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Marine Microfaunas (Bryozoans, Conodonts and Microvertebrate Remains) from the Frasnian-Famennian Interval in Northwestern Junggar Basin of Xinjiang in China

Marine Mikrofaunen (Bryozoen, Conodonten und Mikrovertebratenreste) aus dem Bereich Frasnien–Famennien im Nordwestteil des Junggar Beckens, Xinjiang in China

from

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Inhalt

Abstract

Three standard Late Devonian conodont zones, Late *rhenana* Zone, Middle *crepida* Zone (below and above the F/F boundary respectively) and Early *expansa* Zone (below the C/D boundary) have been recognized in the northwestern Junggar basin of Xinjiang in China. The conodont, microvertebrate remain's and bryozoan faunas, biofacies and lithofacies occurred just or near the three conodont zones have been discussed. Near the F/F boundary at the Bolonggur and Eregennaren Section, conodonts and microvertebrate remains have not been found, bryozoans are also impoverished in both taxa and number, this may be due to both the lithologic character of deposits and the influence of a global Late Frasnian mass extinction event. The analysis of biofacies and lithologic microfacies indicate that the two conodont faunas, *Icriodus subterminus / Polygnathus imparilis* fauna and *Icriodus alternatus alternatus / Polygnathus* ex gr. *webbi* fauna belonging to Late *rhenana* Zone and Middle *crepida* Zone respectively represent a similar shallow water environment of outer shelf. The conodont occurrences confirm that the stratigraphic sequence of the Bulonggur Section is a reversed one and that the age of the Hongguleleng Formation at the section should be of the Late Frasnian – Early Famennian, and that the Hebukehe Formation at the hebukehe Section is of the Middle – Late Famennian age. The study of the bryozoan fauna indicates that both regions – the northwestern periphery of the Junggar basin and Central Kazakhstan, should be belong to the same biogeographic region, but the latter was thought to be the Late Famennian age mainly on basis of brachiopods.

The few specimens represented typical Frasnian to Famennian remains of microvertebrates are firstly discovered, and are proving useful zone fossils for the Middle to Late Devonian especially in the absence of conodonts.

A bryozoan new family Pseudocampylidae has been proposed formally, 41 bryozoan species have been mad a taxonomic description, of which 22 new species have been proposed too. These new species are: *Neotrematopora inspinosa, Pseudocampylus imspinus, Ps. bulonggurensis, Ps. breviseptus, Ps. similivirgatus, Ps. similitarbagataicus, Ps. planiformis, Fistulipora lunuliformis, F. paricella, Eofistulotrypa primacylindilla, Fistuliramus eregennarensis, Cyclotrypa concylindrella, Sulcorandepora hextolgayensis, S. praehextolgavensis, Bactropora hextolgayensis, Niki-*

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forovella cellaris, Acanthoclema junggarensis, Minilya alticarininodialis, Rarifenestella octoformis, Intrapora aperiflorina, In. similitaeniola, In. triangularis. In addition, two new species of conodonts – *Polygnathus* and *Schmidtognathus*, as open nomenclature, have been proposed also. All these bryozoan and conodont species are exactly or roughly controlled by the standard conodont zones in age.

Zusammenfassung

Drei Standard-Conodontenzonen des Spät-Devon, die Spätere *rhenana*-Zone, die Mittlere *crepida*-Zone (bzw. unterhalb und oberhalb der F/F-Grenze) und die Frühere *expansa*-Zone (unterhalb der C/D-Grenze) wurden im Nordwestteil des Junggar-Beckens (Xinjiang, China) nachgewiesen. Conodonten, Mikrovertebratenreste und Bryozoenfaunen, die Conodonten-Biofazies sowie die Lithofazies, die sich genau in diesen oder nahe diesen Zonen fanden, werden diskutiert. In den Profilen von Bolonggur und Eregennaren, nahe der F/F-Grenze wurden weder Conodonten noch Mikrovertebratenreste gefunden. Bryozoa sind gleichfalls – sowohl hinsichtlich der Anzahl der Taxa als auch in bezug auf die Individuenzahl – verarmt. Dies kann seine Ursache entweder im lithologischen Charakter der Ablagerung oder aber im Einfluß des globalen Mass Extinction Event des Späten Frasnien haben. Die Analyse der Conodonten-Biofazies und der Lithofazies zeigen, daß die beiden Conodonten-Faunen –*Icriodus subterminus / Polygnathus imparilis*-Fauna und *Icriodus alternatus alternatus / Polygnathus* ex gr. *webbi*-Fauna –, die zur Späten *rhenana*-Zone und zur Mittleren *crepida*-Zone gehören, einen ähnlichen Biotop eines Seichtwasserbereiches im äußeren Schelfgebiet darstellen. Die Conodontenfunde bestätigen, daß die stratigraphische Abfolge des Profiles von Bulonggur eine umgekehrte ist, sowie, daß das Alter der Hongguleleng-Formation im Profil Spätes Frasnien bis Frühes Famennien sein sollte und ferner, daß das Profil von Hebukehe im Profil von Hebukehe Mittleres bis Spätes Famennien-Alter hat.

Das Studium der Bryozoenfauna zeigt, daß beide Gebiete – die nordwestliche Peripherie des Junggarbeckens und Zentralkasachstan – zur gleichen biogeographischen Region gehören sollten; das letztere wurde allerdings hauptsächlich aufgrund der Brachiopoden für Spätes Famennien gehalten.

Die wenigen Exemplare, welche typische Frasnien-Famennien-Mikrovertebratefossilien darstellen, wurden zum ersten Mal entdeckt und erwiesen sich als nützliche Zonenleitfossilien für das Mittlere bis Späte Devon (besonders die Abwesenheit von Conodonten).

Eine neue Bryozoenfamilie (Pseudocampylidae) wurde aufgestellt; für 41 Bryozoenarten werden taxonomische Bearbeitungen sowie Beschreibungen und ihre genaue oder ungefähre Alterseinstufung durch Conodonten angeführt. Unter diesen Arten finden sich 22 neue; dabei handelt es sich um: *Neotrematopora inspinosa, Pseudocampylus imspinus, Ps. bulonggurensis, Ps. breviseptus, Ps. similivirgatus, Ps. similitarbagataicus, Ps. planiformis, Fistulipora lunuliformis, F. paricella, Eofistulotrypa primacylindilla, Fistuliramus eregennarensis, Cyclotrypa concylindrella, Sulcoretepora hextolgayensis, S. praehextolgavensis, Bactropora hextolgayensis, Nikiforovella cellaris, Acanthoclema junggarensis, Minilya alticarininodialis, Rarifenestella octoformis, Intrapora aperiflorina, In. similitaeniola, In. triangularis.* Zusätzlich werden noch zwei Conodontenarten – *Polygnathus* und *Schmidtognathus* – in offener Nomenklatur vorgeschlagen.

Introduction

The Hongguleleng Formation is rich in animal and plant fossils and is well exposed in outcrops in the Hextolgay district, northwestern Junggar Basin of Xinjiang. It has been studied in datail by Chinese geologists and palaeontologists (ZHAO, 1986; HOU and al., 1988; LU & WICANDER, 1988; ZHAO & WANG, 1990; XU and al., 1990; ZENG & XIAO, 1991; LIAO and al., unpublished report) from different departments of the same and other parts of the country during the last few years. But in respect to an exact age determination of the formation, there is as yet no consensus of opinion. ZENG and al. (1991) concluded that hte age was late Late Devonian (Famennian) mainly on the basis of marine macroinvertebrate, but also on the basis of conodonts from a different but unspecified. Although XU and al. (1990) recognized that the forma-

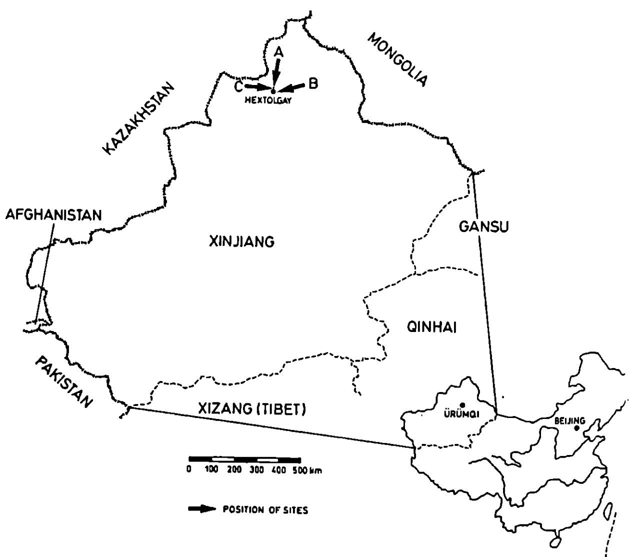

Figure 1: Map of Uygur Autonomous Region of Xinjiang showing location of the sections studied. Section A (Bulonggur section) is situated about 15 km north, Section B (Eregennaren section) about 11 km northeast, and Section C (Hebukehe section) about 8 km north of the town of Hextolgay. Hextolgay is situated approximately 335 km north-northwest from Urumqi.

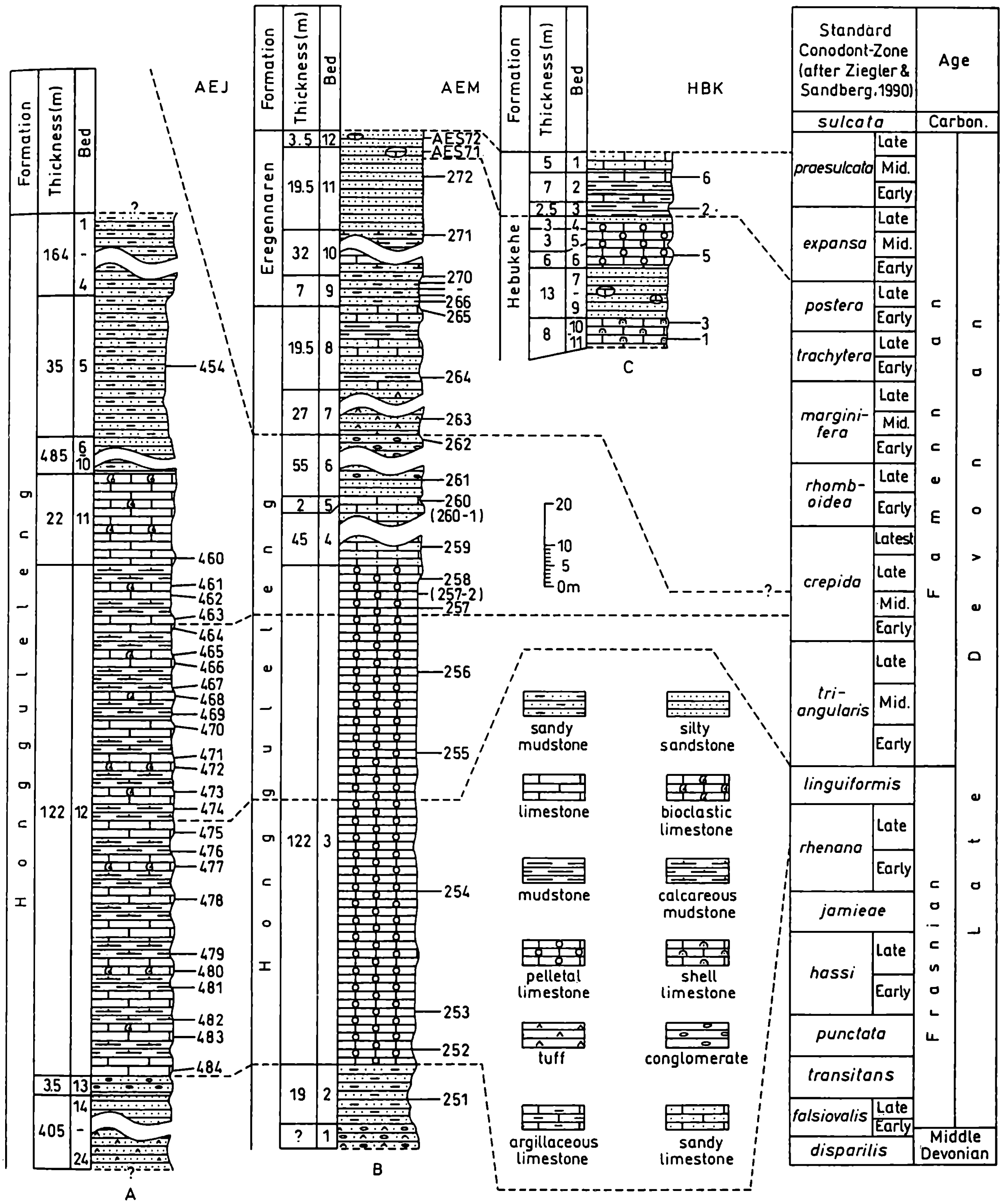

Figure 2: Correlation of stratigraphic sections showing lithology and samples/fossils collected from Section A, Section B and Section C respectively after XU et al. (1990), LIAO et al. (unpublished) and ZHAO (1986) and partly referred to LU and WICANDER (1988). A critically importment modification is made for Section A, in which the previously reported stratigraphic sequence is inverted, which returns it to a normal sequence according to conodont evidence.

tion lay within the boundaries of the Famennian Stage, they suggested that the lower and upper part – yielding plant fossils – should be excluded from the formation as originally defined. Also ZHAO and al. (1990) proposed that the formation should be early to middle Famennian in age according to some conodont material that was not fully identified. Consequently, the writer undertook an extensive study to help settle the controversial issue of the exact age of the formation. During 1986 and 1987, the writer took part in field work of the group dealing with the problem called “Carboniferoues and its Ore Potentiality of North Xinjiang” under State Program 305 of China. I have also done some work together with other colleagues of the group on biostratigraphy of the Upper Devonian, in particular the Hongguleleng Formation, to find the Carboniferous-Devonian (C/D) bounary. First, the writer presents species-level identification of conodonts, based on a conodont sequence across the Frasnian-Famennian (F/F) boundary in two sections near the town of Hextolgay (Fig. 1, A, B and Fig. 2, Section A, B), so that the writer can answer purpose concerning the exact age of the Hongguleleng Formation. Second, the author has discovered som ichthyoliths in several conodont samples from the three measured sections studied (Fig. 2, Section A, B, C) and one unmeasured section (Section A'). Dispite rare districution of microvertebrate remains in the sections, they are very useful for Late Devonian correlation as pointed out by Susan TURNER (pers. comm., 12, 5, 1993). Third, in my sections studied, especially in the Section A, many perfectly preserved bryozoan specimens have been found. LU (in manuscript) described some bryozoans from Section C, but unfortunately he erroneously considered them to be Early Carboniferous in age. The writer has made a taxonomic description of 41 bryozoan species, of which 23 are proposed as new. According to the evidence of conodonts, the writer established their position in his studied sections as exactly as possible. Meanwhile, in order to correct a mistake in respect to the age of the Hebukehe Formation, the writer has also identified conodonts and ichthyoliths in addition to the several bryozoan species described from this formation. The author described two new species of conodonts in open nomenclature. This paper is a summary of the writer's preliminary results on marine microfaunal (bryozoan, conodont and microvertebrate remains) studies.

Conodont Zonation across the F/F Boundary

The standard Late Devonian conodont zonation (pelagic or offshore biofacies), which was revised and expanded from 29 to 32 zones (including the oldest one partly in the Middle Devonian), has been proposed most recently by ZIEGLER and SANDBERG (1990). The conodont zonation across the F/F boundary and the position of the F/F boundary position itself have undergone some important changes in comparison with those as summarized by SANDBERG and DREESEN (19849. These changes are mainly the following ones. The F/F boundary has been placed between *linguiformis* (SANDBERG and al., 1988) and Early *triangularis* Zone rather than the start of Middle *triangularis* Zone (SANDBERG and DREESEN, 1984) or between *triangularis* Zone and *crepida* Zone (HARLAND and al., 1982, 1989). The three zones below the boundary are successively Lower *gigas* Zone, Upper *gigas* Zone and Uppermost *gigas* Zone. The three more zones named by *triangularis* remain unchanged, but on the basis of conodonts, a new Latest *crepida* Zone has been split from the *crepida* Zone. The Late Frasnian mass extinction takes place just within the *linguiformis* Zone. It should be noted here that the F/F boundary and the catatrophic event do not precisely coincide with each other.

The two conodont zones, Late *rhenana* Zone and Middle *crepida* Zone, respectively below and above the F/F boundary, have been recognized in my collections studied (Fig. 1), although the index species of the two zones have not been found. In respect to the Late *rhenana* Zone, according to the revision by ZIEGLER and SANDBERG (1990), its lower and upper limit is indicated, respectively by the first occurrence of *Palmatolepis rhenana rhenana* BISHOFF, 1956 and by the first occurrence of *Pa. linguiformis* MÜLLER, 1956. I have based my conclusions upon the following facts.

Icriodus subterminus has a long, narrower platform and a round medial-row denticles, and may have been derived from *Icriodus alternatus alternatus* BRANSON and MEHL, by apparent lengthening and (or) narrowing of its I element. *I. subterminus* has beeb considered to indicate Early to Upper *rhenana* Zone (SANDBERG and DREESEN, 1984; SAVAGE, 1992). SANDBERG and DREESEN (1984) cited *Icriodus alternatus helmsi* which has been originally described as *Icriodus* cf. *alternatus*, was recognized to be an important zonal index fossils by SANDBERG (1979). Meanwhile, they considered the subspecies to include two morphotypes, the older of which has round medial- row denticles and occurs mainly from Upper and Uppermost *gigas* Zone (= Late *rhenana* Zone and *linguiformis* Zone of ZIEGLER and SANDBERG, 1990). My specimens from Section B and Section A' consist of both morphotypes. BULTYNCK (1988) reported this subspecies from the Middle *triangularis* Zone, possibly a late morphotype that possesses compressed medial-row denticles. In addition, two species of *Polygnathus, Po. imparis* and *Po. planarius*, occupy a relatively dominant position in my collections. The two species apparently are restricted to the Late Frasnian. The former has been found first in the Lower *gigas* Zone (= Early *rhenana* ZIEGLER and SANDBERG, 1990) in Canada (KLAPPER and LANE, 1985). ORCHARD (1988) reported *P. imparis*, occurring along with *P. planarius*, within the Lower to Upper *rhenana* Zone. He also pointed out that the former is a useful index species in the Upper Frasnian, indicates the presence of the Upper *rhenana* Zone below the F/F boundary, and may persist to the top of the Frasnian (ORCHARD, 1988).

The Middle *crepida* Zone has its lower and upper limits defined respectively by the first occurrence of *Palmatolepis termini* SANNEMANN, 1955 and by the first occurrence of *Pa. glabra prima* ZIEGLER and HUDDLE, 1969 (ZIEGLER and SANDBERG, 1990). I recognize this zona by additional evidence as described in the following paragraph.

Palmatolepis minuta minuta is the oldest subspecies of *Pa. minuta* and has been regarded as an index species of Late *triangularis* Zone. The lower limit of the Late *triangularis* Zone has been defined by the first occurrence of this subspecies most recently by ZIEGLER and SANDBERG (1990), but this subspecies does not first occur even in Middle *crepida* Zone in studied sections and can extending instead throughout the zone into *trachyera* Zone (ZIEGLER and SANDBERG, 1990). Another subspecies of *Pa. minuta, Pa. minuta wolskae* as a rule ranges from Middle to Upper *crepida* Zone (ZIEGLER ed., 1977) although its range is not precisely known. Two morphotypes of *Icriodus alternatus alternatus,* one with compressed medial-row denticles and the other round medial-row denticles, are found abundantly in my collections. According to SANDBERG and DREESEN (1984), this subspecies appeared at or slightly above the base of the Upper *gigas* Zone (= Late *rhenana* Zone of ZIEGLER and SANDBERG, 1990) and extended into Upper *crepida* Zone (= Late *crepida* Zone of ZIEGLER and SANDBERG, 1990). There are also two species of *Polygnathus aequalis* and *Po. brevilamiformis.* The former was found first in a lower horizon ranging from Middle to Upper *Polygnathus asymmetricus* Zone (KLAPPER and LANE, 1985). BULTYNCK (1988) reported this species as occurring within Lower or Middle *crepida* Zone, associated with *Pa. minuta minuta* BRANSON and MEHL, 1934; the latter was reported from the lower part of the upper bed with brachiopods (*Cyrtospirifer disjunctus*) of the Frasnian of the central part of the Russian Platform in Russia (OVNATANOVA, 1976). BULTYNCK (1988) reported another species, *Polygnathus brevilaminus,* be similar to *Po. brevilamiformis,* which ranges from Lower *triangularis* Zone through Middle *triangularis* Zone to Lower or Middle *crepida* Zone.

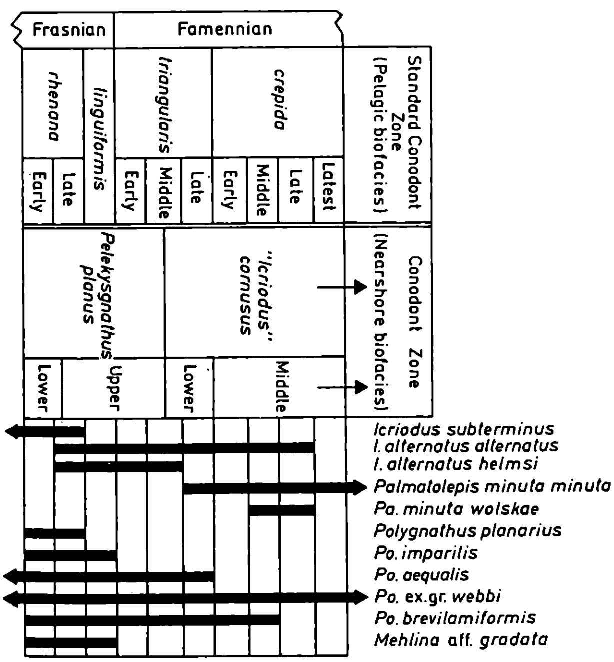

Figure 3: Conodont zonation across the F/F boundary in pelagic (ZIEGLER and SANDBERG, 1990) and nearshore (SANDBERG and DREESEN, 1984) biofacies, and range of some important conodonts occurring in Section A and Section B across the boundary. Correlation of conodont zonation between pelagic and nearshore biofacies is after SANDBERG and DREESEN (1984).

The ranges of some important conodonts occurring in Section A and Section B across the F/F boundary have been shown in Fig. 3. None of the other total five conodont zones between Late *rhenana* Zone and Middle *crepida* Zone have been recognized in the sections. This may be due to the lithologic characteristics and the impossibility to treat samples with acetic acid.

Conodont Zonation below the C/D Boundary

The standard Late Devonian conodont zonation below the C/D boundary as proposed by ZIEGLER and SANDBERG (1990) is nearly unchanged from SANDBERG and DREESEN (1984). The six zones (Fig. 4), except for Early *expansa* Zone and Middle *praesulcata* Zone, are defined by the first occurrence of species or subspecies of the three deep-neritic or pelagic genera *Bispathodus, Siphonodella* and *Protognathus.* The lower and upper limit of Middle *praesulcata* Zone defined respectively by the extinction of *Palmatolepis gracilis gonioclymaniae* MÜLLER and by the entry of Protognathodus kockeli (BISCHOFF) (SANDBERG and DREESEN, 1984).

The Lower *expansa* Zone, the bottom of which is defined by the first occurrence of the nominative subspecies *Palmatolepis gracilis expansa* has been found only in the Hebukehe Formation (Fig. 2, Section C), although the index subspecies does not occur. The identification of the zone is based on the following facts.

Polygnathus communis communis is commonly associated with *Po.* ex gr. *webbi* and occurred in abundance in Section C. As currently known, *Po. communis communis* widely occurs from the Upper Famennian to the Lower Viséan l.c. And the latter occurs in still older strata. ZIEGLER (ed., 1973) recorded that the species ranged from Lower *asymmetricus* Zone to the *vilifer* Zone. Two other pelagic biofacies taxa, *Palmatilepis gracilis* sigmoidalis and *Bispathodus stabilis* Morphotype 3 of SANDBERG and ZIEGLER (1979) are found to be very rare in Section C, but their value in biostratigraphy is important. ZIEGLER (ed., 1977) recorded the former as ranging from Upper *styriacus* Zone through Upper *costatus* Zone and into the overlying *Protognathus* fauna, i.e. corresponding to Early *expansa* Zone to Late *praesulcata* Zone of ZIEGLER and SANDBERG (1990), SANDBERG and ZIEGLER (1979) noticed that the subspecies could range from Lower *marginifer* Zone to Middle *styriacus* Zone, i.e. not older than Early *expansa* Zone of ZIELGER and

SANDBERG (1990). OVER (1992) recently reported that the subspecies was restricted to Early *expansa* Zone to Late *praesulcata* Zone. As for *B. stabilis* Morphotype 3, SANDBERG and ZIEGLER (1979) reported first that the taxon ranged from Middle to Upper *styriacus* Zone in Europe, i.e. corresponding to Early *expansa* Zone. The range of the above-mentioned four species/subspecies below the C/D boundary is shown in Fig. 4.

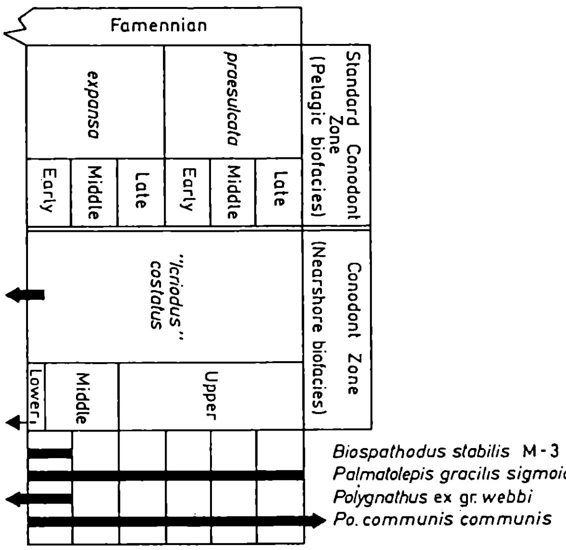

Figure 4: Conodont zonation below the C/D boundary in pelagic (ZIEGLER and SANDBERG, 1990) and nearshore (SANDBERG and DREESEN, 1984) biofacies, and range of several conodonts occurring in Section C. Correlation of conodont zonation between pelagic and nearshore biofacies is after SANDBERG and DREESEN (1984).

Faunas below and above the F/F Boundary and below the C/D Boundary

Conodonts and Biofacies

Two distinct conodont faunas occur respectively below and above the F/F boundary, at the Bulonggur section (Fig. 2, Section A), at an unmeasured section within the same syncline as the Bulonggur section but on the other limb and the Eregenaren section (Fig. 2, Section B).

The oldest conodont fauna, restricted to Late *rhenana* Zone, is dominated by *Polygnathus* and *Icriodus*, which in isolation represent respectively 42 % and 16 % of the Pa elements. *Icriodus* includes only one species, *I. subterminus* YOUNGQUIST, and *Polygnathus* mainly includes three species: *Po. planarius* KLAPPER and LANE, *Po. imparilis* KLAPPER and LANE and *Po.* ex gr. *webbi* STAUFFER, 1938. The genus *Ancyrognathus* also represents a significant portion of the fauna and includes four percent of the Pa elements, but these specimens are broken and could not be identified at species level. At the Eregenaren section (Fig. 2, Section B), a fauna, which could be called the *"Icrodus subterminus / Polygnathus impariis"* fauna is also found and is dominated by *Polygnathus* and *Icriodus*. The two genera in isolation represent respectively 70% and 30% of the Pa elements, which consist mainly of *Icriodus subterminus* YOUNGQUIST, *L. alternatus helmsi* SANDBERG and DREESEN, *Polygnathus imparilis* KLAPPER and LANE and *Po. planarius* KLAPPER and LANE.

The younger conodont fauna, restricted to Middle *crepida* Zone is still characterized by abundance of *Polygnathus* and *Icriodus*, which in combination represent 96% of P elements. The most important species of *Icriodus* is is *Icriodus alternatus alternatus* BRANSON and MEHL, which includes two eo-occurring morphotypes (one with compressed medial-row denticles, the other with round medial-row denticles). In the genus *Polygnathus*, *Po.* ex gr. *webbi* STAUFFER is dominant, *Po. aequalis* KLAPPER and LANE also is represented by a number of specimens and the Late Frasnian species, *Po. brevilamiformis* OVNATANOVA also found in the conodont fauna, which is recognized as the *Icriodus alternatus alternatus / Polygnathus* ex gr. *webbi* fauna. In addition, two new (open nomenclature) species of *Polygnathus* nov.sp. and *Schmidtognatus* nov. sp. occur in the Bulonggur and adjacent unmeasured section. According to ZIEGLER (ed., 1973), *Schmidtognathus* occurs first in the boundary beds of Middle-/Upper Devonian and ranges as high as Lower *asymmetricus* Zone (= Early *falsiovalis* Zone to Early *hassi* Zone of ZIEGLER and SANDBERG, 1990), i.e. into the Frasnian. But as far as we know, the genus has never been found in the early Famennian (ZIEGLER ed., 1975). In addition, it is also worth noting that two species of *Palmatolepis*, *Pa. minuta woskae* SZULEZEWSKI and *Pa. minuta minuta* BRANSON and MEHL, which are though to represent a typical pelagic or offshore biofacies, have been found in the both sections mentioned above.

The conodont fauna contains also some non-platform conodonts such as *Ozarkodina* sp., *Mehlina* sp., and so on which consist of multimenbrate apparati.

The youngest conodont fauna, assigned to Lower *expansa* Zone of the Late Famennian, seems to occur only in the Hobukehe section (Fig. 2, Section C). This fauna contains more stratigraphically important conodont taxa in comparison with both faunas mentioned above and consists largely of *Polygnathus*, which represents more than 80% of pa elements. Two important species of this genus are *Po.* ex gr. *webbi* STAUFFER, which is found in both faunas mentioned above and *Po. communis communis* BRANSON and MEHL, which occurs in this fauna for first time. This fauna can be called *Polygnathus communis communis* fauna herein. Some other conodont taxa occur also but are represented by a few specimens only. Some of the species, such as *Palmatolepis gracilis sigmoidalis* ZIEGLER and *Bispathodus stabilis* (BRANSON and

MEHL) Morphotype 3 of SANDBERG and ZIEGLER (1979) have been commonly considered to be index species of pelagic or offshore facies.

Since SANDBERG (1976) proposed initially five Late Famennian Early *expansa* Zone conodont biofacies types subsequent revisions (SANDBERG and ZIEGLER, 1979; SANDBERG and DREESEN, 1984; SANDBERG and al., 1988) enabled proposal of a relatively complete conodont biofacies scheme by ZIEGLER and SANDBERG (1990). These biofacies types are numbered (I) to (XI) in the shoreward direction. The four outer biofacies types (I–IV) correspond to offshore conditions to more nearshore inner situation, and the six inner biofacies types (V–XI) correspond to the inermost shelf area, each of them representing a specialized microenvironment in the nearshore area (Fig. 5). Conodont biofacies concepts previously summarised by SANDBERG and al. (1988) and subsequently reaffirmed by ZIEGLER and SANDBERG (1990), are based on dominance of one or two genera in the Pa. elements.

In the designated biofacies, one or two dominant genera represent generally more than 80%, less commonly –79% and uncommonly only 70–74%, the total Pa element component of the platform conodont population.

The two conodont faunas, *Icriodus subterminus / Polygnathus imparilis* fauna and *Icriodus alternatus alternatus / Polygnathus* ex gr. *webbi* fauna, indicate a similar common outer shelf polygnathid-icriothid biofacies type (Fig. 5). Although they occur in two different zones, Late *rhenana* Zone and Middle *crepida* Zone (respectively below and above the F/F boundary), the difference between them is only that the former was restriced to more shallow water and the latter was restricted to deeper water than the former. The former occurs in nearshore facies; conodont taxa are represented by *Ancyrognathus*, the later contains some pelagic conodonts such as *Palmatolepis minuta minuta*, *Pa. minuta wolskae* in addition to some dominant taxa. The youngest *Polygnathus communis communis* fauna occurs in the *Early expansa* Zone below the C/D boundary. The species associated with the above-mentioned forms that indicate offshore biofacies conditions include *Palmatolepis gracilis sigmoidalis, Bispathodus stabilis* Morphotype 3 of SANDBERG and ZIEGLER (1979), and another species of *Polygnathus, Po.* ex gr. *webbi*. OVER (1992) described a similar fauna which crossed the C/D boundary, was dominated by *Po. communis communis*, included *Bispathodus stabilis* and *Siphonella sulcata*, indicate of offshore settings, and contained also *Po. symmetricus, Protognathus* sp., and *Pseudopolygnathus primus* from more nearshore conditions. however, he did not indicate to which biofacies type his fauna should belong. SANDBERG and ZIEGLER (1979) in their description related to *Polygnathus communis communis* pointed out that the

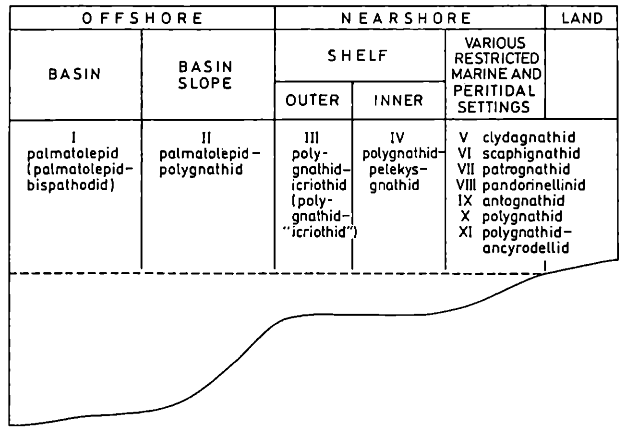

Figure 5: Offshore to nearshore conodont biofacies distribution during Famennian and most of Frasnian. Modified from SANDBERG and DREESEN (1984) and OVER (1992).

range of biofacies of the species in the Upper *styriacus* Zone (= Early *expansa* Zone of ZIEGLER and SANDBERG, 1990) should be from the polygnathid-icriodid biofacies seaward to the palmatolepid-biospathodid biofacies type My fauna is associated mainly with offshore biofacies types and other benthos (such as bryozoans) so it is advisable to attribute the fauna to the polygnathid-icriothid biofacies type of the outer shelf near offshore conditions (Fig. 5).

Microvertebrate Remains and Correlation

Rare microvertebrate remains were found from in some key conodont samples belonging to three standard conodont zones lying below and above the F/F boundary and below the C/D boundary. According to a preliminary report on microvertebrate remains and further remarks on protacrodont teeth by Susan TURNER (pers. commun., 9, 16, 1993 and 10, 14, 19939), the microvertebrate remains are comprised of teeth of phoebodonts, cladodontiformis and protacrodontiforms, sharks, also a few shark scales, and bones, probably belonging to symmoiids or placoderms of Subclass Elasmobranchii BONAPARTE 1883. These microremains of fishes were usually well preserved and some of them are known species, but most of them might be new taxa. These specimens remain to be further research by Susan Turner and others. Because they are associated with conodonts and possess a short range in age but of wide distribution in geography, they have been recommended as useful tools not only in stratigraphic division but also in correlation. Thus it is necessary that the writer should make a blief introduction for these microremains of fishes as one of the important microfossils here.In samples (AEJ484, AEM253) that contained conodonts of Late *rhenana* Zone, four specimens of microremains of sharks were found. They are cf. *Protacrodus vetustus* JAEKEL (GROSS, 1938), a scale of symmoiid (?) or placoderm (?), a microbone plate of placoderms, and a diphoan (?) vonmerine tooth (?).

The writer is not extensively familiar with the microvertebrate and some of the specimens mentioned above must yet be identified precisely. Although it is difficult to correlate with other regions, the writer believes that cf. *Protacrodus vetustus* will be a significant species of protacrodonts in stratigraphy and correlation, because the species has ornamental ribs that are seen on cusps. Following ZANGERL (1981), protacrodont shark teeth are restricted to the Middle to Late Devonian of Germany and USA, in age. Similar specimen of (?) dipnoan vonmerine tooth (?) which is difficult to determine whether it should be assigned to ichthyoliths or to some other group, occur also in the late Fransnian-Famennian bonebeds elsewhere (TURNER, person commun., 09, 16, 1993).

In samples (AEJ460, AES162) containing conodonts of Middle *crepida* Zone, there are five specimens of microvertebrate remains, mainly shark teeth of *Protacrodus* and *Phoebodus*. Cf. *Protacrodus vetustus* JAEKEL (GROSS, 1938) is included, but other specimens might be new taxa. TURNER (pers. commun., 09, 16, 1993) considers that the former was found only from the late Frasnian *Manticoceras* beds of Bad Wildungen of Germany (GROSS, 1938; see also ZANGERL, 1981); thus this species has been to Middle *crepida* Zone. In addition, two specimens (Pl. 27, Figs. 4, 7, 8, 10, 12, 14) which are thought probably to be a new species of protacrodonts, possess a peculiar ornament on the labial side which is like that of some protacrodont teeth from the Upper Devonian of the Kuznetsk Basin – Protacrodonitidae gen and sp. indet. Another species is assigned to cf. a new *Protacrodus* sp. which are from the Upper Frasnian of Kuznetsk and also from the Middle Famennian of Moscow and from the Lower Tounaisian – Visean of Belarus, although TURNER considers that this species sounds too long ranging in age (TURNER, person. commun., 10, 14, 1993; see also LEBEDEV, O. and VYUSHKOVA, L., 1993).

In samples (HBK2) containing conodonts of Early *expansa* Zone, two specimens of shark teeth were found also. One specimen needs further work, but the other one is assigned to *Phoebodus limpidus* GINTER, 1990 by TURNER (pers. commun., 09, 16, 1993). This species was originally thought to be restricted within a longer range from the Latest Frasnian to Late *expansa* Zone or Early *praesulcata* Zone. In addition to Central Poland, this species has been probably found from New York State of USA (not from Himalaya) and South China (GINTER, 1990). Subsequently, GINTER and IVANOV (1992) also found this species in strata corresponding to *trachytera-postera* Zone of Poland and firmly believed that the species should be restricted within Early *trachytera* Zone to Middle *praeculcata* Zone in Poland. Therefore it likely that the Hobukehe Formation where yielded this species can be correlated with the Upper Devonian of the East European platform margin.

Bryozoans, Faunas and Lithofacies

The lowermost bryozoan fauna (Bryozoan fauna 1), occurred just in or mostly in Late *rhenana* Zone below the F/F boundary in my sections (Fig. 2, Section A, AEJ484–475 and Section B, AEM252–254). It is fairly abundant and contains *Pseudocampylus planiformis* sp. nov., *Ps. similitarbagataicus* sp. nov., *Fistulipora lunnuliformis* sp. nov., *Sulcoretepora praehextolgayensis* sp. nov., *Laxifenestella microtuberculata* (NEKHOROSHEV), *Intrapora lanceolata* NEKHOROSHEV, *In. aperiflorina* sp. nov., *Nicklesopora fameniensis* (NECKHOROSHEV) and *N. sexagula* TROIZKAYA, which may be considered to be cross the F/F boundary into the Early Famennian age (Figs. 6, 7). These four known species as originally determined were restricted to the Sulcifer Horizon in the Late Famennian based mainly on evidence from brachiopods in Central Kazakhstan (TROIZKAYA, 1975a).

The next bryozoan fauna, which may be restricted to an interval within the Early *triangularis* Zone above the F/F boundary to Early *crepida* Zone below the C/D boundary in my collections (Fig. 2, Section A, AEJ474–464 and Section B, AEM 255–256), is not well-preserved. it is characterized by dominant Cryptostomata, rare Trepostomata, and a few Cystoporata. In addition to the four previously described species mentioned above that continued from the preceding fauna, other species in this fauna include *Pseudocampylus tarbagataicus* TROIZKAYA, *Ps. breviseptus* sp. nov., *Ps. similivirgatus* sp. nov., *Eridopora* sp., *Acanthoclema junggarensis* sp. nov., *Alternifenestella tshingizica* (TROIZKAYA); *Laxifenestella tichomirovi* (TROIZKAYA), *Minilya alticariniodialis* sp. nov., *M. berkarensis* (TROIZKAYA), and *Intrapora similitainiola* nov. sp. All the previously known species were originally understood to belong to a different part of the Sulcifer Horizon, which had been thought to be of Late Famennian age based on brachiopods in Central Kazakhstan (TROIZKAYA, 1975a).

The next-higher bryozoan faun (Bryozoan fauna 3), which mostly corresponds to Middle *crepida* Zone in my collections (Fig. 2, Section A, AEJ463–460 and Section B, AEM257–262), is abundant and varied yielding 19 species in three orders. They are *Pseudocampylus tarbagataicus* TROIZKAYA, *Ps. bulonggurensis* sp. nov., *Ps. breviseptus* sp. nov., *Ps. inspinosa* sp. nov., *Ps. inspinosa* sp. nov., *Ps. virgatus* TROIZKAYA, *Fistulipora lunuliformis* sp. nov., *F. vassinensis* MOROZOVA, *F. paricella* sp. nov., *Fistuliramus eregennarenensis* sp. nov., *Eofistulotrypa primacylindilla* sp. nov., *Sulcoretepora hextolgayensis* sp. nov., *Alternifenestella nurensis* (NEKHOROSHEV), *Minilya alticarininodialis* sp. nov., *M. berkarensis* (TROIZKAYA), *Rectifenestella praerudis* (TROIZKAYA), *Intrapora similitaeniola* sp. nov., *In. taeniola* TROIZKAYA, *In. triangularis* sp. nov. and *Neotrematopora inspinosa* sp. nov. (Figs. 6, 7). Of these most species

Formation: Hongguleleng Bryozoan Species / Collected number (AEJ)	484	483	482	481	480	479	478	477	476	475	474	473	472	471	470	469	468	467	466	465	464	463	462	461	460
Pseudocampylus tarbagataicus TROIZKAYA, 1960																			—	—	—				x
Ps. bulonggurensis sp.nov.																							x	x	x
Ps. breviseptum sp.nov.														—	—	—							x	x	
Ps. imspinus sp.nov.																						x		x	x
Ps. virgatus TROIZKAYA, 1960																			—	—	—	x		x	x
Ps. planiformis sp.nov.		x																							
Ps. similivirgatus sp. nov.																x									
Ps. similitarbagataicus sp.nov.																									
Fistulipora luniliformis sp.nov.																									x
F. paricella sp.nov.		x																							
Eofistulotrypa primacylindilla sp.nov.																							x		x
Eridopora sp.																			—	—	—				
Cyclotrypa colicylindella sp.nov.																									x
Sulcoretepora hextolgayensis sp.nov.																									x
S. praehextolgayensis sp.nov.		x																							
Bactopora hextolgayensis sp.nov.																							x		
Acanthoclema junggarensis sp.nov.																	x	x							
Nicklesopora famenniensis (NEKHOROSHEV, 1960)	—	—	—	—	—	—	—	—	—	—	—	—	—	—											
N. sexagula TROIZKAYA, 1968	—	—	—	—	—	—	—	—	—	—	—	—	—	—											
Alternifenestella nurensis (NEKHOROSHEV, 1977)																						x			x
Al. tshingizica (TROIZKAYA, 1968)																	—	—							
Laxifenestella tichomirovi (TROIZKAYA, 1968)																			—	—	—				
Minilya alticarininodialis sp.nov.																	—	—	—	—	—	x			
M. berkarensis sp.nov.																			—	—	—			x	
Rectifenestella praerudis (TROIZKAYA, 1963)																								x	x
Intrapora aperiflorina sp.nov.	—	—	—	—	—	—	—	—	—	—	—	—	—	—											
In. lanceolata NEKHOROSHEV, 1960	—	—	—	—	—	—	—	—	—	—	—	—	—	—				x							
In. similitaeniola sp.nov.																			—	—	—	x	x	x	
In. teniola TROIZKAYA, 1968																						x			
In. triangularis sp.nov.																						x	x		x
Neotrematopora imspina sp.nov.																								x	
Correlation with geological age	Late Frasnian										Early Famennian														
Correlation with Standard Conodont Zones (Z. & S., 1990)	Late *rhenana* Zone										Middle *crepida* Zone														

Figure 6: List of bryozoans described from Section A and correlations resulting from conodont analysis. The specimens of some bryozoan species are collected from a certain horizon within the range indicated by the heavy line.

are associated with the *Icriodus alternatus alternatus* / *Polygnathus* ex gr. *webbi* conodont fauna and occur together within the Middle *crepida* Zone. But in the previously known species mentioned above, *Fistulipora vassinensis* was considered to be the Frasnian age of the Kuznets basin (MOROZOVA, 1961), *Alternifenestella nurensis* which was of uncertain position in the Famennian of Kazakhstan (NEKHOROSHEV, 1977) and the remaining five species (*Pseudocampylus tarbagataicus, ps. virgatus, Rectifenestella praerudis, Minilya berkarensis* and *Intrapora taeniola)* were thought to belong only to the Sulcifer Horizon in the Famennian. The basis for this age assignment for the latter five species was the associated brachiopods in Central Kazakhstan (TROIZKAYA, 1975a). some of these species (e.g. *Pseudocampylus tarbagataicus. Ps. virgatus, Minilya berkarensis*) continue elements of the preceding fauna.

The next-higher bryozoan fauna (Bryozoan fauna 4), which may correspond to an unrecognized subdivision

Section	B							C		
Formation	Hongguleleng							Hebukehe		
Collected number (AE /HBK) / Bryozoan Species	253	256	257	262	263	264	265	1	5	2
Fistulipora vassinensis MOROZOVA, 1961				x						
Fistuliramus eregennarensis sp. nov.				x						
Cyclotrypa tubuliformis NEKHOROSHEV, 1953										x
Nikiforovella cellaris sp. nov.							x			
Nicklesopora graciosa TROIZKAYA, 1968										x
Laxifenestella microtuberculata (NEKHOR., 1960)	x									
Rarifenestella octoformis sp. nov.						x				
Rectifenestella crassimuralis (TROIZKAYA, 1968)						x				
R. rengarteni (TROIZKAYA, 1968)		?								
Intrapora aperiflorina sp. nov.	x	x								
Intrapora lanceolata NEKHOROSHEV, 1960	x							x	x	
Conodonts with geological age	Late Famennian	Early Famennian			Middle Famennian			Late Famennian		
Correlation with Standard conodont Zones (ZIEGLER and SANDBERG, 1990)	← Late *rhenana* Zone	Middle *crepida* Zone →			Late *crepida* Zone →			Early *expansa* Zone – *praesulcata* Zone →		

Figure 7: List of bryozoans described from Section B and Section C, and correlations resulting from conodont analysis.

of the Late *crepida* Zone to Late *postera* Zone, has been found only in the Hongguleleng Formation of the Eregennaren section (Fig. 2, Section B, AEM263–272) and is of limited distribution. It includes only three species: *Nikiforovella cellaris* sp. nov., *Rarifenestella octoformis* sp. nov. and *Rectifenestella crassimuralis* (TROIZKAYA) (Fig. 7). Of these some known species are certain to be Late Famennian age in Central Kazakhstan (TROIZKAYA, 1975a). The uppermost bryozoan fauna (Bryozoan fauna 5), which may be assigned to the Early *expansa* Zone, has been found only in the Hebukehe section (Fig. 2, Section C, HBK 1, 5, 2). It is characterized by a small number of crystoporates and cryptostomes and consists only of three species: *Cyclotrypa tubuliformis* NIKHOROSHEV, *Nicklesopora graciosa* TROIZKAYA, and *Intrapora lanceolata* NEKHOROSHEV. The first of these species has been determined to be of middle Tournaisian age in Kazakhstan (NEKHOROSHEV, 1953), and the last two species were regarded as being of Late Famennian age (TROIZKAYA, 1975a).

The distribution of Bryozoa in diverse stratigraphic formations or units depends commonly upon lithological character of deposits, from which one can infer the paleoecological environment. In my collections, the most abundant bryozoans were collected from the Hongguleleng Formation of the Bulonggur section (Fig. 2, Section A), and my study of lithofacies, especially in respect to microfacies, has been focussed on Section A only.

The lower part of the Hongguleleng Formation (sensu XU and al., 1990, the continental deposits containing plant megafossils have not been included in the formation), yields bryozoan fauna 1. The rock consists of thin-bedded micritic limestone with bioclastics, intercalated with calcareous mudstone containing other benthic elements such as brachiopods, rugose corals, crinoids, a small amount of trilobites as well as some acritachs and spores, approximately 40 m thickness. According to analysis of microfacies as offered byJiang

NE-YAN and Zhang JUN-MING (pers. commun., the same below), it corresponds to the following types of microfacies.

a) Crinoid, brachiopod, ostracod and bryozoan wackestone. Fragments of sponge spicules and foraminifera are also present in a small amount.
b) Bryozoan, crinoid packstone. Fragments of brachiopods and trilobites, especially in sample AEJ483, occur also in a small amount.

The middle-upper part of the Hongguleleng Formation yielded bryozoan fauna 2. Petrographically this part of the formation seems not to be different in comparison with the lower part mentioned above, although the distribution of benthos such as bryozoans, brachiopods and crinoids are of no great importance; acritarchs and spores are also abundant (LU and WICANDER, 1988). The thickness of the rock is approximately 30 m. The following types of microfacies are included.

a) Pelletoidal (partly recrystallized) argil aceous lime mudstone. Fragment of bryozoans are also present in small amount.
b) Sponge spiculae wackestone with a small amount of fragments of bryozoans.
c) Brachiopod and pelletoidal wackestone. Fragments of bryozoans and crinoids are also present in small amount.

The upper part of the Hongguleleng Formation contains bryozoan fauna 3. Megascopically this part of the formation corresponds to thin-bedded micritic limestone with variable bedding thickness yielding abundant and diverse benthos such as brachiopods, crinoids, rugose corals, trilobites etc. it is approximately 22 m in thickness and is characterized microscopically by the following types of microfacies.

a) Crinoid, brachiopod, bryozoan packstone. Fragments of ostracods are present also.
b) Bryozoan, crinoid wackestone, with fragments of brachiopods and trilobites.

In summary, analysis of the above-mentioned lithofacies has shown that three parts of the Hongguleleng Formation have yielded a similar lithologic characters and imply roughly the same depositional environment, i.e. an outer shelf in nearshore, which is possessed of weak energy. The environment difference between successive parts of the formation appear to be only variable water depth during different periods, that is from deeper through shallower into deeper again.

Age and Correlation

Hongguleleng Formation

The Hongguleleng Formation was named by Stratigraphic Troops of No. 1 Regional Surveying Party, Bureau of Geological and Mineral Resources of Xinjiang in 1973 after a place named Hongguleleng, located on the southern slopes of Shaerbuerti mountain. But its reference section was at Bulonggur, situated about 15 km northwest of hextolgay town (Fig. 1), because this section possesses a well developed and more complete stratigraphic outcrop and yielded abundant diverse fossil groups. In fact, it subsequently has become stratotype widely acknowledged by some stratigraphers and palaeontologists (HOU and al., 1979; The Compiled Group of Regional Stratigraphic Scheme of uygur Autonomous Region of Xinjiang, 1981; ZHAO and WANG, 1990; XU and al., 1990; ZENG and XIAO, 1991). With regard to the original concept, the formation consists predominantly of myrine deposit, with subsidiary lower continental deposits and composed of gray-green conglomerate (especially in its lower part), sandstone, variegated tuffaceous siltstone, siliceous siltstone and a small amount of limestone lenticules (ZENG and XIAO, 1991). The fossil content is characterized by a great abundance of benthic organisms: brachiopods, rugose corals, trilobites, plant megafossils, rare cephalopods and gastropos. The formation is in conformity with the overlying Hebukehe Formaiton, which was thought to be Early Carboniferous age. The contact with the underlying Zhulumute Formation showed conformity, but locally a sedimentation hiatus. The formation is 595 m in total thickness and its age is thought to be Late Devonian (Famennian).

Further study on biostratigraphy of the Hongguleleng Formation included a more detailed exploration of mineral resources of North Xinjiang and as a result of this study, some stratigraphers an palaeontologists took a sceptical attitude about the age of Hongguleleng Formation.

Field research and prelinimary identification of conodonts caused the writer, following the "Carboniferous and its Ore Potentiality of North Xinjiang" led by Liao ZHOU-TING during 1986–1988, to conclude that the stratigraphic sequence of the Hongguleleng Formation had been interpreted in reserva order and that the marine deposits in the formation could be earlier than Late Famennian in age. Subsequently, ZHAO and WANG (1990) published the interpretation, that the stratigraphic sequences listed by them could be reversed and assigned to the lower-middle part of the Famennian stage, roughly corresponding to the *crepida* Zone to *marginifera* Zone (exact zone uncertain) on the basis of conodonts from the type section. In the same year, XU and al. (1990) revised the original definition of the formation and restricted the formation in the marine portion; they excluded continental deposits containing plant macrofossils. They remeasured the stratigraphic section to be 1266.1 m in total thickness, which included 515.1 m of repeated marine strata. They concluded from various fossil groups that the lower part could be Early Famennian, the middle part could be roughly correlated with the Famennian of Europe, and the Upper part could correspond to the Famennian of Europe, thus the series of marine deposits (the Hongguleleng Formation sensu XU and al., 1990), where assigned to the whole Famennian. LU and WICANDER (1988) first systematics of acritarchs and spore palynoflora from twenty-five samples collected bed by bed from the 80 m marine deposits corresponding to the 12nd and 13rd bed of the section listed by XU and al. (1990). Due to the poor preservation and the long range of some species, the spore assemblage gave no significant evidence for the age. In contrast, they discovered that the acritach assemblage indicated a late Frasnian-Famennian age. Moreover, based on an increase in teh spore/acritarch ratio in an ascenging stratigraphic sequence, and an appearance of woody debris in the upper samples, they considered there to have been shoaling conditions during deposition of the upper part of the section, which they considered to be in normal stratigraphic order. Their determination of age is correct, but they accepted that the sequence was Famennian age based on previous macrofossil determinations. Their view of the paleonenvironment in general can be acepted but unfortunately they had not recognized the reversed stratigraphic sequence in that secion.

During the field work in 1986–1987, at old sampled holes excavation by LU who joined XU and al., in the field work in 1985, 25 conodont samples were collected from the Hongguleleng Formation (Fig. 2, Section A). Although only three (AEJ484, AEJ475 and AEJ460) of 25 samples yielded fairly abundant conodonts, but these conodonts give important evidence for both age and paleoenvironment of the formation. Meanwhile in another limb located in the same synclinal fold as XU and al. (1990) pointed aout, two samples (AES161 and AES162) stratigrapphically equivalent to samples AEJ484 and AEJ460 from Section A have also provided abundant conodonts which are important in recognition of the precise age of the formation. Conodont lists from these samples of the type section, and an unmeasured section A' of another limb located in the same synclinal fold with Section A, are shown in Fig. 8. The range of some important conodonts have been also indicated in Fig. 3.

In samples AEJ484, AEJ475 and AES161 of Section A and Section A', 6 species have been identified. Except for *Polygnathus* ex gr. *webbi*, which ranges from the beginning of the Frasnian to Early *expansa* Zone of the Late Famennian, 5 species *Icriodus subterminus, Polygnathus planarius, Po. imparilis, Mehlina* sp. aff. *gradata, Ancyrognathus* sp., have been generally restricted to the Late Frasnian. Even more precisely, ORCHARD (1988) regarded *Po. imparilis* as a useful index species for the Late *rhenana* Zone below the F/F boundary to the end of the Frasnian. Based on the preceding discussion of conodont zonation across the F/F boundary, I confirm that these above-mentioned conodonts falles within the Late *rhenana* Zone even though the index species *Palmatolepis rhenana rhenana* does not occur in these samples.

In samples AEJ460 and AEJ162 of Section A and Section A', 9 conodont species have been recognized, of these two subspecies of Palmatolepis – *Pa. minuta* and *Pa. minuta wolskae* -- are the most important to determine the precise age. ZIEGLER and SANDBERG (1990) regarded the former, as an index taxon of the Late *triangularis* Zone, ranges from the Late *triangularis* Zone to the *trachytera* Zone. As for the latter, as a rule it is restricted to the Middle-Upper *crepida* Zone (ZIEGLER ed., 1977). In addition, the stratigraphically useful *Icriodus alternatus altrernatus* occurred in the two sections, SANDBERG and DREESEN (1984) recognized that this subspecies appeared at or slightly above the Late *gigas* Zone (= Late *rhenana* Zone of ZIEGLER and SANDBERG, 1990) and ranged through the Late *crepida* Zone. Previously BULTYNCK (1988) reported that hte subspecies with compressed medial-row denticles was found from the Middle *triangularis* Zone o Early Famennian. In addition, two species of Polygnathus – *Po. aequalis and Po. brevilamiformis* – were also recorded originally from the Late Frasnian. However, BULTYNCK (1988) reported *Po. aequalis* and another species (*Po. brevilaminus*), which is similar to *Po. brevilamiformis*, and possibly *Palmatolepis minuta minuta*, to occur also within the Early Middle *crepida* Zone. According to my discussion in preceding section concerning the conodont zonation across the F/F boundary, it is apparent that these above-mentioned species should be assigned to the Middle *crepida* Zone.

Moreover microvertebrate remains some teeth, scales and bone plates of ichthyoliths have offered important evidence regarding age of the formation, although they have not yet been fully studied. According to TURNER's opinion (person commun., 9, 16,1993; 10, 14, 1993), cf. *Protacrodus vetustus* with five cusps and *P. vetustus* JAEKEL (GROSS, 1938) with seven cuspus, which are respectively from Late *rhenana* Zone and Middle *crepida* Zone in the Bulunggur section (Textfig. 2, Section A), have been recognized. To the best of my knowledge, *Protacrodus* has been reported from Middle to Late Devonian of Germany and the USA, and its type species *P. vetustus* was previously restricted within the Late Frasnian of Wildungen, Germany (TURNER, pers. commun., 9, 16, 1993; see also GROSS, 1938 and ZANGERL, 1981). But because apparent *P. vetustus* associate with conodonts of Middle *crepida* Zone in my collection, its range may be extended to Early Famennian.

In summary, two conodont zones – the Late *rhenana* Zone and the Middle *crepida* Zone – recognized herin are significant because the age of the marine deposits containing the conodonts of the Hongguleleng Formation extend through the sequence defined by the two zones. The proper sequence of the Bulonggur section, which has been mistaken considered to be normal sequence for many years can be properly oriented, with the beds of conodont sample AEJ484, AEJ475 (Late *rhenana* Zone) in the lowermost part of the sequence and the beds of conodont samples AEJ460 / AEJ162 (Middle *crepida* Zone) in the upper part of the sequence (Fig. 2, Section A). In addition, *Polygnathus bomorirregularis, Po. granilosus* and *Palmatolepis glabra* were found in the 5th bed of the Bulonggur section remeasured by XU and al. (1990). According to ZIEGLER (ed., 1977), *Palmatolepis* ex gr. *glabra,* which is the most important conodont in that list ranged from the Upper *crepida* Zone up into the Upper *verifer* Zone. If the original identification of these specimens was reliable, then these conodonts may fall within Late *crepida* Zone, meanwhile I have noticed also that the overlying bed – previously mistaken as the underlying bed (XU and al., 1990) – has yielded macrofossils such as brachiopods, rugose corals considered to be of an early Famennian age. Therefore, the uppermost part of the marine deposits of the Hongguleleng Formation may be not higher in age than the Early Famennian. Generally speaking, the age of the Hongguleleng Formation is Late *rhenana* Zone through Middle *crepida* Zone possibly into Late *crepida* Zone, i.e. from the Late Frasnian to the Early Famennian, but no younger than Early Famennian.

Because the lowermost Late *rhenana* Zone and the upper Middle *crepida* Zone have been recognized the Bullonggur section and the Eregennaren section, a number of direct correlations can be made between these two sections and also with other sections within the sections, even though successive standard conodont zones do not appear between the two above-mentioned zones. This is mainly due to unsuitable facies. These correlations are as follows:

1. *Icriodus subterminus* and *Polygnathus* ex gr. *webbi* occurring at the bottom of both sections: a 1 m above the bottom of marine beds at the Bulonggur section, but at 24 m above the bottom at the Eregennaren section.
2. *Polygnathus imparilis* is present in both sections, at 1 m above the bottom of marine beds at the Bulonggur section and at 33 m above the bottom at the Eregennaren section.

Of the above-mentioned conodont 1 and 2, except for *Icriodus subterminus, Polygnathus imparilis* and *Po.* ex gr. *webbi* all occur also in the Mount Hawk and Ronk Formation at Medieine Lake of Western Canada (ORCHARD, 1988).

3. *Schmidtognathus* sp. nov. occurs in both sections, at 80 m above the bottom of marine beds at the Bulonggur section and at 141 m above the bottom at the Eregennaren section.
4. *Polygnathus aequalis* and *Icriodus alternatus alternatus* appear in both sections, at 80 m above the bottom of marine beds at the Bulonggur section, and at 146 m above the bottom at the Eregennaren section.

Of the above-mentioned conodonts 3 and 4, except for *Schmidtognathus* sp. nov., Polygnathus aequalis and *Icriodus alternatus* associated with *Palmatolepis minuta* all occur together in the lower Famennian at the Senzeilles Frasnian/Famennian Section of Germany (BULTYNCK, 1988).

Consequently, the bottom of the Bulonggur section and the lower part of the Eregennaren section can be roughly correlated with the Mount Hawk and Rode Formations of Western Canada, by means of the above-mentioned conodonts 1 and 2. The middle-upper part of marine sequence of the Bulonggur section, the middle part of the Eregennaren section, and the lower Famennian of the Senzeilles Frasnian/Famennian Section of Germany also can be roughly correlated by means of the above mentioned conodonts 3 and 4.

An abundant and diverse bryozoan fauna has been discovered in both sections studied, in particular, in the Bulonggur section; but because bryozoans have not been extensively used in Devonian biostratigraphy (CUFFEY and McKINNEY, 1979), the correlation of Devonian bryozoan fauna in different formations/Units of the world, even in formations/units between close section in the same region is rather difficult. More recently BIGEY (1988) has summarized bryozoan age corresponding as fas as possible to conodont zone in order to make correlation of bryozoan faunas from different formations/units more useful throughout the world. This is a worthwhile enterprise, although there will be many difficulties due to the paucity or absence of conodonts in general and to the ignorance of conodont samples collected in strata being rich in benthos. Thus the correlation of the bryozoans which we have made here is only a preliminary result.

The correlations of the bryozoan faunas from the Bulonggur and the Eregennaren section are as follows:

1. *Intrapora lancelata* and *In. aperiflorina* occur in the lower and middle part of both sections.
2. *Eofistulotrypa primacylindilla* appears in both sections, at the upper part of marine sequence of the Bulonggur section and at the middle part of the Eregennaren section.

Therefore, the whole marine sequence of the Bulonggur section can be roughly correlated with the lower-middle part of the Honguleleng Formation of the Eregennaren section. According to material cited by VEIMARN and al. (1988), M.V. MARTYNOVA has distinguished seven brachiopod assemblage-zones in the Famennian marine sediments of the shallow-water facies in Central Kazakhstan. They are in ascending order: *Mesoplica meisteri-Cytrospirifer calcaratus, Mesoplica tasadyrica-Mucrospirifer posterus, Cyrtospirifer ulentensis* in the Meister Horizon of the lower Famennian, *Mesoplica semisbugensis-Cyrtospirifer sulcifer, Nigerinoplica nigerina-Cyrtospirifer konensis, Acanthoproductus bogdanovi-Athyris tau* in the Sulcifer Horizon of the lower part of Upper Famennian, and *Tenisia data* in the Simorin Horizon of the upper Upper Famennian. The Late Devonian strata of the Kazakhstan region yielded an abundant bryozoan fauna (TROIZKAYA, 1960, 1968; NEKHOROSHEV, 1977), but the ages of bryozoans have been dated mainly on the basis of brachiopods which is the most numerous group in the Upper Devonian and is restricted almost to the Sulcifer Horizon only. 14 known bryozoan species occurring in my collections are known also from different layers of the Sulcifer Horizon in Kazakhstan (Fig. 9). Bryozoan correlation between my collections and Kazakhstan in age is difficulty however due to the following reasons:

a) The age of the bryozoan fauna in Kazakhstan has been determined mainly on the basis of brachiopods as pointed out above, and the age of the bryozoan fauna in my collections is confirmed by conodonts in associate or successive strata. The difference in age of the bryozoan fauna from the two neighbouring regions is rather large: one is of Late Frasnian–Early Famennian age, and the other is of Late Famennian age.
b) The correlation between brachiopod assemblages of shallow-water facies and the standard conodont zones of pelagic facies as made by VEIMARN and al. (1988) has been called into question. The brachiopod *Cyrtospirifer sulcifer* was regarded as an "assemblage-zone" species and localized within the lower part (Aidagarly Layer) of the Sulcifer Horizon and was though to be the Early Famennian in the Bulonggur section by XU and al. (1990). On the other hand, the conodont *Polygnathus brevilaminus*, which has been found in the lower part of the Sulcifer Horizon of shallow-water facies in the Kazakhstan, can occur together with *Palmatolepis minuta minuta, Polygnathus aequalis* in the Lower or Middle *crepida* Zone and can also exist together with other species in a lower horizon, the Lower to Middle *triangularis* Zone of the Senzeilles Frasnian/Famennian Reference Section in Germany. Moreover, *Polygnathus brevilamiformis,* which is similar to *Po. brevilaminus* in morphology, commonly occurs together with some of the above-mentioned species and appears in the Middle *crepida* Zone in the Bulonggur section. In fact, the age of the Simorin Horizon which was originally thought to be Carboniferous has been revised and is regarded as Devonian on the basis of conodonts (VEIMARN and al., 1988) now. Thus we suggest that in respect to the age of the whole Sulcifer horizon there should be an adjustmentm towards a lower stratigraphic horizon on the basis of conodont material.

The writer believes, because the two neighbouring regions of the northwestern periphery of the Juggar basin of North Xinjiang and Central Kazakhstan of Kazakhstan possess so many elements of bryozoan faunas in common (Fig. 9), that the age as indicated by these bryozoans should be the same, which I consider to be Early Famennian. Only three species: *Nicklespopora fameniensis* (NEKHOROSHEV), *N. sexagula* TROIZKAYA and *Intrapora lanceolata* NEKHOROSHEV are known to extend into the Late Frasnian. Moreover we also can confirm that bryozoan faunas of both regions mentioned above should be reliable to make a correlation and can be regarded as belonging to the same biogeographical region.

Hebukehe Formation

The Hebukehe Formation was named – by No. 1 Regional Surveying Party, Bureau of Geological and Mineral Resources of Xinjian in 1979 – after the Hebukehe river located within the boundaries of the Mongolian Autonomous County of Hoboksar in the nothwestern junggar basin, Uygur Autonomous Region of Xinjiang. Its type section is situated on the east bank of the Hebukehe river, about 8 km northwest of Hextolgay town (Fig. 1, C). Before this formation had been formally named, a suite of limestone intercalated with detrital rocks located east of the hebukehe river had been called the Qiliwan Formation, these rocks are located about 1 km away from the type section of the Hebukehe Formation and were subdivided into the Lower Subformation of Tournaisian age and the Upper Subformation of Viséan age by HAO Fu-guang in 1964. Subsequently, the Qiliwan Formation was renamed as the Hebukehe Formation although , following the concept of HAO Fu-guang's formation and was dated as Early Carboniferous. Since then, the age of the formation has been controversial.

In 1984, WANG Yu-jing and al. interpreted the age of the Hebukehe Formation as early-middle Tournaisian, mainly on the basis of brachiopods, rugose corals, bryozoans and so on. One year later, WANG Yu-jing redated it as ranging from Late Devonian to early Early Carboniferous, based on brachiopods, rugose corals, brypozans, radiolarias, an age assignment also accepted by JIN Yu-gan (1984).

ZHAO (1986) subdivided the Hebukehe Formation into two parts, the upper member and the lower member after conodont contents and lithologic characteristics. The upper member is composed predominantly of gray-green sandstone and mudstone, intercalated with some thin beds of different thickness of purplish red siliceous sandstone, gray argillaceous limestone, shell limestone and nodular limestone. Its fossil content is characterized by an abundance of brachiopods, rugose corals, bryozoans, crinoids, conodonts, ostracods, ammonids, etc. The conodont fauna consists mainly of *Apatognathus varians* BRANSON and MEHL, *Gnathodus kockeli* BISCHOFF (= *Protognathus kockeli* BISCHOFF, 1957), and *Polygnathus* ex gr. *communis* BRANSON and MEHL.

The lower member is composed predominantly of gray-green sandstone, sandy conglomerate, mudstone, and sandstone with limestone lumps, intercalated with some thin beds of different thickness of argillaceous limestone, shell limestone, nodular limestone and tuff. Its fossil content is characterized by an abundance of brachiopods, rugose corals, bryozoans, crinoids, cephalopods, ostracods, conodont and trilobites. The conodonts can be divided in descending order into the called *Siphonodella praesulcata – Polygnathus rhabdotus – Icriodus pectinata – Polygnathus perplexus* Assemblage and the *Ancyrognathus bifurcatus – Polygnathus homoirregularis – P. semicostatus – Po. nodocostatus – Polylophodonta* sp. Assemblage. According to conodont identification by ZHAO, the upper member has been suggested to represent the early part of Early Tournaisian, but it is not located at the type section of the Hebukehe Formation and is situated east of the Hextolgay–Boljin highway. The lower member, which occurs at the type section, was though to be of Famennian age. Thus the age of the Hebukehe Formation as expressed at its type section has been defined as Late Devonian rather than Early Carboniferous on the basis of conodont material.

In 1990, LIAO Zhuo-ting and al. further confirmed that ZHAO's opinion in respect to the Late Devonian age of the Hebukehe Formation could be acepted, but their correlation of the Hebukehe Formation with the Honguleleng Formation is inaccurate. However, it should be pointed out that on the basis of the Conodont evidences from the Hebukehe Formation, ZENG and XIAO (1991) considered a Late Famennian age for the Hongguleleng Formation, was incorrect.

The writer (XIA and his collegeagues of the Group of the Problem named "Carboniferous and its Ore Potentiality of North Xinjiang" led by LIAO Zou-ting in field work from 1986 to 1987, collected conodont samples from the third mountain ridge's section which had been measured and studied by ZHAO (1986). Although only two samples (HBK2 and HBK6) in the upper part of this section have yielded some conodonts (Fig. 2, Section C), those conodonts are important for distinguishing the strata from the Hebukehe Formation. The conodont list for these samples of the upper part of Section C and their ranges in the standard conodont zone have been shown in Fig. 8 and Fig. 4 respectively. According to reasons given under previous section, "Conodont zonation below the C/D boundary", these conodonts have been assigned to Early *expansa* Zone. Thus, the upper part of the formation has been restricted to the Early *expansa* Zone of Late Famennian. In addition to conodonts, it is worthwhile to note that two specimens of shark teeth, one of which is assigned to *Phoebodus limpidus* GINTER by TURNER (person. comm., 9, 16, 1993), were found in sample HBK2 mentioned above. GINTER and IVANOV (1992) considered that *Ph. limpidus* only ranges from the *trachytera* Zone to the Middle *praesulcata* Zone in Poland. Thus this occurrence, by which the Hebukehe Formation can be correlated with the Upper Devonian of the East European platform margin, supports my belief. Because no key conodonts which could indicate a precise age have been found from the lower part of the formation, we could not confirm its age. But in terms of ZHAO's opinion (1986), the lowermost part of the Hebukehe Formation has yielded *Ancyrognathus bifurcatus* (ULRICH and BASSLER, 1926) which is restricted probably to the range from *crepida* Zone to *rhomboidea* Zone rather than being of Frasnian age (ZIEGLER, ed., 1981; KLAPPER, 1990). Therefore, the age of the Hebukehe Formation should be restricted to the range from *crepida* Zone to Early *expansa* Zone of Middle–Late Famennian and be considered to be the highest horizon in the district that the writer studied.

The bryozoans found in Hebukehe Formation consist of a lot of specimens, particularly from the upper part, although only three species have been found (Fig. 7). They have not offered any significant evidence in the determination of the exact age due to the long range of these species. It is also worth noticing that bryozoans from Hebukehe Formation described by LU Lin-huan (in manuscript) should be Middle–Late Famennian age rather than Early Carboniferous based on the writer's material in conodonts and microvertebrate remains.

Conclusion

Analysis of bryozoan, conodont and ichthyolith microfaunas have yielded the following results:

1) The two conodont zones, Late *rhenana* Zone and Middle *crepida* Zone below and above the F/F boundary in the Hongguleleng Formation at the Bulunggur section, and another conodont zone, Early *expansa* Zone below the C/D boundary in the Hebukehe Formation at the Hebukehe section, could be identified.
2) The bryozoan, conodont and microvertebrate microfaunas correspond with or are roughly to three conodont zoneas mentioned above.
3) Near the F/F boundary at the Bulonggur and Eregennaren section, conodonts and microvertebrate remains have not been found; bryozoans are also imoperished in both taxa and number, which may be due to both the lithologic character of deposits and the influence of a global late Frasnian mass extinction event.
4) The two conodont faunas, *Icriodus subterminus / Polygnathus imparilis* fauna and *Icriodus alternatus alternatus / Polygnathus* ex gr. *webbi* fauna belonging to the Late *rhenana* Zone and the Middle *crepida* Zone respectively, represent a similar outer shelf polygnathid–icriothid biofacies. The difference between them is only that the former implies a more shallow water environment than the latter.
5) The conodont occurrences confirm that the stratigraphic sequence of the Bulonggur section, which was been misunderstood for a long time, is overturned.

6) The stratigraphic assignment of the Hongguleleng Formation at the Bulonggur section, which has been disputed for a long time, is from Late *rhenana* Zone through Middle *crepida* Zone and possibly into Late *crepida* Zone also, i.e. it ranges from Upper Frasnian to Lower Famennian.
7) The statigraphic level of the Hebukehe Formation at the Hebukehe section, which has been a long-standing problem, has been confirmed to range from the *crepida* Zone to Early *expansa* Zone, i.e. to be Middle – Upper Famennian.
8) The upper part of the Hongguleleng Formation may correspond to the lower part of the Hebukehe Formation, so one can not make a complete stratigraphic placement of the Hebukehe Formation.
9) In both regions – the northwestern periphery of the Junggar basin and Central Kazakhstan – many elements of bryozoan faunas are in common and should belong therefore to the same biogeographic region, but as currently determined they are quite different in respect to their age. Thus I suggest that the age of the Central Kazakhstan bryozoans be reassigned to early Famennian age, found in its stratigraphic equivalent in the Junggar basin.
10) The few microvertebrate specimens represent typical Frasnian to Famennian assemblages and are comprised of remains of placoderms, dipnoans and predominantly chondrichthyans, especially the teeth and scales, in my collections. Cladodont, phoebodontiform and protacrodontiform teeth are well-represented; these teeth, especially the phoebodont, are proving useful zone fossils for the Middle to Late Devonian, especially in the absence of conodonts (TURNER, pers. commun., 9, 16, 1993; see also GINTER and IVANOV, 1992).

Micropaleontology

Systematic Bryozoology

Order Trepostomata ULRICH, 1882
Suborder Halloporidea ASTROVA, 1965
Family Trematoporidae MILLER, 1889

Genus ***Neotrematopora*** MOROZOVA, 1961

1961 *Neotrematopora* MOROZOVA, p. 110.
1968 *Neotrematopora* MOROZOVA, TROIZKAYA, p. 108.
1978 *Neotrematopora* MOROZOVA, ASTROVA, p. 86.

Type species *Neotrematopora typica* MOROZOVA; from the Lebedyan Layer of the Givetian, the Kuznetz basin in Russia.

Diagnosis: Colonies ramose, occasionally with a thin self-overgrowth layer. Apertures circular or slightly ovate. Autozooecial wall strongly thickned in exozone. Diaphragms complete and rare or absent in the endozone, but numerous in exozone and at boundary between endozone and exozone. Mesozooecia variable in number, but commonly abundant and restricted within margin of exozone, some extending to zoarial surface even where exozone is thick, sometimes sufficiently numerous to isolate onto zooecial apertures, locally developed diaphragms. Acanthostyles variable in number, usually rare, even entirely lacking.

Remarks The writer principally follows variable MOROZOVA's original definition, but add that "acanthostyles in number, usually rare, even entirely lacking" Here the writer can not completely agree with ASTROVA's revision of the genus, i.e. "mesozooecia numerous, bearing abundant thickened diaphragms, locally filled by calcitic sediments" and "acanthostyles commonly abundant", because the writer considers that the features of mesozooecia and acanthostyles are an important basis of the genus as established by MOROZOVA.

Range and Distribution Early Famennian of North Xinjiang in China; ? Middle–Late Famennian of Kazakhstan and Russia.

Neotrematopora inspinosa sp. nov.
(Pl. 1, Figs. 1, 8, 10)

Holotype: The specimen illustrated by Pl. 1, Figs. 1, 8, 10.

Derivatio nominis From two Latin word roots: *in* (= not, without), *spin* (= spine) and a Latin suffix: *-osa* (= prone to), in reference to the absence of acanthostyles in the species.

Stratum typicum: Hongguleleng Formation, bed about 12 m micritic limestone yielding conodonts of Middle *crepida* Zone.

Locus typicum: Bulonggur, about 15 km north of Hextolgay town.

Diagnosis: Apertures subelliptical and large. Mesozooecia restricted to exozone only, irregularly polygonal and occupying almost the entire spaces between apertures. Diaphragms rare, one only, restricted to exozone. Acanthostyles entirely lacking.

Description: Zoarium slender and ramose, 1.35 to 2.31 mm in diameter. Autozooecia arising from zoarial centre and diverging obliquely outwards. Endozone of moderate dimensions, 0.72 to 0.87 mm in width. In endozone, autozooecial wall thin, averaging 0.019 mm in thickness, diaphragms entirely lacking. Exozone narrower, 0.54 to 0.63 mm in width. In exozone, autozooecial wall thicker, 0.019 to 0.028 mm. Mesozooecia gradually budded in exozone, well developed, tubular, inserted in and parallel with autozooecia. Diaphrams rare, restricted to zoarial margins only, spaced in both autozooecia and mesozooecia. Apertures subelliptical and large, 0.17 to 0.19 mm as longer diameter and 0.14 to 0.16 mm as short diameter, more regularly arranged, usually 4.5 diagonally and 4 longitudinally in a distance of 1 mm. Mesozooecia numerous, occupying almost the entire space between apertures, numbering from 7 to 9 around each aperture, variable in shape and size, usually polygonal, commonly smaller than apertures. Acanthostyles entirely lacking.

Remarks: This species is similar to *Neotrematopora altilis* YANG, HU and XIA (1988) from the Hsikuangshan Formation of the Upper Devonain, Lianyuan of Hunan in China, in lacking acanthostyles; but it can be distinguished from the latter by having apertures and by having numerous mesozooecia between apertures.

Range: Hongguleleng Formation, about 10 m below micritic limestone yielding conodonts of Middle *crepida* Zone, i.e. can be considered to be within Middle *crepida* Zone.

Distribution: Bulonggur, northwestern periphery of Junggar basin, North Xinjiang.

Material: One specimen only.

Pseudocampylidae fam. nov.

1968 Order Trepostomata, familiae incertae, TROIZKAYA, p. 112.

Type genus Pseudocampylus TROIZKAYA, 1960; from the Famennian of the Tarbagatai ridge of Kazakhstan.

Derivatio nominis From Pseudocampylus created by TROIZKAYA in 1960.

Diagnosis: Colonies ramose. Autozooecia tubular, budding from colonial centre, bending outwards; mesozooecia budding between autozooecia in exozone. Only superior hemisepta existing in autozooecia. Diaphragms generally lacking. Apertures circular-polygonal. Mesozooecia variable in number and size, without diaphragms. One kind of styles only. Autozooecial wall having longitudinal fibrous and reverse V-shaped lamellar structure.

Remarks Only one genus, *Pseudocampylus* TROIZKAYA, can be referred to the new family. Although *Eridocampylus* is similar to *Pseudocampylus* in autozooecial wall structure, as ASTROVA (1970) defined, the former has hook-like, curved, thickened leveled heterophragms and thin complete diaphragms. Thus the writer believe that this genus can be distinguished from the latter. Up to now, the writer has not enough evidence to place *Eridocampylus* in the new family. The new family is close to *Nipponostenoporidae* (XIA, 1987) in having characteristics like mesozooecia and hemisepta, but the autozooecial wall structure is different in both families, the latter having a microgranular structure.

Range: From the Late Devonian probably throughout the Carboniferous into the Early Permian.

Distribution Central Kazakhstan; North Xinjiang, North Tibet of China.

Genus ***Pseudocampylus*** TROIZKAYA, 1960, emend nov.

1960 *Pseudocamplyus* TROIZKAYA, p. 258.
1968 *Pseudocamplyus* TROIZKAYA; TROIZKAYA, p. 112.

Type species: *Pseudocampylus tarbagataicus* TROIZKAYA, 1960; from the upper part of the Famennian in the Tarbagatai ridge of Kazakhstan.

Emended diagnosis: Colonies branching, ramose. Autozooecia tubular, arising from colonial centre, polygonal in traverse section, gradually bending outwards and commonly with intervening mesozooecia in colonial periphery. Only superior hemisepta observed in autozooecia of exozone, sometimes with a few complete diaphragms in autozooecia of endozone, hemisepta generally thickened and slightly curved, diaphragms thin. Autozooecial wall having longitudinal fibrous and reverse V-shaped lamellar structure. Apertures circular or subcircular. Mesozooecia variable in number, as a general rule, numerous and separated from autozooecia, sometimes forming maculae on colonial surface. Large styles variable in number and size, sometimes even lacking.

Remarks: TROIZKAYA (1960), based on the typical heterotryphid wall structure which she had realized, originally assigned this genus to Heterotrypidae ULRICH, 1980. XIA (in press) agreed with her opinion. But after further studies of the specimens collected from the Tarbagatai ridge by TROIZKAYA (1968), she recognized that this genus was different from most other genera, e.g. *Dyoidophragma* DUNCAN and *Eridocampylus* DUNCAN, of the Heterotrypidae in having characteristics such as different mesozooecia and diaphragms, and she suggested this genus should be excluded from Heterotrypidae ULRICH and be placed into another family named "incertae familiae" by her. After studying considerable material from China, the writer also thinks that this genus is quite different from *Dyoidophragma* in having autozooecial wall structure. As ASTROVA (1978) pointed out, *Dyoidophragma* has stenoporid autozooecial wall structure, but this genus is also similar to *Eridocampylus* by having autozooecial wall structure and by having hook-like hemisepta, but *Eridocampylus* differs from this genus in having diaphragms developed in the exozone. In addition, the writer has found this genus is close to *Yunnanopora* XIA of Nipponostenoporidae XIA (XIA 1987) in characteristics of autozooecia, mesozooecia and hemisepta, but the latter is possessed of microgranular structure. Therefore the writer believe this genus should have a taxonomic position at family level, here the writer place it into a new family, Pseudocampylidae fam. nov.

The following species are referred to this genus. They are: *Pseudocampylus tarbagataicus* TROIZKAYA, 1960; *Ps. virgatus* TROIZKAYA, 1960; *Ps. xizangensis* XIA (in press); *Ps. breviseptus* sp. nov.; *Ps. bulong-*

gurensis sp. nov.; *Ps. inspinus* sp. nov.; *Ps. planiformis* sp. nov.; *Ps. similivirgatus* sp. nov.; *Ps. similitarbagataicus* sp. nov.
Range: From the Late Frasnian probably throughout Carboniferous to the Early Permian.
Distribution Central Kazakhstan of Kazakhstan, North Xinjiang and North Tibet of China.

Pseudocampylus tarbagataicus TROIZKAYA
(Pl. 1, Figs. 2–7, 9, 11, 12)

1960 *Pseudocampylus tarbagataicus* TROIZKAYA, p. 258, pl. 63, fig. 1, 2.
1968 *Pseudocampylus tarbagataicus* TROIZKAYA, TROIZKAYA, pl. 17, fig. 1.

Diagnosis: Paurostyles well-developed. Exozone wide and superior hemisepta numerous and long in general.
Description Zoaria ramose, with diameter of 1.92 to 4.04 mm and 1.92 by 3.23 mm respectively measured on longitudinal and transverse sections of broken branches. Autozooecia tubular, first budding from zoarial centre, gradually bending outwards and forming a more narrow endozone with irregular polygonal outlines in transverse section of endozone, and then continually bending and almost perpendicularly spreading to both zoarial surfaces; numerous mesozooecial intercalated between autozoeecia in wide exozone. Endozonal width 0.85 mm; autozooecial wall thin, averaging from 0.01 to 0.02 mm in thickness, with longitudinal fibrous structure. Exozonal width 0.57 to 0.77 mm (each lateral of zoarium), autozooecial wall unequally thickened, ranging from 0.07 to 0.09 mm, with reverse V-shaped lamellar structure. Superior hemisepta numerous, located only within exozone, 5 to 7 per autozooecium, average length 0.07 to 0.09 mm, slightly curved at top.
Apertures oval and subcircular, small, generally 0.12 to 0.23 mm in maximum diameter and 0.09 to 0.14 mm in minimum diameter, irregularly arranged, 7 to 8 and 8 to 9, respectively in longitudinal and transverse rows in a distance of 2 mm; boundary between autozooecial walls very clear. Mesozooecia variable in outline, mainly subcircular, usually 0.05 to 0.11 mm in maximum diameter and 0.03 to 0.07 mm in minimum diameter, sometimes gathered to form maculae. Paurostyles generally numerous, ranging from 0.02 to 0.03 mm in diameter, 3 to 5 around an aperture or mesozooecium.
Remarks: In comparison with specimens described by TROIZKAYA (1960), the writer's specimen have much more strongly developed paurostyles, but other characteristics show no difference. The species can be distinguished from *Pseudocampylus imspinus* sp. nov. chiefly because the latter lacks paurostyles completely.
Range and distribution: Hongguleleng Formation, bed of micritic limestone containing conodonts of Middle *crepida* Zone down to an unrecognized Middle *triangularis* Zone of Early Famennian, Bulonggur of northwestern periphery of Junggar basin of North Xinjiang in China; Kapakengir and Ust'kapaganda Layer of Sulcifer Horizon, which were regarded as Late Famennian by TROIZKAYA (1975a), of Tarbagatai ridge and Central Kazakhstan.
Material: 15 specimens.

Pseudocampylus imspinus sp. nov.
(Pl. 3, Figs. 7–10; Pl. 4, Figs. 1–3, 4–6)

Holotype: The specimen illustrated by Pl. 3, Figs. 7–10.
Derivatio nominis: From two Latin word roots: *im* (= not, without) and *spin* (= spine), referring to the fact that there are no paurostyles in this species.
Stratum typicum: Hongguleleng Formation, bed of micritic limestone yielding conodonts of Middle *crepida* Zone.
Locus typicus: Bulonggur, about 15 km north of Hextolgay town.
Paratype: The specimen illustrated by Pl. 4, Figs. 1–3 and Figs. 4–6.
Diagnosis Except for the complete lack of paurostyles, characteristics like those for *Pseudocampylus tarbagataicus* as described by TROIZKAYA (1960).
Description Zoaria ramose, diameter 2.70 to 4.24 mm and cross section 2.50 by 3.85 mm as measured respectively in longitudinal and transverse section of broken branches. Autozooecia tubular, budding first from zoarial centre, gradually bending outwards and forming a narrow endozone with irregular polygonal outlines in transverse section of endozone, and then continually bending to a surficial angle of 80 to 90°, interspersed with numerous mesozooecia in the wide exozone. Endozonal width 0.77 to 1.54 mm, autozooecial walls thin, averaging from 0.01 to 0.02 mm in thickness, having longitudinal fibrous structure. Exozonal thicknes 0.70 to 1.54 mm, autozooecial walls unequally thickened, ranging from 0.04 to 0.18 mm, with reverse V-shaped lamellar structure. Superior hemisepta numerous, restricted to exozone: 3 to 7 in each autozooecium, with average length of 0.07 mm, slightly curved at top.
Apertures subcircular and small, generally 0.12 to 0.21 mm in maximum diameter and 0.07 to 0.16 mm in minimum diameter, boundary between autozooecial walls clear, autozooecial numbering from 7 to 8 and from 8 to 10 respectively in longitudinal and transverse rows in a distance of 2 mm. Mesozooecia circular and subcircular in general, abundant and large, 0.03 to 0.07 mm in maximum diameter and 0.02 to 0.05 mm in minimum diameter, generally 7 to 14 in single row around each autozooecium. Paurostyles completely lacking.
Remarks: The species is characterized by lacking paurostyles, and thus it can easily be distinguished from *Pseudocampylus tarbagataicus* TROIZKAYA.

R a n g e : Hongguleleng Formation, bed of micritic limestone yielding conodonts of Middle *crepida* Zone and about 27 m below the bed, i.e. within Middle *crepida* Zone and possibly reaching downwards to an unrecognized Late *triangularis* Zone.
D i s t r i b u t i o n Bulonggur, northwestern periphery of Junggar basin of North Xinjiang.
M a t e r i a l 10 specimens (the Holotype and Paratype are also included within the statistics).

Pseudocampylus virgatus TROIZKAYA
(Pl. 4, Figs. 8–10; Pl. 5, Figs. 1–3, 5–8)

1960 *Pseudocampylus virgatus*, TROIZKAYA, p. 259, pl. 63, fig. 3.
1968 *Pseudocampylus virgatus* TROIZKAYA, TROIZKAYA, p. 114, pl. 17, fig. 2.

D i a g n o s i s Exozone narrow, having lancet-like thickened autozooecial walls, few superior hemisepta. Paurostyles well-developed.
D e s c r i p t i o n : Zoaria ramose, diameter 1.93 to 1.98 mm and cross section 1.87 by 2.27 mm as measured in longitudinal and transverse sections respectively of a broken branch. Autozooecia tubular, most budding from zoarial centre, irregularly polygonal in cross section in the endozone, gradually bending outward to an angle of 70 to 80° at the zoarial surface, intercalated with numerous mesozooecia and in the narrow exozone. Endozonal width 1.26 mm, autozooecial walls thin, averaging from 0.01 to 0.02 mm in thickness, having longitudinal fibrous structure. Exozonal thickness from 0.27 to 0.36 mm, autozooecial walls thickened unequally in lancet-like shape, thickness mostly ranging from 0.07 to 0.09 mm, reverse V-shaped lamellar structure. Two or three superior hemisepta per autozooecium, averanging 0.07 to 0.09 mm in length.
Apertures oval and small, generally 0.14 to 0.17 mm in maximum diameter and 0.09 to 0.13 mm in minimum diameter, boundary between autozooecial indistinct, irregular, 7 to 8 and 8 to 9 autozooecia in longitudinal and diagonal rows respectively in a distance of 2 mm. Mesozooecia oval and circular in general, 0.05 to 0.08 mm in maximum diameter and 0.04 to 0.06 mm in minimum diameter, 7 to 9 around each autozooecium. Paurostyles well developed, 0.02 to 0.04 mm in diameter, arranged at junction of apertural angles or in apertural wall.
R e m a r k s : In comparison with specimens described by TROIZKAYA (1960), the writer's specimens have more strongly developed paurostyles, but the other characteristics show no differences. The species is close to the new species *Pseudocampylus bulonggurensis* in having a narrow exozone, but the species is different from the latter in having well-developed paurostyles.
R a n g e a n d d i s t r i b u t i o n Hongguleleng Formation, bed of micritic limestone yielding conodonts of Middle *crepida* Zone and about 27 m below the bed, i.e. within Middle *crepida* Zone and possibly reaching downwards to an unrecognized Late *triangularis* Zone, Bulonggur of northwestern periphery of Junggar basin of North Xinjiang in China; Kapakengir and Ust'kapaganda Layer of Sulcifer Horizon which were thought to be of the Late Famennian age by TROIZKAYA (1968, 1975a), from Tarbagatai ridge and Central Kazakhstan in Kazakhstan.
M a t e r i a l : Four specimens.

Pseudocampylus bulonggurensis sp. nov.
(Pl. 2, Figs. 8–10: Pl. 3, Figs. 1–3, 4–6)

H o l o t y p e : The specimen illustrated by Pl. 2, Figs. 8–10 and Pl. 3, Figs. 1–3.
D e r i v a t i o n o m i n i s : After Bulonggur section, in which all specimens of this species were found.
S t r a t u m t y p i c u m : Hongguleleng Formation, bed of micritic limestone yielding conodonts of Middle *crepida* Zone.
L o c u s t y p i c u s : Bulonggur, about 15 km north of Hextolgay town.
P a r a t y p e : Specimen illustrated by Pl. 3, Figs. 4–6.
D i a g n o s i s : Except for the complete absence of paurostyles, remaining characteristics like those for *Pseudocamplyus virgatus* TROIZKAYA.
D e s c r i p t i o n : Zoaria ramose, diameters 2.54 to 3.87 mm and cross section 1.93 by 3.87 mm measured in longitudinal and transverse section respectively of broken branches. Autozooecia tubular, budding from zoarial centre, with irregular polygonal cross-sections within endozone, gradually bending outwards to form an angle of 70 to 80° to zoarial surfaces, intercalated with numerous mesozooecia in a narrow exozone. Endozonal width 1.53 to 3.29 mm, autozooecial walls thin, averaging from 0.01 to 0.02 mm, having longitudinal fibrous structure. Exozonal width 0.36 to 0.80 mm, autozooecial walls equally thickened, ranging from 0.05 to 0.11 mm, with reverse V-shaped lamellar structure. Superior hemisepta in general numbering from 3 to 5 in each autozooecium, averaging 0.05 to 0.07 mm in length.
Apertures oval and subcircular, 0.13 to 0.22 mm in maximum diameter and 0.09 to 0.19 mm in minimum diameter, boundary between autozooecial walls clear, autozooecia irregularly arranged, numbering from 6 to 7 and from 7 to 8 (occasionally from 9 to 10) respectively in longitudinal and transverse rows in a distance of 2 mm. Mesozooecia small and subcircular in general, 0.04 to 0.09 mm in maximum diameter and 0.02 to 0.06 mm in minimum diameter, sometimes filled by some mineral material thereby giving a false impression of paurostyles, commonly one row numbering from 7 to 9 around each aperture, locally gathered to form maculae. Paurostyles lacking.
R e m a r k s This species is characterized by complande absence of paurostyles, and thus can readily be distinguished from *Pseudocampylus virgatus*

TROIZKAYA. In addition, this species is close to another new species, *Pseudocampylus breviseptus,* in having shorter hemisepta.

Range: Hongguleleng Formation, bed of micritic limestone yielding conodonts of Middle *crepida* Zone and about 10 m below the bed, i.e. can be considered to be within Middle *crepida* Zone.

Distribution: Bulonggur, northwestern periphery of Junggar basin of North Xinjiang.

Material Six specimens (the holotype and paratypes constituated here are also included within the number, and the paratype occupies on specimen only, as the holotype does).

Pseudocampylus breviseptus sp. nov.
(Pl. 2, Figs. 1–7, 11)

Holotype: The specimen illustrated by Pl. 2, Figs. 1–3, 5.

Derivatio nominis From two Latin word roots: *brev* (= short) and *sept* (= fence), referring to the short hemisepta in this species.

Stratum typicum: Hongguleleng Formation, bed about 33 m below micritic limestone yielding conodonts of Middle *crepida* Zone.

Locus typicus: Bulonggur, about 15 km north of Hextolgay town.

Paratype: Specimen illustrated by Pl. 2, Figs. 6, 7, 11.

Diagnosis Exozone narrow, paurostyles lacking, few short hemisepta.

Description Zoaria ramose, diameter 2.70 to 2.85 mm and cross section 2.73 by 3.31 mm measured on longitudinal and transverse sections respectively of broken branches. Autozooecia tubular, budding from zoarial centre, with irregular outline in transverse sections of endozone, gradually bending outwards and forming a wide endozone, then bending outwards continually and spreading at angles of 70 to 80° to zoarial surface, with numerous mesozooecia intercalated into the narrow exozone. Endozonal width 1.23 to 1.73 mm, autozooecial walls thin, averaging from 0.01 to 0.02 mm, having a longitudinal fibrous structure. Exozonal thickness 0.57 to 0.96 mm, autozooecial walls equally thickened, 0.06 to 0.14 mm, and reverse V-shaped lamellar structure. Superior hemisepta short, usually 2 to 4 in each autozzoecium, averaging from 0.04 to 0.06 mm in length (Holotype), and more or less recurved along outer edge.

Apertures oval and subcircular, 0.11 to 0.20 mm in maximum diameter and 0.09 to 0.16 mm in minimum diameter, boundary between autozooecial walls clear, autozooecial apertures irregularly arranged and numbering from 6 to 7 and from 9 to 10 in longitudinal and transverse rows respectively in a distance of 2 mm. Mesozooecia small and subcircular in general, usually 0.01 to 0.17 mm in maximum diameter and 0.01 to 0.11 mm in minimum diameter, intervening among apertures, usually one row of 5 to 8 around each aperture. Paurostyles comlandely lacking.

Remarks: The difference between this species and *Pseudocampylus bulonggurensis* sp. nov. is the fewer and shorter superior hemisepta of the former compared with those of the latter as stated for this species above under "remarks"

Range: Hongguleleng Formation, from 33 to 38 m below micritic limestone yielding conodonts of Middle *crepida* Zone, probably corresponding to an unrecognized Middle *triangularis* Zone.

Distribution: Bulonggur, northwestern periphery of Junggar basin of North Xinjiang.

Material Two specimens.

Pseudocampylus similivirgatus sp. nov.
(Pl. 6, Figs. 5–12)

Holotype: The specimen illustrated by Pl. 6, Figs. 5–8, 10.

Derivatio nominis: From a Latin word root: *simil* (= alike, similar) and from the name of another species *Pseudocampylus virgatus*, referring to the close similarity.

Stratum typicum: Hongguleleng Formation, bed about 39 m below micritic limestone yielding conodonts of Middle *crepida* Zone.

Locus typicus: Bulonggur, about 15 km north of Hextolgay town.

Paratype: Specimen illustrated by Pl. 6, Figs. 9, 11, 12.

Diagnosis Except for having a small number of short superior hemisepta, all remainding characteristics are close to those of *Pseudocampylus virgatus* TROIZKAYA.

Description: Zoaria ramose, diameter 2.20 to 2.62 mm and cross section 2.38 by 2.97 mm as measured in longitudinal and transverse sections respectively. Autozooecia tubular, budding first from zoarial centre, gradually outwards and forming a wide endozone with irregular polygonal outline in transverse sections of zoarium, then bending continually oputwards and spreading at an angle of 70 to 80° to zoarial surface; mesozooecia are intercalated between antozooecia, in the narrow exozone. Endozonal width 1.45 to 1.72 mm; autozooecial walls thin in endozone, averaging from 0.01 to 0.02 mm, having longitudinal fibrous structure. Exozonal width 0.27 to 0.96 mm; autozooecial walls gradually thickened outwartds, in endozone, greatest thickness 0.06 to 0.09 mm, with reverse V-shaped lamellar structure. Superior hemisepta short, usually from 2 to 4 in each autozooecium, tending to be shorter outwards to outermost margins of zoarium, with maximum length of 0.06 to 0.09 mm.

Apertures usually oval and subcircular, 0.11 to 0.20 mm in maximum diameter and 0.09 to 0.15 mm in minimum diameter, boundary between autozooecial walls clear; apertures irregularly arranged, numbering from 7 to 8 and from 9 to 10 in longitudinal and transverse rows respectively in a distance of 2 mm. Mesozooecia usually oval and subcircular, small and few in number, 0.01 to 0.09 mm in maximum diameter and 0.01 to 0.08 mm in minimum diameter, sparsely intervening among apertures, at most 5 to 8 around each aperture. Paurostyles well developed, commonly 0.02 to 0.3 mm in diameter, 3 to 4 arranged at junction of apertural angles and occasionally located in autozooecial wall.

R e m a r k s The species is similar to *Pseudocampylus virgatus* TROIZKAYA in having well-developed paurostyles and in having a narrow exozone. However, the former possesses only a small number of short superior hemisepta, which are progressively shorter outwards and which obviously tend to be shorter than those of the latter, by which it can be distinguished.

R a n g e : Hongguleleng Formation, about 39 m below micritic limestone yielding conodonts of Middle *crepida* Zone, probably corresponding to an unrecognized Middle-Late *triangularis* Zone.

D i s t r i b u t i o n Bulonggur, northwestern periphery of Junggar basin of North Xinjiang.

M a t e r i a l : Two specimens.

Pseudocampylus similitarbagataicus sp. nov.
(Pl. 7, Figs. 1–10)

H o l o t y p e : The specimen illustrated by Pl. 7, Figs. 1–3, 5, 7.

D e r i v a t i o n o m i n i s From a Latin word root: *simil* (= alike, similar) and from the name of another species, *Pseudocampylus tarbagataicus* TROIZKAYA, referring to the close similarity.

S t r a t u m t y p i c u m : Hongguleleng Formation, bed about 8 m above micritic limestone yielding conodonts of Late *rhenana* Zone.

L o c u s t y p i c u s Bulonggur, about 15 km north of Hextolgay town.

P a r a t y p e : Specimen illustrated by Pl. 7, Figs. 6, 8–10.

D i a g n o s i s : Except for having short and thick superior hemisepta, all remainding characteristics are similar to those of *Pseudocampylus tarbagataicus* TROIZKAYA.

D e s c r i p t i o n : Zoaria ramose, diameter 3.00 to 4.24 mm and cross section 2.96 by 4.16 mm measured in longitudinal and transverse section respectively. Autozooecia tubular, most budding from outer region of endozone, gradually decreasing in diameter from branch centre to periphery of endozone, with irregular polygonal outline in transverse sections of zoarium, and continually bending outwards and spreading through exozone at an angle of 80 to 90° to zoarial surface, numerous mesozooecia occur, restricted to the wide exozone. Endozonal width 1.16 to 2.70 mm, autozooecial walls thin, usually 0.01 to 0.02 mm, having longitudinal fibrous structure. Exozonal width 0.80 to 1.35 mm, autozooecial walls equally (locally unequally) thickened to 0.06 to 0.14 mm, with reverse V-shaped lamellar structure. Superior hemisepta well-developed, but short and thick 5 to 7 in each autozooecium, tending to decreas in length outwards, the greatest length from 0.04 to 0.09 mm, the shortest length from 0.03 to 0.05 mm.

Apertures commonly subcircular, with 0.14 to 0.22 mm in maximum diameter and 0.09 to 0.16 mm in minimum diameter, boundary between autozooecial walls obvious and continuously visible, forming polygonal shapes with rounded corner, irregularly spaced, numbering from 7 to 8 and from 8 to 9 in longitudinal and transverse rows respectively in a distance of 2 mm. Mesozooecia commonly subcircular, small and numerous, 0.03 to 0.09 mm in maximum diameter and 0.02 to 0.07 mm in minimum diameter, one row of 7 to 10 around each aperture, occasionally concentrated in maculae. Paurostyles well-developed, 0.03 to 0.04 mm in diameter, from 2 to 4 around each aperture and commonly arranged at junction of apertural angles.

R e m a r k s This species is quite similar to *Pseudocampylus tarbagataicus* TROIZKAYA in having a wide exozone and in having well-developed paurostyles, but the former possesses short and thick superior hemisepta tending to be more shorter from the beginning of exozone to the outermost margins of zoarium. Thus it can easily be distinguished from *P. tarbagataicus.*

R a n g e : Hongguleleng Formation, about 8 m above micritic limestone yielding conodonts of Late *rhenana* Zone, i.e. can be considered to be within the Late *rhenana* Zone.

D i s t r i b u t i o n : Bulonggur, northwestern periphery of the Junggar basin of North Xinjiang.

M a t e r i a l : Two specimens.

Pseudocampylus planiformis sp. nov.
(Pl. 5, Figs. 4, 9–11; Pl. 6, Figs. 1–4)

H o l o t y p e : The specimen illustrated by Pl. 5, Figs. 4, 9–11.

D e r i v a t i o n o m i n i s : From a Latin word root: *plan* (= flat, level) and form (= form, shape), in reference to broad, flat branch cross-sections below bifurcations.

S t r a t u m t y p i c u m : Hongguleleng Formation, bed above micritic limestone yielding conodonts of Late *rhenana* Zone.

L o c u s t y p i c u s Bulonggur, about 15 km north of Hextolgay town.

P a r a t y p e : Specimen illustrated by Pl. 6, Figs. 1–4.

D i a g n o s i s : Except for the absence of paurostyles, all remeinding characteristics close to those of *Pseudocampylus similitarbagataicus* sp. nov.

D e s c r i p t i o n Zoaria ramose, occasionally forming flat columns before branching, cross section 3.20 by 5.60 mm as measured in transverse section of an unbranchied zoarial fragment, and diameter 3.00 to 3.85 mm and cross section 2.73 by 2.96 mm measured in longitudinal and transverse sections respectively of a branched zoarium. Autozooecia tubular, budding from zoarial centre, gradually bending outwards and forming a moderately wide endozone in which autozooecial cross sections are irregular polygonal; autozooecia continually bending outwards and spreading at an angle of 70 to 80° to zoarial surface; some mesozooecial appear in the comparatively wide exozone. Endozonal width averaging from 1.35 to 1.54 mm, autozooecial walls thin, usually 0.01 to 0.02 mm, having a longitudinal fibrous structure. Exozonal width averaging from 0.77 to 0.96 mm; autozooecial wall equally thickened, 0.07 to 0.09 mm, having a reverse V-shaped lamellar structure. Superior hemisepta short, thick, the greatest length from 0.05 to 0.09 mm at the beginning of exozone and shortest length from 0.02 to 0.04 mm at the outermost margins of zoarium, 3 to 4 in each autozooecium. Apertures mainly oval, 0.12 to 0.19 mm in maximum diameter and 0.09 to 0.14 in minimum diameter, boundary between apertures obvious and commonly elongated in longitudinal direction, irregularly spaced, usually numbering from 6 to 7 and from 8 to 9 in longitudinal and transverse rows respectively in a distance of 2 mm. Mesozooecia usually oval and subcircular, small and rare, 0.04 to 0.09 mm in maximum diameter and 0.02 to 0.07 mm in minimum diameter, a row of 3 to 7 around each aperture. Paurostyles lacking.

R e m a r k s : The species is close to *Pseudocampylus bulonggrensis* sp. nov. in having a comparatively wide exozone and in the absence of paurostyles, but it posesses fewer and shorter superior hemisepta than the latter, by which it can be distinguished.

R a n g e a n d d i s t r i b u t i o n : Same as for preceding species.

M a t e r i a l Two specimens.

Order Cystoporata ASTROVA, 1964
Suborder Fistuliporina ASTROVA, 1964
Family Fistuliporidae ULRICH, 1882
Genus ***Fistulipora*** McCOY, 1849

Fistulipora lunuliformis sp. nov.
(Pl. 8, Figs. 1–6)

H o l o t y p e : The specimen illustrated by Pl. 8, Figs. 1, 2, 4, 5.

D e r i v a t i o n o m i n i s : From two Latin roots: *lunul* (= "small moon", crescent) and *form* (= form, shape), in reference to the good development of lunaria in this species.

S t r a t u m t y p i c u m : Hongguleleng Formation, bed of micritic limestone yielding conodonts of Middle *crepida* Zone.

L o c u s t y p i c u s : Bulonggur, about 15 km north of Hextolgay town.

P a r a t y p e The specimen illustrated by Pl. 8, Figs. 3, 6.

D i a g n o s i s : Zoaria irregular, encrusting, overgrowing layer more variable in thickness than basal layer. Autozooecia short tubular, arising either from basal layer or on thickened roofs of vesicles. Apertures subcircular and small, with well-developed lunaria.

D e s c r i p t i o n : Zoaria irregular, encrusting, sometimes enclosing an irregular columnar substrate, commonly with one overgrowing layer only, more variable in thickness, ranging from 0.56 to 5.60 mm. Basal layer comparatively even to irregular undulate. Autozooecia tubular and comparatively long, arising from either basal layer or roofs of preceding basal autozooecia, usually sealed by secondary thickened roofs of vesicles, then budding from thickened roof of vesicles, upwards perpendicular to autozooecial surface. No diaphragms. Vesicular tissue hemispherical and larger near basal layer, becoming flat hemispherical upwards, vesicular roofs commonly and periodically thickened. Apertures suboval and small, with long diameter 0.18 to 0.25 mm and short diameter 0.17 to 0.19 mm, widely isolated by vesicular tissue; 5 in a distance of 2 mm. Vesicles comparatively stable in size, spherical, hemispherical and polygonal in outline. Maculae developed, mainly consisting of vesicular tissue. Lunaria well-developed, located at narrow end of aperture, 0.12 to 0.17 mm in width (= distance of two ends) and 0.07 to 0.09 mm in length (= radius of curve), maximum thickness from 0.02 to 0.05 mm, sometimes its two ends slightly projecting into apertures.

R e m a r k s : This species can readily be distinguished from *Fistulipora altilia* TROIZKAYYA – whcih was regarded to be of Late Famennian age in Central Kazakhstan of Kazakhstan (TROIZKAYA, 1975a) – by the absence of diaphragms and by the well-developed lunaria. In addition, it differs from *Fistulipora uniformica* TROIZKAYA (1975a), which has been found in the same horizon and locality with *Fistulipora altilia* TROIZKAYA, in having suboval apertures and by the absence of diaphragms.

R a n g e : Hongguleleng Formation, within Middle *crepida* Zone.

D i s t r i b u t i o n Bulonggur, northwestern periphery of Junggar basin of North Xinjiang.

M a t e r i a l Two specimens.

Fistulipora paricella sp. nov.
(Pl. 8, Figs. 7–10)

H o l o t y p e : The specimen illustrated by Pl. 8, Figs. 8, 9.

D e r i v a t i o n o m i n i s : From two Latin roots: *par* (= equal) and *cell* (= cell), in reference to the vesicle stable in size and shape in this species.

S t r a t u m t y p i c u m : Hongguleleng Formation, bed of micritic limestone yielding conodonts of Middle *crepida* Zone.

Locus typicus Bulonggur, about 15 km north of Hextolgay town.
Paratype: The specimen illustrated by Pl. 7, Figs. 7, 10.
Diagnosis: Zoaria irregular, encrusting, overgrowing layer more variable in thickness. Autozooecia short, with rare diaphragms. Vesicular tissue consists of uniform vesicles in size and shape. Lunaria distinct, but only slightly thickened at wide end of aperture. Peristomes well-developed.
Description: Zoaria often irregular, encrusting, sometimes enclosing an irregular columnar substrate, commonly with two intraspecific overgrowing layers at least, which are variable in thickness; on overgrowing layer 0.40 to 2.12 mm thick. Basal wall irregular undulate, consisting of two layers, lower granular layer and upper prismatic layer, usually 0.03 to 0.04 mm in total thickness. Autozooecia short and tubular, either directly arising from basal layer or budding on roofs of preceding basal autozooecia, in the former case its proximal part is commonly recumbent on basal layer, subsequently rising from thickened roofs of vesicles, having 2 to 3 diaphragms at most in each. Vesicular tissue in 1 to 5 series between successive autozooecia, vesicles comparatively uniform in size, often hemispherical or subsquare in outline. Apertures subcircular and larger, long diameter from 0.23 to 0.33 mm and short diameter from 0.20 to 0.27 mm, widely isolated by irregular polygonal and vesicules uniform in size, with 4 in a distance of 2 mm. Lunaria indistinct, slightly thickened at wide end of aperture, but peristomes well-developed, 0.05 to 0.07 mm in width.
Remarks This species is morpologically similar to *Fistulipora tokhotasuensis* TROIZKAYA, which was thought to be of the Frasnian age in Kazakhstan by TROIZKAYA (1968), but the latter possesses smaller apertures, visible lunaria and many diaphragms.
Range and distribution: Same as for preceding species.
Material: Two specimens.

Fistulipora vassinensis MOROZOVA
(Pl. 8, Fig. 11; Pl. 9, Figs. 2, 6)

1961 *Fistulipora vassinensis* MOROZOVA, p. 40, pl. 1, fig. 5; pl. 2, fig. 2.

Diagnosis: Apertures ovate or subovate, with well-developed lunaria, isolated by smaller vesicular tissue.
Description Zoaria encrusting, only one layer of growth, 0.27 to 0.72 mm in thickness, basal layer undulate, thickness from 0.03 to 0.04 mm. Autozooecia short tubular, arising from basal layer, mostly perpendicular or slightly oblique to autozooecial surface, usually ticker at proximal part and gradually constricted toward distal part, diaphragms lacking, isolated by 2 to 5 series of vesicular tissue. Near the basal layer vesicules larger, subhemispherical, becoming flat and small subspherical to scale-like in shape.
Apertures ovate to subovate, with long diameter of 0.20 to 0.22 mm and short diameter of 0.18 to 0.20 mm, widely speced, 4 to 5 in distance of 2 mm. Lunaria well-developed, lacated at narrow end of aperture, width from 0.11 to 0.16 mm and length (radius of curve) from 0.09 to 0.11 mm and thickness from 0.03 to 0.05 mm. Vesicles small, cirbular and subcircular between apertures, but vesicules in maculae usually larger, variable in size.
Remarks The writer's specimen corresponds to the holotype described and figures by MOROZOVA (1961). It has very small vesicular tissue between the apertures and a similar apertural morphology. However, the latter possesses very rare diaphragms and a growth layer enclosing another ramose bryozoan. Thereby, they should be considered to be the same species.
Range and distribution Hongguleleng Formation, about 112 m above pelletal limestone yielding conodonts that correspond to the Middle of the *crepida* Zone. Eregennarenwobolezheng Mountain, northwestern periphery of Junggar basin of North Xinjiang. The Kuznands basin, Russia, Vassin bed which was regarded as Late Frasnian by MOROZOVA (1961).
Material: One specimen.

Genus *Eofistulotrypa* MOROZOVA

1959 *Eofistulotrypa* MOROZOVA, p. 79.
1961 *Eofistulotrypa* MOROZOVA, MOROZOVA, p. 47.
1983 *Eofistulotrypa* MOROZOVA, UTGAARD, p. 391.

Type species: *Eofistulotrypa manifesta* MOROZOVA, 1959; from a stratum though to be Frasnian in age, Kuznands Basin, Russia.
Remarks: The genus *Eofistulotrypa*, as established by MOROZOVA (1959), is similar to *Canutrypa* BASSLER (BASSLER, 1952, p. 382, fig. 4; DESSILLY, 1961, p. 2, pl. 1, figs. 1–6, pl. 2, figs. 1–5 and BIGEY, 1988, p. 301, pl. 37, figs. 13–16) and *Fistulotrypa* BASSLER (1929, p. 48, pl. 81(7), figs. 1–4) in the absence of vesicular tissue in the endozone. It can be distinguished from *Canutrypa* BASSLER by having no hemicylindrical cystlike structure with the axis perpendicular to the autozooecial axis in many autozooecia in the exozone. The difference between it and the *Fistulotrypa* is not easily established, MOROZOVA, however, conceived that the two genera have a phylogenandic relationship based on the vesicular tissue: in *Canutrypa* vesicular tissue is restricted to the exozone only, and in *Fistulotrypa* vesicular tissue can extend to the margin of the endozone, as in *Fistuliramus* ASTROVA (1960) where vesicular tissue is well developed in the endozone.
Range At present only known from the Late Devonian.

D i s t r i b u t i o n Russia and China.

Eofistolotrypa primacylindilla sp. nov.
(Pl. 9, Figs. 4, 5, 7–13)

H o l o t y p e : The specimen illustrated by Pl. 9, Figs. 4, 5, 8.
D e r i v a t i o n o m i n i s : From two Latin word roots: *prim* (= first) and *cylind* (= cylinder), and a Latin suffix: *-illa* (= diminutive), in reference to the cylindrical primary autozooecium in the colonial centre.
S t r a t u m t y p i c u m : Hongguleleng Formation, bed of micritic limestone yielding conodonts of Middle *crepida* Zone.
L o c u s t y p i c u s : Bulonggur, about 15 km north of Hextolgay town.
P a r a t y p e The specimen illustrated by Pl. 9, Figs. 7, 10, 11 and 9, 12, 13.
D i a g n o s i s : Zoaria slender and ramose. Zoarial centre can develop a continuous or discontinuous cylindrical primary autozooecium. Vesicular tissue restricted to exozone only. Apertures large and in a regular arrangement.
D e s c r i p t i o n : Zoaria slender and ramose, sometimes zoarial surface overgrown by an encrusting form of *Fistulipora*, diameter 1.44 to 1.73 mm, before bifurcating reaching 2.00 to 2.70 mm. Autozooecia arising obliquely from zoarial centre and sometimes from a cylindrical primary autozooecium. Primary autozooecium irregular and cylindrical, 0.27 to 0.54 mm in diameter, angle between autozooecia and primary autozooecium of about 45°. Endozone moderately wide, 0.72 to 0.90 mm. In endozone, primary autozooecial walls irregularly and undulating, thin, 0.02 mm thickness, diaphragms commonly lacking, autozooecial walls thinner than primary autozooecial walls, less than 0.02 mm in thickness. Exozone narrow, 0.27 to 0.54 mm as each lateral width of zoarium. In exozone, autozooecial walls thickened, averaging 0.05 mm. Vesicular tissue well developed, 2 to 6 rows between successive autozooecia, boxlike to hemispherical in outline, commonly only one near the zoarial surface, but space between autozooecia occupied commonly by stereom at the nearest zoarial surface.
Apertures large and oval or elliptical, 0.23 to 0.28 mm in long diameter and 0.14 to 0.20 mm in short diameter, regularly arranged, with 3 diagonally and 3.5 longitudinally in 1 mm, speces between apertures occupied entirely by stereom. Sometimes end of an aperture slightly thickened, suggesting a lunarial structure.
R e m a r k s : *Eofistulotrypa primacylindilla* sp. nov. is assigned to the genus *Eofistulotrypa* MOROZOVA mainly because of the absence of the hemicylindrical cystlike structure noted above. The species can be distinguished from *Eofistulotrypa manifesta* by its a cylindrical primary autozooecium in the autozooarial centre and having larger apertures.
R a n g e a n d d i s t r i b u t i o n : Hongguleleng Formation, Middle *crepida* Zone and 8 m below the zone, i.e. can be considered roughly to be within Middle *crepida* Zone, Bulonggur about 110 m above pelletal limestone yielding conodonts of Middle *crepida* Zone, i.e. can roughly correspond to Middle *crepida* Zone of Eregenarenwobolezheng Mountain, northwestern periphery of Junggar basin of North Xinjiang.
M a t e r i a l : Four specimens.

Genus *Eridopora* ULRICH, 1882
Eridopora sp.
(Pl. 10, Figs. 1, 2)

D i a g n o s i s : Zoarium encrusting, overgrowing a fenestellid surface. Autozooecia short tubular, diaphragms rare. Apertures pyriform, bearing obvious lunaria at the narrow end.
D e s c r i p t i o n : Zoarium encrusting, overgrowing the obsreve surface of *Minilya alticarininodialis* sp. nov., described in this paper, thickness from 0.54 to 1.20 mm. Autozooecia short tubular, obliquely arising from basal layer, scarcely isolated by 2 to 3 series of vesicular tissue. Basal layer undulating, thickness 0.19 mm. Vesicular tissue hemispherical and like large scales near basal layer, becoming small and short towards zoarial surface.
Apertures pyriform, 0.28 to 0.37 mm in long diameter and 0.26 to 0.28 mm in short diameter, generally 4 in a distance of 2 mm, isolated by vesicular tissue, vesicles irregular polygonal in outline and variable in size. Lunaria located at narrow end of aperture, having obvious an secondarily thickened wall.
R e m a r k s : The species is similar to the type species *Eridopora macrostoma* ULRICH 1882 (SIMPSON, 1897, p. 71, Fig. 128 and UTGAARD, 1983, p. 393, Fig. 181, 1a–d) from Upper Mississippian (Chesterian) in USA, in its morphological features, but it can be distinguished from the latter in having a more irregular vesicular tissue in longitudinal sections.
R a n g e : Hongguleleng Formation, about 18 m below micritic limestone yielding condodonts of Middle crepida Zone, prob ably corresponding to an interval from unrecognized *Late triangularis* Zone to Early *crepida* Zone.
D i s t r i b u t i o n : Bulonggur, northwestern periphery of Junggar basin, North Xinjiang.
M a t e r i a l : One specimen.

Genus *Fistuliramus* ASTROVA, 1960
Fistuliramus eregennarenensis sp. nov.
(Pl. 10, Figs. 3–6, 8–11)

H o l o t y p e : The specimen illustrated by Pl. 10, Figs. 3–5.
D e r i v a t i o n o m i n i s : After Eregennaren section where this species is found.
S t r a t u m t y p i c u m : Hongguleleng Formation, about 112 m above pelletal limestone yielding conodonts of Middle *crepida* Zone.

Locus typicus Eregennarenwobolezhang Mountain, about 11 km northeast of the Hextolgay town.

Paratype: The specimen illusatrated by Pl. 10, Figs. 6, 8–11.

Diagnosis Zoaria solid, ramose and bifurcate, locally having an interspecific layer of overgrowth on the early zoarial surface of the diaphragms, rare in exozone rare and lacking in endozone. Apertures subcircular and large. Peristomes well developed and lunaria distinct.

Description Zoaria solid, ramose and bifurcate, cross section subcircular, before bifurcating branches thicker and centrum commonly not preserved, long diameter 8.00 mm and short diameter 7.36 mm. After bifurcating, branches thinner, centrum well preserved, long diameter 2.40 mm and short diameter 2.24 mm. Autozooecia arise from zoarial centrum and gradually bending outwards. In endozone, diaphragms lacking, vesicular tissue with long blisters. In exozone, diaphragms rare, with max. 4 in a distance of 0.5 mm, and mainly restricted to proximal part of exozone. Vesicular tissue flattening round-quadrate, on original branching surface, sometimes partly surrounded by an interspecific layer of overgrowth, which is variable in thickness, undulate and locally spans, only the ramose colony; layer of overgrowth possesses the same skeletal features as the exozone, thickness from 0.38 to 0.77 mm.

Apertures subcircular and larger, long diameter 0.21 to 0.28 mm and short diameter 0.19 to 0.23 mm; widely and uniformly spaced, with 5 in a distance of 2 mm; commonly isolated by 1 to 4 series of vesicular tissue. Vesicules irregular, polygonal in outline, various in size. Lunaria distinct, thickened only at the end of aperture, but peristome well developed and consisting of numerous radial mural tubuli, width from 0.05 to 0.09 mm.

Remarks: This species is similar to *Fistuliramus pachycystis* BIGEY (1988) from Cambreseque Member of Beaulieu Formation which corresponds to the conodont *asymmetricus* Zone of earlymost Frasnian of Boulonnais in Northern France, but the former is possessed by rare diaphragms in endozone and no lunaria.

Range Hongguleleng Formation, about 112 m above pelletal limestone yielding conodonts of Middle *crepida* Zone, i.e., it may be considered to be within Middle *crepida* Zone.

Distribution Eregennarenwobolezheng Mountain, northwestern periphery of Junggar basin of North Xinjiang.

Material: Four specimens.

Genus ***Cyclotrypa*** ULRICH, 1896

Cyclotrypa concylindrella sp. nov.

(Pl. 11, Figs. 1–4, 9, 11)

Holotype The specimen illustrated by Pl. 11, Figs. 1–3, 11.

Derivatio nominis: From Latin word roots: *con* (= with, together) and *cylindro* (= cylindrical), and Latin suffixe: *-ella* (= diminutive), to indicate the colonial morphology with encrusting layer of overgrowth which has commonly wraped up a columnar substrate in this species.

Stratum typicum: Hongguleleng Formation, bed of micritic limestone yielding conodonts of Middle *crepida* Zone.

Locus typicum: Bulonggur, about 15 km north of Hextolgay town.

Paratype: The specimen illustrated by Pl. 11, Figs. 4, 9.

Diagnosis: Zoaria encrusting, commonly enclosing up an irregular, columnar substrate. Autozooecia moderately short and tubular, usually without diaphragms. Apertures subcircular.

Description: Zoaria encrusting, commonly with a layer of overgrowth, enclosing up an irregular columnar substrate, thickness from 0.54 to 2.80 mm. Basal layer comparatively even to irregular undulate, consisting of a lower granular and an upper granular-prismatic layer, with 0.04 to 0.05 mm in total thickness. Autozooecia moderate and tubular, arising directly from the basal layer. The proximal part is recumbent for a short distance, subsequently oblique and then perpendicular to zoarial surface, with diaphragms rare or lacking only, that are hemispherical in endozonal cross section, vesicular tissue, sometimes covered by thickened vesicular tissue. Vesicules long and hemispherical near the basal layer, becoming flat and thickened on its distal surface, sometimes replaced by stereom near the zoarial surface.

Apertures subcircular and large, diameter usually 0.28 to 0.30 mm, widely isolated by larger and irregular polygonal vesicular tissue, commonly numbering 4 series in a distance of 2 mm. Maculae consist entirely of vesicular tissue.

Remarks: The species resembles morphologically *Cyclotrypa tubularia* NEKHOROSHEV from the upper part of Givetian in Altai (NEKHOROSHEV, 1948) and *Cyclotrypa* aff. *tubularia* from the Frasnian–Famennian in Kazakhstan (NEKHOROSHEV, 1977), but it is readily distinguished from the latter two species in having larger apertures and by the absence of diaphragms.

Range: Hongguleleng Formation, bed of micritic limestone yielding conodonts of Middle *crepida* Zone and about 8 m below the bed, it may be considered to be within Middle *crepida* Zone.

D i s t r i b u t i o n : Bulonggur, northwestern periphery of Junggar basin, North Xinjiang.
M a t e r i a l : Six specimens.

Cyclotrypa tubuliformis NEKHOROSHEV
(Pl. 11, Figs. 5–7, 10; Pl. 12, Figs. 2, 4)

1953 *Cyclotrypa tubuliformis* NEKHOROSHEV, p. 53, pl. 2, figs. 2a, b and pl. 3, figs. 7a, b.

D i a g n o s i s : Zoaria encrusting ant thin, commonly enclosing a thin, regular and columnar substrate and forming tubular branches.
D e s c r i p t i o n Zoaria encrusting, 0.54 to 1.5 mm in thickness, with a layer of overgrowth, commonly enclosing a regular, columnar substrate and forming tubular branches with subcircular cross section. Long diameter 3.26 to 5.86 mm and short diameter 3.08 to 4.80 mm. Basal layer undulating, consisting of a lower granular layer and an upper granular-prismatic layer, with 0.04 to 0.05 mm in total thickness. Autozooecia arise from basal layer, recumbent for a great distance (= two–thirds of the whole autozooecium) at its proximal part, subsequently oblique upwards and near zoarial surface, hemispherical cross section in endozone, usually with rare diaphragms, isolated by two to five series of vesicular tissue. Vesicules large hemispherical near basal layer, decreasing upwards in heigth and being a flat hemispherical and square, sometimes replaced by stereom near the zoarical surface.
Apertures subelliptical and large, long diameter 0.23 to 0.28 mm and short diameter 0.20 to 0.25 mm, widely separated by large, irregular and polygonal vesicular tissue, with 4 to 5 in a distance of 2 mm.
R e m a r k s : The species is similar to *Fistulipora tubulosa* NIKOFOROVA from a stratum in Altai which was regarded as Upper Tounaisian by NEKHOROSHEV (1956). Both *F. tubulosa* and *C. tubuliformis* weakly developed lunaria and possess similar zoarial growth morphology, and apertural size and distribution. However, NEKHOROSHEV (1953) emphasized that there are lunaria which can clearly be recognized in his microphotographs in *F. tubulosa* . We consider out material to be *C. tubuliformis.*
R a n g e a n d d i s t r i b u t i o n : Hebukehe Formation, within Early *expansa* Zone of Hebukehe, northwestern periphery of Junggar basin of North Xinjiang, and the Devonian-Carboniferous passage bed in Central Kazakhstan, which was thought to be of the middle Tounaisian age by NEKHOROSHEV (1953).
M a t e r i a l : Four specimens.

Family Cystodictyonidae ULRICH, 1884
Genus ***Sulcoretepora*** d'ORBIGNY, 1849

T y p e s p e c i e s : *Flustra ? parallela* PHILLIPS, 1836; from the Lower Carboniferous in Yorkshire of England.
R e m a r k s As for definition and classification of this genus, the writer agrees with the opinion of UTGAARD (1983, p. 429). The genus occurrs mainly in the Middle Devonian and Carboniferous (e.g., McNAIR, 1937; TROIZKAYA, 1968; NEKHOROSHEV, 1953, 1956, 1977; TROIZKAYA, 1975 and MOROZOVA, 1979; YANG and LU, 1983; LU, 1993) and a few finds are reported from Permian strata (e.g. SAKAGAMI, 1961; XIA, in press), but only one species has been collected at the base of the Upper Devonian (NEKHOROSHEV, 1948).
R a n g e : From Middle Devonian throughout Upper Devonian and Carboniferous into Permian.
D i s t r i b u t i o n : England, Kazakhstan, Mongolia and China.

Sulcoretepora hextolgayensis sp. nov.
(Pl. 11, Fig. 8; Pl., 12, Figs. 1, 3, 8, 12, 13)

H o l o t y p e : The specimen illustrated by Pl. 11, Fig. 8 and Pl. 12, Figs. 1, 3, 8.
D e r i v a t i o n o m i n i s : From Hextolgay town, about 335 km northwest of Ürümqi, to indicate that this species is first recognized about 15 km north of this town.
S t r a t u m t y p i c u m : Hongguleleng Formation, bed of micritic limestone yielding conodonts of Middle *crepida* Zone.
L o c u s t y p i c u s Bulonggur, about 15 km north of Hextolgay town.
P a r a t y p e : The specimen illustrated by Pl. 12, Figs. 12, 13.
D i a g n o s i s Zoaria bifoliate ramose, with oblique dichotomous branches. Apertures moderately large, with peristomes and without lunaria. Autozooecia short tubular, parallel to mesotheca at proximal parts and perpendicular to zoarial surface at distant parts, diaphragms and hemisepta lacking. Longitudinal range walls fine, straight and strong.
D e s c r i p t i o n : Zoaria bifoliate ramose, with oblique dichotomous branches, 0.96 to 1.80 mm and 0.92 to 1.56 mm in width before and after bifurcating respectively (measured from tangential sections), with four rows of range walls on surface of branches, but at bifurcation can reach ten rows at least. Autozooecia short tubular, subparallel or parallel to mesotheca at proximal part and then abruptly bending at a right angle to zoarial surface, lacking both diaphragms and hemisepta. Vesicular tissue restricted to exozone only, vesicles mostly flat quadrate and gradually replaced by stereom outwards. Branches in transverse section with high, lens-like and subcircular cross section, 1.13 to 1.30 mm in long diameter and 0.99 to 1.13 mm in short diameter. Autozooecia subtriangular and subquadrate at or near mesotheca, vesicular tissue deposited in exozone only, vesicles hemispherical and subquadrate, becoming flat, small and gradually being replaced by stereoms. Mesotheca sinuous, composed of an obscure, coloured median granular layer and lightly coloured lateral fibrous (?) layers, commonly 0.03 to 0.05 mm in thickness.

Apertures elliptical to broadly ovate, 0.17 to 0.22 mm in long diameter and 0.13 to 0.19 mm in short diameter, but rectangular to parallelogram-shaped, both lateral walls contiguous ro range wall, generally with four range walls which are separated from apertures, isolated by irregular polygonal vesicular tissue and stereoms, generally with 5 apertures longitudinally in a distance of 2 mm. Peristomes well-developed, averaging from 0.02 to 0.03 mm. Lunaria lacking.

R e m a r k s : The new species is characterized by havin autozooecia parallel to mesotheca at the proximal part and perpendicular to autozooecial surface at the distal part, by which it differs from all known species which can be assigned to the genus *Sulcoretepora* d'ORBIGNY, 1948.

R a n g e : Hongguleleng Formation, bed of micritic limestone yielding conodonts of Middle *crepida* Zone and about 38 m below the bed, i.e., within Middle *crepida* Zone and reaching downwards to an unrecognized Late *triangularis* Zone.

M a t e r i a l : Four specimens.

Sulcoretepora praehextolgayensis sp. nov.
(Pl. 11, Fig. 8; Pl. 12, Figs. 7, 10, 11, 14, 15)

H o l o t y p e : The specimen illustrated by Pl. 11, Fig. 8 and Pl. 12, Figs. 7, 10, 15.

D e r i v a t i o n o m i n i s : From the Latin word root *prae* (= before) and new species *Sulcoretepora praehextolgayensis* (see above), to indicate its first ocurrence prior to that species in the stratigraphic succession.

S t r a t u m t y p i c u m : Hongguleleng Formation, bed about 8 m above micritic limestone yielding conodonts of Late *rhenana* Zone.

L o c u s t y p i c u s : Bulonggur, about 15 km north of Hextolgay town.

P a r a t y p e : The specimen illustrated by Pl. 12, Figs. 11, 14.

D i a g n o s i s : Zoarium bifoliate ramose, with perpendicular dichotomous branches. Apertures moderately small, with peristomes and without lunaria. Autozooecia short tubular, parallel to mesotheca in proximal part and oblique to zoarial surface in distal part, diaphragms and hemisepta lacking. Range walls thin, straight and strong.

D e s c r i p t i o n Zoarium bifoliate ramose, with perpendicular dichotomous branches, 1.16 to 1.31 mm and 1.07 to 1.27 mm wide on main branches and secondary branches (measured in tangential sections) respectively, with 3 at least range walls on zoarial surface (either on main or on secondary branch surface). Autozooecial short and tubular, proximal part subparallel or parallel to mesotheca, and then abruptly bending to zooarial surface at an angle of 70–80°, diaphragms and hemisepta lacking. Vesicular tissue restricted to exozone only, vesicles mostly flat, quadrate and replaced nearly always by stereom near zoarial surface. Mesotheca slightly undulate, thin and strong, composed of obscure coloured median granular layer and lightly coloured lateral fibrous (?) layers, usually 0.02 to 0.03 mm in thickness. Transverse section of branch with flat elliptical cross section near or at bifurcation, 2.42 mm long diameter and 0.95 mm short diameter; transverse section of branch with short, high lens-like cross section at normal branches, 1.12 mm long diameter and 0.95 mm short diameter.

Apertures elliptical to broadly ovate, moderately small, commonly 0.14 to 0.17 mm long diameter and 0.10 to 0.13 mm short diameter, but in deeper tangential sections 0.17 to 0.19 mm long diameter and 0.13 to 0.15 mm short diameter. In general, four series of apertures longitudinally and separated by three range walls, 5 to 6 apertures longitudinally in 2 mm. Peristomes well-developed, averaging 0.02 mm width. Lunaria lacking.

R e m a r k s The species possesses perpendicular dichotomous branches, autozooecia are parallel to mesotheca at proximal part and oblique to zoarial surface at distal part. The moderately small apertures, readily distinguish it from *S. hextolgayensis*.

R a n g e : Hongguleleng Formation, about 8 m above micritic limestone yielding conodonts of Late *rhenana* Zone; is considered to occur within Late *rhenana* Zone.

D i s t r i b u t i o n : Bulonggur, northwestern periphery of Junggar basin, North Xinjiang.

M a t e r i a l : Two specimens.

Order Cryptostomata VINE, 1884
Suborder Rhabdomesina ASTROVA and MOROZOVA, 1956
Family **Bactroporidae** SIPSON, 1897

1897 Bactoporidae SIMPSON, p. 553.
1983 Bactoporidae SIMPSON, BLAKE, p. 582.

R e m a r k s : The family Bactoporidae as originally established by SIMPSON (1897, p. 553) included only two genera, *Bactopora* HALL, 1887 and Nematopora ULRICH, 1890, but BLAKE's revision of the family kept only the genus *Bactopora* , and no more have been added to date. We consider that the definition of the family may be excessively restricted, and may expand in the future to include taxa with, for example, metapores and diaphragms.

Genus ***Bactopora*** SIMPSON, 1897
Bactopora hextolgayensis sp. A, sp.nov.
(Pl. 12, Figs. 5, 6; Pl. 13, Figs. 1, 2)

H o l o t y p e : The specimen illustrated in Pl. 12, Figs. 5, 6 and Pl. 13, Figs. 1, 2.

D e r i v a t i o n o m i n i s : From Hextolgay town, the only known locality.

S t r a t u m t y p i c u m : Hongguleleng Formation, bed about 9 m below micritic limestone yielding conodonts of Middle *crepida* Zone.

L o c u s t y p i c u s : Bulonggur, about 15 km north of Hextolgay town.

D i a g n o s i s Zoarium slender and ramose. Autozooecia arising back to back from a median plane, lacking diaphragms and hemisepta. Apertures large and elliptical, regularly arranged, locally developing small metapores between successive apertures. Styles developed, forming a row around each aperture and metapore.

D e s c r i p t i o n : Zoarium slender and ramose, 1.52 to 1.62 mm in diameter. median plane thin and straight, locally twisted, 0.09 to 0.019 mm in thickness. Autozooecia tubular and long, alternately and obliquely arising back to back and forming an angle of 45° with median plane. Autozooecia slightly expanded at proximal part, moderately restricted upwards, and abruptly expanding at vestibule and oblique spreading to form an angle of about 70 to 80° with zoarial surface. Endozone wide, averaging 0.72 mm in width, autozooecial walls thin, usually 0.009 in thickness. Exozone narrow, averaging 0.36 mm in width, autozooecial walls thickened, 0.06 to 0.09 mm in thickness, with reverse V-shaped lamellar structure. Diaphragms and hemisepta lacking in both endozone and exozone.

Apertures large and elliptical, 0.17 to 0.28 mm in maximum diameter and 0.11 to 0.19 mm in minimum diameter, commonly regularly spaced, usually with 3 apertures longitudinally and 4 apertures diagonally in a distance of 1 mm. Metapores rare and small, only locally speced between two successive apertures longitudinally, variable in outline, commonly elliptical or ovate, 0.03 to 0.04 mm in maximum diameter and 0.01 to 0.02 mm in minimum diameter. A single row of 7 to 8 styles around each aperture, and usually 4 speced around each metapore, 0.02 to 0.03 mm in diameter.

R e m a r k s : This species is quite similar to two other species, *Bactropora granistriata* (HALL) and *B. simplex* (HALL) as figured again by BLAKE (1983, p. 583, Figs. 290, 1a–c and 1d–f); morphologically, it is readily distinguished from the latter two species in having locally developed metapores.

R a n g e : Hongguleleng Formation, about 9 m below micritic limestone yielding conodonts of Middle*crepida* Zone; it is be considered to occur within Middle*crepida* Zone.

D i s t r i b u t i o n : Bulonggur, northwestern periphery of Junggar basin, North Xinjiang.

M a t e r i a l : One specimen only.

Family **Nikiforovellidae** GORYUNOVA, 1975 emend nov.

1975 Nikiforovellidae GORYUNOVA, p. 67
1983 Nikiforovellidae GORYNOVA, BLAKE, p. 583.

D i a g n o s i s : Colonies dendroid, branches slender. Autozooecia tubular, closelly and spirally arising from a linear axis, true axial zooecia lacking. Exozone, bearing metapores, with thick autozooecial walls characterized by reverse V-shaped lamellar structure. Diaphragms usually less in autozooecia, but in metapores of some species diaphragms may be developed. Hemisepta commonly absent, but in some species they may occur. Apertures usually elliptical, occasionally oval and subcircular, even forming a petaloid due to deflection of styles, in general regularly arranged in longitudinal and diagonal rows. Metapores scattered, or closely spaced between apertures, in some species, apertures and metapores commonly separated by well-developed and irregular longitudinal ridges. Paurostyles and acanthostyles developed, sometimes abundant. Aktinostyles may exist in one genus. Styles generally arising from base of exozone, parallel to autozooecia.

R e m a r k s : The writer agree with BLAKE's revision of this family, but the writer has to add two points as follows: 1) autozooecia closely and spirally arising from a central linear axis; and 2) in some species or genera, irregularly arranged longitudinal ridges may exist and in metapores of some species diaphragms may occurre. In addition, we do not agree with YANG and al. (1988), as proposed by in their review of the classification of the Suborder Rhabdomesina ASTROVA and MOROZOVA, 1956, but the writer is unable to agree with their opinion that the genus Nikiforovella is to be placed into the Family Rhomboporidae SIMPSON, 1895. This genus differs from other genera of that family in having metapores and in having close, spiral and autozooecia growing along a linear axis. Therefore the genus should be kept separate in classification.

At present, only four genera, *Nikiforovella* NEKHOROSHEV, *Acanthoclema* HALL, *Pinegopora* SHISHOVA and *Streblotrypella* NIKIFOROVA are assigned to this family by BLAKE (1983).

R a n g e : From Late Fevonian throughout Carboniferous into the Permian, but mainly restricted to the Early Carboniferous.

D i s t r i b u t i o n : North America, Europe and Asia.

Genus *Nikiforovella* NEKHOROSHEV, 1948
Nikiforovella cellaris sp. nov.
(Pl. 13, Figs. 3–7)

H o l o t y p e : The specimen illustrated by Pl. 13, Figs. 4–6.

D e r i v a t i o n o m i n i s : From Latin word: *cell* (= cell) and Latin suffix: *-alis* (= pertaining to), in reference to a peculiar morphology shown by metapores in longitudinal sections.

S t r a t u m t y p i c u m : Hongguleleng Formation, sandy limestone about 158 m above pelletal limestone yielding conodonts of Middle *crepida* Zone, i.e. about 52 m below a bed containing the conodonts *Pseudopolygnathus primus, Polygnathus communis communis* and others, which are regarded as marking the beginning of the Carboniferous, and forming the uppermost part of the hongguleleng Formation.

L o c u s t y p i c u s Eregennarenwobolezheng

Mountain, about 11 km northeast of Hextolgay town.
Paratype: The specimen illustrated by Pl. 13, Figs. 3, 7.
Diagnosis: Zoaria slender and ramose. Apertures large and elliptical. Metapores small and variable in outline and separated by numerous, irregular ridges. Diaphragms and hemisepta absent.
Description: Zoaria slender and ramose, 1.19 to 2.50 mm in diameter. Autozooecia arise spirally from a linear axis in zoarial centre, moderately bent and spreading to zoarial margin. Endozone wider, commonly 0.72 to 1.17 mm in width, occupying about $^2/_3$ of zoarial diameter. In endozone autozooecial walls thin, 0.01 mm in thickness, with weak wave-like bending. Exozone narrow, only 0.18 to 0.36 mm in lateral width. In exozone, autozooecial walls thickened, thickness from 0.05 to 0.09 mm, with reverse V-shaped lamellar structure, metapores well-developed, inserted into the interspace between autozooecia, morphologically cystoids that may be due to a constriction formed by numerous diaphragms and irregular and undulating autozooecial walls. In autozooecia diaphragms and hemisepta absent.
Apertures large and elliptical, with long diameter of 0.23 to 0.28 mm and short diameter of 0.16 to 0.19 mm, regularly arranged in longitudinal and diagonal rows, commonly with 3 apertures longitudinally and 4 apertures diagonally in 2 mm. Metapores numerous and variable in outline, mainly elongated-oval, elliptical and polygonal, usually with a length of 0.04 to 0.09 mm and a width of 0.02 to 0.05 mm. Paurostyles well-developed, 0.04 to 0.05 mm in diameter, located in the margins of autozooecial and metaporal walls, thus forming petaloid apertures and metapores. Longitudinal ridges developed, irregularly arranged, separated from metapores and forming a mesh-like structure in tangential section.
Remarks: The species is morphologically characterized by cystoid metapores in longitudinal sections and a mesh-like structure in tangential sections. It is readily distinguished from other species of this genus.
Range: Uppermost part of Hongguleleng Formation, about 158 m above pelletal limestone yielding conodonts of Middle *crepida* Zone, this may be considered to be within an unrecognized interval from Late *crepida* Zone to Late *postera* Zone, of Middle-Late Devonian age.
Distribution: Eregennarenwobolezheng Mountain, northwestern periphery of Junggar basin, North Xinjiang.
Material: Two specimens.

Genus *Acanthoclema* HALL, 1886

Type species: *Trematopora alternata* HALL, 1883; from Middle Devonian of New York State in USA.
Remarks: In respect to the genus, the writer agrees with BLAKE's definition (1983, p. 584) and the diagnosis of BIGEY (1988, p. 314). To the writers knowledge, this genus mainly occus in the Middle Devonian, a small number of specimens were also found from Late Devonian strata, but the writer has no knowledge of any record from Early Carboniferous strata.

Acanthoclema junggarensis sp. nov.
(Pl. 13, Figs. 8–13)

Holotype: The specimen illustrated by Pl. 13, Figs. 10–12.
Derivatio nominis From Junggar basin, at the northwestern periphery of which the Bulonggur section yielding this species is found.
Stratum typicum: Hongguleleng Formation, bed about 33 to 35 m below micritic limestone yielding conodonts of Middle *crepida* Zone.
Locus typicus: Bulonggur, about 15 km north of Hextolgay town.
Paratype: The specimen illustrated by Pl. 13, Figs. 8, 9, 13.
Diagnosis: Zoaria ramose, very thin. Autozooecia simple, tubular and bent, diaphragms and hemisepta absent. Acanthostyles well-developed, with two always between successive apertures along a longitudinal row. Metapores rare.
Description: Zoaria ramose, very thin, with a long diameter of 0.77 mm and a short diameter of 0.65 mm and a width of 0.72 to 0.83 mm measured from transverse section and longitudinal section respectively, bifurcations unknown. Autozooecia arise from linear axis, base part oblique to linear axis at an angle of 45°, and then bent moderately upwards and extending to zoarial surface, with intervening more short metapores appear. Distal end oblique to zoarial surface at an angle of 30°, diaphragms and hemisepta absent. Exozone comparatively narrow, averaging 0.18 mm in width. In exozone, autozooecial walls markedly thickened, generally 0.04 to 0.05 mm in thickness, reverse-shaped lamellar structure, obviously penetrated by acanthostyles.
Apertures elliptical, with a long diameter of 0.13 to 0.16 mm and a short diameter of 0.08 to 0.10 mm, regularly arranged, alternating longitudinally ranges, averaging 7 in a distance of 2 mm. Acanthostyles well-developed, with two always between successive apertures, longitudinally isolated by one metapore, 0.05 to 0.07 mm in diameter, with bright coloured core. metapores rare, usually situated between successive acanthostyles, subcirbular or ovate, with a long diameter of 0.07 mm and a short diameter of 0.05 mm.
Remarks The species is morphologically quite similar to *Acanthoclema distilus* BIGEY (1988, p. 315, pl. 39, figs. 10–13), be of probable Middle to late Devonian age, but *A. distilus* possesses rare diaphragms and metapores are developed only local.
Range: Hongguleleng Formation, about 33 to 35 m

below nicritic limestone yielding conodonts of Middle crepida Zone; this may be considered to be within an unrecognized interval from Middle to Late *triangularis* Zone.
Distribution: Bolonggur, northwestern periphery of Junggar basin, North Xinjiang.
Material: Two specimens.

Nicklesoporidae YANG, HU and XIA, 1988
Genus *Nicklesopora* BASSLER, 1952

Type species *Rhombopora elegantula* ULRICH, 1884; from New Providence Shale, Lower Misissippian, Kings Mountain, USA.
Remarks For the diagnosis and classification of this genus, the writer follows YANG and al. (1988), who revised the genus. This genus has not previously been reported from the Devonian of China.

Nicklesopora fameniensis (NEKHOROSHEV)
(Pl. 14, Figs. 1–4)

1960 *Rhombopora fameniensis,* NEKHOROSHEV, p. 282, pl. 70, fig. 2.
1968 *Rhombopora fameniensis* NEKHOROSHEV, TROIZKAYA, p. 157, pl. 34, fig. 1.
1977 *Rhombopora fameniensis* NEKHOROSHEV, NEKHOROSHEV, p. 137, pl. 32, figs. 1–3.

Diagnosis: Zoaria slender and ramose, endozone comparatively wide. Axial region formed by about 4 to 5 axial zooecia asuming a subparallel growth pattern in longitudinal sections. Diaphragms and hemisepta rare or absent in autozooecia of some specimens. Apertures oval and small. Paurostyles well-developed, only one near the aperture, forming a long hexagon or rhomboid in outline.
Description: Zoaria slender and ramose, 1.36 to 1.57 mm in diameter. Axial region formed by about 4 to 5 axial zooecia subparallel growth pattern in longitudinal sections. Axial zooecial walls thin, 0.01 to 0.02 mm in thickness. Autozooecia diverging from axial region at about 20°, and then abruptly and perpendicularly bent spreading outwards to zoarial surface. Endozone comparatively wide, 0.72 to 0.90 mm, occupying about $^1/_2$ of zoarial diameter, diaphragms rare or absent in autozooecia of some specimens. Exozone narrow, 0.27 to 0.45 mm in lateral width of zoarium, occupying only $^1/_3$ of zoarial diameter, autozooecial walls conspicuously thickened, 0.07 to 0.20 mm, with broad reversed v-shaped lamellar structure, hemisepta absent, but occasionally developed: rare, short and opposite to the autozooecia in proximal part of exozone.
Apertures oval and small, with a long diameter of 0.11 to 0.13 mm and a short diameter of 0.05 to 0.07 mm, regularly spaced, with four longitudinal and five diagonally in 1 mm. Paurostyles well developed, 0.03 to 0.04 mm in diameter, arranged in a single row at interspaces between apertures, 9 to 13 around each aperture, forming a long hexagon or a rhomboid in outline.
Remarks: The writers specimens are characterized by small and oval apertures, rhomboidal or hexagonal arrangement of paurostyles and subparallel growth of axial zooecia. They are similar the the characteristics of the holotype as described and assigned to the genus *Rhombopora* by NEKHOROSHEV (1960). The latter is different from the genus *Rhombopora* in having broad, spirally growing autozooecia in axial region as emphasized by YANG and al. (1988).
Range and Distribution Hongguleleng Formation, Late *rhenana* Zone of Late Frasnian and about 76 m above the zone, i.e., it extends upwards to an unrecognized interval from Early to Late *triangularis* Zone of the Early Famennian. Bulonggur of northwestern periphery of Junggar basin, North Xinjaing, Aidgarly, Kapakengir and Ust'kapaganda Layer of Sulcifer Horizon which was thought to be of Late Famennian age by TROIZKAYA (1975a), Central Kazakhstan, Kazakhstan.
Material Three specimens.

Nicklesopora graciosa TROIZKAYA
(Pl. 14, Figs. 5–6)

1968 *Nicklesopora graciosa*, TROIZKAYA, p. 160, pl. 34, fig. 3.
1975b *Nicklesopora graciosa* TROIZKAYA, TROIZKAYA, p. 48, pl. 14, fig. 2.

Diagnosis zoaria slender and ramose, quite norrow. Diaphragms few and scattered, restricted to endozone mainly. Superior hemisepta developed in the beginning part of exozone. Apertures oval and small. Paurostyles developed, a single row, arranged along a polygonal so-called "crest ridge" (sensu TROIZKAYA, 1968) formed by autozooecial boundary.
Description: Zoaria slender and ramose, averaging 1.80 mm in diameter. Endozone wider, usually 1.46 mm in width. Axial zooecia close to perpendicular growth, bent gradually outwards, tilted and spreading to zoarial margin. In endozone, autozooecial walls with wave-liked bendings, thin, less than 0.01 mm in thickness, diaphragms few, 2 to 3 in 1 mm. In exozone, autozooecial walls abruptly thickened, towards zoarial surface thinned, greatest thickness being 0.07 to 0.08 mm, with reverse V-shaped lamellar structure. Diaphragms and superior hemisepta developed at proximal part of exozone commonly one, diaphragm that is thicker than those in endozone, in number only, superior hemiseptum obviously projecting into autozooecial chamber, 0.04 to 0.06 mm in height, sometimes even absent.
Apertures oval and small, with a long diameter of 0.14 to 0.16 mm and a short diameter of 0.07 to 0.08 mm, irregularly spaced, about 4 in 1 mm longitudinally. Paurostyles developed, 0.03 to 0.05 mm in diameter, a single row of about 20, arranged along a so-called

polygonal "crest ridge" formed by autozooecial boundary.

Remarks: The writer's specimen has been erroneously regarded as *Nicklesopora fameniensis* (NEKHOROSHEV, 1960), but subsequently it was recognized to differ from that species in having a superior hemiseptum and diaphragms. In addition, the species is similar to *Nicklesopora tabulata* (ULRICH) from the middle part of the Mengkugao Formation of Hunan in China (YANG and al., 1988) in having diaphragms and a superior hemiseptum, but it can be distinguished from the latter by having smaller apertures.

Range and distribution: Hebukehe Formation, within Lower *expansa* Zone of Hebukehe, northwestern periphery of Junggar basin; Ust'kapaganda Layer of Sulcifer Horizon, which was though to be of Late Famennian age by TROIZKAYA (1975a, b), Tarbagatai ridge, Central Kazakhstan.

Material One specimen only.

Nicklesopora sexagula TROIZKAYA (Pl. 14, Figs. 7–8)

1968 *Nicklesopora sexagula*, TROIZKAYA

Diagnosis Zoaria ramose, moderate in size, endozone wide. Diaphragms common, concentrated in the transitional region from endozone to exozone. Apertures oval and small. Paurostyles developed, arranged in a single row around aperture and forming an irregular hexagon in outline.

Description Zoaria ramose, moderate in size, 2.19 to 2.31 mm in diameter. Axial region formed by 5 to 6 almost parallel axial zooecia as can be seen in longitudinal section, axial zooecial walls thin, thickness less than 0.01 mm. Autozooecia diverging from axial region at 10 to 15°, gradually bent and spreading in exozone, forming an angle of about 80° with zoarial surface. Endozone wider, 1.16 to 1.23 mm, occupying about $^1/_2$ of zoarial diameter, diaphragms usually absent. Exozone narrow, 0.65 mm in lateral width of zoarium, occupying less than $^1/_4$ of zoarial diameter, autozooecial walls abruptly thickened, 0.09 to 0.15 mm, with broad reversed V-shaped lamellar structure. Hemisepta absent. Diaphragms more common, but concentrated in the beginning part of exozone or in the transitional region from endozone to exozone, 3 to 4 in each autozooecium.

Apertures oval and small, with a long diameter of 0.14 to 0.15 mm and a short diameter of 0.09 to 0.11 mm, regularly arranged, 4 in longitudinal direction and 5 diagonally arranged in 1 mm. Paurostyles developed, 0.04 to 0.05 mm in diameter, arranged as single row in interpsace between apertures, not less than 10 around each aperture forming an irregular hexagon in outline.

Remarks The main characters of the writer's specimen are comparable with those specimens collected from the upper part of the Famennian of Kazakhstan and described by TROIZKAYA (1968). However, according to conodonts, the writer's specimen is not higher than Upper *rhenana* Zone in the section.

Range and distribution Hongguleleng Formation, Late *rhenana* Zone, Bulonggur of northwestern periphery of Junggar basin, North Xinjiang; Ust'kapaganda Layer of Sulcifer Horizon which was though to be of Late Famennian age, Central Kazakhstan.

Material One specimen only.

Suborder Fenestellina ASTROVA and MOROZOVA, 1956

Family Fenestellidae KING, 1849

Note: The "Micrometric Formula" conventially used in formal description of fenestellid bryozoans has been extended and measured data included in each column have been considered to be diagnostically indispensable. The explanation of data related with each column in principle has been referred to those of YANG and al. (1988). That is: the 1st and 2nd columns show the number of branches transversely and that of cross-bars longitudinally in 10 mm; the 1st and *2nd* columnar after the 1st double slant line show number of autozooecia and carnial nodes along branches in 5 mm; the numbers after the 2nd double slant line show sizes of fenestrules, of autozooecia, of apertures and of carnial nodes respectively in mm. In addition, in order to make a comparison between some specimens of know species, the writer also uses some abbrevations, most of which are following those used by MILLER (1962) as shown in table. They are explained as follows: B/10 = Branches in 10 mm, C/10 = Cross bars in 10 mm, Z/5 = autozooecia in 5 mm, N/5 = Carnial nodes in 5 mm, Bw = Branch width in mm, Cw = Width of Cross bars in mm, Ad = Aperture diameter in mm, Flxw = Length x width of fenestrule in mm, Zlxw = Length x width of autozooecia in mm. The number in round brackets indicates the nomber of fenestrules.

Genus *Alternifenestella* TERMIER and TERMIER, 1871

Type species: *Fenestella minor* NIKIFOROVA, 1933; Middle Carboniferous, Dontes basin, Russia.

Emended definition from MOROZOVA (1974) "Colony with straight and fine branches and with fine dissepiments (= cross bars) Autozooecial base-shape trapezoid and triangular-trapezoid in observe sections, commonly arranged in one row on each branch in deeper obverse section. Carinae narrow, with one row carnial nodes"

Alternifenestella nurensis (NEKHOROSHEV) (Pl. 14, Fig. 11; Pl. 15, Figs. 2, 3)

1977 *Alternifenestella nurensis*, NEKHOROSHEV, p. 99, pl. 18, fig. 1.

Diagnosis Zoaria irregular flabellate. Autozooecial base-shape subtriangular and trapezoid in obverse section. Cranial nodes numerous, arranged in one row, locally in two rows.

Description: The two specimens described are fragments close to the base of colonies. Zoaria irregular, flabellate, branches undulate, cross bars short and lower than branches, perpendicular to branches. Autozooecial base-shapes subtriangular and trapeozid in shallow tangential at section (the term of the obverse section, which is similar to the term of the longitudinal section, is used to describe the fenestellid bryozoans especially) section, arranged in two rows along branch surface, but in deeper tangential section. Apertures subcircular in shape, with well-developed peristomic nodes, 0.009 to 0.019 mm in diameter. Fenestrules elliptical, usually petaloid due to autozooecia indenting margins, averaging two autozooecia per fenestrule. Outer basal wall thin, 0.04 mm at most. Cranial nodes well-developed, arranged in one row, only locally in two rows. Papillae conspicous, and numerous in the reverse section, same size as peristomic nodes.

Remarks: The writer's specimens coincide morphologically with *Alternifenestella nurensis* (NEKHOROSHEV, 1977) from a stratum which has been regarded to be of Famennian age in Kazakhstan. There exists only a little difference in the size of meches as shown in the following tables.

Range and distribution Hongguleleng Formation, bed of micritic limestone yielding conodonts of Middle *crepida* Zone and about 16 m below the bed, i.e., may be considered to be within Middle *crepida* Zone, Bulonggur of northwestern periphery of Junggar basin, North Xinjiang, China; also, an unnamed stratigraphic unit, thought to be of Famennian age by NEKHOROSHEV (1977), Karanganda district, Central Kazakhstan.

Material: Two specimens.

Alternifenestella normalis TROIZKAYA
(Pl. 14, Fig. 10)

1979 *Alternifenestella normalis*, TROIZKAYA, p. 36, pl. 3, fig. 5.

Diagnosis: Zoaria fine and meshed in a more regular way. Autozooecial base-shapes triangular and trapezoid with round-angulate pattern.

Description: Zoarium. One zoarial fragment with meshes regular, and fine, consisting of branches and cross bars at right angles or obliquely connected to each other.

Autozooecial base-shape triangular and trapezoid with round-angular outlines, alternately arranged in one row. Apertures subcircular in shape, peristomes and peristomic nodes not obversed. Fenestrules subsquare, opposite on both sides and slightly depressed towards the middle part due to the influence of autozooecia, bearing two autozooecia per fenestrule. Carnial nodes developed, obversed in deeper obverse section only.

Remarks: According to the morphological features and size of meshes, the described specimen coincide with the holotype specimen from the Meister Horizon, Central Kazakhstan (TROIZKAYA, 1979) in general. The comparison between both in basic size of meshes can be made as in table 2.

Range and distribution Hongguleleng Formation, about 116 mm above pelletal limestone yielding conodonts of Middle *crepida* Zone, may roughly correspond to an unrecognized Late *crepida* Zone of Early Famennian, Eregennarenwobolezheng

Table 1: *Alternifenestella nurensis*

	B/10	C/10	Z/10	N/5	Bw	Cw	Ad	Flxw	Zlxw
AEJ460/NIGP121509									
	20	15	15–18	25–30	0.21–0.27	0.18–0.22	0.13–0.15	0.52–0.68 x 0.27–0.32	0.18–0.19 x 0.11–0.14
AEJ463/NIGP121510									
	20	15	20	20	0.22–0.27	0.12–0.14	0.09–0.13	0.57–0.68 x 0.23–0.32	0.14–0.19 x 0.10–0.11
NEKHOROSHEV 1977									
	15–18	(10–13)	16–18		0.21–0.29	0.15–0.21	0.11–0.13	0.67–0.70 x 0.21–0.37	?

Table 2: *Alternifenestella normalis*

	B/10	C/10	Z/5	N/5	Bw	Cw	Ad	Dlxw	Zlxw
AEM263/NIGP121508									
	25	25	20	25	0.11–0.14	0.09–0.14	0.09–0.11	0.33–0.37 x 0.28–0.33	0.09–0.12 x 0.09–0.12
TROIZKAYA, 1979									
	25	20	25	?	0.14–0.17	0.08–0.10	0.08	0.35–0.42 x 0.16–0.21	?

Table 3: *Alternifenestella tshingizica*

	B/10	C/10	Z/5	N/5	Bw	Cw	Ad	Dlxw	Zlxw
AEJ467–468/NIGP121513									
	20	20	20	25	0.19–0.28	0.07–0.09	0.07–0.09	0.18–0.23 x 0.09–0.14	0.54–0.61 x 0.30–0.36
AEJ460/NIGP121514									
	20	20	20	25–35	0.14–0.19	0.09–0.11	0.09–0.11	0.39–0.82 x 0.18–0.45	0.15–0.18 x 0.12–0.14
TROIZKAYA, 1968									
	20	(20–22)	20–22	25	0.21–0.25	0.06–0.08	0.1	0.37–0.42 x 0.20–0.31	?

Mountain at northwestern periphery of Junggar basin, North Xinjiang, China; Meister Layer of Meister Horizon, thought to be of Lower Famennian by VEIMARN and al. (1988), east region of Central Kazakhstan.
Material: One specimen.

Alternifenestella tshingizica (TROIZKAYA)
(Pl. 15, Figs. 4, 7)

1968 *Fenestella tshingizica*, TROIZKAYA, p. 130, pl. 22, fig. 3.

Diagnosis Zoaria with regular mesh and moderate size. Autozooecial base-shapes subtriangular and trapezoid in obverse section. Carnial nodes well-developed, arranged in one row.
Description: Zoaria are two fragments. Of these, one is of more regularly meshed and may be from the sessile part of colony, another is comparatively irregularly meshed and may be naear the sessile part of colony. Branches and cross bars narrow, connected right angles. Autozooecial base shapes, subtriangular and trapezoid and near zoarial surface autozooecial shapes short cylindrical in obverse section, arranged in two rows on each branch, and benth back to back towards branch or fenestrule margins, becoming one row in deeper obverse section. Apertures subcircular in shape, peristomes and peristomic nodes not observed. Fenestrules shorter rectangular, emarginate, averaging two autozooecia per fenestrule. Carnial nodes well-developed, arranged in one row. Papillae not observed, outer basal wall thin, not more than 0.05 mm.
Remarks: The described specimens agree morphologically with *Alternifenestella tshingizica* (TROIZKAYA, 1968) from Kazakhstan. Comparison of the basic size of meshes is as in table 3.
Range and distribution Hongguleleng Formation, bed of micritic limestone yielding conodonts of Middle *crepida* Zone and about 35 m below the bed, i.e., it may reach downwards into an unrecognized Late *triangularis* Zone of Early Famennian of Bulonggur, the northwestern periphery of Junggar basin, North Xinjiang; Kapakengir and Ust'kapaganda Layer of Sulcifer Horizon, thought to be of Late Famennian age by TROIZKAYA, 1968, 1975a), Central Kazakhstan.
Material: Tree specimens.

Genus *Laxifenestella* MOROZOVA, 1974

Type species: *Fenestella saytshevae* SCHULGA-NESTERENKO, 1951; Namurian strata, Russian Platform, Russia.
Original definition: "Colony with straight or slightly undulated branches and with moderately wide dissepiments (= cross bars). Autozoecial base shapes square-pentagonal, arranged in two rows on each branch in obverse section, with well-developed hemisepta. Carina commonly bearing one row of small and distinct carnial nodes"

Laxifenestella microtuberculata
(NEKHOROSHEV)
(Pl. 15, Fig. 1)

1960 *Laxifenestella microtuberculata*, NEKHOROSHEV, p. 273, pl. 70, fig. 1.

1968 *Laxifenestella microtuberculata* NEKHOROSHEV, TROIZKAYA, p. 127, pl. 22, fig. 1.

1977 *Laxifenestella microtuberculata* NEKHOROSHEV, NEKHOROSHEV, p. 93, pl. 16, fig. 3.

Diagnosis More regular mesh, straight branches moderate size, and with wider cross bars. Autozooecial base-shapes square and pentagonal in obverse section. Apertures circular, without peristomes and peristomic nodes. Carinae generally elevated above apertural level, but without carnial nodes.
Description Zoarium known only from one fragment. Meshes regular, branches moderate size and straight, cross bars wider and, in general, perpendicular to branches. Autozooecial base shapes square and pentagonal in obverse section, arranged in two rows on each branch, bending back to back towards margins of branches and fenestrules, The distal end occasionally with indented cross bars or junctions of branches and cross bars near the zoarial surface. Apertures circular, peristomes and peristomic nodes not observed. Carinae generally elevated over apertural level, but without carnial nodes. Fenestrules usually elliptical, sometimes emarginate due to indention of autozooecia and apertures, averaging tree autozooecia per fenestrule. Outer-basal wall thin, 0.08 mm in thickness.
Remarks Except for the absence of carinal nodes on carinae, which are smaller than normal carinal nodes, and the 4 to 5 "longitudinal structure" on reverse side of branches, the writer's specimen is comparable to *Laxifenestella micrtuberculata* (NEKHOROSHEV, 1960) from Kazakhstan. The results of the comparison are as in table 4.
Range and distribution: Hongguleleng Formation, Late *rhenana* Zone, Eregennarenwobolezheng Mountain, northwestern periphery of Junggar basin, North Xinjiang, China; Kapakengir and Ust'-kapaganda Layer of Sulcifer Horizon regarded as Late Famennian in Central Kazakhstan.
Material One specimen.

Laxifenestella tichomirovi (TROIZKAYA)
(Pl. 15, Figs. 5, 6)

1968 *Fenestella tichomirovi*, TROIZKAYA, p. 127, pl. 22, fig. 4.

Diagnosis Meshes comparatively regular, branches wide and straight, cross bars lower and narrower, and joined with the former under a right angle. Autozooecial base shapes subpentagonal and prolonged elliptical in observe section. Fenestrules rectangular with round corners. Carnial nodes lower.
Description: The single zoarium has regular meshes. Branches wide and straight, cross bars short,

Table 4: *Laxifenestella microtuberculata*

	B/10	C/10	Z/5	N/5	Bw	Cw	Ad	Dlxw	Zlxw
AEM253/NIGP121511									
	20	12	20	?	0.18–0.32	0.14–0.21	0.13	0.54–0.64 x 0.14–0.32	0.27–0.43 x 0.10–0.13
NEKHOROSHEV, 1960									
	18–20	(10–11)	22–24	?	0.20–0.30	0.27–0.33	0.11–0.13	0.65–0.94 x 0.30–0.35	?
TROIZKAYA, 1968									
	20	(11–12)	22–23	?	0.5	0.21–0.31	0.12	0.57–0.65 x 0.29	?
NEKHOROSHEV, 1977									
	18–20	(10–12)	22–25	?	0.2	0.27–0.35	0.12–0.13	0.65–0.95 x 0.30–0.35	?

Table 5: *Laxifenestella tichomirovi*

	B/10	C/10	Z/5	N/5	Bw	Cw	Ad	Dlxw	Zlxw
AEJ464–466/NIGP121512									
	22–23	12	20	?	0.14–0.28	0.19–0.14	0.07–0.09	0.81–1.06 x 0.18–0.36	0.22–0.25 x 0.09–0.10
TROIZKAYA, 1968									
		19	(12–13)	22–23	10	0.21	0.06	0.10 0.63–0.89 x 0.25	?

lower and narrower than branches, joined with the former under a right angle. Autozooecial base shapes subpentagonal and prolonged elliptical in obverse section, arranged in two rows on each branch. Apertures subcircular, peristomes and peristomic nodes not observed. Carnial nodes not observed in obverse section, but distinct in transverse section, 0.04 to 0.05 mm in height. Fenestrules rectangular with round corners, numbering 3 to 4 autozooecia per fenestrule. Thick outer basal wall, 0.09 to 0.18 mm, parallel lamellar structure, skeletal rods and papillae not developed.

R e m a r k s In terms of size and morphological features, the specimen is assignable to *Laxifenestella tichomirovi* (TROIZKAYA) from Kazakhstan. The results of comparisons are as in table 5.

R a n g e a n d d i s t r i b u t i o n Hongguleleng Formation, about 18 to 27 m below micritic limestone yielding conodonts of Middle *crepida* Zone, i.e., this is considered to be within an unrecognized interval from Late *triangularis* to Early *crepida* Zone, Bulonggur, northwestern periphery of Junggar basin, North Xinjiang, China; Kapakengir and Ust'kapaganda Layer of Sulcifer Horizon, which was though to be of Late Famennian, Central Kazakhstan.

M a t e r i a l : One specimen only.

Genus *Minilya* CROCKFORD, 1944

T y p e s p e c i e s : *Minilya duplaris* CROCKFORD, 1944; from the Early Permian of Australia.

Emended definition from MOROZOVA (1974): "Meshes regular, fenestrules commonly small, branches comparatively wide, bearing autozooecia in two rows, dissepiments (= cross bars) narrow. Autozooecial baseshapes triangular near bifurcations, triangular – pentagonal in obverse section. Carinae wide and low, carnial nodes alternatively arranged in two rows."

Minilya alticarininodiali s sp. nov.

(Pl. 9, Fig. 3; Pl. 10, Fig. 7; Pl. 14, Fig. 9; Pl. 15, Fig. 8; Pl. 16, Figs. 1–4)

H o l o t y p e The specimen illustrated by Pl. 10, Fig. 7, Pl. 15, Fig. 8 and Pl. 16, Figs. 1, 2.

D e r i v a t i o n o m i n i s : From three Latin words: *alti* (= high, tall), *carin* (= keel) and *nod* (= swelling, knot), and one Latin suffix: *-alis* (= pertaining to), referring to the elevated carinal nodes found in this species.

S t r a t u m t y p i c u m : Hongguleleng Formation, bed about 33 to 35 m below micritic limestone yielding conodonts of Middle *crepida* Zone.

L o c u s t y p i c u s : Bulonggur, about 15 km north of Hextolgay town.

P a r a t y p e : The specimen illustrated by Pl. 9, Fig. 3 and Pl. 16, Figs. 3, 4.

D i a g n o s i s : Regular meshes, composed of straight branches and short cross bars mostly. Autozooecial base shapes subtriangular, near the zoarial surface autozooecia curved and columnar in obverse section. Fenestrules long and elliptical. Carinae developed, carinal nodes large, elevated and equidistant.

D e s c r i p t i o n : Zoaria known from three fragments with well-preserved internal structure. Meshes more regular, branches mostly straight, cross bars short, lower than branches, commonly connected with branches under an angle of 90° Autozooecial base shapes subtriangular. Near the zoarial surface, the autozooecia are curved columnar, arranged in two rows on each branch and bending back to back towards margins of branches and fenestrules, but becoming one row on a narrow branch in deeper obverse sections. Apertures circular or subcircular, with peristomes and peristomic nodes. Carinae developed, carinal nodes elevated heightened and equidistant, alternatively arranged in two rows, 0.27 mm between of two neighbouring nodes of the same row and usually 0.13 mm high. Outer basal wall thick, 0.09 to 0.10 mm, parallel lamellar structure, skeletal rods and papillae not developed.

R e m a r k s The species possesses longer elliptical fenestrules, elevated carinal nodes and thick outer basal walls, and may be distinguished readily from all known species of the genus *Minilya* CROCKFORD, 1944.

R a n g e : Hongguleleng Formation, about 16 to 35 m below micritic limestone yielding conodonts of Mid-

Table 6: *Minilya berkarensis*

	B/10	C/10	Z/5	N/5	Bw	Cw	Ad	Dlxw	Zlxw
AEJ464–466/NIGP121517									
	24	16	18–20	20	0.21–0.27	0.14–0.18	0.09–0.10	0.27–0.66 x 0.13–0.31	0.18–0.19 x 0.11–0.13
AEJ461/NIGP121518									
	24	16	18–20	20	0.09–0.18	0.09–0.13	0.07–0.09	0.45–0.72 x 0.18–0.27	0.18–0.20 x 0.13
TROIZKAYA, 1968									
	26–28	17–18	17–18	20	0.16	0.08–0.10	0.08	0.44–0.63 x 0.21–0.23	?
NEKHOROSHEV, 1977									
	25–27	16–18	16–18	32	0.15–0.30	0.15–0.19	0.10–0.11	0.48–0.63 x 0.15–0.23	?

dle *crepida* Zone; it may correspond to an unrecognized interval from Late *triangularis* Zone to Middle *crepida* Zone of the Early Famennian.

D i s t r i b u t i o n : Bulonggur, northwestern periphery of Junggar basin, North Xinjiang.

M a t e r i a l : Three specimens.

Minilya berkarensis (TROIZKAYA)
(Pl. 15, Figs. 9–11; Pl. 16, Fig. 7)

1968 *Fenestella berkarensis* TROIZKAYA, pl. 125, pl. 20, fig. 2.

1977 *Fenestekka berkarensis* TROIZKAYA, NEKHOROSHEV, p. 97, pll. 16, figs. 4–5.

D i a g n o s i s : Meshes distinctly regular and thin. Autozooecial base shapes subtriangular in obverse sections. Carinal modes well-developed, arranged in one row. Outer basal walls thick, numerour papillae especially on the reverse section.

D e s c r i p t i o n Zoaria known from two flattened fragments. Meshes thin and distinctly regular, formed by branches and cross bars. Branches flat and straight, cross bars short and thinner than the branches, and obliquely joined to each other. Autozooecial base shapes subtriangular, surface of autozooecia trapezoid in obverse sections, arranged in two rows on each branch and bent back to back towards margins of branches or fenestrules, becoming one narrow row in deeper obverse section. Apertures subcircular, peristomes and peristomic nodes not observed. Fenestrules round-rectangular only, sometimes emarginate due to autozooecia indenting the margins, averaging two and one-half autozooecia per fenestrule. Carnial nodes well-developed, alternately arranged in two rows. Papillae distinct, especially on branches and cross bars of reverse sections, numerous in number and varible in size. Outer basal walls thick, generally 0.13 to 0.22 mm, composed of laminae perpendicularly perforated by skeletal rods.

R e m a r k s : In size of meshes and morphological features, the specimens described correspond to those from Kazakhstan. Results of comparison are as in table 6.

R a n g e a n d d i s t r i b u t i o n Hongguleleng Formation, about 8 to 27 m below micritic limestone yielding conodonts of Middle *crepida* Zone, i.e., it may correspond to an unrecognized interval between Late *triangularis* Zone and Middle *crepida* Zone of Early Famennian; Kapakengir Layer of Sulcifer Horizon considered to be of Late Famennian, Central Kazakhstan, Kazakhstan.

M a t e r i a l : Two specimens.

Genus *Rarifenestella* MOROZOVA, 1974

T y p e s p e c i e s *Fenestella geometrica* NEKHOROSHEV, 1949; Saldzalisk Formation, Early Devonian of eastern Kazakhstan, Kazakhstan.

O r i g i n a l d e f i n i t i o n "Zoarium with wide, straight branches and with fine dissepiments (= cross bars). Autozooecial base shapes worm-like, arranged in two rows on each branch in obverse section. Carinae narrow and high, bearing carinal nodes, arranged in one rows."

Rarifenestella octoformis sp. A, sp. nov.
(Pl. 16, Figs. 8, 9)

H o l o t y p e The specimen illustrated by Pl. 16, Figs. 8, 9.

D e r i v a t i o n o m i n i s From two Latin words: *octo* (= eight) and *form* (= form, shape), in referring to the fenestrules having the shape of an Arabic "8" due to indention by autozooecia.

S t r a t u m t y p i c u m : Hongguleleng Formation, mudstone bed about 142 m above pelletal limestone yielding conodonts of Middle *crepida* Zone.

L o c u s t y p i c u s Eregennarenwobolezheng Mountain, about 11 km northeast of hextolgay town.

D i a g n o s i s : Meshes regular and fine. Fenestrules with an outline in the form of an "8" Autozooecila base shapes trapezoid, wider in the lower part and narrower in the upper, always with two autozooecia per fenestrule. Carinae well-developed, with higher carinal nods. Outer-basal walls thin.

D e s c r i p t i o n : Zoarium is from one flabellate specimen. Meshes regular and fine, branches moderately narrow, cross bars narrower than branches, commonly connected at a right angle with branches. Fenestrules short, rectangular with rounded angles, and with two markedly emergent lateral median margins due to the indention by autozooecium, so that they have the shape of an Arabic "8" in outline. autozooecial base shapes trapezoid, wider in the lower part and narrow in the upper part as in obverse sections, alternately arranged in two rows and bent back to back, in each row one indented margin of median fenestrules and another indented cross bar, always with two autozooecia per fenestrule. Apertures circular, 0.07 to

Table 7: *Rectifenestella crassimuralis*

	B/10	C/10	Z/5	N/5	Bw	Cw	Ad	Dlxw	Zlxw
AEM264/NIGP121520	20	12	20	?	0.23–0.31	0.09–0.14	0.05–0.09	0.90–0.97 x 0.27–0.36	0.23–0.98 x 0.11–0.19
TROIZKAYA, 1968	20	9–10	20	20	0.21–0.23	0.12	0.10	0.70–0.75 x 0.30–0.35	?

Table 8: *Rectifenestella praerudis*

	B/10	C/10	Z/5	N/5	Bw	Cw	Ad	Dlxw	Zlxw
AEJ461/NIGP121522	16	12	20	20	0.78–0.27	0.09–0.13	0.11	0.86–0.99 x 0.36–0.45	0.14–0.22 x 0.11–0.14
AEJ460/NIGP121521	16	12	18	?	0.11–0.23	0.08–0.11	?	1.04–1.15 x 0.36–0.45	0.23–0.28 x 0.07–0.11
TROIZKAYA. 1968	10	(10)	20–22	?	0.26	0.21	0.1	0.80 x 0.41 (average)	?
NEKHOROSHEV, 1977	15–16	(9–10)	19–21	13	0.31–0.56	0.27–0.46	0.11–0.15	0.72–0.82 x 0.27–0.40	?

Table 9: *Rectifenestella rengarteni*

	B/10	C/10	Z/5	N/5	Bw	Cw	Ad	Dlxw	Zlxw
AEM265/NIGP121523	16	5–6	22	?	0.32–0.40	0.18–0.22	0.08–0.09	1.26–1.44 x 0.27–0.40	0.18–0.27x0.09–0.13
TROIZKAYA, 1968	15–16	4–5	17–18	25	0.29–0.35	0.21–0.31	0.06	1.68–3.00 x 0.42–0.62	?

0.09 mm in diameter, peristomes and peristomic nodes not observed. Carinae well-developed, carinal nodes high, 0.05 to 0.09 mm. Outer basal walls thin, 0.04 to 0.05 mm thick, parallel lamellar structure, skeletal rods and papillae not developed.

Remarks: The species is characterized by strange fenestrules and autozooecia, and may easily be distinguished from all known species which have been assigned to the genus *Rarifenestella* MOROZOVA, 1974.

Range: Hongguleleng Formation, about 142 m above pelletal limestone yielding conodonts of Middle *crepida* Zone, i.e., restricted to an unrecognized interval between Late *crepida* Zone and Late *rhomoidea* Zone of Early-Middle Famennian.

Distribution: EregennarenwobolezhengMountain, the northwestern periphery of Junggar basin, North Xinjiang, China.

Material: One specimen .

Genus *Rectifenestella* MOROZOVA, 1974

Type species *Fenestella medvedkensis* SCHULGA-NESTERENKO, 1951; Kassimovskian of the Upper Carboniferous, Russian Platform, Russia.

Original definition "Colony with straight branches and commonly with straight dissepiments (= cross bars). Autozooecial base shapes pentagonal, before bifurcation triangular pentagonal, arranged in two rows on each branch in obverse section. Carinae bearing carinal nodes and arranged in one row."

Rectifenestella crassimuralis (TROIZKAYA) (Pl. 17, Figs. 1, 2)

1968 *Fenestella crassimuralis* TROIZKAYA, p. 128, pl. 21, fig. 4 and pl. 23, fig. 1.

Diagnosis Meshes fine and irregular, fenestrules rectangular, with three autozooecia per fenestrule length. Autozooecial base shapes subtriangular to pentagonal in obverse section, separated by narrow and obviously elevated carinae.

Description: Zoarium known from one flabellate fragment. Meshes fine and irregular, branches narrow and comparatively straight, connected obliquely by short and narrow cross bars. Fenestrules rectangular, variable in size at different positions. Autozooecial base shapes subtraingular to pentagonal in obverse section, arranged in two alternating rows, normally with three autozooecia per fenestrule. Carinae narrow and obviously elevated, oval carinal nodes observable in local part of obverse section only. Apertures circular, peristomes and peristomic nods not observed.

Remarks: In size and morphological features, the described specimen is similar to *Rectifenestella crassimuralis* (TROIZKAYA, 1968) from Kazakhstan. The results of comparison are as follows.

Range and distribution: Hongguleleng Formation, about 142 m above pelletal limestone yielding conodonts of Middle *crepida* Zone, i.e., restricted to an unrecognized interval from Late *crepida* Zone to Late *rhomboidea* Zone of Early-Middle Famennian, Eregennarenwobolezheng Mountain, northwestern periphery of Junggar basin, Xinjiang, China; Aidgarly, Kapakengir and Ust'kapaganda Layer of Sulcifer Horizon, which has been regarded to be of Upper Famennian, Central Kazakhstan.

Material: One specimen.

Rectifenestella praerudis (TROIZKAYA, 1963) (Pl. 16, Figs. 5, 6; Pl. 17, Figs. 3, 6)

1968 *Fenestella praerudis* TROIZKAYA, TROIZKAYA, p. 128, pl. 23, fig. 2.

1977 *Fenestella praerudis* TROIZKAYA, NEKHOROSHEV, p. 92, pl. 15, fig. 3.

D i a g n o s i s Regular meshes, consisting of wide branches and thinn cross bars. Fenestrules long, rectangular. Autozooecial base shapes pentagonal in obverse sections. Apertures circular, carinal nodes large and long-oval.

D e s c r i p t i o n Zoaria known from three compressed fragments. Meshes small and regular, branches flat and straight, cross bars short and thinner than branches, perpendicularly connected with branches. Autozooecial base shapes pentagonal in obverse sections, arranged in two rows per branch. Apertures circular, peristomes and peristomic nodes not observed. However, hemisepta can be seen in some anterior autozooecia. Fenestrules long and rectangular, averaging four autozooecia per fenestrule. Carinal nods larg and long-oval, arranged in one row. Outer basal wall thin, 0.05 to 0.09 mm.

R e m a r k s : In size and morphologic features, the specimens are assignable to *Rectifenestella praerudis* (TROIZKAYA, 1963), which was redescribed by TROIZKAYA (1968) and NEKHOROSHEV (1977), from Kazakhstan. Differences exist only in the width of branches and cross bars as shown in table 8.

R a n g e a n d d i s t r i b u t i o n Hongguleleng Formation, bed of micritic limestone yielding conodonts of Middle *crepida* Zone and about 7 m below it, i.e., it may be considered to be within Middle *crepida* Zone of Early Famennian, Bulonggur, northwestern periphery of Junggar basin, North Xinjiang, China; Kapakengir and Ust'kapaganda Layer of Sulcifer Horizon, though to be of Upper Famennian, Central Kazakhstan.

M a t e r i a l : Three specimens.

Rectifenestella rengarteni (TROIZKAYA, 1963)
(Pl. 17, Figs. 4, 7)

1968 *Fenestella rengarteni*, TROIZKAYA, p. 129, pl. 23, fig. 3.

D i a g n o s i s Meshes large and irregular. Fenestrules long, on the average seven autozooecia per fenestrule. Autozooecial base shapes extended ova-square in obverse section, separated by a high and wide carina.

D e s c r i p t i o n Zoarium is a flabellate fragment. Meshes large and irregular, branches slightly bent, cross bars narrow and obliquely connected by branches. Autozooecial base-shapes oval-square in obverse section, separated by a high and wide carina and arranged in two rows. Apertures circular, with visible peristomes. Peristomes commonly 0.009 mm in width, but without peristomic nodes. Carinae wide and wavyly bent, usually 0.028 mm in width, carinal nodes not ovserved in obverse sections. Fenestrules extended elliptically, on the average seven autozooecia per fenestrule.

R e m a r k s : The specimen is close to *Rectifenestella rengarteni* (TROIZKAYA) from Kazakhstan, in size and morphological features. The results of comparison are as in table 9.

R a n g e a n d d i s t r i b u t i o n Hongguleleng Formation, about 158 m above pelletal limestone yielding conodonts of Middle *crepida* Zone, i.e., restricted to an unrecognized interval from Late *crepida* to Late *rhomboidea* Zone, of Early-Middle Famennian, Eregennarenwobolezheng Mountain, northwestern periphery of Junggar basin, North Xinjiang, China; Kapakengir and Ust'kapaganda Layer of Sulcifer Horizon considered to be Upper Famennian, Central Kazakhstan.

M a t e r i a l : One specimen.

Suborder Ptilodictyina ASTROVA and MOROZOVA, 1956
Family Intraporidae SIMPSON, 1897
Genus *Intrapora* HALL , 1883

1897 *Intrapora* HALL, SIMPSON, p. 535, pl. 11, figs. 1–9.
1937 *Intrapora* HALL, McNair, p. 126
1953 *Intrapora* HALL, BASSLER, G. 138, fig. 99,8.
1968 *Intrapora* HALL, TROIZKAYA, p. 148.
1983 *Intrapora* HALL, KARKLINS, p. 503, fig. 203, fig. 248.

T y p e s p e c i e s : *Intrapora puteolata* HALL, 1881; from the Upper Helderberg Group, Middle Devonian, USA.

R e m a r k s : I agree with classification of the genus, with the opinion of KARKLINS (1983, p. 503), but emphasize that acanthostyles can be variable, even completely lacking, and that the geologic range extends to the Mississippian. The genus there should be includes six species from the Middle Devonian of North America and Mongolia (McNAIR, 1937; TROIZKAYA, 1968), seven sapecies from the Late Devonian of Kazakhstan and China (NEKHOROSHEV, 1960; TROIZKAYA, 1968, 1975b and in this paper), one species from the Tournaisian (TROIZKAYA, 1975a) and three species from the Mississippian of North America (ULRICH, 1890).

R a n g e a n d d i s t r i b u t i o n From the Eifelian through the Givetian, Frasnian and Famennian into the Tournaisian and Mississippian; North America, Kazakhstan and China.

Intrapora aperiflorina sp. nov.
(Pl. 17, Figs. 5, 8, 9; Pl. 18, Figs. 1–5; Pl. 19, Fig. 6)

H o l o t y p e : The specimen illustrated by Pl. 17, Figs. 5, 8, 9; Pl. 18, Figs. 1, 2 and Pl. 19, Fig. 6.

D e r i v a t i o n o m i n i s From two Latin words: *aper* (= open) and *flor* (= flower), and a Latin suffix: -*ina* (= like, similar), in reference to the apertures formed by acanthostyles.

S t r a t u m t y p i c u m : Hongguleleng Formation, biometric limestone containing conodonts of Late *rhenana* Zone and about 73 m above this zone.

L o c u s t y p i c u s : Bulonggur, about 15 km north of Hextolgay town.

P a r a t y p e : The specimen illustrated by Pl. 18, Figs. 3, 4.

D i a g n o s i s : Apertures oval and subcircular, commonly with petaloid outline due to protruding acanthostyles. Acanthostyles well-developed, usually 2 to 3 around each aperture. Exozone comparatively wide.
D e s c r i p t i o n : Zoaria explanate, with a lenticular section of 3.47 by 1.73 mm measured in transverse section (in paratype) and thickness of 2.31 to 2.47 mm (including an adherent growth layer of 0.27 to 0.39 mm) measured in longitudinal section (in Holotype). Mesotheca slightly curved and comparatively thick, 0.02 to 0.03 mm. Autozooecia tubular, budding obliquely and alternating back to back along mesotheca, diverging from mesotheca at an angle of about 30° at proximal part, widening at vestibular part, and then almost perpendicular spread to zoarial edge. Endozone comparatively narrow, 0.23 to 1.06 mm. In endozone, autozooecial walls thin, 0.019 mm, occasionally one diaphragm in the autozooecia. Exozone comparatively wide, 0.45 to 1.16 mm only on one side of mesotheca. In exozone, autozooecial growth roughly at a perpendicular to mesotheca. Autozooecial walls pronouncedly thickened, 0.04 to 0.11 mm, with broad reverse V-shaped lamellar structure, usually with 2 to 4 diaphragms per autozooecium; autozooecia usually separated by 2 to 4 mesozooecia. Mesozooecia with numerous and closely arranged diaphragms, from 5 to 10 in each mesozooecium.
Apertures oval and subcircular, commonly with petaloid outline due to protruding acanthostyles, 0.13 to 0.23 mm maximum diameter and 0.08 to 0.18 mm minimum diameter, irregular arranged, 5 to 6 in 2 mm. Mesozooecia variable in outline and size, irregularly in a dominant position. Most of them are large, similar to apertures in size, 0.12 to 0.20 mm in maximum diameter and 0.09 to 0.14 mm in minimum diameter, with only a few substantially smaller; one row of 7 to 8 around each aperture. Acanthostyles well-developed, 0.03 to 0.05 mm in diameter, arranged at the inner margin of the autozooecial walls and commonly protruding into apertures, from 2 to 4 around each aperture.
R e m a r k s The species is close to *Intrapora kazakhstanica* NEKHOROSHEV a comparatively wide exozone and in having acanthostyles; the latter species, however, possesses more regularly arranged apertures and less well-developed acanthostyles.
R a n g e a n d d i s t r i b u t i o n Hongguleleng Formation, micritic limestone yielding conodonts of Late *rhenana* Zone and about 73 m above, i.e., it can may extend to an unrecognized Middle *triangularis* Zone of the Bulonggur, and about 15 m below Middle *crepida* Zone, i.e., it corresponds to an unrecognized interval from Late *triangularis* Zone to Early *crepida* Zone of Erengennarenwobolezheng Mountain, northwestern periphery of Junggar basin, North Xinjiang.
M a t e r i a l : Three specimens.

Intrapora lanceolata NEKHOROSHEV
(Pl. 18, Figs. 6–11; Pl. 19, Figs. 1, 2)

1960 *Intrapora lanceolata*, NEKHOROSHEV, p. 280, pl. 70, figs. 4, 5.
1968 *Intrapora lanceolata* NEKHOROSHEV, TROIZKAYA, p. 149, pl. 31, fig. 3.
1977 *Intrapora lanceolata* NEKHOROSHEV, NEKHOROSHEV, p. 128, pl. 29, figs. 3–5.

D i a g n o s i s : Acanthostyles well-developed, 2 to 4 around each aperture. Apertures oval and a short minor axis, more regularly arranged, 2 to 4 between successive apertures along longitudinal row. Exozone comparatively narrow.
D e s c r i p t i o n : Zoaria explanate, broad lenticular in trasverse section, 4.16 mm in width and 1.70 mm in thickness (AEJ467/NIGP121528), and 0.85 to 1.16 mm in thickness in longitudinal section. Mesotheca wavy and thick, 0.019 mm. Autozooecial tubular, budding oblique and alternatively back to back from mesotheca, diverging from mesotheca at an angle of about 45° wide at proximal part, upwards slightly contracted at middle part, moderately widened at vestibular part; perpendicular to lateral zoarial edge, 2 to 3 mesozooecia. Endozone wider, 0.36 to 0.65 mm. In endozone, autozooecial walls tin, 0.009 mm, occasionally one diaphragm near mesotheca. Exozone narrow, 0.15 to 0.32 mm. In exozone, autozooecial walls thickened, 0.06 to 0.07 mm, with broad reverse V-shaped lamellar structure. Autozooecia separated by 2 to 4 mesozooecia, usually 1 to 2 diaphragms in each autozooecium and 3 to 4 in each mesozooecium.
Apertures oval and short minor axis, 0.11 to 0.20 mm in maximum diameter and 0.07 to 0.16 mm in minimum diameter, regularly arranged, 5 to 6 in 2 mm, and 2 to 4 mesozooecia between successive apertures longitudinally. Mesozooedia usually polygonal and small, 0.07 to 0.14 mm in maximum diameter and 0.05 to 0.09 mm in minimum diameter. Acanthostyles well-developed, 0.03 to 0.04 mm in diameter, deposited at margins of apertural walls, occasionally intruding into apertures, 2 to 4 around each aperture.
R e m a r k s : The species possesses narrow exozone, well-developed acanthostyles and regularly arranged apertures. It can easily be distinguished from similar species, for such as *Intrapora simitaeniola* sp. nov. and *In. taeniola* TROIZKAYA.
R a n g e a n d d i s t r i b u t i o n Hongguleleng Formation and Hebukehe Formation, from Late *rhenana* Zone to Early *expansa* Zone, Bulonggur and Hebukehe of northwestern periphery of Junggar basin, North Xinjiang, China; Kapakengir and Ust'kapaganda Layer of Sulcifer Horizon, which is considered Late Famennian, Tarbagatai ridge and Central Kazakhstan.
M a t e r i a l : Five specimens.

Intrapora similitaeniola sp. nov.
(Pl. 19, Figs. 3–5, 7–12)

Holotype: The specimen illustrated by Pl. 19, Figs. 3–5, 7, 8.
Derivatio nominis: From a Latin word: *simil* (= alike, similar) and the species name *Intrapora taeniola* TROIZKAYA, in reference to the similarity with that species.
Stratum typicum: Hongguleleng Formation, 15 m below micritic limestone yielding conodonts of Middle *crepida* Zone.
Locus typicum: Bulonggur, about 15 km northeast of Hextolgay town.
Paratype: The specimen illustrated by Pl. 19, Figs. 9–12.
Diagnosis: Acanthostyles obscure, occasionally one to two may occur. Apertures oval and subelliptical, regularly arranged. Exozone narrow.
Description Zoaria explanate, transverse section broad lenticular, 5.08 to 5.60 mm in width and 1.44 to 2.06 mm in thickness in longitudinal sections, and thickness of 1.60 to 2.40 mm. Mesotheca slightly curved and thin, 0.009 mm to 0.019 mm. Autozooecial tubular, budding obliquely and alternatively back to back from mesotheca, diverging from mesotheca at an angle of about 45° at wide proximal part, slightly contracted upwards at about $^2/_3$ of its length and moderately widened at vestibular part, and then perpendicular to lateral zoarial edge. Endozone 0.77 to 0.84 mm, autozooecial walls in endozone thin, 0.009 mm, occasionally one diaphragms (in holotype) in zooecium. Endozone width 0.27 to 0.46 mm In exozone, autozooecial walls gradually thickened,outwards maximum thickness of 0.06 to 0.07 mm, with broad reverse V-shaped lamellar structure, 1 to 6 diaphragms per autozooecium, autozooecia separated by 2 to 4 mesozooecia, 5 to 6 diaphragms in each mesozooecium. Apertures oval and subcircular, 0.10 to 0.20 mm maximum diameter and 0.07 to 0.13 mm minimum diameter, showing regular arrangement, in 2 mm 5 to 7 in transverse rows and from 6 to 8 respectively in longitudinal rows. Mesozooecia mainly polygonal and large, 0.07 to 0.19 mm maximum diameter and 0.03 to 0.10 mm minimum diameters, up to 7 to 8 around each aperture, small mesozooecia 0.04 to 0.07 mm maximum diameter and 0.03 to 0.05 mm minimum diameter, arranged between apertures. Acanthostyles abscure, occasionally one to two 0.02 to 0.04 mm in diameter (in paratype).
Remarks: The new species is close to *Intrapora taeniola* TROIZKAYA in having a narrow exozone and regularly arranged apertures; it possesses only obscure acanthostyles, at this serves to distinguished it.
Range: Hongguleleng Formation, about 15 to 27 m below micritic limestone yielding conodonts of Middle *crepida* Zone, i.e., corresponding approximately an unrecognized interval from Late *triangularis* Zone to Middle *crepida* Zone.
Distribution: Bulonggur, northwestern periphery of Junggar basin, North Xinjiang.
Material: Five specimens.

Intrapora taeniola TROIZKAYA
(Pl. 20, Figs. 1–3)

1968 *Intrapora taeniola,* TROIZKAYA, p. 150, pl. 31, fig. 2.

Diagnosis: Apertures regular oval, sometimes shapes like an Arabic "8" due to projecting acanthostyles. Acanthostyles present, sometimes 2 on each side of apertures. Exozone comparatively narrow.
Description Zoarium explanate, transverse section lenticular, 7.28 mm in width and 3.68 mm in thickness; with 3 pronounced overgrowth stages, thickness of colony 1.20 to 1.60 mm, thickness of overgrowths 0.29 to 0.50 mm and 0.54 to 0.65 mm. Mesotheca slightly straitening and on the average 0.019 mm in thickness. Autozooecial tubular, budding obliquely and alternatively back to back from mesotheca, diverging from mesotheca at an angle of about 45° in proximal part, widened at vestibular part, continually and obliquely spreading outwards, and then by the same growth pattern completing new colonies of the second and the third growth layer from terminal diaphragms in either autozooecia or mesozooecia of the previous colony except for the most outside autozooecia and mesozooecia, almost forming an angle of 90° with the colonial surface.

Mesotherca partly straight and averaging 0.0186 mm in thickness. Autozooecia tubular, budding obliquely and alternating back to back from mesotheca, extending from mesotheca at an angle of about 45° in proximal part, widening at vestibule and continually spreading outwards. Then the same growth pattern is repeated for two overgrowths that are stacked on top of each other. The overgrowths appear to arise from terminal diaphragms in either autozooecia or mesozooecia of the underlying colony except for the most peripheral autozooecia and mesozooecia, and form a 90° angle to the colony surface.

Endozone wide, 0.58 to 0.77 mm, 0.23 to 0.27 mm and 0.27 to 0.38 mm as in the three different growth layer from the inner to the outer regions. In endozone, autozooecial walls thin, 0.009 to 0.019 mm, diaphragms in autozooecia lacking. Exozone narrow, 0.19 to 0.27 mm, 0.23 to 0.27 mm and 0.15 to 0.27 mm in the three different growth layers. In exozone, autozooecial walls unequably thickened, on the average 0.05 to 0.09 mm, broad reverse V-shaped lamellar structure, autozooecia 1 to 3 diaphragms, parallel to and separated by 2 to 3 mesozooecia, with and 3 to 4 diaphragms in each mesozooecium.

Apertures oval, sometimes forming the shape of an Arabic "8" due to projecting of acanthostyles, 0.13 to 0.17 mm maximum diameter and 0.10 to 0.15 mm minimum diameter, irregularly arranged, generally 6 in of 2 mm. Mesozooecia variable in outline and size, mainly polygonal in size, most of them close to or larger than apertures in size, forming a row of 7 to 8 around each aperture. Acanthostyles present, 0.05 to 0.07 mm in diameter, sometimes 2 arranged on opposite sides of the inner margin of apertural walls, but generally obscure or lacking.

Remarks: The described specimen possesses 3 pronounced growth layers showing different growth stages. The principal characteristics are a narrow exozone and presence of developed acanthostyles and diaphragms, which are not very different to TROIZKAYA's (1968) species. The writer think the long oval apertures identified by TROIZKAYA are obliquely tangential sections of the zooecium.

Range and distribution Hongguleleng Formation, about 15 m below micritic limestone yielding conodonts of Middle *crepida* Zone, apparently restricted to about the Middle *crepida* Zone, Bulonggur of the northwestern periphery of Junggar basin, North Xinjiang; Aidgarly, Kapakengir and Ust'kapaganda Layer of Sulcifer Horizon considered to be Upper Famennian, Central Kazakhstan, Kazakhstan.

Material: One specimen only.

Intrapora triangularis sp. nov.
(Pl. 20, Figs. 4–12)

Holotype: The specimen illustrated inPl. 20, Figs. 4–8.

Derivatio nominis From two Latin word roots: *tri* (= three) and *angul* (= angule), and one Latin suffix: *-alis* (= pertaining to), in reference to one of the zoarial shapes of this species in transverse sections.

Stratum typicum: Hongguleleng Formation, bed about 15 m below micritic limestone yielding conodonts of Middle *crepida* Zone.

Locus typicus: Bulonggur, about 15 km north of Hextolgay town.

Paratype: The specimen illustrated in Pl. 20, Figs. 9–12.

Diagnosis: Acanthostyles obscure, may be present or absent. Exozone wide. Apertures oval or subelliptical. Mesozooecia larger, most of them close to apertures in size.

Description: Zoaria explanate in transverse section, broad lenticular or isosceles triangle outline of 5.08 mm with and 2.04 mm thickness (in holotype) or 3.27 mm height and 0.50 mm bottom width (in paratype) measured and thickness of 1.44 to 2.80 mm measured in longitudinal sections. Mesotheca slightly straightening or wavily bending and thick, 0.019 to 0.028 mm. Autozooecia tubular, budding obliquely and alternating back to back from mesotheca, arising from mesotheca at proximal part, about 45° slightly widening at vestibular part, and then perpendicular lateral zoarial edge. Endozone 0.42 to 1.19 mm in width. In endozone, autozooecial walls thin, average 0.009 mm in thickness, occasionally 1 to 2 diaphragms. Exozone 0.38 to 0.96 mm in the width. In exozone, autozooecial walls thickened, 0.04 to 0.07 mm, broad reverse V-shaped lamellar structure, and 1 to 6 diaphragms in autozooecium, autozooecia separated by 2 to 5 mesozooecia. Mesozooecia numerous and closely spaced; younger colonies have few diaphragms, 5 to 7 in each mesozooecium; older colonies have more diaphragms, 8 to 10 in each mesozooecium.

Apertures irregular oval or subelliptical, 0.10 to 0.19 mm as maximum diameter and 0.07 to 0.14 mm as minimum diameter, in the holotype there are occasionally several large ones present, the largest with 0.30 mm as maximum diameter and 0.22 mm as minimum diameter, rather regularly arranged, numbering from 6 to 7 and from 7 to 8 in longitudinal and transverse rows respectively within a distance of 2 mm. Mesozooecia mainly polygonal and large, close to or larger than apertures in size, 5 to 8 around each aperture. Acanthostyles obscure, occasionally only a few, or absent.

Remarks: The species is quite similar to *Intrapora kasakhstanica* NEKHOROSHEV as described NEKHOROSHEV (1960, p. 279, pl. 70, fig. 3) and by TROIZKAYA (1968, p. 150, pl. 31, fig. 4) with respect to exozone width, *I. kazakhtanica* shape, size and arrangement of apertures, and the presence of diaphragms, but usually by hasacanthostyles.

Range: Hongguleleng Formation, micritic limestone yielding conodonts of Middle *crepida* Zone 15 m below it, i.e., apparently restricted to Middle *crepida* Zone.

Distribution Bulonggur, northwestern periphery of Junggar basin, North Xinjiang.

Material Eight specimens.

Conodonta

Polygnathus sp. nov.
(Pl. 23, Figs. 8, 9)

Diagnosis: Pa element: Free blade long and high, highest in the anterior part. Platform triangular in outline and strongly bent towards inner (right) side. Carina terminated in posterior end of platform, but isolated in median-posterior part of platform. Adcarinal troughs long and deep, flanked by fused carina and free blade, convergent at median part of platform, the whole forming a bent, V-shaped pattern tending to be pointed towards an end.

Description: The multimembrate apparatuses are known only from the platform Pa element. The platform is relatively long and occupies two-thirds or slightly more of the unit length; the anterior third of the platform possesses approximately parallel side margins, and outer-upper anterior margins depressed in median-posterior part. The inner and outer margins

Sections and Sample numbers / Conodont species	A		A'	B			A	A'	C	
	AEJ484	AEJ475	AES161	AEM252	AEM253	AEM257	AEJ460	AES162	HBK2	HBK6
Ancyrognathus sp.			x							
Agatognathus sp.							x			x
Bispathodus stabilis (BRANSON and MEHL, 1934) Morphotype 3 of S. & Z., 1979										x
Icriodus alternatus alternatus BRANSON & MEHL,1934						x	x	x		
I. alternatus helmsi SANDBERG and DREESEN, 1984				x						
I. subterminus YOUNGQUIST, 1974	x		x	x						
Mehlina sp. aff. *gradata* YOUNGQUIST, 1945		x								
Mehlina sp.								x		
Ozarkodina sp.							x			
Palmatolepis minuta minuta BRANSON and MEHL, 1934							x			
Pa. minuta walskae SZULCZEWSKI, 1971							x	x		
Pa. gracilis sigmoidalis ZIEGLER, 1962										x
Polygnathus aequalis KLAPPER and LANE, 1985						x	x			
Po. brevilamiformis OVNATANOVA, 1976							x			
Po. communis communis BRANSON and MEHL, 1934									x	
Po. imparilis KLAPPER and LANE, 1985	x				x					
Po. planarius KLAPPER and LANE, 1985	x				x					
Po. ex gr. *webbi* STAUFFER, 1938	x			x		x	x	x	x	
Polygnathus sp. nov.							x			
Schmidtognathus sp. nov.						x	x			
Standard Conodont Zones (ZIEGLER and SANDBERG, 1990)	Late *rhenana* Zone					Middle *crepida* Zone			Early *expansa* Zone	
Correlation with geological age	Late Frasnian					Early Famennian			Late Famennian	

Figure 8: Conodont list from samples with stratigraphic sections, and correlation with standard conodont zones. Section A' indicates an unmeasured section within the same syncline as the Section A but on the other limb. A' indicates an unmeasured section within the same syncline as the Section A but on the other limb.

Bryozoan species / Stage	Famennian					
Substage	Lower		Upper			
Horizon	Meister		Sulcifer			Simorin
Layer	Uytass	Meister	Aidagarty	Kapakengir	Ust'kapaganda	
Pseudocamplylus tarbagataicus TROIZKAYA, 1960				x	x	
Ps. virgatus TROIZKAYA, 1960				x	x	
Nicklesopora famiensis (NEKHOROSHEV, 1960)			x	x	x	
N. graciosa TROIZKAYA, 1968					x	
N. sexagula TROIZKAYA, 1968					x	
Laxifenestella tichomirovi (TROIZKAYA, 1968)				x	x	
L. microtuberculata (NEKHOROSHEV, 1960)			x			
Rectifenestella crassimuralis (TROIZKAYA, 1968)			x	x	x	
R. praerudis (TROIZKAYA, 1963)				x	x	
R. rengarteni (TROIZKAYA, 1968)				x	x	
Minilya berkarensis (TROIZKAYA, 1968)				x		
Alternifenestella normalis (TROIZKAYA, 1968)		x				
A. tschengizica (TROIZKAYA, 1968)				x	x	
Intrapora taeniola TROIZKAYA, 1968			x	x	x	
In. lanceolata NEKHOROSHEV 1960				x	x	
Correlation with Standard Conodont Zones	*triangularis*, *crepida*	*rhomboidea*, *marginifera*	*trachytera*		*postera*, *expansa*	*praesulcata*
Correlation with Brachiopod Assemblage Zones of Shallow-Water Facies (MARTYNOVA, 1988 [in:] VEIMARN et al., 1988).	*Mesoplica meisteri – Cyrtospirifer calcaratus*	*Mesoplica tasadyrica – Mucrospirifer posterus*; *Cyrtospirifer ulentensis*	*Mesoplica semi bugensis – Cytrospirifer sulcifer*	*Nigerioplica nigerina – Cyrtospirifer konensis*	*Acanthoproductus bogadanovi – Athyris tau*	*Tenisia data*

Figure 9: Division of the Famennian marine strata and distribution of known bryozoan species in this paper in the original stratigraphic units of Central Kazakhstan, and correlation with the Late Devonian standard conodont zones and the brachiopod assemblage zones (Bryozoan distribution after TROIZKAYA, 1975a, 1979; correlation with stratigraphic units with the conodont zones and the division of the Famennian marine strata after VEIMARN et al., 1988).

strongly bend towards the inner side and converge in two arc lines to meet the posterior tip. The lower margin profile is highly arched. The carina extends to the posterior end of the platform, fuses in the anterior platform and is isolated in the median-posterior part of the platform. Transverse ridges flanked by carina and two rows of adcarinal troughs, regularly meet the carina at a right angle in the anterior part and at an oblique angle at the median-posterior part respectively, but become irregular stripe-like at the posterior part. Adcarinal troughs are present in the anterior third or slightly more of the platform and converge and terminate at the median part of the platform, so that the whole tends to form a bent V-shaped pattern. The free blade is comparatively long and high, the anterior part being the highest, and consists of 14 denticles which are mostly fused. The connection of the platform with the free blade is situated mor to the anterior part on the inner than on the outer side, inner and outer anterior margins meet the free blade approximately in a straight line at an oblique angle. In lower view, the basal pit is situated in the anterior fourth of the platform lenght, is comparatively small, and forms a narrow oval with broad subdued rims. The crimps comparatively broaden and extend to the anterior end of the basal pit for some distance.

Remarks The species is to be similar to *Polygnathus* cf. *samueli* KLAPPER and LANE (1985) in having a V-shaped pattern of adcarinal troughs, but in *Polygnathus* cf. *samueli* (specimen shown in Figure 17–11 of KLAPPER and LANE, 1985), the platform outline, details of transverse ridges and carina distinguish it from the species described here. *Polygnathus* sp. nov. is treated in open nomenclature because there is only one Pa element.

Range: Hongguleleng Formation, Middle *crepida* Zone.

Distribution Bulonggur, about 15 km north of Hextolgay town.

Material: One Pa element.

Schmidtognathus sp.nov.
(Pl. 23, Figs. 10–13)

Diagnosis: Pa element: Free blade short and high. Adcarinal troughs comparatively deepened. Platform outline ovate, widened anteriorly and pointed posteriorly. Carina bend to inner (left) side, spreading and tending to reduce gradually the height towards posterior end of platform. Platform margins approximately equal in height and bearing an ornament with short transverse ridges. Basal pit comparatively large, asymmetrical, but without fold. Keels developed.

Description: The multimembrate apparatuses are known from the platform Pa element only. Free blade short and high, consists of about 4 to 5 denticles, the highest is situated at its median-anterior part. Adcarinal troughs present and deepen gradually towards anterior end of platform. Platform is ovate in outline, occupies about two-third or slightly less of unit length, the widest being at its median-anterior part, constricts anteriorly in linguiform and points posteriorly. Right and left platform margins are about equal in height, with short transverse ridges which can run over platform. Carina bent to inner (left) side, spreading and tending to decline gradually in height towards posterior end of platform, consists of fused denticles in the median-posterior part. Connection of platform with free blade is situated more anteriorly on inner (left) than on outer (right) side, inner and outer margins converge just below median denticles of the free blade. Lower surface bears a comparatively large, asymmetrical basal pit which is near anterior end of platform and lacks any fold. Keel present running anteriorly and posteriorly from basal pit and obviously elevates over lower surface.

Remarks *Schmidtognathus* sp.nov. was initially thought to be an unnamed new species of *Polygnathus* by the writer, but subsequently it was discovered that the species possesses a comparatively large basal pit and thus it can be distinguished from that genus. The species is quite similar to *Polygnathus robustus* KLAPPER and LANE (1985) in having an outline of unit in oblique-lateral and lateral view, but it differs from that species in possessing a comparatively large basal pit. The species is close to *Schmidtognathus peracutus* (BRYANT, 1921) which originally was regarded as a species of *Polygnathus* but subsequently assigned to *Schmidtognathus* by ZIEGLER (1973), in having a comparatively large basal pit. It is different from that species in having carinae, and ornamental structure in the upper view. The species is assigned to *Schmidtognathus* mainly on the basis of the relative large basal pit and the short transverse ridges which are constricted within platform margins and run over the platform. The species is treated in open nomenclature because there are only five Pa elements available.

Range: Hongguleleng Formation, Middle *crepida* Zone.

Distribution Bulonggur and Eregennarenwobolezheng Mountain, northwestern periphery of Junggar basin, North Xinjiang.

Material: Five Pa elements.

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EXPLANATION OF PLATES

BRYOZOANS (PLATE 1–20)

Specimens under the heading AEJ, AEM and HBK are collected from the Bulonggur section (Figure 2, Section A), Eregennaren section (Figure 2, Section B) and Hebukehe section (Figure 2, Section C) respectively. All specimens with the number prefixed by NIGP are deposited in nanjing Institute of Geology and Palaeontology, Academia Sinica of P.R. China.

PLATE 1

Bryozoans from Middle *crepida* Zone, Hongguleleng Formation.

Figs. 1, 8, 10. *Neotrematopora inspinosa* sp.nov.; Holotype, AEJ462/NIGP121462.

Fig. 1. Tangential section shows arrangement and outline of apertures with mesozooecia filling virtu ally the entire spaces between apertures; acanthostyles entirely lacking; x 71.

Fig. 8. Transverse section of ramose zoarium; x 11.

Fig. 10. Longitudinal section shows rare diaphragms, restricted in both autozooecia and mesozooecia to zoarial margin; x 20.

Figs. 2–7, 9, 11, 12. *Pseudocampylus tarbagataicus* TROIZKAYA

Figs. 2, 6, 9, 12. Figured specimen, AEJ460/NIGP12464.

Fig. 2. Tangential section shows well-developed paurostyles and mesozooecia; x 60.

Fig. 6. Longitudinal section with wide exozone, to which the numerous superior hemisepta are re– stricted; x 14.

Fig. 9. Transverse section of ramose zoarium with wide exozone; x 14.

Fig. 12. Longitudinal section shows thickened autozooecial walls and attitudinal relationship of superior hemisepta to the walls. Note that the hemisepta are composed of reverse V-shaped lamellae derived from the walls; x 55.

Figs. 3–5, 7, 11. Figured specimen AEJ460/NIGP121463.

Fig. 3. Transverse section; x 18.

Fig. 4. Tangential section shows numerous paurostyles and mesozooecia; x 28.

Fig. 5. Longitudinal section with wide exozone shows well-developed superior hemisepta which are restricted to exozone only; x 18.

Fig. 7. Longitudinal section of ramose zoarium with bifurcated branch shows numerous, long superior hemisepta. Note that the bifurcated branch is somewhat oblique so that some portions occur as tangential sections; x 7.

Fig. 11. Longitudinal section exhibits superior hemisepta; x 55.

PLATE 2

Bryozoans are probably from an unrecognized Middle *triangularis* Zone, Hongguleleng Formation, unless stated otherwise.

Figs. 1–7, 11. *Pseudocampylus breviseptus* sp.nov.

Figs. 1–3, 5. Holotype, AEJ467/NIGP121465.

Fig. 1. Tangential section shows mesozooecia and apertures as well as general absence of paurostyles (although two occur at lower right); x 52.

Fig. 2. Transverse section of ramose zoarium with a narrow exozone; x 17.

Fig. 3. Longitudinal section shows few short superior hemisepta. Note equally thickened autozooecial walls and attitudinal relationship of superior hemisepta to the walls; x 44.

Fig. 5. Longitudinal section with a narrow exozone; x 17.

Figs. 6, 7, 11. AEJ469/NIGP121466.

Fig. 6. Longitudinal section shows equally thickened autozooecial walls. Note the walls are composed of reverse V-shaped lamellae; x 56.

Fig. 7. Tangential section has generally an absence of paurostyles; x 28.

Fig. 11. Longitudinal section with a narrow exozone exhibits few short superior hemisepta; x 20.

Figs. 8–10. *Pseudocampylus bulonggurensis* sp.nov. Middle *crepida* Zone of Hongguleleng Formation.

Fig. 8. Holotype section with a narrow exozone shows short superior hemisepta and equally thickened autozooecial walls, x 17.

Fig. 9. Transverse section with a narrow exozone; x 13.

Fig. 10. Tangential section shows small mesozooecia and complete absence of paurostyles. Note some small mesozooecia close in size to paurostyles; x 24.

PLATE 3

Bryozoans are from Middle *crepida* Zone, Hongguleleng Formation.

Figs. 1–6. *Pseudocampylus bulonggurensis* sp.nov.

Figs. 1–3. Holotype, AEJ460/NIGP121467.

Fig. 1. Tangential section shows complete absence of paurostyles; x 53.

Fig. 2. Tangential section shows arrangement of apertures and mesozooecia; x 13.

Fig. 3. An enlarged view of a part of Pl. 2, Fig. 8, shows equally thickened autozooecial walls and attitudinal relationship of superior hemisepta to the wall. Note the walls are composed of reverse V-shaped lamellae; x 50.

Figs. 4–6. Paratype, AEJ462/NIGP121468.

Fig. 4. Tangential section shows complete absence of paurostyles; x 53.

Fig. 5. Transverse section with a narrow exozone shows equally thick or locally beaded walls in exozone; x 20.

Fig. 6. Longitudinal section shows few superior hemisepta; x 16.

Figs. 7–10. *Pseudocampylus imspinus* sp.nov. Holotype, AEJ460/NIGP121469.

Fig. 7. Transverse section with a narrow endozone; x 20.

Fig. 8. Longitudinal section exhibiting attitudinal relationship of superior hemisepta to walls composed of reverse V-shaped lamellae; x 53.

Fig. 9. Longitudinal section showsunequally thickened walls and numerous superior hemisepta; x 17.

Fig. 10. Tangential section shows absence of paurostyles; x 53.

PLATE 4

Bryozoans from Middle crepida Zone, Hongguleleng Formation.

Figs. 1–6. *Pseudocampylus imspinus* sp.nov.

Figs. 1–3. Paratype, AEJ463/NIGP121470.

Fig. 1. Tangential section shows arrangement of mesozooecia, including a concentration of mesozooecia in a macula, and apertures as well as absence of paurostyles; x 30.

Fig. 2. Transverse section with a narrow endozone; x 18.

Fig. 3. Longitudinal section shows numerous superior hemisepta and attitudinal relationship of the hemisepta to walls. Note the walls are composed of reverse V-shaped lamellae, x 47.

Figs. 4–6. Paratype, AEJ460/NIGP121471.

Fig. 4. Longitudinal section shows numerous superior hemisepta and attitudinal relationship of the hemisepta to walls; x 40.

Fig. 5. Transverse section with a narrow endozone; x 18.

Fig. 6. Tangential section shows mesozooecia absence of commonly in double row between autozooecia and absence of paurostyles; x 58.

Figs. 8–10. *Pseudocampylus virgatus* TROIZKAYA, 1960

Figured specimen, AEG460/NIGP121472.

Fig. 8. Longitudinal section with a narrow exozone shows few long superior hemisepta; x 18.

Fig. 9. Transverse section of ramose zoarium; x 14.

Fig. 10. Longitudinal section shows thickened walls and attitudinal relationship of superior hemisepta to the walls; x 54.

PLATE 5

Bryozoans from Middle crepida Zone, Hongguleleng Formation, unless stated otherwise.

Figs. 1–3, 5–8. *Pseudocampylus virgatus* TROIZKAYA, 1960

Fig. 1. Figured specimen, AEJ460/NIGP121472. Tangential section shows well-developed paurostyles and numerous mesozooecia; x 54.

Figs. 2, 3, 5–8. Figured specimen, AEJ461/NIGP121473.

Fig. 2. Transverse section with a narrow exozone shows pronounced reverse V-shaped lamellar structure; x 16.

Fig. 3. Longitudinal section shows few long superior hemisepta and attitudinal relationship of the hemisepta to walls; x 16.

Figs. 5, 6. Tangential sections at two different positions on the same ramose zoarium shows well-developed paurostyles and numerous mesozooecia; x 16 and x 13 respectively.

Figs. 7, 8. Enlarged views of Fig. 6 and Fig. 5 respectively; growth direction of Fig. 7 is horizontal.

Figs. 4, 9–11. *Pseudocampylus planiformis* sp.nov.

Holotype, AEJ483/NIGP 121474, Late *rhenana* Zone.

Fig. 4. Transverse section with comparatively wide exozone; x 13.

Fig. 9. Tangential section shows absence of paurostyles; x 50.

Fig. 10. Transverse section of flat columnar ramose branch before bifurcation, exhibits wide exozone and walls which are composed of pronounced reverse V-shaped lamellae, x 15.

Fig. 11. Longitudinal section shows few short, superior hemisepta; x 17.

PLATE 6

Bryozoans are may be from the previously Middle-Late *triangularis* Zone, Hongguleleng Formation, unless stated otherwise.

Figs. 1–4. *Pseudocampylus planiformis* sp.nov. Paratype, AEJ483/NIGP121475, Late *rhenana* Zone.

Fig. 1. Longitudinal section shows few short, superior hemisepta and attitudinal relationship of the hemisepta to walls. Note that the walls are composed of pronounced reverse V-shaped lamellae from which the hemisepta arise; x 54.

Fig. 2. Transverse section with a wide exozone; x 14.

Fig. 3. Longitudinal section of ramose zoarium in which the endozone is filled by mineral component, shows arrangement of superior hemisepta in exozone; x 15.

Fig. 4. Tangential section shows absence of paurostyles; x 53.

Figs. 5–12. *Pseudocampylus similivirgatus* sp.nov.

Figs. 5–8, 10. Holotype, AEJ469/NIGP121476.

Fig. 5. Transverse section with a narrow exozone; x 20.

Fig. 6. Tangential section shows well-developed paurostyles; x 53.

Fig. 7. Longitudinal section shows few short superior hemisepta and attitudinal relationship of the hemisepta to walls; x 53.

Fig. 8. Longitudinal section exhibiting growth of superior hemisepta, narrow exozone and wide endozone; x 14.

Fig. 10. Tangential section exhibiting well-developed paurostyles, arrangement of mesozooecia and apertures; x 17.

Figs. 9, 11, 12. Paratype, AEJ469/NIGP121477.

Fig. 9. Longitudinal section shows few short superior hemisepta; x 11.

Fig. 11. Transverse section of specimen, with narrow exozone; x 16.

Fig. 12. Tangential section shows well-developed paurostyles; x 19.

PLATE 7

Bryozoans from Late *rhenana* Zone, Hongguleleng Formation.

Figs. 1–10. *Pseudocampylus similitarbagataicus* sp.nov.

Figs. 1–3, 5, 7. Holotype, AEJ483/NIGP121478.

Fig. 1. Longitudinal section shows well-developed short, thick superior hemisepta. Note that the hemisepta tend to become shorter from the gebinning ot the exozone to the zoarial margin and that a thin self-overgrowth occurs; x 38.

Fig. 2. Tangential section shows well-developed paurostyles; x 53.

Fig. 3. Tangential section exhibiting development of paurostyles, mesozooecia and apertures; x 15.

Fig. 5. Longitudinal section exhibiting well-developed paurostyles, wide exozone, thickened walls and region of origin of the self-overgrowth noted in figure 1; x 10.

Fig. 7. Transverse section with a wide exozone shows thickened walls. Note that there are two narrow regions of self-overgrowth within the exozone; x 13.

Figs. 6, 8–10. Paratype, AEJ483/NIGP121479.

Fig. 6. Transverse section with a comparatively wide exozone, x 9.

Fig. 8. Longitudinal section shows well-developed superior hemisepta and equally or locally unequally thickened walls; x 75.

Fig. 9. Tangential section shows few paurostyles; x 61.

Fig. 10. Longitudinal section shows abundant short, thick superior hemisepta and attitudinal relationship of the hemisepta to walls which are composed of pronounced reverse V-shaped lamellar, unnecessary statement; they could have no other origin; x 90.

PLATE 8

Bryozoans from Middle *crepida* Zone, Hongguleleng Formation, unless stated otherwise.

Figs. 1–6. *Fistulipora lunuliformis* sp.nov.

Figs. 1, 2, 4, 5. Holotype, AEJ460/NIGP121480.

Fig. 1. Tangential section shows development of apertures and pronounced lunaria near the macula at lower right; x 60.

Fig. 2. Longitudinal section of an encrusting zoarium shows an irregular growth layer, short autozooecia and small vesicules, x 8.

Fig. 4. Longitudinal section of different part of the same encrusting zoarium as in Fig. 2, shows longer autozooecia and variably sized and shaped vesicules; x 10.

Fig. 5. Tangential section shows development of apertures, lunaria and vesicular tissue; x 12.

Figs. 3, 6. Paratype, AEJ460/NIGP121481.

Fig. 3. Longitudinal section of an encrusting zoarium; x 6.

Fig. 6. Tangential section shows arrangement of apertures with pronounced lunaria; x 20.

Figs. 7, 10. *Fistulipora paricella* sp.nov. Paratype, AEJ460/NIGP121483.

Fig. 7. Tangential section shows developement of apertures and vesicular tissue; x 10.

Fig. 10. Longitudinal section of an irregular encrusting zoarium shows growth of autozooecia and vesicular tissue; x 10.

Figs. 8, 9. Holotype, AEJ460/NIGP121482.

Fig. 8. Tangential section shows apertures with indistinct lunaria and stable vesicules in size; x 40.

Fig. 9. Longitudinal section of a part of an irregular encrusting zoarium, shows development of autozooecia with rare diaphragms; x 10.

Fig. 11. *Fistulipora vassinensis* MOROZOVA, 1961.

Figured specimen, AEM262/ NIGP121484, probably from Middle *crepida* Zone. Longitudinal section of an irregular encrusting zoarium; x 9.

PLATE 9

Bryozoans from Middle *crepida* Zone, Hongguleleng Formation, unless stated otherwise.

Fig. 1. *Fistulipora paricella* sp.nov.

Paratype. AEJ460/NIGP121483. Tangential section shows a macula and apertures near by. Note the lunaria slightly thickened only at wide end of aperture; x 24.

Figs. 2, 6. *Fistulipora vassinensis* MOROZOVA, 1961.

Figured specimen, AEM262/ NIGP121484, probably of Middle *crepida* Zone.

Fig. 2. Tangential section shows arrangement of apertures with well-developed lunaria; x 25.

Fig. 6. Longitudinal section of encrusting zoarium shows no diaphragms in short tubular autozooecia; x 16.

Fig. 3. *Minilya alticarininodialis* sp.nov.

Paratype, AEJ464–466/NIGP121488, probably from an unrecognized interval from Late *triangularis* Zone to Early *crepida* Zone. Obverse section of meshed segment overgrowing on a fistuliporid zoarium. Note alternatively arranged carinal nodes in two rows; x 20.

Figs. 4, 5, 7–13. *Eofistulotrypa primacylindilla* sp.nov.

Figs. 4, 5, 8. Holotype, AEJ463/NIGP121485.

Fig. 4. Tangential section shows more regularly arrangement of oval or elliptical apertures; x 38.

Fig. 5. Transverse section across a cylindrical primary zooecium; x 19.

Fig. 8. Longitudinal section through a discontinuous cylindrical primary zooecium. Note the vesicular tissue is restricted to exozone only; x 19.

Figs. 7, 10, 11. Paratype, AEM262/NIGP121487.

Fig. 7. Longitudinal section through a continuous irregular cylindrical primary zooecium shows growth of tubular autozooecia; x 17.

Fig. 10. Tangential section shows shape and arrangement of apertures; x 18.

Fig. 11. Transverse section of across a primary zooecium; x 17.

PLATE 10

Bryozoans are probably from Middle crepida Zone, Hongguleleng Formation, unless stated otherwise.

Figs. 1, 2. *Eridopora* sp. Figures specimen, AEJ464–466/NIGP121488, probably an unrecognized interval from Late *triangularis* Zone to Warly *crepida* Zone.

Fig. 1. Tangential section shows outline and arrangement of apertures, x 26.

Fig. 2. Longitudinal section across several branches of Minilya altticarininodialis sp.nov.; x 19.

Figs. 3–6, 8–11. *Fistuliramus eregennarenensis* sp.nov.

Figs. 3–5. Holotype, AEJ262/NIGP121489.

Fig. 3. Tangential section shows regularly arranged apertures; x 25.

Fig. 4. Transverse section of solid ramose zoarium which is badly preserved in centre; x 6.

Fig. 5. Longitudinal section of part of solid ramose zoarium which is badly preserved in centre shows growth and development of tubular autozooecia and vesicular tissue; x 10.

Figs. 6, 8–11. Paratype, AEM262/NIGP121490.

Fig. 6. Longitudinal section through an unpreserved centre of solid ramose zoarium; x 16.

Figs. 8, 10. Two tangential sections shows regularly arranged apertures and vesicular tissue; x 18.

Fig. 9. Transverse section across solid ramose zoarium that is partly surrounded by an intraspecific overgrowth layer; x 10.

Fig. 11. Longitudinal section through an unpreserved centre of solid ramose zoarium; x 10.

Fig. 7. *Minilya alticarininodialis* sp.nov.

Holotype, AEJ464–466/NIGP121488, the same horizon noted for Fig. 1, 2 explained above. Transverse section across six branches shows thicker outer-basal walls and higher carinal nodes; x 27.

PLATE 11

Bryozoans from Middle *crepida* Zone, Hongguleleng Formation, unless stated otherwise.

Figs. 1–4, 9, 11. *Cyclotrypa concylindrella* sp.nov.

Figs. 1–3, 11. Holotype, AEJ460/NIGP121491.

Fig. 1. Tangential section shows arrangement of subcircular apertures; x 18.

Figs. 2, 3. Longitudinal section through an irregular, columnar substratum, x 9.

Fig. 11. Enlarged view of Fig. 1, shows a macula and apertures nearby at below middle right; x 24.

Figs. 4, 9. Paratype, AEJ460/NIGP121492.

Fig. 4. Longitudinal section across a columnar substratum; x 7.

Fig. 9. Tangential section shows arrangement of apertures and irregular, polygonal vesicular tissue; x 10.

Figs. 5–7, 10. *Cyclotrypa tubuliformis* NEKHOROSHEV, 1963

Figs. 5–7. Figured specimen, HBK2/NIGP121493, from Lower *expansa* Zone, Hebukehe Formation.

Fig. 5. Longitudinal section through an encrusting zoarium wrapped up a fine, regular and columnar substratum shows growth of autozooecia, x 23.

Fig. 6. Longitudinal section across an encrusting zoarium wrapped up a columnar substratum; x 10.

Fig. 7. Tangential section; x 30.

Fig. 10. Figured specimen, HBK2/NIGP121494, horizon *idem.* Tangential section shows arrangement of apertures and intervening spaced filled by stereom among apertures; x 38.

Fig. 8. *Sulcoretepora hextolgayensis* sp.nov.

Holotype, AEJ460/NIGP121495. Tangential section of bifurcating bifoliate ramose zoarium; x 30.

PLATE 12

Bryozoans from Middle *crepida* Zone, Hongguleleng Formation, unless stated otherwise.

Figs. 1, 3, 8, 12, 13. *Sulcoretepora hextolgayensis* sp.nov.

Figs. 1, 3, 8. Holotype, AEJ460/NIGP121495.

Fig. 1. Oblique longitudinal section through mesotheca of bifoliate ramose zoarium shows growth and developement of short tubular autozooecia. Note that at the top some portion as occur as tangential section; x 8.

Fig. 3. Transverse section across a bifoliate ramose zoarium, x 14.

Fig. 8. Somewhat oblique tangential section along a bifurcated ramose zoarium; x 7.

Figs. 12, 13. Paratype, AEJ467/NIGP121496, probably in unrecognized Late *triangularis* Zone.

Fig. 12. Tangential section of a bifurcated ramose zoarium shows apertures and range walls; x 11.

Fig. 13. Transverse section across a bifoliate ramose zoarium; x 12.

Figs. 2, 4. *Cyclotrypa tubuliformis* NEKHOROSHEV, 1956.

Figured specimen, HBK2/ NIGP121494, Early *expansa* Zone, Hebukehe Formation.

Fig. 2. Longitudinal section across an encrusting zoarium wrapped up a columnar substratum; x 6.

Fig. 4. Longitudinal section through an encrusting zoarium wrapped up a columnar substratum, shows growth and development of tubular autozooecia and vesicular tissue; x 10.

Figs. 5, 6. *Bactropora hextolgayensis* sp.nov. Holotype, AEJ2/NIGP121499.

Fig. 5. Longitudinal section shows medial lamina and absence of both diaphragms and hemispeta in autozooecia. Note the thickened walls are composed of reverse V-shaped lamellae; x 50.

Fig. 6. Tangential section exhibits elliptical and regularly arranged apertures, rare and small metapores, as well as well-developed styles; x 14.

Figs. 7, 10, 11, 14, 15. *Sulcoretepora praehextolgayensis* sp.nov.

Figs. 7, 10, 15. Holotype, AEJ483/NIGP121497, of Late *rhenana* Zone.

Fig. 7. Oblique longitudinal section. Note that at the upper part some portions occur as tangential section; x 10.

Fig. 10. Oblique tangential section through the bifurcated ramose zoarium, x 6.

Fig. 15. Oblique longitudinal section; x 12.

Figs. 11, 14. Paratype, AEJ483/NIGP121498, horizon *idem.*

Fig. 11. Transverse sections; x 13.

Fig. 14. Tangential section shows outline and arrangement of apertures and range walls; x 36. Note that the growth direction is horizontal.

Fig. 9. *Alternifenestalle nurensis* (NEKHOROSHEV, 1977).

Figured specimen, AEJ460/ NIGP121509. Obverse section of one flabellate, fenestrate segment near the proximal base of colony; x 14.

PLATE 13

Bryozoans are probably from an unrecognized interval from Middle to Late *triangularis* Zone, Hongguleleng Formation, unless stated otherwise.

Figs. 1, 2. *Bactropora hextolgayensis* sp.nov.

Holotype, AEJ462/NIGP121499, of Middle *crepida* Zone.

Fig. 1. Enlarged view of Plate 12, Fig. 6, shows well-developed styles as well as few, small metapores; x 54.

Fig. 2. Longitudinal section exhibits attitudinal relationship of autozooecia to medial lamina; x 16.

Figs. 3–7. *Nikiforovella cellaris* sp.nov.

Paratype, AEM265/NIGP121501, probably from unrecognized interval from Late *crepida* Zone to Late *postera* Zone.

Fig. 3. Longitudinal section shows cystoid metapores restricted to exozone only; x 25.

Fig. 7. Tangential section shows large, elliptical apertures, numerous small metapores and well-developed paurostyles; x 43.

Figs. 4–6. Holotype, AEM265/NIGP121500, horizon *idem*.

Fig. 4. Tangential section; x 18.

Fig. 5. Enlarged view of Fig. 4, shows growth and development of autozooecia and metapores; x 19.

Figs. 8, 9, 13. Paratype, AEJ467/NIGP121503.

Fig. 8. Tangential section shows generally two acanthostyles between successive apertures; x 50.

Fig. 9. Oblique longitudinal section occurring some patterns as tangential section at the bottom; x 10.

Fig. 13. Longitudinal section shows attitudinal relationship of autozooecia to the linear axis as well as thickened walls; x 9.

Figs. 10–12. Holotype, AEJ467–468/NIGP121502.

Fig. 10. Transverse section shows autozooecia arising from a linear axis and thickened walls; x 41.

Fig. 11. Longitudinal section shows attitudinal relationship of autozooecia to the linear axis; x 56.

Fig. 12. Tangential section shows two pronounced acanthostyles beetween successive apertures; x 60.

PLATE 14

Bryozoans from Late rhanana Zone and probably extending to an unrecognized Early triangularis Zone, Hongguleleng Formation, unless stated otherwise.

Figs. 1–4. *Nicklesopra fameniensis* (NEKHOROSHEV, 1960)

Figs. 1, 2. Figured specimen, AEJ472–483/NIGP121504.

Fig. 1. Tangential section shows regularly arranged apertures and well-developed paurostyles; x 54.

Fig. 2. Longitudinal section shows growth and development of axial zooecia and autozooecia; x 26.

Figs. 3, 4. Figured specimen, AEJ471–484/NIGP121505.

Fig. 3. Longitudinal section shows axial zooecia with thin walls and autozooecia with thickened walls; x 15.

Fig. 4. Tangential section exhibiting apertures and paurostyles; x 53.

Figs. 5, 6. *Nicklesopora graciosa* TROIZKAYA, 1968.

Figured specimen, HBK2/ NIGP121506, from Early *expansa* Zone, Hebukehe Formation.

Fig. 5. Oblique tangential section shows irregularly arranged apertures and arrangement of paurostyles; x 58.

Fig. 6. Longitudinal section shows growth of axial zooecia as well as wide endozone and narrow exozone; x 18.

Figs. 7, 8. *Nicklesopora sexagula* TROIZKAYA, 1968.

Figured specimen, AEJ471–484/NIGP121507.

Fig. 7. Longitudinal section shows numerous diaphragms in the transition region from endozone to exozone; x 12.

Fig. 8. Oblique tangential section; x 12.

Fig. 9. *Minilya alticarininodialis* sp.nov.

Paratype, AEJ464–466/NIGP121488, probably from an unrecognized interval from Late *triangularis* zone to Middle *crepida* Zone. Obverse section shows alternating carinal nodes in adjacent rows and autozooecial base-shapes; x 20.

Fig. 10. *Alternifenestella normalis* TROIZKAYA, 1979.

Figured specimen, AEM263/ NIGP121508, probably from an unrecognized Late *crepida* Zone, Hongguleleng Formation. Obverse section shows base-shapes and arrangement of autozooecia; x 37.

Fig. 11. *Alternifenestella nurensis* (NEKHOROSHEV, 1977).

Figured specimen, AEJ463/ NIGP121510, probably from Middle *crepida* Zone. Obverse section of flabellate, fenestrate segment close to the distal part of colony; x 20.

PLATE 15

Bryozoans are probably from an unrecognized interval from Late *triangularis* Zone to Early *crepida* Zone, Hongguleleng Formation, unless stated otherwise.

Fig. 1. *Laxifenestella microtuberculata* (NEKHOROSHEV, 1960).

Figured specimen AEM253/NIGP121511, Late *rhenana* Zone. Obverse section of a more regular, meshed segment; x 9.

Figs. 2, 3. *Alternifenestella nurensis* (NEKHOROSHEV, 1977).

Fig. 2. Figured specimen, AEJ460/NIGP121510, from Middle crepida Zone. Transverse section shows thin outer-basal wall; x 46.

Fig. 3. Figured specimen AEJ460/NIGP121509, horizon *idem*. Transverse section shows thin outer basal walls; x 41.

Figs. 4, 7. *Alternifenestella tshingizica* (TROIZKAYA, 1968).

Fig. 4. Figured specimen, AEJ467–468/NIGP121513, probably of an unrecognized Late *triangularis* Zone. Obverse section from a fenestrate segment; x 10.

Fig. 7. Figured specimen, AEJ460/NIGP121514, from Middle *crepida* Zone. Obverse section of a meshed segment; x 17.

Figs. 5, 6. *Laxifenestella tichomirovi* (TROIZKAYA, 1968).

Figured specimen, AEJ464–466/NIGP121512.

Fig. 5. Obverse section of a regular, fenestrate segment, shows basal-shape and arrangement of autozooecia; x 17.

Fig. 6. Transverse section with thicker outer-basal walls; x 17.

Fig. 8. *Minilya alticarininodialis* sp.nov.

Holotype, AEJ467–468/NIGP121515, probably from an unrecognized interval from Late *triangularis* Zone to Middle *crepida* Zone. Observe section of a regular, fenestrate segment. Note the arrangement of carinal nodes below at the right; x 20.

Figs. 9–11. *Minilya berkarensis* (TROIZKAYA, 1968).

Figured specimen, AEJ464–466/NIGP121; x 20.

Figs. 9, 11. Obverse sections at two different positions of a fenestrate segment.

Fig. 10. Transverse section with thicker outer basal walls.

PLATE 16

Bryozoans from Middle crepida Zone, Hongguleleng Formation, unless stated otherwise.

Figs. 1–4. *Minilya alticarininodialis* sp.nov.

Figs. 1, 2. Holotype, AEJ467–468/NIGP121515, probably from an unrecognized interval from Late *triangularis* Zone to Middle *crepida* Zone; x 13.

Fig. 1. Obverse section of a more regular, fenestrate segment exhibits autozooecial basal-shape, of apertures and carinal nodes.

Fig. 2. Transverse section.

Figs. 3, 4. Paratype, AEJ463/NIGP121516.

Fig. 3. Transverse section across several branches with thick outer basal walls; x 14.

Fig. 4. Obverse section of a more regular, fenestrate segment; x 12.

Figs. 5, 6. *Rectifenestella praerudis* (TROIZKAYA, 1963).

Fig. 5. Figured specimen, AEJ460/NIGP121521. Transverse section across 12 branches with thin outer basal walls; x 12.

Fig. 6. Figured specimen, AEJ461/NIGP121522. Transverse section across 4 branches with thin outer basal walls; x 18.

Fig. 7. *Minilya berkarensis* (TROIZKAYA, 1968).

Figured specimen. AEJ461/ NIGP121518. Obverse section of a fenestrate segment. Note at the top left, transverse section across 3 branches; x 17.

Figs. 8, 9. *Rarifenestella octoformis* sp. nov.

Holotype, AEM264/NIGP121519, probably from an unrecognized interval from Late*crepida* Zone to Late *rhomboidea* Zone.

Fig. 8. Observe section of flabellate segment with a more regular meshwork shows worm-like autozooecial base-shapes and fenestrules with an Arabic "8" due to indention of autozooecium; x 43.

Fig. 9. Transverse section across 5 branches with thin outer basal walls and higher carinal nodes; x 60.

PLATE 17

Bryozoans are probably from an unrecognized interval from late*crepida* Zone to Late *rhomboidea* Zone, Hongguleleng Formation, unless stated otherwise.

Figs. 1, 2. *Rectifenestella crassimuralis* (TROIZKAYA, 1968).

Figured specimen, AEM264/NIGP121520.

Fig. 1. Obverse section of a flabellate, fenestrate segment; x 10.

Fig. 2. Obverse section with two branches shows rectangular fenestrules and base shape of autozooecia; x 20.

Figs. 3, 6. *Rectifenestella praerudis* (TROIZKAYA, 1963).

Fig. 3. Figured specimen, AE460/NIGP121521, from Middle *crepida* Zone. Obverse section of a regular, fenestrate segment; x 19.

Fig. 6. Figured specimen, AEJ461/NIGP121522, horizon*idem.* Obverse section of a regular, fenestrate segment shows pronounced carinal nodes at the left; x 15.

Figs. 4, 7. *Rectifenestella rengarteni* (TROIZKAYA, 1968).

Figured specimen, AEM265/ NIGP121523.

Fig. 4. Obverse section of a more irregular meshed segment; x 8.

Fig. 7. Enlarged view of a part of Fig. 4, shows base-shapes of autozooecia with prolonged oval-square outline and elliptical fenestrules; x 23.

Figs. 5, 8, 9. *Intrapora aperiflorina* sp.nov.

Holotype, AEJ471–484/NIGP121524, from Late*rhenana* Zone and probably extending to an unrecognized Middle *triangularis* Zone.

Fig. 5. Longitudinal section; x 11.

Fig. 8. Tangential section; x 15.

Fig. 9. Enlarged view of a part of Fig. 8, shows apertures with petaloid outline due to projecting of acanthostyles; x 53.

PLATE 18

Bryozoans from Late *rhenana* Zone and probably extending to an unrecognized Middle *triangularis* Zone, Hongguleleng Formation, unless stated otherwise.

Figs. 1–5. *Intrapora aperiflorina* sp.nov.

Figs. 1, 2. Holotype, AEJ471–484/NIGP121524.

Fig. 1. A part of a long lenticular transverse section; x 11.

Figs. 2. Longitudinal section shows attitudinal relationship of autozooecia to mesotheca and thickened autozooecial walls in exozone; x 9.

Figs. 3, 4, 5. Paratype, AEM256/NIGP121525, probably from an unrecognized interval from Late *triangularis* Zone to Early *crepida* Zone.

Fig. 3. Tangential section shows petaloid apertures due to intrusion of acanthostyles; x 58.

Fig. 4. Longitudinal section of explanate zoarium parted along mesotheca; x 13.

Fig. 5. Transverse section with lenticular outline; x 15.

Figs. 6–11. *Intrapora lanceolata* NEKHOROSHEV, 1960.

Figs. 6, 11. Figured specimen, AEJ467/NIGP121528, probably from an unrecognized Late *triangularis* Zone.

Fig. 6. Transverse section; x 8.

Fig. 11. Longitudinal section of partly mineralized explanate zoarium; x 12.

Figs. 7–9. Figured specimen, AEJ471–484/NIGP121526.

Fig. 7. Tangential section shows oval apertures, small, polygonal mesozooecia and well-developed acanthostyles. Note acanthostyles occasionally project into apertures; x 50.

Fig. 8. Tangential section; x 20.

Fig. 9. Deep tangential section. Note there are two mesozooecia between apertures longitudinally in general; x 20.

Fig. 10. Figured specimen, AEJ471–484/NIGP121527. Longitudinal section of explanate zoarium parted along mesotheca; x 9.

PLATE 19

Bryozoans probably from an unrecognized interval from Late *triangularis* Zone to Early *crepida* Zone, Hongguleleng Formation, unless stated otherwise.

Figs. 1, 2. *Intrapora lanceolata* NEKHOROSHEV, 1960.

Fig. 1. Figured specimen, AEJ471–484/NIGP121527, from Late *rhenana* Zone and probably extending to an unrecognized Middle *triangularis* Zone. Oblique tangential section; x 32.

Fig. 2. Figured specimen, AEJ467/NIGP121528, probably from an unrecognized Late *triangularis* Zone. Tangential section exhibiting apertures mesozooecia and acanthostyles. The especially large aperture at the middle left may be a gonozooecium; x 28.

Figs. 3–5, 7–12. *Intrapora similitaeniola* sp.nov.

Figs. 3–5, 7, 8. Holotype, AEJ463/NIGP121529, from Middle *crepida* Zone.

Fig. 3. Tangential section shows obscure acanthostyles; x 46.

Fig. 4. Tangential section exhibiting apertures, mesozooecia and obscure acanthostyles. Note three large apertures may be gonozooecia; x 18.

Fig. 5. Enlarged view of Fig. 8 shows relationship of autozooecia to mesotheca, x 20.

Fig. 7. Transverse section; x 8.

Fig. 8. Longitudinal section; x 11.

Figs. 9–12. Paratype, AEJ464–466/NIGP121.

Fig. 9. Enlarged view of Fig. 12, exhibits apertures, mesozooecia and obscure, few acanthostyles; x 41.

Fig. 10. Longitudinal section shows relationship of autozooecia to mesotheca; x 16.

Fig. 11. Transverse section; x 7.

Fig. 12. Tangential section; x 24.

Fig. 6. *Intrapora aperiflorina* sp.nov.

Holotype, AEJ471–484/NIGP121524, from Late *rhenana* Zone and probably extending to an unecognized Middle *triangularis* Zone. Transverse section; x 10.

PLATE 20

Bryozoans from Middle *crepida* Zone, Hongguleleng Formation.

Figs. 1–3. *Intrapora taeniola* TROIZKAYA

Figured specimen, AEJ463/NIGP 121531.

Fig. 1. Tangential section shows apertural outline, variably shaped and sized mesozooecia and well-developed acanthostyles; x 52.

Fig. 2. Transverse section shows three growth layers; x 5.

Fig. 3. Longitudinal section shows growth layers of autozooecia and relationship of autozooecia to mesotheca; x 10.

Figs. 4–12. *Intrapora triangularis* sp. nov.

Figs. 4–8. Holotype, AEJ463/NIGP121532.

Fig. 4. Tangential section shows regular-shaped apertures, large mesozooecia and obscure acanthostyles; x 53.

Fig. 5. Tangential section in different part of the explanate zoarium in Fig. 4; x 41.

Fig. 6. Transverse section; x 6.

Fig. 7. Longitudinal section shows relationship of autozooecia to mesotheca; x 10.

Fig. 8. Tangential section exhibiting apertures, mesozooecia and few acanthostyles. Note four large apertures may be of gonozooecia; x 19.

Figs. 9–12. Paratype, AEJ460/NIGP121533.

Fig. 9. Enlarged view of Fig. 11, shows autozooecia and zooecial walls in exozone, walls are composed of reverse V-shaped lamellae; x 57.

Fig. 10. Transverse section like anisosceles triangle in outline; x 15.

Fig. 11. Longitudinal section exhibits relationship of autozooecia to mesotheca; x 7.

Fig. 12. Tangential section shows apertures, mesozooecia and obscure acanthostyles; x 53.

CONODONTS (PLATES 21–25)

Samples under the heading AEJ, AEM and HBK, are from the Bulongguhe, Erengennaren and Hebukehe section (i.e., Textfig. 2, Section A, Section B and Section C) respectively. The number prefixed by SEM indicate those of the electronic scanning microphotos. Samples labelled AES where are collected from an unmeasured section (Section A'), the Bulongguhe section but on the other limb, within the same synclinal fold as Section A.

PLATE 21

Conodonts are from Late *rhenana* Zone of Hongguleleng Formation. All views are upper, unless otherwise stated. Figures 1–9 are of I elements, and Figures 10–18 are of Pa elements.

Figs. 1–7. *Icriodus subterminus* YOUNGQUIST 1947.

Long and narrow platform morphotype and a round medial row of denticles.

Fig. 1. AEJ484/SEM1; x 60.

Fig. 2. AEJ484/SEM2; x 110.

Fig. 3. AEJ484/SEM3; x 80.

Fig. 4. AEM252/SEM70; x 110.

Fig. 5. AEM252/SEM60; x 90.

Fig. 6. AES161/SEM45; x 100.

Fig. 7. AES161/SEM48; x 110.

Figs. 8, 9. *Icriodus alternatus helmsi* SANDBERG and DREESEN, 1984.
A posterior cusp is aligned with a row of side denticles.

Fig. 8. With a compressed medial row of denticles, AES161/SEM46; x 100.

Fig. 9. With a round medial row of denticles, AEM252/SEM61; x 110.

Figs. 10–14. *Polygnathus planarius* KLAPPER and LANE, 1985.
Right and left anterior platform margins are equal in height, adcarine troughs best developed in anterior half of platform.

Figs. 10, 11. A sinistral specimen. AEJ484/SEM4; x 50.

Fig. 11. Lower view.

Fig. 12. A sinistral specimen, AEJ484//SEM5; x 50.

Fig. 13. A dextral specimen with broken anterior part of platform, oblique upper view, AEM252/SEM65; x 60.

Fig. 14. A dextral specimen with broken anterior platform margin, AES161/SEM90; x 60.

Figs. 15–18. *Polygnathus imparilis* KLAPPER and LANE, 1985.
Right anterior platform margin higher than left margin, adcarinal troughs deep anteriorly and extending into posterior platform, but commonly not to posterior end.

Figs. 15, 16. A sinistral specimen, AEJ484/SEM7.

Fig. 15. x 60.

Fig. 16. Lower view; x 90.

Fig. 17. Oblique upper view of a dextral specimen, AEJ484v11; x 60.

Fig. 18. A sinistral specimen, AEM253/SEM64; x 70.

PLATE 22

Conodonts are from Middle *crepida* Zone of Hongguleleng Formation except for those in Figures 1–3, which are from Late *rhenana* Zone of the formation. All views are upper, unless otherwise stated. All Figures are of Pa elements.

Figs. 1–3. *Polygnathus* ex gr. *webbi* STAUFFER, 1938.
Right anterior margin distinctly higher than left anterior margin. Carina continuous to posterior tip, paralleled by adcarinal troughs, platform ornamented by more or less developed transverse ridges. Sinistral specimens.

Fig. 1. Broken posterior end of platform and anterior end of free blade, AEJ484/SEM72; x 70.

Fig. 2. Broken anterior end of free blade, AEJ484/SEM10; x 80.

Fig. 3. AEJ484/SEM74; x 70.

Figs. 4, 5. *Palmatolepis minuta minuta* BRANSON and MEHL, 1934.
Platform small, elongated subovate, carina continues posterior to the central node, but posterior carina obviously lower than anterior carina. Broken specimen, AEJ460/SEM18; x 85.

Fig. 4. Lower view.

Figs. 6–9. *Palmatolepis minuta wolskae* SZULCZEWSKI, 1971.
Carina absent from posterior to the extremely large central node.

Figs. 6, 7. A broken specimen at the anterior end of platform, AES162/SEM49; x 90.

Fig. 7. Lower view.

Figs. 8, 9. A complete specimen, AEJ460/SEM17; x 120.

Fig. 9. Lower view.

Figs. 10, 11. *Mehlina* sp. cf. *gradata* YOUNGQUIST, 1945.

Basal pit at midlength and an inverted basal cavity posteriorly. AEJ475/SEM21; x 90.

Fig. 10. Right (outer) lateral view.

Fig. 11. Left (inner) lateral view.

Figs. 12–17. *Polygnathus aequalis* KLAPPER and LANE, 1985.

Anterior right and left platform margins about equal in height. Platform ornament is more or less smooth in the anterior two third and in the posterior third surface variationes from smooth to faintly or moderately well-developed ridges or nodes.

Figs. 12, 13. Two dextral specimens.

Fig. 12. Broken posterior end, AEJ460/SEM78; x 110.

Fig. 13. AEJ460/SEM83; x 70.

Figs. 14–17. Four sinistral specimens.

Fig. 14. AEJ460/SEM27; x 60.

Fig. 15. AEJ460/SEM83; x 100.

Fig. 16. AEJ460/SEM84; x 130.

Fig. 17. Broken both anterior and posterior end of unit, AEM257/SEM68; x 120.

PLATE 23

Conodonts from Middle *crepida* Zone of Hongguleleng Formation. Views are upper, unless stated otherwise.

Figures 1–7 are of I elements, and Figures 8–15 are of Pa elements. Specimens with numbers prefixed by NIGP are deposited in Nanjing Institute of Geology and Palaeontology, Academia Sinica, and have been described in detail in the text of this paper.

Figs. 1–7. *Icriodus alternatus alternatus* BRANSON and MEHL, 1934.

I element in with aligned with and forming posterior termination of medial row of denticles which are strongly reduced relative to both lateral row denticles.

Figs. 1–5. Longer, narrow platform and compressed medial row denticles.

Fig. 1. AES162/SEM50; x 170.

Fig. 2. Oblique upper view, AES162/SEM113; x 150.

Fig. 3. AES162/SEM56; x 130.

Fig. 4. AES162/SEM95; x 110.

Fig. 5. AES257/SEM67; x 160.

Fig. 6. Round anteriorly and compressed posteriorly medial row denticles,AES162/SEM60; x 100.

Fig. 7. Oblique upper view of round medial row denticles,AES162/SEM98; x 100.

Figs. 8, 9. *Polygnathus* sp.nov.

Pa element bent V-shaped pattern with both adcarinal troughs meet at or near midlength, deep of platform anterior at third, and deepending towards the anterior end and so that whole forms a. A sinistral specimen, AEJ460/SEM34; NIGP121534; x 40.

Fig. 8. Lower view.

Figs. 10–13. *Schmidtognathus* sp.nov.

Pa element with platform margins bare, short transverse ridges, and large asymmetrical, basal pit, that lacks folds.

Figs. 10, 11. A dextral specimen with somewhat broken at anterior end of free blade,AEJ460/SEM85; NIGP121535; x 160.

Fig. 10. Somewhat oblique upper view.

Fig. 11. Lower view.

Figs. 12, 13. A sinistral specimen, AEM257/SEM66; NIGP121536; x 140.

Fig. 12. Oblique upper view.

Fig. 13. Lower view.

Figs. 14, 15. *Polygnathus brevilamiformis* OVNATANOVA, 1976.

Platform narrow and longe, about same as free blade in length, and asymmetrical in both laterals of platform. A dextral specimen, AEJ460/SEM37; x 90.

Fig. 14. Lower view.

PLATE 24

Conodonts are from Early *expansa* Zone of Hebukehe Formation of Hebukehe section (Section C), except those in Figures 1–8, which are from Middle *crepida* Zone of Hongguleleng Formation. All Figures are of Pa elements. All views are upper, unless stated otherwise.

Figs. 1–8, 11, 13, 14. *Polygnathus* ex gr. *webbi* STAUFFER, 1938.

Figs. 1, 2, 3, 6, 7. Sinistral specimens.

Figs. 1, 2. Specimen, AEJ460/SEM12; x 90.

Fig. 2. Lower view.

Fig. 3. AEJ460/SEM28; x 890.

Fig. 6. Broken anterior end of free blade, AEJ460/SEM76; x 80.

Fig. 7. Broken posterior end of platform, AEM257/SEM88; x 125.

Figs. 4, 5, 8. Dextral specimens.

Figs. 4, 5. Broken anterior end of free blade, AEJ460/SEM32; x 35.

Fig. 4. Lower view.

Fig. 8. Broken anterior third of unit, AEJ162/SEM59; x 40.

Figs. 11, 13, 14. The upper surfaces of anterior platform almost without ornaments.

Fig. 11. A sinistral specimen with free blade broken off, HBK2/SEM39; x 90.

Figs. 13, 14. Dextral specimen, HBK2/SEM40; x 50.

Fig. 13. Lower view.

Figs. 9, 10. *Palmatolepis gracilis sigmoidalis* ZIEGLER, 1962.

Strongly sigmoidal blade and carina, with a short, extremely small platform, HBK6/SEM69; x 110.

Fig. 9. Lower view.

Fig. 12. *Bispathodus stabilis* (BRANSON and MEHL, 1934).

Morphotype 3 of SANDBERG and ZIEGLER, 1979. With a wide cup that is ornamented by two nodes on the right side, HBK6/SEM45; x 70.

Figs. 15, 16. *Polygnathus communis communis* BRANSON and MEHL, 1934.

In general the upper surfaces of platforms are almost smooth, and both anterior platform margins are about equivalent in height.

Fig. 15. A sinistral specimen with a shorter or wider morphotype platform, HBK2/SEM102; x 120.

Fig. 16. A dextral specimen with a longer and narrower morphotype platform, oblique upper view, HBK2/SEM43; x 90.

PLATE 25

Conodonts are from Middle *crepida* Zone of Hongguleleng Formation. All figures are Pa elements and all view are upper, unless stated otherwise.

Figs. 1, 2, 4, 6. *Mehlina* sp. In Pa element the basal pit is at medial-posterior part of unit.

Figs. 1, 2. Pa element, AES162/SEM53; x 70.

Fig. 2. Right (outer) lateral view.

Fig. 4. Pb element, left (inner) lateral view, AES162/SEM54; x 65.

Fig. 6. M element, front (inner) lateral view, AES162/SEM55; x 80.

Figs. 3, 8, 9. *Polygnathus aequalis* KLAPPER and LANE, 1985.

Fig. 3. A sinistral specimen with a narrower morphotype platform, AES162/SEM57; x 60.

Figs. 8, 9. Two dextral specimens with a wider morphotype platform.

Fig. 8. AES162/SEM94; x 50.

Fig. 9. AES162/SEM96; x 60.

Fig. 5. *Apatognathus* sp. Sa element, front (inner) lateral view, AES460/SEM26; x 55.

Figs. 7, 15. *Polygnathus* ex gr. *webbi* STAUFFER, 1938.

Fig. 7. A sinistral specimen, AEJ460/SEM15; x 80.

Fig. 15. A dextral specimen, AEJ460/SEM16; x 100.

Figs. 10–14, 16. *Ozarkodina* sp.

Fig. 10. Right (outer) lateral view of a Pa element, AEJ460/SEM23; x 50.

Fig. 11. Pa element, AEJ460/SEM106; x 90.

Figs. 12, 13, 16. Pb elements of three specimens, lateral views.

Fig. 12. Right (outer) lateral view, AEJ460/SEM105; x 100.

Fig. 13. Left (inner) view, AEJ460/SEM86; x 120.

Fig. 16. Left (inner) view, AEJ460/SEM25; x 65.

Fig. 14. M element, front (inner) lateral view, AEJ460/SEM24; x 14.

MICROVERTEBRATE REMAINS (PLATES 26–27)

The identifications and brief description are mainly from TURNER (person. commun., 9, 16, 1993 and 10, 14, 1993 respectively) based on microphotographs, and complemented with limited observation of the actual specimens. Specimens under the heading AEJ, AES, AEM and HBK are collected from Bulonggur section (Section A), an unmeasured section (Section A'). Within the same synclinal as Section A but on the other limb, Eregennaren section (Section B) and Hebukehe section (Section C) respectively. The number preceeding by SEM indicates electronic scanning microphotos.

PLATE 26

Microvertebrate remains are from Late rhenana Zone, unless stated otherwise.

Figs. 1, 3, 4. cf. *Protacrodus vetustus* JAEKEL (GROSS, 1938).

An unusual protacrodont broken tooth, with five cusps, the fith one (count from left to right of labial view) was undoubtedly broken off (on the basis of observation from actual specimen); the central cusp slightly larger with few coarse ribs coalescing before distal point in "*australiensis*" manner; the lateral cusps are higher than those of the type, but TURNER considers this might be due to variation; labial base narrow with 9 openings at least. AEJ484/SEM8; x 40.

Fig. 1. Labial view.

Fig. 3. Lingual view.

Fig. 4. Basal view.

Figs. 2, 5, 9. ? dipnoan vomerine tooth. Apparently a bony base but no clear enamel layer; this needs to be sectioned and studied in more detail. Alternatively it is not vertebrate but perhaps crustacean, e.g., phyllocarid-like teeth. AEM253/SEM63; x 80.

Fig. 2. Labial view.

Fig. 5. Oblique basal view.

Fig. 9. Lingual view.

Figs. 6, 7. ? placoderm bone. This might be a broken microplate of a placoderm. AEJ484/SEM9, x 90.

Fig. 6. Lateral view.

Fig. 7. Oblique basal view.

Figs. 8, 14, 16. *Phoebodus limpidus* GINTER, 1990. The figured specimen consists of three main and two smaller, intermediate cusps corresponding to GINTERs (1990:73) diagnosis of*Phoebodus limpidus.* Although main median cusp and two smaller, intermediate cusps are broken, they are undoubtedly present on the basis of observation from the lingual and occlusal view. These cusp (at least, the two at the lateral part of the crown) are covered with pronounced fine striale, and the median central cusp is larger than the two lateral cusps, but its length is undistinct. The base is banana-shaped being elongated laterally and there is one nutritive foramina in lingual view. HBK2/SEM41; x 95. Early *expansa* Zone of Hebukehe Formation.

Fig. 8. Labial view.

Fig. 14. Lingual view.

Fig. 16. Basal view.

Figs. 10, 11, 13. A very fine shark (symmoriid ? or placoderm ?) scale. Multidenticulate crown bears seven denticles and coarse, slightly wavy ribbing on a wider bony base; basal surface D-shaped, flat with cavities concentrated in the distal half; notches on basal rim. AEM253/SEM62.

Fig. 10. Lateral view; x 95.

Fig. 11. Another somewhat oblique lateral view; x 100.

Fig. 13. Basal view; x 95.

Figs. 12, 15, 17. A dipnoan ? vomerine tooth ? Apparently a bony base but no clear enamel layer. HBK2/SEM42; x 100. Early *expansa* Zone of Hebukehe Formation.

Fig. 12. Oblique basal view.

Fig. 15. Lingual view.

Fig. 17. Labial view.

PLATE 27

Microvertebrate remains are from Middle *crepida* Zone.

Figs. 1–3. *Protacrodus vetustus* JAEKEL (GROSS, 1938).

A protacrodont tooth, with slightly asymmetrical seven cusps, median central main cusp larger, skewed to lateral; all lateral cusps almost equal, the left three on each side – one cusp broken off as seen from occlusal and labial view, other side cusps coarsely ribbed, base elongate ovoid with slight stet to labial; at least 12 lingual rim openings; basal surface only slightly concave with large basal foramina concentrated in a central hollow. AEJ460/SEM35; x 60.

Fig. 1. Lingual view.

Fig. 2. Labial view.

Fig. 3. Basal view.

Figs. 4, 7, 8, 10, 12, 14. Teeth of new species of protacrodont teeth. Distinctive scalloped sculpture on round cusps, but too badlyabraded to be certain. However, TURNER (pers. comm.) considers that the peculiar ornament on labial side is like that of some protacrodont teeth from the Upper Frasnian of the Kuznetsk Basin – because of the distinctive ornament this should be prove to be useful species biostratigraphically.

Figs. 4, 7, 14. Figured specimen, AES162/SEM51; x 56.

Fig. 4. Lingual view.

Fig. 7. Labial view.

Fig. 14. Basal view.

Figs. 8, 10, 12. Figured specimen, AES162/SEM97.

Fig. 8. Lateral view; x 50.

Fig. 10. Another lateral view; x 55.

Fig. 12. Basal view; x 55.

Figs. 5, 6, 9. Teeth of new species of a cladont teeth probably. One prominent median cusp and two lateral cusp. Median cusp with 0.13 mm in width (at bottom), lateral cusps with 0.11 mm in width (along the crown); coarse ornament on labial and lingual sides of cusps; prominent labial protuberance; base broken but apparently of horseshoe shape; large basal cavity. AES162/SEM58.

Fig. 5. Lingual view; x 100.

Fig. 6. Labial view; x 95.

Fig. 9. Basal view; x 95.

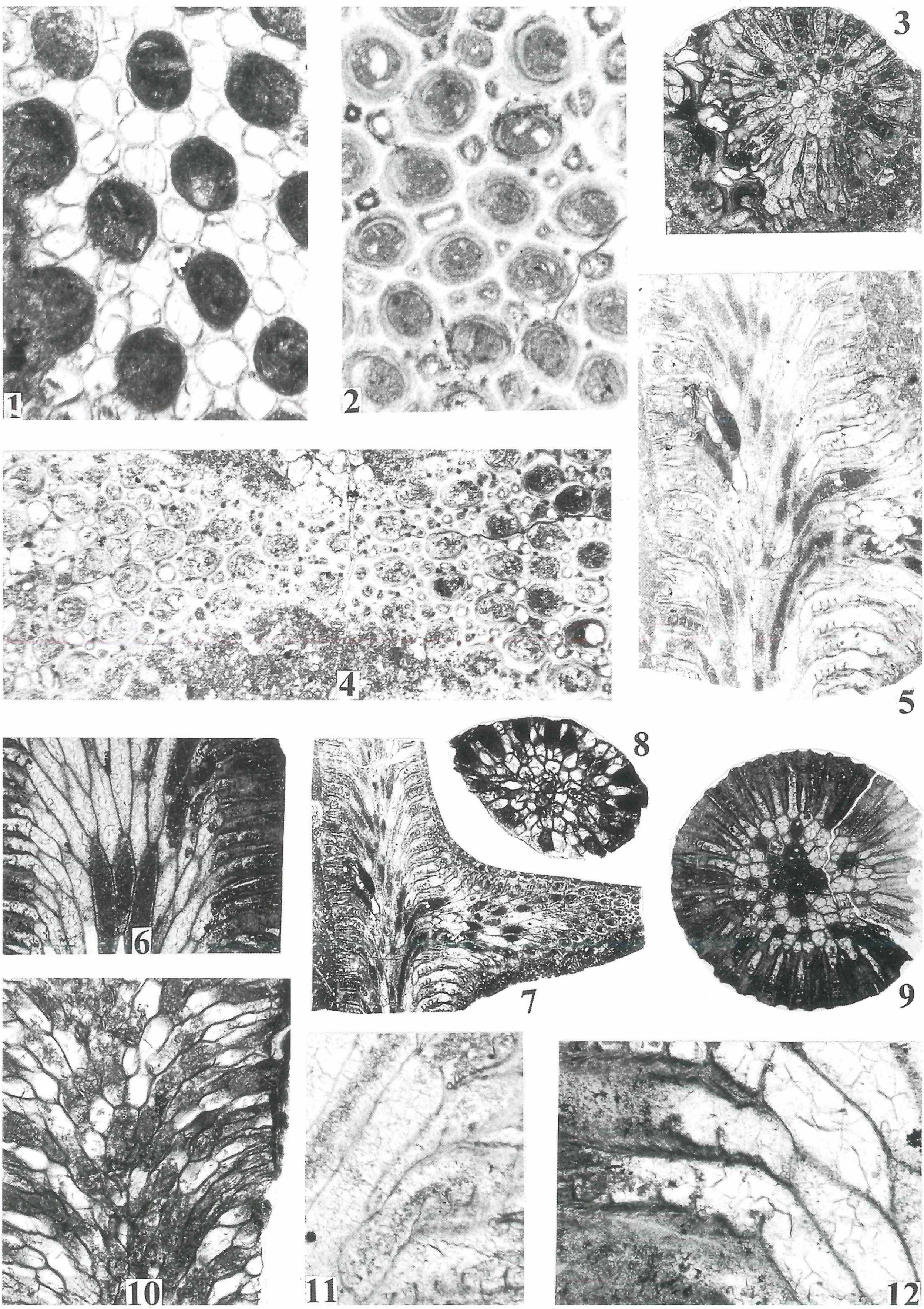
Figs. 11, 13, 15. Probably tricuspid cladodont tooth prabably. Broken cusps; median cusp the largest; cusps coarely sculptured with few striae labially and median cusp with sigmoidal ornament; narrow basal shelf; comparatively flat basal surface in D-shaped base; basal foramina concentrated in a shallow, narrow curved trough just lingual to the labial shelf. This tooth might be symmoriid but the lingual surface of the base is not well-preserved and no clear apical button is apparent. AES162/SEM52; x 50.

Fig. 11. Basal view.

Fig. 13. Lingual view.

Fig. 15. Labial view.

PLATE 1



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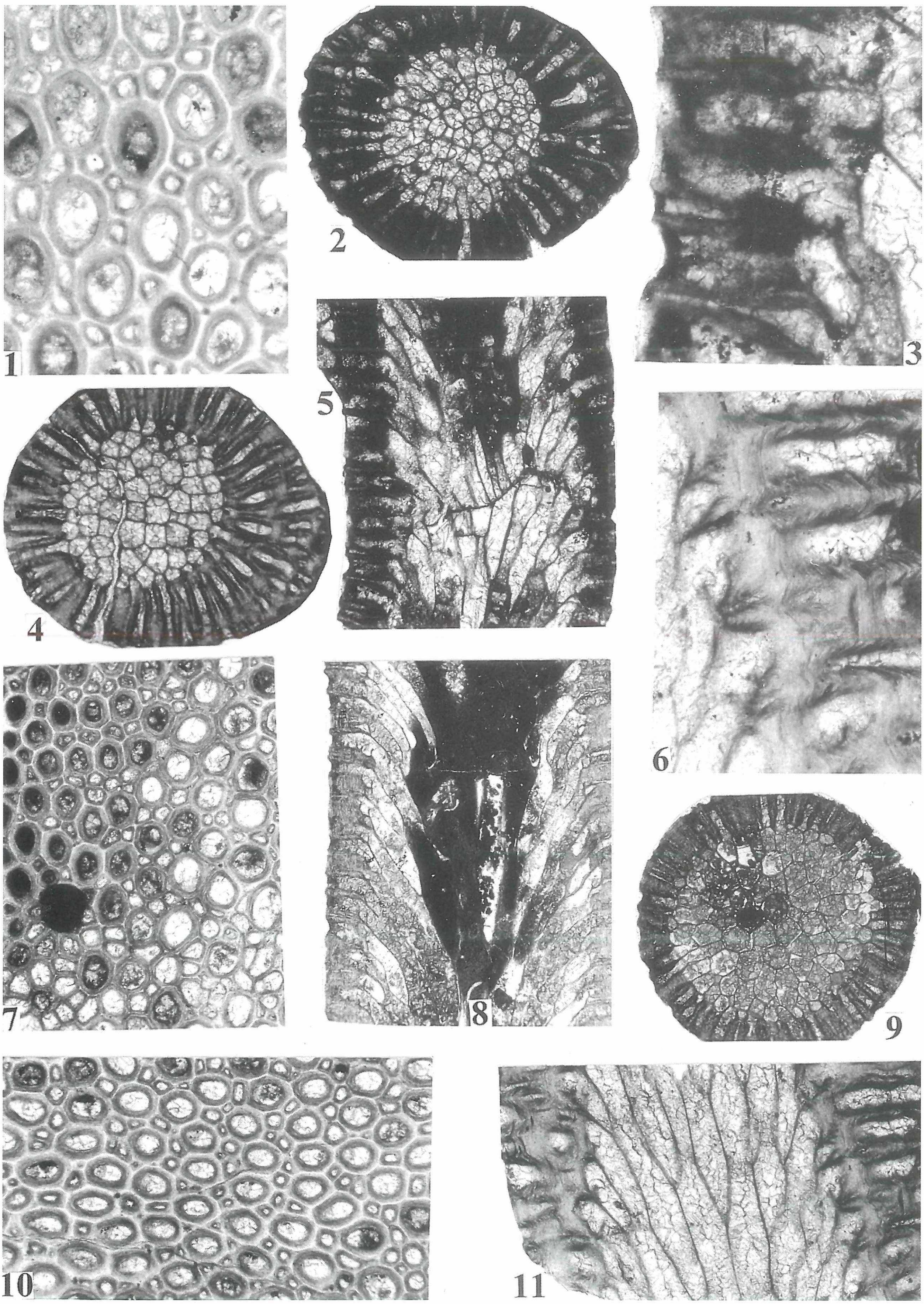

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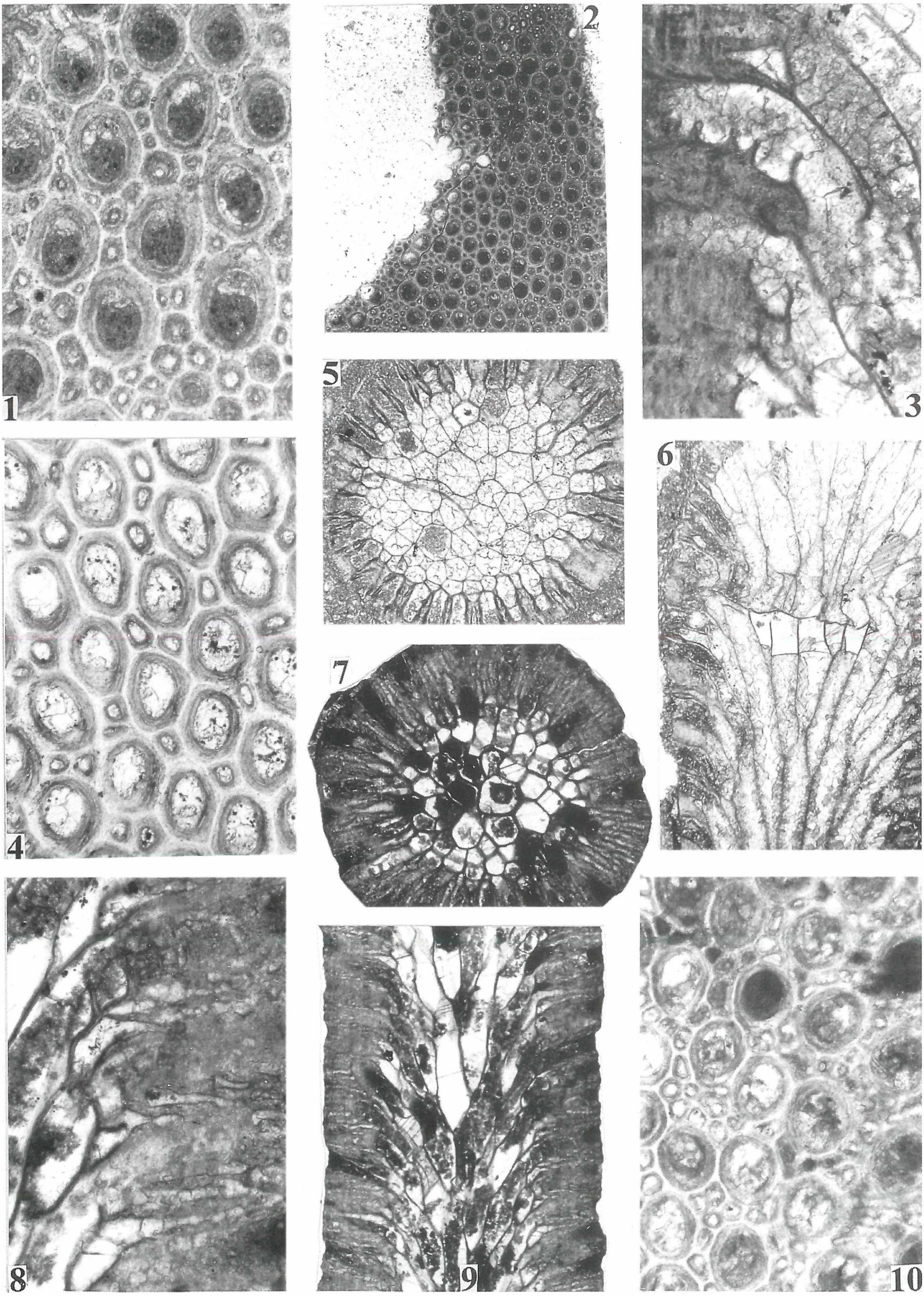

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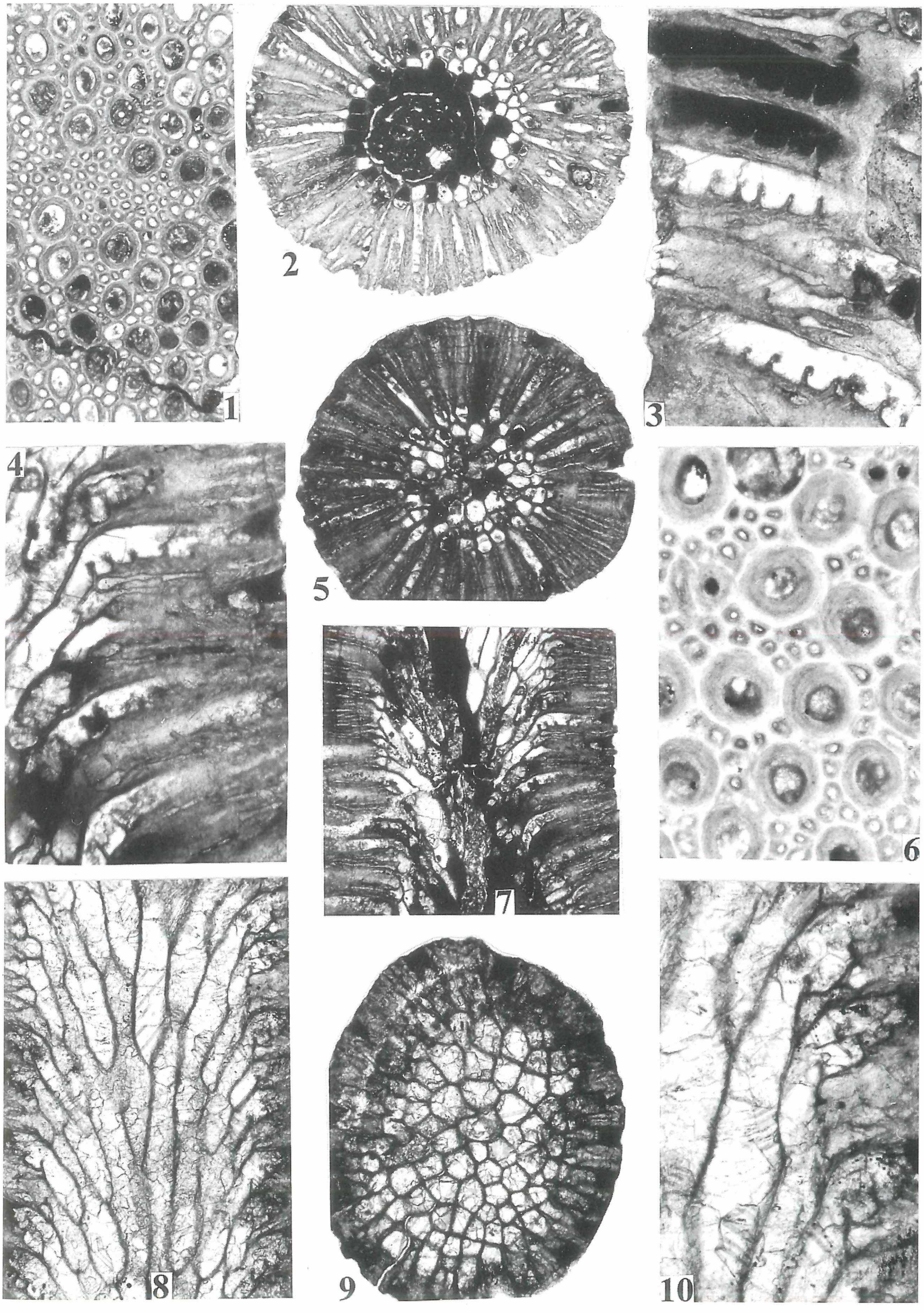

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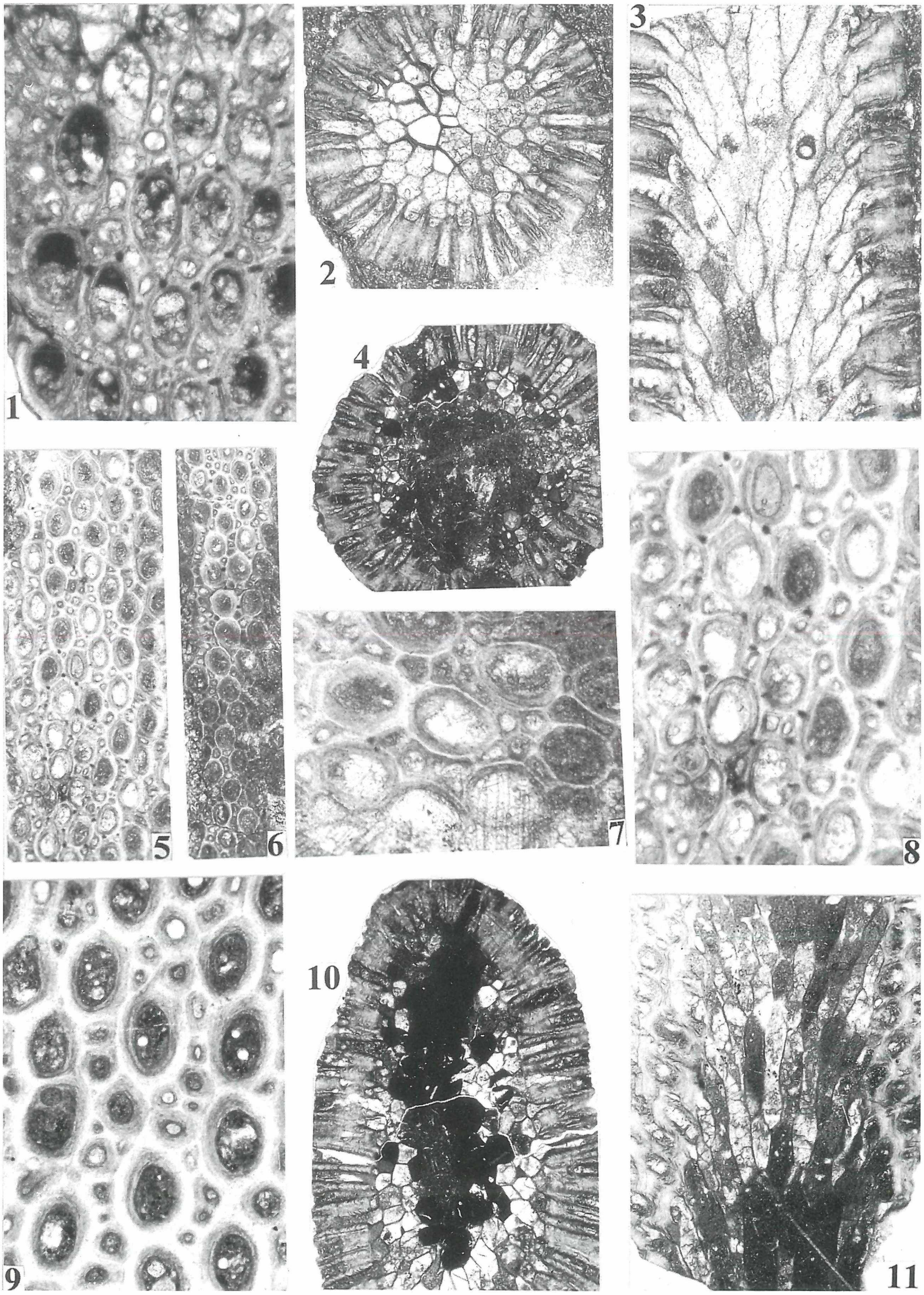

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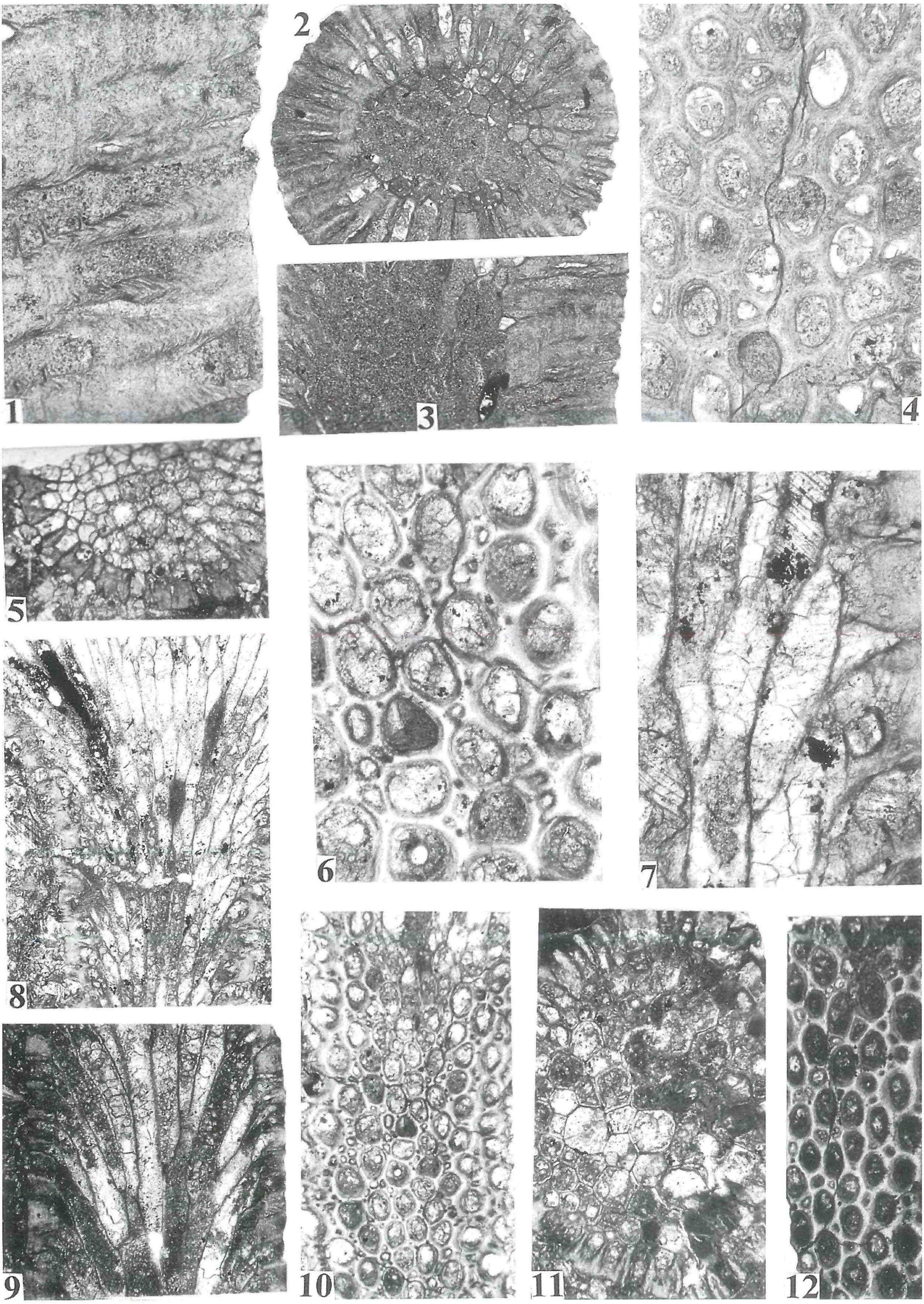

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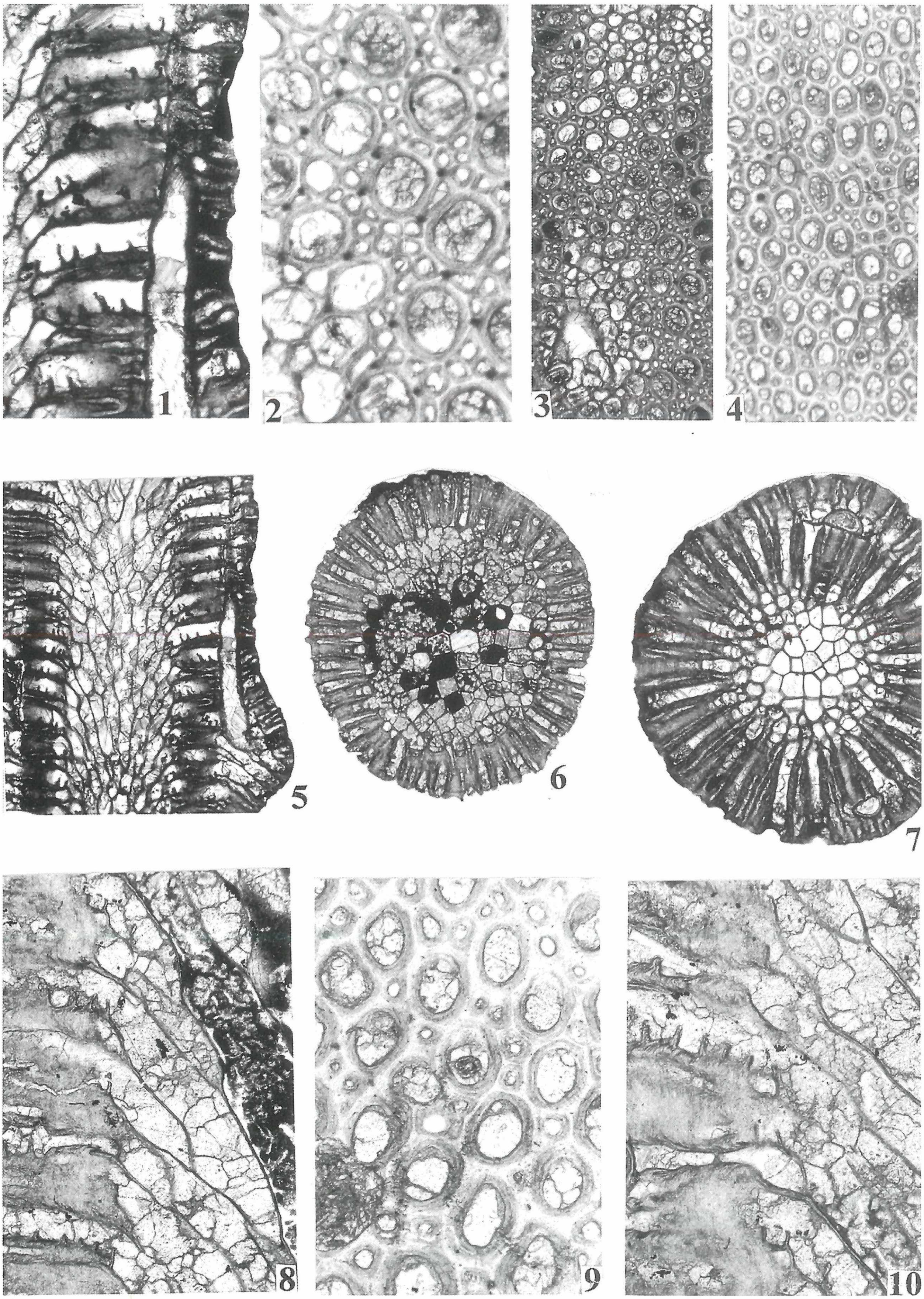

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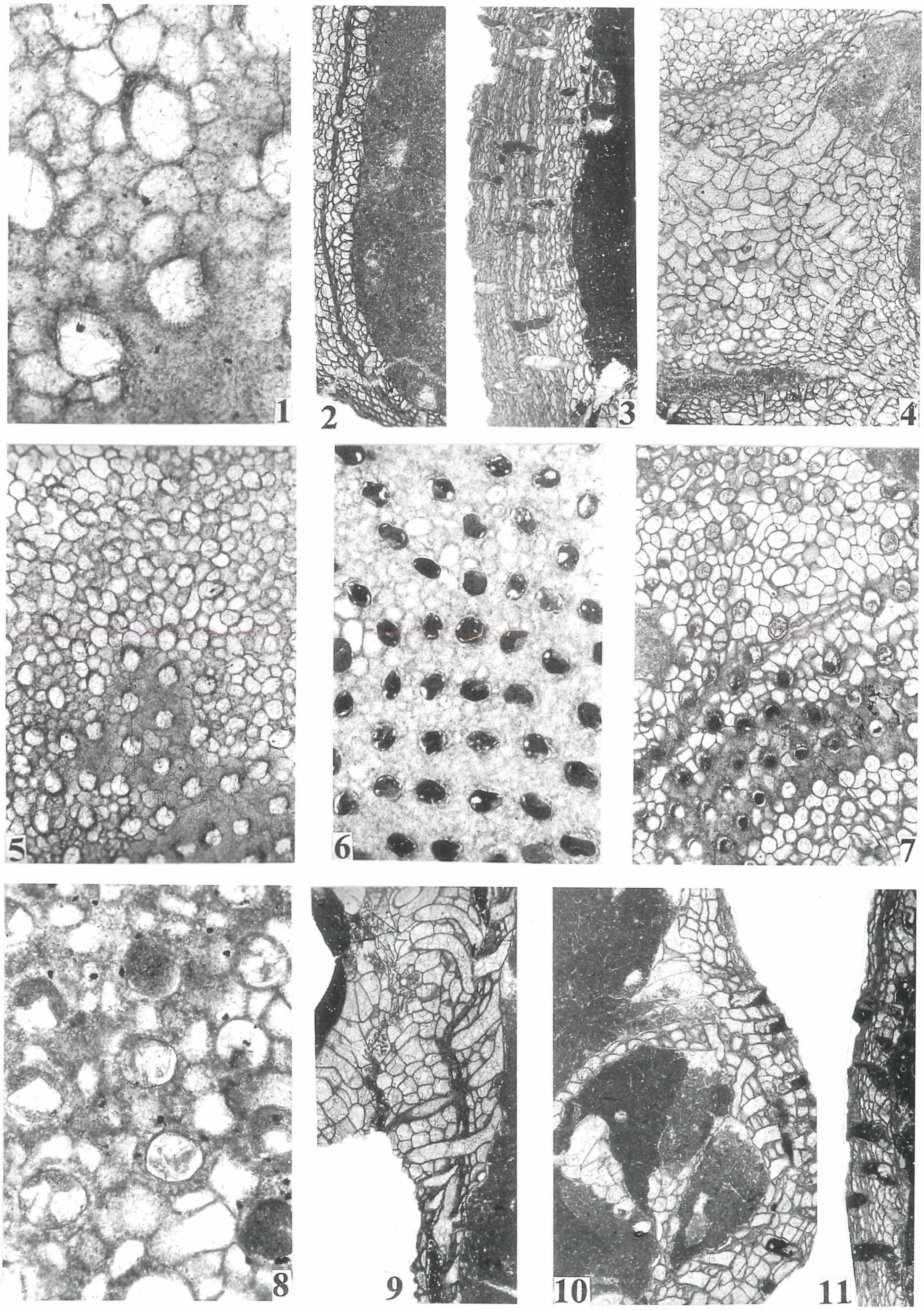

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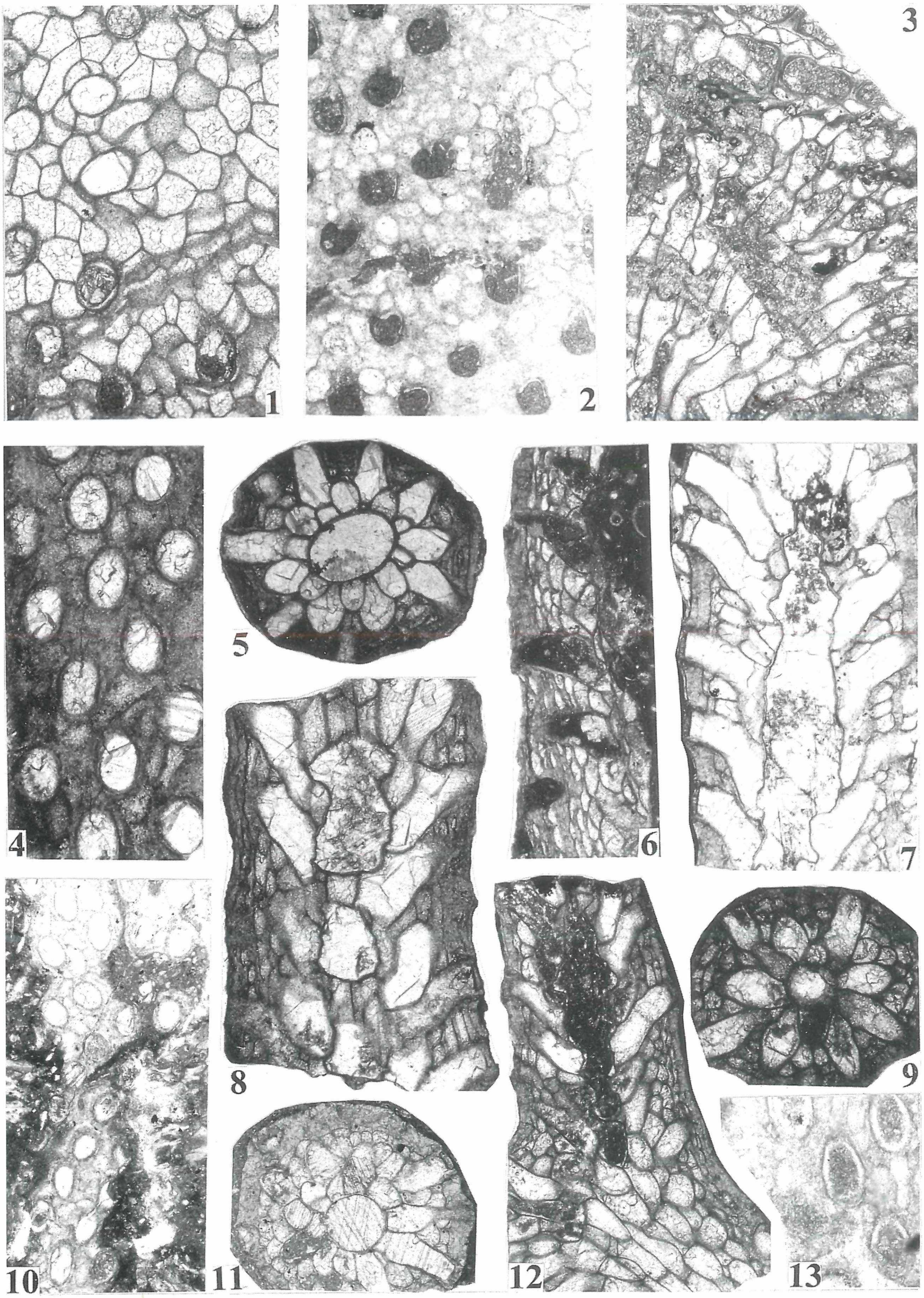

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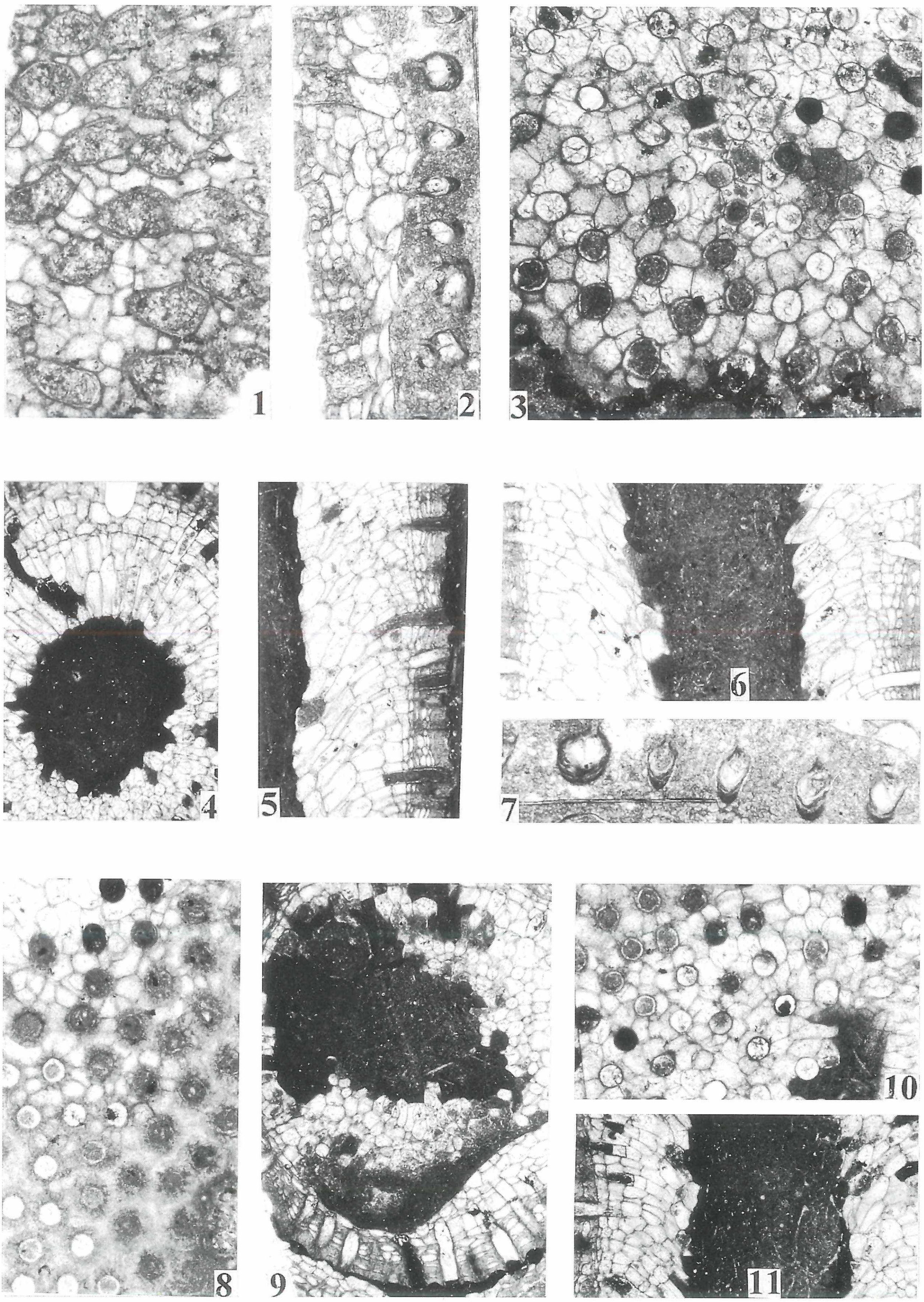

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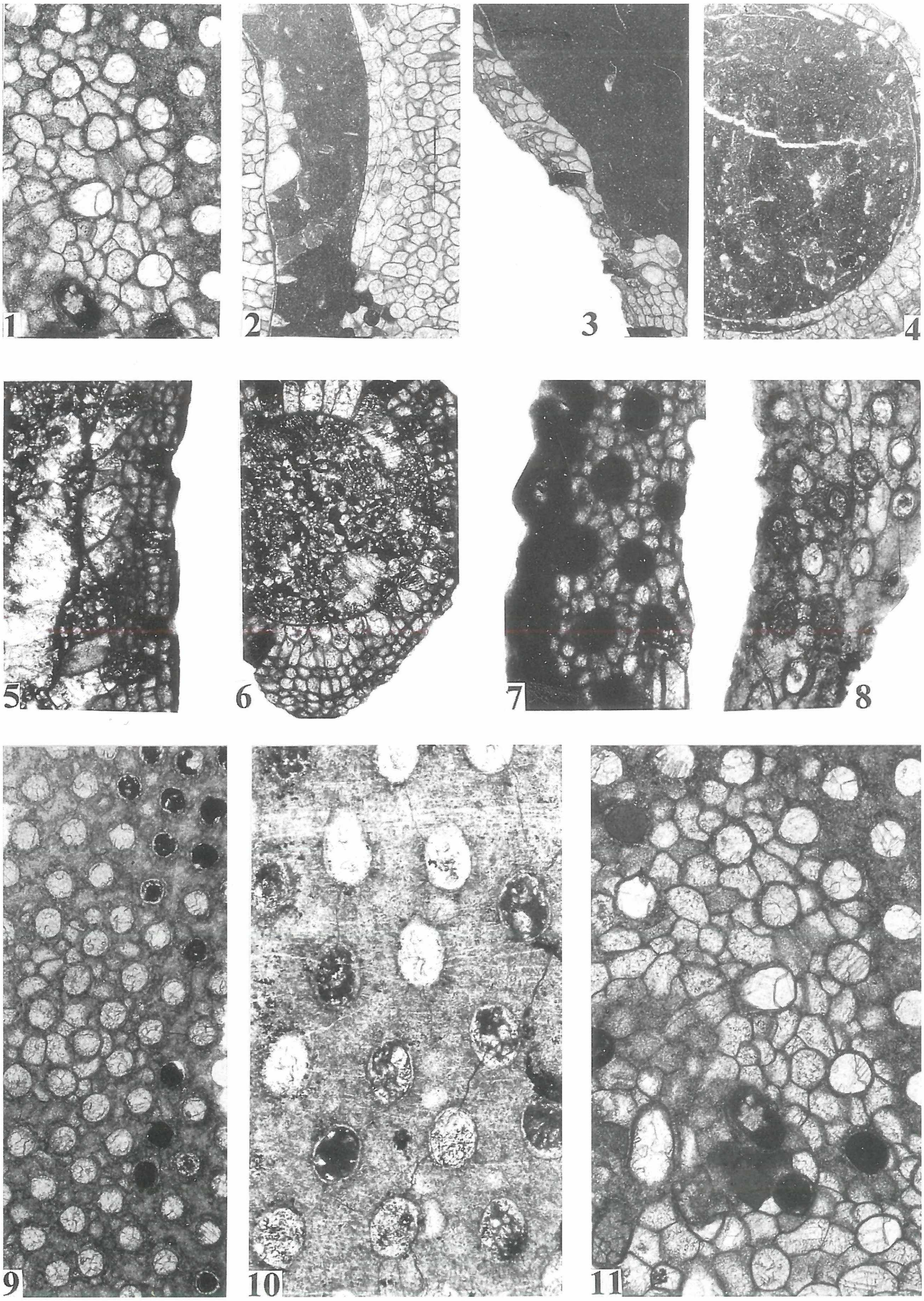

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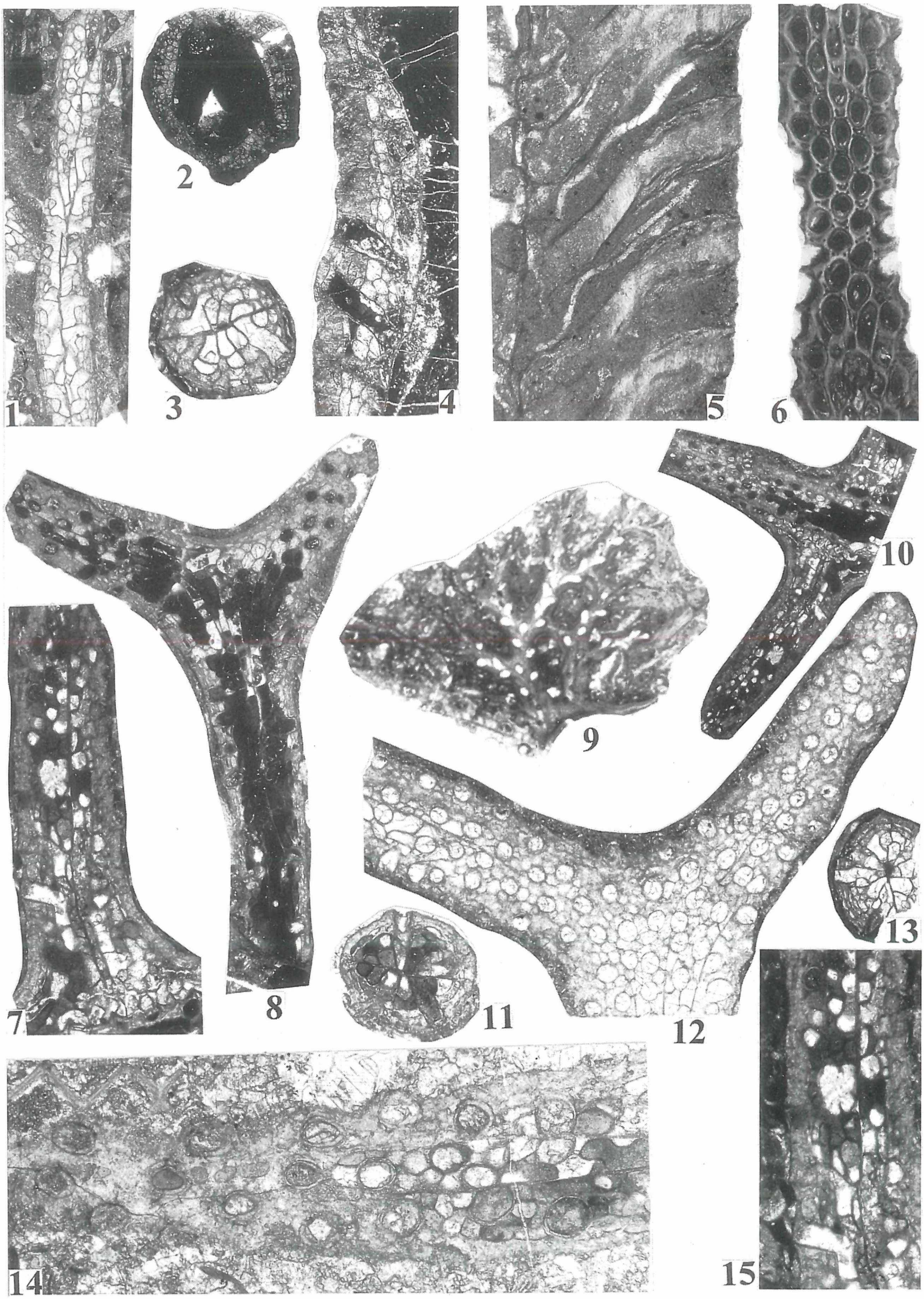

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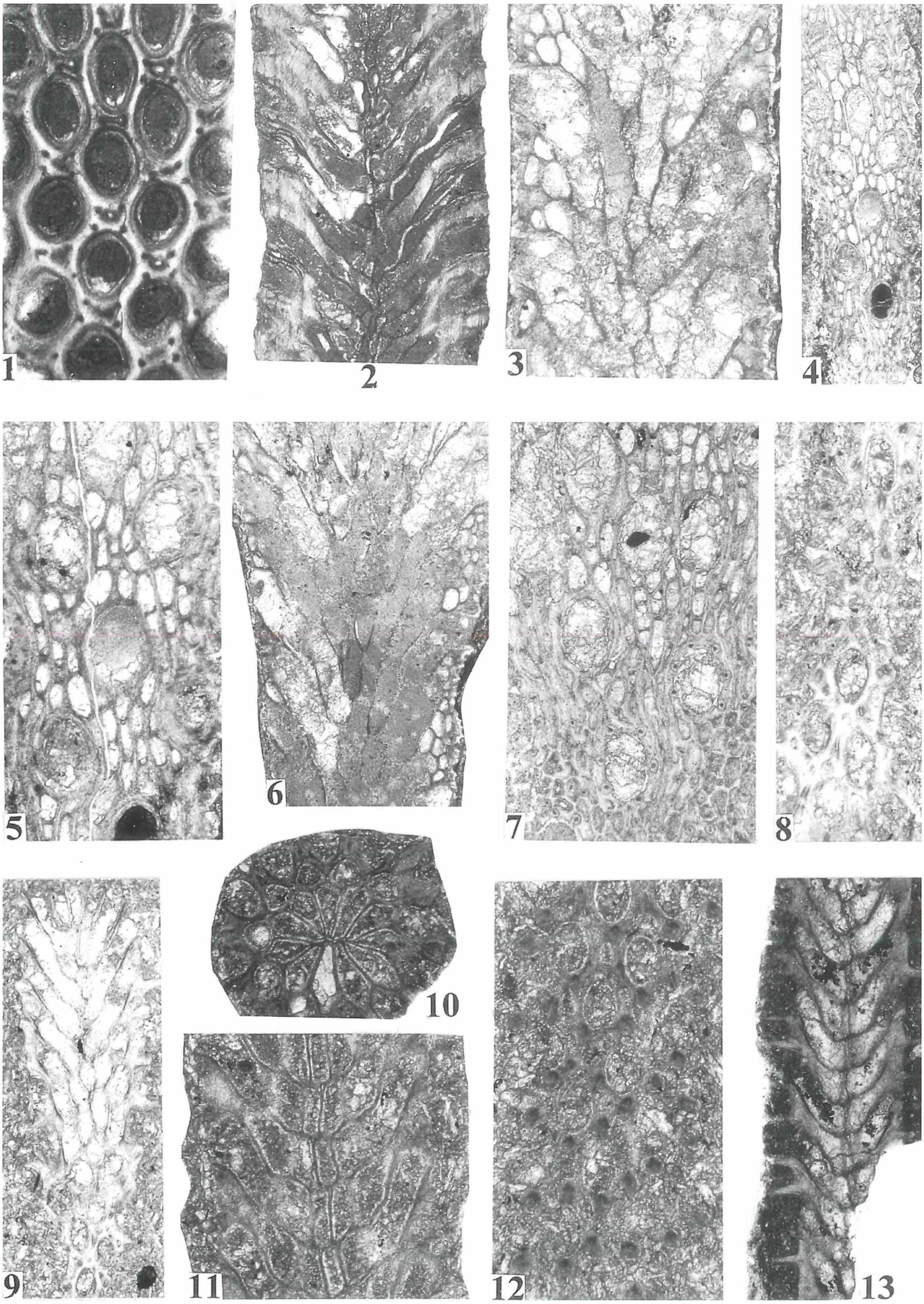

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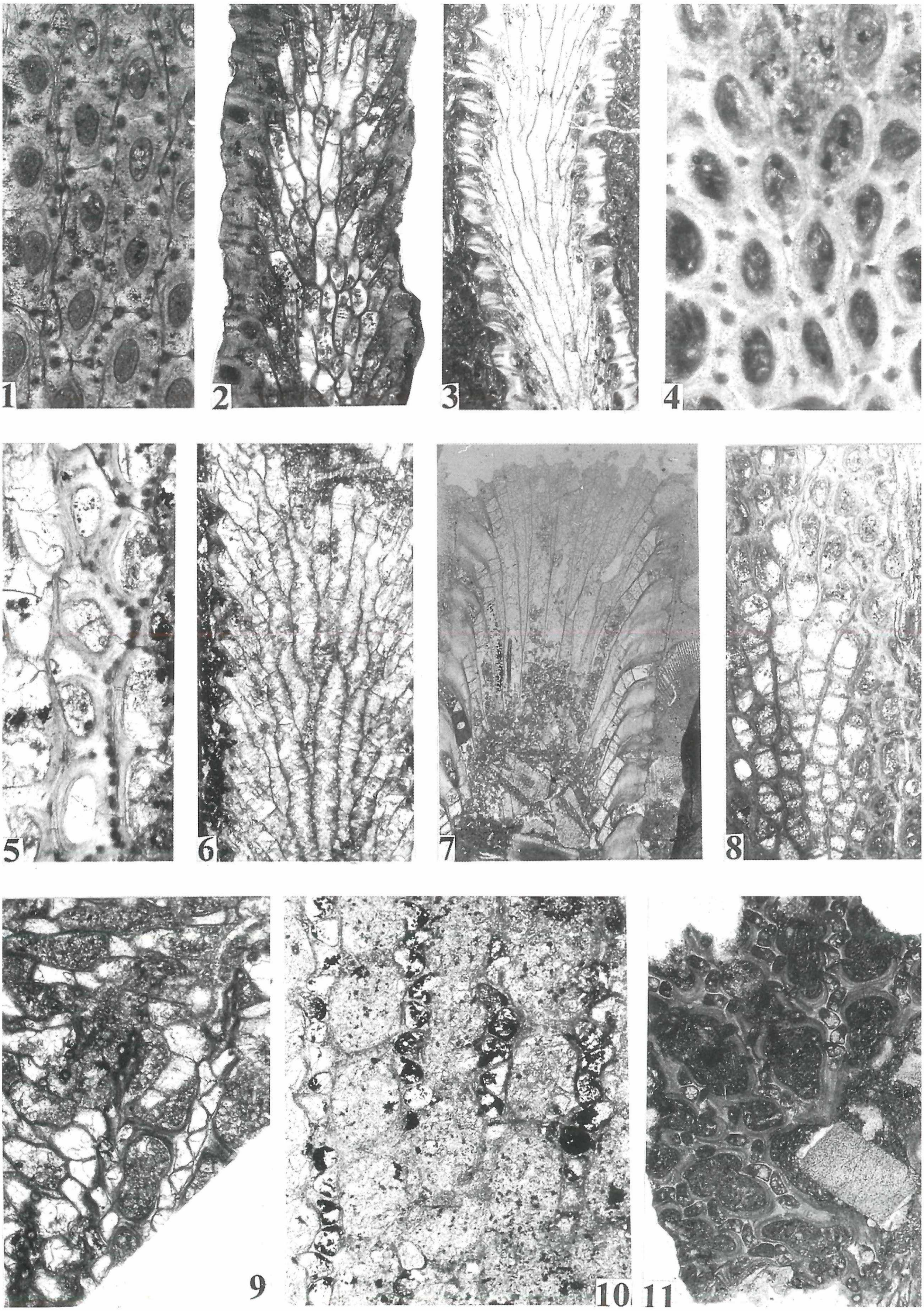

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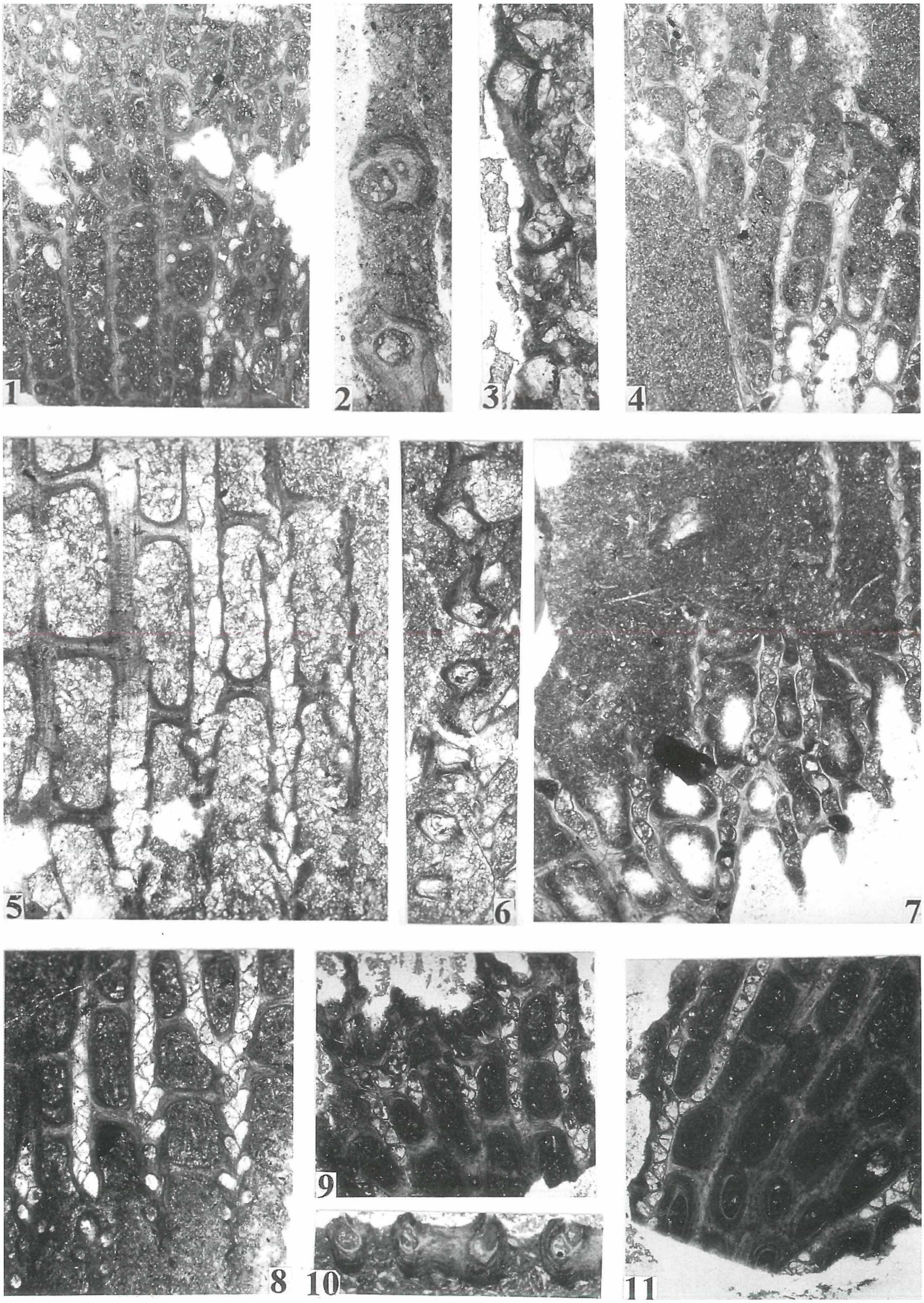

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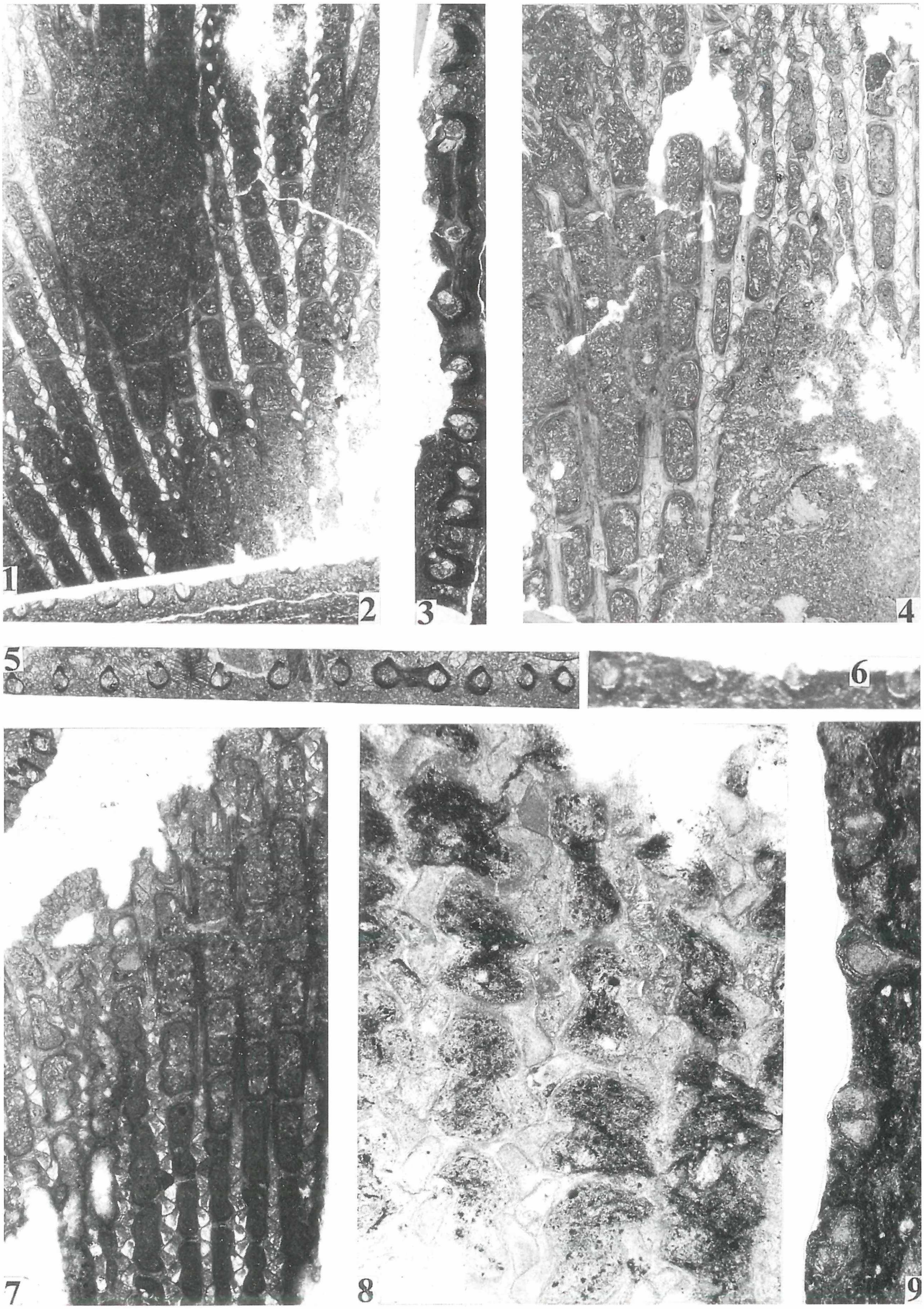

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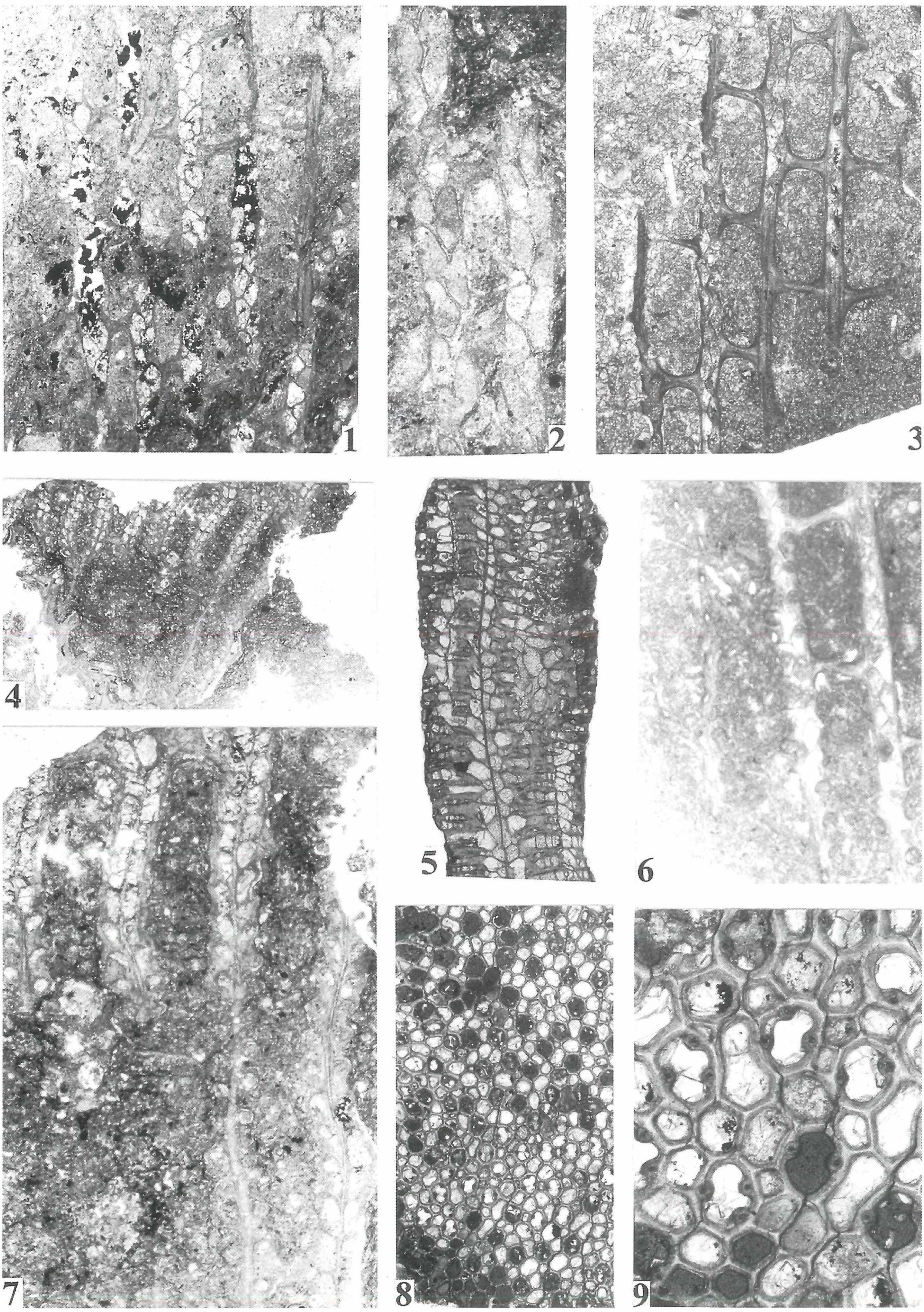

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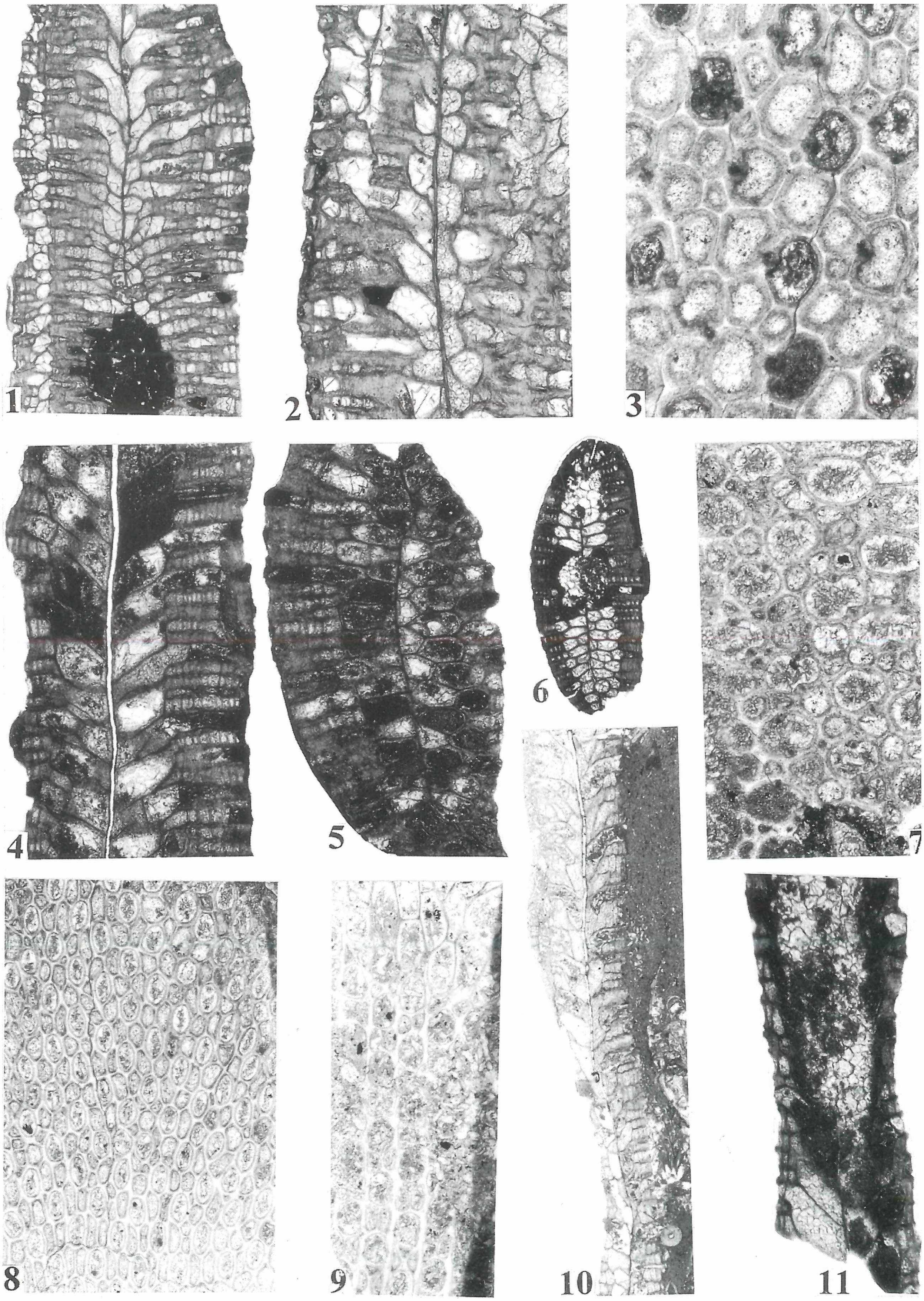

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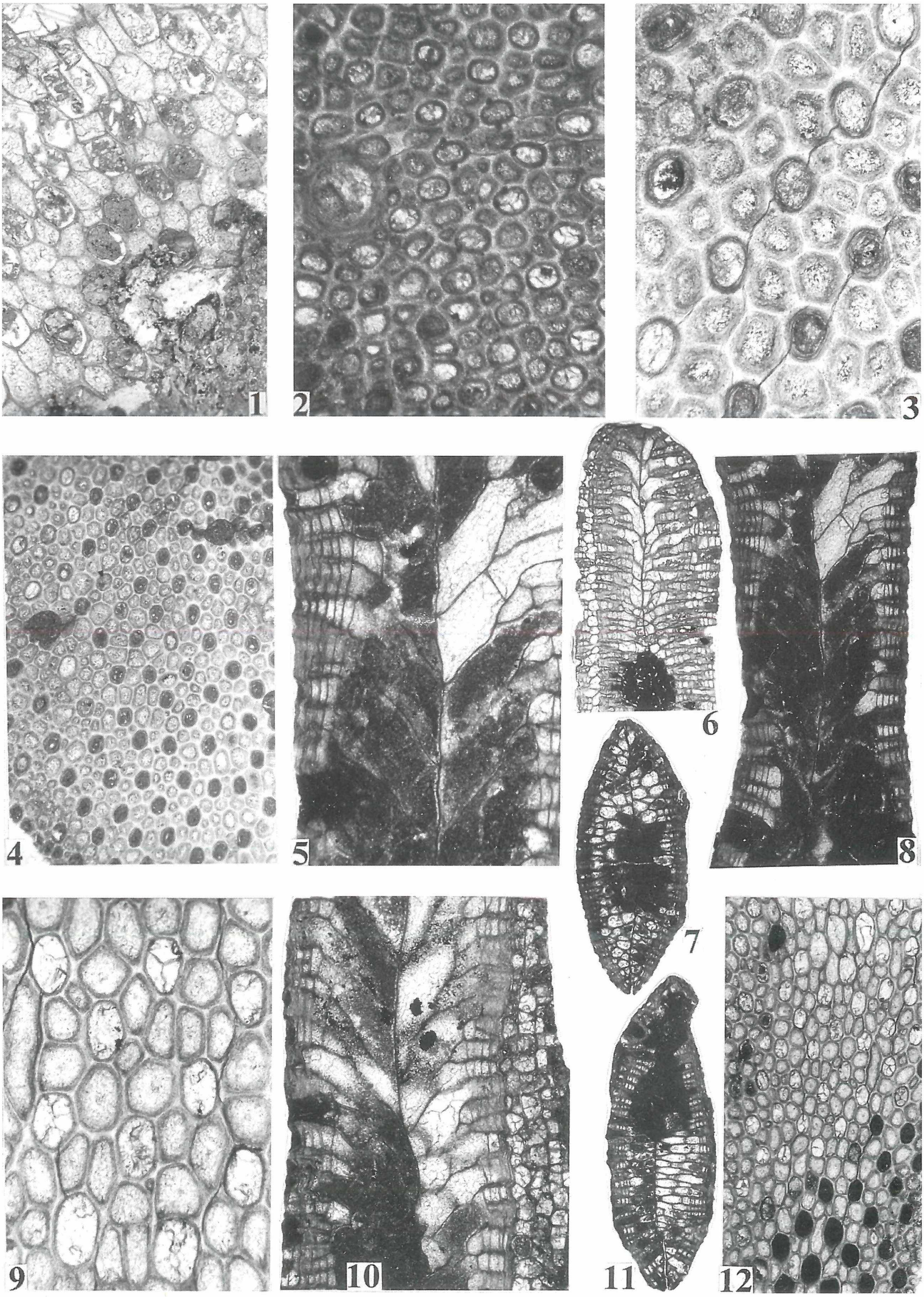

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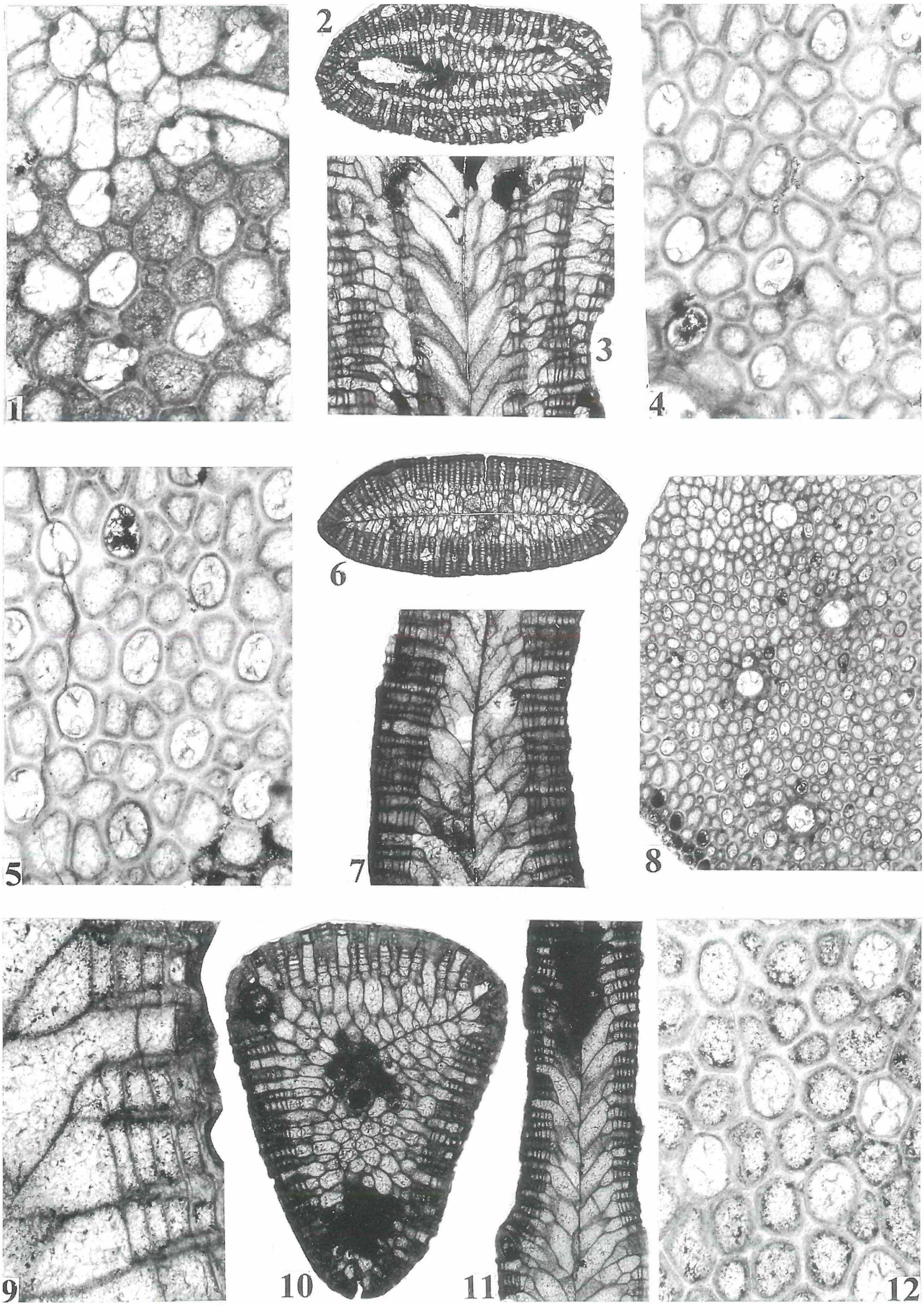

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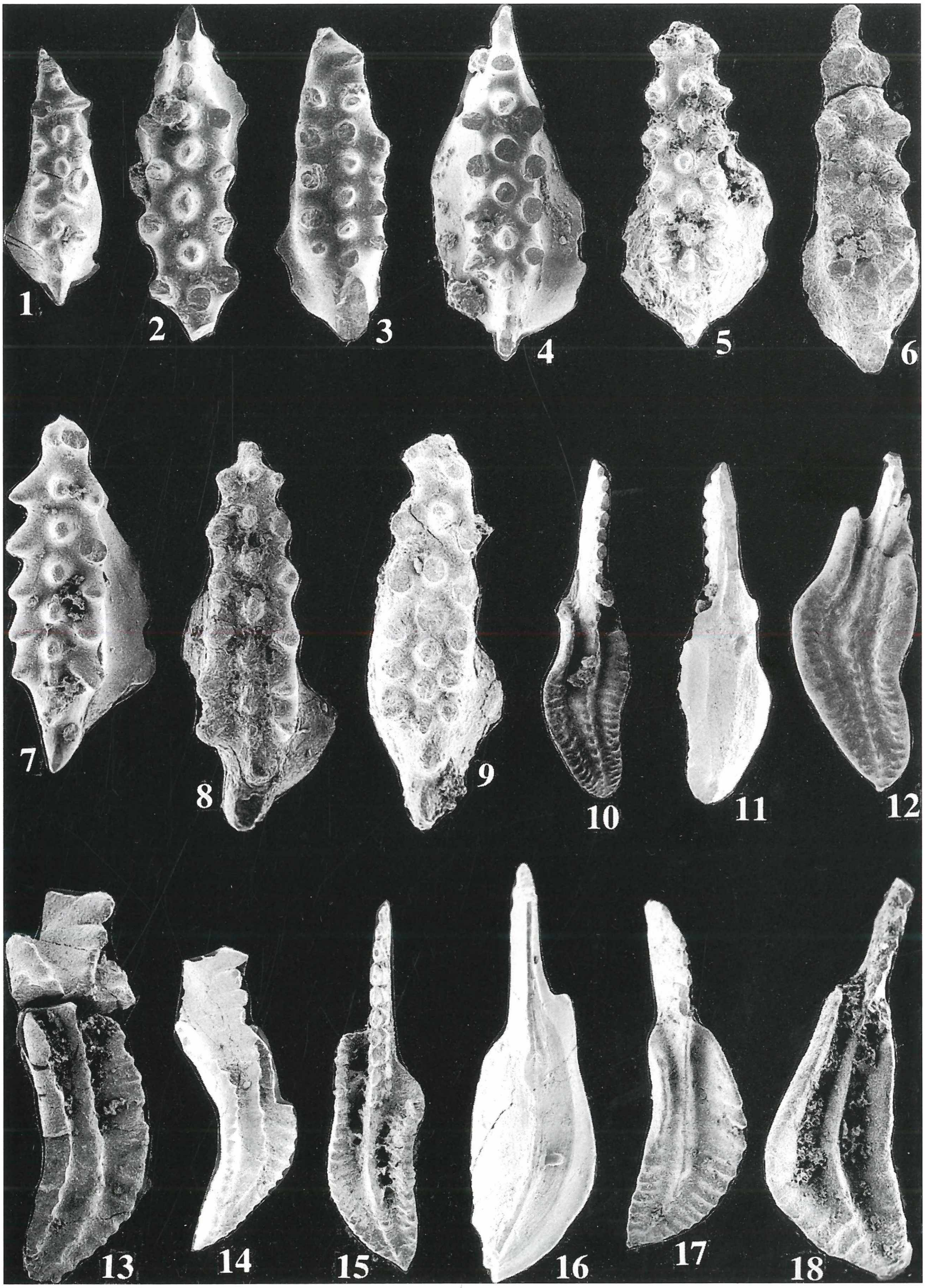

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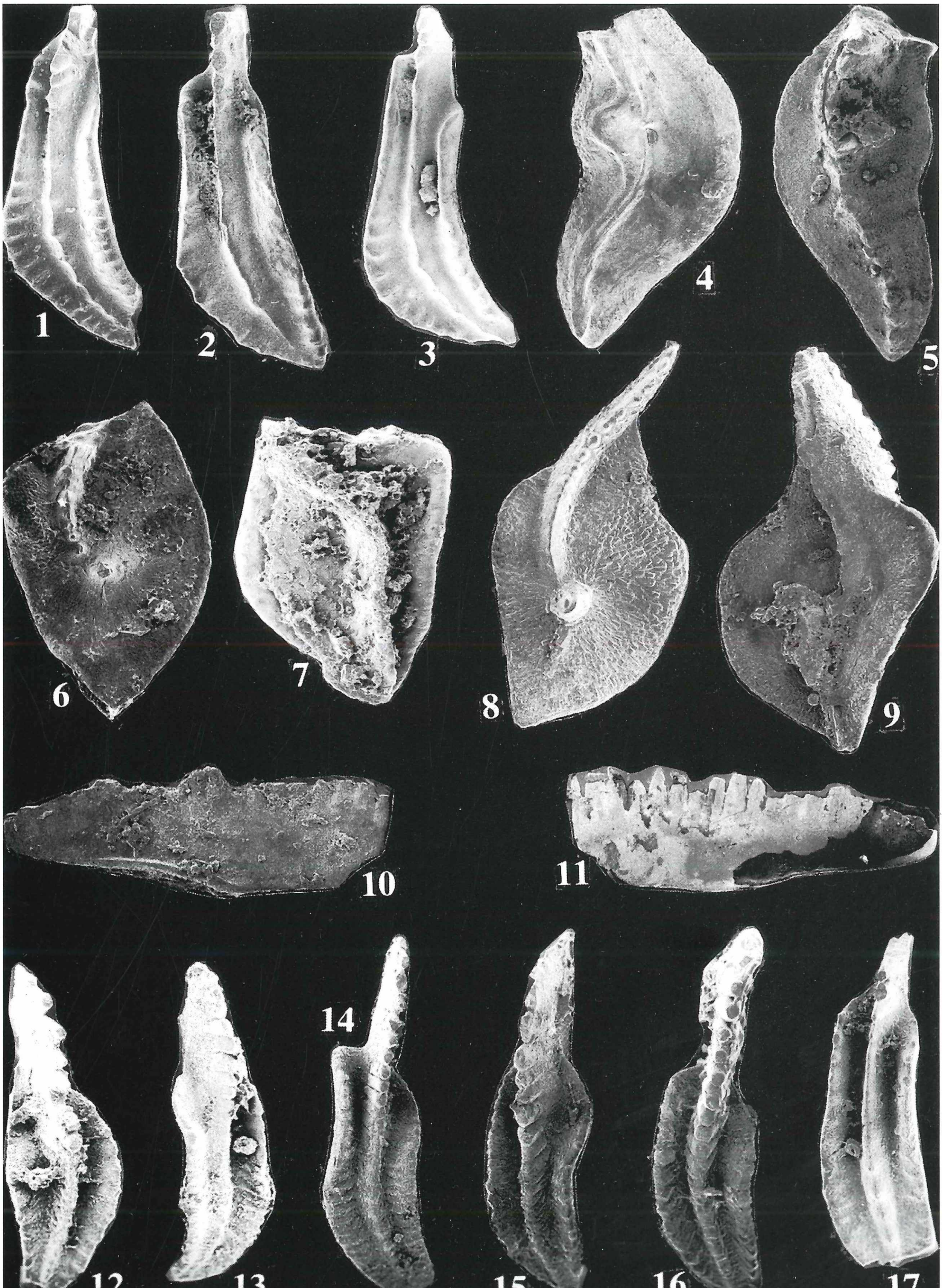

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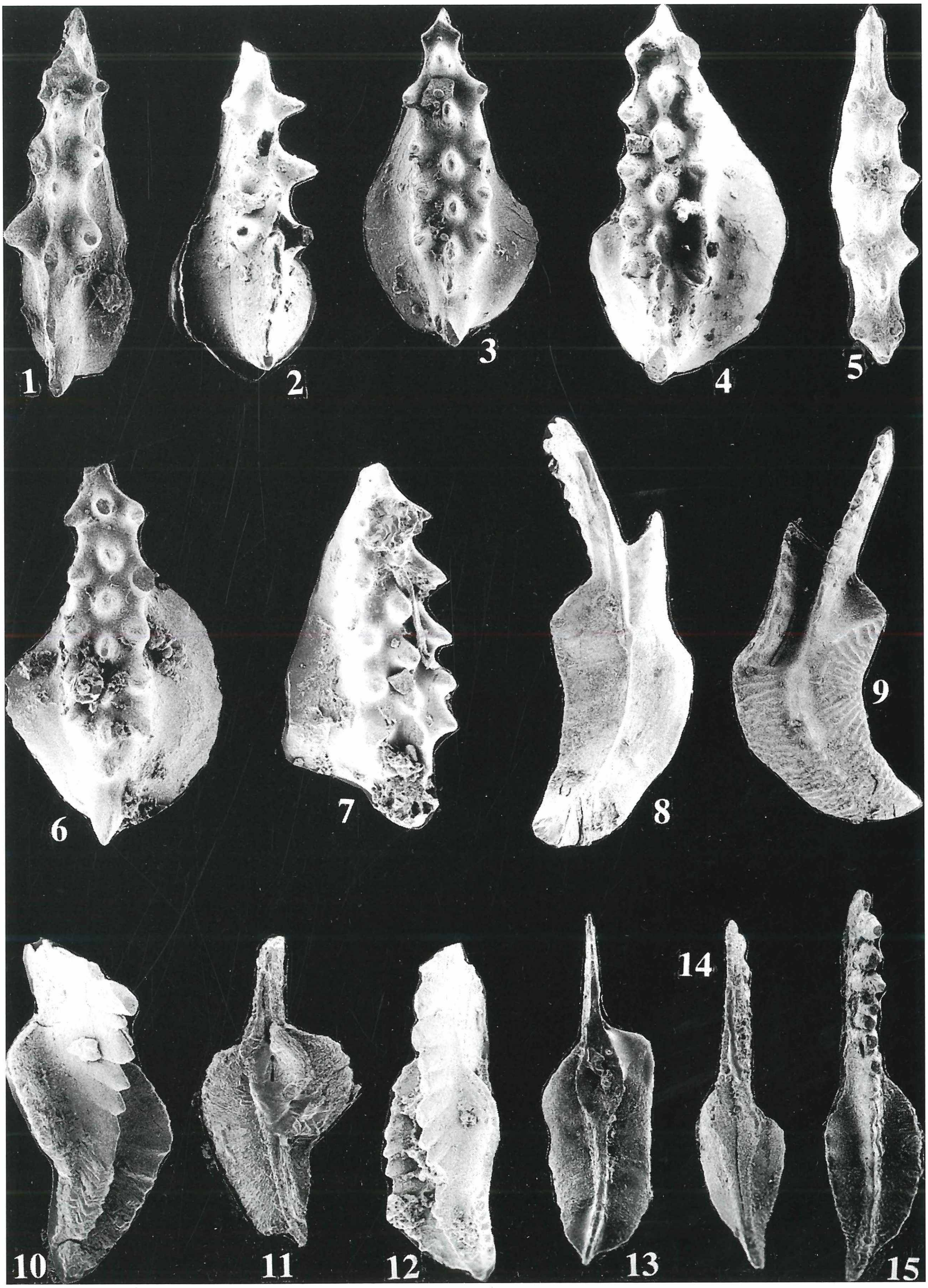

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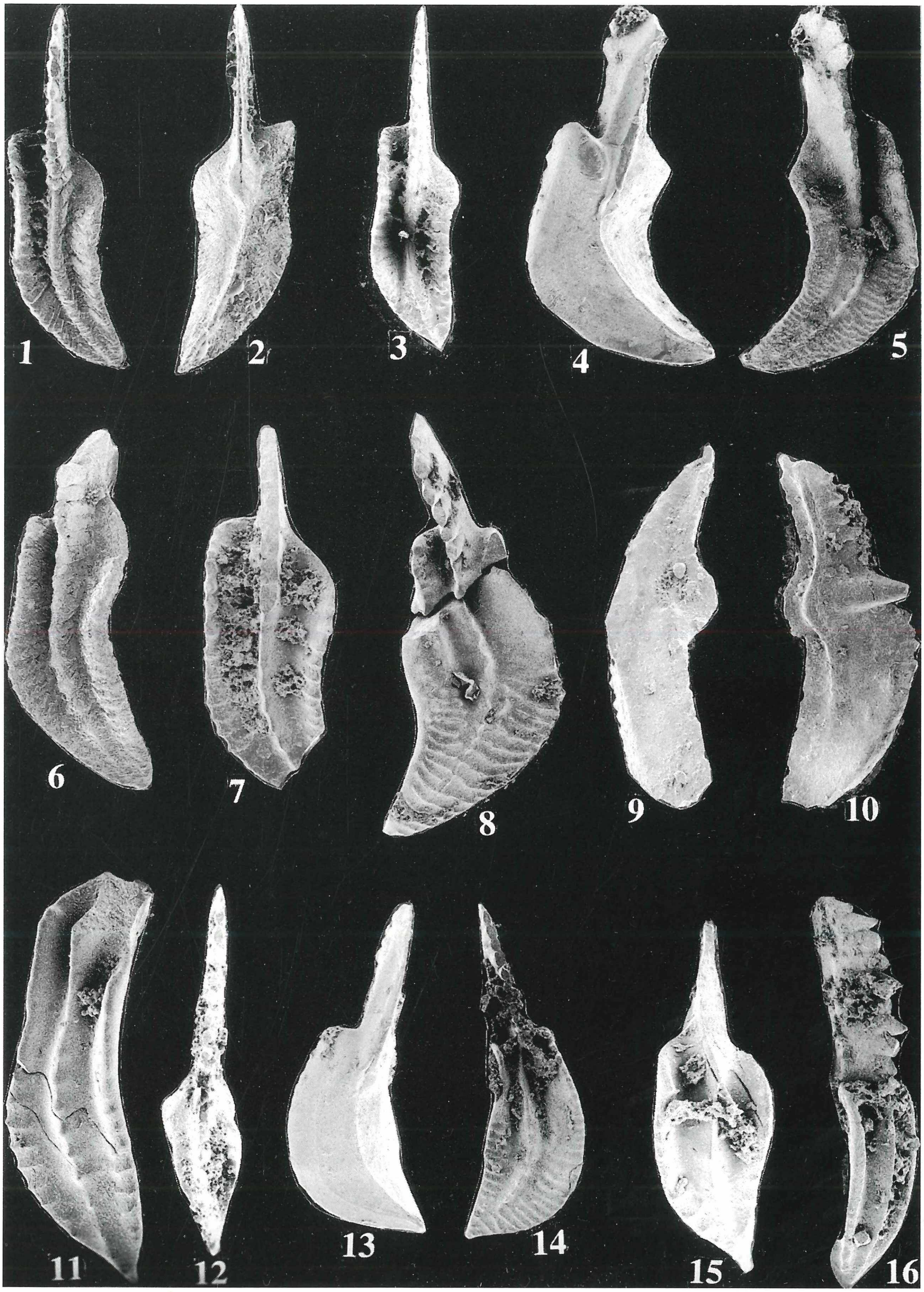

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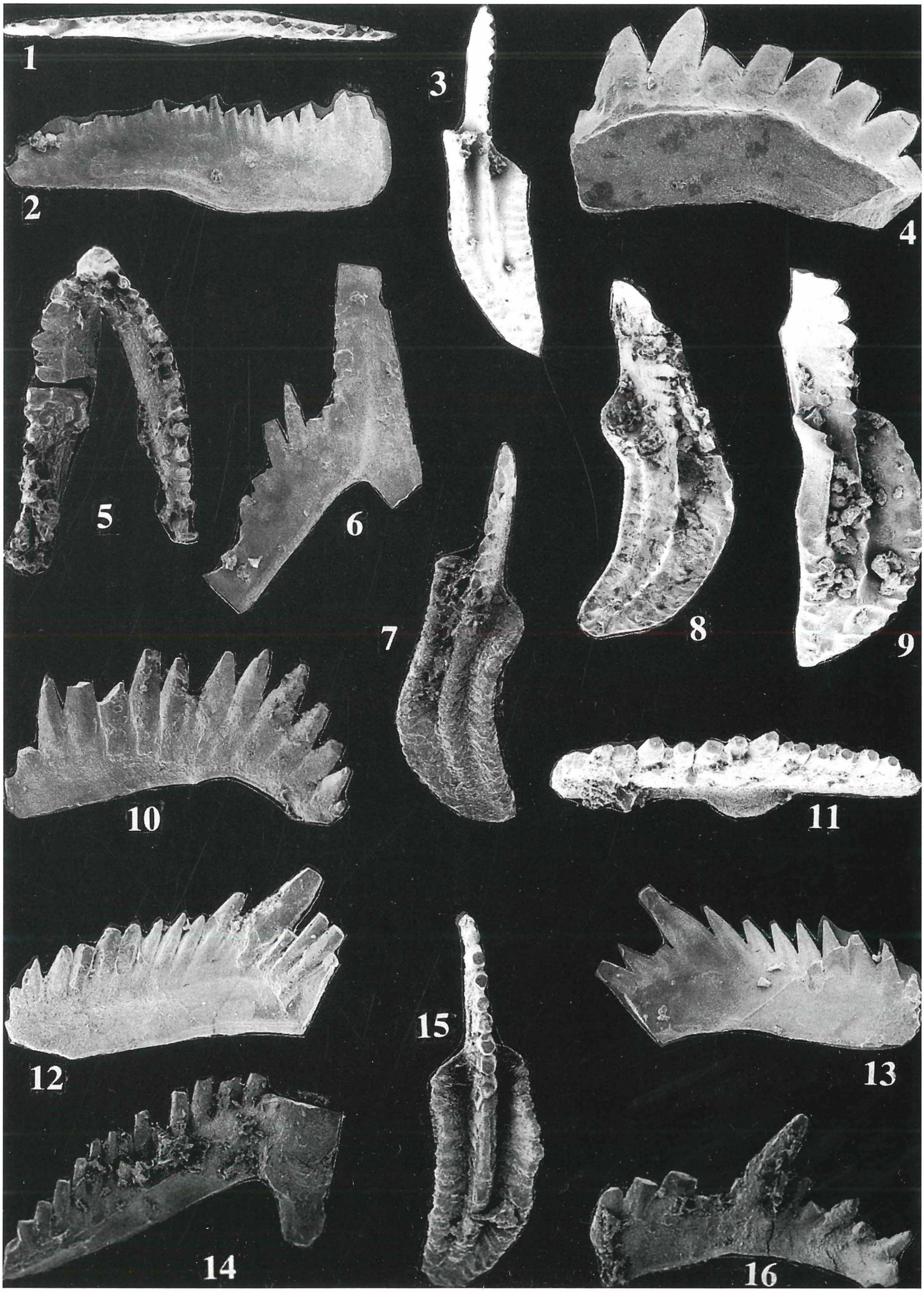

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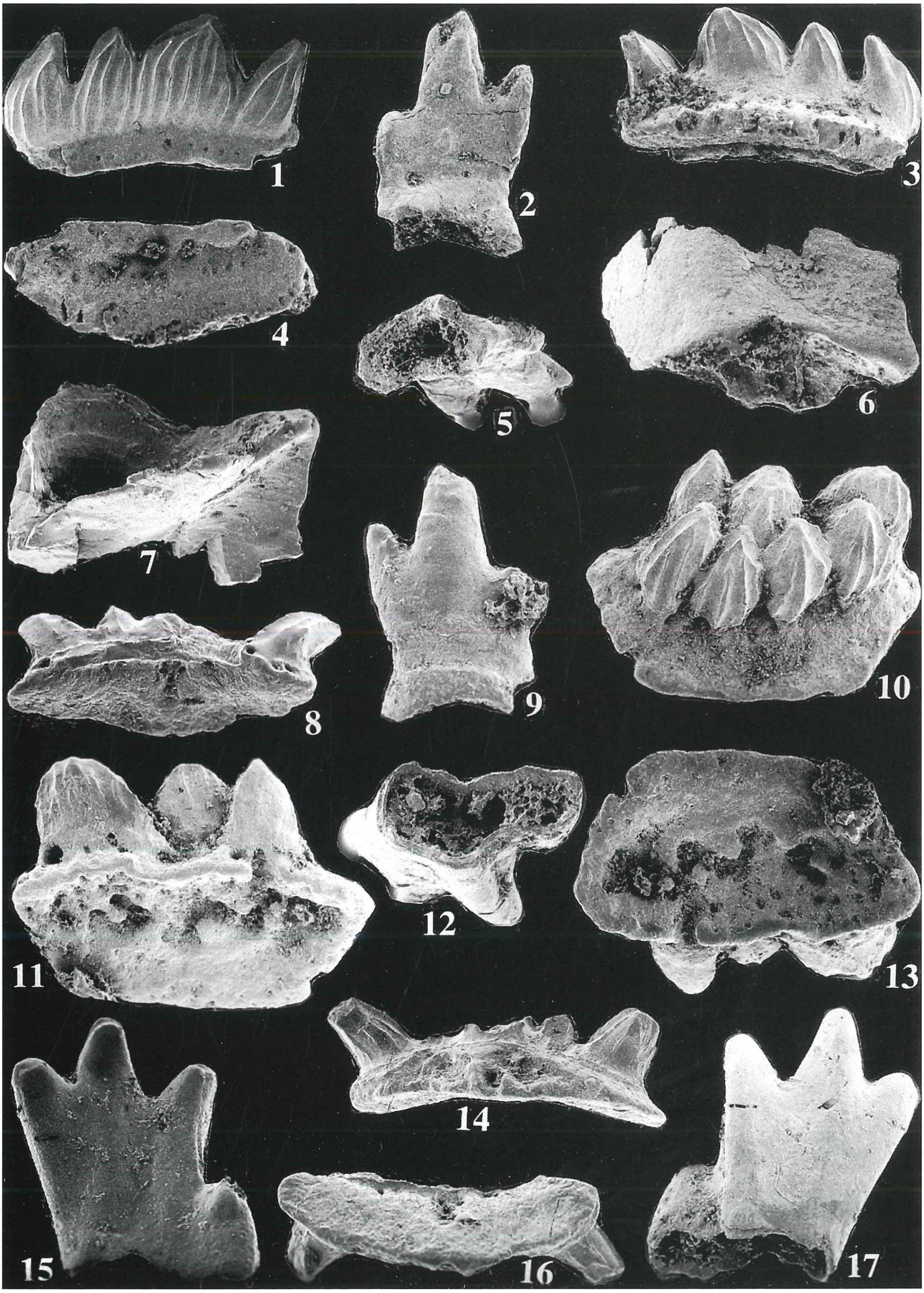

PLATE 27