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江蓠科的一个新属——多穴藻属*

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丹麦海藻学家 Børgesen (1953) 在研究印度洋的毛里求斯島产的海藻标本时，发現了一种具有精子囊窠成羣的江蓠类海藻，但他由于沒有見到窠孔，因此不敢十分肯定是否卽精子囊窠，同时，也沒有采到四分孢子体和雌配子体。他根据精子囊窠成羣的这一特点把它定作江蓠属的一个新种，命名为 *Gracilaria multifurcata* Børgesen。

其后，近江彦荣(1958)检查加納产的 *Gracilaria henriquesiana* Hariot 时，也发現了这一种江蓠的精子囊窠呈球状，切面观为 3—6 个集生在一起，囊窠也同样沒有开口；他訊为这种构造是异于江蓠属中其他种类的。

我們最近在研究中国南海江蓠属的种类时，也遇到了一些具有这种特点的标本，外形上有些象 *Gracilaria edulis* (Gmel.) Silva 和 *G. coronopifolia* J. Ag.。我們从許多的藻体切片中看到了集生成羣的精子囊窠，随着藻体的成熟，窠壁也有不同程度的溶化，最后溶合为两个大的囊窠，囊窠頂端也有相应数目的放散精子的开口。因此，可以肯定这些集生的球状物为精子囊窠。当我們进一步检查采自不同地点和不同时期的 5 号約 50 个以上的蜡叶和液浸标本后，进一步发現了这类海藻的囊果內具有带状且多分歧的滋养絲，这些絲几乎成一規律，完全向囊果的基部伸展，在目前已掌握的标本中，还沒有看到滋养絲伸向果被方向的任何痕迹。在孢子体的标本中，其围繞四分孢子囊的皮层細胞变态为长圓形。此外，在外形上，藻体的基部具有匍匐部分，上生数个直立部分，其下常有盘状固着器。关于江蓠属的种类是否具有匍匐部分，就我們所看到的文献，除 Harvey (1849, pl. 65) 訊为 *G. verrucosa* 的盘状固着器附有假根和 G. M. Smith (1944：266) 訊为江蓠属的藻体自匍匐的根状茎生出外，其他作者，在描述江蓠属的特征时，都只提到固着器为一盘状。Rosenvinge (1931:602) 曾討論过 *G. verrucosa* 的固着器，他訊为丹麦标本的固着器完全为盘状。Dawson (1961：218) 在最近的研究中，描述了 *Gracilariopsis sjoestedtii* (Kylin) Dawson 的盘状固着器連有半根状茎枝，而 G. M. Smith 报告的种类中，本种被列在江蓠属中。因此，他对江蓠属的藻体直立部分是由匍匐的根状茎部分长出的描述，很可能是受了本种的影响。我們检查了我国南北沿岸各地所产的各种江蓠属的标本，迄今也沒有发現匍匐部分。我們考虑了上述这些异于江蓠属的特点后，訊为这些标本应作为江

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蓴科的一个新属，根据其精子囊呈多穴状，新属被命名为多穴藻属，拉丁学名为希腊文 *poly*（多）和 *cavernosa*（穴）二字組成。

多穴藻屬 *Polycavernosa* gen. nov.

Thallis ut in genere *Gracilaria* existentibus; uno usque etiam compluribus ramis, erectibus vel repentibus, e partibus rhizomatiformibus. Tetrasporangia cruciata. Antheridie cavernas subglobosas, ad dimidium in thallum immersas, in cameras minutissimas parietibus tenuissimis divisas formantia. Neque gonimoblasto ut in *Gracilaria* conjugato cum pericarpio cellis nutrientibus, in cellulis parenchymato infra gonimoblasti penetraliter immersa.

Typus: *Polycavernosa fastigiata* sp. nov.

藻体的外形和內部构造与江蓴属同，但基部有匍匐茎，节部生有盘状固着器，上生分枝的直立部分。四分孢子囊散生于体表面，十字形分裂。精子囊窠成羣地集生在一起，形成一多穴状的小球，位于藻体的近表面处；藻体成熟时，窠壁逐漸溶化，交汇成 2 至数个大型的囊窠，頂端有相应数量的窠孔；每个精子囊窠大小和江蓴属的种类相似，因此，多穴状小球形的精子囊窠羣的体积极大，易于識别。囊果內的滋养絲带状、分枝、不与囊果被連接，但伸向下方，穿入产孢絲組織以下的薄壁小細胞間。

模式种：帚状多穴藻 *Polycavernosa fastigiata* sp. nov.。此外，本属中还有繁枝多穴藻 *Polycavernosa ramulosa* sp. nov.。Børgesen 的 *Gracilaria multifurcata* Børg. 和近江最近研究的 *Gracilaria henriquesiana* Hariot 也都应移轉至本新属中。这四种多穴藻可以用下列的检索表加以区别：

多穴藻属种类的检索表

1. 藻体圓柱状 ……2
1. 藻体扁压或扁平 ……3
2. 藻体上部的分枝稀疏，外形似帚状，枝距較长……1. 帚状多穴藻
2. 藻体上部的分枝頻繁，外形非帚状，枝距甚短……2. 繁枝多穴藻
3. 分枝的腋角一般在 45° 以內……3. 加納多穴藻
3. 分枝的腋角近于直角……4. 复叉多穴藻

1. 帚状多穴藻 *Polycavernosa fastigiata* sp. nov.

（图版 I. 1—12，图版 II. 1—6）[1]

Thallis cylindricis ad 5—11 cm. altae, 1.5—2 mm. crassis; infra parcius ramosis, supra virgato-ramosa; sat distante pseudodichotome subpinnatimve in seriebus 5—6 ramosis; ramis in apice attenuatis, plerumque bifidis; cellulis internis magnis, parietibus tenuibus;

1) 本文附图分别为本所馮明华同志和宋华中同志代为描繪和摄影，特此志謝。

corticibus essentialite 2—3 strata cellularum; tetrasporangiis ovatis, ad 26—33μ longis, 17μ latis per corticem passim dispersis, cruciatim divisis; antheridia cavernas subglobosas, ca. 83—191μ; cystocarpi super thallum ubique sparsi, ca. 1.3 mm. diam., prominentes globosis.

藻体直立丛生，圓柱状，5—11 厘米高；鳶色到丁字茶色或焦茶色，軟骨質，制成的蜡叶标本不完全附着于紙上。藻体基部具明显的匍匐茎，上生直立部分，其下有盘状固着器。主枝在体下部虽明显，但不及頂，枝径 1.5—2 毫米；分枝 5—6 次，一般开始于体中部，因而藻体外形有帚状的輪廓，常呈互生状二叉式分歧，偶有三叉、四叉或偏生的現象。分枝基部有时略縊縮；小枝較細，径 0.5—1 毫米；末枝頂端尖鋭，常成叉状。

藻体的內部构造，髓部是大的近圓形的薄壁細胞，胞径 180—332 微米，壁厚 6 微米；外围以 2—3 层小的含色素体的皮层細胞，3.3—6.6 微米×3—4 微米；髓部和皮层之間有明显的界限；皮层的外面有胶質层，厚約 3 微米。

四分孢子囊散生在藻体的皮层細胞中；表面观卵形或长卵形，26—33×16.5 微米；切面观为卵形，36—40×26 微米；周围的皮层細胞显著地变态为长圓柱形，十字形分裂。

精子囊窠球形，成羣的集中在皮层細胞中形成精子囊窠羣，每个囊窠羣常由 6—10 个囊窠組成，囊窠羣的大小一般为 116—191×83—166 微米，其中每个囊窠的大小为 23—33×8—16.5 微米；囊窠羣中的每个精子囊窠成熟到一定时期，囊窠壁开始溶化逐漸合并为 2 至数个大的囊窠，頂端产生开口；溶化后的囊窠呈长袋状，66—99×26—40 微米。精子囊无色反光強，散生在窠壁周围，窠壁周围的細胞明显的变态。

囊果球形，常散生在藻体的中部和上部，突出于体表面，一般径在 1.3 毫米上下，具喙，基部縊縮；产孢絲細胞較大，圓柱形，长 66—116 微米，寬 33—50 微米，无色，壁薄，絲頂端的一些細胞形成果孢子囊；囊球形或卵形，径 26—33 微米，中央具明显的星状色素体；果被約230微米厚，由 9—11 层細胞組成；滋养絲粗壯，具較多的分枝，仅由囊果下部的产孢絲产生，穿入囊果底部的小細胞間；囊果頂端具一开口。

帚状多穴藻生长在中、低潮带的岩石上或石沼中。新种的模式标本为 AST 60-7240 号，雌配子体；异性模式标本 AST 60-7240a 和 AST 60-7240b 分别为雄配子体和四分孢子体，这些标本系 1960 年 8 月 5 日本所郑树栋和周显銅二同志采自广东海南島乐东县的鶯哥海；副模式标本有两号，分别采于 8 月（AST 60-7268, ♂, AST 60-7268a, ♀, AST 60-7268b, ⊕）和 10 月（AST 60-7909, ♂, AST 60-7909, ⊕）。这一新种还見于崖县的馬岭，9 月（AST 60-7645, ♂）。

本种的外形和体質上有些象 *Gracilaria edulis* (Gmel.) Silva，但有关后者的詳細报导很少。May (1948:29) 描述澳洲产的 *G. edulis* 具有匍匐茎，可惜的是沒有任何有关生殖器官的記載。Turner (1809:124) 則記述过这种江蓠的固着器为盘状，直立部分自其上生出。近来，Ohmi (1958:18) 曾解剖了原地模式标本，发現囊果內具有很多滋养絲連于产孢絲和囊果被之間。因此，两者之間在外形上虽近似，但应隶于不同的属中。我們在最初

整理本新种的标本时，从外形上也曾誤訊为是 *G. edulis*，但經深入研究后，始确定为本种。

2. 繁枝多穴藻 *Polycavernosa ramulosa* sp. nov.

(图版 I. 13，图版 II. 7)

Thallis cylindricis ad 6—10 cm. altae, corymboso; infra parcius ramosis, internodiis longioribus, supra dense ramosa, internodiis curtis 0.5—3 mm. et frequenter copiose alternatis vel irregulariter dichotomae; ramis ultimis curte, acutis, vix arcuatim iflexa, alternato-dichotoma; cystocarpiis proeminentibus, globosis ca. 1.2 mm. diam., rotratis basi paullo constrictis; gonimoblasto generis typica; antheridiis, tetrasporangiis ignotis.

藻体直立丛生，近繖房形，圓柱状，高 6—10 厘米；干后梅鼠色或煤竹色；体質較硬，制成的蜡叶标本几乎不能附着于紙上；基部具匍匐茎及盘状固着器。体上部分枝頻繁，枝距甚短；体下部則分枝稀疏，枝距較长；枝互生或不規則地叉分；小枝末端常有輕度弧曲；末枝頂端尖銳，互生状叉分。

藻体內部构造，髓部为大的圓形的薄壁細胞組成，胞径 230—400 微米，最大可达 465 微米，壁 5—6 微米厚；外围以 2—3 层小形含色素体的皮层細胞，6—10×4—6 微米；皮层和髓部之間界限明显；皮层的外面有胶質层，厚 3 微米。

囊果突出于体表面，球形、具喙、基部縊縮，径在 1.2 毫米上下；切面观，由一些长圓形或近圓形細胞組成产孢絲，頂端的一些細胞形成圓球形或近圓形的果孢子囊，囊径24—33 微米；果被 200—215 微米厚，由 10—12 层細胞构成；滋养絲粗壯，具較多的分枝，仅由囊果下部的产孢絲产生，伸向囊果的底部；囊果頂端具一开口。

繁枝多穴藻生长在中潮带岩石上。新种的模式标本为 AST 57-6133 号，雌配子体，系 1957 年 6 月 31 日本所胡本孚同志采自广东海南島崖县的角头。这一新种还見于崖县的紅塘，9 月 (AST 60-7726, ♀)。

本种在外形上有些象 *G. coronopifolia* J. Ag. 但前者的枝距更短，藻体頂端的枝距 0.5—3 毫米，中部的枝距 3—6 毫米，下部的可达 1 厘米，而后者的枝距，根据 Dawson (1949:23)的描述，則最短的为 1.5 毫米，最长的可达 1.5 厘米。他还首次观察到 *G. coronopifolia* J. Ag. 的囊果的內部构造，据称滋养絲是連接在囊果被上的。

本新种虽然只采到雌性配子体和一些未成熟的标本，但根据它的滋养絲的形状、位置和体基部具有匍匐茎等特点使我們确信应属于多穴藻属。

3. 加納多穴藻 *Polycavernosa henriquesiana* (Hariot) C. F. Chang et B. M. Xia, comb. nov.

异名：*Gracilaria henriquesiana* Hariot, 1908:162; De Toni, 1924:269; Dickinson and Foote, 1950:270; Lawson, 1954:165; 近江彦荣, 1958:4—7, 图 A-E。

地理分布：非洲西岸的加納国沿岸。

4. 复叉多穴藻 *Polycavernosa multifurcata* (Børg.) C. F. Chang et B. M. Xia, comb. nov.

异名：*Gracilaria multifurcata* Børgesen, 1953:42—44, figs. 15—16.

地理分布：非洲东岸的毛里求斯島。

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POLYCAVERNOSA, A NEW GENUS OF THE GRACILARIACEAE*

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ABSTRACT

In the studies of the species of *Gracilaria* from Hainan Island, South China Sea, many *Gracilaria*-like specimens are included which after examination has proved to be the representative of a new genus of the Family Gracilariaceae.

Polycavernosa gen. nov.[1)]

Thalli as in the genus *Gracilaria* but consisting of rhizome-like creeping parts from which arise erect, free branches; creeping portion fastened at frequent intervals by a disc-like attachment. Tetrasporangia cruciate. Antheridial caves borne abundantly near the periphery of the thallus. They are globular form, often in great number, the interior of which divided at first into a number of small compartments from the wall of which antheridia are developed, but later become uniting into one to several large cavities and with an or each with an opening through which the spermatia might be able to escape. Pericarp thick, being constructed of many layers of cells which are anticlinally elongated; nutritive filaments band-like and generally with many long branches, often in a great number, but all emerging from the bottom of the gonimoblasts, penetrating the small-celled parenchyma below the gonimoblastic tissue.

Type species: *Polycavernosa fastigiata* sp. nov.

In connection with our study of the new genus *Polycavernosa* from China, we found the characteristics of antheridial caves has also been described by Børgesen (1953: 43, fig. 16) in his *Gracilaria multifurcata* and Ohmi (1958: 4, figs. A-E) in *Gracilaria henriquesiana* Hariot. Hence, it is better now to transfer them to genus *Polycavernosa* from genus *Gracilaria.*

The four species may be distinguished from one another by the following key:

1. Thalli cylindrical. 2
1. Thalli compressed or complanated. 3
2. Branches fastigiate-like in general outline, branching intervals long. . . . 1. *Polycavernosa fastigiata*
2. Branches not fastigiate-like in general outline, branching intervals short. . . 2. *Polycavernosa ramulosa*
3. The angles of the furcations are less than 45° . . . . . 3. *Polycavernosa henriquesiana*
3. The angles of the furcations are nearly right. . . . . 4. *Polycavernosa multifurcata*

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1) For the Latin diagnosis of the new genus, refer to page 120.

1. *Polycavernosa fastigiata* sp. nov.[2)]

(Pl. I, figs. 1—12; Pl. II, figs. 1—6)

Thalli 5—11 cm high, chestnut to vassar tan or van dyke brown in color. With many branches growing from a disk-like holdfast which is developed from a prostrate rhizome. Erect branches cylindrical, 1.5—2 mm in diameter; branches of 5—6 orders, rather dense above, somewhat fastigiate-like in general outline, and densely branched in a divaricate alternate manner, sometimes tri-, tetrachotomous or secund and constricted at the base; ultimate branches slightly attenuated, 0.5—1 mm in diameter and ending in bifurcate apices. Frond in transverse section consisting of a medulla of large thin walled (6μ in thickness) cells, roundish in shape, 180—330μ in diameter and 2—3 layers of small pigmented cortical cells, 3.3—6.6μ × 3—4μ in dimensions, with surface jelly ca. 3μ thick; transition from medulla to cortex is abrupt. Cartilaginous in texture, often adhering imperfectly to paper on drying.

Tetrasporangia densly scattered over almost entire surface of frond, ovoid or sometimes more or less elongated in surface view, 26—33μ × 16.5μ in dimensions, ovoid in transverse section, 36—40μ × 26μ in dimensions, surrounded by somewhat elongated cortical cells; cruciately divided.

Antheridial caves are near globular form, 116—191μ × 83—166μ in dimensions, consisting of 6—10 cavities in transverse section; each cavity 33—99μ × 16—33μ in dimensions.

Cystocarps globoid with an ostiole, prominently protruding, rostrate, up to 1.3 mm in diameter, constricted at the base; gonimoblast consisting of large, cylindrical, colorless, thin-walled cells, 66—116μ long, 33—50μ wide, with several cells toward the end of each branch developing into carposporangia; carposporangia roundish or ovoid, 26—33μ in diameter with a stellate chromatophore in the center; pericarp thick, being constructed of 9—11 layers of cells; nutritive filaments robust with many long branches, all penetrating into the small cells, below the gonimoblastic tissue.

Habitat.—On rocks and rock pools in the middle and Lower littoral regions. Yingchai, Ledung District, in August (AST 60—7240, ♀, TYPE; AST 60—7240a, ♂, AST 60—7240b, ⊕, ALLOTYPE; AST 60—7268, ♂, AST 60—7268a, ♀, AST 60—7268b, ⊕, PARATYPE) and October (AST 60—7909, ♂, AST 60—7909a, ⊕, PARATYPE), Maling, Ya District, in September (AST 60—7645, ♂), both on Hainan I., Kwangtung Province.

2. *Polycavernosa ramulosa* sp. nov.[3)]

(Pl. I, fig. 13, Pl. II. fig. 7)

Thallus 6—10 cm high; rosedust or sepia in color; with several erect branches growing on a prostrate rhizome. Branching sparingly and distant with alternately or irre-

2) For the Latin diagnosis of the new species, refer to page 120—121.

3) For the Latin diagnosis of the new species, refer to page 122.

gularly dichotomy below and rather dense with short intervals above. The branchlets acutely pointed, slightly arcuate, and alternate-dichotomous branched on upper side. This species is similar in structure to *P. fastigiata* but is larger in all dimensions: 230—400μ, up to 465μ in diameter to medullary cells and 6.6—10μ × 4—6μ in dimensions to cortical cells. Hardness in texture, not adhering to paper, when dried.

Cystocarps globoid, ca. 1.2 mm in diameter, rostrate, constricted at the base, with a parenchymatous gonimoblast of round or elongated cells; mature carpospores 24—33μ in diameter; the size and shape of nutritive filaments as in *P. fastigiata*; pericarp thick, ca. 200—215μ in thickness, consisting of 10—12 layers of cells. Tetrasporangia and antheridial caves not found.

Habitat.—On rocks in middle littoral regions. Jiaotou, Ya District, Hainan I., Kwangtung Province, in June (AST 57—6133, ♀ TYPE), Hongtang, Ya District, Hainan I., Kwangtung Province, in September (AST 60—7726, ♀).

The present species closely resembles *Polycavernosa fastigiata* in the internal structure as well as in the external character. However, it is easily distinguished from the latter in its corymbose habit, branching rather dense and very short intervals above, and the branchlets alternate-dichotomous branched on upper side. The present species in question appears at first sight to have some likeness in external features to *Gracilaria coronopifolia* J. Ag., it differs from the latter by prostrate rhizome and the position and shape of nutritive filaments of cystocarp.

3. *Polycavernosa henriquesiana* (Hariot) C. F. Chang et B. M. Xia, comb. nov.

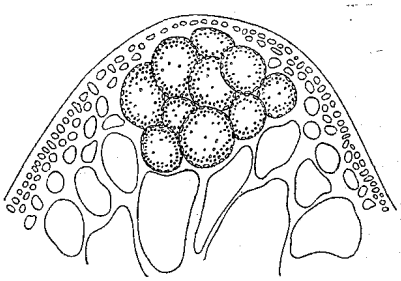
Syn. *Gracilaria henriquesiana* Hariot, 1908: 162; De Toni, 1924: 269; Dickinson and Foote, 1950: 270; Lawson, 1954: 165; Ohmi (近江) 1958: 4—7, figs. A—E.

Geogr. distri.: Ghana.

4. *Polycavernosa multifurcata* (Børg.) C. F. Chang et B. M. Xia, comb. nov.

Syn. *Gracilaria multifurcata* Børgesen, 1953: 42—44, figs. 15—16.

Geogr. distri.: Mauritius, East Africa.



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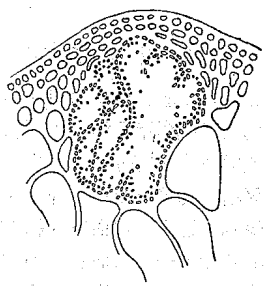

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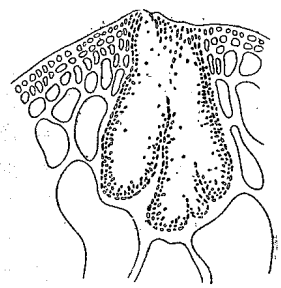

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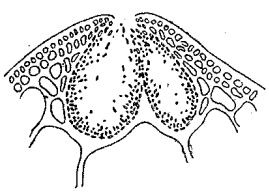

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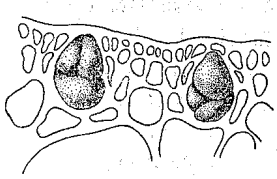

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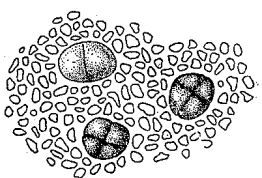

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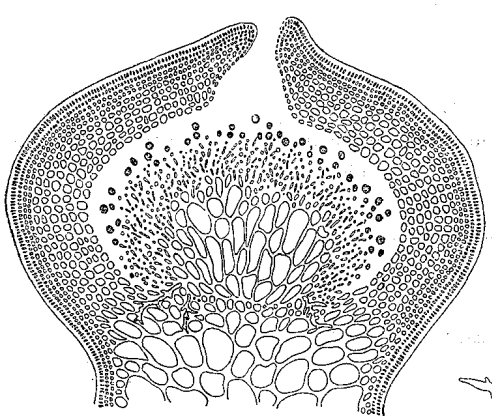

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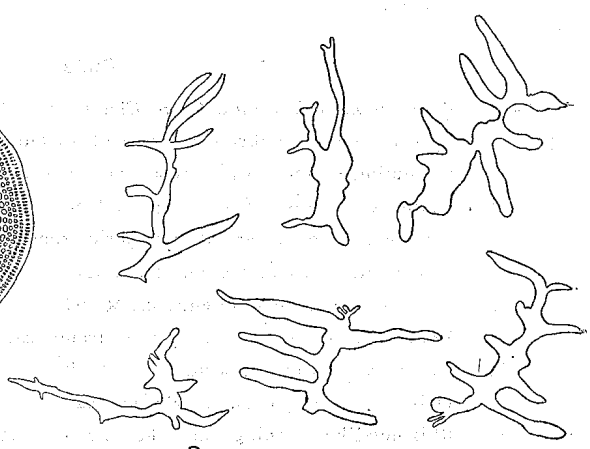

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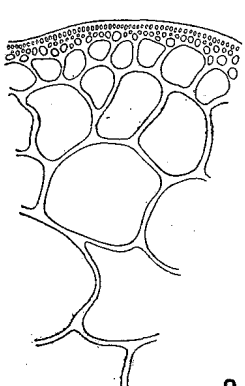

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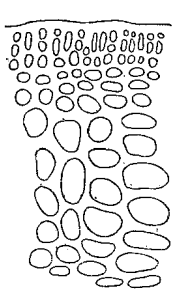

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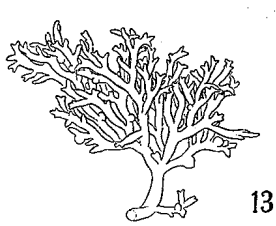

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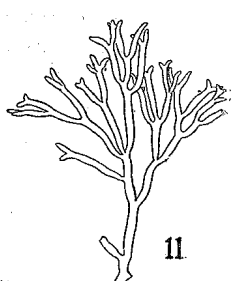

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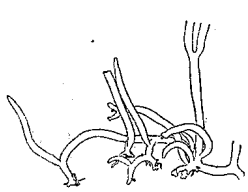

12

圖 版 I 說 明

1. 帚状多穴藻的精子囊窠羣切面観（約 × 140）。
2. 帚状多穴藻精子囊窠壁开始溶化（約 × 140）。
3. 帚状多穴藻精子囊窠壁进一步溶化（約 × 140）。
4. 帚状多穴藻精子囊窠頂端产生开口（約 × 140）。
5. 帚状多穴藻四分孢子囊切面観（約 × 200）。
6. 帚状多穴藻四分孢子囊表面観（約 × 200）。
7. 帚状多穴藻囊果切面観（約 × 40）。
8. 帚状多穴藻各种类型的滋养絲（約 × 200）。
9. 帚状多穴藻藻体横切面（約 × 60）。
10. 帚状多穴藻囊果被切面（約 × 140）。
11. 帚状多穴藻的小枝（約 × 1）。
12. 帚状多穴藻的匍匐茎（約 × 1）。
13. 繁枝多穴藻的小枝（約 × 1）。

Plate I.

1—12. *Polycavernosa fastigiata* C. F. Chang et B. M. Xia sp. nov.

1—4. Transverse section through a part of an antheridial frond showing the process of the dissolution of the wall of small compartments. ca. × 140.

5. Transverse section of a tetrasporic frond. ca. × 200.

6. Surface view of a part of tetrasporic frond. ca. × 200.

7. Mature cystocarp in section. ca. × 40.

8. Detail of nutritive filaments. ca. × 200.

9. Transverse section of a tetrasporic frond. ca. × 60.

10. Part of a pericarp in section. ca. × 140.

11. Habit of upper portion of a plant. ca. × 1.

12. Rhizome-like creeping part, showing holdfasts and the bases of erect portion. ca. × 1.

13. *Polycavernosa ramulosa* C. F. Chang et B. M. Xia sp. nov.: Habit of upper portion of a plant. ca. × 1.

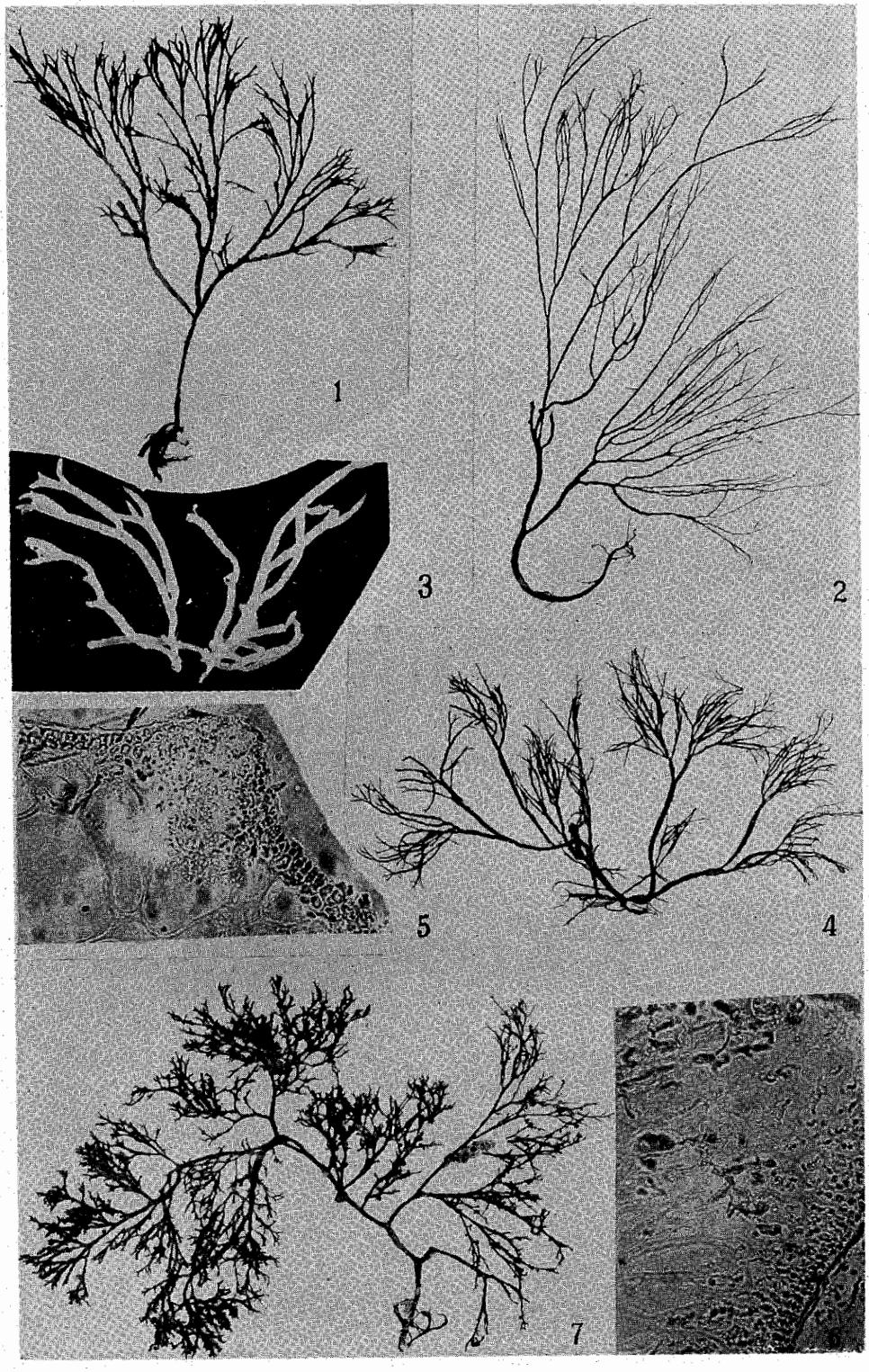
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圖 版 II 說 明

—6. 帚状多穴藻，模式标本 60-7240，♀；系 1960 年 8 月 5 日采自我国广东省海南島乐东县鶯哥海（約 × 2/3）。

1. 帚状多穴藻，副模式标本 60-7268b，⊕；系 1960 年 8 月 6 日采自我国广东省海南島乐东县鶯哥海（約 × 2/3）。

2. 帚状多穴藻的匍匐茎（約 × 1）。

3. 帚状多穴藻，异性模式标本 60-7240a，♂；系 1960 年 8 月 5 日采自我国广东省海南島乐东县鶯哥海（約 × 2/3）。

4. 帚状多穴藻精子囊窠羣的囊窠壁溶化后形成两个大腔，頂端有一开口，精子自該处放散(約×140)。

5. 帚状多穴藻的滋养絲（約 × 140）。

7. 繁枝多穴藻，模式标本 57-6133，♀；系 1957 年 6 月 31 日采自我国广东省海南島崖县角头(約 × 2/3)。

Plate II.

—6. Photographs of *Polycavernosa fastigiata* C. F. Chang et B. M. Xia sp. nov.

1. Type specimen collected from Yinggehai, Ledung District, Kwangtung Province, on 5, VIII, 1960 (No. AST 60-7240, ♀) ca. × 2/3.
2. Paratype specimen collected from the same place as above on 6, VIII, 1960 (AST 60-7268b, ⊕). ca. × 2/3.
3. Rhizome-like creeping part, showing holdfasts and the bases of erect portion. ca. × 1.
4. Allotype specimen collected from Yinggehai, Ledung District, Kwangtung Province, on 5, VIII, 1960 (No. AST 60-7240a, ♂) ca. × 2/3.
5. Transverse section through a part of an antheridial frond showing the dissolution of the wall of small compartments and uniting into one large cavity with an opening through which the spermatia might be able to escape. ca. × 140.
6. A nutrive filament. ca. × 140.
7. Photographs of type specimen of *Polycavernosa ramulosa* C. F. Chang et B. M. Xia sp. nov. collected from Jiaotou, Ya District, Hainan I., Kwangtung Province, on 31, VI, 1957 (No. AST 57-6133, ♀). ca. × 2/3.