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TETHYAN CRETACEOUS RADIOLARIA FROM MALLA JOHAR AREA, KUMAON HIMALAYA, UTTAR PRADESH, INDIA

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ABSTRACT

A rich radiolarian microfauna is recorded from the Tethyan Cretaceous sequence exposed near Sancha Malla, Malla Johar area, Pithoragarh District, Uttar Pradesh. The microfauna has been investigated in thin sections only as the radiolarian shells could not be extracted from the indurated siliceous and glauconitized matrix by chemical treatment. The shells have also undergone large scale glauconitization.

Despite the limitations of thin section study, several taxa have been identified. The radiolarians recorded in this report belong to the lowermost horizons of the Giumal Sandstone (Lower Cretaceous), Upper part of the Jhangu Formation (Upper Cretaceous) and the Balcha Dhura Formation (?Post-Cretaceous). The assemblages from these levels show distinct qualitative and quantitative differences in composition. Based on these differences four radiolarian biofacies have been designated. These radiolarian biofacies in the Cretaceous Tethyan sequence may well prove to be useful in the correlation of Tethyan sequences of the Himalaya and possibly, the other regions of the world.

INTRODUCTION

The radiolarians in the Tethyan Cretaceous sequence of Malla Johar area, Kumaon Himalaya, are known since the work of Heim and Gansser (1939) who first noted their abundance in the petrographic thin sections of cherts. Recent micropalaeontological investigations of the Upper Jurassic-Cretaceous rocks of this area have further revealed a rich and varied microplankton assemblage comprising of dinoflagellates and radiolarians. The dinoflagellates are profuse in the Upper Jurassic Spiti Shale while radiolarians are present only in the Cretaceous sediments. A preliminary account on the occurrence of dinoflagellates and radiolarians of the Malla Johar area has already been published by us (Jain *et al.*, 1978). In the present paper an attempt is made to describe and discuss the significance of the Cretaceous radiolarian fauna.

The extraction of radiolarians from these rocks is a problem due to the large scale glauconitization and silicification, which restricted the present study to only petrographic thin sections. Since radiolarians have great morphological diversity and complexity, their study in thin sections may not usually permit an accurate and righteous morphotaxonomical treatment. The study, therefore, has its own limitations. Nevertheless, it has been felt desirable to record the present radiolarian assemblage for their qualitative and quantitative richness.

GEOLOGICAL SETTING

The Tethys Himalayan belt lying north of the main mountain range of the Central Himalaya exposes a remarkably well developed almost continuous sequence ranging in age from pre-Cambrian to Cretaceous or even younger (?Early Eocene, vide Kumar *et al.*, 1977). Known as the Tethyan or Tibetan Himalaya, this belt extends all along the Himalayan chain from NEFA to Kashmir.

Investigations of the Tethyan sediments of Malla Johar area were initiated during the last century by Strachey (1851) and Greisbach (1891, 1893). Subsequently, Heim and Gansser (1939) and Gansser (1964) added much valuable information to its geology. The structure and stratigraphy of these rocks have recently been reviewed and described by Kumar *et al.* (1972) Sah and Sinha (1975) and Kumar *et al.* (1977).

The Upper Mesozoic succession in the area is exposed in a very hazarduous terrain where the height generally varies between 4500 m to 6000 m. The rocks are dominantly made up of argillaceous and arenaceous clastic sediments with some intercalations of limestone, chert and basic volcanic rock.

The lithostratigraphic subdivision of the entire Upper Jurassic-Cretaceous sequence in the area proposed by Kumar *et al.* (1977) has been summarised in the following Table 1 with some modifications.

MATERIAL

The samples investigated for their microplankton content were collected by one of us (S. Kumar) along the Laptal—Balcha Dhura and Laptal-Chojan La mule tracks during an expedition to the Malla Johar area organised by the Wadia Institute of Himalayan Geology in 1973 (Fig. 1).

All formational units of the Sancha Malla Group, except the basal Spiti Shale, have yielded radiolaria. However, the radiolaria bearing samples are confined to

Table 1 : Classification of Upper Jurassic—Cretaceous rocks of Malla Johar area, Kumaon Himalaya (modified after Kumar *et al.* 1977 ; *after Singh *et al.*, MS).

Group		*Formation*	*Lithology*	*Thickness*	*Age*
MALLA JOHAR SUPERGROUP	Sancha Malla .. Group	Balcha Dhura Formation ..	Basic volcanic rocks interbedded with reddish brown and greyish green shales and radiolarian cherts.	90 m	?Post-Cretaceous
		Jhangu Formation ..	Greenish black graywacke, shales and calcareous sandstones with red foraminiferal limestone and shale at the base, and thin red and green shales with cherty intercalations at the top.	400 m	Upper Cretaceous
		Giumal Sandstone ..	Glauconitic sandstone, shale and silt-stone with black cherty intercalations rich in radiolarians at the base.	400 m	Lower Cretaceous
		Spiti Shale ..	Black friable shales and siltstones with abundant nodules enclosing ammonites in the upper part.	250 m	Lower Hauterivian* to Oxfordian
	Rawali- .. bagar Group	Ferruginous Oolite Formation ..	Ferruginous oolitic limestone and shales with abundant ammonites.	10 m	Callovian

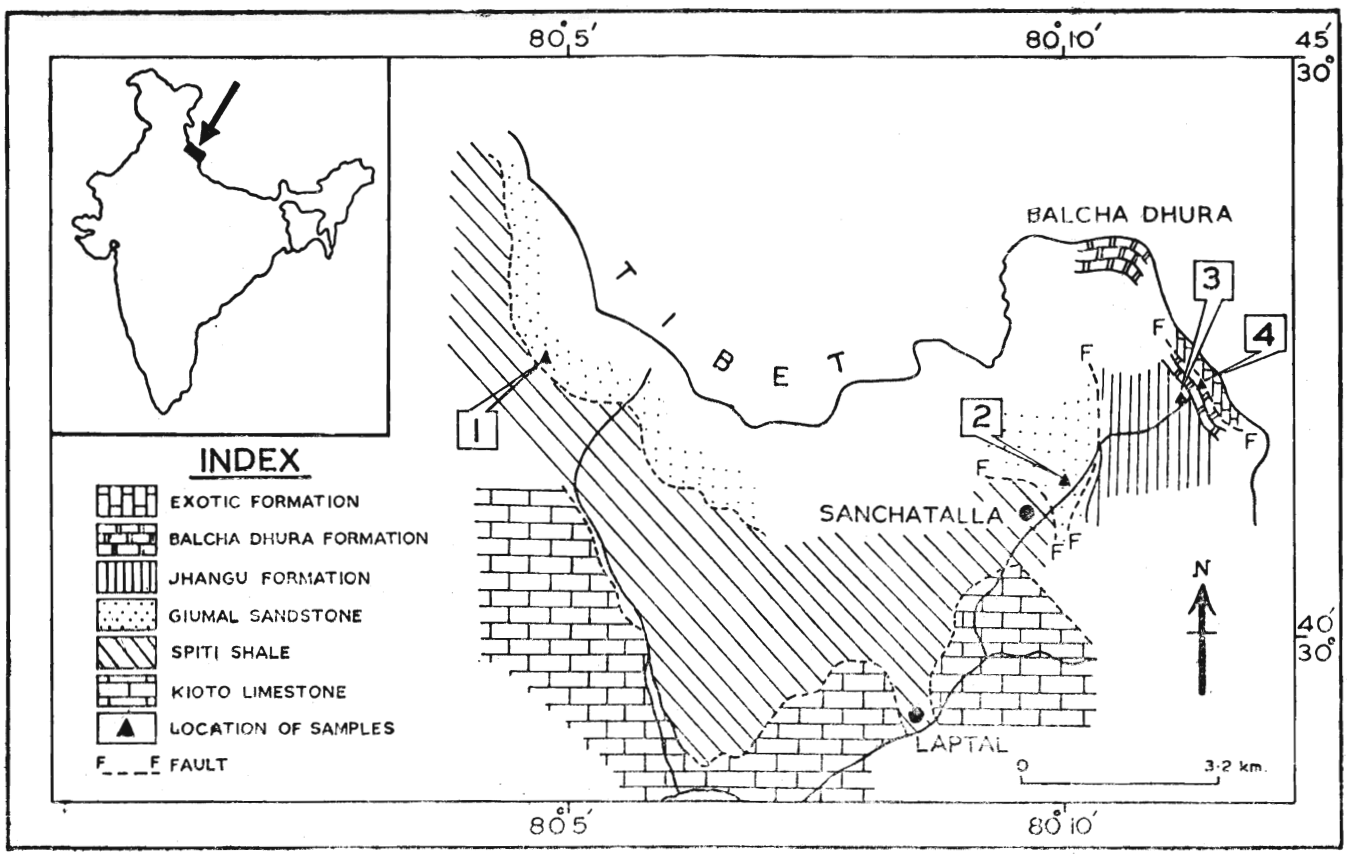

Fig. 1. Geological map of the area showing location of the samples.

a few specific levels only in the 900 m thick sequence. The samples included in the present study belong to the base of the Giumal Sandstone, upper part of the Jhangu Formation and the Middle and the top of the Balcha Dhura Formatoin (Fig. 2).

Radiolaria have also been observed in samples from the upper part of the Giumal Sandstone and lower part of the Jhangu Formation but the assemblages are meagre and poorly preserved. This deficient microfauna has not been included in the present study.

The radiolaria bearing rocks are generally hard and compact cherts, siliceous or cherty shales and greywackes. The last two lithotypes have undergone large scale glauconitization. Attempts to extract radiolarians from indurated siliceous matrix were only partially successful due to the fact that the shells have also been largely replaced by glauconite. The radiolarian shells extracted after chemical treatment are too fragile, often destroyed, and remain in a poor state of preservation. Glauconite has partially or completely replaced the siliceous shells obscuring general morphological features. Recently, Pessagno and Newport (1972) successfully applied the hydrofluoric acid technique for separating the radiolarians from cherts. This method when applied to the present material, also could not give good results due to the poor preservation of microfossils. However, in several of the thin sections of black and red cherts and graywackes, well preserved radiolarian shells are observed showing certain important morphological features.

The stratigraphic position of the productive samples in a part of the Sancha Malla Group are shown in the litholog (Fig. 2). It has been noticed that in horizons which are rich in radiolarians, other microfossils are wanting.

All figured slides are housed at the Museum, Birbal Sahni Institute of Palaeobotany, Lucknow. The co-ordinates refer to the Jena Amplival microscope. The following are the sample numbers with museum slide numbers in paranthesis : E_2SH_1 (5914, 5915), E_1SH_2 5916, 5917); E_2CC_4 (6044); E_2CC_1 (6045); E_3139 (6046, 6046A, 6046B) ; E_2BD_1 (6046C), E_2BD_2 (6046D) and E_2BD_3 (6046E).

PETROGRAPHIC DESCRIPTION OF SAMPLES

Petrographic study of the thin sections reveals that the radiolaria bearing rocks can be broadly grouped into three types (in stratigraphically ascending order) :

(*a*) Greenish grey with cherty radiolarian cherts:

The streaky cherts are interbedded with shale and sandstone near the gradational contact between the Spiti Shale and the Giumal Sandstone. The samples (E_2SH_1 and E_2SH_2) belong to the Giumal Sandstone formation. The cherts are made up of radiolarian shells floating in a light grey to greenish grey chalcedonic matrix. Clay, carbonaceous matter, angular detrital quartz grains and some opaque minerals (most probably pyrite) are irregularly distributed in the matrix.

The radiolarians are abundant and well preserved though the shells are commonly glauconitized and filled up with microcrystalline as well as fibrous silica. The radiolarian assemblage is quite diverse. The nassellarians are more common belonging mostly to the families Williriedellidae and Theoperidae. The most significant constituents of the assemblage are cryptothoracic nassellarians and spumellarians referable to *Cenosphaera*, followed by multisegmented theoperids including some ribbed forms (cf. *Dictyomitra*). Besides these, several unidentifiable spumellarians having spiral as well as concentric pore pattern, have been tentatively assigned to Spongodiscids and/or Pseudoaulophacids. Rare 3 armed, fragmentary? Hagiastrids and spherical shells with strong but short bipolar spines are also present.

(*b*) Greywacke with cherty streaks:

The rocks consist of poorly sorted angular to subrounded quartz grains, rock fragments, felspars and glauconite seen in a clay matrix. These are generally associated with chert streaks which are occasionally rich in radiolarians. The graywacke layers are poor in radiolarians. In some samples, thin layers of chert and graywackes are clearly evident in thin section also. The following samples from the upper part of the Jhangu Formation have been studied (in stratigraphically ascending order) :

(i) E_2CC_{11} : The rock is lithic graywacke. Radiolarians are very rare, represented by a few *?Cenosphaera* and a single specimen of cryptothoracic nassellaria. Some lituolid foraminifera have also been observed at this level.

(ii) E_2CC_{10} : The rock may be termed as lithic graywacke, similar to E_2CC_{11}, with sericite and chlorite flakes. Calcite cement is quite conspicuous. Radiolarians are frequent, represented by rare thick shelled *?Cenosphaera* and theoperids, including a 3-segmented thick walled form (*?Theocapsomma*). A couple of poorly preserved specimens having several concentric shells and referable to Actinomiidae, are also present.

(iii) E_2CC_9 : Radiolarians are few but somewhat well preserved. Thick walled forms referable to *Cenosphaera* which are often distorted or broken, and a couple of cryptocephalic forms are the only radiolarians noticed at this level.

(iv) E_2CC_3 : Radiolarians are moderate in number, represented by thick shelled *?Cenosphaera*, multisegmented theoperids (cf. *Dictyomitra* or *Lithostrobus*), a few cryptocephalic nassellaria and rare cryptothoracic (cf. *Cryptamphorella*) forms.

(v) E_2C_4 : The radiolarian shells are seen in a cryptocrystalline cement. Angular quartz grains with argillaceous matter are commonly distributed. Glauconitization is relatively on a minor scale.

The radiolarian assemblage is rich and contains many forms referable to *Cenosphaera* besides several multisegmented theoperid and cryptothoracic nasselarians. Most of the theoperids are referred to *Dictyomitra*, *Eucyrtis*, *Lithocampe* and *Sethocapsa*. Several spumellarians tentatively referable to Spongodiscids and a few Actinommids, having 3-4 concentric shells and bearing strong polar spines, have also been observed.

(vi) E_2C_2 : In thin sections, calcite cement is seen at a few places. Radiolarians are very rare but somewhat better preserved in an argillaceous matrix. A couple of spherical spumellarians (*?Cenosphaera*) and thick walled cryptocephalic nassellarians with cephalo-thorax partially destroyed, have been encountered.

(vii) E_2CC_1 : The rock is similar to E_2C_4 except that a few dolomite crystals and muscovite flakes are also seen. The radiolarians are fairly common. Single shelled spumellarians (cf. *Cenosphaera*) are most frequent, followed by multisegmented theoperid nassellarians referable to *Dictyomitra*, *Lithocampe* and *Eucyrtidium*. A few longitudinally ribbed *Dictyomitra* specimens have been encountered. Cryptocephalic and cryptothoracic nassellarians are common and significantly represented. The pseudoaulophacid (?) spumellarians are rare.

(viii) E_3139 : The rock is graywacke with thin layers of rich radiolarian chert which are clearly evident in thin sections. Among radiolarians the Nassellaria are more common and varied than Spumellaria. The assemblage is quite significantly dominated by multisegmented theoperids and thick-walled single shelled forms (*?Cenosphaera*). Other forms include some cryptothoracic nassellarians, unidentified spumellarians and a few forms referable to *Amphipyndax*.

(*c*) Red radiolarian cherts:

The cherts occur in association with basic and ultrabasic volcanic rocks. These are exclusively made up of cryptocrystalline chert reddened with hematite dust and clay particles and enclose numerous poorly preserved, spherical, single shelled spumellarian Radiolaria. At places the concentration of hematite and clay is such that the matrix becomes opaque and no details could be seen. The radiolarian shells are generally represented by transparent areas scattered in the cryptocrystalline cement. These areas are usually free of hematite. The rock is criss-crossed with veins made of chalcedony and quartz. The samples (E_2BD_1, E_2BD_2 & E_2BD_3) were obtained from the middle and upper parts of the Balcha Dhura Formation.

Due to their poor preservation, the small, spherical spumellarians could not be assigned satisfactorily to any genus. Among Nassellaria, theoperids alongwith a few cryptothoracic and cryptocephalic forms are commonly encountered. A few sections have also shown presence of some unidentified Spumellaria (?Actinomiids and ?Spongodiscids). A rare, 3 armed spumellarian (?Hagiastrid) has also been encountered.

MICROPALAEONTOLOGY

The qualitative and quantitative diversity of the radiolarian assemblages recovered from different levels of the present sequence in the area is quite significant. The nassellarians are dominant in the Giumal Sandstone and the Jhangu Formation whereas the spumellarians abound in the Balcha Dhura Formation. The nassellarian assemblage of the Giumal Sandstone differs from that of the Jhangu Formation in having an abundance of cryptothoracic forms, whereas the Jhangu Formation is rich in multisegmented Theoperids. Also, the radiolarian shells observed in the Jhangu Formation are quite large and robust than those of the Giumal Sandstone.

Four distinct radiolarian microbiofacies have been identified in the sequence (Fig. 2), which characterize the base of the Giumal Sandstone, top of the Jhangu Formation and upper part of the Balcha Dhura Formation. These assemblages are, however, not intended to represent formal biostratigraphic zones but have been proposed to serve as individual microbiofacies, representative of a few selected stratigraphic horizons, in the correlation of Tethyan Cretaceous succession.

The different radiolarian biofacies identified in the Malla Johar Cretaceous sequence may well prove to be useful in the correlation of Tethyan sequences of the Himalaya and possibly also other regions of the world. The reason for this supposition is the fact that radiolarites and other radiolaria-bearing Jurassic-Cretaceous rocks are found to be quite widespread throughout the Tethyan belt.

DESCRIPTION OF ASSEMBLAGES

Assemblage A : The samples belong to the basal 30 metres of the Giumal Sandstone Formation, containing interbedded black streaky cherts, sandstones and shales (Fig. 2). The assemblage in general is dominated by cryptothoracic and multisegmented theoperid Nassellaria and single shelled Spumellaria (*?Cenosphaera*). Some unidentified Spongodiscid (?) spumellarians are also commonly present.

The characteristic nassellarian taxa present in the

assemblage are : *Lithocampe elegantissima*, *Lithocampe* sp. 1, *Stichocapsa* sp. cf. *S. megalocephalia*, *Sethocapsa* sp., *Eucyrtis* sp. A, *Zhamoidellum* (or *?Cryptamphorella*), *Holocryptocapsa* and *Williriedellum*.

This assemblage compares favourably with some of the Lower Cretaceous assemblages known from different parts of the world. It resembles quite well with the Upper Jurassic-Cretaceous assemblage recorded by Dumitrica (1970) from Romania in having common abundance of cryptothoracic nassellaria. Among theoperids, a few forms viz., *Lithocampe elegantissima*, *Eucyrtis* sp. A and *Sethocapsa* sp. are similar to those recorded from the Lower Cretaceous of Rotti Island near Timor, Point Sal, California and DSDP Leg 26 (Riedel and Sanfilippo, 1974) and DSDP Leg 20 (Foreman, 1973).

The present assemblage, thus, supports a Lower Cretaceous age which is indicated also by its stratigraphic position as it occurs above the cherty intercalations bearing Lower Hauterivian ammonites (Singh *et al.* MS) at the top of the underlying Spiti Shale sequence.

Assemblage B : The samples belong to the 50 m to 100 m interval from the top of the Jhangu Formation (Fig. 2). Several samples from this interval contain radiolarians but the individual assemblages recovered are usually meagre. In general, multisegmented theoperids and single shelled Spumellarians (*?Cenosphaera*) are the most prolific elements of this assemblage. Cryptothoracic nassellarians are also present in good numbers. Rare, well preserved forms of some Actinomiid Spumellaria, containing 2 to 4 concentric shells and bearing strong spines, have also been encountered.

Characteristic forms of this assemblage are : *Eucyrtis* sp. A, *Euyrtis* sp. cf. *E. micropora*, *Dictyomitra* sp. cf. *D. pseudomacrocephala*, *Dictyomitra*, *Lithocampe* sp., cf. *Eucyrtidium*, *Sethocapsa* sp. cf. *S. cetia*, *Sethocapsa* sp., cf. *Gongylothorax*, *Holocryptocanium*, cf. *Cryptamphorella*, *?Amphipyndax* and *?Cenosphaera*.

A perusal of the known Cretaceous assemblages reveals that this assemblage has a distinct Cretaceous aspect. Besides having some forms viz., *Dictyomitra* sp. cf. *D. pseudomacrocephala*, *Holocryptocanium* and *Amphipyndax*, which are variously recorded from the Late Cretaceous, it also includes a few others, viz., *Eucyrtis* sp. cf. *E. micropora* and *Sethocapsa* sp. cf. *S. cetia* which are previously reported only from the Early Cretaceous. The early or late cretaceous age conclusions based on the present assemblages, therefore, could not safely be drawn. However, its age is presently established from the fact that it occurs at a higher stratigraphic level than that of coccolithophorids of the *Tetralithus trifidus* zone which indicates the Campanian-Maestrichtian boundary (S. Jafar in Kumar *et al.*, 1977, p. 419).

Assemblage C : The samples belong to the top most 50 m. of the Jhangu Formation. Radiolarians are profuse and very well preserved at this level. Multisegmented theoperids alongwith the single shelled spumellarians (*?Cenosphaera*) continue to dominate the assemblage but the former are represented commonly by a different suite of forms than contained by the Assemblage B. Cryptothoracic nassellarians are common but fewer in number than present in Assemblage B. Some unidentifiable spumellarians have also been encountered.

Characteristic forms of Assemblage C include *Eucyrtis* sp., *Eucyrtis* sp. cf. *E. micropora*, *Lithocampe* sp. cf. *L. chenodes*, *Dictyomitra* sp. cf. *torquata*, *Dictyomitra* spp., *Lithocampe* spp., cf. *Eucyrtidium*, *Sethocapsa* sp., *Holocryptacanium*, cf. *Cryptamphorella*, *Amphipyndax* and *Cenosphaera*.

This assemblage also includes Late as well as a couple of Early Cretaceous forms as seen in Assemblage B. These are represented respectively by *Dictyomitra* sp. cf. *D. torquata*, *Amphipyndax*, cf. *Cryptamphorella*, *Holocryptocanium* and *Eucyrtis* sp. cf. *E. micropora* and *Lithocampe* sp. cf. *L. chenodes*. However, the present assemblage is also considered to be Late Cretaceous in age due to its stratigraphic position.

Assemblage D : The samples come from the cherty intercalations in the lower and middle horizons of the Balcha Dhura Formation. Radiolarians are extremely abundant but mostly poorly preserved. The assemblage is profusely dominated by unidentifiable small to medium sized single shelled spumellarians, tentatively referred to *Cenosphaera* in this report. The nassellarians, though outnumbered by these spumellarians are somewhat better preserved. Only some of the identifiable nassellarians have been illustrated here. These are represented by a few multisegmented theoperids (*Lithocampe*, *Eucyrtidium*, *Dictyomitra* etc.), *Sethocapsa* and *Theocapsomma* besides rare cryptocephalic and cryptothoracic forms viz. cf. *Gongylothorax* and *Cryptamphorella*.

The Balcha Dhura Formation had been assigned doubtfully a Palaeocene or even Lower Eocene age by Kumar *et al.* (1977) on stratigraphical grounds. The present assemblage is found to include several forms viz. *Sethocapsa*, *Dictyomitra*, cf. *Gongylothorax*, *Cryptamphorella* and a form referable to Hagiastrids which are so far known only from the Cretaceous sediments.

The data in hand is not sufficient enough to establish the age of these sediments. We, however, suggest the possibility of their being Cretaceous in age.

SYSTEMATIC DESCRIPTION

Suborder Nassellaria EHRENBERG, 1875
Family Theoperidae HAECKEL, 1881. emend. RIEDEL, 1967
Genus *Lithocampe* EHRENBERG, 1838

Remarks : A variety of forms which could be assigned to this genus are frequently encountered in the present

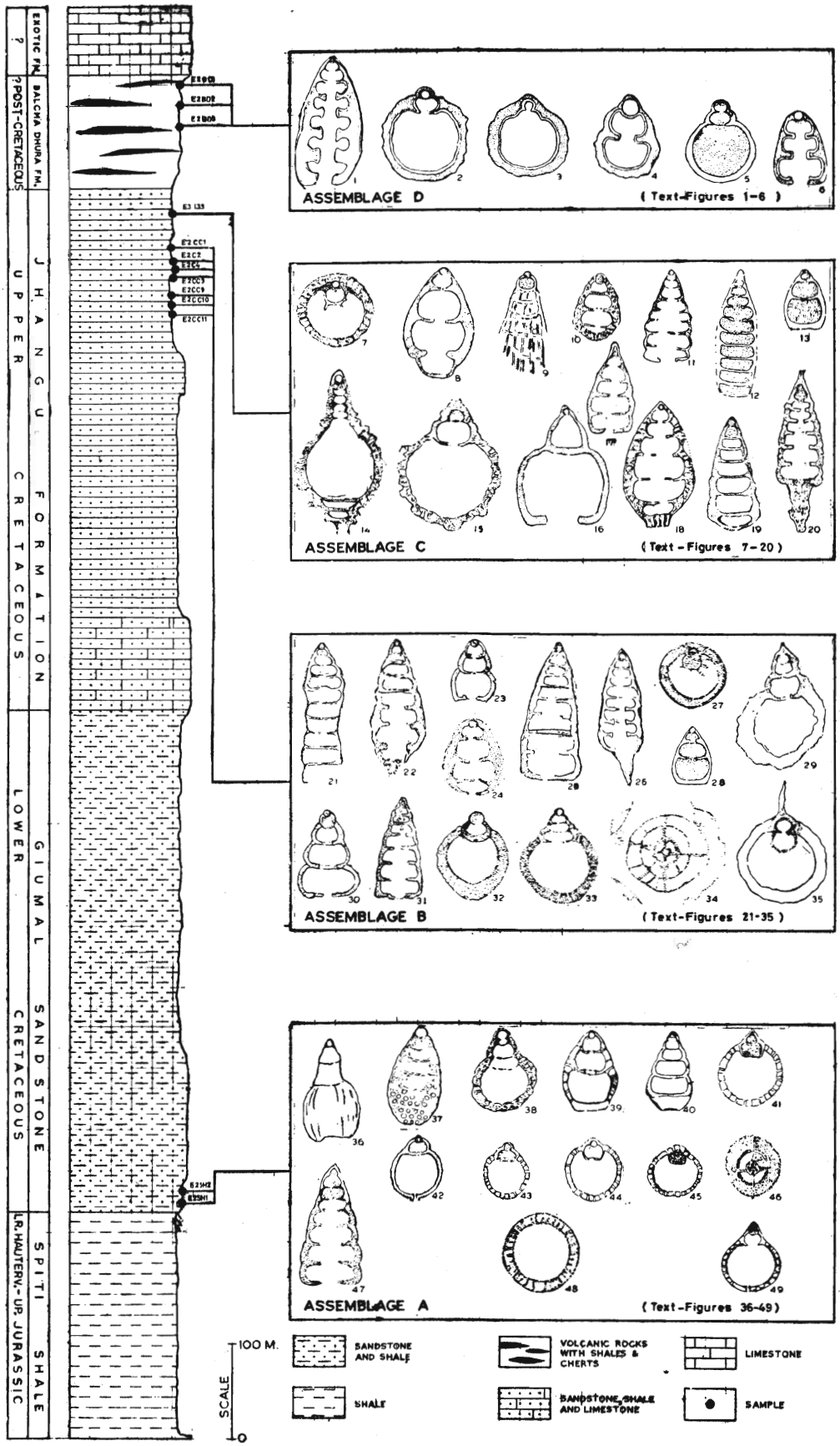
EXOTIC FM.
BALCHA DHURA FM.
?
?POST-CRETACEOUS
UPPER CRETACEOUS
LOWER CRETACEOUS
L.R. HAUTERV.-U.P. JURASSIC
JHANGU FORMATION
GIUMAL SANDSTONE
SPITI SHALE
ASSEMBLAGE D
(Text-Figures 1-6)
ASSEMBLAGE C
(Text - Figures 7-20)
ASSEMBLAGE B
(Text-Figures 21-35)
ASSEMBLAGE A
(Text-Figures 36-49)
100 M.
SCALE
0
SANDSTONE AND SHALE
SHALE
VOLCANIC ROCKS WITH SHALES & CHERTS
SANDSTONE, SHALE AND LIMESTONE
LIMESTONE
SAMPLE

Fig. 2

assemblage. The general criteria taken into account for identification of these forms in thin sections are: multisegmented, usually thick walled shells which are more or less constricted distally; consisting of 4 or more segments increasing in size sometimes markedly with growth, and having either an inflated campanulate distally narrowed last segment or instead, following it a more constricted, reduced, inverted conical or cap-like terminal segment.

Lithocampe elegantissima CITA, 1964
(Fig. 2—36)

Remarks : Forms referred here to this species are characterised by their 4 segmented shells having a small conical proximal portion of about 3 segments and a greatly enlarged, campanulate, distally narrowed post-abdominal segment. This terminal segment is distinguished from small proximal segments by an abrupt change in the shell contour.

A few fragmentary specimens of this species have been recognised in the macerated residues of the black chert samples from Giumal sandstone. The shells, though looking black and uncleared in transmitted light, had the characteristic shape of the shell with the last segment bearing a coarsely costate (ribbed) appearance. Unfortunately due to their bad preservation and fragile nature the forms could not be photographed.

Lithocampe sp. cf. *L. chenodes* RENZ (in RIEDEL & SANFILIPPO, 1974)
(Pl. IV—57 ; Fig. 2—14)

This multisegmented form is quite large, almost pear shaped due to its greatly swollen middle and lower parts. Shell surface is presumably nodose or roughened. Proximally the shell is very narrow, elongate, consisting of 5-6 (or more?) short segments but increases rapidly in size afterwards becoming greatly inflated, almost globose in shape. The shell subsequently narrows only gradually in the distal part. Though there is no clear segmentation visible in the inflated portion, the shell appears to have several short segments which are best seen in the proximal and distal most parts.

The *Lithocampe* species illustrated here is similar to *L. chenodes* Renz (in Riedel & Sanfilippo, 1974 ; pl. 6, figs. 5-7) in general shape, segmentation and also in having a nodose (?) surface. It may also appear comparable to *L. mediodilatata* Rüst (in Riedel & Sanfilippo 1974) in its medianly-terminally swollen shell but no further comparison is possible in thin section.

Lithocampe sp. 1
(Pl. I—10 ; Pl. V—78 ; Fig. 2—1,8)

This common species is distinguished by its subspindle-spindle shaped, stout, thick-walled shells consisting of 4 to 5 inflated annular to campanulate segments with strictures separating them not expressed externally. The segments, excepting the last, increase rapidly in size as added (with growth), The terminal segment is reduced, inverted subconical in shape and has relatively much thinner walls.

Lithocampe sp. 2
(Pl. IV—68 ; Fig. 2—18)

This rare but characteristic form has seven segmented, almost spindle shaped, thick-walled shell having a smooth outline. Strictures separating the segments are not expressed externally. The cephalis is small, subconical (?) or possibly bears a tiny apical spine. Post-cephalic segments are annular, somewhat inflated, increasing regularly but only gradually in size downward, excepting the last couple of segments which subsequently become distally narrower. The terminal segment is smaller in size, thin walled and inverted conical in shape with a constricted aperture (?) surrounded by a peristome (?).

This species compares, to some extent, with *L. perampala* Rüst (in Riedel & Sanfilippo, 1974; pl. 8, figs. 1-4 ; recorded from the Lower Cretaceous of DSDP Leg 26) but for its distally distinctly constricted shell, gradually

Fig. 2. Lithology of a part of Saacha Molla Group showing stratigraphic location of the productive samples and their respective radiolarian assemblages.

Assemblage D :
1. cf. *Lithocampe* 2. *Cryptamphorella* sp. 3. *Gongylothorax* sp. 4. cf. *Theocapsomma* sp. 5. *Sethocapsa* sp. 6. cf. *Lithocampe*

Assemblage C :
7. *Holocryptocapsa* sp. 8. *Lithocampe* sp. 1 9. *Dictyomitra* sp. 10. *Lithocampe* sp. 3 11. *Dictyomitra* sp. cf. *D. torquata* 12. cf. *Dictyomitra* sp. 13. *Lithocampe* sp. 3 14. *Lithocampe* sp. cf. *L. chenodes* 15. *Sethocapsa* sp. 17. cf. *Amphipyndax* 18. *Lithocampe* sp. 2 19. *Eucyrtis* sp. A 20. *Eucyrtis* sp. cf. *E. micropora*

Assemblage B :
21. *Dictyomitra pseudomacrocephala* 22. *Eucyrtis* sp. A 23. cf. *Eucyrtidium* sp. 24. *Lithocampe* sp. 3 25, 31. *Dictyomitra* spp. 26. *Eucyrtis* sp. cf. *E. micropora* 27. *Holocryptocapsa* sp. 28. *Lithocampe* sp. 3 29. *Sethocapsa* sp. 30. Theoperid indet. *?Lithostrobus* 32. *Cryptamphorella* sp. 33. *Sethocapsa* sp. cf. *S. cetia* 34. Spumellaria indet. 35. ?Cryptothoracic Nassellaria

Assemblage A :
36. *Lithocampe elegantissima* 37. *Eucyrtis* sp. A 38. *Sethocapsa* sp. cf. *S. cetia* 39. *Lithocampe* sp. 1 40. *Dictyomitra* sp. 41. *?Zhamoidellum* (or *?Cryptamphorella*) 42,49. *Zhamoidellum* 43, 44. *Cryptamphorella* spp. 45. *Holocryptocapsa* sp. 46. Spumellaria indet. (Actinomiid) 47. cf. *Dictyomitra* spp. 48. cf. *Cenosphaera*

expanding segments and the characteristic inverted-conical terminal segment.

Lithocampe sp. 3

(Pl. III—48 ; Pl. IV—61 ; Fig. 2—13, 28)

This common species is distinguished by its small, five segmented thick-walled shell with segments increasing gradually in size downward and having a reduced, inverted cap-like terminal segment. The shell has a smooth outline without externally expressed strictures separating the segments.

This species differs from *Lithocampe* sp. 1 in its gradually expanding shorter segments and shape and size of the terminal segment. From *Lithocampe* sp. 2 it may be distinguished by its smaller size, fewer segments and the inverted cap-like terminal segment.

?Lithocampe sp.

(Pl. III—52 ; Pl. V—74)

Small, thin-walled shell consisting of 4 segments rapidly increasing in size downward and lacking externally expressed strictures. Cephalis and thorax are small. Last two segments (abdomen and post abdomen) constitute more than two-thirds of the entire shell. The terminal segment is slightly narrowed distally.

The present form has been only tentatively referred to *Lithocampe*.

Genus *Eucyrtidium* EHRENBERG, 1847

cf. *Eucyrtidium* sp.

(Pl. III—49)

This well preserved form compares fairly well with *?Lithocampe* sp. described herein in its similar size, shape and segmentation but differs due to the prominent strictures separating post-cephalic segments. The thorax also appears to be a little larger and distinct in the present form than in *?Lithocampe* sp. The terminal segment is distally narrowed with a constricted aperture.

Genus *Eucyrtis* HAECKEL, 1881

Remarks : The forms described below have been assigned to *Eucyrtis* due to their multisegmented, long, slender shells which are more or less narrowed distally with either a bowl shaped or a tubular terminal segment. The apical horn (spine) is mostly indiscernible except in a couple of specimens. The segments are separated by distinct strictures which are usually not expressed externally.

Forms of this genus are quite commonly encountered in the present material.

Eucyrtis sp. A

(Pl. I—8, 15 & 19 ; Pl. II—25, 26 & 38 ; Pl. IV—66)

This common, distinctive, multisegmented (of 7 to 10 segments) species has subspindle or rarely spindle shaped shell with a small, spherical cephalis possibly without an apical horn, and a short, narrow bowl shaped, distally closed (?) terminal segment. The segments increase gradually in breadth and very gradually in length till the last one or two segments so that the shell appears widest in the distal part. Subsequent couple of segments then become narrower to be followed by the reduced cap-like terminal segment which is sometimes separated by a distinct change in countour from the proceeding one. Externally the segmental strictures are not expressed or only faintly expressed. Rarely, pores on a few distal segments are also preserved ; three transverse rows of small, circular, equal pores are disposed on each segment.

These forms are comparable to *Eucyrtis hanni* (Tan Sin Hok) Renz (*in* Riedel and Sanfilippo, 1974; pl. 12, figs. 16-17) and *Eucyrtis* sp. A (*in* Garg & Jain, 1979; pl. 1, fig. 5 ; pl. 6, fig. 85) in general shape and segmentation. However, lack of the external morphological features in the present case precludes further comparison with these forms.

Eucyrtis sp. cf. *E. micropora* (SQUINABOL) FOREMAN, 1975

(Pl. II—24 ; Pl. IV—54)

This form is characterised by its slender, elongate-conical, multisegmented shell consisting of 9 to 10 short segments increasing regularly in breadth but very gradually in length downward with growth ; and followed by a long narrow, tubular, somewhat tapering terminal segment closing the constricted mouth of the proceeding segment with an abrupt change in shell contour. The shell has a relatively smooth outline as segmental strictures are not expressed externally, but internally the constricted strictures are distinctly seen. The cephalis is small and bears a short and broad apical spine.

The present form could not satisfactorily be assigned either to *E. tenuis* (Rüst) Foreman or *E. micropora* (Squinabol) Foreman due to its segmentation and the presence of the terminal tube-like segment with an abrupt change in the contour of the conical shell. *E. micropora* appears to be closer to the present forms but differs in having a couple of distally narrower segments preceding the terminal tube-like segment and a spiny surface.

Genus *Dictyomitra* ZITTEL, 1876

Remarks : Multisegmented theoperids having elongate conical shells are frequently encountered in the present material. The number of segments varies from 6 to 11. Usually the segments increase regularly in breadth and very gradually in length downward with growth, but in a few cases last couple of segments may become slightly narrower. Distinct strictures separating the segments are seen only internally in most of the forms. In some

of the forms the constrictions are expressed externally also. The generic placement of these forms is difficult as no external morphological details are available. Some of the forms referred here to *Dictyomitra* are briefly discussed below.

Dictyomitra pseudomacrocephala SQUINABOL, 1903
(Pl. II—37)

This rare form illustrated here agrees well with *D. macrocephala* Squinabol described by Riedel and Sanfilippo (1974; pl. 4, figs. 10, 11 ; pl. 14, fig. 11) and *P. pseudomacrocephala* Squinabol described by Petrushevskaya & Kozlova (1972; p. 550, pl. 2, fig. 5) and Foreman (1975, p. 614; pl. 7 fig. 10). According to Foreman (1975, p. 614), *D. pseudomacrocephala* is distinguished from *D. macrocephala* by the presence of vertical ridges and depressions on shell surface, consequently it is not possible to distinguish the two species from each other in thin sections. Foreman further reassigned the forms referred to *D. macrocephala* by Riedel & Sanfilippo (1974) to *D. pseudomacrocephala*. The present form from Malla Johar also has been tentatively included in *D. pseudomarcocephala*.

D. macrocephala is recorded from Late Albian-Coniacian of DSDP Leg 26 (Riedel & Sanfilippo, 1974) and *D. pseudomacrocephala* has been recorded from the Late Cretaceous (possibly Cenomanian) of DSDP Leg 20 (Foreman 1973b, Albian-E. Campanian) of DSDP Leg 14 (Petrushevskaya & Kozlova, 1972) and Late Albian-Cenomanian of DSDP Leg 32 (Foreman, 1975).

Dictyomitra spp.

(Pl. V—79) : 6 or 7 segmented longitudinally ribbed form with a small cephalis and an inflated hemispherical thorax with subsequent segments increasing regularly in breadth downward. Several fragments of ribbed forms have also been encountered in streaky cherts of the Giumal Sandstone and greywackes of the Jhangu Formation.

(Pl. I—18 ; Pl. 2—27) : The forms illustrated here have 6 to 7 segments gradually increasing in length and breadth downward followed by a trapezoidal terminal segment which becomes distally narrower. Internally the segmental strictures are distinct but are not expressed externally. The shell is thin-walled and may be faintly longitudinally ribbed.

(Pl. IV—59) : This 9 segmented distinctive form has a smooth conical proximal part consisting of 4 segments without externally expressed strictures. Subsequent segments are inflated medianly or distally and are separated by distinct external constrictions forming a lobulate shell outline. The segments are short and regularly increase in breadth towards the aperture.

This form compares well with *D. torquata* Foreman, 1971 (in Foreman, 1973; pl. 15, figs. 9-11) in having similar shape and short, inflated segments separated by prominent strictures especially in the distal part. *D. torquata* is known to occur in Late Upper Cretaceous (Santonian-Campanian, mostly Campanian) from several localities (Foreman, 1971, p. 1677 ; 1973, p. 256).

(Pl. IV—55-56) : The forms illustrated here are characterised by their long conical shells having 9-10 short segments increasing regularly in breadth downward with growth and separated by distinct strictures which are expressed externally also.

cf. *Dictyomitra* spp.

(Pl. I—11 ; Pl. II—29, 30, 33 & 36) : These forms are distinguished by their long conical shells with 8-10 short uniform segments gradually increasing in breadth towards a constricted (?) aperture. Segmental strictures which are very distinct internally, are not expressed externally.

(Pl. IV—62 & 64) : These forms are characterised by their long slender shell and several short uniform segments without external constrictions ; first 6 segments form a smooth conical proximal part, distally the shell may be subcylindrical.

Family Theoperidae HAECKEL, 1881 emend. RIEDEL, 1967
Subfamily Syringocapsinae FOREMAN, 1973
Genus *Sethocapsa* HAECKEL, 1881

Remarks : Foreman (1973, p. 267) redefined this genus to include 'Mesozoic' theoperids having a large, globose, closed terminal segment without tube or spines, exclusive of the distinctive group of cryptocephalic and cryptothoracic nassellaria. In the present material 3 to 5 segmented shells having a narrow, conical proximal part with the large, globose terminal segment are quite commonly encountered. The large distalmost segment apparently lacks spines and aperture, hence all comparable forms have been assigned to *Sethocapsa*.

Sethocapsa sp. cf. *S. cetia* FOREMAN, 1973
(Pl. III—50)

Remarks : This 4 to 6 segmented form compares well with *S. cetia* Foreman (1973, p. 267 ; pl. 12, fig. 1 ; pl. 16, fig. 19) but for being much smaller, (nearly one third). The shell is thick-walled and has a rough? surface with strictures separating the segments not expressed externally. There are 3 to 4 short annular segments forming a small conical proximal portion followed by the large, globose terminal segment.

S. cetia has been recorded from ?Lower Jurassic—Early Cretaceous of DSDP Leg 20 (Foreman, 1973) and Lower Cretaceous (Early Berriasian-Valanginian) of DSDP Leg 32 (Foreman, 1975).

Sethocapsa sp.

(Pl. I—3)

Remarks : The shell is small, of four to five segments, with a large almost globose thick-walled terminal segment. The cephalis is small, spherical and without an apical spine. The small narrow conical to subcylindrical proximal part consists of 3 (? or 4) short segments marked by distinct external constrictions.

The forms recorded here from the cherts of the basal Giumal Sandstone agree quite well with *Sethocapsa* spp. described by Foreman (1975, p. 617; pl. 21, figs. 10-12 & 14) from DSDP Leg 32, which according to her are very characteristic of the late Early Cretaceous.

Sethocapsa sp.

(Pl. III—53 ; Pl. V—77, 80)

These large robust forms assigned here to *Sethocapsa* are characterised by a conspicuous proximal part consisting of 3 prominent segments separated by distinct strictures which are expressed externally also. The small cephalis probably bears a short apical spine. Thorax is narrow, conical followed by annular, enlarged abdomen which appears to be slightly inflated. The globose terminal segment is quite large and has a very thick wall probably with a rough (or nodose) surface.

Genus *Stichocapsa* HAEKEL, 1881

Stichocapsa sp. cf. *S. megalocephalia* CAMP. & CLARK, 1944

(Pl. I—12)

This form compares fairly well with *Stichocapsa megalocephalia* recorded from the Upper Cretaceous of California by Campbell & Clark (1944, p. 44; pl. 8, figs. 26, 34) in having subspindle shaped shell lacking externally expressed strictures, a prominent bulbous cephalis and a bowl-shaped terminal segment but differs due to its smaller, nearly half size. Last couple of segments in the form illustrated here show small circular to subcircular pores which are not closely spaced and are disposed in irregular transverse rows.

Family *Williriedellidae* DUMITRICA, 1970

Remarks : Cryptothoracic Nassellaria occur in significant numebrs in all the productive horizons of the Cretaceous sequence of Malla Johar. Precise identification of these nassellarians in thin sections has not been possible due to the lack of morphological characters important for differentiating various closely related genera of the family Williriedellidae (Dumitrica, 1970). However, based on the recognition of a few taxonomically significant characters in thin sections affinities of many of the forms could be suggested as discussed below :

(Pl. I—9, 20) : These thin walled tricyrtids have been provisionally referred here to *Williriedellum* rather than to the closely related genus *Hemicryptocapsa* due to the lesser degree of encasement of thorax into the abdomen and also the apparent absence of small spines descending from the thoracic opening. Cephalis is free, small and the large inflated abdomen has a constricted aperture.

(Pl. I—1 ; Pl. III—45 & 51 ; Pl. V—70) : These small spherical tricyrtids have been assigned to the genus *Holocryptocapsa* due to the complete encasement of the cephalothorax within the large inflated abdomen. In some specimens the thoracic mouth bears few small spines but their exact number could not be ascertained. *Holocryptocanium* which closely resembles this genus, is distinguished in having fewer thoracic spines and generally larger size (Dumitrica, 1970).

(Pl. I—2, 6, 13 & 17 ; Pl. III—40 ; Pl. V—69, 71, & 72 ; Pl. VI—83): These spherical to subspherical or oval cryptothoracic tricyrtids resemble *Cryptamphorella* in the degree of the depression of cephalo-thorax into the abdomen and the apparent absence of descending spines from the thoracic mouth. *Cryptomphorella* is frequently recorded from the Cretaceous (Dumitrica, 1970).

(Pl. I—4) : This form is morphologically very similar to the forms recorded here as *Cryptamphorella*. However, it has been assigned to the closely related Upper Jurassic genus *Zhamoidellum* due to the apparent presence of few rows of pores on the depressed part of thorax. In *Cryptamphorella* species recorded by Dumitrica (1970) from the Cretaceous of Romania, the thorax is invariably poreless except in *C. macropora* which has a few small scattered pores on the depressed part of thorax.

(Pl. I—21) : This thick-walled form has been referred to *Holocryptocanium* rather than to *Holocryptocapsa* solely on the basis of its some what larger size. The number of spines (?) descending from the thoracic mouth could not be ascertained.

(Pl. III—41, 42 & 47) : These thick-walled spherical tricyrtids have a small cephalo-thorax which is almost completely depressed into the large, inflated abdomen. The thorax is characteristically thin walled and almost spherical in shape (?due to differential preservation and sectioning). One of the forms bears an apical horn also. The forms could not be referred satisfactorily to either *Holocryptocapsa* or *Holocryptocanium*.

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EXPLANATION OF PLATES

PLATE I

(All figures ×300)

1. *Holocryptocapsa* sp.; BSIP Slide No. 5916 ; coordinates : 103. 9× 15.6.
2, 6, 13, 17. *Cryptamphorella* spp.; BSIP Slide Nos. 5916, 5917 ; coordinates : 101.5×15.4, 109.8×18.5, 102.3×12.0 and 104.5×8.2 respectively.
3. *Sethocapsa* sp., BSIP, Slide No. 5917 ; coordinates : 104.5×13.5.
4. *?Zhamoidellum*, BSIP Slide No. 5916 ; coordinates : 107×13.
5. Theoperid indet. ; BSIP Slide No. 5916 ; coordinates : 111.1×17.4.
7. ?Actinomiid indet.; BSIP Slide No. 5916 ; coordinates : 105.8×15.4.
8,15,19. *Eucyrtis* sp. A, BSIP Slide No. 5916 ; coordinates : 107.5×16.5, 108×11.2, 101.5×12.8.
9, 20. *Williriedellum* spp., BSIP Slide Nos. 5916, 5914 ; coordinates : 107.6×19.6, 105.2×11.4 respectively.
10. *Lithocampe* sp. 1, BSIP Slide No. 5914 ; coordinates : 104.5×10.6.
11. cf. *Dictyomitra* spp. ; BSIP Slide No. 5916 ; coordinates : 107.6×16.9.
12. *Stichocapsa* sp. cf. *S. megalocephalia ;* BSIP Slide No. 5914 ; coordinates : 105.0×10.8.
14. Spumellaria indet. (?Pseudoaulophacid) ; BSIP Slide No. 5914 ; coordinates : 103.7×11.7.
16. Theoperid indet. (*?Lithostrobus*) ; BSIP Slide No. 5916 ; coordinates : 106.2×10.5.
18. *Dictyomitra* spp. ; BSIP Side No. 5915 ; coordinates : 109.3×14.4.
21. cf. *Holocryptocanium* ; BSIP Slide No. 5916 ; coordinates : 107.0×12.1.
22. Spumellaria indet. (?Spongodiscid) BSIP Slide No. 5916 ; coordinates : 111.4×13.2.
23. Spumellaria indet. ; BSIP Slide No. 5914 ; coordinates : 102.6×10.7.

PLATE II

(All figures × 250)

24. *Eucyrtis* sp. cf. *E. micropora* ; BSIP Slide No. 6044 ; coordinates : 110.9×10.2.
25, 26, 28, 38. *Eucyrtis* sp. A.; BSIP Slide No. 6044 ; coordinates : 104.9×10.9, 97.3×19.0, 102.0×21.2 and 102.8×13.5.
27. *Dictyomitra* spp. ; BSIP Slide No. 6044 ; coordinates : 104.2×7.4.
29, 30, 33, 36. cf. *Dictyomitra* spp., BSIP Slide No. 6044 ; coordinates : 98.3×12.9, 97.5×12.0, 103.4×12.7.
31. ?Amphipyndacid ; BSIP Slide No. 6045 ; coordinates : 105.5×8.7.
32, 34. Theoperid indebt.; BSIP Slide No. 6044 ; coordinates : 100.2×17.3 and 99.3×10.8.
35. Theoperid indet. (*?Lithostrobus*) ; BSIP Slide No. 6044 ; coordinates : 100.8×14.
37. *Dictyomitra pseudomaerocephala* ; BSIP Slide No. 6044 ; coordinates : 109.7×18.5.

PLATE III

(All figures ×250)

39. cf. *Gongylothorax*, BSIP Slide No. 6044 ; coordinates : 113.6×10.2.
40. *Cryptamphorella* ; BSIP Slide No. 6044 ; coordinates : 99.3×10.8.
41, 42, 47. Williriedellid indet.; BSIP Slide No. 6044 ; coordinates : 100.6×12.8, 108.8×17.8 and 106.8×11.
43. Spumellaria indet.; BSIP Slide No. 6044 ; coordinates : 109.6 × 16.
44. Spumellaria indet.; BSIP Slide No. 6044 ; coordinates : 100.5×13.5 and 102.7×9.5.
45, 51. *Holocryptocapsa* ; BSIP Slide No. 6044 ; coordinates : 100.5×13.5 and 102.7×9.5.
46. Theoperid indet. (cf. *Lithocampe*) ; BSIP Slide No. 6045 ; coordinates : 115.2×11.0.
48. *Lithocampe* sp. 3 ; BSIP Slide No. 6044 ; coordinates : 96.7×10.9.
49. cf. *Eucyrtidium* sp.; BSIP Slide No. 6044 ; coordinates : 98.7×13.2.
50. *Sethocapsa* sp. cf. *S. cetia* Foreman ; BSIP Slide No. 6044 ; coordinates : 111.7×5.9.9.
52. *?Lithocampe* sp.; BSIP Slide No. 6044 ; coordinates : 108.9×17.3.
53. *Sethocapsa* sp.; BSIP Slide No. 6044 ; coordinates : 109.5×16.

PLATE IV

(All figures ×250)

54. *Eucyrtis* sp. cf. *E. micropora* ; BSIP Slide No. 6046 ; coordinates : 111.6×12.
55, 56. *Dictyomitra* spp. ; BSIP Slide No. 6046 ; coordinates : 96.4×12.9 and 101.1×16.9.
57. *Lithocampe* sp. cf. *L. chenodes* ; BSIP Slide No. 6046; coordinates : 102.3×10.
58. cf. *Amphipyndax* ; BSIP Slide No. 6046A ; coordinates : 108.6×18.
59. *Dictyomitra* sp. cf. *D. torquata* ; BSIP Slide No. 6046 ; coordinates : 114.8×16.7.
60. Spumellaria indet.; BSIP Slide No. 6046 ; coordinates : 109.1×8.2.
61. *Lithocampe* sp. 3.; BSIP Slide No. 6046 ; coordinates : 105.0×17.6.
62, 64. cf. *Dictyomitra* spp.; BSIP Slide Nos. 6046A and 6046B ; coordinates : 110.4×12.5, 107.8×13.6 respectively.
65. Theoperid indet.; BSIP Slide No. 6046; coordinates : 110.3×11.6.
66. *Eucyrtis* sp. A.; BSIP Slide No. 6046 ; coordinates : 96.4×13.6.
67. Theoperid indet.; BSIP Slide No. 6046 ; coordinates : 114.3×15.2.
68. *Lithocampe* sp. 2.; BSIP Slide No. 6046 ; coordinates : 111.8×11.8.

PLATE V

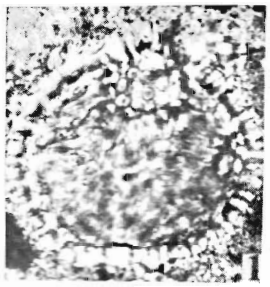
(All figures ×250)

69, 71, 72. *Cryptamphorella* ; BSIP Slide No. 6046 ; coordinates : 96.7×9.4, 103.5×17.8 and 100.5×10.8.
70. *Holocryptocapsa* ; BSIP Slide No. 6046 ; coordinates : 110.1×17.2.
73, 75. *?Cenosphaera* ; BSIP Slide No. 6046 ; coordinates : 107.1×9.4 and 98.3×12.6.
74. *?Lithocampe* sp.; BSIP Slide No. 6046A ; coordinates : 102.6×10.4.
76. cf. *Lithocampe* ; BSIP Slide No. 6046 ; coordinates : 96.8×11.
77, 80. *Sethocapsa* sp.; BSIP Slide No. 6045B, 6046 ; coordinates : 106.3×7.6, 114.0×11.7 respectively.
78. *Lithocampe* sp. 1.; BSIP Slide No. 6046 ; coordinates : 96.6×9.1.
79. *Dictyomitra* spp.; BSIP Slide No. 6046 ; coordinates : 112.0×17.2.
81. Spumellaria indet.; BSIP Slide No. 6046 ; coordinates : 100.5×8.2.
82. Spumellaria indet.; BSIP Slide No. 6046 ; coordinates : 113.3×14.9.

PLATE VI

(All figures ×300)

83. *Cryptamphorella* ; BSIP Slide No. 6046C ; coordinates : 112.0×15.8.
84. cf. *Gongylothorax* ; BSIP Slide No. 6046D ; coordinates : 106.7×13.3
85. *?Sethocapsa* ; BSIP Slide No. 6046D ; coordinates : 106.4×14.3.
87, 91, & 94. Theoperid indet.; (cf. *Lithocampe*) ; BSIP Slide No. 6046D ; coordinates : 102.7×103 and 110.7×17.3.
88. cf. *Eucyrtidium* ; BSIP Slide No. 6046D ; coordinates : 112.6×10.8.
89. Theoperid indet.; BSIP Slide No. 6046D ; coordinates : 106.4×14.2.
90. cf. *Lithocampe* ; BSIP Slide No. 6046D ; coordinates : 106.8×12.
86, 92. *Dictyomitra* sp. cf. *D. torquata* ; BSIP Slide No. 6046D ; coordinates : 103×13 & 107.5×16.3 respectively.
93, 95. cf. *Theocapsomma* sp.; BSIP Slide Nos. 6046E ; coordinates : 103.2×18.0, 103.5×10.7 respectively.
96. Theoperid indet. (cf *Eucyrtidium*) ; BSIP Slide No. 6046D ; coordinates : 112.1×12.7.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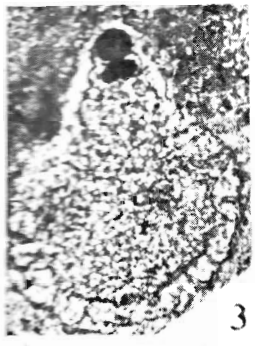
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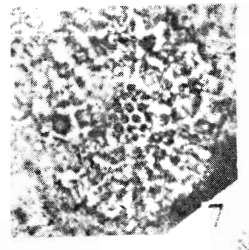
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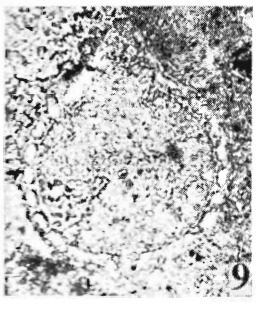
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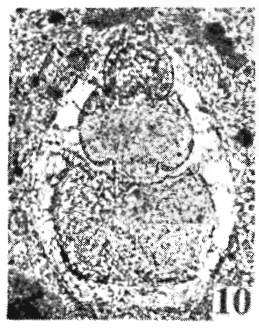
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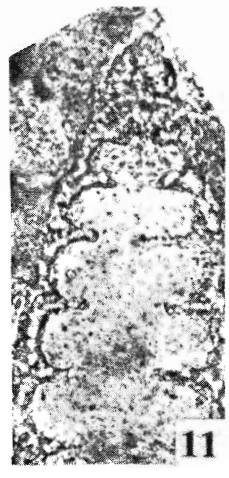
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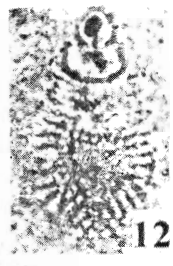
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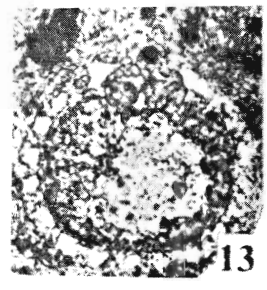
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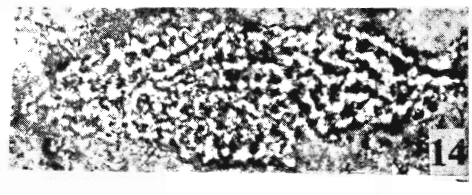
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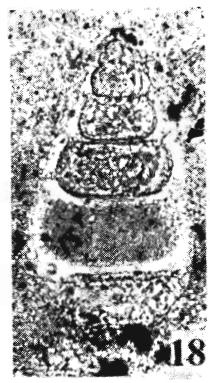
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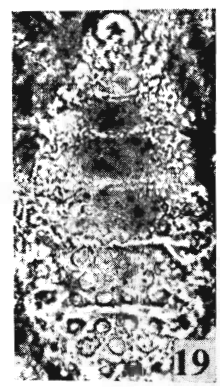
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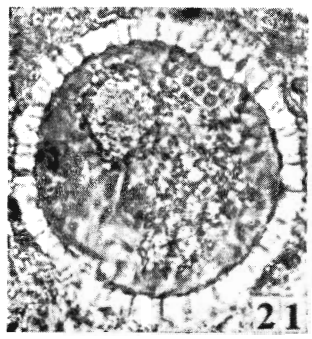
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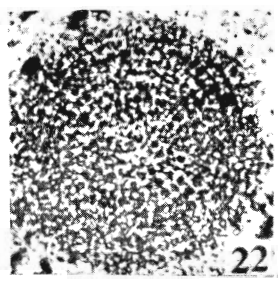
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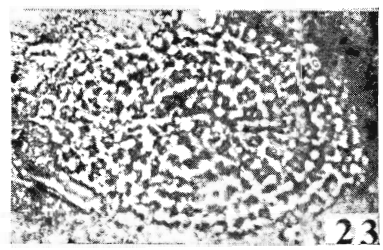
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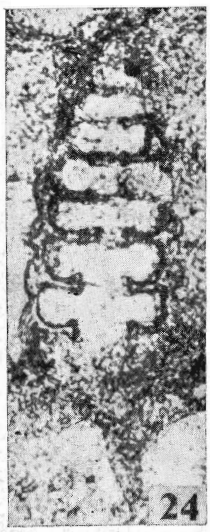
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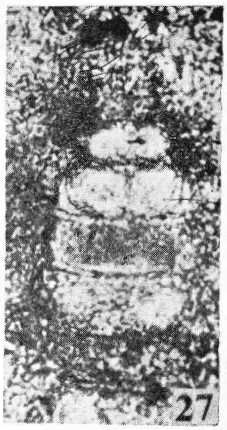
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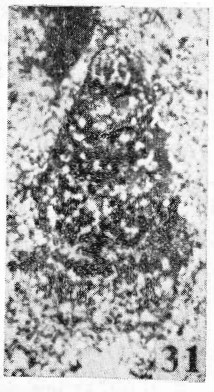
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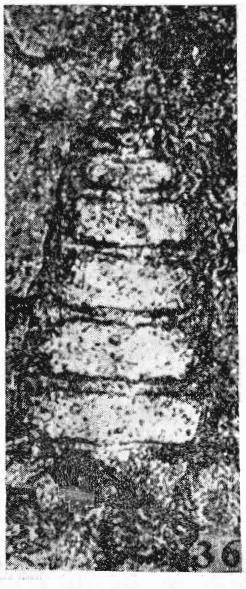
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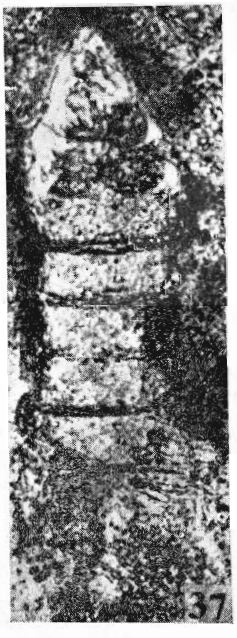
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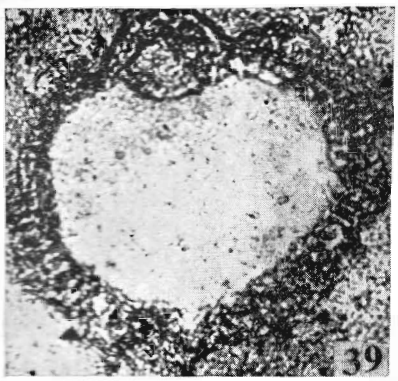
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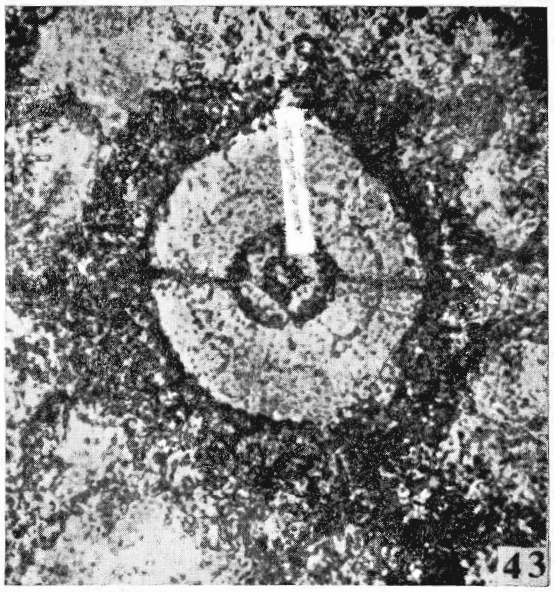
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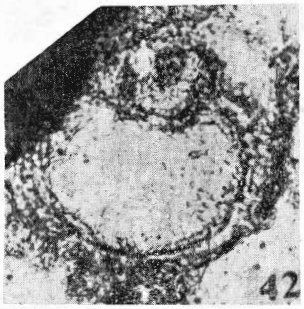
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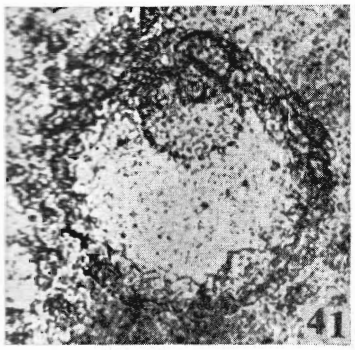
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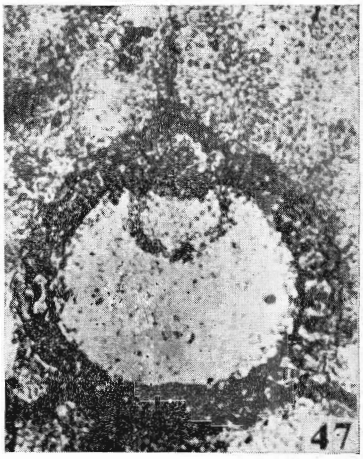
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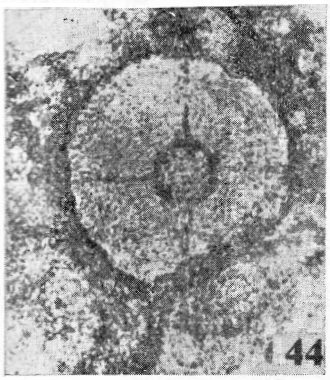
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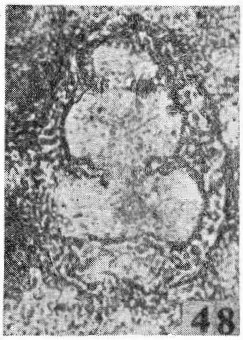
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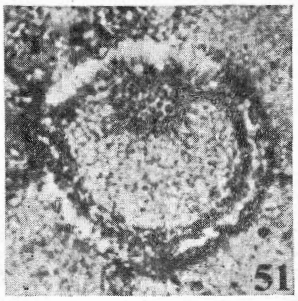
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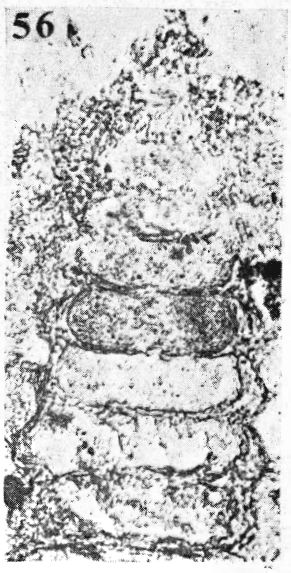
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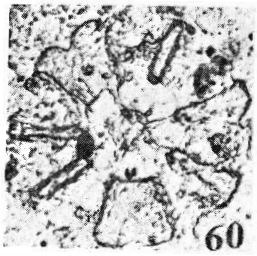
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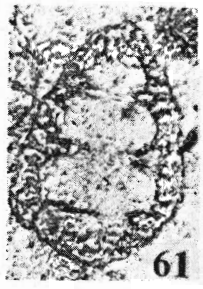
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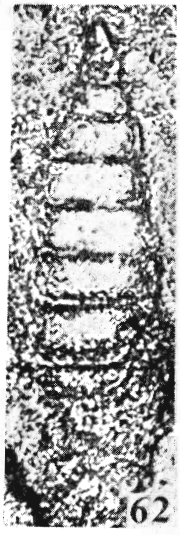
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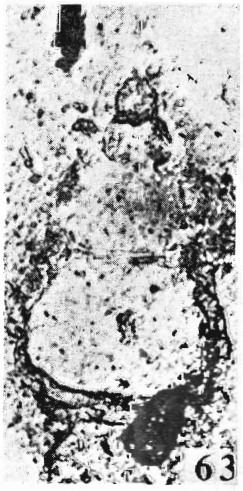
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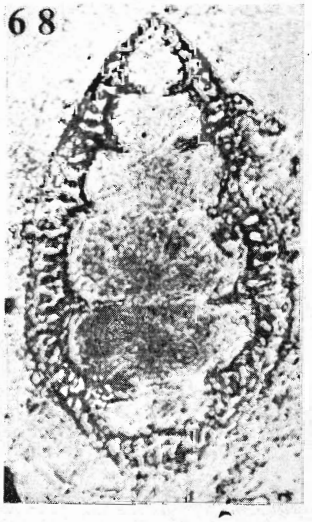
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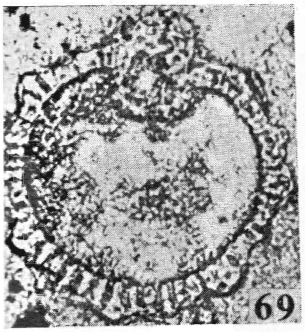
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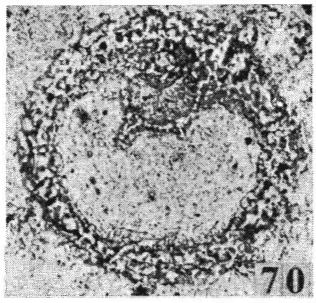
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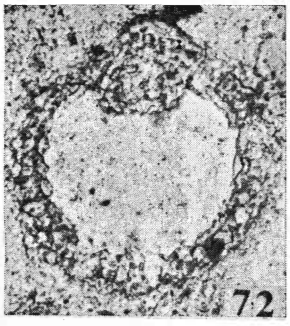
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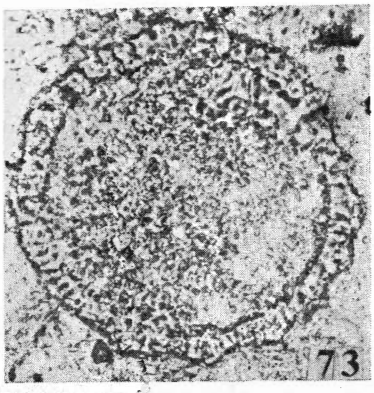
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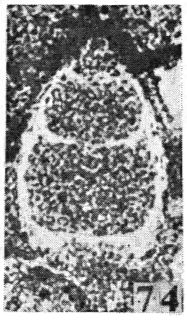
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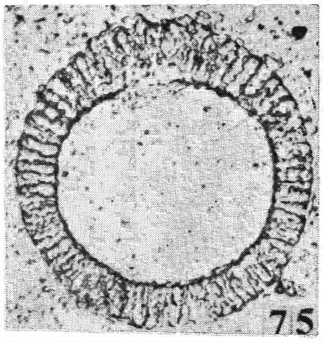
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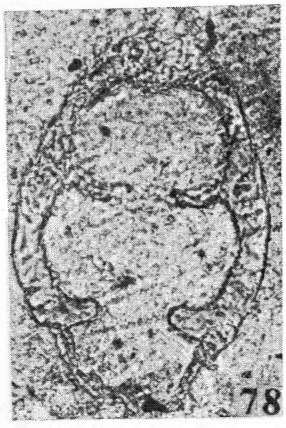
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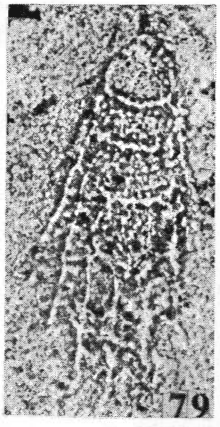
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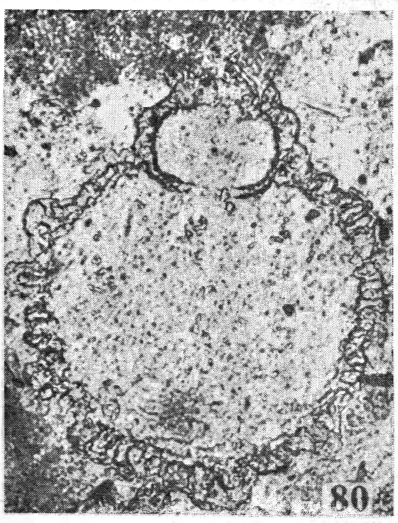
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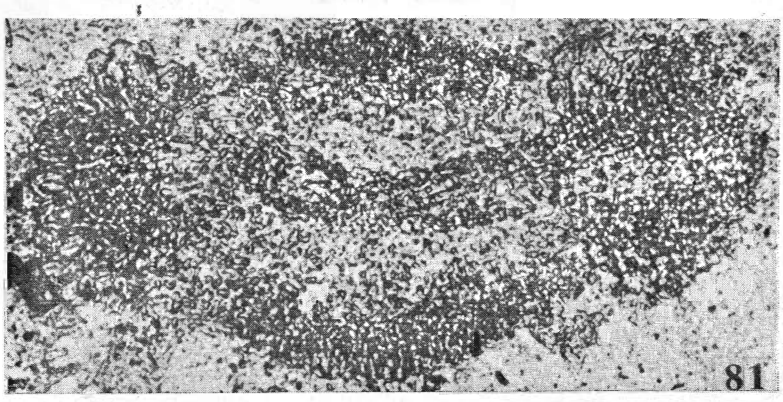
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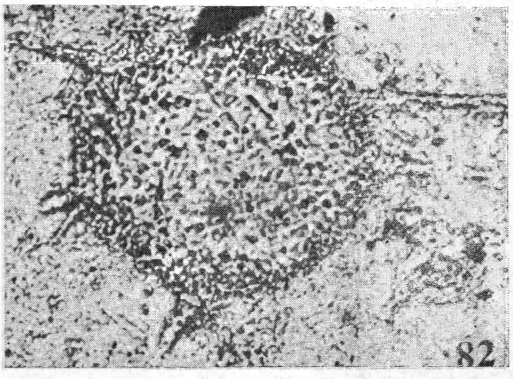
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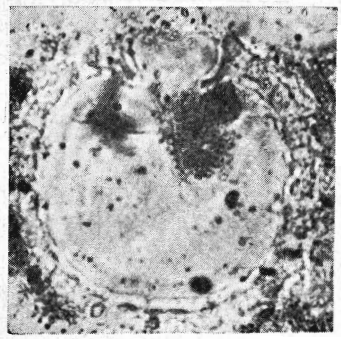

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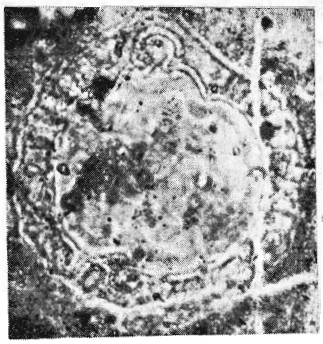

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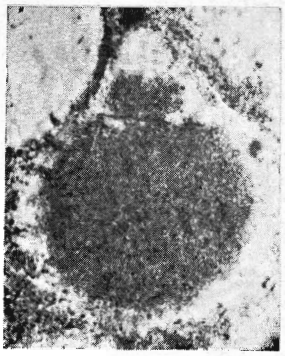

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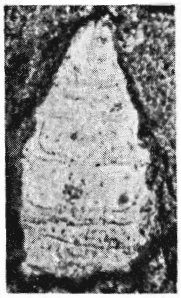

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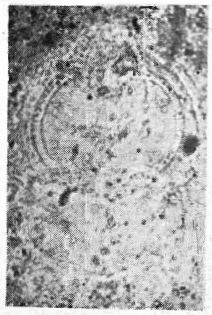

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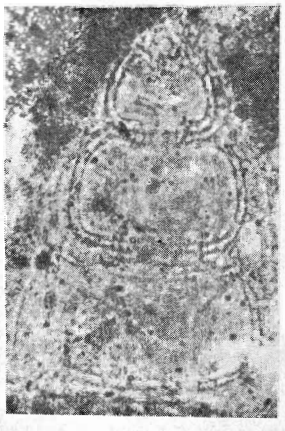

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