Triassic (Skythian) smaller foraminifera from the Elika formation of the central Alborz, northern Iran, and from the Siusi formation of the Dolomites, northern Italy.

by

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Summary

Rectocornuspira kalhori, n. sp., *Cyclogyra? mahajeri,* n. sp., *Earlandia tintinniformis* (Misik) and *Meandrospira iulia* (Premoli Silva) are described from the Triassic Lower Elika formation, central Alborz Mountains, northern Iran. These foraminifera have also been encountered in the Siusi formation of Lower Skythian age of the Costalunga area, Dolomites, Veneto, northern Italy. On the basis of the identical foraminiferal association in both regions a Lower Skythian age is suggested for the lower part of the Elika formation. Field observations, gross lithology and microfacies on the one hand and distribution and composition of microfaunas on the other strongly imply for both formations laterally and vertically rapidly changing sedimentation under marine shallow-water platform to nearshore (tidal flat) conditions.

In the first part of the present note we describe some of the biostratigraphically more important smaller Triassic foraminifera from the thin-bedded grey-yellowish to reddish limestones and dolomitic limestones of the Lower Elika formation which is rather uniformly and widely distributed throughout the central Alborz Mountains of northern Iran (Glaus, 1964, 1965; Stöcklin, 1971). We noticed the presence of *Rectocornuspira kalhori,* n. sp., *Meandrospira iulia* (Premoli Silva), *Cyclogyra? mahajeri*, n. sp. and *Earlandia tintinniformis* (Misik). They all occur also in the micaceous dolomitic quartz sandstones of the Lower Skythian Siusi formation of the Costalunga area, Dolomites, Veneto, northern Italy. With the exception of *Meandrospira iulia* and *Earlandia tintinniformis* the new species seem to be restricted to the Siusi formation and to the Lower Elika formation. The virtually identical foraminiferal associations of the Lower Elika formation and of the Siusi formation are strongly suggestive of the age equivalence of these lithostratigraphic units. The Skythian age of the Lower Elika formation is further supported by the common association of the foraminiferal faunas of both regions with the attached polychaete annelid *Spirorbis phlyctaena* Brönnimann and Zaninetti, 1972, which occurs abundantly in the Skythian and with rich micro-gastropod assemblages of similar composition in the Dolomites and in the Alborz. A description of *Spirorbis phlyctaena* is in press (Brönnimann and Zaninetti, 1972) and the micro-gastropods will be described in a forthcoming note.

Dellenbach (1964, p. 31) mentioned in his description of the geology of the region E of Tehran that the oolitic beds with turriform micro-gastropods characterizing the lower part of the Triassic section at Bibi Shahrbanu, 7 km S of Tehran, were „très voisins de ceux décrits en Italie du Nord dans les „Strati di Campil" du Trentin" by Leonardi (1961). To our knowledge this is the first reference concerning the similarity between the microfacies of the Skythian beds of northern Italy and the Lower Triassic beds of the central Alborz Mountains of northern Iran.

The second part of this note contains the description of the microfacies and microfaunas encountered in the thin sections from the Lower Elika formation and the Siusi formation. Foraminiferal and ostracode associations are in both formations characterized by relatively small sizes of the tests, a low degree of species diversity and a large number of specimens per population. In both formations occur further rich

assemblages of dwarfed gastropods of higher species diversity (20 to 30 species) than that of the foraminifers and ostracodes. The reddish limestones with abundant micro-gastropods are a particularly characteristic feature of the lowermost part of the thin-bedded Lower Elika formation. It is well known that the reduction of salinity is often accompanied by the decrease of the body size of animals and plants (Segerstrale, 1957, p. 77-779, Caspers, 1952, p. 840, 846; Emery et al., 1957, p. 702) and the micro-gastropods and relatively small tests of the foraminifera and ostracodes may indicate subnormal salinity for their environments. The listed faunal features are considered as typical of unstable marine regions as they exist in nearshore marine environments of the inner shelf, including tidal flat, hypersaline bay and brackish water estuarine regimes (Bretsky and Lorenz, 1970). The porcelaneous-walled *Rectocornuspira kalhori*, n. sp., and *Cyclogyra? mahajeri*, n. sp., are the dominant foraminifera. Also Bandy (1961, p. 13) noted in his analysis of the distribution of the Recent benthonic foraminifera in the Gulf of California that the porcelaneous species „comprise more than 20 % of the benthonic species" of the inner shelf biofacies.

Full observations and examinations of microfacies and faunal associations suggest for the Lower Elika formation and for the Siusi formation similar paleoecologic conditions characterized by spatially rapidly changing deposition in a very unstable shallow-water marine nearshore environment.

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I. Paleontology

Order Foraminiferida
Suborder Miliolina
Superfamily Miliolacea
Family Fischerinidae

Genus *Rectocornuspira* Warthin, 1930

The genus *Rectocornuspira* was introduced by Warthin (1930, p. 15) for shallow-water porcelaneous bilocular foraminifera with an early involute, planispirally coiled and an adult evolute, uncoiled, tubular stage. The terms „involute" and „evolute" were apparently used by Warthin to designate „coiled" and „uncoiled". The type species *Rectocornuspira lituiformis* Warthin from the Pennsylvanian Lower Wewoka formation of Oklahoma, U. S. A., has been later re-illustrated (Loeblich and Tappan, 1964, p. C 440, fig. 333, 7a, b). The re-illustration exhibits rather an evolute than an involute early planispiral stage and a wall which seems to be covered by foreign elements, fine-grained on the planispiral and coarse-grained on the uncoiled tubular portion. It is not clear from the drawings whether these foreign elements are impurities secondarily attached to the surface of the porcelaneous test or whether they are agglutinated elements incorporated

within the wall. We noticed that in all the other species of *Rectocornuspira* from the Devonian and Carboniferous as well as in the Triassic forms the wall is never agglutinated. We therefore tend to consider the first possibility as the more probable one. *Rectocornuspira* has been reported from the Devonian of the Russian Platform and the Ural Mountains (Bykova, 1952), from the Lower Carboniferous Visean stage of the Sub-Moscow Basin (Ganelina, 1956) from the Lower Carboniferous of Saratov Oblast, Russia (Orlova, 1958) and from the Upper Carboniferous Pennsylvanian system of Oklahoma, U. S. A., (Warthin, 1930). An initially streptospirally coiled and then uncoiled form represented by *Rectocornuspira submosquensis* Fomina, 1960, from the Lower Carboniferous of the Moscow Basin (Fomina, 1960) and by *Rectocornuspira? insolentis* Ganelina, 1956, from the Lower Carboniferous Visean stage of the Sub-Moscow Basin (Ganelina, 1956) has also been recorded. The initially streptospiral rectocornuspires could either be placed in a new genus or they could be referred to an emended Rectocornuspira Warthin with a definition that would permit to accept also streptospirally coiled forms. This taxonomic problem can only be solved by an analysis of the significance of the type of early enrollment in the rectocornuspires. For the time being we place the early streptospirally coiled forms in Orthovertella Cushman and Waters, 1928.

The porcelaneous *Rectocornuspira* Warthin is homeomorphed by uncoiled ammodiscids such as *Ammodiscus exsertus* Cushman, 1910, from the Recent, and *Ammodiscus brevitubus* Dunn, 1942, from the Silurian. Warthin (1930, p. 16) mentioned in the definition of *Rectocornuspira* that the test may be attached in the gerontic stage. None of the rectocornuspires observed in our material seem to be attached. According to Warthin the total range of the genus is Ordovician to Pennsylvanian. This range is now being extended into the Lower Triassic. *Rectocornuspira kalhori,* n. sp., is one of the most common and morphologically distinct foraminiferal species of the very probably Lower Triassic Elika formation of the central Alborz Mountains, Iran. It seems to be stratigraphically restricted to the thin-bedded limestones and dolomitic limestones of the lower part of the Lower Elika formation (pl. 1, 2). In the Dolomites of Veneto, northern Italy, Rectocornuspira kalhori, n. sp., has been found in the micaceous, dolomitic, fine-grained quartz sandstones of the Lower Skythian Siusi formation (pl. 4).

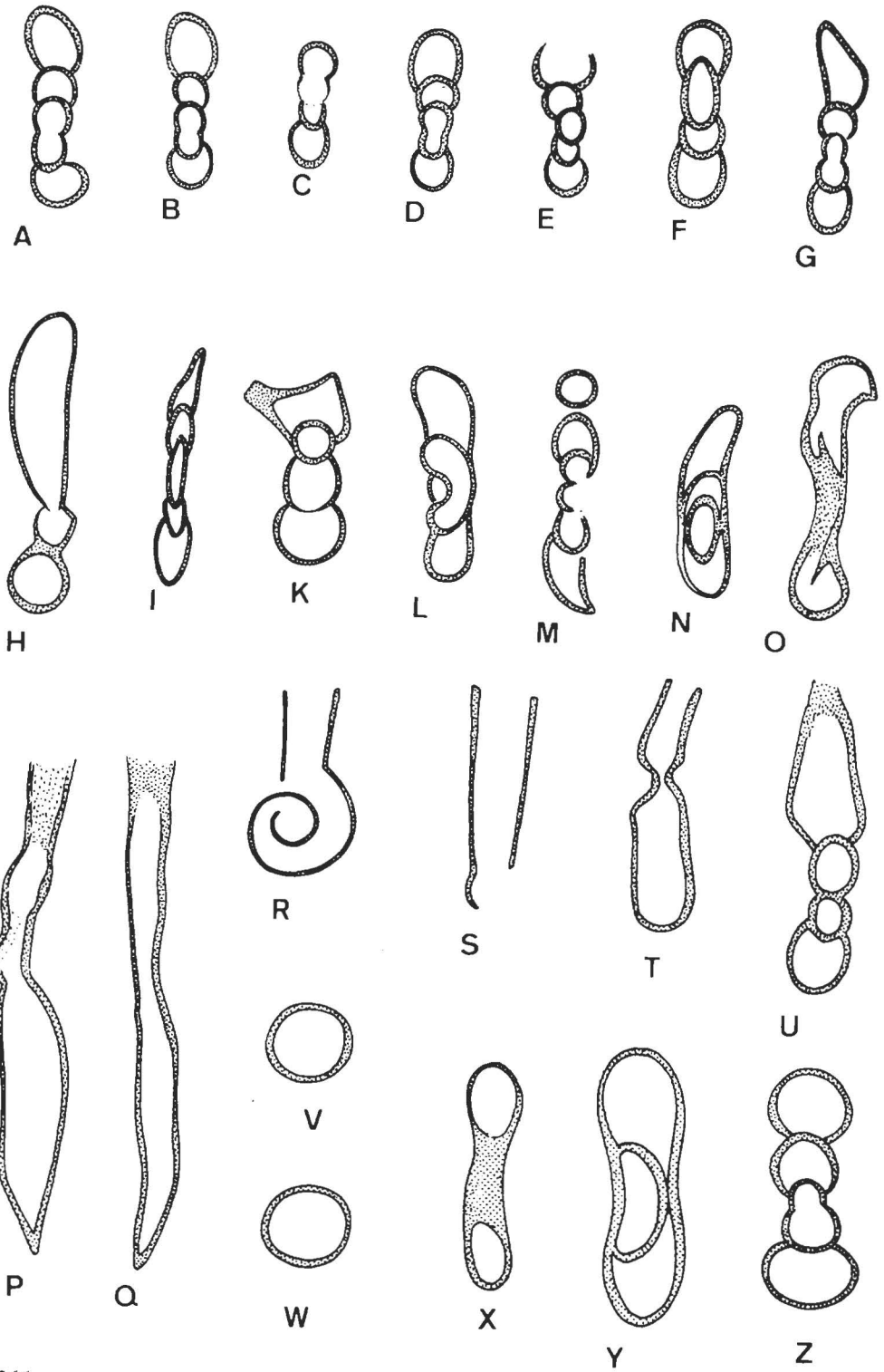
Rectocornuspira kalhori
Brönnimann, Zaninetti and Bozorgnis, n. sp.

Pl. 1, fig. 1–20; Pl. 2, fig. 1–23; Pl. 4, fig. 1, 3, 5–7, 12–15. Text-fig. 1 A–Z.

Description of holotype:

We are designating as holotype of *Rectocornuspira kalhori*, n. sp., the virtually centered longitudinal section of the specimen illustrated by pl. 1, fig. 2. It is from the Lower Elika formation outcropping at Bibi Shahrbanu, about 7 km S of Tehran, Iran, Bozorgnia sample Bz-T-17, thin section a.

The maximum diameter of the planispiral portion of the test is about 72μ and its total length including the incomplete rectilinear tube 105μ. The uncoiled tube was originally much longer but as may be seen by pl. 1, fig. 5, 6, 13 and pl. 2, fig. 2, 12, 18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Text-figure 1

A – Z *Rectocornuspira kalhori* Brönnimann, Zaninetti and Bozorgnia, n. sp. Random cuts from Zaninetti sample Z. 1105, thin sections a and b, Elika formation, Garm Cheshmeh Section, N of Semnan, central Alborz, northern Iran.
All appr. 120 x.

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has either been broken-off or obliquely cut-off. The diameter of the relatively large proloculus is about 15μ. The lumen of the early deuteroloculus is from 5 to 9μ wide. Then it increases just before uncoiling to about 19μ. The diameter of the uncoiled tubular extension measures at its base about 24μ, including the walls. The wall of the deuteroculus is between 1 and 3μ thick.

The holotype of the biloculine *R. kalhori*, n. sp., is planispiral in its early stage and uncoiled rectilinear in the adult. The planispire consists of not quite 2 whorls. With the completion of the planispiral stage the deuteroloculus leaves abruptly the planispiral enrollment and remaining in the same plane as that of the enrollment of the planispire, uncoils in form of a rectilinear tube of subcircular cross section as demonstrated by pl. 2, fig. 6, 7, 11, 20, 22 and text-fig. 1 M, R, U. The uncoiled tube describes with the tangent to the planispiral portion almost a right angle. The poor preservation of the innermost portion of the planispire does not permit the analysis of the prolocular morphology and in particular nothing can be said about the shape of the passage betwenn proloculus and deuteroloculus. The texture of the recrystallized wall which is grayish in transmitted light seems to be so dense that it is extremely difficult ot distinguish individual granules. The wall is, however, not agglutinated neither in the early nor in the late stage of ontogeny. On the other hand it is accompanied by minute specks of varying shape and dimension consisting of a dark brown substance as seen in transmitted light. Accumulations of specks of this dark-brown substance occur quite frequently throughout the thin section. It is presumed that the original wall of *R. kalhori*, n. sp., is imperforate and of porcelaneous non-agglutinated microtexture.

Remarks:

As *Rectocornuspira kalhori*, n. sp., is one of the more commom microfossils of the Lower Elika formation of the central Alborz Mountains and of the Lower Skythian Siusi beds of the Costalunga area, Veneto, Dolomites, we have extensively illustrated the various aspects under which it may appear in thin sections (pl. 1, 2 and pl. 4, and text-fig. 1). In the Lower Elika formation it occurs only in a few beds mainly in floods of very short vertical extension. A single thin section may contain hundreds of different cuts which permit a rapid integration of the general test morphology. On the other hand it does not occur as abundantly in the Siusi formation but apparently also over very short stratigraphic intervals as in the Elika formation. *R. kalhori*, n. sp., is very small for the genus and could be called a „dwarfed" form. The following list contains the maximum diameters of the planispiral portion of the Devonian and Carboniferous species of

Rectocornuspira as given by their respective authors. The smallest form, *R. compta* Ganelina, develops a spiral portion of 170 to 190μ maximum diameter, whereas in *R. kalhori*, n. sp., it ranges from 50μ to a maximum of 130μ.

Species	Diamter of the spiral portion
Rectocornuspira Ganelina, 1956	170–190μ
Rectocornuspira diffusa Ganelina, 1956	460μ
Rectocornuspira dilucida Ganelina, 1956	250μ
Rectocornuspira diserta Ganelina, 1956	230–280μ
Rectocornuspira holdenvillana Warthin, 1930	162μ
Rectocornuspira isachtukensis Orlova, 1955	500μ
Rectocornuspira lituiformis Warthin, 1930	480μ
Rectocornuspira prolixa Ganelina, 1956	220μ
Rectocornuspira siratchoya Bykova, 1952	260μ
Rectocornuspira calcarina Warthin, 1930	390μ

The spiral portion of the individuals of *R. kalhori*, n. sp., from the Lower Elika formation illustrated on pl. 1 ranges from 52 to 96μ and that of the axially sectioned specimens on pl. 2 from 76 to 128μ. The diameters of the spiral portion of the specimens from the Siusi formation illustrated on pl. 4 vary from about 48 to 72μ. In the average the spiral portion of the Triassic rectocornuspires measures about 70 to 80μ in diameter.

Although the innermost parts of the planispire are usually indistinct it seems that the proloculus is rather large in comparison with the diameter of the planispiral stage. In the specimens illustrated by pl. 1 we measeured diameters from about 15 to 32μ. In axial section the coiled portion is slender and typically biumbilicate with about 10 to 15μ across the narrowest part and up to 35μ across the final whorl. The planispire consists throughout of few whorls and it seems that it forms rarely more than 2. The uncoiled rectilinear tube is usually broken or obliquely cut-off and appears in thin sections either open at the apertural and closed at its proximal end (pl. 1, fig. 5, 13) or as an oval cut closed on all sides (pl. 2, fig. 16, center, fig. 17, lower end), or as subcircular cut (pl. 2, fig. 10, 11, 20, 22). The tube increases only slightly in width from the base to the aperture. By this feature fragments of the uncoiled deuteroloculus may be distinguished from the oblique longitudinal toward the aperture rapidly opening cuts of *Earlandia tintinniformis* (Misik) (Pl. 3, fig. 1-5, 9, 12). In the specimen of *R. kalhori*, n. sp., pl. 2, fig. 18, it reaches a maximum width of about 35μ, including the walls. The border of the aperture may be somewhat flaring as in the specimen illustrated by pl. 1, fig. 15. The uncoiled portion of the deuteroloculus may be in an angular position in respect to the planispiral portion, as described in the holotype, pl. 1, fig. 2, or as shown by the specimens pl. 1, fig. 1, 3, 4, 6, 7, or the transition from coiled to uncoiled portion may be much more gradual as in the specimens pl. 1, fig. 9 and 10.

In conclusion it can be stated that *Rectocornuspira kalhori*, n. sp., differs from all of the pre-Triassic rectocornuspires by the much smaller diameter of the planispiral portion consisting of not more than about 2 whorls, by the fairly large proloculus and from some of them by the slender and biumbilicate shape in axial view. It differs by the planispiral enrollment from the streptospirally coiled doubtful rectocornuspires e. g. *R.? insolentis* Ganelina and *R. submosquensis* Fomina.

Stratigraphic occurrence:

Lower Elika formation, central Alborz Montains, northern Iran, and Siusi formation, Dolomites, Costalunga area, Veneto, northern Italy. Lower Skythian.

Genus *Cyclogyra* Wood, 1842

Cyclogyra? mahajeri Brönnimann, Zaninetti and Bozorgnia, n. sp.

Pl. 3, fig. 8, 9, 11-15; Pl. 4, fig. 2, 4? , 8, 10, 11? , 18, 19. Text-fig. 2 A-I.

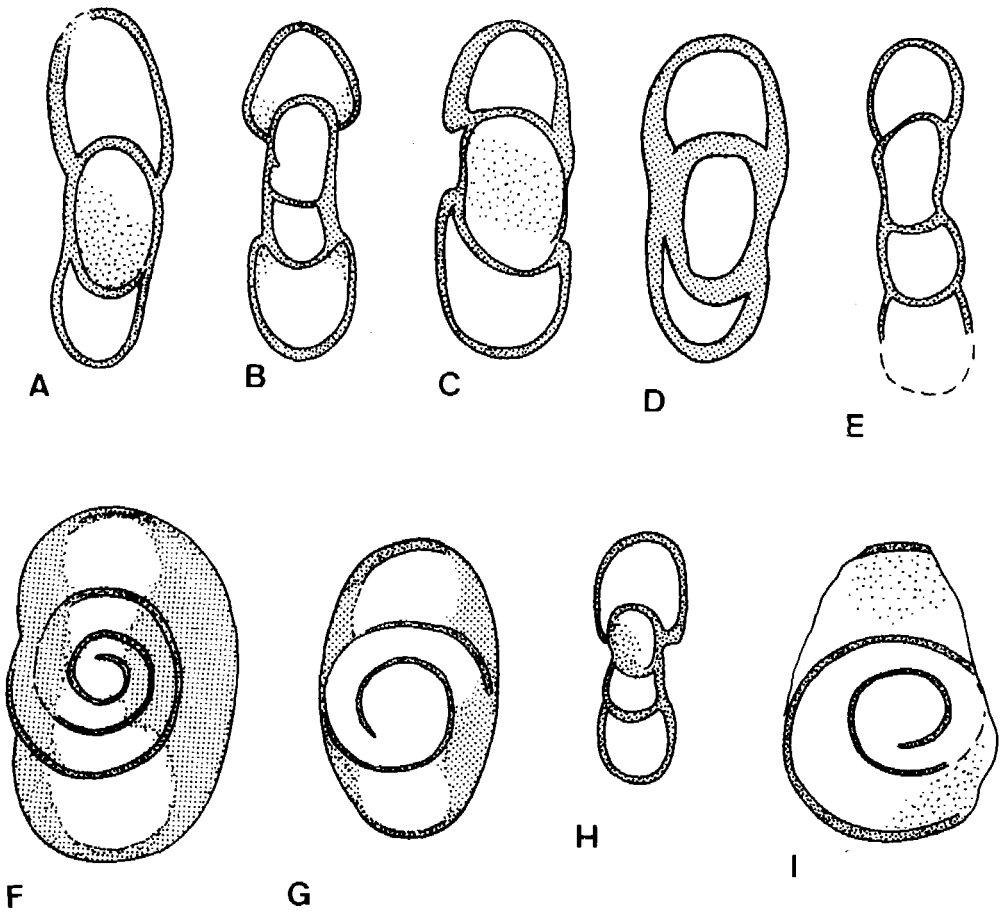
Associated with floods of the much smaller *Rectocornuspira kalhori*, n. sp., we encountered in Huber sample 7584, thin section b, from the Lower Elika formation of the Nessa-Hassanakdar section, Karadj Valley, central Alborz Mountains, northern Iran, a small number of oblique cuts of a planispiral foraminifer which in its enrollment and microtexture of the walls shows affinities with the planispiral portion of *R. kalhori,* n. sp. The new form which most probably possesses originally a porcelaneous imperforate wall is tentatively referred to *Cyclogyra.* In contrast to *R. kalhori*, n. sp., it does not develop an uncoiled uniserial tube.

Description of holotype:

We are designating as the holotype of *Cyclogyra? mahajeri*, n. sp., the specimen represented by the axial section pl. 3, fig. 13 and by text-fig. 2 B. It is from Huber sample H. 7584, thin section b, Lower Elika formation, Nessa-Hassanakdar section, Karadj Valley, central Alborz Mountains, northern Iran. The maximum diameter of the holotype is 162μ and its axial width about 41μ. The lumen of the final whorl overlaps laterally onto the previous coil. This is a distinct feature of *C.? mahajeri*, n. sp., and helps to distinguish this species from the axially slender and strongly biumbilicate planispiral stage of *Rectocornuspira kalhori*, n. sp. The final whorl is in the holotype about 48μ wide and 45μ high, including the wall. The wall is strongly recrystallized, not agglutinated and appears light greyish in transmitted light. It is about 3 to 5μ thick and accompanied by the same light-brownish specks as reported to occur along the walls of *R. kalhori,* n. sp.

Remarks:

Although the morphology of the early planispiral portion of *Rectocornuspira kalhori*, n. sp., is in equatorial section similar to the planispiral test of *Cyclogyra? mahajeri*, n. sp., the photographs of pl. 3, fig. 7, 10, 11, 13–17 and the camera lucida drawings of text-fig. 2 A–I show that the average test of *C. ? mahajeri,* n. sp., from the Lower Elika formation and from the Siusi formation is with a maximum diameter of 150 to 170μ about twice as big as the average spiral portion of *R. kalhori*, n. sp. *C. ? mahajeri,* n. sp., is planispirally enrolled, evolute to slightly involute. The 2 to 3 whorls increase



Text-figure 2

A – I *Cyclogyra? mahajeri* Brönnimann, Zaninetti and Bozorgnia, n. sp. Random cuts from Huber sample H. 7584, thin section b, Lower Elika formation, Nessa-Hassanakdar section, central Alborz, northern Iran.
All appr. 240 x.

Holotype: Fig.B.

rapidly in height. The proloculus of the specimen pl. 3, fig. 14 measures about 25μ across. The height of the first whorl including the wall is about 12μ, of the second whorl 20μ and of the third and final whorl 40μ. The test of *C.? mahajeri*, n. sp., is in axial section only very slightly biumbilicate. The shape of the passage from proloculus to deuteroloculus is unknown. *C.? mahajeri*, n. sp., is not as common as and usually associated with *Rectocornuspira kalhori*, n. sp.

Stratigraphic occurrence:

Lower Elika formation, central Alborz Mountains, northern Iran, and Siusi formation, Dolomites, Costalunga area, Veneto, northern Italy. Lower Skythian.

Genus *Meandrospira* Loeblich and Tappan, 1946

Meandrospira iulia (Premoli Silva), 1962
Pl. 3, Fig. 6.

An axial section of a very small foraminifer of about 50μ maximum diameter has been referred to *Meandrospira iulia* (Premoli Silva). The walls are recrystallized and appear like those of the holotype and paratypes illustrated by Premoli Silva (1962, pl. L, fig. 1–7) from the Skythian beds of the Iulian Alps. The maximum diameter of the cross sections of the tubular deuteroloculus is about 10μ including the walls.

The specimen is from Huber sample H. 7578, thin section h, Lower Elika formation, Nessa-Hassanakdar Section, Karadj Valley, central Alborz Mountains, northern Iran.

Remarks:

In Huber sample H. 7578, thin section k, we encountered a few more random cuts of unquestionable *Meandrospira iulia* with diameters ranging from about 60 to 80μ. Also in these section, the tubular outline of the deuteroloculus cross section is clearly visible. All our specimens are distinctly smaller than those illustrated by Premoli Silva which have diameters of 100 to 140μ. *Meandrospira iulia* is biostratigraphically the most import species of the Lower Elika formation and permits for this part of the Elika formation to accept a Skythian age.

Stratigraphic occurrence:

Lower Elika formation, central Alborz Mountains, northern Iran. Lower Skythian beds of Europe, mediterranean faunal province.

Suborder Fusulinina
Superfamily Parathuramminacea
Family Moravamminidae
Genus *Earlandia* Plummer, 1930.

Synonymy:

1958 *Aeolisaccus* Elliott. Micropal., vol. 4, p. 422.

Earlandia tintinniformis (Misik), 1971.
Pl. 3, fig. 1–5, 8, 9, 12; Pl. 4, fig. 16, 17.

Synonymy:

1971 *Aeolisaccus tintinniformis* Misik. Geol. Sbornik,
Geologica Carpathica, vol. 22, p. 169–172, pl. 1, fig. 1–6, text-fig. 1.

Small elongate tests beginning with a subglobular initial chamber separated by a constriction from a straight conical deuteroloculus and which possess a dark-grey microgranular thin wall are here referred to *Earlandia tintinniformis* (Misik), 1971. This species was first described under the generic name of *Aeolisaccus* Elliott, 1958, from the Ladinian limestones of Jergaly near Donovaly, Lower Tatra, western Carpathian Mountains, Cekoslovakia. *E. tintinniformis* was also found by Misik in the Cutenstein limestone and dolomite of Anisian age, in the Ladinian Reifling limestone, and in Norian limestones of the western central Carpathian Mountains. Our specimens are from Huber sample H. 7576, thin section a and b, Lower Elika formation, Nessa-Hassanakdar Section, Karadj Valley, central Alborz Mountains, northern Iran. The centered longitudinal section of *E. tintinniformis* illustrated by pl. 4, fig. 1, shows a rapidly opening conical test beginning with a subspheric initial chamber of about 22μ maximum diameter including the walls. The conical deuteroloculus opens distally to a maximum of about 40μ including the walls. The total length of this specimen is 130μ. Most of the bilocular tests are obliquely cut above the proloculus. The photographs of pl. 3, fig. 3–5, represent such oblique longitudinal sections across the conical deuteroloculus. Fig. 12 is an oblique transverse section of the conical deuteroloculus. The maximum lengths of the longitudinal sections range from about 100 to 160μ and the maximum widths of the cone from 30 to 65μ. These dimensions agree quite well with those reported by Misik (1971, p. 169) for the maximum external diameter of the conical tube. The average length of Misik's specimens is however somewhat greater than that of our specimens. The microgranular dark greyish thin walls are in transverse sections about 4 to 8μ thick (6 to 8 in Misik's material). In longitudinal section the walls exhibit minute irregularities which on the outside of the conical deuteroloculus probably show up as transverse wrinkles. In addition to these major transverse wall formations there occur in the specimen illustrated by pl. 3, fig. 4, very thin closely spaced transverse lines which perhaps may also be found on the exterior surface of the deuteroloculus. There is not the slightest indication of the beginning of a septation and the wrinkles of the wall are irregularly distributed and do not correspond on both sides of the longitudinal sections. They do not suggest transverse constrictions which exist in *Earlandia perparva* Plummer, 1930, and Earlandia minuta (Cushmann and Waters) from the Pennsylvanian of Texas, 1928.

A similar conical longitudinal section illustred by pl. 4, fig. 17, showing a rapidly opening thin-walled tube occurs in H. 437, thin section 4, from Lower Skythian Siusi beds, Dolomites, Veneto, northern Italy. The maximum length of the section is about 105μ and the maximum width of the cone, including the walls, about 40μ. The irregularly wrinkled sides of the cone and its large diameter refer this individual clearly to *E. tintinniformis* (Misik). In this thin section *E. tintinniformis* is associated with rare *Rectocornuspira kalhori*, n. sp., and *Spirorbis phlyctaena* Brönnimann and Zaninetti.

Stratigraphic occurrence:

Lower Elika formation, central Alborz Mountains, northern Iran, and Siusi formation, Dolomites, Costalunga area, Veneto, northern Italy. Lower Skythian.

II. Microtextures and Microfaunal Associations

A. Elika formation, central Alborz, northern Iran.

a. The composite Bozorgnia sample BZ-T-17, thin section a–q is from the thin bedded yellow reddish limestones and dolomitic limestones of the basal Elika formation outcropping at Bibi Shahrbanu (Dellenbach, 1964). The sample consists of 2 texturally and faunistically different types of thin sections.

Type 1

The dark micritic groundmass consists of minute dolomite crystals and argillaceous substance. There are patches of clear crystals and scattered larger dolomite rhombohedrons. Fracture lines are filled either by clear crystals or by a dark brown argillaceous substance. The thin sections contain floods of *Rectocornuspira kalhori*, n. sp., rare nodosariids, numerous, in places floods, of a very small thin-walled, non-ornamented ostracode, rare *Spirorbis phlyctaena* Brönnimann and Zaninetti, rare microgastropods and locally common fragments of micropelecypods.

Type 2

The clear groundmass consists of large-sized dolomite crystals. In this groundmass occur coarsely dolomitized or micritic pellets, floods of microgastropods and fragments of micropelecypods. There are fracture lines filled with clear crystals. We noticed rare *Rectocornuspira kalhori*, n. sp., and *Spirorbis phlyctaena* Brönnimann and Zaninetti.

b. The composite Huber samples H. 7576, thin sections a–c, H. 7578, thin sections h and k, and H. 7584, thin sections b and f, are from the Elika formation outcropping at Nessa-Hassanakdar. Sample H. 7584 is from the yellow-brown weathering thin-bedded limestones of the Lower Elika formation. Samples H. 7578 and H. 7576 are from yellowish thin-bedded dolomites of the upper part of the Elika formation. The thin sections are described below from base to top:

H. 7584

Thin section b: The groundmass is a light to dark grey micrite consisting of minute euhedral crystals and argillaceous material. In this groundmass occur abundant microgastropods and fragments of minute pelecypods. Within the tests of the microgastropods the micritic groundmass may be replaced by clear, large brownish dolomite rhombohedrons. There are also some dolomitzed pellets and glauconitic patches. We recorded rare *Spirorbis phlyctaena* Brönnimann and Zaninetti, abundant *Rectocornuspira kalhori*, n. sp., common *Cyclogyra? mahajeri*, n. sp., and rare, thin ostracode valves of the same species as recorded in the thin sections of type 1 of Bozorgnia sample Bz-T-17.

Thin section f: The groundmass is a light to dark grey micrite consisting of minute euhedral crystals and argillaceous material. In this groundmass occur tightly packed thin ostracode valves which give it an irregular appearance. The thin section shows a fine layering through the distribution of the argillaceous substance which may be of dark brown color. There occur throughout the groundmass and essentially within its light gray portion, isolated, numerous, brownish dolomite rhobohedrons. Rare fractures are filled with brown argillaceous substance. *Rectocornuspira kalhori*, n. sp., occurs in floods.

H. 7578

Thin section k: The groundmass is dark micritic, argillaceous with minute euhedral crystals in part dolomite rhombohedrons. It is finely layered through the distribution of argillaceous material and through the formation of cloudy argillaceous zones characterized by the accumulation of irregularly shaped micritic units enveloped by a brown grayish argillaceous substance. These units are possibly caused by minute burrowing animals. Fracture lines are common and filled either by clear crystals or by dark brown argillaceous substance. Rare *Meandrospira iulia* (Premoli Silva) occur in the cloudy argillaceous zones.

Thin section h: The groundmass consists of clear euhedral crystals (dolomite?), in part it is micritic argillaceous with minute euhedral crystals. In this essentially clear crystalline groundmass occur tightly packed similar-sized pellets of micritic texture. Their nuclei are frequently foraminifera. They may, in part at least, be fecal pellets. Fracture lines are common. They are filled either by clear crystals or by a dark brown argillaceous substance. The microfauna consists of common ammodiscids which will be described in a forthcoming note (Brönnimann, Zaninetti, Bozorgnia and Huber, 1972), and rare Meandrospira iulia (Premoli Silva).

H. 7576

Thin sections a–c: exhibit a micritic, argillaceous, irregularly streaky and cloudy groundmass which in places shows minute euhedral crystals. There are clear dolomite patches. Fractures are filled by clear crystals or by a dark brown argillaceous substance which also occurs in the interstices between dolomite rhombohedrons. There are specks and patches of a dark brown substance. *Earlandia tintinniformis* (Misik) is common. It is associated by very small glomospirellas which will be described in a forthcoming note on the microfauna of the Elika formation at Nessa-Hassanakdar (Brönnimann, Zaninetti, Bozorgnia and Huber, 1972). Throughout the thin section occur, locally in floods, thin-valved ostracodes.

B. Siusi formation, Costalunga area, Dolomites, Veneto, northern Italy.

The following samples H. 437, H. 438, H. 439 and H. 443 are arranged in stratigraphic order from base to top. They are all from the basal part of the Lower Skythian Siusi formation. The samples between the base of the Siusi formation and H. 437 where *Rectocornuspira kalhori* occurs for the first time are characterized by ostracode, micropelecypode and *Spirorbis phlyctaena* Brönnimann and Zaninetti assemblages. The basal bed of the Siusi formation is oolitic. It overlies a richly fossiliferous Upper Permian algal-foraminiferal limestone.

The composite sample H. 437 is composed of 2 texturally and faunistically different types of thin sections:

Type 1:

The grayish-brown groundmass is micritic. It contains densely packed minute dolomite rhombohedrons. The interstices between the crystals are filled by a dark brown substance. The thin section shows an irregular microlamination through the linear

arrangement of mica flakes. Common small angular quartz and rare glauconite grains are randomly distributed throughout the groundmass. There occur rare *Rectocornuspira kalhori*, n. sp., *Cyclogyra? mahajeri*, n. sp., *Earlandia tintinniformis, Spirorbis phlyctaena* Brönnimann and Zaninetti, microgastropods and echinoderm fragments.

Type 2:

The brownish groundmass is micritic with densely packed dolomite rhombohedrons. The interstices between the dolomite crystals are filled by a dark-brown substance. The thin sections are microlaminated through linear arrangement and accumulation of fragments of micropelecypods, echinoderms and of a curiously hinged fragment of an unknown organism (ostracode?). Mica flakes are common. Rare angular quartz and some glauconite grains are randomly distributed throughout the thin sections. We noticed rare specimens of *Spirorbis phlyctaena* Brönnimann and Zaninetti.

The composite sample H. 438 is immediately overlying sample H. 437. It consists also of 2 texturally and faunistically different types of thin sections:

Type 1.

The clear microcrystalline dolomitic groundmass is in places somewhat argillacous. Throughout this groundmass occur more or less dolomitized, elongate to rounded pellets, microgastropods and fragments of micropelecypods. The pellets may be deformed („micro-boudinage"). Mica flakes and small angular quartz grains are common. Occasionally there occurs a glauconite grain. *Rectocornuspira kalhori*, n. sp., occurs either as nuclei of pellets or in the clear groundmass between the pellets. We noticed further *Spirorbis phlyctaena* Brönnimann and Zaninetti.

Type 2.

The groundmass is a light gray to brown, micrite, consisting of very small dolomite rhombohedrons with dark brown substance in the interstices. The thin section exhibits distinctly graded microbedding. The coarse material contains abundant small angular quartz grains, mica flakes, rare glauconite grains and larger dolomite rhombohedrons. It grades into a much finer terminal material consisting exclusively of minute dolomite rhombohedrons and a dark brown argillaceous substance in the interstices between the dolomite crystals. Then begins again a layer of coarser material. Between sequences of graded laminae are occasionally interbedded layers of group 1 texture. In the basal and the intermediate portion occur common *Rectocornuspira kalhori*, n. sp. The accumulation of the tests in the more coarse portion of the graded sequence is the result of mechanical sorting.

Sample H. 439 is immediately overlying sample H. 438. It consists of only one type of texture. The groundmass is a light brown micrite. It consists of minute dolomite rhombohedrons with a dark brown argillaceous substance in the interstices. There are rare small angular quartz grains and interspersed larger individual dolomite rhombohedrons and patches of dolomite. Fractures are filled with dark brown argillaceous substance. *Rectocornuspira kalhori*, n. sp., and *Earlandia tintinniformis* occur sporadically. We also noticed fragments of micropelecypods and of the doubtful ostracode already listed in H. 437, texture type 1.

Sample H. 443 is the stratigraphically youngest in the sequence of Siusi samples containing *Rectocornuspira kalhori*, n. sp., and *Cyclogyra? mahajeri*, n. sp. The relatively clear groundmass is micritic. It consists of minute euhedral crystals, in part dolomite rhombohedrons and some argillaceous substance. In this relatively clear micritic groundmass occur abundant microgastropods which generally contain large dolomite rhombohedrons. The interstices between the crystals are filled with dark brown substance. There are occasionally small angular quartz and glauconite grains. *Spirorbis phlyctaena* Brönnimann and Zaninetti and fragments of micropelecypods are present.

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Explanation to Plate 1

Fig. 1–20 *Rectocornuspira kalhori* Brönnimann, Zaninetti and Bozorgnia, n. sp.
Holotype: Fig. 2
Fig. 2, 5, 13: Bozorgnia sample Bz-T-17, thin section a.
Fig. 6, 8, 9, 10, 12, 14, 18, 19: Bozorgnia sample Bz-T-17, thin section e.
Fig. 15: Bozorgnia sample Bz-T-17, thin section f.
Fig. 1, 4: Bozorgnia sample Bz-T-17, thin section h.
Fig. 17, 20: Bozorgnia sample Bz-T-17, thin section k.
Fig. 3, 11: Bozorgnia sample Bz-T-17, thin section o.
Fig. 7: Bozorgnia sample Bz-T-18, thin section e.
Fig. 16: Bozorgnia sample Bz-T-25, thin section q.
Fig. 1, 4, 6, 8, 11, 13, 14 approx. 250 x.
Fig. 2, 3, 12, 15, 16, 17, 18 approx. 280 x.
Fig. 19 approx. 220 x.

All samples from the Bibi Shahrbanu section, S of Tehran. Lower Elika formation. Lower Skythian.

Explanation to Plate 2

Fig. 1–23 *Rectocornuspira kalhori* Brönnimann, Zaninetti and Bozorgnia, n. sp.
Fig. 14: Bozorgnia sample Bz-T-17, thin section a.
Fig. 5, 6, 8, 9, 11, 13, 20, 21, 23: Bozorgnia sample Bz-T-17, thin section e.
Fig. 2: Bozorgnia sample Bz-T-17, thin section f.
Fig. 12, 15, 17, 19, 22: Bozorgnia sample Bz-T-17, thin section k.
Fig. 1, 4, 7, 10, 16: Bozorgnia sample Bz-T-17, thin section o.
Fig. 3, 18: Huber sample H 7584, thin section f.
Fig. 2, 4–6, 7, 12 appr. 260 x.
Fig. 1, 8, 13, 22 appr. 280 x.
Fig. 3 appr. 320 x.
Fig. 5, 9, 10, 11, 14, 15, 19, 20, 23 appr. 300 x.
Fig. 16 appr. 90 x .
Fig. 17, 21 appr. 110 x.
Fig. 19 appr. 100 x.

The Bozorgnia samples are from the Bibi Shahrbanu section, S of Tehran, and the Huber sample from the Nessa-Hassanakdar section, Karadj Valley, NW of Tehran. Lower Skythian.

Explanation to Plate 3

Fig. 1–5, 8, 9, 12 *Earlandia tintinniformis* (Misik), 1971.
Fig. 1–5 from Huber sample H. 7576, thin sections a, b, and c.
Fig. 1, 3,: 360 x.
Fig. 2, 4, 5: 300 x.
Fig. 12: 500 x.
Fig. 8 from Huber sample H. 7584, thin section b, 360 x.
Fig. 9 from Huber sample H. 7576, thin section c, 360 x.

Fig. 6 *Meandrospira iulia* (Premoli Silva), 1964. Huber sample H. 7578, thin section h, 360 x.

Fig. 7, 10, 11, 13–17 *Cyclogyra? mahajeri* Brönnimann, Zaninetti and Bozorgnia, n. sp.
Figures 10, 11, 13–17 from Huber sample H. 7584, thin section b.
Holotype: Fig. 13.
Fig. 10, 13, 16, 17: 310 x.
Fig. 11, 15: 400 x.
Fig. 14: 260 x.
Fig. 7: H 443, thin section 2.

The Huber samples H. 7576, H. 7578, and H. 7584 are from the Elika formation, Nessa-Hassanakdar Section, Karadj Valley, NW of Tehran. Lower Skythian.

The sample H. 443 is from the Siusi formation, Costalunga area, Dolomites, Veneto, northern Italy. Lower Skythian.

Explanation to Plate 4

Fig. 1, 3, 5–7, 9 ?, 12–15 *Rectocornuspira kalhori* Brönnimann, Zaninetti and Bozorgnia, n. sp.
Random cuts from thin sections H. 437, H. 438 and H. 439.
Fig. 1, 3, 7, 13 appr. 530 x.
Fig. 5, 15 appr. 400 x.
Fig. 6, 12, 14 (lower left) 260 x.

Fig. 2, 4, 8, 10, 11 ?, 18, 19 *Cyclogyra? mahajeri*, Brönnimann, Zaninetti and Bozorgnia, n. sp.
Random cuts from thin section H. 437.
Fig. 2, 4, 9, 11, 18, 19 appr. 400 x.
Fig. 8 appr. 260 x.

Fig. 14 (upper right) 16 ?, 17 *Earlandia tintinniformis* (Misik), 1971.
Thin sections h. 437 and H. 439.
Fig. 14 appr. 260 x.
Fig. 16 appr. 530 x.
Fig. 17 appr. 400 x.

The sample H. 437, H. 438 and H. 439 are from the Siusi formation, Lower Skythian, Costalunga area, Dolomites, Veneto, northern Italy.

Plate 1

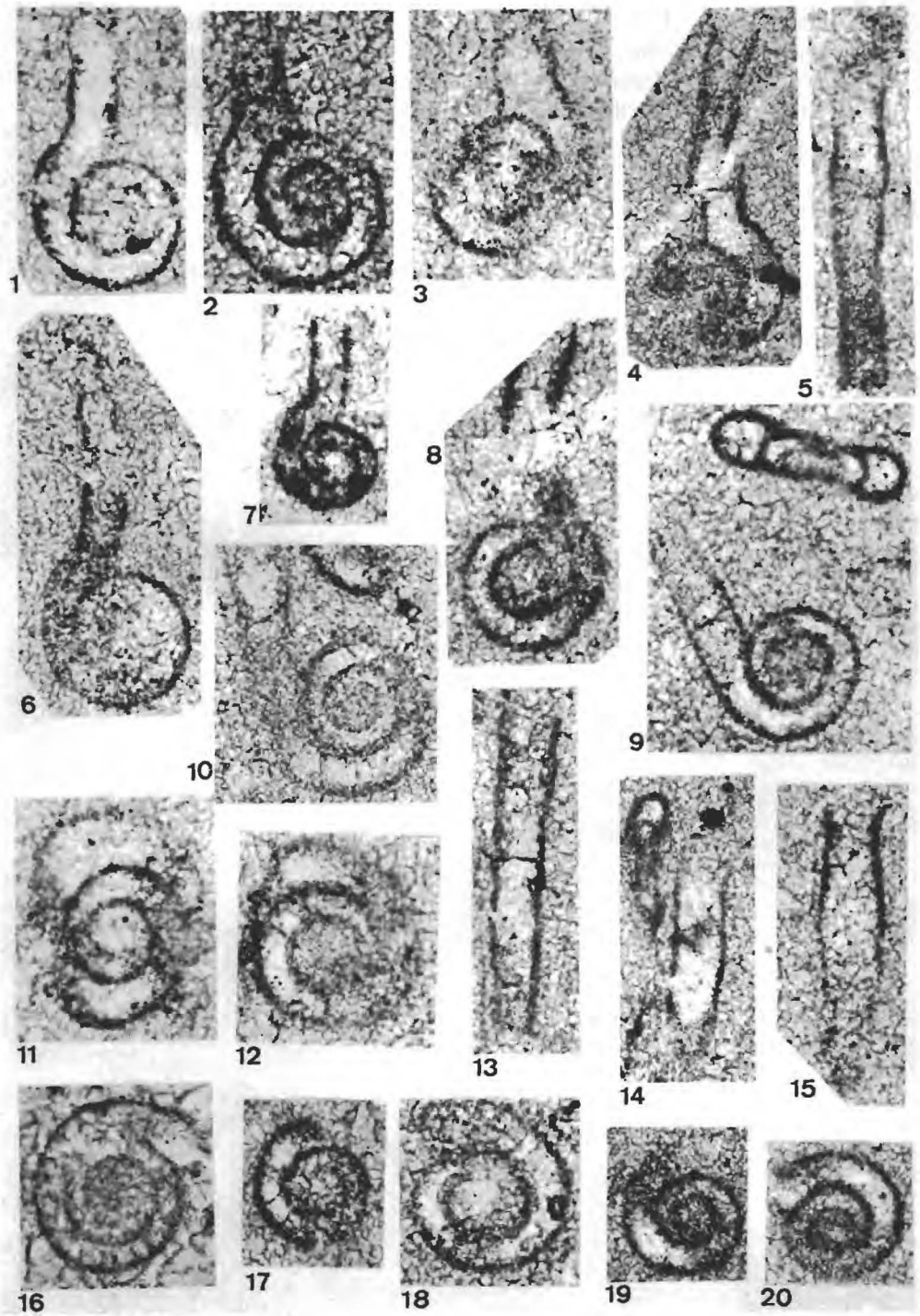

Plate 2

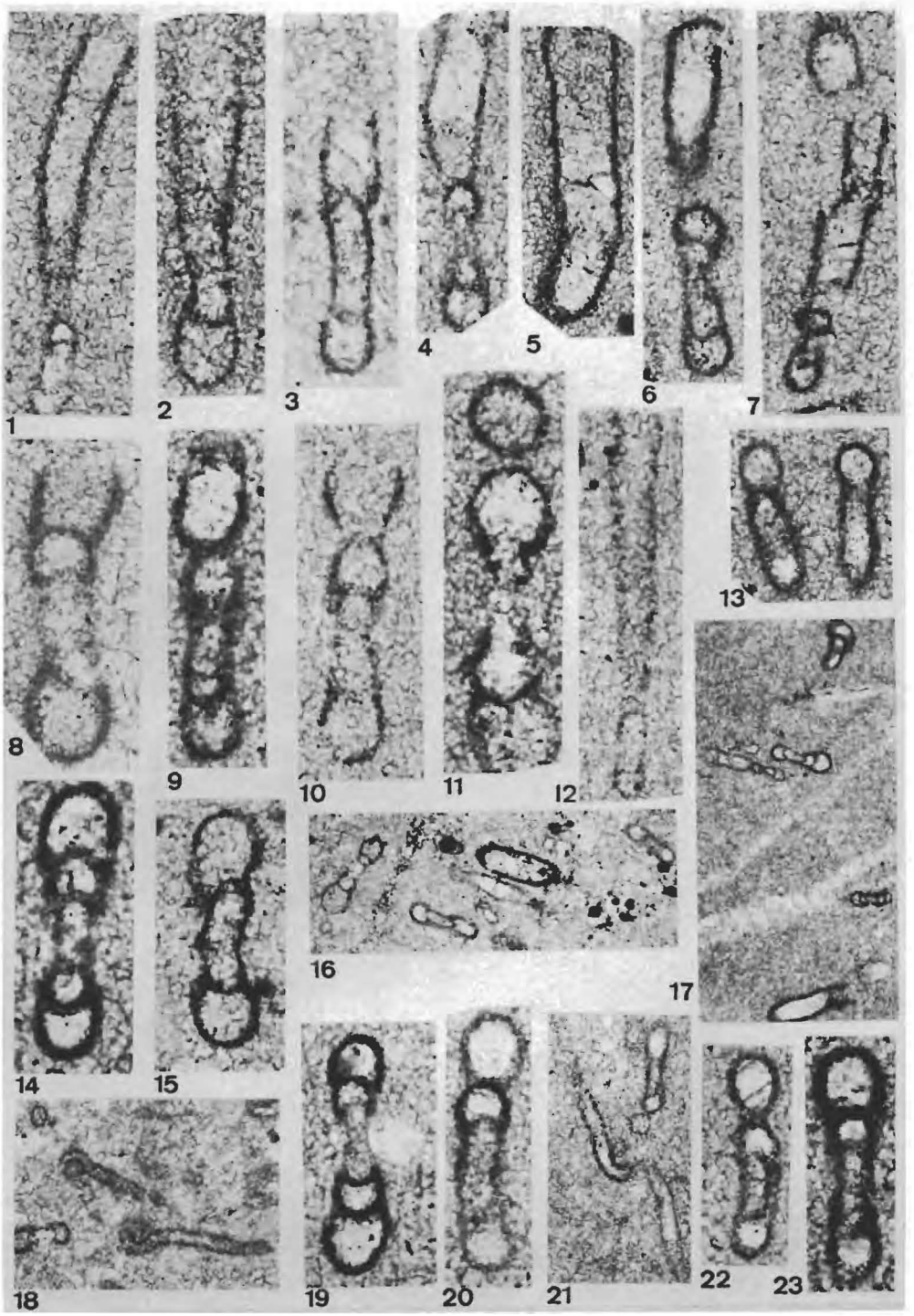

Plate 3

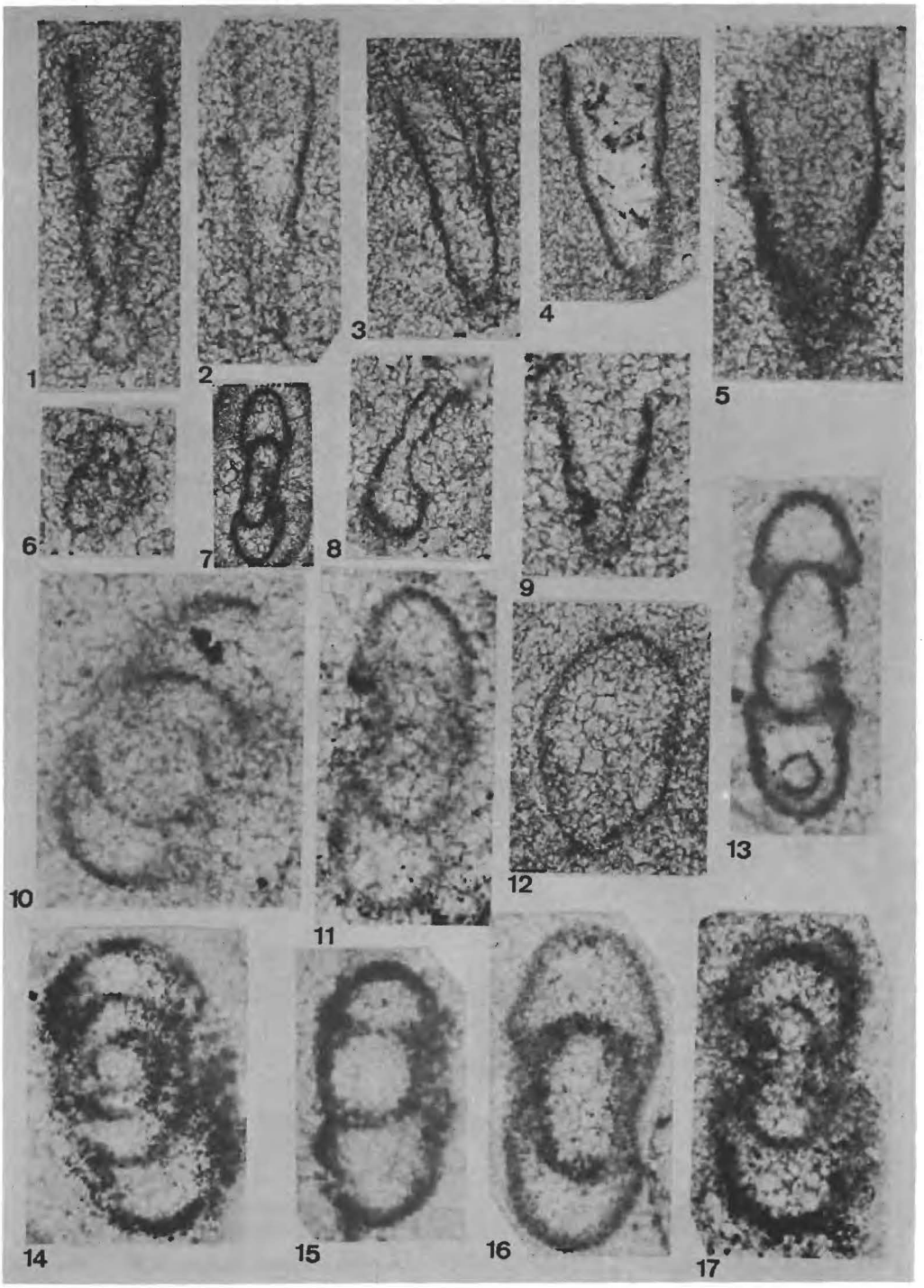

Plate 4