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) Radiolarians 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 Radiolarians 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 multicrytid 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 ft) (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 Silvies 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
Formation (lower Callovian) (text-figure 2). In members where mudstone and shale predominates (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**

**OR501 A, 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 *Torricellliceras*, which are not known below the upper Bathonian and whose lowerest 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

<table>
<thead>
<tr>
<th>Family</th>
<th>Genus</th>
<th>No. of sp./form</th>
<th>Relative Abundance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Centrocubidae</td>
<td>Marianasphaera</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2. Eptingiidae</td>
<td>Peripiryidium</td>
<td>7</td>
<td>common</td>
</tr>
<tr>
<td>3. Quenquecapsularidae</td>
<td>Empirea</td>
<td>1</td>
<td>Vary rare</td>
</tr>
<tr>
<td>4. Pseudoacanthocircidae</td>
<td>Eospongosaturninus</td>
<td>1</td>
<td>Very rare</td>
</tr>
<tr>
<td>5. Saturnalidae</td>
<td>Dicerosaturnalis</td>
<td>1</td>
<td>Vary rare</td>
</tr>
<tr>
<td>6. Entactinarian Incertae Sedis</td>
<td>Corona, n. gen.</td>
<td>2</td>
<td>common</td>
</tr>
<tr>
<td></td>
<td>Nidus, n. gen.</td>
<td>2</td>
<td>common</td>
</tr>
<tr>
<td></td>
<td>Gen. et sp. indet.</td>
<td>2</td>
<td>rare</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>17</td>
<td></td>
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</tbody>
</table>

Table 2. Diversity and relative abundance of nassellarian genera

<table>
<thead>
<tr>
<th>Family</th>
<th>Genus</th>
<th>No. of sp./form</th>
<th>Relative Abundance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Amphipyndacida</td>
<td>Palinandromeda</td>
<td>3</td>
<td>common</td>
</tr>
<tr>
<td>2. Triversus</td>
<td>1 common</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Arcanicapsidae</td>
<td>Arcanicapsa</td>
<td>1</td>
<td>common</td>
</tr>
<tr>
<td>3. Archaeodictyomitridae</td>
<td>Archaeodictyomitra</td>
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<td>common</td>
</tr>
<tr>
<td>4. Arcropyramidida</td>
<td>Cornatella</td>
<td>1</td>
<td>very rare</td>
</tr>
<tr>
<td>5. Eucyrtidiellida</td>
<td>Eucyrtidiellum</td>
<td>1</td>
<td>very rare</td>
</tr>
<tr>
<td>6. Hilarisiregida</td>
<td>Hilarisirex</td>
<td>1</td>
<td>very rare</td>
</tr>
<tr>
<td>7. Hsuidae</td>
<td>Hsuum</td>
<td>5</td>
<td>common</td>
</tr>
<tr>
<td>8. Parahsuum</td>
<td>2</td>
<td></td>
<td>rare</td>
</tr>
<tr>
<td>9. Parvicingulida</td>
<td>Praeparvicingulga</td>
<td>25</td>
<td>abundant</td>
</tr>
<tr>
<td>10. Poulpidae</td>
<td>Ristola</td>
<td>1</td>
<td>common</td>
</tr>
<tr>
<td>11. Wrangellium</td>
<td>1</td>
<td>common</td>
<td></td>
</tr>
<tr>
<td>12. Sethocapsida</td>
<td>Saitoum</td>
<td>1</td>
<td>very rare</td>
</tr>
<tr>
<td>13. Spongocapsulida</td>
<td>Spongocapsula</td>
<td>2</td>
<td>common</td>
</tr>
<tr>
<td>14. Syringocapsida</td>
<td>Pleesus</td>
<td>1</td>
<td>very rare</td>
</tr>
<tr>
<td></td>
<td>Podobursa</td>
<td>8</td>
<td>abundant</td>
</tr>
<tr>
<td></td>
<td>Quarticella</td>
<td>1</td>
<td>common</td>
</tr>
<tr>
<td></td>
<td>Yamatoum</td>
<td>1</td>
<td>very rare</td>
</tr>
<tr>
<td></td>
<td>Windalia</td>
<td>1</td>
<td>very rare</td>
</tr>
<tr>
<td>15. Telacapsulida</td>
<td>Telacapsula</td>
<td>1</td>
<td>common</td>
</tr>
<tr>
<td>16. Tertoniida</td>
<td>Toritenum</td>
<td>2</td>
<td>very rare</td>
</tr>
<tr>
<td>17. Tripedurnulida</td>
<td>Pseudopoulpus</td>
<td>2</td>
<td>rare</td>
</tr>
<tr>
<td>18. Ultranaporida</td>
<td>Napora</td>
<td>4</td>
<td>common</td>
</tr>
<tr>
<td>19. Unumida</td>
<td>Unuma</td>
<td>1</td>
<td>very rare</td>
</tr>
<tr>
<td>20. Williriedellida</td>
<td>Hiscocapsa</td>
<td>4</td>
<td>abundant</td>
</tr>
<tr>
<td>21. Nassellariina Incertae Sedis</td>
<td>Praezhamoidellum</td>
<td>4</td>
<td>abundant</td>
</tr>
<tr>
<td></td>
<td>Zhamoidellum</td>
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<td>abundant</td>
</tr>
<tr>
<td>22. Xitidae</td>
<td>Antexitus</td>
<td>4</td>
<td>common</td>
</tr>
<tr>
<td>23. Novixitus</td>
<td>1</td>
<td>very rare</td>
<td></td>
</tr>
<tr>
<td>24. Belleza</td>
<td>1</td>
<td>common</td>
<td></td>
</tr>
<tr>
<td>25. Canelonus</td>
<td>5</td>
<td>common</td>
<td></td>
</tr>
<tr>
<td>26. Minutusolla</td>
<td>3</td>
<td>common</td>
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</tr>
<tr>
<td>27. Gen. et sp. indet.</td>
<td>5</td>
<td>common</td>
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</tr>
<tr>
<td><strong>Total</strong></td>
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<td>103</td>
<td></td>
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</table>
Table 3. Diversity and relative abundance of spumellarian genera

<table>
<thead>
<tr>
<th>Family</th>
<th>Genus</th>
<th>No. of sp./form</th>
<th>Relative Abundance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Angulobracchiidae</td>
<td>1. <em>Angulobracchia</em></td>
<td>1</td>
<td>vary rare</td>
</tr>
<tr>
<td></td>
<td>2. <em>crucella</em></td>
<td>2</td>
<td>rare</td>
</tr>
<tr>
<td></td>
<td>3. <em>Paronaella</em></td>
<td>11</td>
<td>common</td>
</tr>
<tr>
<td>2. Archaeospongopruniidae</td>
<td>4. <em>Archaeospongoprunum</em></td>
<td>2</td>
<td>rare</td>
</tr>
<tr>
<td></td>
<td>5. <em>Wilvemia</em></td>
<td>1</td>
<td>vary rare</td>
</tr>
<tr>
<td></td>
<td>8. <em>Tympaneides</em></td>
<td>4</td>
<td>abundant</td>
</tr>
<tr>
<td></td>
<td>12. <em>Pseudocrucella</em></td>
<td>5</td>
<td>common</td>
</tr>
<tr>
<td></td>
<td>13. <em>Tetraditryma</em></td>
<td>3</td>
<td>common</td>
</tr>
<tr>
<td></td>
<td>14. <em>Udalia</em></td>
<td>2</td>
<td>common</td>
</tr>
<tr>
<td>8. Leugeonidae</td>
<td>15. <em>Leugeo</em></td>
<td>3</td>
<td>rare</td>
</tr>
<tr>
<td></td>
<td>16. <em>Tappanella</em></td>
<td>6</td>
<td>abundant</td>
</tr>
<tr>
<td>9. Orbiculiformida</td>
<td>17. <em>Oribiculiforma</em></td>
<td>7</td>
<td>abundant</td>
</tr>
<tr>
<td></td>
<td>19. <em>Pachyoncus</em></td>
<td>1</td>
<td>rare</td>
</tr>
<tr>
<td></td>
<td>20. <em>Pantanellium</em></td>
<td>5</td>
<td>common</td>
</tr>
<tr>
<td></td>
<td>21. <em>Zartus</em></td>
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<td>rare</td>
</tr>
<tr>
<td>11. Parvivaccidae</td>
<td>22. <em>Lanubus</em></td>
<td>1</td>
<td>rare</td>
</tr>
<tr>
<td>13. Praeconocaryommidae</td>
<td>24. <em>Neoconocaryomma</em></td>
<td>5</td>
<td>abundant</td>
</tr>
<tr>
<td></td>
<td>25. <em>Praeconocaryomma</em></td>
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<td>rare</td>
</tr>
<tr>
<td>15. Xiphostylidae</td>
<td>27. <em>Archaeocenosphaera</em></td>
<td>1</td>
<td>abundant</td>
</tr>
<tr>
<td></td>
<td>28. <em>Tripocyclia</em></td>
<td>6</td>
<td>common</td>
</tr>
<tr>
<td></td>
<td>29. <em>Xiphostylus</em></td>
<td>5</td>
<td>common</td>
</tr>
<tr>
<td></td>
<td>31. <em>Hexalonche</em></td>
<td>4</td>
<td>common</td>
</tr>
<tr>
<td></td>
<td>32. <em>Loupanus</em></td>
<td>1</td>
<td>very rare</td>
</tr>
<tr>
<td></td>
<td>33. <em>Teichertus</em></td>
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<tr>
<td></td>
<td>34. Gen. et sp. indet.</td>
<td>9</td>
<td>rare</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
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<td><strong>118</strong></td>
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### RANGE ZONES OF SELECTED TAXA

<table>
<thead>
<tr>
<th>Collection and Research (2013) 26: 51-175</th>
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<table>
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<th>RANGE ZONES OF SELECTED TAXA</th>
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</thead>
<tbody>
<tr>
<td>= Range zone.</td>
</tr>
<tr>
<td>= Range zone not known in North America.</td>
</tr>
<tr>
<td>= uncertain first or last occurrence.</td>
</tr>
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</table>

Zonal terminology after Pessagno et al. (1987b)

### MIDDLE JURASSIC

<table>
<thead>
<tr>
<th>COLLECTION AND RESEARCH</th>
</tr>
</thead>
<tbody>
<tr>
<td>(2013) 26: 51-175</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>U. Jura.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aal.</td>
</tr>
<tr>
<td>lower</td>
</tr>
</tbody>
</table>

**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 | Z | 2 | Z | 2 | Z | 2 | Z | 2 | Z | 2 |
|-----------------|---------|---------|---------|---------|---------|---------|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Eospongosaturninus protoformis** (Yao) | ? |
| **Palinandromeda sp. aff. P. depressa** |
| **Hsuum rosebudense** Pessagno & Whalen |
| **Perispyridium tamarackense** P & B |
| **Perispyridium foremanae** P & B |
| **Palinandromeda depressa** (De Wever et al.) | ? |
| **Perispyridium pessagnoi** MacLeod |
| **Archaeodictyomitra exigua** Blome |
| **Hsuum lupheri** Pessagno & Whalen |
| **Parahsuum nitidum** (Pessagno & Whalen) |
| **Praeparvicingula burnensis** (P & W) |
| **Triversus fatigatus** Hull |
| **Olanda olorina** Hull |
| **Corona eximia** Yeh & Pessagno, n. sp. |
| **Nidus nidulans** Yeh & Pessagno, n. sp. |
| **Arcanicapsa brevispinosa** Y & P, n. sp. |
| **Archaeodictyomitra sincera** Y & P, n. sp. |
| **Hilarisirex inflatus** Pessagno et al. |
| **Praeparvicingula ampla** Y & P, n. sp. |
| **Praeparvicingula blackhornensis** (P & W) |
| **Praeparvicingula elegantse** (P & W) |
| **Perispyridium nitidium** P & B |
| **Praeparvicingula decora** (P & W) |
| **Perispyridium packardi** P & B |
| **Hsuum maxwelli** 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.
<table>
<thead>
<tr>
<th>RANGE ZONES OF SELECTED TAXA</th>
<th>MIDDLE JURASSIC</th>
<th>U. Jura.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Aal.</td>
<td>Bajocian</td>
</tr>
<tr>
<td></td>
<td>lower</td>
<td>upper</td>
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<tr>
<td>SUPERZONE 1 (PART)</td>
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</tbody>
</table>

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<thead>
<tr>
<th>Zone 1A (pt.)</th>
<th>Zone 1B</th>
<th>Zone 1C</th>
<th>Zone 1D</th>
<th>Zone 1E</th>
<th>Zone 1F</th>
<th>Zone 1G</th>
<th>Zone 1H</th>
<th>Z</th>
<th>1l</th>
<th>5</th>
<th>7</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Praeparvicingula tellensis Carter</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turanta nodosa Pessagno &amp; Blome</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Praeparvicingula matura (P &amp; W)</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Toritenum hirsutum Dumitrica &amp; Zügel</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Podobursa helvetica (Rüst)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Praeparvicingula media (P &amp; W)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Praeparvicingula sodaensis (P &amp; W)</td>
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<td>Praeparvicingula grantensis (P &amp; W)</td>
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<td>Praeparvicingula sp. aff. P. grantensis</td>
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<td>Praeparvicingula schoolhousensis (P &amp; W)</td>
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<td>Praeparvicingula profunda (P &amp; W)</td>
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<td>Toritenum obesa (Takemura)</td>
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<tr>
<td>Napora antelopensis Pessagno, Whalen &amp; Yeh</td>
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<td>Telacapsula johndayensis Yeh</td>
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<td>Turanta ancoriformis Takemura</td>
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<td>Quarticella takemurai Yeh &amp; Pessagno, n. sp.</td>
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<td>Turanta lupheri Pessagno &amp; Blome</td>
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<td>Podobursa tamanensis (Yang)</td>
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**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.
**RANGE ZONES OF SELECTED TAXA**

--- = Range zone.

---------- = Range zone not known in North America.

? = uncertain first or last occurrence.

Zonal terminology after Pessagno et al. (1987b)

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<thead>
<tr>
<th>MIDDLE JURASSIC</th>
<th>U. Jura.</th>
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</thead>
<tbody>
<tr>
<td>Aal.</td>
<td>Bajocian</td>
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<tr>
<td>lower</td>
<td>upper</td>
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SUPERZONE 1 (PART)  ZONE 2 (pt.)

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<th>Zone 1A (pt.)</th>
<th>Zone 1B</th>
<th>Zone 1C</th>
<th>Zone 1D</th>
<th>Zone 1E</th>
<th>Zone 1F</th>
<th>Zone 1G</th>
<th>Zone 1H</th>
<th>Z</th>
<th>Z1</th>
<th>Z2</th>
<th>Z2γ</th>
<th>SZ</th>
<th>SZ2</th>
<th>SZ2β</th>
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<tr>
<td>Crucella beata (Yeh)</td>
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<tr>
<td>Paronaella grahamensis Carter</td>
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</table>
| Hiscocapsa convexa (Yao) | | | | | | | | | | | | | ?
| Paronaella bandyi Pessagno | | | | | | | | | | | | | .........
| Paronaella kotura Baumgartner | | | | | | | | | | | | | .........
| Antexitus pessagnoi Yeh | | | | | | | | | | | | | |
| Antexitus yangi Yeh | | | | | | | | | | | | | |
| Hiscocapsa matsuokai Yeh | | | | | | | | | | | | | |
| Minutasola yaoi Yeh | | | | | | | | | | | | | |
| Napora izenesis Pessagno, Whalen & Yeh | | | | | | | | | | | | | |
| Zhamoidellum horiae Yeh & Pessagno, n. sp. | | | | | | | | | | | | | |
| Emiluvia kozuri Yeh | | | | | | | | | | | | | |
| Canelonus reliquar Yeh & Pessagno, n. sp. | | | | | | | | | | | | | |
| Emiluvia delicata Yeh & Pessagno, n. sp. | | | | | | | | | | | | | |
| Hiscocapsa echinoampulla Y & P, n. sp. | | | | | | | | | | | | | |
| Praezhamoidellum wui Yeh & Pessagno, n. sp. | | | | | | | | | | | | | |
| Secretacapsa acanata Yeh & Pessagno, n. sp. | | | | | | | | | | | | | |
| Secretacapsa bathonia Yeh & Pessagno, n. sp. | | | | | | | | | | | | | |
| Tympaneides magnacista Y & P, n. sp. | | | | | | | | | | | | | |
| Belleza decorar (Rüst) | | | | | | | | | | | | | |
| Minutasolla nishimurae Y & P, n. sp. | | | | | | | | | | | | | |
| Archaeospongoprurus imlayi Pessagno | | | | | | | | | | | | | |
| Novixitus 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.
<table>
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<tr>
<th>RANGE ZONES OF SELECTED TAXA</th>
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<td>lower</td>
<td>upper</td>
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<tr>
<td>SUPERZONE 1 (PART)</td>
<td>Zone 1A  (pt.)</td>
<td>Zone 1B</td>
</tr>
<tr>
<td>Homoeoparonaella sp. aff. H. elegans (Pess.)</td>
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<tr>
<td>Higumastra exigua Yeh</td>
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<tr>
<td>Tritrabs simplex Kito and de Wever</td>
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<tr>
<td>Pseudocrucella longabracchia Y &amp; P, n. sp.</td>
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<tr>
<td>Tetradiarina corallitosensis (Pessagno)</td>
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<tr>
<td>Leugeo ordinarius (Yang &amp; Wang)</td>
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<tr>
<td>Emiluvia parvinodosa Yeh</td>
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<tr>
<td>Pseudocrucella acutusspina (Yeh)</td>
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<tr>
<td>Hellenid gen. et sp. indet. A</td>
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<tr>
<td>Homoeoparonaella elegans (Pessagno)</td>
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<tr>
<td>Emiluvia sp. cf. E. oregonensis Yeh</td>
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<td>Higumastra angustabracchia Yeh</td>
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<tr>
<td>Udalia sp. A</td>
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<tr>
<td>Tetradiarina pseudopleana Baumgartner</td>
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<tr>
<td>Tetradiarina coldspringensis (Pessagno)</td>
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<td>Emiluvia valida Yeh &amp; Pessagno, n. sp.</td>
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<td>Higumastra perfecta Yeh &amp; Pessagno, n. sp.</td>
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<tr>
<td>Tritrabs brevitubus Yeh &amp; Pessagno, n. sp.</td>
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<tr>
<td>Tappanella fragilis Yeh &amp; Pessagno, n. sp.</td>
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<tr>
<td>Tappanella imlayi Yeh &amp; Pessagno, n. sp.</td>
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<td>Tappanella novacubica Hull</td>
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<tr>
<td>Emiluvia nana Baumgartner</td>
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<td>Tritrabs worzeli (Pessagno)</td>
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**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.
### 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.

<table>
<thead>
<tr>
<th>RANGE ZONES OF SELECTED TAXA</th>
<th>MIDDLE JURASSIC</th>
<th>U. Jura.</th>
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<td></td>
<td>Aal.</td>
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<tr>
<td>SUPERZONE 1 (PART)</td>
<td>ZONE 2 (pt.)</td>
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<tr>
<td>Zone 1A (pt.)</td>
<td>Zone 1B</td>
<td>Zone 1C</td>
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<tr>
<td>Orbiculiforma trispina trispinula Carter</td>
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<tr>
<td>Neoconocaryomma tantulimamma Yeh</td>
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<tr>
<td>Orbiculiforma incognita Blome</td>
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<tr>
<td>Xiphostylus vallieri Pessagno &amp; Yang</td>
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<tr>
<td>Teichertus heliotropica (Baumgartner)</td>
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<td>Pantanellium foceatum Mizutani &amp; Kido</td>
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<td>Orbiculiforma liberataspira Yeh</td>
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<td>Pantanellium sincerum Pessagno &amp; Blome</td>
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<td>Xiphostylus whalenae Pessagno &amp; Yang</td>
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<td>Acaeniotylopsis oregonensis Y &amp; P. n. sp.</td>
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<td>Teichertus pessagnoi Yeh</td>
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<td>Orbiculiforma densaora Yeh</td>
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<td>Orbiculiforma santarotae Yeh</td>
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<td>Pantanellium ultrasincerum Pessagno &amp; Blome</td>
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<td>Tripocyclus brucki Pessagno &amp; Yang</td>
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<td>Hexalonche sp. D</td>
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<td>Teichertus cavernosus Hull</td>
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</table>
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.
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


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, Busuanga 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.


**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 crown in shape. 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** (μm): Holotype + 5 paratypes. WT = maximum width of test; LA = maximum length of arch between two junctions.

<table>
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<tr>
<th></th>
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<th>LA</th>
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<td>Mean</td>
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<tr>
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</table>

**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. Initial 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* (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 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.

*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 large nest-like spongy cortical shell with six or more triradiate spines.

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

*Measurements* (μm): Holotype + 3 paratypes. LC = maximum length of cortical shell; LSP = maximum length of spines.

<table>
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<tr>
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<th>LSP</th>
</tr>
</thead>
<tbody>
<tr>
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<td>260</td>
<td>147</td>
</tr>
<tr>
<td>Mean</td>
<td>235</td>
<td>128</td>
</tr>
<tr>
<td>Maximum</td>
<td>272</td>
<td>151</td>
</tr>
<tr>
<td>Minimum</td>
<td>173</td>
<td>85</td>
</tr>
</tbody>
</table>

*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.


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

*Palinandromeda depressa* (De Wever and Miconnet)
Plate 4, figures 13, 15.


**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. praepobielensis* (Baumgartner)
Plate 4, figures 1, 9, 11-12


**Remarks:** This species differs from *P. praepodbielensis* (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) repeatly; a raised hexagonal pore with a short triradiate spine present at each juction 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) + spinosus-a-um (Latin, adj., meaning thorny) = full of short thorns.

**Measurements** (μm): Holotype + 4 paratypes.

<table>
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<th>LS</th>
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<td>Minimum</td>
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<td>50</td>
<td>198</td>
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</table>

**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; Yang 1993

**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** (μm): 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.  

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<td>160</td>
<td>73</td>
</tr>
<tr>
<td>Mean</td>
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<td>75</td>
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<tr>
<td>Maximum</td>
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<tr>
<td>Minimum</td>
<td>143</td>
<td>72</td>
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**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).

**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.
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.

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 (OR501B); Worldwide.

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 Bajocian, Supperzone 1, upper Zone 1F) from Snowshoe Formation, east-central Oregon (OR501B); Upper Jurassic (middle Oxfordian to lower Kimmeridgian) from volcanopelagc 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 Superzone 1) to 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.


*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 at 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 Orego (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 difference of test structure.

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

*Occurrence:* South Fork Member, Snowshoe and Lonesome formations, east-central Orego (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 decorata** (Pessagno and Whalen)
Plate 8, figures 8-9


*Praecaneta decorata* (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 Josphine ophiolite, Smith River subterrane, 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.

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

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

**Measurements (µm):** Holotype +5 paratypes; LT = length of test excluding horn; WT = maximum width of test.

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**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 (OR501C).
**Praeparvicingula profunda** (Pessagno and Whalen)
Plate 6, figures 12-13

*Parvicingula 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).

**Praeparvicingula schoolhousensis** (Pessagno and Whalen)
Plate 7, figure 15-16, 18, 23

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

Not *Praeparvicingula 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 *Praeparvicingula 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).

**Praeparvicingula sodaensis** (Pessagno and Whalen)
Plate 6, figures 11, 23

*Parvicingula 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 (OR549B and OR501A).

**Praeparvicingulla schoolhousensis** Carter
Plate 5, figures 17, 24

*Pseudoristola* sp. B YEH 1987b, p. 97, pl. 14, fig. 21.
*Parvicingula* sp. D CARTER et al. 1988, p. 56, pl. 15, figs. 1-2.
*Parvicingula* sp. E CARTER et al. 1988, p. 56, pl. 5, fig. 13.
*Ristola* spp. HATTORI 1989, pl. 14, fig. 1.
*Parvicingula* sp. B YAO 1997, pl. 13, fig. 607.

**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.

**Praeparvicingula 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 parvicingulid-type pore frames and non-parvicingulid-type pore frames in non-consistant shape. It is very possible that these forms are abberant of *Praeparvicingula* 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).

**Praeparvicingula vera** (Pessagno and Whalen)
Plate 6, figures 1, 16

*Parvicingula 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 WRANGLLIINAE Yeh 1987a


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.

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.
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


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

Subfamily **POULPINAE** De Wever 1981a


Range and occurrence: Same as for family.

Genus **Saitoum** Pessagno 1977a

Type species: *Saitoum pagei* Pessagno 1977a.

Range and occurrence: Lower Jurassic (Hettangian) 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


**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.


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).


Type species: *Podobursa dunikowski* Wisnioski 1889.

*Syringocapsa* NEVIANI 1900, p. 662.
*Trisyringium* VINASSA DE REGNY 1901-1902, p. 507.

*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


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 (OR501C).

**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 triradiate 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 triradiate horn with knob-like tip, and by having four to six thick triradiate 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 triradiate 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 (μm):** Holotype + 4 paratypes. HCT = height of cephalis and thorax excluding horn; HT = height of test excluding horn; WT = maximum width of test excluding spines.

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**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 (ORMA30A, OR501B).

Genus **Windalia** Ellis 1993

**Type species:** *Amphipyndax (?) 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

**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 **Toritenium** Dumitrica and Zügel 2003  
**Type species**: *Toritenium 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, Antarctic peninsula, and east-central Oregon.

**Toritenium hirsutum** Dumitrica and Zügel 2003  
Plate 4, figures 3, 5, 14

*Parvicingula* sp. aff. *P. (?) obesa* HATTORI 1989, pl. 44, fig. F.  
*Toritenium 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.

**Toritenium 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 *Toritenium 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.

**Type species**: *Pseudopoulpus yamatoensis* Takemura 1986.

**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.

**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. 3-12, 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 upper Bathonian).

**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 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.- GORIĆAN 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 Toarcian, 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. 297-298, pl. 4, figs. 3-12, 14, 17; pl. 7, fig. 5.

**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).
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


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 chambers 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. matsuokai* 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 trepeziodal in outline, each chamber composed of four to five staggered rows of hexagonal pore frames, with larger pore frames along costricted 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.

<table>
<thead>
<tr>
<th></th>
<th>L1</th>
<th>LT</th>
<th>WT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holotype</td>
<td>70</td>
<td>187</td>
<td>133</td>
</tr>
<tr>
<td>Mean</td>
<td>72</td>
<td>172</td>
<td>128</td>
</tr>
<tr>
<td>Maximum</td>
<td>82</td>
<td>187</td>
<td>140</td>
</tr>
<tr>
<td>Minimum</td>
<td>68</td>
<td>167</td>
<td>125</td>
</tr>
</tbody>
</table>

**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 Bajocian).

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

**Hiscocapsa matsuokai** 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 cf. P. parvipora (Tan Sin Hok) by having a test with inflated abdomen.

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

Measurement (μm): 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.

<table>
<thead>
<tr>
<th></th>
<th>WPC</th>
<th>LPC</th>
<th>WPA</th>
<th>LT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holotype</td>
<td>67</td>
<td>63</td>
<td>170</td>
<td>230</td>
</tr>
<tr>
<td>Mean</td>
<td>63</td>
<td>60</td>
<td>160</td>
<td>210</td>
</tr>
<tr>
<td>Maximum</td>
<td>67</td>
<td>64</td>
<td>170</td>
<td>230</td>
</tr>
<tr>
<td>Minimum</td>
<td>62</td>
<td>57</td>
<td>156</td>
<td>193</td>
</tr>
</tbody>
</table>

Type Locality: OR 501 B (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


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


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 Dumitraca 1970
Type species: Zamoidellum ventricosum Dumitraca 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 (μm)**: Holotype + 9 paratypes. LT = length of test, WT = maximum width of test.

<table>
<thead>
<tr>
<th></th>
<th>LT</th>
<th>WT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holotype</td>
<td>163</td>
<td>147</td>
</tr>
<tr>
<td>Mean</td>
<td>170</td>
<td>155</td>
</tr>
<tr>
<td>Max.</td>
<td>190</td>
<td>160</td>
</tr>
<tr>
<td>Min.</td>
<td>155</td>
<td>145</td>
</tr>
</tbody>
</table>

**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 (upper Bajocian to upper Bathonian).

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

**Antexitus sp. aff. A. pessagnoi** Yeh
Plate 7, figure 4

**Remarks**: This morphotype differs from A. pessagnoi 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. pessagnoi** Yeh
Plate 7, figure 3

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

**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

**Bajocian) to Upper Cretaceous (Maaestrichtian). Worldwide.**

**Genus Antexitus** Yeh 2009

**Type species**: Antexitus pessagnoi 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 pessagnoi** Yeh
Plate 7, figure 2

**Antexitus pessagnoi** 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. pessagnoi** Yeh
Plate 7, figure 4

**Remarks**: This morphotype differs from A. pessagnoi 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. pessagnoi** Yeh
Plate 7, figure 3

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

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

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


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 Francian 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 (upper Tithonian) to Cretaceous from Francian Complex and Great Valley Supergroup; volcanic strata overlying Coast Range ophiolite, Stanley Mountain, California.

Genus Belleza Hull 1997
Type species: Stichocapsa decora (Rüst)

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

Belleza decora Hull-YEH 2009, p.71, pl. 17, figs. 4-5, 16, 21.

Canelonus sp. cf. C. conus Hull
Plate 11, figures 9, 16

Canelonus sp. cf. C. conus Hull 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.

Canelonus decadatus Hull-YEH 2009, p.71, pl. 17, figs. 4-5, 16, 21.

Range: Supperzone 1, upper Zone 1F to Zone 2, subzone 2γ; Middle Jurassic (upper Bathonian) to Middle Jurassic (upper 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 1997, p. 142, pl. 47, figs. 5-6, 14, 22-23.

Genus Stichocapsa (Rüst)

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

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

Etymology: reliquus-a-um (Latin, adj.) = outstanding.
**Measurement (μm)**: Holotype + 4 paratypes.

<table>
<thead>
<tr>
<th></th>
<th>Length of test excluding horn</th>
<th>Width of earlier chambers (max.)</th>
<th>Length of horn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holotype</td>
<td>200</td>
<td>100</td>
<td>63</td>
</tr>
<tr>
<td>Mean</td>
<td>200</td>
<td>112</td>
<td>64</td>
</tr>
<tr>
<td>Max.</td>
<td>210</td>
<td>120</td>
<td>70</td>
</tr>
<tr>
<td>Min.</td>
<td>195</td>
<td>100</td>
<td>63</td>
</tr>
</tbody>
</table>

**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.

**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.


**Decriptions**: 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 chamfer 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) pores; 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 (μm)**: Holotype + 6 paratypes. LT = length of test excluding horn, WT = maximum width of thorax, WAB = maximum width of abdomen excluding spines.
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 2γ, 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.

Minutasola 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 multicyrtid 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 multicyrtid 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 **SPUMELLA RINA**
Family **ANGULOB RACHIIDAE** 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 **ANGULOB RACHCADAE**
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 **PATULIBRACCHI NAE** Pessagno 1971; emend. Baumgartner 1980a

*Type genus*: *Patulibracchium* Pessagno 1971.


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.


*Sontonaella* YEH 1987b, p.44.


*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 (μm):** Holotype + 4 paratypes; DC = diameter of cortical shell; LS = maximum length of spines; β = open angle of two spines.

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<tr>
<td>Minimum</td>
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<td>86</td>
<td>74</td>
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</table>

**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, Snowshoe Formation, east-central Oregon (OR501A, C).

**Paronaella grahamensis** Carter
Plate 16, figure 3

**Sononella** 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 Snowshoe 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 PETERCÁKOVÁ 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 Snowshoe 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 bulbose tip.

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

Occurrence: South Fork Member, Snowshoe 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


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

Genus *Archaeospongoprunum* Pessagno 1973

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

Range and occurrence: Same as for family.

*Archaeospongoprunum imlayi* Pessagno
Plate 25, figures 9, 23

*Archaeospongoprunum 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.

*Archaeospongoprunum* sp. cf. *A. praeimlayi* Pessagno et al.
Plate 25, figure 10, 16


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 *Wilvemia* Pessagno, Blome and Hull

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).

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).

Genus Tympaneides Carter 1988
Type species: Tympaneides charlottensis Carter 1988.

Remarks: Carter assigned this genus to family Staurolonchidae Haeckel sensu Pessagno 1977a because of its shape, mode of shell construction and spine structure (Carter et al. 1988, p. 37). Unlike the other staurolonchids, 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 Boleniidae 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

**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.

**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** (μm): Holotype + 5 paratypes. DC = diameter of cortical shell; LS = maximum length of spine.

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<th>LS</th>
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</thead>
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<td>Holotype</td>
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<td>226</td>
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<tr>
<td>Mean</td>
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<td>243</td>
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<tr>
<td>Maximum</td>
<td>206</td>
<td>265</td>
</tr>
<tr>
<td>Minimum</td>
<td>193</td>
<td>226</td>
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</table>

**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:** Dactyliosphera 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 microsphers 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-shape 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 Hagiastridae 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 *Psudocrucella* 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) + capsae-ae (Latin, n., meaning a box).

**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 (µm):** Holotype + 6 paratypes. WC = minimum width of cortical shell; WD =

![Text-Figure 4](image-url)
width of depression area; LS = maximum length of primary spine.

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<td>107</td>
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**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.

**Plate 18, 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 (µm):** Holotype + 6 paratypes. WC = width of cortical shell; WD = width of depression area; LS = maximum length of primary spine.

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</tr>
<tr>
<td>Minimum</td>
<td>133</td>
<td>87</td>
<td>60</td>
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**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.

**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 (µm):** 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.

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**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.

**Emiluvia kozuri** Yeh
Plate 20, figure 6

**Emiluvia kozuri** YEH 2009, p. 48, pl. 11, figs. 8-9, 12-13, 16-17, 20.

**Emiluvia nana** Baumgartner
Plate 20, figure 3


**Range:** Supperzone 1, upper Zone 1F Zone 2, Subzone 2β₂, 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 (µm)**: Holotype + 6 paratypes. WC = width of cortical shell; LS = maximum length of primary spine.

<table>
<thead>
<tr>
<th></th>
<th>WC</th>
<th>LS</th>
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<tr>
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<tr>
<td>Mean</td>
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**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 (OR-MA30A, OR501B, C).

**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 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 (OR501B).

**Higumastra exigua** Yeh

Plate 21, figures 6-7

**Higumastra exigua** YEH 2010, 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.

**Rang**: 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)
Yeh and Pessagno: Upper Bathonian radiolarians

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 (tetrafonal 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 (μm): 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.

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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

Tetratrabs acutusspina YEH 2011, p. 22, pl. 10, figs. 3-4, 16, 18.

Remarks: This species should be assigned to Pseudocrucella Baumgartner rather than Tetratrabs 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 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, tetragonol 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.

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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 Tetradrityma Baumgartner 1980a
Type species: Tetradrityma pseudoplena Baumgartner 1980.

Saldorfu PESSAGNO, BLOME and HULL 1993

Range and occurrence: Lower Jurassic (upper Pliensbachian) to Upper Jurassic (Tithonian) or younger. Worldwide.

Tetradrityma coldspringensis (Pessagno, Blome and Hull)
Plate 15, figure 8
**Saldorfu s 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; volcaniclastic strata above Josphine ophiolite, Smith River subterrane, Klamath Mountains, northeast California.

**Tetraditryma corralitosensis** (Pessagno)

Plate 15, figure 9

**Crucella (?) corralitosensis** PESSAGNO 1977a, p. 72, pl. 2, figs. 10-13.

**Saldorfu s oregonensis** PESSAGNO, BLOME and HULL 1993, p. 127, pl. 3, figs. 11, 12, 18.

*Tetraditryma corralitosensis oregonensis* (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 Form members, Snowshoe Formation, east-central Oregon (OR-MA15, OR549B, OR-MA30A and OR501B); worldwide.

**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 pessagnoi* 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 pessagnoi* Foreman s.l.-YEH 2009, p. 49, pl. 13, figs. 13, 17.

**Remarks:** This morphotype differs from *Emiluvia pessagnoi* 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 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.
**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.

**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.

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**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. H** HATTORI 1989, pl. 1, fig. 6, not fig.7.
**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.
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.


*Type genus:* Leugeo Yang and Wang 1990.

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

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 originally 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.

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**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 hexagon; central pore of each hexagon thicker and raised asymmetrically to form undulate surface.

Remarks: This species is characterized by having a spherical cortical shell with four triradiate secondary spines at apices of a tetragon and lacking prominent ridges around each hexagon.

Etymology: This species is named for Ralph W. Imlay to honor for his contribution to the biostratigraphic studies for the east-central Oregon.

**Measurement (μm)**: 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.

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</table>

Type Locality: OR501C (see Locality Description), Snowshoe Formation, east-central Oregon.

Deposition of types: Holotype = USNM 547386. Paratypes = USNM 547387.
**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.  
Levileugeo 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.


**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

Levileugeo ordinarius YANG and WANG 1990, p.203, pl. 1, figs. 2, 14; pl. II, fig. 1.

Levileugeo sp. B.-PESSAGNO, BLOME and HULL 1993, p.132, pl. 15, fig. 24.


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.

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. ORB10.
*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 librataspira** Yeh
Plate 24, figures 3-4


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

Occurrence: South Fork member 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 trispina 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 zigzag 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 **PANTANELLIDAE** 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 **PANTANELLINAE** 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 subterrane; 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.** 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).


**Pantanellium sincerum** Pessagno and Blome
Plate 25, figure 2

**Remarks:** The presence of this species in the studied sample is a new record of the final occurrence of the species.

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

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

**Pantanellium ultrasincerum** Pessagno and Blome
Plate 25, figures 3-5

**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).

**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

**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: Patulibrachium 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


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, 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-Emerson-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.


**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** *Tripocyclia* Haeckel 1881. emend. Pessagno and Yang 1989

**Type species**: *Tripocyclia* Rüst 1885 (subsequent designation by Campbell 1954, p. D-82).

**Range and occurrence**: Lower Jurassic (lower Toarcian) to Lower Cretaceous; worldwide.

**Tripocyclia brooksi** Pessagno and Yang

Plate 27, figures 1-2

*Tripocyclia 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 volcano-pelagic strata, Stanley Mountain, California.

**Tripocyclia** 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).

**Tripocyclia smithi** Pessagno and Yang

Plate 27, figure 7

*Tripocyclia 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).

**Tripocyclia southforkensis** Pessagno and Yang

Plate 27, figures 3-4


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

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

**Tripocyclia** 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 medulatory shell connected to cortical shell with two thicker triradiate 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 mammes.

**Measurements (µm):** Holotype +6 paratypes. DC=diameter of cortical shell; LS=maximum length of primary spine.

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<th>LS</th>
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<tr>
<td>Minimum</td>
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</table>
**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 lager 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.

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**Genus *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

**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 Stanley Mountain, California. Also present in Northwest Pacific basin and lower member of Taman Formation, east-central Mexico.

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### 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.

Cenodiscus (?) sp. PESSAGNO et al. 1993, p. 135, pl. 5, fig. 5.
Oribiculiforma 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 (= lower upper 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 subterrane, Klamath Mountains, northwestern Californian; northern Argolis Peninsula, Greece, etc.

Teichertus pessagnoi Yeh
Plate 24, figures 6, 10, 18

Teichertus pessagnoi 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 Bajocian).
**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 multispinal forms (*Pseudoheptactladus* 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, *Archaeospongoprunum 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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Yeh and Pessagno: Upper Bathonian radiolarians


Yao and Pessagno


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  
Perispyridium foremanae Pessagno and Blome  
Scales = 100μm; OR501B.  
(P.61)

3, 6  
Perispyridium packardi Pessagno and Blome  
Scales = 100μm; OR501B.  
(P.61)

4  
Perispyridium sp. A  
Scale = 100μm; OR501C.  
(P.62)

5  
Perispyridium tamarackense Pessagno and Blome  
Scale = 100μm; OR501B.  
(P.61)

7-8, 12  
Perispyridium nitidium Pessagno and Blome  
Scales = 100, 100 and 61μm, respectively; OR501B. 8, 12, Same specimen.  
(P.61)

9, 14-15  
Perispyridium pessagnoi MacLeod  
Scales = 100μm; 9, 15, OR501B; 14, OR501A.  
(P.61)

10-11, 13, 16  
Perispyridium sp. B  
Scales = 100, 100, 75 and 83μm, respectively; 10, 13, same specimen; 11, 16, same specimen; OR501C.  
(P.62)

17-18  
Marianasphaera sp. A  
Same specimen, scales = 100 and 34μm, respectively; OR501B.  
(P.61)
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  *Corona eximia* Yeh and Pessagno, n. sp.  
1, 16, Holotype, USNM 547352, scales = 100 and 65 μm, respectively; OR501C. 2-4, Paratypes, USNM547353, scales = 100 μm; 2-3, same specimen, OR501B; 4, OR501C.  

5, 9-13,  *Corona* sp. aff. *C. eximia* Yeh and Pessagno, n. sp.  
Scales = 100, 100, 100, 100, 100 and 87 μm, respectively; OR501C. 5, 9-10, 13, Same specimen.  

6-7  *Corona eximia* Yeh and Pessagno, n. sp.  
Scales = 100 μm; OR501C.  

8, 17  *Corona* sp. aff. *C. eximia* Yeh and Pessagno, n. sp.  
Same specimen, scales = 100 and 52 μm, respectively; OR501C. A broken specimen showing double layer of internal structure.  

14-15, 18  *Empirea* sp. A  
Scales = 100 μm; OR501B.
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  *Nidus nidulus* Yeh and Pessagno, n. sp.  
1, Holotype, USNM 547364, scale = 100μm; 10, paratype, USNM 547365, scale = 100μm; OR501B. 5, a juvenile form, scale = 100μm; OR501B.

2  Entactinaria gen. et sp. indet. A  
Scale = 100μm, OR501B.

3, 6-8  Entactinaria gen. et sp. indet. B  
Scales = 100μm; OR501B. 6-7, Same specimen.

4, 11  *Nidus* sp. A  
Same specimen, scales = 100 and 61μm, respectively; OR501B.

9  *Dicerosaturnalis* sp. A  
Scale = 100μm; OR501C.

12-13  *Eospongosaturninus protoformis* (Yao)  
Scales = 100μm; OR501B.
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, 11-12 **Palinandromeda** sp. aff. *P. praepodbielensis* (Baumgartner) OR501B. 9, internal view of a broken specimen, scale = 100μm. 11-12, Same specimen, scales = 100, 100 and 70μm, respectively; OR501B.

2, 13 **Palinandromeda** sp. aff. *P. depressa* (De Wever and Miconnet) OR501B. Same specimen, scales = 100 and 60μm, respectively; OR501B.

3, 5, 14 **Toritenum hirsutum** Dumitrica and Zügel OR501B. Same specimen, scales = 100, 100 and 56μm, respectively. OR501B.

4, 6 Nassellaria gen. et sp. indet. A OR501B. Same specimen, scales = 100 and 53μm, respectively; OR501B.

7, 10 **Toritenum obesa** (Takemura) OR501A. A broken specimen, scales = 100 and 41μm, respectively; OR501A.

8 **Cornutella** sp. cf. *C. tella* Dumitrica and Zügel OR501B. Scale = 100μm; OR501B.

15 **Palinandromeda depressa** (De Wever and Miconnet) OR501B. Scale = 100μm; OR501B.
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 *Hsuum* sp. cf. *H. robustum* Pessagno and Whalen
Scales =100μm; OR501C. (P.68)

3, 11 *Hsuum* sp. cf. *H. maxwelli* Pessagno
Scales =100μm; 3, OR501A; 11, OR501C. (P.68)

4 *Parahsuum* (?) sp. A
Scale =100μm; OR501B. (P.69)

5-7, 28 *Archaeodictyomitra sincera* 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 *Archaeodictyomitra exigua* Blome
Scales =100 and 44μm, respectively. OR501C. (P.66)

9 *Wrangellium* sp. A
Scale =100μm; OR501B. (P.75)

10 *Hsuum lupheri* Pessagno and Whalen
Scale =100μm. OR501B. (P.68)

12-13, 16, 22 *Praeparvicingula nullacingula* Yeh and Pessagno, n. sp.
12-13, Paratypes, USNM547363, Scales =100μm; OR501A. 16, 22, Holotype, USNM547362, scales =100 and 52μm; OR501B. (P.72)

14 *Praeparvicingula* sp. cf. *P. nullacingula* Yeh and Pessagno, n. sp.
Scale =100μm. OR501C. (P.72)

15 *Parahsuum nitidum* (Pessagno and Whalen)
Scales =100μm. 4, OR501C; 13, OR501B. (P.69)

17, 24 *Praeparvicingulla tellensis* Carter
Scales =100 and 54μm, respectively; same specimen, OR501A. (P.73)

18-20, 29-30 *Praeparvicingula ampla* 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 *Hilarisirex inflatus* Pessagno, Whalen and Yeh
Scales =100 and 61μm, respectively; same specimen, OR501A. (P.68)

23 *Hsuum maxwelli* Pessagno
Scale =100μm; OR501B. (P.68)

27 *Hsuum rosebudense* 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  *Praeparvicingula vera* (Pessagno and Whalen)
Scales = 100μm; OR501C.

2  *Praeparvicingula* sp. aff. *P. vera* (Pessagno and Whalen)
Scale = 100μm; OR501B.

3, 21  *Praeparvicingula* sp. A
Scales = 100 and 48μm, respectively; OR501C.

4-5, 22  *Praeparvicingula blackhornensis* (Pessagno and Whalen)
Scales = 100, 100 and 57μm, respectively; OR501C.

6-7  *Praeparvicingula* sp. cf. *P. blackhornensis* (Pessagno and Whalen)
Scales = 100μm; OR501C.

8-10, 15  *Praeparvicingula grantensis* (Pessagno and Whalen)
Scales = 100μm; 8, OR501C; 9-10, 15, OR501B.

10  *Praeparvicingula* sp. aff. *P. grantensis* (Pessagno and Whalen)
Scale = 100μm; OR501A.

11, 23  *Praeparvicingula sodaensis* (Pessagno and Whalen)
Scales = 100 and 69μm, respectively; same specimen ; OR501A.

12-13  *Praeparvicingula profunda* (Pessagno and Whalen)
Scales = 100μm.12, OR501A; 13, OR501C.

14  *Praeparvicingula eleganse* (Pessagno and Whalen)
Scale = 100μm; 14, OR501B.

17  *Praeparvicingula* sp. cf. *P. eleganse* (Pessagno and Whalen)
Scale = 100μm; OR501C.

18-19  *Praeparvicingula* sp. B
Scale = 100μm. 18, OR501B; 19, OR501C.
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  **Antexitus yangi** Yeh  
Scale = 100μm. OR501A.  (P.84)

2  **Antexitus pessagnoi** Yeh  
Scale = 100μm. OR501C. 2, Test with broken horn.  (P.84)

3  **Antexitus** sp. cf. *A. pessagnoi* Yeh  
Scale = 100μm. OR501C.  (P.84)

4  **Antexitus** sp. aff. *A. pessagnoi* Yeh  
Scale = 100μm; OR501A.  (P.84)

5-7, 22  **Nassellaria** gen. et sp. indet. B  
Scales = 100, 100, 100 and 73μm, respectively; OR501C. 5-6, 22, Same specimen.  (P.87)

8, 19  **Praeparvicingula** sp. C  
Scales = 100 and 55μm, respectively; same specimen; OR501C.  (P.74)

9  **Nassellaria** gen. et sp. indet. C  
Scale = 100μm; OR501C.  (P.87)

10-11  **Praeparvicingula** sp. D  
Scale = 100μm; OR501C.  (P.87)

12, 14  **Praeparvicingula media** (Pessagno and Whalen)  
Scales = 100μm; OR501C.  (P.72)

13  **Praeparvicingula burnsensis** (Pessagno and Whalen)  
Scale = 100μm; OR501C.  (P.71)

15-16, 18, 23  **Praeparvicingula schoolhousensis** (Pessagno and Whalen)  
Scales = 100, 100 and 50μm, respectively; OR501B. 15, 18, OR501A. 16, OR501B.  (P.72)

17  **Praeparvicingula matura** (Pessagno and Whalen)  
Scales = 100μm; OR501B.  (P.72)
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, *Praeparvicingula turpicula* (Pessagno and Whalen)  
Scales = 100μm, OR501C. (P.73)

4 *Pleesus* sp. A  
Scale = 100μm, OR501C. (P.76)

5, 20 *Nassellaria* gen. et sp. indet. D  
Scales = 100 and 66μm, respectively; OR501A. (P.87)

6-7 *Belleza decor*a (Rüst)  
Scales = 100μm. OR501A. (P.85)

8-9 *Praeparvicingula decora* (Pessagno and Whalen)  
Scales = 100μm. 8, OR501B; 9, OR501A. (P.71)

10-12, 22 *Novixitus* sp. A  
Scales = 100, 100, 100 and 60μm, respectively; OR501B. 10-11, 22, same specimen. (P.85)

13-14 *Praeparvicingula* sp. cf. *P. gemmata* Hull  
Scales = 100μm, OR501C. (P.71)

15, 21 *Praeparvicingula* sp. C  
Scales = 100 and 43μm, respectively; OR501B. (P.71)

16 *Windalia* sp. A  
Scale = 100μm, OR501B. (P.78)

17, 24 *Ristola* sp. A  
Scales = 100 and 70μm, respectively; OR501A. (P.74)

18, 25 *Pseudoristola* sp. cf. *P. clava* Hull  
Scales = 100 and 71μm, respectively; OR501B. (P.73)

19, 23 *Telecapsula johndayensis* Yeh  
Scales = 100 and 70μm, respectively; OR501B. (P.79)
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  *Hiscocapsa echinoampulla* Yeh and Pessagno, n. sp.  
1-2, Holotype, USNM547366, scales = 100 and 46 μm, respectively; OR501A. 3, Paratype, USNM547367, scale = 100 μm; 3, OR501C.  
(P.82)

4, 18  *Eucyrtidiellum* sp. A  
Same specimen, scales = 100 and 56 μm, respectively; OR501B.  
(P.67)

5-7, 9, 13, 23  *Quarticella takemurai* Yeh and Pessagno, n. sp.  
5, 23, Holotype, USNM547354, scales = 100 and 47 μm, respectively; OR501C. 6-7, 9, 13, Paratypes, USNM547355, scales = 100, 100, 58 and 100 μm, respectively; 6, 13, same specimen, OR501A; 7, 9, same specimen, OR501C.  
(P.77)

8, 14  *Unuma* sp. cf. *U. echinata* Ichikawa and Yao  
Scales = 100, 100 and 56 μm, respectively; OR501B.  
(P.81)

10-12, 19  *Hiscocapsa* (?) sp. A  
Scales = 100, 100, 100 and 61 μm, respectively; OR501B. 11-12, same specimen.  
(P.82)

15-17, 22  *Arcanicapsa brevispinosa* Yeh and Pessagno, n. sp.  
15, 22, Holotype, USNM547356, scales = 100 and 72 μm, respectively; OR501B. 16, Paratype, USNM547357, scale = 100 μm; OR501A. 17, A broken specimen showing internal view, OR501B.  
(P.66)

20-21  *Olanda olorina* Hull  
Same specimen, scales = 100 μm. OR501B.  
(P.69)
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, 33

1-2, 28, Holotype, USNM547374, scales = 100, 100 and 44μm, respectively; OR501B. 10-12, 33, Paratypes, USNM547375; OR501B; 10-12, scales = 100μm; 33, scale = 54μm; 11-12, 33, same specimen.

3 **Praezhamoidellum** sp. cf. *P. rüsti* (Tan Sin Hok) (P.83)

Scale = 100μm; OR501A.

4-5, 30 **Praezhamoidellum** sp. cf. *P. parvipora* (Tan Sin Hok) (P.83)

Scales = 100, 100 and 50μm, respectively. OR501B.

6, 26 **Plicaforacapsa** sp. cf. *P. catenarum* (Matsuoka) (P.75)

Scales = 100 and 43μm, respectively; OR501A.

7-8, 15 **Hisocapsa matsuokai** Yeh (P.82)

Scales = 100μm. OR501C.

9 **Minutusolla** sp. aff. *M. nishimurae* Yeh and Pessagno, n. sp. (P.87)

Scale = 100μm; OR501B.

13 **Hisocapsa convexa** (Yao) (P.82)

Scale = 100μm; OR501B.

14, 31 Nasellarian gen. et sp. indet. I (P.87)

Same specimen, scales = 100 and 62μm, respectively; OR501C.

16 **Minutusolla yaoi** Yeh (P.87)

Scale = 100μm; OR501B.

17, 32 **Yamatoum** (?) sp. A (P.78)

Same specimen, scales = 100 and 67μm, respectively; OR501B.

18-21, 29 **Zhamoidellum horiae** Yeh and Pessagno, n. sp. (P.83)

18, 29, Holotype, USNM547370, scales = 100 and 58μm, respectively; OR501B. 19-21, Paratypes, USNM 547371, scales = 100μm; 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 70μm, respectively; OR501B. 24, Paratype, USNM547369, scale = 100μm; OR501B.

25, 34 **Praezhamoidellum** sp. A (P.83)

Same specimen, scales = 100 and 64μm, respectively; OR501A.
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, 

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

1-2, 20, Holotype, NMNS547372, scales = 100, 100 and 55 μm, respectively, OR501B. 3-4, 6, 8, Paratypes, NMNS547373, scales = 100 μm; 3-4, same specimen, OR501B; 6, 8, OR501A.

5, 10, 21

**Canelonus** sp. A 

Same specimen, scales = 100, 100 and 63 μm; OR501C.

7

**Spongocapsula** sp. cf. *S. hooveri* Hull 

Scale = 100 μm. OR501C.

9, 16

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

Same specimen, scales = 100 and 62 μm, respectively. OR501B.

11

**Spongocapsula** sp. aff. *S. palmerae* Pessagno 

Scale = 100 μm. OR501B.

12-14

**Canelonus** sp. B 

Scales = 100, 84 and 100 μm, respectively. OR501A.

15, 17

**Canelonus** sp. C 

Same specimen, scales = 100 and 65 μm; OR501C.

18-19

**Triversus fastigatus** Hull 

Same specimen, scales = 100 and 43 μm; OR501C.
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  **Podobursa** sp. A
Same specimen, scales = 100 and 74μm, respectively; OR501A. (P.77)

2, 7, 13  **Podobursa** sp. B
Scales = 100, 100 and 63μm, respectively; OR501C. 1, 13, Same specimen. (P.77)

3, 16  **Podobursa** sp. cf. *P. tetrastyla* (Steiger)
Same specimen, scales = 100 and 66μm, respectively; OR501B. (P.77)

4  **Podobursa lata** (Yang)
Scale = 100μm. OR501C. (P.76)

5, 10  **Podobursa tamanensis** (Yang)
Scales = 100μm. OR501B. (P.77)

6, 14  **Podobursa** sp. cf. *P. polyacantha* (Fischli)
Same specimen, scales = 100 and 76μm, respectively; OR501C. (P.77)

8-9  **Podobursa** sp. cf. *P. basilica* Hull
Scales = 100μm. OR501C. (P.76)

12, 15  **Podobursa helvetica** (Rüst)
Same specimen, scales = 100 and 75μm, respectively, OR501B. (P.76)
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  *Napora antelopensis* Pessagno, Whalen and Yeh
Scales = 100μm. 1, 6, OR501B; 2, OR501C.  (P.81)

3-4  *Napora* sp. cf. *N. parva* Takemura
Scale = 100μm. OR501C.  (P.81)

5  *Pseudopoulpus* sp. A
Scale = 100μm. OR501C.  (P.79)

6  *Pseudopoulpus* sp. B
Scale = 100μm; OR501B.  (P.79)

8  *Turanta morinae* Pessagno and Blome
Scale = 100μm. OR501C.  (P.80)

9, 21  *Napora* (?) sp. A.
Same specimen. scales = 100 and 50μm, respectively; OR501B.  (P.81)

10  *Turanta* sp. A
Scale = 100μm; OR501B.  (P.80)

11  *Turanta lupheri* Pessagno and Blome
Scale = 100μm; OR501B.  (P.80)

12, 20  *Turanta ancoriformis* Takemura
Scales = 100 and 73μm, respectively; OR501C.  (P.80)

13, 17  *Saitoum* sp. A
Scales = 100 and 45μm, respectively; OR501B.  (P.75)

14  *Napora izeensis* Pessagno, Whalen and Yeh
Scale = 100μm. OR501A.  (P.81)

15, 19  *Turanta nodosa* Pessagno and Blome
Scales = 100μm; OR501A, C.  (P.80)

18  *Turanta capsensis* Pessagno and Blome
Scale = 100μm; OR501B.  (P.79)
PLATE 14

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) spumellariians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

1-2, 5, 10  *Tritrabs brevitrabs* Yeh and Pessagno, n. sp.  
1, 10, Holotype, USNM547382, scales=100 and 67μm, respectively; OR501A. 2, 5, Paratype, USNM547383, scales=100μm; OR501A, C.  

3, 7, 9  *Tritrabs simplex* Kito and Dewever  
Scales=100, 100 and 83μm, respectively; 3, OR501A; 7, 9, same specimen, OR501B.  

4  *Paronaella* sp. A  
Scale=100μm; OR501C.  

6  *Paronaella* sp. B  
Scale=100μm; OR501A.  

8, 11, 13  *Angulobracchia* sp. cf. *A. bulbosa* Hull  
Scales=100μm; 8, OR501A. 11, 13, OR501B.  

12  *Tritrabs worzeli* (Pessagno)  
Scale=100μm; OR501B.
PLATE 15

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) spumellariians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

1. *Pseudocrucella acutusspina* (Yeh)
   Scale = 100 μm; OR501C.

2. *Crucella* sp. cf. *C. theokaftensis* Baumgartner
   Scale = 100 μm; OR501B.

3, 7. *Higumastra* sp. A
   Scales = 100 and 86 μm, respectively; OR501C.

4, 10, 13. *Tetraditryma pseudoplena* Baumgartner
   Scales = 100 μm; 4, 10, OR501C; 13, OR501B.

5. *Pseudocrucella* sp. A
   Scale = 100 μm; OR501B.

6. *Crucella beata* (Yeh)
   Scale = 100 μm; OR501C.

8. *Tetraditryma coldspringensis* (Pessagno, Blome and Hull)
   Scale = 100 μm; OR501B.

9. *Tetraditryma corralitosensis* (Pessagno)
   Scale = 100 μm; OR501B.

11-12, 14. *Pseudocrucella longabracchia* Yeh and Pessagno, n. sp.
   11, 14, Holotype, USNM USNM547380, scales = 100 and 55 μm, respectively; OR501B. 12, Paratype, USNM USNM547381, scale = 100 μm; OR501B.
PLATE 16

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) spumellariians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

1-2, 14 *Paronaella bullata* Yeh and Pessagno, n. sp. (P.89)
1, 10, Holotype, USNM547388, scales = 100 and 65μm, respectively; OR501A. 2, Paratype, USNM547389, scale = 100μm; OR501 C.

3 *Paronaella grahamensis* Carter (P.89)
Scale = 100μm; OR501B.

4, 8 *Homoeoparonaella* sp. aff. *H. elegans* (Pessagno) (P.107)
Scales = 100μm; OR501B.

5 *Paronaella bandyi* Pessagno (P.88)
Scale = 100μm; OR501B.

6 *Paronaella* sp. C (P.89)
Scale = 100μm; OR501B.

7 *Homoeoparonaella elegans* (Pessagno) (P.107)
Scale = 100μm; OR501B.

9, 12 *Paronaella* sp. D (P.90)
Scales = 100μm; OR501B.

10 *Paronaella* sp. cf. *P. kotura* Baumgartner (P.89)
Scale = 100μm; OR501B.

11 *Paronaella kotura* Baumgartner (P.89)
Scale = 100μm; OR501B.

13 *Paronaella* sp. E (P.90)
Scale = 100μm; OR501B.
PLATE 17

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) spumellariians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

1, 4  **Tympaneides** sp. cf. *T. charlottensis* Carter
Same specimen, scales = 100 and 72 μm, respectively; OR501B.  

2, 5, 11  **Tympaneides** sp. aff. *T. magnacista* Yeh and Pessagno, n. sp.
Scales = 100 μm; 6, OR501B; 8, OR501A.  

3, 6-8, 10, 12  **Tympaneides magnacista** Yeh and Pessagno, n. sp.
3, Holotype, USNM547376, scale = 100 μm; OR501B. 7, 10, 12, Paratypes, USNM547377, scales = 100 μm; 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.  

9  **Tympaneides** sp. A
Scale = 100 μm; OR501B.
PLATE 18

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) spumellariians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

<table>
<thead>
<tr>
<th>Figures</th>
<th>Description</th>
<th>Specimen Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2, 5, 9</td>
<td><em>Secretacapsa bathonia</em> Yeh and Pessagno, n. sp.</td>
<td>Holotype, USNM547396; scales = 100, 100, 76, and 60 μm, respectively; OR501B. 2, 15, paratypes, USNM547397; same specimen showing internal structure, Scales = 100 μm; OR501C.</td>
</tr>
<tr>
<td>13-15, 17</td>
<td><em>Secretacapsa bathonia</em> Yeh and Pessagno, n. sp.</td>
<td>1, 5, 14, 17, Holotype, USNM547396; scales = 100, 100, 76, and 60 μm, respectively; OR501B. 2, 15, paratypes, USNM547397; same specimen showing internal structure, Scales = 100 μm; OR501C.</td>
</tr>
<tr>
<td>3-4, 6, 8, 10-12, 16, 18-19</td>
<td><em>Secretacapsa acanata</em> Yeh and Pessagno, n. sp.</td>
<td>3, 16, 18, Holotype, USNM 547394; scales = 100, 100, 67, and 60 μm, respectively; OR501B. 4, 8, 12, paratypes, USNM547395; scales = 100 μm; 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 60 μm, respectively; 10, OR501C; 11, 19, same specimen.</td>
</tr>
<tr>
<td>7</td>
<td><em>Secretacapsa</em> sp.</td>
<td>Scale = 100 μm; OR501B.</td>
</tr>
</tbody>
</table>
PLATE 19

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) spumellariians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

1, 4, 13  *Emiluvia validia* Yeh and Pessagno, n. sp.  
Holotype, USNM547392, scales = 100, 100 and 40μm, respectively; OR501B.  

2 - 3,  5,  11-12  *Emiluvia validia* Yeh and Pessagno, n. sp.  
Paratypes, USNM547393, scales = 100, 100, 100, 68 and 68μm, respectively; OR501B.  

6  *Emiluvia* sp. A  
Scale = 100μm; OR501B.  

7-10, 14  *Emiluvia delicata* Yeh and Pessagno, n. sp.  
7-8, 10, Paratypes, USNM547391; 9, 14, Holotype, USNM547390, scales = 100 and 71μm, respectively; OR501B.
PLATE 20

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) spumellariians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

1. *Emiluvia parvinodosa* Yeh
   Scale = 100μm, OR501B.

2, 8. *Emiluvia* sp. cf. *E. hopsoni* Pessagno
   Scales = 100μm, OR501B.

3. *Emiluvia nana* Baumgartner
   Scale = 100μm, OR501A.

4. *Emiluvia* sp. cf. *E. oregonensis* Yeh
   Scale = 100μm, OR501B.

5, 14-16. *Udalia* (?) sp. B
   Scales = 100, 100, 100 and 82μm, respectively; 5, a juvenile form with only inner layer of cortical shell, OR501B; 15-16, same specimen, OR501B.

6. *Emiluvia kozuri* Yeh
   Scale = 100μm; OR501C.

7, 11-13. *Udalia* sp. A
   Scales = 100, 69, 100 and 54μm, respectively; OR501B. 7, 11, same specimen; 12-13, same specimen, a broken specimen showing medullary shells.

9. Spumelaria gen. et sp. indet. A
   Scale = 100μm, OR501A.

10. Spumelaria gen. et sp. indet. B
    Scale = 100μm, OR501B.
PLATE 21

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) spumellariians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

1, 5  \textit{Higumastra angustabraccia} Yeh
Scales = 100 and 53\,\mu m, respectively; same specimen, OR501B.

2-3  \textit{Higumastra} sp. B
Scale = 100\,\mu m; OR501B.

4, 8, 14 \textit{Higumastra} sp. C
Scales = 100, 100 and 57\,\mu m, respectively; OR501B.

6-7  \textit{Higumastra exigua} Yeh
Scales = 100 and 81\,\mu m, respectively; OR501B.

9, 12 \textit{Higumastra perfecta} Yeh and Pessagno
Holotype, USNM547378, scales = 100 and 63\,\mu m, respectively; OR501B.

10-11, 13 \textit{Higumastra} sp. aff. \textit{H. exigua} Yeh
Scales = 100, 100 and 55\,\mu m, respectively; 10, 13, same specimen, OR501B; 11, OR501A.
PLATE 22

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) spumellariians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

1-3, \textit{Tappanella fragilis} Yeh and Pessagno, n. sp. (P.101)

11-12, 14 Tappanella novacubica Hull Scales = 100, 100, 63 and 50\mu m, respectively; OR501B. 3, 11, Paratype, USNM547385, scales = 100 and 44\mu m. OR501A. (P.102)

4-5, 9, 13, Tappanella novacubica Hull Scales = 100, 100, 100, 53 and 50\mu m, respectively; 4, 19, same specimen; OR501C. 5, OR501C. 9, 13, Same specimen, OR501A. (P.102)

6, 17 \textit{Leugo ordinarius} (Yang and Wang) Scales = 100 and 52\mu m, respectively. Same specimen. OR501B. (P.103)

7-8, 15 \textit{Leugo} sp. cf. \textit{L. hullae} Yeh Same specimen, scales = 100, 100 and 58\mu m, respectively; OR501B. (P.103)

10, 16 Helenid gen. et sp. indet. Scales = 100 and 44\mu m, respectively; OR501B. (P.103)
PLATE 23

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) spumellariians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

1-3, 6-7, **Tappanella imlayi** Yeh and Pessagno, n. sp. (P.102)
11-12, 1-3, 16, 20, Holotype, USNM 547386, scales = 100, 100, 100, 57 and 43 μm, respectively; OR501C. 6-7, 11-12, 17, paratypes, USNM547387, scales = 100, 100, 100, 100 and 48 μm, respectively; 6-7, same specimen; note that two pairs of spines present at two diagonal positions of top and bottom surfaces; OR501C.

4-5, 13 **Tappanella** sp. cf. *T. imlayi* Yeh and Pessagno, n. sp. (P.102)
Scales = 100 μm; 4-5, same specimen; OR501C.

8-9, 14, **Tappanella** sp. aff. *T. imlayi* Yeh and Pessagno, n. sp. (P.102)
18, 21 Scales = 100, 100, 100, 54 and 50 μm, respectively; OR501C. 8, 18, same specimen; 14, 21, same specimen.

10 **Tappanella** sp. A (P.103)
Scale = 100 μm, OR501C.

15, 22 Spumelaria gen. et sp. indet. C (P.113)
Same specimen, Scales = 100 and 60 μm, respectively; OR501C.

19 **Leugeo** sp. A (P.103)
Scale = 100 μm, OR501B.
PLATE 23
PLATE 24

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) spumellariians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

1-2  **Orbiculiforma incognita** Blome
Scales = 100μm; 1, OR501B; 2, OR501A. (P.104)

3-4  **Orbiculiforma librataspira** Yeh
Scales = 100μm. OR501A. (P.104)

5, 20  **Orbiculiforma trispina trispinula** Carter
Scales = 100 and 44μm, respectively; OR501B. (P.104)

6, 10, 18  **Teichertus pessagnoi** Yeh
Scales = 100, 100 and 67μm, respectively. OR501C. (P.112)

7  **Teichertus cavernosus** Hull
Scale = 100μm. OR501B. (P.112)

8-9, 17, 19  **Orbiculiforma santarota** Yeh
Scales = 100, 10, 100 and 57μm, respectively; OR501C. 8, 19, Same specimen. (P.104)

11  **Teichertus heliotroapicus** (Baumgartner)
Scale = 100μm. OR501C. (P.104)

12  **Orbiculiforma densaora** Yeh
Scale = 100μm. OR501B. (P.104)

13  **Orbiculiforma** sp. aff. *O. hexagonaora* Yeh
Scale = 100μm. OR501C. (P.104)

14-16  **Orbiculiforma** sp. A
Scales = 100μm; OR501B. 14-15, same specimen. (P.105)
PLATE 25

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) spumellariians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

1. Zartus sp. cf. Z. thayeri Pessagno and Blome
   Scale = 100 μm; OR501B. (P.106)

2. Pantanellium sincerium Pessagno and Blome
   Scale = 100 μm. OR501A. (P.106)

3-5. Pantanellium ultrasincerium Pessagno and Blome
     Scales = 100 μm; 3, OR501A; 4-5, OR501C. (P.106)

6, 19. Pantanellium foveatum Mizutani and Kido
     Scales = 100 and 45 μm, respectively; OR501A. (P.105)

7, 17. Pantanellium sp. A
     Scales = 100 and 41 μm, respectively; OR501C. (P.106)

8, 21. Pachyoncus sp. aff. P. floreus Yeh
     Scales = 100 and 49 μm, respectively; OR501A. (P.105)

9, 23. Archaeospongoprunum imlayi Pessagno
     Scales = 100 and 46 μm, respectively; OR501B. (P.90)

10, 16. Archaeospongoprunum sp. cf. A. praemlayi Pessagno, Blome and Hull
     Scales = 100 and 51 μm, respectively; OR501C. (P.90)

11, 24. Wilvemia sp. A
     Scales = 100 and 52 μm, respectively; OR501C. (P.91)

12, 22. Loupanus sp. A
     Same specimen, scales = 100 and 51 μm, respectively; OR501A. (P.112)

13, 18. Gorgansium sp. A
     Same specimen, scales = 100 and 53 μm, respectively; OR501C. (P.105)

14, 20. Gorgansium sp. B
     Same specimen, scales = 100 and 68 μm, respectively; OR501B. (P.105)

15. Lanubus sp. A
     Scale = 100 μm. OR501C. (P.107)
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  
Scales = 100, 100, 100 and 63 μm, respectively. OR501B. 3, 21, same specimen. (P.113)

4, 14 Spumellaria gen. et sp. indet. E  
Scales = 100 and 67 μm, respectively. OR501A. (P.113)

5 Neoconocaryomma tantulimamma Yeh  
Scale = 100 μm; OR501C. (P.108)

6 Spumellaria gen. et sp. indet. F  
Scale = 100 μm; OR501A. (P.113)

7, 22 Bolena sp. A  
Scales = 100 and 74 μm, respectively; OR501B. (P.91)

8, 13 Spumellaria gen. et sp. indet. G  
Same specimen, scales = 100 μm; OR501B. (P.113)

9 Neoconocaryomma sp. A  
Scale = 100 μm; OR501C. (P.108)

10 Neoconocaryomma acusspina Yeh  
Scale = 100 μm, OR501C. (P.107)

11-12 Bernoulius sp. A  
Scales = 100 μm; OR501B. (P.91)

15 Neoconocaryomma tripalmaspina Yeh  
Scale = 100 μm; OR501B. (P.108)

16-17, 20 Bernoulius sp. B  
Same specimen, scales = 100, 100 and 60 μm, respectively; OR501B. (P.91)

18 Spumellaria gen. et sp. indet. H  
Scale = 100 μm; OR501C. (P.113)

19 Praeconocaryomma sp. A  
Scale = 100 μm, OR501B. (P.108)
PLATE 27

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) spumellariians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

1-2  *Tripocyli*a *brooksi* Pessagno and Yang  
Scale = 100μm; OR501B.  
(P.109)

3-4  *Tripocyli*a *southforkensis* Pessagno and Yang  
Scales = 100μm; 3, OR501C; 4, OR501A.  
(P.109)

5-6  *Tripocyli*a sp. aff. *T. brooksi* Pessagno and Yang  
Scales = 100μm; OR501B.  
(P.109)

7  *Tripocyli*a *smithi* Pessagno and Yang  
Scale = 100μm; OR501B.  
(P.109)

8  *Hexalonche* (?) sp. A  
Scale = 100μm; OR501B.  
(P.111)

9-10  *Tripocyli*a sp. A  
Scales = 100μm; OR501B.  
(P.109)

11  *Bolena* sp. B  
Scale = 100μm; OR501B.  
(P.91)

12  *Hexalonche* (?) sp. B  
Scale = 100μm; OR501A.  
(P.111)

13  *Hexalonche* (?) sp. C  
Scale = 100μm; OR501B.  
(P.111)

14  *Hexalonche* (?) sp. D  
Scale = 100μm; OR501B.  
(P.111)
PLATE 28

All figures are scanning electron micrographs of Middle Jurassic (upper Bathonian) spumellariians from Snowshoe formation, east-central Oregon, USA. Scale (upper right) = number of microns cited for each figure.

1-3, 14, 17

**Acaeniotylopsis oregonensis** 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
**Xiphostylus** sp. cf. *X. sinuosus* Pessagno and Yang (P.109)
Scales = 100 μm, OR501C.

5-6
**Xiphostylus sinuosus** Pessagno and Yang (P.109)
Scales = 100 μm; 5, OR501B; 6, OR501C.

7
**Xiphostylus** sp. A (P.110)
Scale = 100 μm, OR501C.

8, 16
**Acaeniotylopsis** sp. A (P.111)
Same specimen, scales = 100 and 69 μm, respectively; OR501B.

9
**Acaeniotylopsis** sp. B (P.111)
Scale = 100 μm; OR501B.

10
**Xiphostylus vallieri** Pessagno and Yang (P.110)
Scale = 100 μm; OR501C.

11
**Spumellaria** gen. et sp. indet. I (P.113)
Scale = 100 μm, OR501C.

12-13
**Archaeocenosphaera** sp. A (P.108)
Scales = 100 μm; OR501B.

15
**Xiphostylus whalenae** Pessagno and Yang (P.110)
Scale = 100 μm; OR501B.