

STUDIES OF RADIOLARIA FROM THE FIELDS CREEK FORMATION, EAST-CENTRAL OREGON, U.S.A.

KUEI-YU YEH

National Museum of Natural Science, Taichung, Taiwan 40419, R.O.C.

ABSTRACT—From the Fields Creek Formation, east-central Oregon, four major radiolarian assemblages were recovered, they are the Ladinian *Pseudostylosphaera magnispinosa* Assemblage, Karnian *Poulpus karnicus* Assemblage, Norian *Corum parvum* Assemblage, and an upper Norian or Hettangian fauna of *Orbiculiform* sp. A Assemblage. Characteristic species of each assemblage and other distinct radiolarian taxa including twenty three new species and four new genera are figured and described in this report.

The results of this study indicate that (1) the Fields Creek Formation was mainly deposited during Norian times, but the deposition of the Fields Creek sediment may have initiated from Ladinian times, or (2) the rocks contain Ladinian or Karnian Radiolaria represent the allochthonous blocks in the Fields Creek olistostromes.

INTRODUCTION

In east-central Oregon, the Fields Creek Formation (Text-fig.1) is one of the major sedimentary units of the Mesozoic Clastic terrane (Dickinson, 1979) or of Silberling and others' (1984) Izee terrane. The Fields Creek Formation consists of an extremely thick pile of sedimentary rocks (about 15000 ft at type section) which widely expose east of the Poison Creek Fault (Text-fig.2). The depositional history and the tectonic implications of this unit are still not definitely understood mainly because the scarcity of complete biostratigraphic data.

This reports represents the first comprehensive biostratigraphic study of the Fields Creek Formation. The purposes of this research are (1) to determine and to illustrate the radiolarian assemblages from the Fields Creek Formation, and (2) to correlate the Fields Creek Radiolaria with those of the same age from other units in east-central Oregon or from elsewhere in the world.

Within the John Day Inlier, Triassic Radiolaria have been discovered from several rock units, such as the Fields Creek Formation, the Brisbois Member, the Begg Member, and the Rail Cabin Mudstone Member of the Vester Formation (Blome,1983,1984; Blome et al.,1986), the Miller Mountain Melange (Blome, 1984), and the area north of the Canyon Mountain Complex (Blome,

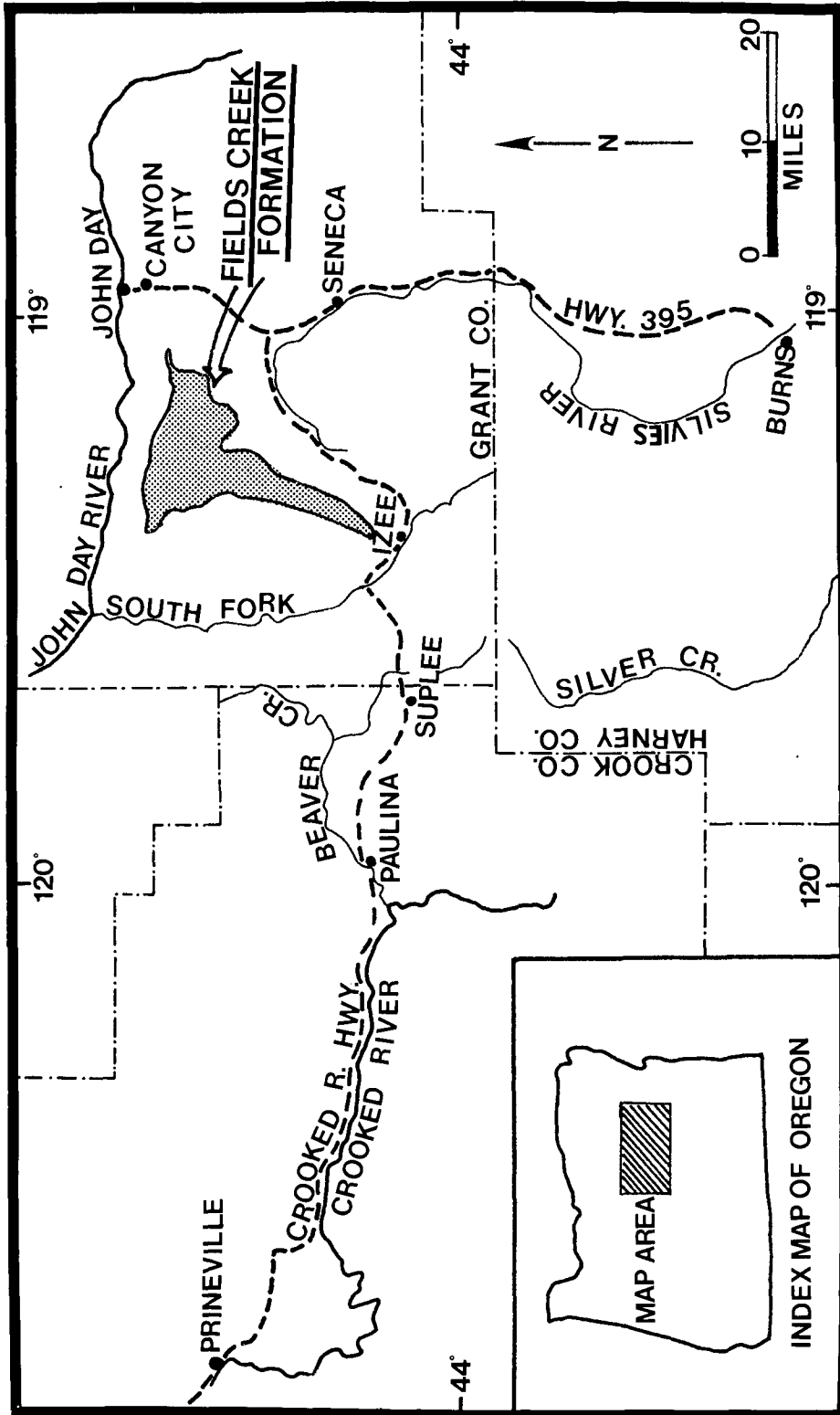
et al.,1986), etc.. So far the detailed studies of radiolarian faunas have only been done for the Rail Cabin Mudstone (Blome,1983,1984) and the Fields Creek Formation (this study). The results of this research should provide more clues to resolve geologic puzzles for this area.

MATERIAL STUDIED

In this study the radiolaria were mostly extracted from cherty mudstone or black shales which exposed from the northern to the southern end of the Fields Creek outcrop area. In general, Radiolaria are very common in the shale or mudstone of the Fields Creek Formation. However, most of them were distorted in various degrees.

Some limestone concretions occurred in the Fields Creek Formation. In this study, only one limestone concretion (Loc. FC1E, see Locality Descriptions) contains extremely abundant, diverse and pyritized radiolarian forms. In this report, this is the only fauna without shape distortion.

In the southern area of the Fields Creek Formation, limestone concretions floated at several localities (e.g., Loc. FC43,FC45,etc., see Locality Descriptions). These limestone concretions are primarily of light grey micrite and barren of Radiolaria. Some of them may contain shallow water faunas (such as ostracods, pelecypods, etc.).



Text-Fig. 1 Location map of the Fields Creek Formation (modified from Dickinson and Vigrass, 1965).

In this study, more than one hundred rock samples from fifty five localities have been examined. Radiolaria have been observed from thirty seven samples. Samples from seventeen localities (Text-fig.3) consists of significant amount of taxa and recognizable radiolarian forms were studied. The type specimens are deposited at the National Museum of Natural Science, Taiwan.

METHODS

A. Sample Processing

(1) HCl-method

Concentrated HCl is used to extract siliceous or pyritized radiolaria from limestone samples (Pessagno, 1977c).

(2) HF-method

To extract siliceous radiolaria from cherts or shales, hydrofluoric acid technique (Pessagno & Newport, 1972) was utilized. In the Fields Creek Formation, most of the cherty mudstones or shales are rich in dark organic matters. Therefore, the radiolaria are usually invisible in the rock surfaces after being etched with concentrated HF for 5 minutes or so. To get clean, isolated radiolaria out from these samples, it had to place the rock fragments in dilute hydrofluoric acid (e.g., nineteen parts water to one part acid) for at least one week or longer. In this study, HF solution of various concentrations and different time periods of rock soaking have been used to rocks which are different in nature.

B. Photography and Measurements of Type Specimens

Samples containing significant radiolaria (see Text-fig.3 and Locality Descriptions) were selected for study. Radiolaria in each sample were hand picked with brush through a stereomicroscope. After preliminary analyses, the Fields Creek Radiolaria were distinguished as several major assemblages. Representative taxa of each assemblage were photoed with scanning Electron Microscope. Due to the preservation problem, transmitted light photos were unable to be taken successfully.

All the measurements of holotype and paratypes were taken with an eyepiece micrometer mounted in a stereoscopic reflected light microscope. Dimension of specimens are

given in micrometers.

LITHOSTRATIGRAPHY

The Fields Creek Formation is the oldest unit in the Aldrich Mountains Group and only exposed east of the Poison Creek Fault (Text-fig.2). It unconformably underlies the Laycock Graywacke (late Norian?) and rests unconformably on the Miller Mountain Melange, the Frenchy Butte Melange, or on the Begg Member (late Karnian?) of the Vester Formation near the northern end of the Poison Creek Fault.

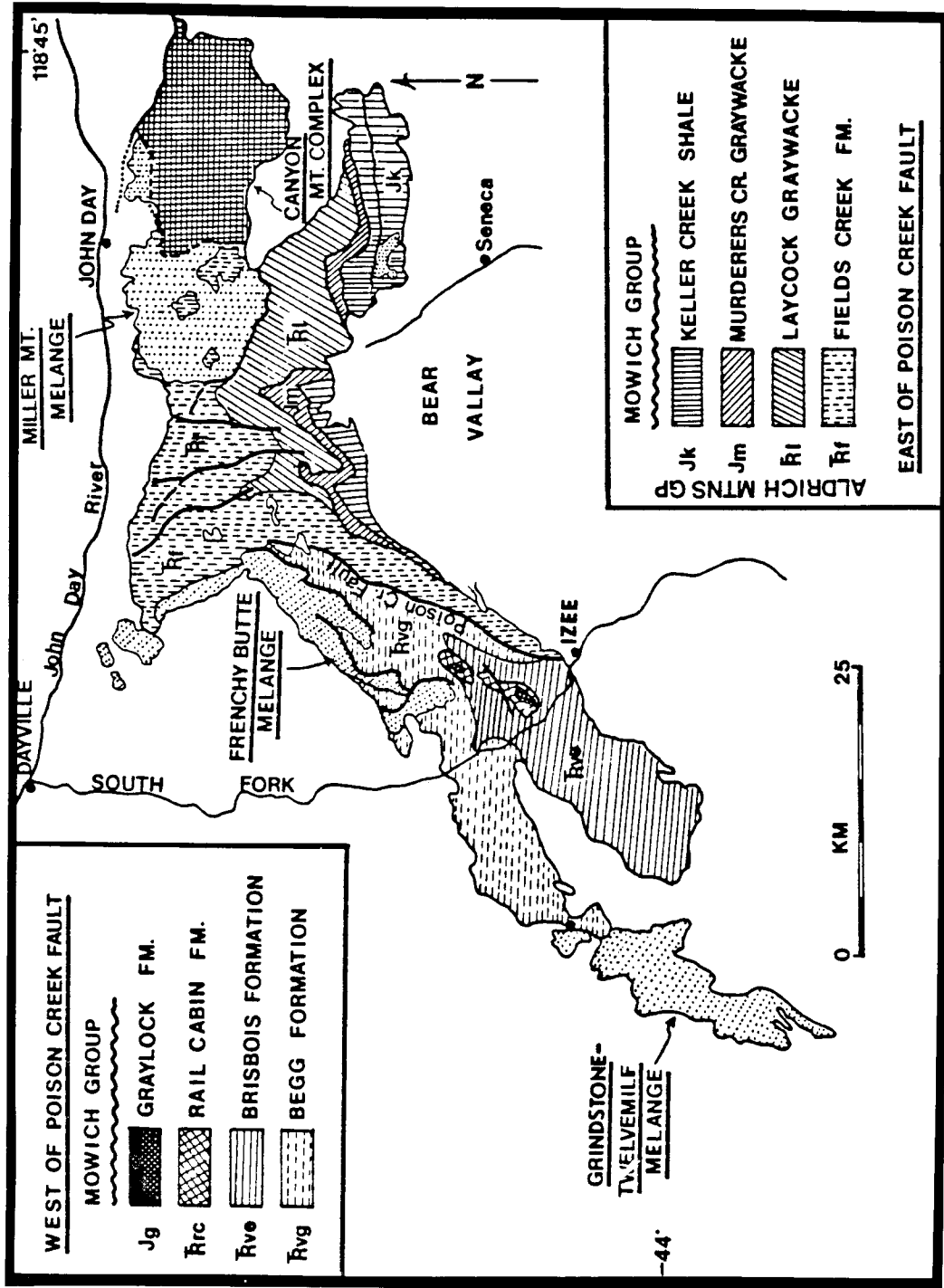
The Fields Creek Formation (Brown and Thayer, 1966a) contains, in ascending order, about 1219 meters (4000 feet) of interbedded black shale, andesitic tuff, banded chert, olistostromal limestone, and lenticular conglomerate; 2134 meters (7000 feet) of thin bedded siliceous mudstone or fissile black shale; and 1219 meters (4000 feet) of andesitic tuffs which crop out in the north-eastern part of the area.

The only diagnostic megafossil in the Fields Creek Formation is *Halorella* (a Rhynchonellid brachiopod) which ranges from upper middle Norian to upper Norian (Silberling, pers. communication with Pessagno). *Halorella* occurs in olistostromal deposits containing blocks of shallow water limestone in the lower part of the Fields Creek Formation. Assumedly, these allochthonous limestone blocks were carried into deeper water by submarine landsliding.

BIOSTRATIGRAPHY

In the Fields Creek Formation, at least four radiolarian assemblages can be recognized, they are *Corum parvum* Assemblage, *Poulpus karnicus* Assemblage, *Pseudostylosphaera magnispinosa* Assemblage, and *Orbiculiforma* sp. A Assemblage. Characteristic species, occurrence, and age determination of each assemblage are listed below.

Due to the absence of diagnostic megafossils, the biostratigraphic correlation of the Fields Creek Radiolaria is mainly based on the Radiolarian Zonation developed by Blome (1984) for the Rail Cabin Mudstone Member of the Vester Formation. Triassic Radiolarian data available from other places of the World (e.g., European Tethys, Japan, and Alaska, etc.) were also used in this study.



Text-Fig. 2 Distribution of Pre-Mowich rock units in John Day Inlier, east-central Oregon (after Dickinson and Thayer, 1978)

Fields Creek Radiolarian Assemblages**I. *Corum parvum* Assemblage***Characteristic species:*

- Capnodoce beaulieui* Blome (pl. 12, fig. 10)
Capnodoce gracilis, n. sp. (pl. 10, figs. 1, 6; pl. 11, fig. 8)
Capnodoce minuta, n. sp. (pl. 11, figs. 5, 9)
Capnodoce sp. cf. *C. extenta* Blome (pl. 10, fig. 14)
Capnodoce sp. B (pl. 10, figs. 11-12)
Capnuhosphaera colemani Blome (pl. 11, fig. 12)
Capnuhosphaera texensis, n. sp. (pl. 12, figs. 12, 14)
Corum candidium, n. sp. (pl. 9, fig. 7-8, 20-21)
Corum parvum, n. sp. (pl. 9, figs. 1-2)
Justium novum Blome (pl. 12, figs. 13, 17)
Kahlerosphaera spp. (pl. 13, figs. 1, 6, 17, 20)
Multimonilis splendidus, n. sp. (pl. 9, figs. 13, 18, 23)
Pachus longinquus Blome (pl. 8, fig. 4)
Quadrisaturnalis dickinsoni, n. sp. (pl. 13, fig. 18)
Quasipetatus spp. (pl. 6, figs. 11-12, 18, 15-16, 19)
Syringocapsa turgida Blome (pl. 11, figs. 10, 13, 19)
Triassocampe immaturum Blome (pl. 8, figs. 11-12)
Xipha pessagno Nakaseko & Nishimura (pl. 8, figs. 7-8, 13)

Occurrence. Locs. FC1A, FC1B, FC8, FC9, FC10B, FC26, FC27, FC28, FC43, FC45C, FC48, FC49, and OR120

Age. Norian.

Remarks. The age of this assemblage is determined by the presence of genus *Justium* and *Capnodoce beaulieui* Blome. According to Blome (1984), the occurrence of these taxa indicates a biostratigraphic position of *Capnodoce* Zone, top of *Justium novum* Subzone/base of *Xipha striata* Subzone.

This assemblage represents the typical fauna extracted from the mudstone or shale cropping out from the northern to the southern parts of the Fields Creek Formation. Compare to the Fauna from the limestone concretion (Loc. FC1E), this radiolarian fauna is much lower in diversity and distorted due to the poor preservation of mudstone and shale.

II. *Poulpus karnicus* Assemblage*Characteristic species:*

- Capnuhosphaera* sp. A (pl. 5, fig. 7)
Capnuhosphaera sp. B (pl. 5, fig. 10)
Capnuhosphaera sp. C (pl. 5, fig. 12)
Gorgansium browni, n. sp. (pl. 7, fig. 9)
Gorgansium thayeri, n. sp. (pl. 7, fig. 12)
Pantanellium sp. B (pl. 7, fig. 4)
Parentactinosphaera(?) longispinosa Kozur & Mostler (pl. 5, fig. 8)
Plafkerium robustum, n. sp. (pl. 3, figs. 13, 15, 16)

- Poulpus karnicus*, n. sp. (pl. 6, figs. 6-8, 13)
Quadrisaturnalis grandis, n. sp. (pl. 4, figs. 12, 16)
Sarla sp. A (pl. 5, figs. 1-2, 15, 16)
Stauracontium? trispinosum ladinicum Dumitrică, Kozur, & Mostler (pl. 3, fig. 7)
Triassocampe illyrica Kozur & Mostler (pl. 2, figs. 14, 23)
Triassocampe sp. aff. *T. illyrica* Kozur & Mostler (pl. 2, fig. 15)
Triassocampe sulovens Kozur & Mostler (pl. 2, fig. 13)
Triassocyrtium (?) sp. A (pl. 2, figs. 9, 10, 16)
Xiphotheca longa Kozur & Mostler (pl. 8, fig. 1)
Occurrence. Loc. FC1E.

Age. Karnian.

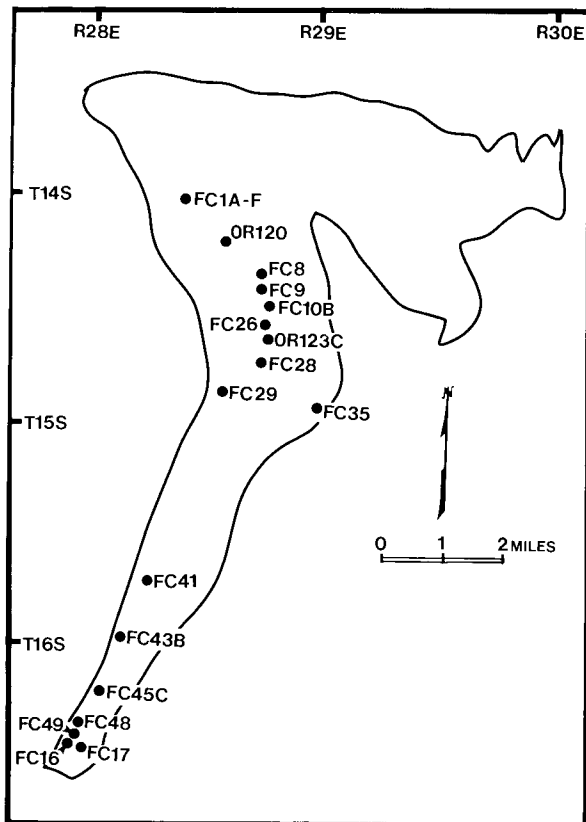
Remarks. Sample FC1E contains a radiolaria fauna which is extremely high in diversity. More than eighty species have been observed. In this report, only sixty forms are shown, most of these species are new. The age of this assemblage is indicated by the presence of *Capnodoce* (pl. 7, fig. 10) and *Gorgansium* Pessagno and Blome (1980) and *Xiphotheca* (De Wever).

III. *Pseudostylosphaera magnispinosa* Assemblage*Characteristic species:*

- Parasepsagon variabilis* (Nakaseko & Nishimura)
Pseudostylosphaera japonica (Nakaseko & Nishimura)
Pseudostylosphaera magnispinosa, n. sp. (pl. 1, figs. 1-2, 11, 18)
Pylostephanidium sp. A (pl. 1, figs. 14, 17)
Radium pessanoi, n. sp. (pl. 1, figs. 10, 13, 15)
Silicarmiger sp. A (pl. 2, figs. 19, 24)
Triassocampe sp. A (pl. 2, fig. 3)
Yeharaia elegans Nakaseko & Nishimura (pl. 2, fig. 17)
Yeharaia sp. aff. *Y. elegans* Nakaseko & Nishimura (pl. 2, fig. 18)
Spumellaria gen. and sp. indet. A (pl. 7, figs. 18, 22)
Nassellaria gen. and sp. indet. B (pl. 8, figs. 5-6, 17, 21)
Occurrence. Loc. OR123C.

Age. Ladinian (?).

Remarks. In the European Tethys, *Parasepsagon* Dumitrică, Kozur and Mostler (1980), *Pylostephanidium* Dumitrică (1978) have been observed in the Ladinian assemblages. *Pseudostylosphaera* spp. may range from middle to upper Triassic (Kozur and Mostler, 1981; Yao, 1982). Since the definite range of each species is



Text-Fig. 3 Radiolarian collecting localities in the Fields Creek Formation

still not certain, the age of this assemblage is temporarily assigned to Ladinian. The present author believes that the true *Gorgansium* Pessagno and Blome is absent in this assemblage. A similar radiolarian assemblage has been found from the Vance Creek area, east-central Oregon (Blome, 1984).

IV. *Orbiculiforma* sp. A Assemblage

Characteristic species:

Canoptum sp. B (p1. 14, fig. 2)

Karnospongella sp. (p1. 14, fig. 5)

Orbiculiforma sp. A (p1. 14, fig. 13)

Crucella sp. A (p1. 14, fig. 14)

Sontonaella sp. A (p1. 14, fig. 6)

Spumellaria gen. and sp. indet. C (p1. 14, fig. 4)

Spumellaria gen. and sp. indet. D (p1. 14, fig. 9)

Occurrence. Loc. FC35.

Age. Late Norian, or Hettangian.

Remarks. This assemblage was only observed in the central-eastern part of the Fields Creek Formation (Loc. FC35). The lateral extension of shales which contain this assemblage is not definitely

known. The age of this fauna is questionably assigned to late Norian/Hettangian by the presence of *Orbiculiforma* sp. A and the absence of *Capnodoce* spp. and *Capnuchosphaera* spp..

DISCUSSION

Shale or mudstone samples collected from most parts of the Fields Creek outcrop area (see occurrence of the *Corum parvum* Assemblage) contain a similar radiolarian fauna. The presence of *Capnodoce* spp., *Justium* spp., *Pachus* spp., and *Xipha* spp. indicates that *Corum parvum* Assemblage is of Norian age. According to Robinson (1988, unpublished thesis, UT-Dallas), the presence of *Capnuchosphaera texensis*, n. sp., *Kahlerosphaera* spp., and *Quasipetatus* spp. indicates that this assemblage is possibly of late Karanian age and not younger than early Norian.

The *Orbiculiform* sp. A Assemblage only observed in the central eastern part of the Fields Creek Formation (Loc. FC35). The definite age of this assemblage is not known. However, the absence of *Capnodoce* spp., *Capnuchosphaera* spp. and *Justium* spp. indicates that this assemblage is possible no older than late Norian. The presence of *Orbiculiforma* sp. A, and some other undescribed spumellarian spp. (p1. 14, figs. 4, 9) indicates that this fauna is possibly of late Norian or of Early Jurassic age. If this is true, the deposition of the Field Creek sediments may have initiated from Triassic and continued till Early Jurassic. To clarify this point of view, more studies on the stratigraphic relationship between this outcrop (Loc. FC35) and the other parts of the Fields Creek Formation need to be done. It is also possible that this area (Loc. FC35) is the western extension of the Murderers Creek Graywacke or part of the Keller Creek Shale.

Sample FC1E is a small limestone nodule collected from a structurally complex section (Loc. FC1, see Text-fig.3 and Locality Descriptions). This section is characterized by graded beds of tuffaceous sandstones, chert clast conglomerate and intercalated dark mudstone layers. This limestone nodule contains very abundant, well-preserved, pyritized radiolaria including *Canoptum* spp., *Capnuchosphaera* spp., *Gorgansium* spp., *Pantanellium* spp., *Sarla* spp., *Austrisaturnalis* spp., *Heliosoma carinata* Kozur and Mostler, *Poulpus* spp., *Pseudosaturniforma minuta* Blome, *Quadrisaturnalis* spp., and *Capnodoce* spp., etc..

This assemblage is possible of Karnian age. So far no identical or similar Karnian radiolarian faunas have been reported from other units in this area. It is obvious that the Karnian radiolaria in this limestone nodule were reworked from older deposits because the black mudstone layers above and below (samples FC1A and FC1B, see Text-fig.3 and Locality Descriptions) this nodule contain Radiolaria of Norian age.

Sample OR123C, a cherty mudstone, was collected near the base of the Fields Creek Formation (Blome, 1984). This sample contains abundant radiolaria including *Parasepsagon variabilis* (Nakaseko and Nishimura), *Radium pessagnoii*, n. sp., *Pseudostylosphaera magnispinosa*, n. sp., *Silicarmiger* spp., and *Yeharaia* spp., etc.. This assemblage is correlative with the black chert of late Ladinian/early Karnian age from the Miller Mountain Melange at the Vance Creek area (Blome 1984). The presence of this radiolarian assemblage may indicate that the deposition of the Fields Creek sediments have initiated from Middle Triassic Ladinian time. Sample OR123C may represent a block of cherty mudstone in an olistostrome. It could be derived from chert masses occurring in the underlying Miller Mountain Melange.

Pseudostylosphaera is abundant and present as a number of species in sample OR123C but relatively rare in the other samples of Fields Creek Formation. The occurrence of *Pseudostylosphaera* in the Fields Creek Formation indicates reworking from the Karnian or Ladinian deposits.

SYSTEMATIC PALEONTOLOGY

Order POLYCYSTIDA Ehrenberg, 1938
Suborder SPUMELLARIINA Ehrenberg, 1875
Superfamily ACTINOMMACEA Haeckel, 1862; emend. Kozur and Mostler, 1979.

Family CENTROLONCHIDAE Campbell, 1954; emend. Kozur and Mostler, 1979

Subfamily CENTROLONCHINAE Campbell, 1954; emend. Kozur and Mostler, 1979

Type genus. *Centrolonchini* Campbell, 1954

Range. Cambrian?; Ordovician to Recent.

Occurrence. Austria, east-central Oregon.

Genus *Parentactinosphaera* Kozur and Mostler, 1979

Type species. *Parentactinosphaera oertlii* Kozur and Mostler, 1979

Range. Paleozoic to Recent.

Occurrence. Austria, east-central Oregon.

Parentactinosphaera ? *longispinosa* Kozur and Mostler, 1979

Range. Paleozoic to Triassic (Karnian).

Occurrence. Austria, and Fields Creek Formation (Loc. FC1E), east-central Oregon.

Superfamily SPONGODISCACEA Haeckel, 1881; emend. Pessagno, 1971, 1973.

Subsuperfamily SPONGODRUPPILAE Haeckel, 1887; emend. Pessagno, 1973.

Range. Triassic to Recent.

Occurrence. Worldwide.

Family PARASATURNALIDAE Kozur and Mostler, 1972; emend. Pessagno, 1979.

Type genus. *Parasaturnalis* Kozur and Mostler, 1972.

Range. Upper Triassic (Karnian) to Upper Cretaceous (Maestrichtian).

Occurrence. Worldwide.

Subfamily PARASATURNALINAE Kozur and Mostler, 1972; emend. Pessagno, 1979.

Type genus. *Parasaturnalis* Kozur and Mostler, 1972.

Range. Upper Triassic (Karnian) to Upper Cretaceous (Maestrichtian).

Occurrence. Worldwide.

Genus *Acanthocircus* Squinabol, 1903; emend. Pessagno, 1979.

Type species. *Acanthocircus irregularis* Squinabol, 1903 (Subsequent designation by Campbell, 1954, p. D106).

Acanthocircus Squinabol, 1903, p. 124.

Spongosaturninus Campbell and Clark, 1944, p. 7 (*Type species* = *S. elliptus* Campbell and Clark).

Range. Upper Triassic (Norian) to Upper Cretaceous (Maestrichtian).

Occurrence. Worldwide.

Acanthocircus sp. aff. *A. rotundus* Blome, 1981. Plate 13, figure 3

Acanthocircus rotundus Blome, 1984, p. 24-25, pl. 2, figs., 4, 5, 15

Remarks. Only several broken specimens of this form were found from locality FC28, Fields Creek Formation. These specimens resemble Blome's

paratype (pl. 2, fig. 5, Blome, 1984) by having a disk-shaped spongy cortical shell and a narrow ring which is ellipsoidal in outline.

Range. Upper Triassic (upper Karnian?; lower to upper middle Norian).

Occurrence. Rail Cabin Mudstone, Fields Creek Formation (Loc. FC28), east-central Oregon.

Genus *Austrisaturnalis* Kozur and Mostler

Type species. *Austrisaturnalis quadriradiatus* Kozur and Mostler, 1972

Range. Triassic, so far as known.

Occurrence. Austria, east-central Oregon.

Austrisaturnalis sp. aff. *A. quadriradiatus* Kozur and Mostler

Plate 4, figure 11

Austrisaturnalis quadriradiatus Kozur and Mostler, 1972, p. 31; pl. 2, fig. 2.

Remarks. This form resembles *A. quadriradiatus* Kozur and Mostler by having a wide, circular ring which lacks peripheral spines and by having a latticed spherical cortical shell which is connected to the ring by four polar spines.

Range. Upper Triassic (Karnian).

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

Genus *Quadrisaturnalis*, n. gen.

Type species. *Quadrisaturnalis gradis*, n. sp.

Description. Single ringed parasaturnalids with four polar spines connected to latticed cortical shell and medullary shells. Polar spines equally spaced. Ring lacking auxiliary spines. Number of peripheral spines varied; well developed forms often consisting of even number of peripheral spines.

Remarks. *Quadrisaturnalis*, n. gen. differs from *Praeheliostaurus* Kozur and Mostler by lacking auxiliary spines. *Quadrisaturnalis*, n. gen. differs from *Acanthocircus* Squinabol by having four equally spaced polar spines rather than two opposed polar spines.

Etymology. *Quadrisaturnalis* = four + *saturnalis*.

Range and Occurrence. Upper Triassic so far as known. Fields Creek Formation, east-central Oregon.

Quadrisaturnalis dickinsoni, n. sp.

Plate 13, figure 18

Description. Ring moderately wide, subcircular in

outline, consisting of 8 long, massive peripheral spines. Ring cavity small, 4 polar spines than, and slender, extending along two axes at right angle to each other. Cortical shell and medullary shells not observed.

Remarks. This form differs from *Q. quadratus*, n. sp., by having a ring which is subcircular to circular in outline and by having 8 peripheral spines which are long, massive, and more or less equal in size. These two forms are questionably assigned to this genus, since the structures of cortical shell and medullary shell(s) are not observable from these broken specimens.

Etymology. This species is named for Dr. W. R. Dickinson, in honor of his contributions to the studies of the geology of Suplee-Izee area.

Measurements (um):

Diameter (ring cavity)	Width (ring)	Length (peripheral spines)	
115	45	90	Holotype
120	50	110	Maxi., 5 specimens
90	30	60	Mini., 5 specimens
110	40	85	Average, 5 specimens

Type locality. Holotype from Loc. FC43B. See *Locality Descriptions*.

Deposition of type. Holotype, NMNS(000851). Paratypes, NMNS(000852) and Yeh Collection.

Range. upper Triassic.

Occurrence. Fields Creek Formation, east-central Oregon.

Quadrisaturnalis sp. cf. *Q. dickinsoni*, n. sp.

Plate 13, figure 14

Remarks. This form differs from *Q. dickinsoni*, n. sp., by having two sets of small secondary peripheral spines between two longer primary peripheral spines (along the polar axis).

Range. upper Triassic.

Occurrence. Fields Creek Formation (Loc. FC43B), east-central Oregon.

Quadrisaturnalis gradis, n. sp..

Plate 4, figures 12, 16

Description. Latticed cortical and medullary shells relatively small, square to subcircular in outline, attached to 4 slender polar spines of the ring. Ring narrow to medium in width, with 8 massive

peripheral spines; 4 polar spines and 4 linger peripheral spines aligned along two axes at right angle to each other. Ring cavity large, length of cortical shell along polar spines nearly 7/8 of diameter of ring cavity. Number of medullary shell(s) not known, at least two.

Remarks. This form differs from *Q. quadratus*, n. sp., by having a larger, ring which consists of 8 short peripheral spines and a large, circular ring cavity.

Etymology. Grandis-e (Latin, adj.) = large.

Measurements (um):

Diameter (ring cavity)	Diameter (medullary shells)	width (ring)	
90	60	23	Holotype
90	60	30	Maxi., 5 specimens
85	55	20	Mini., 5 specimens
88	58	23	Average, 5 specimens

Type locality. Holotype and paratypes from Loc. FC1E. See Locality Descriptions.

Deposition of types. Holotype, NMNS(000853). Paratypes, NMNS(000854) and Yeh Collection.

Range. Upper Triassic (upper Karnian).

Occurrence, Fields Creek Formation (Loc. FC1E), east-central Oregon.

***Quadrisaturnalis quadratus*, n. sp..**

Plate 13, figures 16, 19, 21

Description. Ring narrow, square in outline, consisting of 8 peripheral spines, 4 of which long, extending out from center of 4 sides of the square ring, 4 short peripheral spines extending out from 4 corners of the square ring. Four polar spines relatively massive. Ring cavity moderately large. Cortical shell and medullary shells not observed.

Remarks. This species was compared with *Q. grandis*, n. sp. under the latter species.

Etymology. *Quadratus-a-um* (Latin, adj.) = square.

Measurements (um):

Diameter (cavity)	Width (ring)	Length (peripheral spines)	
100	30	70	Holotype
115	45	90	Maximum, 4 specimens
90	30	60	Minimum, 4 specimens
100	35	70	Average, 4 specimens

Type locality. Holotype from Loc. FC43B. See Locality Descriptions.

Deposition of types. Holotype, NMNS(000855). Paratypes, NMNS(000856) and Yeh Collection.

Range. Upper Triassic.

Occurrence. Fields Creek Formation (Locs. FC43B, FC49), east-central Oregon.

***Quadrisaturnalis* sp. A.**

Plate 4, figures 1, 2, 14, 15

Remarks. Note the cortical shell attached to the ring by four forcep-like polar spines (plate 4, figs. 14,15).

Range. Upper Triassic (Karnian?)

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

***Quadrisaturnalis* sp. B**

Plate 4, figure 4

Remarks. The form differs from *Q. grandis* n. sp. by having a test with wider ring and by having a small central hollow area.

Range. Upper Triassic (Karnian?)

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

***Quadrisaturnalis* sp. C**

Plate 4, figures 5, 13

Remarks. The form differs from other *Quadrisaturnalis* spp. in this report by having a extremely wide ring with 8 short peripheral spines, and by having a small central hollow area.

Range. Upper Triassic (Karnian?)

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

***Quadrisaturnalis* sp. D**

Plate 4, figure 6

Remarks. The form differs from *Q. sp. B* by having a test with a ring which is uneven in width, and by having only four peripheral spines rather than eight.

Range. Upper Triassic (Karnian?)

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

***Quadrisaturnalis* sp. E**

Plate 4, figures 7, 9-10

Remarks. The form differs from other

Quadrisaturnalis spp. in this report by having a large, spherical cortical shell which completely occupies the central hollow area. The circular pores of cortical shall medium in size and evenly spaced.

Range. Upper Triassic (Karnian?)

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

***Quadrisaturnalis* sp. F**
Plate 4, figure 8

Remarks. The form differs from *Q. grandis*, n. sp., by having relatively poorly developed peripheral spines.

Range. Upper Triassic (Karnian?)

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

***Quadrisaturnalis* sp. G**
Plate 13, figure 12

Range. Upper Triassic.

Occurrence. Fields Creek Formation (Loc. FC43B), east-central Oregon.

***Quadrisaturnalis* sp. H.**
Plate 13, figure 13

Range. Upper Triassic.

Occurrence. Fields Creek Formation (Loc. FC43B), east-central Oregon.

Superfamily LIOSPHAERACEA Haeckel, 1881
Subsuperfamily LIOSPHAERILAE Haeckel, 1881

Range. and Occurrence Triassic to Recent, Worldwide.

Family CAPNUCHOSPHERIDAE Dw Wever, 1979; emend. Pessagno, 1979; emend. Blome, 1983

Type genus. *Capnuchosphaera* De Wever, 1979

Remarks. The capnuchosphaerid with four spines (plate 5, figs. 11,14) is also present in the Fields Creek radiolarian fauna (Loc. FC1E).

Range. Upper Triassic (upper Karnian to middle Norian).

Occurrence. Worldwide.

Genus ***Capnuchosphaera*** De Wever, 1979; emend. Blome, 1983; emend.

Type species. *Capnuchosphaera triassica* De Wever
Emended definition. cortical shell connecting to first medullary shell with three primary radial beams;

primary radial beams triradiate with three ridges alternating with three grooves.

Remarks. *Capnuchosphaera* consists of solids, triradiate primary beams (pl. 12, fig. 16) rather than hollow beams.

Range. Upper Triassic (upper Karnian to upper middle Norian).

Occurrence. Baja California, east-central Oregon, California, Alaska, British Columbia, Oman, Greece, Sicily, Turkey, and Japan.

Capnuchosphaera colemani Blome, 1983
Plate 11, figure 12; Plate 12, figure 6

Capnuchosphaera colemani Blome, 1983, P. 28, pl. 3, fig. 8

Range. Upper Triassic (upper Karnian?: lower to upper middle Norian).

Occurrence. Rail Cabin Mudstone, Fields Creek Formation (Locs. OR120, FC28), east-central Oregon.

Capnuchosphaera* sp. aff. *C. sockensis Blome
Plate 12, figure 5

Capnuchosphaera sockensis Blome, p. 17, pl. 2, figs. 2,13,14,16

Remarks. This poorly preserved form closely resembles *C. sockensis* Blome by having cortical shell and spinal shafts, with pore frames of similar structures.

Range. Upper Triassic (Karnian? Norian)

Occurrence. Fields Creek Formation (Loc. OR120), east-central Oregon.

***Capnuchosphaera texensis*, n. sp.**
Plate 12, figures 12,14

Description. Cortical shell large, subspherical in outline; outer layer consisting of variable sized tetragonal, pentagonal and hexagonal pore frames: inner layer consisting of smaller, uniformly sized polygonal pore frames. Tumidaspiniae comprised of short, triradiate spinal shafts, well-developed spinal tumors, and a massive spinal tunnel which is perforated proximally. Length of tumidaspiniae slightly shorter than diameter of test.

Remarks. This form differs from *C. schenki* Blome and *C. smithorum* Blome by having a relatively short spinal shaft and a massive spinal tumor which is broader in cross section.

Etymology. This species derives its name from the type locality, the Tex Creek, located south of John

Day, east-central Oregon.

Measurements (um):

Diameter (cortical shell)	Length (primary spines)	
150	120	Holotype
160	125	Maxi., 4 specimens
120	90	Mini., 4 specimens
140	115	Average, 4 specimens

Type locality. Holotype and paratype from Loc. FC28. See Locality Descriptions.

Deposition of types. Holotype, NMNS(000857). Paratype, NMNS(000858) and Yeh Collection.

Range. Upper Triassic (upper Karnian to lower Norian).

Occurrence. Fields Creek Formation (Locs. FC27, FC28), east-central Oregon; Glenn Shale, east-central Alaska.

***Capnuhosphaera* sp. aff. *C. texensis*, n. sp.**

Plate 12, figure 11

Remarks. This form is slightly different from *C. texensis* n. sp. by having longer spines.

Range. Upper Triassic.

Occurrence. Fields Creek Formation (Loc. FC28), east-central Oregon.

***Capnuhosphaera* sp. A**

Plate 5, figure 7

Range. Upper Triassic (Karnian?)

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

***Capnuhosphaera* sp. B**

Plate 5, figure 10

Remarks. This form differs from *C. sp. A* by having slenderer spinal shafts with longer spines.

Range. Upper Triassic (Karnian?)

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

***Capnuhosphaera* sp. C**

Plate 5, figure 12

Range. Upper Triassic (Karnian?)

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

***Capnuhosphaera* sp. D**

Plate 12, figure 9

Range. Upper Triassic.

Occurrence. Fields Creek Formation (Loc. FC28), east-central Oregon.

***Capnuhosphaera* sp. E**

Plate 12, figure 16

Remarks. This broken specimens shows that the medullary shell connected to the cortical shell with triradial primary beams.

Range. Upper Triassic.

Occurrence. Fields Creek Formation (Loc. OR120), east-central Oregon.

Genus *Catoma* Blome, 1983.

Type species. *Catoma geometrica* Blome, 1983.

Range. Upper Triassic (upper Karnian to upper middle Norian).

Occurrence. East-central Oregon, and east-central Alaska.

***Catoma* sp. A**

Plate 14, figure 11

Range and Occurrence. Upper Triassic. Fields Creek Formation (Loc. FC10B), east-central Oregon.

Genus *Icrioma* De Wever, 1979; emend. Blome, 1983

Type species. *Icrioma tetrancistra* De Wever, 1979.

Range. Upper Triassic (upper Karnian to upper middle Norian)

Occurrence. East-central Oregon, and Turkey.

***Icrioma* sp. A**

Plate 14, figures 7, 8

Range Upper Triassic.

Occurrence. Fields Creek Formation (Loc. FC10B), east-central Oregon.

Genus *Sarla* Pessagno, 1979

Type species. *Sarla prietoensis* Pessagno, 1979

Range. Upper Triassic (lower Karnian to upper Norian).

Occurrence. Baja California, east-central Oregon, Alaska, and British Columbia.

***Sarla formosa*, n. sp.**

Plate 13, figures 15, 23

Description. Cortical shell spherical, comprised of two layers, outer layer of moderately large tubercles interconnected by thin radial bars, radial bars forming large irregular, triangular, tetragonal pore frames; inner layer of small irregular polygonal pore frames. Primary spines equidistant, radially arranged, approximately equal in length, triradiate with 3 grooves alternating with 3 ridges, grooves as wide as ridges proximally; grooves increasing and ridges decreasing in width distally; all three spines displaying slightly torsion of ridges and grooves. Length of a given primary spines equal to diameter of test.

Remarks. This form differs from other *Sarla* spp. in this report by having a large, spherical, nodose cortical shell.

Etymology. *formosus-a-um* (Latin, adj.) = beautiful.

Measurements (um):

Diameter (cortical shell)	Length (primary spines)	
150	120	Holotype
150	150	Maxi., 6 specimens
120	90	Mini., 6 specimens
140	120	Average, 6 specimens

Type locality. Holotype from Loc. FC43B. See Locality Descriptions.

Deposition of types. Holotype, NMNS(000859). Paratypes, NMNS(000860) and Yeh Collection.

Range. Upper Triassic (upper Karnian?; lower to upper middle Norian).

Occurrence. Fields Creek Formation (Loc. FC43B), east-central Oregon.

***Sarla* sp. cf. *S. formosa*, n. sp.**

Plate 13, figures 10-11

Remarks. This form differs from *S. formosa*, n. sp. B by having a cortical shell which is subtriangular rather than spherical in shape.

Range. Upper Triassic (Norian)

Occurrence. Fields Creek Formation (Loc. FC43B), east-central Oregon.

***Sarla triangulata*, n. sp.**

Plate 13, figures 2, 4

Description. Cortical shell subtriangular in outline; outer layer consisting of variable sized polygonal (mostly pentagonal) pore frames; inner layer consisting of small, relatively uniformly sized polygonal pore frames. Primary spines long, equal in length, equidistant, radially arranged, extending out from each triangular side; triradiate with 3 wide grooves alternating with 3 massive ridges; grooves twice as wide as ridges; ridges and grooves remaining the same width through much of their length. Length of test along triangular side about half as long as a given primary spine.

Remarks. This form differs from other *Sarla* spp. in this report by having a relatively small, triangularly shaped cortical shell.

Etymology. *Triangulatus-a-um* (Latin, adj.) = Triangle-shaped.

Measurements (um):

Diameter (cortical shell)	Length (primary spines)	
100	160	Holotype
120	150	Maximum, 5 specimens
75	105	Minimum, 5 specimens
95	135	Average, 5 specimens

Type localities. Holotype and paratype from Loc. FC43B. See Locality Descriptions.

Deposition of types. Holotype, NMNS(000861). Paratypes, NMS(000862) and Yeh Collection.

Range. Upper Triassic (upper Karnian?; Lower to upper middle Norian).

Occurrence. Fields Creek Formation (Loc. FC43B), east-central Oregon.

***Sarla*(?) sp. A**

Plate 5, figures 1, 2, 15, 16

Remarks. This form is questionably assigned to genus *Sarla* because the presence of secondary radial beams, which has never been clearly defined in the previous reports.

Range. Upper Triassic.

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

Sarla sp. B

Plate 5, figure 4

Range. Upper Triassic.

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

Sarla sp. C

Plate 5, figure 5

Remarks. This form differs from *Sarla* sp. B by having a larger cortical shell with thick primary spines.

Range. Upper Triassic.

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

Sarla(?) sp. D

Plate 5, figure 6

Remarks. This form differs from *Sarla(?)* sp. A by having straight primary spines rather than twisting spines.

Range. Upper Triassic.

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

Sarla sp. E

Plate 5, figures 9, 13

Range. Upper Triassic.

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

Sarla sp. F

Plate 11, figure 14

Range. Upper Triassic.

Occurrence. Fields Creek Formation (Loc. OR120), east-central Oregon.

Sarla sp. G

Plate 12, figure 2

Range. Upper Triassic.

Occurrence. Fields Creek Formation (Loc. OR120), east-central Oregon.

Family PANTANELLIDAE Pessagno, 1977b; emend. Pessagno and Blome, 1980.

Type genus. *Pantanellium* Pessagno, 1977a.

Range. Upper Triassic (Karnian) to Lower Cretaceous (Albian).

Occurrence. Worldwide.

Subfamily CAPNODOCINAE Pessagno, 1979; emend. Blome, 1983

Type genus. *Capnodoce* De Wever, 1979.

Range. Upper Triassic (upper Karnian to upper middle Norian).

Occurrence. Worldwide.

Genus **Capnodoce** De Wever, 1979; emend. Pessagno, 1979; emend. Blome, 1983Type species. *Capnodoce anapetes* De Wever, 1979.

Range. Upper Triassic (upper Karnian to upper middle Norian).

Occurrence. Worldwide.

Capnodoce beaulieui Blome, 1983

Plate 12, figure 10

Capnodoce beaulieui Blome, 1983, p. 25, pl. 6, figs. 1, 8, 13, 15

Range. Upper Triassic (upper Karnian?; lower to upper middle Norian).

Occurrence. Rail Cabin Mudstone, Fields Creek Formation, east-central Oregon.

Capnodoce sp. cf. *C. extenta* Blome

Plate 10, figure 14

Capnodoce extenta Blome, 1983, pl. 6, figs. 3, 7, 9, 17Remarks. This form differs from *C. extenta* Blome by having a cortical shell with smaller nodes at pore frame vertices.

Range. Upper Triassic (Norian);

Occurrence. Fields Creek Formation (Loc. FC28), east-central Oregon.

Capnodoce minuta, n. sp.

Plate 11, figures 5, 9

Description. Cortical shell subspherical, slightly compressed in plane of primary spines; meshwork consisting mostly of hexagonal pore frames with nodes at vertices: base of pore frames thin in Y direction, thick in Z direction; nodes low in relief. Four to six pore frames visible along the axis of a given primary spine. Primary spines tubular, maintaining the same diameter over much of their length, with internal tripartite partition and pointed tip. Two primary spines about equal in length, slightly shorter than third spine, and closer together. Diameter of cortical shell approximately equal to length of the longest spine.

Remarks. This form differs from *C. gracilis*, n. sp., by having 3 thin and slender primary spines, two of which are equal in length and slightly shorter than the third spine which is situated normally at one side of cortical shell.

Etymology. *Minutus-a-um* (Latin, adj.) = small.

Measurements (um): System of measurement show in Text-fig.4.

Diameter (cortical shell)	Length (primary spines)			
	S1	S2	S3	
120	105	70	65	Holotype
105	120	70	60	Maxi., 5 spc.
90	90	60	60	Mini., 5 spc.
100	105	65	65	Ave., 5 spc.

Type locality. Holotype and paratypes from Loc. C28. See Locality Descriptions.

Deposition of types. Holotype, NMNS(000863). Paratypes, NMNS(000864) and Yeh Collection.

Range. Upper Triassic (lower to upper middle Norian).

Occurrence. Fields Creek Formation, east-central Oregon.

Capnodoce gracilis, n. sp.

Plate 10, figures 1,6; plate 11, figure 8

Description. Cortical shell subspherical to circular in outline, slightly compressed in the plane of primary spines; meshwork consisting predominately of hexagonal pore frames with nodes at vertices. Bars of pore frames thin in Y direction, moderately thick in Z direction. Five to six pore frames visible along an axis of given primary spine. Primary spines slender, tubular, with pointed tips and internal tripartite partitions, maintaining the same diameter through most of their length. All three spines unequal in length, two shorter ones closer together; third spine about twice as long as short spines and nearly equal to diameter of test. The longest spine often inclining to the side of the shortest spine.

Remarks. *Capnodoce gracilis*, n. sp. differs from *C. minuta*, n. sp. by having primary spines which are unequal in length, two short ones are closer together, the third spine is longer and often inclines to the side of the shortest spine.

Etymology. *Gracilis-e* (Latin, adj.) = slender.

Measurements (um): System of measurement shown in Text-fig.4.

Diameter (cortical shell)	Length (primary spines)			
	S1	S2	S3	
112	175	98	70	Holotype
98	112	70	56	Paratype
115	180	100	70	Maxi., 5 specimens
110	150	85	65	Mini., 5 specimens
112	170	95	66	Average, 5 specimens

Type locality. Holotype and paratypes from Loc. FC28. See Locality Descriptions.

Deposition of types. Holotype, NMNS(000865). Paratypes, NMNS(000866) and Yeh Collection.

Range. Upper Triassic (upper Karnian?; lower to upper middle Norian).

Occurrence. Fields Creek Formation, east-central Oregon.

Capnodoce(?) sp. A

Plate 11, figure 6

Remarks. This is an immature form of *Capnodoce*, it consists of two tubular primary spines and one triradiate spine which has 3 extremely wide ridges alternating with 3 very narrow grooves.

Range. Upper Triassic (upper Karnian?; lower to upper middle Norian).

Occurrence. Loc. FC28, Fields Creek Formation, east-central Oregon.

Capnodoce sp. B

Plate 10, figures 11, 12

Remarks. This form differs from *C. gracilis*, n. sp. by having a cortical shell which is more compressed to the plane of primary spines.

Range. Upper Triassic (upper Karnian?; lower to upper middle Norian).

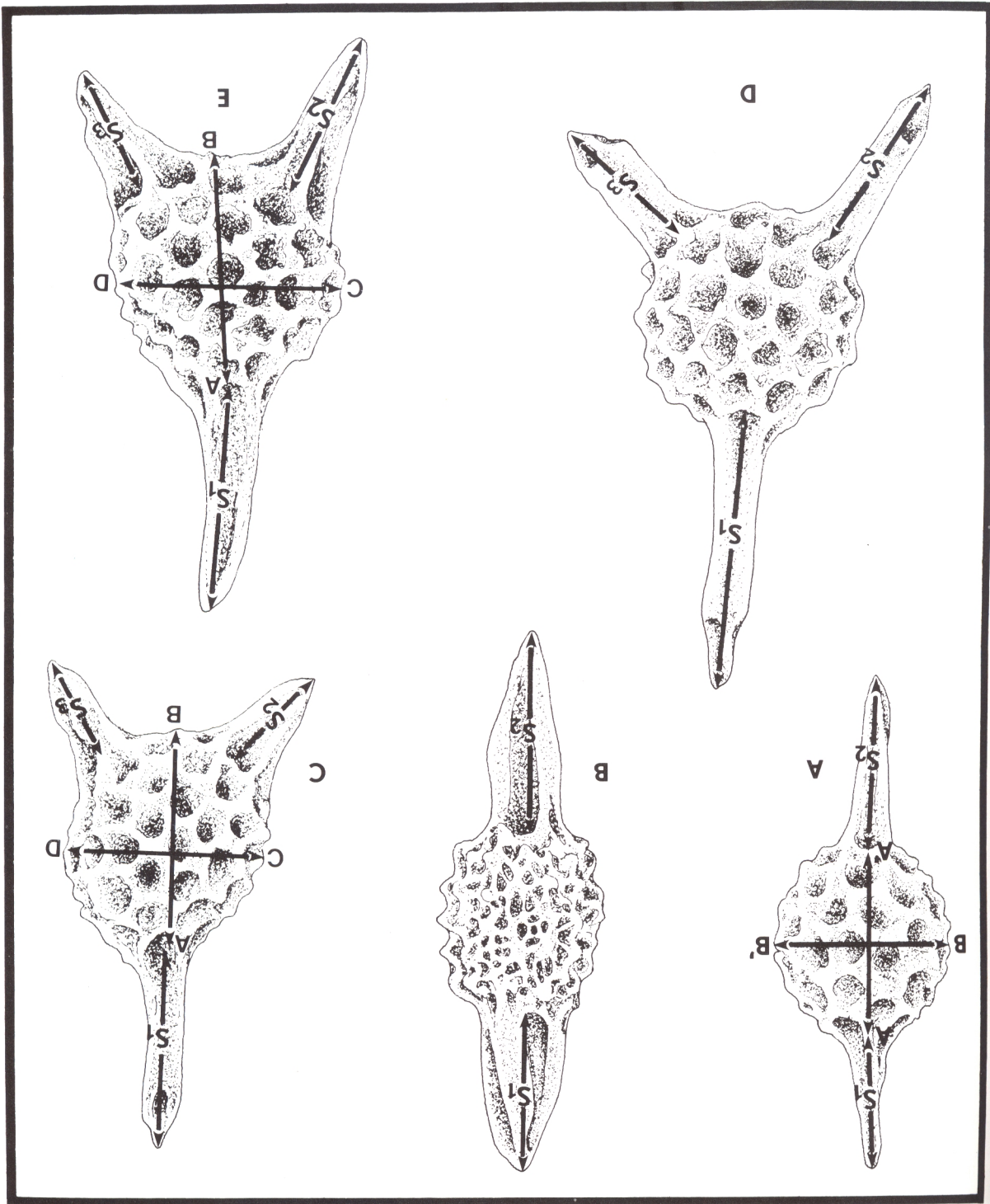
Occurrence. Fields Creek Formation (Loc. FC28), east-central Oregon.

Capnodoce sp. C

Plate 7, figure 10

Range. Upper Triassic (Karnian?).

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.



Text-Fig. 4 Schematic diagram depicting the method of measurement of some Spumellarina having spines of different length: (A) *Pantanelium* sp., (B) *Pseudostylosphaera*, (C) *Justium* sp., (D) *Cap-nodoce* sp., (E) *Gorgansium* sp..

***Capnodoce* sp. D**

Plate 10, figure 7

Range. Upper Triassic (Norian).*Occurrence.* Fields Creek Formation (Loc. OR120), east-central Oregon.***Capnodoce* sp. E**

Plate 10, figure 17

Range. Upper Triassic (Norian).*Occurrence.* Fields Creek Formation (Loc. FC28), east central Oregon.***Capnodoce* sp. F**

Plate 10, figure 18

Range. Upper Triassic (Norian).*Occurrence.* Fields Creek Formation (Loc. FC28), east-central Oregon.***Capnodoce* sp. G.**

Plate 11, figure 1

Range. Upper Triassic (Norian).*Occurrence.* Fields Creek Formation (Loc. FC28), east-central Oregon.***Capnodoce* sp. H**

Plate 12, figure 3

Range. Upper Triassic (Norian).*Occurrence.* Fields Creek Formation (Loc. OR120), east-central Oregon.***Capnodoce* sp. I**

Plate 12, figures 4, 8, 15

Range. Upper Triassic (Norian).*Occurrence.* Fields Creek Formation (Loc. OR120), east-central Oregon.***Capnodoce* sp. J.**

Plate 12, figure 7

Range. Upper Triassic (Norian).*Occurrence.* Fields Creek Formation (Loc. OR120), east-central Oregon.**Genus *Justium* Blome, 1983***Type species.* *Justium novum* Blome, 1983*Range.* Upper Triassic (upper Karnian?: lower to upper middle Norian).*Occurrence.* Baja California, east-central Oregon.***Justium medium*, n. sp.**

Plate 10, figure 3; Plate 11, figures 2, 3, 15

Description. Cortical shell ovate to circular in outline, consisting predominately of hexagonal pore frames with poorly developed nodes at vertices; bars of pore frames thin to moderate in Y direction, thick in Z direction. Five to six pore frames visible along AB and CD. One primary spine tubular with tripartite internal partitions, nearly twice as long as the other two spines; two short spines closer together, triradiate with 3 grooves alternating with 3 ridges, one of triradiate spines having extremely wide ridges almost connected as a tubular spine.*Remarks.* This form is distinguished from other species of *Justium* in this paper by having a triradiate primary spine which consists of three extremely wide ridges alternating with three very narrow grooves.*Etymology.* *Medius-a-um* (Latin, adj.) = intermediate. *Measurements* (um): System of measurement shown in Text – fig.4.

Diameter (cortical shell)	Length (primary spines)			
	S1	S2	S3	
105	90	45	45	Holotype
120	120	45	45	Maxi., 3 specimens
100	60	35	35	Mini., 3 specimens
105	90	42	42	Average, 3 specimens

Type locality. Holotype and paratype from Loc. FC28. See Locality Descriptions.*Deposition of types.* Holotype, NMNS(000867). Paratype, NMNS(000868) and Yeh Collection.*Range.* Upper Triassic (upper Karnian?: lower to upper middle Norian).*Occurrence.* Fields Creek Formation (Loc. FC28), east-central Oregon.***Justium novum* Blome**

Plate 12, figures 13, 17

Justium novum Blome, 1983, pp. 44, 46, pl. 10, figs. 3, 9, 10, 14.*Range.* Upper Triassic (upper Karnian?: lower to upper middle Norian).*Occurrence.* Rail Cabin Formation, Fields Creek Formation, east-central Oregon.

***Justium* sp. A**

Plate 10, figures 2, 9

Range. Upper Triassic (Norian).*Occurrence.* Fields Creek Formation (Loc. FC28), east-central Oregon.***Justium* sp. B**

Plate 10, figures 4-5

Range. Upper Triassic (Norian).*Occurrence.* Fields Creek Formation (Loc. FC28), east-central Oregon.***Justium* sp. C**

Plate 11, figure 4

Range. Upper Triassic (Norian).*Occurrence.* Fields Creek Formation (Loc. FC28), east-central Oregon.***Justium* sp. D**

Plate 11, figures 7, 11

Range. Upper Triassic (Norian).*Occurrence.* Fields Creek Formation (Loc. OR120), east-central Oregon.**Genus *Loffa* Pessagno, 1979***Type species.* *Loffa mulleri* Pessagno*Range.* Upper Triassic (upper Karnian?; lower to upper middle Norian).*Occurrence.* Baja California, east-central Oregon.***Loffa* sp. A**

Plate 12, figure 1

Remarks. Only few incomplete specimens of *Loffa* sp. A were found. This distorted form is similar to *L. vesterensis* Blome.*Range.* Upper Triassic (upper Karnian?; lower to upper middle Norian).*Occurrence.* Fields Creek Formation (Loc. OR120), east-central Oregon.**Genus *Renziium* Blome, 1983***Type species.* *Renziium webergorum* Blome, 1983*Range.* upper Triassic (upper Karnian?; lower to upper middle Norian).*Occurrence.* Rail Cabin Mudstone, Fields Creek Formation, east-central Oregon.***Renziium webergorum* Blome**

Plate 11, figure 17

Renziium webergorum Blome, 1983, pp. 40, 42, pl. 10, figs. 1, 6, 7, 12*Range.* Upper Triassic (upper Karnian?; lower to upper middle Norian).*Occurrence.* Rail Cabin Mudstone, Fields Creek Formation (Loc. FC49), east-central Oregon.***Renziium* sp. A**

Plate 10, figures 8, 13

Remarks. This form differs from *R. webergorum* Blome by having longer polar spines; it is also distinguished from *R. adversum* Blome by possessing a relatively larger cortical shell.*Range.* Upper Triassic (upper Karnian?; lower to upper middle Norian).*Occurrence.* Fields Creek Formation (Loc. FC49), east-central Oregon.**Subfamily PANTANELLINAE Pessagno, 1977b***Type genus.* *Pantanellium* Pessagno, 1977a.*Range.* Upper Triassic (Karnian) to Lower Cretaceous (upper Albian).*Occurrence.* Worldwide.**Genus *Cantalum* Pessagno, 1979***Type species.* *Cantalum holdsworthi* Pessagno, 1979*Range.* Upper Triassic (Karnian? to Norian).*Occurrence.* Baja California, Queen Charlotte Islands, and Fields Creek Formation (Loc. FC1E), east-central Oregon.***Cantalum* sp. A**

Plate 7, figure 19

Range. Upper Triassic (Karnian?).*Occurrence.* Fields Creek Formation (Loc. FC1E), east-central Oregon.**Genus *Gorgansium* Pessagno and Blome, 1980***Type species.* *Gorgansium silviesense* Pessagno and Blome, 1980*Range.* Upper Triassic (upper Karnian) to Upper Jurassic (lower Callovian).*Occurrence.* Baja California, east-central Oregon.

***Gorgansium beaverense*, n. sp.**

Plate 10, figure 10

Description. Cortical shell ovate to subcircular in outline, consisting of hexagonal and pentagonal pore frames with well-developed nodes at vertices. Bars of pore frames moderately thick in both Y and Z directions. Five to six pore frames visible along AB and CD. Primary spines triradiate with 3 wide grooves alternating with 3 massive ridges, grooves about 1 to 3/2 times as wide as ridges. All three spines unequal in length, two shorter ones closer together. Diameter of cortical shell approximately equal to length of the longest spine.

Remarks. This form differs from *G. browni*, n. sp., by having 3 primary spines which are asymmetricaly arranged and are unequal in length.

Etymology. The name of this species derived from the Beaver Creek adjacent to the type locality.

Measurements (um): System of measurement shown in Text-fig. 4.

Diameter (cortical shell)	Length (primary spines)			
	S1	S2	S3	
100	90	60	57	Holotype
110	95	60	58	Maxi., 3 specimens
95	90	55	53	Mini., 3 specimens
100	92	58	55	Average, 3 specimens

Type locality. Holotype and paratypes from Loc. FC28. See Locality Descriptions.

Deposition of types. Holotype, NMNS(000869). Paratypes, NMNS(000870) and Yeh Collection.

Range. Upper Triassic (upper Karnian?; lower to upper middle Norian).

Occurrence. Fields Creek Formation, east-central Oregon.

***Gorgansium browni*, n. sp.**

Plate 7, figure 9

Description. Cortical shell spherical, consisting of large hexagonal and pentagonal pore frames. Bars of pore frames moderately thick in both Y and Z directions. Five to six pore frames visible along AB and CD. Primary spines approximately equal in length, two slightly closer together. All three spines triradiate in axial section, 3 moderately wide grooves alternating with moderately massive ridges, grooves as wide as ridges. Diameter of cortical shell slightly longer than the length of a given spine.

Remarks. This form differs from other species of *Gorgansium* in this paper by having three primary spines which are almost equal in length, nearly equidistant, and radially arranged. It is believed that this species is a transitional form between *Gorgansium* and *Betraccium*.

Etymology. This species is named for Dr. C.E. Brown, in honor of his contributions in investigation of the Fields Creek Formation.

Measurements (um):

Diameter (cortical shell)	Length (primary spines)		
60	60		Holotype
65	70		Maxi., 3 specimens
55	50		Mini., 3 specimens
60	60		Average, 3 specimens

Type locality. Holotype and paratypes from Loc. FC1E. See Locality Descriptions.

Deposition of types. Holotype, NMNS(000871). Paratypes, NMNS(000872) and Yeh Collection.

Range. Upper Triassic (Karnian).

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

***Gorgansium thayeri*, n. sp.**

Plate 7, figure 12

Description. Cortical shell spherical, consisting of pentagonal and hexagonal pore frames with poorly developed nodes at vertices. Bars of pore frames thin in Y direction, moderately thick in Z direction. Five to six pore frames visible along AB and CD. Primary spines triradiate in axial section; 3 wide grooves alternating with 3 narrow ridges, grooves 2 to 3 times as wide as ridges. Two short spines closer together, about half to one third as long as third spine which showing weakly distortion distally.

Remarks. This form differs from *G. sp. A* Yeh, by having a relatively larger cortical shell lacking well-developed nodes at pore frame vertices and by having primary spines which are not twisted.

Etymology. This species is named for Dr. T.P. Thayer, in honor of his pioneering investigations of the Fields Creek Formation.

Measurements (um): System of measurement shown in Text-fig. 4.

Diameter (cortical shell)	length (primary spine)			
	S1	S2	S3	
90	65	30	30	Holotype
90	65	45	30	Maxi., 5 specimens
75	60	40	30	Mini., 5 specimens
85	62	43	30	Average, 5 specimens

Type locality. Holotype and paratypes from Loc. FC1E. Ess Locality Descriptions.

Deposition of types. Holotype, NMNS(000873). Paratypes, NMNS(000874) and Yeh Collection.

Range. Upper Triassic (Karnian).

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

***Gorgansium* sp. cf. *G. thayeri*, n. sp.**

Plate 7, figure 11

Remarks. This form differs from *G. thayeri*, n. sp. by having less massive spines.

Range. Upper Triassic (Karnian?).

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

***Gorgansium* sp. A**

Plate 7, figure 1

Range. Upper Triassic (Karnian?).

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

***Gorgansium* sp. B**

Plate 7, figures 3, 21

Range. Upper Triassic (Karnian?).

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

***Gorgansium* sp. C**

Plate 7, figure 5

Range. Upper Triassic (Karnian?)

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

***Gorgansium* sp. D**

Plate 7, figure 7

Range. Upper Triassic (Karnian?).

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

***Gorgansium* sp. E**

Plate 7, figure 13

Range. Upper Triassic (Karnian?).

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

***Gorgansium* sp. F**

Plate 7, figure 17

Remarks. This form is characterized by having 3 twisted primary spines and by having a small, spherical cortical shell which consisting of hexagonal and pentagonal pore frames with well-developed nodes at pore frames vertices.

Range. Upper Triassic (Karnian?).

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

***Gorgansium* sp. G**

Plate 10, figure 15

Range. Upper Triassic (lower to upper middle Norian).

Occurrence. Fields Creek Formation (Loc. FC28), and Rail Cabin Mudstone, east-central Oregon.

***Gorgansium* sp. H**

Plate 10, figure 19

Range. Upper Triassic (Norian).

Occurrence. Fields Creek Formation (Loc. FC28), east-central Oregon.

Genus *Pantanellium* Pessagno, 1977a

Type species. *Pantanellium riedeli* Pessagno, 1977a

Range. Upper Triassic (Karnian) to Lower Cretaceous (upper Aptian/lower Albian).

Occurrence. Worldwide.

***Pantanellium fostleri* Pessagno & Blome**

Plate 11, figures 16, 18

Pantanellium fostleri Pessagno & Blome, 1980, p. 242, pl. 3, figs. 1, 8, 16

Range. Upper Triassic (upper Norian).

Occurrence. Queen Charlotte Islands; Fields Creek Formation (Loc. FC28), east-central Oregon.

***Pantanellium* sp. A**

Plate 7, figure 2

Range. Upper Triassic (Karnian?).

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

***Pantanellium* sp. B**
Plate 7, figure 4

Range. Upper Triassic (Karnian?).

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

***Pantanellium* sp. C**
Plate 7, figure 6

Range. Upper Triassic (Karnian?).

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

***Pantanellium* sp. D**
Plate 7, figure 8

Range. Upper Triassic (Karnian?).

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

***Pantanellium* sp. E**
Plate 7, figures 14, 20

Range. Upper Triassic (Karnian?).

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

***Pantanellium* sp. F**
Plate 7, figure 15

Remarks. This form differs from *P.* sp. E by having a cortical shell with smaller nodes at pore frame vertices.

Range. Upper Triassic (Karnian?).

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

***Pantanellium* sp. G**
Plate 7, figure 16

Range. Upper Triassic (Karnian?).

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

Family HAGIASTRIDAE Riedel, emend.
Baumgartner, 1980

Type genus. *Hagiastrum* Haeckel, 1881

Range. Upper Triassic to Middle Cretaceous.

Occurrence. Worldwide.

Subfamily TRITRABINAE Baumgartner, 1980

Type genus. *Tritrabs* Baumgartner, 1980

Range and Occurrence. Upper Triassic to Lower

Cretaceous. Worldwide.

Genus ***Tetratrabs*** Baumgartner, 1980

Type species. *Tetratrabs gratiosa* Baumgartner, 1980

Range and Occurrence. Lower Toarcian to Upper Tithonian. Worldwide.

***Tetratrabs* sp. A**
Plate 14, figure 10

Range. Upper Triassic (Norian).

Occurrence. Fields Creek Formation (Locs. FC28, and FC49), east-central Oregon.

Family PRAECONOCARYOMMIDAE Pessagno, 1976

Type genus. *Praeconocaryomma* Pessagno, 1976

Range. Upper Triassic (Norian) to Upper Cretaceous (Campanian)

Occurrence Worldwide.

Genus ***Praeconocaryomma*** Pessagno, 1976

Type species. *Praeconocaryomma universa* Pessagno, 1976

Range and Occurrence. Same as for family.

***Praeconocaryomma* sp. A**
Plate 14, figure 12

Range. Upper Triassic (Norian).

Occurrence. Fields Creek Formation (Locs. FC1E, and OR120), east-central Oregon.

***Praeconocaryomma* sp. B**
Plate 14, figure 17

Range. Upper Triassic (Norian).

Occurrence. Fields Creek Formation (Loc. FC49), east-central Oregon.

Family SEPSAGONIDAE Kozur & Mostler

Type genus. *Sepsagon* Dumitrică, Kozur & Mostler, 1980

Range. Triassic.

Occurrence. Southern Alps, Italy, Japan, and east-central Oregon (Miller Mountain Melange and the Fields Creek Formation).

Genus ***Parasepsagon*** Dumitrică, Kozur and Mostler, 1980

Type species. *Parasepsagon tetracanthus* Dumitrica Kozur and Mostler, 1980

Range. Lower Triassic to Upper Triassic.

Occurrence. Italy, east-central Oregon, and Japan.

Parasepsagon variabilis (Nakaseko and Nishimura) Plate 1, figures 16, 19

Staurodoras variabilis Nakaseko and Nishimura, 1979, p. 71-72, pl. 3, figs. 5, 8.

Remarks. This form is closely related to *Sepsagon* Dumitrica, Kozur and Mostler and *Pseudostylosphaera* by having similar internal spicule in inner shell and by possessing a cortical shell which consists of tuberulated outer layer.

Range. Triassic (Ladinian?).

Occurrence. Italy, Fields Creek Formation (Loc. OR123C), east-central Oregon, and Japan.

***Parasepsagon* sp. A**

Plate 3, figures 2, 4-5, 8, 12, 14

Range. Triassic (Ladinian?) so far as known.

Occurrence. Fields Creek Formation (Loc. OR123C), east-central Oregon.

***Parasepsagon* sp. B**

Plate 3, figure 3

Range. Triassic (Ladinian?) so far as known.

Occurrence. Fields Creek Formation (Loc. OR123C), east-central Oregon.

Genus ***Pseudostylosphaera*** Kozur & Mostler, 1981

Type species. *Pseudostylosphaera gracilis* Kozur & Mostler, 1981

Remarks. This genus was referred to *Archaeospongoprimum* Pessagno by Nakaseko and Nishimura (1979). It is different from the latter genus by having a latticed cortical shell which consists of two layers rather than a spongy meshwork of polygonal pore frames arranged in concentric and 4 basal spines arising from a short median bar in its latticed medullary shell Text-fig. 5.

Pseudostylosphaera differs from other palaeoscenids by having a double layered cortical shell, and bipolar triradiate primary spines. This genus is similar to *Parasepsagon* and *Sepsagon* (Dumitrică, Kozur and Mostler, 1980) by having triradiate primary spines, a double-layered cortical shell and a *Palaeoscenidium* type spicule in the latticed internal shell.

Range. Triassic.

Occurrence. Italy, Japan, and the Miller Mountain Melange, the Fields Creek Formation of east-central Oregon.

Pseudostylosphaera japonica (Nakaseko & Nishimura)

Plate 1, figure 4

Archaeospongoprimum japonicum Nakaseko & Nishimura, 1979, pl. 1, figure 2 Not *Archaeospongoprimum japonicum* Nakaseko & Nishimura, 1979, pl. 1, figures 4, 9

Remarks. This form is referred to *Pseudostylosphaera japonica* (Nakaseko & Nishimura) by having a similar test to that of holotype.

Range. Triassic (Ladinian).

Occurrence. Fields Creek Formation (Loc. OR123C), east-central Oregon.

Pseudostylosphaera magnispinosa, n. sp.

Plate 1, figures 1, 2, 11, 18

Description. Cortical shell ellipsoidal to subrectangular, outer layer consisting of well-developed tubercles interconnected by radial rays, and surrounded by subtriangular or ellipsoidal pores; inner layer consisting of small, uniformly sized polygonal pore frames. Two massive polar spines unequal in length, triradiate with 3 wide grooves alternating with 3 massive ridges, ridges as wide as grooves; one spine slightly shorter and thicker than the other.

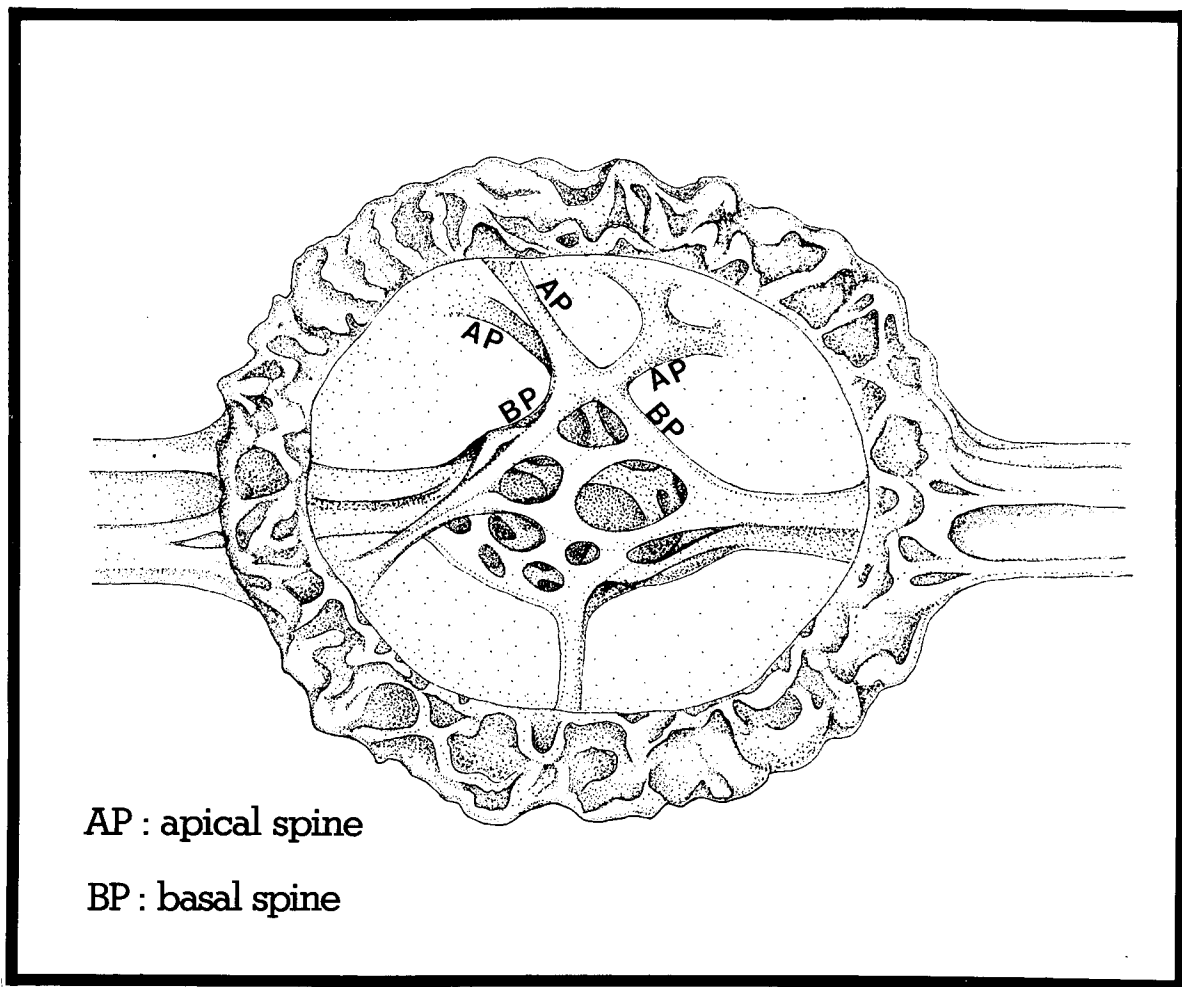
Remarks. This form differs from *Pseudostylosphaera japonica* (Nakaseko & Nishimura) by having a relatively smaller cortical shell and by having polar spines which are slightly wider in axial section.

Etymology. *Magnus* (Latin, adj.) = big; *spina* (Latin, n.) = a spine.

Measurements (um): System of measurement shown in Text-fig. 4.

Cortical shell		Length of primary spines		
AA'	BB'	S1	S2	
150	115	150	120	Holotype
155	120	150	120	Maxi., 6 specimens
120	100	120	100	Mini., 6 specimens
145	110	140	115	Average, 6 specimens

Type locality. Holotype from Loc. OR123C. See Locality Descriptions.



Text-Fig. 5 The latticed internal shell of *Pseudostylosphaera*. Note the Palaeoscenidium type spicule - 3 apical spines and 4 basal spines arising from a short medium bar.

Deposition of types. Holotype, NMNS(000875).

Paratypes, NMNS(000876) and Yeh Collection.

Range. Middle Triassic (Ladinian?).

Occurrence. Fields Creek Formation (Loc. OR123C), east-central Oregon.

***Pseudostylosphaera* sp. A**

Plate 1, figures 3, 12

Range. middle Triassic (Ladinian?).

Occurrence. Fields Creek Formation (Loc. OR123C), east-central Oregon.

***Pseudostylosphaera* sp. B**

Plate 1, figures 5, 20-21

Range. middle Triassic (Ladinian?) so far as known.

Occurrence. Fields Creek Formation (Loc. OR123C), east-central Oregon.

***Pseudostylosphaera* sp. C**

Plate 1, figure 6

Range. Triassic.

Occurrence. Fields Creek Formation (Loc. OR123C), east-central Oregon.

Family STAUROLONCHIDAE Haeckel, 1881, emend, Pessagno, 1977

Type genus. *Staurolonche* Haeckel, 1881

Range. Mesozoic.

Occurrence. Worldwide.

Genus *Plafkerium* Pessagno, 1979

Type species. *Plafkerium abbotti* Pessagno, 1979

Remarks. *Plafkerium* Pessagno is similar to another group of Spumellaria (pl. 3, figs. 2-4, 8, 12, 14) by having four spines and having one spine often longer than others. However, the character of cortical test wall is different. *Plafkerium* consists of double-layered test wall and homogeneous ornamentation throughout its cortical shell except the base of primary spines, whereas the other four spines group consists of single-layered test wall along the vertical side of cortical shell, with nodes and outer layer only occurring at two planiform surface planes. *Palaeoscenidium* type spicule is absent in the forms of this genus.

Range. Upper Triassic (Karnian?/Norian).

Occurrence. Worldwide.

Plafkerium robustum, n. sp.

Plate 3, figures 13, 15, 16

Description. Cortical shell small, square in outline, boxlike with 4 short primary spines extending from 4 sides of the square; outer layer consisting of large, irregular, raised polygonal pore frames; inner layer of small, uniformly sized polygonal pore frames. Primary spines tapering distally, triradiate with 3 wide grooves alternating with 3 ridges, grooves slightly wider than ridges. One primary spine slightly longer than other 3. Each side of cortical shell slightly longer than a given primary spine.

Etymology. *Robustus-a-um* (Latin, adj.) = firm.

Measurements (um):

Length (cortical shell)	Length (primary spines)	
90	50	Holotype
90	60	Maxi., 5 specimens
75	65	Mini., 5 specimens
80	50	Average, 5 specimens

Type locality. Holotype and paratypes from Loc. FC1E. See Locality Descriptions.

Deposition of types. Holotype, NMNS(000877). Paratypes, NMNS(000878) and Yeh Collection.

Range. Upper Triassic (Karnian).

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

Plafkerium sp. A

Plate 3, figure 1

Range. Upper Triassic (Karnian?)

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

Plafkerium sp. B

Plate 3, figure 6

Range. Upper Triassic (Karnian?)

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

Plafkerium sp. C

Plate 3, figures 9, 10

Range. Upper Triassic (Karnian?)

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

Superfamily SPONGODISCACEA Haeckel, 1882, emend. Pessagno, 1971, 1973

Subsuperfamily PSEUDOAULOPHACILAE Riedel, 1971.

Range and Occurrence. Paleozoic to Holocene. Worldwide.

Family ORBICULIFORMIDAE Pessagno, 1973

Type genus. *Orbiculiforma* Pessagno, 1973

Range. Triassic to Upper Cretaceous (Maestrichtian).

Occurrence. Worldwide.

Genus *Orbiculiforma* Pessagno, 1973

Type species. *Orbiculiforma quadrata* Pessagno, 1973

Range and Occurrence. same as for family.

Orbiculiforma sp. A

Plate 14, figure 13

Range. Lower Jurassic (?)

Occurrence. Fields Creek Formation (Loc. FC35), east-central Oregon.

Family PATULIBRACCHIIDAE Pessagno, 1971, emend. Baumgartner, 1980

Type genus. *Patulibracchium* Pessagno, 1971

Range. Late Paleozoic to Upper Cretaceous.

Occurrence. Worldwide.

Subfamily PATULIBRACCHIINAE Pessagno, 1971, emend. Baumgartner, 1980

Type genus. *Patulibracchium* Pessagno, 1971
Range. Late Paleozoic to Upper Cretaceous.
Occurrence. Worldwide.

Genus *Crucella* Pessagno, 1971, emend Baumgartner, 1980

Type species. *Crucella messinae* Pessagno, 1971
Range and Occurrence. Paleozoic to Upper Cretaceous. Worldwide.

Crucella sp. A
 Plate 14, figure 14

Range. Lower Jurassic (?).
Occurrence. Fields Creek Formation (Loc. FC35), east-central Oregon.

Genus *Sontonaella* Yeh, 1987b

Type species. *Sontonaella snowshoensis* 1987b
Range. Upper Triassic (Norian) to Upper Jurassic (Tithonian).
Occurrence. Worldwide.

Sontonaella sp. A
 Plate 14, figure 6

Range. Lower Jurassic (?)
Occurrence. Fields Creek Formation (Loc. FC35).

Sontonaella sp. B
 Plate 14, figure 15

Range. Upper Triassic (Norian).
Occurrence. Fields Creek Formation (Loc. FC28), east-central Oregon.

SPUMELLARIA INCERTAE SEDIS

The follow spumellaria genera are listing in alphabetic order without supergenetic classification.

Genus *Kahlerosphaera* Kozur and Mostler, 1979

Type species. *Kahlerosphaera parvispinosa* Kozur and Mostler, 1979

Remarks. The following four species are temporarily assigned to *Kahlerosphaera* Kozur and Mostler. Recently these trialtuspinae forms have been studied by Robinson (1988, M. S. thesis, UT-Dallas) and have been assigned to a new genus *Trialtuspina*. These forms are very distinctive in some Fields

Creek cherty mudstone samples.
Range. Upper Triassic (Upper Karnian to Lower Norian).
Occurrence. Europe, east-central Oregon, and Alaska.

Kahlerosphaera sp. A
 Plate 5, figure 3

Range. Upper Triassic.
Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

Kahlerosphaera sp. B
 Plate 13, figures 1, 20

Range. Upper Triassic.
Occurrence. Fields Creek Formation (Loc. FC28), east-central Oregon.

Kahlerosphaera sp. C
 Plate 13, figure 5

Range. Upper Triassic.
Occurrence. Fields Creek Formation (Loc. FC43B), east-central Oregon.

Kahlerosphaera sp. D
 Plate 13, figures 6, 17

Range. Upper Triassic.
Occurrence. Fields Creek Formation (Loc. FC28), east-central Oregon.

Genus *Karnospongella* Kozur and Mostler, 1981

Type species. *Karnospongella bispinosa* Kozur and Mostler, 1981

Range. Triassic to Lower Jurassic (?).
Occurrence. European Tethys, east-central Oregon.

Karnospongella sp. A
 Plate 14, figure 5

Frage. Upper Triassic (?); Lower Jurassic (?).
Occurrence. Fields Creek Formation (Loc. FC35), east-central Oregon.

Kamospongella sp. B
 Plate 14, figure 16

Range. Upper Triassic (Norian).
Occurrence. Fields Creek Formation (Loc. FC8), east-central Oregon.

Genus *Spongostylus* Haeckel 1882

Spongostylus carnicus Kozur and Mostler, 1979

Plate 13, figure 8

Spongostylus carnicus Kozur and Mostler, 1979, p. 56, pl. 9, figs. 5, 6, 8,

Range. Triassic.

Occurrence. Europe, and Fields Creek Formation (Loc. FC28), east-central Oregon.

Spongostylus sp. A

Plate 13, figures 7, 22

Range. Upper Triassic so far as Known.

Occurrence. Fields Creek Formation (Loc. FC28), east-central Oregon.

Spongostylus sp. B

Plate 13, figure 9

Remarks. This form differs from *S.* sp. A. by having two relatively shorter spines.

Range. Upper Triassic (Norian) so far as known.

Occurrence. Fields Creek Formation (Loc. FC28), east-central Oregon.

Genus *Pylostephanidium* Dumitrica

Type species. *Pylostephanidium clavator* Dumitrică

Range. Ladinian so far as known.

Occurrence. Buchenstein Limestone of Italy, and the Fields Creek Formation (Loc. OR123C), east-central Oregon.

Pylostephanidium sp. A

Plate 1, figures 14, 17

Remarks. The cephalic structure of this form is not observed due to the poorly preservation. However, the pylom of this form is distinctive. This form differs from *P. clavator* Dumitrica by having two short horns.

Range. Triassic (Ladinian?).

Occurrence. Fields Creek Formation (Loc. OR123C), east-central Oregon.

Genus *Radium*, n. gen.

Type species. *Radium pessagnoii*, n. sp.

Description. Cephalis spindle in shape, consisting of two layers: outer layer of tubercles connected by radiating bars; inner layer of variable sized subcircular to ellipsoidal pore frames. The spindle test terminated with a short, triradiate spine at one end and a moderately long pylom at the other end.

Cephalic spicules not observed.

Remarks. It seems that *Radium*, n. gen. is closely related to *Pylostephanidium* Dumitrică (1977a), both genera are characterized by the same structure of cephalic wall and by having triradiate horn(s) and a pylom. *Radium* n. gen., differs from *Pylostephanidium* Dumitrica by having a spindle-shaped test rather than globular test, and by possessing only one horn rather than two horns.

Etymology. *Radium* is a name formed by an arbitrary combination of letters (ICZU, 1985, p. 201, Appendix D, Pt. IV, Recommendation 40).

Range. Triassic (late Ladinian?).

Occurrence. Miller Mountain Melange, Fields Creek Formation (Loc. OR123C), east-central Oregon.

Radium pessagnoii, n. sp.

Plate 1, figures 10, 13, 15

Description. Test as with genus, cephalic wall double layered, outer layer of uniformly sized tubercles interconnected by radiating bars, inner layer of variable sized subcircular pores outlined by fragile bars. One horn situated at one end of test, horn short and triradiate proximally. Pylom tapering distally, comprised of irregular pore frames without tubercles on outer layer. Horn about half as long as pylom. The maximum width of test approximately 4/5 as long as test along the axis of horn and pylom.

Etymology. This species is named for Dr. E.A. Pessagno, Jr., in honor of his great contributions in Mesozoic Radiolaria.

Measurements (um)

Length (test)	Width (test)	Length (horn)	Length (pylom)	
182	132	33	66	Holotype
195	165	35	66	Maxi., 4 specimens
180	150	30	40	Mini., 4 specimens
185	155	32	50	Average, 4 specimens

Type locality. Holotype and paratypes from Loc. OR123C. See Locality Descriptions.

Deposition of types. Holotype, NMNS(000879). Paratypes, NMNS(000880) and Yeh Collection.

Range. Middle Triassic (late Ladinian) to Upper Triassic (early Karnian).

Occurrence. Miller Mountain Melange, Fields Creek Formation (Loc. OR123C), east-central Oregon.

Radium sp. A

Plate 1, figures 7, 9

Remarks. This form differs from *R. pessagnoii*, n. sp. by having a test which is more slender in shape.

Range. Triassic (Ladinian?).

Occurrence. Fields Creek Formation (Loc. OR123C), east-central Oregon.

Radium sp. B

Plate 1, figure 8

Range. Triassic (Ladinian?).

Occurrence. Fields Creek Formation (Loc. OR123C), east-central Oregon.

Genus *Stauracantium* Haeckel, 1882; emend. Kozur and Mostler, 1979

Ruestia Vinassa de Regny, 1898

Xiphostauria Vinassa de Regny, 1898

Range. Triassic.

Occurrence. European Tethys; east-central Oregon.

Stauracantium? trispinosum ladinicum Dumitrică, Kozur and Mostler, 1980

Plate 3, figure 7

Stauracantium? trispinosum ladinicum Dumitrică, Kozur and Mostler, 1980, P.17, pl. 1, fig. 5; pl. 2, fig. 4; pl. 3, figs. 6-7; pl. 5, fig. 4; pl. 14, fig. 5.

Range. Middle Triassic (Ladinian) to Upper Triassic (Karnian).

Occurrence. Austria, and Fields Creek Formation (Loc. FC1E), east-central Oregon.

Spumellaria gen. and sp. indet. A

Plate 7, figures 18, 23

Remark. This form is characterized by having a triangular-shaped cortical shell with two planiform surface and three nearly vertical sides, three triradiate primary spines usually attached to the cortical shell at mid-point of each triangle side.

Range. Triassic (Ladinian?).

Occurrence. Fields Creek Formation (Loc. OR123C), east-central Oregon.

Spumellaria gen. and sp. indet. B

Plate 7, figure 22

Remark. This form is characterized by having massive nodes at the outer layer of cortical shell.

Range. Triassic (Norian).

Occurrence. Fields Creek Formation (Loc. FC28), east-central Oregon.

Spumellaria gen. and sp. indet. C

Plate 14, figure 4

Remark. This form is characterized by having a pyramid-shaped test with four tubular arms.

Range. Lower Jurassic (?).

Occurrence. Fields Creek Formation (Loc. FC35), east-central Oregon.

Spumellaria gen. and sp. indet. D

Plate 14, figure 9

Remark. This form is characterized by having a triangular-shaped test with planiform surface and three triradiate primary spines at vertices.

Range. Lower Jurassic (?).

Occurrence. Fields Creek Formation (Loc. FC35), east-central Oregon.

Suborder NASSELLARIINA Ehrenberg, 1875

Superfamily CYRTOIDEA Haeckel, 1862

Subsuperfamily EUCYRTIDILAE Ehrenberg, 1847

Range and Occurrence. Triassic to Recent. Worldwide.

Family CANOPTIDAE Pessagno, 1979, emend. Yeh, 1987a

Type genus. *Canoptum* Pessagno, 1979

Range. Upper Triassic (upper Karnian?; Norian) to Lower Jurassic (Toarcian).

Occurrence. Worldwide.

Subfamily CANOPTIINAE Pessagno, 1979

Type genus. *Canoptum* Pessagno, 1979

Range and Occurrence. Same as for family.

Genus *Canoptum* Pessagno, 1979

Type species. *Canoptum poissoni* Pessagno, 1979

Range and Occurrence. Same as for family.

Canoptum sp. cf. *C. macoyense* Blome

Plate 9, figure 3

Canoptum macoyense Blome, 1984, p. 48, pl. 11, figs. 10, 15, 18; pl. 17, fig. 7

Remark. This form differs from *C. macoyense* Blome by having a longer cephalis.

Range. Upper Triassic (Norian).

Occurrence. Fields Creek Formation (Loc. OR120), east-central Oregon.

Canoptum laxum Blome, 1984.

Plate 9, figure 5

Canoptum laxum Blome, 1984, p. 47, pl. 11, figs. 9, 14

Range. Upper Triassic (upper Karnian?: lower to upper middle Norian).

Occurrence. Rail Cabin Mudstone, Fields Creek Formation, east-central Oregon.

***Canoptum* sp. A**

Plate 9, figure 4

Range. Upper Triassic (upper Karnian?).

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

***Canoptum* sp. B**

Plate 14, figure 2

Range. Lower Jurassic (?).

Occurrence. Fields Creek Formation (Loc. FC35), east-central Oregon.

Genus ***Pachus*** Blome, 1981.*Type species. Pachus firmus* Blome, 1981

Range. Upper Triassic (upper Karnian?: lower to upper middle Norian).

Occurrence. east-central Oregon, Alaska, British Columbia.

Pachus longinquus Blome, 1984.

Plate 8, figure 4

Pachus longinquus Blome, 1984, p. 49, figs. 6, 11, 13, 14; pl. 17, fig. 9.

Range. Upper Triassic (upper Karnian?: lower to upper middle Norian).

Occurrence. Rail Cabin Mudstone, Fields Creek Formation, east-central Oregon.

***Pachus* (?) sp. A**

Plate 2, figure 12

Range. Upper Triassic (Karnian?).

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

Family PSEUDODICTYOMITRIDAE Pessagno, 1977b

Type genus. Pesudodictyomitridae Pessagno, 1977b

Range. Upper Triassic?; Upper Jurassic (middle/upper Tithonian) to Upper Cretaceous (middle Turonian).

Occurrence. Worldwide.

Genus ***Corum*** Blome, 1984.*Type species. Corum speciosum* Blome, 1984.

Range. Upper Triassic (upper Karnian?: lower to upper middle Norian).

Occurrence. Alaska, British Columbia, and east-central Oregon.

Corum candidum, n. sp.

Plate 9, figures 7, 8, 20, 21

Description. Test as with genus, consisting of 6 to 8 post-abdominal chambers. Thorax trapezoidal, smooth with weakly developed costae at basal portion. Abdomen and post-abdominal chambers strongly costate; costae wide, inflated through most of the chambers, smaller and irregular on the final one or two chambers. One row of primary pores at the distal end of costae, moderate to large in size, subcircular to elliptical in outline. Final post-abdominal chamber perforate with small, relict pores, poorly developed costae often absent. Chambers increasing slowly in height and moderately in width as added; the exception being the final post-abdominal chamber which decreases in width.

Remarks. This form is characterized by its moderately large, smooth, subtriangular cephalis and by its perforate, narrow final post-abdominal chamber.

Etymology. *Candidus-a-um* (Latin, adj.) = honest, clear.

Measurements (um)

Length (test)	Width (maxi.) (test)	
300	135	Holotype
300	140	Maxi., 5 specimens
240	125	Mini., 5 specimens
280	130	Average, 5 specimens

Type locality. Holotype from Loc. FC28. See Locality Descriptions.*Deposition of types.* Holotype, NMNS(000881). Paratypes, NMNS(000882) and Yeh Collection.

Range. Upper Triassic (upper Karnian?: lower to upper middle Norian).

Occurrence. Fields Creek Formation, east-central Oregon.

***Corum parvum*, n. sp.**
Plate 9, figures 1, 2

Description. Test as with genus, slender, consisting of 7 or more post-abdominal chambers. Cephalis and thorax imperforate, smooth. Costae moderately to weakly developed on abdomen and first 3 or 4 post-abdominal chambers (8 to 9 visible laterally), extremely weak to indistinct on last 2 or 3 chambers; final post-abdominal chamber imperforate, smooth. One row of primary pore along base of each chamber. Chambers increasing slowly in both width and height as added

Remarks. This form differs from other *Corum* spp. in this paper by having a extremely slender test, relatively poorly developed costae which only present on first few chambers, and by having a smooth, imperforate final post-abdominal chamber. A small horn on cephalis may be visible on the well-preserved specimens.

Etymology. *Parvus-a-um* (Latin, adj.) = little, young.
Measurements (um):

Length (test)	Width (maxi.) (test)	
240	90	Holotype
220	90	Maxi., 6 specimens
180	75	Mini., 6 specimens
230	85	Average, 6 specimens

Type locality. Holotype from Loc. FC28. Paratypes from Loc. FC28 and FC28. See Locality Descriptions.

Deposition of types. Holotype, NMNS(000883). Paratypes, NMNS(000884) and Yeh Collection.

Range. Upper Triassic (upper Karnian?; lower to upper middle Norian).

Occurrence. Fields Creek Formation, east-central Oregon.

***Corum* sp. A**
Plate 9, figure 6

Range. Upper Triassic (Norian).

Occurrence. Fields Creek Formation (Loc. FC28), east-central Oregon.

Family PSEUDOSATURNIFORMIDAE Kozur and Mostler, 1979

Type genus. *Pseudosaturnumiforma* Kozur and Mostler, 1979

Range. Upper Triassic (Karnian? Norian) to Upper Cretaceous (middle Turonian).

Occurrence. Europe, western North America.

Genus ***Pseudosaturnumiforma*** Kozur and Mostler, 1979

Type species. *Pseudosaturnumiforma latimarginata* Kozur and Mostler, 1979

Range. Upper Triassic (upper Karnian?: Norian).

Occurrence. Austria, Oregon, and Baja California.

Pseudosaturnumiforma minuta Blome, 1984.

Plate 6, figures 9, 14

Pseudosaturnumiforma minuta Blome, 1984, P. 52, pl. 13, fig. 10; pl. 14, figs. 1, 15, 17; pl. 17, fig. 12.

Remarks. This form slightly differs from Blome's holotype (pl. 13, fig. 10, 1984) by having a slightly larger cephalic ring (diameter of cephalic ring about twice the diameter of cephalis).

Range. Upper Triassic (upper Karnian?; lower to upper middle Norian).

Occurrence. Rail Cabin Mudstone, Fields Creek Formation (Loc. FC1E), east-central Oregon.

***Pseudosaturnumiforma* sp. A**

Plate 6, figure 17

Remarks. This form differs from *P. minuta* Blome by having a highly elevated cephalis with a narrowing.

Range. Triassic (Ladinian?).

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

Family SILICARMIGERIDAE Kozur and Mostler, 1981

Type genus. *Silicarmiger* Kozur and Mostler, 1981
Range and occurrence. Anisian and Lower Ladinian of the Southern Alps and Hungary, Japan, and Fields Creek Formation of east-central Oregon.

Genus ***Silicarmiger*** Kozur and Mostler, 1981

Type species. *Silicarmiger costatus* Kozur and Mostler, 1981

Range and Occurrence. Same as for family.

***Silicarmiger* sp. A**

Plate 2, figures 19, 24

Range. Triassic.

Occurrence. Fields Creek Formation (Loc. OR123C, and FC8), east-central Oregon.

Family SYRINGOCAPSIDAE Forman, 1973

Type genus. *Syringocapsa* Neviani, 1900

Range and Occurrence. Triassic to Cretaceous. Worldwide.

Genus *Syringocapsa* Neviani, 1900

Type species. *Theosyringium robustum* Vinassa, 1900
Range. Upper Triassic (Karnian?; Norian) to Cretaceous.

Occurrence. Worldwide.

Syringocapsa turgida Blome, 1984

Plate 11, figures 10, 13, 19

Syringocapsa turgida Blome, 1984, p. 53, pl. 14, figs. 2, 6, 7, 16.

Range. Upper Triassic (upper Karnian?; lower to upper middle Norian).

Occurrence. Rail Cabin Mudstone, Fields Creek Formation (Locs. FC10B, and FC49), east-central Oregon.

Family XIPHOTHECIDAE Kozur and Mostler, 1981

Type genus. *Xiphotheca* De Wever, 1979

Range. Triassic so far as known.

Occurrence. European Tethys, and east-central Oregon.

Genus *Xiphotheca* De Wever, 1979

Type species. *Xiphotheca karpenissionensis* De Wever, 1979

Range. Triassic so far as known.

Occurrence. European Tethys, and east-central Oregon.

Xiphotheca longa Kozur and Mostler

Plate 8, figure 1

Xiphotheca longa Kozur and Mostler, in Kozur and Mostler, 1981, p. 113-114, pl. 41, figs. 2.

Range. Triassic (?late Karnian, Norian).

Occurrence. European Tethys, Fields Creek Formation (Loc. FC1E), east-central Oregon.

Xiphotheca sp. A

Plate 2, figure 1

Range. Triassic (Karnian?).

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

NASSELLARIINA INCERTAE SEDIS

The following Nassellariian genera are listing in alphabetic order without supergeneric classification.

Genus *Castrum* Blome, 1984.

Type species. *Castrum perornatum* Blome, 1984.

Range. Upper Triassic (lower Karnian to upper middle Norian).

Occurrence. British Columbia, east-central Oregon.

Castrum perornatum Blome, 1984.

Plate 8, figure 9

Castrum perornatum Blome, 1984, p. 54, pl. 14, figs. 4, 9, 12, 14; pl. 17, fig. 14.

Range. Upper Triassic (lower Karnian to upper middle Norian).

Occurrence. Rail Cabin Mudstone, Fields Creek Formation, east-central Oregon.

Castrum sp. A

Plate 8, figures 3, 18

Remarks. This form differs from *C. perornatum* Blome by having denser smaller tetragonal pore frames at post-abdominal chamber, and by having a small cephalic spine.

Range. Upper Triassic (Norian).

Occurrence. Fields Creek Formation (Loc. OR120), east-central Oregon.

Genus *Hetalum*, n. gen.

Type species. *Hetalum brevilabrum* Yeh, n. sp.

Description. Test helmet-shaped; cephalis consisting of a cephalocone with slit-like pores and an imperforate dome apically. Cephalic skeletal needles not observed. Collar structure indistinct. Thorax consisting of polygonal pore frames. Thoracic skirt well-developed, perforate or imperforate.

Etymology. *Hetalum* is an arbitrary combination of letters (ICZN, 1985, Appendix D, pt. IV, Recommendation 40, p.20).

Range. Upper Triassic (upper Karnian?; lower to upper middle Norian).

Occurrence. Fields Creek Formation, east-central Oregon.

Hetalum brevilabrum, n. sp.

Plate 8, figures 14, 15, 19, 20

Description. Test as genus, except as follows: thorax

consisting of tetragonal or rhombohedral pore frames with nodes at vertices, pore frames decreasing in size proximally. Thoracic skirt narrow, two rows of small pores along inner portion of the skirt.

Etymology. *Brevis-e* (Latin, adj.) = narrow: *labrum-i* (Latin, n.), edge, rim.

Measurements (um):

Height (cephalis)	Width (cephalis)	Width (skirt)	
90	150	60	Holotype
120	170	60	Maxi., 5 specimens
110	150	25	Mini., 5 specimens
115	160	35	Average, 5 specimens

Type localities. Holotype from Loc. OR120, paratypes from Locs. OR120 and FC1A. See Locality Descriptions.

Deposition of types. Holotype, NMNS(000885). Paratypes, NMNS(000886) and Yeh Collection.

Range. Upper Triassic (upper Karnian?: lower to upper middle Norian).

Occurrence. Fields Creek Formation, east-central Oregon.

Genus *Latium* Blome, 1984

Type species. *Latium longulum* Blome, 1984.

Range. Upper Triassic (upper Karnian to lower Norian).

Occurrence. Fields Creek Formation, Rail Cabin Mudstone, east-central Oregon; Alaska.

Latium longulum Blome, 1984.

Plate 9, figure 14

Latium longulum Blome, 1984, p. 55, pl. 14, figs. 5, 10, 13.

Range. Upper Triassic.

Occurrence. Rail Cabin Mudstone, Fields Creek Formation, east-central Oregon.

Latium mundum Blome

Plate 9, figures 10, 11, 15

Latium mundum Blome, 1984, p. 55, pl. 15, figs. 1, 7, 13.

Remarks. The thorax of *Latium mundum* Blome is marked by a pattern of radiating slit-like pores. This feature was also observed on *Latium longulum* Blome from the specimens of the Fields Creek For-

mation. *Corum regium* (Blome, 1984, pl. 13, figs. 3, 8) shows the same pattern on its thoracic chamber. It is possible that this mark represents a phylogenetic relationship between *Corum* Blome and *Latium* Blome. *Latium* Blome may evolve from *Corum* Blome by covering more microgranular silica between costae; the costae under Scanning Electric Microscope are traceable from *Latium* sp. with heavy chemical leaching.

Range. Upper Triassic.

Occurrence. Rail Cabin Mudstone, Fields Creek Formation, east-central Oregon.

Genus *Multimonilis*, n. gen.

Type species. *Multimonilis pulcher*, n. sp.

Description. Test conical, multicystid, consisting of 6 or more post-abdominal chambers. Cephalis subconical to dome in shape, imperforate, with or without a small horn. Thorax trapezoidal, imperforate to slightly perforate, surface smooth or weakly nodose. Abdomen and post-abdominal chamber trapezoidal in outline, test wall perforated with numerous small pores, pores often buried by microgranular silica. All chambers separated by narrow elevated circumferential ridges, ridges modified by well-developed nodes or discontinuous costae, just like strings of pearl-necklace hanging on conical test. Chambers expanding rapidly in width and slowly in height as added.

Remarks. *Multimonili*, n. gen., differs from *Corum* Blome by having post-abdominal chambers which are separated by a narrow elevated circumferential ridges, by having ellipsoidal costae which are sitting on circumferential ridges, the boundary of chambers, rather than on central portion of chambers, and also by having relict pores which may present between ridges.

Etymology. Multi (Latin, adj.) = many; *Monile-is* (Latin, n.) = a necklace.

Range. Upper Triassic (Norian).

Occurrence. Fields Creek Formation, east-central Oregon.

Multimonilis pulcher, n. sp.

Plate 9, figures 9, 19

Description. Test as with genus, consisting of 8 or more post-abdominal chambers. Thorax subtrapezoidal in outline, slightly perforate and nodose, separated from cephalis by one row of small circular pores. Test wall of abdomen and post-abdominal chambers perforated with

numerous small circular to ellipsoidal pores, one row of larger circular pores along top and base of circumferential ridges; nodes well-developed on circumferential ridges, numbers of nodes 6 to 7 on abdomen, 13 to 14 on final post-abdominal chamber. Chambers increasing gradually in both width and height as added.

Etymology. *Pulcher-cra-crum* (Latin, adj.) = beautiful.

Measurements (um):

Maximum length (test)	Maximum width (test)	
370	180	Holotype
450	195	Maximum, 3 specimens
360	180	Minimum, 3 specimens
400	185	Average, 3 specimens

Type locality. Holotype from Loc. FC28. See Locality Descriptions.

Deposition of types. Holotype, NMNS(000887), Paratypes, NMNS(000888) and Yeh Collection.

Range. Upper Triassic (upper Karnian?; lower to upper middle Norian).

Occurrence. Fields Creek Formation, east-central Oregon.

***Multimonilis splendidus*, n. sp.**

Plate 9, figures 13, 18, 23

Description. Test as with genus, consisting of 6 or more post-abdominal chambers. Cephalis conical in shape, smooth on surface. Thorax trapezoidal, imperforate, weakly nodose. Abdomen and post-abdominal chambers divided by nodose circumferential ridges, nodes well-developed, ellipsoidal in shape, 6 to 7 visible laterally on abdomen, 15 to 16 on final post-abdominal chamber. Chambers increasing slowly in height and rapidly in width as added.

Remarks. This form differs from *M. pulcher*, n. sp., by having perforated test wall only visible on last few chambers, and by having an imperforated thorax and possessing a conical test which increases in width more rapidly than *M. pulcher* does.

Etymology. *Splendidus-a-um* (Latin, adj.) = brilliant, splendid.

Measurements (um):

Maximum length (test)	Maximum width (test)	
270	150	Holotype
390	165	Maximum, 8 specimens
230	135	Minimum, 8 specimens
320	150	Average, 8 specimens

Type locality. Holotype from Loc. FC30B.

Deposition of types. Holotype, NMNS(000889).

Paratypes, NMNS(000890) and Yeh Collection.

Range. Upper Triassic (Norian).

Occurrence. Fields Creek Formation, east-central Oregon.

***Multimonilis* sp. cf. *M. splendidus*, n. sp.**

Plate 9, figure 16

Remarks. This form differs from *M. splendidus*, n. sp., by having more small pore frames visible along strictures.

Range. Triassic (Norian?).

Occurrence. Fields Creek Formation (Locs. FC10B, FC28, and FC43B), east-central Oregon.

***Multimonilis* sp. A**

Plate 9, figures 12, 22

Range. Triassic (Norian?).

Occurrence. Fields Creek Formation (Loc. FC9), east-central Oregon.

***Multimonilis* sp. B**

Plate 9, figure 17

Range. Triassic (Norian?).

Occurrence. Fields Creek Formation (Loc. FC28), east-central Oregon.

Genus *Poulpus* De Wever, 1979

Type species. *Poulpus piabyx* De Wever, 1979

Range. Middle Triassic to Jurassic.

Occurrence. Worldwide.

***Poulpus curvispinus* Dumitrică, Kozur and Mostler, 1980**

Plate 14, figure 1

(Sic) *Poulpus curvispinus* Dumitrică, Kozur and Mostler, 1980, p. 22, pl. 2, fig. 1; pl. 15, figs. 5, 6.

Range. Middle Triassic to Upper Triassic (Norian?).

Occurrence. The Southern Alps, and Fields Creek

Formation (Loc. FC9), east-central Oregon.

***Poulpus karnicus*, n. sp.**

Plate 6, figures 6, 7, 8, 13

Description. cephalis subtriangular with one horn and three feet; horn straight, long, triradiate with 3 extremely wide grooves alternating with 3 narrow ridges; feet long, slightly curved downwardly, primarily triradiate with 3 wide grooves alternating with 3 narrow ridges, grooves nearly four times as wide as ridges; two outer ridges coalescing to form a hollow foot at proximal portion; inner ridges of feet connected to dorsal and primary lateral bars of spicule elements at base of cephalis.

Etymology. This species is named for the occurrence in Karnian.

Measurement (um):

Height (cephalis)	Width (cephalis)	Length (horn)	Length (spines)	
60	60	60	60	Holotype
69	60	90	65	Maxi., 7 spc.
45	45	50	55	Mini., 7 spc.

Type locality. Holotype and paratypes from Loc. FC1E. See Locality Descriptions.

Deposition of types. Holotype, NMNS(000891). Paratypes, NMNS(000892) and Yeh Collection.

Range. Upper Triassic (Karnian).

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

***Poulpus* sp. A**

Plate 6, figures 1, 2

Range. Triassic (Karnian?).

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

***Poulpus*(?) sp. B**

Plate 6, figure 3

Range. Triassic (Karnian?).

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

***Poulpus*(?) sp. C**

Plate 6, figures 5, 10

Remarks. This form is questionably assigned to *Poulpus* because each ridges of each triradiate foot terminating with long spike-like extension.

Range. Triassic (Karnian?).

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

***Poulpus* sp. D**

Plate 14, figure 3

Range. Upper Triassic (Norian?).

Occurrence. Fields Creek Formation (Loc. FC49), east-central Oregon.

Genus *Quasipetatus* Blome, 1984

Type species. *Quasipetatus insolitus* Blome, 1984

Range. Upper Triassic (upper Karnian to lower Norian);

Occurrence. East-central Oregon, Baja California, British Columbia, and Alaska.

***Quasipetatus* sp. aff. *Q. insolitus* Blome**

Plate 6, figure 11

Quasipetatus insolitus Blome, 1984, p. 58, pl. 16, figs. 2, 8, 12; pl. 17, fig. 17.

Remarks. This form differs from *Q. insolitus* Blome by having a subspherical cephalis which lacks a horn, and by having a shorter abdomen, a smaller abdominal skirt, and less heavy constrictions at the joints between chambers, and also by possessing chambers which slightly decrease in width distally.

Range. Upper Triassic.

Occurrence. Fields Creek Formation, east-central Oregon.

***Quasipetatus tubus*, n. sp.**

Plate 6, figures 12, 18

Description. Test tricyrtid, cephalis semispherical to subrectangular, lacking horn, consisting of two layers, inner layer of small, uniformly sized polygonal pore frames; outer layer consisting of large, elevated polygonal pore frames, usually 1 to 2 rows on thorax, 2 to 3 rows on abdomen. Two narrow imperforate joints separating thorax from cephalis and from abdomen. Abdomen 2 to 3 times as high as thorax; all chambers approximately equal in width. Abdominal skirt small, slightly wider than abdomen.

Remarks. This form differs from *Q. insolitus* Blome by having a subrectangular cephalis and a cylindrical thorax and abdomen which are equal in width.

Etymology. *Tubsu-i* (Latin, n.)=tube.

Measurements (um):

Length (test)	Width (maxi.) (test)	
245	160	Holotype
270	185	Maxi., 5 specimens
195	145	Mini., 5 specimens
230	155	Average, 5 specimens

Type locality. Holotype from Loc. OR120. See Fig. 3 and Localitp Descriptions.

Deposition of types. Holotype, NMNS(000893). Paratypes, NMNS(000894) and Yeh Collection.

Range. Upper Triassic.

Occurrence. Fields Creek Formation, east-central Oregon.

Quasipetatus sp. A

Plate 6, figures 15, 19

Range. Upper Triassic (Norian).

Occurrence. Fields Creek Formation (Loc. FC8A), east-central Oregon.

Quasipetatus sp. B

Plate 6, figure 16

Range. Upper Triassic.

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

Genus *Triassocampe* Dumitrică, Kozur and Mostler, 1980

Type species. *Triassocampe scalaris* Dumitrică, Kozur and Mostler, 1980

Remarks. Based on the original definition of *Triassocampe* (Dumitrică, Kozur, and Mostler, 1981), the form with one row pore frames at each post-abdominal Chamber (pl. 2, figs. 2, 3, 7, 13; pl. 8, figs. 2, 10), the forms with two transverse rows pore frames at each post-abdominal Chamber (pl. 2, figs. 4, 6), and the forms with more than two transverse rows pore frames at each post-abdominal chamber (pl. 2, figs. 8, 14, 15, etc.) can be lumped to one genus. The forms may be questionably assigned to this genus including those with short, poorly developed horn (pl. 2, figs. 4, 5, 20-22). The present author believes that these forms should be splitted to several genera on the basis of the presence/absence of horn, the number of rows of transverse pore frames at post-abdominal chambers, the type of pore frame structure and arrangement, and the ornamentation of outer layer

of test wall.

Range. Middle Triassic (Ladinan) to Upper Triassic (Norian).

Occurrence. Southern Alps, east-central Oregon, Alaska, British Columbia, and Austria.

Triassocampe exilis, n. sp.

Plate 2, figures 8, 25, 26

Description. Test as with genus, conical in outline, consisting of 6 post-abdominal chambers; cephalis dome-shaped; thorax subtrapezoidal, both cephalis and thorax imperforate, smooth on surface. Abdomen and first post-abdominal chamber perforate with small circular pores, lacking pore frames; other post-abdominal chambers comprised of two rows of raised rectangular pore frames. Chambers separating each other by deep, imperforate strictures; strictures nearly half as high as bands of pore frames. Chambers increasing slowly in both height and width as added.

Remarks. This form differs from *T. hilaris*, n. sp. by having a relatively smaller cephalis and by lacking pore frames on abdomen and the first post-abdominal chamber, and by possessing only two rows of pore frames on each chamber.

Etymology. *Exilis-e* (Latin, adj.) = lean, slender.

Measurements (um):

Maximum length (test)	Maximum width (test)	
270	100	Holotype
245	90	Maximu, 4 specimens
180	60	Minimu, 4 specimens
220	75	Average, 4 specimens

Type locality. Holotype from Loc. FC49. See Fig. 3 and Locality Descriptions.

Deposition of types. Holotype, NMNS(000895). Paratypes, NMNS(000896) and Yeh Collection.

Range. Upper Triassic (upper Karnian?; lower to upper middle Norian).

Occurrence. Fields Creek Formation, east-central Oregon.

Triassocampe illyrica. Kozur and Mostler

Plate 2, figures 14, 23

Triassocampe illyrica. Kozur and Mostler, 1981, p. 98, pl. 15, fig. 2

Range. Upper Triassic (Karnian).

Occurrence. Fields Creek Formation (Loc. FC1E),

east-central Oregon.

Triassocampe* sp. aff. *T. illyrica Kozur and Mostler
Plate 2, figure 15

Remarks. This form differs from *T. illyrica* Kozur and Mostler by having two staggered rows of larger pore frames on the distal end of post-abdominal chambers rather than three of more rows of smaller pore frames.

Range. Upper Triassic (Karnian?).

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

Triassocampe immaturum Blome
Plate 8, figures 11, 12

Triassocampe immaturum Blome, 1984, p. 58, pl. 16, figs. 3, 10, 13.

Range. Upper Triassic (Karnian?); lower to upper middle Norian).

Occurrence. Rail Cabin Mudstone, Fields Creek Formation (Loc. FC1E), east-central Oregon.

Triassocampe(?)* sp. cf. *T.(?) pulchra Kozur and Mostler
Plate 2, figure 4

Triassocampe(?) pulchra Kozur and Mostler, 1981, p. 98, pl. 12, fig. 3.

Range. Triassic (Ladinian?).

Occurrence. Fields Creek Formation (Loc. OR123C), east-central Oregon.

Triassocampe sulovensis Kozur and Mock
Plate 2, figure 13

Triassocampe sulovensis Kozur and Mock, in Kozur and Mostler, 1981, p. 99, pl. 13, fig. 3.

Range. Triassic.

Occurrence. Lower-middle Karnian of Western Carpathians, Northern Alps, rare, and Fields Creek Formation (Loc. OR123C), east-central Oregon.

***Triassocampe* sp. A**
Plate 2, figure 3

Range. Triassic (Ladinian?).

Occurrence. Fields Creek Formation (Loc. OR123C), east-central Oregon.

Genus ***Triassocyrtium*** Kozur and Mostler, 1979

Type species. *Triassocyrtium hamatum* Kozur and Mostler, 1979

Range. Triassic.

Occurrence. Cordevol von Gostling, and Fields Creek Formation, east-central Oregon.

***Triassocyrtium(?)* sp. A**
Plate 2, figures 9, 10, 16

Remarks. This form is questionably assigned to *Triassocyrtium* Kozur and Mostler by having one horn at cephalis and spines at thorax, horn and spines are circular at cross-section.

Range. Triassic.

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

***Triassocyrtium(?)* sp. B**
Plate 2, figure 11

Remarks. This form is questionably assigned to *Triassocyrtium* Kozur and Mostler by having one horn at cephalis and three spines at thorax, horn and spines are triradiate in cross-section.

Range. Triassic.

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

Genus ***Veghia*** Kozur and Mostler, 1981

Type species. *Veghia goestlingensis* Kozur and Mostler, 1979

Range. Triassic (Karnian to Norian).

Occurrence. European Tethys and east-central Oregon.

***Veghia* sp. A**
Plate 6, figure 4

Remarks. This form is assigned to *Veghia* Kozur and Mostler by having a large spherical cephalis without a horn and by having triradiate feet with a ridge rather than a groove facing outwards.

Range. Triassic (Karnian?).

Occurrence. Fields Creek Formation (Loc. FC1E), east-central Oregon.

Genus ***Xipha*** Blome, 1984

Type species. *Dictyomitra pessagnoii* Nakaseka and Nishimura, 1979

Range. Upper Triassic (upper Karnian?; Norian).

Occurrence. East-central Oregon, British Columbia, and Japan.

Xipha pessagnoii Nakaseko and Nishimura, 1979
Plate 8, figures 7, 8, 13

Xipha pessagnoii Nakaseko and Nishimura, 1979, p. 77, pl. 9, figs. 2-4

Remarks. This form differs from Blome's holotype (1984, pl. 16, figs. 6, 9, 17) by having well-developed costae extensions.

Range. Upper Triassic (upper Karnian?; lower to upper middle Norian).

Occurrence. Rail Cabin Mudstone, Fields Creek Formation, east-central Oregon.

Genus ***Yeharaia*** Nakaseko and Nishimura

Type species. *Yeharaia elegans* Nakaseko and Nishimura, 1979

Range. Triassic.

Occurrence. Japan, and Fields Creek Formation, east-central Oregon.

Yeharaia elegans Nakaseko and Nishimura
Plate 2, figure 17

Yeharaia elegans Nakaseko and Nishimura, 1979, p. 82, pl. 10, figs. 2-5; pl. 12, figs. 2, 6

Range. Triassic.

Occurrence. Japan, and Fields Creek Formation (Loc. OR123C), east-central Oregon.

Yeharaia* sp. aff. *Y. elegans Nakaseko & Nishimura
Plate 2, figure 18

Range. Triassic.

Occurrence. Fields Creek Formation (Loc. OR123C), east-central Oregon.

***Yeharaia* sp. A**
Plate 2, figure 6

Range. Triassic.

Occurrence. Fields Creek Formation (Loc. OR123C), east-central Oregon.

Nassellaria gen. and sp. indet. A
Plate 7, figure 24

Range and Occurrence. Triassic (Karnian?) so far as known. Fields Creek Formation (Loc. FC1E), east-central Oregon.

Nassellaria gen. and sp. indet. B
Plate 8, figures 5, 6, 17, 21

Remarks. It seems that this form is very close to

Wrangellinae Yeh by having inner test wall of three regular to subregular transverse rows of pore frame between two H-linked ridges of each post-abdominal chamber.

Range. Triassic (Ladinian?).

Occurrence. Fields Creek Formation (Loc. OR123C), east-central Oregon.

Nassellaria gen. and sp. indet. C
Plate 8, figure 16

Range and Occurrence. Triassic (Karnian?). Fields Creek Formation (Loc. FC1E), east-central Oregon.

ACKNOWLEDGMENTS

This research has been supported by grants to Dr. E. A. Pessagno, Jr. from the National Science Foundation (NSF EAR 76-22029; EAR 7812934) and by founding from the Atlantic Richfield Company, the Exxon Production Research Company and the Mobile Oil Corporation.

I wish to thank the following individuals for their help during the course of this project: Dr. Emile A. Pessagno, Jr. (Univ. of Texas at Dallas), for his guidance and continual support during my graduate study, and for the valuable comments on manuscript review; Dr. Charles D. Blome (USGS, Denver) for supplying valuable samples; Dr. Tunyow Huang (Central Geological Survey of Taiwan) and Dr. sc. Heinz Kozur (Hungary) for their critical review of the manuscript. Mr. Y-J Yang for his help in plate preparation, and Miss. S-K Hu for word-processing the manuscript.

REFERENCES

- Blome, C. D., 1983. Upper Triassic Capnuchosphaeridae and Capnodocinae from eastern Oregon. *Micropaleontology*, vol. 29, no. 1, pp. 11-49, pls. 1-11
- Blome, C. D., 1984. Upper Triassic Radiolaria and Radiolarian Zonation from Western North America. *Bulletin of American Paleontology*, Vol. 85, No. 318, 88PP. Pls. 1-17.
- Brooks, H. C., and Vallier, T. L., 1978. Mesozoic rocks and tectonic evaluation of eastern Oregon and Western Idaho. In: Howell, D.G., and McDougall, K.A., (eds.): *Mesozoic paleontology of the western United States*. Pacific Section Soc. Econ. Paleontologists and

- Mineralogists, 133-145.
- Brown, C. E., and Thayer, T. P., 1966a. Geologic map of the Mount Vernon Quadrangle, Grant County, Oregon: U. S. Geol. Surv. map, CO-548.
- Brown, C.E., and Thayer, T. P., 1977. Geology of pre-Tertiary rocks in the east end and south of the Aldrich Mtn., Grant County, Oregon. U. S. Geol. Surv. Map I-1021.
- Campell, A, S., 1954. Radiolaria. In: Moore, R. R., (ed.), Treatise on Invertebrate Paleontology. Pt. D, Protista 3:11-163
- Campbell, A. S., and Clark, B. L., 1944. Radiolaria from the Upper. Cretaceous of Middle California: Geol. Soc. Amer. Spec. Paper, 57:1-61.
- Deflandre, G., 1963. Etat Actuel de nos connaissances sur la representation au Trias de quelques groupes de microprotistes, autres que foraminiferes. In: Le Trias de la France et des regions limitrophes. B.R.G.M., K5:541-542.
- Deflandre, G., 1972. Le systeme trabeculaire interne chez les Pylentonemides et les Popofskyellides, Radiolaires du Paleozoique, Phylogene des Nassellaires. C. R. Acad. Sc. Paris, 274, 3535-3540, Paris.
- De Wever, P., Sanfillipo, A., Riedel, W. R., and GRUBER, B., 1979. Triassic radiolarians from Greece, Sicily, and Turkey. Micropaleontology, 25(1):75-109.
- Dickinson, W. R., 1976. Sedimentary basins developed during the evolution of Mesozoic-Cenozoic arc-trench system in western North America. Canad. Jour. Earth Sci., 13:1268-1287.
- Dickinson, W. R., 1979. Mesozoic forearc basin in central Oregon. Geology, 7:166-170
- Dickinson, W. R., and Thayer, T. P., 1978. Paleogeographic and Paleotectonic implications of Mesozoic stratigraphy and structure in the John Day Inlier of central Oregon. In: Howell, D. G., and McDougall, K. A. (eds.), Mesozoic paleogeography of the western United States. Pacific Sec., Soc. Econ. Paleontologists and Mineralogists, 2:147-161.
- Dickinson, W. R., and Vigrass, L. W., 1964. Pre-Cenozoic history of the Suplee-Izee district, Oregon: Implications for geosynclinal theory. Geol. Soc. Amer. Bull., 75:1037-1044.
- Dickinson, W. R., 1965. Geology of the Suplee-Izee area, Crook, Grant, and Harney Counties, Oregon. Oregon Dept. Geol, and Mineral Industries Bull., 58:1-109.
- Dumitrică, P., 1977a. The new family Eptingiidae, extinct Nassellariina with sagital ring. D.S. Inst. Geol. Geofiz., 64(1976-1977), part 3, paläont., 27-38.
- Dumitrică, P., 1977b. Triassic Palaeosceniidae and Entactiniidae from the Vicentinian Alps (Italy) and Eastern Carpathians (Romania). Ibid., 39-54.
- Dumitrică, P., Kozur, H., and Mostler, H., 1980. Contribution to the radiolarian fauna of the Middle Triassic of the Southern Alps. Geol. Palaönt. Mitt. Innsbruck, Bd, 10(1):1-46.
- Ehrenberg, C.G., 1847. Über die mikroskopischen kieselschaligen Polycystinen als mächtige Gebirgsmasse von Barbados und über das Verhältniss der aus mehr als 300 neuen Arten bestehenden ganz eigenthümlichen Formengruppe jener Felsmasse zu den lebenden Thieren und zur Kreidebildung. Eine neue Anregung zur Erforschung des Erdlebens. Monatsber. Kgl. Preuss. Akad. Wiss. Berlin, Jahrg. 1847:40-60.
- Ehrenberg, C. G., 1875. Fortsetzung der mikrogeologischen Studien als Gesamt-Uebersicht der mikroskopischen Paläontologie gleichartig analysirter Gebirgsarten der Erde, mit specieller Rücksicht auf den Polycystinen-Mergel von Barbados. Abh. kgl. Preuss. Acad. Wiss. Berlin, Jahrg. 1875:1-226.
- Givens, C. R., and Susuki, T., 1963. Late Triassic fauna from interlava sediments of east-central Vancouver Islands. Geol. Soc. Amer., Abst., Spec. Paper, 76:203.
- Haeckel, E., 1861. Über neue lebende Radiolarien des Mittelmeeres. Monatsber preuss. Akad. Wiss, Berlin, Jahrg. 1860:794-817.
- Haeckel, E., 1862. Die Radiolarien (Rhizopoda Radiolaria). Eine Monographie. (Riemer, Berling):1-572.
- Haeckel, E., 1882. Entwurf eines Radiolarien Systems auf Grund von Studien der Studien der Challenger, Radiolarien, Jena. Zeitschr. Naturwiss, 15(n.F. 8), 418-472. Jena.
- Haeckel, E., 1887. Report on the Radiolaria collected by H.M.S. Challenger during the years 1873-1876. Rept. Voy.6 Challenger, Zool., 18: i-clxxxviii + 1-1803, pls. 1-140.
- International Code of Zoological Nomenclature (ICZN), 1985. Adopted by the XX General Assembly of the International Union of Biological Sciences. pp.1-338.
- Jones, D. L., Silberling, N. J., and Hillhouse, S.,

1977. Wrangellia-A displaced terrane in northwestern North America. *Canad. Jour. Earth Sci.*, 14(11):2566-2577.
- Kozur, H., and Mostler, H., 1972. Beiträge zur Erforschung der mesozoischen Radiolarien. Teil I. Revision der Oberfamilie Coccodiscacea Haeckel, 1862, emend. und Beschreibung ihrer triassischen Vertreter: *Geol. Paläont. Mitt. Innsbruck*, Bd. 2, 8:1-60.
- Kozur, H., and Mostler, H., 1978. Beiträge zur Erforschung der mesozoischen Radiolarien. Teil II: Oberfamilie Trematodiscacea Haeckel, 1862, emend. und Beschreibung ihrer triassischen Vertreter. *Geol. Paläont. Mitt. Innsbruck*, 8:123-182.
- Kozur, H., 1979. Beiträge zur Erforschung der mesozoischen Radiolarien. Teil III: Oberfamilien Actinommacea Haeckel, 1862, emend., Artiscacea Haeckel, 1882, Multiarcusellacea nov. der Spumellaria und triassische Nassellaria. *Geol. Paläont. Mitt. Innsbruck*. 8:1-132.
- Kozur, H., and Mostler, H., 1981. Beiträge zur Erforschung der mesozoischen Radiolarien. Teil IV: Thalassosphaeracea Haeckel, 1862, Hexastylacea Haeckel, 1882 emend. Petrussevskaia, 1979, Sponguracea Haeckel, 1862 emend. und weitere triassische Lithocyclusacea, Trematodiscacea, Actinommacea und Nassellaria. *Geol. Paläont. Mitt. Innsbruck Sonderbd.* S1-208.
- Nakaseko, K., and Nishimura, A., 1979. Upper Triassic Radiolaria from southwest Japan. *Sci. Rep., Col. Educ. Osaka Univ.*, 28(2):61-109.
- Neviani, A., 1900. Supplement alla fauna a Radiolari delle rocce mesozoiche del Bolognese. *Boll. Soc. Geol. Ital.*, 19:645-671.
- Pessagno, E. A., Jr., 1971b. A new radiolaria from the Upper Cretaceous of the California Coast Ranges. *Micropaleontology*, 17(3):361-364, pl. 1.
- Pessagno, E. A., Jr., 1973. Upper Cretaceous Spumellariina from the Great Valley sequence - - California Coast Ranges. *Bull. Amer. Pal.*, 63(276):49-102, pls. 9-21.
- Pessagno, E. A., Jr., 1976. Radiolarian zonation and stratigraphy of the Great Valley sequence, California Coast Ranges. *Micropaleontology*, spec. paper, 2:1-95.
- Pessagno, E.A., Jr., 1977a. Upper Jurassic Radiolaria and radiolarian biostratigraphy of the California Coast Ranges. *Micropaleontology*, 23(1):56-113.
- Pessagno, E. A. Jr., 1977b. Lower Cretaceous radiolarian biostratigraphy of the Great Valley sequence and the Franciscan Complex, California Coast Ranges. *Cushman Found. Foram. Res. Spec. Publ.* 15:1-87.
- Pessagno, E.A. Jr., Finch, J. W., and Abbott, P. L., 1979. Upper Triassic Radiolaria from the San Hipolito Formation, Baja California, *Micropaleontology*, 25(2):160-197.
- Pessagno, E. A. Jr., and Blome, C. D., 1980. Upper Triassic and Jurassic Pantanellinae from California, Oregon, and British Columbia. *Micropaleontology*, 26(3):225-273.
- Pessagno, E. A. Jr., and Whalen, P. A., 1981. Multicyrtid Nassellariina from California, east-central Oregon, and the Queen Charlotte Islands, British Columbia. *Micropaleontology*: 28(2): 111-169, Pls.1-13.
- Riedel, W. R., 1967b. Protozoa (subclass Radiolaria). In:Marland, W. B., et al., Eds., *The fossil record*. *Geol. Soc. London*:291-298.
- Robinson, B. E., 1988. Upper Triassic Radiolarian Biostratigraphy of the Glenn Shale, east-central Alaska. Unpublished thesis, UT-Dallas. 171pp.
- Squinabol, S., 1903. Le Radiolarie dei noduli selciosi nella scaglia degli Euganei. *Riv. Italiana Pal.*, 9(4):10S-150, Pls. 8-10.
- Thayer, T. P., 1978. The Canyon Mountain Complex, Oregon, and some problems of ophiolites. In: Coleman, R. G., and Irwin, W.P., (eds.): *Ophiolites*. *Oregon Dept. Geol. and Mineral Inds. Bull.*, 95:93-106.
- Thayer, T. P., and Brown, C. E., 1960. Upper Triassic graywackes and associated rocks in the Aldrich Mountains, Oregon. *U. S. Geol. Surv. Prof. Paper*, 400-B:300-302.
- Vinassa de Rehny, P. E., 1898. Nuove famiglie e nuovi generi di Radiolari - - *Riv. Ital. Paleont.*, 4, s. 50-53, Parma.
- Yao, A., Matsuda, T., and Izizaki, Y., 1980. Upper Triassic and Jurassic Radiolarians from the Inuyama area, Central Japan. *Jour. Geosci.*, *Osaka City Univ.*, 23:135-164.
- Yeh, K. Y., 1987a. A Revised Classification for Family Canoptidae (Radiolaria). *Memoir of the Geol Soc. of China*, No.8,99.63-72.
- Yeh, K. Y., 1987b. Taxonomic Studies of Lower Jurassic Radiolaria from East-Central Oregon. *Special Publication No.2*, National Museum of Natural Science, Taichung, Taiwan. 169p. Pls. 1-30.

APPENDIX

Radiolarian Locality Descriptions: Fields Creek Formation.

FC1. A road-cut section about 30 yards long, 80 feet high, located 6.7 miles south of intersection of Hwy. 26 and Rd. 21. USGS Aldrich Mtn. 15' Quad.: NW 1/4, NE 1/4, sec.24, T.14 S., R.28 E. This outcrop consists of thin beds of turbidites faulted against thin, folded beds of gray sandstone, massive brown cherty mudstone, and black mudstone intercalated with sparse limestone nodules.

FC1A. Cherty mudstone containing poorly preserved radiolaria of Norian age.

FC1B. Black mudstone containing well-preserved Radiolaria of Norian age.

FC1E. Black micritic limestone nodule, about 3 inches in diameter with well-preserved, highly diversified pyritized radiolarian assemblage of Karnian age.

FC2. Cherty mudstones collected from a road-cut section located 7.2 miles south of intersection of Hwy. 26 and Rd. 21, right at the intersection of Rds. 21 and 14027. USGS Aldrich Mtn. 15' Quad.: NE 1/4, SE 1/4, T.14 S., R.29 E.. This sample contains Radiolaria of Norian age.

FC8. Black shales collected from a small outcrop located 0.3 miles southeast of intersections of Rds. 14027 and 1435B. USGS Aldrich Mtn. 15' Quad.: NW 1/4, NE 1/4, sec.32, T.14 S., R.29 E., This sample contains Radiolaria of Norian age.

FC9. Black shales sample collected from roadside located at 1435B, 0.9 miles south of intersection of Rds. 14027 and 1435B. USGS Aldrich Mtn. 15' Quad.: SE 1/4, NE 1/4, sec.32, T.14 S., R.29 E. This sample contains Radiolaria of Norian age.

FC10B. Black mudstone from a small road-cut outcrop located on Rd. 1435B, 1.1 miles south of intersection of Rds. 1435B and 14027. USGS Aldrich Mtn. 15' Quad.: SW 1/4, SW 1/4, sec.33, T.14 S., R.29 E.. This sample contains well-preserved Radiolaria of Norian age.

FC17. Fissile black shales from a road-cut outcrop 0.24 miles southeast of intersection of Rds. 1627 and 1631B. USGS Aldrich Mtn. 15' Quad.: NW 1/4, SW 1/4, sec.34, T.16 S., R.28 E.. This sample contains Radiolaria of Norian age.

FC20. Black cherty mudstone from a road-cut section located 5.7 miles south of intersections of Hwy. 26 and Rd. 21. USGS Aldrich Mtn. 15' Quad.: SE 1/4, NW 1/4, sec.13, T.14 S., R.28 E.. This sample contains poorly preserved Radiolaria which are

similar to those in FC 1A and also Norian age.

FC26. Black shale from a small creek at Rd. 14027, about 1.5 miles south of intersections of Rds. 1435B and 14027. USGS Aldrich Mtn. 15' Quad.: NE 1/4, SE 1/4, T.15 S., R.29 E..

FC27. Black cherty mudstones from a small road-cut outcrop located on Rd. 14027, 2.9 miles south of intersection of Rds. 14027 and 1435B. USGS Aldrich Mtn. Quad.: NE 1/4, NE 1/4, sec.8, T.15 S., R.29 E.. This sample contains Radiolaria of Norian age.

FC28. Dark-gray cherty mudstone beds, cropping out 2.4 miles south of intersection of Rds. 14027 and 1435B, on Rd. 14027. USGS Aldrich Mtn. 15' Quad.: SW 1/4, NE 1/4, Sec.8, T.15 S., R.29 E.. This sample contains well-preserved Radiolaria of Norian age.

FC29. Black shales from an outcrop at Rd. 14027, 3.6 miles south of the intersection of Rds. 14027 and 1435B. USGS Aldrich Mtn. 15' Quad.: NE 1/4, NE 1/4, sec.18, T.15 S., R.29 E.. This sample contains Radiolaria of late Ladinian age.

FC30. Black shales from a road-cut section about 300 feet long, located at intersection of Rds. S1 and 14027. USGS Aldrich Mtn. 15' Quad.: SW 1/4, NE 1/4, T.15 S., R.29 E.. This sample contains well-preserved Norian Radiolaria.

FC31. Black bedded cherty mudstones sample collected from a small outcrop located 0.42 miles southeast of intersection of Rds. 21N and 21E.. USGS Aldrich Mtn. 15' Quad.: NE 1/4, SW 1/4, sec.18, T.15 S., R.29 E.. This sample contains Radiolaria of Norian age.

FC35. Gray shales from a road-cut section located 0.5 miles east of intersection of Rd. 21 and Charlie Mac Creek Rd. USGS Aldrich Mtn. 15' Quad.: NE 1/4, SW 1/4, sec.15, T.15 S., R.29 E., This sample contains Radiolaria which is thought to be Early Jurassic in age.

FC41. Black shales from an outcrop along Rd. 1537, 1 mile north of intersection of Rds. 1537 and 1611. USGS Aldrich Mtn. 15' Quad.: SE 1/4, NE 1/4, sec.11, T.16 S., R.28 E.. This sample contains Radiolaria of Norian age.

FC43B. Black mudstone matrix of olistostrome occurring at spur 1, 0.14 mile south of intersection of Rds. 1611 and 1627. USGS Aldrich Mtn. 15' Quad.: SW 1/4, SW 1/4, sec.1; T.16S., R.28 E.. Limestone blocks containing *Hallorella* and crinoids are also found in this olistostrome. The black mudstone matrix contains poorly preserved Norian Radiolaria which are similar to those from FC 49.

FC45C. Black shales from an outcrop 7.3 miles south of intersection of Rds. 1611 and 1627. Some limestone blocks containing brachiopods and ostracodes have been found around this outcrop (USGS Aldrich Mtn. 15' Quad.: SW 1/4, NE 1/4, sec.27, T.16 S., R.28 E.). This sample contains Norian Radiolaria.

FC48. Black shales containing well-preserved, relatively high diversified Radiolaria which are similar to those from FC28 and FC17. This sample was collected from east side of Rd. 1627. 9.1 miles south of intersection of Rds. 1611 and 1627. USGS Aldrich Mtn. 15' Quad.: SW 1/4, NW 1/4, sec.34, T.16 S., R.28 E..

FC49. Black shales from a road-cut section located

9.29 miles south of intersection of Rds. 1611 and 1627. USGS Aldrich Mtn. 15' Quad.: SE 1/4, NE 1/4, sec.33, T.16 S., R.28 E.. This sample contains Radiolaria which, are similar to those from FC 43B. OR120. Thin bedded (3-6'' thick) of siliceous mudstone occurring 8.4 miles south of intersection of Hwy. 26 and Rd. 21, on the east side of Rd. 21. This sample contains Radiolaria of Norian age.

OR123C. Black chert collected near the base of the Fields Creek Formation along Fields Creek Road, approximately 11.3 miles south of the intersection of Hwy. 26 and Fields Creek Road, USGS Aldrich Mtn. 15' Quad.: NE 1/4, SE 1/4, sec.5, T.15 S., R.29 E.. This sample contains Ladinian?/ Karnian Radiolaria.

三疊紀菲爾芝魁克層放射蟲之研究

葉貴玉

摘要

本文乃奧瑞岡中部菲爾芝魁克層放射蟲研究結果之報告。菲爾芝魁克層乃該區中生代碎屑岩系列中規模最大，出露面積最廣的一層。本層堆積厚達5000米左右，但岩性以黑色泥岩為主，除發現過上部三疊紀的腕足類於轉石中外，尙未報導過其他大型化石的出現。黑色泥岩中所含的放射蟲在無形中為生物地層對比或解說板塊活動史的主要證據之一。根據分析之結果，菲爾芝魁克層中含有四個放射蟲族群，分別為中部三疊紀 *Ladinian Pseudostylosphaera magnispinsa* 族群，上部三疊紀 *Karnian Poulpus karnicus* 族群，上部三疊紀 *middle Norian Corum parvum* 族群，以及可能為下部侏羅紀的 *Orbiculiforma sp. A* 族群。其中新命名的有二十三種及三個新屬。本研究指出：

- (一) 菲爾芝魁克層的沉積主要發生於上部三疊紀晚期 Norian 時代，
- (二) 中部三疊紀或上部三疊紀初期的放射蟲應為洋底大規模滑落再沉積作用的產物；
- (三) 至於下部侏羅紀化石的出現可能指示侏羅紀的凱樂魁克頁岩層應比前人所劃定的區域再向西側延伸。

PLATE 1

All figures are scanning electron micrographs of Triassic Radiolaria from the Fields Creek Formation, east-central Oregon. Length of scale bar, upper right, equals number of micrometers cited for each illustration.

- 1-2,11, *Pseudostylosphaera magnispinosa*, n. sp.
18 1,11, holotype (NMNS 000875), scales = 99, 60 um, respectively, OR123C. 2,18, paratype (Yeh Collection), scales = 84 42 um, respectively, FC49.
- 3,12 *Pseudostylosphaera* sp. A
Scales = 84, 75 um, respectively OR123C. 12, showing the internal structure.
- 4 *Pseudostylosphaera japonica* (Nakaseko & Nishimura)
Scale = 84 um, OR120.
- 5,20-21 *Pseudostylosphaera* sp. B
5, scale = 84 um, OR123C; 20,21, scales = 50 um, OR123C, internal view of transverse and parallel sections, respectively to the axis of spines.
- 6 *Pseudostylosphaera* sp. C
Scale = 84 um, OR123C.
- 7,9 *Radium* sp. A
Scales = 84 um, 75 um, respectively, OR123C.
- 8 *Radium* sp. B
Scale = 84 um, OR123C.
- 10,13,15 *Radium pessagnoii*, n. sp.
10, holotype (NMNS 000879), scale = 84 um, OR123C;
13, paratype (NMNS 000880), scale = 75 um, OR123C;
15, scale = 66 um, OR123C. Note the double-layered test wall.
- 14,17 *Pylostephanidium* sp. A
Scales = 75 um, OR123C.
- 16,19 *Parasepsagon variabilis* (Nakaseko & Nishimura)
Scales = 60, 42um, respectively, OR123C.

PLATE 1

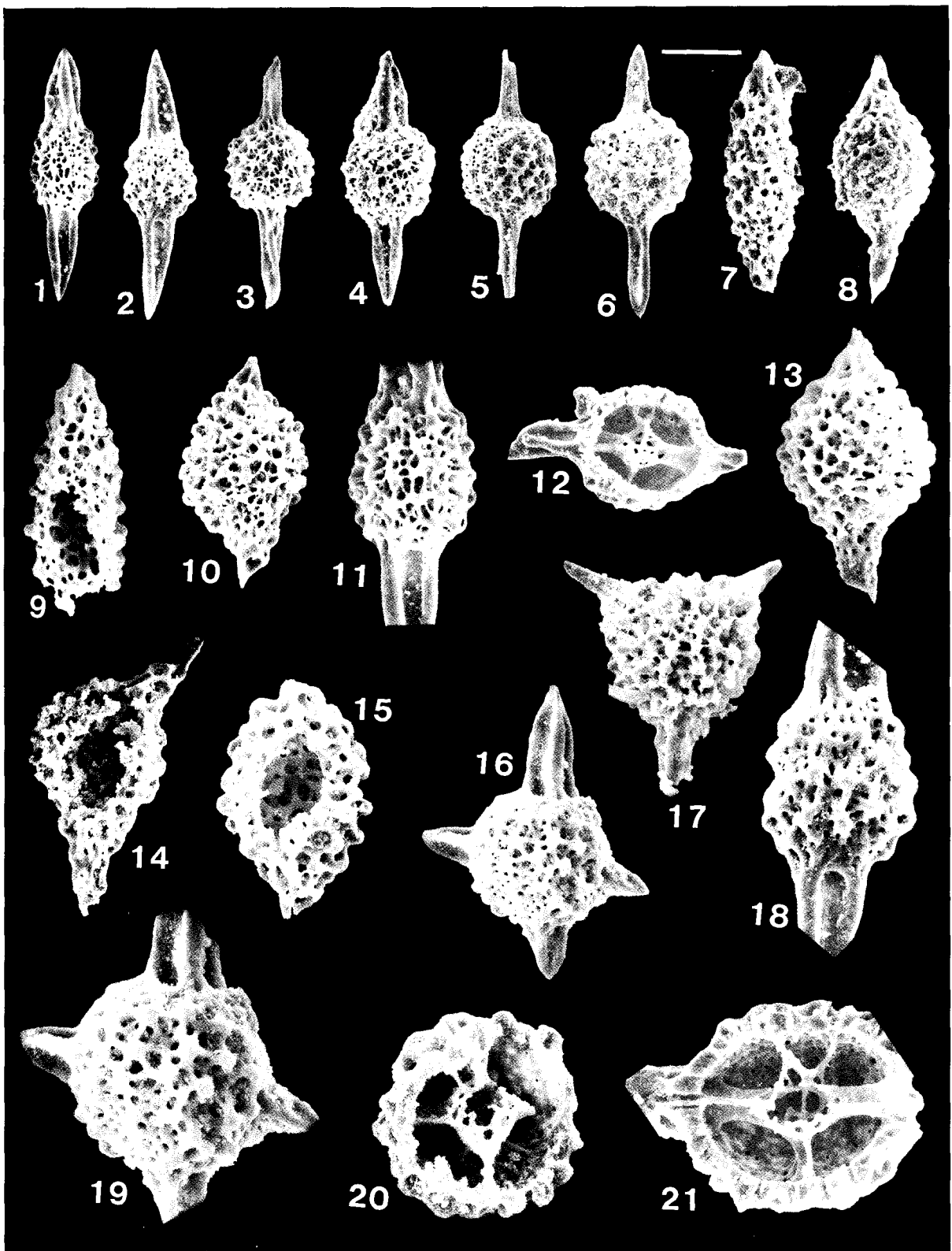


PLATE 2

All figures are scanning electron micrographs of Triassic Radiolaria from the Fields Creek Formation, east-central Oregon. Length of scale bar, upper right, equals number of micrometers cited for each illustration.

- 1 *Xiphotheca* sp. A
Scale=99 um, FC1E.
- 2 Unnamed Nassellaria
Scale=84 um, OR123C.
- 3 *Triassocampe* sp. A
Scale=84 um, OR123C.
- 4 *Triassocampe* (?) sp. cf. *T. (?) pulchra* Kozur & Mostler
Scale=75 um, FC1E.
- 5 Unnamed Nassellaria
Scale=99 um, FC1E.
- 6 *Yeharaia* sp. A
Scale=75 um, OR123C.
- 7 Unnamed Nassellaria
Scale=66 um, OR123C.
- 8,25,26 *Triassocampe exilis*, n. sp.
Holotype (NMNS 000895), scales=84,48,48 um, respectively. FC43B.
- 9,10,16 *Triassocyrtium* (?) sp. A
Scales=66, 66, 37 um, respectively. Note the hollow thorax spines circular in cross-section.
FC1E.
- 11 *Triassocyrtium* (?) sp. B
Scale=55 um, FC1E. Note solid thorax spines triradiate in cross-section.
- 12 *Pachus* (?) sp. A
Scale=60 um, FC1E.
- 13 *Triassocampe sulovens* Kozur & Mock
Scale=75 um, FC1E.
- 14,23 *Triassocampe illyrica* Kozur & Mostler, 1981
Scales=66, 36 um, respectively. FC1E.
- 15 *Triassocampe* sp. aff. *T. illyrica* Kozur & Mostler
Scale=60 um, FC1E. Note cephalis and thorax indistinct and forming a large U-shaped dome.
- 17 *Yeharaia elegans* Nakaseko & Nishimura
Scale=75 um, OR123C.
- 18 *Yeharaia* sp. aff. *Y. elegans* Nakaseko & Nishimura
Scale=84 um, OR123C.
- 19,24 *Silicarmiger* sp. A
Scales=75 um; 19, OR123C; 24, FC8
- 20-22 *Triassocampe* (?) sp.
20, scale=60 um, FC10B; 21-22, scales=60, 33 um, respectively, FC1E.

PLATE 2

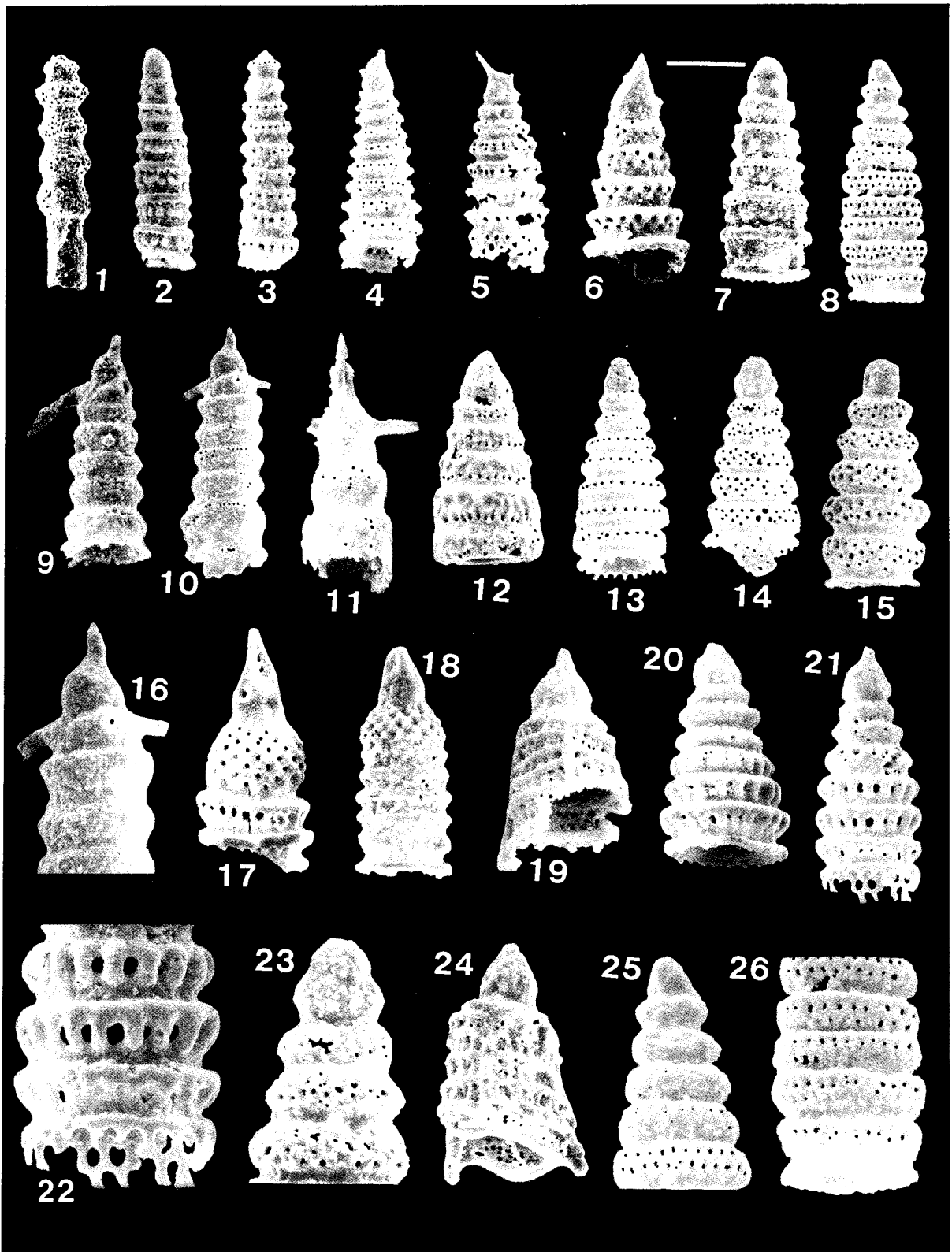


PLATE 3

All figures are scanning electron micrographs of Triassic Radiolaria from the Fields Creek Formation, east-central Oregon. Length of scale bar, upper right, equals number of micrometers cited for each illustration.

- 1 *Plafkerium* sp. A
Scale = 75 μ m, FC1E. Specimen pyritized.
- 2,4-5,8, *Parasepsagon* sp. A
12,14 2, 5, scales = 120, 99 μ m, respectively, OR 123C.
4, scale = 99 μ m, OR123C.
8, 12, scales = 99, 84 μ m, respectively. OR123C.
14, scale = 48 μ m, OR123C.
- 3 *Parasepsagon* sp. B
Scale = 66 μ m, OR123C.
- 6 *Plafkerium* sp. B
Scale = 75 μ m, FC1E. Specimen pyritized.
- 7 *Stauracontium ? trispinosum ladanicum* Dumitrică, Kozur & Mostler
Scale = 88 μ m, FC1E. Specimen Pyritized.
- 9, 10 *Plafkerium* sp. C
Scales = 66 μ m, 10, specimen tilted 45. FC1E. Specimens pyritized.
- 11 *Stauracontium* sp. A
Scale = 60 μ m, FC1E. Specimen pyritized.
- 13,15,16 *Plafkerium robustum*, n. sp.
13, holotype (NMNS000877), scale = 60 μ m, FC1E. 15, 16,
scales = 36, 48 μ m, respectively. FC1E. Specimens pyritized.

PLATE 3

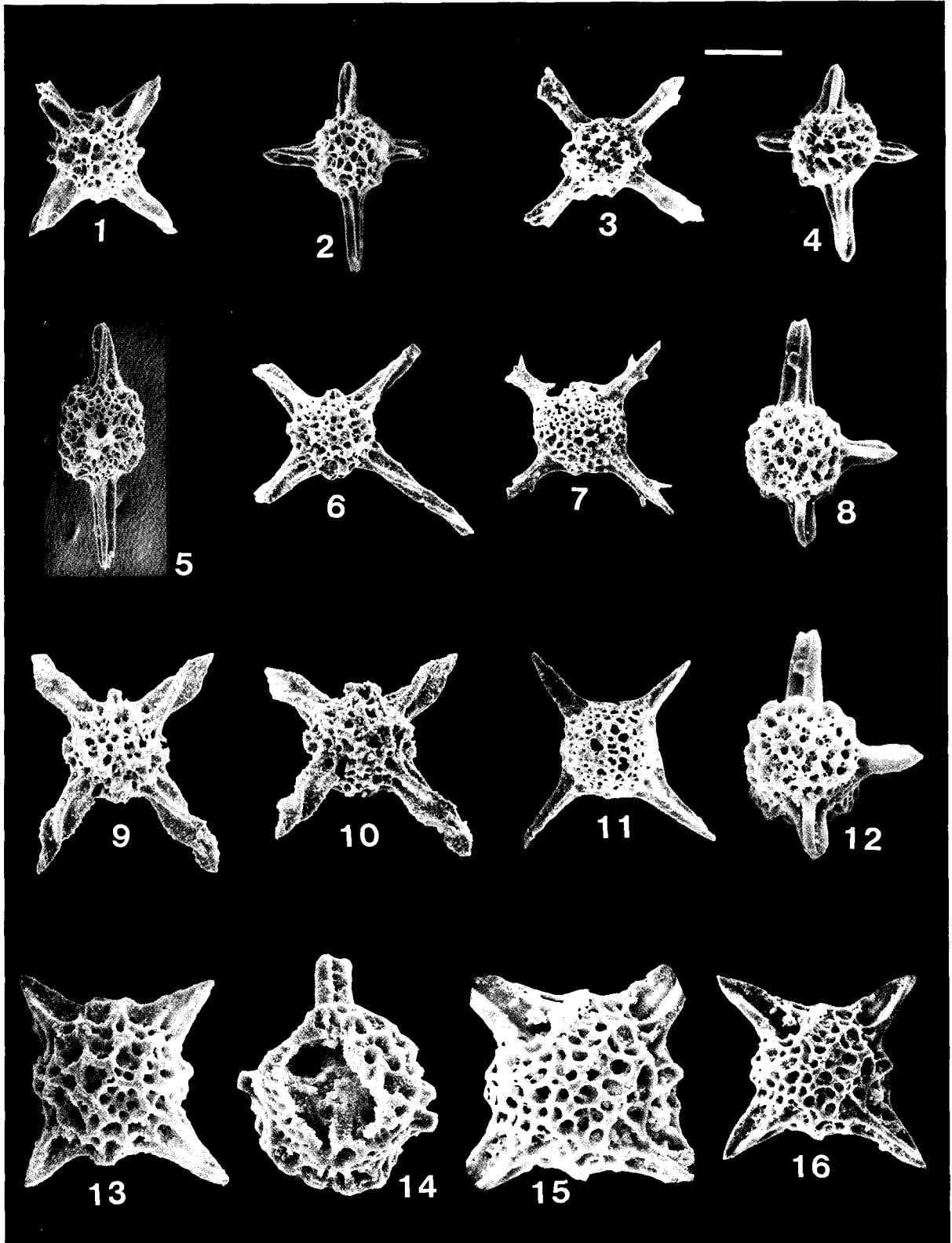


PLATE 4

All figures are scanning electron micrographs of Triassic Radiolaria from the Fields Creek Formation, east-central Oregon. Length of scale bar, upper right, equals number of micrometers cited for each illustration.

- 1-2, 14-15 *Quadrisaturnalis* sp. A
Scales = 75, 75, 50, 30 um, respectively FC1E. Specimen pyritized.
- 3 Unnamed spumellaria
Scale = 50 um, FC1E. Specimen pyritized.
- 4 *Quadrisaturnalis* sp. B
Scale = 66 um, FC1E. Specimen pyritized.
- 5,13 *Quadrisaturnalis* sp. C
Scales = 99, 50 um, respectively. FC1E. Specimen pyritized.
- 6 *Quadrisaturnalis* sp. D
Scale = 60 um, FC1E. Specimen pyritized.
- 7,9-10 *Quadrisaturnalis* sp. E
Scales = 50, 60, 30 um, respectively. FC1E. Specimen pyritized.
- 8 *Quadrisaturnalis* sp. F
Scale = 50 um, FC1E. Specimen pyritized.
- 11 *Austrisaturnalis* sp. aff. *A. quadriradiatus* Kozur & Mostler
Scale = 60 um, FC1E. Specimen pyritized.
- 12,16 *Quadrisaturnalis grandis*, n. sp.
Holotype (NMNS 000853). scales = 75, 30 um, respectively. FC1E. Specimen pyritized.

PLATE 4

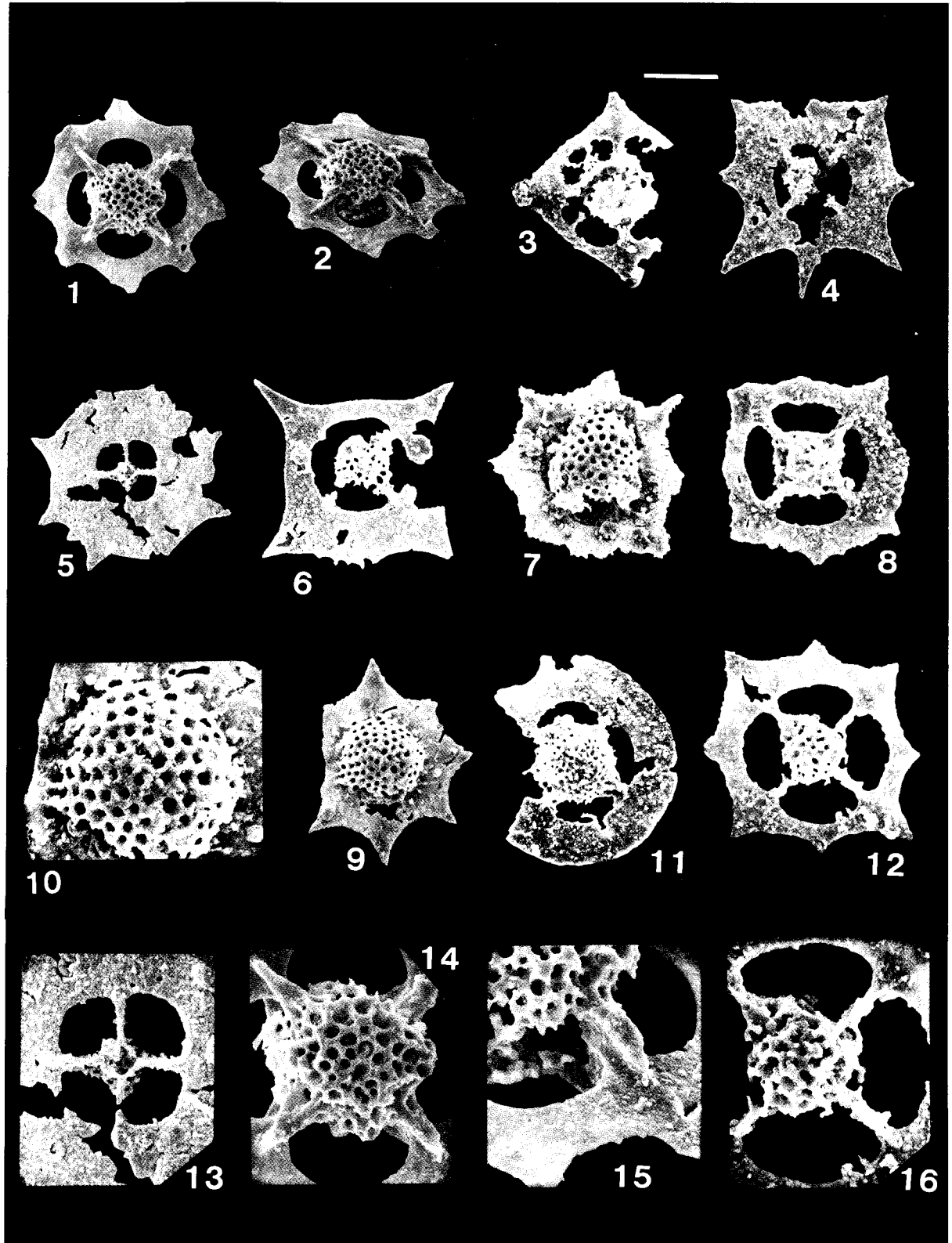


PLATE 5

All figures are scanning electron micrographs of Triassic Radiolaria from the Fields Creek Formation, east-central Oregon. Length of scale bar, upper right, equals number of micrometers cited for each illustration.

- 1-2, *Sarla* (?) sp. A
15-16 1,15, scales = 75, 42 um, respectively. FC1E. 2,16, scales = 66, 33 um, respectively. FC1E. Note the cortical shell connecting to the first medullary shell with both primary & secondary radial beams. Specimens pyritized.
- 3 *Kahlerosphaera* sp. A
Scale = 99 um, FC1E. Specimen pyritized.
- 4 *Sarla* sp. B
Scale = 84 um, FC1E. Specimen pyritized.
- 5 *Sarla* sp. C
Scale = 60 um, FC1E. Specimen pyritized.
- 6 *Sarla*(?) sp. D
Scale = 84 um, FC1E. Specimen pyritized.
- 7 *Capnuchosphaera* sp. A
Scale = 84 um, FC1E. Specimen pyritized.
- 8 *Parentactinosphaera* ? *longispinosa* Kozur & Mostler
Scale = 60 um, FC1E. Specimen pyritized.
- 9,13 *Sarla* sp. E
Scale = 66, 42 um, respectively. FC1E. Specimen pyritized.
- 10 *Capnuchosphaera* sp. B
Scale = 75 um, FC1E. Specimen pyritized.
- 11,14 *Capnuchosphaerids* sp.
Scales = 60, 39 u, respectively. FC1E. Specimen pyritized. Note arrow pointing to the broken remanent of the fourth spine.
- 12 *Capnuchosphaera* sp. C
Scale = 75 um, FC1E. Specimen pyritized.

PLATE 5

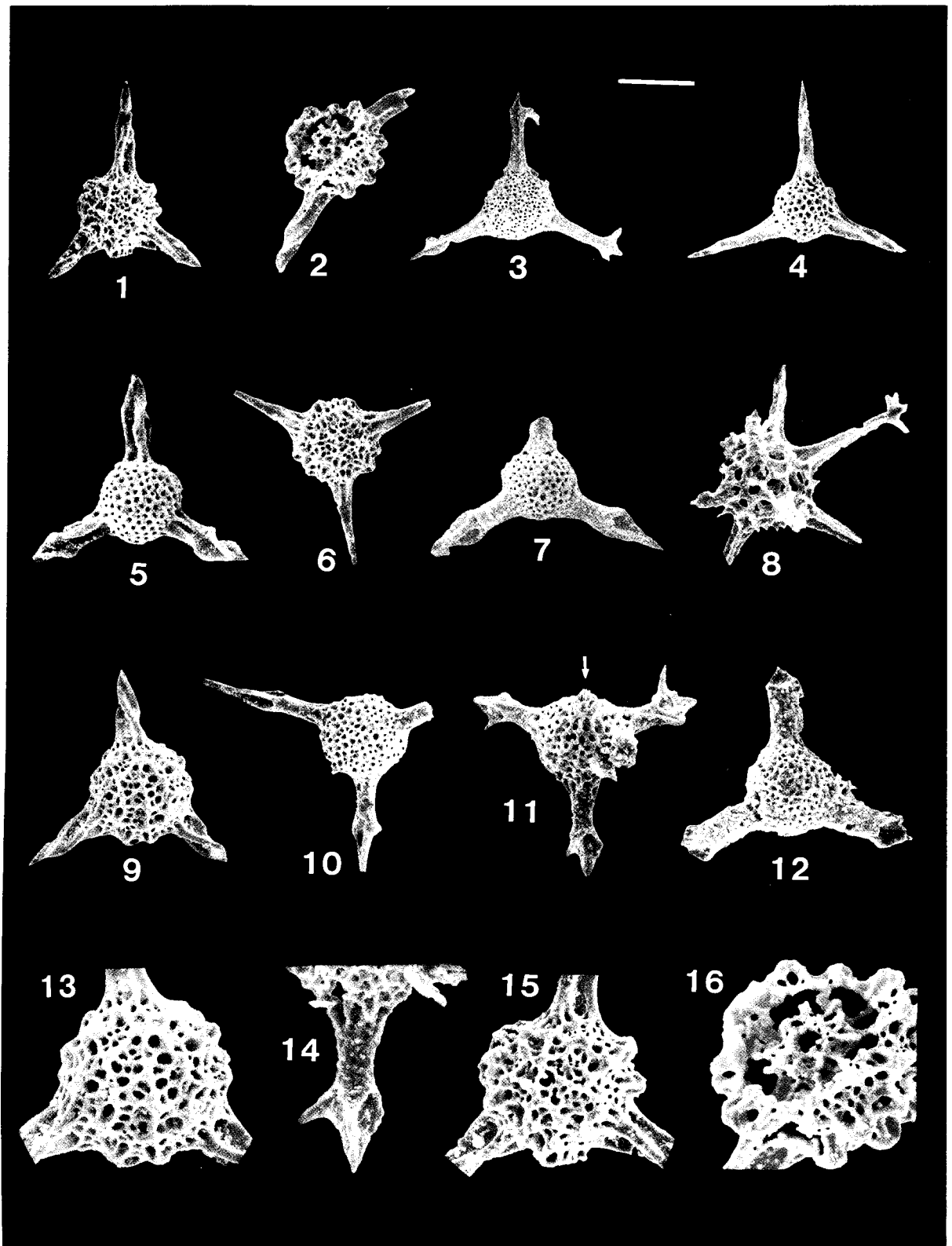


PLATE 6

All figures are scanning electron micrographs of Triassic Radiolaria from the Fields Creek Formation, east-central Oregon. Length of scale bar, upper right, equals number of micrometers cited for each illustration.

- 1,2 *Poulpus* sp. A
Scales = 60, 40 um, respectively. 2, Note velum structure supporting by feet. FC1E.
- 3 *Poulpus* (?) sp. B
Scale = 60 um, FC1E.
- 4 *Veghia* sp. A
Scale = 60 um, FC1E.
- 5,10 *Poulpus* (?) sp. C
Scales = 60, 40 um, respectively. FC1E.
- 6-8,13 *Poulpus karnicus*, n. sp.
6, holotype (NMNS 000891), scale = 48 um, FC1E.
7-8,14 scales = 42,42,45 um, respectively. FC1E.
- 9,14 *Pseudosaturnumforma minuta* Blome
Scale = 60 um, FC1E.
- 11 *Quasipetatus* sp. aff. *Q. insolitus* Blome
Scale = 75 um, OR120.
- 12,18 *Quasipetatus tubus*, n. sp.
12, holotype (NMNS 000893), scale = 84 um, OR120.
18, scale = 75 um, OR120.
- 15,19 *Quasipetatus* sp. A
Scales = 75, 60 um, respectively. FC8.
- 16 *Quasipetatus* sp. B.
Scale = 48 um, FC1E.
- 17 *Pseudosaturnumforma* sp. A
Scale = 60 um, OR123C.

PLATE 6

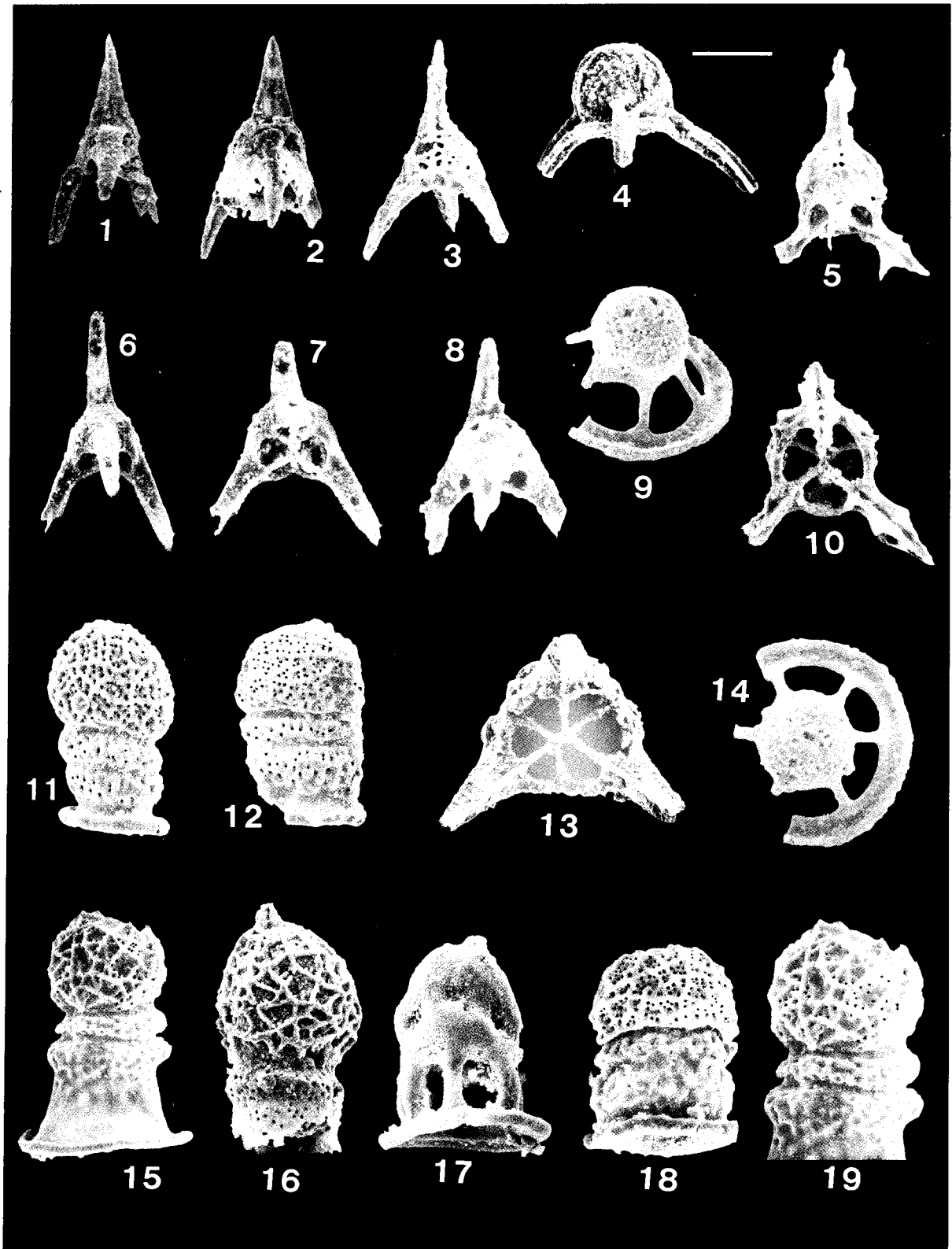


PLATE 7

All figures are scanning electron micrographs of Triassic Radiolaria from the Fields Creek Formation, east-central Oregon. Length of scale bar, upper right, equals number of micrometers cited for each illustration.

- 1 *Gorgansium* sp. A
1, scale = 60 um, FC1E. Specimen pyritized.
 - 2 *Pantanellium* sp. A
Scale = 75 um, FC1E. Specimen pyritized.
 - 3,21 *Gorgansium* sp. B
Scale = 75, 40 um, respectively. FC1E. specimen pyritized.
 - 4 *Pantanellium* sp. B
Scale = 60 um, FC1E. Specimen pyritized.
 - 5 *Gorgansium* sp. C
Scale = 66 um, FC1E. Specimen pyritized.
 - 6 *Pantanellium* sp. C
Scale = 66 um, FC1E. Specimen pyritized.
 - 7 *Gorgansium* sp. D
Scale = 60 um, FC1E. Specimen pyritized.
 - 8 *Pantanellium* sp. D
Scale = 66 um, FC1E. Specimen pyritized.
 - 9 *Gorgansium browni*, n sp.
Holotype (NMNS 000871). scale = 66 um, FC1E. Specimen pyritized.
 - 10 *Capnodoce* sp. C
Scale = 75 um, FC1E. Specimen pyritized.
 - 11 *Gorgansium* sp. cf. *G. thayeri*, n. sp.
Scale = 54 um, FC1E. Specimen pyritized.
 - 12 *Gorgansium thayeri*, n. sp.
Holotype (NMNS 000873). scale = 54 um, FC1E. Specimen pyritized.
 - 13 *Gorgansium* sp. E
Scale = 60 um, FC1E. Specimen pyritized.
 - 14,20 *Pantanellium* sp. E
Scales = 60, 39 um, respectively. FC1E. Specimen pyritized.
 - 15 *Pantanellium* sp. F
Scale = 54 um, FC1E. Specimen pyritized.
 - 16 *Pantanellium* sp. G
Scale = 54 um, FC1E. Specimen pyritized.
 - 17 *Gorgansium* sp. F
Scale = 60 um, FC1E. Specimen pyritized.
 - 18,23 Spumellaria gen. and sp. indet. A
Scale = 50, 60 um, respectively. OR123C.
 - 19 *Cantalum* sp. A
Scale = 54 um, FC1E. Specimen pyritized.
 - 22 Spumellaria gen. and sp. indet. B
Scale = 66 um, FC28.
- Nassellaria gen. and sp. indet. A
Scale = 99 um, FC1E. Specimen pyritized.

PLATE 7

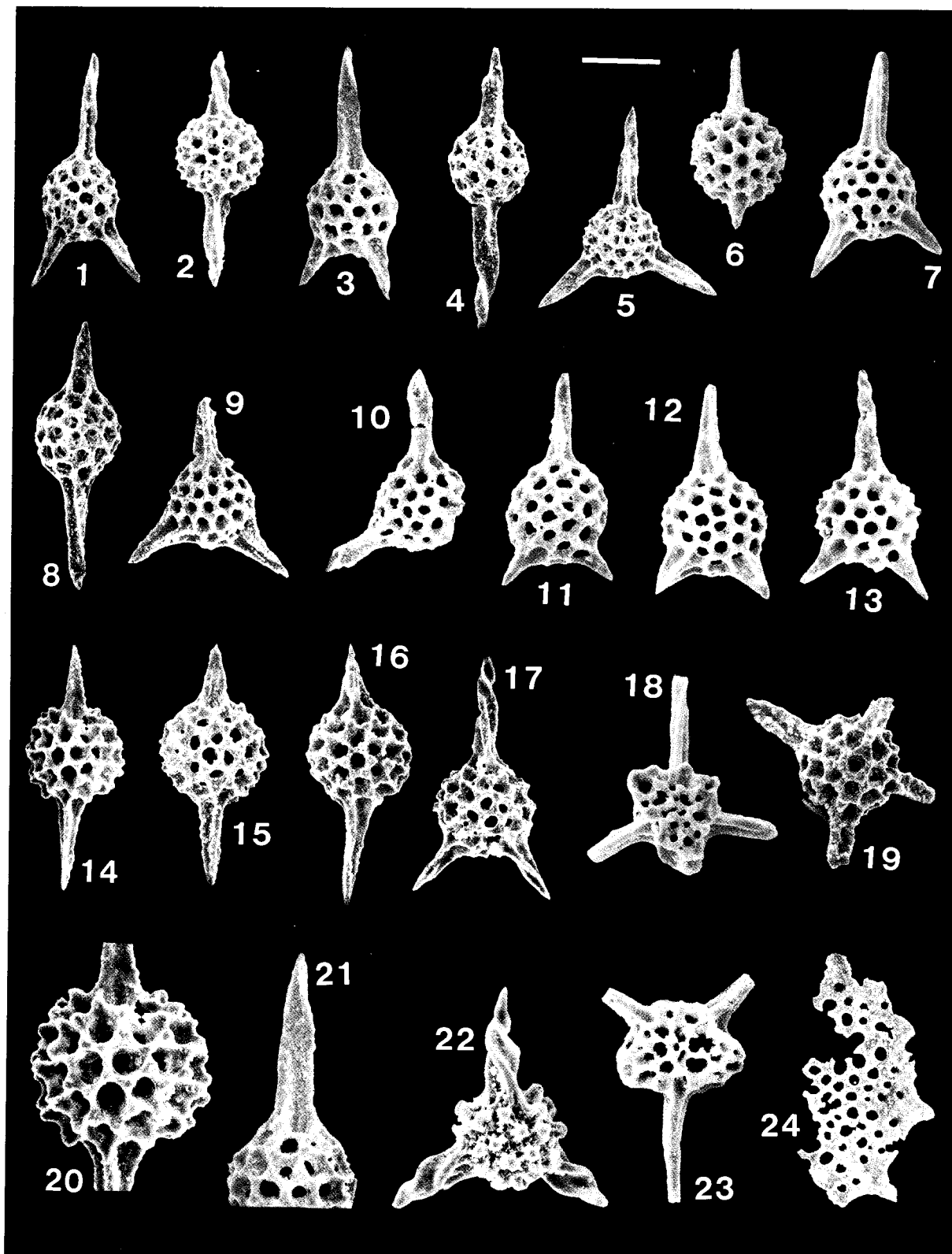


PLATE 8

All figures are scanning electron micrographs of Triassic Radiolaria from the Fields Creek Formation, east-central Oregon. Length of scale bar, upper right, equals number of micrometers cited for each illustration.

- 1 *Xiphotheca longa* Kozur & Mock, 1981.
Scale= 66 um, FC1E.
- 2 Unnamed Nassellaria
Scale= 66 um, FC1E.
- 3,18 *Castrum* sp. A
Scale= 66, 54 um, respectively, OR120.
- 4 *Pachus longinquus* Blome
Scale= 44 um, FC10B.
- 5-6,17, Nassellaria gen. and sp. indet. B
21 5, scale = 84 um, OR123C. 6, 17, 21, scales = 75, 42,33 um, respectively, OR123C.
- 7-8,13 *Xipha pessagnoii* Nakaseko & Nishimura
Scales= 54, 60, 48 um, respectively, OR120.
- 9 *Castrum perornatum* Blome
Scale= 66 um, FC49.
- 10 Unnamed Nassellaria
Scale= 75 um, FC10B.
- 11-12 *Triassocampe immaturum* Blome, 1984
Scales= 75, 66 um, respectively, OR120.
- 14-15, *Hatalum brevilabrum*, n. sp.
19-20 14, 19, holotype (NMNS 000885), scales = 66, 54 um, respectively. 15, 20, scales = 66 um, OR120.
- 16 Nassellaria gen. and sp. indet. C
Scale= 54 um, FC1E.

PLATE 8

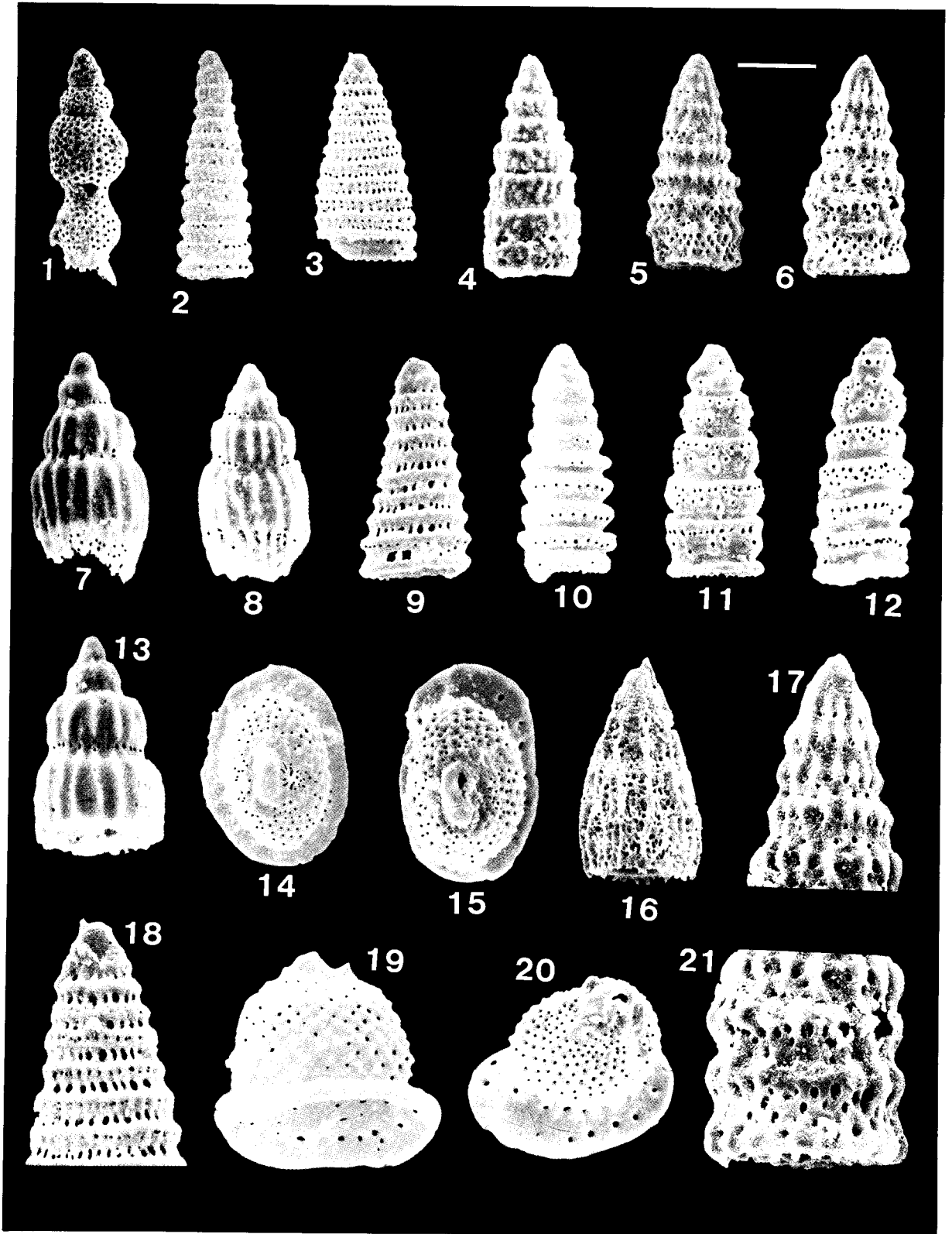


PLATE 9

All figures are scanning electron micrographs of Triassic Radiolaria from the Fields Creek Formation, east-central Oregon. Length of scale bar, upper right, equals number of micrometers cited for each illustration.

- 1-2 *Corum parvum*, n. sp.
1, holotype. (NMNS 000883), scale = 75 μ m, FC28.
2, paratype (NMNS 000884), scale = 75 μ m, FC28.
- 3 *Canoptum* sp. cf. *C. macoyense* Blome
Scale = 84 μ m, OR120. Cephalis slightly longer than that of *C. macoyense* Blome.
- 4 *Canoptum* sp. A
Scale = 84 μ m, FC1E.
- 5 *Canoptum laxum* Blome
Scale = 75 μ m, OR120.
- 6 *Corum* sp. A
Scale = 75 μ m, FC28.
- 7-8, 20-21 *Corum candidum*, n. sp.
7, paratype (NMNS 000882), scale = 66 μ m, FC28.
8, 20, 21, holotype (NMNS 000881), scales = 99, 54, 48 μ m, respectively, FC9.
- 9, 19 *Multimonilis pulcher*, n. sp.
Holotype (NMNS 000887), scales = 66, 33 μ m respectively. FC28.
- 10-11, 15 *Latium mundum* Blome
Scales = 75, 75, 66 μ m, respectively. FC10B.
- 12, 22 *Multimonilis* sp. A
Scales = 99, 48 μ m, respectively. FC9.
- 13, 18, 23 *Multimonilis splendidus*, n. sp.
13, scale = 75 μ m, OR120; 18, 23, holotype (NMNS 000889), scales = 84, 60 μ m, respectively, FC9.
- 14 *Latium longulum* Blome
Scale = 75 μ m, FC10B.
- 16 *Multimonilis* sp. cf. *M. splendidus*, n. sp.
Scale = 75 μ m, Note Chambers with wider Strictures & less dense H-linked circumferential ridges.
FC28.
- 17 *Multimonilis* sp. B
Scale = 99 μ m, FC28.

PLATE 9

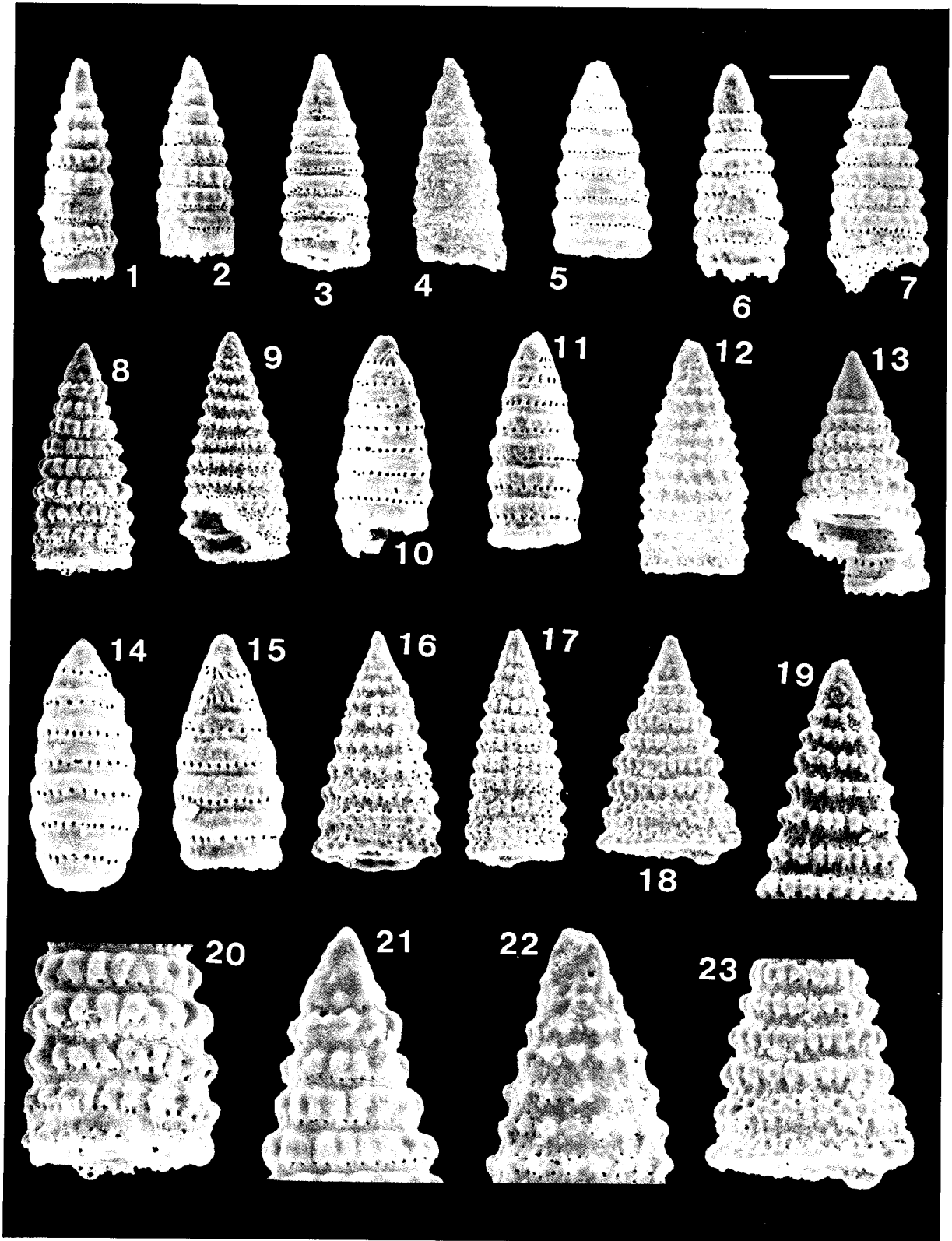


PLATE 10

All figures are scanning electron micrographs of Triassic Radiolaria from the Fields Creek Formation, east-central Oregon. Length of scale bar, upper right, equals number of micrometers cited for each illustration.

- 1,6 *Capnodoce gracilis*, n. sp.
1, paratype (NMNS 000866). scale = 90 um, FC28.
6, holotype (NMNS 000865). scale = 84 um, FC28.
- 2,9 *Justium* sp. A
Scale = 66, 75 um, respectively. FC28.
- 3 *Justium medium*, n. sp.
Scale = 75 um, FC28.
- 4-5 *Justium* sp. B
Scale = 60 um, FC28.
- 7 *Capnodoce* sp. D
Scale = 60 um, OR120.
- 8,13 *Renzium* sp. A
Scales = 75, 66 um, respectively. FC49.
- 10 *Gorgansium beaverense*, n. sp.
Holotype (NMNS 000869). scale = 66 um, FC28.
- 11-12 *Capnodoce* sp. B
Scale = 66 um, FC28.
- 14 *Capnodoce* sp. cf. *C. extenta* Blome
Scale = 75 um, FC28.
- 15 *Gorgansium* sp. G
Scale = 45 um, FC28.
- 16 Unnamed capnodocids
Scale = 66 um, FC28.
- 17 *Capnodoce* sp. E
Scale = 75 um, FC28.
- 18 *Capnodoce* sp. F
Scale = 66 um, FC28.
- 19 *Gorgansium* sp. H
Scale = 50 um, FC28.

PLATE 10

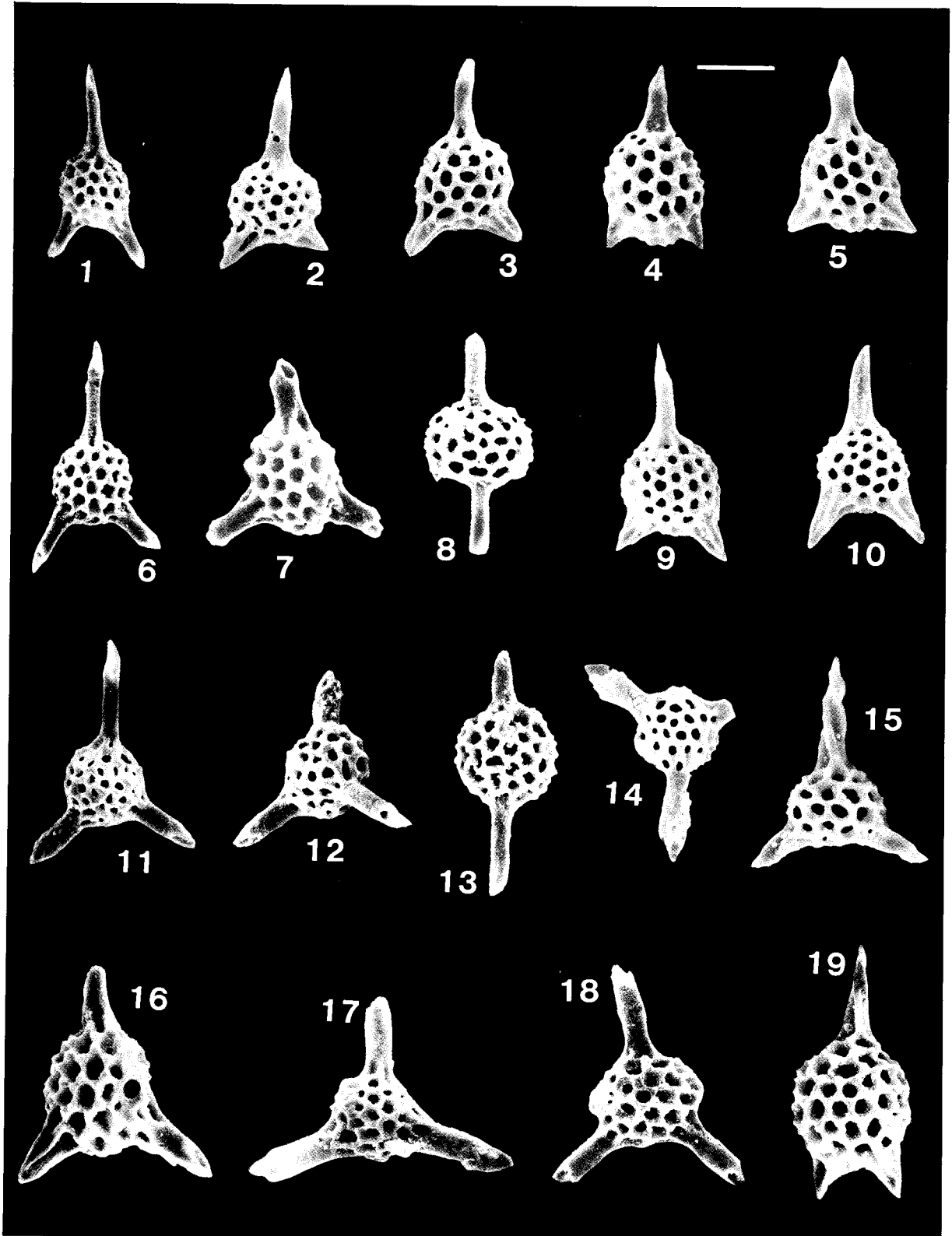


PLATE 11

All figures are scanning electron micrographs of Triassic Radiolaris from the Fields Creek Formation, east-central Oregon. Length of scale bar, upper right, equals number of micrometers cited for each illustration.

- 1 *Capnodoce* sp. G
Scale= 66 um, respectively. FC28.
- 2-3,15 *Justium medium*, n. sp.
2, 15, holotype (NMNS 000867), scales = 75, 48 um, respectively. FC28. 3, scale = 66 um, FC28.
- 4 *Justium* sp. C
Scale= 66 um, FC28.
- 5, 9 *Capnodoce minuta*, n. sp.
Holotype (NMNS 000863), scales = 75 um, FC28.
- 6 *Capnodoce* (?) sp. A
Scale= 84 um, FC28.
- 7,11 *Justium* sp. D
Scales= 60 um, OR120.
- 8 *Capnodoce gracilis*, n. sp.
Scale= 66 um, FC28.
- 10,13, *Syringocapsa turgida* Blome
19 Scales= 84, 75, 66 um, respectively; 10, 19, OR120; 13, FC49.
- 12 *Capnuhosphaera colemani* Blome
Scale= 99 um, OR120.
- 14 *Sarla* sp. F
Scale= 60 um, OR120.
- 16,18 *Pantanellium fostleri* Pessagno & Blome
Scale= 42 um, FC28.
- 17 *Renzium webergorum* Blome
Scale= 60 um, FC49.

PLATE 11

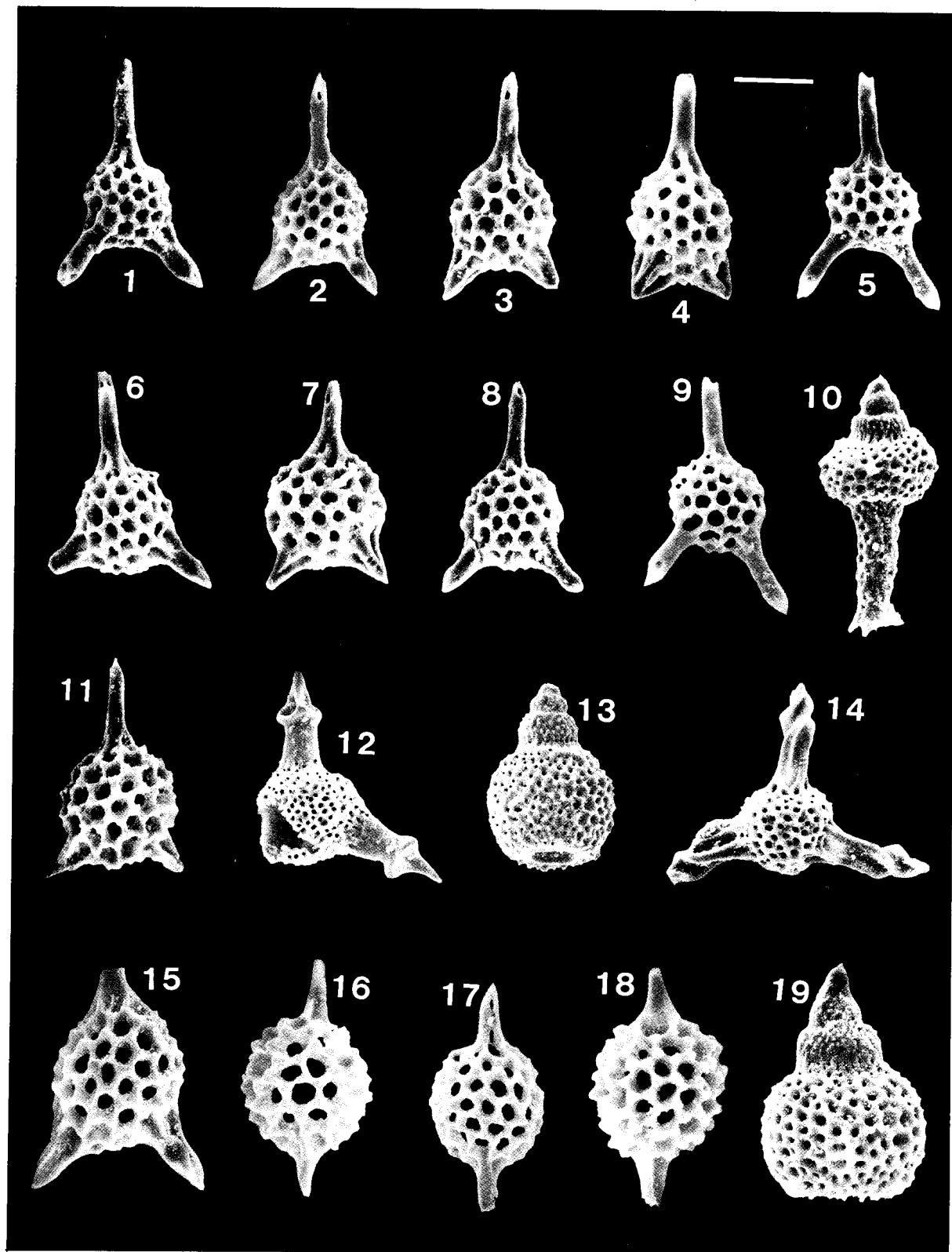


PLATE 12

All figures are scanning electron micrographs of Triassic Radiolaria from the Fields Creek Formation, east-central Oregon. Length of scale bar, upper right, equals number of micrometers cited for each illustration.

- 1 *Loffa* sp. A
Scale= 75 um, OR120.
- 2 *Sarla* sp. G
Scale= 99 um, OR120.
- 3 *Capnodoce* sp. H
Scale= 75 um, OR120.
- 4,8,15 *Capnodoce* sp. I
Scales= 84, 175, 60 um, respectively, OR120.
- 5 *Capnuhosphaera* sp. aff. *C. sockensis* Blome
Scale= 99 um, OR120.
- 6 *Capnuhosphaera colemani* Blome
Scale= 84 um, FC28.
- 7 *Capnodoce* sp. J.
Scale= 75 um, OR120.
- 9 *Capnuhosphaera* sp. D
Scale= 99 um, FC28.
- 10 *Capnodoce beaulieui* Blome
Scale= 75 um, FC28.
- 11 *Capnuhosphaera* sp. aff. *C. texensis*, n. sp.
Scale= 90 um, FC28.
- 12,14 *Capnuhosphaera texensis*, n. sp.
12, holotype (NMNS 000857), scale = 99 um. FC28.
14, paratype (NMNS 000858), scale = 99 um, FC28.
- 13,17 *Justium novum* Blome
Scales= 60, 46 um, respectively, OR120.
- 16 *Capnuhosphaera* sp. E
Scale= 99 um. OR120. Note the medullary shell connected with the cortical shell by three triradial primary beams.

PLATE 12

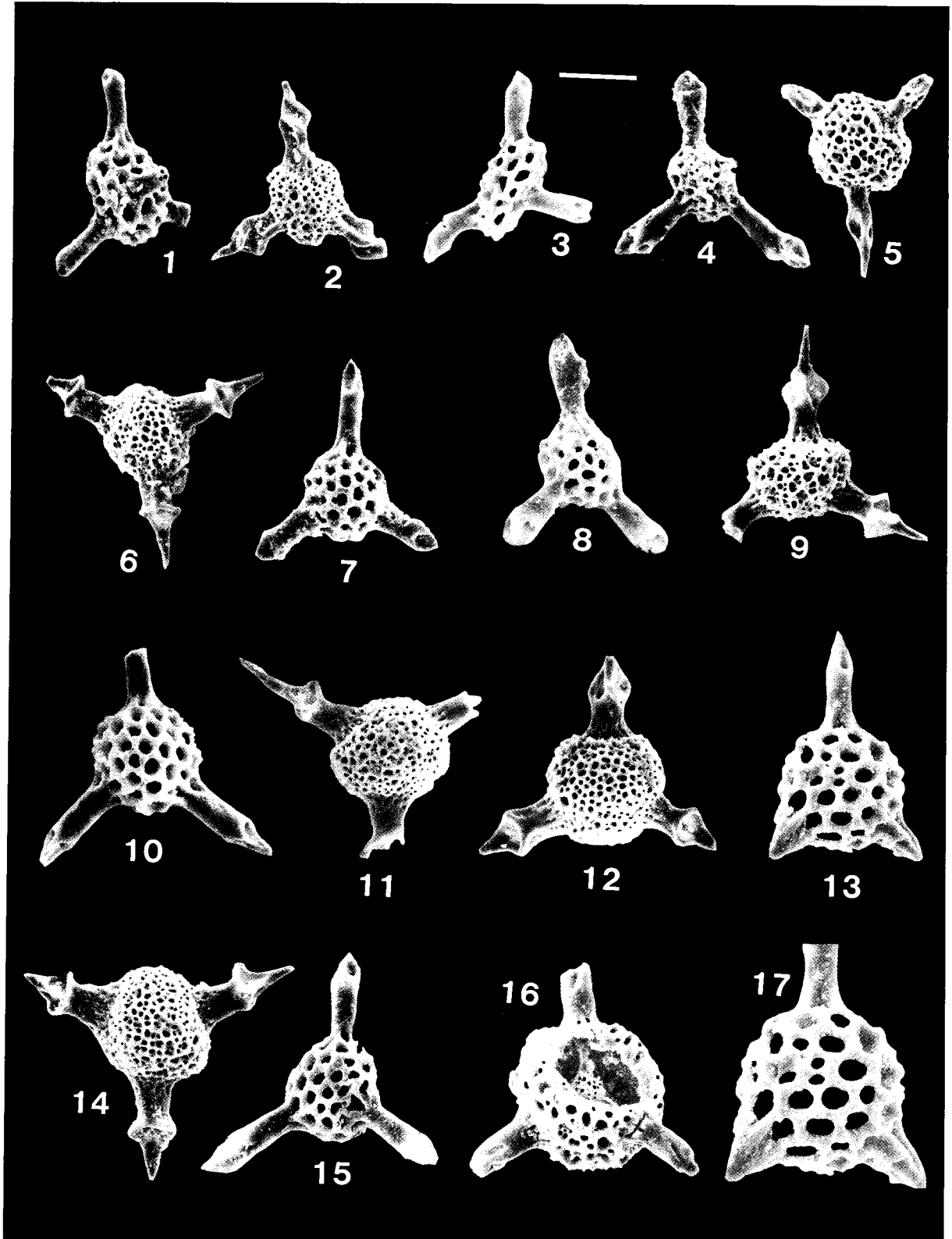


PLATE 13

All figures are scanning electron micrographs of Triassic Radiolaria from the Fields Creek Formation, east-central Oregon. Length of scale bar, upper right, equals number of micrometers cited for each illustration.

- 1,20 *Kahlerosphaera* sp. B
Scales=99, 48 um, respectively. FC28.
- 2,4 *Sarla triangulata*, n. sp.
2, holotype (NMNS 000861), scale=99 um, FC43B.
4, paratype (Yeh collection), scale=97 um, FC43B.
- 3 *Acanthocircus* sp. aff. *A. rotundus* Blome
Scale=120 um, FC28.
- 5 *Kahlerosphaera* sp. C
Scale=84 um, FC43B.
- 6,17 *Kahlerosphaera* sp. D
Scales=99, 184 um, respectively. FC28.
- 7,22 *Spongostylus* sp. A
Scales=99, 33 um, respectively. FC28.
- 8 *Spongostylus carnicus* Kozur & Mostler
Scale=120 um, FC28.
- 9 *Spongostylus* sp. B
Scale=99 um, FC28.
- 10-11 *Sarla* sp. cf. *S. formosa*, n. sp.
Scales=75, 60 um, respectively. FC43B.
- 12 *Quadrisaturnalis* sp. G
Scale=66 um, FC43B.
- 13 *Quadrisaturnalis* sp. H
Scale=99 um, FC43B.
- 14 *Quadrisaturnalis* sp. cf. *Q. dickinsoni*, n. sp.
Scale=99 um, FC43B.
- 15,23 *Sarla formosa*, n. sp.
Holotype (NMNS 000859), scales=84, 48 um, respectively. FC43B.
- 16,19, 21 *Quadrisaturnalis quadratus*, n. sp.
16, 19 scales=75, 90 um, respectively FC43B. 21, holotype (NMNS 000855), scale=66 um, FC43B.
- 18 *Quadrisaturnalis dickinsoni*, n. sp.
Holotype (NMNS 000851), scale=99 um, FC43B.

PLATE 13

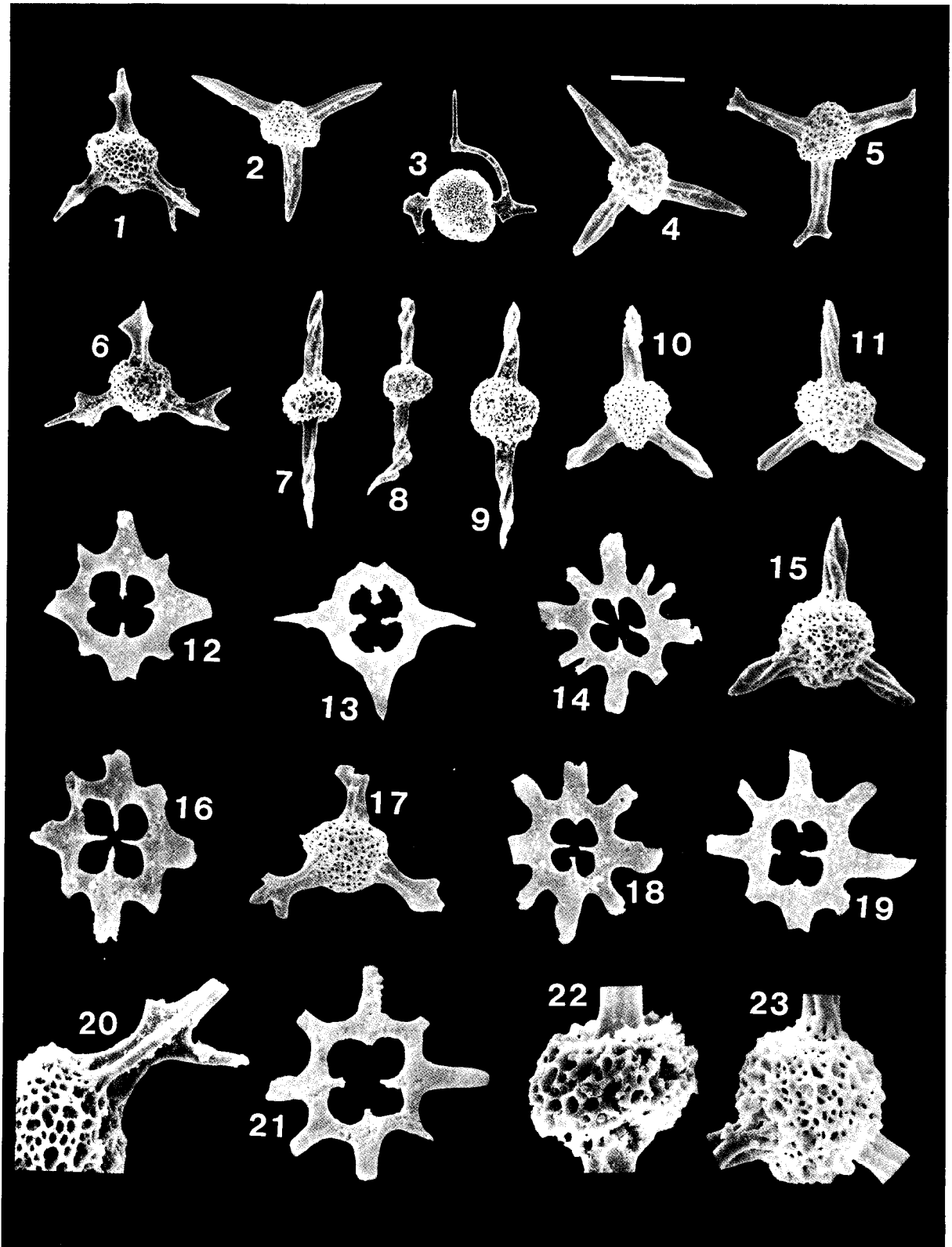


PLATE 14

All figures are scanning electron micrographs of Triassic and Jurassic Radiolaria from the Fields Creek Formation, east-central Oregon. Length of scale bar, upper right, equals number of micrometers cited for each illustration.

- 1 *Poulpus curvispinus* Dumitrica, Kozur & Mostler
Scale=66 um, FC10B.
- 2 *Canoptum* sp. B
Scale=84 um, FC35.
- 3 *Poulpus* sp. D
Scale=84 um, FC49.
- 4 Spumellaria gen. and sp. indet. C
Scale=99 um, FC35.
- 5 *Karnospongella* sp. A
Scale=84 um, FC35.
- 6 *Sontonaella* sp. A
Scale=99 um, FC35.
- 7,8 *Icrioma* sp. A
Scales=99, 90 um, respectively. 8, tilted 20°. FC10B
- 9 Spumellaria gen. and sp. indet. D
Scale=84 um, FC35.
- 10 *Tetrarabs* sp. A
Scale=60 um, FC28.
- 11 *Catoma* sp. A
Scale=99 um, FC10B.
- 12 *Praeconocaryomma* sp. A
Scale=66 um, FC10B.
- 13 *Orbiculiforma* sp. A
Scale=84 um, FC35.
- 14 *Crucella* sp. A
Scale=75 um, FC35.
- 15 *Sontonaella* sp. B
Scale=75 um, FC28.
- 16 *Karnospongella* sp. B
Scale=66 um, FC8.
- 17 *Praeconocaryomma* sp. B
Scale=54 um, FC49.

PLATE 14

