyridina semiconcava* (Waagen) and some fenestellid bryozoa, indicative of a Lower Permian age. The paper describes and illustrates the fauna.

INTRODUCTION

Although the geology of the well described segment of the Lesser Himalayan terrain of Garhwal is well known through the publications of Medlicott (1864), Middlemiss (1885 and 1887), Auden (1934 and 1937), Shanker and Ganesan (1973) and more recently, Dhoundiyal and Kumar (1976; in Kumar and Dhoundiyal, 1980), the interplay of field geology and palaeontology has played a restricted role in the build-up of the local stratigraphy for the unfossiliferous nature of thick rock suquences. Only very few fossiliferous horizons are known from there and one them relates to the Permian period. The persent paper describes some additional fossil elements from the Permian horizon and argues its biostratigraphy.

GEOLOGICAL SET-UP

In recent years the Garhwal Synform has been remapped in detail by Shanker, Dhoundiyal and Ganesan (in Ganesan, 1972), Shanker and Ganesan (1973) and more recently by Dhoundiyal and Kumar (1976; in Kumar Dhoundiyal, 1980). As a sequel, two contrasting views have emerged. Shanker and Ganesan have suggested a four tier tectonic set-up, separated by thrusts (Table 1), which is a partially modified form of Auden's (1937) pioneering scheme.

Kumar and Dhoundiyal (1980), on the other hand, have concluded that the entire sequence, consisting of several formations ranging in age from Precambrian to Recent, if have unconformable junctions, are not thrust bound, as understood so far (see also Kumar, 1979).

In the scheme of the latter workers, the Upper Palaeozoic fossil yielding Boulder Slate sequence of the Lower Bijni Unit of Shanker and Ganesan (1973) has been proposed to be placed within the sequence of Blaini Formation—a possibility that was alluded to in the key paper of Auden (1937, p. 424).

Earlier Valdiya (1975) had shown the Boulder Slate sequence to be the lowest member (his Jogira Member of the Permian age) of Tal Formation, the latter manifesting, according to his proposal, the entire Permian. This hypothesis, which transgressed quite a bit from the accepted Mesozoic (Late ?) age for the Tal sequence, has not been accepted in later publications (Bhargava, 1979; Singh 1979a, 1979b; Bhatia, 1980; Singh 1980), most of whom relegate the Boulder Slate sequence as well as

Table 1. Lithotectonic sequence of Garhwal Nappe (after Shanker and Ganesan, 1973).

	Tectonic units	Lithology
GARHWAL NAPPE	Amri unit	Schistose phyllite with Lansdowne Granite
	..... Amri Thrust	
	Upper Bijni Unit	Purple, green, white quartzite with subordinate green, gritty slate.
	Bijni Thrust	
	Lower Bijni unit	a. Sandy limestone b. Gritty quartzite c. Boulder slate d. Quartzite and phyllite
	.....Garhwal Thrust	
	KROL BELT	

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the Tal Formation to their original positions in the accepted stratigraphic ladder, except for Singh (1979a, b) who regards the Boulder Slate sequence the remnant of a Carboniferous-Permian marine incursion in the area, independent of any stratigraphic implications, outlying over the Precambrian succession of the Krol Belt (including Tal Formation) in general, somewhat analogous to the Narmada valley sequence of the Peninsular India.

However, the fauna of the Bouder Slate sequence has been shown to be of only Lower Permian in the present paper as it does not reveal characteristic Carboniferous elements.

The Permian fossiliferous horizon in the Lesser Himalayan Garhwal has been variously referred to as "Volcanic Breccia", (Middlemiss, 1887), Sila Mudstone (Chaturvedi and Talent, 1971), Boulder Slate Sequence of the 'Lower Bijni' unit (Shanker and Ganesan, 1973), Jogira Member (Valdiya, 1975) in the published literature. The present paper uses the terminology of Shanker and Ganesan (1973) for its more frequent current use.

SYSTEMATIC PALAEONTOLOGY

The fossil collection described here was collected from a greenish-grey shaly horizon of the Boulder slate sequence exposed about 0.80 km NW of Ghildiyal village (29° 47′ 00″ : 78° 40′ 15″), near a spring on Malethan-Konakholi foot track; this indicates the same sample location as one of the localities of Shanker *et al.*, (1973). The fossils were collected in field by one of us (MPS) in collaboration with Ravi Shanker in 1973.

All the figured specimens are housed in the Museum, Geology Department, Lucknow University, Lucknow, under Catalogue Nos. GLUMF 1320 to 1327. Additional material exists in the personal collection of Dr. M. P. Singh.

SYSTEMATIC DESCRIPTION

Phylum Brachiopoda
Class Articulata Huxley, 1869
Order Spiriferida Waagen, 1883
Sub-order Spiriferidina Waagen, 1883
Superfamily Spiriferacea King, 1846
Family Spiriferidae King, 1846

Neospirifer fasciger (Keyserling, 1846)

(Plate I—1)

1846 *Spirifer fasciger* Keyserling, Reise in *des Petschoraland* Taf. VIII, fig. 3.

Material : One nearly-complete, well preserved and the other well preserved but partial brachial valve and one or two fragmentary pieces.

Remarks : The two brachial valves in the collection resemble closely the figured specimens of Bion and Middlemiss (1928 ; pl. I, Fig. 5), with characteristic angular fasciculi. The ribs in the fasciculus, however, are only faintly observable because of the partially eroded surface wall of the shells. But the shell outline with the characteristic shape of the fasciculi undoubtedly place the forms under the species. Lack of any trace of concentric ornamentation differentiates the present forms from *Brachythyrinella* cf. *narsarhensis* (Reed, 1928).

Dimensions in mm :

Specimen	Valve	Length	Width
No. Glumf 1320 ..	Brachial	27.6	55.4

Order Productida Sarycheva, Likharev and Sokolaskaya, 1960
Sub-order Productidina Waagen, 1885
Superfamily Productacea Gray, 1840
Family Linoproductidae Stehli, 1954
Subfamily Linoproductinae Stehli, 1954

Linoproductus cf. *cora* (d'Orbigny, 1842)

(Pl. I—2)

1842 *Productus cora* d' Orbigny, *Voyage dans l' Amerique Meridionale, Meridionale*, Vol. III, *Palaeontologie*, p. 55, Pl. V. Figs. 8, 9.

Material : Two relatively well preserved pedicle valves and six additional fragmentary specimens.

Remarks : The specimens closely resemble the figured specimens of Diener (1911, Pl. III, Figs. 3-13) from Shan State of Burma. All the specimens are small in size and exhibit characteristic costellate ornamentation of the shell wall, interrupted with few transverse lamellae which become prominent on the sides of shell. The shells in the collection are generally slightly deformed by compression.

Dimensions in mm :

Specimen	Valve	Length	Width
No. GLUMF 1321 ..	Pedicle	17.2	20.5

Family Echinoconchidae Stehli, 1954
Subfamily Waagenoconchinae Muir-Wood and Cooper, 1960

Waagenoconcha cf. *gangetica* (Diener, 1897)

(Pl. I—3)

1897. *Productus gengeticus* Diener, *Pal. Ind.*, Ser. 15, Vol. I, pt. 4 Pl. I, Figs. 1a-d, 2 and 3, Pl. II, Fig. 3.

Material : One relatively well preserved specimen and three additional fragmentary specimens.

Remarks : The characteristic transversely oval shape of the pedicle valve with straight hinge line is clearly discernible. The shell-wall ornamentation is finely postulose.

Dimensions in mm :

Specimen	Valve	Length	Width
No. GLUMF 1322 ..	Pedicle	25	27.5

Order Spiriferida WAAGEN, 1883
Suborder Retziidina BOUCOT JOHNSON and STATON, 1964
Superfamily Athyrisinaceae GRABAU, 1931
Family Athyrididae M'COY, 1844
Subfamily Athyridinae M'COY, 1844

Cleiothyridina semiconcava (WAAGEN, 1883)

1883. *Arthyris semiconcava* Waagen, *Pal. Ind.* Ser. 13, Vol. 1, pt. 4, Pl. 41, Figs. 4-6.

Material : One relatively better preserved pedicle valve and five additional specimens. Several fragmentary specimens.

Remarks : The general outline of the shell as more or less transversely oval with nearly flat brachial valve is characteristic of this species. The transverse growth lamellae are, however, only faintly visible because of the generally imperfect preservation.

Dimensions in mm :

Specimen	Valve	Length	Width
No. GUMiF 1323 ..	Pedicle	17.2	23.4

Bryozoa

Family Fenestellidae KING, 1950

Fenestella sp.

(Pl. I—5)

Material : All the samples are usually crowded with this genus.

Remarks : The zoarium is funnel or fan-shaped. The characters of zooecia and fenestrule nearly resemble the figured specimens of Ganesan (1972, Fig. 2).

Polypora cf. *dieneri* GANESAN, 1972

1972. *Polypora dieneri* Ganesan, *Him. Geol.* Vol. 2, Fig. 5.

Material : Five better preserved specimens and several fragmentary specimens.

Remarks : The specimen in the collection is nearly identical to the figured specimens of Ganesan (1972, Fig. 5). The fenestrules are oval to rectangularly oval and are of nearly uniform length, while their width varies considerably.

Polypora sp.

(Pl. I—7 & 8)

Material : Several fragmentary specimens in the collection.

Remarks : The colony is irregularly shaped. The fenestrules are nearly rounded in outline. The characters of zooecia and dissepiments are not well preserved for precise identification.

FAUNAL ASSEMBLAGE

The brachiopod genera *Neospirifer fasciger*, *Waagenoconcha gangetica* and *Linoproductus cora* are known from strata ranging in age from Lower Carboniferous to Upper Permian (Diener, 1890, 1897, 1903, 1911 and 1915 ; Hayden, 1904 ; Bion and Middlemmiss, 1928 ; Reed, 1932 ; and Muirwood and Oakley, 1941).

Likewise the bryozoan genera being recorded here are also widely known from the Carboniferous and Permian sequences of the Tethyan basins of Himalaya and were first described from the present Lesser Himalayan area by Ganesan (1972). However, the present record of *Cleiothyridina semiconcava* (Waagen 1883) is significant from the point of view of giving a more or less precise age to the present fossil assemblage as being of Artinskian, as this species is known to be characteristic of the Amb formation of Salt Range which is indisputably assigned to Artinskian by all the workers (Waagen, 1883 and Waterhouse and Gupta, 1977). The authors are, therefore, of the view that the present assemblage is suggestive of the presence of Artinskian elements too in the fossiliferous Permian of Garhwal Synform.

C. semiconcava (Waagen 1883) has also been recorded recently from the Calcareous Sandstone (underlying the Productus Shale) of Spiti along with additional fossils favouring Artinskian age (Bhatt and Joshi, 1981).

REMARKS ON THE AGE OF THE PERMIAN FOSSILIFEROUS HORIZON

To date there are seven previous publications on palaeontological-palynological aspects of this important fossiliferous horizon.

Commencing with the significant discovery of fenestellid bryozoans by Ganesan (1971 and 1972) and of brachiopods and bivalves by Chaturvedi and Talent (1971), the scope of the palaeontological data was further broadened with the fossil records of Shanker *et al.*, (1973), Waterhouse and Gupta (1978), Singh *et al.*, (1979) and Gupta and Visscher (1980).

The assignment of age as Middle to late Carboniferous by Ganesan (1972) on the basis of largely non-diagnostic fenestellids (*Fenestella*, *Polypora* and a new genus *Dogaddanella*), which are so very common in Carboniferous as well as Permian sequences in the northerly Tethyan basins, has to be relegated to the status of historical perspective, especially when evaluation of age on specific brachiopod and bivalve assemblage is now available (Waterhouse and Gupta, 1978). A general Permian age assigned by Chaturvedi and Talent (1971), who also collected species of the bivalve *Aviculopecten* and brachiopods *Spirifer* and *Strophalosia* besides *Fenestella*, from the locality of Sila Gad valley, is however, more in line with the development of the idea of age with accumulating fossil evidences.

Assignment of Middle Carboniferous age to a conglomeration of fossils by Shanker *et al.*, (1973), who collected from five different localities, is also not acceptable now with ever improving precision in the fossil data, as will be clear later. Moreover, Shanker and Ganesan (1973)

assigned the same horizon a Permocarboniferous to Permian age. According to H. M. Kapoor (in Valdiya, 1975) the assemblage of Shanker *et al.*, (1973) contained elements of Lower Artinskian (or Sakmarian) age.

Waterhouse and Gupta (1978), who collected samples from Ganesan's locality, showed the similarity of their brachiopod and bivalve fauna with the Umaria fauna of Peninsular India and considered it of Sakmarian. Though a definite age for the Umaria fauna is disputed (Waterhouse 1970 ; Dickins and Shah, 1977), yet its comparison with west Australian faunas favours a Sakmarian age (Dickins and Shah, 1977). Many workers regard the Umaria fauna to include Artinskian elements too (Sastry and Shah, 1964 ; Shah and Ghosh, 1977).

The brachiopod collection with us, however, does not reveal Sakmarian elements specifically.

Keeping the above in mind, we draw the conclusion that in the entire thickness of fossiliferous Permian horizon of Garhwal, whereas similar bryozoan genera may be occurring more or less throughout, the specific brachiopod and bivalve elements are likely to occur in different layers, most probably, vertically separated.

An important find fortifying the above contention, is the recent fossil record of Singh *et al.*, (1979) from the Tal nadi section. It is exclusively a bivalve assemblage and has dominance of eurydesmids in the fauna. It includes elements of Bren beds of Kashmir and Manendragarh fauna of the Peninsular India, indicative of a probable Asselian age (Acharyya and Shah, 1975 ; Kapoor and Shah, 1979).

A very recent record of palynomorphs from this horizon (Gupta and Visscher, 1980) shows a possibility of the occurrence of elements of Talchir, Karharbari and Barakar formations of the Lower Gondwana, which, in turn, would indicate Asselian to early Artinskian age (Sastry *et al.*, 1977).

CONCLUSION

Under the tentative proposals alluded to in the present paper it is clear that the Boulder Slate fauna of Garhwal is not older than Permian and includes the faunal elements of only Lower Permian, possibly of all its stages. As a further step in this regard it now becomes important in a future work to systematically collect samples along several measured profiles of the Permian fossiliferous horizon (=Boulder slate sequence) and study the fauna to establish if the fauna really occurs sequentially, from Asselian through Sakamarian to Artinskian, for which there exists a reasonable possibility with the more recent fossil records at hand.

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REFERENCES

Acharyya, S. K. and Shah, S. C. 1975. Biostratigraphy of the marine fauna associated with the diamictites of the Himalayas. *Bull. Indian Geol. Assoc.* **8**(2) : 9-23.

Auden, J. B. 1934. The geology of the Krol Belt. *Rec. Geol. Sur. India.* **67** : 357-454.

Auden, J. B. 1937. The structure of Himalaya in Garhwal. *Rec. Geol. Surv. India.* **71** : 407-433.

Bhargava, O. N. 1979. Lithostratigraphic classification of the Blaini, Infra Krol, Krol and Tal formations—a revi w. *Jour. Geol. Soc. India.* **20** : 7-16.

Bhatia, S. B. 1980. The Tal tangle. In K. S. Valdiya & S. B. Bhatia (Eds.) *Strat. correlations of Lesser Himalayan formations.* Hindustan Publishing Corpor. (India) Delhi. 79-96.

Bhatt, D. K. and Joshi, V. K. 1981. Artinskian (Lower Permian) in spiti. *Rec. Geol. Surv. India.* **112**(8) : 45-50.

Bion, H. S. and Middlemiss, C. S. 1928. The fauna of the Agglomeratic slate series of Kashmir. *Pal. Indica.* (N. S.) **12** : 1-42.

Chaturvedi, R. S. and Talent, J. A. 1971. A preliminary note o. the discovery of richly fossiliferous Permian rocks in Garhwal Himalayas in Lansdowne area. *Second Semi ar Wadia Inst. Himal. Geol.* (Special report .

Dhoundiyal, J. N. and Kumar, G. 1976. On the geolo y of part of Garhwal synform, Tehri Garhwal and Garhwal districts, U. P. Presented at *Symp. on the Contri. Earth Sci. in Res. and Development Activities in Northern Region Geol. Surv. India*, Lucknow (125th Anniversary Celeberations of GSI).

Dickins, J. M. and Shah, S. C. 1977. Correlation of the Permian marine sequence of India and Western Australia. Key paper sec. VI, *4th Int. Gond. Symp. Geol. Surv. India, Calcutta* : 1-44.

Diener, C. 1890. Anthracolithic fossils of Kashmir and Spiti. *Pal. Indica.* Ser. 15, **1**(2) : 1-95.

Diener, C. 1897. The Permo-Carboniferous Fauna of Chitichum No. 1. *Pal. Indica.* Ser. 15, **1** 3) : 1-105.

Diener, C. 1903. Permian fossils f the Central Himalaya. *Pal. Indica.* Ser. 15, **1**(5 : 1-204.

Diener, C. 1911. Anthracolithic fossils of the Sha States. *Pal. Indica* (N. S.) **3**(4) : 1-74.

Diener, C. 1915. Anthracolithic fauna of Kashmir, Kanaur and Spiti. *Pal. Indica* (N. S.) **5**(2) : 1-135.

Ganesan, T. M. 1971. Note on the first record of fenestellid bryozoan in the "Volcanic Breccia" of Garhwal. *Indian Minerals.* **24** : 257.

Ganesan, T. M. 1972. Fenestellid Bryozoa from the Boulder Slate sequence of Garhwal. *Him. Geol.* **2** : 431-451.

Gupta, V. J. and Visscher, H. 1980. Early Permian palynomorphs from the Bijni tectonic unit of Garhwal Himalaya. *Bull. Indian Geol. Assoc.* **13**(1) : 63-65.

Hayden, H. H. 1904. The Geology of Spiti with parts of Bashahr and Rupshu. *Mem. Geol. Surv. India.* **36**(1) : 1-121.

Kapoor, H. M. and Shah, S. C. 1979. Lower Permian in Kashmir Himalayas—a discussion. *Geol. Surv. India Misc. Pub.* **41**(1) : 97-113.

Kumar, G. and Dhaundiyal, J. N. 1980. On the stratigraphic position of the Tal Formation, Garhwal synform, Garhwal and Tehri Garhwal districts, Uttar Pradesh. *Jour. Pal. Soc. India.* **23-24** : 58-66.

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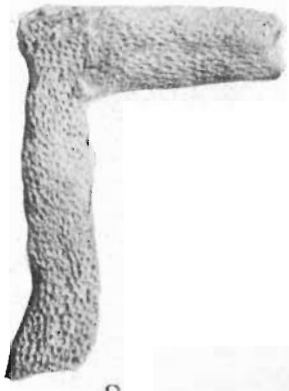

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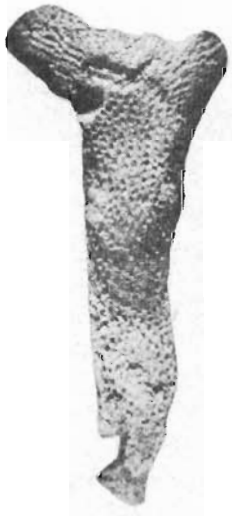

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KUMAR, G. 1979. Structural framework and Tectonic evolution of Kumaun Himalaya in parts of Garhwal and Kumaun divisions U. P. Abst. *Tenth Seminar Him. Geol. Wadia Inst. Dehradun.* : 2-4.

MEDLICOTT, H. B. 1864. On the geological structure and relation of the southern portion of the Himalayan Ranges between the rivers Ganges and Ravee. *Mem. Geol. Surv. India.* **3**(2) : 1-206.

MIDDLEMISS, C. S. 1885. A fossiliferous series in the Lower Himalaya, Garhwal. *Rec. Geol. Surv. India.* **18**(2) : 73-77.

MIDDLEMISS, C. S. 1887. Physical Geology of West British Garhwal with note on a route traverse through Jaunsar Bawar and Tehri Garhwal. *Rec. Geol. Surv. India.* **20**(1) : 26-40.

MUI WOOD, H. M. AND OAKLEY, K. P. 1941. Upper Palaeozoic faunas of North Sikkim. *Pal. Indica* (N. S.) **31**(1) : 1-19.

REED, F. R.C. 1932. New fossils from the Agglomeratic slate of Kashmir. *Pal. Indica* (N. S.) **20**(1) : 1-79.

SASTRY, M.V.A. AND SHAH, S. C. 1964. Permian marine transgression in Peninsular India. *22nd Int. Geol. Cong.* **19** : 139-150.

SASTRY, M. V. A., ACHARYYA, S. K., SHAH, S. C., SATSANGI. P. P., GHOSH, S. C., RAHA, P. K., SINGH, G. AND GHOSH, R. N. 1977. Stratigraphic lexicon of Gondwana Formations of India. *Geol. Surv. India Misc. Pub.* **36** : 1-170.

SHAH, S. C. AND GHOSH, R. N. 1977. In Sastry, M. V. A. *et al.*, (e ls.) Stratigraphic lexicon of Gondwana Formations of India. *Geol. Surv. India Misc. Pub.* **36** : 93-94.

SHANKER, R. AND GANESAN, T. M. 1973. A note on Garhwal Nappe. *Him. Geol.* **3** : 72-82.

SHANKER, R., DHOUNDIYAL, J. N. AND KAPOOR, H. M. 1973. The fossiliferous bed (Boulder slate member) of Garhwal syncline. *Jour. Pal. Soc. India.* **17** : 50-54.

SINGH, I. B. 1979a. Recognition of a sedimentological break between quartizite and limestone members of the Tal Formation, Lesser Himalaya, India. *Curr. Sci.* **8** : 206-208.

SINGH, I. B. 1979b. Environment and age of the Tal Formation f Mussoorie and Nilkanth areas of Garhwal Himalaya. *Jour. Geol. Soc. India.* **20** : 214-225.

SINGH, M. P., MEHROTRA, P. C. AND KACKER, R. K. 1979. Some observations on the structure of the Garhwal syncline, U. P. Himalaya. *Curr. Sci.* **18**(8) : 346-349.

SINGH, P. 1980. Microfauna, age, palaeoenvironment and palaeobiogeography of the Tal Formation, Lesser Himalaya, Garhwal, Uttar Pradesh India. *Curr. Sci.* **49** : 255-261.

VALDIYA, K. S. 1975. Lithology and age of the Tal Forma ion in Garhwal and implication on stratigraphic scheme of Krol belt in Kumaun Himalaya. *Jour. Geol. Soc. India.* **16**(2) : 119-134.

WAAGEN, W. 1883. Salt Range Fossil Brachiopod. *Pal. Indica.* **3**(4).

WATERHOUSE, J. B. 1970. Gondwana occurrence of the Upper Palaeozoic Brachiopod *Stepanoviella. Jour. Pal.* **44**(1) : 37-50.

WATERHOUSE, J. B. AND GUPTA, V. J. 1977. Permian faunal zones and correlation of the Himalayas. *Bull. Ind. Geol. Assoc.* **10**(2) : 1-19.

WATERHOUSE, J. B. AND GUPTA, V. J. 1978. Early Permian fossils from Bijni tectonic unit, Garhwal Himalaya. *Recent Researches in Geology.* Hindustan Publishing Corporation, Delhi. **4** : 410-437.

EXPLANATION OF PLATE

PLATE I

1 *Neospirifer fasciger* (Keyserling), brachial valve, No. GLUMF 1320, ×0.8.
2 *Linoproductus* cf. *cora* (d' Orbigny), pedicle valve, No. GLUMF 1321, ×1.7.
3 *Waagenoconcha* cf. *gangetica* (Diener), pedicle valve, No. GLUMF 1322, ×1.
4 *Cleiothyridina semiconcava* (Waagen), pedicle valve, No. GLUMF 1323, ×2.
5 *Fenestella* Sp. No. GLUMF 1324×2.
6 *Polypora* cf. *dieneri* Ganesan, No. GLUMF 1325, ×2.
7 *Polypora* Sp. No. GLUMF 1326, ×2.2.
8 *Polypora* Sp. No. GLUMF 1327, ×2.4.