

中国沿岸水域养殖贝类及其养殖笼网 污损苔虫 7 新种^{*}

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拟小孔苔虫属 *Microporella* 和斑孔苔虫属 *Fenestrulina* 均隶于唇口目 Cheilostomida 有囊亚目 Ascophorina 皮壳次目 Lepraliomorpha 裂孔超科 Schizoporelloidea 拟小孔苔虫科 Microporellidae。这两个属的主要区别在于: 拟小孔苔虫属具有鸟头体, 而斑孔苔虫属无鸟头体。我们在研究中国沿岸水域养殖贝类及其养殖笼网的污损苔虫时发现, 中国一些学者以前所报道的“纤毛拟小孔苔虫”并非 Pallas (1766) 所鉴定的种, 而是包括不同于纤毛拟小孔苔虫 *Microporella ciliata* Pallas, 1766 的 5 个不同的独立种, 即本文所描述的拟小孔苔虫属的 5 个新种: 空穴拟小孔苔虫 *Microporella vacuatus* sp. nov.、小筛网拟小孔苔虫 *Microporella cribellata* sp. nov.、无齿拟小孔苔虫 *Microporella inermis* sp. nov.、异北方拟小孔苔虫 *Microporella antiborealis* sp. nov. 和项链拟小孔苔虫 *Microporella monilifera* sp. nov.。这 5 个新种与纤毛拟小孔苔虫的主要区别是: 5 新种的口刺为 2~6 根, 除无齿拟小孔苔虫的口上卵胞仅具一列边缘孔外, 其他 4 新种卵胞前表面还有分散的穿孔; 而纤毛拟小孔苔虫的口刺为 6 根, 口上卵胞细颗粒状, 无穿孔。研究中我们还发现前人所定名为“马氏斑孔苔虫”的种并非 Audouin (1826) 所描述的种, 而是 4 种不同于马氏斑孔苔虫 *Fenestrulina mallusii* Audouin, 1826 的独立种, 其中两种不属于污损苔虫的范畴, 另外的两种即本文所描述的斑孔苔虫属的两新种, 即中华斑孔苔虫 *Fenestrulina sinica* sp. nov. 和东方斑孔苔虫 *Fenestrulina orientalis* sp. nov.。这两个新种与马氏斑孔苔虫的主要区别在于: 两新种口刺均为 4~6 根, 受孕个虫有 2 根裸露的口刺; 而马氏斑孔苔虫的口刺为 2~3 根, 受孕个虫无裸露的口刺。

1 空穴拟小孔苔虫 (新种) *Microporella vacuatus* sp. nov. (图版 I, 1~2)

正模标本 No. 75BBY6015-1, 1975 年 6 月 15 日采自北黄海 (37°30'N, 123°30'E), 水深 54m, 1 群体附于贝壳上。标本保存于中国科学院海洋研究所。

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副模标本 No. 85BBY1025-1, 1985 年 10 月 25 日采自灵山岛沿岸水域(35° 40' N, 120° 15' E), 1 群体附着于牡蛎壳上, 水深 20m。标本收藏于中国科学院海洋研究所。

其他标本 No. 97BYF0825-2, 1997 年 8 月 25 日采自青岛石老人沿岸水域(36° 04' N, 120° 24' E), 3 群体附着于养殖栉孔扇贝壳上, 水深 4m。标本收藏于中国科学院海洋研究所。

词源 拉丁词 *vacuatus*(使中空的)为 *vacuo* 的过去分词, 指本新种前壁穿孔孔底无互连成筛网状的钙质突起, 以区别于本新种的近似种雅丽拟小孔苔虫 *Microporella elegans* Suwa & Mawatari, 1998。

形态描述 群体被覆, 淡黄色或灰白色, 在基质上形成不规则形状的单层皮壳。个虫卵圆形、类六角形或长方形, 长 0.520~0.735mm, 宽 0.294~0.442mm; 五点形排列, 相邻个虫以室间细沟间隔, 个虫界限清楚。前壁稍凸, 粗颗粒状, 饰有许多大小不一的圆形小孔; 孔的内缘光滑或具 1~2 个齿状突起伸入孔腔, 但这些齿状突起从不彼此愈合。室口 D 字形, 宽大于长, 长 0.080~0.110mm, 宽 0.108~0.130mm, 底边略直, 内缘细锯齿状, 始端两隅略圆, 具小而明显的齿突, 周缘略隆起形成低平的口围。普通个虫口刺 4~5 个, 受孕个虫口刺常被卵胞遮盖或始端两隅各有一裸露的短刺。口盖半圆形, 淡黄色, 其大小与室口相同; 底边略直, 始端两隅略收缢, 沿弧缘有一粗壮的褐色几丁质硬缘, 前表面呈细颗粒状。调整囊孔圆形, 位于室口始端中央前壁上, 紧贴室口底边, 外缘隆起, 内缘相邻的刺状突起彼此愈合成筛状圆板。调整囊孔始端前壁平坦, 无突起。鸟头体单一, 位于个虫一侧; 鸟头体室大而膨胀, 其表面颗粒状; 吻三角形, 均指向一侧, 末端有一弯向基面的吻沟; 躯轴完整, 膜下孔卵圆形; 颞骨长三角形, 末端呈鞭状, 其长度约为吻的 2 倍, 在中部两侧光滑无钩刺。口上卵胞球形, 长大于宽, 基部埋于末端个虫内, 前表面鼓凸, 除末端和两侧一系列边缘孔外, 还饰有许多大小不一的小孔, 孔底光滑无齿状突起; 卵胞前表面的无孔区饰有许多大小不一的球形颗粒, 末端和两侧的颗粒呈放射状排列。个虫基面均钙化, 中央无膜质窗孔。基孔室末端 2 个, 末端两侧各 3 个。未发现初虫。

地理分布 目前仅发现于北黄海和胶州湾沿岸水域, 水深 4~54m。

污损范围 目前仅在养殖栉孔扇贝壳上发现 3 个群体, 其附着量和出现频率均较低。

讨论 本新种与雅丽拟小孔苔虫 *Microporella elegans* Suwa & Mawatari, 1998 在个虫形态上很相似, 尤其两者调整囊孔都呈圆形, 孔内均有筛孔状圆形小板; 两者附属鸟头体均单一, 鸟头体室均大而膨胀, 三角形的吻均指向一侧, 长三角形的颞骨末端均呈鞭状。但本新种前壁穿孔孔底无筛孔状圆形小板; 鸟头体颞骨中部两侧无钩刺; 卵胞弧形边缘部分饰有一列边缘孔和放射肋, 前表面中央饰有许多球形颗粒和小孔, 孔的内缘光滑。而雅丽拟小孔苔虫前壁穿孔孔底具筛孔状圆形小板; 鸟头体颞骨两侧具一对钩形几丁质小刺; 卵胞弧形部分的末端和两侧具颗粒装饰和穿孔, 卵胞弧形部分的始端和内侧为光滑的无孔区, 故两者区别明显。

2 小筛网拟小孔苔虫(新种) *Microporella cribellata* sp. nov. (图版 I, 5; 图版 III 4~5)

正模标本 No. 85BBY0508-1, 1985 年 5 月 8 日采自灵山岛(35° 50' N, 120° 15' E)沿岸水域, 水深 5m, 1 群体附于贻贝 *Mytilus galloprovincialis* 贝壳上。标本保存于中国科学院海洋研究所。

副模标本 No. 85BBY0508-2, 1985 年 5 月 8 日采自灵山岛(经纬度同正模标本)沿岸水域, 水

深 5m, 1 幼群体附于环纹筛壁苔虫 *Cribrilina annulata* 群体上。标本保存于中国科学院海洋研究所。

其他标本 No. 84BBY0708-1, 1984 年 7 月 8 日采自渤海海峡(38°15'N, 120°45'E), 水深 45m, 1 群体附于牡蛎壳上。No. 94BBYF0815-1, 1994 年 8 月 15 日采自青岛石老人(35°04'N, 120°24'E)沿岸水域, 2 群体附于养殖栉孔扇贝壳上。标本均保存于中国科学院海洋研究所。

词源 种名 *cribellata* 系由拉丁文 *cribellum*(小筛)和词尾 *ata*(持有)构成, 表示前壁穿孔孔底具筛网状钙质板。

形态描述 群体被覆, 黄色或淡褐色, 在基质上形成亚圆形单层斑块或不规则的单层皮壳。个虫长方形或类六角形, 长 0.710~0.840mm, 宽 0.230~0.296mm, 五点形排列, 相邻个虫以室间沟间隔, 个虫界限清楚。前壁凸, 饰有许多微小颗粒, 均匀穿孔, 孔底具筛网状圆板。室口 D 字形, 宽大于长, 长 0.075~0.096mm, 宽 0.108~0.126mm, 始端两隅各有一三角形小齿突, 底边平直或略弯。普通个虫口刺 4~5 根, 受孕个虫在卵胞始端两隅各有一裸露的口刺。口盖半圆形, 宽大于长, 黄褐色; 弧缘有一褐色几丁质硬缘; 底边光滑、平直或略弯, 两隅各有一微小收缢。调整囊孔位于室口始端中央的前壁上, 外缘厚而隆起, 内缘钙质齿突互连成筛网状。鸟头体通常单一, 位于调整囊孔一侧, 具完整的躯轴; 其吻圆三角形或半椭圆形, 斜向末端, 无吻沟; 颞骨圆三角形或半椭圆形。口上卵胞球形, 表面细颗粒状, 长大于宽, 其基部埋于末端个虫内, 两侧和末端具放射肋和 2~3 列边缘孔, 有时表面始端另有若干分散的小孔。个虫基壁完全钙化, 无圆形或裂状膜质窗孔。基孔室, 末端具 2~3 个, 末端两侧各 3 个。初虫答答型(tatiform), 长卵圆形, 始端裸壁狭小, 墙缘呈波形; 前膜卵圆形, 四周裸壁具边缘刺 9 根。在初虫末端中央产生 1 围初虫, 该围初虫室口具 5 根口刺, 位于室口始端中央的调整囊孔内缘齿状突起不互连成网状, 前壁穿孔少, 孔底内缘齿状突起或互连成网状或不互连。围初虫产生 3 个子个虫, 末端中央 1 个, 末端两侧各 1 个。

地理分布 至今仅发现于渤海和黄海南部(胶州湾及其邻近水域), 水深 4~45m。

污损范围 迄今为止仅发现本新种参与养殖栉孔扇贝污损生物群落组成, 但无论从其出现频率还是从其附着量来说都不构成主要污损苔虫种类组成。

讨论 本新种的某些形态特征, 如个虫形态、鸟头体指向、调整囊孔的形态, 以及前壁穿孔的形态与新筛网拟小孔苔虫 *Microporella neocribroides* Dick & Ross, 1988 十分相似。但本新种鸟头体的颞骨呈圆三角形或半椭圆形, 无倒钩; 初虫长卵圆形; 普通个虫具 4~5 根口刺, 受孕个虫在卵胞两侧各有一裸露的口刺。而新筛网拟小孔苔虫鸟头体的颞骨末端呈矛状延伸, 基部两侧各有一倒钩; 初虫类六角形; 普通个虫口刺一般 2 根(位于室口末端), 受孕个虫无口刺裸露。本新种个虫基面完全钙化, 未显示新筛网拟小孔苔虫的某些个虫所持有的裂状膜质窗孔。新筛网拟小孔苔虫群体有时发育成由两层个虫背向排列而成的直立双层结构, 本新种群体则始终持单层被覆生长态势。

3. 无齿拟小孔苔虫(新种) *Microporella inermis* sp. nov. (图版 II, 1~2)

正模标本 No. 96BYF0926-1, 1996 年 9 月 26 日采自石老人沿岸水域(35°04'N, 120°24'E), 水深 3~4m, 1 群体附于养殖栉孔扇贝壳上。标本保存于中国科学院海洋研究所。

副模标本 No. 96BYF0926-2, 1996 年 9 月 26 日采自石老人沿岸水域(经纬度同正模标本), 水深 3~4m, 1 群体附于养殖栉孔扇贝壳上。标本保存于中国科学院海洋研究所。

其他标本 No. 97BBY0825-1, 1997 年 8 月 25 日采自石老人沿岸水域(经纬度同正模标本),

水深 3~4m, 1 群体附于养殖栉孔扇贝上, 标本保存于中国科学院海洋研究所。

词源 拉丁词 *inermis* (解除武装的), 表示本新种个虫前壁穿孔内缘光滑, 孔底无齿状或刺状突起互连而成的筛网状钙质板, 以示与其他前壁穿孔且孔底具筛网状钙质板的近似种新筛网拟小孔苔虫 *Microporella neocribroides* Dick & Ross, 1988 和小筛网拟小孔苔虫, 新种 *Microporella cribrillata* sp. nov. 的区别。

形态描述 群体被覆, 灰褐色, 在基质上形成不规则的单层皮壳。个虫长椭圆形、类六角形或长方形, 长 0.530~0.648mm, 宽 0.212~0.280mm, 五点形排列, 相邻个虫以隆起的室间脊间隔, 个虫界限清楚。前壁平坦或略凸, 除有时在末端、两侧和始端有一个或若干个大而明显的边缘孔外, 个虫表面饰有均匀分布的细小穿孔; 小孔孔底无筛网状亚圆形小板, 孔间前壁均呈颗粒状。每一个虫在室口始端中央有一略呈圆锥形的口下突。初生室口亚半圆形, 宽大于长, 长 0.132~0.154mm, 宽 0.198~0.210mm, 底边略呈弧形, 内缘光滑无锯齿, 两侧和末端略隆起, 形成低平的口围; 无齿突。口刺通常 2 根, 有时 3 根, 均位于室口末端, 受孕个虫口刺均被遮盖。口盖形状和大小与初生室口完全相符, 底边常呈波纹状, 始端两隅略收缢且各有一明显的口盖肌附着痕, 弧缘几丁质硬缘细而狭。调整囊孔类肾形或类圆形, 宽大于长, 位于室口始端中央, 寓于口下突内, 孔底具筛孔状小板。鸟头体通常单一, 有时成对, 偶尔无鸟头体, 位于室口始端一侧; 鸟头体室略隆起, 表面光滑或细颗粒状; 吻三角形, 斜向末端, 吻端具明显的吻沟; 颚骨长三角形, 近末端两侧光滑, 无几丁质钩状小刺。口上卵胞球形, 长大于宽, 基部埋于末端个虫内; 前表面鼓凸, 末端和两侧具斜向前表面中央的放射肋和一系列边缘孔, 放射肋内缘的卵胞前表面一无孔区, 表面饰有许多微小颗粒, 但有时除边缘孔外, 前表面边缘部分有若干分散的小孔。

地理分布 目前仅发现于青岛及其邻近海域。

污损范围 迄今为止仅发现本新种参与养殖栉孔扇贝污损生物群落组成, 但无论从其出现频率还是从其附着量来说都不构成主要污损苔虫种类组成。

讨论 本新种与新筛网拟小孔苔虫在调整囊孔的形态, 其所在位置以及鸟头体着生位置, 其吻的指向等形态特征上十分相似。但本新种前壁穿孔内缘光滑无刺, 孔底无圆形筛状板, 口侧鸟头体颚骨为简单的长三角形; 而新筛网拟小孔苔虫前壁穿孔内缘钙质刺互连成网状, 口侧鸟头体颚骨末端呈膨大的双叉形, 两侧缘中间部分各有一倒钩, 故两者区别明显。

4 异北方拟小孔苔虫 (新种) *Microporella antiborealis* sp. nov. (图版 I, 3~4; 图版 III 3)

正模标本 No. 85BBY1025-3, 1985 年 10 月 25 日采自青岛胶州湾灵山岛 (35°40'N, 120°15'E) 沿岸水域, 水深 20m, 1 幼群体附于贝壳上。标本保存于中国科学院海洋研究所。

副模标本 No. 85BBY1025-4, 1985 年 10 月 25 日采自青岛胶州湾灵山岛 (35°40'N, 120°15'E) 沿岸水域, 水深 20m, 1 幼群体附于贝壳上。标本保存于中国科学院海洋研究所。

其他标本 No. 85BBY0508-3, 1985 年 5 月 8 日采自灵山岛 (35°40'N, 120°15'E) 沿岸水域, 水深 20m, 4 个幼群体附于贝壳上。No. 75BBY0613-1, 1975 年 6 月 13 日采自南黄海 (35°45'N, 124°00'E), 水深 84m, 2 群体附于贝壳上。No. 95BBY0816-1, 1995 年 8 月 16 日采自胶州湾口团岛湾 (36°02'N, 120°17'E), 水深 4m, 1 群体附于养殖皱纹盘鲍贝壳上。所有标本均保存于中国科学院海洋研究所。

词源 种名 *antiborealis* 由希腊词 *ant-*(反对, 替代)和 *borealis*(北方的)构成, 表示本新种与其近似种北方拟小孔苔虫 *Microporella borealis* Suwa & Mawatani, 1988 相似, 但具有明显的不同。

形态描述 群体被覆, 淡黄色、黄色或淡褐色, 在基质上形成亚圆形单层斑块。个虫长卵圆形或类六角形, 长 0.500~0.714mm, 宽 0.290~0.334mm, 五点形排列, 相邻个虫以室间脊间隔, 个虫界限清楚。个虫前壁凸, 表面粗颗粒状, 在颗粒之间嵌有许多类圆形的低陷小孔, 小孔内缘光滑无齿。室口 D 字形, 宽大于长, 长 0.070~0.088mm, 宽 0.100~0.116mm, 始端两隅各有一三角形齿突, 底边细锯齿状; 口刺 5~6 根, 位于两侧和末端弧缘, 在群育变化初生带口刺通常 6 根, 在群育重复初生带口刺通常 5 根; 受孕个虫口刺被遮盖。口盖半圆形, 宽大于长, 淡褐色或褐色, 始端两隅各有一收缢, 底边细锯齿状, 近弧缘有一深褐色几丁质硬缘。口围低平不隆起。调整囊孔位于室口始端中央前壁上, 寓于一较低平的类圆形龛突内, 呈宽大于长的半圆形, 其始端弧形孔壁较宽, 较隆起; 调整囊孔始端弧形内缘呈细锯齿状, 末端直或略弯, 顶边中央有一舌形或长三角形突起伸入调整囊孔的中央, 舌形突起的自由缘呈细锯齿状; 调整囊孔顶边与室口底边的距离通常约为调整囊孔横径的 2/3, 但有时等于或大于调整囊孔的横径, 在调整囊孔顶边与室口底边之间的前壁为十分凹陷的光滑区。鸟头体单一, 位于调整囊孔始端一侧, 其圆三角形的附着内缘约与调整囊孔所在的类圆形龛突的一侧位于同一纵轴线上, 或略偏于中央, 或略偏于外侧; 吻三角形, 吻沟粗, 末端向基面倾斜, 末端略平截; 颞骨长, 其长度约为自个虫长度的 1/3, 其末端呈鞭状延伸, 中部两侧缘光滑无钩状刺。口上卵胞球形, 长大于宽。前表面中央十分凸出, 末端和两侧边缘有一列边缘孔, 末端近边缘另有 1 或 2 列排列稀疏的小孔, 中央区也有若干小孔; 卵胞表面与个虫前壁一样, 呈粗颗粒状, 颗粒排列不规则; 卵胞始端向室口两侧延伸形成弓形架覆盖在室口上方。基孔室, 末端 3 个, 两侧各 3 个。个虫基面钙化, 无膜质窗孔。初虫答答型, 长卵圆形, 侧裸壁狭, 始端较宽; 前膜长卵圆形; 边缘刺 8 根; 隐壁周缘型, 末端和两侧较狭, 始端较宽, 表面光滑, 内缘无锯齿; 始端裸壁表面细颗粒状。围初虫 2 个, 由端出芽形成。

地理分布 目前仅发现于黄海南部(中国近海)和青岛及其邻近海域, 水深 4~84m。

污损范围 迄今为止仅发现本新种参与养殖栉孔扇贝污损生物群落组成, 但无论从其出现频率还是从其附着量来说都不构成主要污损苔虫种类组成。

讨论 本新种初生室口和口盖形态、口刺排列和数目、调整囊孔所在的位置及其形态、单一鸟头体所在位置及其鞭状颞骨以及其答答型初虫的形态等特征都与北方拟小孔苔虫十分相似。但北方拟小孔苔虫个虫前壁穿孔孔底具互连成网状的钙质齿突; 个虫基面具卵圆形膜质窗孔; 鸟头体室十分膨胀, 因而使吻端十分隆起, 其鞭状颞骨中部两侧各有钩状小刺。而新种前壁穿孔内缘光滑, 孔底无钙质齿突互连成的网状圆板; 个虫基面完全钙化而无膜质区; 鸟头体室完全陷于前壁内, 吻沟向基面倾斜, 吻端平截斜向基面, 鞭状延伸的颞骨两侧缘无钩刺, 故两者区别明显。

5. 项链拟小孔苔虫(新种) *Microporella monilifera* sp. nov. (图版 II, 图 3~5; 图版 III 图 1)

正模标本 No. 95BSF0820-1, 1995 年 8 月 20 日采自海南岛三亚(18°11'N, 109°39'E), 1 群体附于养殖马氏珠母贝壳上, 水深 4m。标本保存于中国科学院海洋研究所。

副模标本 No. 85BSF0820-1, 1985 年 8 月 20 日采自广东大亚湾(22°35' N, 114°35' E), 1 群体附于养殖马氏珠母贝壳上, 水深 4m。标本保存于中国科学院海洋研究所。

词源 种名 *monilifera* 系由拉丁词 *monil-*(项链, 项圈)和词尾 *-fera*(具有)构成, 表示 D 字形初生室口的弧缘具明显的念珠状齿突, 使弧缘呈项链状。

形态描述 群体被覆, 淡黄色, 在基质上形成单层的亚圆形斑块。个虫长卵圆形或类六角形, 长 0.342~0.568mm, 宽 0.310~0.450mm, 五点形排列, 相邻个虫以室间细沟间隔, 个虫界限清楚。除末端中央调整囊孔区外, 个虫前壁较平坦, 表面饰有许多球形颗粒状突起和类圆形小孔, 孔内无筛网状钙质圆板; 在个虫前壁始端和始端两隅常有 1 个或 2 个较大的边缘孔, 有时末端两隅中部一侧和两侧也有类似的边缘孔。室口 D 字形, 宽大于长, 长 0.054~0.066mm, 宽 0.064~0.104mm, 周缘略隆起形成低平的口围; 室口底边平直, 内缘光滑, 末端和两侧的弧形内缘具念珠状突起, 无齿突。口刺 3~5 根, 粗壮, 在群育变化初生带口刺 5 根, 而在群育重复初生带口刺仅 3 根; 受孕个虫在卵胞每侧有一裸露的口刺。调整囊孔位于室口始端中央前壁上, 寓于一圆形口下龛突内, 呈宽大于长的肾形, 内缘锯齿状, 调整囊孔末端的钙质板狭, 始端的钙质板宽而隆起。口下龛突离室口底边的距离约为室口底边长度的 1/2。附属鸟头体单一, 位于个虫中部一侧; 鸟头体室中等大小, 略膨胀, 表面细颗粒状; 躯轴完整; 吻三角形, 指向一侧或略斜向末端; 吻沟深, 吻端钝圆; 颞骨长三角形, 两侧缘光滑无钩状小刺, 末端呈鞭状延伸。口上卵胞球形, 宽大于长, 基部埋于末端个虫内, 除一系列边缘孔外, 前表面饰有许多小孔。初虫答答型, 倒卵圆形, 末端较宽, 始端较狭, 边缘刺多达 18 根。围初虫 2 个, 位于末端中央。

地理分布 目前仅发现于(中国)广东大亚湾和海南三亚沿岸水域, 水深 4m。

污损范围 本新种附于养殖马氏珠母贝上, 至今仅发现一个群体, 目前尚无任何资料可以描述本种的污损程度。

讨论 本新种与纤毛拟小孔苔虫 *Microporella ciliata* (Pallas, 1766) 的外形相似, 但本新种的口下龛突离室口底边的距离比纤毛拟小孔苔虫的长, 调整囊孔呈肾形, 而纤毛拟小孔苔虫呈亚圆形; D 字形室口的弧缘也不像纤毛拟小孔苔虫那样光滑而呈明显的念珠状。本新种前壁始端、末端和中部两侧各有 1~2 个较明显的边缘孔, 这种分散的边缘孔在纤毛拟小孔苔虫并不存在。本新种的卵胞除一系列边缘孔外前壁表面另有许多分散的小孔, 无放射肋; 而纤毛拟小孔苔虫的卵胞仅具一系列边缘孔, 边缘放射肋十分显著。本新种的副模标本为一尚未充分发育的群体, 计有 18 个个虫世代构成, 卵胞尚未发育, 故处于群育早期阶段的后期, 令人遗憾的是在制备扫描电镜样品时, 初虫被损坏, 仅能显示其末端 5 根边缘刺, 故确定初虫为答答型。从现有标本我们发现幼群体发育从第 4 无性世代开始才出现单一的附属鸟头体。鸟头体颞骨的形态与纤毛拟小孔苔虫很相似。

6 中华斑孔苔虫(新种) *Fenestulina sinica* sp. nov. (图版 III, 2; 图版 IV, 1~2)

Microporella mallusi; Androsova, 1959 (pars): 50, Pl. 2, Fig. 13; Wang & Cai, 1977 (pars): 20, Fig. 32 (nec *Cellepora mallusii* Audouin, 1826)

Fenestulina mallusi; Huang et al., 1990 (pars): 748, Fig. 6G; Huang, 1994 (pars): 620 and other Chinese authors (nec *Cellepora mallusii* Audouin, 1826)

正模标本 No. 96BYF0926-3, 1996 年 9 月 26 日采自石老人沿岸水域(34°04' N, 120°24' E), 水深 4m, 1 群体附于养殖栉孔扇贝壳上。标本保存于中国科学院海洋研究所。

副模标本 No. 85BBY0508-4, 1985年5月8日采自灵山岛沿岸水域(35°50'N, 120°15'E), 水深5m, 1群体附于贝壳上。标本保存于中国科学院海洋研究所。

其他标本 No. 75BBY0613-2, 1975年6月13日采自南黄海(35°45'N, 124°00'E), 水深84m, 1群体附于贝壳上。No. 96BYF0926-4, 1996年9月26日采自石老人海岸水域(经纬度同正模标本)。No. 57BBY0704-1, 1957年7月4日采自渤海海峡(28°10'N, 120°51'E), 水深54m, 5群体附于酸浆贝 *Terebralella koreanica* 介壳上。No. 85BBY1025-5, 1985年10月25日采自灵山岛沿岸水域(35°40'N, 120°15'E), 水深5m, 5群体附于贝壳上。No. 96BYF0926-4, 1996年9月26日采自石老人沿岸水域(经纬度同正模标本), 水深2~4m, 3群体附于养殖栉孔扇贝壳上。标本保存于中国科学院海洋研究所。

词源 种名 *sinica* 系源自拉丁词 *sinensis*(中国的), 表示模式标本取自中国。

形态描述 群体被覆, 灰白色, 淡黄色或淡褐色, 在基质上形成宽大的亚圆形斑块或不规则的单层皮壳。个虫卵圆形、类六角形或长方形, 长0.378~0.834mm, 宽0.352~0.402mm, 五点形排列, 相邻个虫以深沟间隔, 个虫界限清楚。个虫裸壁隆起, 在前壁周缘形成由始端沿两侧伸向末端并在室口底边愈合的隆起脊, 此隆起脊所裹的宽大区域较低陷平坦。在裸壁隆起脊所裹的宽大平坦区内, 表面光滑, 在室口底边和调整囊孔之间有1~3行(通常2行)、在前壁两侧各有1~3列(通常1~2列, 有时3列)排列不规则的类圆形穿孔, 这些穿孔通常在群育变化初生带的个虫上较少, 而在群育重复初生带的个虫上较多, 所有穿孔内缘都具有钙质突起互连而成的星芒状钙质板。在室口末端的前壁上两侧各有1较大、中央1较小的椭圆形穿孔, 孔内也具类似的钙质齿突。在室口两侧各有一无孔区。室口D字形, 长大于宽, 长0.102~0.154mm, 宽0.066~0.090mm; 室口始端两隅各有一三角形小齿突, 底边平直无锯齿; 室口周缘体壁略隆起, 但不形成明显的口围。口刺1~4根, 在群育变化初生带口刺通常1(少数个虫)或2根(多数个虫), 在群育重复初生带口刺通常3~4根, 受孕个虫在卵胞始端两隅可清楚见到各有一斜向末端的口刺。调整囊孔新月形, 寓于前壁平坦区中央类圆形突起内, 内缘呈锯齿状。在受孕个虫的末端个虫, 此类圆形突起的始端部分的钙质隆起常与前位个虫卵胞顶边愈合。口上卵胞球形, 长大于宽, 基部埋于末端个虫内; 前表面十分鼓凸, 两侧和末端边缘有一列大的边缘孔, 边缘孔之间的隆起部分形成由边缘指向卵胞中央的放射肋, 放射肋在卵胞前表面中央互相愈合形成一横向的隆起脊, 无颗粒状装饰。基孔室末端2个, 末端两侧各2个。个虫基面完全钙化。初虫卵圆形, 均小于其后续个虫, 室口D字形, 有一与其后续个虫相似的调整囊孔, 但室口始端和前壁两侧仅有1列穿孔, 口刺1~2根。初虫产生3个围初虫: 末端1个, 末端两侧各1个。

地理分布 目前仅发现于黄海、渤海(中国近海)和东海北部沿岸水域, 水深2~84m。

污损范围 本种是马氏珠母贝、美丽日月贝、杂色鲍等养殖贝类及其养殖笼网的常见污损苔虫。

讨论 根据 Hayward 等(1979)和 Gordon(1989), 马氏斑孔苔虫 *Fenestulina malusii* (Audouin, 1826)(按拟小孔苔虫科的有关文献, 马氏斑孔苔虫的种名在不同学者常不一致, 有的书写为 *malusi*, 有的书写为 *malusii*, 本文按多数学者根据 Audouin 的原始文献, 拼作 *malusii*)分布于地中海、英国和欧洲大西洋沿岸。Harmer(1957)报道于印度太平洋海区的“*Fenestulina malusii*”至少包括2种, 其中1种已由 Winston 等(1986)确定为一新种, 即 *Fenestulina harmeri* (Winston et al, 1986: 28~30, Fig. 67~69)。

Robertson (1908) 和 Osburn (1952) 报道于北美太平洋沿岸的“*Fenestulina malusii*”已由 Soule 等 (1995) 系统研究并区分出 4 种, 并根据其中一种建立了一新属, 即仿斑孔苔虫属 *Fenestruroides* Soule, Soule & Chaney, 1995 (Soule et al., 1995: 156 ~ 171)。分布于中国沿岸水域一直被命名为“*Fenestulina malusii*”的苔藓虫, 至少包括 4 种, 其中 2 种分布于南沙群岛水域, 一种即为 Winston (1986) 描述的 *Fenestulina harmeri*, 其前壁均匀穿孔, 另一种前壁仅在室口和调整囊孔之间有一列穿孔, 因属非污损苔虫, 故另文描述。其他两种均参与污损生物群落组成, 即本文所描述的两个新种中华斑孔苔虫 (新种) *Fenestulina sinica* sp. nov. 和东方斑孔苔虫 (新种) *Fenestulina orientalis* sp. nov.。中华斑孔苔虫与欧洲海域的马氏斑孔苔虫有以下明显的区别: (1) 前者初虫与其后续个虫形状相似, 其前壁钙化, 有调整囊孔和稀疏的单列穿孔, 后者初虫答答型, 即有一较大的前膜区, 前膜周缘裸壁有 10 根边缘刺; (2) 前者在前壁两侧有 2 列穿孔, 室口始端和调整囊孔之间有 2 行穿孔, 两侧的穿孔通常不延伸至个虫始端 (即个虫前壁始端常无穿孔), 在末端仅延伸至室口始端两侧, 在室口末端另有 3 个穿孔, 即在室口两侧有一无孔区; 而后者前壁两侧各有一列、室口始端和调整囊孔之间有 2 行穿孔, 两侧穿孔常延伸至前壁始端 (即个虫前壁始端有穿孔), 在室口区延伸至末端, 室口两侧均有穿孔; (3) 前者口刺 4 ~ 6 根, 沿室口两侧和弧缘均排列, 后者口刺仅 2 ~ 3 根, 均位于室口末端; (4) 前者室口始端两隅各有一三角形小齿突, 后者室口无齿突; (5) 前者受孕个虫室口两侧各有 1 根裸露的口刺, 后者受孕个虫口刺全被遮盖。

Androsova (1959) 和王复振等 (1977) 分别报道于中国烟台、青岛和浙江沿岸水域的“*Microporella mallusii*”并非 Audouin (1826) 所描述的种, 因为他们描述的受孕个虫均有 2 根口刺裸露; 他们的“*Microporella mallusii*”实际上包括两个完全不同的独立种, 即 *Fenestulina sinica* sp. nov. 和 *Fenestulina orientalis* sp. nov., 但 Androsova (1959) 所描述的标本似乎更接近于后一新种, 而王复振等 (1977) 描述的标本更接近前一新种。Huang 等 (1990) 报道于香港及其邻近水域的“*Fenestulina malusii*”经我们重新鉴定研究发现他们的污损苔虫标本实际上为 *Fenestulina orientalis* sp. nov., 但其绘图标本为取自青岛沿岸水域的污损苔虫标本, 实际上为本文描述的 *Fenestulina sinica* sp. nov.。

7. 东方斑孔苔虫 (新种) *Fenestulina orientalis* Liu sp. nov. (图版 IV, 3 ~ 5)

Microporella mallusii: Okada, 1929: 27, text Fig. 12; Androsova, 1959: 50, 65, Pl. 2, Fig. 13; Wang & Cai, 1977 (pars): 20, Fig. 32 (nec *Cellepora mallusii* Audouin, 1826)

Fenestulina malusii: Mawatari, 1952: 265; 1936: 9; 1965: 618 Fig. 119a ~ b; Mawatari & Mawatari, 1981b: 53; 1986: 97, Fig. 4° 8a; Li, 1989: 108; Huang et al., 1990 (pars): 748 excluding Fig. 6G and other Chinese authors (nec *Cellepora mallusii* Audouin, 1826).

正模标本 No. 92BBS0319, 1992 年 3 月 19 日采自三亚珊瑚湾 (18° 11' N, 109° 41' E), 1 群体附于珊瑚上, 水深 3 ~ 7m。标本保存于中国科学院海洋研究所。

副模标本 No. 90BBS1103-1, 1990 年 11 月 3 日采自三亚湾 (18° 15' N, 109° 28' E), 1 群体附于贝壳上, 水深 16m。标本保存于中国科学院海洋研究所。

其他标本 No. 75BBY0615-2, 1975 年 6 月 15 日采自北黄海 (37° 30' N, 123° 30' E), 水深 54m, 1 群体附于贝壳上。No. 75BBY0613-2, 1975 年 6 月 13 日采自南黄海 (35° 45' N, 124° 00' E), 水深 84m, 2 群体附于贝壳上。No. 96BYF0926, 1996 年 9 月 26 日采自石老人沿岸水域 (34° 04' N, 120° 24' E), 水深 4m,

3 群体附于养殖栉孔扇贝壳上。No. 75BBE1010-1, 1975 年 10 月 10 日采自东海(30°30'N, 127°00'E), 水深 100m, 2 群体附于贝壳上。No. 76BBE0829, 1976 年 8 月 29 日采自东海(26°30'N, 124°00'E), 水深 139m, 2 群体附于贝壳上。No. 59BBS0707-1, 1959 年 7 月 7 日采自南海(24°45'N, 115°15'E), 水深 70m, 3 群体附于扇贝壳上。No. 60BBS0210-1, 1960 年 2 月 10 日采自南海(19°30'N, 110°15'E), 水深 97m, 2 群体附于海胆壳上。No. 85BSF0820-2, 1985 年 8 月 20 日采自广东大亚湾(22°35'N, 119°35'E), 水深 4m, 3 群体附于养殖马氏珠母贝壳上。No. 90BTS1103-1, 1990 年 11 月 3 日采自海南邻昌礁(19°55'N, 109°26'E), 水深 0~2m, 许多群体附于珊瑚和贝壳上。No. 92BBS0324-1, 1992 年 3 月 24 日采自海南沙湾(19°22'N, 110°41'E), 水深 3~12m, 4 群体附于珊瑚和贝壳上。No. 95BSF0820-2, 1995 年 8 月 20 日采自三亚(18°11'N, 109°29'E), 水深 4m, 5 群体附于养殖马氏珠母贝壳上。No. 95BSF0822-1, 1995 年 8 月 22 日采自海南新村(18°26'N, 110°31'E), 水深 4m, 5 群体附于养殖马氏珠母贝壳上。还有许多幼群体, 附于用作人工试板的海湾扇贝壳上(试验点为青岛、厦门和新村)。所有标本均保存于中国科学院海洋研究所。

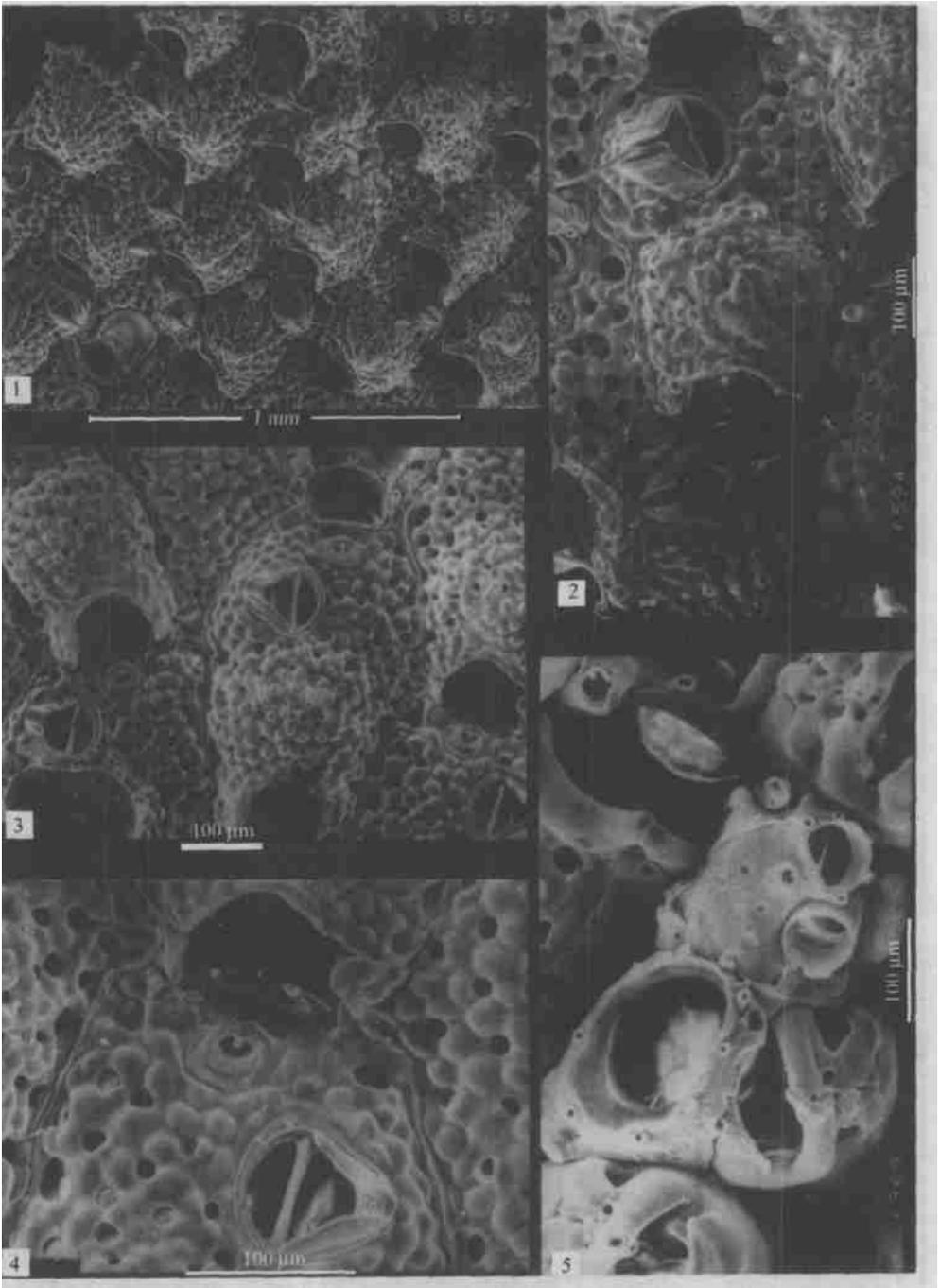
词源 本新种曾被误定为马氏斑孔苔虫, 但分布于日本和中国沿岸的斑孔苔虫是与分布于欧洲大洋和地中海水域的 *Fenestulina malusii* sp. str., 完全不同的独立种, 故取名为 *orientalis* 以示区别。

形态描述 群体被覆, 灰白色、黄白色或淡黄色, 在基质上形成亚圆形单层斑块或不规则的单层皮壳, 有时部分个虫直立生长形成不规则分歧的叶状薄膜。个虫卵圆形或六角形, 长 0.270~0.696mm, 宽 0.200~0.320mm, 放射状排列, 相邻个虫以室间细沟间隔, 个虫界限清楚。裸壁隆起, 在个虫边缘形成一个把室口和前壁都包围在内的裸壁脊。裸壁脊所裹的前壁中央凸, 两侧和始端较低平, 表面光滑, 在室口底边和调整囊孔之间有 1~3 行星芒状小孔(在群育变化初生带孔较少, 通常为 1 行, 在群育重复初生带孔较多, 通常有 2 列, 有时有 3 列), 在前壁两侧和始端通常仅有 1 列穿孔, 有时有 2 列穿孔, 在室口末端和末端两侧有时有 1 列穿孔, 所有穿孔均呈星芒状, 即孔内具有在中心愈合的刺状突起。室口 D 字形, 宽大于长, 长 0.056~0.072mm, 宽 0.064~0.096mm, 无齿突。室口周缘略隆起, 形成低平的口围。普通个虫口刺 4~6 根, 在群育变化初生带口刺 6 根, 在群育重复初生带口刺通常 4 根, 受孕个虫室口两侧各有一裸露的口刺。口盖黄褐色或褐色, 具一深褐色的边缘几丁质硬缘。调整囊孔位于个虫前壁中央偏末端的亚圆形突起上, 突起在末端中央有一舌形或半圆形突起伸向始端, 两侧和始端有一呈新月形或马蹄形的加厚伸入孔内, 舌形或半圆形突起和新月形或马蹄形加厚自由缘均呈锯齿状, 故调整囊孔内缘呈锯齿状。卵胞口上型, 长大于宽, 基部埋于末端个虫内, 表面光滑, 中央鼓凸, 两侧和末端弧缘有一列边缘孔和放射肋。基孔室, 末端 3 个, 两侧各 3 个。初虫答答型, 前膜大, 约为初虫前区的 4/5; 裸壁在末端细狭, 由室口两侧向始端逐渐加宽, 表面均光滑, 边缘刺 10~12 根; 初虫产生 3 个围初虫, 末端一个, 末端两侧各 1 个。

地理分布 广泛分布于渤海、黄海、东海(中国近海)和南海等广大水域, 从潮间带至水深 140m 都有分布。

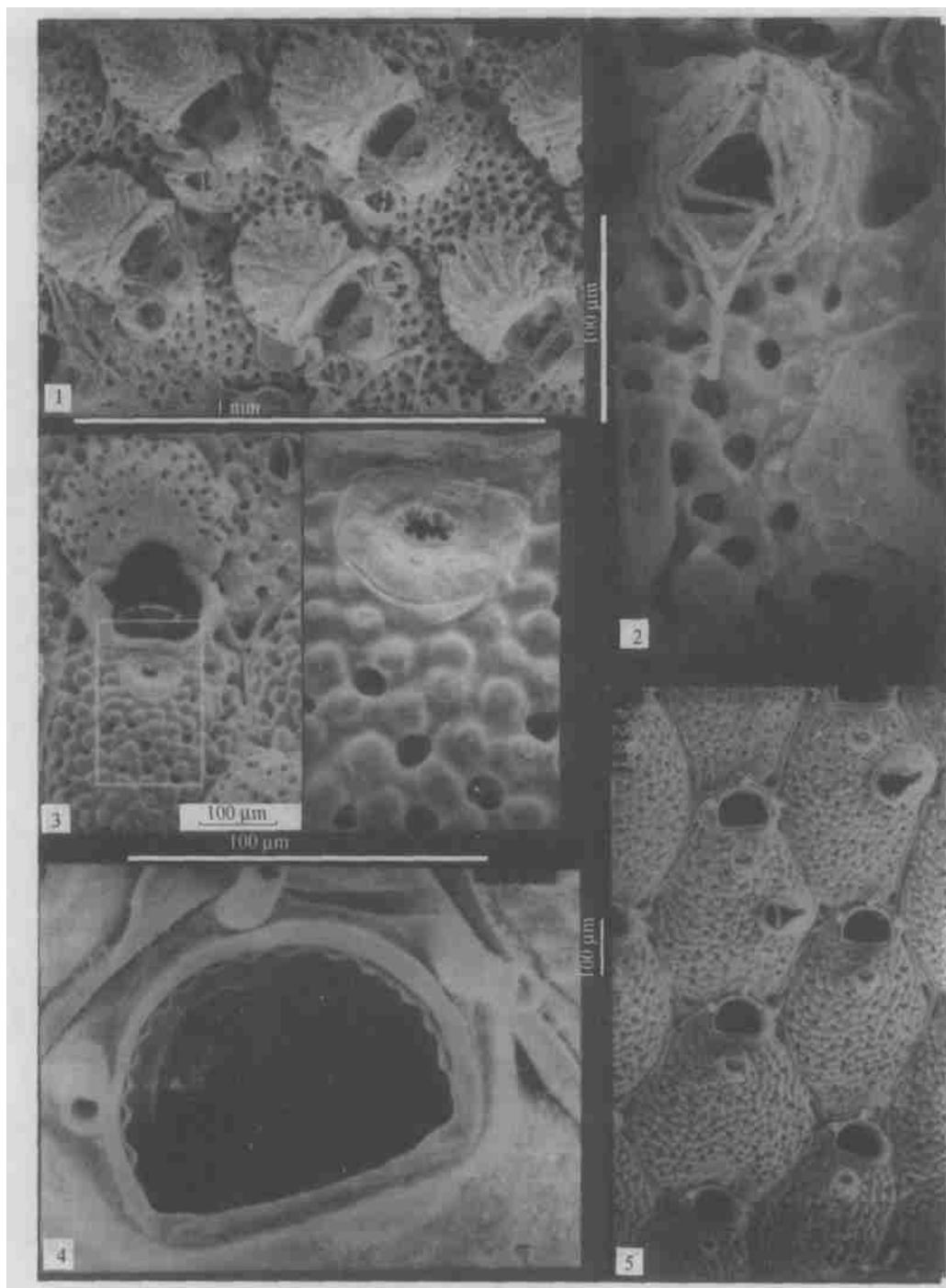
污损范围 本新种参与扇贝、牡蛎、珍珠贝、日月贝、鲍类等养殖贝类和养殖笼网的污损生物群落组成, 是常见的主要污损生物之一, 但出现的频率不大, 从不构成优势类群。

讨论 本新种与分布于欧洲大西洋和地中海沿岸水域的马氏斑孔苔虫 *Fenestulina malusii* sp. str. 的个虫形态相似, 尤其是当个虫前壁在室口底边与调整囊孔之间具 2 行星芒状穿孔时, 两者个虫尤其相似。这两种斑孔苔虫的答答型初虫形态相似: 卵



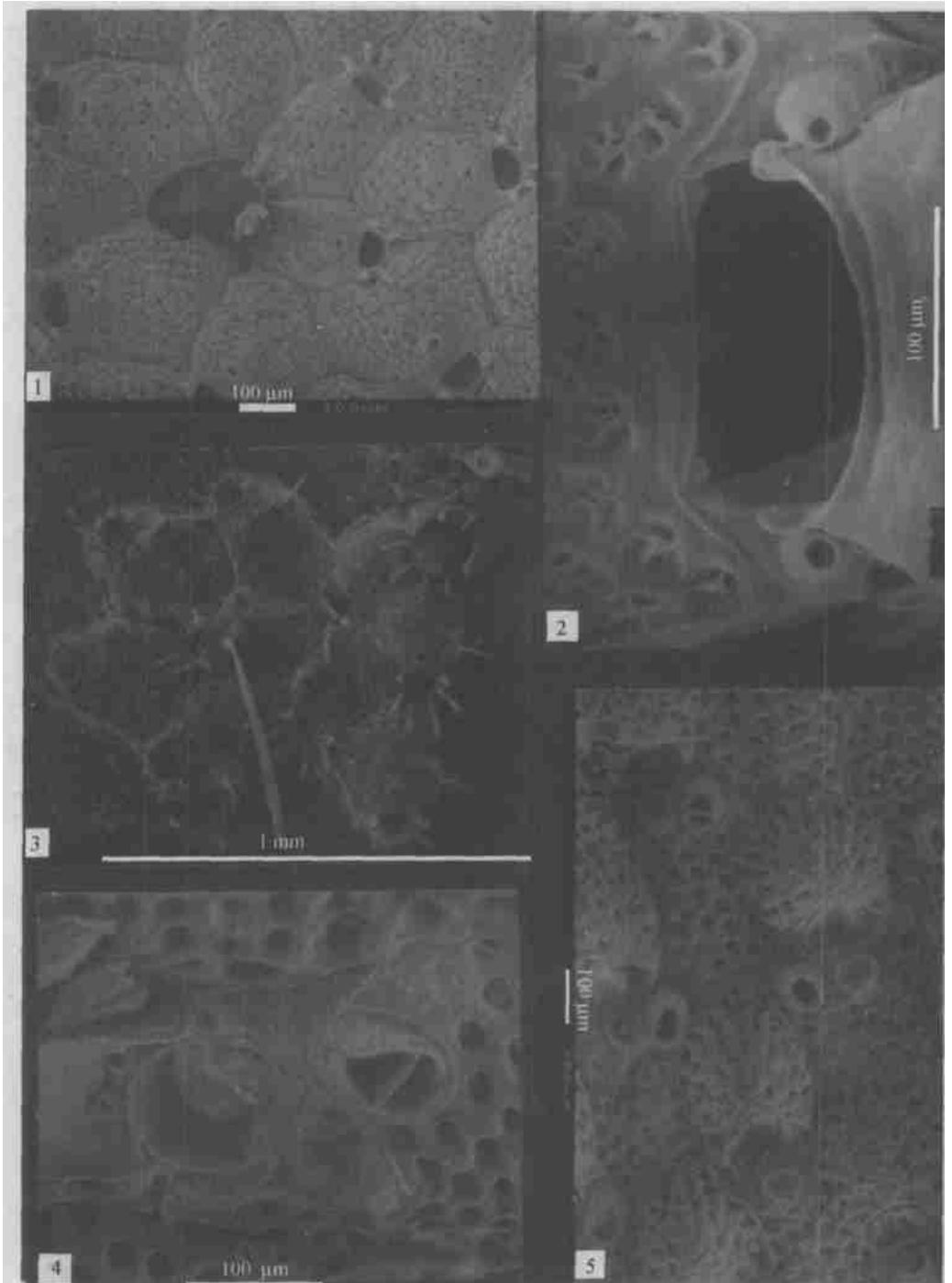
图版 (Plate I)

图 1~2; 空穴拟小孔苔虫(新种) *Microporella vacuatus* sp. nov. 1 群体的一部分, 示个虫、卵胞、鸟头体和调整囊孔, 比例尺 1mm。2 受孕个虫, 示前壁穿孔、鸟头体及其颞骨、调整囊孔和卵胞, 比例尺 100 μ m。图 3~4; 异北方拟小孔苔虫(新种) *Microporella antiborealis* sp. nov.。3 群体的一部分, 示个虫、卵胞、鸟头体和调整囊孔, 比例尺 100 μ m。4 受孕个虫, 示前壁穿孔、调整囊孔、鸟头体、齿突和室口的锯齿状底边 比例尺 100 μ m。图 5; 小筛网拟小孔苔虫(新种) *Microporella cribellata* sp. nov. 的幼群体, 示初虫及其末端围初虫(附于环纹筛壁苔虫 *Cribrilina annulata* 上), 比例尺 100 μ m。



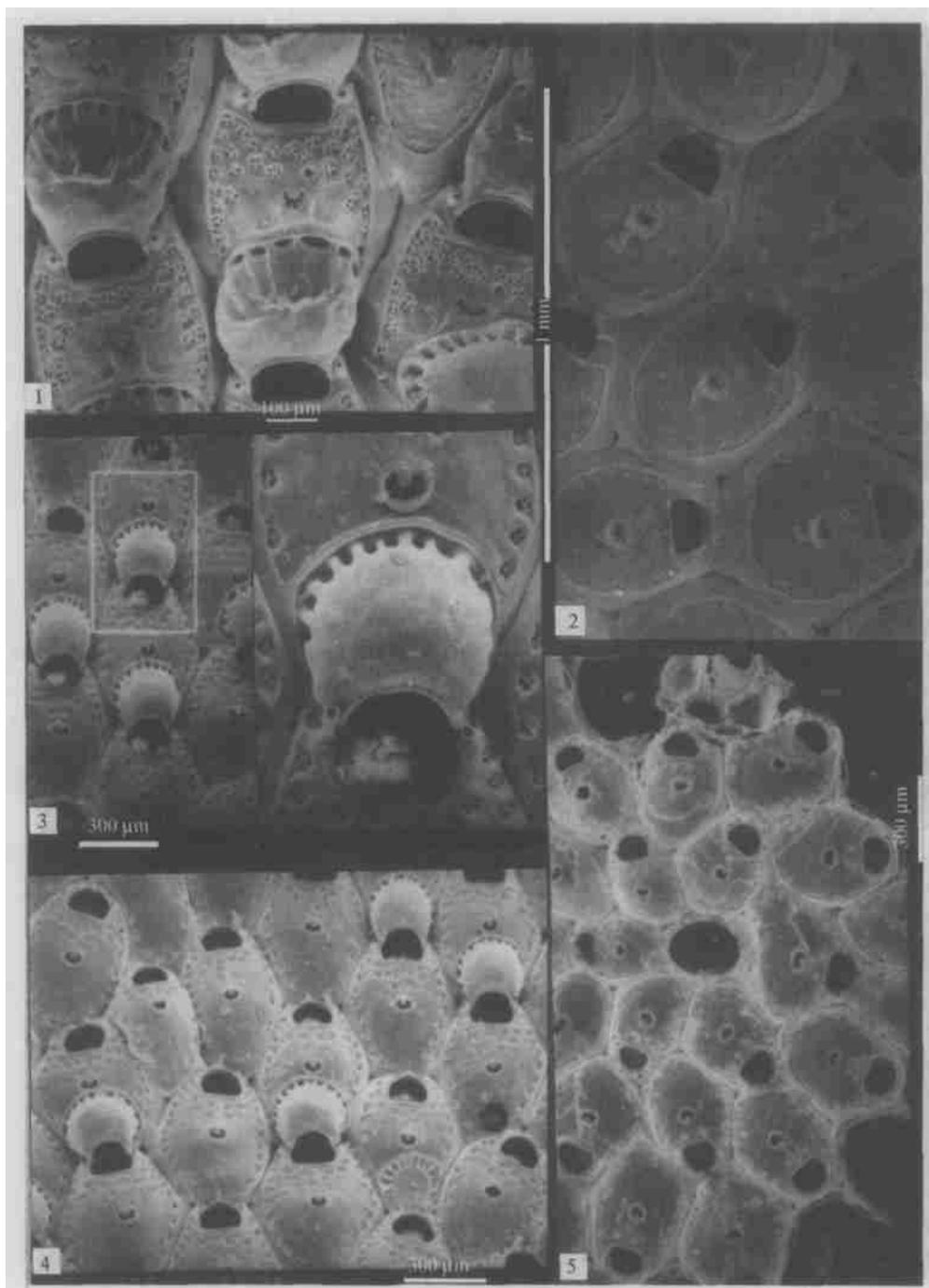
图版(Plate) II

图1~2: 无齿拟小孔苔虫(新种) *Microporella inermis* sp. nov. 1. 群体的一部分, 示个虫、卵胞、调整囊孔和鸟头体, 比例尺 1mm。2. 个虫的一部分, 示前壁穿孔、鸟头体及其颞骨和调整囊孔(始端部分), 比例尺 100 μ m。图3~5: 项链拟小孔苔虫(新种) *Microporella monilifera* sp. nov.。3. 图左: 一受孕个虫, 示卵胞和调整囊孔, 比例尺 100 μ m。图右: 此受孕个虫前壁穿孔和调整囊孔的放大。4. 室口, 示室口末端内缘念珠状突起和口刺, 比例尺 100 μ m。5. 群体的一部分, 示个虫前壁穿孔、分散的边缘孔、室口、口刺、调整囊孔和鸟头体, 比例尺 100 μ m。



图版(Plate) III

图 1: 项链拟小孔苔虫(新种) *Microporella monilifera* sp. nov. 的幼群体, 示初虫(已破损)及其围初虫 比例尺 100 μ m。
图 2: 中华斑孔苔虫(新种) *Fenestrulina sinia* sp. nov. 的受孕个虫的一部分, 示室口的齿突、口刺和室口两侧的无孔区, 比例尺 1mm。图 3: 异北方拟小孔苔虫(新种) *Microporella antiborialis* sp. nov. 的幼群体, 示初虫及其围初虫, 比例尺 1mm。图 4~5: 小筛网拟小孔苔虫(新种) *Microporella citelata* sp. nov.。4 个虫的一部分, 示前壁穿孔、调整囊孔和鸟头体, 比例尺 100 μ m。5. 群体的一部分, 示个虫、室口、调整囊孔、卵胞和鸟头体, 比例尺 100 μ m。



图版(Plate) IV

图 1~2: 中华斑孔苔虫(新种) *Fenestulina sinica* sp. nov. 1. 群育重复初生带的一部分, 示受孕个虫及其室口、前壁穿孔、调整囊孔和卵胞, 比例尺 $100\mu\text{m}$ 。2. 群育变化初生带的一部分, 示个虫及其室口、口刺和调整囊孔, 比例尺 1mm 。图 3~5: 东方拟小孔苔虫(新种) *Fenestulina orientalis* sp. nov. 3. 图左: 群体的一部分, 示个虫、室口、卵胞和调整囊孔, 比例尺 $300\mu\text{m}$; 图右: 一受孕个虫的末端部分及其后续个虫的始端部分的放大, 示前壁穿孔、室口、卵胞和调整囊孔。4. 群育重复初生带的一部分, 示普通个虫和受孕个虫, 比例尺 $300\mu\text{m}$ 。5. 幼群体, 示初虫及其围初虫, 比例尺 $300\mu\text{m}$ 。

圆形前膜区均具有 10~12 根边缘刺, 均在末端产生 3 个围初虫。两者的群体发育也十分相似: 在群育变化初生带个虫室口底边与调整囊孔之间的穿孔均有一自围初虫开始向初生带末端递增的倾向, 在群育重复初生带个虫室口底边与调整囊孔之间区域绝大多数个虫有 2 行穿孔, 有些个虫则有 3 行穿孔(虽然始端 1 行穿孔孔数比末端 2 行的孔数少)。但马氏斑孔苔虫所有个虫前壁在调整囊孔水平以下的穿孔均沿边缘排列 1~2 列, 而本新种群育重复初生带有些个虫通常有 2 列穿孔。本新种的口刺较多, 普通个虫有 4~6 根, 受孕个虫每侧有 1 根裸露的口刺, 口上卵胞表面光滑无颗粒装饰。马氏斑孔苔虫的口刺较少, 仅 2~3 根, 受孕个虫无裸露的口刺, 卵胞表面具粗壮的颗粒状装饰。本新种调整囊孔所寓的 C_1 突成亚圆形, 而马氏斑孔苔虫的 C_1 突呈宽大于长的半圆形。

根据对现有标本的观察, 发现 Androsova(1959)报道于烟台、青岛沿岸的“*Microporella malusii*”不是 Audouin(1826)的种, 而隶于本新种的范畴。因为按照其图版所示, 其前壁室口底边与调整囊孔之间有星芒状小孔 2~3 行, 边缘孔均为 2 列。Androsova(1959)所描述的“标本口刺 2~5 根, 受孕个虫‘或不具小刺’或在基部具有 2 个小刺”显然是观察不仔细的结果。现在标本所有受孕个虫均有 2 根裸露的口刺, 普通个虫口刺 4~6 根。Androsova(1959)在描述其标本特征时未指出调整囊孔位于亚圆形的 C_1 突上, 而亚圆形 C_1 突的形态是本新种与马氏斑孔苔虫的区别特征之一。

我们认为日本学者(如 Okada, 1929; Mawatari, 1952, 1963, 1965a; Mawatari et al., 1986)报道于日本沿岸水域的“*Fenestrulina malusii*”并非 Audouin(1826)所描述的种, 这是因为: (1)普通个虫口刺 4~5 根, 受孕个虫口刺 2 根; (2)前壁边缘的星芒状穿孔在调整囊孔两侧和始端排成 1~2 列。日本材料与中国材料不同之处在于: (1)日本材料卵胞末端和两侧一列边缘孔之间的放射肋比较明显, 卵胞表面具微细的颗粒装饰; 中国材料放射肋不显著, 卵胞表面光滑无颗粒装饰; (2)日本材料室口底边与调整囊孔之间星芒状小孔排成 1~2 列, 而中国材料为 1~3 列。尽管存在上述区别, 我们认为中国和日本材料均可归为同一种的不同地理亚群, 但与欧洲大西洋和地中海沿岸水域的 *Fenestrulina malusii* sp. str. 显然属于不同的种。

本新种与前一新种中华斑孔苔虫除初虫明显不同外, 本新种裸壁脊将室口包裹在内, 前壁周缘均有一列边缘孔, 室口始端两侧无齿突, 口上卵胞前表面中央无横脊; 而中华斑孔苔虫裸壁脊未把室口包裹在内, 室口两侧有一无孔区, 室口始端两侧各有一三角形小齿突, 口上卵胞末端和两侧边缘的放射肋常在前表面中央愈合为单一的横脊。

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SEVEN NEW SPECIES OF GENUS *MICROPORELLA* AND *FENESTRULINA* COLLECTED FROM THE CULTURED SHELL AND THEIR FLOATING CAGES IN CHINESE WATERS^{*}

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Abstract

This present paper introduces 7 new species, among which 5 are referred to genus *Microporella* Jullien, 1888, i. e., *Microporella vacuatus* sp. nov., *Microporella cribellata* sp. nov., *Microporella inermis* sp. nov., *Microporella antiborealis* sp. nov., and *Microporella monilifera* sp. nov.; 2 are referred to genus *Fenestulina* Jullien, 1888, i. e., *Fenestulina sinica* sp. nov. and *Fenestulina orientalis* sp. nov..

Diagnoses of new family, new genus and new species

Microporella vacuatus sp. nov. (Pl. I, Figs. 1~2)

Colony encrusting, yellowish or grey-white, forming an irregularly shaped encrustation. Zooids oval, subhexangular or rectangular, arranged quincuncially, separated by fine sutures. Primary orifice D-shaped, slightly straight proximally, nearly rounded at either proximal corner; with a conspicuous, small condyle at either proximal corner; peristome slightly raised. 4~5 oral spines present in ordinary zooid; 1 oral spine not concealed at either proximal side of the ovicells or all the oral spines entirely concealed in fertilized zooids. Frontal wall gently convex, coarsely granulated, perforated by small, various-sized, subcircular pores whose inner borders are smooth or has 1~2 denticles. Operculum yellowish, equal to the orifice in shape and size, with a robust, brown sclerite along the arched margin, marked with many granules on the frontal surface. Ascopore circular, cribrate, situated median-proximally to the orifice, separated from proximal edge of orifice by a very short span, with raised outer peripheral margin forming a lowered umbo. Avicularium single, located at one side of the frontal wall, with an entire crossbar; Avicularian chamber expanded and marked with granules; Rostrum triangular, directed laterally, rostral groove slightly curved towards the basal side. Mandible with a setiform distal extension and without a hook at either side. Hyperstomial ovicell globose, longer than wide, embedded basally, marked with a row of marginal pores and a row of radial ribs disto-laterally; frontal surface convex, nodular, with a few small pores scattered over its surface. With basal porechambers, 2 distally and 3 disto-laterally. Ancestrulae absent.

This new species resembles *Microporella elegans* Suwa & Mawatari, 1998 in the shape of

zooid, the presence of the cribrate ascopore, the direction and chamber character of the single avicularium and the appearance of the mandible. But differs from that species in that the frontal pores of the new species not having a cribrate bottom, and that the setiform mandible not having a hook at each side of the base.

Microporella cribellata sp. nov. (Pl. I, Figs. 5; Pl. III, Figs. 4~5)

Colony encrusting, unilaminar, forming a subcircular patch or irregularly-shaped encrustation. Zooids rectangular or subhexangular, arranged quincuncially, separated by distinct sutures. Orifice D-shaped, wider than long, with a nearly straight or slightly concave proximal border and a small, triangular condyle at either proximal corner. Operculum corresponding to the orifice in shape and size, with a small constriction at either proximal corner and with a brown chitinous semicircular sclerite along its arched margin. Oral spines 4~5. Frontal wall convex, finely granulated, perforated by evenly distributed pores whose bottoms have circular cribrate plates. Ascopore circular, cribrate, situated proximally to the orifice, raised and thickened proximally much more than distally to form a suboral umbo. Adventitious avicularium usually single, sometimes double, and located beside the ascopore. Rostrum rounded triangular or semielliptical, directed obliquely to the distal end and without a rostral groove. Mandible rounded triangular or semielliptical. Ovicell hyperstomial, embedded basally, globose, longer than wide, marked with radial ribs and 2~3 rows of small pores along the distal and lateral margin, frontal surface with many minute granules and several dispersed pores. 4~5 oral spines in ordinary zooids and with one oral spine not concealed at either proximal side of the fertilized zooid. Ancestrula tatiform, elongate oval, with an oval frontal membrane surrounded by an undulate mural rim, with 9 marginal spines on the gymnocyst along the mural rim, and giving rise to a distal periancestrula. Basal wall of the zooid calcified entirely and without oval or slit-like membranous fenestrae. Basal porechambers 2~3 distally and 3 disto-laterally.

This species resembles *Microporella neocribroides* Dick & Ross, 1988 in the direction of the avicularian rostrum, the presence of the cribrate plate at the bottom of frontal pore, and the circular, cribrate ascopore. But differs from that species in that its avicularian mandible is rounded triangular or semielliptical, its oral spines are 4~5 in ordinary zooids and 2 oral spines exposed in the fertilized zooid its basal wall is entirely calcified, and its ancestrula is elongate oval. However in *Microporella neocribroides*, its avicularian mandible is lanceolate with paired hooks at the base, its oral spines are 2 in the ordinary zooid and are completely concealed in the fertilized zooid, its ancestrula is subhexangular, its basal wall is not entirely calcified and with a slit-like fenestra.

Microporella inermis sp. nov. (Pl. II, Figs. 1~2)

Colony encrusting, brownish, forming an irregularly-shaped, unilaminar encrustation. Zooids elongate elliptical, subhexangular or rectangular, arranged quincuncially, separated by distinct interzooidal ridges. Orifice D-shaped, semicircular, wider than long slightly concave and smooth proximally. No condyles. Oral spines usually 2, sometimes 3, located at the distal margin of the orifice; peristome lowered. Operculum equal to the orifice in shape and size, proximal corners rounded, wave-shaped proximally and with a fine sclerite. Frontal wall flattened or slightly convex, granulated, with evenly distributed pores whose bottom without cribrate plate, several large marginal pores situated

distally, laterally and proximally. A scopore circular, cribrate, raised and thickened proximally much more than distally to form a suboral umbo. Adventitious avicularium usually single, sometimes double, rarely absent, located beside the scopore, and directed obliquely upwards. Rostrum raised, triangular, truncate terminally and with a rostral groove. Avicularian chamber slightly expanded laterally and with granular ornaments on the surface. Crossbar entire. Mandible triangular, with an elongate projection. Hyperstomial ovicells globose, embedded basally, wider than long or longer than wide, frontal surface granulated, marked with a row of marginal pores and ribs; the ribs are robust, extended from the peripheral border to the center of the ovicells and rimmed thickly along the ooeportal margin. Basal porechambers 2 distally and 1 disto-laterally. A subcircular, membranous window is present on the basal wall.

This new species is similar to *Microporella neocribroides* Dick & Ross, 1988 in the morphology and position of the scopore, the shape and orientation of the adventitious avicularium. But the new species can be easily distinguished from that species by its non-cribrate frontal pores and by its avicularian mandible being elongate triangular and without paired hook at the base.

Microporella antiborealis sp. nov. (Pl. I, Figs. 3~4; Pl. III, Figs. 3)

Colony encrusting, yellowish, yellow or brownish, unilaminar, forming a circular patch or an irregularly-shaped incrustation. Zooids elongate elliptical or subhexangular, arranged quincuncially, distinct, and separated by interzooidal ridges. Orifice D-shaped, with a serrated proximal border and a triangular condyle at each proximal corner. Operculum semicircular, wider than long, slightly constricted at either proximal corner, serrated proximally, and with a semicircular, brown sclerite; condyles triangular. Oral spines 5~6. Frontal walls convex, coarsely nodular, marked with many subcircular, lowered pores whose bottom without cribrate plate. Scopore situated on a circular suboral umbo, slightly raised, wider than long, crescent, proximal border finely serrated, distal border straight or slightly arched, with a triangular or linguiform central process directed downwards. The area between the proximal border of the orifice and the suboral umbo are imperforated. A vicarium single, situated at one side proximally to the suboral umbo or below the suboral umbo and embedded in the frontal wall. Rostrum triangular, directed outwards, truncated terminally, with a wide, short rostral groove slightly oblique towards the basal side at the terminal. Mandible elongate, with a flagelloid distal extension without a hook at the either side proximally. Oral spines concealed entirely in the fertilized zooid. Hyperstomial ovicells globose, longer than wide, embedded basally, convex frontally, marked with a single row of marginal pores and another 1~2 series of pores dispersed disto-laterally; frontal surface marked granulated, perforated by small pores. The proximal part of the ovicell extended laterally downwards along the orifice border to form an arched rim. Ancestrula tati-form, elongate oval, with a well-developed proximal gymnocyst and an elliptical frontal membrane; marginal cryptocyst smooth on the surface, without serration at the inner border and marked with 8 marginal spines around the frontal membrane; and from the distal and disto-lateral three periancestrulae were budded. Multiporous mural porechamber 2 in the transverse wall and 4 in each lateral wall. Basal porechambers 3 distally and 3 disto-laterally. Basal surface of the zooid entirely calcified.

This new species is similar to *Microporella borealis* Suwa & Mawatari, 1998 in the shape of

the orifice and operculum, the number and arrangement of the oral spines, the morphology and position of the ascopore, and the presence of the single adventitious avicularium with flagelloid mandible. But it is different from the later species in that its frontal pore is without a cribrate plate at the bottom, its basal wall is entirely calcified, its avicularian chamber is entirely embedded in the frontal wall, its avicularian rostral groove obliquely directed towards the basal side, its avicularian rostral terminal is truncate and directed basally and its flagelloid mandible is smooth at either side. *Microporella borealis* is characterized by the cribrate plate at the bottom of the frontal pore, by the raised and expanded avicularian chamber, by the oval membranous window on the basal wall, by the much raised avicularian rostral terminal, and by the flagelloid mandible with a hook at either proximal side.

Microporella monilifera sp. nov. (Pl. II, Figs. 3~5; pl. III, Figs. 1)

Colony encrusting, yellowish, unilaminar, forming a subcircular patch or an irregularly-shaped incrustation. Zooids elongate oval or subhexangular, arranged quincuncially, distinct, and separated by finely interzooidal grooves. Orifice D-shaped, wider than long, smooth in the inner margin of the straight proximal border, bead-like in the inner margin of the semicircular border, and the peripheral margin raised slightly to form a lowered peristome. No condyles. 5 oral spines present in the zooids of the primary zone of astogenic change, and 3 present in the zooids of the primary zone of astogenic repetition. Frontal wall flattened except for the portion where the ascopore is situated, coarsely nodular, and marked with subcircular pores without cribrate plate at the bottom. One or two large marginal pores present proximally, latero-proximally, distally or mid-laterally. Adventitious avicularium single, situated mid-laterally on the frontal wall, median in size; avicularian chamber slightly expanded and granular; crossbar entire; rostrum triangular, oriented laterally or obliquely distally, with a deep groove and an obtuse terminal; mandible elongate triangular, without a horn at either side and with a flagelloid distal portion. Ascopore situated within a round suboral umbo, nearly crescent, serrated in the inner margin. Hyperstomial ovicells globose, wider than long, subimmersed, convex frontally, marked with a row of the marginal pores and many dispersed, small pores. Ancestrula tati-form, oval, wider distally than proximally, with 18 marginal spines surrounding the frontal membrane, and giving rise to 3 periancestrulae; 1 distally and 1 on each disto-lateral side.

This new species resembles *Microporella ciliata* (Pallas, 1766), in the morphology of the avicularian mandible. But it differs from *Microporella ciliata* (Pallas, 1766) in the presence of the bead-like ornament along the inner semicircular margin of its orifice, and in the presence of many dispersed pores on the frontal surface of its ovicell besides a row of the marginal pores, and the presence of large, dispersed marginal pores on the zooidal frontal wall besides the frontal perforations.

Fenestulina sinica sp. nov. (Pl. III, Figs. 2; Pl. IV, Figs. 1~2)

Colony encrusting, grey-white, yellowish or brownish, subcircular or irregularly-shaped, forming an extensive unilaminar incrustation. Zooid oval, subhexangular or rectangular, arranged quincuncially, distinct, and separated by deep grooves. Orifice D-shaped, wider than long, straight proximally, with a small, triangular condyle at either proximal corner, raised slightly peripherally to form a lowered peristome. Oral spines 1~2 on the zooid in the primary zone of astogenic change, 3~4 on the zooids in the primary zone of astogenic repetition, and 1 visible at either proximal corner of the fer-

tilized zooid. Frontal wall flattened, gymnocyst smooth, much raised, forming a narrow, circling ridge running from the proximal end up laterally to the either proximal corner of the orifice and further turning inwards to unite with each other along the proximal border of the orifice. Ascopore situated centrally on the frontal wall, nearly crescent, the outer peripheral margin slightly raised, forming a lowered umbo; the inner margin of the ascopore finely serrated, a robust linguiform projection disto-centrally protruding downwards and serrated on the edge. The umbo on the distal zooid of the fertilized zooid fused proximally with the distal rim of the ovicell. 2 ~ 3 rows of large pores present between the central umbo and the proximal border of the orifice. One smaller and two larger pores present respectively centro-distally and latero-distally to the orifice, and an imperforated area was left laterally to the orifice. 1 ~ 2 (rarely 3) rows of similar pores present laterally to the umbo, and 1 row of similar pores proximally. Hyperstomial ovicell globose, longer than wide, embedded basally, convex frontally; rim thickened disto-laterally, marked with a row of the marginal pores and a row of the radial ribs some of which extended proximally to form a more or less transverse ridge on the frontal surface. Basal porechambers 2 distal and 2 on each disto-lateral side. Ancestrula oval, similar in shape, gymnocystal ridge and ascopore to ordinary zooid, but smaller in size than ordinary zooid; 1 ~ 2 oral spines on the distal border of the D-shaped orifice, and only a row of the pores between the ascopore and the proximal border of the orifice. Periancestrulae 3: 1 distal and 1 on each disto-lateral side.

This new species was referred to *Fenestrulina malusii* by the Chinese authors. It differs from the latter species in its ancestrula being similar to ordinary zooids instead of tatiform, in the two oral spines visible in the fertilized zooid, in the presence of the imperforated area beside the orifice, in the presence of the condyles at the proximal corners of the orifice, and in the presence of a more or less transverse ridge on the frontal surface of the ovicell.

Fenestrulina orientalis sp. nov. (Pl. IV, Figs. 3 ~ 5)

Colony encrusting, grey-white, white-yellow or yellowish, forming a unilaminar, subcircular patch or an irregular-shaped incrustation; or sometimes encrusting-erect, forming an irregular-furcated, foliate sheet. Zooids oval or hexangular, arranged radially, distinct, and separates by fine, inter-zooidal groove. Orifice D-shaped, wider than long, without condyles, slightly raised peripherally to form a lowered peristome. Oral spines 6 on the zooids in the primary zone of astogenic change, 4 on the zooids in the primary zone of astogenic repetition and 2 oral spines visible in the fertilized zooids. Operculum semicircular, wider than long, brownish, with a brown, marginal sclerite. Gymnocyst raised laterally and proximally to form a gymnocyst ridge running from the proximal end to the distal end to surround the orifice and the frontal wall. Frontal wall convexed centrally, lowered latero-proximally and smooth on the surface. A row of the round marginal pores with stellate calciferous processes at the bottom arranged along the inner border of the gymnocystal ridge. 2 ~ 3 rows of similar pores present between the ascopore and the proximal border of orifice. Ascopore crescent, situated on the center of the frontal wall, raised in the outer peripheral margin to form a lowered circular umbo; the proximal inner border serrated; a robust, linguiform, disto-central projection protruding downwards from the distal inner border, with its edge serrated. Hyperstomial ovicells globose, longer than

wide, embedded basally, convex frontally, rim thickened disto-laterally, smooth on the frontal surface, and marked with a row of the large marginal pores and with the short, radial ribs intercalated between the marginal pores. Basal porechambers 3 distally and 3 on each disto-lateral side. Ancestrula tatiform, oval, and with a large frontal membrane which occupies the four fifths of the frontal area and is surrounded by 10 ~ 12 marginal spines. Periancestrulae 3: 1 distal and 1 either disto-lateral.

Fenestrulina malusii (Audouin, 1826) is exclusively Atlantic and Mediterranean species. This new species differs from *Fenestrulina malusii* sp. str. in that the oral spines is 4 ~ 6 instead of 2 ~ 3, the fertilized zooid has two oral spines exposed instead of concealed, the umbo which bears the ascopore is subcircular instead of semicircular, and the frontal pores between the ascopore and the proximal border of the orifice are 1 ~ 3 (usually 2) rows instead of 1 ~ 2 (usually 1) rows. Except for the ancestrula, this new species is different from *Fenestrulina sinica* sp. nov. in the gymnocystal ridge running from the proximal end to the distal end to surround the orifice, and the marginal pores evenly displayed along the gymnocystal ridge, which means that no imperforated area is present beside the orifice, and in the absence of a more or less transverse ridge on the frontal surface of the ovicell.

“*Fenestrulina malusii*” reported from the Japanese waters is different from *Fenestrulina malusii*, sp. str. in that 4 ~ 5 instead of 2 ~ 3 oral spines present in ordinary zooids and two oral spines visible instead of concealed in fertilized zooids, so it is a distinct species from *Fenestrulina malusii* (Audouin, 1826), and seems to be referred to this new species.