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Upper Triassic Radiolaria and Radiolarian Zonation from Western North America

by

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Text-figure 4.—Occurrence and relative abundance of Radiolaria in Upper Triassic strata, eastern Oregon and Queen Charlotte Islands, British Columbia. R = rare (1-2 specimens); C = common (3-6 specimens); A = abundant (more than 6 specimens). OR = specimens from eastern Oregon; QC = specimens from the Queen Charlotte Islands. M = siliceous mudstone; L = limestone.

Age	Formation	Number of meters above base	Sample	*Acanthocircus burnsensis* n. sp.	*Acanthocircus dotti* n. sp.	*Acanthocircus harrisonensis* n. sp.	*Acanthocircus izeensis* n. sp.	*Acanthocircus largus* n. sp.	*Acanthocircus laxus* n. sp.	*Acanthocircus lupheri* n. sp.	*Acanthocircus macoyensis* n. sp.	*Acanthocircus ochocoensis* n. sp.	*Acanthocircus prinevillensis* n. sp.	*Acanthocircus rotundus* n. sp.	*Acanthocircus silverensis* n. sp.	*Acanthocircus supleensis* n. sp.	*Acanthocircus usitatus* n. sp.	*Acanthocircus vigrassi* n. sp.	*Acanthocircus* sp.	*Betraccium deweveri* Pessagno and Blome	*Betraccium* (?) *incohatum* n. sp.	*Betraccium inornatum* n. sp.	*Betraccium maclearni* Pessagno and Blome	*Betraccium yakounense* Pessagno and Blome	*Betraccium* sp.	*Canesium lentum* n. sp.	*Canoptum* (?) *browni* n. sp.	*Canoptum farawayense* n. sp.	*Canoptum laxum* n. sp.	*Canoptum macoyensis* n. sp.	*Canoptum* sp.	*Cantalum alium* n. sp.	*Cantalum globosum* n. sp.	*Cantalum* sp.	*Capnodoce* sp. aff. *C. anapetes* DeWever
Upper Triassic; upper Norian	Kunga Formation	See Locality Descriptions	L QC-51A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	R	..	R	..	R	R	..	..	..	..	..	..	A	..	..	..
Upper Triassic; upper Norian	Kunga Formation	See Locality Descriptions	L QC-49	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	R	..	C	..	R	R	..	..	..	..	..	..	C	..	..	..
Upper Triassic; upper Norian	Kunga Formation	See Locality Descriptions	L QC-42	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	R	..	C	R	R	R	..	..	..	..	..	..	R	R	R	..
Upper Triassic; upper Norian	Kunga Formation	199.5	L QC-26	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	A	..	R	C	C	C	..	..	..	..	..	..	R	C	R	..
Upper Triassic; upper Norian	Kunga Formation	184.1	L QC-24	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	A	..	C	A	A	A	..	..	..	..	..	..	C	A	C	..
Upper Triassic; upper Karnian ?/lower to upper middle Norian	Rail Cabin Mudstone	107.9	M OR-126	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	R	C	R	R	C	R	..	..	..	..
Upper Triassic; upper Karnian ?/lower to upper middle Norian	Rail Cabin Mudstone	106.4	M OR-125	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	R	C	R	R	C	R	..	..	..	..
Upper Triassic; upper Karnian ?/lower to upper middle Norian	Rail Cabin Mudstone	102.7	M OR-155	..	..	..	R	R	..	R	..	R	..	..	..	..	R	..	R	..	..	..	..	..	..	R	..	..	R	..	R	..	..	..	R
Upper Triassic; upper Karnian ?/lower to upper middle Norian	Rail Cabin Mudstone	100.0	M OR-154	R	..	..	R	R	..	R	R	R	R	..	R	..	R	R	R	..	..	..	..	..	..	C	C	R	R	R	R	..	..	..	R
Upper Triassic; upper Karnian ?/lower to upper middle Norian	Rail Cabin Mudstone	97.0	M OR-153	C	..	..	C	C	..	C	R	C	C	..	R	..	C	C	A	..	..	..	..	..	..	A	A	C	R	A	C	..	..	..	C
Upper Triassic; upper Karnian ?/lower to upper middle Norian	Rail Cabin Mudstone	90.5	M OR-152	R	..	..	R	C	..	R	..	C	R	..	..	..	..	R	C	..	..	..	..	..	..	A	A	C	R	A	C	..	..	..	R
Upper Triassic; upper Karnian ?/lower to upper middle Norian	Rail Cabin Mudstone	84.8	M OR-151	R	..	..	C	C	..	R	R	R	R	..	R	..	R	R	R	..	..	..	..	..	..	C	C	C	R	C	C	..	..	..	R
Upper Triassic; upper Karnian ?/lower to upper middle Norian	Rail Cabin Mudstone	78.7	L OR-150	..	..	..	..	R	..	R	..	..	..	..	..	..	..	R	R	..	..	..	..	..	..	C	C	R	R	C	R	..	..	..	R
Upper Triassic; upper Karnian ?/lower to upper middle Norian	Rail Cabin Mudstone	71.3	M OR-149	..	..	..	R	C	..	R	R	..	R	C	R	..	R	C	C	..	..	..	..	..	..	A	A	C	C	A	C	..	..	..	R
Upper Triassic; upper Karnian ?/lower to upper middle Norian	Rail Cabin Mudstone	65.2	M OR-148	..	..	..	R	C	..	..	..	..	R	R	R	..	R	R	R	..	..	..	..	..	..	A	C	C	C	C	C	..	..	..	R
Upper Triassic; upper Karnian ?/lower to upper middle Norian	Rail Cabin Mudstone	58.8	M OR-147	..	..	..	..	R	..	..	..	..	..	..	..	..	..	R	R	..	..	..	..	..	..	R	R	R	R	R	R	..	..	..	..
Upper Triassic; upper Karnian ?/lower to upper middle Norian	Rail Cabin Mudstone	55.8	M OR-146	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	C	C	C	C	C	R	..	..	..	..
Upper Triassic; upper Karnian ?/lower to upper middle Norian	Rail Cabin Mudstone	45.1	M OR-145	..	..	..	..	R	..	..	..	..	..	..	R	..	R	R	R	..	..	..	..	..	..	C	C	R	R	C	R	..	..	..	..
Upper Triassic; upper Karnian ?/lower to upper middle Norian	Rail Cabin Mudstone	39.0	M OR-144	..	..	..	C	C	..	..	..	..	R	..	A	..	R	C	C	..	..	..	..	..	..	C	C	R	C	C	R	..	..	..	..
Upper Triassic; upper Karnian ?/lower to upper middle Norian	Rail Cabin Mudstone	35.4	M OR-143	..	R	..	R	..	..	..	..	..	R	..	R	..	R	R	..	..	R	..	..	..	R	A	C	R	C	C	R	..	..	..	..
Upper Triassic; upper Karnian ?/lower to upper middle Norian	Rail Cabin Mudstone	32.3	M OR-142	..	R	R	..	R	..	..	..	..	..	..	..	R	..	..	R	..	R	..	..	..	R	C	C	R	R	R	R	..	..	..	..
Upper Triassic; upper Karnian ?/lower to upper middle Norian	Rail Cabin Mudstone	17.1	M OR-141	..	C	R	..	R	C	..	..	..	..	..	..	C	..	..	C	..	C	..	..	..	R	C	C	R	R	R	R	..	..	..	..
Upper Triassic; upper Karnian ?/lower to upper middle Norian	Rail Cabin Mudstone	9.8	M OR-140	..	C	C	..	R	R	..	..	..	..	..	..	C	..	..	C	..	C	..	..	..	R	R	R	..	R	R	R	..	..	..	..
Upper Triassic; upper Karnian ?/lower to upper middle Norian	Rail Cabin Mudstone	1.8	M OR-139	..	A	A	..	R	C	..	..	..	..	..	..	A	..	..	A	..	A	..	..	..	R	C	C	..	R	R	R	..	..	..	..
Upper Triassic; upper Karnian ?/lower to upper middle Norian	Rail Cabin Mudstone	0.3	M OR-138	..	R	R	..	..	R	..	..	..	..	..	..	R	..	..	R	..	C	..	..	..	R	R	R	..	..	..	R	..	..	..	..
Upper Triassic; upper Karnian ?/lower to upper middle Norian	Rail Cabin Mudstone	See Locality Descriptions	M OR-55	..	..	..	..	..	..	R	..	..	..	..	..	..	..	A	R	..	..	..	..	..	..	A	A	C	R	A	C	..	..	..	R
Upper Triassic; upper Karnian ?/lower to upper middle Norian	Rail Cabin Mudstone	See Locality Descriptions	M OR-52	A	..	..	C	A	..	C	R	A	C	A	R	..	R	C	A	..	..	..	..	..	..	A	A	C	R	A	C	..	..	..	R
Upper Triassic; upper Karnian ?/lower to upper middle Norian	Rail Cabin Mudstone	See Locality Descriptions	M OR-51	C	..	..	A	C	..	R	A	C	R	..	C	..	C	R	C	..	..	..	..	..	..	C	C	R	R	C	R	..	..	..	..
Upper Triassic; upper Karnian ?/lower to upper middle Norian	Rail Cabin Mudstone	See Locality Descriptions	L OR-39	A	..	..	R	A	..	A	A	C	C	A	C	..	A	C	A	..	..	..	..	..	..	A	A	A	C	A	C	..	..	..	A
Upper Triassic; upper Karnian ?/lower to upper middle Norian	Brisbois Mbr.		M OR-6	..	..	..	..	C	..	..	..	..	..	..	..	..	..	..	C	..	R	..	..	..	..	C	C	..	C	R	R	..	..	..	..

Sample	*Capnodoce angusta* Blome	*Capnodoce antiqua* Blome	*Capnodoce baldiensis* Blome	*Capnodoce beaulieui* Blome	*Capnodoce copiosa* Blome	*Capnodoce extenta* Blome	*Capnodoce fragilis* Blome	*Capnodoce insueta* Blome	*Capnodoce kochi* Blome	*Capnodoce malaca* Blome	*Capnodoce media* Blome	*Capnodoce miniscula* Blome	*Capnodoce sinuosa* Blome	*Capnodoce traversi* Blome	*Capnodoce* sp.	*Capnuchosphaera colemani* Blome	*Capnuchosphaera deweveri* Kozur and Mostler	*Capnuchosphaera schenki* Blome	*Capnuchosphaera silviesensis* Blome	*Capnuchosphaera smithorum* Blome	*Capnuchosphaera sockensis* Blome	*Capnuchosphaera soldierensis* Blome	*Capnuchosphaera* sp.	*Castrum perornatum* n. sp.	*Catoma concinna* Blome	*Catoma geometrica* Blome	*Catoma inedita* Blome	*Catoma* sp.	*Corum perfectum* n. sp.	*Corum regium* n. sp.	*Corum speciosum* n. sp.	*Corum* sp.
L QC-51A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
L QC-49	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
L QC-42	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
L QC-26	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
L QC-24	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
M OR-126	..	..	..	..	R	R	..	R	R	..	..	R	..	..	R	R	R	..	..	R	..	..	R	R	..	R	..	R	R	..	R	R
M OR-125	..	..	..	..	R	R	..	C	R	..	..	C	..	..	R	R	R	R	..	R	..	..	R	R	..	R	..	R	R	..	R	R
M OR-155	..	..	..	..	R	R	R	R	R	R	..	C	R	R	R	R	R	R	R	R	R	..	R	..	..	R	..	R	..	..	R	R
M OR-154	..	..	..	R	C	R	R	C	C	R	..	C	R	R	C	R	R	R	R	R	C	R	R	C	R	C	R	R	..	..	R	R
M OR-153	R	R	R	C	C	R	C	A	C	C	..	A	C	C	C	C	C	C	C	C	C	R	C	C	C	C	C	C	R	C	R	R
M OR-152	R	R	R	C	C	C	C	A	C	C	..	A	C	C	C	C	C	C	C	C	C	C	C	C	R	C	R	C	C	R	R	R
M OR-151	R	R	R	R	C	R	R	C	C	R	R	C	R	C	R	R	R	R	R	R	R	R	R	C	R	C	R	R	C	R	R	R
L OR-150	R	R	R	R	R	..	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	C	C	R	R
M OR-149	C	C	C	C	C	..	R	C	R	R	C	C	R	C	C	C	C	C	R	C	R	R	R	C	R	C	R	R	C	C	C	R
M OR-148	A	C	C	R	C	..	..	C	R	R	C	C	R	C	R	C	C	C	..	R	..	..	R	A	R	R	R	..	A	R	C	R
M OR-147	R	R	R	R	R	..	..	R	R	..	R	R	..	R	R	R	R	..	..	R	..	..	R	R	..	..	..	..	R	R	R	R
M OR-146	A	C	C	R	C	..	..	C	R	..	C	C	..	R	R	R	R	R	..	R	..	..	R	C	..	R	..	R	C	R	C	R
M OR-145	C	R	R	..	R	..	..	..	R	..	C	..	..	R	R	..	R	R	..	..	..	..	R	R	R	R	R	R	C	R	R	R
M OR-144	C	C	C	..	C	..	..	R	..	..	C	R	..	..	C	R	R	R	..	R	..	..	R	C	..	R	R	R	R	R	C	R
M OR-143	A	A	C	R	C	..	..	R	R	..	A	R	..	..	C	R	R	R	..	R	..	..	R	C	R	R	..	R	R	R	A	R
M OR-142	R	R	R	..	C	..	..	..	..	..	C	R	..	..	C	..	..	..	..	..	..	..	R	R	R	R	..	R	R	..	C	R
M OR-141	C	C	R	..	R	..	..	..	..	..	C	R	..	..	C	R	..	..	..	..	..	..	R	R	..	..	..	..	R	..	A	R
M OR-140	A	C	R	..	R	..	..	..	..	..	R	R	..	..	R	..	..	..	..	..	..	..	R	R	..	..	..	..	..	..	R	R
M OR-139	A	A	R	..	C	..	..	..	..	..	R	R	..	..	C	R	..	..	..	..	..	..	C	C	..	..	..	R	R	..	C	R
M OR-138	C	C	R	..	R	..	..	..	..	..	R	R	..	..	R	..	..	..	..	..	..	..	R	R	..	..	..	..	..	..	R	R
M OR-55	..	R	R	R	C	R	R	C	R	R	..	C	R	R	C	C	R	R	..	R	..	..	R	C	R	R	R	R	R	R	R	R
M OR-52	R	R	R	R	C	C	R	C	C	R	..	C	C	R	C	C	C	C	..	C	..	R	R	C	R	C	R	R	C	R	R	R
M OR-51	..	..	..	..	R	R	..	R	R	..	..	R	R	R	R	R	R	R	..	R	..	..	R	R	R	R	R	R	R	R	R	R
L OR-39	R	C	C	A	A	C	A	A	C	C	R	A	A	C	A	A	A	A	C	A	A	C	C	A	C	A	C	A	C	A	C	C
M OR-6	A	C	C	..	C	..	..	..	..	..	..	..	..	..	C	R	..	..	..	..	..	..	R	R	..	..	..	..	..	..	R	R

Sample	*Ferresium contortum* n. sp.	*Ferresium hecatense* n. sp.	*Ferresium laseekense* n. sp.	*Ferresium loganense* n. sp.	*Ferresium lyellense* n. sp.	*Ferresium tiiulense* n. sp.	*Ferresium* sp.	*Gorgansium acutum* n. sp.	*Gorgansium richardsoni* Pessagno and Blome	*Gorgansium* sp.	*Icrioma praecipua* Blome	*Icrioma transversa* Blome	*Icrioma* sp.	*Justium novum* Blome	*Justium robustum* Blome	*Justium* sp.	*Latium longulum* n. sp.	*Latium mundum* n. sp.	*Latium paucum* n. sp.	*Latium* sp.	*Laxtorum atliense* n. sp.	*Laxtorum hindei* n. sp.	*Laxtorum kulense* n. sp.	*Laxtorum* sp.	*Loffa lepida* Blome	*Loffa vesterensis* Blome	*Loffa* sp.	*Pachus firmus* n. sp.	*Pachus indistinctus* n. sp.	*Pachus longinquus* n. sp.	*Pachus luculentus* n. sp.	*Pachus* sp.
L QC-51A	..	R	..	..	..	R	R	..	..	..	..	..	..	..	..	..	..	..	..	..	..	R	R	R	..	..	..	..	..	..	..	..
L QC-49	..	R	..	..	..	R	R	..	..	..	..	..	..	..	..	..	..	..	..	..	..	R	R	R	..	..	..	..	..	..	..	..
L QC-42	..	..	R	C	..	R	C	..	R	R	..	..	..	..	..	..	..	..	..	..	C	C	R	R	..	..	..	..	..	..	..	..
L QC-26	R	C	A	C	R	C	C	..	C	R	..	..	..	..	..	..	..	..	..	..	R	C	R	R	..	..	..	..	..	..	..	..
L QC-24	C	A	A	A	A	C	A	..	A	C	..	..	..	..	..	..	..	..	..	..	C	A	C	C	..	..	..	..	..	..	..	..
M OR-126	..	..	..	..	..	..	..	..	..	..	..	R	R	..	..	..	..	..	C	R	..	..	..	..	..	R	R	C	..	..	R	R
M OR-125	..	..	..	..	..	..	..	..	..	..	..	R	R	..	..	..	..	..	C	R	..	..	..	..	..	R	R	C	..	..	C	R
M OR-155	..	..	..	..	..	..	..	..	..	..	..	R	R	..	..	..	..	..	..	R	..	..	..	..	..	R	R	..	..	..	R	R
M OR-154	..	..	..	..	..	..	..	..	..	R	R	C	R	..	..	..	R	..	C	R	..	..	..	..	R	R	R	C	R	R	C	R
M OR-153	..	..	..	..	..	..	..	..	..	R	C	C	R	..	..	..	R	..	C	R	..	..	..	..	C	C	R	A	R	R	C	C
M OR-152	..	..	..	..	..	..	..	..	..	R	C	C	C	..	..	..	C	..	A	C	..	..	..	..	C	C	R	A	C	C	A	C
M OR-151	..	..	..	..	..	..	..	..	..	R	R	C	R	..	..	..	R	..	C	R	..	..	..	..	R	R	R	C	R	R	C	R
L OR-150	..	..	..	..	..	..	..	..	..	..	R	R	R	..	..	..	R	..	R	R	..	..	..	..	R	R	R	C	R	..	R	R
M OR-149	..	..	..	..	..	..	..	..	..	R	R	C	R	..	..	..	C	R	C	R	..	..	..	..	..	..	R	C	C	R	C	R
M OR-148	..	..	..	..	..	..	..	..	..	R	R	R	R	..	..	..	C	R	C	R	..	..	..	..	..	R	R	A	R	R	C	C
M OR-147	..	..	..	..	..	..	..	..	..	R	..	..	..	..	..	..	R	R	..	R	..	..	..	..	..	..	R	R	..	R	R	R
M OR-146	..	..	..	..	..	..	..	..	..	..	..	R	R	..	..	..	C	R	..	R	..	..	..	..	..	..	R	C	..	R	C	R
M OR-145	..	..	..	..	..	..	..	..	..	..	R	R	R	..	..	..	R	R	..	R	..	..	..	..	..	..	..	C	..	R	R	R
M OR-144	..	..	..	..	..	..	..	..	..	..	..	R	R	..	..	..	C	C	..	R	..	..	..	..	..	..	R	C	..	R	C	R
M OR-143	..	..	..	..	..	..	..	R	..	..	R	R	R	R	..	R	A	A	..	R	..	..	..	..	..	..	R	C	..	R	C	R
M OR-142	..	..	..	..	..	..	..	R	..	R	..	R	R	R	..	R	C	..	..	R	..	..	..	..	..	..	..	R	..	..	R	R
M OR-141	..	..	..	..	..	..	..	C	..	R	..	..	..	C	R	R	R	..	..	R	..	..	..	..	..	..	R	R	..	..	R	..
M OR-140	..	..	..	..	..	..	..	C	..	R	..	..	..	C	R	R	R	..	..	R	..	..	..	..	..	..	R	..	..	..	..	..
M OR-139	..	..	..	..	..	..	..	A	..	R	..	..	..	A	C	C	R	..	..	R	..	..	..	..	..	..	R	..	..	..	..	..
M OR-138	..	..	..	..	..	..	..	C	..	R	..	..	..	C	R	R	..	..	..	R	..	..	..	..	..	..	..	..	..	..	..	..
M OR-55	..	..	..	..	..	..	..	..	..	..	R	C	R	..	..	..	..	..	R	R	..	..	..	..	..	R	R	A	..	..	C	..
M OR-52	..	..	..	..	..	..	..	..	..	R	C	C	R	..	..	..	C	..	C	R	..	..	..	..	R	C	R	A	R	R	C	C
M OR-51	..	..	..	..	..	..	..	..	..	..	R	R	R	..	..	..	A	..	R	R	..	..	..	..	R	R	R	C	..	..	R	R
L OR-39	..	..	..	..	..	..	..	..	..	C	A	A	C	..	..	..	C	..	C	R	..	..	..	..	..	A	R	A	C	C	A	A
M OR-6	..	..	..	..	..	..	..	C	..	..	..	..	..	C	R	..	..	..	R	R	..	..	..	..	..	..	..	R	..	..	..	..

Sample	*Pantanellium dawsoni* Pessagno and Blome	*Pantanellium fosteri* Pessagno and Blome	*Pantanellium rothwelli* Pessagno and Blome	*Pantanellium skidegatense* Pessagno and Blome	*Pantanellium* sp.	*Pseudoheliodiscus sandspitensis* n. sp.	*Pseudoheliodiscus* sp.	*Pseudosaturniforma carnica* Kozur and Mostler	*Pseudosaturniforma minuta* n. sp.	*Quasipetasus disertus* n. sp.	*Quasipetasus insolitus* n. sp.	*Renzium adversum* Blome	*Renzium webergorum* Blome	*Renzium* sp.	*Sarla delicata* Blome	*Sarla* (?) *externa* Blome	*Sarla longispinosa* Kozur and Mostler	*Sarla plena* Blome	*Sarla* sp. aff. *S. vetusta* Pessagno	*Sarla* sp.	*Syringocapsa turgida* n. sp.	*Triassocampe immaturum* n. sp.	*Triassocampe proprium* n. sp.	*Triassocampe* sp.	*Xenorum flexum* n. sp.	*Xenorum largum* n. sp.	*Xenorum* sp.	*Xipha pessagnoi* Nakaseko and Nishimura	*Xipha striata* n. sp.	*Xipha* sp.
L QC-51A	C	R	..	..	R	R	C	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
L QC-49	C	R	..	..	R	R	C	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
L QC-42	A	C	R	C	R	A	C	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
L QC-26	C	C	C	R	R	C	R	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
L QC-24	A	A	A	C	C	A	C	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
M OR-126	..	..	..	..	..	..	..	..	..	..	R	..	..	..	..	..	..	..	..	..	..	R	..	R	..	R	R	..	C	R
M OR-125	..	..	..	..	..	..	..	R	..	..	R	..	..	..	..	..	..	..	..	..	..	R	..	R	..	R	R	..	A	R
M OR-155	..	..	..	..	..	..	..	R	..	..	R	R	..	R	R	..	R	..	..	R	..	R	R	R	..	R	R	..	C	R
M OR-154	..	..	..	..	..	..	..	R	..	..	R	R	..	R	R	..	C	..	..	R	R	R	R	R	R	R	R	..	C	R
M OR-153	..	..	..	..	..	..	..	C	..	..	C	C	..	R	C	R	C	..	..	R	R	R	R	R	C	C	R	R	C	R
M OR-152	..	..	..	..	..	..	..	C	..	R	C	C	..	R	C	C	C	..	..	R	C	C	C	R	C	C	C	C	A	R
M OR-151	..	..	..	..	..	..	..	R	..	R	C	C	..	R	R	R	R	..	..	R	R	R	C	R	R	C	R	R	C	R
L OR-150	..	..	..	..	..	..	..	R	..	R	R	R	..	R	R	R	R	R	..	R	R	R	R	R	R	R	R	R	R	R
M OR-149	..	..	..	..	..	..	..	R	C	R	C	C	..	R	R	..	R	R	R	R	A	C	R	R	C	A	C	C	A	R
M OR-148	..	..	..	..	..	..	..	C	C	C	C	C	..	R	..	..	..	R	R	R	C	C	..	R	R	C	R	A	C	R
M OR-147	..	..	..	..	..	..	..	R	R	R	..	R	..	R	R	..	..	R	R	R	R	R	..	R	R	R	R	R	R	R
M OR-146	..	..	..	..	..	..	..	R	C	C	..	R	..	R	R	..	..	R	R	R	C	C	..	R	R	C	R	C	C	R
M OR-145	..	..	..	..	..	..	..	R	R	R	..	..	..	R	..	..	..	..	..	R	R	..	..	..	R	R	R	R	C	R
M OR-144	..	..	..	..	..	..	..	R	C	C	..	R	R	R	R	..	..	R	C	R	C	C	..	R	R	C	R	C	R	R
M OR-143	..	..	..	..	..	..	..	R	C	A	..	R	R	R	..	..	..	C	A	R	C	C	..	R	R	A	C	A	R	R
M OR-142	..	..	..	..	..	..	..	..	R	C	..	..	R	R	..	..	..	R	R	R	R	..	..	..	..	R	R	..	..	..
M OR-141	..	..	..	..	..	..	..	..	R	R	..	..	C	R	..	..	..	A	A	R	R	C	..	R	..	C	R	..	..	..
M OR-140	..	..	..	..	..	..	..	..	R	R	..	..	C	R	..	..	..	C	R	R	R	R	..	R	..	C	R	..	..	..
M OR-139	..	..	..	..	..	..	..	..	C	C	..	..	A	R	..	..	..	A	C	R	R	A	..	C	..	C	C	..	..	..
M OR-138	..	..	..	..	..	..	..	..	R	R	..	..	C	R	..	..	..	R	R	R	..	R	..	R	..	R	R	..	..	..
M OR-55	..	..	..	..	..	..	..	R	..	..	R	..	..	R	R	R	R	..	..	R	R	C	R	R	R	C	R	..	C	..
M OR-52	..	..	..	..	..	..	..	R	..	..	C	C	..	R	C	C	C	..	..	R	C	C	C	R	C	C	R	R	A	R
M OR-51	..	..	..	..	..	..	..	R	..	..	R	R	..	R	..	R	..	..	..	R	R	R	..	R	R	R	R	..	R	R
L OR-39	..	..	..	..	R	..	..	A	C	C	A	A	..	C	A	C	A	..	..	R	A	C	A	C	A	A	C	R	A	C
M OR-6	..	..	..	..	..	..	..	..	..	..	..	..	C	R	..	..	..	R	R	R	R	A	..	R	..	C	R	..	..	..

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Upper Triassic Radiolaria and Radiolarian Zonation from Western North America

by

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UPPER TRIASSIC RADIOLARIA AND RADIOLARIAN ZONATION FROM WESTERN NORTH AMERICA

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ABSTRACT

Radiolaria have proven to be of great value in interpreting the stratigraphy within complex geologic terranes. This report focuses on Norian age Radiolaria from strata in eastern Oregon (Rail Cabin Mudstone), Baja California (San Hipolito Formation), and the Queen Charlotte Islands, British Columbia ("Middle member" of the Kunga Formation). Fifty-four new species and ten new genera are described herein.

A preliminary system of radiolarian zonation (two zones, five subzones) is proposed for the Norian Stage of the Upper Triassic of western North America. This zonal system has been based upon biostratigraphic data offered by pectenacid bivalves (*Halobia* Bronn, 1830 and *Monotis* Bronn, 1830), as well as various ammonites.

The lower *Capnodoce* Zone was originally defined by Pessagno (1979) and termed an Oppel Zone. In this report the *Capnodoce* Zone is expanded and divided into three subzones: a lower *Justium novum* Subzone; a middle *Xipha striata* Subzone; and an upper *Latium paucum* Subzone. The base of the *Capnodoce* Zone is defined by the first occurrence of *Capnodoce* DeWever, 1979. Other genera that make their apparent first appearance at or near the base of the zone are *Loffa* Pessagno, 1979; *Renzium* Blome, 1983; *Justium* Blome, 1983; *Xenorum* new genus; *Corum* new genus; *Canesium* new genus; *Castrum* new genus; *Latium* new genus; and *Quasipetasus* new genus. The top of the *Capnodoce* Zone is defined by the final occurrence of *Capnodoce*.

The upper *Betraccium* Zone is treated as an Oppel Zone and is divided into two subzones: a lower *Pantanellium silberlingi* Subzone, and an upper *Betraccium deweveri* Subzone. The base and top of this zone are defined by the first and final occurrences of *Betraccium* Pessagno, 1979.

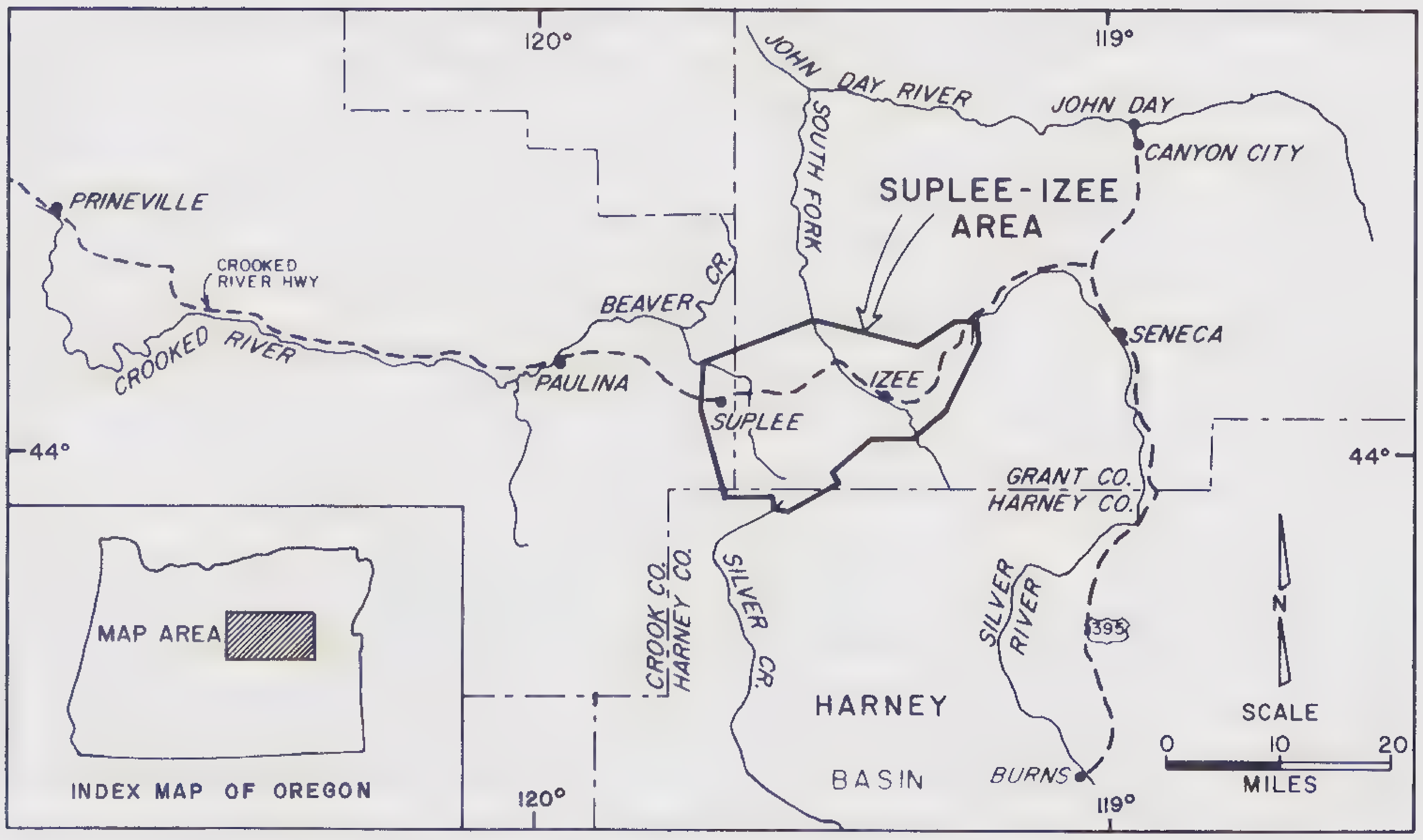
Newly described genera, in alphabetical order, include: *Canesium, Castrum, Corum, Ferresium, Latium, Laxtorum, Pachus, Quasipetasus, Xenorum,* and *Xipha.* Newly described species include: *Acanthocircus burnsensis, A. dotti, A. harrisonensis, A. izeensis, A. largus, A. laxus, A. lupheri, A. macoyensis, A. ochocoensis, A. prinevillensis, A. rotundus, A. silverensis, A. supleensis, A. usitatus, A. vigrassi, Betraccium* (?) *incohatum, B. inornatum, Canesium lentum, Canoptum* (?) *browni, C. farawayense, C. laxum, C. macoyense, Cantalum alium, C. globosum, Castrum perornatum, Corum perfectum, C. regium, C. speciosum, Gorgansium acutum, Ferresium contortum, F. hecatense, F. laseekense, F. loganense, F. lyellense, F. titulense, Latium longulum, L. mundum, L. paucum, Laxtorum atliense, L. hindei, L. kulense, Pachus firmus, P. indistinctus, P. longinquus, P. luculentus, Pseudoheliodiscus sandspitensis, Pseudosaturniforma minuta, Quasipetasus disertus, Q. insolitus, Syringocapsa turgida, Triassocampe immaturum, T. proprium, Xenorum flexum, X. largum, Xipha striata.*

INTRODUCTION

This report is the fourth in a series of studies dealing with the morphology, phylogeny, and stratigraphic distribution of Late Triassic Radiolaria from western North America. One early published study of Triassic Radiolaria was by Pessagno (1979) on Late Triassic (Norian) Radiolaria from the San Hipolito Formation, Baja California. The Pantanellinae, one subfamily within the Pantanellidae, was described and expanded by Pessagno and Blome (1980). Two biostratigraphically important radiolarian groups, the Capnuchosphaeridae and the Pantanellidae (Capnodocinae), have recently been described by Blome (1983). Numerous Triassic studies from outside North America include those of DeWever (1979); Dumitrica (1977a, 1977b); Dumitrica, Kozur, and Mostler (1980); Ishida (1983); Kishida and Sugano (1982); Kojima (1982); Kozur and Mostler (1978, 1979, 1982); Matsuda and Isozaki (1982); Nakaseko and Nishimura (1979); Takashima and Koike (1982); Yao (1982); Yao, Matsuda, and Izozaki (1980); and Yao, Matsuoka, and Nakatani (1982).

Numerous samples containing well-preserved radiolarians were collected in east-central Oregon (Suplee-Izee area of Dickinson and Vigrass, 1964, 1965; Text-fig. 1), from strata of late Karnian? to late middle Norian age. Upper Norian rocks containing equally well-preserved Radiolaria were collected from the middle black limestone member of the Kunga Formation, Queen Charlotte Islands (Kunga Island; Text-fig. 2). Most of these radiolarian-bearing samples could be correlated with those containing biostratigraphically important ammonites and pectenacid bivalves.

This is the second attempt to utilize radiolarians in the development of a zonation for the Upper Triassic of North America. Pessagno (1979) had previously di-



Text-figure 1.—Locality map of the Suplee-Izee area, eastern Oregon.

vided the Norian Stage into two zonal units based on studies in Baja California. The new zonal scheme presented herein, which is represented by two zones and five subzones, encompasses Upper Triassic (Norian) strata from eastern Oregon, Baja California, and the Queen Charlotte Islands (British Columbia). This zonal scheme has been integrated as closely as possible with biostratigraphic data offered by megafossils. Preliminary radiolarian zonations proposed for Upper Triassic strata outside North America (Japan) include those by Kishida and Sugano (1982); Nakaseko and Nishimura (1979); Yao, Matsuda, and Isozaki (1980); and Yao, Matsuoka, and Nakatani (1982).

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LITHOSTRATIGRAPHY

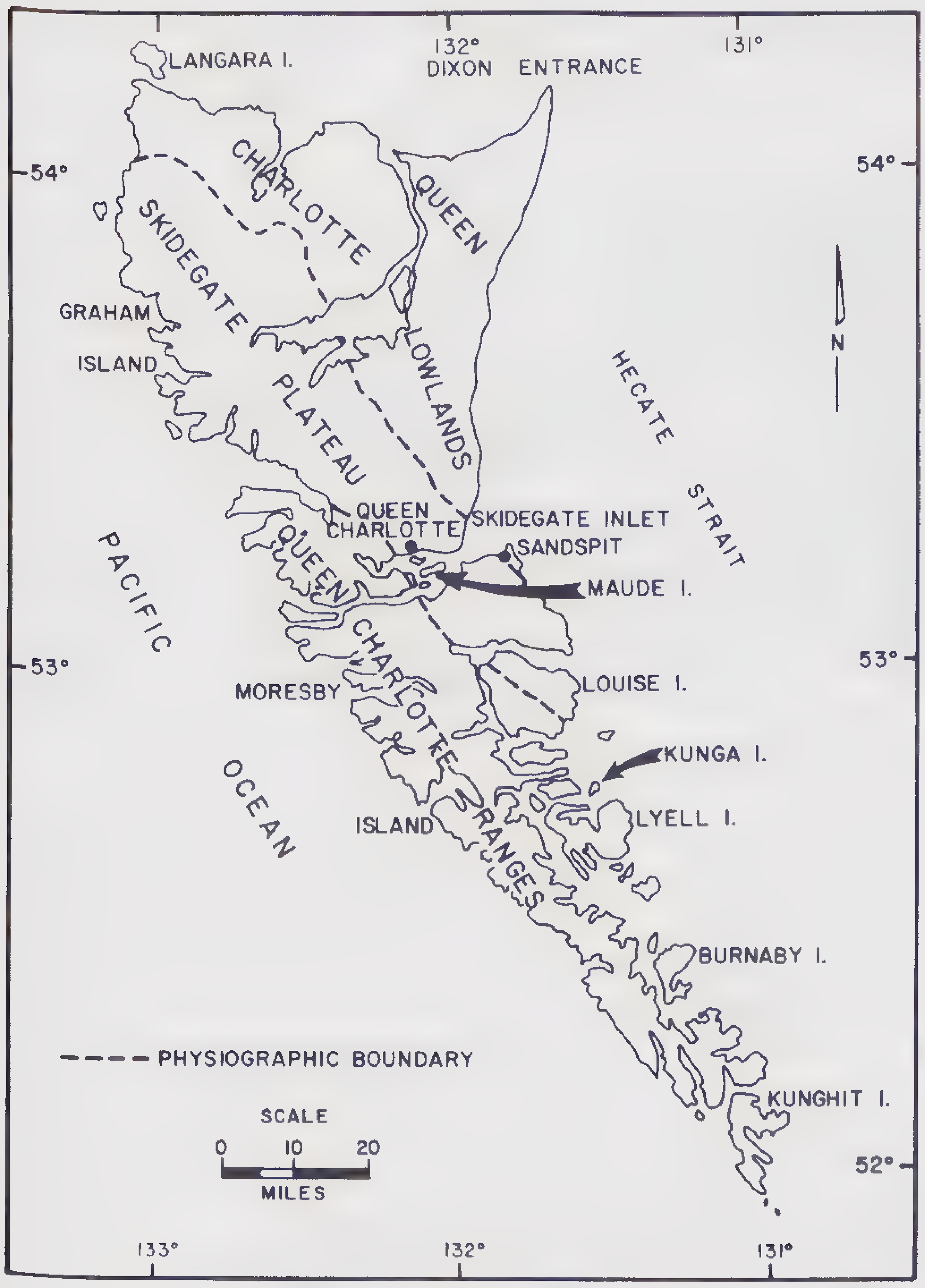
EASTERN OREGON (Suplee-Izee area)

Within the Suplee-Izee area (Text-fig. 3), the oldest stratigraphic unit is the melange terrane of Dickinson and Thayer (1978, p. 150). This melange terrane is exposed along the northern border of the area and contains various tectonic blocks that range in age from Devonian through Triassic.

The Miller Mountain melange area contains abundant siliceous mudstone and chert. The Frenchy Butte melange area (north of Izee) is typified by metavolcanic rocks and serpentinite. Chert, graywacke, and fossiliferous limestone predominate west of Suplee in the Grindstone Creek melange area.

The Upper Triassic sedimentary units resting atop the melange terrane are chiefly composed of turbidite sequences along with minor finer-grained basinal deposits. The uplifting of the melange terrane, as well as the older parts of the clastic sequences, provided the source for the sequentially younger Triassic units (Dickinson, 1976).

Upper Triassic rocks within this area are divided into two distinct stratigraphic units by the north-south trending Poison Creek fault (Text-fig. 3). Upper Triassic rocks west of the fault contain the Begg and Brisbois Members of the Vester Formation (Brown and Thayer, 1977), as well as the Rail Cabin Argillite (herein renamed the Rail Cabin Mudstone). Upper Triassic rocks east of the fault include the Fields Creek Formation



Text-figure 2.—Locality map of the Queen Charlotte Islands, showing Maude and Kunga Islands.

and Laycock Graywacke, both of the Aldrich Mountains Group (Thayer and Brown, 1960).

The Begg Member represents the oldest Triassic rocks within the Suplee-Izee area and unconformably overlies the Paleozoic melange terrane. This member is characterized by chert-grain sandstone, chert-pebble conglomerate, volcaniclastic rocks, and sedimentary breccia intercalated with equal or greater amounts of mudstone and siltstone.

According to Dickinson and Thayer (1978, p. 153), the association of graded, lenticular bodies (to 10 m thick) of conglomerate and sandstone with finer grained siltstone and mudstone suggests a combined channel-overbank mode of turbidite deposition. They conclude that deposition took place on the inner or proximal portion of a subsea fan.

The Brisbois Member consists predominantly of thinly bedded, gray to black siliciclastic mudstone and siltstone. Coarse-grained, resistant calcareous sandstone and sandy calcarenite are intercalated with the finer grained rocks. According to Dickinson and Thayer (1978, p. 155), the Brisbois Member represents limestone turbidites derived from local carbonate platforms perched on melange. Downslope transport preceded deposition in base of slope and fan-fringe environments. Pelecypods (*Halobia* sp.), as well as ammonites, have been collected from this member and are regarded herein as being from displaced limestone blocks.

The Begg and Brisbois are, in part, facies equivalents ("sedimentary facies" of Moore, 1949) with the Begg thinning out toward the southeast by intertonguing with the Brisbois. Thickness estimates are approximately 2,500 m (8,200 ft) for the Begg and 1,250 m (4,100 ft) for the Brisbois. Both members were intensely folded and faulted during late Karnian time and supposedly supplied the detritus for the Aldrich Mountains Group to the east (Dickinson and Thayer, 1978).

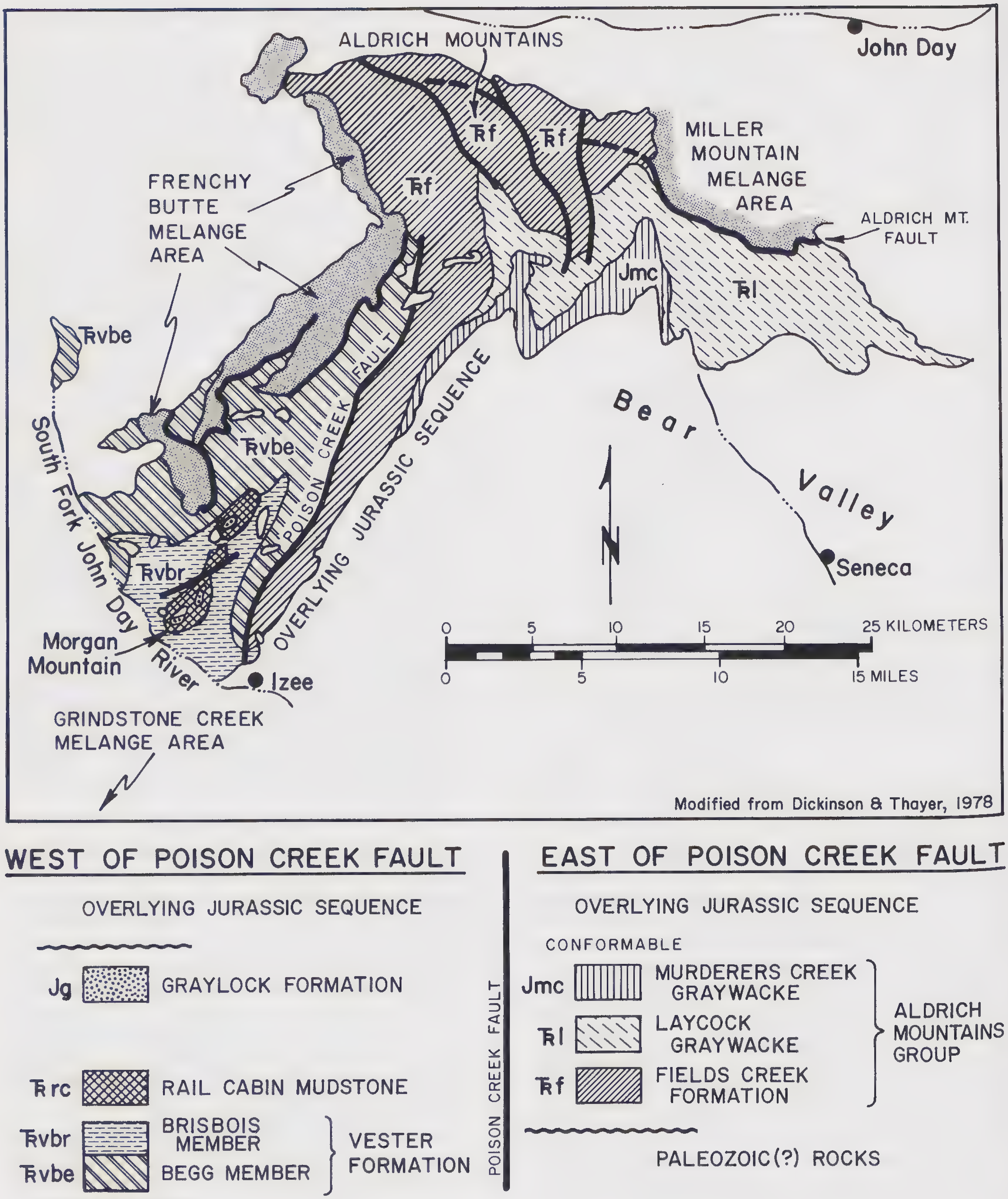
The Rail Cabin was originally described as an argillite by Dickinson and Vigrass (1965, p. 27). A sequence of thinly bedded siliceous mudstone, chert, and felsitic tuff, it is herein renamed the Rail Cabin Mudstone to better reflect its lithology. The term "argillite" has, in the past, been given a variety of meanings (see Holmes, 1928, p. 35; Grout, 1932, p. 365; Twenhofel, 1937, p. 84; Rice, 1941, p. 22; Dickinson and Vigrass, 1965, p. 99; and Lapedes, 1978, p. 21).

The Rail Cabin Mudstone consists predominantly of thinly bedded radiolarian-rich, dark-gray to black siliceous mudstone and chert. Lenticular masses of gray-brown bioclastic limestone containing displaced shallow-water invertebrates occur sporadically throughout the unit. Minor amounts of thinly bedded, dark-gray to black (weathering brown) calcilutite occur within the upper part of the unit.

The siliceous (cherty) mudstone beds of the Rail Cabin typically range in thickness from 2.5 to 10 cm (1 to 4 in), with some beds exhibiting fine internal laminations. These cherty mudstone beds generally appear blocky or hackly due to the presence of interbed joints.

The Rail Cabin Mudstone appears to be best exposed along the slopes of Morgan Mountain, situated northwest of the town of Izee (Text-fig. 3). Siliceous mudstone samples containing Radiolaria were collected from 110 m (360 ft) of section near Elkhorn Creek (USGS Izee 15′ Quad.: SE ¼ sec. 14, T. 17 S., R. 27 E.; Text-fig. 4 and Appendix). This was one of the few localities where a gradational contact could be observed between the Rail Cabin and the underlying Brisbois Member.

The Rail Cabin and the Brisbois Members seem to be, at least in the western part of the study area, sedimentary facies equivalents. Radiolarian rich samples



Text-figure 3.—Geologic map showing distribution of Triassic strata surrounding Izee, eastern Oregon.

were collected from the top of the Brisbois Member approximately 1 km (0.6 mi) southwest of Morgan Mountain (USGS Izee 15′ Quad.: NW ¼ sec. 14, T. 17 S., R. 27 E.). The Radiolaria extracted from these samples, particularly at locality OR-6 (see Appendix and Text-fig. 4), are identical to Radiolaria found within the lower portion of the Rail Cabin to the northeast.

Farther to the north, at the type locality of the Rail Cabin Mudstone (USGS Izee 15′ Quad.: SE ¼ sec. 11, T. 17 S., R. 27 E.), a sharp lithologic break exists between the mudstone of the Brisbois Member and the overlying harder siliceous mudstone. This contact was interpreted by Dickinson and Vigrass (1965, p. 28) to be unconformable, based upon the marked divergent bedding attitudes exhibited at Graylocke Butte (USGS Izee 15′ Quad.: NE ¼ sec. 36, T. 16 S., R. 27 E.).

Approximately 2.4 km (1.5 mi) southwest of Izee near "Hole in the Ground": (USGS Izee 15′ Quad.: SE ¼ sec. 26, T. 17 S., R. 27 E.; see Appendix), 31 m (102 ft) of late Norian age siliceous mudstone (see Biostratigraphy—Eastern Oregon) overlies a thick section of thinly bedded, soft mudstone. This lower mudstone section is lithologically equivalent to the Brisbois Member. The overlying siliceous mudstone was originally mapped by Dickinson (Dickinson and Vigrass, 1965) as Brisbois. The stratigraphic evidence obtained from both Morgan Mountain and the "Hole in the Ground" suggests that the Rail Cabin and the Brisbois are facies equivalents, the Rail Cabin thinning out toward the south by intertonguing with the Brisbois.

The Rail Cabin Mudstone, in contrast with the lower portion of the Brisbois Member, exhibits thin, persistent bedding as well as a large siliceous fossil component (Radiolaria and sponge spicules). The presence of fine laminations within this siliceous mudstone indicates that deposition occurred in a quiet-water environment below wave base.

The predominantly siliceous Rail Cabin Mudstone represents a period of pelagic sedimentation within a lower slope or basinal depositional environment moderately free from terrigenous input. The minor occurrence of calcilutite (containing ammonites) in the upper portion of the formation may represent an intermittent change in pelagic sedimentation rate and (or) sea level. The partly contemporaneous, intertonguing Brisbois Member of the Vester Formation is interpreted as being hemipelagic middle and upper slope deposits that were diluted by displaced calcarenite debris originally deposited in shallower water.

The Graylock Formation (Dickinson and Vigrass, 1965) consists of approximately 122 m (400 ft) of thinly bedded, dark siltstone and thin-bedded, black, argillaceous limestone (calcilutite) intercalated within the basal 15 to 23 m (50 to 75 ft) of the formation. The dark siltstone beds are commonly cross-laminated. The Graylock Formation, according to Dickinson and Vigrass (1965, p. 29), rests conformably upon the Rail Cabin in its type area. The Rail Cabin-Graylock contact, at both Morgan Mountain and the "Hole in the Ground" is covered by colluvium.

Upper Triassic rocks east of the Poison Creek fault include the Fields Creek Formation and the Laycock Graywacke of the Aldrich Mountains Group. The Fields Creek Formation rests unconformably on the underlying Begg Member near the northern end of the Poison Creek fault (Dickinson and Thayer, 1978).

The Fields Creek Formation is characterized by massive beds of dark mudstone with minor intercalations of graded sandstone. The base of this formation is largely composed of slide blocks of varying rock types, presumably derived from the melange terrane to the north. A conformable contact exists between the Fields Creek and the overlying Laycock Graywacke. Compositionally, the Laycock Graywacke consists of a mixture of graywacke and mudstone with minor amounts of cherty sedimentary breccia and boulder conglomerate.

Dickinson and Thayer (1978, p. 155), interpreted the mudstone of the Fields Creek Formation and Laycock Graywacke to represent a fine-grained slope facies. The graded sandstone beds (Fields Creek) and the volcaniclastic graywacke and sedimentary breccia (Laycock Graywacke) represent intercalated turbidites and debris flows. The Laycock Graywacke is conformably overlain by the Lower Jurassic Murderers Creek Graywacke and Keller Creek Shale of the Aldrich Mountains Group (Thayer and Brown, 1960).

Samples collected by the author from the olistostrome-rich, basal portion of the Fields Creek Formation contain Upper Triassic (lower Karnian to middle Norian) Radiolaria (see Biostratigraphy). According to Dickinson and Thayer (1978, p. 156), the Vester Formation (Karnian and younger) was faulted and contributed detritus across the Poison Creek fault into the thicker Aldrich Mountains Group (Norian and younger). The Karnian age for a portion of the Fields Creek, in addition to the facies relationship established between the upper part of the Brisbois and Rail Cabin, both suggest a different source for the Fields Creek Formation.

QUEEN CHARLOTTE ISLANDS

Upper Triassic rocks of the Queen Charlotte Islands include the volcanic Karmutsen Formation and the overlying lower and middle members (grey and black limestone members, respectively) of the Kunga Formation (Text-fig. 5). The Lower Jurassic upper black argillite member of the Kunga Formation rests conformably on the Triassic middle member.

According to Sutherland Brown (1968, pp. 40–42), the Karmutsen Formation is a thick accumulation [4,268 m (14,000 ft)] of submarine basic lavas, clastic sediments, dikes and sills, and minor limestone. The largest part of the formation is composed of highly chloritized, textureless basic volcanic rock called greenstone, along with basaltic pillow lavas and pillow breccias. Sedimentary rocks form an insignificant part of the Karmutsen and are mostly of volcanic origin. Finely crystalline limestone lenses are sparsely distributed throughout the formation.

The presence of pillow lavas and intercalated limestone throughout the Karmutsen Formation suggests an eruption entirely within a submarine environment (Sutherland Brown, 1968). Muller, Northcote, and Carlisle (1974, p. 11) suggested that the Karmutsen and the Kunga Formations may have developed within an inter-arc basin (Karig, 1971a, 1971b). These types of basins develop by rifting of a volcanic island arc during active subduction. Younger pillow lavas normally compose the basin floor and may form a volcanic high on which younger sediments are deposited.

The Kunga Formation is a sedimentary unit composed primarily of limestone and siliceous mudstone that rests conformably on the Karmutsen Formation. Its type section is located on the northern shore of Kunga Island (see Text-fig. 2). According to Hoadley (1953, pp. 21–29), the Kunga Formation is the correlative of the Quatsino Limestone and the lower Bonanza Formation on Vancouver Island.

Sutherland Brown (1968, p. 51) divided the Kunga Formation into three members of contrasting lithology: a lower massive gray limestone member 31–183 m (100–600 ft) thick that overlies the Karmutsen Formation, a middle thin-bedded, black limestone member, 214–275 m (700–900 ft) thick, and an upper thin-bedded, black argillite member that has a maximum thickness of 580 m (1,900 ft) (Text-fig. 4).

The lower gray limestone member is most commonly characterized by massive, gray-weathering limestone that contains poorly preserved corals and gastropods. At the type locality on Kunga Island, the lower member is 183 m (600 ft) thick and apparently conformable with the overlying black member.

The origin of the heavily recrystallized limestone member, with its sparse benthic fauna, remains questionable. Other features that are common in the overlying members, such as bedding structures and presence of carbonaceous material, are absent. The low clastic and volcaniclastic input and the high percentage of carbonate material suggest that deposition may have occurred within a shallow-water carbonate environment atop the submersed Karmutsen lava plateau.

The middle black limestone member includes thinly bedded, black carbonaceous limestone and rarer cross-bedded gray calcarenite, fissile laminated black limestone, thinly bedded black siliceous (siliclastic) mudstone ("argillites"), and dark-gray lithic sandstone. The contact between the middle black limestone member and the upper black argillite member appears gradational at the type locality. I chose this contact as the point at which the black argillite became the predominant lithology.

The black limestone beds range in thickness from 2.5–15 cm (1–6 in) with some beds exhibiting fine internal laminations. The basal 31–46 m (100–150 ft) of the member appears schistose in outcrop view. The rest of the member appears blocky or hackly due to the presence of interbed joints. Intercalated in minor amounts with the black limestone is thinly bedded [1–5 cm (0.5–2 in) thick], black siliceous mudstone. Less common are thicker [5–60 cm (2–24 in)], lensoid beds of cross-bedded calcisiltite and calcirudite.

Limestone nodules that are internally black and mostly fine-grained (calcisiltite to calcilutite) are interbedded with thin, black limestone beds. These nodules make their first appearance within the bottom 61 m (200 ft) of the member, and increase in abundance towards the top. Only those nodules (calcilutite) near the top of the member contain abundant, well-preserved Radiolaria (see Appendix; Text-fig. 4).

The upper black argillite member is characterized by thin, commonly rhythmically bedded, black siliceous mudstone that superficially resembles ribbon chert. Rarer black limestone (calcisiltite and calcilutite), gray clastic limestone, gray cellular limestone, dark-gray to green lithic sandstone, and thinly bedded calcareous shale occur throughout the upper member. Abundant limestone nodules (calcilutite) occur sporadically throughout most of the member. At Kunga Island this unit is approximately 497 m (1,630 ft) thick. The contact of the black argillite member is either transitional and conformable with the overlying Maude Formation or unconformable with the still younger Yakoun Formation.

The black limestone and argillite members, in contrast with the gray limestone member, exhibit thin, persistent bedding and a much greater clastic component. The amount of pyritic and carbonaceous material, although not extremely large, gives both members their distinct dark color.

Both the black limestone and argillite members contain contrasting rock types that reflect two differing

MIDDLE JURASSIC	CALLOVIAN	VANCOUVER GROUP	YAKOUN FORMATION 3,000–6,000ft. (915–1,830m)	E MEMBER 455ft.(139m)	VOLCANIC SANDSTONE, SHALE, CALCAREOUS SILTSTONE
				D MEMBER 800ft. (244m)	TUFF, CROSS-BEDDED TUFFACEOUS SANDSTONE
				C MEMBER 950ft. (290m)	PORPHYRITIC ANDESITE AGGLOMERATE AND CRYSTAL TUFF
				B MEMBER 100+ ft.(31+ m)	SHALE, TUFFACEOUS SHALE, AND SANDSTONE
	BAJOCIAN			A MEMBER 650ft. (198m)	CALCITE-CEMENTED SCORIACEOUS LAPILLI TUFF
LOWER JURASSIC	TOARCIAN		CONFORMABLE TO SLIGHTLY UNCONFORMABLE, AND INTRUSIVE		
	PLIENSBACHIAN		MAUDE FORMATION	UP TO 600ft.(183m)	INTERBEDDED GREY SHALE, BLOCKY DARK-GREY ARGILLITE
			CONFORMABLE CONTACT		
	SINEMURIAN		KUNGA FORMATION UP TO 3,400ft. (1,037m)	BLACK ARGILLITE MEMBER UP TO 1,900ft. (579m)	FLAGGY, GRADED BLACK ARGILLITE, SILTSTONE, AND SHALE
UPPER TRIASSIC	NORIAN			BLACK LIMESTONE MEMBER 700-900ft. (213-274m)	FLAGGY BLACK CARBONACEOUS LIMESTONE
	KARNIAN			GREY LIMESTONE MEMBER 100-600ft. (31-183m)	MASSIVE GREY-WEATHERING LIMESTONE
			CONFORMABLE CONTACT		
			KARMUTSEN FORMATION	14,000+ft. (4,268+m)	BASALT PILLOW LAVAS, PILLOW BRECCIAS

Text-figure 5.—Correlation of lithostratigraphic units within the Vancouver Group, Queen Charlotte Islands.

modes of deposition. The predominantly fine-grained, carbonaceous limestone and argillite are the result of pelagic sedimentation provided by eolian-derived? clay, nektonic megafossils, and planktonic siliceous microfossils. In the finer grained rocks of the black limestone member, the thin-shelled pelecypods *Halobia* Bronn, 1830 and *Monotis* Bronn, 1830 predominate whereas the black argillite member contains mostly arietitid ammonites. Radiolaria are common in both members.

The coarser-grained, volcanic-rich siltstone and sandstone units, which exhibit both graded and cross-laminated bedding, are interpreted as being sediment gravity flow (turbidity current) deposits. A volcanic arc terrane enclosing the depositional basin probably provided the source for these rocks rich in feldspar and volcanic rock fragments.

The presence of finely disseminated pyrite, as well as the moderate carbonaceous content within these rocks, indicates that deposition occurred within a low-energy, anaerobic or reducing environment. Carlisle and Susuki (1974, p. 275), stated that this type of environment can occur at almost any water depth.

The laminated, matrix-supported, siliceous nature of the finer grained rocks, as well as the presence of an entirely pelagic fauna, suggests that deposition occurred within a moderately deep-water environment at or near the calcium carbonate compensation depth. Minor depth fluctuations could have produced the alternating beds of limestone and argillite commonly observed within both members.

The dominantly calcareous black limestone member represents a period of pelagic sedimentation within a deep depositional basin free from arc-derived volcanic detritus. With time and increasing water depth, deposition became less calcareous (black argillite member) and less uniform due to the increasing influx of terrigenous detritus from a nearby volcanic source.

TECTONIC IMPLICATIONS

Upper Triassic rocks of the Queen Charlotte Islands may represent a portion of a large allochthonous terrane that extends along the Pacific margin of North America, from Vancouver Island to southern Alaska. This terrane, referred to as "Wrangellia" by Jones, Silberling, and Hillhouse (1977), is thought to have originated far to the south of its present day position (Hillhouse, 1977).

The base of this terrane is typified by a thick sequence of tholeiitic basalts and pillow lavas (Nikolai Greenstone—Wrangell Mountains, Alaska; Karmutsen Formation—Queen Charlotte and Vancouver Islands) which are, in turn, overlain by calcareous sedimentary rocks (Chitistone and Nizina Limestones, McCarthy Formation—Wrangell Mountains; Kunga Formation—Queen Charlotte Islands; and Quatsino and Parson Bay Formations—Vancouver Island). According to Jones, Silberling, and Hillhouse (1977, p. 575), large-scale volcanism was followed by inner platform carbonate deposition and later more fine-grained, basinal deposition.

Northeast of the Suplee-Izee area is the Wallowa Mountains-Seven Devils Mountains volcanic arc terrane (Vallier, Brooks, and Thayer, 1977; Brooks and Vallier, 1978). This assemblage includes the mafic, volcanic, and volcaniclastic Seven Devils Group (Upper Permian to Upper Triassic), the Martin Bridge Limestone (Upper Triassic), and the argillite-carbonate Hurwal Formation (Upper Triassic-Lower Jurassic). According to Jones, Silberling, and Hillhouse (1977) this sequence of rocks is similar to that on Vancouver Island and is a possible detached block of "Wrangellia".

Brooks and Vallier (1978, p. 143) speculated that the Begg and Brisbois Members of the Vester Formation, as well as the Huntington Formation (Brooks, McIntyre, and Walker, 1976) found within the Juniper Mountain-Cuddy Mountain volcanic arc terrane (located directly south of the Wallowa Mountains-Seven Devils Mountains volcanic arc terrane), are intraoceanic in origin and may represent parts of the same allochthonous tectonic block. They also suggested that all younger rocks may have been deposited after the above units and the underlying oceanic crust terranes were accreted. The younger Rail Cabin Mudstone would most likely be included within this pre-accretion phase since it is, in part, a sedimentary facies equivalent of the underlying Brisbois Member.

BIOSTRATIGRAPHY

EASTERN OREGON (Suplee-Izee area)

The structurally complex melange terrane of Dickinson and Thayer (1978), contains the oldest lithologic units within the Suplee-Izee area. The age of this melange terrane ranges from Devonian to the Late Triassic. The northwestern Miller Mountain melange contains Early Permian fusulinids as well as Middle to Late Triassic Radiolaria. Black chert samples (OR-68-71; see Appendix) collected near Vance Creek, southwest of the city of John Day, contain early Karnian Radiolaria. The Frenchy Butte melange area, although unfossiliferous, is thought to be Permian and (or) Triassic in age by correlation with the ophiolitic Canyon Mountain Complex (Thayer, 1978). This ophiolitic complex has yielded radiometric dates at or near the Permian/Triassic boundary (Dickinson and Thayer, 1978).

Limestones from the Grindstone-Twelvemile melange area contain a variety of fossils that range in age from Devonian through Permian time (Merriam and Berthiaume, 1943; Kleweno and Jeffords, 1961; Dickinson and Vigrass, 1965). A chert sample (GC-4A; see Appendix) from the Grindstone Creek area, located south of the town of Suplee, contained faunal elements belonging to the *Pseudoalbaillella* assemblage of Holdsworth and Jones (1980, p. 283). This assemblage is indicative of an Early Pennsylvanian to Early Permian age.

The sparse invertebrate fauna found within the Begg Member of the Vester Formation prevents a precise age assignment. The Begg is questionably assigned to the Karnian Stage below the *Tropites subbullatus* Zone (Smith, 1927), though the basal part of the formation could extend down into the Middle Triassic. This Karnian age is based upon the presence of the nautiloid *Proclydonautilus* Mojsisovics, 1902, which is known only from Upper Triassic rocks. Spiriferid brachiopods and coelenterates from the Begg Member are comparable to those of the overlying Brisbois Member (Dickinson and Vigrass, 1965).

Ammonites collected from the Brisbois Member are all indicative of the upper Karnian *Tropites subbullatus* Zone (Dickinson and Vigrass, 1965). *Halobia* (*H. ornatissima* Smith, 1927) collected from the Brisbois Member (Dickinson's loc. V177), is late Karnian in age (N. J. Silberling, written commun., 1978).

Megafossils have been recovered from the Rail Cabin Mudstone in its type locality at Morgan Mountain. Unfortunately, the only ones recovered in place are from Dickinson's locality D15, which is situated somewhat above the middle of the formation. N. J. Silberling (written commun., 1977) later collected a fauna along strike from Dickinson's locality D15 from float approximately 60 m (200 ft) below the contact with the overlying Graylock Formation. The megafossils from Dickinson's locality D15 and Silberling's float collection are both assignable to the *Himavatites columbianus* Zone (Tozer, 1967), of late middle Norian age. Because of the lack of megafossils within the lower half of the Rail Cabin Mudstone, the precise age of this interval is unknown.

Chert samples containing lower to middle Norian species of *Halobia* [*H. cordillerana* Smith, 1927; *H.* cf. *H. dilatata* Kittl, 1912; and *H. lineata* (Muenster, 1833)], as well as Radiolaria, have been collected by P. Swain (University of California, Los Angeles) from the Brooks Range of Alaska. A comparison of the Radiolaria collected from the base of the Rail Cabin Mudstone with Swain's suggests that the lower half of the Rail Cabin, at its type locality, ranges in age from early Norian (late Karnian?) to late middle Norian.

Approximately 5 km (3 mi) south of the type Rail Cabin, near Hole in the Ground (USGS Izee 15′ Quad.: SE ¼ sec. 26, T. 17 S., R. 27 E.), N. J. Silberling (written commun., 1977) reported *Monotis subcircularis* Gabb, 1864, of late Norian age in strata of Rail Cabin lithology. This section is underlain by strata lithologically equivalent to the Brisbois Member. It would thus appear that the top of the Rail Cabin Mudstone, at least at Hole in the Ground, is of late Norian age. Radiolarian recovery was extremely poor, and only one sample (OR-102; see Appendix) yielded Radiolaria identifiable to the generic level.

The lower part of the Graylock Formation contains ammonite faunas, all of which are indicative of the Lower Jurassic Hettangian Stage (Dickinson and Vigrass, 1965). According to Pessagno and Whalen (1982), it is possible that the unfossiliferous upper portion contains strata of Sinemurian and early Pliensbachian age.

Until recently, the only fossils known from the Fields Creek Formation were Norian megafossils from reworked limestone blocks. These transported limestone blocks, collected from the basal part of the formation, contained middle Norian individuals of the bivalve *Halorella* Bittner, 1884 (Brown and Thayer, 1977). A siliceous mudstone sample that I collected from this structurally complicated basal portion (OR-123C; see Appendix), was subsequently found to contain well-preserved Radiolaria ranging in age from early Karnian to middle Norian. The overlying unfossiliferous Laycock Graywacke is thought to be Late Triassic in age because of its stratigraphic position beneath the Lower Jurassic Murderers Creek Graywacke.

The Murderers Creek Graywacke contains Early Jurassic (Hettangian) megafossils in place. Late Triassic as well as Paleozoic fossils have been found within resedimented cobbles and limestone blocks (Brown and Thayer, 1977).

QUEEN CHARLOTTE ISLANDS

In the Queen Charlotte Islands, the age of the Karmutsen Formation is poorly defined. The upper part of the unit exhibits a fauna diagnostic of Karnian age (Givens and Susuki, 1963), whereas the lower part might be Middle Triassic.

On Vancouver Island, the Karmutsen Formation unconformably overlies the Sicker Group, which contains an Early Permian fauna (Muller, Northcote, and Carlisle, 1974). Hoadley (1953) collected diagnostic Upper Triassic fossils from the upper part of the Karmutsen Formation. Jeletsky (1950, p. 12) referred to Karnian age fossils collected from the upper part of the same formation. According to Muller, Northcote, and Carlisle (1974), an underlying "unnamed sediment-sill unit" contains *Daonella* sp., the presence of which indicates a Middle Triassic (late Ladinian) age. The upper portion of the Karmutsen is also dated by faunas collected from limestone that occur near the top of the formation. According to Tozer (1967, p. 33), they represent the Dilleri Zone of the upper Karnian Stage.

The Kunga Formation ranges in age from Late Triassic (Karnian) to middle Early Jurassic (Sinemurian). Preservation of megafossils in the lower member of the formation, in contrast with that in the middle and upper members, is poor.

The lower massive gray limestone member is presently placed within the Karnian Stage (below the *Tropites welleri* Zone of Tozer, 1967). This assignment is based upon the occurrence of the pelecypod *Halobia* Bronn, 1830, found within the uppermost part of the member (Sutherland Brown, 1968).

The middle black limestone member contains common, but only moderately well-preserved pectenacids, along with rare ammonites. According to Sutherland Brown (1968, p. 61), various species of *Halobia* (*Halobia alaskana* Smith, 1927 and *H.* cf. *H. rugosa* Guembel, 1861) have been collected over much of this member. These molluscan assemblages, which are most common within the lower portion of the member, correlate with the *Mojsisovicsites kerri* Zone (Tozer, 1967) of early Norian age. Sutherland Brown also noted that *Monotis subcircularis* Gabb, 1864 and *M. salinaria* Bronn, 1830, of late Norian age, only occur at the top of the black limestone member. Pectenacids collected by the author (see Appendix) from the middle part of the black limestone member contained, according to N. J. Silberling (written commun., 1978), *Monotis subcircularis* Gabb, 1864, of late Norian age.

The upper black argillite member contains, according to Sutherland Brown (1968, p. 61), Sinemurian arietitid ammonites (mostly *Arietites* Waagen, 1869). These ammonites occur in all but the lower 56 m (184 ft) of the upper member. The lower interval between the first occurrence of Sinemurian ammonites and the last occurrence of *Monotis subcircularis* Gabb, 1864, at the top of the middle member, lacks megafossils. Pessagno and Whalen (1982) noted that the radiolarian assemblage from this lower interval is Jurassic (pre-Sinemurian) in aspect, and is completely different from the underlying Norian faunas. Although a Rhaetian age cannot be completely discounted for these strata, they are more likely to be Hettangian.

RADIOLARIAN ZONATION

Within the past ten years, the biostratigraphic utility of Radiolaria has increased tremendously. Radiolarian zonations based on samples collected on the Deep Sea Drilling Project have been established for parts of the Mesozoic and Cenozoic by Foreman (1973, 1975, 1977) and Riedel and Sanfillipo (1974). Recent studies by Pessagno (1976, 1977a, 1977b) have resulted in the formulation of a preliminary system of radiolarian zonation for Upper Jurassic (upper Kimmeridgian/lower Tithonian) to Upper Cretaceous (Maestrichtian) strata of the California Coast Ranges. A radiolarian zonation may soon be erected that would encompass strata ranging in age from Late Triassic (Norian) to Late Cretaceous (Maestrichtian).

Upper Triassic (Norian) strata from eastern Oregon, Baja California, and the Queen Charlotte Islands (British Columbia) are represented by two zones and five subzones. This preliminary zonal system has been based upon biostratigraphic data offered by ammonites and the pectenacid bivalves *Halobia* Bronn, 1830 and *Monotis* Bronn, 1830. The local range zones and abundance zones of species characterizing these zonal units are presented in Text-figure 6.

The zonation proposed herein incorporates either interval zones or Oppel zones (Hedberg, 1971). Formal names have been applied to all zonal units.

DEFINITION OF ZONAL UNITS

Capnodoce Zone (Emended)

The base of this zone is defined by the first occurrence of *Capnodoce* DeWever, 1979.

Other genera that make their apparent first appearance at or near the base of this zone are *Loffa* Pessagno, 1979; *Renzium* Blome, 1983; *Justium* Blome, 1983; *Xenorum* n. gen.; *Corum* n. gen.; *Canesium* n. gen.; *Castrum* n. gen.; *Latium* n. gen.; and *Quasipetasus* n. gen. Species that may make their first appearances at or near the base of this zone are shown in Text-figure 6.

The base of the *Capnodoce* Zone is questionably placed within the upper Karnian or lower Norian due to the absence of datable megafossils within both the lower portion of the Rail Cabin Mudstone and the upper portion of the Brisbois Member (Vester Formation). Until Karnian age radiolarian assemblages are better understood, the age of this base is questionable. It is also impossible to determine whether the previously mentioned genera (other than *Capnodoce*) range below the biohorizon defined by the first occurrence of *Capnodoce*.

The top of the *Capnodoce* Zone is defined by the final occurrence of *Capnodoce*. Other genera that make their apparent final appearance at or near the top of this zone are *Catoma* Blome, 1983; *Icrioma* DeWever, 1979; *Renzium, Xenorum, Corum, Pachus, Canesium, Castrum, Latium, Quasipetasus,* and *Xipha,* new genera. Species that may make their final appearances at or near the top of this zone are shown in Text-figure 6.

A paraconformity may exist, at least at its type section at Morgan Mountain, between the Rail Cabin Mudstone and the strata of the overlying Graylock Formation [Lower Jurassic (Hettangian)]. However, the contact between the two formations is either poorly exposed or covered. The radiolarian assemblages from the upper portion of the Rail Cabin Mudstone lack faunal elements found in the upper portion of the *Capnodoce* Zone in Baja California (Pessagno, 1979). For this reason, the top of the *Capnodoce* Zone (part of the upper middle Norian) may be missing in eastern Oregon. The *Betraccium* Zone (upper middle to upper Norian) is missing in eastern Oregon.

The *Capnodoce* Zone was originally defined by Pessagno (1979) and termed an Oppel Zone. In this report the *Capnodoce* Zone is expanded and divided into three subzones: a lower *Justium novum* Subzone; a middle *Xipha striata* Subzone; and an upper *Latium paucum* Subzone. Stratigraphic ranges and relative abundances of taxa characterizing these subzones are indicated in Text-figure 6.

Range.—Upper Triassic (upper Karnian?; lower to upper middle Norian). Occurrence: Baja California, California, eastern Oregon, Alaska, British Columbia, Oman, Greece, Austria, Italy, and Sicily.

Samples assigned to this zone.—OR-6, OR-39, OR-51, OR-52, OR-55, OR-125, OR-126, OR-138 through OR-155 (see Appendix; Text-fig. 4).

In the measured section OR-138–155, the lower 32.3 m (106 ft) of the Rail Cabin Mudstone is assignable to the *Justium novum* Subzone. The *Xipha striata* Subzone occurs in the interval between 35.4 m (116 ft) and 58.8 m (193 ft). The remaining 49.1 m (161 ft) of the Rail Cabin Mudstone is assignable to the *Latium paucum* Subzone. The boundary between the *Justium novum* Subzone and the *Xipha striata* Subzone occurs in the interval between OR-142 at 32.3 m (106 ft) and OR-143 at 35.4 m (116 ft). The boundary between the *Xipha striata* Subzone and the *Latium paucum* Subzone occurs in the interval between OR-147 at 58.6 m (193 ft) and OR-148 at 65.2 m (214 ft).

Justium novum Subzone.—The base of this subzone is defined by the same criteria that define the base of the *Capnodoce* Zone. *Acanthocircus largus* n. sp.; *A. laxus* n. sp.; *A. supleensis* n. sp.; *Catoma concinna* Blome, 1983; *C. geometrica* Blome, 1983; *Icrioma transversa* Blome, 1983; *Justium robustum* Blome, 1983; *Canoptum farawayense* n. sp.; *Pachus firmus* n. sp.; and *P. luculentus* n. sp., make their first appearances within the subzone.

The top of this subzone is defined by the final occurrence of *Justium* Blome, 1983; as well as *Gorgansium acutum* n. sp. Other species that make their apparent final appearance at or near the top of this subzone are *Acanthocircus dotti* n. sp.; *A. harrisonensis* n. sp.; *Renzium webergorum* Blome, 1983; and *Betraccium*(?) *incohatum* n. sp. Ranges and abundances of taxa characterizing this subzone are indicated in Text-figure 6.

Samples assigned to this subzone.—OR-6, OR-138 through OR-142 (see Text-fig. 4).

Occurrence elsewhere.—Baja California.

Xipha striata Subzone.—The base of this subzone is defined by the first occurrence of *Xipha* n. gen., and of *Xipha striata* n. sp., and *X. pessagnoi* Nakaseko and Nishimura, 1979. Other species that make their first appearance at or near the base of this subzone are *Acanthocircus silverensis* n. sp.; *Capnuchosphaera deweveri* Kozur and Mostler, 1979; *C. schenki* Blome, 1983; *C. smithorum* n. sp.; *Sarla delicata* Blome, 1983; *Icrioma praecipua* Blome, 1983; *Capnodoce insueta* Blome, 1983; *Renzium adversum* Blome, 1983; *Xenorum flexum* n. sp.; *Corum regium* n. sp.; and *Latium mundum* n. sp.

The top of the *Xipha striata* Subzone is defined by the final occurrence of *Pseudosaturniforma minuta* n. sp.; *Latium mundum* n. sp.; and *X. pessagnoi* Nakaseko and Nishimura, 1979. Ranges and abundances of taxa characterizing this subzone are indicated in Text-figure 6.

Samples assigned to this subzone.—OR-143 through OR-147 (see Text-fig. 4).

Occurrence elsewhere.—Baja California, Alaska, and the Cache Creek Complex, British Columbia.

Latium paucum Subzone.—The base of this subzone is defined by the first occurrence of *Latium paucum* n. sp. as well as *Loffa vesterensis* Blome, 1983, and *Quasipetasus insolitus* n. sp. Other species that make their apparent first appearances at or near the base of this subzone are *Acanthocircus lupheri* n. sp.; *A. macoyensis* n. sp.; *A. rotundus* n. sp.; *Capnuchosphaera silviesensis* Blome, 1983; *C. sockensis* Blome, 1983; *C. soldierensis* Blome, 1983; *Sarla* (?) *externa* Blome, 1983; *S. longispinosa* (Kozur and Mostler, 1979); *Capnodoce fragilis* Blome, 1983; *C. malaca* Blome, 1983; *C. sinuosa* Blome, 1983; *Gorgansium* species A; *Pachus* (?) *indistinctus* n. sp.; and *Triassocampe proprium* n. sp.

Numerous species of *Sarla* Pessagno, 1979 and *Capnodoce* DeWever, 1979 as well as *Acanthocircus rotundus* n. sp.; *Capnuchosphaera silviesensis* Blome, 1983; *C. sockensis* Blome, 1983; *Catoma concinna* Blome, 1983; *C. inedita* Blome, 1983; *Icrioma praecipua* Blome, 1983; *Pachus longinquus* n. sp.; *Syringocapsa turgida* n. sp.; *Latium longulum* n. sp.; *Quasipetasus disertus* n. sp.; and *Triassocampe proprium* n. sp., make their final appearances within the body of the subzone.

The top of this subzone is defined by the same criteria used to define the top of the *Capnodoce* Zone. Range zones and abundance zones of taxa characterizing this subzone are indicated in Text-figure 6.

Samples assigned to this subzone.—OR-39, OR-51, OR-52, OR-55, OR-125, OR-126, OR-148, OR-149, OR-150, OR-151, OR-152, OR-153, OR-154, OR-155 (see Text-fig. 4).

Occurrence elsewhere.—Baja California.

Betraccium Zone

The base of this zone is defined by the first occurrence of *Betraccium* Pessagno, 1979, as well as *Pantanellium silberlingi* Pessagno, 1979, *Betraccium smithi* Pessagno, 1979, and *Pseudoheliodiscus finchi* Pessagno, 1979. Of these taxa, the first occurrence of *Betraccium* is regarded as the most important. It is important to note that the base of this zone occurs above the biohorizon defined by the final occurrence of *Capnodoce* DeWever, 1979. Unfortunately, the base of this zone is missing in eastern Oregon and is only represented in Baja California and Alaska. Other species that make their apparent first appearance at or near the base of this zone are *Capnuchosphaera lenticulata* Pessagno, 1979; *C. mexicana* Pessagno, 1979; and *Sarla natividadensis* Pessagno, 1979 (see Text-fig. 6).

The top of the *Betraccium* Zone is defined by the final occurrence of *Betraccium* Pessagno. Other species that make their apparent final appearance at or near the top of this zone are *Pseudoheliodiscus sandspitensis* n. sp.; *Pantanellium dawsoni* Pessagno and Blome, 1980; *P. fosteri* Pessagno and Blome, 1980; *Betraccium deweveri* Pessagno and Blome, 1980; *B. inornatum* n. sp.; *B. yakounense* Pessagno and Blome, 1980; *Cantalum alium* n. sp.; *Ferresium hecatense* n. sp.; *F. titulense* n. sp.; *Laxtorum hindei* n. sp.; and *L. kulensis* n. sp. Ranges and abundances of taxa characterizing this zone are indicated in Text-figure 6.

The *Betraccium* Zone is treated as an Oppel Zone and is divided into two subzones: a lower *Pantanellium* *silberlingi* Subzone (conceptually an Oppel Zone), and an upper *Betraccium deweveri* Subzone (conceptually an Interval Zone).

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

Occurrence.—Baja California, eastern Oregon, California, British Columbia.

Samples assigned to this zone.—See Text-figure 4.

Pantanellium silberlingi Subzone (Emended).—The base of this subzone is defined by the same species that define the base of the *Betraccium* Zone. *Plafkerium hindei* Pessagno, 1979, *Pantanellium silberlingi* Pessagno, 1979, *P. tozeri* Pessagno, 1979, *Sarla vetusta* Pessagno, 1979, and *S. vizcainoensis* Pessagno, 1979 make their first or final appearances within the body of the subzone.

The top of this subzone is defined by the final occurrence of *Capnuchosphaera* DeWever, 1979. Other species that make their final appearance within the body of the subzone are *Pseudoheliodiscus finchi* Pessagno, 1979; *P. viejoensis* Pessagno, 1979; *Capnuchosphaera lenticulata* Pessagno, 1979; *C. mexicana* Pessagno, 1979; *Sarla natividadensis* Pessagno, 1979; *S. prietoensis* Pessagno, 1979; *S. vetusta* Pessagno, 1979; *Pantanellium tozeri* Pessagno, 1979; and *Plafkerium abbotti* Pessagno, 1979. Range zones and abundance zones of taxa characterizing this subzone are indicated in Text-figure 6.

The *Pantanellium silberlingi* Subzone was originally defined by Pessagno (1979) and was termed an Oppel Zone. In this report, this unit is redefined and reduced to subzone status.

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

Samples assigned to this zone.—See Pessagno (1979, p. 7).

Occurrence elsewhere.—Baja California, Alaska.

Betraccium deweveri Subzone.—The base of this subzone is arbitrarily defined herein as lying above the biohorizon offered by the final occurrence of *Capnuchosphaera* DeWever, 1979. Other genera and species that make their apparent first appearance at or near the base of the subzone are *Ferresium* n. gen., and *Laxatorum* n. gen., as well as *Pseudoheliodiscus sandspitensis* n. sp.; *Pantanellium dawsoni* Pessagno and Blome, 1980; *P. fosteri* Pessagno and Blome, 1980; *P. rothwelli* Pessagno and Blome, 1980; *P. skidegatense* Pessagno and Blome, 1980; *Betraccium deweveri* Pessagno and Blome, 1980; *B. inornatum* n. sp.; *B. maclearni* Pessagno and Blome, 1980; *B. yakounense* Pessagno and Blome, 1980; *Cantalum alium* n. sp.; *C. globosum* n. sp.; and *Gorgansium richardsoni* Pessagno and Blome, 1980.

The following taxa make their final appearances within the body of the subzone: *Pantanellium rothwelli* Pessagno and Blome, 1980; *P. skidegatense* Pessagno and Blome, 1980; *Betraccium maclearni* Pessagno and Blome, 1980; *Cantalum globosum* n. sp.; *Gorgansium richardsoni* Pessagno and Blome, 1980; *Ferresium contortum* n. sp.; *F. laseekense* n. sp.; *F. loganense* n. sp.; *F. lyellense* n. sp.; and *Laxtorum atliensis* n. sp.

The top of the *Betraccium deweveri* Subzone is defined by the same species that define the top of the *Betraccium* Zone. Ranges and abundances of taxa characterizing this subzone are indicated in Text-figure 6.

Range.—Upper Triassic (upper Norian).

Samples assigned to this subzone.—QC-24, QC-26, QC-42, QC-49, QC-51A (see Text-fig. 4).

Occurrence.—Queen Charlotte Islands, British Columbia.

CORRELATION OF UPPER TRIASSIC RADIOLARIAN ZONATIONS

BAJA CALIFORNIA

The first and only other radiolarian zonal scheme for Upper Triassic strata from North America was proposed by Pessagno (1979), based upon the radiolarian-bearing chert member of the San Hipolito Formation, Baja California. This lower chert member was formally divided into two Oppel zones: a lower *Capnodoce* Zone and an upper *Pantanellium silberlingi* Zone. The bottom portion of Pessagno's *Capnodoce* Zone was poorly dated due to the absence of megafossils within the lower portion of the chert member and was interpreted to be either late Karnian? or early Norian in age. According to Pessagno (1979, p. 164), specimens of middle Norian *Halobia lineata* (Muenster, 1833) collected from locality V5F8 were assigned to the top of the *Capnodoce* Zone. Other localities assigned by Pessagno to the lower portion of the *Pantanellium silberlingi* Zone were also found to be at or near the same stratigraphic horizon as locality V5F8. The top of the *Capnodoce* Zone, as well as the base of the *Pantanellium silberlingi* Zone, was interpreted by Pessagno (1979, p. 163) to be late middle Norian in age. Late Norian age *Monotis* sp. cf. *M. subcircularis* (Gabb, 1864) was collected from the upper portion of the overlying limestone member. Radiolarian-bearing samples from the limestone member contained faunal elements in common with the *Pantanellium silberlingi* Zone. The poor preservation of the Radiolaria prevented the assignment of these samples to this upper zonal unit, and the top of the *Pantanellium silberlingi* Zone was tentatively interpreted by Pessagno to be of

STAGES			NORTH AMERICA: THIS REPORT		NORTH AMERICA: BAJA CALIF. PESSAGNO (1979)	JAPAN: NAKASEKO AND NISHIMURA (1979)	JAPAN: YAO, MATSUDA, AND ISOZAKI (1980)	JAPAN: KISHIDA AND SUGANO (1982)	JAPAN: YAO (1982)
UPPER TRIASSIC	NORIAN	Upper	Betraccium Zone	Betraccium deweveri Subzone			Dictyomitrella sp. B Assemblage	? Spongosaturnalis multidentatus Zone	Canoptum triassicum Assemblage
		Upper / Middle		Pantanellium silberlingi Subzone	Pantanellium silberlingi Zone				
		Middle	Capnodoce Zone	Latium paucum Subzone	Capnodoce Zone	— — ? — —		— — ? — —	
		Lower		Xipha striata Subzone		Capnuchosphaera theloides (T) Assemblage		Capnodoce anapetes Zone	Triassocampe nova Assemblage
				Justium novum Subzone					
			?	?	?				
	KARNIAN	Upper				— — ? — —		— — ? — —	
		Lower				Tripocyclia cf. acythus (R) Assemblage (part)	Dictyomitrella sp. A Assemblage (part)	Eptingium manfredi (?) Zone (part)	

Text-figure 7.—Correlation of radiolarian zonations for the Upper Triassic of North America and Japan.

late Norian age. For a listing of the taxa assigned to both the *Capnodoce* Zone (revised herein) and *Pantanellium silberlingi* Zone (reduced herein to subzone status), refer to the previous section titled "Definition of zonal units" as well as Text-figure 6.

JAPAN

Nakaseko and Nishimura (1979) described three radiolarian assemblages from radiolarian-bearing rocks in both central and southwest Japan (Chichibu and Sambosan Groups, respectively). These radiolarian faunal assemblages are, from oldest to youngest, the *Emiluvia* (?) *cochleata* (S type), *Tripocyclia* cf. *acythus* (R type), and *Capnuchosphaera theoloides* (T type; see Text-fig. 7).

The *Emiluvia* (?) *cochleata* Assemblage is unfortunately based upon a single sample and only includes taxa described by Nakaseko and Nishimura (1979). Associated taxa include: *Emiluvia* (?) *cochleata* Nakaseko and Nishimura, 1979, *Pseudostylosphaera tenue* (Nakaseko and Nishimura, 1979) (=*Archaeospongoprunum tenue* Nakaseko and Nishimura, 1979; for a complete discussion of the genus *Pseudostylosphaera,* Kozur and Mostler, 1982, refer to Kozur and Mostler, 1982, p. 31), *Staurocontium minoense* Nakaseko and Nishimura, 1979, *Saturnosphaera pileata* Nakaseko and Nishimura, 1979, *Saturnosphaera triassica* Nakaseko and Nishimura, 1979, and *Dictyomitrella deweveri* Nakaseko and Nishimura, 1979 (in this report, *Dictyomitrella* DeWever, 1979, is considered a junior synonym of *Triassocampe* Dumitrica, Kozur, and Mostler, 1980).

The *Tripocyclia* cf. *acythus* Assemblage is represented by *Tripocyclia* cf. *T. acythus* DeWever, 1979, *Archaeospongoprunum japonicum* Nakaseko and Nishimura, 1979 (=*Pseudostylosphaera japonicum* in this report; for a discussion of the genus *Pseudostylosphaera,* refer to Kozur and Mostler, 1982), *Staurodoras variabilis* Nakaseko and Nishimura, 1979, *Trilonche japonica* Nakaseko and Nishimura, 1979, and *Triassocampe deweveri* (Nakaseko and Nishimura, 1979) (=*Dictyomitrella deweveri* in Nakaseko and Nishimura, 1979).

As noted by Nakaseko and Nishimura (1979, p. 64), their *Capnuchosphaera theoloides* Assemblage closely resembles the late Karnian/early Norian radiolarian faunas from the European Tethys described by DeWever (1979). The *Capnuchosphaera theoloides* Assemblage typically contains *Capnuchosphaera theoloides* DeWever, 1979, *C. triassica* DeWever, 1979, *Capnodoce anapetes* DeWever, 1979, *C. sarisa* DeWever, 1979, *Syringocapsa* cf. *S. batodes* DeWever, 1979, and *Dictyomitra pessagnoi* Nakaseko and Nishimura, 1979.

Nakaseko and Nishimura (1979, p. 64) state that the stratigraphic position of the three radiolarian assemblages cannot be precisely determined and that all three radiolarian assemblages range in age from the late Karnian through Norian time based on conodonts recovered from both chert and limestone samples. A comparison of these faunal assemblages with other radiolarian assemblages reported from Japan (Yao, Matsuda, and Isozaki, 1980; Yao, Matsuoka, and Nakatani, 1982; and Kishida and Sugano, 1982) indicate that both the *Tripocyclia* cf. *acythus* Assemblage and the *Emiluvia* (?) *cochleata* Assemblage are older than the late Karnian and that the *Emiluvia* (?) *cochleata* Assemblage may be as old as early Karnian or even late Ladinian in age (see Text-fig. 7).

Yao, Matsuda, and Isozaki (1980) described four distinctive radiolarian assemblages from the clastic sedimentary sequences (predominantly limestone and chert) in the Inuyama area, central Japan: *Dictyomitrella* sp. A, *Dictyomitrella* sp. B, *Dictyomitrella* sp. C–*Archaeodictyomitra* sp. A, and *Unama echinatus* assemblages (see Text-fig. 7). For the purpose of this report, only the *Dictyomitrella* sp. A and *Dictyomitrella* sp. B assemblages will be discussed.

Characteristic species belonging to the *Dictyomitrella* sp. A Assemblage includes *Dictyomitrella* sp. A (=*Dictyomitrella deweveri* in Nakaseko and Nishimura, 1979; in this report *Dictyomitrella* DeWever, 1979, is considered a junior synonym of *Triassocampe* Dumitrica, Kozur, and Mostler, 1980), *Xiphosphaera* sp. B, *Staurosphaera* sp. A (=*Cecrops floridus* in Nakaseko and Nishimura, 1979), and *Ellipsoxiphus* sp. The *Dictyomitrella* sp. A Assemblage ranges in age from the Ladinian to the early Karnian Stage.

Characteristic species belonging to the *Dictyomitrella* sp. B Assemblage include *Dictyomitrella* sp. B (in this report, *Dictyomitrella* is considered a junior synonym of *Triassocampe* Dumitrica, Kozur, and Mostler, 1980), *Capnodoce* (?) sp., *Spongosaturnalis multidentatus* Kozur and Mostler, 1979 (in this report, *Spongosaturnalis* Campbell and Clark, 1944, is considered a junior synonym of *Acanthocircus* Squinabol, 1903), *Spongosaturnalis gracilis* Kozur and Mostler, 1979, *Triactoma* sp. B (=*Tripocyclia* cf. *T. acythus* DeWever, 1979), *Eucyrtidium* (?) sp., and *Syringocapsa* sp. A. The *Dictyomitrella* sp. B Assemblage ranges in age from the late Karnian to the middle (?) Norian. The poor preservation and the use of transmitted light photomicroscopy for illustration prevents a precise identification and comparison of Yao's taxa to other Japanese radiolarian assemblages.

Kishida and Sugano (1982) established five assemblage zones for Triassic strata from the Chichibu Belt in the Kuchi and Oita Prefecture, Japan (see Text-fig. 7). Their lower *Eptingium manfredi* (?) Zone is mainly characterized by taxa described by Nakaseko and Nishimura (1979). These taxa include *Eptingium manfredi* (?) Dumitrica, 1977a, *Triassocampe deweveri, Tripocyclia* cf. *T. acythus* DeWever, 1979, *Stylosphaera* (?) *compacta* Nakaseko and Nishimura, 1979, *S.* (?) *japonica* Nakaseko and Nishimura, 1979, *S.* (?) *spinulosa* Nakaseko and Nishimura, 1979, and *Staurodoras variabilis* Nakaseko and Nishimura, 1979. Although the majority of this assemblage represents the Ladinian Stage, the upper portion may extend into the lower Karnian (see Text-fig. 7).

Overlying the *Eptingium manfredi* (?) Zone is the *Capnodoce anapetes* Zone. The base and the top are defined by the first and final occurrences of species belonging to the genus *Capnodoce* DeWever, 1979, such as *C. anapetes* DeWever, 1979 and *C. primaria* Pessagno, 1979. Kishida and Sugano (1982) tentatively place the base of this zone within the middle Karnian and the top somewhere within the middle Norian (see Text-fig. 7).

The overlying *Spongosaturnalis multidentatus* Zone is typified by species of the genus *Spongosaturnalis* Campbell and Clark, 1944 (=*Acanthocircus* Squinabol, 1903, in this report), and *Paleosaturnalis* Donofrio and Mostler, 1978 (some forms = *Pseudoheliodiscus* Kozur and Mostler, 1972, in this report). Also included are *Sarla natividadensis* Pessagno, 1979 and *S. vizcainoensis* Pessagno, 1979. Kishida and Sugano (1982) define the base of the zone with the first occurrence of *Paleosaturnalis* and the top of the zone as the final occurrence of most species belonging to both *Spongosaturnalis* and *Paleosaturnalis.* Their range for this assemblage zone is middle Norian to ? early Rhaetian.

The top of the Triassic (Rhaetian) is represented by Kishida and Sugano's (1982) *Pantanellium* sp. B–*Gorgansium* sp. A Zone. This zone is characterized by undescribed species of *Pantanellium* (sp. B), *Gorgansium* (sp. A), *Paleosaturnalis* (sp. L), and *Dictyomitra* (?) (sp. E).

Three successive radiolarian assemblages of Middle to Late Triassic age have been established by Yao (1982) and include the *Triassocampe deweveri* Assemblage, the *Triassocampe nova* Assemblage, and the *Canop-*

tum triassicum Assemblage (see Text-fig. 7). These three radiolarian assemblages are based on Radiolaria collected from continuous sequences of chert in the Inuyama area, central Japan. Only those radiolarian assemblages of Late Triassic age will be discussed in this report.

Characteristic species belonging to the *Triassocampe nova* Assemblage include *Triassocampe nova* Yao, 1982, *Xipha* (?) *pessagnoi* (=*Eucyrtidium* ? *pessagnoi* in Nakaseko and Nishimura, 1979), *Syringocapsa batodes* DeWever, 1979, *Capnodoce sansa* DeWever, 1979, *C. venusta* Pessagno, 1979, *Capnuchosphaera triassica* DeWever, 1979, and *C. theoloides* DeWever, 1979. The range of this assemblage is Karnian to middle Norian.

Overlying the *Triassocampe nova* Assemblage is the *Canoptum triassicum* Assemblage. Characteristic species include *Canoptum triassicum* Yao, 1982, and numerous taxa belonging to the genus *Paleosaturnalis* Donofrio and Mostler, 1978 (some forms = *Pseudoheliodiscus* Kozur and Mostler, 1972, in this report). The age of this radiolarian assemblage is late Norian to Rhaetian.

Both Kishida and Sugano's *Pantanellium* sp. B–*Gorgansium* sp. A Zone, as well as Yao's *Canoptum triassicum* Assemblage, are supposedly Rhaetian (whole or part) in age. The Rhaetian Stage was originally named by Guembel (1861) for the Kossen beds of the Bavarian Alps. According to Silberling and Tozer (1968, p. 18), the Rhaetian Stage is generally regarded as the youngest Triassic stage and stratigraphically lies above the Norian. It is unfortunate that its relationship to the Norian is not completely understood since the Kossen beds are not in stratigraphic contact with the typical ammonoid-bearing Norian strata of the Halstatt succession. All of the ammonoid genera of the typical Rhaetian are known from Norian strata, with all but a few ammonoid taxa ranging from Norian to Rhaetian.

In North America, the Rhaetian Stage is poorly represented, except in the Gabbs Valley of Nevada and the Tyaughton Creek area of British Columbia (Silberling and Tozer, 1968). The stratigraphic evidence from North America and elsewhere indicates that the Rhaetian accounts for only a small portion of Triassic time. For the purposes of this report, the Rhaetian Stage is disregarded. The youngest Triassic strata, represented by the *Betraccium deweveri* Subzone, is of late Norian age based on the presence of *Monotis subcircularis* Gabb, 1864, and *M. salinaria* Bronn, 1830.

The *Capnuchosphaera theoloides* (T) Assemblage of Nakaseko and Nishimura (1979), the *Dictyomitrella* sp. B Assemblage of Yao, Matsuda, and Isozaki (1980), the *Capnodoce anapetes* Zone of Kishida and Sugano (1982), and the *Triassocampe nova* Assemblage of Yao (1982), all contain various taxa of the genus *Capnodoce* DeWever, 1979. The base of Kishida and Sugano's *Capnodoce anapetes* Zone is defined by the first occurrence of the genus *Capnodoce* DeWever, and they questionably place this boundary at or near the middle Karnian Stage (see Text-fig. 7). The base of the *Capnodoce* Zone, as emended herein, is questionably placed within the upper Karnian due to the absence of datable megafossils within the lower portions of the Rail Cabin Mudstone and chert member of the San Hipolito Formation, Baja California (see Biostratigraphy Section).

The very top of the *Capnodoce theoloides* (T) Assemblage, the *Capnodoce anapetes* Zone, and the *Triassocampe nova* Assemblage, all occur within the middle Norian and near the upper middle Norian boundary defined by the final occurrence of *Capnodoce* DeWever proposed within this report. The very top of the *Capnodoce anapetes* Zone proposed by Kishida and Sugano (1982) is also defined by the final occurrence of *Capnodoce* DeWever.

The base of the *Betraccium* Zone (=base of the *Pantanellium silberlingi* Subzone) is defined by the first occurrence of the genus *Betraccium* Pessagno, 1979, as well as *Pantanellium silberlingi* Pessagno, 1979, *Betraccium smithi* Pessagno, 1979, and *Pseudoheliodiscus finchi* Pessagno, 1979. These important North American biostratigraphic markers are mostly absent in the Japanese assemblages. The top of the *Pantanellium silberlingi* Subzone (*Betraccium* Zone), as emended herein, is marked by the final occurrence of *Capnuchosphaera* DeWever, 1979. *Capnuchosphaera,* although common in the older Japanese *Capnuchosphaera theoloides* (T) Assemblage of Nakaseko and Nishimura (1979), *Capnodoce anapetes* Zone of Kishida and Sugano (1982), and *Triassocampe nova* Assemblage of Yao (1982), is surprisingly absent in the upper Norian *Spongosaturnalis multidentatus* Zone of Kishida and Sugano (1982) and *Canoptum triassicum* Assemblage of Yao (1982). Most of the other taxa belonging to the *Spongosaturnalis multidentatus* Zone of Kishida and Sugano (1982) and Yao's *Canoptum triassicum* Assemblage, with the exception of various *Paleosaturnalis* sp. (*Pseudoheliodiscus* herein), are unrepresented in the *Betraccium deweveri* Subzone.

SYSTEMATIC PALEONTOLOGY

INTRODUCTION

Radiolarian morphotypic studies are commonly controlled by the state of preservation exhibited by the Radiolaria. Most Tertiary age Radiolaria have tests composed of opaline silica and are hyaline enough to be studied and illustrated utilizing transmitted light photomicroscopy. In contrast, Mesozoic and Paleozoic age Radiolaria rarely have tests comprised of opaline silica and are diagenetically altered to either chalcedony or microcrystalline quartz. Many tests are completely replaced by calcite, pyrite, limonite or smectite. Even when their tests are siliceous in composition, the common infilling of the test with aluminosilicates (clays) negates transmitted light photomicroscopy.

These preservational problems inherent in Mesozoic radiolarian-bearing rocks brought about the utilization of both the scanning electron microscope (SEM) and the standard reflected-light binocular microscope for Mesozoic radiolarian taxonomic studies. The scanning electron microscope is capable of recording the minutest details of radiolarian morphology. Mesozoic Radiolaria commonly present a wealth of morphologic data, and such taxa are commonly described in more detail than would be normal utilizing transmitted light optics. It is therefore imperative that the Mesozoic radiolarian specialist utilize the reflected light microscope in conjunction with the SEM, and that any morphologic character that is not readily observable in reflected light be ignored in species differentiation.

While both the external and internal features of Cenozoic Radiolaria are easily discernable utilizing standard transmitted light photomicroscopy, most Mesozoic age radiolarian faunas extracted from chert are usually too recrystallized to be examined in transmitted light. In contrast, siliceous radiolarian faunas extracted from limestone or phosphatic concretions tend to be better preserved. This state of preservation may be due to either the presence of organics, an abundance of aluminosilicates, or to other factors that affect silica solubility in sedimentary rocks. An example of this preferred state of preservation is exhibited with a sample from locality OR-39 (see Appendix). The siliceous mudstones overlying and underlying this limestone sample contain moderately well-preserved Radiolaria, and yet this sample contains better preserved forms, as well as an increase in abundance and diversity. It is not well understood at this time whether this increase in abundance and diversity is due to processing biases (the etching of the limestone utilizing HCl *versus* HF with chert) or to true paleoenvironmental differences. The Mesozoic and Paleozoic radiolarian specialist should always attempt to collect limestones in addition to cherts, so that transmitted light photomicroscopy can be utilized to ascertain radiolarian internal structures. The development of a Mesozoic and Paleozoic radiolarian taxonomic classification that emphasizes internal structure, especially at the suprageneric level, is critical in understanding the phylogenetic relationships between different radiolarian taxa.

Ten new genera and 54 new species are described herein. Rare or poorly preserved taxa may be figured but not described. Many of the Spumellariina taxa mentioned have been described by Pessagno (1979), DeWever (1979), or Blome (1983). Most of the new taxa described belong to the Nassellariina. The tests of many Triassic Nassellariina are multilayered, and one family in particular, the Canoptidae, possesses a thick outer layer of microgranular silica that covers the inner latticed meshwork. Nassellariina, especially those with thick test walls, tend to persist while other Radiolaria with more fragile tests have been destroyed by diagenetic alteration.

All ringed Spumellariina mentioned herein belonging to the Family Parasaturnalidae possess well-developed polar spines with fragmentary thorns and sturdy spines (terminology after Yao, 1972). The fragmentary thorns mark the points of attachment of a concentrically layered spongy cortical shell, and the sturdy spines mark the attachment of the latticed medullary shells.

The terminology for describing the thickness of the bars of the pore frames among the Subfamily Pantanellinae is taken from Pessagno and Blome (1980). "Y" equals the thickness of the bars as measured in a plane tangential to the test surface, and "Z" equals the thickness of bars as measured in a plane at right angles to test surface.

Dimensions of specimens are given in μm (1 μm = 10^{-6} m). In the Spumellariina, measurements include the diameter of the cortical shell and the length of the primary spines. In the Nassellariina, both the length and maximum width of the test are measured. Type specimens (the holotype and one set of paratypes) are assigned catalogue numbers and deposited in the U.S. National Museum of Natural History (USNM), Washington, D.C. A second set of paratypes, not as well preserved as those sent to the USNM, are kept in the Blome Collection, Menlo Park, CA. This collection serves as potential replacements (neotypes) in case of damage to the USNM types. Holotypes are isolated on one hole cardboard slides bearing a USNM catalogue number. All paratypes of a given taxon deposited at the USNM are mounted on one glass slide and bear a single USNM catalogue number.

All taxa mentioned in this report are illustrated by means of scanning electron microscopy and some, where preservation permits, are illustrated by transmitted light photomicrography. Many of the specimens, especially new taxa, are photographed at increased magnifications to better illustrate a particular morphologic feature, such as spine or cortical shell structure with the spumellarians and horn or circumferential ridge ornamentation with the nassellarians.

Measurements of the newly described taxa are made with a micrometer mounted in one ocular of either a stereoscopic microscope (holotypes) or a transmitted light microscope (paratypes). Measurements made from bar scales on the scanning electron micrographs have proven to be be unreliable due to the inclination of the specimens on the SEM stub.

Order **POLYCYSTIDA** Ehrenberg, 1838

Suborder **SPUMELLARIINA** Ehrenberg, 1875

Superfamily **SPONGODISCACEA** Haeckel, 1887, (emend. Pessagno, 1971, 1973)

Subsuperfamily **SPONGODRUPPILAE** Haeckel, 1887 (emend. Pessagno, 1973)

Range and occurrence.—Triassic to Recent. Worldwide.

Family **PARASATURNALIDAE** Kozur and Mostler, 1972 (emend. Pessagno, 1979)

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

Range.—Upper Triassic (Karnian?; Norian) 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?; Norian) to Upper Cretaceous (Maestrichtian).

Occurrence.—Worldwide.

Genus **ACANTHOCIRCUS** Squinabol, 1903 (emend. Pessagno, 1979)

Acanthocircus Squinabol, 1903, p. 124.
Spongosaturninus Campbell and Clark, 1944, p. 7 (type species = *S. elliptus* Campbell and Clark, 1944).
Spongosaturnalis Campbell and Clark, 1944, p. 7 (type species = *S. spiniferus* Campbell and Clark, 1944).

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

Remarks.—*Spongosaturninus* and *Spongosaturnalis* are herein regarded as junior synonyms of *Acanthocircus.*

Range.—Upper Triassic (Karnian?; Norian) to Upper Cretaceous (Maestrichtian).

Occurrence.—Worldwide.

Acanthocircus burnsensis new species
Plate 1, figures 1, 11

Etymology.—This species is named for the town of Burns, located in east-central Oregon.

Description.—Test with relatively wide ring, hexagonal in outline. Peripheral spines narrow, long and broad; axial spines approximately the same length as circumaxial spines; six circumaxial spines, three to either side of axis defined by axial and polar spines. Ring cavity subcircular in outline; polar spines long and narrow.

Comparisons.—*Acanthocircus burnsensis* n. sp. differs from *A. macoyensis* n. sp. by having a wider, more circular ring, and by having narrower axial and circumaxial spines.

Table 1.—Diagnostic features of species of *Acanthocircus* Squinabol, 1903.

Taxa	ring	ring width	number of spines	width of spines	ring cavity
A. burnsensis	hexagonal	wide	8	narrow	subcircular
A. dotti	elliptical	wide	10	wide	elliptical
A. harrisonensis	subcircular	wide	12	wide	elliptical
A. izeensis	square	wide	8	moderate	subcircular
A. largus	octagonal	wide	8	wide	elliptical
A. laxus	subcircular	wide	10	wide	elliptical
A. lupheri	subcircular	wide	8	wide	elliptical
A. macoyensis	square	wide	8	wide	square
A. ochocoensis	elliptical	wide	6	wide	elliptical
A. prinevillensis	elliptical	narrow	8	moderate	elliptical
A. rotundus	circular	narrow	4	moderate	circular
A. silverensis	subcircular	wide	8	moderate	subcircular
A. supleensis	elliptical	wide	12	wide	elliptical
A. usitatus	elliptical	wide	12	wide	elliptical
A. vigrassi	elliptical	narrow	12	moderate	elliptical

Measurements (in μm).—

	maximum diameter of ring	maximum length of peripheral spines
Holotype (USNM 305857)	44	151
All (9) paratypes		
(USNM 305858; Blome coll.)		
largest value recorded	53	170
smallest value recorded	42	96
mean value recorded	46	142

Type localities.—Holotype from OR-39; paratypes from OR-39 and OR-52 (see Appendix).

Types.—Holotype: USNM 305857; paratypes: USNM 305858 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Acanthocircus dotti new species
Plate 1, figures 2, 3, 12

Etymology.—This species is named for R. H. Dott in honor of his contributions to Permo-Triassic plate tectonics in the western Cordilleran region.

Description.—Test with wide ring, elliptical in outline. Peripheral spines massive, extremely broad; axial spines as wide as and slightly longer than the circumaxial spines; eight (rarely nine) circumaxial spines, four to either side of axis defined by axial and polar spines. Ring cavity elliptical in outline; polar spines long and broad.

Comparisons.—*Acanthocircus dotti* n. sp. differs from *A. laxus* n. sp. by having a ring and ring cavity that is elliptical in outline, and by having a wider, more massive ring.

Measurements (in μm).—

	maximum diameter of ring	maximum length of peripheral spines
Holotype (USNM 305859)	38	84
All (9) paratypes		
(USNM 305860; Blome coll.)		
largest value recorded	46	120
smallest value recorded	29	62
mean value recorded	36	96

Type locality.—OR-139 (see Appendix).

Types.—Holotype: USNM 305859; paratypes: USNM 305860 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Acanthocircus harrisonensis new species
Plate 1, figures 4, 5, 13

Etymology.—This species is named for Harrison Mountain, located directly east of the town of Izee, east-central Oregon.

Description.—Test with wide ring, subcircular in outline. Peripheral spines massive, long and broad; axial spines approximately the same length and width as the circumaxial spines; ten circumaxial spines, five to either side of axis defined by axial and polar spines. Ring cavity elliptical in outline.

Comparisons.—*Acanthocircus harrisonensis* n. sp. differs from *A. usitatus* n. sp. by having a ring that is subcircular in outline, and by having wider, more massive peripheral spines.

Measurements (in μm).—

	maximum diameter of ring	maximum length of peripheral spines
Holotype (USNM 305861)	38	92
All (7) paratypes		
(USNM 305862; Blome coll.)		
largest value recorded	51	121
smallest value recorded	32	56
mean value recorded	41	81

Type locality.—OR-139 (see Appendix).

Types.—Holotype: USNM 305861; paratypes: USNM 305862 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Acanthocircus izeensis new species
Plate 1, figures 6, 14

Etymology.—This species is named for the town of Izee, located in east-central Oregon.

Description.—Test with wide ring, nearly square in outline. Peripheral spines massive; axial spines longer and thinner than the circumaxial spines; six circumaxial spines, three to either side of axis defined by axial and polar spines. Ring cavity subcircular in outline.

Comparisons.—*Acanthocircus izeensis* n. sp. differs from *A. macoyensis* n. sp. by having a ring that is wider and less square in outline and by having a subcircular ring cavity.

Measurements (in μm).—

	maximum diameter of ring	maximum length of peripheral spines
Holotype (USNM 305863)	44	112
All (8) paratypes		
(USNM 305864; Blome coll.)		
largest value recorded	55	151
smallest value recorded	34	91
mean value recorded	44	117

Type locality.—OR-51 (see Appendix).

Types.—Holotype: USNM 305863; paratypes: USNM 305864 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Acanthocircus largus new species
Plate 1, figures 7, 8, 15, 16

Etymology.—*largus* (Latin) = abundant, plentiful, numerous.

Description.—Test with wide ring, octagonal in outline. Peripheral spines massive, long and broad; axial spines as wide as and slightly longer than the circumaxial spines; six (rarely seven) circumaxial spines, three to either side of axis defined by axial and polar spines. Ring cavity elliptical in outline.

Comparisons.—*Acanthocircus largus* n. sp. differs from *A. ochocoensis* n. sp. and *A. prinevillensis* n. sp. by having a wider ring, and by having a ring that is octagonal in outline.

Measurements (in μm).—

	maximum diameter of ring	maximum length of peripheral spines
Holotype (USNM 305865)	43	113
All (8) paratypes		
(USNM 305866; Blome coll.)		
largest value recorded	48	168
smallest value recorded	34	90
mean value recorded	40	125

Type locality.—OR-52 (see Appendix).

Types.—Holotype: USNM 305865; paratypes: USNM 305866 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Acanthocircus laxus new species
Plate 1, figures 9, 17

Etymology.—*laxus* (Latin) = wide, spacious.

Description.—Test with wide ring, subcircular in outline. Peripheral spines massive, long, broad; axial spines approximately the same length and width as the circumaxial spines; eight circumaxial spines, four to either side of axis defined by axial and polar spines. Ring cavity elliptical in outline.

Comparisons.—*Acanthocircus laxus* n. sp. differs from *A. dotti* n. sp. by having a narrower, less massive ring that is subcircular in outline.

Measurements (in μm).—

	maximum diameter of ring	maximum length of peripheral spines
Holotype (USNM 305867)	26	90
All (7) paratypes		
(USNM 305868; Blome coll.)		
largest value recorded	35	121
smallest value recorded	25	62
mean value recorded	29	90

Type locality.—OR-139 (see Appendix).

Types.—Holotype: USNM 305867; paratypes: USNM 305868 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Acanthocircus lupheri new species
Plate 1, figures 10, 18

Etymology.—This species is named for R. L. Lupher in honor of his contributions to the Jurassic stratigraphy of the Suplee-Izee area, east-central Oregon.

Description.—Test with wide ring, subcircular in outline. Peripheral spines massive, long and broad; axial spines longer than circumaxial spines; six circumaxial spines, three to either side of axis defined by axial and polar spines. Ring cavity elliptical in outline; polar spines short, broad.

Comparisons.—*Acanthocircus lupheri* n. sp. differs from *A. silverensis* n. sp. having a much narrower, less massive ring.

Measurements (in μm).—

	maximum diameter of ring	maximum length of peripheral spines
Holotype (USNM 305869)	40	152
All (7) paratypes		
(USNM 305870; Blome coll.)		
largest value recorded	48	181
smallest value recorded	32	112
mean value recorded	37	146

Type locality.—OR-39 (see Appendix).

Types.—Holotype: USNM 305869; paratypes: USNM 305870 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Acanthocircus macoyensis new species
Plate 2, figures 1, 12

Etymology.—This species is named for McCoy Creek, located northwest of the town of Izee, east-central Oregon.

Description.—Test with wide ring, square in outline. Peripheral spines massive, long and broad; axial spines longer and thinner than the circumaxial spines; six circumaxial spines, three to either side of axis defined by axial and polar spines. Ring cavity square in outline.

Comparisons.—*Acanthocircus macoyensis* n. sp. differs from *A. izeensis* n. sp. by having a ring that is narrower and more square in outline, and by having a square ring cavity.

Measurements (in μm).—

	maximum diameter of ring	maximum length of peripheral spines
Holotype (USNM 305871)	40	187
All (8) paratypes		
(USNM 305872; Blome coll.)		
largest value recorded	43	206
smallest value recorded	36	106
mean value recorded	40	156

Type localities.—Holotype from OR-39. Paratypes from OR-39 and OR-55 (see Appendix).

Types.—Holotype: USNM 305871; paratypes: USNM 305872 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Acanthocircus ochocoensis new species
Plate 2, figures 2, 13

Etymology.—This species is named for the Ochoco National Forest, located in east-central Oregon.

Description.—Test with ring, elliptical in outline. Peripheral spines massive, long, broad; axial spines longer than and approximately the same width as the circumaxial spines; six circumaxial spines, three to either side of axis defined by axial and polar spines. Ring cavity elliptical in outline; polar spines long, broad.

Comparisons.—*Acanthocircus ochocoensis* n. sp. differs from *A. largus* n. sp. by having a ring and ring cavity that is more elliptical in outline, and by having a slightly narrower ring.

Measurements (in μm).—

	maximum diameter of ring	maximum length of peripheral spines
Holotype (USNM 305873)	37	119
All (8) paratypes		
(USNM 305874; Blome coll.)		
largest value recorded	40	149
smallest value recorded	33	75
mean value recorded	37	112

Type locality.—OR-52 (see Appendix).

Types.—Holotype: USNM 305873; paratypes: USNM 305874 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Acanthocircus prinevillensis new species
Plate 2, figures 3, 14

Etymology.—This species is named for the town of Prineville, located in east-central Oregon.

Description.—Test with narrow ring, elliptical in outline. Peripheral spines massive; axial spines slightly longer than circumaxial spines; six circumaxial spines, three to either side of axis defined by axial and polar spines. Ring cavity elliptical in outline; polar spines long, broad.

Comparisons.—*Acanthocircus prinevillensis* n. sp. differs from *A. largus* n. sp. and *A. ochocoensis* n. sp. by having a much narrower ring.

Measurements (in μm).—

	maximum diameter of ring	maximum length of peripheral spines
Holotype (USNM 305875)	31	109
All (6) paratypes		
(USNM 305876; Blome coll.)		
largest value recorded	36	154
smallest value recorded	28	89
mean value recorded	31	114

Type localities.—Holotype from OR-39. Paratypes from OR-39 and OR-52 (see Appendix).

Types.—Holotype: USNM 305875; paratypes: USNM 305876 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Acanthocircus rotundus new species
Plate 2, figures 4, 5, 15

Etymology.—*rotundus* (Latin) = round, circular.

Description.—Test with narrow ring, circular in outline. Peripheral spines massive, long and broad; axial spines approximately the same length as circumaxial spines; two circumaxial spines, one to either side of axis defined by axial and polar spines. Ring cavity circular in outline.

Comparisons.—*Acanthocircus rotundus* n. sp. differs from *A. vigrassi* n. sp. by having a circular ring and ring cavity, and by having four rather than six peripheral spines.

Measurements (in μm).—

	maximum diameter of ring	maximum length of peripheral spines
Holotype (USNM 305877)	28	138
All (8) paratypes		
(USNM 305878; Blome coll.)		
largest value recorded	29	185
smallest value recorded	21	96
mean value recorded	25	136

Type locality.—OR-39 (see Appendix).

Types.—Holotype: USNM 305877; paratypes: USNM 305878 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Acanthocircus silverensis new species
Plate 2, figures 6, 16

Etymology.—This species is named for Silver Creek, located in the Suplee-Izee area, eastern Oregon.

Description.—Test with broad ring, subcircular in outline. Peripheral spines massive, of medium length and width; axial spines about same length as circumaxial spines; six circumaxial spines, three to either side of axis defined by axial and polar spines. Ring cavity subcircular in outline; polar spines short, broad.

Comparisons.—*Acanthocircus silverensis* n. sp. differs from *A. burnsensis* n. sp. by having a much broader ring, and by having more massive axial and circumaxial spines.

Measurements (in μm).—

	maximum diameter of ring	maximum length of peripheral spines
Holotype (USNM 305879)	56	96
All (7) paratypes		
(USNM 305880; Blome coll.)		
largest value recorded	60	142
smallest value recorded	46	86
mean value recorded	51	116

Type locality.—OR-39 (see Appendix).

Types.—Holotype: USNM 305879; paratypes: USNM 305880 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Acanthocircus supleensis new species
Plate 2, figures 7, 17

Etymology.—This species is named for the town of Suplee, located in east-central Oregon.

Description.—Test with wide ring, elliptical in outline. Peripheral spines massive, long and broad; axial spines slightly more massive and sometimes longer when compared with the circumaxial spines; ten circumaxial spines, five to either side of axis defined by axial and polar spines. Ring cavity elliptical in outline; polar spines long and broad.

Comparisons.—*Acanthocircus supleensis* n. sp. differs from *A. harrisonensis* n. sp. by having a ring and ring cavity that is elliptical in outline. *A. supleensis* n. sp. differs from *A.* sp. cf. *A. triassicus* Kozur and Mostler, 1972, by having wider, more massive peripheral spines.

Measurements (in μm).—

	maximum diameter of ring	maximum length of peripheral spines
Holotype (USNM 305881)	28	86
All (7) paratypes		
(USNM 305882; Blome coll.)		
largest value recorded	33	103
smallest value recorded	26	71
mean value recorded	29	87

Type locality.—OR-139 (see Appendix).

Types.—Holotype: USNM 305881; paratypes: 305882 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Acanthocircus usitatus new species
Plate 2, figures 8, 18

Etymology.—*usitatus* (Latin) = usual, ordinary.

Description.—Test with narrow ring, elliptical in outline. Peripheral spines massive; axial spines appreciably longer than circumaxial spines; ten circumaxial spines, five to either side of axis defined by axial and polar spines. Ring cavity elliptical in outline.

Comparisons.—*Acanthocircus usitatus* n. sp. differs from *A. supleensis* n. sp. by having a narrower ring, and by having narrower, less massive peripheral spines. *A. usitatus* n. sp. differs from *A. fluegeli* Kozur and Mostler, 1972, by having an elliptical (*versus* subcircular) ring and ring cavity. *A. usitatus* n. sp. has been compared to *A. harrisonensis* n. sp. under the latter species.

Measurements (in μm).—

	maximum diameter of ring	maximum length of peripheral spines
Holotype (USNM 305883)	38	160
All (9) paratypes		
(USNM 305884; Blome coll.)		
largest value recorded	42	178
smallest value recorded	30	103
mean value recorded	37	141

Type locality.—OR-39 (see Appendix).

Types.—Holotype: USNM 305883; paratypes: USNM 305884 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Acanthocircus vigrassi new species
Plate 2, figures 9, 10

Etymology.—This species is named for Laurence W. Vigrass in honor of his contributions towards the Paleozoic history of the Suplee-Izee area, east-central Oregon.

Description.—Test with narrow ring, subcircular in outline. Peripheral spines massive, long and narrow; axial spines slightly longer than circumaxial spines; four circumaxial spines, two to either side of axis defined by axial and polar spines. Ring cavity elliptical in outline; polar spines long and broad.

Comparisons.—*Acanthocircus vigrassi* n. sp. differs from *A. rotundus* n. sp. by having a subcircular ring and an elliptical ring cavity. *A. vigrassi* n. sp. differs from *A. hexagonus* Yao, 1972, by having a ring that is more circular in outline, by lacking ridges on the ring and peripheral spines, and by possessing axial spines.

Measurements (in μm).—

	maximum diameter of ring	maximum length of peripheral spines
Holotype (USNM 305885)	20	69
All (8) paratypes		
(USNM 305886; Blome coll.)		
largest value recorded	24	90
smallest value recorded	18	53
mean value recorded	21	71

Type localities.—Holotype from OR-39. Paratypes from OR-52 (see Appendix).

Types.—Holotype: USNM 305885; paratypes: USNM 305886 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Acanthocircus species A
Plate 2, figure 11

Comparisons.—*Acanthocircus* sp. A differs from other species of *Acanthocircus* described in this report by having a subelliptical ring and ring cavity in combination with massive axial and circumaxial spines.

Range and occurrence.—OR-139. Upper Triassic (upper Karnian?; lower to upper middle Norian). Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon. Rare.

Acanthocircus species B
Plate 3, figure 1

Comparisons.—*Acanthocircus* sp. B differs from *A. supleensis* n. sp. by having a more rectangular ring with fewer (eight *versus* ten) circumaxial spines.

Range and occurrence.—OR-139. Upper Triassic (upper Karnian?; lower to upper middle Norian). Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon. Rare.

Acanthocircus species C
Plate 3, figure 2

Comparisons.—*Acanthocircus* sp. C differs from *A. silverensis* n. sp. by having a circular ring and ring cavity, and by having 11 or 12 circumaxial spines. *A.* sp. C differs from *A. triassicus* Kozur and Mostler, 1972, by having significantly shorter peripheral spines, and by having axial spines that are appreciably longer than the circumaxial spines.

Range and occurrence.—OR-39. Upper Triassic (upper Karnian?; lower to upper middle Norian). Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon. Rare.

Acanthocircus species D
Plate 3, figure 3

Comparisons.—*Acanthocircus* sp. D differs from *A. laxus* n. sp. by having a wider, more massive ring, and by having a ring cavity that is subcircular in outline.

Range and occurrence.—OR-39. Upper Triassic (upper Karnian?; lower to upper middle Norian). Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon. Rare.

Acanthocircus species E
Plate 3, figures 4, 5

Comparisons.—*Acanthocircus* sp. E differs from *A. dotti* n. sp. by having a ring and ring cavity that is square in outline, and by having a wider, more massive ring.

Range and occurrence.—OR-139. Upper Triassic (upper Karnian?; lower to upper middle Norian). Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon. Rare.

Subfamily **HELIOSATURNALINAE**
Kozur and Mostler, 1972
(emend. Pessagno, 1979)

Type genus.—*Heliosaturnalis* Kozur and Mostler, 1972.

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

Occurrence.—Worldwide.

Genus **PSEUDOHELIODISCUS**
Kozur and Mostler, 1972
(emend. Pessagno, 1979)

Type species.—*Pseudoheliodiscus riedeli* Kozur and Mostler, 1972.

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

Occurrence.—Triassic of Austria, California, Washington, Alaska, western Canada (Queen Charlotte Islands), and Japan. It also occurs in the Lower Jurassic of California and Turkey.

Pseudoheliodiscus finchi Pessagno

Pseudoheliodiscus finchi Pessagno, 1979, pp. 170–171, pl. 5, figs. 9–10.

Comparisons.—*Pseudoheliodiscus finchi* Pessagno differs from *P. sandspitensis* n. sp. by having a narrower ring, and by having peripheral spines that are wider in diameter as well as smaller in number (10 *versus* 14).

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

Occurrence.—San Hipolito Formation, Baja California.

Pseudoheliodiscus sandspitensis new species
Plate 3, figures 6, 7; Plate 17, figure 1

Etymology.—This species is named for the town of Sandspit, located on Skidegate Inlet, Queen Charlotte Islands, British Columbia.

Description.—Test with wide ring. Peripheral spines massive, short and broad; axial spines about the same length as the circumaxial spines; seven circumaxial spines on either side of the polar axis. Ring cavity large; polar spines of medium length, one shorter than the other; auxiliary spines slightly shorter than polar spines, two to either side of axis defined by polar spines.

Comparisons.—*Pseudoheliodiscus sandspitensis* n. sp. differs from *P. viejoensis* Pessagno, 1979, by having a slightly broader ring, by having a larger number of peripheral spines with seven circumaxial spines to either side of the polar axis, and by having longer auxiliary spines.

Measurements (in μm).—

	maximum diameter of ring	maximum length of peripheral spines
Holotype (USNM 305887)	43	48
All (5) paratypes (USNM 305888; Blome coll.)		
largest value recorded	44	59
smallest value recorded	29	40
mean value recorded	39	49

Type locality.—QC-24 (see Appendix).

Types.—Holotype: USNM 305887; paratypes: USNM 305888 and Blome collection.

Range.—Upper Triassic (upper Norian).

Occurrence.—Middle black limestone member of the Kunga Formation, Queen Charlotte Islands.

Pseudoheliodiscus viejoensis Pessagno

Pseudoheliodiscus viejoensis Pessagno, 1979, p. 171, pl. 5, fig. 12.

Comparisons.—*Pseudoheliodiscus viejoensis* Pessagno differs from *P. sandspitensis* n. sp. by having a narrower and more circular ring.

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

Occurrence.—San Hipolito Formation, Baja California.

Superfamily **LIOSPHAERACEA** Haeckel, 1881

Subsuperfamily **LIOSPHAERILAE** Haeckel, 1881

Family **CAPNUCHOSPHAERIDAE** DeWever, 1979
(emend. Pessagno, 1979; emend. Blome, 1983)

Type genus.—*Capnuchosphaera* DeWever, 1979.

Comparisons.—The Capnuchosphaeridae differs from the Pantanellidae Pessagno, 1977b, by possessing a double-layered cortical shell.

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

Occurrence.—Worldwide.

Genus **CAPNUCHOSPHAERA** DeWever, 1979
(emend. Pessagno, 1979; emend. Blome, 1983)

Type species.—*Capnuchosphaera triassica* DeWever, 1979.

Comparisons.—*Capnuchosphaera* differs from *Sarla* Pessagno, 1979, by possessing tumidaspinae. *Capnuchosphaera* also differs from *Icrioma* DeWever, 1979, by possessing three (*versus* four) primary spines.

Table 2.—Diagnostic features of species of *Capnuchosphaera* DeWever, 1979.

Taxa	shell outline	tunnel	tumors	shaft
C. colemani	ovate	long	prominent	long
C. deweveri	spherical	moderate	prominent	long
C. lenticulata	compressed	moderate	prominent	long
C. mexicana	spherical	short	prominent	short
C. schenki	spherical	long	prominent	long
C. silviesensis	spherical	short	subdued	long
C. smithorum	spherical	long	prominent	long
C. sockensis	spherical	short	subdued	long
C. soldierensis	spherical	long	prominent	long

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

Occurrence.—Baja California, eastern Oregon, California, Alaska, British Columbia, Oman, Greece, Sicily, Turkey, and Japan.

Capnuchosphaera colemani Blome
Plate 3, figure 8

Capnuchosphaera colemani Blome, 1983, p. 15, pl. 1, figs. 1, 2, 6, 7, 10, 15.

Comparisons.—*Capnuchosphaera colemani* differs from *C. smithorum* Blome, 1983, and *C. schenki* Blome, 1983, by having an ovate-shaped cortical shell, and by having tumidaspinae that are more massive in character.

Type localities.—Holotype from OR-39. Paratypes from OR-39 and OR-139 (see Appendix).

Types.—Holotype: USNM 305785; paratypes: USNM 305786 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Capnuchosphaera deweveri
Kozur and Mostler, 1979
(emend. Blome, 1983)
Plate 3, figure 9

Capnuchosphaera deweveri Kozur and Mostler, 1979, pp. 75–76, pl. 10, figs. 4–7; pl. 12, fig. 1.

Capnuchosphaera deweveri Kozur and Mostler. Blome, 1983, p. 16, pl. 1, figs. 3, 8, 9, 16, 18.

Comparisons.—*Capnuchosphaera deweveri* differs from *C. soldierensis* Blome, 1983, by having tumidaspinae with smooth, rather than porous, spinal tunnels, and by having well-developed spinal tumors.

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

Occurrence.—East-central Oregon, Alaska, and Europe.

Capnuchosphaera lenticulata Pessagno

Capnuchosphaera lenticulata Pessagno, 1979, p. 173, pl. 7, figs. 1–3, pl. 9, fig. 2.

Comparisons.—*Capnuchosphaera lenticulata* Pessagno differs from *C. smithorum* Blome, 1983, as well as from other species described in this report, by possessing a lenticular cortical shell.

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

Occurrence.—San Hipolito Formation, Baja California.

Capnuchosphaera mexicana Pessagno

Capnuchosphaera mexicana Pessagno, 1979, p. 173, pl. 6, figs. 3–6, pl. 9, fig. 3.

Comparisons.—*Capnuchosphaera mexicana* Pessagno differs from *C. schenki* Blome, 1983, and *C. smithorum* Blome, 1983, by having larger pore frames, and by possessing shorter tumidaspinae. *C. mexicana* also differs from *C. colemani* Blome, 1983 by having a larger, spherical cortical shell possessing larger pore frames.

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

Occurrence.—San Hipolito Formation, Baja California.

Capnuchosphaera schenki Blome
Plate 3, figure 10

Capnuchosphaera schenki Blome, 1983, p. 16, pl. 1, figs. 4, 12, 14, 17.

Comparisons.—*Capnuchosphaera schenki* differs from *C. colemani* Blome, 1983, and *C. smithorum* Blome, 1983, by having tumidaspinae with spinal tumors that are less massive, and by having longer spinal tunnels.

Type localities.—Holotype from OR-39. Paratypes from OR-39 and OR-148 (see Appendix).

Types.—Holotype: USNM 305789; paratypes: USNM 305790 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Capnuchosphaera silviesensis Blome
Plate 3, figure 13

Capnuchosphaera silviesensis Blome, 1983, pp. 16–17, pl. 1, figs. 5, 11, 13.

Comparisons.—*Capnuchosphaera silviesensis* differs from *C. sockensis* Blome, 1983, by having a cortical shell that consists of an outer layer of flat, hexagonal and pentagonal (*versus* raised and polygonal) pore frames, and by having more uniformly sized pore frames.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Capnuchosphaera smithorum Blome
Plate 3, figure 11

Capnuchosphaera smithorum Blome, 1983, p. 17, pl. 2, figs. 1, 6, 9, 15.

Comparisons.—*Capnuchosphaera smithorum* differs from *C. colemani* Blome, 1983, by having a larger, more spherical cortical shell. *C. smithorum* also differs from *C. schenki* Blome, 1983, by having tumidaspinae with more massive spinal tumors, and by having small secondary indentations situated midway between the tumidapores at the base of the spinal tumor.

Type localities.—Holotype from OR-39. Paratypes from OR-39 and OR-52 (see Appendix).

Types.—Holotype: USNM 305793; paratypes: USNM 305794 and Blome collection.

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

Occurrence.—East-central Oregon, Alaska.

Capnuchosphaera sockensis Blome
Plate 3, figure 12

Capnuchosphaera sockensis Blome, 1983, p. 17, pl. 2, figs. 2, 13, 14, 16.

Comparisons.—*Capnuchosphaera sockensis* differs from *C. silviesensis* Blome, 1983, by having a cortical shell that consists of an outer layer of raised (*versus* flat) pentagonal to hexagonal pore frames, and by having pore frames that are more varied in size.

Type localities.—Holotype from OR-39. Paratypes from OR-39 and OR-148 (see Appendix).

Types.—Holotype: USNM 305795; paratypes: USNM 305796 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Capnuchosphaera soldierensis Blome
Plate 3, figure 14

Capnuchosphaera soldierensis Blome, 1983, pp. 17–18, pl. 2, figs. 3, 7, 12, 17.

Comparisons.—*Capnuchosphaera soldierensis* differs from *C. silviesensis* Blome, 1983, by having a larger cortical shell, and by having primary spines that display weak to moderate torsion.

Type localities.—Holotype from OR-39. Paratypes from OR-39 and OR-55 (see Appendix).

Types.—Holotype: USNM 305797; paratypes: USNM 305798 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Genus **CATOMA** Blome, 1983

Type species.—*Catoma geometrica* Blome, 1983.

Comparisons.—*Catoma* differs from *Icrioma* DeWever, 1979, by having primary spines that lack tumidaspinae (medial portion with alternating ridges and grooves). *Catoma* also differs from *Hagiastrum* Haeckel, 1881 (emend. Baumgartner, 1980), and any other genera belonging to the Hagiastridae Riedel, 1971 (emend. Baumgartner, 1980), by having a two-layered cortical shell.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Catoma concinna Blome
Plate 3, figure 15

Catoma concinna Blome, 1983, pp. 20–21, pl. 4, figs. 2, 12, 14, 18.

Comparisons.—*Catoma concinna* differs from *C. geometrica* Blome, 1983, and *C. inedita* Blome, 1983, by having a smaller cortical shell, by having smaller, less massive nodes at the pore frame vertices, and by having primary spines with both the medial and distal portions exhibiting alternating ridges and grooves.

Type localities.—Holotype from OR-39. Paratypes from OR-39 and OR-52 (see Appendix).

Types.—Holotype: USNM 305807; paratypes: USNM 305808 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Catoma geometrica Blome
Plate 3, figure 16

Catoma geometrica Blome, 1983, p. 21, pl. 4, figs. 3, 9, 15, 16, 19.

Comparisons.—*Catoma geometrica* differs from *C. concinna* Blome, 1983, and *C. inedita* Blome, 1983, by having primary spines that possess a short, triradiate medial portion, and by having primary spines with wider ridges separating grooves. *C. geometrica* also differs from *C. concinna* by having a larger cortical shell, and by having larger, more massive nodes at the pore frame vertices.

Type localities.—Holotype from OR-39. Paratypes from OR-39 and OR-148 (see Appendix).

Types.—Holotype: USNM 305809; paratypes: USNM 305810 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Catoma inedita Blome
Plate 3, figure 17

Catoma inedita Blome, 1983, p. 21, pl. 4, figs. 4, 10, 11, 20; pl. 11, fig. 11.

Comparisons.—*Catoma inedita* differs from *C. concinna* Blome, 1983, and *C. geometrica* Blome, 1983, by having both the proximal and medial portions of the primary spines consisting of polygonal pore frames. *C. inedita* also differs from *C. concinna* by possessing a larger cortical shell, and by having larger, more massive nodes at the pore frame vertices.

Type localities.—Holotype from OR-39. Paratypes from OR-39 and OR-52 (see Appendix).

Types.—Holotype: USNM 305811; paratypes: USNM 305812 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Genus **ICRIOMA** DeWever, 1979
(emend. Blome, 1983)

Type species.—*Icrioma tetrancistra* DeWever, 1979.

Comparisons.—*Icrioma* differs from *Catoma* Blome, 1983, by having primary spines that possess tumidaspinae. *Icrioma* also differs from other genera belonging to the family Capnuchosphaeridae DeWever, 1979, by having a four-sided cortical shell with four radially arranged primary spines, and by having an outer layer of meshwork consisting of variably sized, raised polygonal pore frames with massive nodes at the pore frame vertices.

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

Occurrence.—Eastern Oregon, Sicily, and Turkey.

Icrioma praecipua Blome
Plate 3, figure 18

Icrioma praecipua Blome, 1983, p. 22, pl. 5, figs. 1, 6, 14; pl. 11, fig. 9.

Comparisons.—*Icrioma praecipua* differs from *I. transversa* Blome, 1983, by having radially arranged primary spines that do not lie in the same plane, and by having primary spines with less prominent spinal tumors. *I. praecipua* differs from *I. tetrancistra* DeWever, 1979, by having a four-sided (*versus* subspherical) cortical shell, and by having primary spines with less prominent spinal tumors.

Type localities.—Holotype from OR-39. Paratypes from OR-39 and OR-148 (see Appendix).

Types.—Holotype: USNM 305813; paratypes: USNM 305814 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Icrioma transversa Blome
Plate 3, figure 19

Icrioma transversa Blome, 1983, pp. 22–23, pl. 5, figs. 2, 7, 8, 11, 15; pl. 11, fig. 10.

Comparisons.—*Icrioma transversa* differs from *I. praecipua* Blome, 1983, and *I. tetrancistra* DeWever, 1979, by having four radially arranged primary spines that occur in the same plane. *I. transversa* differs from *I. praecipua* by having primary spines with well-developed, prominent spinal tumors.

Type localities.—Holotype from OR-39. Paratypes from OR-39 and OR-148 (see Appendix).

Types.—Holotype: USNM 305815; paratypes: USNM 305816 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Genus **SARLA** Pessagno, 1979

Type species.—*Sarla prietoensis* Pessagno, 1979.

Comparisons.—*Sarla* differs from *Capnuchosphaera* DeWever, 1979, by having primary spines that lack pronounced, swollen medial portions (tumidaspinae). *Sarla* differs from *Tripocyclia* Haeckel, 1881, by possessing a double-layered cortical shell.

Table 3.—Diagnostic features of species of *Sarla* Pessagno, 1979.

Taxa	shell	triradiate portion of primary spines	width of primary spines	torsion
S. delicata	spherical	proximal half	narrow	slight
S. (?) *externa*	spherical	proximal fourth	narrow	none
S. longispinosa	spherical	entire	narrow	none
S. natividadensis	spherical	entire	narrow	strong
S. plena	spherical	entire	narrow	slight
S. prietoensis	subspherical	entire	wide	strong
S. vetusta	subspherical	entire	wide	slight
S. vizcainoensis	spherical	two-thirds	wide	strong

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

Occurrence.—Baja California, eastern Oregon, Alaska, and British Columbia.

Sarla delicata Blome
Plate 3, figure 20

Sarla delicata Blome, 1983, p. 18, pl. 3, figs. 1, 6, 14.

Comparisons.—*Sarla delicata* differs from *S.* (?) *externa* Blome, 1983, by having more primary spines that are triradiate in axial section (½ to ⅔ of total length), and by possessing primary spines that display slight torsion.

Type localities.—Holotype from OR-39. Paratypes from OR-39 and OR-52 (see Appendix).

Types.—Holotype: USNM 305799; paratypes: USNM 305800 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Sarla (?) **externa** Blome
Plate 4, figure 1

Sarla (?) *externa* Blome, 1983, pp. 18–19, pl. 3, figs. 2, 8, 9, 15.

Comparisons.—*Sarla* (?) *externa* Blome, differs from *S. delicata* Blome, 1983, by having only the proximal fourth of each primary spine triradiate in axial section, and by possessing primary spines that lack torsion. *S.* (?) *externa* Blome, is questionably assigned to the genus *Sarla.* Unlike most species of the genus, *S.* (?) *externa* Blome, lacks primary spines that are triradiate in axial section for most of their length.

Type localities.—Holotype from OR-39. Paratypes from OR-39 and OR-55 (see Appendix).

Types.—Holotype: USNM 305801; paratypes: USNM 305802 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Sarla longispinosa (Kozur and Mostler, 1979) (emend. Blome, 1983)
Plate 4, figure 3

Triactoma longispinosum Kozur and Mostler, 1979, p. 59, pl. 1, fig. 6; pl. 11, figs. 3, 8; pl. 12, fig. 6; pl. 13, fig. 1.
Sarla longispinosum (Kozur and Mostler). Blome, 1983, pp. 19–20, pl. 3, figs. 5, 7, 10, 18; pl. 11, fig. 4.

Comparisons.—*Sarla longispinosa* differs from *S. delicata* Blome, 1983, and *S.* (?) *externa* Blome, 1983, by having primary spines that are triradiate in axial section, the exception being the circular distal end. *S. longispinosa* also differs from *S.* sp. A of Pessagno (1979), by having primary spines with grooves separated by thinner, less massive ridges.

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

Occurrence.—Eastern Oregon, Europe.

Types.—The type specimens of *Sarla longispinosa* were kept by Kozur, and have no numerical designation.

Sarla natividadensis Pessagno

Sarla natividadensis Pessagno, 1979, p. 174, pl. 7, figs. 9–11.

Comparisons.—*Sarla natividadensis* Pessagno differs from *S. plena* n. sp. by having a larger, less spherical cortical shell that possesses larger pore frames, and by having broader primary spines that display greater torsion.

Range.—Upper Triassic (upper middle Norian).

Occurrence.—San Hipolito Formation, Baja California.

Sarla plena Blome
Plate 4, figure 2

Sarla plena Blome, 1983, p. 19, pl. 3, figs. 3, 11, 12, 16.

Comparisons.—*Sarla plena* differs from *S. natividadensis* Pessagno, 1979, by having a smaller cortical shell, and by having less massive primary spines with thinner ridges separating grooves. *S. plena* differs from *S. delicata* Blome, 1983, by having primary spines that are completely triradiate in axial section. *S. plena* also differs from *S. longispinosum* (Kozur and Mostler, 1979), by having primary spines that display slight to moderate torsion and have ridges separated by wider grooves.

Type locality.—OR-139 (see Appendix).

Types.—Holotype: USNM 305803; paratypes: USNM 305804 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Sarla prietoensis Pessagno

Sarla prietoensis Pessagno, 1979, p. 174, pl. 8, figs. 3–6.

Comparisons.—*Sarla prietoensis* Pessagno differs from *S. delicata* n. sp. and *S. plena* n. sp. by having a subspherical cortical shell and by having more massive primary spines that display greater torsion.

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

Occurrence.—San Hipolito Formation, Baja California.

Sarla vetusta Pessagno

Sarla vetusta Pessagno, 1979, pp. 174–175, pl. 7, figs. 4, 6–7, 13–14.

Comparisons.—*Sarla vetusta* Pessagno differs from *S. vizcainoensis* Pessagno by having primary spines that display less torsion, and that are completely triradiate in axial section.

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

Occurrence.—San Hipolito Formation, Baja California.

Sarla sp. aff. **S. vetusta** Pessagno
Plate 4, figure 4

Sarla sp. aff. *S. vetusta* Pessagno. Blome, 1983, p. 19, pl. 3, figs. 4, 13, 17.

Comparisons.—This form differs from *S. vetusta* Pessagno, 1979, by having a more spherical cortical shell, and by possessing primary spines that display slightly greater torsion.

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

Occurrence.—East-central Oregon, Alaska.

Sarla vizcainoensis Pessagno

Sarla vizcainoensis Pessagno, 1979, p. 175, pl. 7, figs. 8, 12.

Comparisons.—*Sarla vizcainoensis* Pessagno differs from *S. plena* n. sp. and *S. vetusta* Pessagno by having primary spines that display greater torsion, and by having primary spines in which the distal third is circular in axial section.

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

Occurrence.—San Hipolito Formation, Baja California.

Family **PANTANELLIDAE** Pessagno, 1977b
(emend. Pessagno and Blome, 1980)

Type genus.—*Pantanellium* Pessagno, 1977a.

Comparisons.—The Pantanellidae is divided into two subfamilies, the Capnodocinae Pessagno (1979), and the Pantanellinae Pessagno (1977b), on the basis of the structure of the primary spines and radial beams.

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

Occurrence.—Worldwide.

Subfamily **CAPNODOCINAE** Pessagno, 1979
(emend. Blome, 1983)

Type genus.—*Capnodoce* DeWever, 1979.

Comparisons.—The Capnodocinae differs from the Pantanellinae Pessagno, 1977b, by possessing hollow, tubular rather than solid, bladed primary spines and radial beams.

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

Occurrence.—Baja California, eastern Oregon, Washington, Alaska, California, British Columbia, Oman, Greece, Sicily, Turkey, and Japan.

Genus **CAPNODOCE** DeWever, 1979
(emend. Pessagno, 1979; emend. Blome, 1983)

Type species.—*Capnodoce anapetes* DeWever, 1979.

Comparisons.—*Capnodoce* differs from *Loffa* Pessagno, 1979, and *Renzium* Blome, 1983, by having three radially arranged, tubular primary spines that lie in the same plane.

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

Occurrence.—Baja California, eastern Oregon, Washington, Alaska, California, British Columbia, Oman, Greece, Sicily, Turkey, and Japan.

Capnodoce sp. aff. **C. anapetes** DeWever
Plate 4, figure 18

Capnodoce anapetes DeWever, 1979, p. 81, pl. 2, figs. 5–7.
Capnodoce sp. aff. *C. anapetes* DeWever. Blome, 1983, p. 23, pl. 8, figs. 3, 10, 11, 18; pl. 11, figs. 8, 15.

Table 4.—Diagnostic features of species of *Capnodoce* DeWever, 1979.

Taxa	shell outline	nodes	primary spines		
			length	symmetry	shape
C. aff. *C. anapetes*	subtriangular	small	moderate	symmetrical	expanding distally
C. angusta	circular	large	short	asymmetrical	tapering distally
C. antiqua	circular	large	short	symmetrical	expanding distally
C. baldiensis	circular	large	moderate	symmetrical	uniform diameter
C. beaulieui	subcircular	large	moderate	asymmetrical	expanding distally
C. copiosa	circular	large	moderate	symmetrical	expanding proximally and distally
C. crystallina	subspherical	large	moderate	symmetrical	tapering proximally and distally
C. extenta	subcircular	moderate	moderate	symmetrical	expanding distally
C. fragilis	subcircular	large	long	symmetrically curved	expanding distally
C. insueta	circular	large	moderate	symmetrical	expanding distally
C. kochi	circular	large	moderate	symmetrical	uniform diameter
C. malaca	circular	large	moderate	symmetrical	uniform diameter
C. media	circular	large	short	symmetrical	expanding distally
C. miniscula	circular	large	moderate	symmetrical	expanding distally
C. primaria	subspherical	large	long	symmetrical	uniform diameter
C. sinuosa	circular	large	moderate	symmetrically curved	expanding distally
C. traversi	subspherical	small	moderate	symmetrical	uniform diameter
C. venusta	circular	small	moderate	symmetrical	tapering proximally and distally

Comparisons.—This form differs from *C. anapetes* by having a subtriangular cortical shell with slightly rounded sides. The general shape of the primary spines seems comparable to that displayed by the European specimen.

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

Occurrence.—Rail Cabin Mudstone, east-central Oregon; and the Isparta Cay Formation, Turkey.

Capnodoce angusta Blome
Plate 4, figure 5

Capnodoce angusta Blome, 1983, pp. 23–24, pl. 5, figs. 3, 9, 10, 16.

Comparisons.—*Capnodoce angusta* differs from *C. copiosa* Blome, 1983, by having primary spines that are asymmetrically arranged.

Type locality.—OR-143 (see Appendix).

Types.—Holotype: USNM 305817; paratypes: USNM 305818 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Capnodoce antiqua Blome
Plate 4, figure 6

Capnodoce antiqua Blome, 1983, p. 24, pl. 5, figs. 4, 12, 17.

Comparisons.—*Capnodoce antiqua* differs from *C. copiosa* Blome, 1983, by having wider, more massive primary spines. *C. antiqua* differs from *C. media* Blome, 1983, by having primary spines that are thinner medially.

Type localities.—Holotype from OR-6. Paratypes from OR-6 and OR-139 (see Appendix).

Types.—Holotype: USNM 305819; paratypes: USNM 305820 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Capnodoce baldiensis Blome
Plate 4, figure 7

Capnodoce baldiensis Blome, 1983, p. 24–25, pl. 5, figs. 5, 13, 18.

Comparisons.—*Capnodoce baldiensis* differs from *C. extenta* Blome, 1983, and *C. insueta* Blome, 1983, by having narrower, less massive primary spines that maintain the same diameter over most of their length.

Type localities.—Holotype from OR-6. Paratypes from OR-6 and OR-139 (see Appendix).

Types.—Holotype: USNM 305821; paratypes: USNM 305822 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Capnodoce beaulieui Blome
Plate 4, figure 8

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

Comparisons.—*Capnodoce beaulieui* differs from *C. angusta* Blome, 1983, by having longer, more massive primary spines, and by having nodes at the pore frame vertices that are more massive and higher in relief. *C.*

beaulieui differs from *C. venusta* Pessagno, 1979, by having primary spines that are asymmetrically arranged.

Type localities.—Holotype from OR-39. Paratypes from OR-39 and OR-52 (see Appendix).

Types.—Holotype: USNM 305823; paratypes: USNM 305824 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Capnodoce copiosa Blome
Plate 4, figure 5

Capnodoce copiosa Blome, 1983, p. 25, pl. 6, figs. 2, 12, 14, 16.

Comparisons.—*Capnodoce copiosa* differs from *C. baldiensis* Blome, 1983, and *C. miniscula* Blome, 1983, by having primary spines that are thinner medially and wider both proximally and distally. *C. copiosa* differs from *C. antiqua* Blome, 1983, by having narrower, less massive primary spines.

Type localities.—Holotype from OR-39. Paratypes from OR-39 and OR-139 (see Appendix).

Types.—Holotype: USNM 305825; paratypes: USNM 305826 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Capnodoce crystallina Pessagno

Capnodoce crystallina Pessagno, 1979, p. 176, pl. 1, figs. 1–3.

Comparisons.—*Capnodoce crystallina* Pessagno differs from *C. antiqua* Blome, 1983, and *C. traversi* Pessagno, 1979, by having primary spines that are thicker in the medial portions. *C. crystallina* differs from *C. kochi* Blome, 1983, and *C. traversi* by having more massive and less numerous pore frames on the top and bottom surfaces of the cortical shell.

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

Occurrence.—San Hipolito Formation, Baja California.

Capnodoce extenta Blome
Plate 4, figure 10

Capnodoce extenta Blome, 1983, pp. 25–26, pl. 6, figs. 3, 7, 9, 17.

Comparisons.—*Capnodoce extenta* differs from *C. insueta* Blome, 1983, and *C. kochi* Blome, 1983, by having wider, more inflated primary spines. *C. extenta* differs from *C. beaulieui* Blome, 1983, by having primary spines that are symmetrically arranged.

Type localities.—Holotype from OR-39. Paratypes from OR-39 and OR-51 (see Appendix).

Types.—Holotype: USNM 305827; paratypes: USNM 305828 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Capnodoce fragilis Blome
Plate 4, figure 11

Capnodoce fragilis Blome, 1983, p. 26, pl. 6, figs. 4, 10, 18; pl. 11, fig. 5.

Comparisons.—*Capnodoce fragilis* differs from *C. sinuosa* Blome, 1983, by having longer primary spines.

Type localities.—Holotype from OR-39. Paratypes from OR-39 and OR-55 (see Appendix).

Types.—Holotype: USNM 305829; paratypes: USNM 305830 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Capnodoce insueta Blome
Plate 4, figure 12

Capnodoce insueta Blome, 1983, p. 27, pl. 6, figs. 5, 6, 11, 19; pl. 7, figs. 1, 7, 15; pl. 11, fig. 6.

Comparisons.—*Capnodoce insueta* differs from *C. baldiensis* Blome, 1983, *C. extenta* Blome, 1983, and *C. media* Blome, 1983, by having the medial and distal portions of the primary spines elliptical to subtriangular in axial section, and the sides flattened.

Type localities.—Holotype from OR-39. Paratypes from OR-39 and OR-55 (see Appendix).

Types.—Holotype: USNM 305831; paratypes: USNM 305832 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Capnodoce kochi Blome
Plate 4, figure 13

Capnodoce kochi Blome, 1983, pp. 28, 30, pl. 7, figs. 2, 8, 9, 16.

Comparisons.—*Capnodoce kochi* differs from *C. miniscula* Blome, 1983, and *C. traversi* Pessagno, 1979, by having primary spines that are thicker medially and taper both proximally and distally. *C. kochi* differs from *C. venusta* Pessagno, 1979, by having narrower, less inflated primary spines.

Type localities.—Holotype from OR-39. Paratypes from OR-39 and OR-52 (see Appendix).

Types.—Holotype: USNM 305833; paratypes: USNM 305834 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Capnodoce malaca Blome
Plate 4, figure 14

Capnodoce malaca Blome, 1983, pp. 30, 32, pl. 7, figs. 3, 11, 14, 17.

Comparisons.—*Capnodoce malaca* differs from *C. baldiensis* Blome, 1983, and *C. miniscula* Blome, 1983, by having a cortical shell with the sides slightly rounded and the top and bottom surfaces flattened, and by having extremely narrow primary spines.

Type localities.—Holotype from OR-39. Paratypes from OR-39 and OR-55 (see Appendix).

Types.—Holotype: USNM 305835; paratypes: USNM 305836 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Capnodoce media Blome
Plate 4, figure 15

Capnodoce media Blome, 1983, p. 32, pl. 7, figs. 4, 10, 12, 18.

Comparisons.—*Capnodoce media* differs from *C. antiqua* Blome, 1983, by having primary spines that expand distally. *C. media* differs from *C. baldiensis* Blome, 1983, *C. insueta* Blome, 1983, and *C. miniscula* Blome, 1983, by having shorter primary spines.

Type locality.—OR-143 (see Appendix).

Types.—Holotype: USNM 305837; paratypes: USNM 305838 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Capnodoce miniscula Blome
Plate 4, figure 16

Capnodoce miniscula Blome, 1983, pp. 32, 34, pl. 7, figs. 5, 6, 12, 19; pl. 8, figs. 1, 9, 13.

Comparisons.—*Capnodoce miniscula* differs from *C. baldiensis* Blome, 1983, and *C. copiosa* Blome, 1983, by having a smaller cortical shell, and by having primary spines that increase in diameter over most of their length.

Type localities.—Holotype from OR-39. Paratypes from OR-39 and OR-52 (see Appendix).

Types.—Holotype: USNM 305839; paratypes: USNM 305840 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Capnodoce primaria Pessagno

Capnodoce primaria Pessagno, 1979, p. 176, pl. 1, figs. 5–7, 15, 16.

Comparisons.—*Capnodoce primaria* Pessagno differs from *C. malaca* Blome, 1983, by having more massive pore frames on the top and bottom surfaces, and by having wider and more massive primary spines. *C. primaria* differs from *C. miniscula* Blome, 1983, by possessing a larger, thicker cortical shell with flattened top and bottom surfaces, as well as larger and more numerous pore frames.

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

Occurrence.—San Hipolito Formation, Baja California.

Capnodoce sinuosa Blome
Plate 4, figure 17

Capnodoce sinuosa Blome, 1983, p. 34, pl. 8, figs. 2, 7, 8, 17; pl. 11, fig. 17.

Comparisons.—*Capnodoce sinuosa* differs from *C. fragilis* Blome, 1983, by having shorter, wider primary spines.

Type localities.—Holotype from OR-39. Paratypes from OR-39 and OR-52 (see Appendix).

Types.—Holotype: USNM 305841; paratypes: USNM 305842 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Capnodoce traversi Pessagno
Plate 4, figure 19

Capnodoce traversi Pessagno, 1979, p. 42, pl. 1, figs. 11, 12; Blome, 1983, p. 36, pl. 8, figs. 4, 16.

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

Occurrence.—Cache Creek Group, British Columbia; Rail Cabin Mudstone, east-central Oregon.

Capnodoce venusta Pessagno

Capnodoce venusta Pessagno, 1979, p. 177, pl. 1, figs. 8–10, 13–14.

Comparisons.—*Capnodoce venusta* Pessagno differs from *C. antiqua* Blome, 1983, and *C. media* Blome, 1983, by possessing primary spines with inflated medial portions.

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

Occurrence.—San Hipolito Formation, Baja California.

Genus **LOFFA** Pessagno, 1979

Type species.—*Loffa mulleri* Pessagno, 1979.

Comparisons.—*Loffa* differs from *Capnodoce* DeWever, 1979, by having a cortical shell that is subpyramidal in shape, and by having four radially arranged, tubular primary spines that are not in the same plane.

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

Occurrence.—Baja California, east-central Oregon.

Loffa lepida Blome
Plate 4, figure 20

Loffa lepida Blome, 1983, p. 38, pl. 9, figs. 6, 9, 10, 13, 18; pl. 11, fig. 14.

Comparisons.—*Loffa lepida* differs from *L. vesterensis* Blome, 1983, by having a spherical cortical shell, and by having longer, narrower primary spines.

Type localities.—Holotype from OR-39. Paratypes from OR-39 and OR-55 (see Appendix).

Types.—Holotype: USNM 305845; paratypes: USNM 305846 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Loffa mulleri Pessagno

Loffa mulleri Pessagno, 1979, p. 177, pl. 2, figs. 1–6, 8, 14–15.

Comparisons.—*Loffa mulleri* Pessagno differs from *L. lepida* Blome, 1983, by possessing an ovate cortical shell, and from both *L. lepida* and *L. vesterensis* Blome, 1983, by having shorter, wider primary spines.

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

Occurrence.—San Hipolito Formation, Baja California.

Loffa vesterensis Blome
Plate 5, figure 1

Loffa vesterensis Blome, 1983, pp. 38, 40, pl. 9, figs. 7, 11, 14, 19, 20; pl. 11, figs. 12, 13.

Comparisons.—*Loffa vesterensis* differs from *L. lepida* Blome, 1983, by having an ovate cortical shell, and by having shorter, slightly wider primary spines.

Type locality.—OR-39 (see Appendix).

Types.—Holotype: USNM 305847; paratypes: USNM 305848 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Genus **RENZIUM** Blome, 1983

Type species.—*Renzium webergorum* Blome, 1983.

Comparisons.—*Renzium* differs from *Capnodoce* DeWever, 1979, by having two bipolar, rather than three radially arranged, primary spines.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Renzium adversum Blome
Plate 5, figure 2

Renzium adversum Blome, 1983, pp. 40, 42, pl. 10, figs. 1, 6, 7, 12.

Comparisons.—*Renzium adversum* differs from *R. webergorum* Blome, 1983, by having a smaller, more spherical cortical shell, and by having longer, slender bipolar primary spines.

Type localities.—Holotype from OR-39. Paratypes from OR-39 and OR-52 (see Appendix).

Types.—Holotype: USNM 305849; paratypes: USNM 305850 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Renzium webergorum Blome
Plate 5, figure 3

Renzium webergorum Blome, 1983, p. 42, pl. 10, figs. 2, 5, 8, 13.

Comparisons.—*Renzium webergorum* differs from *R. adversum* Blome, 1983, by having a larger, elliptical cortical shell, and by having shorter, more massive bipolar spines.

Type locality.—OR-139 (see Appendix).

Types.—Holotype: USNM 305851; paratypes: USNM 305852 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Genus **JUSTIUM** Blome, 1983

Type species.—*Justium novum* Blome, 1983.

Comparisons.—*Justium* differs from *Gorgansium* Pessagno and Blome, 1980, as well as other genera belonging to the subfamily Pantanellinae Pessagno, 1979, by possessing one hollow, tubular (with a tripartite internal partition) primary spine in combination with two solid triradiate primary spines.

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

Occurrence.—East-central Oregon, Baja California.

Justium novum Blome
Plate 5, figure 4

Justium novum Blome, 1983, pp. 44, 46, pl. 10, figs. 3, 9, 10, 14.

Comparisons.—*Justium novum* differs from *J. robustum* Blome, 1983, by having two triradiate primary spines with less massive, narrower ridges separating grooves.

Type locality.—OR-139 (see Appendix).

Types.—Holotype: USNM 305853; paratypes: USNM 305854 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Justium robustum Blome
Plate 5, figure 5

Justium robustum Blome, 1983, pp. 46, 48, pl. 10, figs. 4, 11, 15.

Comparisons.—*Justium robustum* differs from *J. novum* Blome, 1983, by having two triradiate primary spines that are more massive in character, the ridges being three to four times as wide as the grooves.

Type locality.—OR-139 (see Appendix).

Types.—Holotype: USNM 305855; paratypes: USNM 305856 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Subfamily **PANTANELLINAE** Pessagno, 1977b

Type genus.—*Pantanellium* Pessagno, 1977a.

Comparisons.—The Pantanellinae differs from the Capnodocinae Pessagno, 1979, by possessing solid, bladed, triradiate rather than hollow, tubular, primary spines and radial beams.

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

Occurrence.—Worldwide.

Genus **BETRACCIUM** Pessagno, 1979

Type species.—*Betraccium smithi* Pessagno, 1979.

Comparisons.—*Betraccium* differs from *Capnodoce* DeWever, 1979, by having solid, bladed primary spines and radial beams, which are triradiate in axial section. *Betraccium* differs from *Gorgansium* Pessagno and Blome, 1980, by having symmetrically arranged, more or less equidistant primary spines of equal length.

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

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

Betraccium deweveri Pessagno and Blome
Plate 5, figures 6, 7, 13, 20

Betraccium deweveri Pessagno and Blome, 1980, pp. 230–231, pl. 1, figs. 1, 2, 5–8, 13, 14.

Table 5.—Diagnostic features of species of *Betraccium* Pessagno, 1979.

		pore frames		primary spines		
Taxa	shell	number	nodes	length	width	torsion
B. deweveri	spherical	5	well-developed	long	wide	strong
B. (?) *incohatum*	spherical	7	well-developed	short	narrow	none
B. inornatum	subspherical	4	well-developed	long	narrow	none
B. maclearni	subspherical	6	well-developed	moderate	wide	moderate
B. smithi	ovate	6	well-developed	moderate	wide	strong
B. yakounense	subspherical	5	poorly developed	short	narrow	none

Comparisons.—*Betraccium deweveri* differs from *B. maclearni* Pessagno and Blome, 1980, and *B. yakounense* Pessagno and Blome, 1980, by having a more spherical cortical shell, and by having primary spines that display extreme torsion of the ridges and grooves.

Type locality.—QC-24 (see Appendix).

Types.—Holotype: USNM 278001; paratypes: USNM 278002 and Blome collection.

Range.—Upper Triassic (upper Norian).

Occurrence.—Queen Charlotte Islands, British Columbia, Alaska.

Betraccium (?) **incohatum** new species
Plate 5, figures 8, 15, 16, 18

Etymology.—*incohatus* (Latin) = incomplete, only begun.

Description.—Cortical shell large, spherical with large, predominantly hexagonal pore frames having relatively well-developed nodes at the pore frame vertices; nodes low in relief. Bars of pore frames thick in **Y** direction; moderately thick in **Z** direction. Six to seven pore frames visible on top and bottom surfaces along an axis in line with that of a given primary spine. Primary spines extremely short, rudimentary, triradiate in axial section, longitudinally comprised of three wide grooves alternating with three narrow ridges; grooves approximately six times as wide as ridges; ridges and grooves straight, lacking torsion.

Comparisons.—*Betraccium* (?) *incohatum* n. sp. differs from all other species of *Betraccium* described in this report by having extremely short, rudimentary primary spines with wide grooves. *B.* (?) *incohatum* n. sp. is questionably assigned to the genus *Betraccium* Pessagno, 1979. The medullary shell with its primary and secondary radial beams are poorly preserved.

Measurements (in μm).—

	diameter of cortical shell	length of primary spines
Holotype (USNM 305889)	88	15
All (8) paratypes		
(USNM 305890; Blome coll.)		
largest value recorded	91	23
smallest value recorded	81	12
mean value recorded	87	18

Type locality.—OR-139 (see Appendix).

Types.—Holotype: USNM 305889; paratypes: USNM 305890 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Betraccium inornatum new species
Plate 5, figures 9, 12, 17, 19

Etymology.—*inornatus* (Latin) = unadorned, plain.

Description.—Cortical shell subspherical with large, predominantly hexagonal pore frames having relatively well-developed nodes at pore frame vertices; nodes low in relief. Bars of pore frames thick in both **Y** and **Z** directions. Four pore frames visible on top and bottom surfaces along an axis in line with that of a given primary spine. Primary spines long, triradiate in axial section, longitudinally comprised of three wide grooves that alternate with three wide ridges; grooves approximately two to three times as wide as ridges, ridges and grooves straight, lacking torsion.

Comparisons.—*Betraccium inornatum* n. sp. differs from *B. yakounense* Pessagno and Blome, 1980, by having a smaller cortical shell, by having a smaller number of pore frames visible on top and bottom surfaces, and by having longer primary spines that lack torsion.

Measurements (in μm).—

	diameter of cortical shell	length of primary spines
Holotype (USNM 305891)	66	73
All (6) paratypes		
(USNM 305892; Blome coll.)		
largest value recorded	68	87
smallest value recorded	61	46
mean value recorded	65	66

Type localities.—Holotype from QC-24; paratypes from QC-24 and QC-26 (see Appendix).

Types.—Holotype: USNM 305891; paratypes: USNM 305892 and Blome collection.

Range.—Upper Triassic (upper Norian).

Occurrence.—Middle member of the Kunga Formation, Queen Charlotte Islands.

Betraccium maclearni Pessagno and Blome
Plate 5, figure 10

Betraccium maclearni Pessagno and Blome, 1980, p. 231, pl. 1, figs. 3, 9, 10, 15.

Comparisons.—*Betraccium maclearni* differs from *B. deweveri* Pessagno and Blome, 1980, by having a subspherical cortical shell, and by having primary spines that display less torsion. *B. maclearni* differs from *B. yakounense* Pessagno and Blome, 1980, by having more massive nodes at the pore frame vertices, and by having longer primary spines that, in general, display greater torsion.

Type locality.—QC-24 (see Appendix).

Types.—Holotype: USNM 278003; paratypes: USNM 278004 and Blome collection.

Range.—Upper Triassic (upper Norian).
Occurrence.—Queen Charlotte Islands.

Betraccium smithi Pessagno

Betraccium smithi Pessagno, 1979, p. 178, pl. 2, figs. 7, 11–12, 16.

Comparisons.—*Betraccium smithi* Pessagno differs from *B. deweveri* Pessagno and Blome, 1980, by possessing a small, ovate (*versus* large, spherical) cortical shell.
Range.—Upper Triassic (upper middle to lower upper Norian).
Occurrence.—San Hipolito Formation, Baja California.

Betraccium yakounense Pessagno and Blome
Plate 5, figures 11, 14, 21

Betraccium yakounense Pessagno and Blome, 1980, pp. 321–322, pl. 1, figs. 4, 11, 12, 16; pl. 2, figs. 1, 10, 14.

Comparisons.—*Betraccium yakounense* differs from *B. deweveri* Pessagno and Blome, 1980, and *B. maclearni* Pessagno and Blome, 1980, by having shorter primary spines that display little or no torsion.
Type locality.—QC-24 (see Appendix).
Types.—Holotype: USNM 278005; paratypes: USNM 278006 and Blome collection.
Range.—Upper Triassic (upper Norian).
Occurrence.—Queen Charlotte Islands.

Genus **CANTALUM** Pessagno, 1979

Type species.—*Cantalum holdsworthi* Pessagno, 1979.
Comparisons.—*Cantalum* differs from *Betraccium* Pessagno, 1979, by having a cortical shell that is subpyramidal in shape, and by having four radially arranged, bladed primary spines that lie in more than a single plane.
Range.—Upper Triassic (Norian) to Middle Jurassic (Bajocian?).
Occurrence.—Baja California and the Queen Charlotte Islands, British Columbia.

Cantalum alium new species
Plate 6, figures 1, 12, 15, 16, 17

Etymology.—*alius* (Latin) = another, other, one or other of two, different.
Description.—Test as for genus. Cortical shell subcircular in outline, with large, pentagonal and hexagonal pore frames having well-developed nodes at pore frame vertices; nodes high in relief. Bar of pore frames thick in both **Y** and **Z** directions. Primary spines long, triradiate in axial section, longitudinally comprised of three wide grooves alternating with three equally wide ridges; grooves only slightly wider than ridges; ridges and grooves straight, lacking torsion.
Comparisons.—*Cantalum alium* n. sp. differs from *C. globosum* n. sp. by having a subspherical cortical shell, and by having primary spines that display equally wide grooves and ridges, and lack torsion.
Measurements (in μm).—

	diameter of cortical shell	length of primary spines
Holotype (USNM 305893)	79	72
All (7) paratypes		
(USNM 305894; Blome coll.)		
largest value recorded	83	82
smallest value recorded	73	52
mean value recorded	79	66

Type localities.—Holotype from QC-24. Paratypes from QC-24 and QC-26 (see Appendix).
Types.—Holotype: USNM 305893; paratypes: USNM 305894 and Blome collection.
Range.—Upper Triassic (upper Norian).
Occurrence.—Middle member of the Kunga Formation, Queen Charlotte Islands.

Cantalum globosum new species
Plate 6, figures 2, 10, 11, 18

Cantalum sp. B, Pessagno and Blome, 1980, p. 234, pl. 2, fig. 3.

Etymology.—*globosus* (Latin) = spherical, round.
Description.—Test as for genus. Cortical shell large, ovate in outline, with large, pentagonal and hexagonal pore frames having well-developed nodes at pore frame vertices; nodes high in relief. Bar of pore frames thick in both **Y** and **Z** directions. Primary spines long, triradiate in axial section, longitudinally comprised of three wide grooves alternating with three narrow ridges; grooves three to four times as wide as ridges; ridges and grooves displaying strong torsion.
Comparisons.—*Cantalum globosum* n. sp. differs from *C. alium* n. sp., by possessing a cortical shell that is ovate in outline, and by having primary spines with wider grooves that display moderate to strong torsion.
Measurements (in μm).—

	diameter of cortical shell	length of primary spines
Holotype (USNM 305895)	106	66
All (8) paratypes		
(USNM 305896; Blome coll.)		
largest value recorded	110	84
smallest value recorded	95	50
mean value recorded	101	72

Type localities.—Holotype from QC-24. Paratypes from QC-24 and QC-26 (see Appendix).

Types.—Holotype: USNM 305895; paratypes: USNM 305896 and Blome collection.

Range.—Upper Triassic (upper Norian).

Occurrence.—Middle member of the Kunga Formation, Queen Charlotte Islands.

Cantalum holdsworthi Pessagno

Cantalum holdsworthi Pessagno, 1979, p. 178, pl. 2, figs. 9–10, 13.

Comparisons.—*Cantalum holdsworthi* Pessagno differs from *C. alium* n. sp. and *C. globosum* n. sp. by possessing a cortical shell that is subtriangular in outline, and by having primary spines that increase in diameter distally.

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

Occurrence.—San Hipolito Formation, Baja California.

Cantalum species A
Plate 6, figure 3

Cantalum sp. A, Pessagno and Blome, 1980, p. 234, pl. 2, fig. 2.

Comparisons.—*Cantalum* sp. A differs from *Cantalum globosum* n. sp., by having a more spherical cortical shell, and by having extremely twisted primary spines.

Range and occurrence.—QC-24. Upper Triassic (upper Norian). Middle member—Kunga Formation. Queen Charlotte Islands, British Columbia. Rare.

Genus **GORGANSIUM** Pessagno and Blome, 1980

Type species.—*Gorgansium silviesense* Pessagno and Blome, 1980.

Comparisons.—*Gorgansium* differs from *Betraccium* Pessagno (1979), by having primary spines that are asymmetrically arranged and of unequal length (with two shorter spines situated close together).

Range.—Upper Triassic (upper Karnian?; Norian) to Upper Jurassic (lower Callovian).

Gorgansium acutum new species
Plate 6, figures 4, 9, 14, 19

Etymology.—*acutus* (Latin) = sharp, pointed.

Description.—Cortical shell large, spherical; meshwork of large, pentagonal and hexagonal (predominantly pentagonal) pore frames with relatively well-developed nodes at pore frame vertices; nodes low in relief. Bars of pore frames thin in **Y** direction; thick in **Z** direction. Six pore frames visible on top and bottom surfaces along an axis in line with axis of primary spines. Primary spines short, triradiate in axial section; longitudinally comprised of three wide grooves alternating with three narrow ridges; grooves three to four times as wide as ridges; ridges and grooves straight, lacking torsion.

Comparisons.—*Gorgansium acutum* n. sp. differs from *Gorgansium* sp. A by having a larger, spherical cortical shell, and by having shorter primary spines with slightly narrower ridges separating grooves.

Measurements (in μm).—

	diameter of cortical shell	length of primary spines
Holotype (USNM 305897)	88	33
All (7) paratypes		
(USNM 305898; Blome coll.)		
largest value recorded	94	38
smallest value recorded	84	24
mean value recorded	90	31

Type locality.—OR-139 (see Appendix).

Types.—Holotype: USNM 305897; paratypes: USNM 305898 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Gorgansium richardsoni Pessagno and Blome
Plate 6, figure 5

Gorgansium richardsoni Pessagno and Blome, 1980, pp. 234–235, pl. 2, figs. 4, 11, 13.

Comparisons.—*Gorgansium richardsoni* differs from other species of *Gorgansium* by having primary spines that display strong torsion.

Type locality.—QC-24 (see Appendix).

Types.—Holotype: USNM 278009; paratypes: USNM 278010 and Blome collection.

Range.—Upper Triassic (upper Norian).

Occurrence.—Queen Charlotte Islands.

Gorgansium species A
Plate 6, figures 6, 13, 20

Gorgansium sp. E, Pessagno and Blome, 1980, p. 236, pl. 2, fig. 6.

Range and occurrence.—OR-148. Upper Triassic (upper Karnian?; lower to upper middle Norian). Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon. Rare.

Gorgansium species B
Plate 6, figure 7

Gorgansium sp. F, Pessagno and Blome, 1980, p. 236, pl. 2, fig. 7.

Range and occurrence.—OR-148. Upper Triassic (upper Karnian?; lower to upper middle Norian). Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon. Rare.

Table 6.—Diagnostic features of species of *Pantanellium* Pessagno, 1977a.

Taxa	shell	pore frames		primary spines		
		number	nodes	length	torsion	other
P. dawsoni	subspherical	4–5	large	unequal	none	
P. fosteri	spherical	5	large	short	none	
P. rothwelli	subspherical	5–6	small	moderate	strong	
P. silberlingi	spherical	4–5	small	unequal	none	secondary grooves
P. skidegatense	subspherical	4	moderate	long	none	
P. tozeri	subspherical	4–5	small	unequal	none	

Genus **PANTANELLIUM** Pessagno, 1977a

Type species.—Pantanellium riedeli Pessagno, 1977a.

Comparisons.—Pantanellium differs from all other genera belonging to the subfamily Pantanellinae Pessagno, 1977b, by possessing bipolar, triradiate primary spines. For an updated synopsis of this genus and subfamily, see Pessagno and Blome (1980).

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

Occurrence.—Worldwide.

Pantanellium dawsoni Pessagno and Blome
Plate 6, figure 8

Pantanellium dawsoni Pessagno and Blome, 1980, pp. 241–242, pl. 2, figs. 8, 9, 15, 16.

Comparisons.—Pantanellium dawsoni differs from *P. fosteri* Pessagno and Blome, 1980, and *P. skidegatense* Pessagno and Blome, 1980, by having one polar spine shorter than the other, and by having polar spines with three relatively broad grooves separating three narrow ridges.

Type locality.—QC-24 (see Appendix).

Types.—Holotype: USNM 278031; paratypes: USNM 278032 and Blome collection.

Range.—Upper Triassic (upper Norian).

Occurrence.—Queen Charlotte Islands.

Pantanellium fosteri Pessagno and Blome
Plate 7, figure 1

Pantanellium fosteri Pessagno and Blome, 1980, p. 242, pl. 3, figs. 1, 8, 16.

Comparisons.—Pantanellium fosteri differs from *P. dawsoni* Pessagno and Blome, 1980, and *P. skidegatense* Pessagno and Blome, 1980, by having short polar spines, and by having a more spherical cortical shell. *P. fosteri* differs from *P. dawsoni* by having polar spines with broader ridges separating the grooves, and by having polar spines that are more equal in length.

Type locality.—QC-24 (see Appendix).

Types.—Holotype: USNM 278033; paratypes: USNM 278034 and Blome collection.

Range.—Upper Triassic (upper Norian).

Occurrence.—Queen Charlotte Islands.

Pantanellium rothwelli Pessagno and Blome
Plate 7, figures 2, 3, 18, 19

Pantanellium rothwelli Pessagno and Blome, 1980, pp. 244–245, pl. 3, figs. 2, 3, 9, 10, 13, 14, 18.

Comparisons.—Pantanellium rothwelli differs from other species of *Pantanellium* by having polar spines that display considerable torsion. *P. rothwelli* differs from *P. dawsoni* Pessagno and Blome, 1980, *P. fosteri* Pessagno and Blome, 1980, and *P. skidegatense* Pessagno and Blome, 1980, by having poorly developed nodes at the pore frame vertices, and by having polar spines with broader grooves separating the ridges.

Type locality.—QC-24 (see Appendix).

Types.—Holotype: USNM 278045; paratypes: USNM 278046 and Blome collection.

Range.—Upper Triassic (upper Norian).

Occurrence.—Queen Charlotte Islands.

Pantanellium silberlingi Pessagno

Pantanellium silberlingi Pessagno, 1979, pp. 178–179, pl. 8, figs. 7–10, 13–14.

Comparisons.—Pantanellium silberlingi Pessagno differs from other species of *Pantanellium* mentioned in this report, by having bipolar primary spines with paired ridges separated by secondary grooves.

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

Occurrence.—San Hipolito Formation, Baja California.

Pantanellium skidegatense Pessagno and Blome
Plate 7, figures 4, 5

Pantanellium skidegatense Pessagno and Blome, 1980, p. 246, pl. 3, figs. 4, 11, 17.

Comparisons.—Pantanellium skidegatense differs from *P. dawsoni* Pessagno and Blome, 1980, and *P. fosteri* Pessagno and Blome, 1980, by having a smaller number of pore frames, by having larger pore frames, and by having longer primary spines.

Type locality.—QC-24 (see Appendix).

Types.—Holotype: USNM 278053; paratypes: USNM 278054 and Blome collection.

Table 7.—Diagnostic features of species of *Ferresium*, new genus.

		nodes and pore frames		primary spines	
Taxa	shell	relief	size	width	torsion
F. contortum	subspherical	high	small	short, symmetrical	strong
F. hecatense	spherical	high	large	moderate, symmetrical	little or none
F. laseekense	subspherical	high	large	moderate, symmetrical	strong
F. loganense	spherical	high	large	short, symmetrical	strong
F. lyellense	subspherical	high	large	unequal, asymmetrical	strong
F. titulense	ovate	high	large	short, symmetrical	little or none

Range.—Upper Triassic (upper Norian).

Occurrence.—Queen Charlotte Islands.

Pantanellium tozeri Pessagno

Pantanellium tozeri Pessagno, 1979, p. 179, pl. 8, figs. 11–12, 15–16; pl. 9, figs. 1, 5, 9, 13.

Comparisons.—*Pantanellium tozeri* Pessagno differs from *P. fosteri* Pessagno and Blome, 1980, by having a smaller, less inflated cortical shell, and by possessing proportionately longer and more massive bipolar primary spines.

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

Occurrence.—San Hipolito Formation, Baja California.

Pantanellium species A
Plate 7, figure 6

Pantanellium sp. I, Pessagno and Blome, 1980, p. 248, pl. 3, figs. 6, 12, 19.

Range and occurrence.—OR-39. Upper Triassic (upper Karnian?; lower to upper middle Norian). Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon. Rare.

Pantanellium species B
Plate 7, figure 7

Pantanellium sp. J, Pessagno and Blome, 1980, p. 248, pl. 3, figs. 7, 15, 20.

Range and occurrence.—OR-39. Upper Triassic (upper Karnian?; lower to upper middle Norian). Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon. Rare.

LIOSPHAERACEA incertae sedis

The genera and species cited below cannot, at present, be placed within a meaningful supergeneric classification. They follow herein in alphabetical order.

Genus **FERRESIUM** new genus

Etymology.—*Ferresium* is a name formed by an arbitrary combination of letters (ICZN, 1964, p. 113, Appendix D, pt. IV, Recommendation 36).

Type species.—*Ferresium laseekense* n. sp.

Description.—Cortical shell ovate to spherical with three radially arranged primary spines of equal length that lie in the same plane; surface of cortical shell planiform to convex; sides vertical to convex. Meshwork of cortical shell consisting of three layers; inner two layers with coarse, polygonal pore frames, pores polygonal in outline; outer layer consisting of coarse, polygonal pore frames with nodes (usually massive) at the pore frame vertices, pores polygonal to subcircular in outline; nodes interconnected by thin, fragile bars, nodes of outer layer superimposed on vertices of polygonal pore frames beneath. Test lacking medullary shell, consisting of a central cavity containing a simple, eccentric, internal spicule; spicule connected to outer shell by primary radial beams. Primary spines symmetrically to asymmetrically arranged, bladed, solid, with alternating ridges and grooves; spines triradiate in axial section.

Comparisons.—*Ferresium* new genus differs from *Xenorum,* new genus, by having a multilayered test consisting of three layers of polygonal pore frames, and by having thin, fragile bars connecting nodes at the pore frame vertices (see Pl. 9, figs. 13–16). *Ferresium* belongs to a diverse group of, as yet, undescribed radiolarians that appear to be restricted to the Upper Triassic and Lower Jurassic.

Range.—Upper Triassic (upper Norian).

Occurrence.—Middle member of the Kunga Formation, Queen Charlotte Islands.

Ferresium contortum new species
Plate 7, figures 8, 12, 13, 20

Etymology.—*contortus* (Latin) = intricate.

Description.—Test as for genus. Cortical shell large, subspherical; top and bottom surfaces convex, sides slightly convex. Meshwork of cortical shell consisting of three layers of polygonal pore frames; outer layer exhibiting numerous, small triangular to tetragonal pore frames with small, closely spaced nodes, nodes relatively high in relief. Primary spines symmetrically arranged, of short length and moderate width; triradiate in axial section; longitudinally comprised of three wide grooves alternating with three narrow ridges; grooves three to four times as wide as ridges; ridges and grooves displaying strong torsion.

Comparisons.—*Ferresium contortum* n. sp. differs from *F. loganense* n. sp. by having a more inflated cortical shell, by having smaller polygonal pore frames with more closely spaced nodes at the pore frame vertices, and by having primary spines that appear narrower and less massive.

Measurements (in μm).—

	diameter of cortical shell	length of primary spines
Holotype (USNM 305899)	151	71
All (5) paratypes		
(USNM 305900; Blome coll.)		
largest value recorded	152	78
smallest value recorded	147	58
mean value recorded	150	66

Type locality.—QC-24 (see Appendix).

Types.—Holotype: USNM 305899; paratypes: USNM 305900 and Blome collection.

Range.—Upper Triassic (upper Norian).

Occurrence.—Middle member of the Kunga Formation, Queen Charlotte Islands.

Ferresium hecatense new species
Plate 7, figures 9, 16, 17, 21

Etymology.—This species is named for Hecate Strait, located on the eastern side of the Queen Charlotte Islands, British Columbia.

Description.—Test as for genus. Cortical shell spherical; top and bottom surfaces slightly convex or flattened, sides slightly convex. Meshwork of cortical shell consisting of three layers of polygonal pore frames; outer layer exhibiting polygonal pore frames possessing large, massive polygonal to subcircular nodes, nodes high in relief. Primary spines symmetrically arranged, triradiate in axial section; longitudinally comprised of three wide grooves alternating with three narrow ridges; grooves three to four times as wide as ridges; ridges and grooves displaying little or no torsion.

Comparisons.—*Ferresium hecatense* n. sp. differs from *F.* sp. A by having a spherical cortical shell that is less inflated on all surfaces, and by having primary spines that display considerably less torsion.

Measurements (in μm).—

	diameter of cortical shell	length of primary spines
Holotype (USNM 305901)	114	76
All (6) paratypes		
(USNM 305902; Blome coll.)		
largest value recorded	131	86
smallest value recorded	108	63
mean value recorded	116	76

Type locality.—QC-24 (see Appendix).

Types.—Holotype: USNM 305901; paratypes: USNM 305902 and Blome collection.

Range.—Upper Triassic (upper Norian).

Occurrence.—Middle member of the Kunga Formation, Queen Charlotte Islands.

Ferresium laseekense new species
Plate 7, figures 10, 11, 14, 15, 22; Plate 8, figures 1, 5, 8, 12, 14; Plate 17, figure 2

Etymology.—This species is named for Laseek Bay, located directly north of Kunga Island, east coast of Queen Charlotte Islands.

Description.—Test as for genus. Cortical shell circular to elliptical in outline; top and bottom surfaces slightly convex, sides convex. Meshwork of cortical shell consisting of three layers of polygonal pore frames; outer layer exhibiting large triangular to tetragonal pore frames with large, massive polygonal nodes, nodes high in relief. Primary spines symmetrically arranged, massive, one spine slightly longer than other two; triradiate in axial section; three wide longitudinal grooves alternate with three narrow ridges; grooves four to five times as wide as ridges; ridges and grooves displaying strong torsion.

Comparisons.—*Ferresium laseekense* n. sp. differs from *A. hecatense* n. sp. by having a cortical shell that is commonly elliptical in outline, and by having primary spines that display greater torsion.

Measurements (in μm).—

	diameter of cortical shell	length of primary spines
Holotype (USNM 305903)	124	90
All (6) paratypes		
(USNM 305904; Blome coll.)		
largest value recorded	126	92
smallest value recorded	118	76
mean value recorded	121	84

Type locality.—QC-24 (see Appendix).

Types.—Holotype: USNM 305903; paratypes: USNM 305904 and Blome collection.

Range.—Upper Triassic (upper Norian).

Occurrence.—Middle member of the Kunga Formation, Queen Charlotte Islands.

Ferresium loganense new species
Plate 8, figures 2, 7, 9, 15

Etymology.—This species is named for Logan Inlet, located directly northwest of Kunga Island, Queen Charlotte Islands.

Description.—Test as for genus. Cortical shell inflated, spherical; top and bottom surfaces convex, sides slightly convex. Meshwork of cortical shell consisting of three layers of polygonal pore frames; outer layer exhibiting small, triangular to tetragonal pore frames with large, polygonal to subcircular nodes, nodes high in relief. Primary spines symmetrically arranged, massive, short; triradiate in axial section; longitudinally comprised of three wide grooves alternating with three narrow ridges; grooves four to five times as wide as ridges; ridges and grooves displaying strong torsion.

Comparisons.—*Ferresium loganense* n. sp. differs from *F. contortum* n. sp. by having a less inflated cortical shell, by having larger polygonal pore frames with large, less closely spaced nodes at the pore frame vertices, and by having primary spines that appear wider and more massive.

Measurements (in μm).—

	diameter of cortical shell	length of primary spines
Holotype (USNM 305905)	112	60
All (5) paratypes		
(USNM 305906; Blome coll.)		
largest value recorded	124	69
smallest value recorded	108	47
mean value recorded	114	61

Type locality.—QC-24 (see Appendix).

Types.—Holotype: USNM 305905; paratypes: USNM 305906 and Blome collection.

Range.—Upper Triassic (upper Norian).

Occurrence.—Middle member of the Kunga Formation, Queen Charlotte Islands.

Ferresium lyellense new species
Plate 8, figures 3, 10, 11, 16, 17

Etymology.—This species is named for Lyell Island, located directly south of Kunga Island, east coast of Queen Charlotte Islands, British Columbia.

Description.—Test as for genus. Cortical shell subspherical; top and bottom surfaces slightly convex, sides convex. Meshwork of cortical shell consisting of three layers of polygonal pore frames; outer layer exhibiting pore frames with large, massive polygonal nodes, nodes relatively high in relief. Primary spines asymmetrically arranged, long, subequal in length, one spine longer than other two; triradiate in axial section; longitudinally comprised of three wide grooves alternating with three narrow ridges; grooves three to four times as wide as ridges; ridges and grooves displaying strong torsion.

Comparisons.—*Ferresium lyellense* n. sp. differs from all other species of *Ferresium* by having primary spines that are asymmetrically arranged.

Measurements (in μm).—

	diameter of cortical shell	length of primary spines
Holotype (USNM 305907)	108	91
All (6) paratypes		
(USNM 305908; Blome coll.)		
largest value recorded	117	107
smallest value recorded	106	71
mean value recorded	111	82

Type locality.—QC-24 (see Appendix).

Types.—Holotype: USNM 305907; paratypes: USNM 305908 and Blome collection.

Range.—Upper Triassic (upper Norian).

Occurrence.—Middle member of the Kunga Formation, Queen Charlotte Islands.

Ferresium titulense new species
Plate 8, figures 4, 6, 13, 18

Etymology.—This species is named for Titul Island, located north of Kunga Island, Queen Charlotte Islands.

Description.—Test as for genus. Cortical shell ovate; top and bottom surfaces slightly convex, sides slightly convex. Meshwork of cortical shell consisting of three layers of polygonal pore frames; outer layer exhibiting triangular pore frames with large, massive polygonal to circular (predominantly subcircular) nodes, nodes high in relief. Primary spines symmetrically arranged, short and narrow, equal in length; triradiate in axial section; longitudinally comprised of three wide grooves alternating with three narrow ridges; grooves four times as wide as ridges; ridges and grooves displaying little or no torsion.

Comparisons.—*Ferresium titulense* n. sp. differs from all other species of *Ferresium* by having an ovate cortical shell. *F. titulense* n. sp. also differs from *F. laseekense* n. sp. by having primary spines that are less massive and that display less torsion.

Measurements (in μm).—

	diameter of cortical shell	length of primary spines
Holotype (USNM 305909)	100	48
All (6) paratypes		
(USNM 305910; Blome coll.)		
largest value recorded	101	52
smallest value recorded	91	41
mean value recorded	96	46

Type locality.—QC-24 (see Appendix).

Types.—Holotype: USNM 305909; paratypes: USNM 305910 and Blome collection.

Range.—Upper Triassic (upper Norian).

Occurrence.—Middle member of the Kunga Formation, Queen Charlotte Islands.

Ferresium species A
Plate 9, figures 1, 5, 6, 10

Comparisons.—*Ferresium* sp. A differs from *F. hecatense* n. sp. by having a more inflated cortical shell with all surfaces more convex, and by having primary spines that display considerably greater torsion. Rare.

Range and occurrence.—QC-24. Upper Triassic (upper Norian). Middle member—Kunga Formation, Queen Charlotte Islands.

Ferresium species B
Plate 9, figures 2, 4, 8, 12; Plate 17, figure 3

Comparisons.—*Ferresium* sp. B differs from *F. hecatense* n. sp. and *F. laseekense* n. sp. by having a subspherical cortical shell, and by having narrower, less massive primary spines.

Range and occurrence.—QC-24. Upper Triassic (upper Norian). Middle member—Kunga Formation, Queen Charlotte Islands.

Ferresium species C
Plate 9, figures 3, 7, 9, 11

Comparisons.—*Ferresium* sp. C differs from *Ferresium contortum* n. sp. by having the top and bottom surfaces, as well as the sides of the cortical shell, flattened.

Range and occurrence.—QC-24. Upper Triassic (upper Norian). Middle member—Kunga Formation, Queen Charlotte Islands.

Genus **XENORUM** new genus

Etymology.—*Xenorum* is a name formed by an arbitrary combination of letters (ICZN, 1964, p. 113, Appendix D, pt. IV, Recommendation 40).

Type species.—*Xenorum largum,* n. sp.

Description.—Cortical shell circular to subcircular in outline, with three radially arranged primary spines of equal length situated in the same plane; surface of cortical shell planiform to convex; sides vertical to convex. Meshwork of cortical shell consisting of two layers of pore frames; outer layer of meshwork consisting of coarse, polygonal pore frames with massive nodes at pore frame vertices, pores polygonal to subcircular (predominantly subcircular); inner layer with coarse, polygonal pore frames, pores polygonal to subcircular; nodes interconnected by narrow to moderately wide bars; nodes of outer layer superimposed on vertices of polygonal pore frames beneath. Test lacking medullary shell; interior of test containing a simple, eccentric, internal spicule (Pl. 11, fig. 2; Pl. 17, fig. 19); spicule connected to outer shell by primary radial beams. Primary spines symmetrically arranged, bladed, solid, with alternating ridges and grooves; spines triradiate in axial section.

Comparisons.—*Xenorum* new genus differs from *Ferresium* new genus by having a cortical shell possessing two (*versus* three) layers of polygonal pore frames, by having more massive nodes at the pore frame vertices, and by having wider, more massive bars connecting nodes. *Xenorum* n. genus also differs from *Eptingium* Dumitrica, 1977a, by possessing massive nodes at the pore frame vertices and by having symmetrically arranged primary spines.

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

Occurrence.—Eastern Oregon, California, British Columbia, and Alaska.

Xenorum flexum new species
Plate 10, figures 1, 2, 6, 7, 12, 13, 16, 17;
Plate 17, figure 4

Etymology.—*flexus* (Latin) = bending, turning.

Description.—Test as for genus. Cortical shell subspherical to spherical; top and bottom surfaces convex, sides slightly convex. Meshwork of cortical shell consisting of two layers of polygonal (triangular to pentagonal) pore frames, pores polygonal to subcircular in outline; outer layer exhibiting large, variably sized pore frames with large, massive polygonal to subcircular nodes, nodes high in relief. Primary spines symmetrically arranged, long, triradiate in axial section; longitudinally comprised of three wide grooves alternating with three narrow ridges; grooves approximately three times as wide as ridges; ridges and grooves displaying extreme torsion.

Comparisons.—*Xenorum flexum* n. sp. differs from *X. largum* n. sp. by having primary spines that are long, that exhibit wider grooves, and that display extreme torsion.

Measurements (in μm).—

	diameter of cortical shell	length of primary spines
Holotype (USNM 305911)	152	189
All (9) paratypes (USNM 305912; Blome coll.)		
largest value recorded	172	243
smallest value recorded	149	174
mean value recorded	158	205

Type localities.—Holotype from OR-39. Paratypes from OR-39 and OR-52 (see Appendix).

Types.—Holotype: USNM 305911; paratypes: USNM 305912 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Xenorum largum new species
Plate 10, figures 3, 4, 8, 9, 10, 14, 18, 19;
Plate 17, figures 5, 19

Etymology.—*largus* (Latin) = abundant, plentiful, numerous.

Description.—Test as for genus. Cortical shell subspherical to spherical; top and bottom surfaces moderately planiform, sides straight to slightly convex. Meshwork of cortical shell consisting of two layers of polygonal (triangular to pentagonal) pore frames, pores polygonal to subcircular (predominantly subcircular) in outline; outer layer exhibiting large polygonal pore frames with large, massive polygonal to subcircular nodes, nodes high in relief. Primary spines symmetrically arranged, of medium length; triradiate in axial section; longitudinally comprised of three wide grooves alternating with three narrow ridges; grooves twice as wide as ridges; ridges and grooves displaying strong torsion.

Comparisons.—*Xenorum largum* n. sp. differs from *X. flexum* n. sp. by having primary spines of medium length that display strong torsion.

Measurements (in μm).—

	diameter of cortical shell	length of primary spines
Holotype (USNM 305913)	150	128
All (7) paratypes (USNM 305914; Blome coll.)		
largest value recorded	158	152
smallest value recorded	139	111
mean value recorded	148	131

Type localities.—Holotype from OR-39. Paratypes from OR-39 and OR-6 (see Appendix).

Types.—Holotype: USNM 305913; paratypes: USNM 305914 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Xenorum species A
Plate 10, figures 5, 11, 15, 20

Comparisons.—*Xenorum* sp. A differs from *X. flexum* n. sp. and *X. largum* n. sp. by having short primary spines that lack torsion.

Range and occurrence.—OR-39. Upper Triassic (upper Karnian?; lower to upper middle Norian). Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon. Rare.

Suborder **NASSELLARIINA** Ehrenberg, 1875

Superfamily **CYRTOIDEA** Haeckel, 1862

Subsuperfamily **EUCYRTIDILAE** Ehrenberg, 1847

Range and occurrence.—Triassic to Recent. Worldwide.

Family **CANOPTIDAE** Pessagno, 1979

Type genus.—*Canoptum* Pessagno, 1979.

Comparisons.—The Canoptidae include Nassellariina with meshwork consisting of two distinct layers; an outer layer, comprised of microgranular material, that lacks pore frames and an inner layer of polygonal pore frames.

Range.—Upper Triassic (upper Karnian?; Norian) to Middle Jurassic (lower Bajocian).

Occurrence.—Worldwide.

Genus **CANOPTUM** Pessagno, 1979

Type species.—*Canoptum poissoni* Pessagno, 1979.

Range.—Upper Triassic (Karnian) to Middle Jurassic (lower Bajocian).

Occurrence.—Worldwide.

Canoptum (?) **browni** new species
Plate 11, figures 5, 6, 11, 12, 16, 17, 20;
Plate 17, figure 6

Etymology.—This species is named for C. Ervin Brown, in honor of his many contributions to the geology of eastern Oregon.

Description.—Test conical; cephalis cone-shaped with a small, cephalic spine, spine not connecting cephalic skeletal elements. Thorax, abdomen, and post-abdominal chambers subtrapezoidal in outline. Five or six post-abdominal chambers, increasing in height and more rapidly in width as added; width of any chamber approximately twice the height. Circumferential ridges of outer layer with small, circular to elliptical pores on the final post-abdominal chamber, aligned in rows flanking either side of the circumferential ridge.

Comparisons.—*Canoptum* (?) *browni* n. sp. differs from other species of *Canoptum* described in this report by having a small cephalic spine. *C.* (?) *browni* n. sp. differs from *C. farawayense* n. sp. and *C. macoyense* n. sp. by having a smaller number of post-abdominal chambers, and by having less massive circumferential ridges. *C.* (?) *browni* n. sp. differs from species belonging to the genus *Relanus* Pessagno and Whalen, 1982, by lacking a true horn (cephalic spine connecting the cephalic skeletal elements), and by having a more extensive veneer of microgranular silica.

Table 8.—Diagnostic features of species of *Canoptum* Pessagno, 1979.

Taxa	test	horn	post-abdominal chambers	circumferential ridges
C. (?) *browni*	conical	small	5–6	subdued
C. farawayense	conical	absent	7–8	subdued
C. laxum	conical	absent	4	extremely inflated
C. macoyense	conical	absent	6–7	inflated

Measurements (in μm).—

	length of test	maximum width of test
Holotype (USNM 305921)	176	87
All paratypes		
USNM 305922; Blome coll.)		
largest value recorded	186	88
smallest value recorded	166	81
mean value recorded	174	85

Type localities.—Holotype from OR-39. Paratypes from OR-148 and OR-152 (see Appendix).

Types.—Holotype: USNM 305921; paratypes: USNM 305922 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Canoptum farawayense new species
Plate 11, figures 7, 8, 13, 19

Etymology.—This species is named for Camp Faraway, located in the southwestern portion of the Malheur National Forest, eastern Oregon.

Description.—Test conical, with a broad, dome-shaped cephalis lacking a horn. Thorax trapezoidal in outline; abdomen and post-abdominal chambers subtrapezoidal in outline. Seven to eight post-abdominal chambers, increasing gradually in height and more rapidly in width as added; width of any chamber approximately three times the height. Circumferential ridges of outer layer with small, circular to elliptical pores aligned in a single row flanking the bottom side of the circumferential ridges; observed on the final two or three post-abdominal chambers.

Comparisons.—*Canoptum farawayense* n. sp. differs from other species of *Canoptum* described in this report by having a greater number (seven to eight) of post-abdominal chambers. *C. farawayense* n. sp. differs from *C. macoyense* n. sp. in having less massive circumferential ridges. *C. farawayense* n. sp. differs from *C. poissoni* Pessagno, 1979, by having more massive circumferential ridges.

Measurements (in μm).—

	length of test	maximum width of test
Holotype (USNM 305923)	264	96
All (5) paratypes		
(USNM 305924; Blome coll.)		
largest value recorded	291	99
smallest value recorded	212	80
mean value recorded	259	93

Type localities.—Holotype from OR-39. Paratype from OR-152 (see Appendix).

Types.—Holotype: USNM 305923; paratypes: USNM 305924 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Canoptum laxum new species
Plate 11, figures 9, 14

Etymology.—*laxus* (Latin) = wide, loose, spacious.

Description.—Test conical; cephalis dome-shaped, lacking horn. Thorax, abdomen, and post-abdominal chambers subcylindrical. Four post-abdominal chambers, distally increasing slightly in height and more rapidly in width; width of any chamber approximately three times the height. Circumferential ridges greatly inflated.

Comparisons.—*Canoptum laxum* n. sp. differs from other species of *Canoptum* described in this report by having a smaller number of post-abdominal chambers (four), and by having chambers with extremely inflated circumferential ridges. Pores on final post-abdominal chambers not observed on type material, buried by an outer layer of microgranular silica.

Measurements (in μm).—

	length of test	maximum width of test
Holotype (USNM 305925)	187	85
All (5) paratypes		
(USNM 305926; Blome coll.)		
largest value recorded	192	88
smallest value recorded	169	75
mean value recorded	184	84

Type localities.—Holotype from OR-6. Paratypes from OR-6 and OR-143 (see Appendix).

Types.—Holotype: USNM 305925; paratypes: USNM 305926 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Canoptum macoyense new species
Plate 11, figures 10, 15, 18; Plate 17, figure 7

Etymology.—This species is named for McCoy Creek, located near the town of Izee, east-central Oregon.

Description.—Test conical with a large, broad, dome-shaped cephalis that lacks a horn. Thorax and abdomen trapezoidal in outline. Post-abdominal chambers subtrapezoidal in outline. Six to seven post-abdominal chambers, distally increasing gradually in height and very rapidly in width; width of any chamber three to four times the height. Circumferential ridges massive; outer layer with small circular to elliptical pores aligned in a single row that flanks the bottom side of the circumferential ridges; observed on the final post-abdominal chambers.

Comparisons.—*Canoptum macoyense* n. sp. differs from *C.* (?) *browni* n. sp. and *C. farawayense* n. sp. by having a more massive cephalis, and by having more massive circumferential ridges.

Measurements (in μm).—

	length of test	maximum width of test
Holotype (USNM 305927)	220	101
All (8) paratypes (USNM 305928; Blome coll.)		
largest value recorded	248	106
smallest value recorded	194	90
mean value recorded	219	98

Type localities.—Holotype from OR-39. Paratypes from OR-148 (see Appendix).

Types.—Holotype: USNM 305927; paratypes: USNM 305928 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Canoptum species A
Plate 12, figures 1, 7, 12, 16

Comparisons.—*Canoptum* sp. A differs from other species of *Canoptum* described in this report by having fewer post-abdominal chambers, less massive circumferential ridges, and fairly well-developed pores situated at the base of most of the post-abdominal chambers.

Range and occurrence.—OR-39. Upper Triassic (upper Karnian?; lower to upper middle Norian). Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon. Rare.

Canoptum species B
Plate 12, figure 2

Comparisons.—*Canoptum* sp. B differs from *C. laxum* n. sp. by having a greater number of post-abdominal chambers (five *versus* four), by having less inflated circumferential ridges, and by having post-abdominal chambers that increase more rapidly in width as added, the width of any chamber being approximately four times the height.

Range and occurrence.—OR-39. Upper Triassic (upper Karnian?; lower to upper middle Norian). Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon. Rare.

Genus **PACHUS** new genus

Etymology.—*Pachus* is a name formed by an arbitrary combination of letters (ICZN, 1964, p. 113, Appendix D, pt. IV, Recommendation 40).

Type species.—*Pachus firmus,* n. sp.

Description.—Test as for family. Test grossly conical, inflated, with a dome-shaped, imperforate cephalis, with horn. Thorax and abdomen trapezoidal in outline. Post-abdominal chamber trapezoidal to rectangular in outline; earlier post-abdominal chambers generally trapezoidal, final post-abdominal chambers rectangular in outline. All chambers separated by broad, highly nodose circumferential ridges; ridges with one to two rows of variably sized nodes, nodes generally high in relief. Area between two given circumferential ridges perforate to imperforate, pores aligned in single rows flanking ridges; pores circular to elliptical in outline, not set in pore frames; pores may be buried by an outer layer of accreted microgranular silica. Chambers constricted between joints.

Comparisons.—*Pachus* new genus differs from *Canoptum* Pessagno, 1979, by possessing a horn. It differs from both *Canoptum* and *Relanus* Pessagno and Whalen, 1982, by having a test with broad, highly nodose circumferential ridges. *Pachus* new genus is questionably placed within the Family Canoptidae Pessagno, 1979, because it lacks an observable inner layer of polygonal pore frames.

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

Occurrence.—Eastern Oregon, Alaska, British Columbia.

Table 9.—Diagnostic features of species of *Pachus*, new genus.

Taxa	horn	post-abdominal chambers	circumferential ridges	rows of nodes
P. firmus	small	4–5	moderate	1–2
P. indistinctus	absent	7–8	low	1
P. longinquus	large	5–6	moderate	1–2
P. luculentus	absent	4–5	high	1–2

Pachus firmus new species
Plate 12, figures 3, 4, 8, 9, 15, 17;
Plate 17, figure 8

Etymology.—*firmus* (Latin) = firm, strong, stout.

Description.—Test as for genus. Cephalis with small, rudimentary horn. Four to five post-abdominal chambers, increasing moderately in height and more rapidly in width as added; width of any chamber approximately twice the height. Circumferential ridges of outer layer inflated; one row of large, subspherical nodes on thorax, abdomen, and early post-abdominal chambers; two rows of nodes on final two post-abdominal chambers; nodes high in relief. Area between two given ridges perforate, pores circular to subcircular in outline. Chambers constricted between joints.

Comparisons.—*Pachus firmus* n. sp. differs from *P. luculentus* n. sp. by having post-abdominal chambers that increase more slowly in height, and are separated by narrower, less inflated circumferential ridges. *P. firmus* n. sp. differs from *P. longinquus* n. sp. by having circumferential ridges with one to two rows of larger, more massive nodes.

Measurements (in μm).—

	length of test	maximum width of test
Holotype (USNM 305929)	188	100
All (8) paratypes (USNM 305930; Blome coll.)		
largest value recorded	210	104
smallest value recorded	181	90
mean value recorded	191	98

Type localities.—Holotype from OR-39. Paratypes from OR-39 and OR-152 (see Appendix).

Types.—Holotype: USNM 305929; paratypes: USNM 305930 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Pachus (?) **indistinctus** new species
Plate 12, figures 5, 10, 18, 19

Etymology.—*indistinctus* (Latin) = indistinct, obscure.

Description.—Test as for genus. Cephalis lacking a discernible horn. Seven to eight post-abdominal chambers, increasing gradually in both height and width; width of any chamber approximately four times the height. Circumferential ridges of outer layer with one row of irregular nodes. Area between two given ridges sparsely perforate, pores subcircular in outline. Inner layer of polygonal pore frames well exposed on final post-abdominal chambers. Chambers slightly constricted between joints.

Comparisons.—*Pachus* (?) *indistinctus* n. sp. differs from other species of *Pachus* by lacking a discernible horn, by having a greater number of post-abdominal chambers (seven to eight), by having short chambers, the width of any chamber approximately four times the height, and by possessing an observable layer of polygonal pore frames on the final post-abdominal chambers. *P.* (?) *indistinctus* n. sp. is questionably assigned to the genus *Pachus*. *P.* (?) *indistinctus* n. sp. differs from *Canoptum anulatum* Pessagno and Poisson, 1979 and *C. rugosum* Pessagno and Poisson, 1979, as well as other species of *Canoptum* Pessagno, 1979, by possessing highly nodose and less defined circumferential ridges that lack the linked-**H** ridge structure.

Measurements (in μm).—

	length of test	maximum width of test
Holotype (USNM 305931)	226	105
All (6) paratypes (USNM 305932; Blome coll.)		
largest value recorded	234	114
smallest value recorded	192	93
mean value recorded	219	103

Type localities.—Holotype from OR-39. Paratypes from OR-39 and OR-52 (see Appendix).

Types.—Holotype: USNM 305931; paratypes: USNM 305932 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Pachus longinquus new species
Plate 12, figures 6, 11, 13, 14; Plate 17, figure 9

Etymology.—*longinquus* (Latin) = long.

Description.—Test as for genus. Cephalis with well-developed horn. Five to six post-abdominal chambers, increasing gradually in width and more rapidly in height as added, the exception being the great increase in width between the second and third post-abdominal chambers; width of any chamber approximately twice the height. Circumferential ridges of outer layer with one row of large, subspherical nodes on thorax, abdomen, and early post-abdominal chambers; two rows of nodes on final post-abdominal chambers; nodes high in relief. Area between any two given ridges perforate, pores circular to subcircular in outline. Chambers slightly constricted between joints.

Comparisons.—*Pachus longinquus* n. sp. differs from *P. luculentus* n. sp. by possessing a well-developed cephalic horn, and by having narrower, less inflated circumferential ridges separating chambers. *P. longinquus* n. sp. differs from *P. firmus* n. sp. by having circumferential ridges with one to two rows of smaller, less massive nodes.

Measurements (in μm).—

	length of test	maximum width of test
Holotype (USNM 305933)	269	120
All (6) paratypes		
(USNM 305934; Blome coll.)		
largest value recorded	292	121
smallest value recorded	259	109
mean value recorded	275	116

Type localities.—Holotype from OR-39. Paratypes from OR-39 and OR-55 (see Appendix).

Types.—Holotype: USNM 305933; paratypes: USNM 305934 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Pachus luculentus new species

Plate 13, figures 1, 6, 12; Plate 17, figure 10

Etymology.—*luculentus* (Latin) = brilliant, distinguished, splendid.

Description.—Test as for genus. Cephalis lacking horn. Four to five post-abdominal chambers, increasing in height and width as added, the exception being the final post-abdominal chamber which may decrease in width; width of any chamber approximately two to three times the height. Circumferential ridges of outer layer with one row of broad, inflated, subspherical nodes on thorax; two rows of nodes on abdomen and post-abdominal chambers; nodes high in relief. Area between any two given ridges sparsely perforate, pores circular to elliptical in outline. Chambers constricted between joints.

Comparisons.—*Pachus luculentus* n. sp. differs from *P. firmus* n. sp. and *P. longinquus* n. sp. by lacking a cephalic horn, by having wider, more inflated circumferential ridges separating chambers, and by having a final post-abdominal chamber that may decrease in width.

Measurements (in μm).—

	length of test	maximum width of test
Holotype (USNM 305935)	219	100
All (6) paratypes		
(USNM 305936; Blome coll.)		
largest value recorded	231	101
smallest value recorded	215	97
mean value recorded	223	99

Type localities.—Holotype from OR-39. Paratypes from OR-39 and OR-152 (see Appendix).

Types.—Holotype: USNM 305935; paratypes: USNM 305936 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Family PSEUDODICTYOMITRIDAE

Pessagno, 1977b

Type genus.—*Pseudodictyomitra* Pessagno, 1977b.

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

Occurrence.—Worldwide.

Genus CORUM new genus

Etymology.—*Corum* is a name formed by an arbitrary combination of letters (ICZN, 1964, p. 113, Appendix D, pt. IV, Recommendation 40).

Type species.—*Corum speciosum* n. sp.

Description.—Test multicyrtid, conical. Cephalis dome-shaped, lacking horn; thorax subtrapezoidal in outline; cephalis and thorax imperforate, smooth or with weakly developed, discontinuous costae. Abdomen and post-abdominal chambers subtrapezoidal in outline, slightly inflated and strongly costate, costae mostly discontinuous. One row of primary pores adjacent to distal end of costae; pores large, circular to elliptical in outline; final post-abdominal chamber slightly perforate to imperforate. Chambers expanding in width and less rapidly in height as added.

Comparisons.—*Corum* new genus differs from *Pseudodictyomitra* Pessagno, 1977b, by having only one row of primary pores situated between chambers, and by lacking rows of large relict pores that occur between costae. *Corum* new genus differs from *Dictyomitra* Zittel, 1876 *s.s.*, by having discontinuous costae.

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

Occurrence.—Eastern Oregon, Alaska, and British Columbia.

Corum perfectum new species
Plate 13, figures 2, 7, 16; Plate 17, figure 11

Etymology.—*perfectus* (Latin) = perfect, complete, finished.

Description.—Test as for genus, consisting of six to seven post-abdominal chambers. Thorax subtrapezoidal in outline, smooth. Abdomen and post-abdominal chambers strongly costate; costae well-developed, discontinuous, moderately inflated, with about 28 to 30 costae (14 to 15 visible laterally). Pores at the distal end of costae small in size, circular to elliptical in outline. Final post-abdominal chamber imperforate, lacking well-developed costae on well-preserved specimens. Chambers increasing gradually in height and more rapidly in width as added, the exception being the final post-abdominal chamber, which decreases in width; width of any chamber approximately three times the height.

Comparisons.—*Corum perfectum* n. sp. differs from *C. regium* n. sp. by having a greater number of post-abdominal chambers (seven *versus* six), by possessing a greater number of costae (28 *versus* 24), and by possessing broader costae. *C. perfectum* n. sp. has been compared to *C. speciosum* n. sp. under the latter species.

Measurements (in μm).—

	length of test	maximum width of test
Holotype (USNM 305915)	229	103
All (6) paratypes		
(USNM 305916; Blome coll.)		
largest value recorded	234	110
smallest value recorded	224	101
mean value recorded	229	105

Type locality.—OR-148 (see Appendix).

Types.—Holotype: USNM 305915; paratypes: USNM 305916 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Corum regium new species
Plate 13, figures 3, 8, 15

Etymology.—*regius* (Latin) = royal, splendid, magnificent, regal.

Description.—Test as for genus, consisting of five to six post-abdominal chambers. Thorax trapezoidal in outline, smooth or with weakly developed costae. Abdomen and post-abdominal chambers strongly costate; costae coarse, discontinuous, with about 24 costae (12 visible laterally). Pores at the distal end of costae large, circular to subcircular in outline. Final post-abdominal chamber imperforate, lacking costae on well-preserved specimens. Chambers increasing gradually in height and more rapidly in width as added; the exception being the final post-abdominal chamber, which decreases in width; width of any chamber approximately three times the height.

Comparisons.—*Corum regium* n. sp. has been compared to *C. perfectum* n. sp. and *C. speciosum* n. sp. under the latter species.

Measurements (in μm).—

	length of test	maximum width of test
Holotype (USNM 305917)	196	94
All (6) paratypes		
(USNM 305918; Blome coll.)		
largest value recorded	221	100
smallest value recorded	190	92
mean value recorded	209	95

Type localities.—Holotype from OR-39. Paratypes from OR-39 and OR-52 (see Appendix).

Types.—Holotype: USNM 305917; paratypes: USNM 305918 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Corum speciosum new species
Plate 13, figures 4, 13, 14, 17

Etymology.—*speciosus* (Latin) = beautiful, splendid.

Description.—Test as for genus, consisting of seven to eight post-abdominal chambers. Thorax subtrapezoidal in outline, smooth or with weakly developed costae. Abdomen and post-abdominal chambers strongly costate; costae well-developed, wide, extremely inflated, some costae irregular in outline, with about 18 to 20 costae (nine to 10 visible laterally); costae on last four to five post-abdominal chambers merge together at the distal ends to form U-shaped costal elements. Pores at distal end of costae moderate in size, subcircular to elliptical in outline. Final post-abdominal chamber with small, irregular relict pores occurring between costae. Chambers increasing gradually in height and more rapidly in width as added; width of any chamber approximately three times the height.

Comparisons.—*Corum speciosum* n. sp. differs from *C. perfectum* n. sp. and *C. regium* n. sp. by having a greater number of post-abdominal chambers (eight), by possessing a smaller number of costae (18 to 20), by possessing extremely inflated, wide costae that merge, on the final post-abdominal chambers, to form U-shaped costal elements, and by lacking a final post-abdominal chamber that decreases in width.

Measurements (in μm).—

	length of test	maximum width of test
Holotype (USNM 305919)	238	114
All (8) paratypes		
(USNM 305920; Blome coll.)		
largest value recorded	263	120
smallest value recorded	208	96
mean value recorded	235	108

Type locality.—OR-143 (see Appendix).

Types.—Holotype: USNM 305919; paratypes: USNM 305920 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Family **PSEUDOSATURNIFORMIDAE** Kozur and Mostler, 1979

Type genus.—*Pseudosaturniforma* Kozur and Mostler, 1979.

Range.—Upper Triassic (Karnian to Norian).

Occurrence.—Europe, western North America.

Genus **PSEUDOSATURNIFORMA** Kozur and Mostler, 1979

Type species.—*Pseudosaturniforma latimarginata* Kozur and Mostler, 1979.

Comparisons.—*Pseudosaturniforma* differs from other ring-shaped Nassellariina by being monocyrtid, and by having the cephalis and cephalic ring situated in more than one plane.

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

Occurrence.—Austria, Oregon, and Baja California.

Pseudosaturniforma carnica Kozur and Mostler, 1979
Plate 13, figures 5, 9, 11, 18

Pseudosaturniforma carnica Kozur and Mostler, 1979, p. 92, pl. 17, fig. 3.

Comparisons.—*Pseudosaturniforma carnica* differs from *P. minuta* n. sp. by having a small cephalis with the distal portion greatly constricted, and by having a large, wide cephalic ring.

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

Occurrence.—Austria, east-central Oregon.

Pseudosaturniforma minuta new species
Plate 13, figure 10; Plate 14, figures 1, 15, 17; Plate 17, figure 12

Etymology.—*minutus* (Latin) = small, little, minute.

Description.—Test as for genus. Cephalis large, circular in outline; proximal portion of cephalis convex, distal portion slightly constricted; extreme distal end of cephalis funnel-shaped, flaring in direction of cephalic ring. Rodlike structures, elliptical in axial section, connecting the cephalis with cephalic ring. Cephalic ring small, circular in outline; diameter of cephalic ring one-and-a-half times the diameter of cephalis.

Comparisons.—*Pseudosaturniforma minuta* n. sp. differs from *P. carnica* Kozur and Mostler, 1979, by having a larger cephalis, by having the distal portion of the cephalis less constricted, and by having a proportionately smaller cephalic ring.

Measurements (in μm).—

	length of test	width of cephalis	width of cephalic skirt
Holotype (USNM 305937)	118	73	158
All (7) paratypes			
(USNM 305938; Blome coll.)			
largest value recorded	121	82	162
smallest value recorded	108	71	139
mean value recorded	115	76	149

Type locality.—OR-139 (see Appendix).

Types.—Holotype: USNM 305937; paratypes: USNM 305938 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Family **SYRINGOCAPSIDAE** Foreman, 1973

Type genus.—*Syringocapsa* Neviani, 1900.

Comparisons.—This group was originally defined by Foreman (1973, p. 265) as the subfamily Syringocapsinae, which belonged to the family Amphipyndacidae (type genus = *Amphipyndax* Foreman, 1973). Pessagno (1977a) later suggested that the subfamily be raised to family status because the genera, included by Foreman in Syringocapsinae, showed little relationship to the Amphipyndacidae.

Range and occurrence.—Triassic to Cretaceous. Worldwide.

Genus **SYRINGOCAPSA** Neviani, 1900

Type species.—*Theosyringium robustum* Vinassa de Regny, 1900.

Comparisons.—*Syringocapsa* differs from *Podobursa* Wisniowski, 1889, *Podocapsa* Rust, 1885, and *Dibolachras* Foreman, 1973, by lacking radially arranged spines situated on the abdomen or first post-abdominal chamber.

Range.—Upper Triassic (Karnian?; Norian) to Cretaceous.

Occurrence.—Worldwide.

Syringocapsa turgida new species
Plate 14, figures 2, 6, 7, 16

Etymology.—*turgidus* (Latin) = swollen.

Description.—Test as for genus; cephalis dome-shaped. Thorax and abdomen subcylindrical, imperforate, with massive nodes. Proximal portion of post-abdominal chamber highly inflated, increasing rapidly in height and width as added; distal portion of post-abdominal chamber cylindrical, tapering distally. Meshwork of post-abdominal chambers consisting of large, variably sized, pentagonal pore frames having relatively well-developed nodes at pore frame vertices.

Comparisons.—*Syringocapsa turgida* n. sp. differs from *S. agolarium* Foreman, 1973, and *S. limatum* Foreman, 1973, by lacking an apical horn and by possessing four (*versus* three) segments. *S. turgida* n. sp. differs from *S. limatum* by having a post-abdominal chamber that lacks nodes. *S. turgida* n. sp. extends the range of *Syringocapsa* Neviani, 1900, to include the Upper Triassic.

Measurements (in μm).—

	length of test	maximum width of test
Holotype (USNM 305939)	313	131
All (7) paratypes		
(USNM 305940; Blome coll.)		
largest value recorded	389	151
smallest value recorded	306	129
mean value recorded	350	139

Type localities.—OR-143 (see Appendix).

Types.—Holotype: USNM 305939; paratypes: 305940 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

CYRTOIDEA incertae sedis

The genera and species cited below cannot, at present, be placed within a meaningful supergeneric classification. They follow herein in alphabetical order.

Genus **CANESIUM** new genus

Etymology.—*Canesium* is a name formed by an arbitrary combination of letters (ICZN, 1964, p. 113, Appendix D, pt. IV, Recommendation 40).

Type species.—*Canesium lentum,* n. sp.

Description.—Test multicyrtoid, subconical in outline. Cephalis dome-shaped, perforate, lacking a horn. Thorax and abdomen perforate, subcylindrical to cylindrical. Cephalis, thorax, and abdomen covered by an outer layer of microgranular silica. Post-abdominal chamber(s) large, inflated, cylindrical; meshwork consisting of a single layer of large, variably-sized polygonal pore frames having well-developed, massive nodes at the pore frame vertices; pores circular to elliptical in outline. Chambers separated from each other by one row of pores situated at strictures, pores circular to subcircular in outline; chambers constricted. Chambers expanding rapidly in both height and width.

Comparisons.—*Canesium* new genus differs from *Syringocapsa* Neviani, 1900, by lacking a tapering final post-abdominal chamber, and by having chambers that increase rapidly in both height and width. *Canesium* new genus differs from *Sethocapsa* Haeckel, 1881, by having the first three segments covered by an outer layer of microgranular silica, and by possessing a less globose, open terminal segment.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Canesium lentum new species
Plate 14, figures 3, 8, 11; Plate 17, figure 13

Eucyrtidium (?) sp. A Nakaseko and Nishimura, 1979, p. 78, pl. 9, figs. 5, 9.

Etymology.—*lentus* (Latin) = tough, resistant, barely yielding to force.

Description.—Test as for genus. Cephalis dome-shaped. Thorax and abdomen imperforate, subcylindrical. Test with one post-abdominal chamber; meshwork consisting of large, polygonal pore frames having relatively well-developed nodes at pore frame vertices; nodes moderate in relief. Chambers increasing rapidly in both height and width as added; width of any chamber only slightly larger than height. All chambers constricted.

Comparisons.—*Canesium lentum* n. sp. differs from *Syringocapsa turgida* n. sp. by possessing a highly inflated, final post-abdominal chamber.

Measurements (in μm).—

	length of test	maximum width of test
Holotype (USNM 305941)	175	118
All (7) paratypes (USNM 305942; Blome coll.)		
largest value recorded	197	131
smallest value recorded	164	110
mean value recorded	179	120

Type localities.—Holotype from OR-143. Paratypes from OR-143 and OR-39 (see Appendix).

Types.—Holotype: USNM 305941; paratypes: USNM 305942 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Genus **CASTRUM** new genus

Etymology.—*castrum* (Latin) = castle, fort, fortress.

Type species.—*Castrum perornatum* n. sp.

Description.—Test multicyrtoid, conical, consisting of seven or more post-abdominal chambers (segments). Cephalis dome-shaped, imperforate, lacking a horn. Thorax, abdomen, and post-abdominal chambers trapezoidal to subtrapezoidal in outline, separated from each other by strongly nodose circumferential ridges; nodes massive, high in relief. Area between two given circumferential ridges perforate, consisting of two different-sized sets of polygonal pore frames (predominantly tetragonal); larger pore frames with large, subcircular pores; smaller pore frames with circular to subcircular pores; smaller set of pore frames integral with nodose circumferential ridges. Chambers (segments) constricted between circumferential ridges.

Comparisons.—*Castrum* new genus differs from other Triassic genera described in this report by having a test with chambers consisting of two different-sized sets of polygonal pore frames that are separated by nodose circumferential ridges.

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

Occurrence.—Eastern Oregon, British Columbia.

Castrum perornatum new species
Plate 14, figures 4, 9, 12, 14, 18;
Plate 17, figure 14

Dictyomitrella sp. B DeWever, 1979, p. 90, pl. 5, fig. 17.

Etymology.—*perornatus* (Latin) = very ornate.

Description.—Test as for genus. Eight or nine post-abdominal chambers, increasing gradually in height and more rapidly in width as added; width of any chamber approximately 3.5 times the height. Circumferential ridges with massive, polygonal nodes, nodes high in relief. Pore frames between circumferential ridges well-developed; larger pore frames triangular to rectangular in outline with large, subcircular to elliptical pores; smaller pore frames tetragonal in outline with circular to subcircular pores; smaller subcircular pores of the cephalis, abdomen, and earlier post-abdominal chambers poorly preserved.

Comparisons.—*Castrum perornatum* n. sp. differs from other Nassellariina described in this report by having chambers consisting of two different-sized sets of polygonal pore frames separated by nodose circumferential ridges.

Measurements (in μm).—

	length of test	maximum width of test
Holotype (USNM 305943)	268	122
All (8) paratypes (USNM 305944; Blome coll.)		
largest value recorded	274	124
smallest value recorded	214	97
mean value recorded	236	115

Type locality.—OR-39 (see Appendix).

Types.—Holotype: USNM 305943; paratypes: USNM 305944 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area and the Vance Creek area of east-central Oregon; Cache Creek Group, British Columbia.

Genus **LATIUM** new genus

Etymology.—*Latium* (Latin) = a district in Italy in which Rome was situated (ICZN, 1964, p. 113, Appendix D, pt. IV, Recommendation 36).

Type species.—*Latium longulum,* n. sp.

Description.—Test multicyrtid, elongate, conical. Cephalis dome-shaped, imperforate, lacking a horn. Thorax trapezoidal to subtrapezoidal in outline. All chambers separated by narrow, perforate circumferential ridges; one row of large, rectangular pore frames occurs at the base of the circumferential ridges on the thorax, abdomen, and post-abdominal chambers, pore frames low in relief; pores large, circular to elliptical in outline. Final post-abdominal chambers imperforate, lacking pore frames. Chambers expanding slowly in width and height as added.

Comparisons.—*Latium* new genus differs from other Nasellariina described in this report by having one row of rectangular pore frames situated at the base of each circumferential ridge.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Latium longulum new species
Plate 14, figures 5, 10, 13

Etymology.—*longulus* (Latin) = somewhat long.

Description.—Test as for genus, consisting of seven or more post-abdominal chambers (segments). Cephalis imperforate, dome-shaped, smooth; thorax subtrapezoidal in outline; remaining chambers rectangular in outline. Abdomen and post-abdominal chambers with weakly developed, rectangular pore frames with about 24 to 26 pores (12 to 13 visible laterally); pore frames low in relief. Chambers increasing slowly in height and more rapidly in width proximally; maintaining the same height and width medially and distally, the exception being the final post-abdominal chamber, which decreases in width; width of any chamber approximately three times the height.

Comparisons.—*Latium longulum* n. sp. differs from *L. mundum* n. sp. and *L. paucum* n. sp. by having a greater number of post-abdominal chambers (eight *versus* six), and by having post-abdominal chambers that maintain approximately the same width throughout most of its length.

Measurements (in μm).—

	length of test	maximum width of test
Holotype (USNM 305945)	198	78
All (6) paratypes		
(USNM 305946; Blome coll.)		
largest value recorded	206	86
smallest value recorded	187	76
mean value recorded	199	80

Type locality.—OR-143 (see Appendix).

Types.—Holotype: USNM 305945; paratypes: USNM 305946 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Latium mundum new species
Plate 15, figures 1, 7, 13

Etymology.—*mundus* (Latin) = clean, neat, elegant.

Description.—Test as for genus, consisting of six post-abdominal chambers (segments). Cephalis imperforate, dome-shaped, smooth; thorax subtrapezoidal in outline; remaining chambers rectangular in outline. Abdomen and post-abdominal chambers with faint, rectangular pore frames, with about 26 pores (13 visible laterally); pore frames low in relief. Chambers increasing slowly in height and more rapidly in width as added, the exception being the final post-abdominal chamber which decreases in width; width of any chamber approximately three times the height.

Comparisons.—*Latium mundum* n. sp. differs from *L. longulum* n. sp. by having fewer post-abdominal chambers (six *versus* seven to eight), and by having post-abdominal chambers that increase more rapidly in width. *L. mundum* n. sp. differs from *L. paucum* n. sp. by having fewer pores visible laterally (13 *versus* 16), and by having post-abdominal chambers that increase more rapidly in width.

Measurements (in μm).—

	length of test	maximum width of test
Holotype (USNM 305947)	212	88
All (7) paratypes		
(USNM 305948; Blome coll.)		
largest value recorded	215	90
smallest value recorded	192	81
mean value recorded	205	85

Type locality.—OR-143 (see Appendix).

Types.—Holotype: USNM 305947; paratypes: USNM 305948 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Latium paucum new species
Plate 15, figures 2, 8, 14

Etymology.—*paucus* (Latin) = few, little.

Description.—Test as for genus, consisting of six post-abdominal chambers (segments). Cephalis imperforate, dome-shaped, smooth; thorax smooth, subtrapezoidal in outline; remaining chambers rectangular in outline. Abdomen and post-abdominal chambers with well-developed, rectangular pore frames with about 30 to 32 pores (15 to 16 visible laterally); pore frames low in relief. Chambers increasing slowly in height and width as added, the exception being the final two post-abdominal chambers, which decrease in width; width of any chamber approximately three times the height.

Comparisons.—*Latium paucum* n. sp. differs from *L. mundum* n. sp. by having a greater number of pores visible laterally (16 *versus* 13), and by having post-abdominal chambers that increase less rapidly in width. *L. paucum* n. sp. differs from *L. longulum* n. sp. by having a greater number of pores visible laterally (16 *versus* 13), and by having post-abdominal chambers that increase more rapidly in width.

Measurements (in μm).—

	length of test	maximum width of test
Holotype (USNM 305949)	188	90
All (6) paratypes		
(USNM 305950; Blome coll.)		
largest value recorded	204	98
smallest value recorded	181	84
mean value recorded	193	92

Type locality.—OR-148 (see Appendix).

Types.—Holotype: USNM 305949; paratypes: USNM 305950 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Genus **LAXTORUM** new genus

Etymology.—*Laxtorum* is a name formed by an arbitrary combination of letters (ICZN, 1964, p. 113, Appendix D, pt. IV, Recommendation 40).

Type species.—*Laxtorum hindei* n. sp.

Description.—Test multicyrtid, consisting of four or more post-abdominal chambers (segments). Cephalis conical, imperforate, with a large, well-developed horn. Thorax trapezoidal in outline, perforate, in some specimens buried by microgranular silica. Abdomen and post-abdominal chambers trapezoidal in outline. Test wall consisting of two layers: inner layer comprised of triangular to pentagonal pore frames that lack nodes; outer layer comprised of triangular to hexagonal pore frames with massive, polygonal nodes at the pore frame vertices, nodes low in relief; pores of both layers of pore frames large, subcircular to polygonal in outline; pore frames of the outer layer generally restricted to the circumferential ridges, with the exception of the final post-abdominal chambers. Post-abdominal chambers commonly increasing more rapidly in width than in height.

Comparisons.—*Laxtorum* new genus differs from *Canoptum* Pessagno, 1979, by having a test in which the pores are not buried by an outer layer of accreted microgranular silica.

Range.—Upper Triassic (upper Norian); Lower Jurassic?.

Occurrence.—Kunga Formation, Queen Charlotte Islands.

Laxtorum atliense new species

Plate 15, figures 3, 9, 15, 16; Plate 17, figure 15

Etymology.—This species is named for Atli Inlet located on the northern portion of Lyell Island, Queen Charlotte Islands, British Columbia.

Description.—Test as for genus. Cephalis possessing a long, relatively massive horn (tip of horn broken on type material). Thorax trapezoidal in outline, partially perforate. Abdomen and post-abdominal chambers subtrapezoidal in outline; six post-abdominal chambers, increasing gradually in height and more rapidly in width; width of any chamber approximately four times the height. Circumferential ridges of outer layer with two rows of polygonal pore frames, pores circular to subcircular in outline.

Comparisons.—*Laxtorum atliense* n. sp. has been compared to *L. kulense* n. sp. under the latter species.

Measurements (in μm).—

	length of test	maximum width of test
Holotype (USNM 305951)	181	93
All (6) paratypes		
(USNM 305952; Blome coll.)		
largest value recorded	196	98
smallest value recorded	177	86
mean value recorded	184	92

Type locality.—QC-24 (see Appendix).

Types.—Holotype: USNM 305951; paratypes: USNM 305952 and Blome collection.

Range.—Upper Triassic (upper Norian).

Occurrence.—Middle member of the Kunga Formation, Queen Charlotte Islands.

Laxtorum hindei new species

Plate 15, figures 4, 10, 17, 18

Etymology.—This species is named for G. J. Hinde, in honor of his early contributions towards the study of Triassic Radiolaria.

Description.—Test as for genus. Cephalis large, with a short, broad horn. Thorax trapezoidal in outline, partially perforate. Abdomen and post-abdominal chambers subtrapezoidal in outline; five post-abdominal chambers increasing gradually in height and more rapidly in width as added; width of any chamber approximately three times the height. Circumferential ridges of outer layer with one row of polygonal pore frames, pores subcircular in outline.

Comparisons.—*Laxtorum hindei* n. sp. differs from other species of *Laxtorum* new genus described in this report by having a shorter, broader horn.

Measurements (in μm).—

	length of test	maximum width of test
Holotype (USNM 305953)	163	78
All (8) paratypes		
(USNM 305954; Blome coll.)		
largest value recorded	210	101
smallest value recorded	157	72
mean value recorded	174	85

Type locality.—QC-24 (see Appendix).

Types.—Holotype: USNM 305953; paratypes: USNM 305954 and Blome collection.

Range.—Upper Triassic (upper Norian).

Occurrence.—Middle member of the Kunga Formation, Queen Charlotte Islands.

Laxtorum kulense new species
Plate 15, figures 5, 11, 12, 19

Etymology.—This species is named for Kul Rocks, located directly south of Kunga Island in Richardson Inlet, Queen Charlotte Islands.

Description.—Test as for genus. Cephalis with a long, relatively massive horn (tip of horn broken on type material). Thorax trapezoidal in outline, partially perforate. Abdomen and post-abdominal chambers subtrapezoidal in outline; seven post-abdominal chambers, increasing gradually in height and more rapidly in width, the exception being the final three to four post-abdominal chambers, which tend to be of the same width; width of any chamber approximately five times the height. Circumferential ridges of outer layer with one to two rows of polygonal pore frames, pores circular to elliptical in outline. Area between circumferential ridges narrow.

Comparisons.—*Laxtorum kulense* n. sp. differs from *L. atliense* n. sp. by having a much wider test, width of any chamber approximately five times the height.

Measurements (in μm).—

	length of test	maximum width of test
Holotype (USNM 305955)	159	90
All (7) paratypes		
(USNM 305956; Blome coll.)		
largest value recorded	187	95
smallest value recorded	154	84
mean value recorded	171	91

Type locality.—QC-24 (see Appendix).

Types.—Holotype: USNM 305955; paratypes: USNM 305956 and Blome collection.

Range.—Upper Triassic (upper Norian).

Occurrence.—Middle member of the Kunga Formation, Queen Charlotte Islands.

Laxtorum species A
Plate 15, figure 6

Remarks.—*Laxtorum* sp. A differs from *L. atliense* n. sp. and *L. kulense* n. sp. by having a more elongate, slender test that tapers distally, and by having a slender, narrower horn.

Range and occurrence.—QC-24. Upper Triassic (upper Norian). Middle member of the Kunga Formation, Queen Charlotte Islands. Rare.

Genus **QUASIPETASUS** new genus

Etymology.—*quasi* (Latin) = as it were, a sort of + *petasus* (Latin) = a broad brimmed hat.

Type species.—*Quasipetasus insolitus* n. sp.

Description.—Test dicyrtid to tricyrtid, hat-shaped in outline, with a large, inflated cephalis; cephalis subspherical to spherical, with or without a horn. Cephalis perforate, comprised of two layers of pore frames when well preserved; outer layer of meshwork consisting of large, massive, polygonal pore frames with large nodes at the pore frame vertices; inner layer comprised of smaller, polygonal pore frames with large, circular to subcircular pores. Thorax subcylindrical to cylindrical; abdomen, when present, large, subcylindrical; thorax and abdomen with large, flaring imperforate skirt, skirt ridged. Meshwork of thorax and abdomen consisting of a single layer of extremely wide, raised polygonal pore frames that lack distinct nodes; pores circular to elliptical in outline. Wide, imperforate band at joint separating chambers.

Comparisons.—*Quasipetasus* n. genus differs from other Triassic Nassellariina by having a hat-shaped test possessing an imperforate skirt.

Quasipetasus disertus new species
Plate 16, figures 1, 7, 18, 19; Plate 17, figure 16

Etymology.—*disertus* (Latin) = eloquent, expressive.

Description.—Test dicyrtid; cephalis large, bulbous, extremely wide, lacking a horn; outer layer of polygonal pore frames poorly preserved on type material; inner layer with uniformly sized, raised polygonal pore frames with poorly developed nodes at pore frame vertices; pores large, circular to subcircular in outline. Thorax exhibiting one layer of wide, raised polygonal pore frames that lacks distinct nodes; pores large, circular to elliptical in outline. Thoracic skirt thick, massive, slightly narrower than width of abdomen, rounded apically (towards cephalis) and abapically. Chambers decreasing rapidly in width from cephalis to thorax; approximately equal in height. Chambers heavily constricted at joints.

Comparisons.—*Quasipetasus disertus* n. sp. differs from *Q. insolitus* n. sp. by being dicyrtid, by having a wider, more bulbous cephalis that lacks a horn, and by having a narrower, more massive thoracic skirt.

Measurements (in μm).—

	length of test	maximum diameter of cephalis
Holotype (USNM 305961)	225	138
All (8) paratypes		
(USNM 305962; Blome coll.)		
largest value recorded	233	148
smallest value recorded	222	131
mean value recorded	227	138

Type locality.—OR-143 (see Appendix).

Types.—Holotype: USNM 305961; paratypes: USNM 305962 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Quasipetasus insolitus new species
Plate 16, figures 2, 8, 12; Plate 17, figure 17

Unnamed hat-shaped Nassellarian, Pessagno, 1979, p. 69, pl. 5, figs. 1–2.

Etymology.—*insolitus* (Latin) = unusual, strange, uncommon.

Description.—Test tricyrtid; cephalis large, bulbous, wide, with small, asymmetrically-positioned, rudimentary horn; outer layer comprised of coarse, variably-sized, polygonal pore frames with nodes at some pore frame vertices, nodes relatively high in relief; inner layer with smaller, uniformly-sized, polygonal pore frames with large, circular to subcircular pores. Thorax and abdomen exhibiting one layer of wide, raised polygonal pore frames that lack distinct nodes; pores large, circular to elliptical in outline. Abdominal skirt thin, moderately flaring, skirt approximately one-and-one-half times the diameter of the abdomen, rounded apically (toward cephalis) and abapically. Chambers decreasing slightly in width as added; increasing slightly in height, the exception being the shortened thorax. Chambers heavily constricted at joints.

Comparisons.—*Quasipetasus insolitus* n. sp. differs from *Q. disertus* n. sp. by being tricyrtid, by having a narrower, less bulbous cephalis which possesses a horn, and by having a wider, less massive abdominal skirt.

Measurements (in μm).—

	length of test	maximum diameter of cephalis
Holotype (USNM 305963)	249	123
All (8) paratypes		
(USNM 305964; Blome coll.)		
largest value recorded	258	125
smallest value recorded	228	113
mean value recorded	244	120

Type localities.—Holotype from OR-39. Paratypes from OR-152 (see Appendix).

Types.—Holotype: USNM 305963; paratypes: USNM 305964 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, east-central Oregon; San Hipolito Formation, Baja California; and the Cache Creek Group of British Columbia.

Genus **TRIASSOCAMPE**
Dumitrica, Kozur, and Mostler, 1980
(emend. herein)

Type species.—*Triassocampe scalaris* Dumitrica, Kozur, and Mostler, 1980.

Comparisons.—*Triassocampe* differs from *Yeharaia* Nakaseko and Nishimura, 1979, by lacking the gourd-like first two segments and by lacking a large, well-developed apical horn.

Range.—Middle Triassic (Ladinian) to Upper Triassic (Norian).

Occurrence.—Eastern Oregon, Alaska, British Columbia, Austria, Greece, Sicily, Turkey, and Japan.

Triassocampe immaturum new species
Plate 16, figures 3, 10, 13

Etymology.—*immaturus* (Latin) = immature, unripe, untimely.

Description.—Test as for genus. Cephalis dome-shaped in outline, slightly perforate, lacking a horn. Thorax and abdomen subcylindrical. Post-abdominal chambers subtrapezoidal to subcylindrical; chambers increasing more rapidly in width than in height. Three to four post-abdominal chambers inflated, increasing slowly in height and width as added; width of any chamber approximately twice the height. Circumferential ridges massive, rounded with large, circular to subcircular pores aligned in a single row; pores situated at the base of the circumferential ridges.

Comparisons.—*Triassocampe immaturum* n. sp. differs from *T. deweveri* Nakaseko and Nishimura, 1979, *T. proprium* n. sp. and *T. scalaris* Dumitrica, Kozur, and Mostler, 1980, by having a cephalis that lacks a horn, by having a more rounded thorax and abdomen, and by having more inflated post-abdominal chambers.

Measurements (in μm).—

	length of test	maximum width of test
Holotype (USNM 305957)	167	78
All (6) paratypes		
(USNM 305958; Blome coll.)		
largest value recorded	232	91
smallest value recorded	143	72
mean value recorded	170	82

Type locality.—OR-148 (see Appendix).

Types.—Holotype: USNM 305957; paratypes: USNM 305958 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Triassocampe proprium new species
Plate 16, figures 4, 11, 14

Etymology.—*proprius* (Latin) = one's own, special, particular, peculiar.

Description.—Test as for genus. Cephalis dome-shaped with a well-developed, centrally positioned horn; horn triradiate in axial section. Thorax and abdomen subtrapezoidal in outline, chambers increasing slowly in height and width. Five to six post-abdominal chambers, subtrapezoidal in outline, increasing slowly in height and width; width of any chamber approximately three times the height. Circumferential ridges massive, rounded with large, circular to subcircular pores aligned in a single row; pores situated at the base of the circumferential ridges.

Comparisons.—*Triassocampe proprium* n. sp. differs from *T. immaturum* n. sp. by having a cephalis which possesses a horn, by having a thorax and abdomen which is subtrapezoidal in outline, and by having more inflated, wider post-abdominal chambers, the width of any chamber approximately three times the height.

Measurements (in μm).—

	length of test	maximum width of test
Holotype (USNM 305959)	265	100
All (5) paratypes		
(USNM 305960; Blome coll.)		
largest value recorded	272	105
smallest value recorded	212	83
mean value recorded	245	93

Type localities.—Holotype from OR-39. Paratypes from OR-52 (see Appendix).

Types.—Holotype: USNM 305959; paratypes: USNM 305960 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

Genus **XIPHA** new genus

Etymology.—The word *Xipha* (fem.) is a name formed by an arbitrary combination of letters (ICZN, 1964, p. 113, Appendix D, pt. IV, Recommendation 41).

Type species.—*Xipha pessagnoi* Nakaseko and Nishimura, 1979.

Description.—Test multicyrtid, conical in shape, with well-developed strictures. Cephalis dome-shaped, imperforate, lacking a horn. Thorax subtrapezoidal to subcircular in outline, with or without massive costae. Subcircular pores commonly found at strictures separating thorax, abdomen, and post-abdominal chambers; most pores subsequently buried by an outer layer of accreted microgranular silica. Abdomen and post-abdominal chambers subcylindrical, rounded, with massive, continuous costae; costal extensions present on final post-abdominal chambers with some taxa. All chambers increasing rapidly in both height and width as added.

Comparisons.—*Xipha* new genus differs from other Triassic genera described in this report by possessing a multicyrtid test that exhibits wide, continuous costae. *Xipha* new genus differs from *Eucyrtidium* Ehrenberg, 1847, by lacking an apical horn, by consistently having four or more chambers, and by having subcircular pores situated at the strictures separating chambers. *Xipha* new genus also differs from *Dictyomitra* Zittel 1876 (emend. Pessagno, 1976 [type species = *D. multicostata* Zittel, 1876; see Nakaseko and Nishimura, 1979, p. 77]) by being broadly conical in outline (*versus* spindle-shaped), by lacking large pores with accessory flaps situated between the costae, and by possessing a much smaller number of post-abdominal chambers.

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

Occurrence.—Eastern Oregon, British Columbia, and Japan.

Xipha pessagnoi Nakaseko and Nishimura, 1979
(emend. herein)
Plate 16, figures 6, 9, 17

Dictyomitra pessagnoi Nakaseko and Nishimura, 1979, p. 77, pl. 9, figs. 2, 3, 4.

Emended definition.—Test as for genus. Thorax broad, subcircular in outline, with remnants of costae at base. Abdomen and first post-abdominal chamber robust, inflated, subcylindrical; first post-abdominal chamber may be flattened; chambers exhibit well-developed, continuous costae; costae connecting strictures; costal extensions absent. All chambers increase in width and more rapidly in height as added; width of any chamber approximately one-and-one-half times the height. Well-developed, circular to subcircular pores occurring at strictures separating thorax, abdomen, and first post-abdominal chambers.

Comparisons.—*Xipha pessagnoi* Nakaseko and Nishimura, 1979, as herein emended, differs from *X. striata* n. sp. by having less massive, continuous costae connecting strictures, by lacking costal extensions, and by possessing well-developed pores at the strictures.

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

Occurrence.—Rail Cabin Mudstone, east-central Oregon; and the Mino Belt, central Japan.

Xipha striata new species
Plate 16, figures 5, 15, 16, Plate 17, figure 18

Etymology.—*striatus* (Latin) = fluted, channeled.

Description.—Test as for genus. Thorax broad, subcylindrical in outline, with well-developed, massive costae. Abdomen and first post-abdominal chamber robust, circular in outline, both chambers exhibiting massive, continuous costae; first post-abdominal chamber with flattened costae, costal extensions well-developed; stricture area on all chambers free of costae. All chambers increasing rapidly in width and height as added; width of any chamber approximately twice the height. Pores absent at strictures separating chambers.

Comparisons.—*Xipha striata* n. sp. differs from *X. pessagnoi* Nakaseko and Nishimura, 1979, by having more massive costae, and by having well-developed costal extensions.

Measurements (in μm).—

	length of test	maximum width of test
Holotype (USNM 305965)	162	94
All (9) paratypes		
(USNM 305966; Blome coll.)		
largest value recorded	180	99
smallest value recorded	156	79
mean value recorded	166	90

Type localities.—Holotype from OR-39. Paratypes from OR-39 and OR-52 (see Appendix).

Types.—Holotype: USNM 305965; paratypes: USNM 305966 and Blome collection.

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

Occurrence.—Rail Cabin Mudstone, Suplee-Izee area, east-central Oregon.

APPENDIX

COLLECTING LOCALITIES

Eastern Oregon

OR-5 through OR-10.—13.1 m (43 ft) of thinly bedded, silty mudstone at the top of the Brisbois Member; becoming more siliceous towards the top and the contact with the Rail Cabin Mudstone. USGS Izee 15′ Quad.: NW¼, NE¼, sec. 14, T. 17 S., R. 27 E. Western side of Morgan Mountain. Position in section is relative to Brisbois - Rail Cabin contact.

- OR-5.—Green-black silty mudstone 13.1 m (43 ft) below contact.
- OR-6.—Green-black silty mudstone 10.7 m (35 ft) below contact.
- OR-7.—Green-black silty mudstone 9.1 m (30 ft) below contact.
- OR-8.—Green-black silty mudstone 6.1 m (20 ft) below contact.
- OR-9.—Green-black silty mudstone 3.0 m (10 ft) below contact.
- OR-10.—Green-black mudstone 1.5 m (5 ft) below contact.

OR-39.—Black calcilutite float. Limestones of this type only occur in the upper part of the Rail Cabin Mudstone in this area. USGS Izee 15′ Quad.: SE¼, NE¼, sec. 14, T. 17 S., R. 27 E. Top of ridge immediately west of Elkhorn Creek. This sample contains Radiolaria no older than late middle Norian (See Text-fig. 4).

OR-42 through OR-57.—99.7 m (327 ft) of thinly bedded black siliceous (siliclastic) mudstone overlying the Brisbois Member; becoming more siliceous near the top. Contact with the Graylock Formation missing. USGS Izee 15′ Quad.: SE¼, NE¼, sec. 14, T. 17 S., R. 27 E. East side of unnamed drainage west of Elkhorn Creek, south side of Morgan Mountain. Position in section is relative to Rail Cabin - Brisbois contact.

- OR-42.—Dark green-black siliceous mudstone 0.3 m (1 ft) above contact.
- OR-43.—Green-black siliceous mudstone 2.4 m (8 ft) above contact.
- OR-44.—Green-black siliceous mudstone 4.0 m (13 ft) above contact.
- OR-45.—Black siliceous mudstone 5.5 m (18 ft) above contact.
- OR-47.—Green-black siliceous mudstone 16.8 m (55 ft) above contact.
- OR-48.—Green-black siliceous mudstone 19.8 m (65 ft) above contact.
- OR-50.—Black siliceous mudstone 31.1 m (102 ft) above contact.
- OR-51.—Black siliceous mudstone 41.8 m (137 ft) above contact.
- OR-52.—Black siliceous mudstone 63.1 m (207 ft) above contact.
- OR-53.—Black siliceous mudstone 72.3 m (237 ft) above contact.
- OR-54.—Black siliceous mudstone 78.4 m (257 ft) above contact.
- OR-55.—Green-black siliceous mudstone 81.4 m (267 ft) above contact.
- OR-56.—Black siliceous mudstone 92.1 m (302 ft) above contact.
- OR-57.—Green-black siliceous mudstone 99.7 m (327 ft) above contact.

OR-68 through OR-71.—Dark black chert samples occurring within the Miller Mt. melange. USGS Mt. Vernon 15′ Quad.: SW¼, NE¼, sec. 5, T. 14 S., R. 30 E., approximately 0.2 mi north of Vance Creek. These samples contain Radiolaria that are late Ladinian/early Karnian in age.

OR-102 through OR-108*.—31 m (102 ft) of thinly bedded, black siliceous (siliclastic) mudstone and gray-weathering limestone overlying the Brisbois Member. USGS 15′ Quad.: SE¼, NW¼, sec. 26, T. 17 S., R 27 E. Western side of Brisbois Gulch. Position in section is relative to the Rail Cabin - Brisbois contact.

OR-102.—Black siliceous mudstone 0.6 m (2 ft) above contact.
OR-103.—Dark, aphanitic limestone 2.1 m (7 ft) above contact.
OR-104.—Dark, aphanitic limestone 5.2 m (17 ft) above contact.
OR-105.—Black siliceous mudstone 11.3 m (37 ft) above contact.
OR-106.—Black siliceous mudstone 15.9 m (52 ft) above contact.
OR-107.—Dark, aphanitic limestone 16.5 m (54 ft) above contact.
OR-108.—Black siliceous mudstone 31.1 m (102 ft) above contact.

OR-123C.—Black chert sample collected near the base of the Fields Creek Formation along Fields Creek road, approximately 11.3 mi south of the intersection of Hwy. 26 and Fields Creek road. USGS Aldrich Mt. 15′ Quad.: NE¼, SE¼, sec. 5, T. 14 S., R. 29 E. This sample contains Radiolaria that are early Karnian in age.

OR-138 through OR-158.—109.5 m (359 ft) of thinly bedded black siliceous (siliclastic) mudstone overlying the Brisbois Member; the section becoming more siliceous near the top and its contact with the Graylock Formation. USGS Izee 15′ Quad.: SE¼, NW¼, sec. 14, T. 17 S., R 27 E. West side of unnamed drainage west of Elkhorn Creek, south side of Morgan Mt. Position in section is relative to the Rail Cabin - Brisbois contact. Sample localities are given in ascending order as in Text-figure 4.

OR 138.—Black siliceous mudstone 0.3 m (1 ft) above contact.
OR-139.—Black siliceous mudstone 1.8 m (6 ft) above contact.
OR-140.—Black siliceous mudstone 9.8 m (32 ft) above contact.
OR-141.—Black siliceous mudstone 17.1 m (56 ft) above contact.
OR-142.—Black siliceous mudstone 32.2 m (106 ft) above contact.
OR-143.—Black siliceous mudstone 35.4 m (116 ft) above contact.
OR-144.—Black siliceous mudstone 39.0 m (128 ft) above contact.
OR-145.—Black siliceous mudstone 45.0 m (148 ft) above contact.
OR-146.—Black siliceous mudstone 55.8 m (183 ft) above contact.
OR-147.—Black siliceous mudstone 58.8 m (193 ft) above contact.
OR-148.—Black siliceous mudstone 65.2 m (214 ft) above contact.
OR-149.—Black siliceous mudstone 71.3 m (234 ft) above contact.
OR-151.—Black siliceous mudstone 84.8 m (278 ft) above contact.
OR-152.—Black siliceous mudstone 90.5 m (297 ft) above contact.
OR-153.—Black siliceous mudstone 97.0 m (318 ft) above contact.
OR-154.—Black siliceous mudstone 100.0 m (328 ft) above contact.
OR-155.—Black siliceous mudstone 102.7 m (337 ft) above contact.
OR-125.—Black siliceous mudstone 106.4 m (349 ft) above contact.
OR-126.—Black siliceous mudstone 107.9 m (354 ft) above contact.
OR-127.—Black siliceous mudstone 109.4 m (359 ft) above contact.

GC-4A.—Dark-red chert sample occurring within the Grindstone-Twelvemile melange. USGS Suplee 7½′ Quad.; SE¼, NW¼, sec. 11, T. 18 S., R. 25 E. Located approximately 0.6 mi northeast of the North Fork of Trout Creek, and 0.4 mi northwest of Long Spring at the base of a topographic bench. This sample contains Radiolaria that are early Pennsylvanian to early Permian in age.

Queen Charlotte Islands (Kunga Formation type locality, north shore of Kunga Island; see Text-fig. 4)

QC-24.—Black limestone member. Thin-bedded black calcilutite and interbedded black siliceous (siliclastic) mudstones. Sample from dark-gray calcilutite nodule 15 cm (6 in) in diameter; 55.5 m (182 ft) below contact with the black argillite member.

QC-26.—Black limestone member. Thin-bedded black calcilutite and interbedded black siliceous mudstone. Sample from dark-gray calcilutite nodule 20 cm (8 in) in diameter; 41.2 m (135 ft) below the contact with the black argillite member.

QC-42.—Black limestone member. Thin-bedded black calcilutite and interbedded black siliceous mudstone. Sample from dark-gray calcilutite nodule 15 cm (6 in) in diameter; 48.8 m (160 ft) below the contact with the black argillite member.

QC-49.—Black limestone member. Thin-bedded black calcilutite and interbedded black siliceous mudstone. Sample from dark-gray calcilutite nodule 20 cm (8 in) in diameter; 15.9 m (52 ft) below the contact with the black argillite member.

QC-51A.—Black limestone member. Thin-bedded black calcilutite and interbedded black siliceous mudstone. Sample from dark-gray calcilutite nodule 12.5 cm (5 in) in diameter; 4.0 m (13 ft) below the contact with the black argillite member.

Samples QC-38, QC-16, and QC-37, were collected 65.9 m (216 ft), 74.0 m (243 ft) and 81.4 m (267 ft) below sample QC-24. These samples contained fragments of *Monotis*, Bronn, 1830, which, according to N. J. Silberling (USGS, Denver; written commun.), is probably *Monotis subcircularis* Gabb, 1864. Brown (1968, p. 57) reports *Monotis subcircularis* occurring within an interval 21.3 m (70 ft) beneath the contact with the overlying black argillite member and 34.1 m (112 ft) above sample QC-24.

* According to N. J. Silberling (personal commun.), *Monotis subcircularis* Gabb (upper Norian) was recovered from these strata by David Taylor (Univ. of California, Berkeley).

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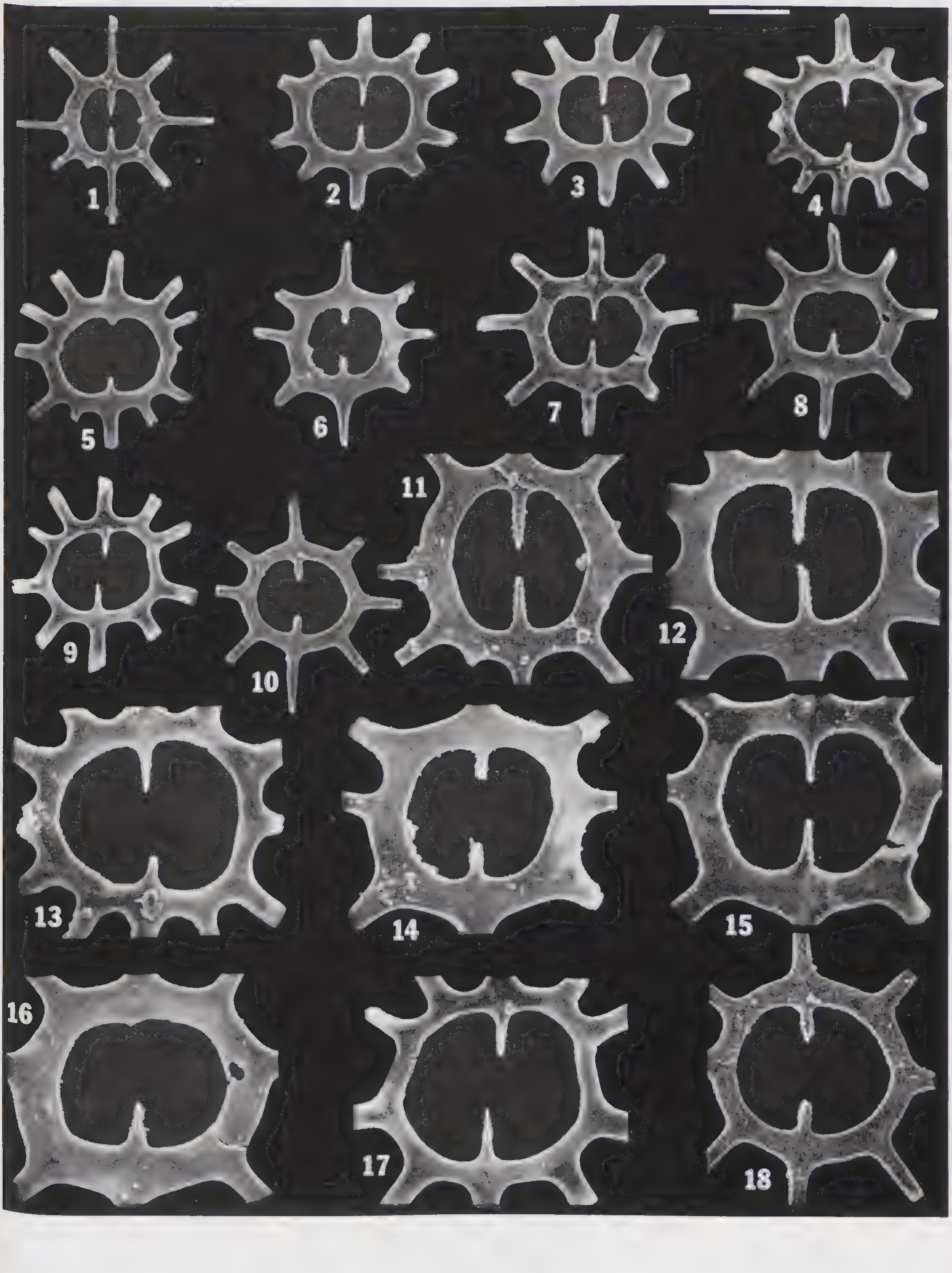
PLATES

Magnification is given by assigning a length, in μm, to the scale bar that appears in the upper right portion of each plate. Collecting localities are described in detail in the Appendix.

EXPLANATION OF PLATE 1

All figures are scanning electron micrographs of Upper Triassic (upper Karnian?; lower to upper middle Norian) acanthocircid Radiolaria from the Rail Cabin Mudstone of eastern Oregon.

Figure		Page
1, 11.	***Acanthocircus burnsensis*** new species	21
	Holotype (USNM 305857): Scale bar = 200 and 100 μm, respectively. Loc. OR-39.	
2, 3, 12.	***Acanthocircus dotti*** new species	22
	2. Holotype (USNM 305859): Scale bar = 150 μm. Loc. OR-139.	
	3, 12. Paratype (USNM 305860): Scale bar = 150 and 100 μm, respectively. Loc. OR-139.	
4, 5, 13.	***Acanthocircus harrisonensis*** new species	22
	4, 13. Holotype (USNM 305861): Scale bar = 150 and 100 μm, respectively. Loc. OR-139.	
	5. Paratype (USNM 305862): Scale bar = 150 μm. Loc. OR-139.	
	Note that *A. harrisonensis* n. sp. has a ring that is subcircular in outline and peripheral spines that are wider than those of *A. usitatus* n. sp. (Pl. 2, figs. 8, 18).	
6, 14.	***Acanthocircus izeensis*** new species	22
	Holotype (USNM 305863): Scale bar = 171 and 109 μm, respectively. Loc. OR-51.	
	Note that *A. izeensis* n. sp. has a subcircular ring cavity and a ring that is wider and less square in outline than that of *A. macoyensis* n. sp. (Pl. 2, figs. 1, 12).	
7, 8, 15, 16.	***Acanthocircus largus*** new species	23
	7, 15. Holotype (USNM 305865): Scale bar = 150 and 100 μm, respectively. Loc. OR-52.	
	8, 15. Paratype (USNM 305866): Scale bar = 150 and 100 μm, respectively. Loc. OR-52.	
	Note that *A. largus* n. sp. has a ring that is wider and less elliptical in outline than that of *A. ochocoensis* n. sp. (Pl. 2, figs. 2, 13) and *A. prinevillensis* n. sp. (Pl. 3, figs. 3, 14).	
9, 17.	***Acanthocircus laxus*** new species	23
	Holotype (USNM 305867): Scale bar = 150 and 100 μm, respectively. Loc. OR-139.	
10, 18.	***Acanthocircus lupheri*** new species	23
	Holotype (USNM 305869): Scale bar = 171 and 109 μm, respectively. Loc. OR-39.	
	Note that *A. lupheri* n. sp. has a much narrower, less massive ring than that of *A. silverensis* n. sp. (Pl. 2, figs. 6, 16).	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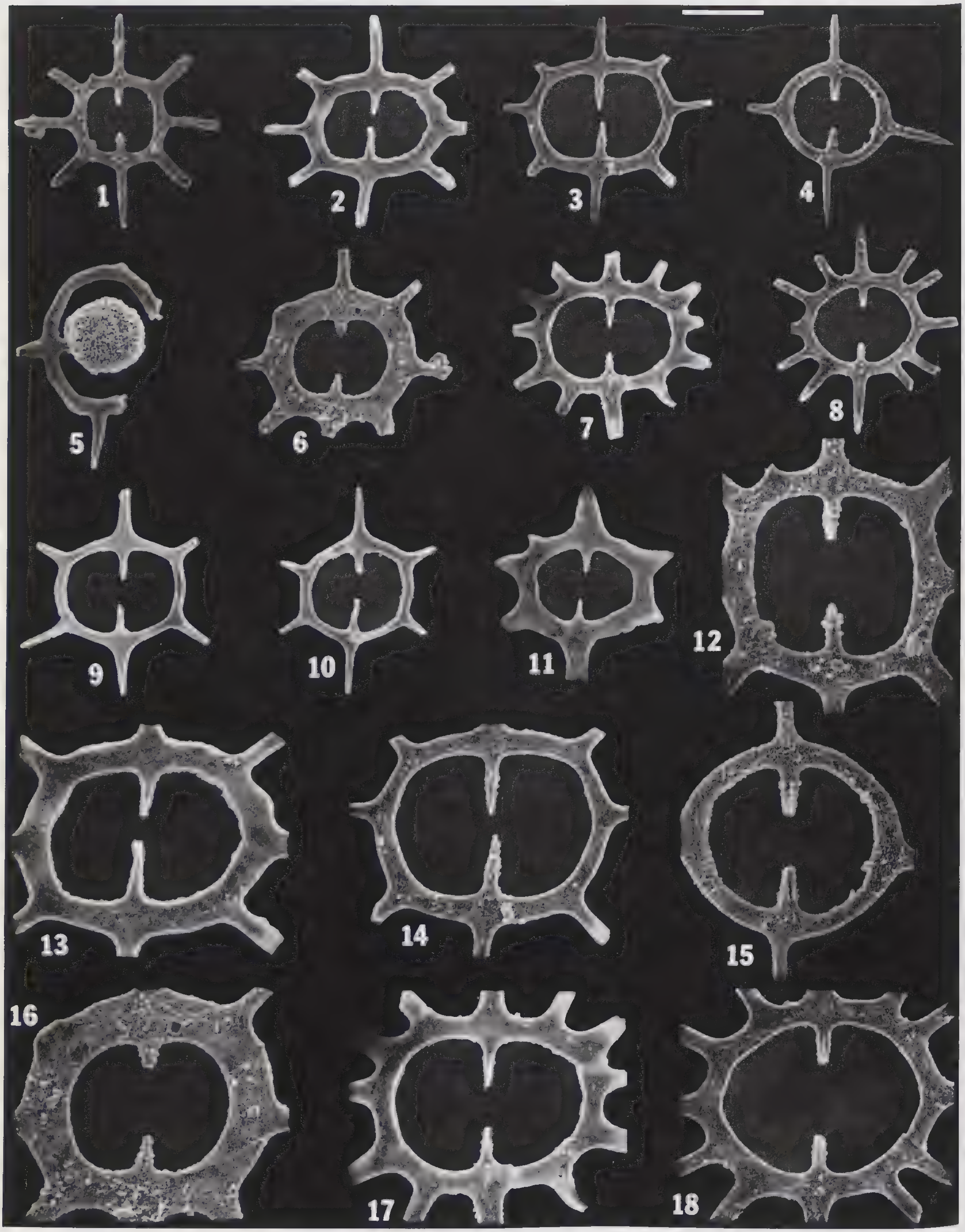
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EXPLANATION OF PLATE 2

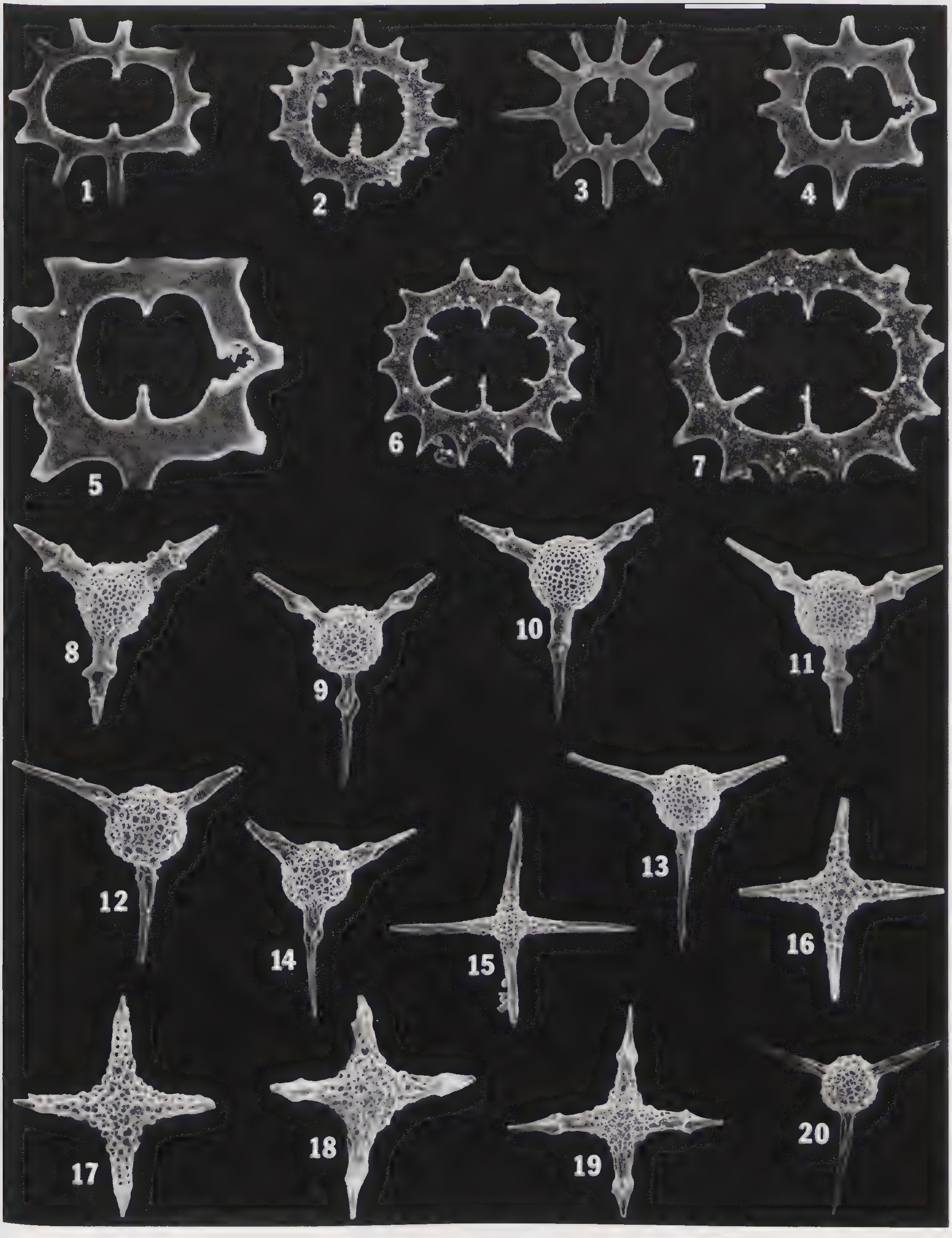
All figures are scanning electron micrographs of Upper Triassic (upper Karnian?; lower to upper middle Norian) acanthocircid Radiolaria from the Rail Cabin Mudstone of eastern Oregon.

Figure		Page
1, 12.	***Acanthocircus macoyensis*** new species .... Holotype (USNM 305871): Scale bar = 200 and 100 μm, respectively. Loc. OR-39. Note that *A. macoyensis* n. sp. has a ring and ring cavity that is square in outline [compare with *A. izeensis* n. sp. (Pl. 1, figs. 6, 14)].	24
2, 13.	***Acanthocircus ochocoensis*** new species .... Holotype (USNM 305873): Scale bar = 150 and 100 μm, respectively. Loc. OR-52.	24
3, 14.	***Acanthocircus prinevillensis*** new species .... Holotype (USNM 305875): Scale bar = 150 and 100 μm, respectively. Loc. OR-39.	24
4, 5, 15.	***Acanthocircus rotundus*** new species .... 4, 15. Holotype (USNM 305877): Scale bar = 171 and 100 μm, respectively. 5. Paratype (USNM 305878): Scale bar = 150 μm. Loc. OR-39. Note the presence of the spongy cortical shell, which is normally broken away on most specimens of *Acanthocircus.*	24
6, 16.	***Acanthocircus silverensis*** new species .... Holotype (USNM 305879): Scale bar = 171 and 100 μm, respectively. Loc. OR-39. Note that *A. silverensis* n. sp. has a broader ring and more massive axial and circumaxial spines than does *A. burnsensis* n. sp. (Pl. 1, figs. 1, 11).	25
7, 17.	***Acanthocircus supleensis*** new species .... Holotype (USNM 305881): Scale bar = 150 and 100 μm, respectively. Loc. OR-139.	25
8, 18.	***Acanthocircus usitatus*** new species .... Holotype (USNM 305883): Scale bar = 200 and 100 μm, respectively. Loc. OR-39. Note that *A. usitatus* n. sp. has a narrower ring and less massive peripheral spines than does *A. supleensis* n. sp. (Pl. 2, figs. 7, 17).	25
9, 10.	***Acanthocircus vigrassi*** new species .... 9. Holotype (USNM 305885): Scale bar = 150 μm. 10. Paratype (USNM 305886): Scale bar = 150 μm. Loc. OR-39.	26
11.	***Acanthocircus*** species A .... Hypotype (Blome coll.): Scale bar = 150 μm. Loc. OR-139.	26

EXPLANATION OF PLATE 3

All figures are scanning electron micrographs of Upper Triassic Spumellariina. All but one specimen are from the Rail Cabin Mudstone of eastern Oregon (late Karnian?; early to late middle Norian in age).

Figure		Page
1.	***Acanthocircus*** species B Hypotype (Blome coll.): Scale bar = 134 μm. Loc. OR-139.	26
2.	***Acanthocircus*** species C Hypotype (Blome coll.): Scale bar = 150 μm. Loc. OR-39.	26
3.	***Acanthocircus*** species D Hypotype (Blome coll.): Scale bar = 200 μm. Loc. OR-39.	26
4, 5.	***Acanthocircus*** species E Hypotype (Blome coll.): Scale bar = 150 and 100 μm, respectively. Loc. OR-139.	26
6, 7.	***Pseudoheliodiscus sandspitensis*** new species Holotype (USNM 305887): Scale bar = 171 and 120 μm, respectively. Loc. QC-24. Upper Norian. Middle black limestone member. Kunga Formation.	27
8.	***Capnuchosphaera colemani*** Blome Holotype (USNM 305785): Scale bar = 134 μm. Loc. OR-39.	28
9.	***Capnuchosphaera deweveri*** Kozur and Mostler Hypotype (Blome coll.): Scale bar = 150 μm. Loc. OR-39.	28
10.	***Capnuchosphaera schenki*** Blome Holotype (USNM 305789): Scale bar = 150 μm. Loc. OR-39.	28
11.	***Capnuchosphaera smithorum*** Blome Holotype (USNM 305793): Scale bar = 171 μm. Loc. OR-39.	29
12.	***Capnuchosphaera sockensis*** Blome Holotype (USNM 305795): Scale bar = 150 μm. Loc. OR-39.	29
13.	***Capnuchosphaera silviesensis*** Blome Holotype (USNM 305791): Scale bar = 150 μm. Loc. OR-39.	29
14.	***Capnuchosphaera soldierensis*** Blome Holotype (USNM 305797): Scale bar = 171 μm. Loc. OR-39.	29
15.	***Catoma concinna*** Blome Holotype (USNM 305807): Scale bar = 240 μm. Loc. OR-39.	29
16.	***Catoma geometrica*** Blome Holotype (USNM 305809): Scale bar = 150 μm. Loc. OR-39.	30
17.	***Catoma inedita*** Blome Holotype (USNM 305811): Scale bar = 134 μm. Loc. OR-39.	30
18.	***Icrioma praecipua*** Blome Holotype (USNM 305813): Scale bar = 120 μm. Loc. OR-39.	30
19.	***Icrioma transversa*** Blome Holotype (USNM 305815): Scale bar = 150 μm. Loc. OR-39.	30
20.	***Sarla delicata*** Blome Holotype (USNM 305799): Scale bar = 171 μm. Loc. OR-39.	31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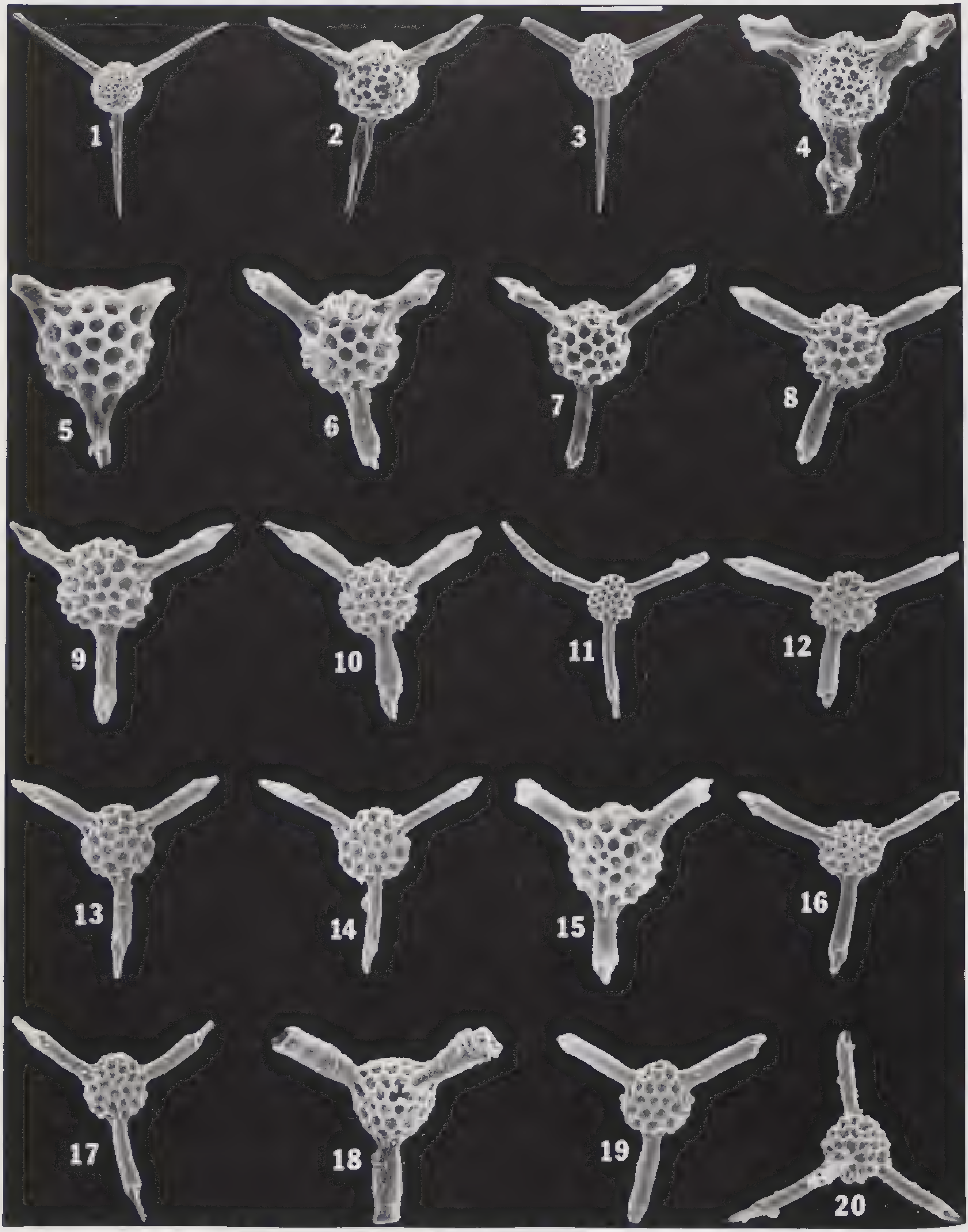
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EXPLANATION OF PLATE 4

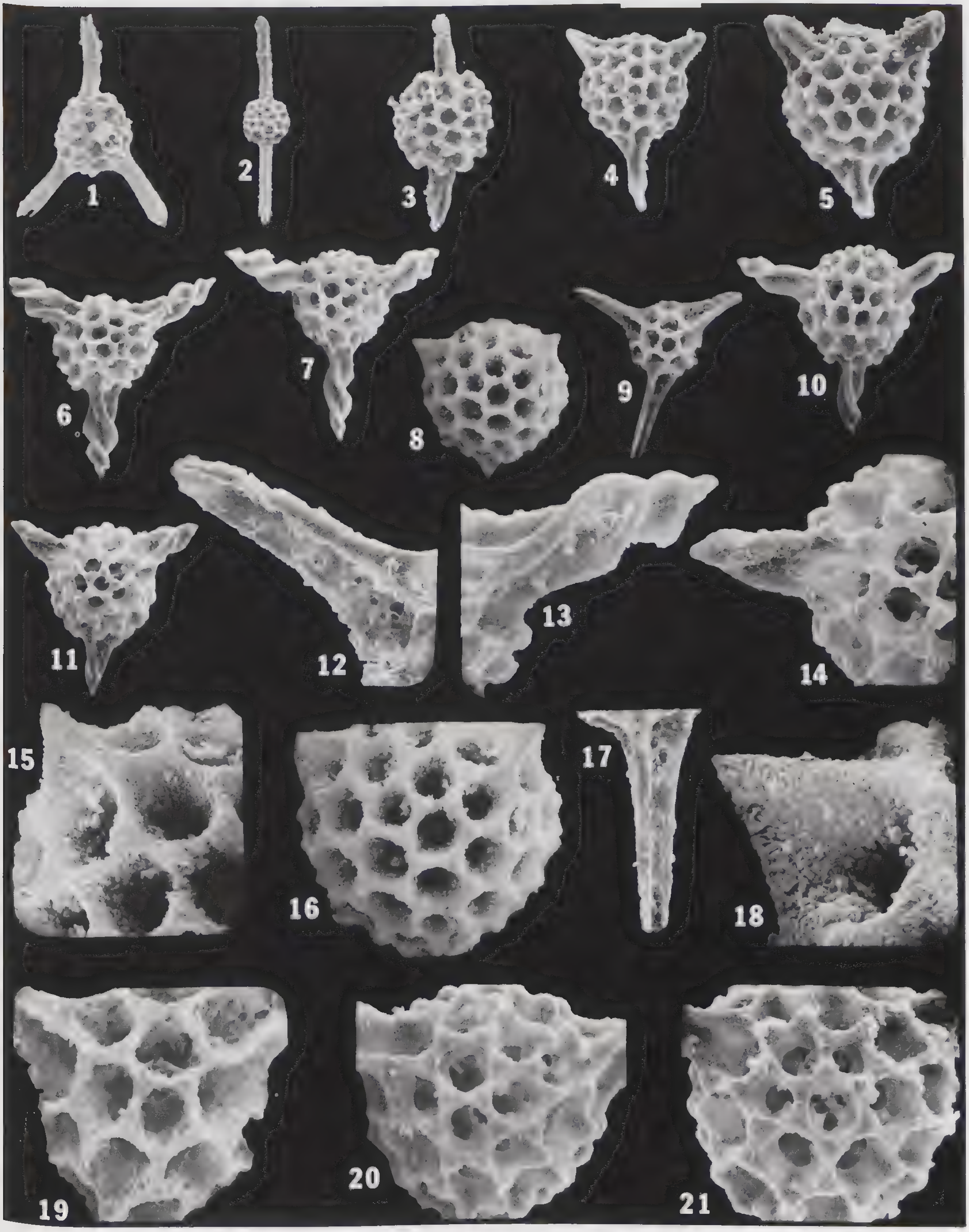
All figures are scanning electron micrographs of Upper Triassic (upper Karnian?; lower to upper middle Norian) Capnuchosphaeridae and Capnodocinae from the Rail Cabin Mudstone of eastern Oregon.

Figure		Page
1.	***Sarla* (?) *externa*** Blome Holotype (USNM 305801): Scale bar = 200 μm. Loc. OR-39.	31
2.	***Sarla plena*** Blome Holotype (USNM 305803): Scale bar = 109 μm. Loc. OR-139.	31
3.	***Sarla longispinosa*** (Kozur and Mostler) Hypotype (Blome coll.): Scale bar = 200 μm. Loc. OR-39.	31
4.	***Sarla*** sp. aff. ***S. vetusta*** Pessagno Hypotype (Blome coll.): Scale bar = 86 μm. Loc. OR-143.	32
5.	***Capnodoce angusta*** Blome Holotype (USNM 305817): Scale bar = 67 μm. Loc. OR-143.	33
6.	***Capnodoce antiqua*** Blome Holotype (USNM 305819): Scale bar = 109 μm. Loc. OR-6.	33
7.	***Capnodoce baldiensis*** Blome Holotype (USNM 305821): Scale bar = 100 μm. Loc. OR-6.	33
8.	***Capnodoce beaulieui*** Blome Holotype (USNM 305823): Scale bar = 134 μm. Loc. OR-39.	33
9.	***Capnodoce copiosa*** Blome Holotype (USNM 305825): Scale bar = 100 μm. Loc. OR-39.	34
10.	***Capnodoce extenta*** Blome Holotype (USNM 305827): Scale bar = 120 μm. Loc. OR-39.	34
11.	***Capnodoce fragilis*** Blome Holotype (USNM 305829): Scale bar = 200 μm. Loc. OR-39.	34
12.	***Capnodoce insueta*** Blome Holotype (USNM 305831): Scale bar = 150 μm. Loc. OR-39.	34
13.	***Capnodoce kochi*** Blome Holotype (USNM 305833): Scale bar = 150 μm. Loc. OR-39.	34
14.	***Capnodoce malaca*** Blome Holotype (USNM 305835): Scale bar = 150 μm. Loc. OR-39.	35
15.	***Capnodoce media*** Blome Holotype (USNM 305837): Scale bar = 86 μm. Loc. OR-39.	35
16.	***Capnodoce miniscula*** Blome Holotype (USNM 305839): Scale bar = 150 μm. Loc. OR-39.	35
17.	***Capnodoce sinuosa*** Blome Holotype (USNM 305841): Scale bar = 150 μm. Loc. OR-39.	35
18.	***Capnodoce*** sp. aff. ***C. anapetes*** DeWever Holotype (USNM 305843): Scale bar = 86 μm. Loc. OR-39.	32
19.	***Capnodoce traversi*** Pessagno Hypotype (Blome coll.): Scale bar = 150 μm. Loc. OR-39.	35
20.	***Loffa lepida*** Blome Holotype (USNM 305845): Scale bar = 150 μm. Loc. OR-39.	36

EXPLANATION OF PLATE 5

All figures are scanning electron micrographs of Upper Triassic Spumellariina.

Figure		Page
1.	***Loffa vesterensis*** Blome Holotype (USNM 305847): Scale bar = 120 μm. Loc. OR-39. Upper Karnian?; lower to upper middle Norian. Rail Cabin Mudstone.	36
2.	***Renzium adversum*** Blome Holotype (USNM 305849): Scale bar = 200 μm. Loc. OR-39. Upper Karnian?; lower to upper middle Norian. Rail Cabin Mudstone.	36
3.	***Renzium webergorum*** Blome Holotype (USNM 305851): Scale bar = 86 μm. Loc. OR-139. Upper Karnian?; lower to upper middle Norian. Rail Cabin Mudstone.	36
4.	***Justium novum*** Blome Holotype (USNM 305853): Scale bar = 75 μm. Loc. OR-139. Upper Karnian?; lower to upper middle Norian. Rail Cabin Mudstone.	37
5.	***Justium robustum*** Blome Holotype (USNM 305855): Scale bar = 67 μm. Loc. OR-139. Upper Karnian?; lower to upper middle Norian. Rail Cabin Mudstone.	37
6, 7, 13, 20.	***Betraccium deweveri*** Pessagno and Blome 6, 13. Holotype (USNM 278001): Scale bar = 100 and 38 μm, respectively. 7, 20. Paratype (USNM 278002): Scale bar = 86 and 38 μm, respectively. Loc. QC-24. Upper Norian. Middle black limestone member of the Kunga Formation.	37
8, 15, 16, 18.	***Betraccium* (?) *incohatum*** new species Holotype (USNM 305889): Scale bar = 50, 15, 30, and 10 μm, respectively. Loc. OR-139. Upper Karnian?; lower to upper middle Norian. Rail Cabin Mudstone.	38
9, 12, 17, 19.	***Betraccium inornatum*** new species Holotype (USNM 305891): Scale bar = 86, 27, 38, and 30 μm, respectively. Loc. QC-24. Upper Norian. Middle black limestone member of the Kunga Formation.	38
10.	***Betraccium maclearni*** Pessagno and Blome Holotype (USNM 278003): Scale bar = 86 μm. Loc. QC-24. Upper Norian. Middle black limestone member of the Kunga Formation.	38
11, 14, 21.	***Betraccium yakounense*** Pessagno and Blome Holotype (USNM 278005): Scale bar = 75, 33, and 38 μm, respectively. Loc. QC-24. Upper Norian. Middle black limestone member of the Kunga Formation.	39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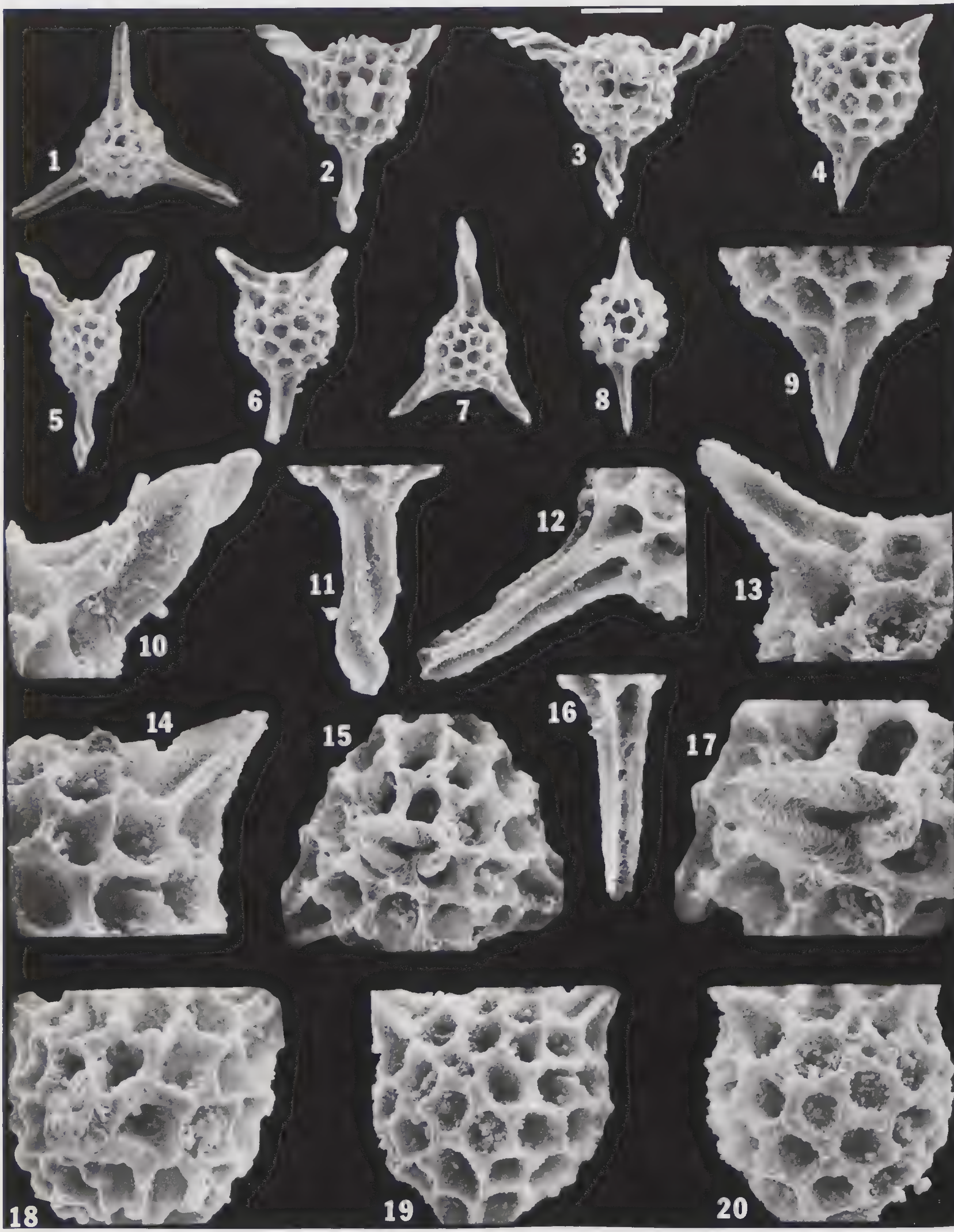
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EXPLANATION OF PLATE 6

All figures are scanning electron micrographs of Upper Triassic Pantanellinae.

Figure	Page

1, 12, 15, 16, 17. ***Cantalum alium*** new species 39
Holotype (USNM 305893): Scale bar = 75, 33, 30, 36, and 15 μm, respectively. Loc. QC-24.
Upper Norian. Middle black limestone member of the Kunga Formation.

2, 10, 11, 18. ***Cantalum globosum*** new species 39
Holotype (USNM 305895): Scale bar = 75, 20, 30, and 30 μm, respectively. Loc. QC-24.
Upper Norian. Middle black limestone member of the Kunga Formation.

3. ***Cantalum*** species A 40
Hypotype (Blome coll.): Scale bar = 86 μm. Loc. QC-24.
Note the extremely twisted primary spines. Upper Norian. Middle black limestone member of the Kunga Formation.

4, 9, 14, 19. ***Gorgansium acutum*** new species 40
Holotype (USNM 305897): Scale bar = 60, 30, 20, and 36 μm, respectively. Loc. OR-139.
Note the short, straight, primary spines. Upper Karnian?; lower to upper middle Norian. Rail Cabin Mudstone.

5. ***Gorgansium richardsoni*** Pessagno and Blome 40
Holotype (USNM 278009): Scale bar = 100 μm. Loc. QC-24.
Upper Norian. Middle black limestone member of the Kunga Formation.

6, 13, 20. ***Gorgansium*** species A 40
Hypotype (Blome coll.): Scale bar = 55, 18, and 26 μm, respectively. Loc. OR-148.
Upper Karnian?; lower to upper middle Norian. Rail Cabin Mudstone.

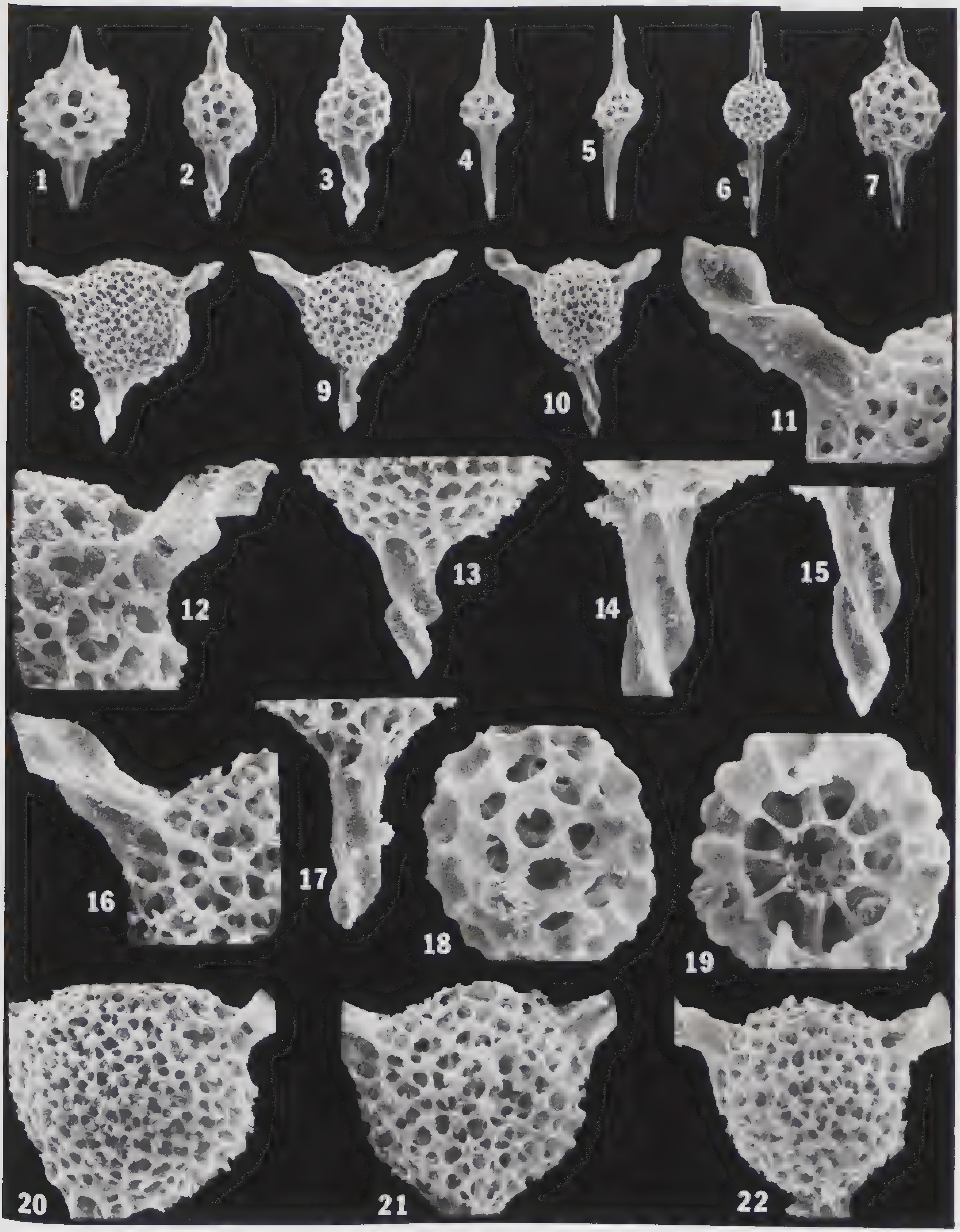
7. ***Gorgansium*** species B 40
Hypotype (Blome coll.): Scale bar = 60 μm. Loc. OR-148.
Upper Karnian?; lower to upper middle Norian. Rail Cabin Mudstone.

8. ***Pantanellium dawsoni*** Pessagno and Blome 41
Holotype (USNM 278031): Scale bar = 67 μm. Loc. QC-24.
Upper Norian. Middle black limestone member of the Kunga Formation.

EXPLANATION OF PLATE 7

All figures are scanning electron micrographs of Upper Triassic Spumellariina.

Figure		Page
1.	***Pantanellium fosteri*** Pessagno and Blome Holotype (USNM 278033): Scale bar = 60 μm. Loc. QC-24. Upper Norian. Middle black limestone member of the Kunga Formation.	41
2, 3, 18.	***Pantanellium rothwelli*** Pessagno and Blome Holotype (USNM 278045): Scale bar = 100, 109, and 36 μm, respectively. Loc. QC-24. Upper Norian. Middle black limestone member of the Kunga Formation.	41
4, 5.	***Pantanellium skidegatense*** Pessagno and Blome Holotype (USNM 278053): Scale bar = 109 and 100 μm, respectively. Loc. QC-24. Upper Norian. Middle black limestone member of the Kunga Formation.	41
6.	***Pantanellium*** species A Hypotype (Blome coll.): Scale bar = 134 μm. Loc. OR-39. Upper Karnian?; lower to upper middle Norian. Rail Cabin Mudstone.	42
7.	***Pantanellium*** species B Hypotype (Blome coll.): Scale bar = 67 μm. Loc. OR-39. Upper Karnian?; lower to upper middle Norian. Rail Cabin Mudstone.	42
8, 12, 13, 20.	***Ferresium contortum*** new species Holotype (USNM 305899): Scale bar = 86, 33, 46, and 50 μm, respectively. Loc. QC-24. Upper Norian. Middle black limestone member of the Kunga Formation.	42
9, 16, 17, 21.	***Ferresium hecatense*** new species Holotype (USNM 305901): Scale bar = 100, 30, 33, and 43 μm, respectively. Loc. QC-24. Upper Norian. Middle black limestone member of the Kunga Formation.	43
10, 11, 14, 15, 22.	***Ferresium laseekense*** new species Holotype (USNM 305903): Scale bar = 100, 30, 33, 33, and 50 μm, respectively. Loc. QC-24. Note that *F. laseekense* n. sp. has a cortical shell that is elliptical in outline and primary spines that display greater torsion when compared with *F. hecatense* n. sp. (Pl. 7, figs. 16, 17, 21). Upper Norian. Middle black limestone member of the Kunga Formation.	43
19.	***Pantanellium rothwelli*** Pessagno and Blome Hypotype (Blome coll.): Scale bar = 30 μm. Loc. QC-24. Note the large primary and secondary radial beams connecting medullary and cortical shells. Upper Norian. Middle black limestone member of the Kunga Formation.	41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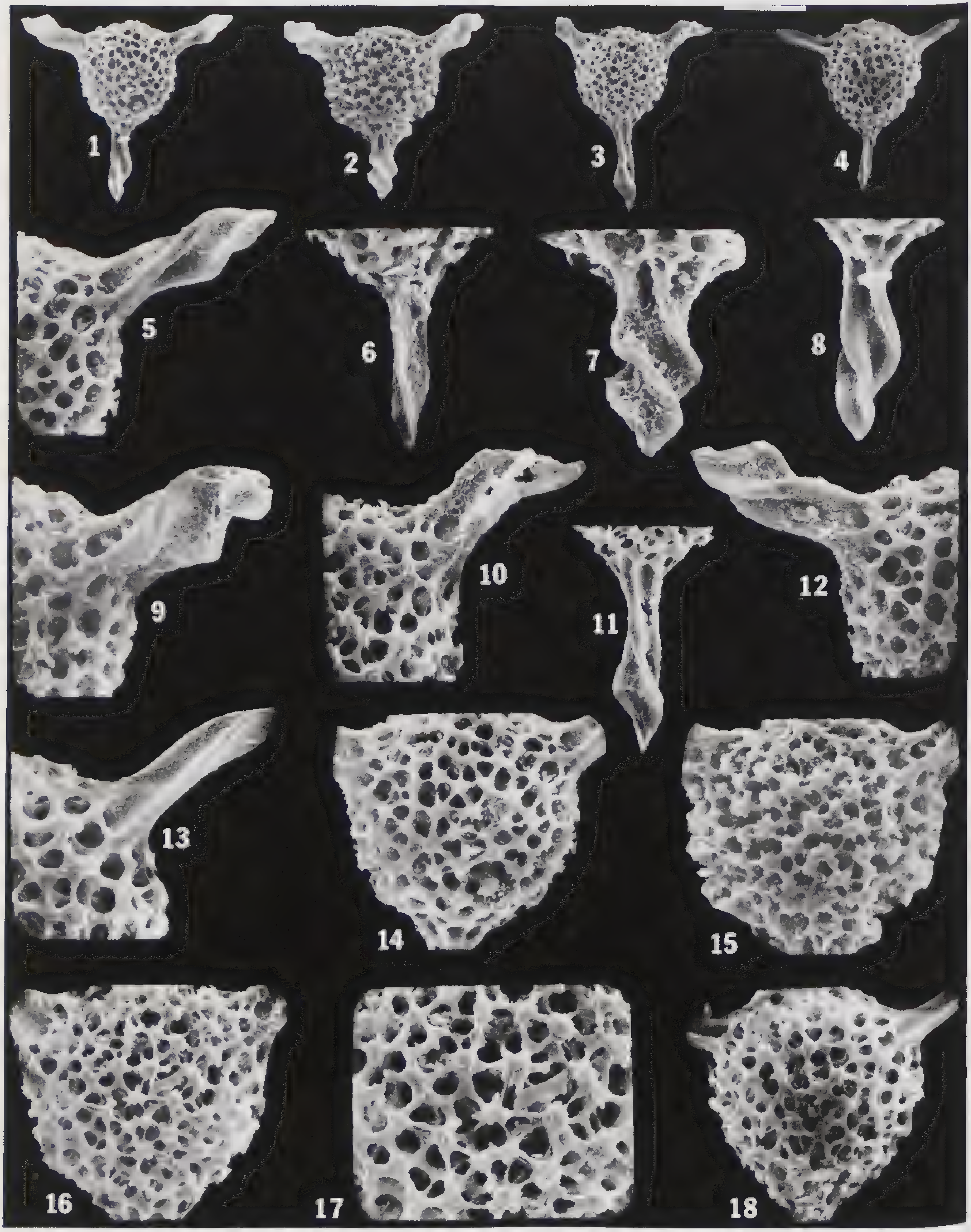
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EXPLANATION OF PLATE 8

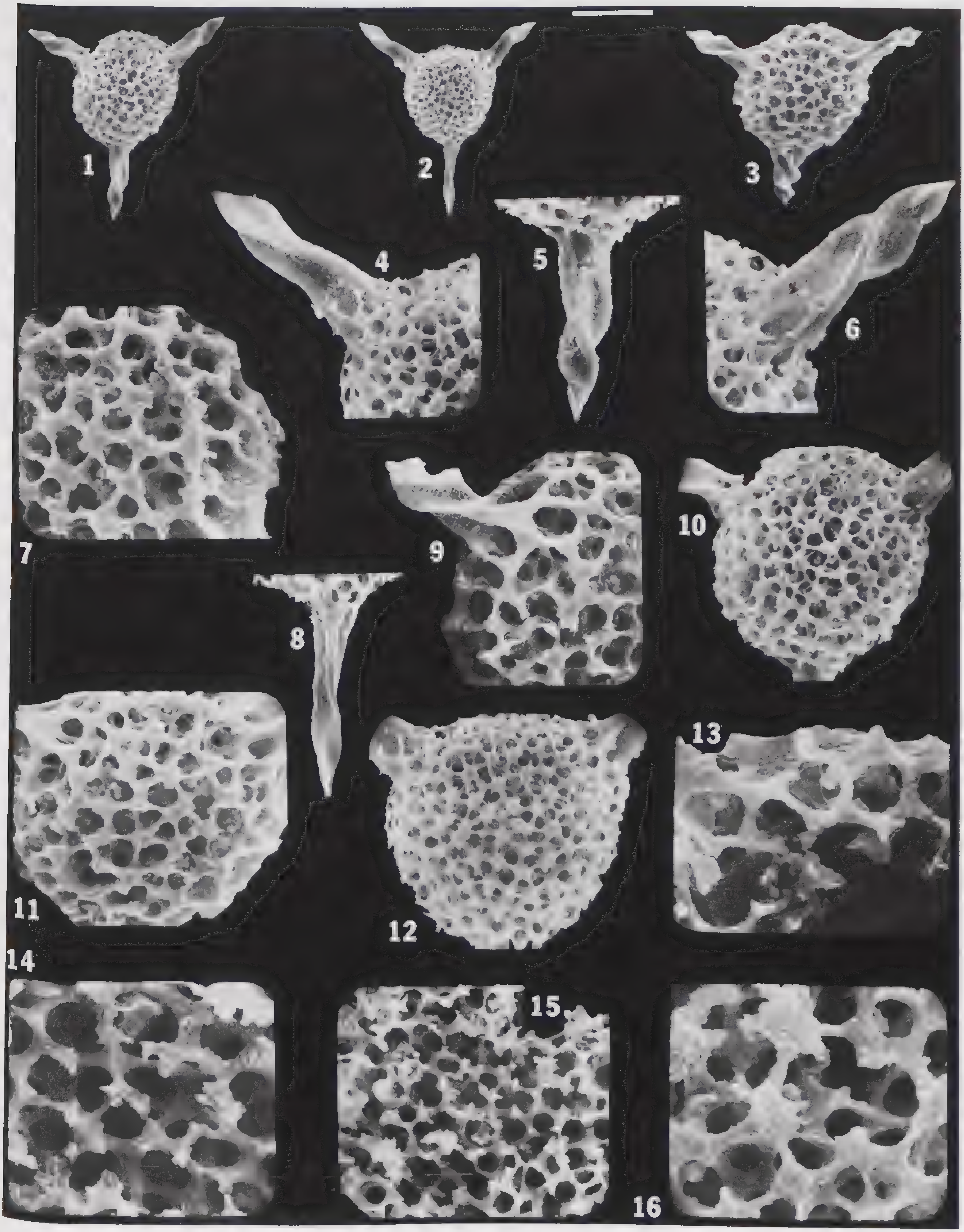
All figures are scanning electron micrographs of Upper Triassic (upper Norian) Spumellariina from the middle black limestone member of the Kunga Formation, Queen Charlotte Islands.

Figure		Page
1, 5, 8, 12, 14.	***Ferresium laseekense*** new species ... Paratype (USNM 305904): Scale bar = 100, 38, 38, 38, and 43 μm, respectively. Loc. QC-24.	43
2, 7, 9, 15.	***Ferresium loganense*** new species ... Holotype (USNM 305905): Scale bar = 86, 30, 30, and 40 μm, respectively. Loc. QC-24. Note that *F. loganense* n. sp. has a less inflated cortical shell and wider, more massive primary spines than does *F. contortum* n. sp. (Pl. 7, figs. 12, 13, 20).	43
3, 10, 11, 16, 17.	***Ferresium lyellense*** new species ... Holotype (USNM 305907): Scale bar = 86, 30, 43, 38, and 22 μm, respectively. Loc. QC-24. Note the primary spines, which are subequal in length, two spines being significantly shorter than the third.	44
4, 6, 13, 18.	***Ferresium titulense*** new species ... Holotype (USNM 305909): Scale bar = 78, 30, 26, and 43 μm, respectively. Loc. QC-24.	44

EXPLANATION OF PLATE 9

All figures are scanning electron micrographs of Upper Triassic (upper Norian) Spumellariina from the middle black limestone member of the Kunga Formation, Queen Charlotte Islands.

Figure		Page
1, 5, 6, 10.	***Ferresium*** species A Scale bar = 100, 40, 30, and 50 μm, respectively. Loc. QC-24.	45
2, 4, 8, 12.	***Ferresium*** species B Scale bar = 100, 38, 40, and 40 μm, respectively. Loc. QC-24.	45
3, 7, 9, 11.	***Ferresium*** species C Scale bar = 75, 27, 33, and 38 μm, respectively. Loc. QC-24.	45
13, 14, 15, 16.	Broken specimens of ***Ferresium*** showing internal structure Scale bar = 15, 15, 30, and 15 μm, respectively. Locs. QC-24 and QC-26. Note the three layers of polygonal pore frames comprising the cortical shell.	42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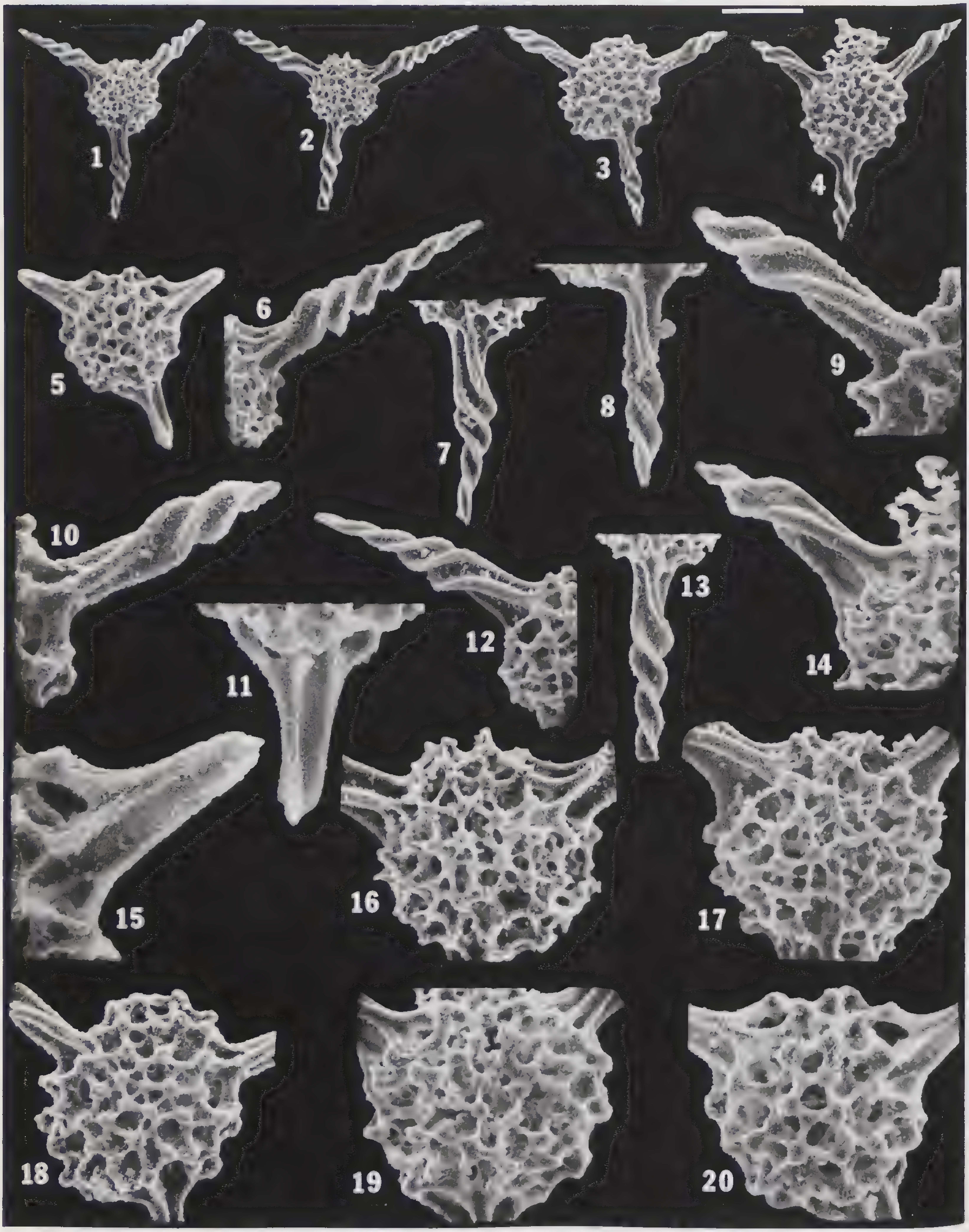
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EXPLANATION OF PLATE 10

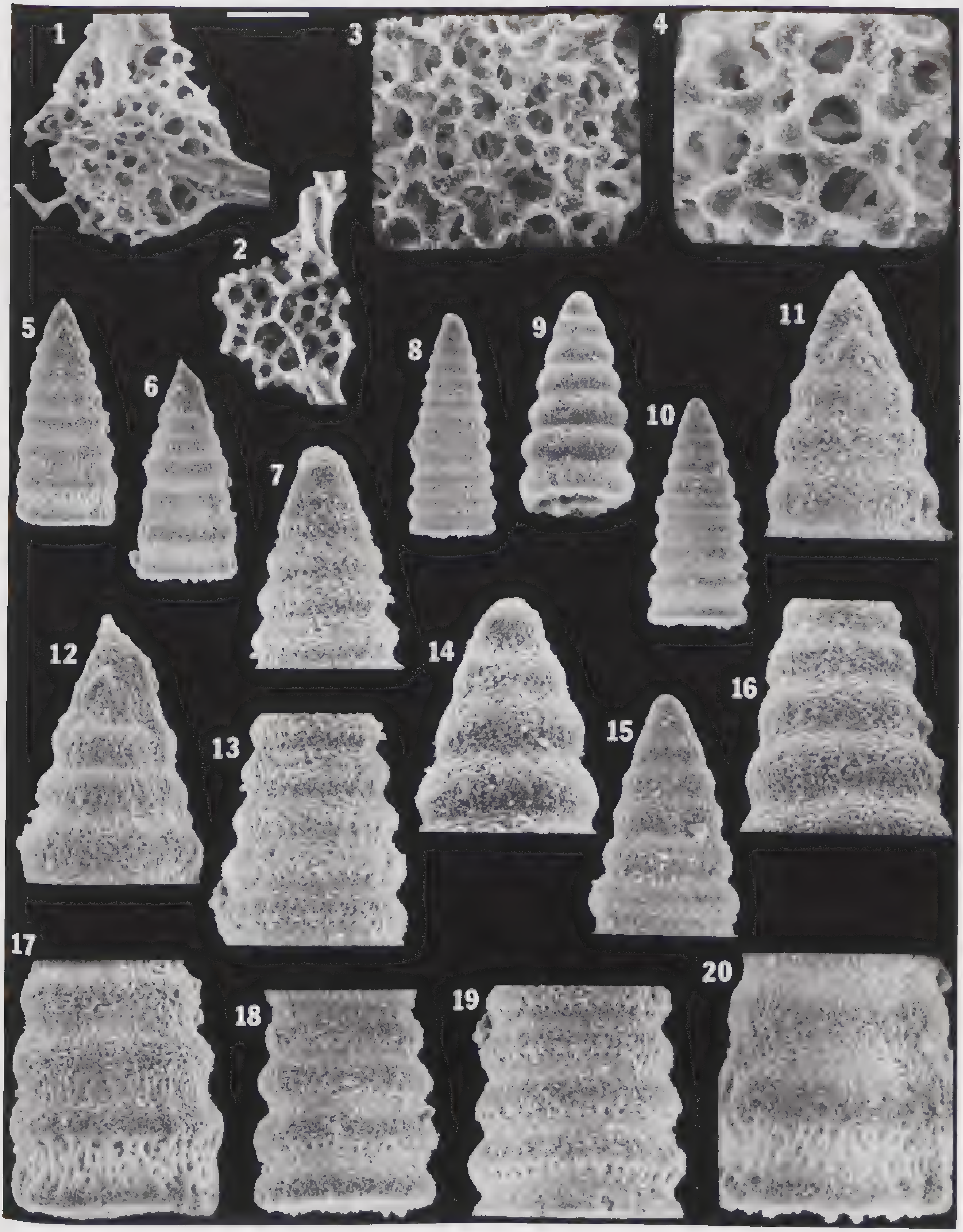
All figures are scanning electron micrographs of Upper Triassic (upper Karnian?; lower to upper middle Norian) Spumellariina from the Rail Cabin Mudstone, eastern Oregon.

Figure		Page
1, 7, 12, 16.	***Xenorum flexum*** new species Holotype (USNM 305911): Scale bar = 150, 75, 60, and 55 μm, respectively. Loc. OR-39.	45
2, 6, 13, 17.	***Xenorum flexum*** new species Paratype (USNM 305912): Scale bar = 150, 75, 75, and 55 μm, respectively. Loc. OR-39.	45
3, 8, 9, 10, 18.	***Xenorum largum*** new species Holotype (USNM 305913): Scale bar = 120, 60, 46, 46, and 67 μm, respectively. Loc. OR-39. Note that *X. largum* n. sp. has shorter primary spines that display lesser torsion than do those of *X. flexum* n. sp. (Pl. 10, figs. 6, 7, 12, 13).	46
4, 14, 19.	***Xenorum largum*** new species Paratype (USNM 305914): Scale bar = 171, 43, and 50 μm, respectively. Loc. OR-39.	46
5, 11, 15, 20.	***Xenorum*** species A Hypotype (Blome coll.): Scale bar = 75, 30, 26, and 40 μm, respectively. Loc. OR-39.	46

EXPLANATION OF PLATE 11

All figures are scanning electron micrographs of Upper Triassic (upper Karnian?; lower to upper middle Norian) Spumellariina and Nassellariina from the Rail Cabin Mudstone, eastern Oregon.

Figure		Page
1–4.	***Xenorum*** species	45
	Scale bar = 55, 67, 30, and 26 μm, respectively. Loc. OR-39. Note in figure 2 the simple spicule connecting interior of test to outer shell. Figures 3 and 4 exhibit polygonal pore frames with massive nodes at the pore frame vertices.	
5, 6, 11, 12, 16, 17, 20.	***Canoptum*** (?) ***browni*** new species	46
	5, 11, 16, 17. Holotype (USNM 305921): Scale bar = 75, 33, 33, and 38 μm, respectively. 6, 12, 20. Paratype (USNM 305922): Scale bar = 75, 33, and 30 μm, respectively. Both from Loc. OR-148. Note that *C.* (?) *browni* n. sp. has a cephalis with a horn, and a smaller number of post-abdominal chambers than does *C. farawayense* n. sp. (Pl. 11, figs. 8, 13, 19) and *C. macoyense* n. sp. (Pl. 11, figs. 15, 18).	
7, 8, 13, 19.	***Canoptum farawayense*** new species	47
	Holotype (USNM 305923): Scale bar = 43, 100, 43, and 43 μm, respectively. Loc. OR-39. Note that *C. farawayense* n. sp. has a greater number of post-abdominal chambers and less massive circumferential ridges than does *C. macoyense* n. sp. (Pl. 11, figs. 15, 18).	
9, 14.	***Canoptum laxum*** new species	47
	Holotype (USNM 305925): Scale bar = 60 and 30 μm, respectively. Loc. OR-6.	
10, 15, 18.	***Canoptum macoyense*** new species	48
	Holotype (USNM 305927): Scale bar = 86, 46, and 46 μm, respectively. Loc. OR-39.	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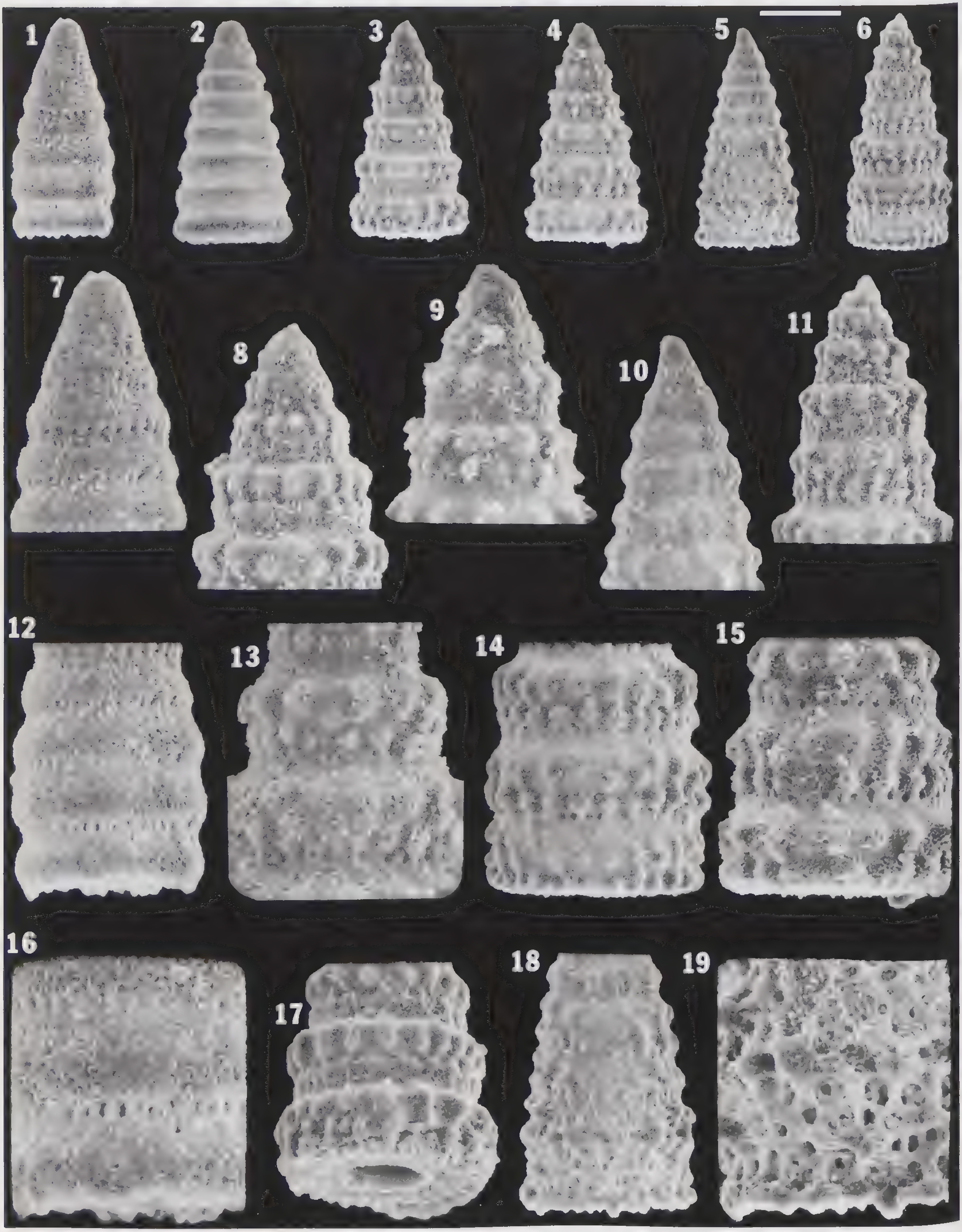
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EXPLANATION OF PLATE 12

All figures are scanning electron micrographs of Upper Triassic (upper Karnian?; lower to upper middle Norian) Nassellariina from the Rail Cabin Mudstone, eastern Oregon.

Figure | Page

1, 7, 12, 16. ***Canoptum*** species A 48
Hypotype (Blome coll.): Scale bar = 67, 38, 38, and 26 μm, respectively. Loc. OR-39.

2. ***Canoptum*** species B 48
Hypotype (Blome coll.): Scale bar = 60 μm. Loc. OR-39.

3, 8, 17. ***Pachus firmus*** new species 49
Holotype (USNM 305929): Scale bar = 75, 36, and 40 μm, respectively. Loc. OR-39.
Note that *P. firmus* n. sp. has post-abdominal chambers that increase more slowly in height, and narrower, less inflated circumferential ridges separating chambers than does *P. luculentus* n. sp. (Pl. 13, figs. 1, 6, 12).

4, 9, 15. ***Pachus firmus*** new species 49
Paratype (USNM 305930): Scale bar = 75, 33, and 36 μm, respectively. Loc. OR-39.

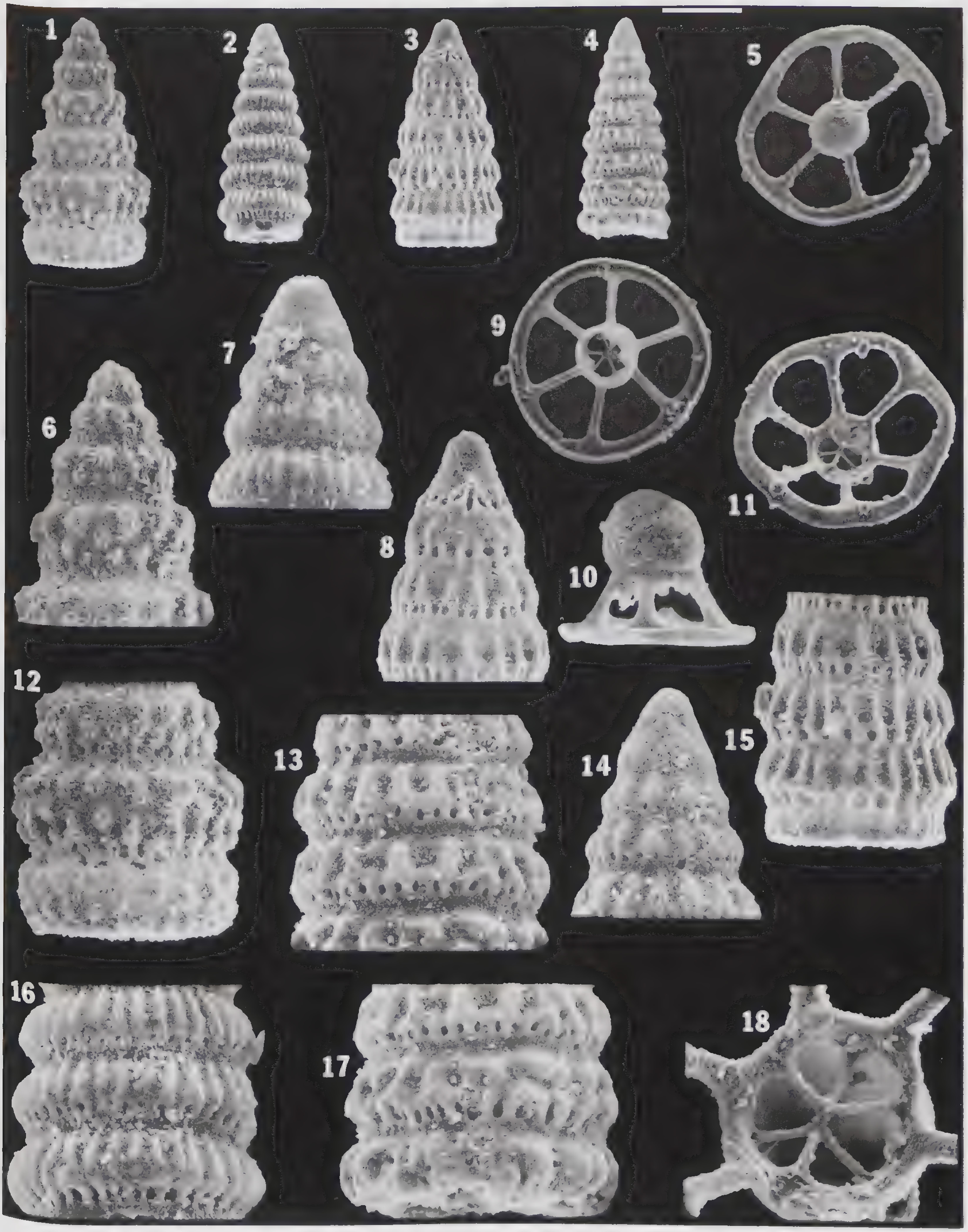
5, 10, 18, 19. ***Pachus*** (?) ***indistinctus*** new species 49
Holotype (USNM 305931): Scale bar = 86, 43, 50, and 30 μm, respectively. Loc. OR-39.

6, 11, 13, 14. ***Pachus longinquus*** new species 49
Holotype (USNM 305933): Scale bar = 86, 50, 30, and 46 μm, respectively. Loc. OR-39.
Note that *P. longinquus* n. sp. has circumferential ridges with one to two rows of nodes that are smaller and less massive than those of *P. firmus* n. sp. (Pl. 12, figs. 8, 9, 15, 17).

EXPLANATION OF PLATE 13

All figures are scanning electron micrographs of Upper Triassic (upper Karnian?; lower to upper middle Norian) Nassellariina from the Rail Cabin Mudstone, eastern Oregon.

Figure		Page
1, 6, 12.	***Pachus luculentus*** new species Holotype (USNM 305935): Scale bar = 75, 38, and 43 μm, respectively. Loc. OR-39.	50
2, 7, 16.	***Corum perfectum*** new species Holotype (USNM 305915): Scale bar = 86, 30, and 30 μm, respectively. Loc. OR-148. Note that *C. perfectum* n. sp. has a greater number of post-abdominal chambers and broader costae than does *C. regium* n. sp. (Pl. 13, figs. 8, 15).	51
3, 8, 15.	***Corum regium*** new species Holotype (USNM 305917): Scale bar = 75, 40, and 40 μm, respectively. Loc. OR-39.	51
4, 13, 14, 17.	***Corum speciosum*** new species Holotype (USNM 305919): Scale bar = 100, 30, 30, and 30 μm, respectively. Loc. OR-143. Note that *C. speciosum* n. sp. has fewer post-abdominal chambers and extremely inflated costae, compared with *C. perfectum* n. sp. (Pl. 13, figs. 7, 16) and *C. regium* n. sp. (Pl. 13, figs. 8, 15).	51
5, 9, 11, 18.	***Pseudosaturniforma carnica*** Kozur and Mostler Hypotype (Blome coll.): Scale bar = 171, 100, 100, and 30 μm, respectively. Loc. OR-39.	52
10.	***Pseudosaturniforma minuta*** new species Holotype (USNM 305937): Scale bar = 67 μm. Loc. OR-139. Note that *P. minuta* n. sp. has a larger cephalis and a comparatively small cephalic ring, compared with *P. carnica* Kozur and Mostler (Pl. 13, figs. 5, 9, 11).	52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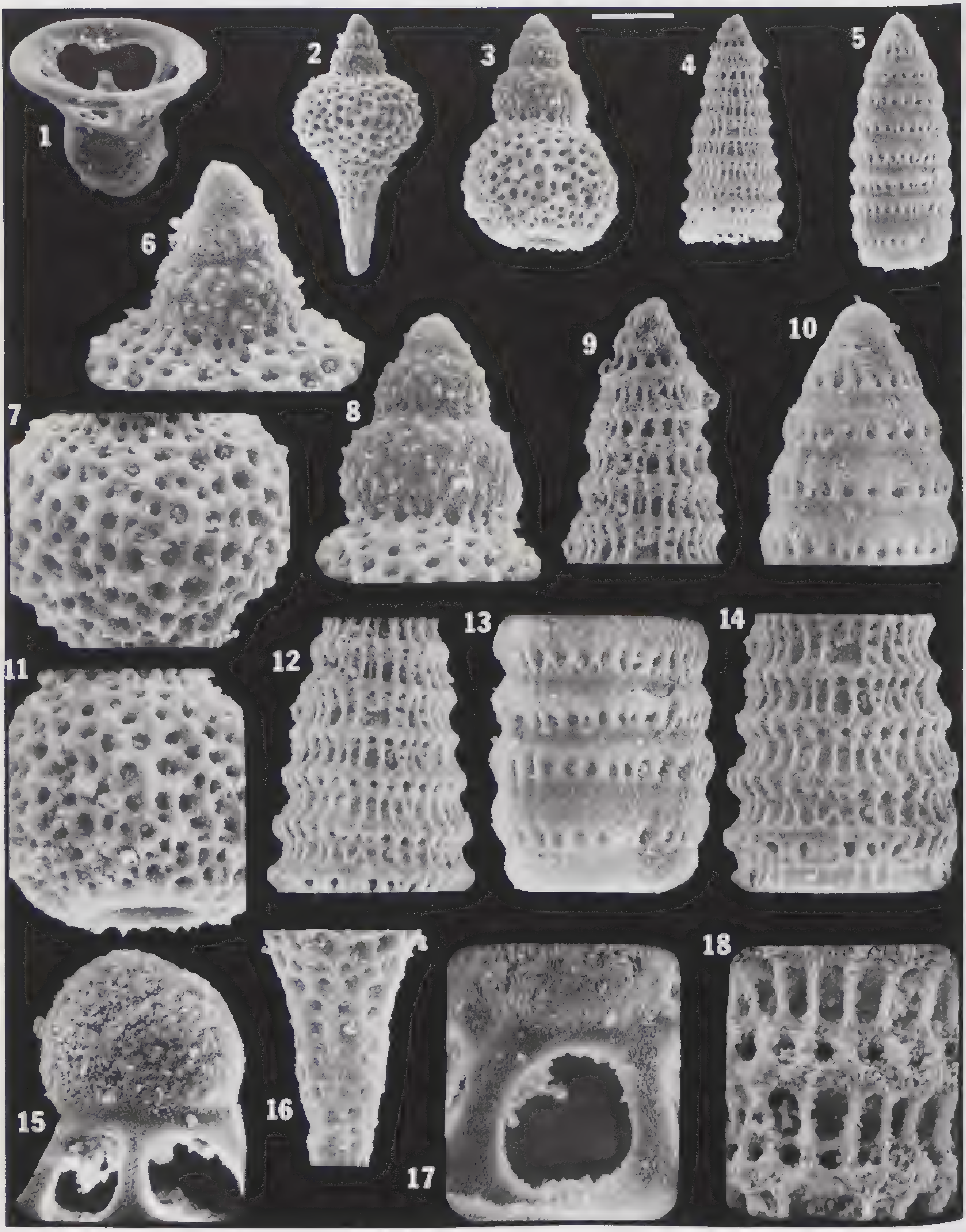
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EXPLANATION OF PLATE 14

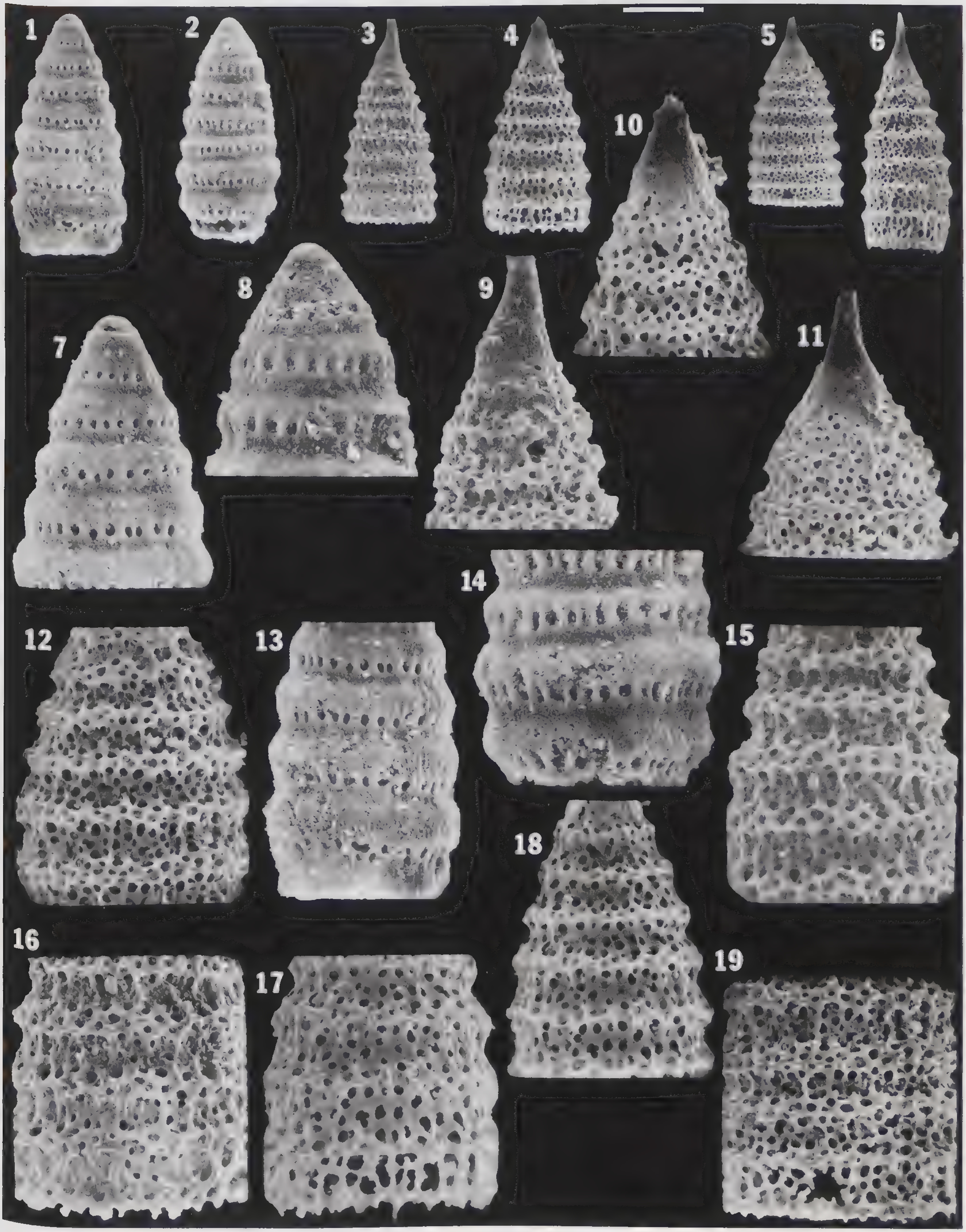
All figures are scanning electron micrographs of Upper Triassic (upper Karnian?; lower to upper middle Norian) Nassellariina from the Rail Cabin Mudstone, eastern Oregon.

Figure		Page
1, 15, 17.	***Pseudosaturniforma minuta*** new species .... Paratype (USNM 305938): Scale bar = 67, 30, and 20 μm, respectively. Loc. OR-139.	52
2, 6, 7, 16.	***Syringocapsa turgida*** new species .... Holotype (USNM 305939): Scale bar = 86, 30, 30, and 30 μm, respectively. Loc. OR-143.	53
3, 8, 11.	***Canesium lentum*** new species .... Holotype (USNM 305941): Scale bar = 60, 30, and 36 μm, respectively. Loc. OR-143.	53
4, 9, 12, 14, 18.	***Castrum perornatum*** new species .... Holotype (USNM 305943): Scale bar = 100, 50, 50, 43, and 20 μm, respectively. Loc. OR-39.	54
5, 10, 13.	***Latium longulum*** new species .... Holotype (USNM 305945): Scale bar = 67, 30, and 30 μm, respectively. Loc. OR-143. Note that *L. longulum* n. sp. has a greater number of post-abdominal chambers, which maintain the same width throughout most of the length [compare to *L. mundum* n. sp. (Pl. 15, figs. 7, 13) and *L. paucum* n. sp. (Pl. 15, figs. 8, 14)].	55

EXPLANATION OF PLATE 15

All figures are scanning electron micrographs of Upper Triassic Nassellariina.

Figure		Page
1, 7, 13.	***Latium mundum*** new species	55
	Holotype (USNM 305947): Scale bar = 75, 40, and 43 μm, respectively. Loc. OR-143. Upper Karnian?; lower to upper middle Norian. Rail Cabin Mudstone.	
2, 8, 14.	***Latium paucum*** new species	55
	Holotype (USNM 305949): Scale bar = 75, 30, and 30 μm, respectively. Loc. OR-148. Note that *L. paucum* n. sp. has a greater number of pores that are visible laterally, and post-abdominal chambers that increase less rapidly in width, than does *L. mundum* n. sp. (Pl. 15, figs. 7, 13). Upper Karnian?; lower to upper middle Norian. Rail Cabin Mudstone.	
3, 9, 15, 16.	***Laxtorum atliense*** new species	56
	Holotype (USNM 305951): Scale bar = 100, 30, 30, and 30 μm, respectively. Loc. QC-24. Note that *L. atliense* n. sp. has a more elongate horn than does *L. hindei* n. sp. (Pl. 15, figs. 10, 17, 18). Upper Norian, Middle black limestone member of the Kunga Formation.	
4, 10, 17, 18.	***Laxtorum hindei*** new species	56
	Holotype (USNM 305953): Scale bar = 67, 30, 27, and 30 μm, respectively. Loc. QC-24. Upper Norian. Middle black limestone member of the Kunga Formation.	
5, 11, 12, 19.	***Laxtorum kulensis*** new species	57
	Holotype (USNM 305955): Scale bar = 86, 30, 30, and 30 μm, respectively. Loc. QC-24 Note that *L. kulensis* n. sp. has a more inflated, wider test than do *L. atliensis* n. sp. (Pl. 15, figs. 9, 15, 16) and *L. hindei* n. sp. (Pl. 15, figs. 10, 17, 18). Upper Norian. Middle black limestone member of the Kunga Formation.	
6.	***Laxtorum*** species A	57
	Hypotype (Blome coll.): Scale bar = 75 μm. Loc. QC-24. Upper Norian. Middle black limestone member of the Kunga Formation.	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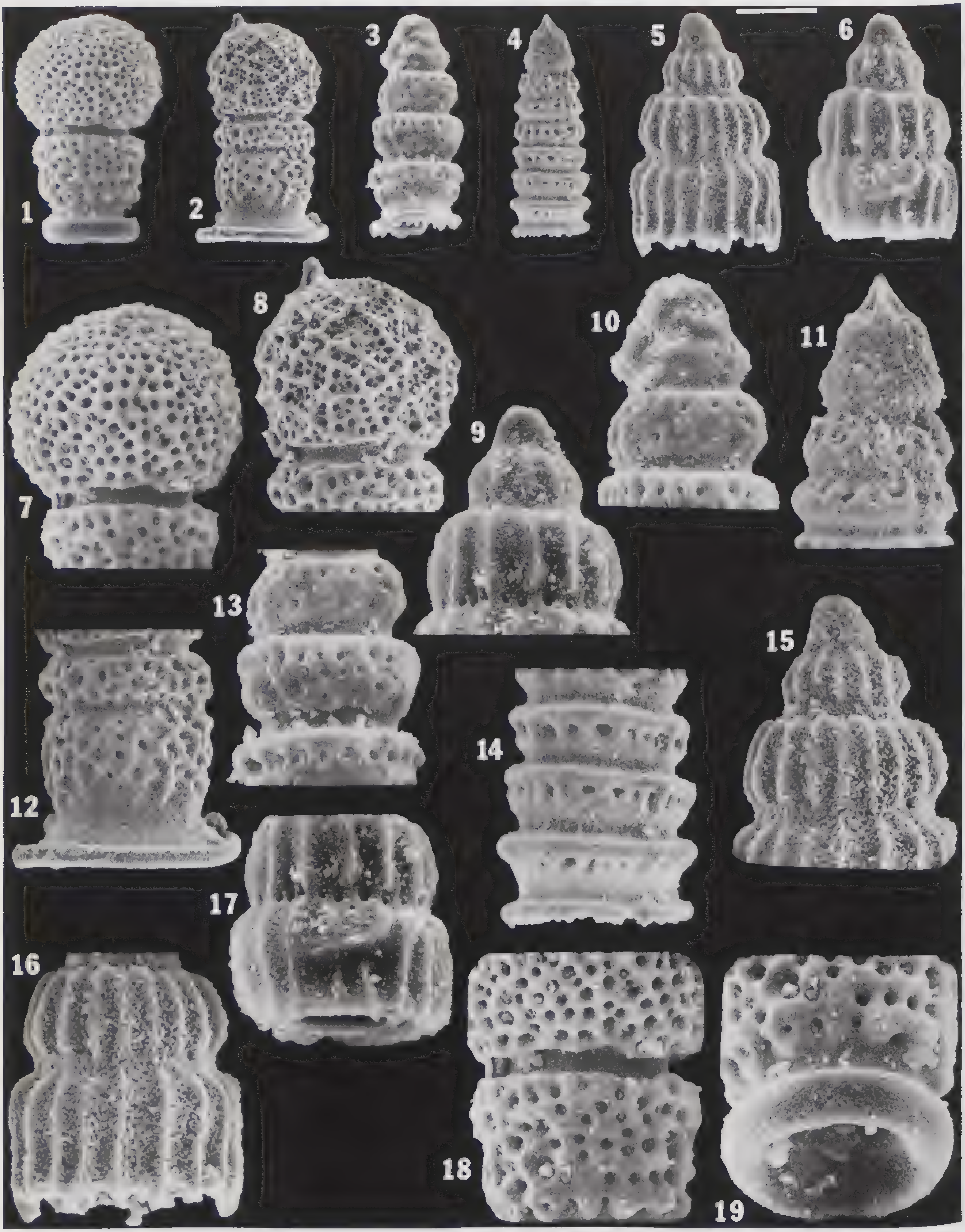
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EXPLANATION OF PLATE 16

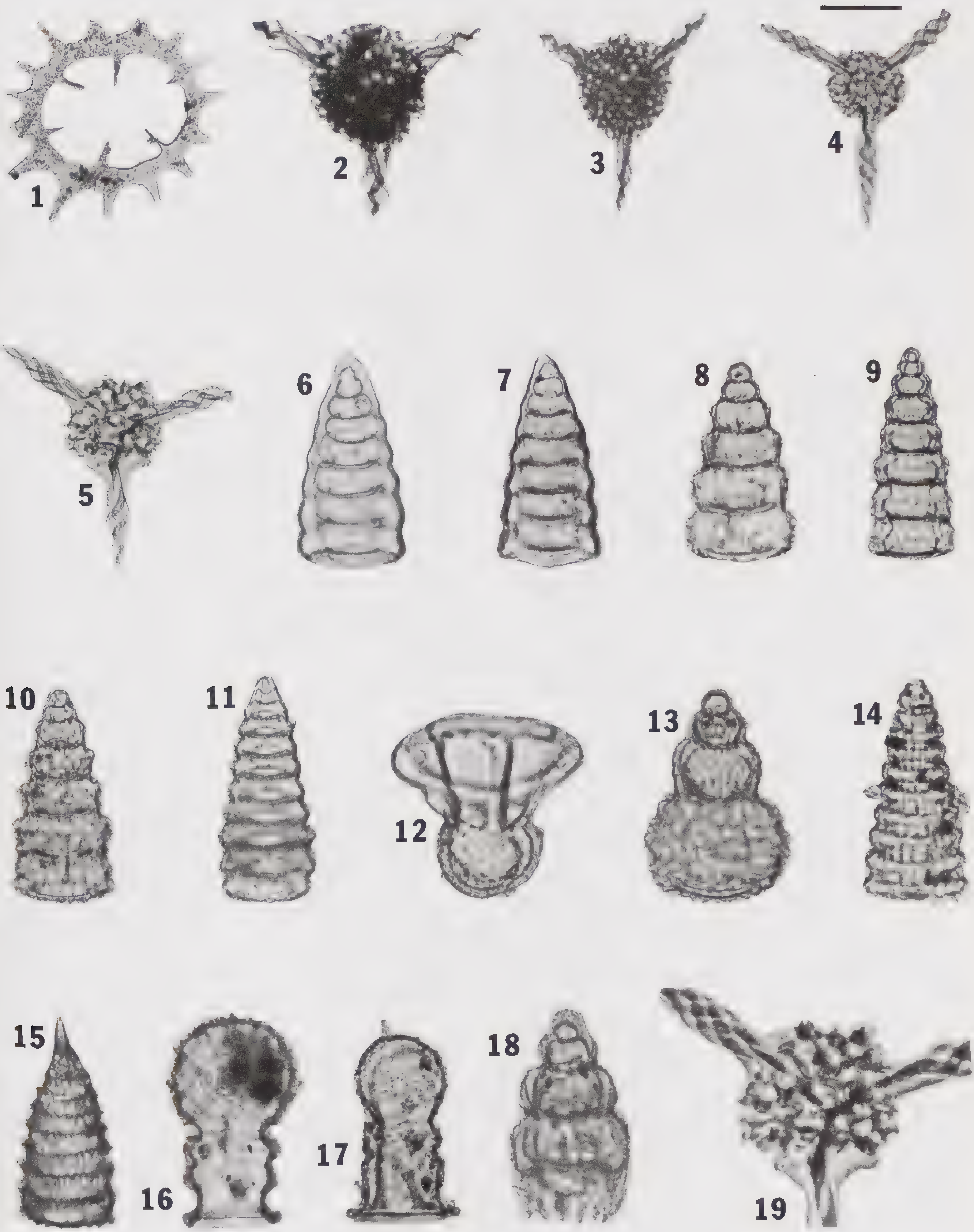
All figures are scanning electron micrographs of Upper Triassic (upper Karnian?; lower to upper middle Norian) Nassellariina from the Rail Cabin Mudstone, eastern Oregon.

Figure		Page
1, 7, 18, 19.	***Quasipetasus disertus*** new species	57
	Holotype (USNM 305961): Scale bar = 75, 50, 38, and 30 μm, respectively. Loc. OR-143. Note that *Q. disertus* n. sp. has a wider, more bulbous cephalis that lacks a horn, and a more massive thoracic skirt than does *Q. insolitus* n. sp. (Pl. 16, figs. 8, 12).	
2, 8, 12.	***Quasipetasus insolitus*** new species	58
	Holotype (USNM 305963): Scale bar = 86, 50, and 50 μm, respectively. Loc. OR-39.	
3, 10, 13.	***Triassocampe immaturum*** new species	58
	Holotype (USNM 305957): Scale bar = 67, 30, and 30 μm, respectively. Loc. OR-148. Note that *T. immaturum* n. sp. has a cephalis that lacks a horn, and more inflated chambers than does *T. proprium* n. sp. (Pl. 16, figs. 11, 14).	
4, 11, 14.	***Triassocampe proprium*** new species	59
	Holotype (USNM 305959): Scale bar = 100, 43, and 43 μm, respectively. Loc. OR-39.	
5, 15, 16.	***Xipha striata*** new species	60
	Holotype (USNM 305965): Scale bar = 50, 30, and 30 μm, respectively. Loc. OR-39. Note that *X. striata* n. sp. has more massive costae and well-developed costal extensions than does *X. pessagnoi* Nakaseko and Nishimura (Pl. 16, figs. 6, 9, 17).	
6, 9, 17.	***Xipha pessagnoi*** Nakaseko and Nishimura	59
	Hypotype (Blome coll.): Scale bar = 60, 30, and 30 μm, respectively. Loc. OR-143.	

EXPLANATION OF PLATE 17

All figures are transmitted light photomicrographs of Upper Triassic Spumellariina and Nasellariina.

Figure		Page
1.	***Pseudoheliodiscus sandspitensis*** new species Paratype (USNM 305888): Scale bar = 171 μm. Loc. QC-24. Upper Norian. Middle black limestone member of the Kunga Formation.	27
2.	***Ferresium laseekense*** new species Paratype (USNM 305904): Scale bar = 86 μm. Loc. QC-24. Upper Norian. Middle black limestone member of the Kunga Formation.	43
3.	***Ferresium*** species B Hypotype (Blome coll.): Scale bar = 100 μm. Loc. QC-24. Upper Norian. Middle black limestone member of the Kunga Formation.	45
4.	***Xenorum flexum*** new species Paratype (USNM 305912): Scale bar = 150 μm. Loc. OR-39. Upper Karnian?; lower to upper middle Norian. Rail Cabin Mudstone.	45
5, 19.	***Xenorum largum*** new species Paratype (USNM 305914): Scale bar = 120 and 86 μm, respectively. Loc. OR-39. Upper Karnian?; lower to upper middle Norian. Rail Cabin Mudstone.	46
6.	***Canoptum*** (?) ***browni*** new species Paratype (USNM 305922): Scale bar = 86 μm. Loc. OR-39. Upper Karnian?; lower to upper middle Norian. Rail Cabin Mudstone.	46
7.	***Canoptum macoyense*** new species Paratype (USNM 305928): Scale bar = 120 μm. Loc. OR-39. Upper Karnian?; lower to upper middle Norian. Rail Cabin Mudstone.	48
8.	***Pachus firmus*** new species Paratype (USNM 305930): Scale bar = 100 μm. Loc. OR-39. Upper Karnian?; lower to upper middle Norian. Rail Cabin Mudstone.	49
9.	***Pachus longinquus*** new species Paratype (USNM 305934): Scale bar = 120 μm. Loc. OR-39. Upper Karnian?; lower to upper middle Norian. Rail Cabin Mudstone.	49
10.	***Pachus luculentus*** new species Paratype (USNM 305936): Scale bar = 100 μm. Loc. OR-39. Upper Karnian?; lower to upper middle Norian. Rail Cabin Mudstone.	50
11.	***Corum perfectum*** new species Paratype (USNM 305916): Scale bar = 86 μm. Loc. OR-148. Upper Karnian?; lower to upper middle Norian. Rail Cabin Mudstone.	51
12.	***Pseudosaturniforma minuta*** new species Paratype (USNM 305938): Scale bar = 67 μm. Loc. OR-139. Upper Karnian?; lower to upper middle Norian. Rail Cabin Mudstone.	52
13.	***Canesium lentum*** new species Paratype (USNM 305942): Scale bar = 75 μm. Loc. OR-143. Upper Karnian?; lower to upper middle Norian. Rail Cabin Mudstone.	53
14.	***Castrum perornatum*** new species Paratype (USNM 305944): Scale bar = 120 μm. Loc. OR-39. Upper Karnian?; lower to upper middle Norian. Rail Cabin Mudstone.	54
15.	***Laxtorum atliense*** new species Paratype (USNM 305952): Scale bar = 100 μm. Loc. QC-24. Upper Norian. Middle black limestone member of the Kunga Formation.	56
16.	***Quasipetasus disertus*** new species Paratype (USNM 305962): Scale bar = 100 μm. Loc. OR-143. Upper Karnian?; lower to upper middle Norian. Rail Cabin Mudstone.	57
17.	***Quasipetasus insolitus*** new species Paratype (USNM 305964): Scale bar = 150 μm. Loc. OR-39. Upper Karnian?; lower to upper middle Norian. Rail Cabin Mudstone.	58
18.	***Xipha striata*** new species Paratype (USNM 305966): Scale bar = 75 μm. Loc. OR-39. Upper Karnian?; lower to upper middle Norian. Rail Cabin Mudstone.	60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Note: Page numbers are in light face, plate numbers are in **bold face** type; **F** and **B** indicate foldouts inside front and back covers, respectively.

Text-figure 6.—Radiolarian zonation for the Upper Triassic of eastern Oregon, Baja California, and the Queen Charlotte Islands, British Columbia. Genera arranged alphabetically; species within each genus arranged biostratigraphically. ¦ = rare; | = common; ▌= abundant; ? = questionable occurrence.

PREPARATION OF MANUSCRIPTS

Bulletins of American Paleontology usually comprises two or more separate monographs in two volumes each year. This series is a publication outlet for significant longer paleontological monographs for which high quality photographic illustrations and the large quarto format are a requisite.

Manuscripts submitted for publication in this monograph series must be typewritten, and double-spaced *throughout* (including direct quotations and references). All manuscripts should contain a table of contents, lists of text-figures and (or) tables, and a short, informative abstract that includes names of all new taxa. Format should follow that of recent numbers in the series. All measurements must be stated in the metric system, alone or in addition to the English system equivalent. The maximum dimensions for photographic plates are 178 mm × 229 mm (7″ × 9″; outlined on this page). Single-page text-figures should be drafted for reproduction as single column (82 mm; 3¼″) or full page (178 mm; 7″) width, but arrangements can be made to publish text-figures that must be larger. Any lettering in illustrations should follow the recommendations of Collinson (1962).

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Authors are requested to enclose $10 with each manuscript submitted, to cover costs of postage during the review process.

Collinson, J.
1962. *Size of lettering for text-figures.* Journal of Paleontology, vol. 36, p. 1402.

Gilbert Dennison Harris
(1864 - 1952)

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