

# 中国两种新紫菜\*

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中国海岸线漫长,南北环境条件各异,特别是水温,变化很大,紫菜种类较多,已报道过的有十一种。现在,我国人工养殖的紫菜,在长江以南主要是坛紫菜 (*Porphyra haitanensis* T. J. Chang et B. F. Zheng)<sup>[1,3]</sup>,在长江以北主要是条斑紫菜 (*P. yezoensis* Ueda)<sup>[3]</sup>。我们认为,可以作为养殖对象的种类,必然不止上述两种。因此,有必要对我国紫菜种类进行全面的调查,以便能因地制宜地选择各地最适宜的紫菜养殖品种,为进一步发展我国紫菜生产事业创造条件。我们在全国沿海地区调查过程中,发现了一些尚未报道过的种类。本文所描述的广东紫菜(新种)和华北半叶紫菜(新变种)就是其中的两种。这两种紫菜的丝状体阶段的壳孢子放散的特点,我们早在1963年就作了报道<sup>[4]</sup>。新种的模式标本存于中国科学院海洋研究所植物标本室。

## 1. 广东紫菜(新种) *Porphyra guangdongensis* sp. nov. (图版I:1,2; 图1)

*Porphyra kwangtungensis* Tseng et T. J. Chang, 1963. (*Nomen nudum*).

Thalli membranacei, irregulariter elliptici vel elongato-elliptici, aliquot lanceolati, cum plicatis marginibus, ad basis cordati vel rotundi, aliquot cuneati, cyano-viridi-purpurei, plerumque 12—30 cm, usque ad 34 cm alti, 4—22 cm lati; laminis ad margine dentatis, dens 1—3 cellularis, monostromaticis, 32—38  $\mu$  crassis, cellulis vegetativis in sectione transversali 12—25  $\mu$  latis, 18—22  $\mu$  altis, cum chromatophoro singulo et stellato; plantis homothallicis, spermatangiis 128 in quoque fasciculo (spermatangiophoro), modis divisionis  $\sigma^4 A_4 B_4 C_8$ , carposporangiis cum 32 carposporiis, modis divisionis  $\sigma^4 A_2 B_4 C_4$ .

**Hab.** In rupes littoralibus, Insulae Shangehuan, Provincia Guangdong, China, 25—II—1955, Holotypus AST 55—1908.

藻体膜状,紫色而带蓝绿,近基部绿色的成分更为明显<sup>1)</sup>;叶片不规则的椭圆形或长椭圆形,有的披针形;边缘部分有较稀疏的皱褶;基部心脏形或圆形,有的楔形;固着部柄短,不甚明显;体高一般为12—30cm,可达34cm,宽4—22cm;叶片边缘具有1—3细胞所组成的锯齿状突起(图1:1),近基部锯齿较紧密;单层,藻体厚32—38  $\mu$ ,营养细胞表面观直径12—25  $\mu$ ,断面观细胞内腔高18—22  $\mu$ (图1:2,3);具单一的星状色素体;带根丝的固着细胞圆形或卵形(图1:4)。

雌雄同体;精子囊群开始出现在藻体顶端或侧缘,没有很固定的区域,有时也和果孢

\* 中国科学院海洋研究所调查研究报告第330号。本文所引用的标本是郑树栋、郑宝福、唐志洁、王立明等同志采集制作的;模式标本照片是宋华中同志摄影;附图由冯明华同志协助描绘,均此致谢。

1) 本新种标本压制数月后,一般转为淡紫色能紧贴标本纸上。

子囊混生在一起；每一个成熟的精子囊器<sup>2)</sup>具有 128 个精子囊，表面观 16 个，8 层，分裂式为  $\sigma A_4B_4C_8$  (图 1:9, 10)，但成熟了的精子囊容易脱落放散，所以一般只观察到 4 层的精子囊器。果孢子囊一般生长在雄区的里侧，成熟后呈深紫红色；常几个成群地分布着，它们之间混杂着象是未受精的果胞或退化的营养细胞(图 1:5, 7)。因此在肉眼下，整个果孢子囊区都象布满了许多深紫色的细点(图版 I:1, 2)。每一个果孢子囊具有 32 个果孢子，表面观一般是 8 个，4 层，分裂式为  $\eta A_2B_4C_4$  (图 1:5, 6)。但有时在比较老的个体上可以看到一些果孢子囊的表面观数目为 16 个或 16 个以上的不正常现象。在这种情况下，里面

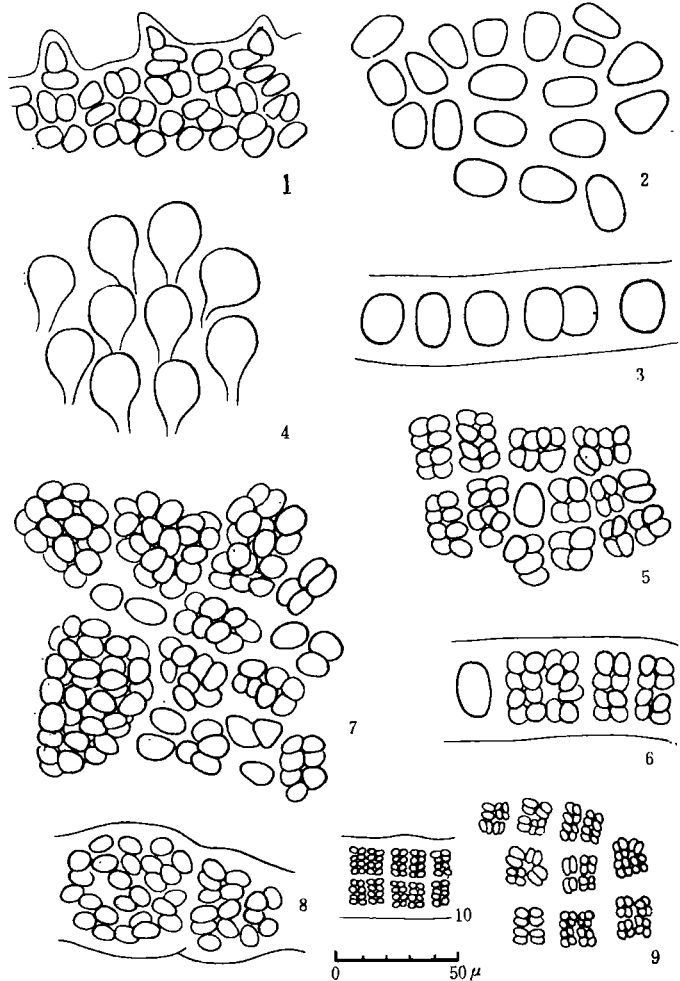


图 1 广东紫菜(新种)的营养细胞和生殖细胞

1.藻体边缘部分的顶面观； 2.营养细胞的顶面观； 3.营养细胞的断面观； 4.基部长假根丝的固着细胞的顶面观； 5.果孢子囊的顶面观； 6.果孢子囊的断面观； 7.比较老成的果孢子囊的顶面观，显示其果孢子囊大小不一，果孢子的排列较为凌乱； 8.同上，断面观； 9.精子囊器的顶面观； 10.精子囊器的断面观。

1) 多年来紫菜的雄性生殖细胞放散出来的生殖单位多被认为是不动精子 (spermatia)。但事实早已证明，这些并不是精子而是精子囊 (spermatangia)。在受精的过程中，它们各产生了一个不具鞭毛的精子。因此，对于产生过去常被误称为“精子”的精子囊的雄性细胞应有一个合适的名称。对于从单一的精子囊母细胞所分裂成的一个精子囊组合，我们建议采用“精子囊器” (spermatangiophore)。

的果孢子一般排列很凌乱,也常有厚达4层以上,甚至8层的,并显著地突出于一般的营养细胞的水平表面之上(图1:7,8)。上述果孢子囊区所呈现的深紫红色细点,有不少就是由这些特大的不正常的果孢子囊所组成的。

**习性和产地** 生长在潮间带岩礁上。模式标本 AST55-1098, 1955年2月25日采自广东省上川岛沙堤村。(采集者:郑树栋)。等模标本有55-1115, 55-2063, 57-2051, 57-2063, 57-2088, (以上上川岛), 57-2151, 57-2196 (广东省海丰县)。

本种早在1956年就根据采自广东省上川岛的标本定为新种,当时命名为上川紫菜(*Porphyra shangchuanensis*); 1957年在广东省海丰县又采到这一种的标本,所以改称为广东紫菜(*P. guangdongensis*)。1955—1957年,我们用5种紫菜进行温度因子对壳孢子形成和放散试验,其中就有这种紫菜;根据实验结果,本新种丝状体阶段的壳孢子放散的适宜温度是26℃左右<sup>[4]</sup>。

广东紫菜在分类系统方面,属真紫菜亚属刺边紫菜组;在本组中最接近冈村紫菜(*P. okamurai* Ueda)。根据殖田<sup>[6]</sup>和 Tanaka<sup>[10]</sup>的报道,冈村紫菜精子囊器的分裂式与本种一样,体形(卵形至长卵形或竹叶状)和营养体厚度(35—40μ)也与本种很相似;但果孢子囊的分裂式(♀A<sub>2</sub>B<sub>2</sub>C<sub>4</sub>)不同,果孢子囊区也没有布满许多肉眼可见的深紫色细点的现象,而且藻体也小得多(高达5—15cm),只有本种的一半左右。在刺缘紫菜组的种类中,冈村紫菜分布的北限最高<sup>[2]</sup>,南起本州的山口<sup>[5]</sup>(约34°N),北达北海道的东北角和利尻、礼文二岛<sup>[7]</sup>(45°—46°N之间),主要分布在本州和北海道的日本海沿岸,我国沿岸迄今还没有发现。而在日本分布较南的的圆紫菜(*P. suborbiculata* Kjellm.)则盛产于黄海、东海和部分南海的我国沿岸。广东紫菜迄今局限于南海我国沿岸22°—23°N的亚热带地区里。考虑了上述情况,我们认为广东紫菜和冈村紫菜是两个不同种类。

在已发表的真紫菜亚属刺缘紫菜组的雌雄同株种类中,除了冈村紫菜以外,在我国及其邻近海域还有产于我国的圆紫菜(*P. suborbiculata* Kjellm.)及绉紫菜(*P. crispata* Kjellm.),产于越南的越南紫菜(*P. vietnamensis* Tanaka et P. H. Ho)<sup>[11]</sup>,和产于澳大利亚的刺紫菜(*P. denticulata* Levring)<sup>[8]</sup>等四种。它们与本新种比较,藻体的大小和形状都不一样,它们都较小,一般都在10cm以内;圆紫菜多为圆形或肾脏形,而绉紫菜则多具深裂片,花簇状,椭圆形或肾脏形<sup>[3,6,10]</sup>,越南紫菜和刺紫菜都有裂片,丛生。刺缘紫菜组的坛紫菜,一般是雌雄异株,个别藻体雌雄同株时,精子囊器和果孢子囊分别集中局限于一定部位上,而且藻体厚度常在60μ以上<sup>[1]</sup>;而本新种从未发现有雌雄异体的情况,雌雄部分的分布不局限于一定部位上,藻体也薄得很多。至于本种与长紫菜(*P. dentata* Kjellm.)之间的关系,由于长紫菜是雌雄异株的种类,它们的区别则是很清楚的。

**2. 半叶紫菜华北变种(新变种) *Porphyra katadai* Miura var. *hemiphylla* Tseng et T. J. Chang var. nov.** (图版 I:2, 3; 图 1)。

*Porphyra hemiphylla* Tseng et T. J. Chang, 1963. (*Nomen nudum*).

Thalli ovati irregulariter elliptici vel reniformi, ad basis cordati, orbiculati vel cuneati, purpureo-rubri, plerumque 7—17 cm, usque ad 24 cm alti, plerumque 3—8 cm, usque ad 17 cm lati; laminis ad margine edentatis, monostromaticis, 35—40 μ, usque ad 45 μ crassis, ubi 38 μ crassis, cellulis vegetativis in sectione transversali 25—28 μ

altis, alto erica 1.5—2.0-plo latitudinis, plantis homothallicis, unusquisque cum duobus partibus (hemiphyllis) sexualiter dissimilibus, per lineam conspicuum separatis; parte masculinis angustiore, pallide purpuro-flavis vel flavo-albidis, spermatangiis 128 in quoque fasciculo (spermatangiophoro), modis divisionis  $\sigma^4 A_4 B_4 C_8$ ; parte femineis latiore, profunde purpuro-rubris, carposporangiis cum 16 carposporis, modis divisionis  $\rho^4 A_2 B_2 C_4$ .

**Hab.** Ad *Gymnogongrum flabelliformem* Harv. in rupes littoralibus, Qingdao (Tsingtao), China 8—III—1956. Holotypus AST 56-1080.

藻体膜状, 鲜紫红色或紫粉红色, 有的在紫红色中略带棕色, 富有光泽, 制成标本后呈淡紫红色, 能紧贴在标本纸上; 叶片卵圆形, 不规则的椭圆形或肾脏形, 少数为亚倒三角形, 一般都是高度大于宽度, 体高 7—17cm, 可达 24cm, 宽 3—8cm; 最宽的有 17cm; 叶片基部心脏形、圆形或楔形; 靠边部分略有皱褶; 显微镜全缘; 中部细胞表面观圆形, 椭圆形或略呈三角形, 排列较整齐, 径长一般为宽  $12-17\mu$ , 长  $15-22\mu$ , 边缘部分的细胞比较细密, 直径一般只有  $10-15\mu$  (图 2:1), 分裂较盛的边缘细胞更为细密, 直径有时只有  $6-7\mu$ ; 膜状体由单层细胞组成, 厚  $30-40\mu$ , 有的可达  $45\mu$ 。四月下旬以后开始显出衰老时, 厚度甚至可达  $50\mu$ 。当厚度为  $38\mu$  时, 细胞内腔高度约为  $25-28\mu$ , 高度约为

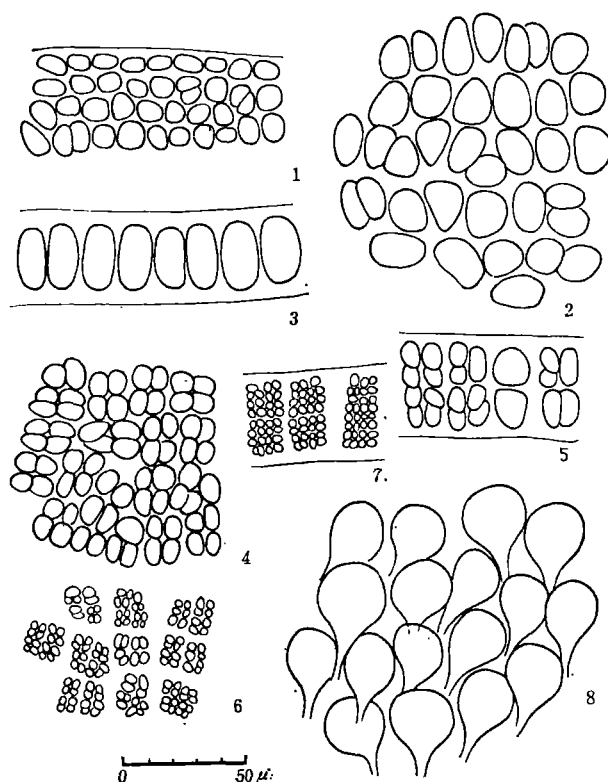


图 2 半叶紫菜华北变种(新变种)的营养细胞和生殖细胞

1. 藻体边缘部分的顶面观; 2. 营养细胞的顶面观; 3. 营养细胞的断面观; 4. 果孢子囊的顶面观; 5. 果孢子囊的断面观; 6. 精子囊器的顶面观; 7. 精子囊器的断面观; 8. 基部长假根丝的固着细胞的顶面观。

宽度的1.5—2.0倍(图2:2,3)。细胞各具一个星状色素体。带假根丝的固着细胞圆形,宽20—30 $\mu$ ,排列相当整齐(图2:8)。

雌雄同体;雄区和雌区位于藻体的对边,二区之间常沿着一条直线从上部边缘直达基部而区别开来,形成了两个大小不一的部分——两个性别不同的“半叶”。这是本种最显著的特征,有的在高度为2cm时就开始出现这个特征。雄区淡紫黄色至黄白色,所占藻体面积一般都比雌区小;在肾脏形的个体上,雄区总是处于凹入的一边。每一精子囊器具有128个精子囊;表面观16个,8层,分裂式为 $\sigma A_4B_4C_8$ (图2:6,7)。雌区深紫红色,每一果孢子囊具有16个果孢子;表面观4个,4层,分裂式为 $\rho A_2B_2C_4$ (图2:4,5)。此外,每年在整个生长季节里所采到的几百个标本中,有时还偶然找到几棵个体比较细小,体高只有3—7cm的全雄个体,但却从未发现有相应的全雌的个体。

**习性和产地** 附生在潮间带岩礁上的叉枝藻(*Gymnogongrus flabelliformis* Harv.)藻体上。模式标本AST 56-1080,1956年3月8日采自山东省青岛市团岛湾小黑涧(采集者:唐志洁);等模标本有54-510,55-215,57-81,60-258,63-3241。本变种除了生长在礁石和附生在叉枝藻上外,还发现附着生长在其它各种基质上,如牡蛎及其它软体动物的贝壳上和养殖海带的浮竹架上,等等。在我国除了青岛,还发现分布于山东省烟台地区沿海和辽宁省旅大市海区。

这个新变种和日本产的*Porphyra katadai* Miura<sup>[9]</sup>相比较,不同之处主要在于:(1)藻体的厚度不同——新变种藻体的厚度一般在30 $\mu$ 以上,可达45 $\mu$ ;而*P. katadai*原种的厚度只有20—30 $\mu$ ;(2)精子囊器的分裂式不完全一致——本新变种成熟的精子囊器为8层,而*P. katadai*原种仅为4层。但必须说明,我们也经常见到本新变种只是4层的精子囊器切面;不过,我们认为这些都是未经最后一次分裂的精子囊器。由于半叶紫菜藻体质地比较柔软,成熟边缘上的生殖细胞很容易受海浪的冲击而脱落流失,一般都需要多作切片,多观察一些切面才能观察到真正成熟的8层的精子囊器。为此,我们虽然曾于1963年以“半叶紫菜”作为一个新种和实验材料而对其丝状体阶段的壳孢子放散适温进行了实验观察<sup>[4]</sup>,但在我们对*P. katadai*的精子囊器的层数有更具体的了解之前,我们决定暂时将中国产的这种紫菜只作为*P. katadai*的一个新变种来处理。

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## ON TWO NEW *PORPHYRA* FROM CHINA\*\*

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### ABSTRACT

Two new *Porphyra* are described, namely, *Porphyra guangdongensis* sp. nov. of the section *Dentata* Tseng et T. J. Chang and *P. katadai* Miura, var. *hemiphylla* var. nov. of the section *Edentata* Tseng et T. J. Chang, both of the subgenus *Euporphya* Rosenv., type specimens all deposited at the herbarium of the Institute of Oceanology, Academia Sinica.

1. *Porphyra guangdongensis*<sup>1)</sup> has a membranous thallus irregularly elliptic or elongate-elliptic sometimes lanceolate in shape, generally 12—30 cm, reaching 34 cm high, 4—22 cm broad, purple in colour with a bluish-green tint, more greenish towards the base, distantly ruffled at the edge, with cordate or orbiculate sometimes cuneate base; blade monostromatic, margin dentate with 1—3 celled microscopic teeth, more closely dentate near the base, 33—38  $\mu$  thick; vegetative cells 12—25  $\mu$  in diam. in surface view, 18—22  $\mu$  high in transverse section, each with a single stellate chromatophore; hold-fast cells with rhizoidal filaments rotund or ovate.

Plants homothallic, spermatangia in packets——spermatangiophores<sup>2)</sup>, first appearing at the apex or marginal portions, their position not definite, sometimes intermixed with the carposporangia; mature spermatangiophore with 16 spermatangia in surface view, 8-layered, mode of division  $\sigma$  A<sub>4</sub>B<sub>4</sub>C<sub>8</sub> (Fig. 1:9, 10), when fully mature, readily liberating the spermatangia, hence only 4 layers generally observed; carposporangia generally appearing at the inner portion of the marginal spermatangial region, deep purple in colour when mature, generally several together forming sori intermixed with few unfertilized carpogonia or degenerated vegetative cells (Fig. 1:5, 7), resulting in mottled appearance of the carpogonial region provided with numerous deep purplish dots (Pl. I:1, 2), each carposporangium with 32 carpospores, 8 on the surface view, 4-layered, mode of division  $\rho$  A<sub>2</sub>B<sub>4</sub>C<sub>4</sub> (Fig. 1:5, 6), in older thalli abnormally large carposporangia being observed, with 16 or more carpospores on the surface view, more than 4-layered, with carpospores very disorderly arranged (Fig. 1:7, 8).

**Type specimen** AST 55-1098, collected from littoral rocks, Shati village, Shangehuan Island, Guangdong Province, on 25 February, 1955, deposited at the Herbarium of the Institute of Oceanology, Academia Sinica. Specimens when dried

\*\* Contribution No. 330 from the Institute of Oceanology, Academia Sinica

1) For Latin description, see p. 76.

2) The male reproductive units of the porphyras are generally erroneously called "spermatia" which are actually spermatangia each liberating a single spermatium through the prototrichogyne into the carpogonium. The groups of spermatangia are generally erroneously called "antheridia", it is therefore imperative to introduce a new term, the "spermatangiophore", for designating the groups of spermatangia.

turned to pale purplish, adhering closely to the herbarium paper.

The new species is similar to the Japanese *Porphyra okamurai* Ueda<sup>[6]</sup> also monoecious belonging to the Section *Dentata*, in shape and thickness of the thallus as well as the spermatangial mode of division, differing in the carposporangial mode of division and especially in the size, the present species being more than double the size of the Japanese species. In Japan, *P. okamurai* is the most northernly distributed dentate *Porphyra*<sup>[2]</sup>, reaching as far north as 45—60°N, not found in regions south of 34°N, being temperate in nature, whereas the distribution of the present species is limited to 22—23°N, in regions of strongly subtropical nature.

Among the published monoecious dentate euporphyras, besides *P. okamurai*, distributed in China and the neighboring regions are *P. suborbiculata* Kjellm. and *P. crispata* Kjellm. of China and Japan, *P. vietnamensis* Tanaka et P.-H. Ho<sup>[11]</sup> of Vietnam and *P. denticulata* Levring<sup>[9]</sup> of Australia. These four species are all much smaller than our species, generally not more than 10 cm high. *P. suborbiculata* is orbiculate or suborbiculate, *P. crispata*, generally with deeply divided conglobate thalli and *P. vietnamensis* and *P. denticulata* are generally provided with divided blades and in tufts. *P. haitanensis* T. J. Chang et B. F. Zheng<sup>[1]</sup> is a predominately dioecious dentate euporphyra, rarely monoecious thalli being found; when they are monoecious, the spermatangial and the carposporangial portions are delimited from each other by a straight, curved or crooked line, and they are much thicker than the present species.

2. *Porphyra katadai* Miura, var *hemiphylla*<sup>1)</sup> has a brilliantly purplered or purple-pink red membranous thallus, blade ovate or irregularly elliptical, generally 7—17 cm, up to 24 cm in height, 3—8 cm, up to 17 cm in breadth, somewhat ruffled at the edge, with cordate, orbiculate or cuneate base; margin microscopically edentate, cells generally 12—17  $\mu$  broad and 15—22  $\mu$  long, cells near the margin more closely arranged, generally 10—15  $\mu$  in diam. (Fig. 2:1) and cells at the margin even more closely arranged, sometimes only 6—7  $\mu$  diam.; membrane monostromatic, generally 35—40  $\mu$ , reaching 45  $\mu$  thick, at the end of April and afterwards, even as thick as 50  $\mu$ ; when the membrane is 38  $\mu$  thick, the cells about 25—28  $\mu$  high, with the height about 1.5—2.0 times the breadth (Fig. 2:2, 3); rhizoidal cells orbiculate, 20—30  $\mu$  diam., rather regularly arranged (Fig. 2:8).

Plant homothallic, rarely andro-dioecious, gametangia and carposporangia separately, aggregated in different parts of the thallus, distinctly separated from each other by a more or less straight line running from the apex of the blade to the base, thus dividing the fertile blade into two unequal halves, or semiphylls, a smaller, pale purplish yellow hemiphyll — entirely of spermatangial packets, or spermatangiophores, and a larger, deep purplish red hemiphyll — entirely of carposporangia; the sexually hemiphyllous condition, the most outstanding characteristic of the species and the present new variety appearing in plants as small as 2 cm in height; in kidney-shaped thallus, the spermatangiophores always locating in the notch, each with 128 spermatangia, mode of division being  $\sigma$  A<sub>4</sub>B<sub>4</sub>C<sub>8</sub> (Fig. 2:6, 7); carposporangia each with 16 carpospores, mode of division  $\rho$  A<sub>2</sub>B<sub>2</sub>C<sub>4</sub> (Fig. 2:4, 5). In the course of the study, we have found, among the hundreds of specimens examined, only a few rather small, all-male thalli, about 3—7 cm high, and not a single all female thallus.

1). For Latin description see p. 78—79.

The type specimen of the present new variety: AST 56—1080, grew on *Gymnogongrus flabelliformis* Harv., collected from littoral rocks, Xiaoheilan, Tuandao Bay, Qingdao (Tsingtao) China, on 8 March, 1956. The present species was found growing readily on littoral rocks as well as on various other substrates, such as oyster and other molluscan shells and even on the bamboo floats of *Laminaria* cultivation rafts. The cotype specimens were collected in the months from January to April, from various places at Qingdao, from Yantai (Chefoo) Shandong (Shantung) Province and Dalian (Dairen), Liaoning Province, apparently widely distributed in the Yellow Sea region.

This *Porphyra* had been known in China under the manuscript name *Porphyra hemiphylla* Tseng et T. J. Chang since 1963 when a study of its conchospores formation and liberation was published<sup>[4]</sup>. A comparison of this *Porphyra* with the Japanese *P. katadai* Miura (1968) shows that the two porphyras are very similar to each other in the shape, colour, epiphytic habitat and the carposporangial divisional mode of the fronds, which are generally homothallic each separated by an oblique longitudinal line into a smaller yellowish male half and a larger reddish female half. The Chinese porphyra differs from the Japanese species, however, in its much thicker frond, being almost twice as thick as that of the latter and in the mode of division of their spermatangiophores, being 128 ( $A_4B_4C_8$ ) that of the Japanese species being 64 ( $A_4B_4C_8$ ). In view of the close relationship between the Chinese and the Japanese marine flora, we have decided to treat our plant as a variety of the Japanese species, and the difference mentioned above as geographical variations due to the more southern distribution of our plant, hence *Porphyra katadai* Miura var. *hemiphylla* var. nov.