

# Upper Bathonian (Middle Jurassic) Radiolarians from Snowshoe Formation, east-central Oregon, USA

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**Abstract.** This report represents the first comprehensive analysis of uppermost Bathonian (Middle Jurassic) Radiolaria from the South Fork Member of Snowshoe Formation, east-central Oregon. A total of 238 morphotypes are illustrated, among which 3 new genera (*Corona*, *Nidus* and *Secretacapsa*) and 24 new species are described. The results of this study provide a basic foundation for all future studies of Radiolaria from the Boreal upper Bathonian strata of the Snowshoe Formation. In addition, these data should further document the faunal change that occurred in the Izee Terrane from the Toarcian Tethyan Realm to the Bathonian Boreal Realm. Finally, these data may assist in the development of a more precise radiolarian zonation for the Middle Jurassic.

**Key words:** radiolarian, upper Bathonian, Middle Jurassic, Snowshoe Formation, east-central Oregon

## INTRODUCTION

This is the third in a series of studies dealing with the radiolarian assemblage of the Snowshoe Formation, east-central Oregon, USA. The present study focuses on the Boreal upper Bathonian radiolarian assemblage of the South Fork Member of the Snowshoe Formation.

For the last three decades many well preserved radiolarians have been extracted from micritic limestone nodules collected at a number of horizons throughout the Snowshoe Formation. The results from these preliminary studies demonstrate that the Snowshoe radiolarian faunas range in age from Early Jurassic (Toarcian) to Middle Jurassic (latest Bathonian). Many distinctive forms, such as pantanelliids and multicyrtilid nassellarians, were described in earlier reports by Pessagno and Blome 1980; Pessagno and Whalen 1982; Pessagno, Whalen and Yeh, 1986; MacLeod 1988; and Pessagno et al. 1989.

## STRATIGRAPHIC SUMMARY OF SNOWSHOE FORMATION

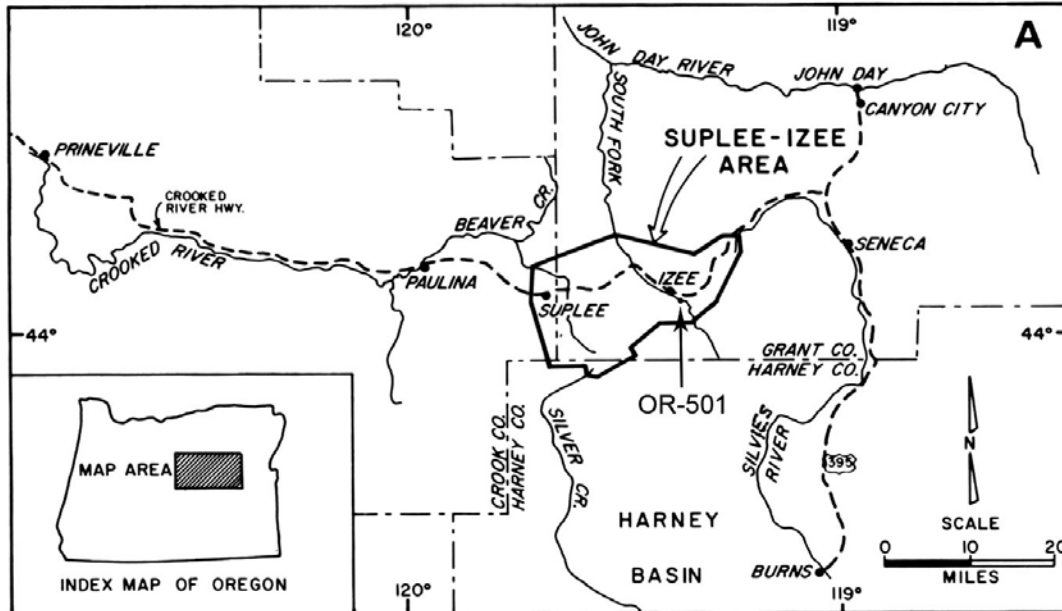
The Snowshoe Formation rests conformably on the Hyde Formation and either conformably or unconformably beneath the Trowbridge Formation. It was subdivided into three informal member units by Dickinson and Vigrass (1965) which were subsequently formally named by Smith (1980). These are in ascending order: the Warm Springs Member, the Schoolhouse Member and the South Fork Member. In its type area near Izee (text-figure 1), the total thickness of the Snowshoe Formation is about 838 m (2750 f) (Dickinson and Vigrass 1965). To the east and west of Izee, the Schoolhouse Member interfingers respectively with the mudstone, tuff breccia, and volcanic conglomerate of the Silvie Member and the tuff breccia and volcanic sandstone of the Basey Member (Dickinson and Vigrass 1965; Imlay 1973, 1980). The South Fork Member rests conformably or unconformably beneath the Trowbridge

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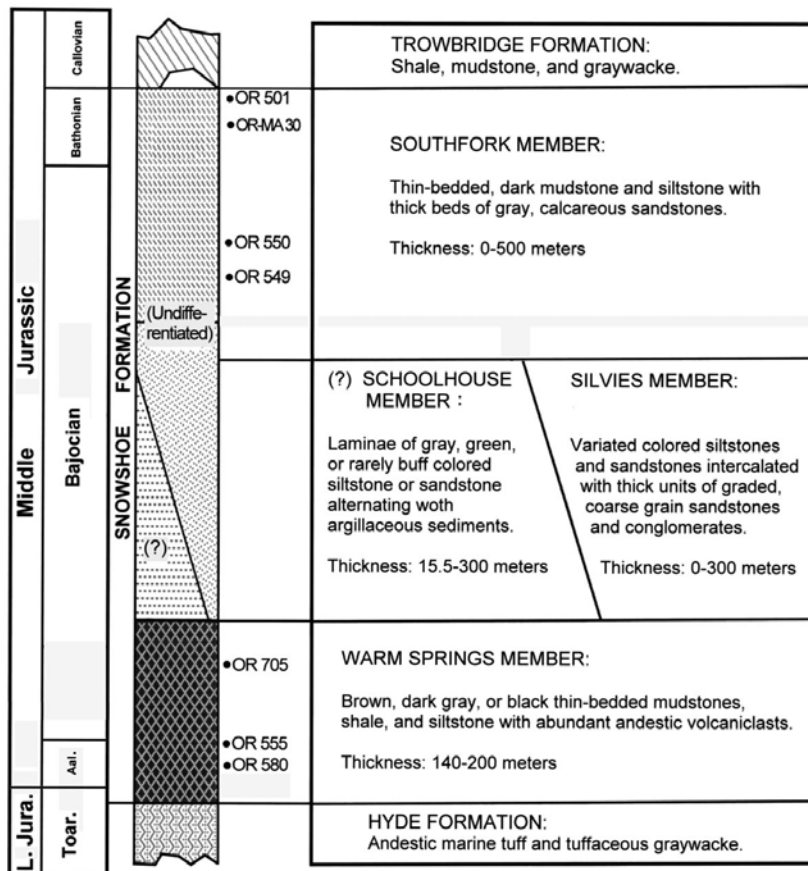
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Formation (lower Callovian) (text-figure 2). In members where mudstone and shale predominate (e.g., Schoolhouse Member and Warm Springs Member) nodules and concretions consisting

of dark to medium gray micrite are frequently common. These nodules often contain well-preserved silicified Radiolaria as well as ammonites. (i.e., Pessagno and Blome 1980;



TEXT-FIGURE 1. Sample locality and map of Suplee-Izee area, east-central Oregon.



TEXT-FIGURE 2. Generalized stratigraphic column (not to scale) of the Snowshoe Formation in the Izee-Seneca area; the Schoolhouse Member is not recognized in the field; sample localities are marked at proper stratigraphic horizons (modified from Tang 1994); please noted that the horizons of OR555 and OR580 are corrected.

Pessagno and Whalen 1982; Yeh 1987a, b; Yeh 2009, 2011; and Pessagno et al. 1989). The co-occurrence of ammonites and Radiolaria both in many of these nodules themselves and at nodule-bearing horizons allowed Pessagno et al. (1989) to integrate radiolarian biostratigraphic data directly with that of the ammonites and to develop a more accurate system of Radiolarian zonation for the Lower and Middle Jurassic.

## LOCALITY DESCRIPTION

### OR501A, B, C

Uppermost part of South Fork Member, Snowshoe Formation. Dark-gray mudstone with common dark-gray micritic limestone nodules just below the conformable contact with green vitric tuff at base of overlying Trowbridge Formation. Interbedded greywacke becoming more common down section at this locality.

Sample OR501C was collected just below the contact with the overlying Trowbridge Formation. Samples OR501 A and OR501B were collected somewhat below OR501C and within 1m (3.28f) interval below the contact. USGS Izee Quadrangle (15'): T17S; R29E; SE1/4 section 29, strata cropping out on northeast side of Grant County Road 63 (Izee-Paulian Rd.) about 0.65 km (0.4 mi) east of settlement of Izee (Pessagno et al. 1986, Pessagno et al. 1989).

## AGE DETERMINED ON THE BASIS OF AMMONITES

An ammonite sample was collected by Blome and Pessagno at 37.8m (124f) below the top of the South Fork Member and identified by Imlay as *Xenocephalites vicarious* Imlay. According to Imlay (1982, written communication with Pessagno), this species occurs from the upper 183m (600f) of the Snowshoe Formation, all the Trowbridge Formation and the lower 2134m (7000f) of the Lonesome Formation; and the range of this species is Bathonian to middle Callovian.

In Izee area, upper Bathonian beds have been identified with ammonites in the upper 210m (689f) of the South Fork Member (Smith 1980, p.1605) at the top of the Snowshoe Formation (Imlay 1981, p. 6-10). The ammonite faunas are characterized by *Iniskinites* and *Cobbanites*,

which are not known above the upper Bathonian, and by associating with *Xenocephalites*, *Kepplerites* and *Torricelliceras*, which are not known below the upper Bathonian and whose lowermost occurrences are respectively 190m, 170m and 180m below the top of South Fork Member (Imlay 1986, p.56).

## MATERIAL STUDIED

The radiolarian assemblages for this study were extracted separately from three limestone nodules which were collected by Pessagno and Blome from localities OR501A, B and C in 1977 (see Locality Description). Numerous Radiolaria from these samples were studied and illustrated in previous reports by Pessagno and Blome 1980 and 1982, Pessagno and Whalen 1982, Pessagno et al. 1986, and Pessagno and Yang 1989. The materials used in this study are exactly the same residual samples. Some radiolarian forms from a small portion of the residual sample OR501C have also been examined and reported by Nagai and Mizutani (1992).

## FAUNAL COMPOSITION

Totally 238 radiolarian morphotypes (17 entactinarians, 103 nassellarians and 118 spumellarians) were identified and assigned to 75 genera (7 entactinarians, 35 nassellarians and 33 spumellarians) and 39 families (5 entactinarians, 20 nassellarians and 14 spumellarians). Among them 3 new genera (*Corona*, *Nidus* and *Secretacapsula*) and 24 new species were described. Tables 1, 2 and 3 are the lists to show the diversities in family and genus (including the species number of each genus and relative abundance of each genus).

## SYSTEMATIC PALEONTOLOGY

In this section, the designation USNM (547352-547399) refers to the repository numbers of type specimens at the National Museum of Natural History, Smithsonian Institution, Washington, D.C. The taxa of the studied faunas are illustrated in the plates (1-28) with SEM photos of same scale (x100) and some with higher magnification when necessary. Range and

Table 1. Diversity and relative abundance of entactinarian genera

Family	Genus	No. of sp./form	Relative Abundance
1. Centrocubidae	1. <i>Marianasphaera</i>	1	
2. Eptingiidae	2. <i>Peripyridium</i>	7	common
3. Quenquecapsulariidae	3. <i>Empirea</i>	1	Vary rare
4. Pseudoacanthocircidae	4. <i>Eospongosaturninus</i>	1	Very rare
5. Saturnalidae	5. <i>Dicerosaturnalis</i>	1	Vary rare
6. Entactinarian Incertae Sedis	6. <i>Corona</i> , n. gen.	2	common
	7. <i>Nidus</i> , n. gen.	2	common
	8. Gen. et sp. indet.	2	rare
<b>Total</b>		<b>17</b>	

Table 2. Diversity and relative abundance of nassellarian genera

Family	Genus	No. of sp./form	Relative Abundance
1. Amphipyndacidae	1. <i>Palinandromeda</i>	3	common
	2. <i>Triversus</i>	1	common
2. Arcanicapsidae	3. <i>Arcanicapsa</i>	1	common
3. Archaeodictyomitridae	4. <i>Archaeodictyomitra</i>	2	common
4. Arcopyramididae	5. <i>Cornutella</i>	1	very rare
5. Eucyrtidiellidae	6. <i>Eucyrtidiellum</i>	1	very rare
6. Hilarisiregidae	7. <i>Hilarisirex</i>	1	very rare
7. Hsuidae	8. <i>Hsuum</i>	5	common
	9. <i>Parahsuum</i>	2	rare
8. Obeliscoitidae	10. <i>Olanda</i>	1	very rare
9. Parvicingulidae	11. <i>Praeparvicingula</i>	25	abundant
	12. <i>Ristola</i>	1	common
	13. <i>Wrangellium</i>	1	very rare
10. Poulpidae	14. <i>Saitoum</i>	1	very rare
11. Sethocapsidae	15. <i>Plicaforacapsa</i>	1	very rare
12. Spongocapsulidae	16. <i>Spongocapsula</i>	2	common
13. Syringocapsidae	17. <i>Pleesus</i>	1	very rare
	18. <i>Podobursa</i>	8	abundant
	19. <i>Quarticella</i>	1	common
	20. <i>Yamatoum</i>	1	very rare
	21. <i>Windalia</i>	1	very rare
14. Telacapsulidae	22. <i>Telacapsula</i>	1	common
15. Tertoniidae	23. <i>Toritenum</i>	2	very rare
16. Tripedurnulidae	24. <i>Pseudopoulpus</i>	2	rare
	25. <i>Turanta</i>	4	common
17. Ultranaporidae	26. <i>Napora</i>	4	common
18. Unumidae	27. <i>Unuma</i>	1	very rare
19. Williriedellidae	28. <i>Hiscocapsa</i>	4	abundant
	29. <i>Praezhamoidellum</i>	4	abundant
	30. <i>Zhamoidellum</i>	1	abundant
20. Xitidae	31. <i>Antexitus</i>	4	common
	32. <i>Novixitus</i>	1	very rare
21. Nassellariina Incertae Sedis	33. <i>Belleza</i>	1	common
	34. <i>Canelonus</i>	5	common
	35. <i>Minutusolla</i>	3	common
	36. Gen. et sp. indet.	5	common
<b>Total</b>		<b>103</b>	

occurrence of each taxon are based on the data from the published reports and this study. Ranges of selected taxa are shown in text-figures 3-1 to 3-5. Radiolarian zonation established by Pessagno and Yang (1989, pp. 207, 209) and subsequently refined in Pessagno et al. (1993, p. 96) was

adopted herein. Systematic radiolarian are presented alphabetically only in four taxonomic levels (Family, subfamily, genus and species) under three orders (Entactinaria, Nassellaria and Spumellaria).

Table 3. Diversity and relative abundance of spumellarian genera

Family	Genus	No. of sp./form	Relative Abundance
1. Angulobracchiidae	1. <i>Angulobracchia</i>	1	vary rare
	2. <i>crucella</i>	2	rare
	3. <i>Paronaella</i>	11	common
2. Archaeospongopruniidae	4. <i>Archaeospongoprunum</i>	2	rare
	5. <i>Wilvemia</i>	1	vary rare
3. Bernoullidae	6. <i>Bernoullius</i>	2	rare
4. Bolenidae	7. <i>Bolena</i>	2	rare
	8. <i>Tympaneides</i>	4	abundant
5. Dactyliospheridae	9. <i>Secretacapsa</i> , n. gen.	2	v. abundant
6. Emiluvidae	10. <i>Emiluvia</i>	8	v. abundant
7. Hagiastriidae	11. <i>Higumastra</i>	7	abundant
	12. <i>Pseudocrucella</i>	5	common
	13. <i>Tetraditryma</i>	3	common
	14. <i>Udalia</i>	2	common
8. Leugeonidae	15. <i>Leugeo</i>	3	rare
	16. <i>Tappanella</i>	6	abundant
9. Orbiculiformidae	17. <i>Orbiculiforma</i>	7	abundant
10. Pantanellidae	18. <i>Gorgansium</i>	2	rare
	19. <i>Pachyoncus</i>	1	rare
	20. <i>Pantanellium</i>	5	common
	21. <i>Zartus</i>	1	rare
11. Parvivaccidae	22. <i>Lanubus</i>	1	rare
12. Patulibracchiidae	23. <i>Homoeoparonaella</i>	2	rare
13. Praeconocaryommidae	24. <i>Neconocaryomma</i>	5	abundant
	25. <i>Praeconocaryomma</i>	1	rare
14. Tritrabidae	26. <i>Tritrabs</i>	2	common
15. Xiphostylidae	27. <i>Archaeocenosphaera</i>	1	abundant
	28. <i>Tripocyclia</i>	6	common
	29. <i>Xiphostylus</i>	5	common
16. Spumellaria Incertae Sedis	30. <i>Acaeniotylopsis</i>	2	abundant
	31. <i>Hexalonche</i>	4	common
	32. <i>Loupanus</i>	1	very rare
	33. <i>Teichertus</i>	2	common
	34. Gen. et sp. indet.	9	rare
<b>Total</b>		<b>118</b>	

<b>RANGE ZONES OF SELECTED TAXA</b>  — = Range zone. ..... = Range zone not known in North America. ? = uncertain first or last occurrence. Zonal terminology after Pessagno et. al. (1987b)	MIDDLE JURASSIC								U. Jura.			
	Aal.	Bajocian				Batho.	Callovian			Oxfordian		
		lower	upper			l	m	u	l	m	u	
	SUPERZONE 1 (PART)								ZONE 2 (pt.)			
Zone 1A (pt.)	Zone 1B	Zone 1C	Zone 1D	Zone 1E	Zone 1F	Zone 1G	Zone 1H	Z 1l	SZ 2 $\alpha$	SZ 2 $\gamma$	SZ 2 $\beta_2$	
<i>Eospongosaturinus protoformis</i> (Yao)	? —											
<i>Palinandromeda</i> sp. aff. <i>P. depressa</i>												
<i>Hsuum rosebudense</i> Pessagno & Whalen												
<i>Perispyridium tamarackense</i> P & B												
<i>Perispyridium foremanae</i> P & B												
<i>Palinandromeda depressa</i> (De Wever et al.)		? .....						?				
<i>Perispyridium pessagnoii</i> MacLeod												
<i>Archaeodictyomitra exigua</i> Blome												
<i>Hsuum lupheri</i> Pessagno & Whalen												
<i>Parahsuum nitidum</i> (Pessagno & Whalen)												
<i>Praeparvicingula burnsensis</i> (P & W)												
<i>Triversus fatigatus</i> Hull												
<i>Olanda olorina</i> Hull												
<i>Corona eximia</i> Yeh & Pessagno, n. sp.												
<i>Nidus nidulus</i> Yeh & Pessagno, n. sp.												
<i>Arcanicapsa brevispinosa</i> Y & P, n. sp.												
<i>Archaeodictyomitra sincera</i> Y & P, n. sp.												
<i>Hilarisirex inflatus</i> Pessagno et al.												
<i>Praeparvicingula ampla</i> Y & P, n. sp.												
<i>Praeparvicingula blackhornensis</i> (P & W)												
<i>Praeparvicingula eleganse</i> (P & W)												
<i>Perispyridium nitidum</i> P & B												
<i>Praeparvicingula decora</i> (P & W)												
<i>Perispyridium packardi</i> P & B												
<i>Hsuum maxwelli</i> Pessagno												

TEXT-FIGURE 3-1

Ranges of selected radiolarian taxa from the South Fork Member of Snowshoe Formation, east-central Oregon on the bases of data from the previous reports and this study.

<b>RANGE ZONES OF SELECTED TAXA</b>  — = Range zone. ..... = Range zone not known in North America. ? = uncertain first or last occurrence. Zonal terminology after Pessagno et. al. (1987b)	MIDDLE JURASSIC								U. Jura.		
	Aal.	Bajocian		Batho.	Callovian			Oxfordian			
	X	lower	upper	X	l	m	u	l	m	u	
	SUPERZONE 1 (PART)							ZONE 2 (pt.)			
Zone 1A (pt.)	Zone 1B	Zone 1C	Zone 1D	Zone 1E	Zone 1F	Zone 1G	Zone 1H	Z 1l	SZ 2 $\alpha$	SZ 2 $\gamma$	SZ 2 $\beta_2$
<i>Praeparvicingulla tllellensis</i> Carter	—										
<i>Turanta nodosa</i> Pessagno & Blome	—										
<i>Praeparvicingula matura</i> (P & W)		—									
<i>Turanta morinae</i> Pessagno & Blome		—									
<i>Toritenum hirsutum</i> Dumitrica & Zügel	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
<i>Podobursa helvetica</i> (Rüst)		.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
<i>Praeparvicingula media</i> (P & W)				—	—	—	—				
<i>Praeparvicingula sodaensis</i> (P & W)				—	—	—	—				
<i>Praeparvicingula grantensis</i> (P & W)					—	—	—				
<i>Praeparvicingula</i> sp. aff. <i>P. grantensis</i>					—	—	—				
<i>Praeparvicingula schoolhousensis</i> (P & W)					—	—	—				
<i>Praeparvicingula vera</i> (P & W)					—	—	—				
<i>Turanta capsensis</i> Pessagno & Blome					—	—	—				
<i>Praeparvicingula profunda</i> (P & W)					—	—	—				
<i>Toritenum obesa</i> (Takemura)					—	—	—				
<i>Napora antelopensis</i> Pessagno, Whalen & Yeh					—	—	—				
<i>Telacapsula johndayensis</i> Yeh					—	—	—				
<i>Turanta ancoriformis</i> Takemura					.....	.....	.....				
<i>Praeparvicingula turpicula</i> (P & W)					—	—	—				
<i>Quarticella takemurai</i> Yeh & Pessagno, n. sp.					—	—	—				
<i>Turanta lupheri</i> Pessagno & Blome					—	—	—				
<i>Praeparvicingula nullacingula</i> Y&P, n. sp.					—	—	—				
<i>Podobursa lata</i> (Yang)					—	.....	.....	.....	.....	.....	.....
<i>Podobursa tamanensis</i> (Yang)					—	.....	.....	.....	.....	.....	.....

TEXT-FIGURE 3-2

Ranges of selected radiolarian taxa from the South Fork Member of Snowshoe Formation, east-central Oregon on the basis of data from the previous reports and this study.

<b>RANGE ZONES OF SELECTED TAXA</b>  — = Range zone. ..... = Range zone not known in North America. ? = uncertain first or last occurrence. Zonal terminology after Pessagno et. al. (1987b)	MIDDLE JURASSIC								U. Jura.			
	Aal.	Bajocian				Batho.	Callovian			Oxfordian		
		lower	upper			l	m	u	l	m	u	
	SUPERZONE 1 (PART)								ZONE 2 (pt.)			
Zone 1A (pt.)	Zone 1B	Zone 1C	Zone 1D	Zone 1E	Zone 1F	Zone 1G	Zone 1H	Z 1I	SZ 2 $\alpha$	SZ 2 $\gamma$	SZ 2 $\beta_2$	
<i>Crucella beata</i> (Yeh)					—							
<i>Paronaella grahamensis</i> Carter					—							
<i>Hiscocapsa convexa</i> (Yao)	? —											
<i>Paronaella bandyi</i> Pessagno			.....	.....	.....							
<i>Paronaella kotura</i> Baumgartner			.....	.....	.....							
<i>Antexitus pessagnoii</i> Yeh					—	—						
<i>Antexitus yangi</i> Yeh					—	—						
<i>Hiscocapsa matsukoi</i> Yeh					—	—						
<i>Minutasola yaoi</i> Yeh					—	—						
<i>Napora izeensis</i> Pessagno, Whalen & Yeh					—	—						
<i>Zhamoidellum horiae</i> Yeh & Pessagno, n. sp.					—	—						
<i>Emiluvia kozuri</i> Yeh					—	—						
<i>Canelonus reliquus</i> Yeh & Pessagno, n. sp.					—	—						
<i>Emiluvia delicata</i> Yeh & Pessagno, n. sp.					—	—						
<i>Hiscocapsa echinoampulla</i> Y & P, n. sp.					—	—						
<i>Praezhamoidellum wui</i> Yeh & Pessagno, n. sp.					—	—						
<i>Secretacapsa acanata</i> Yeh & Pessagno, n. sp.					—	—						
<i>Secretacapsa bathonia</i> Yeh & Pessagno, n. sp.					—	—						
<i>Tympaneides magnacista</i> Y & P, n. sp.					—	—						
<i>Belleza decora</i> (Rüst)					—	—	—	—	—	—	—	
<i>Minutusolla nishimurae</i> Y & P, n. sp.					—	—	—	—	—	—	—	
<i>Archaeospongoprimum imlayi</i> Pessagno					—	—	—	—	—	—	—	
<i>Novixitus</i> sp. A					—	—	—	—	—	—	—	

TEXT-FIGURE 3-3

Ranges of selected radiolarian taxa from the South Fork Member of Snowshoe Formation, east-central Oregon on the basis of data from the previous reports and this study.

<b>RANGE ZONES OF SELECTED TAXA</b>  — = Range zone. ..... = Range zone not known in North America. ? = uncertain first or last occurrence. Zonal terminology after Pessagno et. al. (1987b)	MIDDLE JURASSIC								U. Jura.		
	Aal.	Bajocian		Batho.	Callovian			Oxfordian			
	X	lower	upper	X	l	m	u	l	m	u	
	SUPERZONE 1 (PART)								ZONE 2 (pt.)		
Zone 1A (pt.)	Zone 1B	Zone 1C	Zone 1D	Zone 1E	Zone 1F	Zone 1G	Zone 1H	Z 1l	SZ 2 $\alpha$	SZ 2 $\gamma$	SZ 2 $\beta_2$
<i>Homoeoparonaella</i> sp. aff. <i>H. elegans</i> (Pess.)					—————						
<i>Higumastra exigua</i> Yeh					—————						
<i>Tritrabs simplex</i> Kito and de Wever					—————						
<i>Pseudocrucella longabraccia</i> Y & P, n. sp.			—————								
<i>Tetraditryma corralitosensis</i> (Pessagno)			.....		—————						
<i>Leugeo ordinarius</i> (Yang & Wang)			—————								
<i>Emiluvia parvinodosa</i> Yeh					—————						
<i>Pseudocrucella acutuspina</i> (Yeh)					—————						
Helenid gen. et sp. indet. A					—————						
<i>Homoeoparonaella elegans</i> (Pessagno)					? .....	—————					
<i>Emiluvia</i> sp. cf. <i>E. oregonensis</i> Yeh					—————						
<i>Higumastra angustabraccia</i> Yeh					—————						
<i>Udalia</i> sp. A					—————						
<i>Tetraditryma pseudoplana</i> Baumgartner					—————						
<i>Tetraditryma coldspringensis</i> (Pessagno)					—————						
<i>Emiluvia validia</i> Yeh & Pessagno, n. sp.					—————						
<i>Higumastra perfecta</i> Yeh & Pessagno, n. sp.					—————						
<i>Tritrabs brevitrabs</i> Yeh & Pessagno, n. sp.					—————						
<i>Tappanella fragilis</i> Yeh & Pessagno, n. sp.					—————						
<i>Tappanella imlayi</i> Yeh & Pessagno, n. sp.					—————						
<i>Tappanella novacubica</i> Hull					—————						
<i>Emiluvia nana</i> Baumgartner					—————						
<i>Tritrabs worzeli</i> (Pessagno)					—————						

TEXT-FIGURE 3-4

Ranges of selected radiolarian taxa from the South Fork Member of Snowshoe Formation, east-central Oregon on the basis of data from the previous reports and this study.

<b>RANGE ZONES OF SELECTED TAXA</b>  — = Range zone. ..... = Range zone not known in North America. ? = uncertain first or last occurrence. Zonal terminology after Pessagno et. al. (1987b)	MIDDLE JURASSIC								U. Jura.			
	Aal.	Bajocian		Batho.	Callovian			Oxfordian				
	X	lower	upper	X	l	m	u	l	m	u		
	SUPERZONE 1 (PART)							ZONE 2 (pt.)				
	Zone 1A (pt.)	Zone 1B	Zone 1C	Zone 1D	Zone 1E	Zone 1F	Zone 1G	Zone 1H	Z 1l	SZ 2 $\alpha$	SZ 2 $\gamma$	SZ 2 $\beta_2$
<i>Orbiculiforma trispina trispinula</i> Carter	—	—	—	—	—	—						
<i>Neoconocaryomma tantulimamma</i> Yeh	—	—	—	—	—	—						
<i>Orbiculiforma incognita</i> Blome	—	—	—	—	—	—						
<i>Xiphostylus vallieri</i> Pessagno & Yang		—	—	—	—	—						
<i>Teichertus heliotropica</i> (Baumgartner)		.....	.....	.....	.....	.....						
<i>Pantanellium foveatum</i> Mizutani & Kido			—	—	—	—						
<i>Orbiculiforma librataspira</i> Yeh					—	—						
<i>Pantanellium sincerum</i> Pessagno & Blome					—	—						
<i>Xiphostylus whalena</i> Pessagno & Yang					—	—						
<i>Acaeniotylopsis oregonensis</i> Y & P, n. sp.					—	—						
<i>Teichertus pessagno</i> Yeh					—	—						
<i>Orbiculiforma densa</i> Yeh					—	—						
<i>Orbiculiforma santarota</i> Yeh					—	—						
<i>Pachyoncus</i> sp. aff. <i>P. floreus</i> Yeh					—	—						
<i>Pantanellium ultrasincerum</i> Pessagno & Blome					—	—						
<i>Lanubus</i> sp. A					—	—						
<i>Neoconocaryomma acusspina</i> Yeh					—	—						
<i>Neoconocaryomma tripalmaspina</i> Yeh					—	—						
<i>Tripocyelia brooksi</i> Pessagno & Yang						—	—	—	—	—	—	—
<i>Hexalonche</i> sp. D						—	—	—	—	—	—	—
<i>Teichertus cavernosus</i> Hull						—	—	—	—	—	—	—

TEXT-FIGURE 3-5

Ranges of selected radiolarian taxa from the South Fork Member of Snowshoe Formation, east-central Oregon on the basis of data from the previous reports and this study.

Class ACTINOPODA  
 Subclass RADIOLARIA  
 Superorder POLYCYSTIDA Ehrenberg 1838, emend. Riedel 1967b  
 Order ENTACTINARIA Kozur and Mostler 1982

Family CENTROCUBIDAE Hollande and Enjumet 1960, emend. Dumitrica 1983

Type genus: *Centrocubus* Haeckel 1887.

Range: Middle Triassic (middle Anisian) to Recent.

Genus *Marianasphaera* Li and Sashida 2011

Type species: *Marianasphaera ogawai* Li and Sashida 2011.

*Range and occurrence:* Middle Jurassic (upper Bathonian) from Snowshoe Formation, east-central Oregon, Upper Jurassic (lower Tithonian) from the Solenhofen area, Southern Germany and Lowermost Cretaceous (Berriasian) from Mariana Trench.

***Marianasphaera* sp. A**  
Plate 1, figures 17-18

*Remarks:* This specimen is characterized by having a cortical shell with very long triradiate spines and with internal skeleton consisting of two apical bars, one median bar, four basal bars, four arches interconnecting these spines and four antapical spines arising from the arches. All these internal spines are prolonged outside cortical shell into long three-bladed spines.

*Range:* Superzone 1, Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon so far as known.

Family **EPTINGIIDAE** Dumitrica 1978  
*Type genus:* *Eptingium* Dumitrica 1978.

*Range:* Middle Triassic (Anisian) to Upper Jurassic (Tithonian).

*Occurrence:* worldwide.

Genus ***Perispyridium*** Dumitrica 1978  
*Type species:* *Trilonche* (?) *ordinaria* Pessagno 1977a.

*Range and occurrence:* Same as for family.

***Perispyridium foremanae*** Pessagno and Blome  
Plate 1, figures 1-2

*Perispyridium foremanae* PESSAGNO and BLOME 1982, p. 293, pl. 2, figs. 5, 8, 11, 13, 16; pl. 7, fig. 6; pl. 8, fig. 8.

*Range:* Superzone 1, base of Zone 1C to Zone 1F top; Middle Jurassic (upper lower Bajocian to upper Bathonian).

*Occurrence:* Warm Springs (OR554) and South Fork (OR550C and OR501B) members, Snowshoe Formation, east-central Oregon.

***Perispyridium nitidum*** Pessagno and Blome  
Plate 1, figures 7-8, 12

*Perispyridium nitidum* PESSAGNO and BLOME 1982, p. 294, pl. 4, figs. 5-7; pl. 8, fig. 5.-BLOME 1984, p. 357, pl. 9, fig. 4.

*Range:* Superzone I, upper Zone 1F to Zone 1G top; Middle Jurassic (upper Bathonian to middle Callovian).

*Occurrence:* South Fork Member (OR501A, B), Snowshoe Formation, east-central Oregon and Shelikof Formation, southern Alaska.

***Perispyridium packardi*** Pessagno and Blome  
Plate 1, figures 3, 6

*Perispyridium packardi* PESSAGNO and BLOME 1982, p. 295, pl. 4, figs. 8-9, 15, 18; pl. 8, fig. 7.

*Range:* Superzone 1, upper Zone 1F or younger; Middle Jurassic (upper Bathonian; lower Callovian?).

*Occurrence:* Snowshoe Formation (OR501B, C) and possibly in Lonesome Formation, east-central Oregon.

***Perispyridium pessagnoii*** MacLeod  
Plate 1, figures 9, 14-15

*Perispyridium pessagnoii* MACLEOD 1988, p. 304-306, pl. 4, figs. 1, 4, 7, 10, 13.

*Range:* Superzone 1, upper Zone 1D to Zone 1F top; Middle Jurassic (upper Bajocian to uppermost Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon.

***Perispyridium tamarackense*** Pessagno and Blome  
Plate 1, figure 5

*Perispyridium tamarackense* PESSAGNO and BLOME 1982, p. 295-296, pl. 1, figs. 5-7, 12-13, 15; pl. 7, fig. 1.

*Range:* Superzone 1, Zone 1B base to middle Zone 1F; Middle Jurassic (lowermost Bajocian to uppermost Bathonian).

*Occurrence:* Warm Springs and South Fork members, Snowshoe Formation, east-central Oregon (OR555 and OR501B).

***Perispyridium* sp. A**  
Plate 1, figure 4

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501C).

***Perispyridium* sp. B**  
Plate 1, figures 10-11, 13, 16

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501C).

Family **QUINQUECAPSULARIIDAE**  
Dumitrica 1995  
*Type genus:* Quenquecapsularia Pessagno 1971b.

*Range:* Upper Triassic to Recent.

*Occurrence:* Queen Charlotte Islands, British Columbia; east-central Oregon and California; Italy and Spain.

Genus ***Empirea*** Whalen and Carter 1998  
*Type species:* *Empirea hasta* Whalen and Carter 1998.

*Range:* Lower Jurassic (lower Hettangian) to Upper Jurassic (upper Tithonian).

*Occurrence:* Queen Charlotte Islands, British Columbia; East-central Oregon and British Columbia.

***Empirea* sp. A**  
Plate 2, figures 14-15, 18

*Remarks:* This species is characterized by having a test with cortical shell comprised by simple frame work.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

Family **PSEUDOACANTHOCIRCIDAE** Kozur and Mostler 1990  
*Type genus:* *Pseudoacanthocircus* Kozur and Mostler 1990.

*Range and occurrence:* Upper Triassic to Upper Cretaceous; worldwide.

Genus ***Eospongosaturninus*** Kozur and Mostler 1990  
*Type species:* *Spongosaturnalis protoformis* Yao 1972.

*Range:* Middle Jurassic.

*Occurrence:* Japan, Bushuanga Island of Philippines and east-central Oregon.

***Eospongosaturninus protoformis*** (Yao)  
Plate 3, figures 12-13

*Spongosaturnalis protoformis* YAO 1972, p. 27, pl. I, figs. 2-7; ol. X, figs. 1-2.

*Eospongosaturninus protoformis* (Yao) – KOZUR and MOSTLER 1990, p. 211,

*Acanthocircus protoformis* Yao-BAUMGARTNER et al. 1995, p. 64, pl. 2021, figs. 1-3.

*Acanthocircus protoformis* Yao-YEH and CHENG 1996, p.108, pl. 2, fig. 11.

*Range:* Middle Jurassic; Aalenian to upper Bathonian.

*Occurrence:* Busuanga Island, Philippines; Mino Belt in northern Inuyama area, Central Japan, and South Fork Member of Snowshoe Formation, east-central Oregon (OR501B).

Family **SATURNALIDAE** Deflandre 1953  
Subfamily **HEXASATURNALINAE** Kozur and Mostler 1983  
*Type genus:* *Hexasaturnalis* Kozur and Mostler 1983.

*Range and occurrence:* Upper Triassic (Norian) to Upper Cretaceous. Worldwide.

Genus ***Dicerosaturnalis*** Dumitrica and Jud in O'Dogherty 1994

*Type species: Saturnulus trizonalis* Rüst 1898.

*Range and occurrence:* Middle Jurassic (Bathonian) to Lower Cretaceous (Albian or younger); worldwide.

*Dicerosaturnalis* sp. A  
Plate 3, figure 9

*Remarks:* Only one broken specimen lacking of diagnostic features was found.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501C).

## ENTACTINARIA INCERTAE SEDIS

Genus *Corona* Yeh and Pessagno, n. gen.  
*Type species: Corona eximia* Yeh and Pessagno, n. sp.

*Description:* Test crown in shape. Cortical shell composed of massive arches and without any meshwork between arches. Medullary shells latticed and double layered; second medullary shell connecting to cortical shell with ten triradiate beams at ten convergent junctions of arches; ridges of each beam widening outward to support three arches of cortical shell. Arches triradiate with three ridges alternating with three grooves and united with other arches by sharing ridges. Ridges of outer surface with or without thickening structure. Spines or other structure present at junctions of arches.

*Remarks:* This genus is characterized by having a cortical shell simply formed with arches and by having two latticed layers of medullary shell.

*Etymology:* *Corona-ae* (Latin, n.) = crown with a garland.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501A, B, C).

*Corona eximia* Yeh and Pessagno, n. sp.  
Plate 2, figures 1-4, 6-7, 16

*Description:* Test as with genus; arches of cortical shell relatively thin, outer surface of arches covered with microgranular silica and with equal-sized beads along top ridge of each arch. Tubercle structure with three or four larger pores on top and two smaller pores at each end of ridges present at convergent junctions of arches and terminating with spine; spines triradiate at basal portion, circular in cross-section when getting longer.

*Etymology:* *eximius-a-um* (Latin, adj.) = exceptional, distinguished.

*Measurements* ( $\mu\text{m}$ ): Holotype + 5 paratypes. WT = maximum width of test; LA = maximum length of arch between two junctions.

	WT	LA
Holotype	226	83
Mean	225	84
Maximum	247	97
Minimum	210	73

*Type locality:* Holotype from OR501A, paratypes from OR501B, C (See Locality Description), Snowshoe formation, east-central Oregon.

*Deposition of types:* Holotype, USNM 547352; paratypes, USNM 547353.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501A, B, C).

*Corona* sp. aff. *C. eximia* Yeh and Pessagno, n. sp.  
Plate 2, figures 5, 8-13, 17

*Remarks:* This species differs from *C. eximia* Yeh and Pessagno, n. sp., by having a thicker cortical shell with larger nodes on arches and lacking spine at junctions of arches.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501C).

Genus *Nidus* Yeh and Pessagno, n. gen.

*Type species: Nidus nidulus* Yeh and Pessagno, n. sp.

*Description:* Spongy cortical shell spherical to subspherical in outline, internally with a heteropolar shell, externally with one or two spines at upper hemisphere and pointing upwards and four or more spines at lower hemisphere and pointing downwards. Spines unequal in length, triradiate with three ridges alternating with three grooves. Internal skeletons not observed.

*Remarks:* This genus is assigned to Entactinaria due to the presence of asymmetrically arranged spines and the internal heteropolar shell.

*Etymology:* *Nidus-i* (Latin, m.) = a nest, meaning the forms of this genus have a nest-like cortical shell.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon.

*Nidus nidulus* Yeh and Pessagno, n. sp.  
Plate 3, figures 1, 5, 10

*Description:* Test as with genus, small to large in size, subspherical in outline. Cortical shell composed of small to medium sized spongy polygonal pore frame and with very short spines present at vertices of pore frame. Cortical shell with six or more spines; spines unequal in length, short to medium in length, tapering distally, triradiate with three narrow ridges alternating with three narrow grooves. One or two spines at upper hemisphere and pointing upwards, four to five spines at lower hemisphere and pointing downwards; maximum length of spines smaller than diameter of cortical shell. Internal structure of test not observed.

*Remarks:* This species is characterized by having a relatively large nest-like spongy cortical shell with six or more triradiate spines.

*Etymology:* *nidulus-i* (Latin, m.) = a little nest.

*Measurements* ( $\mu\text{m}$ ): Holotype + 3 paratypes.  
LC = maximum length of cortical shell; LSP =

maximum length of spines.

	LC	LSP
Holotype	260	147
Mean	235	128
Maximum	272	151
Minimum	173	85

*Type locality:* OR501B (See Locality Description), Snowshoe formation, east-central Oregon.

*Deposition of types:* Holotype, USNM 547364; paratypes, USNM 547365.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

*Nidus* sp. A  
Plate 3, figures 4, 11

*Remarks:* This species differs from *Nidus nidulus* Yeh and Pessagno, n. sp., by having a relatively smaller test with cortical shell composed of larger spongy pore frames. Inside it one can see a large heteropolar shell that could support the entactinarian nature of this genus.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon so far as known.

**Entactinaria** gen. et sp. indet. A  
Plate 3, figure 2

*Remarks:* This form is characterized by having a cubic shaped cortical shell, by having the six faces of the cube slightly convex outward, and eight triradiate spines at the eight corners of the cube. It is very possible that this is a form of centrocubidae however the structure of internal skeleton has not been observed.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon so far as known.

**Entactinaria** gen. et sp. indet. B

Plate 3, figures 3, 6-8

*Remarks:* The internal spicules of this morphotype consists of two apical spines and four basal spines and a very short median bar.

*Range Occurrence:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon so far as known.

**Order NASSELLARIINA Ehrenberg 1875**Family **AMPHIPYNDACIDAE** Riedel 1967a*Type genus:* *Amphipyndax* Foreman 1966.Genus *Palinandromeda* Pessagno et al. 1993*Type species:* *Andromeda crassa* Baumgartner 1980b.

*Andromeda* Baumgartner-BAUMGARTNER et al. 1980b, p. 49-50. –YANG and WANG 1990, p. 212.

*Palinandromeda* PESSAGNO, BLOME and HULL 1993, nomen novum for *Andromeda* BAUMGARTNER et al. 1980.

*Range and occurrence:* Lower to Upper Jurassic. Worldwide.

*Palinandromeda depressa* (De Wever and Miconnet)

Plate 4, figures 13, 15.

*Andromeda depressa* DE WEVER and MICONNET 1985, p. 384, pl. 2, figs. 1-2, 4-5.- BAUMGARTNER et al. 1995, p. 360-361, pl. 3005.

*Range:* Middle Jurassic; upper Bathonian (Supperzone 1, upper Zone 1F) in Snowshoe Formation; lower middle Bajocian (= lower Bajocian) in this report) to Upper Jurassic (lower Callovian) in Baumgartner et al. 1995.

*Occurrence:* Lucany Southern Italy and South Fork Member of Snowshoe Formation, east-central Oregon, etc.

*Palinandromeda* sp. aff. *P. depressa* (De Wever and Miconnet)

Plate 4, figures 2, 13

*Palinandromeda* sp. aff. *P. depressa* (De Wever and Miconnet)-BAUMGARTNER et al. 1995, p. 360, pl. 3415.

*Palinandromeda* sp. A YEH 2009, p. 73, pl. 23, fig. 17; not figs. 3-5, 10, 13.

*Range:* Middle Jurassic; lower Bajocian to upper Bathonian (Supperzone 1, base of Zone 1B to Zone 1F top) in Snowshoe Formation; lower middle Bajocian (= lower Bajocian) in this report to upper Bajocian in Baumgartner et al. 1995.

*Occurrence:* Southern Italy and South Fork Member of Snowshoe Formation, east-central Oregon (OR555B, OR-MA30A and OR501B).

*Palinandromeda* sp. aff. *P. praepobiensis* (Baumgartner)

Plate 4, figures 1, 9, 11-12

*Andromeda praepobiensis* BAUMGARTNER 1984, p. 756, pl. 1, figs. 13-15.

*Palinandromeda praepobiensis* (Baumgartner)-BAUMGARTNER 1995a, p. 364, pl. 3006, figs. 1-3.

*Remarks:* This species differs from *P. praepodbiensis* (Baumgartner) by having a test with less than seven segments.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

Genus *Triversus* Takemura 1986*Type species:* *Triversus japonicus* Takemura 1986.

*Range and occurrence:* Middle to Upper Jurassic; worldwide.

*Triversus fastigatus* Hull

Plate 11, figures 18-19

*Triversus fastigatus* HULL 1997, p. 170, pl. 51, figs. 3-, 16, 22.-KIESSLING 1999, P. 60-62, pl. 11, figs. 5-6.- YEH 2009, p. 74, pl. 17, figs. 9-11.

*Remarks:* This species is similar to the holotype of *Triversus fastigatus* Hull (1997, pl. 51, figs. 5, 16, 22) by having a pointed cephalis with a short horn. The specimens with rounded cephalis lacking horn (i.e., Kiessling 1999; Yeh 2009) are

also included in this species. Further studies need to be done to confirm their relationship.

*Range:* Supperzone 1, Zone 1F to Zone 4; Middle Jurassic (lower Bathonian) to Upper Jurassic (upper lower to upper Tithonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR-MA30A, OR501C); volcanopelagic strata overlying the Coast Range ophiolite, Stanley Mountain, California.

Family **ARCANICAPSIDAE** Takemura 1986

*Type genus:* *Arcanicapsa* Takemura 1986.

*Range and occurrence:* Middle Jurassic from Mino Terrane, central Japan, Alpine Tethys and east-central Oregon.

Genus *Arcanicapsa* Takemura 1986

*Type species:* *Arcanicapsa sphaerica* Takemura 1986.

*Range and occurrence:* Same as for family.

*Arcanicapsa brevispinosa* Yeh and Pessagno, n. sp.

Plate 9, figures 15-17, 22

*Description:* Test tricyrtid, consisting of a short apical horn on small conical-shaped cephalis, narrow and trapezoidal-shaped thorax and a large bulbous abdomen. Pore frame of test formed by uniting four complete or incomplete hexagones (each hexagone with one central hexagonal pore surrounded by six hexagonal pores) repeatedly; a raised hexagonal pore with a short triradiate spine present at each junction of four hexagones at outer surface of abdomen; with or without raised ridges developed along joints of hexagons. Pore frames of cephalis covered by microgranular silica, pore frames of thorax similar in formation but smaller in size and lacking raised pores with spines and radiating ridges.

*Remarks:* This species is characterized by having a large spherical abdomen with outer surface full of short spines.

*Etymology:* *brevispinosa* = *brevis* (Latin, adj., meaning short) + *spinosa* (Latin, adj., meaning thorny) = full of short thorns.

*Measurements* ( $\mu\text{m}$ ): Holotype + 4 paratypes. HCT = height of cephalis and thorax excluding horn; WT = maximum width of thorax; WA = maximum width of abdomen; LS = maximum length of spine(s) at abdomen.

	HTC	WT	WA	LS
Holotype	53	53	230	30
Mean	47	53	205	32
Maximum	55	57	235	37
Minimum	44	50	198	23

*Type locality:* Holotype from OR501B, paratypes from OR501A and B (See Locality Description), Snowshoe formation, east-central Oregon.

*Deposition of types:* Holotype, USNM547356; paratypes, USNM547357.

*Range Occurrence:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501A, B).

Family **ARCHAEODICTYOMITRIDAE**

Pessagno 1976; emend. Pessagno 1977b

*Type genus:* *Archaeodictyomitra* Pessagno 1976; emend. Pessagno 1977b.

*Range and occurrence:* Jurassic to Upper Cretaceous (Maastrichtian); worldwide.

Genus *Archaeodictyomitra* Pessagno 1976; emend. Pessagno 1977b; Yang 1993

*Type species:* *Archaeodictyomitra squinaboli* Pessagno 1976.

*Range and occurrence:* Middle Jurassic (Bajocian) to Upper Cretaceous (Campanian); worldwide.

*Archaeodictyomitra exigua* Blome

Plate 5, figures 8, 25

*Archaeodictyomitra exigua* BLOME 1984, p. 356, pl. 8, figs. 4, 7-8, 10, 12-13; pl. 15, figs. 14-15.-YEH 2011, p. 8, pl. 2, figs. 6, 12.

*Range:* Supperzone 1, middle Zone 1E to Zone 1H; Middle Jurassic (upper Bajocian to middle Callovian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR549B, OR501A, C), and middle Callovian from Shelikof Formation, southern Alaska (80A-JM-84 and 81CB-119).

*Archaeodictyomitra sincera* Yeh and Pessagno, n. sp.  
Plate 5, figures 5-7, 28

*Description:* Test small, conical in apical portions, cylindrical at middle portion, last chambers constricted and terminating in a very small aperture. Eleven to fifteen longitudinal costae visible laterally. One line of pores between two adjacent costae; pores larger at central portion, smaller towards both ends, and test imperforate at very apical portion.

*Remarks:* This species is characterized by having a cucumber-shaped test with final chambers constricted into a very small aperture. It differs from *Bagotum* by having a test with one linearly arranged circular pores between two adjacent longitudinal costae rather than formed by a series of tetragonal pore frames.

*Etymology:* *sincerus-a-um* (Latin, adj.) = pure, unmixed, sound, genuine.

*Measurements* ( $\mu\text{m}$ ): Holotype + 5 paratypes. LT = length of testa; WT = maximum width of test.

*Type locality:* Holotype from OR501A, paratypes from OR501C (See Locality Description), Snowshoe formation, east-central Oregon.

	LT	WT
Holotype	160	73
Mean	158	75
Maximum	180	87
Minimum	143	72

*Deposition of types:* Holotype=USNM 547358. Paratypes=USNM 547359.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501A, C).

Family **ARCROPYRAMIDIDAE** Haeckel 1881  
*Type genus:* *Arcopyramis* Haeckel 1881.

Genus *Cornutella* Ehrenberg 1838

*Type species:* *Cornutella clathrata* Ehrenberg 1838.

*Cornutella* sp. cf. *C. tella* Dumitrica and Zügel 2003

Plate 4, figure 8

*Cornutella tella* DUMITRICA and ZÜGEL 2003, p. 48, fig. 24D-H.

*Remarks:* This morphotype differs from *C. tella* Dumitrica and Zügel by having a test with distal expanded portion not curved but straight in outline.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

Family **EUCYRTIDIELLIDAE** Takemura 1986

*Type genus:* *Eucyrtidiellum* Baumgartner 1984.

*Range and occurrence:* Middle to Upper Jurassic; worldwide.

Genus *Eucyrtidiellum* Baumgartner 1984

*Type species:* *Eucyrtidium* (?) *unumaensis* Yao 1979.

*Range and occurrence:* Same as for family.

*Eucyrtidiellum* sp. A

Plate 9, figure 4, 18

*Remarks:* This specimen differs from *Eucyrtidiellum* (?) *quinatum* Takemura by having a test with less distinctive strictures.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation (OR501B), east-central Oregon.

Family **HILARISIREGIDAE** Takemura and Nakaseko 1982; emend. Pessagno et al. 1986

*Type genus:* *Hilarisirex* Takemura and Nakaseko 1982.

*Range:* Lower Jurassic (middle Toarcian) to Upper Jurassic (upper Kimmeridgian/lower Tithonian).

*Occurrence:* Mino Complex of Japan; Eugenia Formation of Baja California Sur; volcanopelagic strata above the Coast Range ophiolite, California Coast Ranges.

*Genus Hilarisirex* Takemura and Nakaseko 1982; emend. Pessagno et al. 1986

*Type species: Hilarisirex quadrangularis* Takemura and Nakaseko 1982.

*Range and occurrence:* Same as for family.

*Hilarisirex inflatus* Pessagno, Whalen and Yeh Plate 5, figures 21, 26

*Hilarisirex inflatus* PESSAGNO et al. 1986, p. 30, pl. 8, figs. 4-6, 10, 13-14, 17.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation (OR501A, B), east-central Oregon.

Family **HSUIDAE** Pessagno and Whalen 1982

*Type genus: Hsuum* Pessagno 1977a.

*Range and occurrence:* Lower Jurassic (lower Pliensbachian) to Lower Cretaceous (lower Hauterivian). Worldwide.

*Genus Hsuum* Pessagno 1977a

*Type species: Hsuum cuestanense* Pessagno 1977a (=nomen correctum).

*Hsuum* PESSAGNO 1977a, p. 81.

*Transhsuum* TAKEMURA 1986, p. 51.

*Semihsuum* PESSAGNO et al. 1993

*Range and occurrence:* Same as for family.

*Hsuum lupheri* Pessagno and Whalen Plate 5, figure 10

*Hsuum lupheri* PESSAGNO and WHALEN 1982, p. 131, pl. 9, figs. 1, 13, 18; pl. 13, fig. 16.-YEH 2011, p. 10, pl. 3, figs. 5-7, 19, 23.

*Range:* Supperzone 1, middle Zone 1E to Zone 1F top; Middle Jurassic (upper Bajocian to upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR549B, OR501B).

*Hsuum maxwelli* Pessagno

Plate 5, figure 23

*Hsuum maxwelli* PESSAGNO 1977a, p. 81, pl. 7, figs. 14-16.-HULL 1997, p. 86, pl. 34, fig. 15.

*Range:* Supperzone 1, upper Zone 1F to Zone 4; Middle Jurassic (upper Bathonian) to Upper Jurassic (upper Tithonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B); Worldwide.

*Hsuum* sp. cf. *H. maxwelli* Pessagno

Plate 5, figures 3, 11

*Hsuum maxwelli* PESSAGNO 1977a, p. 81, pl. 7, figs. 14-16.

*Remarks:* This specimen differs from *H. maxwelli* Pessagno by having a smaller test.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501A, C).

*Hsuum* sp. cf. *H. robustum* Pessagno and Whalen Plate 5, figures 1-2

*Hsuum robustum* PESSAGNO and WHALEN 1982, p. 133-134, pl. 8, figs. 3-4, 13, 18.-YEH 2011, p. 11, pl. 3, figs. 13, 14, 20, 24.

*Remarks:* This specimen differs from *H. robustum* Pessagno and Whalen by having a smaller test with thinner costae.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501C).

***Hsuum rosebudense*** Pessagno and Whalen  
Plate 5, figure 27

*Hsuum rosebudense* PESSAGNO and WHALEN 1982, p. 134, pl. 6, figs. 3, 14, 19; pl. 12, fig. 14.

**Range:** Supperzone 1, Zone 1B base to upper Zone 1F; Middle Jurassic (lower Bajocian to upper Bathonian).

**Occurrence:** Warm Springs Member (OR555) and South Fork Member (OR501B), Snowshoe Formation, east-central Oregon. Rare in the studied sample.

**Genus *Parahsuum*** Yao 1982  
**Type species:** *Parahsuum simplum* Yao 1982.

*Parahsuum* YAO 1982  
*Lupherium* PESSAGNO & WHALEN 1982  
*Drulanta* YEH 1987b

**Range:** Lower Jurassic (Hettangian) to Upper Jurassic (Kimmeridgian).  
**Occurrence:** Worldwide.

***Parahsuum nitidum*** Pessagno and Whalen  
Plate 5, figure 15

*Lupherium* (?) *nitidum* PESSAGNO & WHALEN 1982, p. 135, pl. 8, figs. 7-8; pl. 13, fig. 7.

**Range:** Supperzone 1, upper Zone 1E to Zone 1F top; Middle Jurassic (upper Bajocian to upper Bathonian).

**Occurrence:** South Fork Member, Snowshoe Formation, east-central Oregon (OR550C, OR501B, C).

***Parahsuum*** (?) sp. A  
Plate 5, figure 4

**Remarks:** This specimen is questionably assigned to *Parahsuum* Yao because it differs from other *Parahsuum* spp. by having a test with final post-abdominal chamber constricted.

**Range:** Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

**Occurrence:** South Fork Member, Snowshoe Formation, east-central Oregon (OR501C).

Family **OBELISCOITIDAE** O'Dogherty 1994  
**Type genus:** *Obeliscoites* O'Dogherty 1994.

**Range:** Middle Jurassic (Bajocian) to Upper Cretaceous (Cenomanian) in De Wever et al. 2001.

**Occurrence:** worldwide.

**Genus *Olanda*** Hull 1997  
**Type species:** *Olanda olorina* Hull 1997.

**Range:** Middle Jurassic (upper Bajocian) to Cretaceous (Berriasian) in Baumgartner et al., 1995a.

**Occurrence:** Upper Bathonian from Snowshoe Formation, east-central Oregon. Oxfordian to Kimmeridgian in the Stanley Mountain remnant of the Coast Range ophiolite Volcanopelagic.

***Olanda olorina*** Hull  
Plate 9, figures 20-21

*Olanda olorina* HULL 1997, p. 152, pl. 49, figs. 4-6, 12, 16.

**Range and occurrence:** Middle Jurassic (upper Bathonian, Supperzone 1, upper Zone 1F) from Snowshoe Formation, east-central Oregon (OR501B); Upper Jurassic (middle Oxfordian to lower Kimmeridgian) from volcanopelagic strata overlying the Coast Range ophiolite, Stanley Mountain, California.

Family **PARVICINGULIDAE** Pessagno 1977a; emend. Pessagno and Whalen 1982  
**Type genus:** *Parvicingula hsui* Pessagno 1977a.

**Range:** Lower Jurassic (Toarcian: base of Supperzone 1) to Lower Cretaceous (lower Hauterivian in Pessagno et al. 1993; lower Aptian in De Wever et al. 2001).

**Occurrence:** Worldwide.

Subfamily **PARVICINGULINAE** Pessagno 1977a  
**Type genus:** *Parvicingula hsui* Pessagno 1977a.

**Range and occurrence:** Same as for family.

Genus *Praeparvicingula* Pessagno, Blome and Hull

*Type species: Parvicingula profunda* Pessagno and Whalen 1982.

*Praeparvicingula* PESSAGNO, BLOME and HULL 1993, p. 144.

*Praecaneta* PESSAGNO, BLOME and HULL 1993, p. 142.

*Praeparvicingula* Hull-GORIČAN et al. 2006, p. 334.

*Remarks:* Parvicingulids with test in conical to cylindrical outline, with or without horn, with or without nodose H-linked circumferential ridges are treated as criterion in species rather than in generic level.

*Range and occurrence:* Same as for subfamily.

*Praeparvicingula ampla* Yeh and Pessagno, n. sp. Plate 5, figures 18-20, 29-30

*Description:* Test broad, conical in shape, usually with five to six post-abdominal chambers. Cephalis small, dome shaped, sparsely perforated, with a short horn; remaining chambers trapezoidal to subrectangular in outline. Apical portion composed of pore frames less regularly in arrangement and variable in size. Post-abdominal chambers composed of pore frames more regular in arrangement and in size, usually of three staggered transverse rows of polygonal pore frames. Test built with meshwork in composition of one larger hexagonal central pore surrounded by six smaller hexagonal pores. Uneven to thorny surface caused by pore frames partially thickening outward often present, especially on surface of thorax and abdominal chamber. Circumferential ridges weakly developed along joints of post-abdominal chambers.

*Remarks:* This species is characterized by having a relatively short and wide test with pore frames varied in size and less regularly in arrangement at earlier chambers, and by having weakly developed transverse ridges along joints of post-abdominal chambers.

*Etymology:* *amplus-a-um* (Latin, adj.) = wide.

*Type locality:* OR501C (See Locality Description).

*Deposition of types:* Holotype=USNM 547360. Paratypes=USNM 547361.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501C).

*Praeparvicingula blackhornensis* (Pessagno and Whalen)

Plate 6, figures 4-5, 22

*Parvicingula blackhornensis* PESSAGNO and WHALEN 1982, p. 137, pl. 10, figs. 10-12; pl. 13, fig. 14.-BLOME 1984, p. 357-358, pl. 9, figs. 6, 22, 15, 22; pl. 15, figs. 3, 8.

*Remarks:* This species is very similar to a paratype of *P. blackhornensis* (Pessagno and Whalen 1982, pl. 10, fig. 12) that is characterized by having tubercle pore frames along circumferential ridges throughout the post-abdominal chambers. It seems that it should be separated from the holotype of *P. blackhornensis* (Pessagno and Whalen 1982, pl. 10, figs. 10-11) and reassigned to *Antexitus* Yeh due to the the difference of test structure.

*Range:* Supperzone 1, upper Zone 1F to Zone 1 G top; Middle Jurassic (upper Bathonian to middle Callovian).

*Occurrence:* South Fork Member, Snowshoe and Lonesome formations, east-central Oregon (OR501C, OR583) and Shelikof Formation, southern Alaska. Abundant in the studied sample.

*Praeparvicingula* sp. cf. *P. blackhornensis* (Pessagno and Whalen)

Plate 6, figures 6-7

*Remarks:* This morphotype differs from *P. blackhornensis* (Pessagno and Whalen) by having a test with wider trapezoidal thorax and a thicker horn.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501C).

***Praeparvicingula burnsensis*** (Pessagno and Whalen)

Plate 7, figure 13

*Parvicingula burnsensis* PESSAGNO and WHALEN 1982, p. 137, pl. 9, figs. 5-7, 4-15, 19-20; pl. 13, fig. 2.- YEH 2009, p. 61, pl. 16, figs. 11, 21.-2011, p. 12, pl. 5, figs. 6-8, 22.

**Range:** Supperzone 1, Zone 1F; Middle Jurassic (lower to upper Bathonian).

**Occurrence:** South Fork Member, Snowshoe Formation, east-central Oregon (OR-MA30A, OR501C).

***Praeparvicingula decora*** (Pessagno and Whalen)

Plate 8, figures 8-9

*Ristola decora* PESSAGNO and WHALEN 1982, p. 148, pl. 11, figs. 7, 10, 17, 21; pl. 13, figs. 12-13.

*Praecaneta decora* (Pessagno and Whalen)- PESSAGNO, BLOME and HULL 1993, p. 142-143, pl. 6, fig. 15.-YEH 2009, p. 61, pl. 17, figs. 1-3, 12, 20.

**Range:** Supperzone 1, upper Zone 1F to Zone 2, Subzone 2 delta; Middle Jurassic (upper Bathonian) to Upper Jurassic (middle Oxfordian).

**Occurrence:** South Fork Member, Snowshoe Formation, east-central Oregon (OR501A, B, C); volcanic member of Josephine ophiolite and volcanopelagic strata overlying Josephine ophiolite, Smith River subterranean, Klamath Mountains.

***Praeparvicingula eleganse*** (Pessagno and Whalen)

Plate 6, figure 14

*Parvicingula eleganse* PESSAGNO and WHALEN 1982, p. 138, pl. 10, figs. 7, 16, 20; pl. 13, fig. 9. -BLOME 1984, p. 360, pl. 9, fig. 16.

**Range:** Supperzone 1, upper Zone 1F to Zone 1G; Middle Jurassic (upper Bathonian to lower middle Callovian).

**Occurrence:** South Fork Member of Snowshoe Formation and Lonesome Formation, east-central Oregon (OR501B, OR583) and Alaska.

***Praeparvicingula* sp. cf. *P. eleganse*** (Pessagno and Whalen)

Plate 6, figure 17

*Parvicingula eleganse* PESSAGNO and WHALEN 1982, p. 138, pl. 10, figs. 7, 16, 20; pl. 13, fig. 9.

**Remarks:** This morphotype differs from *P. eleganse* (Pessagno and Whalen) by having a relatively narrower test with smaller cephalis.

**Range:** Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

**Occurrence:** South Fork Member, Snowshoe Formation, east-central Oregon (OR501C).

***Praeparvicingula grantensis*** (Pessagno and Whalen)

Plate 6, figures 8-10, 15

*Parvicingula grantensis* PESSAGNO and WHALEN 1982, p. 138, pl. 8, figs. 5-6, 16-17, 21; pl. 13, fig. 10.-YEH 2011, p. 12, pl. 4, figs. 1-3, 14, 18.

*Parvicingula* sp. aff. *P. vera* Pessagno and Whalen -YEH 2009, pl. 16, fig. 9, 15, not 10,16.

**Range:** Supperzone 1, middle Zone 1E to Zone 1F top; Middle Jurassic (upper Bajocian to upper Bathonian).

**Occurrence:** South Fork Member, Snowshoe Formation, east-central Oregon (OR549B, ORMA30A and OR501C).

***Praeparvicingula* sp. aff. *P. grantensis*** (Pessagno and Whalen)

Plate 6, figure 10

*Parvicingula* sp. aff. *P. elegans* PESSAGNO and WHALEN 1982, p. 138, pl. 9, figs. 2, 8.

**Range:** Supperzone 1, middle Zone 1E to Zone 1F top; Middle Jurassic (upper Bajocian to upper Bathonian).

**Occurrence:** South Fork Member, Snowshoe Formation, east-central Oregon (OR549B and OR501C).

***Praeparvicingula* sp. cf. *P. gemmata*** Hull

Plate 8, figures 13-14

*Praeparvicingula gemmata* HULL 1997, p. 36, pl. 5, figs. 9-10, 14, 19.

**Remarks:** This morphotype differs from *P. gemmata* Hull by having a relatively narrower test with apical end in conical rather than hemispherical outline.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501C).

***Praeparvicingula matura*** (Pessagno and Whalen)  
Plate 7, figure 17

*Parvicingula matura* PESSAGNO and WHALEN 1982, p. 139, pl. 7, figs. 1-3, 15, 19-20; pl. 13, fig. 1.

*Range:* Supperzone 1, Zone 1A, Subzone 1A1 top to Zone 1F top; Middle Jurassic (upper Aalenian to upper Bathonian).

*Occurrence:* Warm Springs and South Fork members, Snowshoe Formation, east-central Oregon (OR580, OR555, OR501C).

***Praeparvicingula media*** (Pessagno and Whalen)  
Plate 7, figures 12, 14

*Parvicingula media* PESSAGNO and WHALEN 1982, p. 139, pl. 9, figs. 3-4, 17, 21; pl. 13, fig. 6.

*Praeparvicingula schoolhousensis* (Pessagno and Whalen)-YEH 2009, p. 61, pl. 16, figs. 1, 8, 14.

*Range:* Supperzone 1, Zone 1E base to Zone 1F top; Middle Jurassic (upper Bajocian to upper Bathonian).

*Occurrence:* South Fork Member, Middle Jurassic (upper Bajocian to upper Bathonian) from Snowshoe Formation, east-central Oregon (OR549C, OR-MA30A, OR501C).

***Praeparvicingula nullacingula*** Yeh and Pessagno, n. sp.  
Plate 5, figures 12-13, 16, 22

*Parvicingula* (?) sp. YAMAMOTO et al. 1985, p. 37, pl. 6, figs. 4a-b, 5;

*Parvicingula* (?) sp. A -BAUMGARTNER et al. 1995, p. 414, pl. 3239, figs. 1-3.

*Description:* Test small to medium in size, elongate with five or more post-abdominal chambers, without constrictions at joints of chambers. Cephalis dome shaped, with moderately long horn. Test composed of polygonal pore frames in pattern of seven-pore unit (each unit with one central pore

surrounded by six pores) throughout; each unit either flat or slightly concave outwards. Pore frames less regular in apical portion and getting regular distally with three staggered rows of polygonal pore frames (tetragonal, pentagonal and hexagonal) in each post-abdominal chamber. Circumferential ridges not well-defined along joints of final chambers.

*Remarks:* This species is characterized by having pore frames visible throughout the test and also be lacking of well-defined circumferential ridges.

*Etymology:* *nullacingula* = *nullus-a-um* (Latin, adj., meaning not any) + *cingula-ae* (Latin, meaning a girdle).

*Measurements* ( $\mu\text{m}$ ): Holotype +5 paratypes; LT = length of test excluding horn ; WT = maximum width of test.

	LT	WT
Holotype	213	133
Mean	185	120
Maximum	213	133
Minimum	160	110

*Type locality:* Holotype from B, paratypes from OR-501 A (See Locality Description), Snowshoe Formation, east-central Oregon.

*Deposition of types:* Holotype = USNM547362. Paratypes = USNM547363.

*Range:* Supperzone 1, upper Zone 1F to Zone 1G; Middle Jurassic (upper Bathonian to lower Callovian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501A, B, C) and Blake Bahama Basin (Leg76-534A-126-1), Atlantic Ocean.

***Praeparvicingula*** sp. cf. ***P. nullacingula*** Yeh and Pessagno, n. sp.  
Plate 5, figure 14

*Remarks:* This morphotype differs from *P. nullacingula* Yeh and Pessagno, n. sp., by having a test with cephalis covered by microgranular silica.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR 501C).

***Praeparvingula profunda*** (Pessagno and Whalen)

Plate 6, figures 12-13

*Parvingula profunda* PESSAGNO and WHALEN 1982, p. 140, pl. 10, figs. 3-6, 14-15, 18-19; pl. 13, fig. 7.-YEH 2009, p. 61, pl.16, figs. 4-6.

**Range:** Supperzone 1, Zone 1F; Middle Jurassic (lower to upper Bathonian).

**Occurrence:** South Fork Member, Snowshoe Formation, east-central Oregon (ORMA30A and OR501A, C).

***Praeparvingula schoolhousensis*** (Pessagno and Whalen)

Plate 7, figure 15-16, 18, 23

*Parvingula schoolhousensis* PESSAGNO and WHALEN 1982, p. 140, pl. 11, figs. 1-2, 9, 14-15, 18; pl. 13, fig. 5.

Not *Praeparvingula schoolhousensis* (Pessagno and Whalen)-YEH 2009, p. 61, pl. 16, figs. 1, 8, 14.

*Ristola prisca* Blome-YEH 2011, p. 13, pl. 5, figs. 13, 18.

**Remarks:** The specimens assigned to this species in the previous report (Yeh 2009, p. 61, pl. 16, figs.1, 8, 14) should be reassigned to *Praeparvingula media* (Pessagno and Whalen).

**Range:** Supperzone 1, middle Zone 1E to Zone 1F top; Middle Jurassic (upper Bajocian to upper Bathonian).

**Occurrence:** South Fork Member, Snowshoe Formation, east-central Oregon (OR549B and OR501A, B).

***Praeparvingula sodaensis*** (Pessagno and Whalen)

Plate 6, figures 11, 23

*Parvingula sodaensis* PESSAGNO and WHALEN 1982, p. 140-144, pl. 9, figs. 11-12, 16; pl. 13, fig. 15.-YEH 2009, p. 61, pl. 16, figs. 2-3, 19-20.

**Range:** Supperzone 1, lower Zone 1E to Zone 1F top; Middle Jurassic (upper Bajocian to upper Bathonian).

**Occurrence:** South Fork Member, Snowshoe Formation, east-central Oregon (OR549C, OR-MA30A, OR501A).

***Praeparvingulla tllellensis*** Carter

Plate 5, figures 17, 24

*Pseudoristola* sp. B YEH 1987b, p. 97, pl. 14, fig. 21.

*Parvingula* sp. D CARTER et al. 1988, p. 56, pl. 15, figs. 1-2.

*Parvingula* sp. E CARTER et al. 1988, p. 56, pl. 5, fig. 13.

*Ristola* spp. HATTORI 1989, pl. 14, fig. I.

*Parvingula* sp. B YAO 1997, pl. 13, fig. 607.

*Parvingula* aff. *decora* (Pessagno and Whalen) GORIČAN et al. 2003, p. 297, pl. 5, figs. 6-9.

*Praeparvingulla tllellensis* CARTER 2006, in Goričan et al. 2006, p. 340, pl. PCA02, figs. 1-6.

**Range:** Zone 01 to Supperzone 1, Zone 1F top, Lower to Middle Jurassic (lower Toarcian to upper Bathonian) in Hype and Snowshoe formations (OR600A and OR501A), east-central Oregon; lower Toarcian to upper Bajocian from Mino Terrane, central Japan.

**Occurrence:** Worldwide.

***Praeparvingula turpicula*** (Pessagno and Whalen)

Plate 8, figures 1-3

*Ristola(?) turpicula* PESSAGNO and WHALEN 1982, p. 150-151, pl. 11, figs.8, 12-13, 16, 20.

**Remarks:** The forms assigned to this species are not exactly similar to each other in test structure from cephalis to the final post-abdominal chamber. The test of each form was combined with chambers of three staggered rows of parvingulid-type pore frames and non-parvingulid-type pore frames in non-consistent shape. It is very possible that these forms are aberrant of *Praeparvingula* sp. aff. *P. turpicula* (Pessagno and Whalen) in this report.

**Range:** Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

**Occurrence:** South Fork Member, Snowshoe Formation, east-central Oregon (OR501A, B, C).

***Praeparvingula vera*** (Pessagno and Whalen)

Plate 6, figures 1, 16

*Parvingula vera* PESSAGNO and WHALEN 1982, p. 144-146, pl. 11, figs. 3-5, 11, 19; pl. 13, fig. 8.-YEH 2011, p. 12, pl. 4, figs. 4, 11, 16-17.

*Range:* Supperzone 1, middle Zone 1E to Zone 1F top; Middle Jurassic (upper Bajocian to upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR549B, OR501C).

***Praeparvicingula* sp. aff. *P. vera*** (Pessagno and Whalen)  
Plate 6, figure 2

*Remarks:* This morphotype differs from *P. vera* (Pessagno and Whalen) by having a smaller test with relatively larger cephalis and shorter horn.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

***Praeparvicingula* sp. A**  
Plate 6, figures 3, 21

*Remarks:* This morphotype differs from *P. inornata* (Blome) by having a test which is more conical in shape and has a relatively small cephalis.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501C).

***Praeparvicingula* sp. B**  
Plate 6, figures 18-19

*Remarks:* This morphotype is characterized by having an open conical test with a very short cephalis and with thick circumferential ridges.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B, C).

***Praeparvicingula* sp. C**  
Plate 7, figures 8, 19

*Remarks:* This morphotype has weakly developed ridges obliquely across chambers. It is possible

that this is a transitional form showing the evolutionary trend from *Praeparvicingula* Pessagno et al. to *Antexitus* Yeh.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

***Praeparvicingula* sp. D**  
Plate 7, figures 10-11

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501C).

Genus ***Ristola*** Pessagno and Whalen 1982  
*Type species:* *Parvicingula procera* Pessagno 1977a.

*Range and occurrence:* Middle Jurassic (upper Bajocian) to Lower Cretaceous (Berriasian).  
Worldwide.

***Ristola* sp. A**  
Plate 8, figures 17, 24

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon.

Subfamily **WRANGELLIINAE** Yeh 1987a  
*Type genus:* *Wrangellium* Pessagno and Whalen 1982.

*Remarks:* This subfamily was originally assigned to family Canoptidae Pessagno by Yeh (1987a). The classification proposed by De Wever et al. 2001 is followed herein.

*Range and occurrence:* Upper Triassic (Rhaetian) to Lower Cretaceous (Berremian) in De Wever et al. 2001; worldwide.

Genus ***Wrangellium*** Pessagno and Whalen 1982  
*Type species:* *Wrangellium thurstoense* Pessagno and Whalen 1982.

*Range and occurrence:* Lower Jurassic (upper Sinemurian) to Middle Jurassic (Bathonian);

Kunga Formation, Queen Charlotte Islands, B.C.; Nicely, Hyde and Snowshoe formations, east-central Oregon; Franciscan Complex, California.

**Wrangellium** sp. A  
Plate 5, figure 9

**Remarks:** This morphotype differs from *Wrangellium oregonense* Yeh by having a test with less lobated joints and covered with a wider and thicker band between two perforated joints.

**Range:** Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

**Occurrence:** South Fork Member, Snowshoe formations, east-central Oregon.

Family **POULPIDAE** De Wever 1981a  
**Type genus:** *Poulpus* De Wever 1979 (in De Wever et al. 1979).

**Range and occurrence:** Middle Triassic (Anisian) to Lower Cretaceous (Albian) in De Wever et al. 2001. Worldwide.

Subfamily **POULPINAE** De Wever 1981a  
**Type genus:** *Poulpus* De Wever 1979 in De Wever et al. 1979.

**Range and occurrence:** Same as for family.

Genus **Saitoum** Pessagno 1977a  
**Type species:** *Saitoum pagei* Pessagno 1977a.

**Range and occurrence:** Lower Jurassic (Hettagian) to Cretaceous (middle Albian). Worldwide.

**Saitoum** sp. A  
Plate 13, figures 13, 17

**Remarks:** This specimen is very small in size.

**Range:** Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

**Occurrence:** South Fork Member, Snowshoe Formation, east-central Oregon (OR501A, B). Extremely rare in the studied sample.

Family **SETHOCAPSIDAE** Haeckel 1881  
**Type genus:** *Sethocapsa* Haeckel 1881.

**Range and occurrence:** Middle Jurassic to Cretaceous; worldwide.

Genus **Plicaforacapsa** O'dogherty et al. 2006  
**Type species:** *Stylocapsa spiralis* Matsuoka 1982.

**Range and occurrence:** Middle Jurassic (Bathonian or older) to Upper Jurassic (middle Oxfordian); worldwide.

**Plicaforacapsa** sp. cf. **P. catenarum** (Matsuoka)  
Plate 10, figures 6, 26

*Stylocapsa catenarum* MATSUOKA 1982, p. 75, pl. 2, figs. 1-11.- MATSUOKA 1983, p. 18, pl. 2, fig. 10; pl. 7, figs. 1-2.-BAUMGARTNER et al. 1995, p. 530-531, pl. 3044, figs. 1-7.

*Plicaforacapsa catenarum* (Matsuoka)-O'DOGHERTY et al. 2006, p. 443, pl. 7, figs. 28-38.

**Remarks:** This morphotype differs from *P. catenarum* (Matsuoka) by having a test with poorly developed chain-like plicae.

**Range:** Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

**Occurrence:** South Fork Member, Snowshoe Formation, east-central Oregon (OR501A).

Family **SPONGOCAPSULIDAE** Pessagno 1977a  
**Type genus:** *Spongocapsula* Pessagno 1977a.

**Range and occurrence:** Middle Jurassic (Bathonian, Supperzone 1, Zone 1F) to Upper Cretaceous (lower Cenomania). Worldwide.

Genus **Spongocapsula** Pessagno 1977a  
**Type species:** *Spongocapsula palmerae* Pessagno 1977a.

**Range and occurrence:** Same as for family.

**Spongocapsula** sp. cf. **S. hooveri** Hull  
Plate 11, figure 7

*Spongocapsula hooveri* HULL 1997, p. 96, pl. 40, figs. 1-2, 14, 18.

**Remarks:** This species differs from *S. hooveri* Hull by having a shorter test.

**Range:** Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formations, east-central Oregon (OR501C).

*Spongocapsula* sp. aff. *S. palmerae* Hull  
Plate 11, figure 11

*Spongocapsula* sp. aff. *S. palmerae* HULL 1997, p. 96-98, pl. 40, figs. 3-4, 15.

*Remarks:* This morphotype is characterized by having a conical test with weakly developed stricture.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formations, east-central Oregon (OR501B).

Family **SYRINGOCAPSIDAE** Foreman 1973; emend. Hull 1997

*Type genus:* *Syringocapsa* Neviani 1900.

*Range and occurrence:* Triassic to Cretaceous. Worldwide.

Genus *Pleesus* Yeh 1987b

*Type species:* *Pleesus aptus* Yeh 1987b.

*Range and occurrence:* Lower Jurassic (lower Pliensbachian) to Middle Jurassic (upper Bathonian, Supperzone 1, upper Zone 1F); worldwide.

*Pleesus* sp. A  
Plate 8, figure 4

*Remarks:* This specimen is characterized by having a very small test with relatively large pore frames.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formations, east-central Oregon (OR501C)

Genus *Podobursa* Wisnioski 1889; emend. Foreman 1973; emend. Hull 1997

*Type species:* *Podobursa dunikowski* Wisnioski 1889.

*Syringocapsa* NEVIANI 1900, p. 662.

*Trisyringium* VINASSA DE REGNY 1901-1902, p. 507.

*Range and occurrence:* Triassic to Cretaceous. Worldwide.

*Podobursa* sp. cf. *P. basilica* Hull  
Plate 12, figures 8-9

*Podobursa basilica* HULL 1997, p. 100, pl. 41, figs. 7-8, 10, 18, 20-21.

*Remarks:* This morphotype differs from *P. basilica* Hull by having a test with thicker and less pointed horn, also by having a tubular extension relatively wider at distal portion.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formations, east-central Oregon (OR501C).

*Podobursa helvetica* (Rüst)  
Plate 12, figures 12, 15

*Theosyringium Helvetica* RÜST 1885, p. 309, pl. 37, fig. 14.

*Podobursa helvetica* (Rüst)-BAUMGARTNER et al. 1980, p. 60, pl. 3, fig. 11.- BAUMGARTNER et al. 1995, p. 422, pl. 3169, figs. 1,3, 5; 2, 4?-HULL 1997, p. 100-102, pl. 4, fig. 13.

*Podobursa nonhelvetica* YANG and WANG 1990, p. 209-210, pl. 4, figs. 2, 4, 16.

*Range:* Middle Jurassic (lower Bajocian) to Upper Jurassic (lower Kimmeridgian) (UA Zones 3-10) in Baumgartner et al. (1995a); Middle Jurassic (upper Bathonian, Supperzone 1, upper Zone 1F to Zone 2, subzone 2 beta ) in Hull 1997 and this study.

*Occurrence:* Worldwide; in North America it has been recovered from South Fork Member, Snowshoe Formations, east-central Oregon (OR501B) and volcanopelagic strata at Stanley Mountain.

*Podobursa lata* (Yang)  
Plate 12, figure 4

*Syringocapsa lata* YANG 1993, p. 132, pl. 24, figs. 1-2, 16, 20-21; pl. 26, figs. 7, 11, 15.

*Range:* Supperzone 1, upper 1F to Zone4; Middle Jurassic (upper Bathonian) to Upper Jurassic (upper Tithonian).

*Occurrence:* South Fork Member, Snowshoe Formations, east-central Oregon (OR501A, B, C); Taman Formation, east-central Mexico.

***Podobursa* sp. cf. *P. polyacantha*** (Fischli)  
Plate 12, figures 6, 14

*Theosyringium polyacantha* FISCHLI 1916, p. 47, fig. 41.  
*Podobursa polyacantha* (Fischli)- BAUMGARTNER et al. 1995, p. 424, pl. 3174, figs. 1-3; not 4; not FOREMAN 1973 (part), p. 266, pl. 13, figs. 2, 4, 6-7 –not YANG 1993, p. 128, pl. 25, fig. 1; pl. 26, fig. 4.

*Remarks:* This morphotype differs from *P. polyacantha* (Fischli) by having a large globular chamber with six thick circumferential spines which are triradiate and terminated with knob-like tip rather than circular in cross-section and pointed distally.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formations, east-central Oregon (OR501C).

***Podobursa* sp. aff. *P. tetrastyla*** (Steiger)  
Plate 12, figures 3, 16

*Katroma tetrastyla* STEIGER 1992, p. 77, pl. 21, fig. 6.

*Remarks:* This morphotype differs from *P. tetrastyla* (Steiger) by having a test with closed tube at final chamber.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formations, east-central Oregon (OR501B, C).

***Podobursa tamanensis*** (Yang)  
Plate 12, figures 5, 10

*Syringocapsa tamanensis* YANG 1993, p. 133-134, pl. 26, figs. 1-2, 19, 21.

*Range:* Supperzone 1, upper 1F to Zone4; Middle Jurassic (upper Bathonian) to Upper Jurassic (upper Tithonian).

*Occurrence:* South Fork Member, Snowshoe Formations, east-central Oregon (OR501 B, C); Taman Formation, east-central Mexico.

***Podobursa* sp. A**  
Plate 12, figures 1, 11

*Remarks:* This morphotype differs from *P. sp. cf. P. polyacantha* (Fischli) by having a test with shorter apical neck with a massive triradate horn.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, from Snowshoe Formations, east-central Oregon (OR501A).

***Podobursa* sp. B**  
Plate 12, figures 2, 7, 13

*Remarks:* This morphotype is characterized by having a test with short apical neck, by having a long massive triradate horn with knob-like tip, and by having four to six thick triradate circumferential spines with knob-like tips.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formations, east-central Oregon (OR501B).

Genus ***Quarticella*** Takemura  
*Type species:* *Quarticella ovalis* Takemura 1986.

*Range and occurrence:* Middle Jurassic from Mino Terrane, Japan and Snowshoe Formation, east-central Oregon.

***Quarticella takemurai*** Yeh and Pessagno, n. sp.  
Plate 9, figures 5-7, 9, 13, 23

*Quarticella* spp. NAGAI & MIZUTANI 1992. p. 54, pl. 6, fig. 1, not 2.

*Description:* Test small; cephalis conical and with a short horn; thorax and abdomen trapezoidal in outline, post-abdominal chamber rounded in outline but terminating with a large, slightly constricted aperture. Test increasing in width and length gently from cephalis to abdomen, more rapidly from abdomen to post-abdominal chamber. Test composed of irregular polygonal pore frames but cephalis usually covered with microgranular silica; pore frames variable in size, with smaller size in cephalis and thorax, possibly larger in abdomen or in last chamber. Short triradate spines randomly distributed in last two

chambers. Strictures between chambers not well developed but recognizable.

*Remarks:* This species is characterized by having a small test with randomly distributed short spines in last two chambers.

*Etymology:* This species is named for Dr. Atsushi Takemura (Kyoto University, Japan) for his contribution to the study of Mesozoic Radiolaria.

*Measurements* ( $\mu\text{m}$ ): Holotype + 4 paratypes. HCT = height of cephalis and thorax excluding horn; HT = height of test excluding horn; WT = maximum width of test excluding spines.

	HTC	HT	WT
Holotype	67	133	117
Mean	48	145	115
Maximum	67	157	127
Minimum	33	148	113

*Type locality:* Holotype from OR501C, paratypes from OR501A and C (See Locality Description), Snowshoe formation, east-central Oregon.

*Deposition of types:* Holotype, USNM 547354; paratypes, USNM 547355.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501A, C).

Genus *Yamatoum* Takemura 1986.

*Type species:* *Yamatoum elegans* Takemura 1986.

*Range and occurrence:* Middle Jurassic from Mino terrane, Japan and Snowshoe Formation, east-central Oregon.

*Yamatoum* (?) sp. A  
Plate 10, figures 17, 32

*Yamatoum* (?) sp. A TAKEMURA 1986, pl. 8, fig. 8.

*Yamatoum* sp. A HATTORI 1987, pl. 23, fig. 6.

*Range and occurrence:* Middle Jurassic; Bathonian or older from Mino Terrane and Nanjo Massif, central Japan and upper Bathonian (Supperzone 1, upper Zone 1F) from Snowshoe Formation, east-central Oregon (OR501B).

Genus *Windalia* Ellis 1993

*Type species:* *Amphypyndax* (?) *pyrgodes* Renz 1974.

*Remarks:* As mentioned in Kiessling (1999, p. 62), the species of this genus are characterized by having a combination of oblique longitudinal ridges at joints and circular pores. The internal cephalic structure agrees with the *Yamatoum*-type sensu Takemura (1986).

*Range and occurrence:* Middle Jurassic (upper Bathonian, Supperzone 1, upper Zone 1F) from Snowshoe Formation, east-central Oregon (OR501B); and Paleo-southern Hemisphere as in Kiessling (1999, p. 62): Upper Jurassic (Tithonian) to Cretaceous (Albian) from DSDP Leg 27, Indian Ocean; ODP Leg 119, Wendell Sea; ODP Leg 123, off northwest Australia; *Windalia* Radiolarite, West Australia; Wallumbilla Formation, Queensland, Australia; Ameghino Formation, Antarctic Peninsula.

*Windalia* sp. A  
Plate 8, figure 16

*Windalia* sp. B KIESSLING 1999, p. 62-65, pl. 9, fig. 3.

*Remarks:* This morphotype is slightly different from *Windalia* sp. B of Kiessling 1999 by having a test with pore frames of thinner bars.

*Range and occurrence:* Middle Jurassic (upper Bathonian, Supperzone 1, upper Zone 1F) from Snowshoe Formation, east-central Oregon (OR501B); Lower Cretaceous (Berriasian) from Ameghino Formation, Antarctic Peninsula.

Family **TELACAPSULIDAE** Yeh 2009  
*Type genus:* *Telacapsula* Yeh 2009.

*Range:* Supperzone 1, Zone 1F; Middle Jurassic (Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formations, east-central Oregon (ORMA30A, OR501B).

Genus *Telacapsula* Yeh 2009  
*Type species:* *Telacapsula odoghertyi* Yeh 2009.

*Range and occurrence:* Same as for family.

***Telacapsula johndayensis* Yeh**

Plate 8, figures 19, 23

*Telacapsula johndayensis* YEH 2009, p. 63-64, pl. 19, figs. 10-12, 14, 18.**Range:** Supperzone 1, Zone 1F; Middle Jurassic (Bathonian).**Occurrence:** South Fork Member, Snowshoe Formations, east-central Oregon (ORMA30A, OR501B).Family **TERTONIIDAE** Dumitrica and Zügel 2003**Type genus:** *Tertonium* Dumitrica and Zügel 2003.**Range and occurrence:** Lower Jurassic (Pliensbachian) to Upper Jurassic (Tithonian) in Dumitrica and Zügel 2003; worldwide.Genus ***Toritenum*** Dumitrica and Zügel 2003**Type species:** *Toritenum hirsutum* Dumitrica and Zügel 2003.*Laxuscingular* YEH 2009**Range and occurrence:** Lower to Upper Jurassic (lower Pliensbachian to lower Tithonian) in Dumitrica and Zügel 2003; Turkey, Japan, Anarctic peninsula, and east-central Oregon.***Toritenum hirsutum*** Dumitrica and Zügel 2003

Plate 4, figures 3, 5, 14

*Parvicingula* sp. aff. *P. (?) obesa* HATTORI 1989, pl. 44, fig. F.*Toritenum hirsutum* DUMITRICA and ZÜGEL 2003, p. 52, figs. 26A-C, H.**Range and occurrence:** Lower Middle Jurassic from Japan, Middle Jurassic (upper Bathonian, Supperzone 1, upper Zone 1F ) from Snowshoe Formations, east-central Oregon (OR501A, B) and Upper Jurassic (lower Tithonian) from Solnhofen area, Southern Germany.***Toritenum obesa*** (Takemura)

Plate 4, figures 7, 10

*Parvicingula (?) obesa* TAKEMURA 1986, p. 52, pl. 6, figs. 8-10, 11-12.*Laxuscingular obesa* (Takemura)-YEH 2009, p. 72, pl. 23, figs. 1, 6-7, 11, 15-16.**Remarks:** It is very possible that this is a broken specimen of *Parvicingula (?) obesa* Takemura. It differs from *Toritenum hirsutum* Dumitrica and Zügel by having a test with larger pore frames.**Range:** Supperzone 1, Zone 1F, Middle Jurassic (Bathonian). Mino Terrane, Central Japan and South Fork Member of Snowshoe Formation, east-central Oregon.**Occurrence:** Mino Terrane, Central Japan and South Fork Member of Snowshoe Formation, east-central Oregon.Family **TRIPEDURNULIDAE** Dumitrica 1991**Type genus:** *Tripedurnula* Dumitrica 1991.**Range and occurrence:** Middle Triassic to Middle Cretaceous (Albian). Worldwide.Genus ***Pseudopoulpus*** Takemura 1986, emend. Yeh 1987b.**Type species:** *Pseudopoulpus yamatoensis* Takemura 1986.**Range and occurrence:** Middle Triassic to Middle Cretaceous. Worldwide.***Pseudopoulpus* sp. A**

Plate 13, figure 5

**Range:** Supperzone 1, upper Zone 1F; Middle Jurassic (Bathonian).**Occurrence:** South Fork Member, Snowshoe Formations, east-central Oregon (OR501C).***Pseudopoulpus* sp. B**

Plate 13, figure 6

**Remarks:** This morphotype differs from *Pseudopoulpus* sp. A in this report by having a test with three horns.**Range:** Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).**Occurrence:** South Fork Member, Snowshoe Formations, east-central Oregon (OR501B).Genus ***Turanta*** Pessagno and Blome 1982; emend. Takemura 1986**Type species:** *Turanta capsensis* Pessagno and Blome 1982.

*Turanta* PESSAGNO and BLOME 1982, p. 296-297; -emend. TAKEMURA 1986, p. 64; -Goriča et al., 2006, p. 392.

*Range and occurrence:* (Toarcian) to Upper Jurassic (lower Tithonian). Worldwide.

*Turanta ancoriformis* Takemura  
Plate 13, figures 12, 20

*Turanta ancoriformis* TAKEMURA 1986, p. 65, pl. 11, figs. 13-18.

*Range:* Supperzone 1, Zone 1F; Middle Jurassic (Bathonian).

*Occurrence:* Mino Terrane, Central Japan and South Fork Member of Snowshoe Formation, east-central Oregon (OR501C).

*Turanta capsensis* Pessagno and Blome  
Plate 13, figure 18

*Turanta capsensis* PESSAGNO and BLOME 1982, p. 297-298, pl. 4, figs. 3, 11-12, 14, 17; pl. 7, fig. 5.

*Remarks:* This species differs from *T. lupheri* Pessagno and Blome by having a relatively smaller globus test with much longer spines. This species can be distinguished from *T. nodosa* Pessagno and Blome by having a test composed of relatively thinner pore frames without prominent rounded nodes at pore frame vertices.

*Range:* Supperzone 1, upper Zone 1E to Zone 1F top; Middle Jurassic (upper Bajocian to top of upper Bathonian).

*Occurrence:* Warm Springs and South Fork members, Snowshoe Formation, east-central Oregon (OR550C, OR501A, B and C).

*Turanta lupheri* Pessagno and Blome  
Plate 13, figure 11

*Turanta lupheri* PESSAGNO and BLOME 1982, p. 300, pl. 4, figs. 1-2, 13, 16.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

*Turanta morinae* Pessagno and Blome 1982  
Plate 13, figure 8

*Turanta morinae* PESSAGNO and BLOME 1982, p. 300, pl. 1, figs. 3-4, 8, 11, 16.- GORIČAN et al., 2006, p. 392-393, pl. 3247.-CARTER 1988, p. 62, pl. 14, fig. 8.-YEH 2009, p. 66, pl. 9, figs. 14, 16.-YEH 2011, p. 14, pl. 1, figs. 10, 16.

*Range:* Middle Jurassic (upper Aalenian to upper Bathonian, Supperzone 1, upper Zone 1A to Zone 1F top).

*Occurrence:* Warm springs and South Fork members of Snowshoe Formation, east-central Oregon; Queen Charlotte Islands, British Columbia; Mino Complex, Japan; Liminangcong Chert, Philippines; Sogno Formation, Italy.

*Turanta nodosa* Pessagno and Blome  
Plate 13, figures 15, 19

*Turanta nodosa* PESSAGNO and BLOME 1982, p. 301, pl. 2, fig. 4; pl. 3, figs. 1-3, 8, 11, 12, 14. -CARTER 1988, p. 63, pl. 14, figs. 3, 11. -YEH 2009, p. 66, pl. 9, figs. 14, 16.-YEH 2011, p. 15, pl. 1, fig. 15.

*Range and occurrence:* Middle Jurassic; upper middle/lower upper Toarcian from Phantom Creek Formation, Graham Island, Queen Charlotte Islands, British Columbia and lower Bajocian to upper Bathonian (Supperzone 1, Zone 1C to Zone 1F) from top of Warm Springs Member (OR-MA15) and South Fork Member (OR549B,C; OR-MA30A; OR501A, B, C), Snowshoe Formation, east-central Oregon.

*Turanta* sp. A  
Plate 13, figure 10

*Remarks:* This specimen is distinguished from *T. capsensis* Pessagno and Blome by having a test with larger pores at cephalic skeletons.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

Family **ULTRANAPORIDAE** Pessagno 1977b; emend. Pessagno et al. 1986

*Type genus:* *Ultranapora* Pessagno 1977b (= *Napora* Pessagno 1977a).

*Range and occurrence:* Lower Jurassic (upper Sinemurian?; lower Pliensbachian) to Upper Cretaceous. Worldwide.

Genus *Napora* Pessagno 1977a

*Type species:* *Napora burkryi* Pessagno 1977a.

*Napora* PESSAGNO 1977a, p. 94.

*Ultranapora* PESSAGNO 1977b. P. 38

*Range and occurrence:* Same as for family.

*Napora antelopensis* Pessagno, Whalen and Yeh  
Plate 13, figures 1-2, 7

*Napora antelopensis* PESSAGNO, WHALEN and YEH 1986, p. 34-35, pl. 8, figs. 2-3, 15, 20-23; pl. 11, fig. 18.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B, C).

*Napora izeensis* Pessagno, Whalen and Yeh  
Plate 13, figure 14

*Napora izeensis* PESSAGNO, WHALEN and YEH 1986, p. 41-42, pl. 8, figs. 1, 7-9, 11, 16; pl. 11, fig. 8.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501A, B).

*Napora* sp. cf. *N. parva* Takemura  
Plate 13, figures 3-4

*Napora parva* TAKEMURA 1986, p. 7, pl. 3, figs. 10-14.

*Remarks:* This morphotype differs from *Napora parva* Takemura by having a test without cephalocone.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501C).

*Napora* (?) sp. A  
Plate 13, figures 9, 21

*Remarks:* This morphotype is questionably assigned to *Napora* Pessagno because it has only two feet.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

Family **UNUMIDAE** Kozur 1984

*Type genus:* *Unuma* Ichikawa and Yao 1976.

*Range and occurrence:* Middle Jurassic (Aalenian) to Lower Cretaceous (Aptian or younger) in De Wever et al. 2001; worldwide.

Genus *Unuma* Ichikawa and Yao

*Type species:* *Unuma typicus* Ichikawa and Yao 1976.

*Range and occurrence:* Middle Jurassic; worldwide.

*Unuma* sp. cf. *U. echinata* Ichikawa and Yao  
Plate 9, figures 8, 14

*Unuma echinata* ICHIKAWA and YAO 1976, p. 112, pl. 1, figs. 5-6; pl. 2, figs. 5-7.-BAUMGARTNER 1995, p. 620, pl. 3231, figs. 1-5.-HULL 1997, p. 172, pl. 43, figs. 4, 21.

*Remarks:* This morphotype differs from *U. echinata* Ichikawa and Yao by having a test with wider post-abdominal chamers and with less and much smaller spines.

*Range:* Supperzone 1, upper Zone 1F to Zone 2, subzone 2γ), Middle Jurassic (upper Bathonian) to Upper Jurassic (middle Oxfordian).

*Occurrence:* South Fork Member of Snowshoe Formation, east-central Oregon (OR501B) and lower portion of volcanopelagic strata overlying the Coast Range ophiolite, Stanley Mountain, California.

Family **WILLIRIEDELLIDAE** Dumitrica

*Type genus:* *Williriedellum* Dumitrica 1970.

*Range and occurrence:* Lower Jurassic (early Sinemurian) to Upper Cretaceous; worldwide.

*Genus* ***Hiscocapsa*** O'Dogherty 1994; emend. Hull 1997

*Type species:* *Cyrtocapsa grutterinki* Tan Sin Hok.

*Range and occurrence:* Middle Jurassic to Cretaceous; worldwide.

***Hiscocapsa convexa*** (Yao)

Plate 10, figure 13

*Stichocapsa convexa* YAO 1979, p. 35-36, pl. 5, figs. 14-16; pl. 6, figs. 1-7.-AITA 1982, pl. 1, figs. 6-7b.-TAKEMURA 1986, p. 55, pl. 7, figs. 9-10.-BAUMGARTNER et al. 1995, p. 518, pl. 3055.

*Remarks:* This species differs from *H. robusta* (Matsuoka) by having a longer test with first three chambers higher and narrower. It can be distinguished from *H. matsukai* Yeh by having a test without constriction between the third and the last globous chamber.

*Range:* Supperzone 1, middle Zone 1A to Zone 3 (Subzone 3β?).

*Occurrence:* worldwide.

***Hiscocapsa echinoampulla*** Yeh and Pessagno, n. sp.

Plate 9, figures 1-3, 24

*Description:* Test composed of four chambers. Cephalis small and rounded; thorax and abdomen trepezoidal in outline, each chamber composed of four to five staggered rows of hexagonal pore frames, with larger pore frames along constricted joints. Cephalis and upper part of thorax covered with thick microgranular silica. Apical portion increasing in width gradually as chamber added; post-abdominal globus, with small circular aperture at bottom center, composed of pore frames in seven-pore pattern (one central pore surrounded by six pores) and with homogeneously distributed short spines formed by silica projection at central pore of each seven-pore unit. Same type of short spines also present randomly at some pore frames of abdomen.

*Remarks:* This species is characterized by having a bottle-shape test and by having a globous post-abdominal chamber with thorny tubercle pore frames at outer surface.

*Etymology:* *echinoampulla* = *echinus* (sea urchin) + *ampulla-ae* (Latin, meaning a bottle) = a bottle with sea urchin-like thorns.

*Measurement* (µm) : Holotype + 4 paratypes; L1= length of cephalis, thorx and abdomen; LT = length of test; WT = maximum width of test excluding thorns.

	L1	LT	WT
Holotype	70	187	133
Mean	72	172	128
Maximum	82	187	140
Minimum	68	167	125

*Type Locality:* Holotype from OR501A, paratypes from OR501A, B and C (see Locality Description).

*Deposition of types:* Holotype=USNM547366. Paratypes=USNM547367.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501A, B, C).

***Hiscocapsa matsukai*** Yeh

Plate 10, figures 7-8, 15

*Hiscocapsa matusokai* YEH 2009, p. 67, pl. 21, figs. 1, 8, 20, 22.-YEH 2011, p. 16, pl. 7, figs. 10-13.

*Range:* Supperzone 1, middle Zone 1E to Zone 1F top; Middle Jurassic (upper Bajocian to upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR549B, OR-MA30A, OR501B).

***Hiscocapsa*** (?) sp. A

Plate 9, figures 10-12, 19

*Remarks:* According to Hull (1997), only four chambered williridellids are included in *Hiscocapsa* O'Dogherty. These specimens are questionably assigned to this genus because they have only three segments.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence*: South Fork Member, Snowshoe Formation, east-central Oregon.

*Genus Praezhamoidellum* Kozur 1984, emend. Hull 1997

*Type species*: *Praezhamoidellum yaoi* Kozur 1984.

*Range and occurrence*: Middle Jurassic to Upper Jurassic. Worldwide.

*Praezhamoidellum wui* Yeh and Pessagno, n. sp. Plate 10, figures 22-24, 27

*Description*: Test medium in size. Cephalis small, bell-shaped, imperforated; thorax trapezoidal in outline, abdomen inflated but truncated at base and constricted to form a small circular aperture. Test composed of regularly arranged hexagonal pore frames and with larger pore frames at abdomen. Bars of pore frames widening around each pore and thickening upwards at central line of each pore and short spines often present at triple junctions of pore frame bars.

*Remarks*: This species differs from *Praezhamoidellum* sp. cf. *P. parvipora* (Tan Sin Hok) by having a test with inflated abdomen.

*Etymology*: This species is named for Prof. Hao-ruo Wu, Institute of Geology, Academia Sinica, for his contribution to the study of Mesozoic radiolarians.

*Measurement* ( $\mu\text{m}$ ) : Holotype + 5 paratypes; WPC = maximum width of abdomen, LPC = length of earlier chambers including cephalis, thorax and abdomen, WPA = maximum width of post-abdomen; LT = length of whole test.

	WPC	LPC	WPA	LT
Holotype	67	63	170	230
Mean	63	60	160	210
Maximum	67	64	170	230
Minimum	62	57	156	193

*Type Locality*: OR501B (See Locality Descriptions), Snowshoe Formation, east-central Oregon.

*Deposition of types*: Holotype = USNM547368; paratypes = USNM547369, National Museum of Natural History, Smithsonian Institute.

*Range*: Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence*: South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

*Praezhamoidellum* sp. cf. *P. parvipora* (Tan Sin Hok)  
Plate 10, figures 4-5, 30

*Tricolocapsa* sp. cf. *T. parvipora* Tan –YAO 1979, p. 31, pl. 2, figs. 28-37; pl. 3, figs. 1-7.

*Range*: Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence*: Mino Terrane, Central Japan; South Fork Member of Snowshoe Formation, east-central Oregon (OR501B).

*Praezhamoidellum* sp. cf. *P. rüsti* (Tan Sin Hok)  
Plate 10, figure 3

*Tricolocapsa* sp. cf. *T. parvipora* Tan –YAO 1979, p. 30, pl.3, figs. 8-20.

*Range*: Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence*: Mino Terrane, Central Japan; South Fork Member of Snowshoe Formation, east-central Oregon (OR501A).

*Praezhamoidellum* sp. A  
Plate 10, figures 25, 34

*Remarks*: This morphotype is characterized by having a relatively larger test with globous abdomen.

*Range*: Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence*: South Fork Member, Snowshoe Formation, east-central Oregon (OR501A).

*Genus Zamoidellum* Dumitrica 1970

*Type species*: *Zamoidellum ventricosum* Dumitrica 1970.

*Range and occurrence*: Middle Jurassic to Cretaceous. Worldwide.

*Zhamoidellum horiae* Yeh and Pessagno, n. sp.  
Plate 10, figures 18-21, 29

*Zhamoidellum funatoensis* (Aita) YEH 2009, p. 68, pl. 21, figs. 10-11, 17, 25.

**Description:** Test as with genus; cephalis small without horn, spherical in shape, mostly imperforated; thorax perforated, trapezoidal in outline, slightly wider than cephalis, lumbar pores present. Abdomen large globous and composed of large pore frames in pattern of seven-pore unit (one larger central pore surrounded by six smaller pores); outer surface of abdomen undulated because thicker raised bars merged present by central pores.

**Remarks:** This species differs from the forms mis-assigned to *Zhamoidellum funatoensis* (Aita) in Yeh (2009, p. 68, pl. 21, figs. 10-11, 17, 25) by having a larger test with relatively smaller cephalis and thorax.

**Etymology:** This species is named for Rie Hori, Ehime University (Japan), for her contributions to the study of Mesozoic radiolarians.

**Measurement** ( $\mu\text{m}$ ) : Holotype + 9 paratypes. LT = length of test, WT = maximum width of test.

	LT	WT
Holotype	163	147
Mean	170	155
Max.	190	160
Min.	155	145

**Type Locality:** Holotype from, paratypes from OR501A and B (See Locality Descriptions), Snowshoe Formation, east-central Oregon.

**Deposition of types:** Holotype = USNM547370; paratypes = USNM547371, National Museum of Natural History, Smithsonian Institute.

**Range:** Supperzone 1, Zone 1F; Middle Jurassic (Bathonian).

**Occurrence:** South Fork Member, Snowshoe Formation, east-central Oregon (OR-MA30A, OR501A, B).

Family **XITIDAE** Pessagno 1977b

**Type genus:** *Xitus* Pessagno 1977b.

**Remarks:** The presence of *Antexitus* spp. in this studied material indicates that the range of *xitids* goes down to upper Bajocian.

**Range and occurrence:** Middle Jurassic (upper

Bajocian) to Upper Cretaceous (Maastrichtian). Worldwide.

**Genus** *Antexitus* Yeh 2009

**Type species:** *Antexitus pessagnoii* Yeh 2009.

**Range:** Supperzone 1, Zone 1E to Zone 1F top; Middle Jurassic (upper Bajocian to upper Bathonian).

**Occurrence:** South Fork Member, Snowshoe Formation, east-central Oregon.

***Antexitus pessagnoii*** Yeh

Plate 7, figure 2

*Antexitus pessagnoii* YEH 2009, p. 69-70, pl. 22, figs. 1-3, 8, 14, 18-19.-YEH 2011, p. 17, pl. 6, figs. 20-21.

**Range:** Supperzone 1, middle Zone 1E to Zone 1F top; Middle Jurassic (upper Bajocian to upper Bathonian).

**Occurrence:** South Fork Member, Snowshoe Formations, east-central Oregon (OR549B, OR-MA30A, OR501C).

***Antexitus* sp. aff. *A. pessagnoii*** Yeh

Plate 7, figure 4

**Remarks:** This morphotype differs from *A. pessagnoii* Yeh by having a test with two horns.

**Range:** Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

**Occurrence:** South Fork Member, Snowshoe Formations, east-central Oregon (OR501A).

***Antexitus* sp. cf. *A. pessagnoii*** Yeh

Plate 7, figure 3

**Remarks:** This morphotype differs from *A. pessagnoii* Yeh by having a test with final two post-abdominal chambers constricted.

**Range:** Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

**Occurrence:** South Fork Member, Snowshoe Formations, east-central Oregon (OR501C).

***Antexitus yangi*** Yeh

Plate 7, figure 1

*Antexitus yangi* YEH 2009, p. 70-71, pl. 22, figs. 6-7, 13, 17.-YEH 2011, p. 18, pl. 6, figs. 10, 17, 28.

**Range:** Supperzone 1, middle Zone 1E to Zone 1F top; Middle Jurassic (upper Bajocian to upper Bathonian).

**Occurrence:** South Fork Member, Snowshoe Formation, east-central Oregon (OR549B, OR-MA30A, OR501A, C).

Genus *Novixitus* Pessagno 1977b

**Type species:** *Novixitus mclaughlini* Pessagno 1977b.

**Range and occurrence:** Middle Jurassic (upper Bathonian, Supperzone 1, upper Zone 1F) from Snowshoe Formation, east-central Oregon; Upper Jurassic (upper Tithonian) to Cretaceous from Franciscan Complex and Great Valley Supergroup; volcanic strata overlying Coast Range ophiolite, Stanley Mountain, California.

*Novixitus* sp. A

Plate 8, figures 10-12, 22

*Anicyrtis* sp. F YAO 1997, pl. 13, fig. 607.

**Range and occurrence:** Middle Jurassic; lower middle Bajocian (=upper lower Bajocian in this study) from Mino Terrane, central Japan; upper Bathonian (Supperzone 1, upper Zone 1F) from Snowshoe Formation, east-central Oregon (OR501B).

## NASALLARIINA INCERTAE SEDIS

Genus *Belleza* Hull 1997

**Type species:** *Stichocapsa decora* (Rüst)

**Range and occurrence:** Middle Jurassic (upper Bajocian) to Upper Jurassic (Oxfordian); worldwide.

*Belleza decora* (Rüst)

Plate 8, figures 6-7

*Stichocapsa decora* RÜST 1885, p. 319, pl. 42, fig. 3.-AITA 1987, pl. 11, figs. 6-7; -Baumgartner et al. 1995, p.520, pl. 3269, figs. 1-4.-HULL 1997, p. 142, pl. 47, figs. 5-6, 14, 22-23.

**Range:** Supperzone 1, upper Zone 1F to Zone 2, subzone 2γ; Middle Jurassic (upper Bathonian) to Middle Jurassic (middle Oxfordian) in North America.

**Occurrence:** Alps, Japan, east-central Oregon and Stanley Mountain, California.

Genus *Canelonus* Hull 1997

**Type species:** *Canelonus conus* Hull 1997.

**Range and occurrence:** Middle Jurassic (Bathonian, Supperzone 1, Zone 1F) from Snowshoe Formation, east-central Oregon; Upper Jurassic (middle Oxfordian) from Stanley Mountain, California.

*Canelonus* sp. cf. *C. conus* Hull

Plate 11, figures 9, 16

*Canelonus* sp. cf. *C. conus* Hull-YEH 2009, p.71, pl. 17, figs. 4-5, 16, 21.

**Range:** Supperzone 1, Zone 1F, Middle Jurassic (Bathonian).

**Occurrence:** South Fork Member from Snowshoe Formation, east-central Oregon (OR-MA30A, OR501B).

*Canelonus reliquus* Yeh and Pessagno, n. sp.

Plate 11, figures 1-4, 6, 8, 20

**Description:** Test multicytid, with seven to eight chambers, with a moderately thick pointing horn; earlier test conical with chambers trapezoidal in outline, increasing in height more rapidly than in width; final chamber closed, sub-globous, flat at base and flanking with 7 to 9 medium sized triradiate spines; spines equally disposed and pointing downward. Test composed of hexagonal and pentagonal pore frames throughout, pores gradually increasing in size distally; outer surface of cephalis and thorax mostly covered with microgranular silica; two to three staggered rows of pore frames across each chamber.

**Remarks:** This species is characterized by having a test with very narrow conical earlier chambers and with a long pointing spine on the small cephalis.

**Etymology:** *reliquus-a-um* (Latin, adj.) = outstanding.

*Measurement* ( $\mu\text{m}$ ) : Holotype + 4 paratypes.

	Length of test excluding horn	Width of earlier chambers (max.)	Length of horn
Holotype	200	100	63
Mean	200	112	64
Max.	210	120	70
Min.	195	100	63

*Type Locality*: OR501B (See Locality Descriptions), Snowshoe Formation, east-central Oregon.

*Deposition of types*: Holotype = USNM547372; paratypes = USNM547373, National Museum of Natural History, Smithsonian Institute.

*Range*: Supperzone 1, upper Zone 1F, Middle Jurassic (upper Bathonian).

*Occurrence*: South Fork Member from Snowshoe Formation, east-central Oregon (OR501B).

***Canelonus* sp. A**

Plate 11, figures 5, 10, 21

*Remarks*: This morphotype differs from *Canelonus reliquus* Yeh and Pessagno, n. sp., by having a relatively shorter hornless test with better developed stricture at joints and composed of thick pore frames.

*Range*: Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence*: South Fork Member, Snowshoe Formation, east-central Oregon.

***Canelonus* sp. B**

Plate 11, figures 12-14

*Remarks*: This morphotype differs from *Canelonus reliquus* Yeh and Pessagno, n. sp., by having a relatively larger test with 11 shorter spines at base of final chamber and by having more than three rows of smaller polygonal pore frames across two adjacent joints of post-abdominal chambers.

*Range*: Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence*: South Fork Member, Snowshoe Formation, east-central Oregon.

***Canelonus* sp. C**

Plate 11, figures 15, 17

*Remarks*: This morphotype differs from *Canelonus reliquus* Yeh and Pessagno, n. sp., by having a relatively shorter test with less post-abdominal chambers.

*Range*: Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence*: South Fork Member, Snowshoe Formation, east-central Oregon (OR501C).

**Genus *Minutusolla* Yeh 2009**

*Type species*: *Minutusolla tangae* Yeh 2009.

*Remarks*: Forms of this genus is very rare in the studied sample.

*Range and occurrence*: Middle Jurassic (upper Bajocian to Bathonian) from Snowshoe Formation, east-central Oregon.

***Minutusolla nishimurae* Yeh and Pessagno, n. sp.**  
Plate 10, figures 1-2, 10-12, 28, 33

*Stichocapsa* sp. B YAMAMOTO et al. 1985, p. 38, pl. 7, fig. 6.

*Podobursa* (?) sp. B HULL 1997, p. 108, pl. 43, figs. 5, 18-19.

*Descriptions*: Test as with genus with four segments, small in size. Cephalis small, imperforated and rounded in outline, partially cryptocephalic, with a very short horn, with five or more collar pores. Thorax subrectangular in outline, about twice as wide as cephalis; Abdomen inflated, post-abdominal chamber constricted and terminating with hemispherical extension with small aperture at bottom. Thorax and following chambers composed of nearly equally sized thin and wide polygonal (mostly hexagonal and pentagonal) pore frames; pores circular, slightly smaller at thorax and larger at final portion; many tubercle spines and oblique ridges present at outer surface of abdomen.

*Etymology*: This species is named for Akiko Nishimura to honor her contributions on the study of Mesozoic radiolarians.

*Measurement* ( $\mu\text{m}$ ) : Holotype + 6 paratypes. LT = length of test excluding horn, WT = maximum width of thorax, WAB = maximum width of abdomen excluding spines.

	LT	WT	WAB
Holotype	173	50	117
Mean	180	54	125
Max.	190	60	140
Min.	173	50	117

*Type Locality:* OR501B (See Locality Descriptions), Snowshoe Formation, east-central Oregon.

*Deposition of types:* Holotype = USNM547374; paratypes = USNM547375, National Museum of Natural History, Smithsonian Institute.

*Range:* Supperzone 1, upper Zone 1F to Zone 2, Subzone 2 $\gamma$ , Middle Jurassic (upper Bathonian to middle Oxfordian).

*Occurrence:* South Fork Member of Snowshoe Formation, east-central Oregon; Stanley Mountain, California and Blake Bahama Basin, West Atlantic Ocean, etc.

*Minutusolla* sp. aff. *M. nishimurae* Yeh and Pessagno, n. sp.  
Plate 10, figure 9

*Remarks:* This morphotype differs from *M. nishimurae* Yeh and Pessagno, n. sp., by having a test with conical cephalis and final portion tapering distally, by having abdomen and post-abdominal chamber composed of relatively larger pore frames and by having last chamber terminating with small conical extension.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

*Minutasola yaoi* Yeh  
Plate 10, figure 16

*Minutasola yaoi* YEH 2009, p. 72-73, pl. 18, figs 1-2, 8-9, 15-17, 22-25, 29; pl. 21, fig. 12.-YEH 2011, p. 18, pl. 7, figs. 14, 24.

*Range:* Supperzone 1, middle Zone 1E to Zone 1F top; Middle Jurassic (upper Bajocian to upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR549B, OR-MA30A, OR501B).

**Nassellarian** gen. et sp. indet. A  
Plate 4, figures 4, 6

*Remarks:* This species is characterized by having a multicyrtd conical test with narrow proximal portion, by having final last two chambers much wider and outer surface layer covered with pore frames in pattern of a center hexagonal pore frame surrounded by six polygonal pores.

*Range and occurrence:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian). South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

**Nassellarian** gen. et sp. indet. B  
Plate 7, figures 5-7, 22

*Remarks:* This species is characterized by having a small multicyrtd conical test with porous undulated surface and with weakly developed circumferential ridges present at last one or two chambers.

*Range and occurrence:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian). South Fork Member, Snowshoe Formation, east-central Oregon (OR501C).

**Nassellarian** gen. et sp. indet. C  
Plate 7, figure 9

*Range and occurrence:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian). South Fork Member, Snowshoe Formation, east-central Oregon (OR501C).

**Nassellarian** gen. et sp. indet. D  
Plate 8, figures 5, 20

*Range and occurrence:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian). South Fork Member, Snowshoe Formation, east-central Oregon (OR501A).

**Nassellarian** gen. et sp. indet. E  
Plate 10, figures 14, 31

*Range and occurrence:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian). South Fork Member, Snowshoe Formation, east-central Oregon (OR501C).

**Order SPUMELLARIINA**

Family **ANGULOBRACIIDAE** De Wever et al. 2001

*Type genus: Angulobracchia* Baumgartner 1980a.

*Range and occurrence:* Middle Triassic (lower Ladinian) to Upper Cretaceous (Maastrichtian) in De Wever et al. 2001. Worldwide.

Subfamily **ANGULOBRACCHIINAE** Baumgartner 1980a

*Type genus: Angulobracchia* Baumgartner 1980a.

*Range and occurrence:* Middle Jurassic or older to Upper Cretaceous. Worldwide.

Genus *Angulobracchia* Baumgartner 1980a

*Type species: Paronaella* ( ?) *purisimaensis* Pessagno 1971.

*Range and occurrence:* Middle Jurassic (Bajocian) to Lower Cretaceous (Aptian). Worldwide.

*Angulobracchia* sp. cf. *A. bulbosa* Hull

Plate 14, figures 8, 11, 13

*Angulobracchia bulbosa* HULL 1997, p. 17-18, pl. 2, figs. 6, 8, 12-14, 18.

*Remarks:* This morphotype differs from *A. bulbosa* Hull by having a test with a triangular shaped central area.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501A, B).

Subfamily **PATULIBRACCHIINAE** Pessagno 1971; emend. Baumgartner 1980a

*Type genus: Patulibracchium* Pessagno 1971.

*Range and occurrence:* Upper Paleozoic to Upper Cretaceous. Worldwide.

Geuns *Crucella* Pessagno 1971; emend. Baumgartner 1980a

*Type species: Crucella messinae* Pessagno 1971.

*Range and occurrence:* Upper Triassic (Rhaetian) to Upper Cretaceous. Worldwide.

*Crucella beata* (Yeh)

Plate 15, figure 6

*Pseudocrucella beata* YEH 1987b, p. 28, pl.2, figs. 11-12; pl. 23, figs. 10, 25.

*Pseudocrucella* sp. B YEH 1987b, p. 30, pl.2, figs. 6, 10.

*Crucella beata* (Yeh)- YEH 2009, p. 55, pl. 14, figs. 3, 7, 16.

*Range and occurrence:* Lower Jurassic (upper Pliensbachian) to Middle Jurassic (upper Bathonian, Supperzone 1, upper Zone 1F). Nicely Formation, Hyde formation and Snowshoe Formation, east-central Oregon.

*Crucella* sp. cf. *C. theokaftensis* Baumgartner

Plate 15, figure 2

*Crucella theokaftensis* BAUMGARTNER 1980a, p. 308, pl. 8, figs. 19-22; pl. 12, fig. 1.-

*Crucella theokaftensis* (Baumgartner)-HULL 1997, pl. 4, fig. 12, 14; not fig. 6.

*Remarks:* This morphotype differs from *C. theokaftensis* Baumgartner by having a test with less slender rays and smaller spines.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

Geuns *Paronaella* Pessagno 1971; emend. Baumgartner 1980a

*Type species: Paronaella solanoensis* Pessagno 1971.

*Paronaella* PESSAGNO 1971, pp. 46-47. - BAUMGARTNER 1980a, p. 300.

*Sontonaella* YEH 1987b, p.44.

*Range and occurrence:* Upper Paleozoic (?) to Upper Cretaceous. Worldwide.

*Paronaella bandyi* Pessagno

Plate 16, figure 5

*Paronaella bandyi* PESSAGNO 1977a, p. 69, pl. 1, figs. 1-3.- BAUMGARTNER 1980a, p. 300, pl. 9, fig. 4.; 1984, p. 777, pl. 6, fig. 16.- PESSAGNO et al. 1993, p. 122, pl. 2, fig. 1.- BAUMGARTNER et al. 1995, p. 392, pl. 3135.- HULL 1997, p. 22, pl. 5, fig. 2.

*Range:* Middle Jurassic (upper Bathonian, Supperzone 1, Zone 1F) to Upper Jurassic (upper Tithonian) from North America. Middle Jurassic (lower middle Bajocian = upper lower Bajocian in this report) to Upper Jurassic (lower Kimmeridgian) in Baumgartner et al. 1995.

*Occurrence:* South Fork Member of Snowshoe Formation, east-central Oregon; volcanopelagic strata overlying the Coast Range ophiolite at Point Sal and Stanley and Kalama mountains, California; Greece, Morocco and Japan.

*Paronaella bullata* Yeh and Pessagno, n. sp.  
Plate 16, figures 1-2, 14

*Description:* Test small to medium in size with three symmetrically placed rays. Rays short, ellipsoidal at proximal portion and expanded at distal end, terminating with centrally placed spine. Spines tapering distally, triradiate at basal portion and circular in cross-section at distal end; length of spine about equal to that of ray. Central area triangular in outline or slightly convex at three sides, and often with uneven outline between two adjacent tips. Test composed of uniformly-sized irregular polygonal pore frames with thin to moderately thick bars connecting irregularly arranged small to medium-sized nodes.

*Remarks:* This species differs from *P. grahamensis* Carter by having a test with relatively larger central area, which is triangular in shape or convex at three sides, and by having a longer spine at each ray tip.

*Etymology:* *bullatus-a-um* (Latin, adj.) = furnished with a bulla.

*Measurement* ( $\mu\text{m}$ ) : Holotype + 4 paratypes; DC = diameter of cortical shell; LS = maximum length of spines;  $\beta$  = open angle of two spines.

	DC	LR	LS
Holotype	88	88	81
Mean	84	95	78
Maximum	90	101	82
Minimum	73	86	74

*Type Locality:* OR501A, C (see Locality Description), Snowshoe Formation, east-central Oregon.

*Deposition of types:* Holotype = USNM547388. Paratypes = NSNM547389.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowahoe Formation, east-central Oregon (OR501A, C).

*Paronaella grahamensis* Carter  
Plate 16, figure 3

*Sontonaella* sp. B YEH 1987b, p. 11, fig. 10.

*Paronaella grahamensis* CARTER 1988, p. 40, pl. 11, figs. 10-12.-YEH 2009, p. 56, pl. 14, figs. 1, 5, 9, 22.

*Range:* Lower Jurassic (upper middle Toarcian) to Middle Jurassic (Bathonian, Supperzone 1, Zone 1F top).

*Occurrence:* Queen Charlotte Islands, British Columbia; South Fork Member of Snowahoe Formation, east-central Oregon; Baja California Sur; Austria and Japan.

*Paronaella kotura* Baumgartner  
Plate 16, figure 11

*Paronaella kotura* BAUMGARTNER 1980a, p. 302, pl.9, figs. 15-19, pl. 12, fig. 8.- BAUMGARTNER 1984, p. 776-777, pl. 6, fig. 1. -DE WEVER et al. 1986, pl. 9, fig. 2. OZVOLDOVÁ and PETERČÁKOVÁ 1987, p. 120, pl. 34, figs. 7, 9. OZVOLDOVÁ 1988, pl. 6, fig. 4. DANELIAN 1989, p. 173. CONTI and MARCUCCI 1991, pl. 3, fig. 5. -WIDZ 1991, P. 248, pl. 2, fig. 17.- BAUMGARTNER et al. 1995, p. 394, pl.3140.- HULL 1997, p.23, pl.6, fig. 12 ; YEH 2009, p. 56, pl. 14, fig. 20.

*Range:* Middle Jurassic (upper Bathonian, Supperzone 1, upper Zone 1F) from Snowahoe Formation, east-central Oregon (OR501B); Middle Jurassic (lower middle Bajocian = upper lower Bajocian in this report) to Upper Jurassic (lower Kimmeridgian) in Baumgartner et al. 1995.

*Occurrence:* Worldwide.

*Paronaella* sp. cf. *P. kotura* Baumgartner  
Plate 16, figure 10

*Paronaella kotura* Baumgartner- HULL 1997, p.23, pl.6, fig. 12.

*Remarks* : This morphotype differs from *P. kotura* Baumgartner by having a test with thinner rays which lacks well developed bulbous tip.

*Range*: Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence*: South Fork Member, Snowahoe Formation, east-central Oregon (OR501B).

***Paronaella* sp. A**  
Plate 14, figure 4

*Range*: Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence*: South Fork Member, Snowshoe Formation, east-central Oregon (OR501C).

***Paronaella* sp. B**  
Plate 14, figure 6

*Range*: Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence*: South Fork Member, Snowshoe Formation, east-central Oregon (OR501A).

***Paronaella* sp. C**  
Plate 16, figure 6

*Range and occurrence*: Middle Jurassic (upper Bathonian) from Snowshoe Formation, east-central Oregon (OR501B).

***Paronaella* sp. D**  
Plate 16, figures 9, 12

*Range*: Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence*: South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

***Paronaella* sp. E**  
Plate 16, figure 13

*Range*: Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence*: South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

Family **ARCHAEOSPONGOPRUNIDAE**  
Pessagno 1973

*Type genus*: *Archaeospongoprimum* Pessagno 1973.

*Range and occurrence*: Permian to Tertiary (Eocene) in De Wever et al. (2001); worldwide.

Genus ***Archaeospongoprimum*** Pessagno 1973  
*Type species*: *Archaeospongoprimum venadoense* Pessagno 1973 (=nomen correctum).

*Range and occurrence*: Same as for family.

***Archaeospongoprimum imlayi*** Pessagno  
Plate 25, figures 9, 23

*Archaeospongoprimum imlayi* PESSAGNO 1977a, p. 73, pl. 3, figs. 1-4.-HULL 1997, p. 28, pl. 8, fig. 1.

*Range*: Supperzone 1, upper Zone 1F to Zone 4, Middle Jurassic (upper Bathonian) to Upper Jurassic (upper Tithonian) or younger.

*Occurrence*: South Fork Member of Snowshoe Formation (OR501B), east-central Oregon Volcanopelagic strata, Stanley Mountain, California.

***Archaeospongoprimum* sp. cf. *A. praeimlayi***  
Pessagno et al.  
Plate 25, figure 10, 16

*Archaeospongoprimum praeimlayi* PESSAGNO et al. 1993, p.116-117, pl. 1, figs. 8, 9, 20, 22, 25, 29.-HULL 1997, p. , pl. 8, fig. 1.-YEH 2009, p. 57, pl. 13, figs. 6, 15.-YEH 2011, p. 31, pl. 17, figs. 1-2, 14-15.

*Remarks*: This morphotype differs from *A. praeimlayi* Pessagno et al. by having a test with cortical shell composed of coarser pore frames.

*Range*: Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence*: South Fork Member, Snowshoe Formation, east-central Oregon (OR501C).

Genus ***Wilvemina*** Pessagno, Blome and Hull  
*Type species*: *Wilvemina whiskeyensis* Pessagno et al. 1993.

*Range and occurrence:* Middle Jurassic; upper Bajocian to upper Bathonian (Supperzone 1, Zone 1E to Zone 1F top) from Snowshoe Formation, east-central Oregon; Callovian from volcanic member of Josephine ophiolite, Smith River terrane, northwestern California.

*Wilvemia* sp. A

Plate 25, figures 11, 24

*Remarks:* This morphotype is characterized by having a test with an ellipsoidal, compressed spongy cortical shell and with two moderately thick triradiate spines.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501C).

Family **BERNOULLIIDAE** Pessagno et al. 1993

*Type genus:* *Bernoullius* Baumgartner 1984.

*Range and occurrence:* Lower Jurassic (upper middle Toarcian) to Upper Jurassic (uppermost Tithonian); worldwide.

Genus *Bernoullius* Baumgartner 1984

*Type species:* *Eucyrtis* (?) *dicera* Baumgartner 1980b.

*Range and occurrence:* Triassic (?) to Upper Jurassic.

*Bernoullius* sp. A

Plate 26, figures 11-12

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

*Bernoullius* sp. B

Plate 26, figures 16-17, 20

*Remarks:* This morphotype differs from *Bernoullius* sp. A by having a larger test with smaller spines

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

Family **BOLENIDAE** Hull 1997

*Type genus:* *Bolena* Hull 1997.

*Range and occurrence:* Middle to Upper Jurassic; worldwide.

Genus *Bolena* Hull

*Type species:* *Hexastylus* (?) *tetradactylus* Conti and Marcucci.

*Range and occurrence:* Middle to Upper Jurassic; worldwide.

*Bolena* sp. A

Plate 26, figures 7, 22

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

*Bolena* sp. B

Plate 27, figure 11

*Remarks:* This morphotype differs from *Bolena* sp. A in this report by having a larger cortical shell with very distinctive two layers of pore frames and by having longer primary spines.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501A, B).

Genus *Tympaneides* Carter 1988

*Type species:* *Tympaneides charlottensis* Carter 1988.

*Remarks:* Carter assigned this genus to family Staurolophidae Haeckel sensu Pessagno 1977a because of its shape, mode of shell construction and spine structure (Carter et al. 1988, p. 37). Unlike the other staurolophids, the type of the only species of *Tympaneides* shows that its four spines extend from mid-point of four sides rather than four corners of cortical shell. Genus *Tympaneides* Carter is reassigned to family Bolenidae Hull due to the nature of primary spines, the same type of double layered cortical shell, the similar structure of two layers of

medullary shells and the way they attached to cortical shell.

*Range:* Lower Jurassic (Middle Toarcian to lower upper Aalenian) in Carter et al. 1988 and Carter et al. 1991; Middle Jurassic, upper lower Bajocian to upper Bathonian (Supperzone 1, Zone 1D to Zone 1F top) in this study; middle Oxfordian to lower Kimmeridgian in Hull 1997.

*Occurrence:* Queen Charlotte Islands, British Columbia; South Fork Member, Snowshoe Formation, east-central Oregon; Stanley Mountain, California, Argolis Peninsula, Greece, etc.

*Tympaneides* sp. cf. *T. charlottensis* Carter  
Plate 17, figures 1, 11

*Tympaneides charlottensis* CARTER- in CARTER et al. 1988, p. 37, pl. 9, figs. 4-5.

*Remarks:* This morphotype differs from *T. charlottensis* Carter by having a test with cortical shell not so square in outline and by having longer primary spines, which are tapering rapidly at one third of distal portion.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

*Tympaneides magnacista* Yeh and Pessagno, n. sp.  
Plate 17, figures 3, 6-8, 10, 12

*Description:* Cortical shell large, subcircular in outline, drum-shaped, with four spines extending from mid-point of four sides. Spines moderately thick and long, triradiate with three medium thick ridges alternating with three wide grooves; ridges of spines either tapering distally or with finger-like projections at spinal tips. Cortical shell double layered, inner layer comprised of smaller sized hexagonal or other polygonal pore frames, outer layer comprised of larger and thick polygonal pore frames and often incomplete at sides.

*Etymology:* *maganacista* = *maganus-a-um* (Latin, adj., meaning great, large) + *cista-ae* (Latin, n., meaning a chest, box).

*Measurements* ( $\mu\text{m}$ ): Holotype + 5 paratypes. DC = diameter of cortical shell; LS= maximum length of spine.

	DC	LS
Holotype	193	226
Mean	198	243
Maximum	206	265
Minimum	193	226

*Type locality:* OR501B (See Locality Description), Snowshoe formation, east-central Oregon.

Deposition of types: Holotype=USNM547376. Paratypes=USNM547377.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon.

*Tympaneides* sp. aff. *T. magnacista* Yeh and Pessagno, n. sp.  
Plate 17, figures 2, 5, 11

*Remarks:* This morphotype differs from *T. magnacista* Yeh and Pessagno, n. sp., by having a test with smaller cortical shell.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon.

*Tympaneides*\_sp. A  
Plate 17, figure 9

*Remarks:* This morphotype is characterized by having a test with large cortical shell and short tapering spines.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

Family **DACTYLIOSPHERIDAE** Squinabol 1904

*Type genus:* *Dactyliosphaera* Squinabol 1904.

*Range and occurrence:* Middle Jurassic to Tertiary in De Wever et al. 2001.

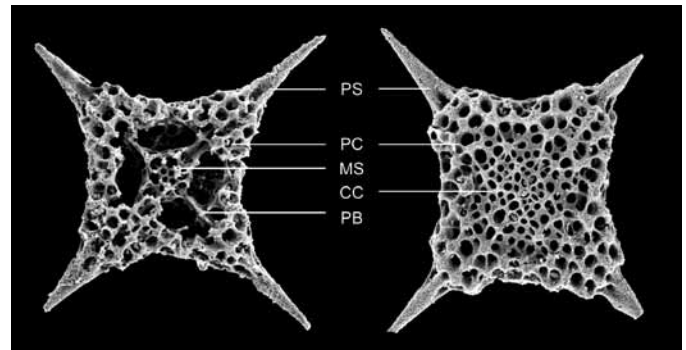
Genus *Secretacapsa* Yeh and Pessagno, n. gen.

*Type species:* *Secretacapsa acanata* Yeh and Pessagno, n. sp.

*Description:* Test as with family; initial microspheres with a primary square ring lying in the equatorial plane of test; primary ring with four triradiate primary beams (= primary spines in De Wever et al. 2001, p. 132) originating in four corners. Cortical shells box shaped, subrectangular in outline, sides with vertical wall, with four primary spines (as extension of four primary beams) present at four corners; top and bottom surfaces flat at peripheral area and with a large square depression at central area. Central depression area with one layer of smaller polygonal pore frames and supported internally by radial beams from last medullary shell (pl.18, fig.7). Peripheral area of cortical shell composed of larger irregular or sub-regularly arranged polygonal pore frames, with or without arm-like structure developed along distal portion of primary beams. Large space present between microsphere and inner face of cortical shell. Terms for describing the forms of this genus are illustrated in text-figure 4.

*Remarks:* The forms of this genus are characterized by having a tetragonal box-shaped cortical shell with large central depression at top and bottom surfaces. They are different from *Pseudocrucella* Baumgartner by having a large central depression and lacking well-developed rays. As mentioned in De Wever et al. 2001 (p. 134), family Dactyliospheridae is closely related to the family Hagiastride from which it differs in not having arms. Some forms of this genus (e.g., *Secretacapsa acanata* Yeh and Pessagno, n. sp.) have cortical shell with very primitive arm like structure. It is very possible they are the linkage of dactyliospherids and hagiastrids. Some forms of *Pseudocrucella* with similar internal structure recovered from Callovian strata by Blome 1984 may be closely related to this genus.

*Etymology:* *Secretacapsa* = *Secretus-a-um* (Latin, adj., meaning secret, mysterious) + *capsa-ae* (Latin, n., meaning a box).



TEXT-FIGURE 4. *Secretacapsa* Yeh and Pessagno, n. gen. PS = primary spine. PC = peripheral area of cortical shell. MS = microsphere. CC = central area of cortical shell. PB = primary beam.

*Range:* Supperzone 1, upper Zone 1F to 1G?; Middle Jurassic (upper Bathonian, possibly to Callovian or younger).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon.

*Secretacapsa acanata* Yeh and Pessagno, n. sp.

Plate 18, figures 3-4, 6, 8, 10-12, 16, 18-19

*Description:* Test as with genus, cortical shell sub-rectangular in outline, with moderately thick vertical wall at four sides; four sides straight or slightly concave outwards. Peripheral area of cortical shell composed of larger nodosed sublinearly arranged pore frames and with arm-like structure developed at distal portion of primary beams. Central depression area large, about two thirds as wide as cortical shell and composed of one layer of smaller polygonal pore frames. Primary beams triradiate, about half as thick as primary spines. Primary spines short, triradiate proximally, circular in cross-section at distal portion.

*Remarks:* This species is characterized by having a relatively large cortical shell with arm-like structure developed at distal portion of four primary beams.

*Etymology:* *acanata*, n. sp., is formed from an arbitrary combination of letters (ICZN online, 4th edition, 2000, Article 11, 11.3).

*Measurements* ( $\mu\text{m}$ ): Holotype + 6 paratypes. WC = minimum width of cortical shell; WD =

width of depression area; LS=maximum length of primary spine.

	WC	WD	LS
Holotype	162	110	97
Mean	168	115	95
Maximum	187	123	105
Minimum	140	107	87

*Type Locality:* Holotype from OR501B, paratypes from OR501B and C (See Locality Description), Snowshoe Formation, east-central Oregon.

*Deposition of types:* Holotype=USNM547394. Paratypes=USNM547395.

*Range:* Supperzone 1, upper Zone 1F, Middle Jurassic (upper Bathonian).

*Occurrence:* South fork Member of Snowshoe Formation, east-central Oregon (OR501 B).

*Secretacapsa bathonia* Yeh and Pessagno, n. sp.  
Plate18, figures 1-2, 5, 9, 13-15, 17

*Description:* Test as with genus, cortical shell sub-rectangular in outline, with vertical wall at four sides; four sides straight or slightly convex outwards. Cortical shell composed of one layer of smaller irregular polygonal pore frames at central depression area, of multiple layers of larger irregular spongy pore frames at peripheral area, lacking primitive arm-like structure developed at distal portion of primary beams. Outer surfaces of cortical shell with small raised nodes at vertices of pore frames. Central depression area large, about two thirds as wide as cortical shell. Primary beams of initial microsphere triradiate, about two thirds as thick as primary spine. Primary spines tapering distally, triradiate at proximal half portion, circular in cross-section distally.

*Remarks:* This species differs from *Secretacapsa acanata* Yeh and Pessagno, n. sp., by lacking arm-like structure developed along distal portion of primary beams and by having small raised nodes present at vertices of pore frames at peripheral portion of cortical shell.

*Etymology:* This species is named for the stage of Bathonian when it was first discovered.

*Measurements* ( $\mu\text{m}$ ): Holotype + 6 paratypes. WC=width of cortical shell; WD= width of

depression area; LS=maximum length of primary spine.

	WC	WD	LS
Holotype	167	95	125
Mean	158	102	88
Maximum	180	117	125
Minimum	133	87	60

*Type Locality:* Holotype from OR501B, paratypes from OR501C (See Locality Description), Snowshoe Formation, east-central Oregon.

*Deposition of types:* Holotype=USNM547396. Paratypes=USNM547397.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B, C).

Family **EMILUVIIDAE** Dumitrica 1995  
*Type genus:* *Emiluvia* Foreman, 1973.

*Staurolochidae* Haeckel 1881, *sensu* Pessagno 1977a.

*Range and occurrence:* Middle Jurassic (or earlier) to Upper Cretaceous in De Wever et al. 2001. Worldwide.

Genus *Emiluvia* Foreman, 1973; emend. Pessagno 1977a

*Type species:* *Emiluvia chica* Foreman, 1973.

*Range and occurrence:* Lower Jurassic (Toarcian) to Lower Cretaceous (earliest Hauterivian). Worldwide.

*Emiluvia delicata* Yeh and Pessagno, n. sp.  
Plate 19, figures 7-10, 14

*Description:* Cortical shell relatively small, subrectangular to subcircular in outline; top and bottom surfaces with nodosed polygonal pore frames. Each surface consisting of 22 to 28 nodes, with larger nodose at outer ring, smaller and curved or irregular-shaped nodes at center. Pore frames irregular, small to medium in size, formed with bars radiated from nodes or with bars from last medullary shell to cortical shell. Primary spines very long and tapering distally, one slightly longer than others, triradiate with three ridges alternating with three deep grooves, length of spine about twice as wide as cortical shell.

*Remarks:* This species is characterized by having a test with relatively small cortical shell and long primary spines.

*Etymology:* *delicatus-a-um* (Latin, adj.) = dainty, nice.

*Measurements* ( $\mu\text{m}$ ): Holotype + 5 paratypes. WC=width of cortical shell; LS=maximum length of primary spine.

*Type Locality:* Sample OR501B (See Locality Description), Snowshoe Formation, east-central Oregon.

	WC	LS
Holotype	130	283
Mean	120	250
Maximum	130	285
Minimum	100	220

*Deposition of types:* Holotype=USNM547390. Paratypes=USNM547391.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon.

*Emiluvia* sp. cf. *E. hopsoni* Pessagno  
Plate 20, figures 2, 8

*Emiluvia hopsoni* PESSAGNO 1977a, p. 76, pl. 4, figs. 14-16, pl. 5, figs. 1-7, pl. 12, figs. 15-16.

*Remarks:* This species differs from *E. hopsoni* Pessagno by having a cortical shell with smaller nodes and by lacking well developed fork at distal end of spines.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501A, B).

*Emiluvia kozuri* Yeh  
Plate 20, figure 6

*Emiluvia kozuri* YEH 2009, p. 48, pl. 11, figs. 8-9, 12-13, 16-17, 20.

*Range:* Supperzone 1, Zone 1F; Middle Jurassic (Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR-MA30A, OR501C).

*Emiluvia nana* Baumgartner  
Plate 20, figure 3

*Emiluvia nana* BAUMGARTNER- BAUMGARTNER et al. 1995, p. 202, pl. 3212, figs. 1-2.-HULL 1997, p. 67, pl. 27, figs. 3, 15.

*Range:* Supperzone 1, upper Zone 1F Zone 2, Subzone 2 $\beta_2$ , Middle Jurassic (upper Bathonian,) to Upper Jurassic (upper Oxfordian);

*Occurrence:* Blake Bahama Basin, Western North Atlantic; South form Member of Snowshoe Formation, east-central Oregon (OR501A) and volcanopelagic strata overlying Coast Range ophiolite at Stanley Mountain.

*Emiluvia* sp. cf. *E. oregonensis* Yeh  
Plate 20, figure 4

*Emiluvia* sp. cf. *E. oregonensis* YEH 2009, p. 49, pl. 10, figs. 6-7.

*Range:* Supperzone 1, Zone 1F; Middle Jurassic (Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR-MA30A, OR501B).

*Emiluvia parvinodosa* Yeh  
Plate 20, figure 1

*Emiluvia parvinodosa* YEH 2011, p. 33, pl. 16, figs. 1-4, 13, 18.

*Range:* Supperzone 1, middle Zone 1E to Zone 1F top; Middle Jurassic (upper Bajocian to upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR549B, OR501B).

*Emiluvia validia* Yeh and pessagno, n. sp.  
Plate 19, figures 1-5, 11-13

*Description:* Cortical shell square to rectangular in outline; top and bottom surfaces with nodose polygonal pore frames. Each surface consisting of 24 to 28 nodes; nodes discrete, mostly rounded and about equal in size. Pore frames irregular, small to medium in size, larger pore frames formed with bars radiated from nodes, smaller pore frames formed with bars from last medullary shell to cortical shell. Primary spines relatively short, thick and tapering distally, one slightly longer than others; each spine triradiate with three thick ridges alternating with three deep grooves, length of spine slightly longer than width of cortical shell.

*Remarks:* This species differs from *E. delicata* Yeh and Pessagno, n. sp., by having a test with relatively larger cortical shell and with much shorter spines.

*Etymology:* *validius-a-um* (Latin, adj.) = strong, stout.

*Measurements* ( $\mu\text{m}$ ): Holotype + 6 paratypes. WC=width of cortical shell; LS=maximum length of primary spine.

	WC	LS
Holotype	133	153
Mean	130	169
Maximum	140	203
Minimum	120	150

*Type Locality:* OR501B (See Locality Description), Snowshoe Formation, east-central Oregon.

*Deposition of types:* Holotype=USNM547392. Paratypes=USNM547393.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

*Emiluvia* sp. A  
Plate 19, figure 6

*Remarks:* This morphotype differs from *E. validia* Yeh and Pessagno, n. sp., by having a relatively thinner cortical shell with smaller nodes, which are more closely distributed on top and bottom surfaces.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

Family **HAGIASTRIDAE** Riedel 1971; emend. Baumgartner 1980a

*Type genus:* *Hagiastrum* Haeckel 1881.

*Range:* Early Jurassic (early Sinemurian) or older to Early Cretaceous.

*Occurrence:* Worldwide.

Genus ***Higumastra*** Baumgartner 1980a

*Type species:* *Higumastra inflata* Baumgartner 1980a.

*Range and occurrence:* same as for family.

***Higumastra angustabraccia*** Yeh

Plate 21, figures 1, 5

*Higumastra angustabraccia* YEH 2009, p. 33, pl. 4, figs. 7-8, 11.

*Range:* Supperzone 1, Zone 1F; Middle Jurassic (Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR-MA30A, OR501B, C).

***Higumastra exigua*** Yeh

Plate 21, figures 6-7

*Higumastra exigua* YEH 2011, p. 20, pl. 9, figs. 1-2, 5, 14-15, 17.

Not *Crucella sanfilippoae* PESSAGNO 1977a, p. 72, pl. 2, figs. 15-16.

*Pseudocrucella sanfilippoae* (Pessagno) CARTER et al. 1988, p. 29, pl. 1, 4.

Not *Higumastra* sp. A CARTER et al. 1988, p. 29, pl.10, fig. 6.

Not *Higumastra* sp. A, C, D- HATTORI 1988, pl. 5, figs. C, E, F.

*Range:* Lower Jurassic (Toarcian) from Queen Charlotte Islands, B. C. and Middle Jurassic (upper Bajocian and upper Bathonian, Supperzone 1, middle Zone 1E to upper Zone 1F)

from Snowshoe Formation, east-central Oregon (OR549B, OR501B).

*Occurrence:* Queen Charlotte Islands, B. C. and South Fork Member, Snowshoe Formation, east-central Oregon (OR549B, OR501B).

*Higumastra* sp. aff. *H. exigua* Yeh, n. sp.  
Plate 21, figures 10-11, 13

*Remarks:* This morphotype differs from *H. exigua* Yeh by having a relatively larger test with a larger cortical shell and slightly longer rays.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501A, B).

*Higumastra perfecta* Yeh and Pessagno, n. sp.  
Plate 21, figures 9, 12

*Description:* Test as with genus. Rays slender, subrectangular in cross-section and equal in width throughout, terminating in medium to long needle-like spines; spines circular in cross-section; fully developed spine about half as long as ray. Central area of cortical shell relatively small, covered with irregular polygonal pore frames and flat at top and bottom surfaces. Meshwork of rays consisting of medium sized linearly arranged polygonal (tetrafolal and hexagonal in central row, tetragonal and pentagonal in side rows) pore frames with small nodes at vertices; three rows of pore frames visible from top view.

*Remarks:* *Higumastra perfecta* Yeh and Pessagno, n. sp., differs from *H. exigua* Yeh by having a relatively larger test with smaller cortical shell and with longer and narrower rays. This species differs from *H. angustabraccia* Yeh by having a larger test with four longer rays terminating in long needle-like spines, and by lacking a square central lacuna in top surface of cortical shell.

*Etymology:* *Perfectus-a-um* (Latin, adj.) = perfect.

*Measurements* ( $\mu\text{m}$ ): Holotype + 3 paratypes. DC = diameter of central area; WR = width of ray at basal portion; LR = length of ray, exclusive of spine(s) at tips; LS = maximum length of spine.

	DC	WR	LR	LS
Holotype	117	61	183	97
Mean	108	56	173	82
Maximum	117	61	183	97
Minimum	103	53	165	81

*Type locality:* OR501B (See Locality Description), Snowshoe formation, east-central Oregon.

*Deposition of types:* Holotype = USNM547378. Paratypes = USNM547379.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon.

*Higumastra* sp. A  
Plate 15, figures 3, 7

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501C).

*Higumastra* sp. B  
Plate 22, figures 2-3

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

*Higumastra* sp. C  
Plate 22, figures 4, 8, 14

*Remarks:* This morphotype differs from *Higumastra* sp. B in this report by having a test with thicker and larger pore frames.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

Genus *Pseudocrucella* Baumgartner 1980a  
*Type species:* *Crucella sanfilippoae* Pessagno 1977a.

*Range and occurrence:* Middle Jurassic (lower Bajocian) to Lower Cretaceous (Barremian). Worldwide.

***Pseudocrucella acutusspina* (Yeh)**

Plate 15, figure 1

*Tetrarabs acutusspina* YEH 2011, p. 22, pl. 10, figs. 3-4, 16, 18.

*Remarks:* This species should be assigned to *Pseudocrucella* Baumgartner rather than *Tetrarabs* Baumgartner because each ray of the test does not have well defined six rows of widely spaced external beams visible laterally.

*Range:* Supperzone 1, middle Zone 1E to Zone 1F top; Middle Jurassic (upper Bajocian to upper Bathonian).

***Pseudocrucella longabracchia* Yeh and Pessagno, n. sp.**

Plate 15, figures 11-12, 14

*Description:* Test medium to large in size; diameter of central area small, about twice as wide as ray. Rays narrow and medium in length, subrectangular in axial section, each ray terminating with a long massive spine. Spines of rays thick at basal portion, tapering distally and triradiate with 3 narrow ridges alternating with three wide grooves; grooves tapering distally and deep at very proximal portion. Length of ray about equal to that of spine. Pore frames irregularly in shape at central area, tetragonl or irregular polygonal at each ray; linearly arranges at some portion of each ray; number of rows of pore frame not equal at proximal and distal portion of each ray. Small nodes present on surfaces of central area. Three to five longitudinal ridges visible on top view of ray surfaces. Rays weakly torsioned.

*Remarks:* This species differs from *P. acutusspina* (Yeh) by having a test with longer subrectangular rays which terminating in longer and more massive spines, and also by having more prominent longitudinally ridges on ray surfaces.

*Etymology:* *longabracchia* = *longabracchia* = *longus-a-um* (Latin, adj. = long) + *bracchia* (Latin, n. = arm).

*Measurement* (µm) : Holotype + 3 paratypes; DC = Diameter of cortical shell; LR = maximum length of ray; WR = maximum width of ray; LS = length of spine.

	DC	LR	WR	LS
Holotype	87	133	43	133
Mean	86	130	42	135
Maximum	88	133	43	155
Minimum	83	127	38	130

*Type Locality:* OR501B (see locality Description), Snowshoe Formation, east-central Oregon.

*Deposition of types:* Holotype = USNM547380. Paratypes = USNM547381.

*Range:* Supperzone 1, Zone 1C to Zone 1F top; Middle Jurassic (upper lower Bajocian to upper Bathonian).

*Occurrence:* Top of Warm Springs and South Fork members, Snowshoe Formation, east-central Oregon (OR-MA15, OR501B).

***Pseudocrucella* sp. A**

Plate 15, figure 5

*Remarks:* This morphotype is characterized by having a test with flat top and bottom surfaces, with a relatively small central area, with four thick rays expanded at distal portion and terminating in moderately long triradiate spine at center of ray tip.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

**Genus *Tetraditryma* Baumgartner 1980a**

*Type species:* *Tetraditryma pseudoplana* Baumgartner 1980.

*Saldorfus* PESSAGNO, BLOME and HULL 1993

*Range and occurrence:* Lower Jurassic (upper Pliensbachian) to Upper Jurassic (Tithonian) or younger. Worldwide.

***Tetraditryma coldspringensis* (Pessagno, Blome and Hull)**

Plate 15, figure 8

*Saldorfus coldspringensis* PESSAGNO, BLOME and HULL 1993, p. 126, pl. 3, figs. 1, 4, 7.

*Tetraditryma coldspringensis* (Pessagno, Blome and Hull)-YEH 2009, p. 36, pl. 6, figs. 8-11.

**Range Occurrence:** Supperzone 1, Zone 1F to Zone 2, Subzone 2 delta; Middle Jurassic (lower Bathonian) to Upper Jurassic (middle Oxfordian).

**Occurrence:** Snowshoe Formation, east-central Oregon; volcanopelagic strata above Josphine ophiolite, Smith River subterranean, Klamath Mountains, northeast California.

***Tetraditryma corralitosensis*** (Pessagno)  
Plate 15, figure 9

*Crucella* (?) *corralitosensis* PESSAGNO 1977a, p. 72, pl. 2, figs. 10-13.

*Saldorfus oregonensis* PESSAGNO, BLOME and HULL 1993, p. 127, pl. 3, figs. 11, 12, 18.

*Tetraditryma corralitosensis corralitosensis* (Pessagno)-BAUMGARTNER et al. 1995, p. 556, pl. 3124.-HULL 1997, p. 47, pl. 15, figs. 7, 8, 14, 15, 20; pl. 17, figs. 4, 12.-YEH, 2009, p. 36, pl. 6, figs. 1-3, 4-7.-YEH 2011, p. 22, pl. 10, fig. 8.

**Range:** Supperzone 1, middle Zone 1E to Zone 4, Subzone 4 beta, Middle Jurassic (upper lower Bajocian) to Upper Jurassic (Tithonian) base on Hull 1997 and this study. Unitary Association Zones 3-10, Middle to Upper Jurassic, lower middle Bajocian (= upper lower Bajocian in this study) to upper Oxfordian-lower Kimmeridgian in Baumgartner et al. 1995.

**Occurrence:** Warm Springs and South Fork members, Snowshoe Formation, east-central Oregon (OR-MA15, OR549B, OR-MA30A and OR501B); worldwide.

***Tetraditryma pseudoplena*** Baumgartner  
Plate 15, figures 4, 10, 13

*Hagiastrum plenum* RÜST- PESSAGNO, 1977a, p. 72, pl. 2, fig. 14.

*Tetraditryma pseudoplena* BAUMGARTNER 1980, p. 297, pl. 1, fig. 9; pl. 7, figs. 1-11.- BAUMGARTNER 1984, p. 788, pl. 9, figs. 12, 14.- BAUMGARTNER et al. 1995, p. 558, pl. 3123. -YANG 1993, p. 35, pl. 5, figs. 7, 23.-YEH 2009, p. 36, pl. 5, figs. 13-14.

**Range:** Supperzone 1, Zone 1F to Zone 4, Middle Jurassic (Bathonian) to Upper Jurassic (lower Tithonian); Unitary Association Zones 4-11 (upper Bajocian to upper Kimmeridgian/lower Tithonian) in Baumgartner et al. 1995.

**Occurrence:** South Fork Member, Snowshoe Formation (OR-MA30A and OR501B, C); worldwide.

Genus ***Udalia*** Whalen and Carter 1998

**Type species:** *Udalia dennisoni* Whalen and Carter 1998.

**Range and occurrence:** Lower Jurassic (Hettangian-Sinemurian) from Queen Charlotte Islands, British Columbia and Middle Jurassic (upper Bathonian, Supperzone 1, Zone 1F) from Snowshoe Formation, east-central Oregon (OR-MA30A, OR501B).

***Udalia* sp. A**

Plate 20, figures 7, 11-13

Not *Emiluvia pessagno* FOREMAN -1973, p. 262, pl. 8, fig. 6.-PESSAGNO 1977a, p. 76-77, pl. 5, fig. 8.-BAUMGARTNER 1984, p. 762, pl. 3, fig. 3.-BAUMGARTNER et al. 1995, p. 206, pl. 3066, figs. 1-2; pl. 3226, figs 1-4.

*Emiluvia pessagno* Foreman s.l.-YEH 2009, p. 49, pl. 13, figs. 13, 17.

**Remarks:** This morphotype differs from *Emiluvia pessagno* Foreman s.l. in Baumgartner 1984 by having a test with relatively longer and tapering spines. It is reassigned to *Udalia* Whalen and Carter (1998) herein due to its cortical shell composed of multi-layered spongy pore frames (see pl. 20, figs. 12-13) and with smaller and denser homogeneous nodes at pore frame vertices of outer surfaces rather than composed of single or double layered of regularly or irregularly arranged pore frames with relatively larger nodes on top and bottom surfaces which are mostly convex outwards.

**Range:** Supperzone 1, Zone 1F, Middle Jurassic (upper Bathonian).

**Occurrence:** South Fork Member of Snowshoe Formation, east-central Oregon (OR-MA30A, OR501B).

***Udalia(?)* sp. B**

Plate 20, figures 5, 14-16

**Remarks:** This morphotype is questionably assigned to this genus because the cortical shell is not vertical at sides.

**Range:** Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

**Occurrence:** South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

Family **TRITRABIDAE** Baumgartner 1980

**Type genus:** *Tritrabs* Baumgartner 1980.

**Range and occurrence:** Upper Triassic (Norian) to Upper Cretaceous (Maastrichtian). Worldwide.

Genus ***Tritrabs*** Baumgartner 1980a

**Type species:** *Paronaella (?) casmaliaensis* Pessagno 1977a.

**Range and occurrence:** Lower Jurassic (Aalenian) to Lower Cretaceous (Hauterivian). Worldwide.

***Tritrabs brevitrabs*** Yeh and Pessagno, n. sp.

Plate 14, figures 1-2, 5, 10

*Tritrabs casmaliaensis* (Pessagno)-BAUMGARTNER et al., 1995a, p. 605, pl. 317, figs. 2-3; not 1, 5.

Not *Tritrabs casmaliaensis* (Pessagno)-BAUMGARTNER 1984, p. 791, pl. 10, fig. 9.

**Description:** Test small in size, with three rays subequally arranged; individuals with two rays 100 to 150 degrees apart. Rays short and relatively narrower, lacking expanded structure at tips, three longitudinal ridges visible from top or bottom view and ended with two or more short spines which tapering distally. Central area of test subtriangular in outline, composed of irregular polygonal pore frames. Adjacent external beams separated by two rows of subtriangular or pentagonal pore frames.

**Remarks:** This species is characterized by having a small test with three short and narrow rays with truncated tips with two or more short spines extended from longitudinal ridges.

**Etymology:** *brevitrabs* = *brevi* (Latin, adj., meaning short) + *trabs* (Latin, meaning a beam).

**Measurement** (µm) : Holotype + 4 paratypes; DC = maximum diameter of central area; LR = maximum length of ray excluding spine; WR = maximum width of ray.

	DC	LR	WR
Holotype	87	117	40
Mean	78	132	38
Maximum	87	171	53
Minimum	67	104	31

**Type Locality:** OR501A and OR501C (see Locality description).

**Deposition of types:** Holotype = USNM547382. Paratypes = USNM547383.

**Range:** Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

**Occurrence:** South Fork Member, Snowshoe Formation (OR501A, C), east-central Oregon.

***Tritrabs simplex*** Kito and De Wever 1992

Plate 14, figures 3, 7, 9

*Tritrabs* sp. G HATTORI 1987, pl. 4, figs. 3-4.

*Tritrabs* sp. A HATTORI 1988a, pl. 6, fig. 1.

*Tritrabs* sp. HORI and OTSUKA 1989, pl. 1, fig. 6, not fig. 7.

*Tritrabs simplex* KITO and DE WEVER 1992, p. , pl. 1, figs. 3, 7, 9.

*Tritrabs* sp. cf. *T. worzeli* (Pessagno)-YEH 2009, p. 37, pl. 3, figs. 6-8, 16.-YEH 2011, p. 37, pl. 3, figs. 6-8, 16.

**Range and occurrence:** Supperzone 1, Zone 1F; Middle Jurassic (upper Bathonian) from South Fork Member, Snowshoe Formation (OR-MA30A, OR501A, B), east-central Oregon; certain time in Lower to Middle Jurassic from Japan (Hattori 1987, 1989; Hori and Otsuka 1989) and Middle Jurassic from Sicily, Italy (Kito and De Wever 1992); Lower to Middle Jurassic (lower lower Aalenian to middle Bathonian) in Baumgartner et al. 1995.

***Tritrabs worzeli*** (Pessagno)

Plate 14, figure 12

*Paronaella worzeli* PESSAGNO 1971, p. 50, pl. 19, fig. 6.- PESSAGNO 1977a, p. 70, pl. 1, figs. 14-15.-

*Tritrabs worzeli* (Pessagno)-BAUMGARTNER 1980a, p. 294, pl. 4, fig. 8.-DE WEVER et al. 1986, pl. 8, fig.

4.-AITA 1987, p. 64.-OZVOLDOVÁ 1988, pl. 3, fig. 10.- PESSAGNO et al. 1993, p. 127-128, pl. 3, fig. 8.-DUMITRICA 2013, p. 54, fig. 4.

*Tritrabs ewingi worzeli* (Pessagno) - BAUMGARTNER et al. 1995, p. 608, pl. 3115.

**Remarks:** *Tritrabs worzeli* (Pessagno) can be distinguished from *Tritrabs ewingi* (Pessagno) by having a test with three rays terminating in one triradiate spine at middle of tips.

**Range:** Supperzone 1, upper Zone 1F to Zone 5, Subzone 5A; Middle Jurassic (upper Bathonian) to Lower Cretaceous (Berriasian) based on this study and Pessagno et al. (1993).

**Occurrence:** South Fork Member of Snowshoe Formation, east-central Oregon (OR501A, C); worldwide.

Family **LEUGEONIDAE** Yang and Wang 1990; emend. Hull 1997; emend. Yeh 2009

**Type genus:** *Leugeo* Yang and Wang 1990.

**Range and occurrence:** Middle Jurassic (Bajocian) to Lower Cretaceous (Albian). World wide.

Subfamily **HELENINAE** Hull 1997

**Type genus:** *Helena* Hull 1997.

**Range and occurrence:** Same as for family.

Genus ***Tappanella*** Hull 1997

**Type species:** *Tappanella novacubica* Hull 1997; emend. herein.

**Emended definition:** Test as with subfamily. Cortical shell cubic or spherical in shape with or without weakly developed ridges surrounding "hexagones" (a term original named by Baumgartner 1984, p. 780; each hexagone consisting of one central pore surrounded by six pores), central pore usually slightly larger and raised outward. Secondary spines eight or less, always present at positions corresponding to corners of visible or invisible cube. Medullary shell one layer, with six secondary triradiate beams oriented at right angles to one another.

**Remarks:** The species of *Tappanella* Hull are distinguished from other leugeonids by having a cortical shell without well defined hexagones at

outer surface and by lacking superimposed pore frames. Unlike the original definition (Hull 1997), the shape of cortical shell as well as number and shape of secondary spines are treated as diagnostic characteristics at species rather than generic level herein.

**Range and occurrence:** Middle Jurassic (upper Bathonian, Supperzone 1, Zone 1F ) from Snowshoe Formation, east-central Oregon, Upper Jurassic (middle Oxfordian to lower Tithonian) from volcanopelagic strata overlying the Coast Range ophiolite at Stanley Mountain, California Coast Ranges and Lombard Basin, Southern Alps.

***Tappanella fragilis*** Yeh and Pessagno, n. sp.  
Plate 22, figures 1-3, 11-12, 14

**Description:** Cortical shell cubic in shape with eight secondary spines extending from eight corners of the cube. Secondary spines slender, tapering distally, triradiate with three narrow ridges alternating with three grooves; grooves slightly wider than ridges. Cortical shell composed of single layer of poorly defined *Leugeo*-type pore frames with one hexagonal central pore surrounded by six polygonal pores; some pore frames slightly larger and thicker.

**Remarks:** This species is characterized by having a cortical shell composed of single layer of poorly defined *Leugeo*-type pore frames and by having eight slender and fragile secondary spines extending from eight corners of cube. This species differs from *Tappanella novacubica* Hull by having eight secondary spines tapering distally.

**Etymology:** *fragilis-e* (Latin, adj.) = *fragile, easily broken*.

**Measurement (µm) :** Holotype + 3 paratypes; DC = maximum length of cortical shell; LR = maximum length of ray excluding spine; WR = maximum width of ray; LS = length of spine.

	DC	LS
Holotype	140	113
Mean	133	110
Maximum	140	113
Minimum	130	79

**Type Locality:** OR501A (see Locality Description), Snowshoe Formation, east-central Oregon.

*Deposition of types:* Holotype = USNM 547384. Paratypes = USNM 547385.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation (OR501A), east-central Oregon.

***Tappanella imlayi*** Yeh and Pessagno, n. sp.  
Plate 23, figures 1-3, 6-7, 11-12, 16-17, 20

*Description:* Test spherical with four secondary spines at apices of a tetragon. Spines medium in thickness and in length, straight and gently tapered distally, triradiate with three narrow ridges alternating with three wide grooves; length of spine slightly shorter than diameter of cortical shell. Cortical shell composed of poorly defined hexagones and lacking prominent ridges around each hexagone; central pore of each hexagone thicker and raised asymmetrically to form undulate surface.

*Remarks:* This species is characterized by having a spherical cortical shell with four tiradiate secondary spines at apices of a tetragon and lacking prominent ridges around each hexagon.

*Etymology:* This spesies is named for Ralph W. Imlay to honor for his contribution to the biostratigraphic studies for the east-central Oregon.

*Measurement* ( $\mu\text{m}$ ) : Holotype + 4 paratypes; DC = maximum length of cortical shell; LR = maximum length of ray excluding spine; WR = maximum width of ray; LS = length of spine.

	DC	LS
Holotype	121	95
Mean	125	102
Maximum	134	125
Minimum	120	83

*Type Locality:* OR501C (see Locality Description), Snowshoe Formation, east-central Oregon.

*Deposition of types:* Holotype = USNM 547386. Paratypes = USNM 547387.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation (OR501C), east-central Oregon.

***Tappanella*** sp. aff. *T. imlayi* Yeh and Pessagno, n. sp.  
Plate 23, figures 8-9, 14, 18, 21

*Remarks:* This morphotype differs from *T. imlayi* Yeh and Pessagno, n. sp., by having only three secondary spines.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation (OR501C), east-central Oregon.

***Tappanella*** sp. cf. *T. imlayi* Yeh and Pessagno, n. sp.  
Plate 23, figures 4-5, 13

*Remarks:* This morphotype differs from *T. imlayi* Yeh and Pessagno, n. sp., by having more than four secondary spines.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation (OR501C), east-central Oregon.

***Tappanella novacubica*** Hull  
Plate 22, figures 4-5, 9, 13, 19

*Tappanella novacubica* HULL 1997, p. 55, pl. 21, figs. 7-9, 11, 15 18.

*Remarks:* The presence of This species in the studied sample represents the earlist occurrence of the species and genus.

*Range:* Supperzone 1, Zone 1F to Zone 2, Subzone 2 gamma, Middle Jurassic (upper Bathonia) to Upper Jurassic (middle Oxfordian) so far as know.

*Occurrence:* South Fork Member, Snowshoe Formation (OR501A, C), east-central Oregon; volcanopelagic strata at Stanley Mountain, California; Lombard Basin, Southern Alps.

***Tappanella*** sp. A  
Plate 23, figure 10

*Remarks:* This morphotype has only two secondary spines.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation (OR501C), east-central Oregon.

**Helenid** gen. et sp. indet.  
Plate 22, figures 10, 16

Helenid gen. et sp. indet.-HULL 1997, p. 55, pl. 21, figs. 4-5, 17

*Remarks:* The same morphotype has been observed in an upper Bajocian assemblage (OR550C) from Snowshoe Formation. It shows that it has a Leugeo-type medullary shell (one spherical shell with 6 beams at hexagonal axial positions).

*Range:* Supperzone 1, Zone 1E top to Zone 2, Subzone 2 gamma; Middle Jurassic (upper Bajocian) to Upper Jurassic (middle Oxfordian) so far as know.

*Occurrence:* South Fork Member, Snowshoe Formation (OR550C, OR501C), east-central Oregon; volcanopelagic strata at Stanley Mountain, California.

Subfamily **LEUGEONINAE** Hull 1997, emend. Yeh 2009

*Type genus:* *Leugeo* Yang and Wang 1990.

*Hexasphaera* HULL 1997, p. 53.

*Leugeo* YANG and WANG 1990, p. 203.

*Levilleugeo* YANG and WANG 1990, p. 203.

*Range and occurrence:* Same as for family.

Genus ***Leugeo*** Yang and Wang; emended Yeh 2009; emended Yeh 2011

*Type species:* *Praeconocaryomma* (?) *hexacubica* Baumgartner 1984.

*Leugeo* YANG and WANG 1990, p. 203.-Hull 1997, p. 52; YEH 2009, p. 40.

*Levilleugeo* YANG and WANG 1990, p. 203. -Hull 1997, p. 52-53; YEH 2009, p. 39.

*Range and occurrence:* Middle Jurassic (upper Bajocian) to Upper Jurassic (lower Tithonian). Worldwide.

***Leugeo*** sp. cf. ***L. hullae*** Yeh  
Plate 22, figures 7-8, 15

*Leugeo hullae* YEH 2009, p. 40, pl.7, figs. 1-3, 6-8, 11-16, 18

*Remarks:* This morphotype differs from *L. hullae* Yeh by having a cortical shell with outer layer composed of poorly defined hexagons and with secondary spines pointed rather than rounded at distal end.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501A, B).

***Leugeo ordinarius*** (Yang and Wang)  
Plate 22, figures 6, 17

*Levilleugeo ordinarius* YANG and WANG 1990, p.203, pl. I, figs. 2, 14; pl. II, fig. 1.

*Levilleugeo* sp. B.-PESSAGNO, BLOME and HULL 1993, p.132, pl. 15, fig. 24.

*Levilleugeo ordinarius* Yang and Wang-HULL 1997, p. 53, pl. 20, figs. 6, 7.-YEH 2009, p. 39, pl. 7, figs. 4-5, 20.

*Leugeo ordinarius* (Yang and Wang)-YEH 2011, p. 24, pl.11, figs. 3, 19.

*Range:* Supperzone 1, Zone 1D to Zone 2, Subzone 2 beta; Middle Jurassic (upper Bajocian) to Upper Jurassic (lower Tithonian).

*Occurrence:* Rutog County, Xizang, China; Snowshoe and Lonesome formations, east-central Oregon; volcanopelagic strata at Stanley Mountain, California.

***Leugeo*** sp. A  
Plate 23, figure 15

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation (OR501B), east-central Oregon.

Family **ORBICULIFORMIDAE** Pessagno 1973, emend. Yeh 2009

*Type genus:* *Orbiculiforma* Pessagno 1973.

*Range and occurrence:* Triassic to Cretaceous. Worldwide.

Genus *Orbiculiforma* Pessagno 1973, emend. Yeh 2009

*Type species:* *Orbiculiforma quadrata* Pessagno 1973.

*Range and occurrence:* Triassic to Cretaceous; Worldwide.

***Orbiculiforma densaora* Yeh**

Plate 24, figure 12

*Orbiculiforma densaora* YEH 2009, p. 52, pl. 12, figs. 20, 24, 27.

*Range:* Supperzone 1, Zone 1F; Middle Jurassic (Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation (OR-MA30A, OR501B), east-central Oregon.

***Orbiculiforma* sp. aff. *O. hexagonaora* Yeh**

Plate 24, figure 13

*Orbiculiforma hexagonaora* YEH 2009, p. 52, pl. 12, figs. 5, 10, 15-16.

*Remarks:* This morphotype is slightly different from *O. hexagonaora* Yeh by having a test with more than six sides in outline.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation (OR501B), east-central Oregon.

***Orbiculiforma incognita* Blome**

Plate 24, figures 1-2

*Orbiculiforma(?) incognita* BLOME 1984, p. 353, pl. 5, figs. 1-23, 8-9, 12-13.- GORIČAN et al. 2003, p. 296, pl. 3, figs. 5-7.

*Spongotrochus (Stylospongidium) sp. aff. S. (S.) echinodiscus* Clark and Campbell-CARTER et al. 1988, p. 46, pl. 10, figs. 7, 10.

*Orbiculiformella incognita* (Blome)-GORIČAN et al. 2006, p. 262, pl. ORB06.

*Orbiculiforma* sp. A YEH 2009, p. 54, pl. 12, figs. 3, 8, 13-14.

*Range:* Supperzone 1, Zone 1A to Zone 1G, Lower to Middle Jurassic (upper Toarcian to middle Callovian).

*Occurrence:* Lower Jurassic (upper Toarcian) from Phantom Creek and Graham Island Formation, Queen Charlotte Island, British Columbia; Skrile Formation, Slovenia. Middle Jurassic (Bathonian) from Snowshoe Formation (OR-MA30A, OR501A, B), east-central Oregon, and (middle Callovian) from Shelikof Formation, southern Alaska.

***Orbiculiforma librata* Yeh**

Plate 24, figures 3-4

*Orbiculiforma librata* YEH 2009, p. 53, pl. 12, figs. 1-2, 6-7, 11, 17-18, 21-22, 25.-YEH 2011, p. 25, pl. 12, figs. 8-9.

*Range:* Supperzone 1, middle Zone 1E to Zone 1F top, Middle Jurassic (upper Bajocian to upper Bathonian).

*Occurrence:* South Fork members of Snowshoe Formation, east-central Oregon.

***Orbiculiforma santarota* Yeh**

Plate 24, figures 8-9, 17, 19

*Orbiculiforma santarota* YEH 2009, p. 53, pl. 12, figs. 4, 9, 12.

*Range:* Supperzone 1, Zone 1F; Middle Jurassic (Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation (OR-MA30A, OR501C), east-central Oregon.

***Orbiculiforma trispina trispinula* Carter**

Plate 24, figures 5, 20

*Orbiculiforma trispinula* CARTER et al. 1988, p. 44, pl. 1, figs. 7, 10.

*Orbiculiformella ? trispina trispinula* (Carter)-GORIČAN et al., 2006, p. 268, pl. ORB10.

*Range:* Zone 01 to Supperzone 1, Zone 1F top, Lower Jurassic (upper Pliansbachian) to Middle Jurassic (upper Bathonian).

*Occurrence:* Fannin Formation, Maude Island; South Fork Member of Snowshoe Formation (OR501B), east-central Oregon.

***Orbiculiforma* sp. A**  
Plate 24, figures 14-16

*Remarks:* This morphotype is characterized by having a moderately large disc-shaped test that is composed of dense spongy pore frames and zig-zag in outline, and by having a centrally placed knob in top surface of central depressed area.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe formation, east-central Oregon (OR501B).

Family **PANTANELLIIDAE** Pessagno 1977b, sensu Pessagno and MacLeod 1987  
*Type genus:* *Pantanellium* Pessagno 1977a; sensu Pessagno and Blome 1980.

*Range and occurrence:* Upper Triassic (Karnian) to Lower Cretaceous (upper Aptian?; lower Albian). Worldwide.

Subfamily **PANTANELLIINAE** Pessagno 1977b, sensu Pessagno and Blome 1980  
*Type genus:* *Pantanellium* Pessagno 1977a; sensu Pessagno and Blome 1980.

*Range and occurrence:* Same as for family.

Genus ***Gorgansium*** Pessagno and Blome  
*Type species:* *Gorgansium silviesense* Pessagno and Blome 1980.

*Range and occurrence:* Upper Triassic (Karnian) to Upper Jurassic (Tithonian) or higher. Worldwide.

***Gorgansium* sp. A**  
Plate 25, figures 13, 18

*Remarks:* This morphotype is characterized by having a small subtriangular shape cortical shell with three moderately long straight triradiate spines, which are unequal in length.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501C).

***Gorgansium* sp. B**  
Plate 25, figures 14, 20

*Remarks:* This morphotype differs from *Gorgansium* sp. A by having a test with much spines.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

Genus ***Pachyoncus*** Pessagno and Blome  
*Type species:* *Pachyoncus tumidus* Pessagno and Blome 1980.

*Range:* Supperzone 1, Zone 1E to Zone 2, Subzone 2 delta; Middle Jurassic (upper Bajocian) to Upper Jurassic (Oxfordian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon; Klamath Mountains, northeastern California, Smith River subterranean; Mino Terrane, Japan.

***Pachyoncus* sp. aff. *P. floreus*** Yeh  
Plate 25, figures 8, 21

*Pachyoncus floreus* YEH 2009, p. 41, pl. 8, figs. 12-14, 29, 32-33.

*Pachyoncus* sp. aff. *P. floreus* YEH 2009, p. 42, pl. 8, fig. 15.

*Range:* Supperzone 1, Zone 1F; Middle Jurassic (Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR-MA30A, OR501B).

Genus ***Pantanellium*** Pessagno 1977a; sensu Pessagno and Blome 1980  
*Type species:* *Pantanellium riedeli* Pessagno 1977a.

*Range and occurrence:* Same as for family.

***Pantanellium foveatum*** Mizutani and Kido  
Plate 25, figures 6, 19

*Pantanellium* sp. A MIZUTANI et al. 1981, p. 197, fig. 2b.

*Pantanellium* sp. alpha MIZUTANI and KOIKE 1982, p. 122, pl. 1, fig. 2.

*Pantanellium foveatum* MIZUTANI and KIDO, 1983, pp. 256-257, pl. 51, figs. 1a-d, 2a-c; pl. 52, figs. 1-3.-PESSAGNO et al. 1993, p. 129, pl. 4, figs. 11, 19, 22.-YEH 2009, p. 42, pl. 8, figs. 1-2.-YEH 2011, p. 26, pl. 13, figs. 1, 19.

**Remarks:** This species has also been observed by the first author in a sample (OR-MA15R) collected by Ms. Yi Tang at upper part of Warm Springs Member. It represents the earliest occurrence of this species based on the data available so far.

**Range:** Supperzone 1, Zone 1C to Zone 2, subzone 2 delta; Middle Jurassic (upper lower Bajocian) to Upper Jurassic (middle Oxfordian).

**Occurrence:** Warm Springs and South Fork Member, Snowshoe Formation, east-central Oregon (OR-MA15, OR549B, OR-MA30A, OR501A, C). Volcanopelagic strata above Josephine ophiolite, Klamath Mtns., Smith River subterranean, northwestern California.

***Pantanellium sincerum*** Pessagno and Blome  
Plate 25, figure 2

*Pantanellium sincerum* PESSAGNO and BLOME 1980, p. 245, pl. 10, figs. 4-6, 10-12, 15.-YEH 2011, p. 26, pl. 13, figs. 15, 22.

**Remarks:** The presence of This species in the studied sample is a new record of the final occurrence of the species.

**Range:** Supperzone 1, middle Zone 1E to 1F top; Middle Jurassic (Bathonian).

**Occurrence:** South Fork Member, Snowshoe Formation, east-central Oregon (OR549B, OR501A).

***Pantanellium ultrasincerum*** Pessagno and Blome  
Plate 25, figures 3-5

*Pantanellium ultrasincerum* PESSAGNO and BLOME 1980, p. 247, pl. 11, figs. 9, 14, 17, 19, 22, 25.-YEH 2009, p. 43, pl. 8, figs. 4-5.

**Remarks:** The presence of this species in the studied sample is a new record of the final occurrence of the species.

**Range:** Supperzone 1, Zone 1F; Middle Jurassic (Bathonian).

**Occurrence:** South Fork Member, Snowshoe Formation, east-central Oregon (OR-MA30A, OR501A, C).

***Pantanellium* sp. A**  
Plate 25, figures 7, 17

**Range:** Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

**Occurrence:** South Fork Member, Snowshoe Formation, east-central Oregon.

Genus ***Zartus*** Pessagno and Blome  
**Type species:** *Zartus jonesi* Pessagno and Blome 1980.

**Range and occurrence:** Lower Jurassic (lower Pliensbachian) to Middle Jurassic (Bathonian). Queen Charlotte Islands, British Columbia; east-central Oregon; Japan and Slovenia.

***Zartus* sp. cf. *Z. thayeri*** Pessagno and Blome 1980  
Plate 25, figure 1

*Zartus thayeri* PESSAGNO and BLOME 1980, p. 254-256, pl. 8, figs. 3-6, 13, 19-21.-YEH 2009, p. 43-44, pl. 8, figs. 6-7.-YEH 2011, p. 27, figs. 126, 23.

**Remarks:** This morphotype differs from *Z. thayeri* Pessagno and Blome by having a thicker test with larger pore frames at median raised band.

**Range:** Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

**Occurrence:** South Fork Member, Snowshoe Formation, east-central Oregon.

Family **PARVIVACCIDAE** Pessagno and Yang 1989

**Type genus:** *Parvivacca* Pessagno and Yang 1989.

*Range and occurrence:* Middle Jurassic (Aalenian) to Upper Jurassic (upper Tithonian) or younger.

Genus *Lanubus* Pessagno and Yang 1989

*Type species:* *Lanubus holdworthi* Pessagno and Yang 1989.

*Range and occurrence:* Middle Jurassic (Aalenian) to Upper Jurassic (upper Tithonian).

*Lanubus* sp. A

Plate 25, figure 15

*Lanubus*(?) sp. A YEH 2009, p. 44, pl. 9, figs. 5, 12.

*Range:* Supperzone 1, Zone 1F; Middle Jurassic (Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR-MA30A and OR501C).

Family **PATULIBRACCHIDAE** Pessagno 1971, emend. Dumitrica et al. 2006

*Type genus:* *Patulibracchium* Pessagno 1971.

*Range and occurrence:* Middle Jurassic to Cenozoic (Pliocene) in Dumitrica et al. 2006.

Genus *Homoeoparonaella* Baumgartner 1980a

*Type species:* *Paronaella elegans* Pessagno 1977a.

*Range and occurrence:* Middle Jurassic (upper Bathonian, Supperzone 1, upper Zone 1F) to Lower Cretaceous (Aptian); worldwide.

*Homoeoparonaella elegans* (Pessagno)

Plate 16, figure 7

*Paronaella elegans* PESSAGNO 1977a, p. 70, pl. 1, figs. 10-11.

*Homoeoparonaella elegans* (Pessagno)-BAUMGARTNER 1980, p. 289, pl. 1, fig. 15; pl. 2, figs. 2-6; pl. 11, fig. 6. – BAUMGARTNER et al. 1995, p. 273, pl. 3104, figs. 3, 4-5; not figs. 1-2.-HULL 1997, p. 41, pl. 13, fig. 4.

*Range:* Supperzone 1, upper Zone 1F to Zone 4, Middle Jurassic (upper Bathonian) to Upper Jurassic (Tithonian) based on this study and Hull 1997; Middle Jurassic (upper Bajocian) to Upper Jurassic (lower Kimmeridgian) in Baumgartner et al. 1995.

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B); Coast Range, California; Taman Formation, Mexico; Greece; Sicily; Morocco; southern Alps; Austria and Poland, etc.

*Homoeoparonaella* sp. aff. *H. elegans* (Pessagno) Plate 16, figures 4, 8

*Homoeoparonaella* sp. aff. *H. elegans* (Pessagno)-BAUMGARTNER 1980, p. 289, pl. 1, fig. 15; pl. 2, figs. 2-6; pl. 11, fig. 6.-CARTER 1988, p. 28-29, pl. 16, fig. 7.-BAUMGARTNER et al., 1995a, p. 274, pl. 2004.

*Range:* Zone 01 to Supperzone 1, upper Zone 1F, Lower to Middle Jurassic (lower middle Toarcian to upper Bathonian).

*Occurrence:* Greece, Graham Island, British Columbia and South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

Family **PRAECONOCARYOMMIDAE** Pessagno 1976; emend. Yeh 2009

*Type genus:* *Praeconocaryomma* Pessagno 1976.

*Range and occurrence:* Lower Jurassic (upper Pliensbachian) to Upper Cretaceous (middle Campanian). Worldwide.

Genus *Neoconocaryomma* Yeh

*Type species:* *Neoconocaryomma acusspina* Yeh 2009.

*Range and occurrence:* Middle Jurassic (upper Bajocian to middle Callovian) so far as known. Shelikof Formation, southern Alaska; Snowshoe Formation, east-central Oregon.

*Neoconocaryomma acusspina* Yeh

Plate 26, figure 10

*Neoconocaryomma acusspina* YEH 2009, p. 46, pl. 10, figs. 10-11, 15-16, 21-24.

*Range:* Supperzone 1, Zone 1F; Middle Jurassic (Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR-MA30A, OR501C).

*Neoconocaryomma tantulimamma* Yeh

Plate 26, figure 5

*Praeconocaryomma* sp. D YEH 1987b, p.41, pl. 19, figs. 3, 18.

*Praeconocaryomma* sp. aff. *P. universa* Pessagno-CARTER et al.1988, p. 32, pl. 17, fig. 6.

*Neoconocaryomma tantulimamma* YEH 2011, 30, pl. 15, figs. 1-3, 7-10, 13, 17-18, 20-21.

**Range:** Zone 01, Subzone 01B to Supperzone 1, upper Zone 1F, Middle Jurassic (upper lower Bajocian to upper Bathonian).

**Occurrence:** Phantom Creek Formation, Graham Island, British Columbia; Hyde Formation (OR600A), Warm Springs and South Fork members of Snowshoe Formation, east-central Oregon (OR-MA15P, OR549B, OR501C).

*Neoconocaryomma tripalmaspina* Yeh

Plate 26, figure 15

*Neoconocaryomma tripalmaspina* YEH 2009, p.46-47, pl. 10, figs. 13-14, 19.

**Range:** Supperzone 1, Zone 1F; Middle Jurassic (Bathonian).

**Occurrence:** South Fork Member, Snowshoe Formation, east-central Oregon (OR-MA30A, OR501B).

*Neoconocaryomma* sp. A

Plate 26, figure 9

**Remarks:** This morphotype differs from *N. tantulimamma* Yeh by having a test with thicker triradiate spines.

**Range:** Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

**Occurrence:** South Fork Member, Snowshoe Formation, east-central Oregon (OR501C).

Genus *Praeconocaryomma* Pessagno 1976

**Type species:** *Praeconocaryomma universa* Pessagno 1976.

*Conocaryomma* Lipman-EMPSON-MORIN 1981 (part)

**Range and occurrence:** same as for family.

*Praeconocaryomma* sp. A

Plate 26, figure 19

**Remarks:** This morphotype is characterized by having a spherical cortical shell with mammae pentagonal or hexagonal in outline.

**Range:** Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

**Occurrence:** South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

Family **XIPHOSTYLIDAE** Haeckel 1881 (nomen correctum); emend. Pessagno and Yang 1989

**Type genus:** *Xiphostylus* Haeckel 1881; emend. Pessagno and Yang 1989.

Xiphostylidae Haeckel –PESSAGNO et al., 1989, pp. 202-203.

**Range and occurrence:** Triassic to Cretaceous. Worldwide.

Genus *Archaeocenosphaera* Pessagno and Yang 1989, emend. herein.

**Type species:** *Archaeocenosphaera ruesti* Pessagno and Yang 1989.

*Amuria* WHALEN and CARTER 1998.

**Emended definition:** Cortical shell spherical, with or without spines, consisting of two fused latticed layers. Latticed layers comprised of symmetrical polygonal pore frames, outer latticed layer often quite thick.

**Remarks:** The *Archaeocenosphaera* type spherical tests with spines are also included in this genus.

**Range and occurrence:** Triassic to Cretaceous; worldwide.

*Archaeocenosphaera* sp. A

Plate 28, figures 12-13

**Remarks:** This morphotype is characterized by having a large spherical cortical shell with or without short secondary spines.

**Range:** Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

Genus *Tripocyclus* Haeckel 1881. emend. Pessagno and Yang 1989

*Type species:* *Tripocyclus* Rüst 1885 (subsequent designation by Campbell 1954, p. D-82).

*Range and occurrence:* Lower Jurassic (lower Toarcian) to Lower Cretaceous; worldwide.

*Tripocyclus brooksi* Pessagno and Yang  
Plate 27, figures 1-2

*Tripocyclus brooksi* PESSAGNO and YANG 1989, p. 216-218, pl. 5, figs. 7-9, 11-13, 15, 20.-HULL 1997, p. 71-72, pl. 29, figs. 2-3, 9, 13, 16, 18, 24-25.

*Range:* Supperzone 1, upper Zone 1F to Zone 2, Subzone 2 gamma; Middle Jurassic (upper Bathonian) to Upper Jurassic (middle Oxfordian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (PR501B, C) and volcanopelagic strata, Stanley Mountain, California.

*Tripocyclus* sp. cf. *T. brooksi* Pessagno and Yang  
Plate 27, figures 5-6

*Remarks:* This morphotype differs from *T. brooksi* Pessagno and Yang by having a larger cortical shell with relatively shorter spines.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

*Tripocyclus smithi* Pessagno and Yang  
Plate 27, figure 7

*Tripocyclus smithi* PESSAGNO and YANG 1989, p. 223-224, pl. 5, figs. 4-6, 10, 14, 17-19.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

*Tripocyclus southforkensis* Pessagno and Yang  
Plate 27, figures 3-4

*Tripocyclus southforkensis* PESSAGNO and YANG 1989, p. 224-225, pl. 5, figs. 1-3, 16, 21.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

*Tripocyclus* sp. A  
Plate 27, figures 9-10

*Remarks:* This morphotype is characterized by having a test with three spines terminated with three knob-like nodes at distal end of three ridges.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

Genus *Xiphostylus* Haeckel 1881; emend. Pessagno and Yang 1989

*Type species:* *Xiphostylus attenuatus* Rüst 1885 (nomen correctum) (Subsequent designation by Campbell, 1954, p. D82) .

Not *Xiphosphaera* Haeckel 1881, p. 450. Type species: *Xiphosphaera gaea* Haeckel 1887 (Subsequent designation by Frizzell and Middour, 1954, p. 13) .

*Range and occurrence:* Lower Jurassic to Upper Jurassic (middle Oxfordian); Western North American Mesozoic tectonic terranes and Japan.

*Xiphostylus sinuosus* Pessagno and Yang  
Plate 28, figures 5-6

*Xiphostylus sinuosus* PESSAGNO et al., 1989, p. 239, pl. 6, figs. 2-4, 10, 21, 28.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B, C).

*Xiphostylus* sp. cf. *X. sinuosus* Pessagno and Yang  
Plate 28, figure 4

*Remarks:* This morphotype differs from *X. sinuosus* Pessagno and Yang by having a smaller test with thinner polar spines.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501C).

*Xiphostylus vallieri* Pessagno and Yang  
Plate 28, figure 10

*Xiphostylus vallieri* PESSAGNO et al., 1989, p. 239-240, pl. 1, figs. 4, 10, 13 ; plate 2, figures 1-3, 12, 15-16, 19, 23.-YEH 2009, p. 50, pl. 1, figs. 7, 10.

*Range:* Supperzone 1, middle Zone 1B to Zone 1F top; Middle Jurassic (lower Bajocian to upper Bathonian).

*Occurrence:* Warm Springs and South Fork members, Snowshoe Formation, east-central Oregon (OR-705, OR-MA30A, OR501C).

*Xiphostylus whalenae* Pessagno and Yang  
Plate 28, figure 15

*Xiphostylus whalenae* PESSAGNO et al., 1989, p. 240, pl. 1, fig. 3 ; pl. 4, figs. 2, 17, 19.

*Range:* Supperzone 1, middle Zone 1E to Zone 1F top; Middle Jurassic (upper Bajocian to upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR549B, OR501B).

*Xiphostylus* sp. A  
Plate 28, figure 7

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501C).

**SPUMELLARIA (?) INCERTAE SEDIS**

*Genus Acaeniotylopsis* Kito and De Wever 1994  
*Type species:* *Acaeniotylopsis triacanthus* Kito and De Wever 1994.

*Range and occurrence:* Lower to Middle Jurassic (Toarcian to upper Bathonian); Sicily, Italy and South Fork Member of Snowshoe Formation, east-central Oregon (OR501B).

*Acaeniotylopsis oregonensis* Yeh and Pessagno, n. sp.  
Plate 28, figures 1-3, 14, 17

Bolenid gen. et sp. indet. D YEH 2011, p. 19, pl. 8, figs. 4, 15.

*Description:* Test composed of a spherical to subspherical cortical shell with two polar spines. Polar spines slender, one longer than the other, triradiate with three narrow ridges alternating with three grooves; ridges tapering distally, grooves narrow at proximally portion and slightly widening distally. Test composed of two layers of medullary shell and one layer of cortical shell. Cortical shell comprised of two layers of pore frames; inner layer with medium sized polygonal pore frames; outer layer with nodose tubercle pore frames and united to each other by sharing ridges radiating from nodes. Outer medullary shell consisting of two primary radial beams and many secondary radial beams, with primary radial beams connected to primary spines, and secondary radial beams connected to nodes of tubercle pore frames one to one; all radial beams triradiate with three ridges alternating with three grooves, primary radial beams much thicker than secondary radial beams.

*Remarks:* This species is characterized by having a subspherical *Acaeniotylopsis*-type cortical shell with slender polar spines. It differs from praeconocayromids by having a test with last medullary shell connected to cortical shell with two thicker triradate polar beams aligned with polar spines rather than having equal sized radial beams aligned with each mamma and by having equal sized spines at all the mammae.

*Measurements (µm):* Holotype +6 paratypes. DC=diameter of cortical shell; LS=maximum length of primary spine.

	DC	LS
Holotype	157	247
Mean	141	191
Maximum	157	247
Minimum	127	133

*Etymology:* This species is named for the state of Oregon where the type specimens were collected.

*Type Locality:* Holotype from OR501B, paratypes from OR501C (See *Locality Description*), Snowshoe Formation, east-central Oregon.

*Deposition of types:* Holotype=USNM547398. Paratypes=USNM547399.

*Range:* Supperzone 1, middle Zone 1E to Zone 1F top; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR549B, OR501B, C).

*Acaeniotylopsis* sp. A  
Plate 28, figures 8, 16

*Remarks:* This morphotype is characterized by having a small cortical shell with three slender triradiate spines.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

*Acaeniotylopsis* sp. B  
Plate 28, figure 9

*Remarks:* This morphotype differs from *Acaeniotylopsis* sp. A by having a larger cortical shell with larger nodes at outer surface and with shorter spines.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

*Genus Hexalonche* Haeckel 1881

*Type species:* *Hexalonche phaenaxonia* Haeckel 1881 (subsequent designation by Campbell 1954, p. D-82).

*Range and occurrence:* Jurassic? to Recent. Worldwide.

*Hexalonche* (?) sp. A  
Plate 27, figure 8

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

*Hexalonche* (?) sp. B  
Plate 27, figure 12

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501A).

*Hexalonche* (?) sp. C  
Plate 27, figure 13

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

*Hexalonche* (?) sp. D  
Plate 27, figure 14

*Trochodiscus exaspina* Squinabol-FOREMAN 1975, p. 612, pl. 2F, fig. 11 ; ?pl.4, fig. 11.

*Hexalonche* (?) sp. A HULL 1997, p. 74, pl.12, figs. 1-2.

*Remarks:* This morphotype differs from *Hexalonche* ? sp. C by having a test with cortical shell composed of smaller and thinner pore frames and by having much longer spines

*Range and occurrence:* Middle Jurassic (upper Bathonian, Supperzone 1, upper Zone 1F) from Snowshoe Formation, east-central Oregon (OR501A, B); Upper Jurassic (upper Kimmeridgian) to Lower Cretaceous (Albian) in Hull 1997. Upper Jurassic (upper lower/upper Tithonian) from Stanely Mountain, California. Also present in Northwest Pacific basin and lower member of Taman Formation, east-central Mexico.

*Genus Loupanus* Carter 1993

*Type species:* *Loupanus thompsoni* Carter 1993.

*Range:* Upper Triassic (Rhaetian) to Upper Jurassic (Tithonian) (Personal communication with Dumitrica)

*Occurrence:* Queen Charlotte Islands, British Columbia and South Fork Member of Snowshoe Formation, east-central Oregon, etc.

***Loupanus*** sp. A  
Plate 16, figures 12, 22

*Remarks:* This morphotype is characterized by having an *Archaeospongoprunum*-type cortical shell with three equally disposed spines at equator.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501C).

*Genus* ***Teichertus*** Hull 1997  
*Type species:* *Orbiculiforma* (?) *heliotropica* Baumgartner 1995a.

*Orbiculiforma* sp. A WIDZ 1991, p. 247, pl. 2, fig. 12.  
*Cenodiscus* (?) sp. PESSAGNO et al. 1993, P. 135, pl. 5, fig. 5.

*Range:* Supperzone 1, Zone 1F to Zone 2, Subzone 2 beta; Middle Jurassic (Bathonian) to Upper Jurassic (upper Oxfordian).

*Occurrence:* South Fork Member of Snowshoe Formation, east-central Oregon; Stanely Mountain, California; Josephine ophiolite (JO-34), Klamath Mtns., California; Taman Formation, east-central Mexico; Greece, etc.

***Teichertus cavernosus*** Hull  
Plate 24, figure 7

*Teichertus cavernosus* HULL 1997, p. 76, pl. 31, figs. 3, 5-6, 11, 15-16; pl. 8, figs. 14, 22-23.

*Range:* Supperzone 1, upper Zone 1F to Zone 4, Subzone 4 beta.

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B); Stanley Mountain, California and Taman Formation, Mexico.

***Teichertus heliotropicus*** (Baumgartner)  
Plate 24, figure 11

*Orbiculiforma* sp. A WIDZ 1991, p. 247, pl. 2, fig. 12.  
*Cenodiscus* sp. A PESSAGNO et al. 1993, p. 135, pl. 5, fig. 5.

*Orbiculiforma heliotropica* BAUMGARTNER et al. 1995, p. 352, pl. 3204.

*Teichertus* sp. HULL 1997, p. 78, pl.8, figs. 15, 25.

*Range:* Supperzone 1, upper Zone 1F to Zone 4, Subzone 4 beta, Middle Jurassic (upper Bathonian) to Upper Jurassic (upper Tithonian) based on Pessagno et al. 1993, Hull 1997 and this study. Middle Jurassic, lower middle Bajocian (= upper lower Bajocian in this report) to middle upper Oxfordian from Greece in Baumgartner et al. 1995.

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501C); Volcanopelagic strata above Josephine ophiolite, Smith River subterranean, Klamath Mountains, northwestern Californian; northern Argolis Peninsula, Greece, etc.

***Teichertus pessagnoii*** Yeh  
Plate 24, figures 6, 10, 18

*Teichertus pessagnoii* YEH 2009, p. 58, pl. 13, figs. 9-10, 14, 18, 20-21.-YEH 2011, p. 35, pl. 12, fig. 15.  
*Teichertus* sp. HULL 1997, p. 78, pl.8, figs. 15, 25.

*Range:* Supperzone 1, middle Zone 1E to Zone 4, Subzone 4 beta; Middle Jurassic (upper Bajocian) to Upper Jurassic (upper Tithonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR549B, OR-MA30A, OR501C); Stanely Mountain, California.

***Spumellaria*** gen. et sp. indet. A  
Plate 20, figure 9

*Remarks:* This specimen is characterized by having a small test with subspherical cortical shell composed of one layer of medium sized polygonal pore frames and with four triradiate spines terminating as finger-like projections.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501A).

**Spumellaria** gen. et sp. indet. B  
Plate 20, figure 10

*Remarks:* This specimen differs from Spumellarian gen. et sp. indet A by having a smaller cortical shell with four longer triradiate spines terminating as longer finger-like projections.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

**Spumellaria** gen. et sp. indet. C  
Plate 23, figures 15, 22

*Remarks:* This form is characterized by having a test with pyramid-shape cortical shell that is composed of thick and tight irregular spongy pore frames, and by having four needle-like spines at four corners of the pyramid. The Lower Jurassic multispiral forms (*Pseudoheptacladus* spp.) with cortical shells composed of same type of pore frames have been reported (Carter et al. 1998, p. 59, pl. 11, figs. 4, 8, 12). A Middle Jurassic (middle Callovian) bipolar form, *Archaeospongoprimum helense* Blome also has a cortical shell of similar pore frames (Blome 1984, p. 349-350, pl. 1, figs. 1-2, 6-7, 14-15). Further studies need to be done to figure out their relationships.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501C).

**Spumellaria** gen. et sp. indet. D  
Plate 26, figures 1-3, 21

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

**Spumellaria** gen. et sp. indet. E  
Plate 26, figures 4, 14

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501A).

**Spumellaria** gen. et sp. indet. F  
Plate 26, figure 6

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501A).

**Spumellaria** gen. et sp. indet. G  
Plate 26, figures 8, 13

Nassellarian gen. et sp. indet. C YEH 2009, p. 74, pl. 23, figs. 8-9, 12.

*Remarks:* The internal structure indicates that this morphotype is not a nassellaria.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501B).

**Spumellaria** gen. et sp. indet. H  
Plate 26, figure 18

*Remarks:* This morphotype is characterized by having an egg-shape test which is composed of dense irregularly arranged spongy pore frames and and by having a rough opening structure at one of polar ends.

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501C).

**Spumellaria** gen. et sp. indet. I  
Plate 28, figure 6

*Range:* Supperzone 1, upper Zone 1F; Middle Jurassic (upper Bathonian).

*Occurrence:* South Fork Member, Snowshoe Formation, east-central Oregon (OR501C).

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## 美國奧瑞岡中侏羅世晚巴通時期放射蟲族群

葉貴玉 · 裴桑諾

此乃吾等最近重新針對出露於美國奧瑞岡中部的史諾修組 (Snowshoe Formation) 進行系列性放射蟲族群全面性分類研究的第三篇報告；其研究標本為裴桑諾教授 (Prof. Emile A. Pessagno) 採自史諾修組最上部 (South Fork Member 頂部) 的三個鈣質泥岩結核 (標本產地編號為 OR501A, B, C)。裴桑諾教授曾經從這三個族群選出最易於辨識的對象 (例如 multicyrtyid nassellarians, pantanellids, xiphostylids 以及形狀特異者) 進行分類研究並發表論文。本研究則從他用過的標本 (如今存在美國華府之史密森自然史博物館古生物庫房) 進行全族群 (whole faunal) 之分類。總共鑑定出 238 個不同型態的放射蟲 (包括 17 個 entactinarians, 103 個 nassellarian 以及 118 個 spumellarians)，並描述了三個新屬 (Corona, *Nidus* and *Secretacapsa*) 以及 24 個新種，並根據文獻資料和本研究整理出每一種放射蟲之出現年代及產地分部。本研究結果不單純只是呈現北半球晚巴通時期 (upper Bathonian) 較為完整之放射蟲族群資料，還有更深層的價值。因為史諾修組之放射蟲跨躍了早侏羅晚期到中侏羅中期 (Toarcian to Bathonian)，一旦各層位之放射蟲族群分類研究完成，族群變化趨勢即可一目了然，屆時也將有更豐富的資料修訂出一個較為準確的中侏羅放射蟲帶。

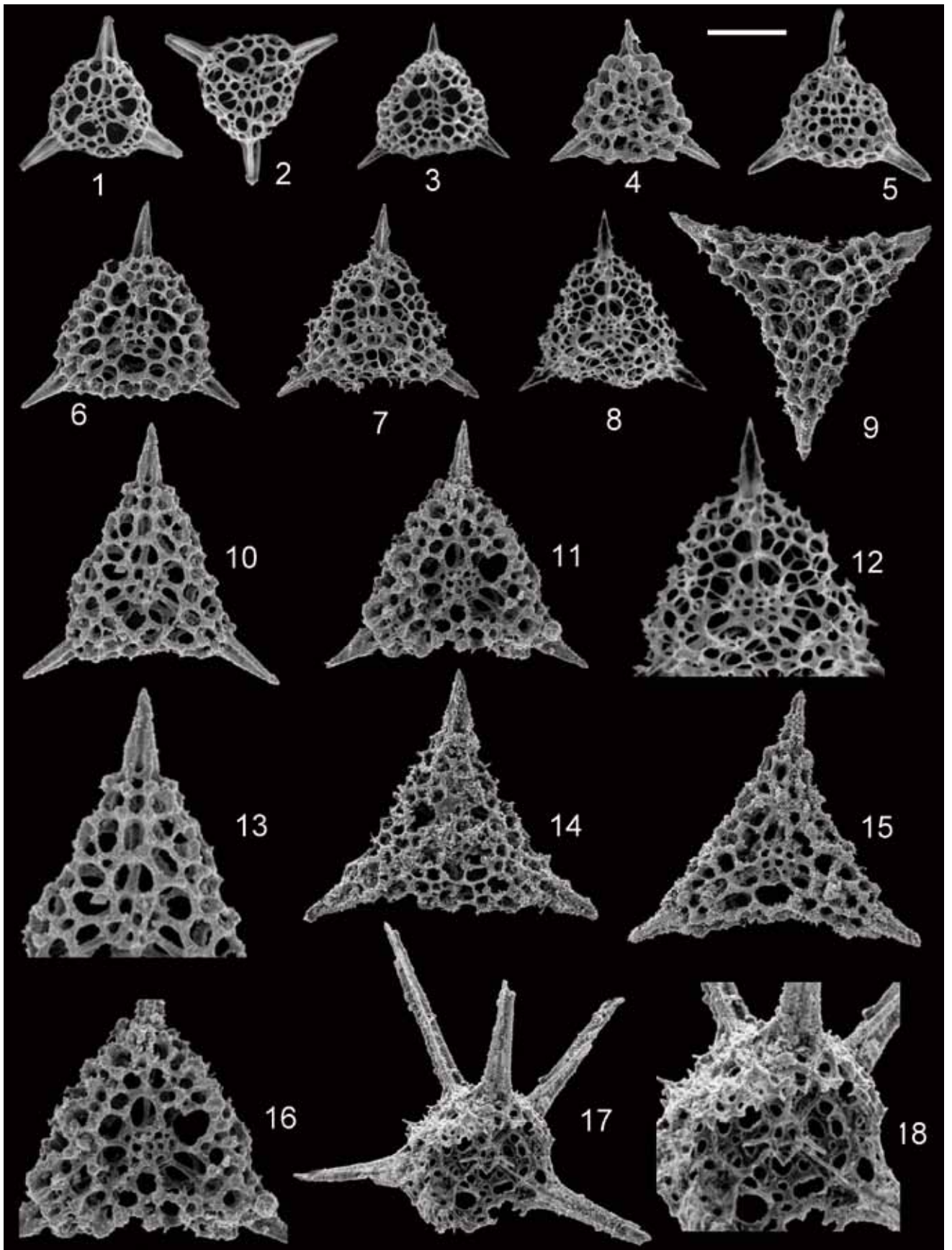
關鍵詞：放射蟲、晚巴通時期、中侏羅世，史諾修組，奧瑞岡中部

## PLATE 1

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) entactinarians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

- |                  |   |        |
|------------------|---|--------|
| 1-2              | <i>Perispyridium foremanae</i> Pessagno and Blome<br>Scales = 100µm; OR501B.  | (P.61) |
| 3, 6             | <i>Perispyridium packardi</i> Pessagno and Blome<br>Scales = 100µm; OR501B.   | (P.61) |
| 4                | <i>Perispyridium</i> sp. A<br>Scale = 100µm; OR501C.  | (P.62) |
| 5                | <i>Perispyridium tamarackense</i> Pessagno and Blome<br>Scale = 100µm; OR501B.  | (P.61) |
| 7-8, 12          | <i>Perispyridium nitidium</i> Pessagno and Blome<br>Scales = 100, 100 and 61µm, respectively; OR501B. 8, 12, Same specimen.       | (P.61) |
| 9, 14-15         | <i>Perispyridium pessagnoii</i> MacLeod<br>Scales = 100µm; 9, 15, OR501B; 14, OR501A.   | (P.61) |
| 10-11, 13,<br>16 | <i>Perispyridium</i> sp. B<br>Scales = 100, 100, 75 and 83µm, respectively; 10, 13, same specimen; 11, 16, same specimen; OR501C. | (P.62) |
| 17-18            | <i>Marianasphaera</i> sp. A<br>Same specimen, scales = 100 and 34µm, respectively; OR501B.  | (P.61) |

PLATE 1

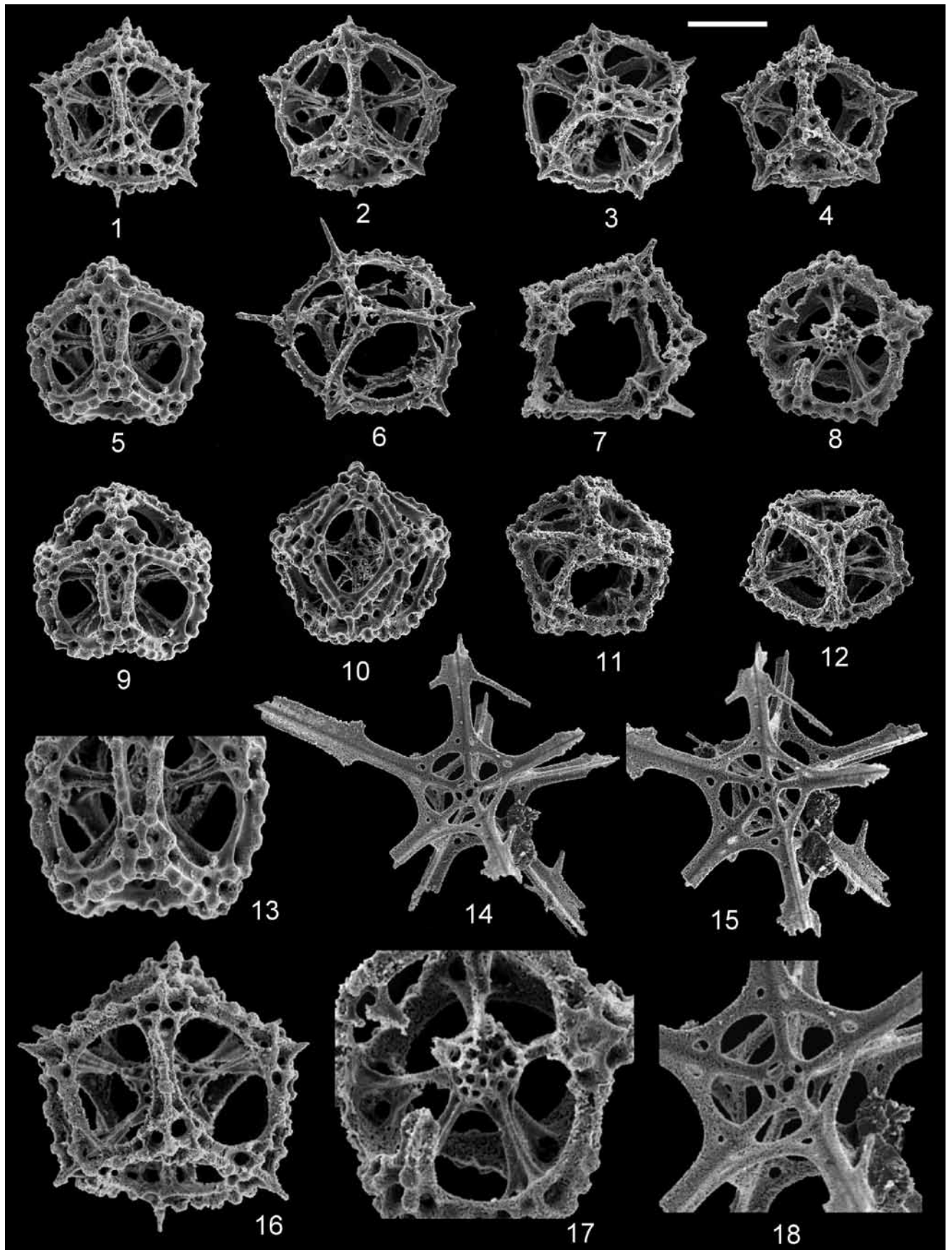


## PLATE 2

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) entactinarians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure. All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) entactinarians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

- |           |   |
|-----------|---|
| 1-4, 16   | <p><b><i>Corona eximia</i></b> Yeh and Pessagno, n. sp. (P.63)<br/>         1, 16, Holotype, USNM 547352, scales = 100 and 65<math>\mu</math>m, respectively;<br/>         OR501C. 2-4, Paratypes, USNM547353, scales = 100<math>\mu</math>m; 2-3, same<br/>         specimen, OR501B; 4, OR501C.</p> |
| 5, 9-13,  | <p><b><i>Corona</i></b> sp. aff. <b><i>C. eximia</i></b> Yeh and Pessagno, n. sp. (P.63)<br/>         Scales = 100, 100, 100, 100, 100 and 87<math>\mu</math>m, respectively; OR501C. 5,<br/>         9-10, 13, Same specimen.</p>  |
| 6-7       | <p><b><i>Corona eximia</i></b> Yeh and Pessagno, n. sp. (P.63)<br/>         Scales = 100<math>\mu</math>m; OR501C.</p>  |
| 8, 17     | <p><b><i>Corona</i></b> sp. aff. <b><i>C. eximia</i></b> Yeh and Pessagno, n. sp. (P.63)<br/>         Same specimen, scales = 100 and 52<math>\mu</math>m, respectively; OR501C. A<br/>         broken specimen showing double layer of internal structure.</p>                                       |
| 14-15, 18 | <p><b><i>Empirea</i></b> sp. A (P.62)<br/>         Scales = 100<math>\mu</math>m; OR501B.</p>   |

PLATE 2

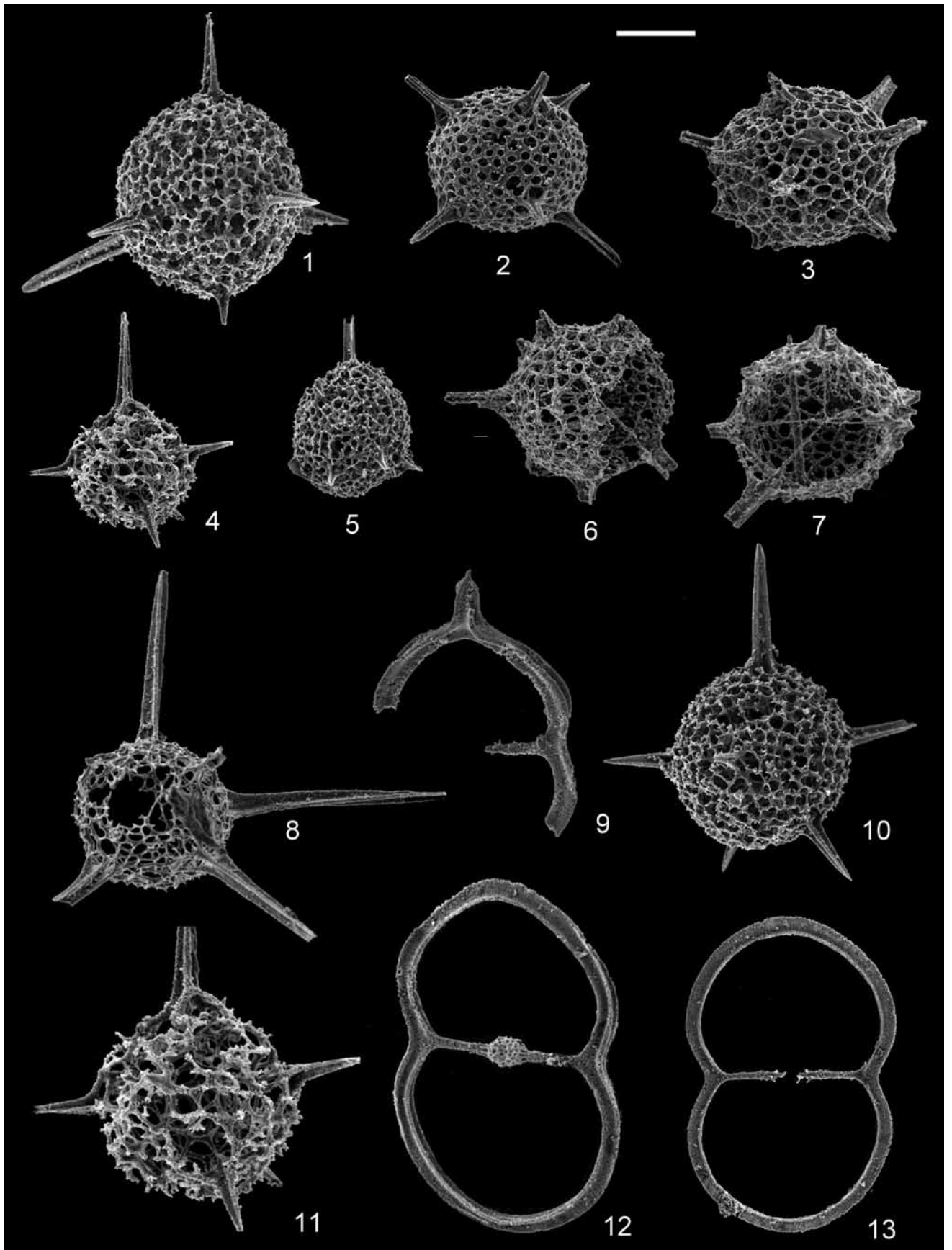


### PLATE 3

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) entactinarians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

- |          |  |        |
|----------|--|--------|
| 1, 5, 10 | <i>Nidus nidulus</i> Yeh and Pessagno, n. sp.<br>1, Holotype, USNM 547364, scale = 100µm; 10, paratype, USNM 547365, scale = 100µm; OR501B. 5, a juvenile form, scale = 100µm; OR501B. | (P.64) |
| 2        | Entactinaria gen. et sp. indet. A<br>Scale = 100µm, OR501B.  | (P.64) |
| 3, 6-8   | Entactinaria gen. et sp. indet. B<br>Scales = 100µm; OR501B. 6-7, Same specimen.   | (P.65) |
| 4, 11    | <i>Nidus</i> sp. A<br>Same specimen, scales = 100 and 61µm, respectively; OR501B.  | (P.64) |
| 9        | <i>Dicerosaturnalis</i> sp. A<br>Scale = 100µm; OR501C.  | (P.63) |
| 12-13    | <i>Eospongosaturninus protoformis</i> (Yao)<br>Scales = 100µm; OR501B.   | (P.62) |

PLATE 3

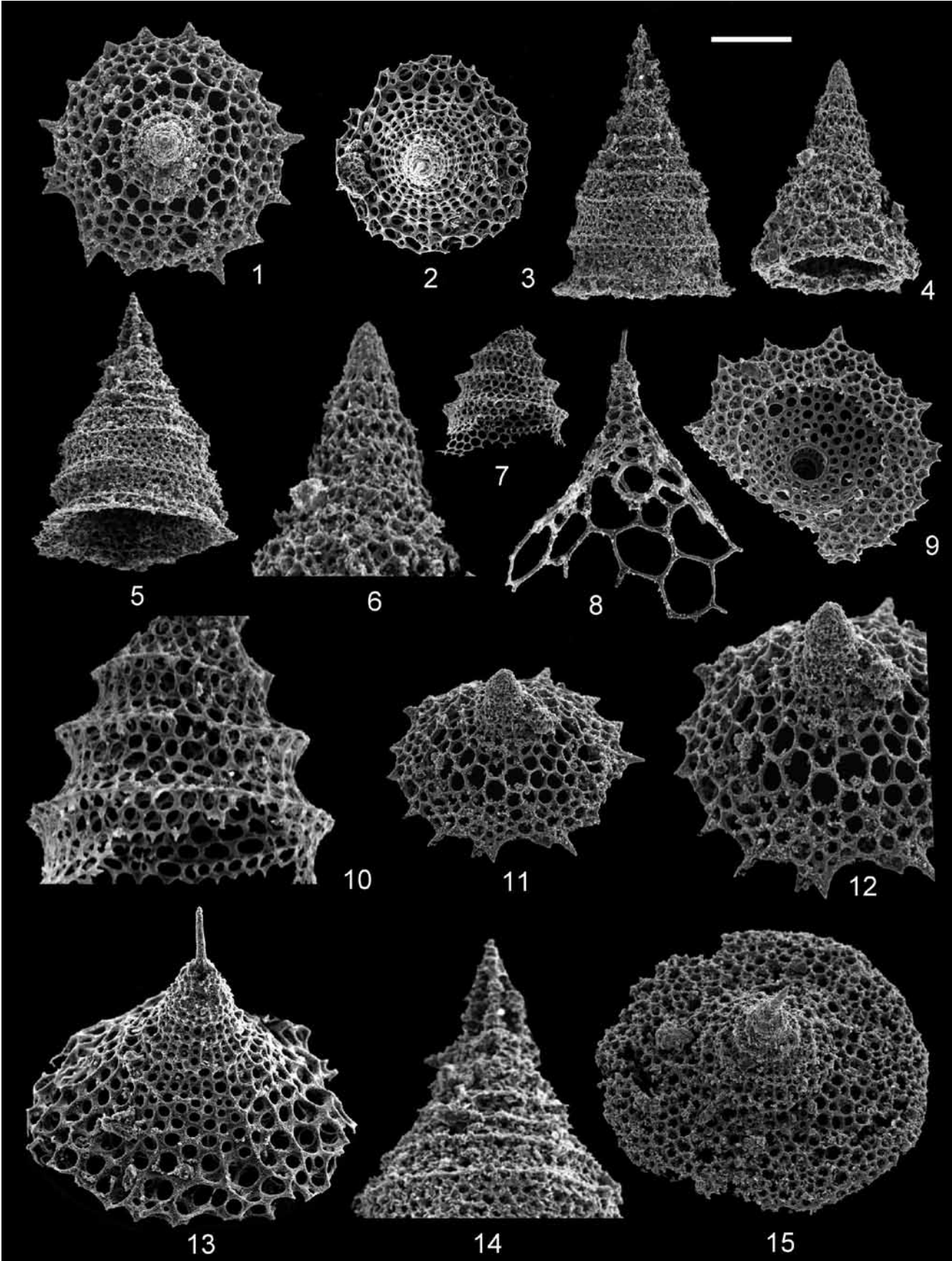


## PLATE 4

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) nassellarians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

- |                |   |        |
|----------------|---|--------|
| 1, 9,<br>11-12 | <b><i>Palinandromeda</i></b> sp. aff. <b><i>P. praepodbielensis</i></b> (Baumgartner)<br>1. 11-12, Same specimen, scales = 100, 100 and 70 $\mu$ m, respectively; OR501B. 9, internal view of a broken specimen, scale = 100 $\mu$ m. OR501B. | (P.65) |
| 2, 13          | <b><i>Palinandromeda</i></b> sp. aff. <b><i>P. depressa</i></b> (De Wever and Micconnet)<br>Same specimen, scales = 100 and 60 $\mu$ m, respectively; OR501B.   | (P.65) |
| 3, 5, 14       | <b><i>Toritenum hirsutum</i></b> Dumitrica and Zügel<br>Same specimen, scales = 100, 100 and 56 $\mu$ m, respectively. OR501B.  | (P.79) |
| 4, 6           | Nassellaria gen. et sp. indet. A<br>Same specimen, scales = 100 and 53 $\mu$ m, respectively; OR501B.   | (P.87) |
| 7, 10          | <b><i>Toritenum obesa</i></b> (Takemura)<br>A broken specimen, scales = 100 and 41 $\mu$ m, respectively; OR501A.   | (P.79) |
| 8              | <b><i>Cornutella</i></b> sp. cf. <b><i>C. tella</i></b> Dumitrica and Zügel<br>Scale = 100 $\mu$ m; OR501B.   | (P.67) |
| 15             | <b><i>Palinandromeda depressa</i></b> (De Wever and Miconnet)<br>Scale = 100 $\mu$ m; OR501B.   | (P.65) |

PLATE 4

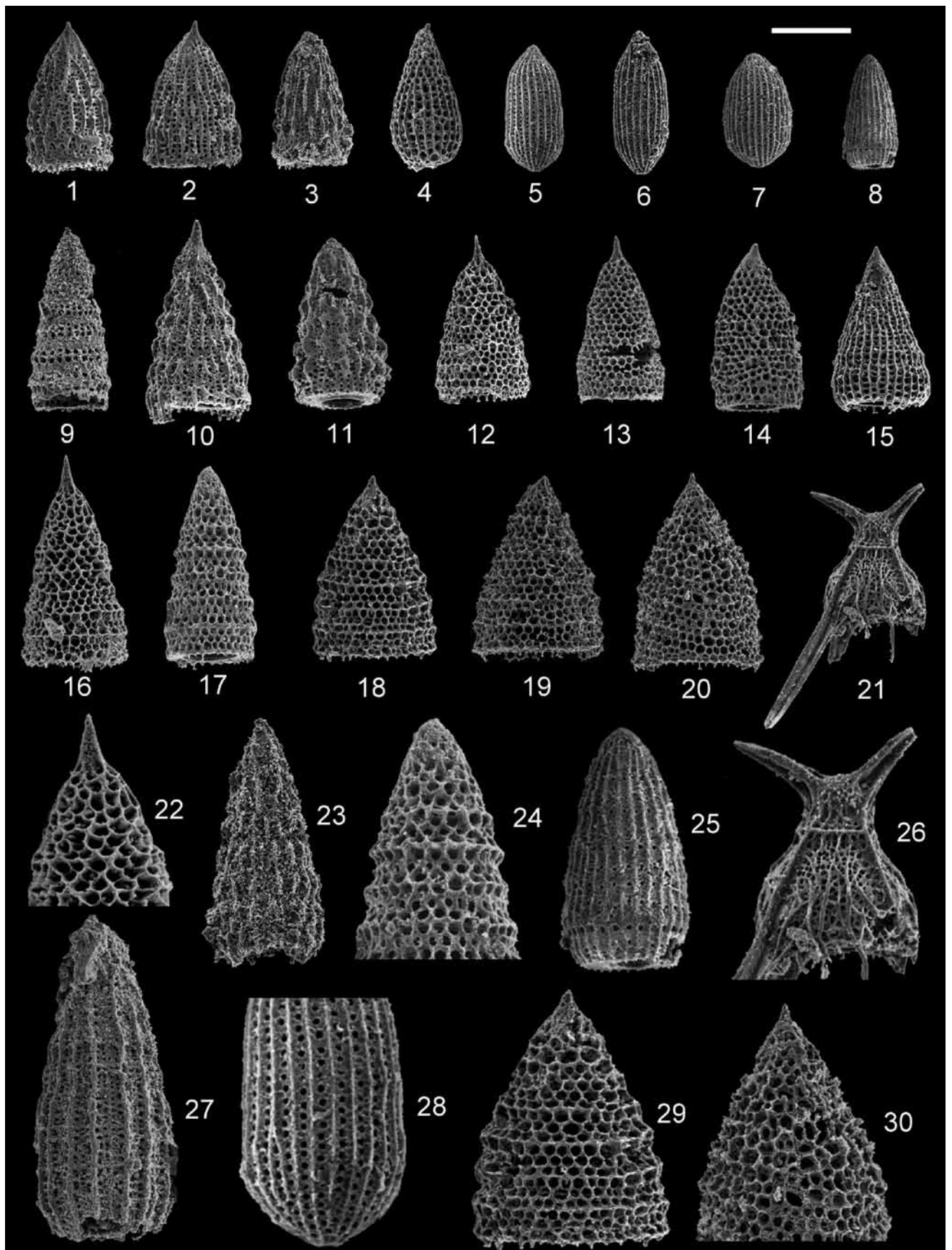


## PLATE 5

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) nassellarians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

1-2	<i>Hsuum</i> sp. cf. <i>H. robustum</i> Pessagno and Whalen Scales = 100µm; OR501C.	(P.68)
3, 11	<i>Hsuum</i> sp. cf. <i>H. maxwelli</i> Pessagno Scales = 100µm; 3, OR501A; 11, OR501C.	(P.68)
4	<i>Parahsuum</i> (?) sp. A Scale = 100µm; OR501B.	(P.69)
5-7, 28	<i>Archaeodictyomitra sincera</i> Yeh and Pessagno, n. sp. 5, 28, Holotype, USNM 547358, scales = 100 and 51µm, respectively; OR501A. 6-7, Paratypes, USNM547359, Scales = 100µm; OR501C.	(P.67)
8, 25	<i>Archaeodictyomitra exigua</i> Blome Scales = 100 and 44µm, respectively. OR501C.	(P.66)
9	<i>Wrangellium</i> sp. A Scale = 100µm; OR501B.	(P.75)
10	<i>Hsuum lupheri</i> Pessagno and Whalen Scale = 100µm. OR501B.	(P.68)
12-13, 16, 22	<i>Praeparvicingula nullacingula</i> Yeh and Pessagno, n. sp. 12-13, Paratypes, USNM547363, Scales = 100µm; OR501A. 16, 22, Holotype, USNM547362, scales = 100 and 52µm; OR501B.	(P.72)
14	<i>Praeparvicingula</i> sp. cf. <i>P. nullacingula</i> Yeh and Pessagno, n. sp. Scale = 100µm. OR501C.	(P.72)
15	<i>Parahsuum nitidum</i> (Pessagno and Whalen) Scales = 100µm. 4, OR501C; 13, OR501B.	(P.69)
17, 24	<i>Praeparvicingula tllellensis</i> Carter Scales = 100 and 54µm, respectively; same specimen, OR501A.	(P.73)
18-20, 29-30	<i>Praeparvicingula ampla</i> Yeh and Pessagno, n. sp. 18, 29, Holotype, USNM547360, scales = 100 and 66µm. 19-20, 30, Paratypes, USNM547361, scales = 100, 100 and 63µm, respectively, OR501C.	(P.70)
21, 26	<i>Hilarisirex inflatus</i> Pessagno, Whalen and Yeh Scales = 100 and 61µm, respectively; same specimen, OR501A.	(P.68)
23	<i>Hsuum maxwelli</i> Pessagno Scale = 100µm; OR501B.	(P.68)
27	<i>Hsuum rosebudense</i> Pessagno and Whalen Scale = 100µm; OR501B.	(P.69)

PLATE 5

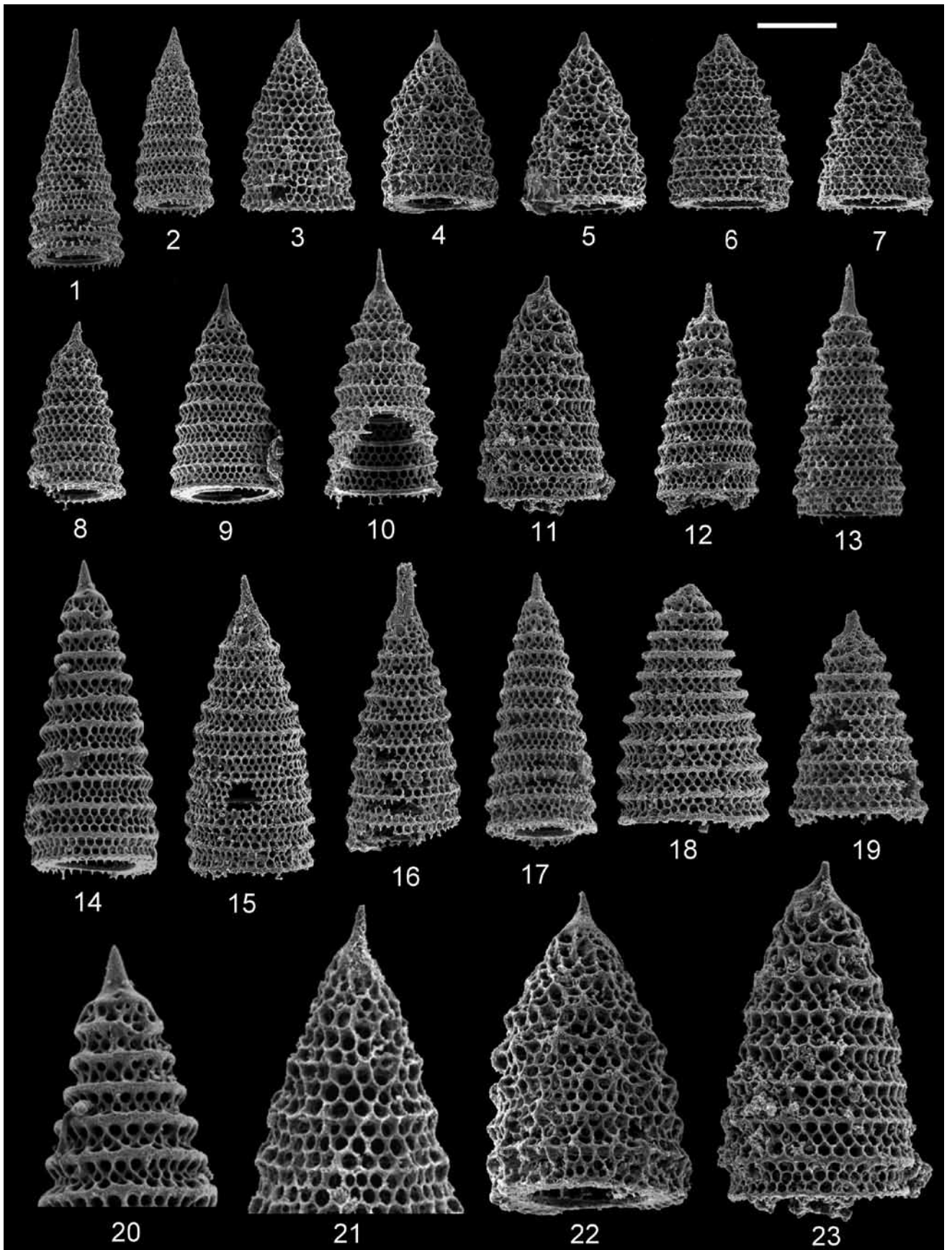


## PLATE 6

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) nassellarians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

- |          |   |        |
|----------|---|--------|
| 1, 16    | <i>Praeparvicingula vera</i> (Pessagno and Whalen)<br>Scales = 100µm; OR501C.   | (P.73) |
| 2        | <i>Praeparvicingula</i> sp. aff. <i>P. vera</i> (Pessagno and Whalen)<br>Scale = 100µm; OR501B.                         | (P.74) |
| 3, 21    | <i>Praeparvicingula</i> sp. A<br>Scales = 100 and 48µm, respectively; OR501C.   | (P.74) |
| 4-5, 22  | <i>Praeparvicingula blackhornensis</i> (Pessagno and Whalen)<br>Scales = 100, 100 and 57µm, respectively; OR501C.       | (P.70) |
| 6-7      | <i>Praeparvicingula</i> sp. cf. <i>P. blackhornensis</i> (Pessagno and Whalen)<br>Scales = 100µm; OR501C.               | (P.70) |
| 8-10, 15 | <i>Praeparvicingula grantensis</i> (Pessagno and Whalen)<br>Scales = 100µm; 8, OR501C; 9-10, 15, OR501B.                | (P.71) |
| 10       | <i>Praeparvicingula</i> sp. aff. <i>P. grantensis</i> (Pessagno and Whalen)<br>Scale = 100µm; OR501A.                   | (P.71) |
| 11, 23   | <i>Praeparvicingula sodaensis</i> (Pessagno and Whalen)<br>Scales = 100 and 69µm, respectively; same specimen ; OR501A. | (P.73) |
| 12-13    | <i>Praeparvicingula profunda</i> (Pessagno and Whalen)<br>Scales = 100µm.12, OR501A; 13, OR501C.                        | (P.73) |
| 14       | <i>Praeparvicingula eleganse</i> (Pessagno and Whalen)<br>Scale = 100µm; 14, OR501B.                                    | (P.71) |
| 17       | <i>Praeparvicingula</i> sp. cf. <i>P. eleganse</i> (Pessagno and Whalen)<br>Scale = 100µm; OR501C.                      | (P.71) |
| 18-19    | <i>Praeparvicingula</i> sp. B<br>Scale = 100µm. 18, OR501B; 19, OR501C.   | (P.64) |

PLATE 6

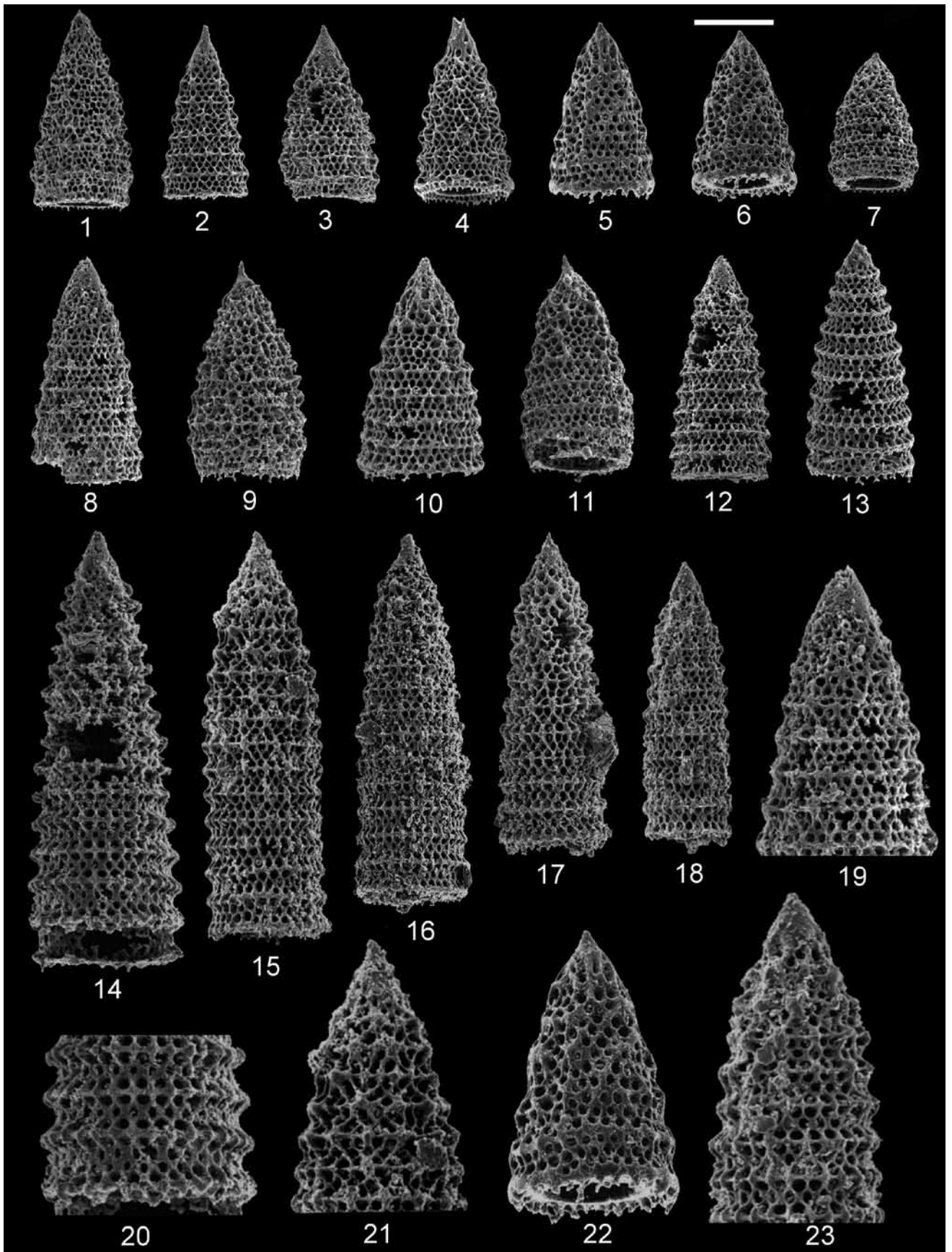


## PLATE 7

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) nassellarians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

- |                  |   |        |
|------------------|---|--------|
| 1                | <i>Antexitus yangi</i> Yeh<br>Scale = 100µm. OR501A.  | (P.84) |
| 2                | <i>Antexitus pessagnoii</i> Yeh<br>Scale = 100µm. OR501C. 2, Test with broken horn.   | (P.84) |
| 3                | <i>Antexitus</i> sp. cf. <i>A. pessagnoii</i> Yeh<br>Scale = 100µm. OR501C.   | (P.84) |
| 4                | <i>Antexitus</i> sp. aff. <i>A. pessagnoii</i> Yeh<br>Scale = 100µm; OR501A.  | (P.84) |
| 5-7, 22          | Nassellaria gen. et sp. indet. B<br>Scales = 100, 100, 100 and 73µm, respectively; OR501C. 5-6, 22,<br>Same specimen.                             | (P.87) |
| 8, 19            | <i>Praeparvicingula</i> sp. C<br>Scales = 100 and 55µm, respectively; same specimen; OR501C.  | (P.74) |
| 9                | Nassellaria gen. et sp. indet. C<br>Scale = 100µm; OR501C.  | (P.87) |
| 10-11            | <i>Praeparvicingula</i> sp. D<br>Scale = 100µm; OR501C.   | (P.87) |
| 12, 14           | <i>Praeparvicingula media</i> (Pessagno and Whalen)<br>Scales = 100µm; OR501C.  | (P.72) |
| 13               | <i>Praeparvicingula burnsensis</i> (Pessagno and Whalen)<br>Scale = 100µm; OR501C.  | (P.71) |
| 15-16, 18,<br>23 | <i>Praeparvicingula schoolhousensis</i> (Pessagno and Whalen)<br>Scales = 100, 100 and 50µm, respectively; OR501B. 15, 18, OR501A.<br>16, OR501B. | (P.72) |
| 17               | <i>Praeparvicingula matura</i> (Pessagno and Whalen)<br>Scales = 100µm; OR501B.   | (P.72) |

PLATE 7

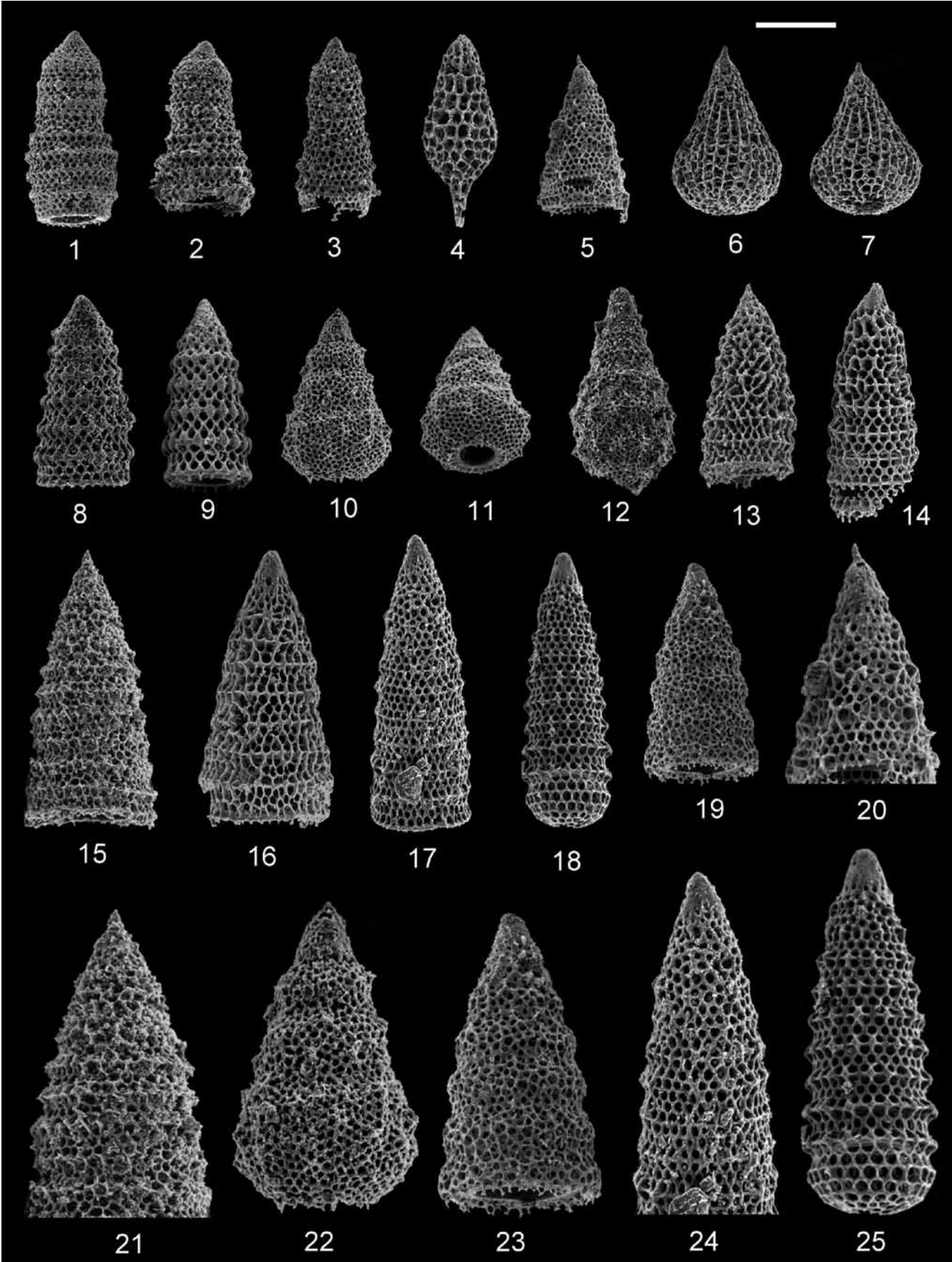


## PLATE 8

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) nassellarians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

- |           |   |        |
|-----------|---|--------|
| 1-3,      | <i>Praeparvicingula turpicula</i> (Pessagno and Whalen)<br>Scales = 100µm, OR501C.                            | (P.73) |
| 4         | <i>Pleesus</i> sp. A<br>Scale = 100µm, OR501C.  | (P.76) |
| 5, 20     | Nassellaria gen. et sp. indet. D<br>Scales = 100 and 66µm, respective; OR501A.                                | (P.87) |
| 6-7       | <i>Belleza decora</i> (Rüst)<br>Scales = 100µm. OR501A.   | (P.85) |
| 8-9       | <i>Praeparvicingula decora</i> (Pessagno and Whalen)<br>Scales = 100µm. 8, OR501B; 9, OR501A.                 | (P.71) |
| 10-12, 22 | <i>Novixitus</i> sp. A<br>Scales = 100, 100, 100 and 60µm, respectively; OR501B. 10-11, 22,<br>same specimen. | (P.85) |
| 13-14     | <i>Praeparvicingula</i> sp. cf. <i>P. gemmata</i> Hull<br>Scales = 100µm, OR501C.                             | (P.71) |
| 15, 21    | <i>Praeparvicingula</i> sp. C<br>Scales = 100 and 43µm, respectively; OR501B.                                 | (P.71) |
| 16        | <i>Windalia</i> sp. A<br>Scale = 100µm, OR501B.   | (P.78) |
| 17, 24    | <i>Ristola</i> sp. A<br>Scales = 100 and 70µm, respectively; OR501A.  | (P.74) |
| 18, 25    | <i>Pseudoristola</i> sp. cf. <i>P. clava</i> Hull<br>Scales = 100 and 71µm, respectively; OR501B.             | (P.73) |
| 19, 23    | <i>Telecapsula johndayensis</i> Yeh<br>Scales = 100 and 70µm, respectively; OR501B.                           | (P.79) |

PLATE 8

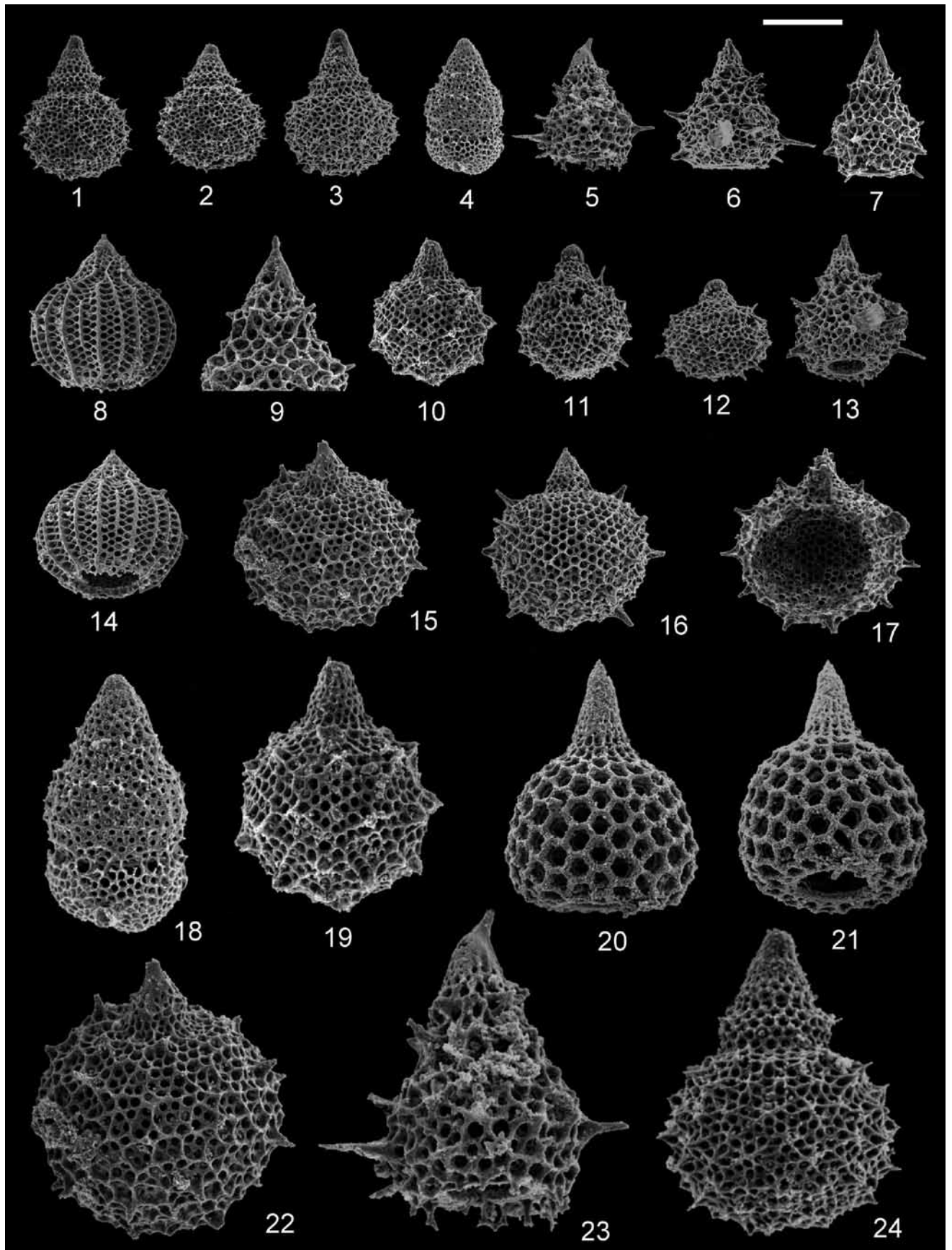


## PLATE 9

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) nassellarians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

- |                   |   |        |
|-------------------|---|--------|
| 1-3, 24           | <b><i>Hiscocapsa echinoampulla</i></b> Yeh and Pessagno, n. sp.<br>1-2, Holotype, USNM547366, scales=100 and 46µm, respectively;<br>OR501A. 3, Paratype, USNM547367, scale=100µm; 3, OR501C.  | (P.82) |
| 4, 18             | <b><i>Eucyrtidiellum</i></b> sp. A<br>Same specimen, scales = 100 and 56µm, respectively; OR501B.   | (P.67) |
| 5-7, 9,<br>13, 23 | <b><i>Quarticella takemurai</i></b> Yeh and Pessagno, n. sp.<br>5, 23, Holotype, USNM547354, scales=100 and 47µm, respectively;<br>OR501C. 6-7, 9, 13, Paratypes, USNM547355, scales=100, 100, 58<br>and 100µm, respectively; 6, 13, same specimen, OR501A; 7, 9, same<br>specimen, OR501C. | (P.77) |
| 8, 14             | <b><i>Unuma</i></b> sp. cf. <b><i>U. echinata</i></b> Ichikawa and Yao<br>Scales=100, 100 and 56µm, respectively; OR501B.   | (P.81) |
| 10-12, 19         | <b><i>Hiscocapsa</i></b> (?) sp. A<br>Scales=100, 100, 100 and 61µm, respectively; OR501B. 11-12, same<br>specimen.   | (P.82) |
| 15-17, 22         | <b><i>Arcanicapsa brevispinosa</i></b> Yeh and Pessagno, n. sp.<br>15, 22, Holotype, USNM547356, scales = 100 and 72µm,<br>respectively; OR501B. 16, Paratype, USNM547357, scale = 100µm;<br>OR501A. 17, A broken specimen showing internal view, OR501B.                                   | (P.66) |
| 20-21             | <b><i>Olanda olorina</i></b> Hull<br>Same specimen, scales = 100µm. OR501B.   | (P.69) |

PLATE 9

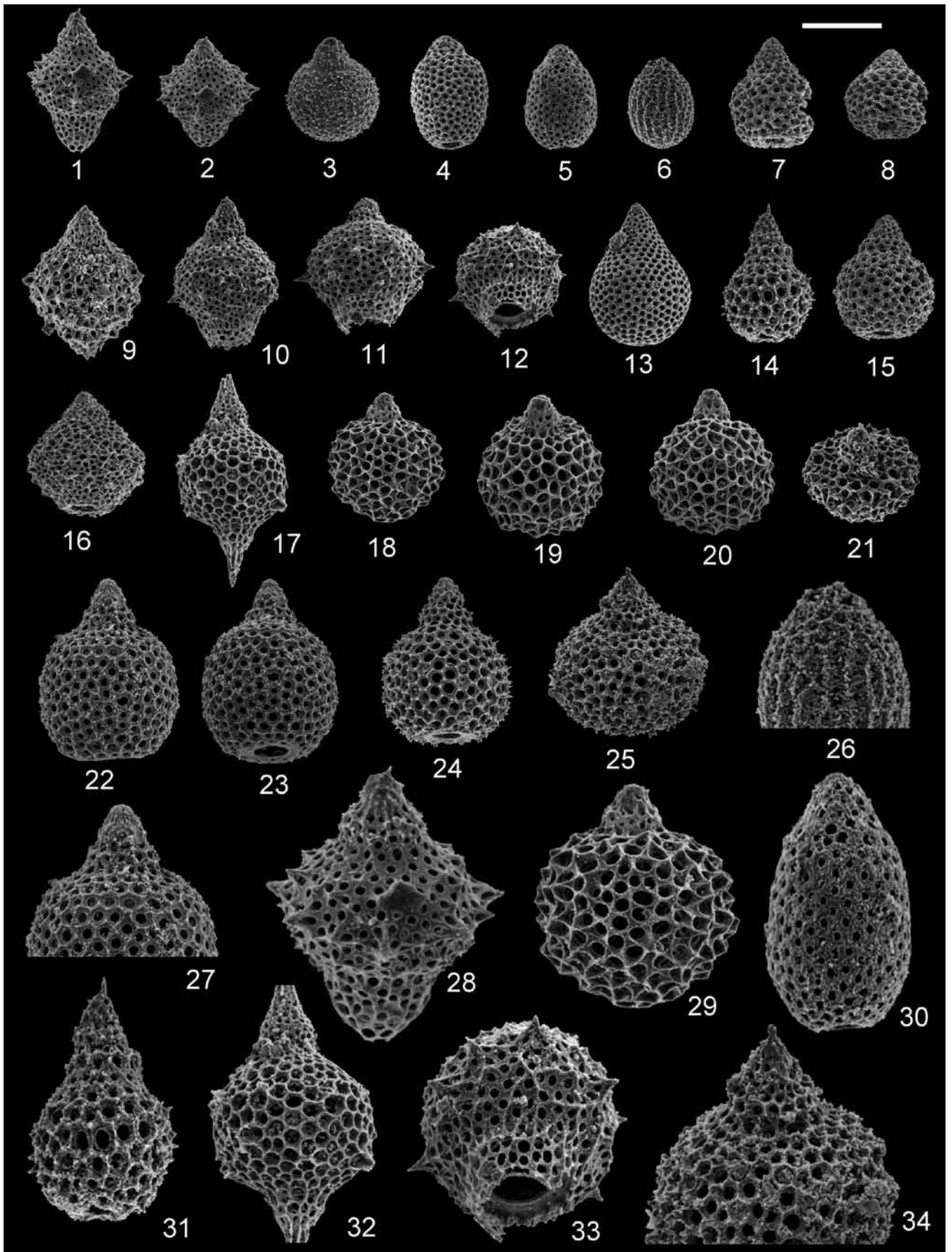


## PLATE 10

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) nassellarians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

- 1-2, *Minutusolla nishimurae* Yeh and Pessagno, n. sp. (P.86)  
 10-12, 28, 1-2, 28, Holotype, USNM547374, scales=100, 100 and 44 $\mu$ m,  
 33 respectively; OR501B. 10-12, 33, Paratypes, USNM547375; OR501B;  
 10-12, scales =100 $\mu$ m; 33, scale =54 $\mu$ m; 11-12, 33, same specimen.
- 3 *Praezhamoidellum* sp. cf. *P. rüsti* (Tan Sin Hok) (P.83)  
 Scale=100 $\mu$ m; OR501A.
- 4-5, 30 *Praezhamoidellum* sp. cf. *P. parvipora* (Tan Sin Hok) (P.83)  
 Scales=100, 100 and 50 $\mu$ m, respectively. OR501B.
- 6, 26 *Plicaforacapsa* sp. cf. *P. catenarum* (Matsuoka) (P.75)  
 Scales=100 and 43 $\mu$ m, respectively; OR501A.
- 7-8, 15 *Hiscocapsa matsuokai* Yeh (P.82)  
 Scales=100 $\mu$ m. OR501C.
- 9 *Minutusolla* sp. aff. *M. nishimurae* Yeh and Pessagno, n. sp. (P.87)  
 Scale=100 $\mu$ m; OR501B.
- 13 *Hiscocapsa convexa* (Yao) (P.82)  
 Scale=100 $\mu$ m; OR501B.
- 14, 31 Nasellarian gen. et sp. indet. I (P.87)  
 Same specimen, scales=100 and 62 $\mu$ m, respectively; OR501C.
- 16 *Minutusolla yaoi* Yeh (P.87)  
 Scale=100 $\mu$ m; OR501B.
- 17, 32 *Yamatoum* (?) sp. A (P.78)  
 Same specimen, scales=100 and 67 $\mu$ m, respectively; OR501B.
- 18-21, 29 *Zhamoidellum horiae* Yeh and Pessagno, n. sp. (P.83)  
 18, 29, Holotype, USNM547370, scales=100 and 58 $\mu$ m, respectively;  
 OR501B. 19-21, Paratypes, USNM 547371, scales=100 $\mu$ m;  
 OR501A. 19, 20, same specimen.
- 22-24, 27 *Praezhamoidellum wui* Yeh and Pessagno, n. sp. (P.83)  
 22-23, 27, Holotype, USNM547368, scales=100, 100 and 70 $\mu$ m,  
 respectively; OR501B. 24, Paratype, USNM547369, scale=100 $\mu$ m;  
 OR501B.
- 25, 34 *Praezhamoidellum* sp. A (P.83)  
 Same specimen, scales =100 and 64 $\mu$ m, respectively; OR501A.

PLATE 10

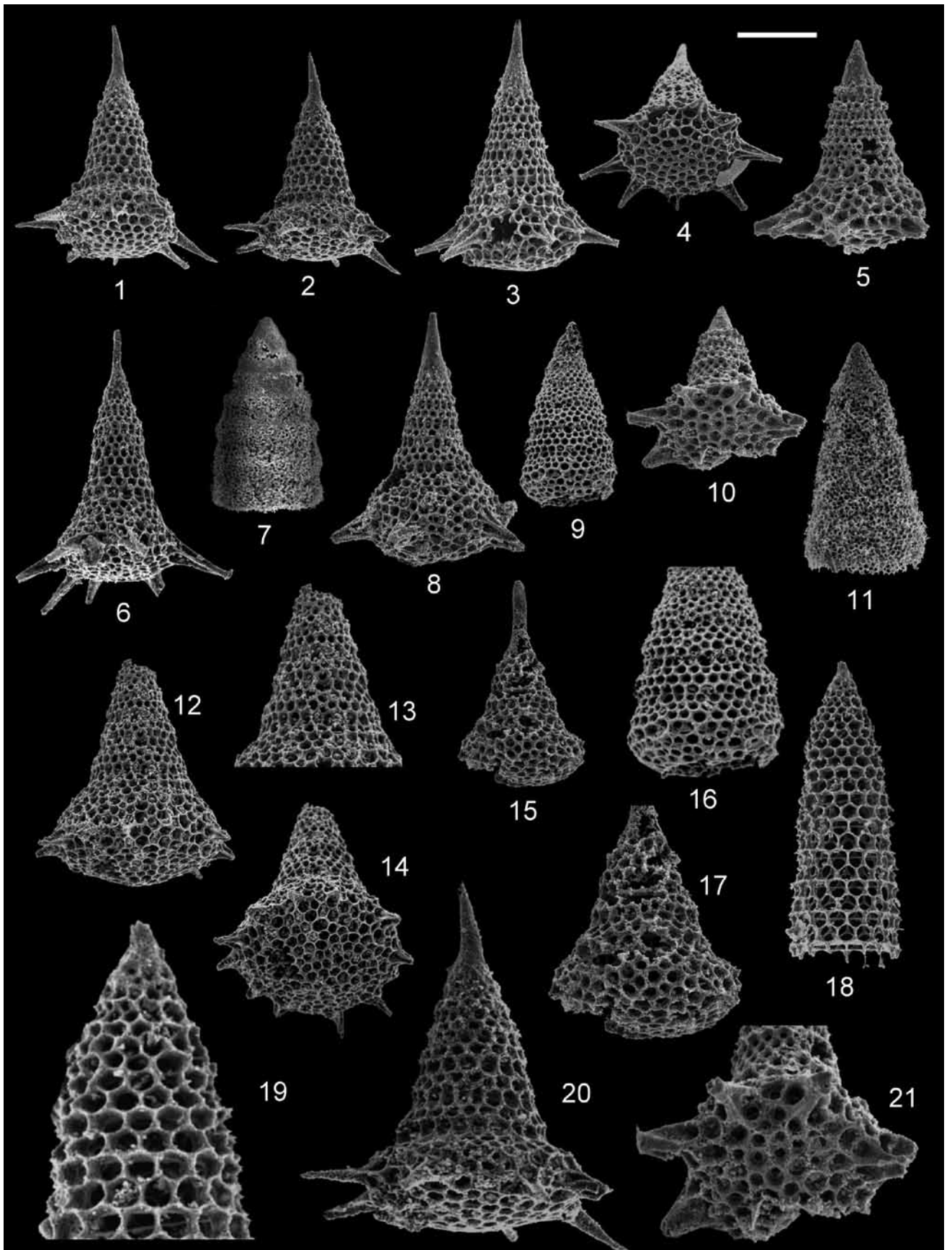


## PLATE 11

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) nassellarians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

- |                  |  |        |
|------------------|--|--------|
| 1-4, 6, 8,<br>20 | <b><i>Canelonus reliquus</i></b> Yeh and Pessagno, n. sp.<br>1-2, 20, Holotype, NMNS547372, scales=100, 100 and 55µm,<br>respectively, OR501B. 3-4, 6, 8, Paratypes, NMNS547373, scales=<br>100µm; 3-4, same specimen, OR501B; 6, 8, OR501A. | (P.85) |
| 5, 10, 21        | <b><i>Canelonus</i></b> sp. A<br>Same specimen, scales=100, 100 and 63µm; OR501C.  | (P.86) |
| 7                | <b><i>Spongocapsula</i></b> sp. cf. <b><i>S. hooveri</i></b> Hull<br>Scale=100µm. OR501C.  | (P.75) |
| 9, 16            | <b><i>Canelonus</i></b> sp. cf. <b><i>C. conus</i></b> Hull<br>Same specimen, scales=100 and 62µm, respectively. OR501B.   | (P.85) |
| 11               | <b><i>Spongocapsula</i></b> sp. aff. <b><i>S. palmerae</i></b> Pessagno<br>Scale=100µm. OR501B.  | (P.76) |
| 12-14            | <b><i>Canelonus</i></b> sp. B<br>Scales=100, 84 and 100µm, respectively. OR501A.   | (P.86) |
| 15, 17           | <b><i>Canelonus</i></b> sp. C<br>Same specimen, scales=100 and 65µm; OR501C.   | (P.86) |
| 18-19            | <b><i>Triversus fastigatus</i></b> Hull<br>Same specimen, scales=100 and 43µm; OR501C.   | (P.65) |

PLATE 11

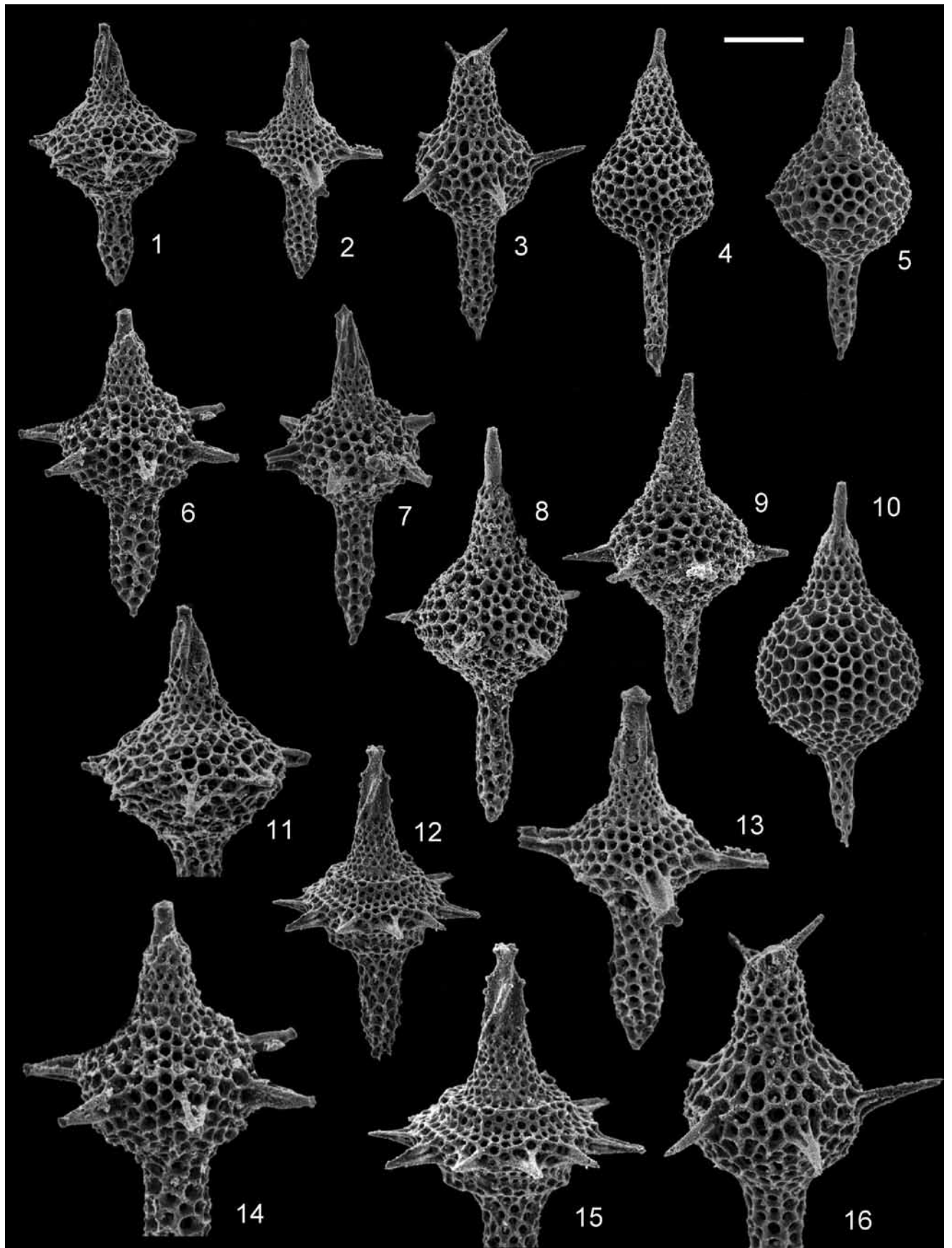


## PLATE 12

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) nassellarians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

- |          |   |        |
|----------|---|--------|
| 1, 11    | <b><i>Podobursa</i></b> sp. A<br>Same specimen, scales = 100 and 74µm, respectively; OR501A.  | (P.77) |
| 2, 7, 13 | <b><i>Podobursa</i></b> sp. B<br>Scales = 100, 100 and 63µm, respectively; OR501C. 1, 13, Same specimen.                              | (P.77) |
| 3, 16    | <b><i>Podobursa</i></b> sp. cf. <b><i>P. tetrastyla</i></b> (Steiger)<br>Same specimen, scales = 100 and 66µm, respectively; OR501B.  | (P.77) |
| 4        | <b><i>Podobursa lata</i></b> (Yang)<br>Scale = 100µm. OR501C.   | (P.76) |
| 5, 10    | <b><i>Podobursa tamanensis</i></b> (Yang)<br>Scales = 100µm. OR501B.  | (P.77) |
| 6, 14    | <b><i>Podobursa</i></b> sp. cf. <b><i>P. polyacantha</i></b> (Fischli)<br>Same specimen, scales = 100 and 76µm, respectively; OR501C. | (P.77) |
| 8-9      | <b><i>Podobursa</i></b> sp. cf. <b><i>P. basilica</i></b> Hull<br>Scales = 100µm. OR501C.   | (P.76) |
| 12, 15   | <b><i>Podobursa helvetica</i></b> (Rüst)<br>Same specimen, scales = 100 and 75µm, respectively, OR501B.                               | (P.76) |

PLATE 12

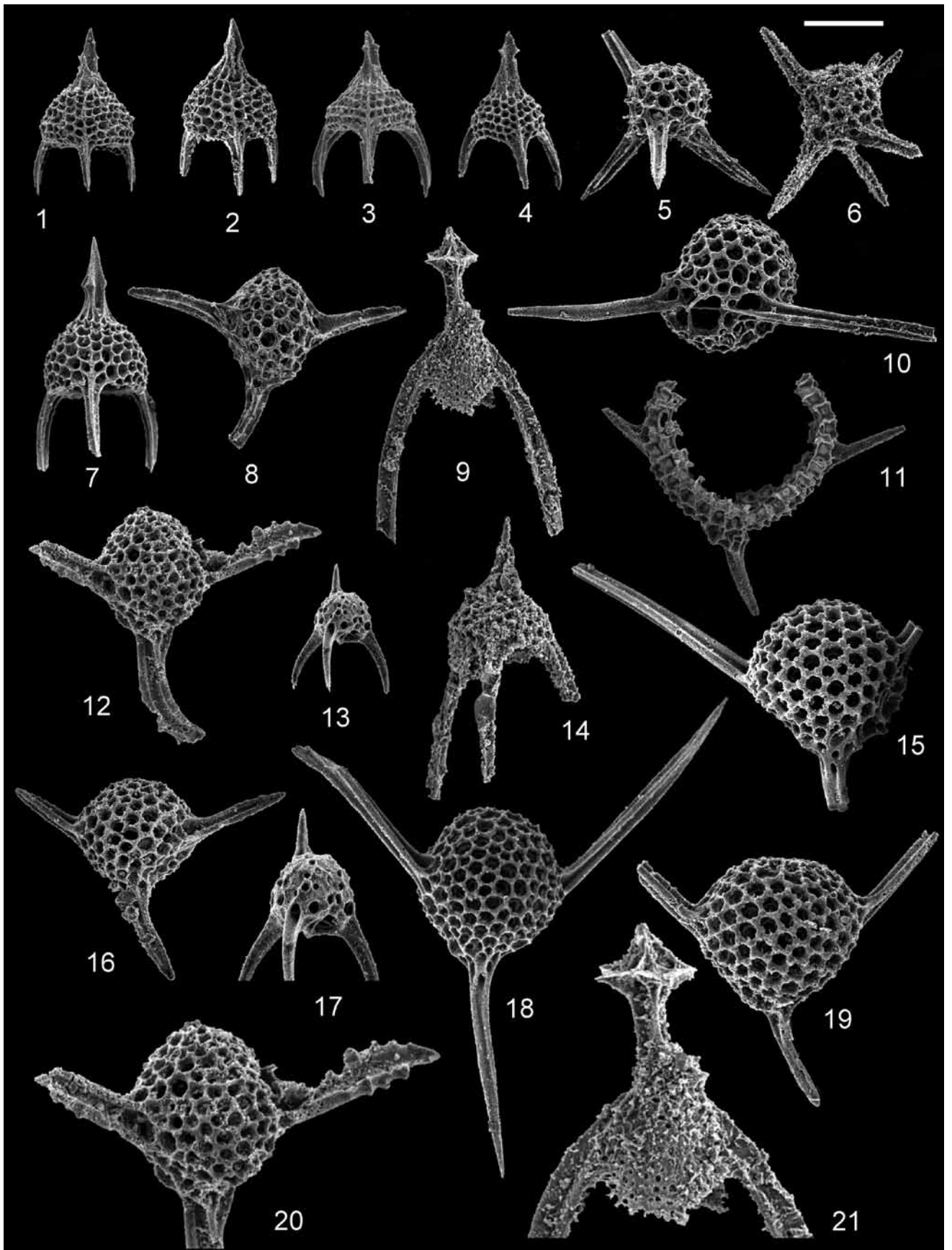


## PLATE 13

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) nassellarians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

1-2, 7	<i>Napora antelopensis</i> Pessagno, Whalen and Yeh Scales = 100µm. 1, 6, OR501B; 2, OR501C.	(P.81)
3-4	<i>Napora</i> sp. cf. <i>N. parva</i> Takemura Scale = 100µm. OR501C.	(P.81)
5	<i>Pseudopoulpus</i> sp. A Scale = 100µm. OR501C.	(P.79)
6	<i>Pseudopoulpus</i> sp. B Scale = 100µm; OR501B.	(P.79)
8	<i>Turanta morinae</i> Pessagno and Blome Scale = 100µm. OR501C.	(P.80)
9, 21	<i>Napora</i> (?) sp. A. Same specimen. scales = 100 and 50µm, respectively; OR501B.	(P.81)
10	<i>Turanta</i> sp. A Scale = 100µm; OR501B.	(P.80)
11	<i>Turanta lupheri</i> Pessagno and Blome Scale = 100µm; OR501B.	(P.80)
12, 20	<i>Turanta ancoriformis</i> Takemura Scales = 100 and 73µm, respectively; OR501C.	(P.80)
13, 17	<i>Saitoum</i> sp. A Scales = 100 and 45µm, respectively; OR501B.	(P.75)
14	<i>Napora izeensis</i> Pessagno, Whalen and Yeh Scale = 100µm. OR501A.	(P.81)
15, 19	<i>Turanta nodosa</i> Pessagno and Blome Scales = 100µm; OR501A, C.	(P.80)
18	<i>Turanta capsensis</i> Pessagno and Blome Scale = 100µm; OR501B.	(P.79)

PLATE 13

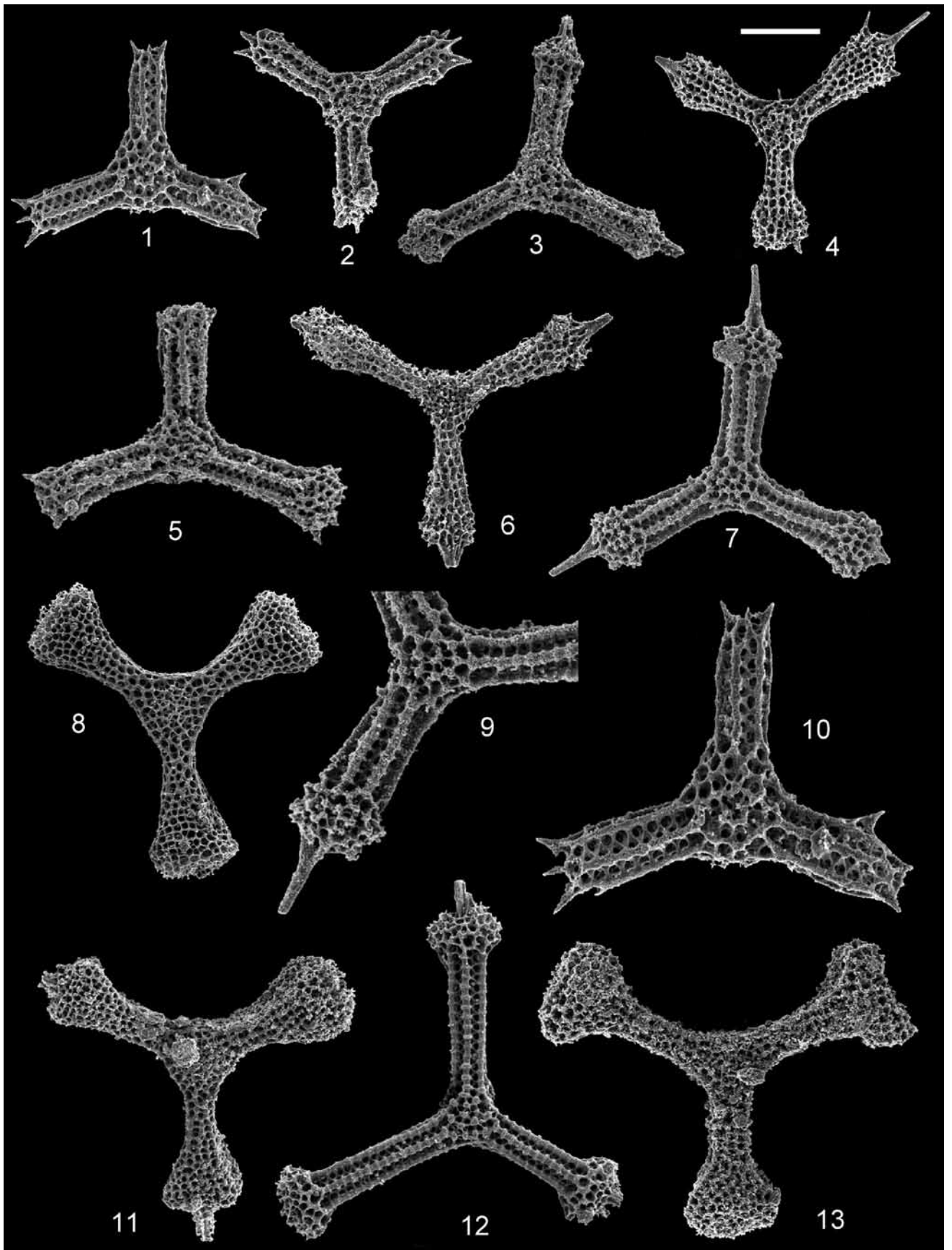


## PLATE 14

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) spumellarians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

- |            |   |         |
|------------|---|---------|
| 1-2, 5, 10 | <b><i>Tritrabs brevitrabs</i></b> Yeh and Pessagno, n. sp.<br>1, 10, Holotype, USNM547382, scales = 100 and 67µm, respectively;<br>OR501A. 2, 5, Paratype, USNM547383, scales = 100µm; OR501A, C. | (P.100) |
| 3, 7, 9    | <b><i>Tritrabs simplex</i></b> Kito and Dewever<br>Scales = 100, 100 and 83m, respectively; 3, OR501A; 7, 9, same<br>specimen, OR501B.  | (P.100) |
| 4          | <b><i>Paronaella</i></b> sp. A<br>Scale = 100µm; OR501C.  | (P.90)  |
| 6          | <b><i>Paronaella</i></b> sp. B<br>Scale = 100µm; OR501A.  | (P.90)  |
| 8, 11, 13  | <b><i>Angulobracchia</i></b> sp. cf. <i>A. bulbosa</i> Hull<br>Scales = 100µm; 8, OR501A. 11, 13, OR501B.   | (P.88)  |
| 12         | <b><i>Tritrabs worzeli</i></b> (Pessagno)<br>Scale = 100µm; OR501B.   | (P.100) |

PLATE 14

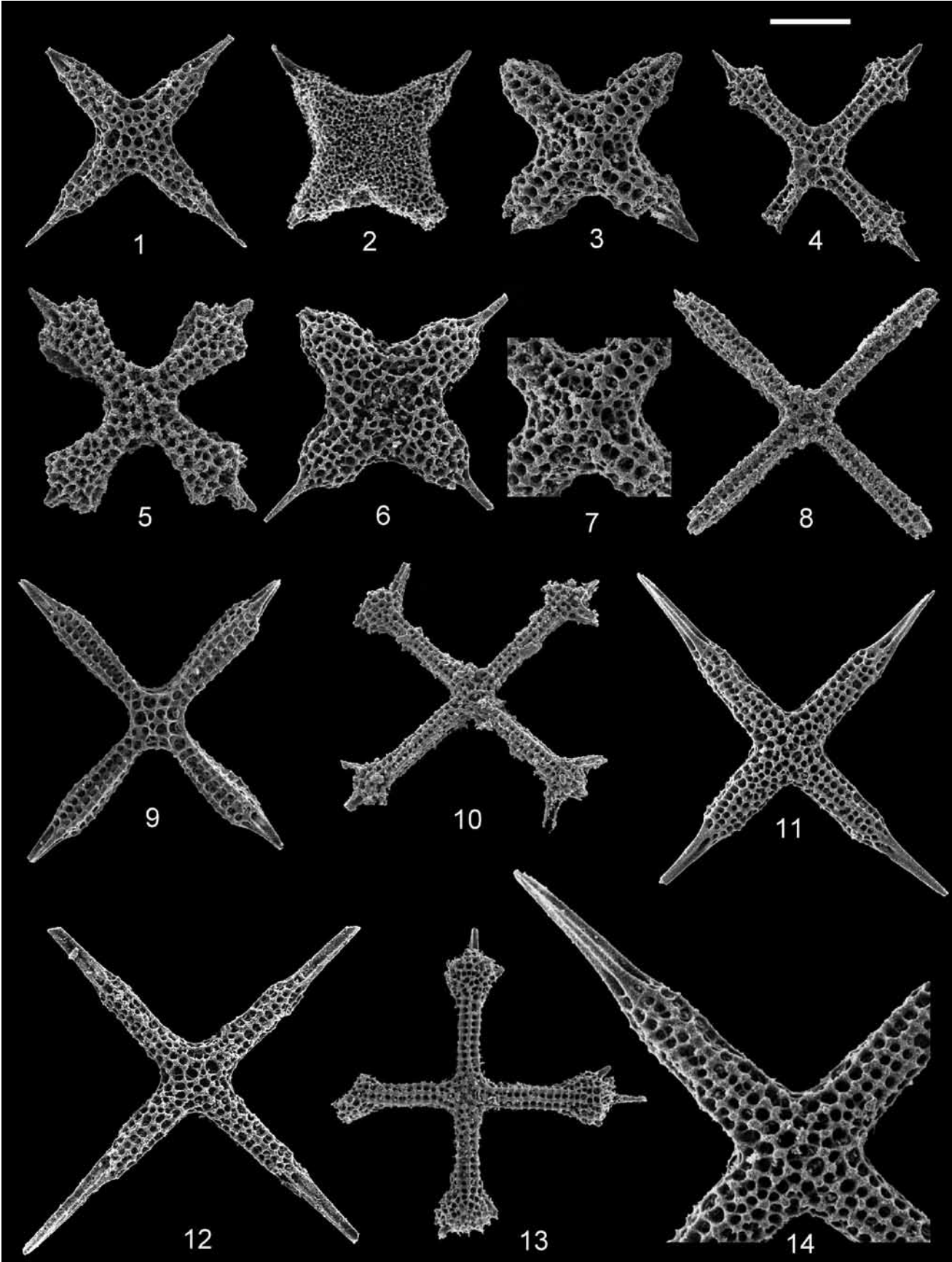


## PLATE 15

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) spumellarians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

- |           |   |        |
|-----------|---|--------|
| 1         | <i>Pseudocrucella acutusspina</i> (Yeh)<br>Scale = 100µm; OR501C.   | (P.98) |
| 2         | <i>Crucella</i> sp. cf. <i>C. theokaftensis</i> Baumgartner<br>Scale = 100µm; OR501B.   | (P.88) |
| 3, 7      | <i>Higumastra</i> sp. A<br>Scales = 100 and 86µm, respectively; OR501C.   | (P.97) |
| 4, 10, 13 | <i>Tetraditryma pseudoplena</i> Baumgartner<br>Scales = 100µm; 4, 10, OR501C; 13, OR501B.   | (P.98) |
| 5         | <i>Pseudocrucella</i> sp. A<br>Scale = 100µm; OR501B.   | (P.98) |
| 6         | <i>Crucella beata</i> (Yeh)<br>Scale = 100µm; OR501C.   | (P.88) |
| 8         | <i>Tetraditryma coldspringensis</i> (Pessagno, Blome and Hull)<br>Scale = 100µm; OR501B.  | (P.98) |
| 9         | <i>Tetraditryma corralitosensis</i> (Pessagno)<br>Scale = 100µm; OR501B.  | (P.99) |
| 11-12, 14 | <i>Pseudocrucella longabracchia</i> Yeh and Pessagno, n. sp.<br>11, 14, Holotype, USNM USNM547380, scales = 100 and 55µm, respectively; OR501B. 12, Paratype, USNM USNM547381, scale = 100µm; OR501B. | (P.98) |

PLATE 15

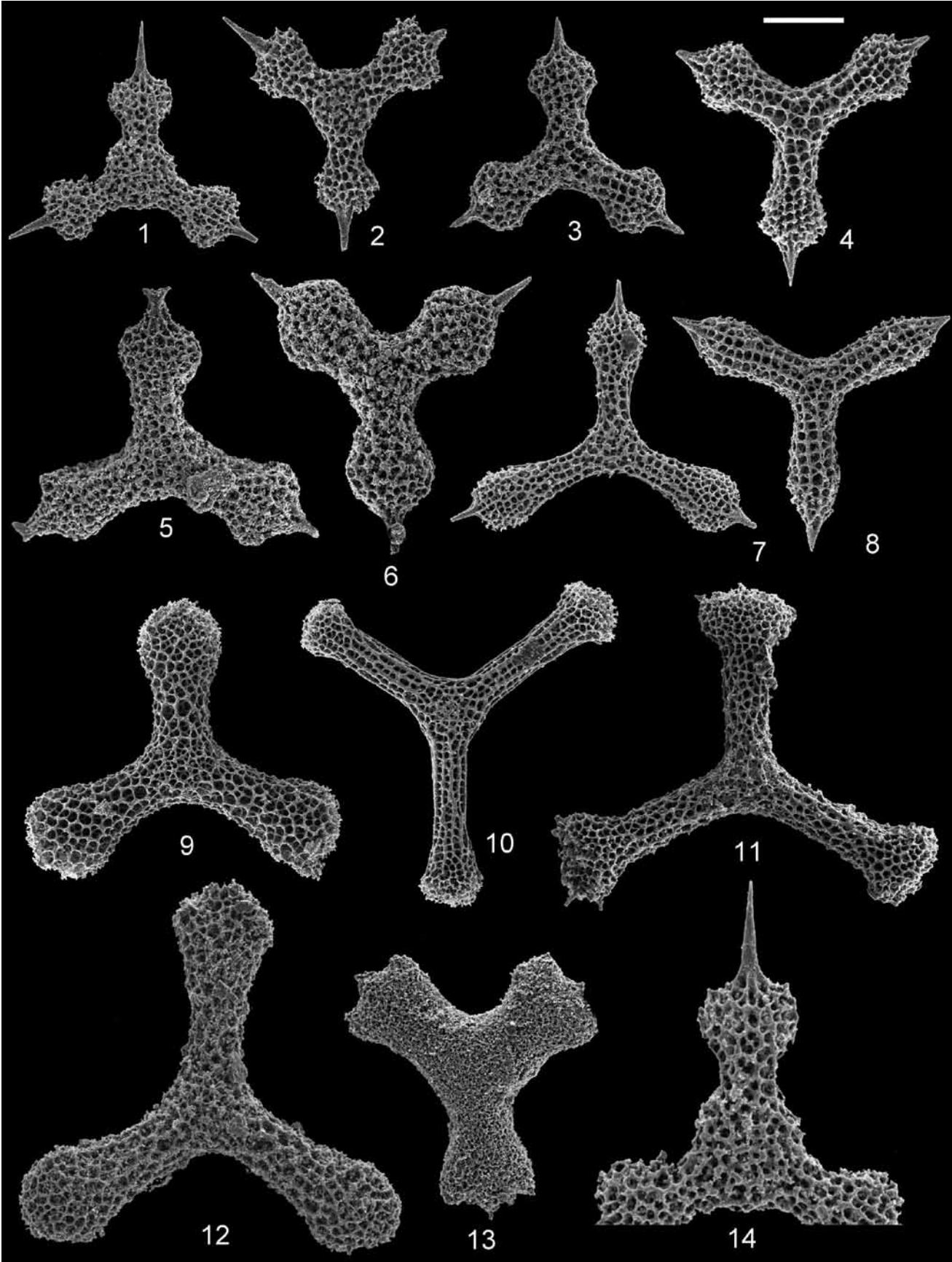


## PLATE 16

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) spumellarians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

- |         |   |         |
|---------|---|---------|
| 1-2, 14 | <b><i>Paronaella bullata</i></b> Yeh and Pessagno, n. sp.<br>1, 10, Holotype, USNM547388 , scales = 100 and 65 $\mu$ m, respectively;<br>OR501A. 2, Paratype, USNM547389, scale = 100 $\mu$ m; OR501 C. | (P.89)  |
| 3       | <b><i>Paronaella grahamensis</i></b> Carter<br>Scale = 100 $\mu$ m; OR501B.   | (P.89)  |
| 4, 8    | <b><i>Homoeoparonaella</i></b> sp. aff. <b><i>H. elegans</i></b> (Pessagno)<br>Scales = 100 $\mu$ m; OR501B.  | (P.107) |
| 5       | <b><i>Paronaella bandyi</i></b> Pessagno<br>Scale = 100 $\mu$ m; OR501B.  | (P.88)  |
| 6       | <b><i>Paronaella</i></b> sp. C<br>Scale = 100 $\mu$ m; OR501B.  | (P.89)  |
| 7       | <b><i>Homoeoparonaella elegans</i></b> (Pessagno)<br>Scale = 100 $\mu$ m; OR501B.   | (P.107) |
| 9, 12   | <b><i>Paronaella</i></b> sp. D<br>Scales = 100 $\mu$ m; OR501B.   | (P.90)  |
| 10      | <b><i>Paronaella</i></b> sp. cf. <b><i>P. kotura</i></b> Baumgartner<br>Scale = 100 $\mu$ m; OR501B.  | (P.89)  |
| 11      | <b><i>Paronaella kotura</i></b> Baumgartner<br>Scale = 100 $\mu$ m; OR501B.   | (P.89)  |
| 13      | <b><i>Paronaella</i></b> sp. E<br>Scale = 100 $\mu$ m; OR501B.  | (P.90)  |

PLATE 16

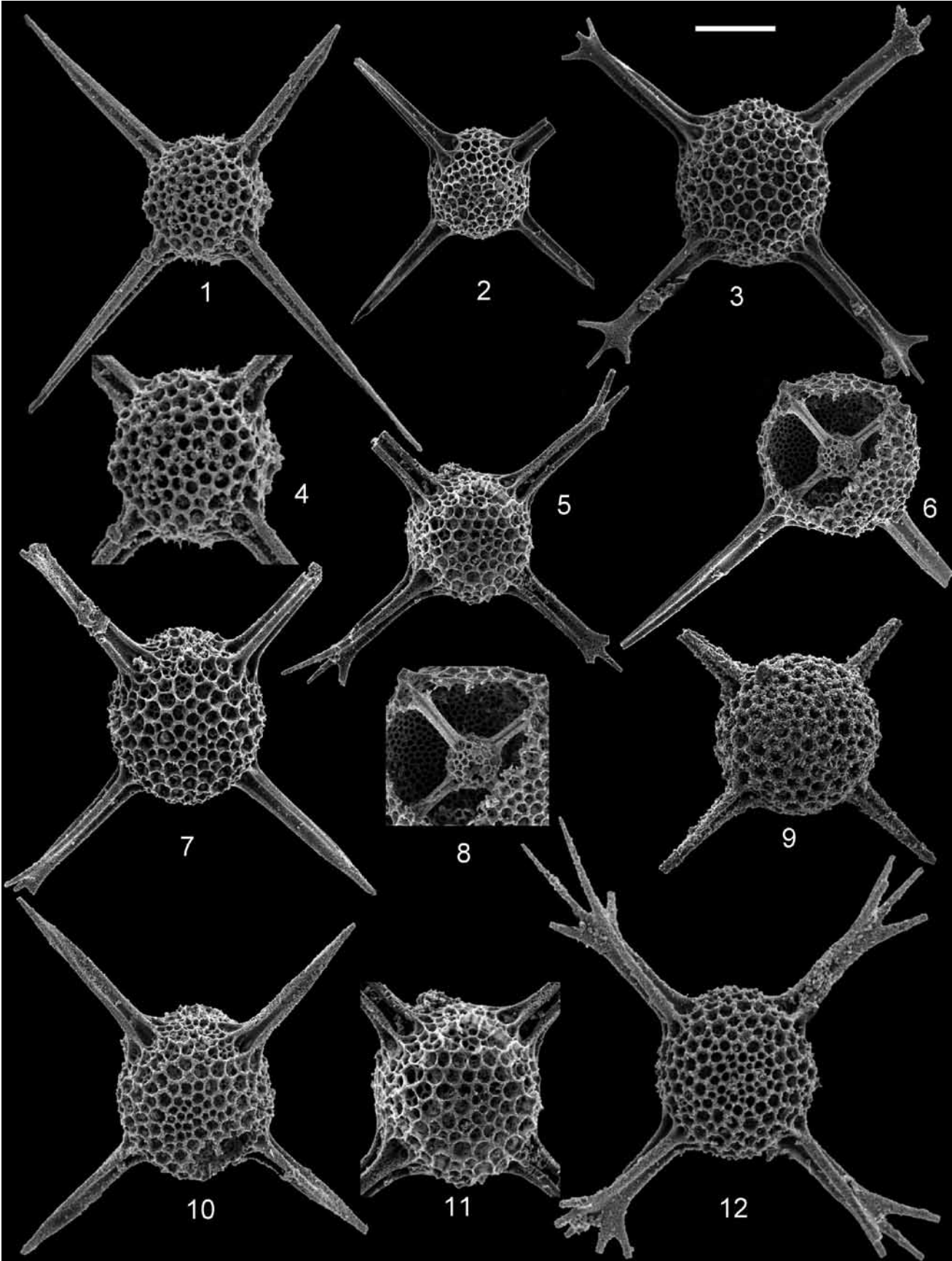


## PLATE 17

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) spumellarians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

- |                   |  |        |
|-------------------|--|--------|
| 1, 4              | <p><i>Tympaneides</i> sp. cf. <i>T. charlottensis</i> Carter<br/>Same specimen, scales = 100 and 72µm, respectively; OR501B.</p>   | (P.92) |
| 2, 5, 11          | <p><i>Tympaneides</i> sp. aff. <i>T. magnacista</i> Yeh and Pessagno, n. sp.<br/>Scales = 100µm; 6, OR501B; 8, OR501A.</p>   | (P.92) |
| 3, 6-8, 10,<br>12 | <p><i>Tympaneides magnacista</i> Yeh and Pessagno, n. sp.<br/>3, Holotype, USNM547376, scale = 100µm; OR501B. 7, 10, 12, Paratypes, USNM547377, scales = 100µm; OR501B. 6, 8, A broken specimen showing internal structure. 7, A specimen has a test with simple tapering spine and also with finger-like projections spinal tips present at other spines.</p> | (P.92) |
| 9                 | <p><i>Tympaneides</i> sp. A<br/>Scale = 100µm; OR501B.</p>   | (P.92) |

PLATE 17

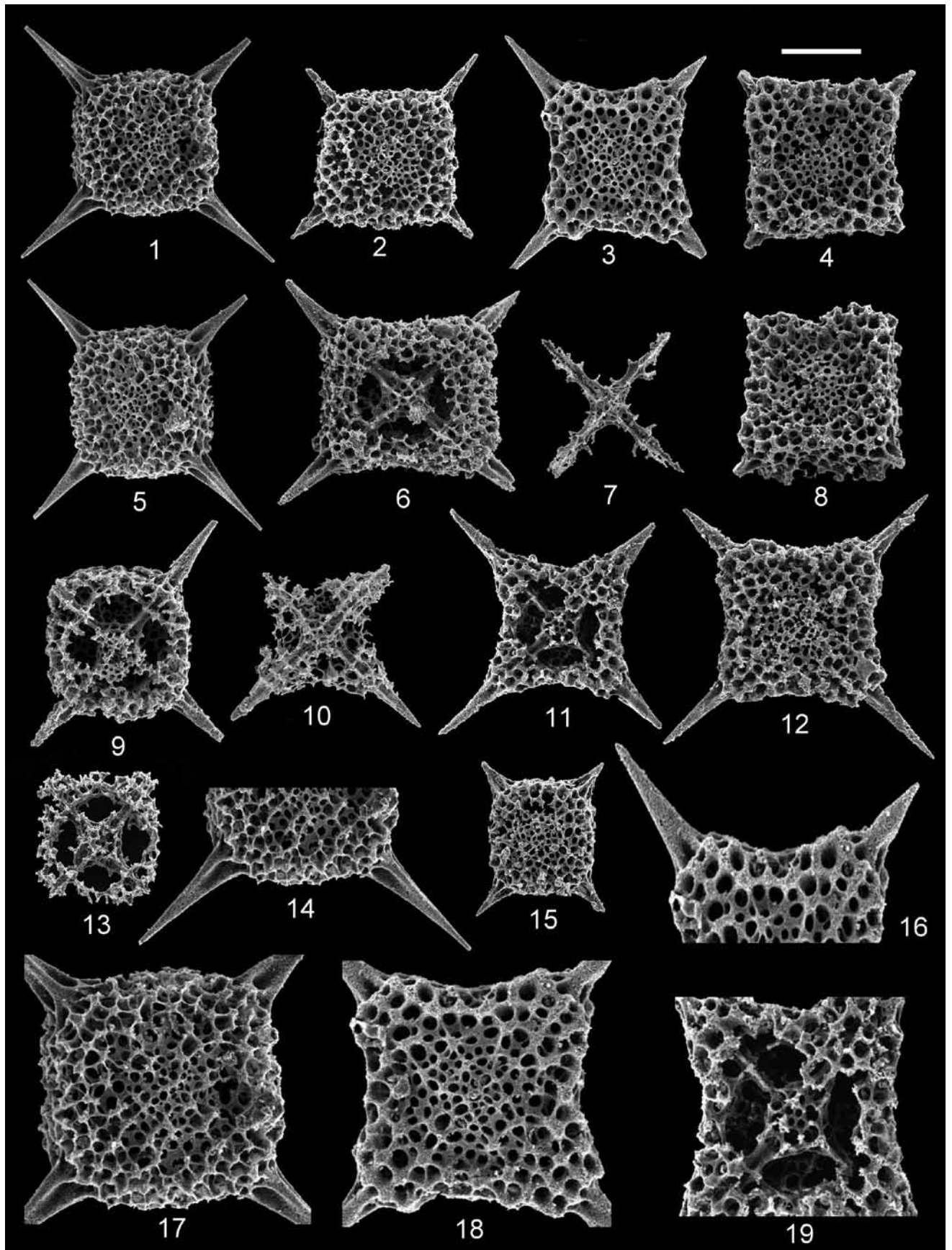


## PLATE 18

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) spumellarians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

- |                                   |   |        |
|-----------------------------------|---|--------|
| 1-2, 5, 9,<br>13-15, 17           | <b><i>Secretacapsa bathonia</i></b> Yeh and Pessagno, n. sp.<br>1, 5, 14, 17, Holotype, USNM547396, scales=100, 100, 76 and 60µm, respectively; OR501B. 2, 15, paratypes, USNM547397, same specimen showing internal structure, Scales=100µm; OR501C.   | (P.94) |
| 3-4, 6, 8,<br>10-12, 16,<br>18-19 | <b><i>Secretacapsa acanata</i></b> Yeh and Pessagno, n. sp.<br>3, 16, 18, Holotype, USNM 547394 , scales= 100, 100, 67 and 60µm, respectively; OR501B. 4, 8, 12, paratypes, USNM547395, scales= 100µm; 4, 8, same specimen, OR501B; 12, OR501C. 10-11, 19, Two broken specimens showing internal structure and two layers of medullary shells; scales=100, 100 and 60µm, respectively; 10, OR501C; 11, 19, same specimen, | (P.94) |
| 7                                 | <b><i>Secretacapsa</i></b> sp.<br>Scale= 100µm; OR501B.   | (P.93) |

PLATE 18

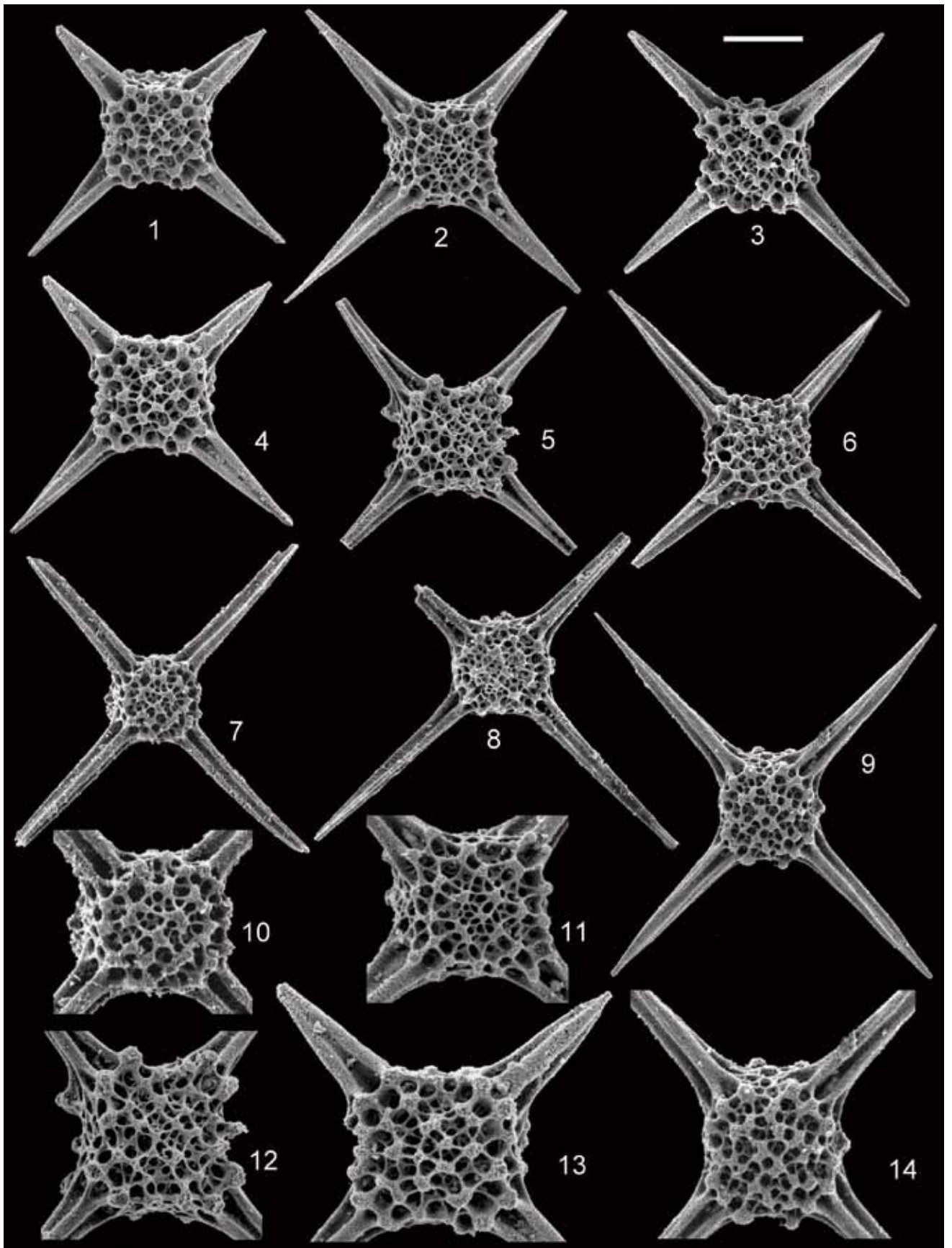


## PLATE 19

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) spumellarians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

- |                      |   |        |
|----------------------|---|--------|
| 1, 4, 13             | <i>Emiluvia validia</i> Yeh and Pessagno, n. sp.<br>Holotype, USNM547392, scales=100, 100 and 40 $\mu$ m, respectively;<br>OR501B.                                    | (P.95) |
| 2 - 3 , 5 ,<br>11-12 | <i>Emiluvia validia</i> Yeh and Pessagno, n. sp.<br>Paratypes, USNM547393, scales=100, 100, 100, 68 and 68 $\mu$ m,<br>respectively; OR501B.                          | (P.95) |
| 6                    | <i>Emiluvia</i> sp. A<br>Scale=100 $\mu$ m; OR501B.   | (P.96) |
| 7-10, 14             | <i>Emiluvia delicata</i> Yeh and Pessagno, n. sp.<br>7-8, 10, Paratypes, USNM547391; 9, 14, Holotype, USNM547390,<br>scales=100 and 71 $\mu$ m, respectively; OR501B. | (P.94) |

PLATE 19

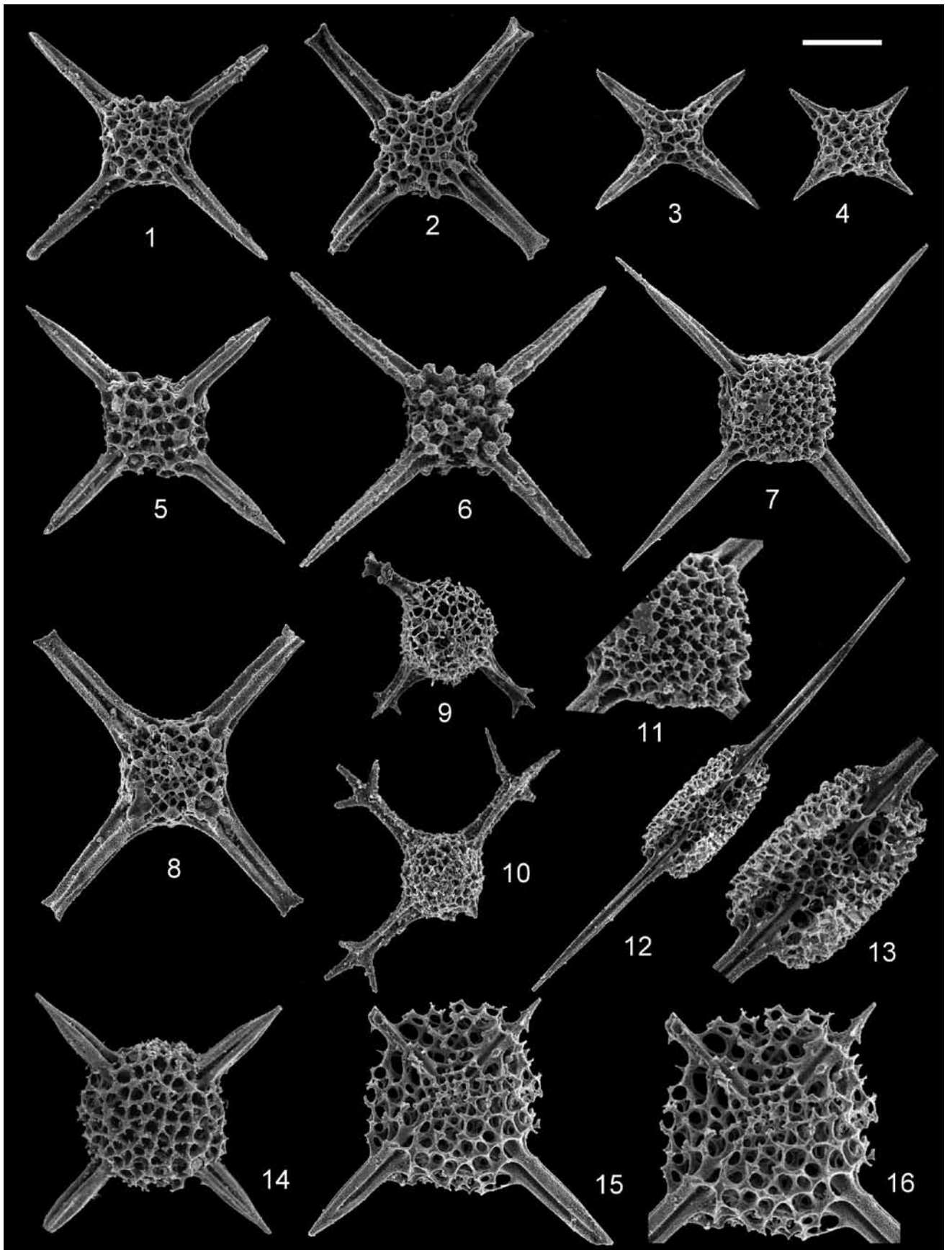


## PLATE 20

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) spumellarians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

- |          |   |         |
|----------|---|---------|
| 1        | <i>Emiluvia parvinodosa</i> Yeh<br>Scale = 100µm, OR501B.   | (P.95)  |
| 2, 8     | <i>Emiluvia</i> sp. cf. <i>E. hopsoni</i> Pessagno<br>Scales = 100µm, OR501B.   | (P.95)  |
| 3        | <i>Emiluvia nana</i> Baumgartner<br>Scale = 100µm, OR501A.  | (P.95)  |
| 4        | <i>Emiluvia</i> sp. cf. <i>E. oregonensis</i> Yeh<br>Scale = 100µm, OR501B.   | (P.95)  |
| 5, 14-16 | <i>Udalia</i> (?) sp. B<br>Scales = 100, 100, 100 and 82µm, respectively; 5, a juvenile form with only inner layer of cortical shell, OR501B; 15-16, same specimen, OR501B. | (P.95)  |
| 6        | <i>Emiluvia kozuri</i> Yeh<br>Scale = 100µm; OR501C.  | (P.95)  |
| 7, 11-13 | <i>Udalia</i> sp. A<br>Scales = 100, 69, 100 and 54µm, respectively; OR501B. 7, 11, same specimen; 12-13, same specimen, a broken specimen showing medullary shells.        | (P.99)  |
| 9        | Spumelaria gen. et sp. indet. A<br>Scale = 100µm, OR501A.   | (P.112) |
| 10       | Spumelaria gen. et sp. indet. B<br>Scale = 100µm, OR501B.   | (P.113) |

PLATE 20

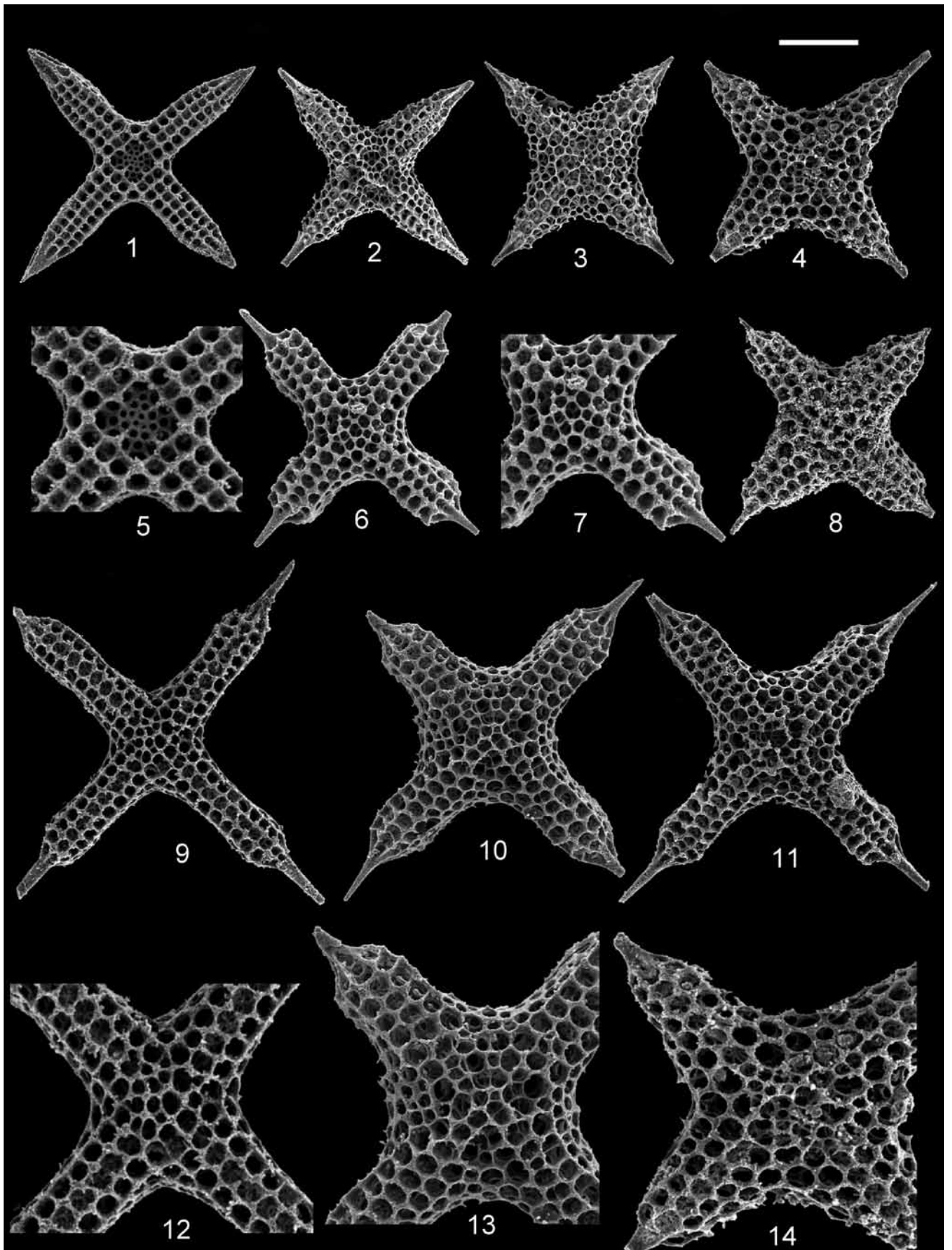


## PLATE 21

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) spumellarians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

- |           |  |        |
|-----------|--|--------|
| 1, 5      | <b><i>Higumastra angustabraccia</i></b> Yeh<br>Scales = 100 and 53 $\mu$ m, respectively; same specimen, OR501B.   | (P.96) |
| 2-3       | <b><i>Higumastra</i></b> sp. B<br>Scale = 100 $\mu$ m; OR501B.   | (P.97) |
| 4, 8, 14  | <b><i>Higumastra</i></b> sp. C<br>Scales = 100, 100 and 57 $\mu$ m, respectively; OR501B.  | (P.97) |
| 6-7       | <b><i>Higumastra exigua</i></b> Yeh<br>Scales = 100 and 81 $\mu$ m, respectively; OR501B.  | (P.96) |
| 9, 12     | <b><i>Higumastra perfecta</i></b> Yeh and Pessagno<br>Holotype, USNM547378, scales = 100 and 63 $\mu$ m, respectively;<br>OR501B.                              | (P.97) |
| 10-11, 13 | <b><i>Higumastra</i></b> sp. aff. <b><i>H. exigua</i></b> Yeh<br>Scales = 100, 100 and 55 $\mu$ m, respectively; 10, 13, same specimen,<br>OR501B; 11, OR501A. | (P.97) |

PLATE 21

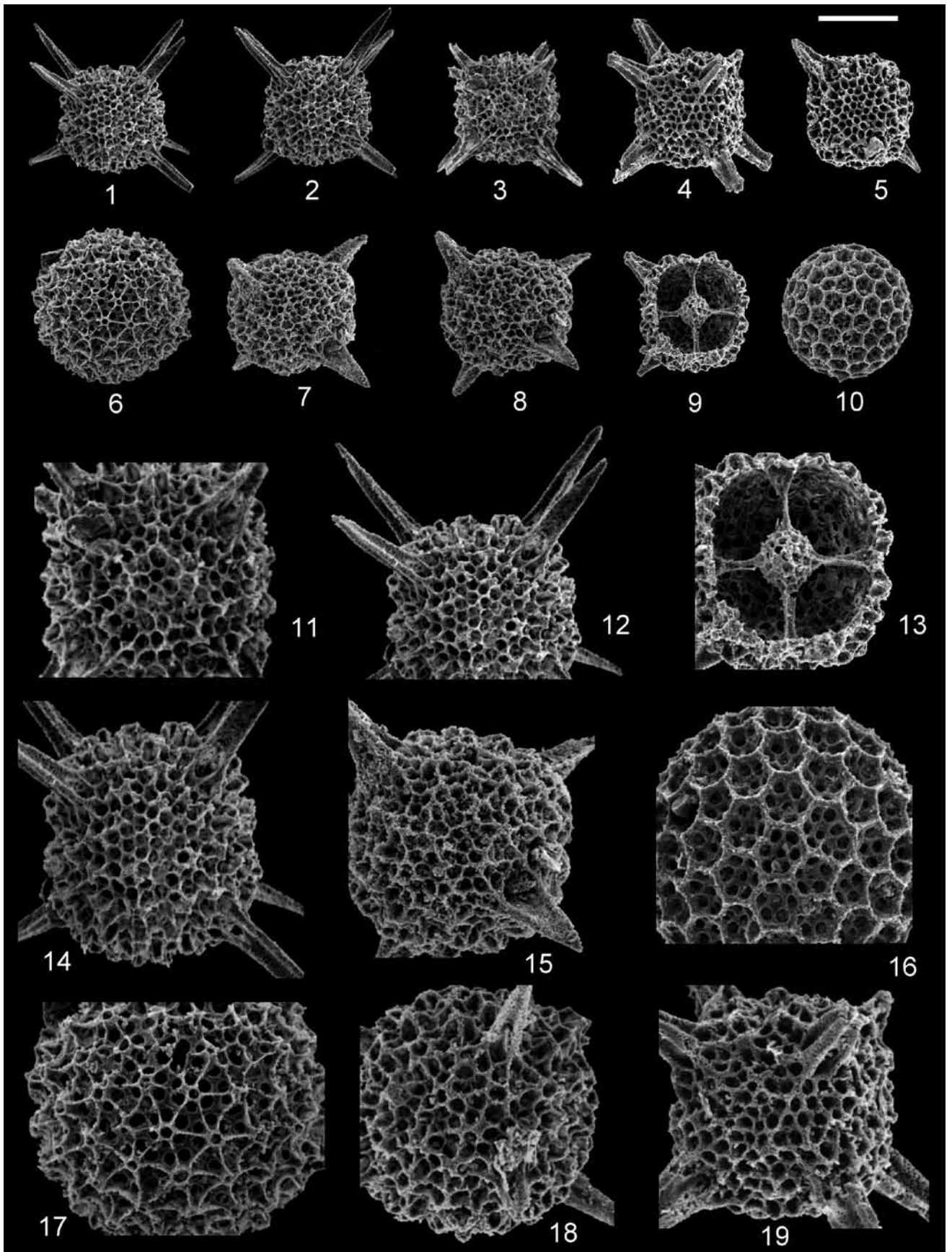


## PLATE 22

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) spumellarians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

- |                   |  |         |
|-------------------|--|---------|
| 1-3,<br>11-12, 14 | <b><i>Tappanella fragilis</i></b> Yeh and Pessagno, n. sp.<br>1-2, 12, 14, Holotype, USNM547384, scales = 100, 100, 63 and 50 $\mu$ m,<br>respectively; OR501B. 3, 11, Paratype, USNM547385, scales = 100<br>and 44 $\mu$ m. OR501A. | (P.101) |
| 4-5, 9, 13,<br>19 | <b><i>Tappanella novacubica</i></b> Hull<br>Scales = 100, 100, 100, 53 and 50 $\mu$ m, respectively; 4, 19, same<br>specimen; OR501C. 5, OR501C. 9, 13, Same specimen, OR501A.   | (P.102) |
| 6, 17             | <b><i>Leugo ordinarius</i></b> (Yang and Wang)<br>Scales = 100 and 52 $\mu$ m, respectively. Same specimen. OR501B.  | (P.103) |
| 7-8, 15           | <b><i>Leugeo</i></b> sp. cf. <b><i>L. hullae</i></b> Yeh<br>Same specimen, scales = 100, 100 and 58 $\mu$ m, respectively; OR501B.   | (P.103) |
| 10, 16            | Helenid gen. et sp. indet.<br>Scales = 100 and 44 $\mu$ m, respectively; OR501B.   | (P.103) |

PLATE 22

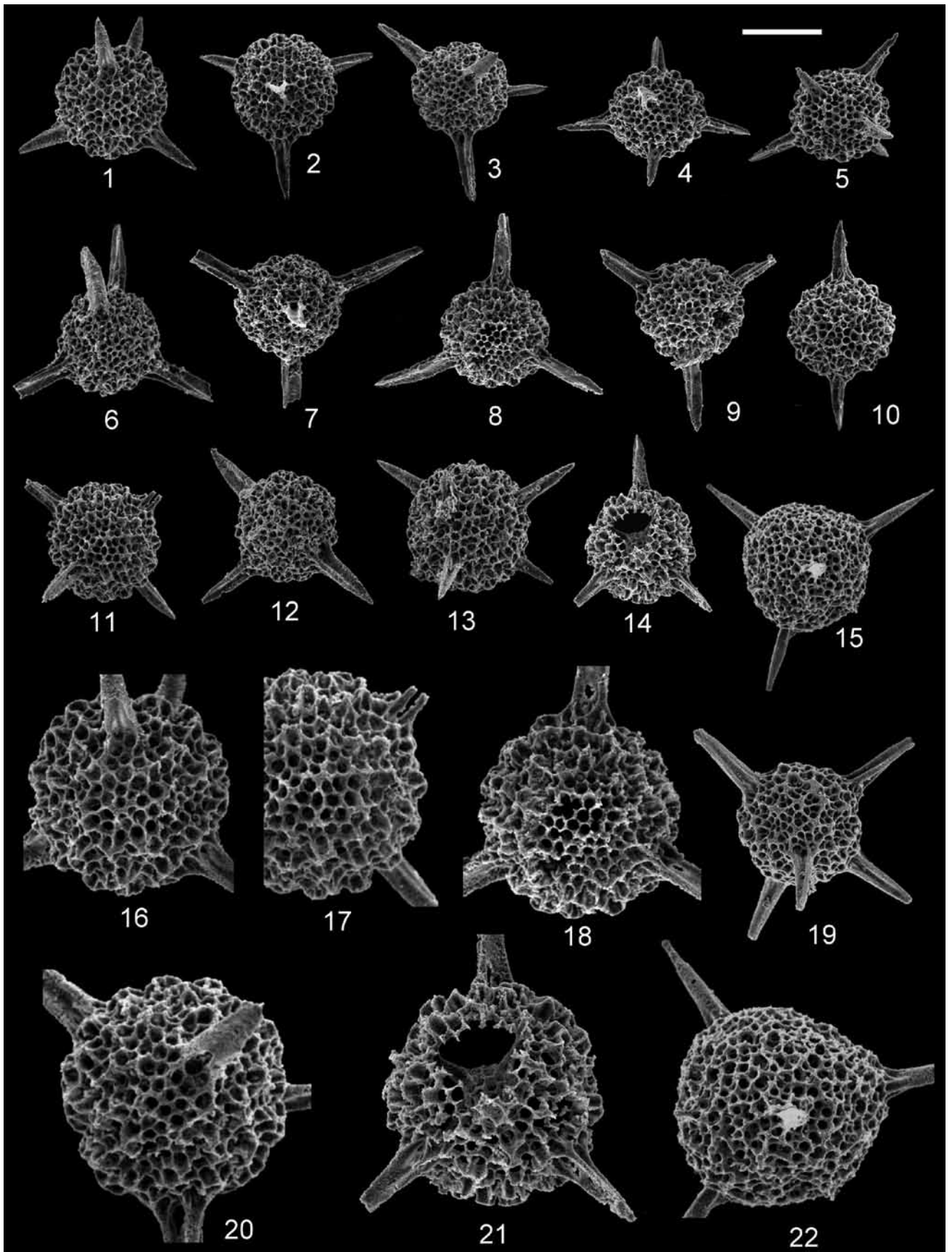


## PLATE 23

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) spumellarians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

- |                                  |   |         |
|----------------------------------|---|---------|
| 1-3, 6-7,<br>11-12,<br>16-17, 20 | <b><i>Tappanella imlayi</i></b> Yeh and Pessagno, n. sp.<br>1-3, 16, 20, Holotype, USNM 547386, scales=100, 100, 100,<br>57 and 43 $\mu$ m, respectively; OR501C. 6-7, 11-12, 17, paratypes,<br>USNM547387, scales=100, 100, 100, 100 and 48 $\mu$ m, respectively;<br>6-7, same specimen; note that two pairs of spines present at two<br>diagonal positions of top and bottom surfaces; OR501C. | (P.102) |
| 4-5, 13                          | <b><i>Tappanella</i></b> sp. cf. <b><i>T. imlayi</i></b> Yeh and Pessagno, n. sp.<br>Scales=100 $\mu$ m; 4-5, same specimen; OR501C.  | (P.102) |
| 8-9, 14,<br>18, 21               | <b><i>Tappanella</i></b> sp. aff. <b><i>T. imlayi</i></b> Yeh and Pessagno, n. sp.<br>Scales=100, 100, 100, 54 and 50 $\mu$ m, respectively; OR501C. 8, 18,<br>same specimen; 14, 21, same specimen.  | (P.102) |
| 10                               | <b><i>Tappanella</i></b> sp. A<br>Scale=100 $\mu$ m, OR501C.  | (P.103) |
| 15, 22                           | Spumelaria gen. et sp. indet. C<br>Same specimen, Scales=100 and 60 $\mu$ m, respectively; OR501C.  | (P.113) |
| 19                               | <b><i>Leugeo</i></b> sp. A<br>Scale=100 $\mu$ m, OR501B.  | (P.103) |

PLATE 23

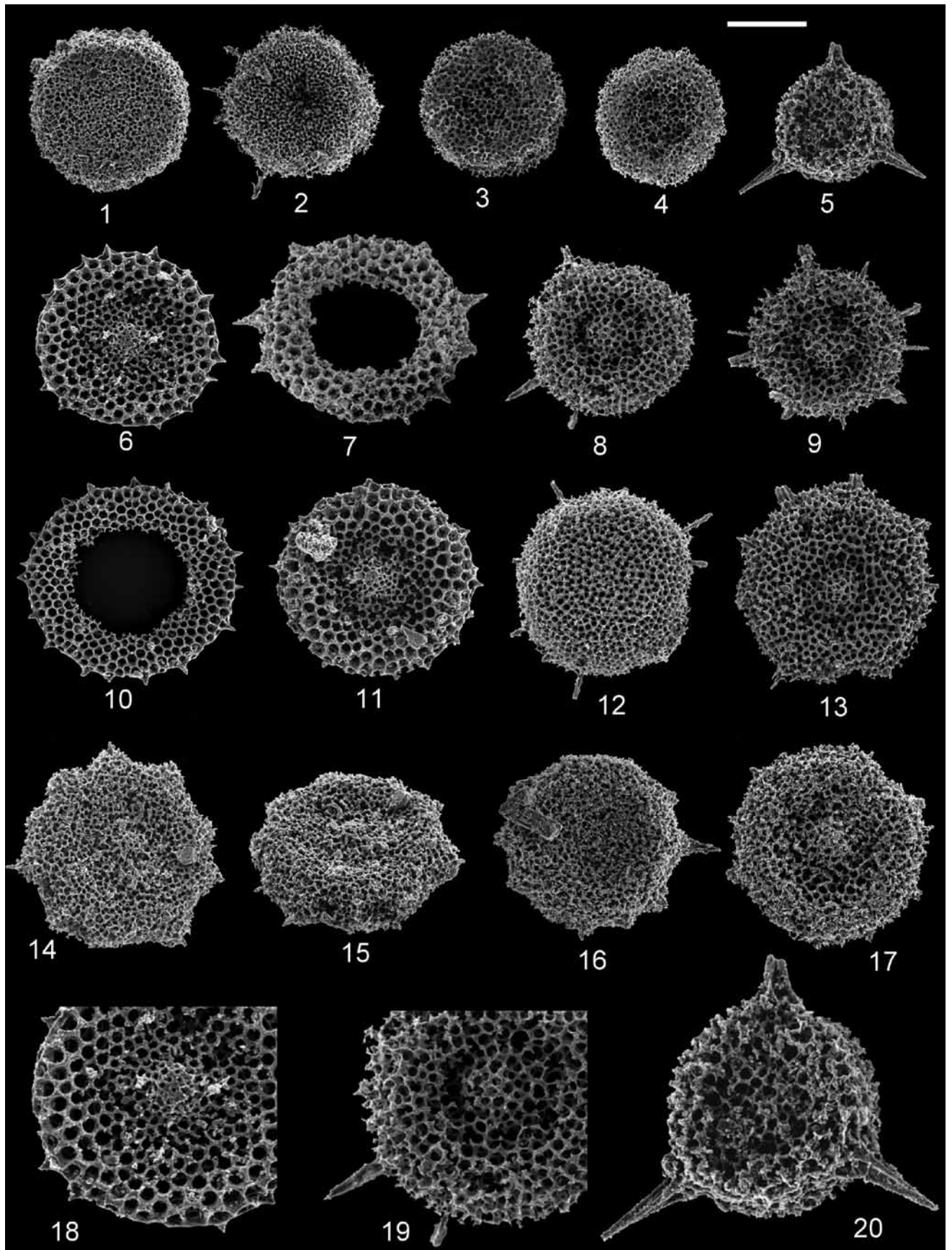


## PLATE 24

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) spumellarians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

- |             |  |         |
|-------------|--|---------|
| 1-2         | <b><i>Orbiculiforma incognita</i></b> Blome<br>Scales = 100µm; 1, OR501B; 2, OR501A.                                     | (P.104) |
| 3-4         | <b><i>Orbiculiforma librata</i></b> spira Yeh<br>Scales = 100µm. OR501A.   | (P.104) |
| 5, 20       | <b><i>Orbiculiforma trispina trispinula</i></b> Carter<br>Scales = 100 and 44µm, respectively; OR501B.                   | (P.104) |
| 6, 10, 18   | <b><i>Teichertus pessagnoii</i></b> Yeh<br>Scales = 100, 100 and 67µm, respectively. OR501C.                             | (P.112) |
| 7           | <b><i>Teichertus cavernosus</i></b> Hull<br>Scale = 100µm. OR501B.   | (P.112) |
| 8-9, 17, 19 | <b><i>Orbiculiforma santarota</i></b> Yeh<br>Scales = 100, 10, 100 and 57µm, respectively; OR501C. 8, 19, Same specimen. | (P.104) |
| 11          | <b><i>Teichertus heliotroapicus</i></b> (Baumgartner)<br>Scale = 100µm. OR501C.  | (P.104) |
| 12          | <b><i>Orbiculiforma densaora</i></b> Yeh<br>Scale = 100µm. OR501B.   | (P.104) |
| 13          | <b><i>Orbiculiforma</i></b> sp. aff. <b><i>O. hexagonaora</i></b> Yeh<br>Scale = 100µm. OR501C.                          | (P.104) |
| 14-16       | <b><i>Orbiculiforma</i></b> sp. A<br>Scales = 100µm; OR501B. 14-15, same specimen.                                       | (P.105) |

PLATE 24

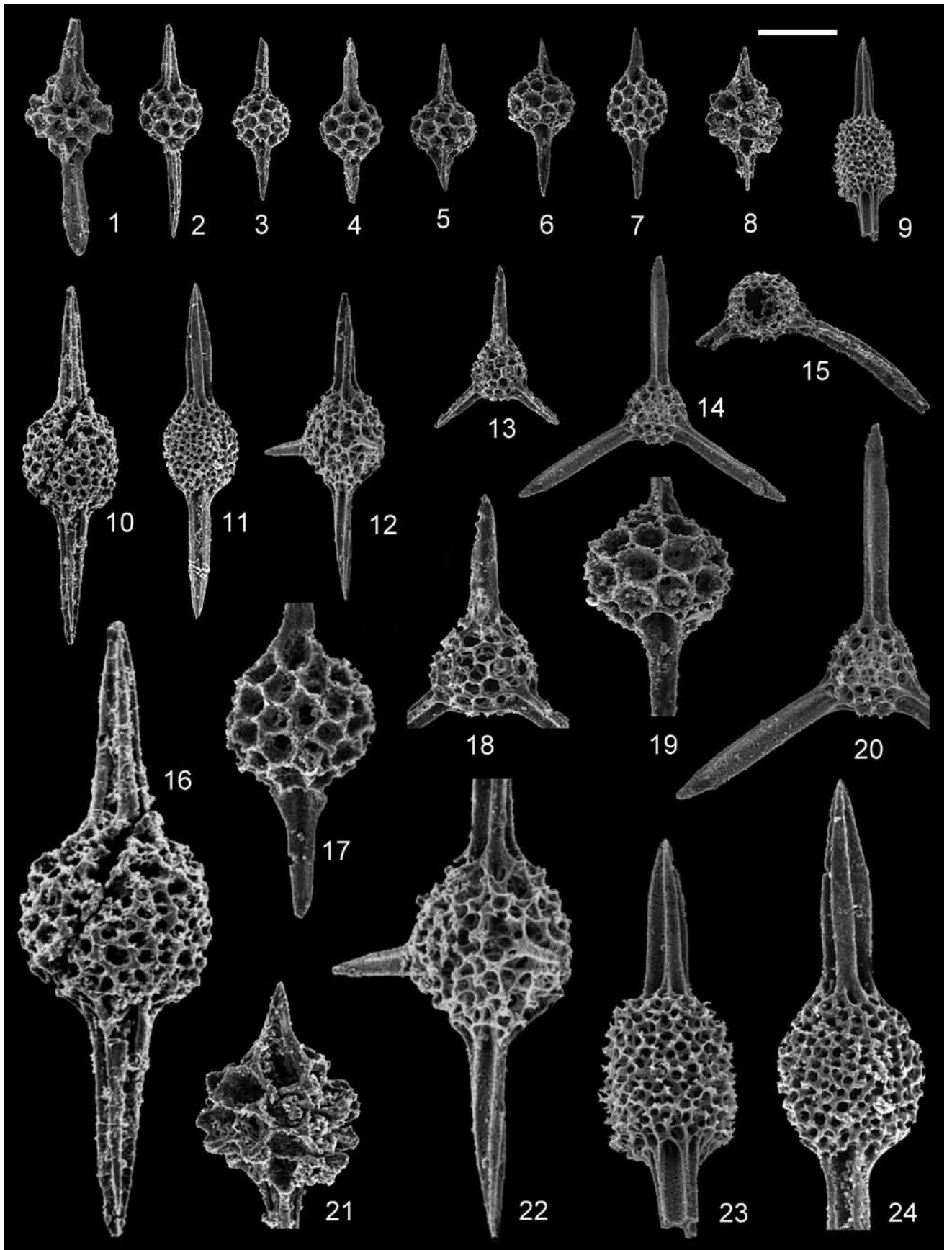


## PLATE 25

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) spumellarians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

- |        |  |         |
|--------|--|---------|
| 1      | <i>Zartus</i> sp. cf. <i>Z. thayeri</i> Pessagno and Blome<br>Scale = 100µm; OR501B.   | (P.106) |
| 2      | <i>Pantanellium sincerium</i> Pessagno and Blome<br>Scale = 100µm. OR501A.   | (P.106) |
| 3-5    | <i>Pantanellium ultrasincerium</i> Pessagno and Blome<br>Scales = 100µm; 3, OR501A; 4-5, OR501C.                                 | (P.106) |
| 6, 19  | <i>Pantanellium. foveatum</i> Mizutani and Kido<br>Scales = 100 and 45µm, respectively; OR501A.                                  | (P.105) |
| 7, 17  | <i>Pantanellium</i> sp. A<br>Scales = 100 and 41µm, respectively; OR501C.  | (P.106) |
| 8, 21  | <i>Pachyoncus</i> sp. aff. <i>P. floreus</i> Yeh<br>Scales = 100 and 49µm, respectively; OR501A.                                 | (P.105) |
| 9, 23  | <i>Archaeospongoprunum imlayi</i> Pessagno<br>Scales = 100 and 46µm, respectively; OR501B.                                       | (P.90)  |
| 10, 16 | <i>Archaeospongoprunum</i> sp. cf. <i>A. praeimlayi</i> Pessagno, Blome and Hull<br>Scales = 100 and 51µm, respectively; OR501C. | (P.90)  |
| 11, 24 | <i>Wilvemina</i> sp. A<br>Scales = 100 and 52µm, respectively; OR501C.   | (P.91)  |
| 12, 22 | <i>Loupanus</i> sp. A<br>Same specimen, scales = 100 and 51µm, respectively; OR501A.   | (P.112) |
| 13, 18 | <i>Gorgansium</i> sp. A<br>Same specimen, scales = 100 and 53µm, respectively; OR501C.   | (P.105) |
| 14, 20 | <i>Gorgansium</i> sp. B<br>Same specimen, scales = 100 and 68µm, respectively; OR501B.   | (P.105) |
| 15     | <i>Lanubus</i> sp. A<br>Scale = 100µm. OR501C.   | (P.107) |

PLATE 25

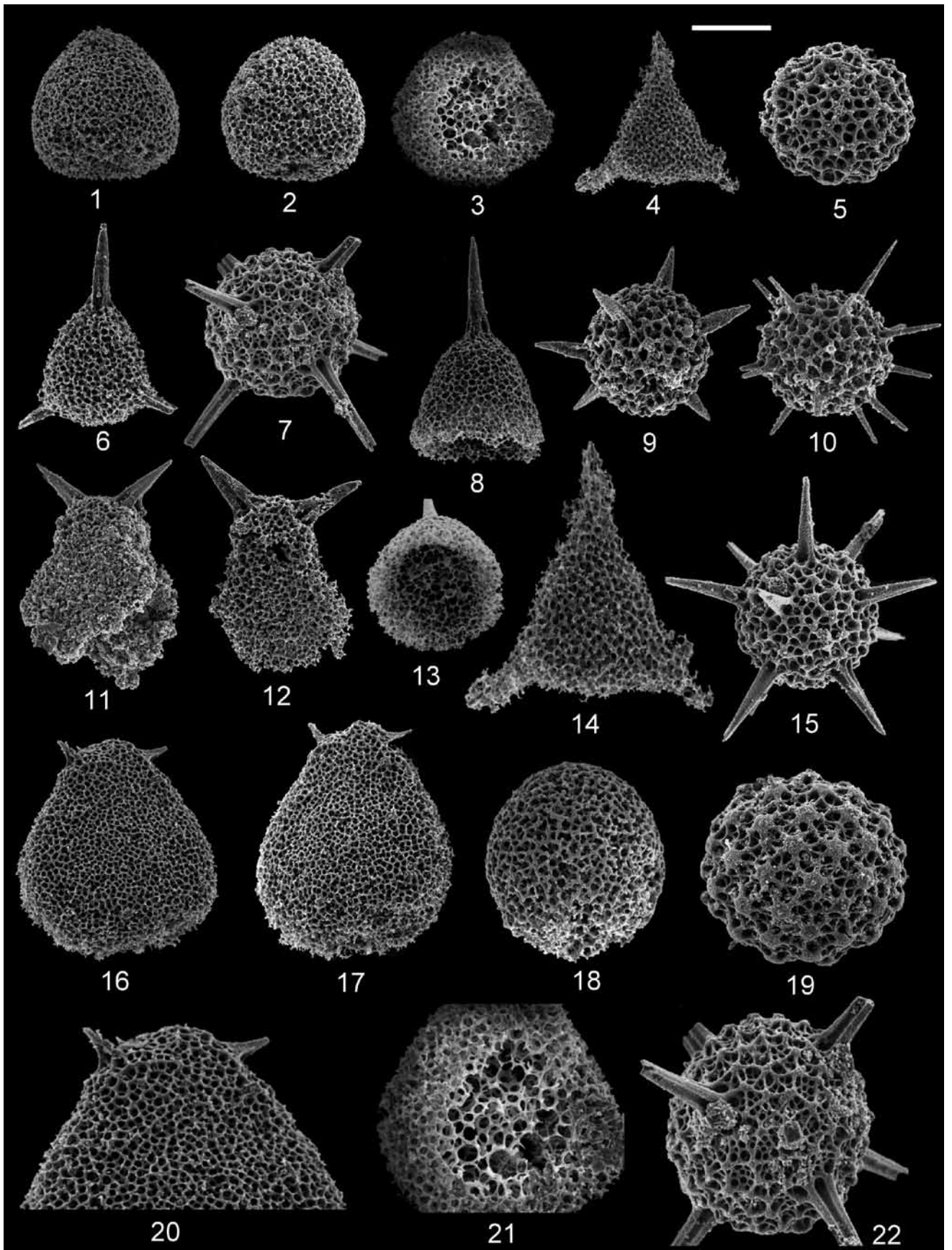


## PLATE 26

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) spumellarians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

- |           |  |         |
|-----------|--|---------|
| 1-3, 21   | Spumellaria gen. et sp. indet. D<br>Scales=100, 100, 100 and 63 $\mu$ m, respectively. OR501B. 3, 21, same specimen. | (P.113) |
| 4, 14     | Spumellaria gen. et sp. indet. E<br>Scales=100 and 67 $\mu$ m, respectively. OR501A.                                 | (P.113) |
| 5         | <i>Neoconocaryomma tantulimamma</i> Yeh<br>Scale=100 $\mu$ m; OR501C.  | (P.108) |
| 6         | Spumellaria gen. et sp. indet. F<br>Scale=100 $\mu$ m; OR501A.   | (P.113) |
| 7, 22     | <i>Bolena</i> sp. A<br>Scales=100 and 74 $\mu$ m, respectively; OR501B.  | (P.91)  |
| 8, 13     | Spumellaria gen. et sp. indet. G<br>Same specimen, scales=100 $\mu$ m; OR501B.                                       | (P.113) |
| 9         | <i>Neoconocaryomma</i> sp. A<br>Scale=100 $\mu$ m; OR501C.   | (P.108) |
| 10        | <i>Neoconocaryomma acusspina</i> Yeh<br>Scale=100 $\mu$ m, OR501C.   | (P.107) |
| 11-12     | <i>Bernoulius</i> sp. A<br>Scales=100 $\mu$ m; OR501B.   | (P.91)  |
| 15        | <i>Neoconocaryomma tripalmspina</i> Yeh<br>Scale=100 $\mu$ m; OR501B.  | (P.108) |
| 16-17, 20 | <i>Bernoulius</i> sp. B<br>Same specimen, scales=100, 100 and 60 $\mu$ m, respectively; OR501B.                      | (P.91)  |
| 18        | Spumellaria gen. et sp. indet. H<br>Scale=100 $\mu$ m; OR501C.   | (P.113) |
| 19        | <i>Praeconocaryomma</i> sp. A<br>Scale=100 $\mu$ m, OR501B.  | (P.108) |

PLATE 26

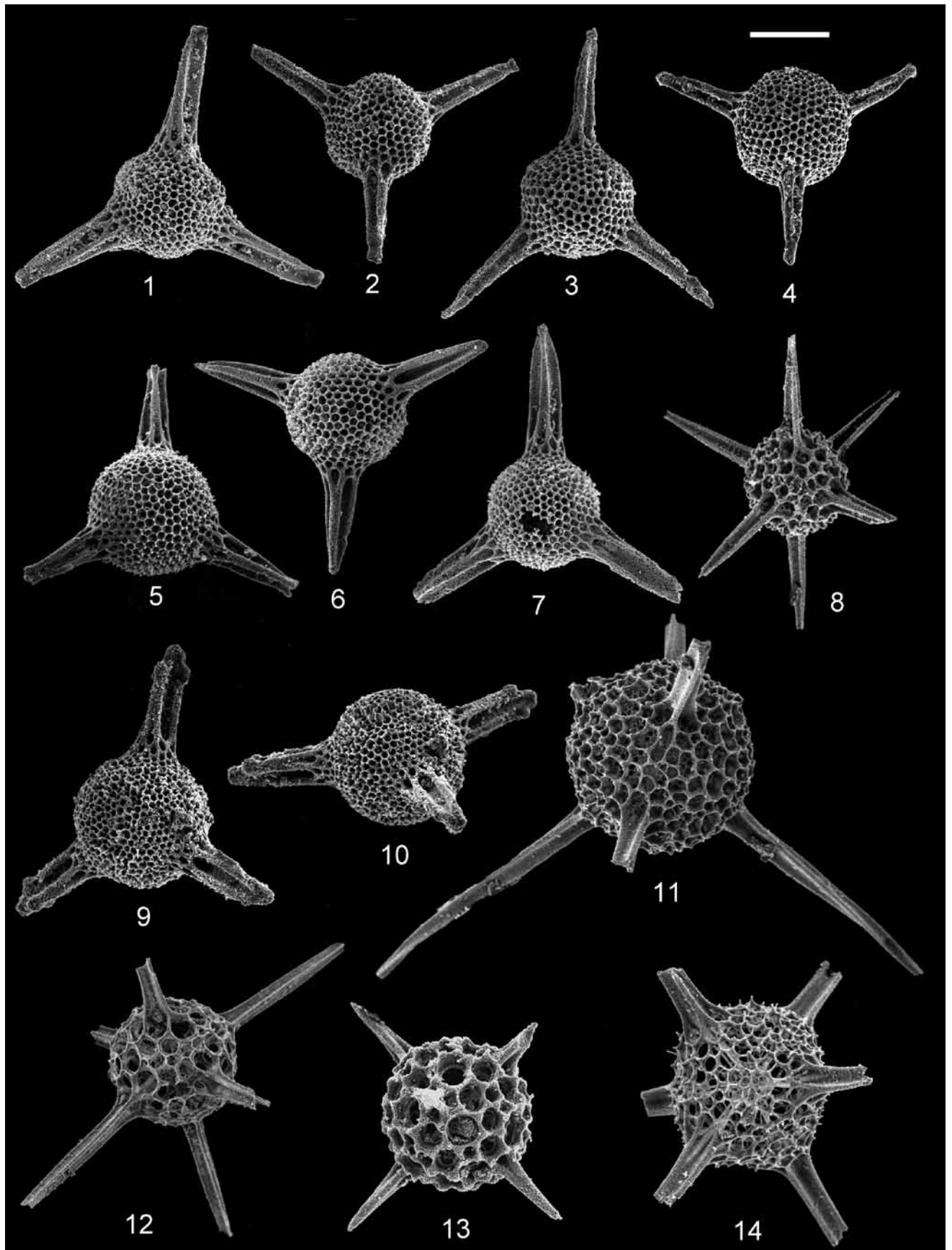


## PLATE 27

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) spumellarians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

- |      |  |         |
|------|--|---------|
| 1-2  | <i>Tripocyclus brooksi</i> Pessagno and Yang<br>Scale = 100µm; OR501B.                       | (P.109) |
| 3-4  | <i>Tripocyclus southforkensis</i> Pessagno and Yang<br>Scales = 100µm; 3, OR501C; 4, OR501A. | (P.109) |
| 5-6  | <i>Tripocyclus</i> sp. aff. <i>T. brooksi</i> Pessagno and Yang<br>Scales = 100µm; OR501B.   | (P.109) |
| 7    | <i>Tripocyclus smithi</i> Pessagno and Yang<br>Scale = 100µm; OR501B.                        | (P.109) |
| 8    | <i>Hexalonche</i> (?) sp. A<br>Scale = 100µm; OR501B.  | (P.111) |
| 9-10 | <i>Tripocyclus</i> sp. A<br>Scales = 100µm; OR501B.  | (P.109) |
| 11   | <i>Bolena</i> sp. B<br>Scale = 100µm; OR501B.  | (P.91)  |
| 12   | <i>Hexalonche</i> (?) sp. B<br>Scale = 100µm; OR501A.  | (P.111) |
| 13   | <i>Hexalonche</i> (?) sp. C<br>Scale = 100µm; OR501B.  | (P.111) |
| 14   | <i>Hexalonche</i> (?) sp. D<br>Scale = 100µm; OR501B.  | (P.111) |

PLATE 27



## PLATE 28

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) spumellarians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

- |                |  |         |
|----------------|--|---------|
| 1-3, 14,<br>17 | <i>Acaeniotylopsis oregonensis</i> Yeh and Pessagno, n. sp.  | (P.110) |
|                | 1, 14, Holotype, USNM547398, scales = 100 and 63µm, respectively; OR501B. 2-3, 17, Paratypes, USNM547399, scales = 100, 100 and 65µm, respectively; 2, 17, same specimen, OR501B; 3, OR501C. |         |
| 4              | <i>Xiphostylus</i> sp. cf. <i>X. sinuosus</i> Pessagno and Yang<br>Scales = 100 µm, OR501C.  | (P.109) |
| 5-6            | <i>Xiphostylus sinuosus</i> Pessagno and Yang<br>Scales = 100µm; 5, OR501B; 6, OR501C.   | (P.109) |
| 7              | <i>Xiphostylus</i> sp. A<br>Scale = 100µm, OR501C.   | (P.110) |
| 8, 16          | <i>Acaeniotylopsis</i> sp. A<br>Same specimen, scales = 100 and 69µm, respectively; OR501B.  | (P.111) |
| 9              | <i>Acaeniotylopsis</i> sp. B<br>Scale = 100µm; OR501B.   | (P.111) |
| 10             | <i>Xiphostylus vallieri</i> Pessagno and Yang<br>Scale = 100µm; OR501C.  | (P.110) |
| 11             | Spumellaria gen. et sp. indet. I<br>Scale = 100µm, OR501C.   | (P.113) |
| 12-13          | <i>Archaeocenosphaera</i> sp. A<br>Scales = 100µm; OR501B.   | (P.108) |
| 15             | <i>Xiphostylus whalenae</i> Pessagno and Yang<br>Scale = 100µm; OR501B.  | (P.110) |

PLATE 28

