

西沙群岛钙扇藻属的几个新种*

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钙扇藻属¹⁾ (*Udotea*) 植物广为分布于热带海洋, 特别盛产于珊瑚礁上。绝大多数种类的分布具有很大的海区局限性, 例如, 一般的大西洋种类(除了个别例外)不产于印度-西太平洋海区, 反过来也一样。与它们的广泛热带分布相反, 对其分类研究工作做的却很少。自从1911年 Gepp 等对这个属进行了系统分类, 报道了15种; 六十几年来, 只增添了一个新种和一个新变种²⁾, 还没有任何藻类工作者对这属的系统分类进行研究。除 Gepp 等报道了它们的内部结构以外, 其他藻类工作者仅简略地描述了外部形态和一些藻丝的情况。

1957年和1958年, 中国科学院海洋研究所曾派调查组到我国西沙群岛进行海藻调查时, 采集了113号标本³⁾。经过我们的初步分析研究, 西沙群岛的钙扇藻属的区系是非常丰富的。本文所报道的六个新种, 仅只是西沙群岛钙扇藻区系的一部分。所用标本, 包括模式标本都保存在中国科学院海洋研究所植物标本室。

一、分类上所应用的特征

钙扇藻属植物藻体分为扇形叶片、圆柱形或扁压的柄部和假根团三部分, 都为一系列的多次叉分枝的藻丝所组成, 藻体和藻丝都有不同程度的钙化。Gepp 等在系统整理钙扇藻属的种类过程中, 根据他们在形态方面的研究, 提出在鉴定种类中具有主要意义的有下列几项特征:

1. 组成叶片的藻丝单层或多层;
2. 藻丝有无“侧生附属物”(lateral appendage);
3. “侧生附属物”的形状和排列;
4. 藻丝分叉上部的缢缩的有无和均匀与否(分叉上部两条藻丝的缢缩是否在同样的部位);
5. 藻丝的直径大小;

* 中国科学院海洋研究所调查研究报告第338号。

- 1) *Udotea* Lamx. 一属, “孢子植物名称”译为“海扇藻”。我们认为, 译名最好能确切地表现生物的特殊性。在海藻里具有扇形特点的种属不少; “海扇藻”可用于 *Udotea*, 也可用于 *Padina* 等属的植物。但在藻体为扇形的藻类里, 只有 *Udotea* 是钙化的。因此, 我们建议用“钙扇藻”代替“海扇藻”作为 *Udotea* Lamx. 的中译名。
- 2) Taylor (1928) 描述了新种 *Udotea sublittoralis* Taylor, 而 Dawson (1957) 提出了新变种 *U. palmetta* var. *marshallensis* Dawson; Gilbert (1962) 所描述的夏威夷岛(Hawaii)的新种 *Udotea? abbreviata* Gilb., 结构简单, 不钙化, 我们认为不属于钙扇藻属, 而是丝扇藻属 (*Flabellaria*) 的一种, 因此改订为 *Flabellaria abbreviata* (Gilbert) Tseng et Dong, **comb. nov.**
- 3) 本文引用标本是本所郑树栋、夏恩湛和胡本孚三位同志采集的; 模式标本照片是本所宋华中同志摄照的, 特此致谢。

6. 柄部单管或多管(为一条或几条纵行藻丝所组成)。

此外, Gepp 等还应用了下列特征进行种类的鉴定:

7. 藻丝在放大50倍观察下,是否清晰可见;

8. 藻体的形状、大小;

9. 叶面光滑或丝状、粒状;

10. 去钙后藻丝容易或难于分离拨开。

我们基本同意 Gepp 等利用上述特征作为分类鉴定的基础,特别是“侧生附属物”的有无和形状、排列,因为这个构造很显然是在进化过程中形成和演变的。由于这个构造在分类上的重要意义和藻类分类工作者所用名称较乱,我们认为有必要把词汇统一起来。我们同意 Fritsch (1935) 的意见,称之为侧生长 (lateral), 因为它是垂直地从组成藻体的藻丝的侧面生长出来的构造,它可以是简单的突起或简单的棒状、刺状或分枝很复杂的树枝状。同时,我们还建议把表层藻丝称为皮丝(cortical filament),而内部藻丝称为髓丝(medullary filament); 前者虽然是从后者生长出来的,但在形态上有一定区别,多数种类的皮丝缢缩较多,多少成为念珠状,全部或大部分侧生长就是从它产生出来的,而髓丝一般为圆柱状,缢缩较少,侧生长也较少。

根据我们的经验,我们认为除了 Gepp 等所应用的藻丝和侧生长及其他特征以外,下列几个特征也具有一定的分类价值:

1. 藻体的厚薄和藻丝的层次;

2. 藻体的钙化程度;

3. 藻丝的钙化程度和丝与丝间的钙化情况。

二、新种的描述

1. 薄叶钙扇藻(新种) *Udotea tenuifolia* sp. nov. (图版 I:1, II:1, 图 1)

Planta griseo-viridis, 4 cm. alta, filamentis repetite dichotome ramosa, constrictio-nibus supra-dichotomialibus asymmetricis instructa. Frons cuneato-flabellata, zonata, circa 3 cm. alta, 2 cm. lata, leviter calcareo-incrustata, superficie omnino manifesto fibrosa (sub 10—20 × lente), tenuissima, ad basem circa 300 μ crassa, filamentis tetrastratis, ad apicem fimbriatis circa 65—80 μ crassa, filamentis bistratis; fila-menta corticalia 20—30 μ crassa, ad apicem imperfecte calcifacta (utringue calcifacta, in centro filamentis non calcifacta), inferne omnino incrustata, structuris lateralibus superne papillatis, inferne virgatis, non constrictis, simplicibus vel ad apicem bifidis, 30—60 μ longis instructa; filamenta medullosa 30—40 μ crassa, structuris lateralibus similis sed paucis instructa. Stipes simplex, circa 1—2 cm. altus, subcylindricus, filamentis 50—75 μ crassis, structuris lateralibus inferne constrictis superne 2—4 dichotome ramosis, usque ad 365 μ longis instructi.

Hab. In rupe corallino submarino littorali inferno, ad Beidao, Ins. Xisha, in Mari Sinensi Australi, 30, IV, 1957 (AST 57-5313, Holotypus).

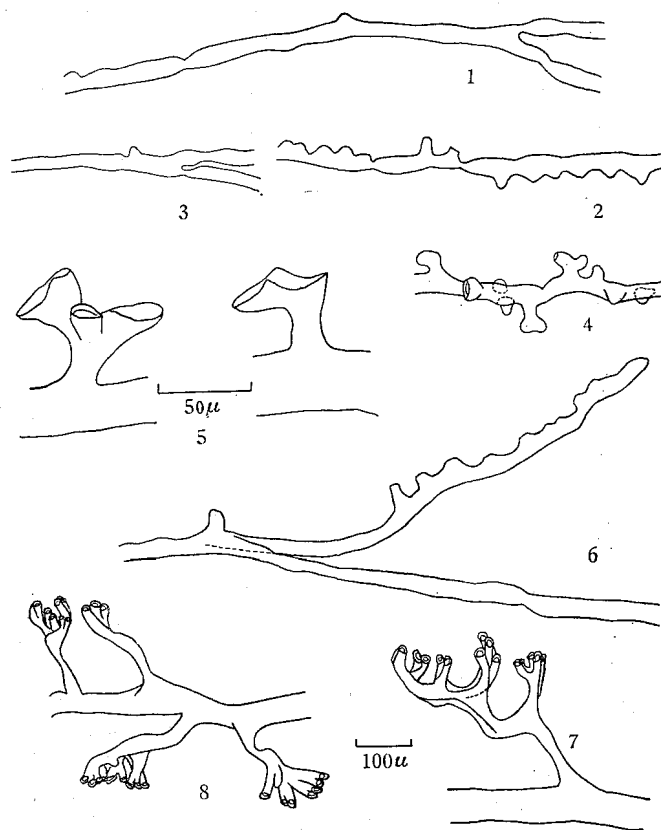


图1 薄叶钙扇藻

1.叶片上部藻丝,具乳头侧生长; 2.叶片中部皮丝,具乳头和棒状侧生长; 3.叶片中部髓丝,具乳头侧生长; 4.叶片下部皮丝,具不规则排列和密生侧生长; 5.叶片中部侧生长,顶凹形; 6.叶片下部髓丝,显示其上枝向外生长成为皮丝; 7.柄部髓丝及较长的侧生长; 8.柄部皮丝,具密生侧生长。(除图1:5放大230倍外,其他均放大70倍)

藻体灰绿色,约4.2厘米高,为叉形分枝藻丝所组成,叉上缢缩部位不等。叶片扇形(图版I:1),基部楔形,体薄,边缘不完整,约2厘米宽,3厘米高,钙化轻,均匀,呈明显带状,浅色带与深色带宽度不等,前者约1毫米宽,后者约2毫米宽;在一般放大镜(10—20×)下,皮丝清晰可见,丝间疏松;近柄部约 300μ 厚,为4层藻丝所组成,由基部向上逐渐减少,至顶部 $65-80\mu$ 厚,2层藻丝;上部藻丝在丝两侧钙化,中间不具钙质(图版II:1),中部和下部皮丝全钙化;丝径和侧生长随藻体部位而异,上部皮丝径 $20-30\mu$,侧生长表现为轻微突起(图1:1);中部皮丝径 $30-35\mu$,具单列的不等长侧生长,这些侧生长单条,不缢缩,顶呈凹形(图1:2), $30-60\mu$ 长;下部皮丝径 $30-40\mu$,具同样排列的侧生长(图1:4),它们单条或上部简单二裂,不缢缩,顶呈凹形, $30-60\mu$ 长。髓丝径 $30-40\mu$,具类似皮丝的单列侧生长,但稀疏。

柄部单条,钙化轻,较软,1.2厘米长,楔形,上部亚圆柱形,约2毫米宽,下部略窄,约1毫米宽。藻丝钙化轻;皮丝径 $50-65\mu$,具单列、二列或不规则排列的密生侧生长,这些侧生长有缢缩,2—4回叉分,可达 365μ 长,顶呈凹形(图1:8),相互紧密联结,去钙后,侧生长难于分离。髓丝径 $50-75\mu$,具有类似皮丝的单列侧生长(图1:7),虽稀疏,但较长。

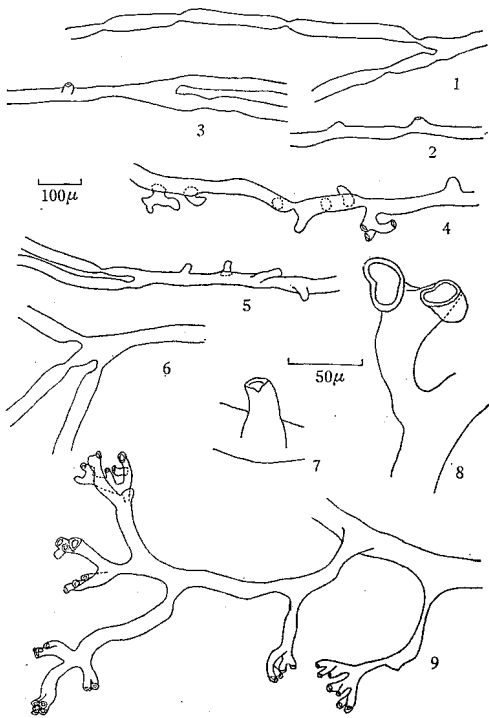


图2 脆叶钙扇藻

1. 叶片上部藻丝无任何乳头突起； 2. 叶片中部皮丝，具乳头突起； 3. 叶片中部髓丝，具一个乳头突起； 4. 叶片下部皮丝具不规则排列的不同形状的侧生长； 5. 叶片下部皮丝显示不等部位的叉上缢缩和不规则排列的侧生长； 6. 叶片藻丝的三叉分枝； 7—8. 叶片下部侧生长及其顶端； 9. 柄部藻丝及侧生长。（除图2:7—8放大192倍外，其他均放大58倍）

标本产地 我国西沙群岛的长岛，采自低

潮线附近，1957年4月30日，模式标本AST57-5313（采集者：郑树栋、夏恩湛、胡本孚）和永兴岛，采自低潮线附近环礁内珊瑚礁上，3月（AST58-4068）。后一号标本较大，藻体可达6厘米高，叶片达4厘米高，3.5厘米宽，柄部2厘米长。

主要特征 (1) 藻体薄，边缘不完整，钙化轻；(2) 叶片藻丝在10—20×放大镜下全部清晰可见，丝间疏松；(3) 丝的侧生长一般单条，无缢缩，单列、二列或不规则排列在丝上。本种近缘种为印度钙扇藻 (*U. indica* A. et E. S. Gepp) 和掌状钙扇藻 (*U. palmetta* Decaisne)，这三种都是钙化轻，叶片藻丝在一般放大镜下清晰可见，藻丝的叉上缢缩部位不等，丝的侧生长简单。但是，本种叶片顶部藻丝两层，藻丝侧生长有单列，也有二列，甚至不规则排列，柄部藻丝比叶片藻丝大很多，将近一倍，叶片基部楔形，而其它两种的叶片顶部藻丝三层，藻丝侧生长则为单列，柄部和叶片部藻丝大小差不多（根据附图测量）。

2. 脆叶钙扇藻（新种） *Udotia fragilifolia* sp. nov. (图版I:2, II:2, 图2)

Planta griseo-viridis, 5 cm alta, filamentis repete dichotome ramosa, constrictionibus supra-dichotomialibus asymmetricis instructa. Frons flabellata, leviter calcareo-incrustata, fragilis, facile longitudinaliter fissurata, 4 cm alta, 5 cm lata, obscure zonata, praeter basem pro parte minore prope stipem manifesto fibrosa (sub 10—20 × lente), ad basem subcordata, prope stipem 330 μ crassa, filamentis quinque stratis, ad apicem 50—65 μ crassa, filamentis bistratis, filamentis parcellis vel subparcellis, imperfecte calcifactis; filamenta aliquando trichotome ramosa; filamenta corticalia 25—35 μ diam. saperne leviter constrictis, sine structuris lateralibus, inferne structuris lateralibus virgatis, non constrictis, inaequaliter longis simplicibus vel superne bilobatis, unifaris, bifaris vel irregulariter dispositis, usque ad 65 μ longis, ad apicem depressis instructa; filamenta medullosa 30—40 μ diam. structuris lateralibus similaribus sed paucis instructa. Stipes simplex valde calcareo-incrustatis, circa 1 cm altis, subcylindricis, 2.0—2.5 mm latis; filamenta corticalia valde calcifacta, 50—60 μ diam, structuris lateralibus densis, unifaris, bifaris vel irregulariter dispositis, inferne

constrictis, superne 1—4 dichotomis usque ad 350μ longis instructi.

Hab. In rupe corallino submarino, 4—5 M. infra superficiem crescens, ad Chenhangdao, Ins. Xisha, in Mari Sinensi Australi, 24, V. 1958 (AST 58-4750, Holotypus).

藻体灰绿色, 5 厘米高, 为平行或几乎平行排列的叉形分枝的藻丝所组成, 又上缢缩部位不等。叶片亚圆扇形, 质脆, 易纵裂(从顶部一直裂开到近柄部), 约 4 厘米高, 5 厘米宽, 基部斜心脏形, 钙化轻, 均匀, 隐约地带状, 带间距离大致相等, 浅色带与深色带各约 0.5 毫米宽; 在一般放大镜 (10—20 $\times$) 下, 除了近基部很小一部分外, 皮丝都清晰可见, 整齐, 紧密平行排列, 多数皮丝两侧钙化, 中间不具钙质 (图版 II:2); 近柄部 330μ 厚, 为 5 层藻丝所组成, 由基部向上逐渐减少, 至顶部为 $50—65\mu$, 2 层藻丝; 除了叉形分枝以外, 有时也见到三叉分枝 (图 2:6), 这些分枝的两侧枝缢缩部位差不多, 但中枝缢缩部位较高。丝径与侧生长随所处部位而异, 上部皮丝径 $25—35\mu$, 无侧生长, 仅有轻微缢缩 (图 2:1); 中部皮丝径 $30—35\mu$, 具不规则排列的单列或二列侧生长, 这些侧生长只是单个突起, 仅 20μ 长, 顶呈凹形 (图 2:2); 下部皮丝径 $30—35\mu$, 具单列、二列或不规则排列的不等长侧生长, 这些侧生长单条棒形, 无缢缩 (图 2:5、7) 或顶端二裂 (图 2:4、8), 偶有偏生, $45—65\mu$ 长, 顶呈凹形。髓丝径 $30—40\mu$, 具类似皮丝的侧生长, 但稀疏 (图 2:3)。

柄部单条, 钙化重, 较硬, 亚圆柱状, 1 厘米长, 楔形, 约 2 毫米宽。皮丝钙化重, 丝径 $50—60\mu$, 具单列、二列或不规则排列的密生侧生长, 有缢缩, 1—4 回叉分, 可达 350μ , 顶呈凹形 (图 2:1)。髓丝不完全钙化, 丝径 $50—65\mu$, 具类似皮丝的单列侧生长。此外, 尚有叉形分枝的纤细藻丝, 这些可能向下生长成为假根。

标本产地 我国西沙群岛琛航岛小岛南及西南面, 生长于环礁外低潮线下 4—5 米的珊瑚礁上, 1958 年 5 月 24 日采集, 模式标本 AST 58-4750 (采集者: 郑树栋)。

主要特征 (1) 体薄, 叶片脆质, 常从顶部纵裂到近柄部, 形成若干裂片; (2) 藻丝紧密平行排列; (3) 藻丝钙化不完全, 多数限于两侧; (4) 藻丝具单列、二列或不规则地排列的棒状, 不等长的侧生长, 不缢缩。在第一、二特征方面, 本种很象爪哇钙扇藻 (*U. javensis* A. et E. S. Gepp) 和突起钙扇藻 (*U. papillosa* A. et E. S. Gepp), 但后两种的藻体呈楔扇形, 为单层藻丝所组成, 藻丝无侧生长或侧生长为乳头状突起,

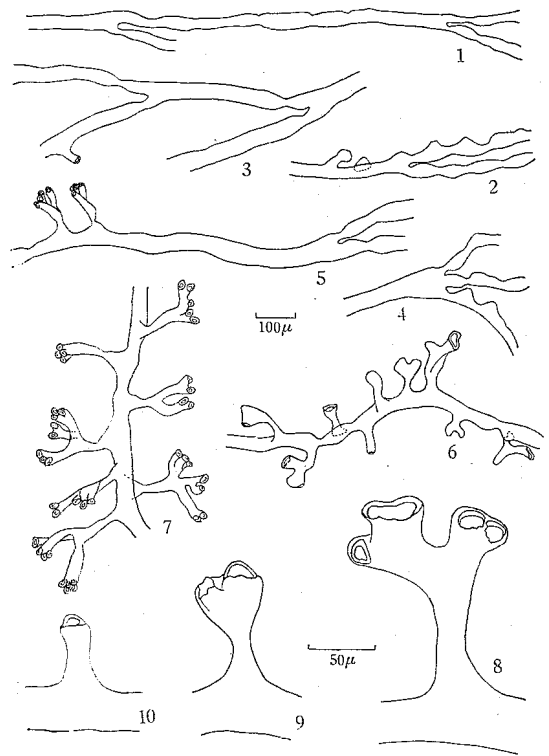


图 3 西沙钙扇藻

1. 叶片上部藻丝; 2. 叶片中部皮丝及侧生长, 显示念珠状的缢缩部分; 3. 叶片中部髓丝具侧生长, 并显示不等部位的缢缩; 4. 叶片藻丝的三叉分枝; 5. 叶片下部髓丝具叉分枝的单列侧生长; 6. 叶片下部皮丝具不等长和不同形状的侧生长; 7. 柄部藻丝具侧生长。8—9. 叶片下部侧生长及凹顶; 10. 叶片中部棒状侧生长及凹顶。(除图 3: 8—9 放大 176 倍外, 其他均放大 54 倍)

钙化不全,形成多孔状,而本种呈亚圆扇形,为多层藻丝所组成,藻丝有棒状侧生长,钙化主要限于两侧。在第三、四特征方面,本种接近薄叶钙扇藻 (*U. tenuifolia* Zeng et Dong),但第一、二特征足以区别这两种,而且后者上部藻丝不完全钙化,中下部藻丝则完全钙化。本种与印度钙扇藻 (*U. indica* A. et E. S. Gepp) 也有相似之处,但头三个特征足以区别这两种,而且后者的藻丝侧生长均为单列。

3. 西沙钙扇藻(新种) *Udotea xishaensis* sp. nov. (图版 I:3, II:3, 图 3)

Planta grises-viridis, 6 cm alta, filamentis repetite dichotoma ramosis, constricti-
onibus supradichotomialibus asymmetricis instructa. *Frons* modice calcareo-incrus-
tata, flabellata, zonata, longitudinaliter plicata, ad apicem plus minusve lacerata,
120—130 μ crassa, filamentis tristratis, ad basem plus minusve inaequalis, subtrun-
cata vel subcordata, 415 μ crassa, superficie pro parte maxima manifesto fibrosa (sub
10—20 $\times$ lente), filamentis 7-stratis; filamenta aliquando trichotome ramosa; fila-
menta corticalia pro parte maxima omnino calcifactoria, aliquot imperfecte calcifactoria,
25—40 μ diam., ad apicem structuris lateralibus non constrictis, paucis, simplicibus,
20—35 μ longis instructa, inferne structuris lateralibus non constrictis, virgatis, uni-
fariis, bifariis vel irregulariter dispositis, simplices, apicibus bifidis, 50—70 μ longis
instructa, prope basem structuris lateralibus similiter dispositis, dichotome vel unila-
teraliter ramosis, generaliter 100—160 μ longis, ad apicem depressis instructa; filamenta
medullosa structuris lateralibus similis sed paucis instructa. *Stipes* simplex, valde
calcareo-incrustatus, rigidus, inferne cylindricus 1.5 mm latus, superne compressus 2
mm latus; filamenta corticalia valde calcifactoria, 45—55 μ diam., structuris lateralibus
bifariis vel irregulariter dispositis, 2—4 dichotomis, usque ad 365 μ longis instructa;
filamenta medullosa leviter calcifactoria, aliquot ex parte calcifactoria, 45—65 μ diam.,
structuris lateralibus similis sed paucis instructa.

Hab. In rupe corallino submarino, Ca. 1 M. infra superficiem crescens ad Jinjingdao, Ins.
Xisha, in Mari Sinensi Australi, 13. V. 1958 (AST 58-4563, Holotypus).

藻体灰绿色,约 6 厘米高,为多次叉形分枝的藻丝所组成,叉上缢缩部位不等。叶片
扇形(图版 I:3),约 5.5 厘米宽,3 厘米高,顶部多少裂开,叶缘不整齐,中、上部有纵褶皱
与裂片,基部两边不等。明显地带状,带间距离大致相等,各约 2 毫米宽。在一般放大镜
(10—20 $\times$)下,皮丝钙化较轻,少数不完全钙化,不均匀,常有白色小钙块。中、上部和部
分下部皮丝清晰可见,丝间空隙多(图版 II:3),近柄部藻丝隐约可见,丝间空隙少。近柄
部约 415 μ 厚,为 7 层藻丝所组成,由基部向上逐渐减少,在顶端为 120—130 μ , 3 层藻
丝,除叉形分枝外,有时有三叉分枝(图 3:4)。丝径与侧生长随叶片部位而异,上部皮丝
径 25—35 μ ,具稀少的无缢缩的单条侧生长(图 3:1),20—35 μ 长,顶呈凹形,中部皮丝
径 30—40 μ ,具单列、二列或不规则排列的棒形顶拳状侧生长(图 3:2),50—70 μ
长,偶有顶部二裂,顶呈凹形;下部皮丝径 35—40 μ ,具同样排列的密生侧生长,这些侧生
长又分或偏生(图 3:6),100—160 μ 长,有缢缩,顶呈凹形。髓丝较粗,上部径 35—40 μ ,
中部径 40—45 μ (图 3:3),下部径 40—50 μ (图 3:5),具有类似皮丝的单列侧生长,但稀疏。

柄部皮丝钙化重，丝径 $45-55\mu$ ，具二列或不规则排列的密生侧生长（图 3:7），2—4 回叉分，可达 365μ 长，去钙后分离时容易断折。髓丝钙化轻，有的不完全钙化，丝径 $45-65\mu$ ，具有类似皮丝的稀疏而较长的侧生长及纤细藻丝，这些纤细藻丝可能向下生长形成假根。

标本产地 我国西沙群岛晋卿岛西部，生长于环礁内，在低潮线约 1 米附近的珊瑚礁上，1958 年 5 月 13 日采；模式标本 AST 58-4563（采集者：郑树栋）。此外，还采自北礁，3 月（AST 58-4018）；琛航岛，5 月（AST 58-4654）；永兴岛的西南面，4 月（AST 58-4198），南面，6 月（AST 58-5010）及西北面，6 月（AST 58-4914）。

主要特征 (1) 藻体具明显的纵褶皱，顶部多少裂开，叶缘不整齐；(2) 叶片中、上部全部皮丝和下部分皮丝清晰可见，丝间空隙多，但近柄部藻丝不清（在 $10-20\times$ 放大镜检查下）；(3) 叶片中、上部皮丝具单列、二列或不规则排列的侧生长，这些侧生长一般单条，棒状，无缢缩，下部皮丝有叉分侧生长。本种和上面所描述的两新种有许多相似处，它们藻体的中、上部皮丝在放大镜下清晰可见，中部皮丝都具有单列、二列或不规则排列的简单棒状的侧生长，它们的藻丝和西沙群岛其它种类一样，又上缢缩部位不等，但本种的藻丝侧生长特别是叶片下部的藻丝侧生长要比上面两种长得多，密得多，有分枝，而且，藻体的形状及其它特征也相差甚大。

4. 肾形钙扇藻(新种) *Udotea reniformis* sp. nov. (图版 I:4, II:4, 图 4、5)

Planta griseo-viridis, 5.5 cm alta, filamentis repitite dichotome ramosis, constricti-
onibus supra-dichotomialibus asymmetricis instructa, structuris lateralibus unifaris,
bifaris vel irregulariter dispositis, inaequaliter longis, ad apicem depressis instructa.
Frons valde calcareo-incrustata, reniformis-fabellata, inaequalis, obscure zonata, super-
ficie partibus superis et medianis manifesto fibrosa (sub $10-20\times$ lente), ad apicem
margine plerumque integro, $115-135\mu$ crassa, filamentis tristratosi, ad basem oblique
cordata, $650-700\mu$ crassa, filamentis 7-stratosi; filamenta corticalia $25-45\mu$ diam.
superne structuris lateribus virgatis, non constrictis, simplicibus, $35-50\mu$ longis, in-
ferne structuris lateralibus virgatis, numerosis, bifidis vel dichotome ramosis, usque
ad 130μ longis, ad basem structuris lateralibus similariter dispositis, inferne constrictis,
superne dichotome vel unilateraliter vel irregulariter ramosis, usque ad 250μ
longis instructa; filamenta medullose plerumque calcifactorum aliquot non calcifactorum,
superne $25-35\mu$ inferne $35-45\mu$, ad basem $45-65\mu$ diam., structuris lateralibus
similaribus sed longioribus instructa. Stipes simplex, valde calcareo-incrustata, rigidus,
inferne subcylindricis, circa 2 mm diam., superne compressis, 3 mm latis; filamenta
corticalia valde calcifactorum, $40-50\mu$ diam., structuris lateralibus superne 2—4 dichotome
ramosis, dactylinis, inferne constrictis, usque ad 415μ longis instructi; filamenta
medullosa imperfecte calcareo-incrustata, $50-70\mu$ diam., structuris lateralibus similaribus
sed paucis instructa.

Hab. In rupe corallino submarino littorali inferno crescens, ad Shidao, Yongxingdao, Ins. Xisha, in Mari Sinensi Australi, 13, V, 1957 (AST 57-5332 Holotypus).

藻体灰绿色，5.5 厘米高，为叉形分枝的藻丝所组成，又上缢缩部位不等，除叶片上部

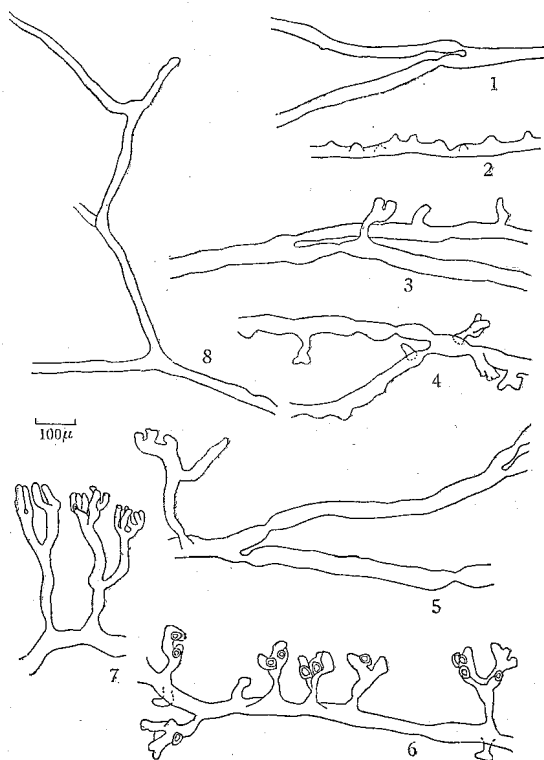


图4 肾形钙扇藻

1.叶片上部髓丝的轻微突起和不同部位缢缩；2.叶片上部皮丝及乳头状侧生长；3.叶片中部髓丝具稀疏的侧生长；4.叶片中部皮丝具不规则排列的侧生长；5.叶片下部髓丝具稀疏而长的侧生长；6.叶片下部皮丝具密生侧生长；7.柄部藻丝及侧生长；8.生于柄部髓丝的纤细藻丝。(均放大50倍)

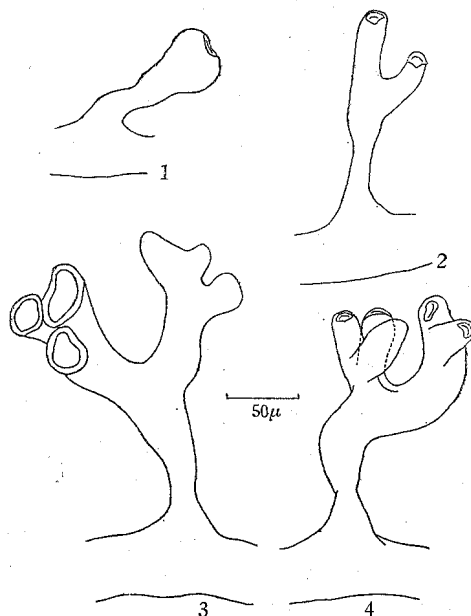


图5 肾形钙扇藻

1.叶片中部藻丝的单条侧生长；2.叶片中部藻丝的叉分枝侧生长；3.叶片下部藻丝的三次叉分枝侧生长；4.叶片下部藻丝的指头状分枝的侧生长。注意这些侧生长的凹顶。(均放大190倍)

以外,藻丝具单列、二列或不规则排列的密生侧生长,它们不等长,简单至多次叉分,顶端呈凹形。叶片肾形、扇状,顶端边缘基本整齐,两边不完全对称(图版I:4),约5.5厘米宽,3.5厘米高,基部斜心脏形;钙化较重,不均匀,常有白色钙化小块,隐约地带状,浅色带较宽,约3.5毫米宽,深色带较窄,约1.5毫米宽;在一般放大镜(10—20×)下,大致叶片1/3的下部藻丝不清,叶片2/3的中上部藻丝清晰可见;近柄部650—700 μ 厚,为7层藻丝所组成,由基部向上逐渐减少,至顶端为115—135 μ ,3层藻丝。叶片皮丝钙化,上部皮丝径25—35 μ ,具单列棒状侧生长,35—50 μ 长,无缢缩,顶呈凹形;中部皮丝径30—40 μ ,侧生长棒状或简单的叉分(图4:4),可达130 μ 长,缢缩或有或无;下部皮丝径35—45 μ ,侧生长1—4回叉分,不少形成指头状(图4:6,图5:3,4)或偏生或不规则分枝,可达250 μ 长,有缢缩,互相联结甚紧,去钙后,不易分离。髓丝一般钙化,少数不完全钙化,上部髓丝径25—35 μ ,具有稀疏的棒状侧生长;中部髓丝35—45 μ ,侧生长叉分,少数呈指头状(图4:3),有缢缩,可达180 μ 长,但稀疏;下部髓丝径45—65 μ ,具有类似下部皮丝的单列侧生长(图4:5),它们虽较稀疏,但一般都很长,不少在200 μ 以上,甚至延伸到皮丝以外,与皮丝的侧生长联结在一起共同组成皮层。

柄部单条,钙化重,较硬,2厘米长,楔形,上部宽扁,达3毫米宽,下部亚圆柱形,约2毫米宽。皮丝钙化重,径 $40-50\mu$,侧生长有缢缩,2—4回叉分,有的如指头状,可达 415μ 长,去钙后,难于拨开。髓丝不完全钙化,丝径 $50-70\mu$,具类似皮丝的稀疏侧生长,但较长。

标本产地 我国西沙群岛的永兴岛、石岛,低潮线附近珊瑚礁上;1957年5月13日采,模式标本AST57-5332(采集者:郑树栋、夏恩湛、胡本孚)。此外,还于4月采自北岛(AST 57-5210),1958年4月采自永兴岛、石岛(AST 58-4219),5月采自晋卿岛东北部(AST 58-4639)。

主要特征 (1)藻体很厚(达 700μ),肾形,两边不完全对称,基部斜心脏形,顶端边缘基本整齐;(2)钙化较重,不均匀,藻体皮丝只有中上部清晰可见;(3)藻体中部藻丝侧生长已相当发展,多数为叉形分枝,下部藻丝的侧生长多次叉分,不少形成指头状。本种的近缘种为上面描述的西沙钙扇藻,具体表现在藻丝的类似的侧生长,但后者的叶片中部的藻丝侧生长基本单条,个别顶部二裂,下部的侧生长虽都有叉分,但比较简单,只有本种的一半左右长,一般不超过 160μ ;在藻体的形状,厚度,钙化程度,藻丝的大小等方面,这两种之间有很大差别。

5. 茸毛钙扇藻(新种) *Udotea velutina* sp. nov. (图版 I:5、II:5, 图 6)

Planta viridi-flava, 2.7 cm alta, filamentis repetite dichotome ramosis, constrict-ionibus supra-dichotomialibus asymmetricis, structuris lateralibus unifaris, bifaris vel irregulariter dispositis, inaequaliter longis, ad apicem depressis instructa. Frons reniformis-flabellata, obscure zonata, 1.5 cm alta, 3 cm lata, ad basem profunde cordata, superficie velutina, leviter calcareo-incrustata, aequata, superne obscure fibrosa, inferne spongiosa, porosa (sub $10-20 \times$ lente), prope stipem 415μ crassa, filamentis sex-stratosis, ad apicem 115μ crassa, filamentis duobus stratosis; filamenta corticalia, calcifacta, ad apicem $30-40\mu$ crassa, structuris lateralibus virgatis, inferne constrictis vel non constrictis, simplicibus vel superne bilobatis, $50-80\mu$ longis instructa, in parte medio $35-40\mu$ crassa, structuris lateralibus similariter et dense dispositis, inferne constrictis, superne 1—2 dichotome ramosis, $80-130\mu$ longis instructa, prope stipem $40-50\mu$ crassa, structuris lateralibus similariter et dense dispositis, inferne constrictis, superne 2—3 dichotome ramosis, dendriticis vel daetylinis, $150-$

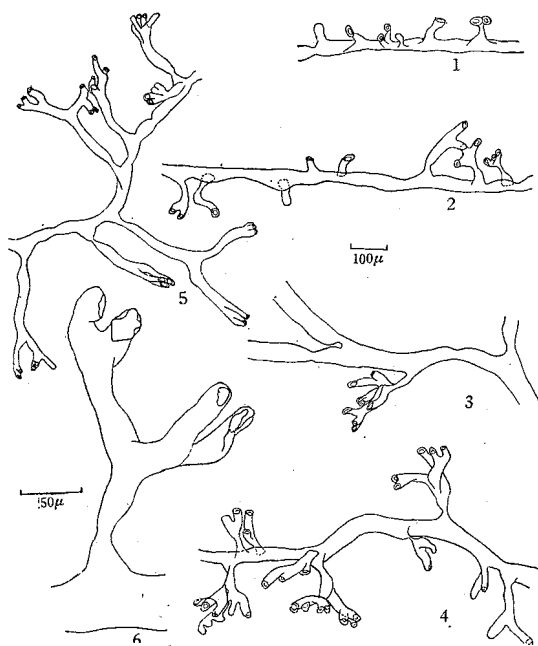


图 6 茸毛钙扇藻

1. 叶片上部藻丝及不同形状的侧生长; 2. 叶片中部皮丝具有不规则排列的不等长的侧生长; 3. 叶片下部髓丝缢缩部位不等, 并具侧生长; 4. 叶片下部皮丝具不规则排列的密生侧生长; 5. 叶片中部藻丝侧生长; 6. 柄部藻丝及侧生长, 注意侧生长的凹顶。(除图 6:6 放大 153 倍外, 其他均放大 50 倍)

230 μ longis instructa; filamenta medullosa imperfecte calcifactor, superne 35—45 μ diam., inferne 35—50 μ diam. prope partem basalibus 50—70 μ diam., structuris lateralibus similis sed paucis instructa. Stipes simplex, modice et aequaliter calcareo-incrustatis; filamenta corticalia 40—50 μ diam, structuris lateralibus inferne constrictis, superne 2—4 dichotome ramosis, dendriticis, usque ad 360 μ longis instructa; filamenta medullosa imperfecte calcifactor, 50—65 μ diam., structuris lateralibus similibus sed paucis instructa.

Hab. In rupe corallino submarino ca. 1 M. infra superficiem crescens, Yongxingdao, Ins. Xisha, in Mari Sinensi Australi, 15. VI. 1958 (AST 58-4885, Holotypus).

藻体绿黄色, 2.7 厘米高, 为多次叉形分枝藻丝所组成, 叉上缢缩部位不等, 具单列、二列或不规则排列的侧生长, 不等长, 一般下面有缢缩, 顶呈凹形。

叶片肾形, 扇状 (图版 I:5), 约 3 厘米宽, 1.5 厘米高, 基部深心脏形。表面观茸毛状, 钙化轻, 均匀, 隐约地带状。在一般放大镜 (10—20 $\times$) 下, 叶片下部和大部分中部皮丝不清, 明显地多孔状 (图版 II:5), 上部皮丝隐约可见。近柄部 415 μ 厚, 为 6 层藻丝所组成, 由基部向上逐渐减少; 至顶部 115 μ 厚, 藻丝 2 层。叶片皮丝钙化, 上部皮丝径 30—40 μ , 侧生长单条或二裂 (图 6:1), 50—85 μ 长, 缢缩或有或无; 中部皮丝径 35—40 μ , 侧生长有缢缩 (图 6:2), 一般 1—2 回叉分, 80—130 μ 长; 下部皮丝径 40—50 μ , 侧生长非常密生 (图 6:4), 一般 2—3 回叉分如树枝状或指头状, 150—230 μ 长。髓丝不完全钙化, 上部径 35—45 μ , 中部径 35—50 μ , 下部径 50—70 μ , 具类似皮丝的侧生长, 虽稀疏但较长, 下部髓丝的侧生长可达 330 μ , 它们一般延伸到皮丝中, 与皮丝的侧生长互相联合共同形成皮层。

柄部单条, 钙化轻, 均匀, 较软, 1.2 厘米长 (不全), 下面亚圆柱形, 上面宽扁, 达 3 毫米宽。柄部皮丝钙化轻, 丝径 40—50 μ ; 侧生长密生, 有缢缩, 2—4 回叉分如树枝状, 长达 360 μ , 去钙后不易分离。髓丝不完全钙化, 丝径 50—65 μ , 具类似皮丝的侧生长, 虽稀疏而较长。在髓丝上还可可见少量纤细藻丝, 这些藻丝可能往下面形成假根。

标本产地 我国西沙群岛永兴岛南面, 低潮线下约 1 米环礁内的珊瑚礁上。1958 年 6 月 15 日采, 模式标本 AST 58-4885 (采集者: 郑树栋)。此外, 还产于晋卿岛, 5 月 (AST 58-4986) 和永兴岛石岛, 4 月 (AST 58-4977)。

主要特征 (1) 绿黄色表面观非常均匀的茸毛状, 钙化轻, 肾形扇状叶片; (2) 叶片中、下部藻丝具非常密生的长分枝的侧生长, 把皮丝全部盖住, 因此, 虽然钙化很轻, 在放大镜下还是看不清皮丝。同时具有这两个特点的种类, 在钙扇藻中迄今只有这一种。在我国西沙群岛钙扇藻中, 藻丝的侧生长在叶片中部已经分枝而它们长达 200 μ 以上的种类迄今共有三种; 除了本种以外, 其他两种, 即肾形钙扇藻和韧皮钙扇藻, 它们的藻体钙化较重, 也较厚 (约为本种厚度的 160%)。

6. 韧皮钙扇藻 (新种) *Udotea tenax* sp. nov. (图版 I:6, II:6, 图 7、8)

Planta cineracea, 4.5 cm alta, valde calcereo-incrassata, filamentis repetite dichotome ramosis, constrictionibus supra-dichotomialibus asymmetricis, structuris lateralibus unifaris, bifaris vel irregulariter dispositis, inaequaliter longis, plerumque inferne constrictis, ad apicem depressis instructis. Frons cuneata, obcampanulata, 2 cm alta,

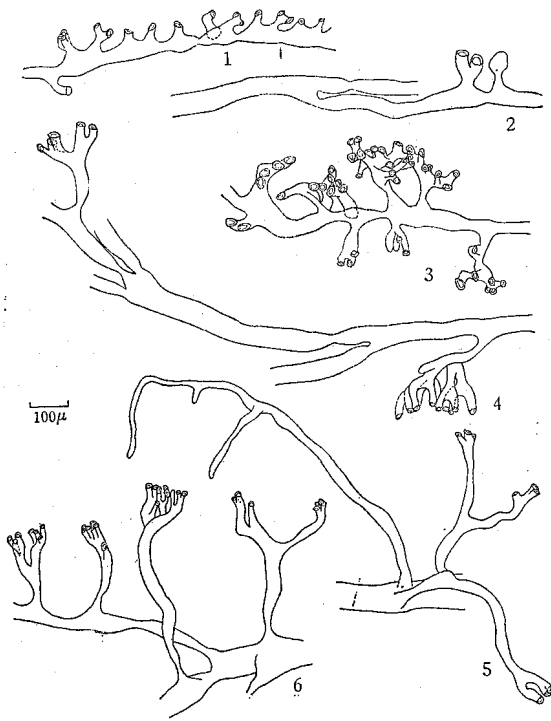


图7 韧皮钙扇藻

1. 叶片上部皮丝, 具密生的单条或顶二裂的侧生长; 2. 叶片中部髓丝, 叉上缢缩部位不等, 具稀疏侧生长; 3. 叶片下部皮丝具密生不规则排列、不等长的侧生长; 4. 叶片下部髓丝具稀疏而较长的侧生长; 5. 柄部髓丝的侧生长及纤细藻丝(这些可能形成假根); 6. 柄部皮丝具有侧生长。(均放大 50 倍)

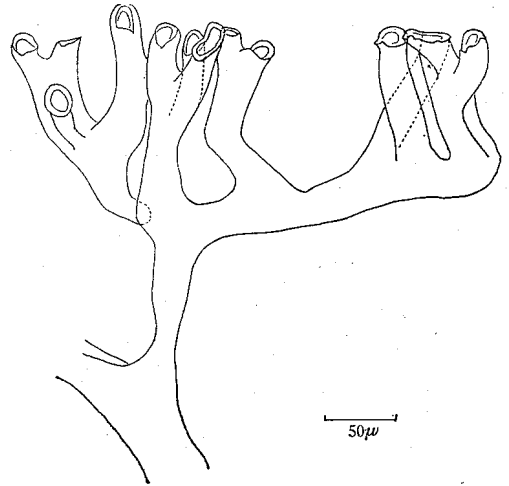


图8 韧皮钙扇藻

叶片下部藻丝侧生长, 显示其复杂的分枝情况和顶端。(放大 180 倍)

2 cm lata, azonata, superficie plerumque obscure, ad basem 660μ crassa, filamentis septem-stratosis, ad apicem $250-350\mu$ crassa, filamentis tristratosis; filamenta aliquando trichotome ramosa; filamenta corticalia superne $35-40\mu$ diam., structuris lateralibus plerumque virgatis, interdum dichotome ramosis, non constrictis, $35-115\mu$ longis instructa, inferne $40-45\mu$ diam., structuris lateralibus constrictis, densis, dichotome vel irregulariter ramosis vel unilateralis, $100-200\mu$ longis instructa, ad basem generaliter 50μ diam., structuris lateralibus constrictis, densis, 2-4-dichotome ramosis, dendriticus, usque ad 265μ longis instructa; filamenta medullosa superne et inferne $40-50\mu$ crassa, ad basem, $50-60\mu$ crassa, structuris lateralibus similis sed paucis et longiore, usque ad 330μ longis instructa; structurae laterales filamentorum corticalium et medullosorum intricate combinati, cortices tenicis usque ad 165μ crassis una formans. Stipes simplex, teres, 2.5 cm longis, 1 mm diam., filamenta corticalia valde calcareo-incrassata, $60-65\mu$ diam. structuris lateralibus 3-6 dichotome ramosis, dendriticus, usque ad 410μ longis, inferne constrictis instructa; filamenta medullosa imperfecte calcifacta, structuris lateralibus similis sed paucis instructa.

Hab. In rupe corallino submarino ca. 1 m. infra superficiem crescens, ad Shidao, Yongxingdao, Ins. Xisha, in Mari Sinensi Australi, 2, IV, 1958 (AST 58-4122 Holotypus).

藻体灰绿色, 4.5 厘米高, 为多次叉形分枝藻丝所组成, 叉上缢缩部位不等, 大部分藻丝的侧生长单列、二列或不规则排列, 不等长, 一般下面有缢缩, 顶呈凹形。叶片倒钟形 (图版 I:6), 略为纵褶, 2 厘米宽, 2 厘米高, 基部楔形; 表面观钙化重, 较为均匀, 但较粗糙, 无颜色深浅不同的带; 在一般放大镜 (10—20 $\times$) 下, 除少数皮丝隐约可见外, 大部分皮丝看不清 (图版 II:6); 近柄部 660 μ 厚 (未去钙), 为 7 层藻丝所组成, 由基部向上逐渐减少, 至顶部为 250—350 μ , 藻丝 3 层; 藻丝钙化, 除叉形分枝外, 偶有三叉分枝; 上部皮丝径 35—40 μ , 侧生长多数为单条 (图 7:1), 无缢缩, 常有叉分侧生长, 35—115 μ 长; 中部皮丝径 40—45 μ , 侧生长密生, 叉形分枝, 偏生或不规则分枝, 一般 100—200 μ 长, 常弯曲; 下部皮丝一般径 50 μ , 侧生长密生 (图 7:3), 2—4 回叉分如树枝状, 可达 265 μ 长, 去钙后, 由于侧生长互相紧密联结, 不易分离, 在分离过程中常断折; 偶而可见稀少的纤细藻丝, 这些藻丝可能最后形成假根; 叶片上、中部髓丝径为 40—50 μ , 下部髓丝径 50—60 μ , 具类似皮丝的单列侧生长, 虽稀疏, 但较长, 可达 330 μ 长, 它们一般延伸到皮丝, 与皮丝侧生长互相联结共同组成坚韧的皮层, 皮层 150—165 μ 厚 (去钙后)。

柄部单条, 较硬, 2.5 厘米长, 圆柱形, 1 毫米宽, 上部略扁; 柄部皮丝钙化重, 丝径 60—65 μ , 侧生长 3—6 回叉分如树枝状, 可达 410 μ , 下有缢缩, 去钙后互相联结的侧生长难于分离。髓丝不完全钙化, 丝径 60—75 μ , 具类似皮丝的侧生长, 虽稀疏, 但较长, 它们一般延伸到皮丝, 与皮丝的侧生长互相联结共同组成皮层。此外, 还有叉形分枝的纤细藻丝 (图 7:5), 丝径约 23 μ , 随着反复叉分, 丝径逐渐减少, 最后可能向下发展成为假根。

标本产地 我国西沙群岛永兴岛附近的石岛, 生于环礁内低潮线下约 1 米的珊瑚礁上, 1958 年 4 月 2 日采, 模式标本 AST 58-4122 (采集者: 郑树栋)。

主要特征 (1) 藻体具长柄, 倒钟形, 叶片无带状, 钙化重, 均匀, 除少数部分外, 皮丝都见不到; (2) 藻丝侧生长又多又长, 不等长, 多次分枝为树枝状, 互相联结, 形成坚韧皮层。

本种的近缘种为广泛分布在热带海洋的扇形钙扇藻 [*U. flabellum* (Ell. et Sol.) Lamx.], 这两种的侧生长都是不等长, 不规则地在藻丝上排列, 上部多次叉形分枝, 指头状或簇生, 错综联合形成坚韧皮层, 去钙后, 由于侧生长的紧密联合, 不易将侧生长分离, 而在分离过程中, 侧生长容易断折。本种与扇形钙扇藻的区别主要有以下几点: (1) 藻丝具有叉上缢缩 (后者没有); (2) 叶片无盲枝, 表面无深浅不同颜色的带 (后者有盲枝, 表面有颜色深浅不同的带); (3) 柄部较长, 上下圆柱形 (后者柄部较短, 上部扁平)。此外, 本种藻体表面有些粗糙, 而后者则很光滑。

本种和我国西沙群岛其他钙扇藻差别很大, 钙化程度最重, 藻丝侧生长分枝最复杂, 最长。在藻丝侧生长的复杂与长度方面, 只有茸毛钙扇藻可以与它比较, 但后者的绿茸毛状, 肾状扇形, 基部心脏形的较薄叶片以及它的轻微钙化, 是与本种差别很大的。

我们虽然只掌握一个标本, 但其特征非常显著, 所以提出作为新种处理。

三、讨 论

上述六种钙扇藻的分类研究结果表明,这些种有一些显著的共同特点,与已报导的种类不同,说明了这些种类在进化过程中具有共同起源,这些表现在下列几点:

1. 组成藻体的叉形分枝藻丝,叉上缢缩部位都不等,两个分枝的缢缩部位总是一高一低,一个分枝在分叉处,而另一个则在分叉处上略高些的部位,这一点 Gepp 等 (1911) 在他们的专论中已经提到了。西沙群岛的种类,至少在脆叶钙扇藻、西沙钙扇藻和韧皮钙扇藻都可找到三叉分枝,这些分枝的两侧枝的缢缩部位差不多,都在分叉处,但中枝缢缩部位则较高。

2. 皮丝和髓丝有显著的差别。皮丝一般缢缩多,形成念珠状,但髓丝很少缢缩。这一点在 Gepp 等 (1911) 的专论或其他报导中都没有见到,可能是西沙群岛种类的特有情况。

3. 髓丝一般都有侧生长,但稀疏,较长,延伸到皮丝以外与皮丝的侧生长作不同程度的联结,共同组成皮层。这一点前人也没有报道过,可能也是西沙群岛种类的特有情况。

4. 藻丝侧生长都不等长,而在报道过的种类只有世界性的扇形钙扇藻具有不等长的侧生长。

5. 藻丝侧生长在藻丝上的排列一般都是从单列、二列到不规则,完全单列象 *U. indica* A. et E. S. Gepp 和 *U. palmetta* Decaisne 或规则地二列和轮生如 *U. verticillosa* A. et E. S. Gepp 和 *U. wilsoni* Gepp et Howe 则没有见到。

6. 藻丝侧生长除两种以外都有不同程度的分枝,特别是在藻体的下部,而在已经描述过的种类只有 *U. flabellum* (Ell. et Sol.) Lamx 具有类似的分枝侧生长 (*U. argentea* Zanard. 和 *U. occidentalis* A. et E. S. Gepp. 只在顶端具有裂片)。

7. 在 10—20× 放大镜下的表面观,这六种都或多或少,个别或全部的皮丝清晰可见,即使在钙化很重的韧皮钙扇藻也能见到一小部分的皮丝。

根据上述情况,这些种类似有共同的起源,当然,由于进化的结果,现在形成了在其他方面截然不同的物种。

钙扇藻属的分类,过去虽然也根据藻丝侧生长的特点,但对这个特点的检查分析似乎不够全面,不够深入。事实上,侧生长在叶片的上、中、下部就很不同,仅凭一个取样往往产生错误的判断。藻丝的大小也具有同样的情况。这是我们在这次研究工作中的一个比较深刻的体会。

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SOME NEW SPECIES OF UDOTEA FROM THE XISHA ISLANDS, GUANGDONG PROVINCE, CHINA*

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The siphonaceous genus *Udotea* is a group of widely distributed tropical algae, although one species extend its distribution to subtropical regions. Since the monographic study of this genus by A. and E. S. Gepp in 1911, only one new species (*U. sublittoralis* Taylor, 1928) and one new variety (*U. palmetta* var. *marshallensis* Dawson, 1957) have been added to the genus. Gilbert (1962) described from Hawaii *Udotea* (?) *abbreviata* Gilb. which is, however, non-calcified and *Flabellaria* in structure, and is better transferred to that genus, becoming *F. abbreviata* comb. nov.

In April to May, 1957 and March to June 1958, the Institute of Oceanology, Academia Sinica, sent two collecting groups to the Xisha Islands of the Guangdong Province, these being coral islands in the central South China Sea, and 113 nos. of *Udotea* spp. were collected. A preliminary analysis of these specimens showed that the Xisha *Udotea* flora is very rich, and the six new species described in this paper are only a part of it. The specimens studied including the type specimen are all deposited in the herbarium of the Institute of Oceanology, Academia Sinica at Qingdao.

1. *Udotea tenuifolia* sp. nov.¹⁾

The present species is characterized by its thin and lightly calcified, cuneate-flabellate, apically fimbriate, zonate frond with clearly visible (under an ordinary 10—20 × hand-lens) cortical filaments²⁾ which are only partially calcified (calcification restricted to both sides of the filaments), possessing merely papillate laterals³⁾ on the upper part of the frond and which are completely calcified, possessing simple rod-shaped non-constricted lateral growths unifariiously, bifariiously or irregularly dis-

* Contribution No. 338 from the Institute of Oceanology, Academia Sinica.

1) For the Latin diagnosis, see p. 2.

2) In the Xisha *Udotea* examined, the filaments are of two types. At both surfaces of the frond, the superficial filaments are provided with numerous constrictions, resulting in some cases bead-like appearance, and may be called the "cortical filaments". The filaments insides are provided with few constrictions, and may be called "medullary filaments" which when growing out to the surface become the cortical filaments.

3) These are structures growing out laterally and perpendicularly from the algal filaments, and are known in the literature under various names. The Gepps called them "lateral appendages" and employed their characteristics in the identification and classification of the genus. We follow Fritsch (1935) using the term "lateral" or "lateral growth" to designate such structures. Both the cortical and the medullary filaments bear laterals, abundantly in the former and scantily in the latter, these adhering to each other in various ways, some-times very intricately, forming the cortex, which in some species such as the tropically cosmopolitan *U. flabellum* (Ell. et Sol.) Lamx. and *U. tenax* described in the present paper is very tough and its intricate cortification component lateral growths of the filaments are difficult to separate from each other without breaking after decalcification.

posed on the filaments in the middle and lower parts. This species is closely related to *U. indica* A. and E. S. Gepp and *U. palmette* Decaisne, both of the Indo-Pacific region, differing in the form of the thallus, in the more loosely placed cortical filaments and in the laterals which tend to be irregularly disposed on the filaments.

2. *Udotea fragilifolia* sp. nov.¹⁾

The present species is characterized by its thin, broadly flabellate, fragile frond dehiscing longitudinally from the apex to the base near the stipe and the tightly pressed parallel or subparallel cortical filaments which are mostly visible (except the small portion near the base) under an ordinary 10—20 × hand-lens, and are incompletely calcified, the calcification being limited to both sides of the filaments. Superficially it looks like *Udotea papillosa* A. et E. S. Gepp or a large specimen of *U. javensis* A. et E. S. Gepp, but the latter two species have cuneate-flabellate frond composed of a single layer of algal filaments and their algal filaments are provided with papillose lateral or none. The new species should also be compared with *U. indica* A. et E. S. Gepp but the shape and characteristic of the frond and frondal filaments and arrangement of the laterals on the filaments are very different from those of the present species. In the simplicity of the laterals, and their arrangement, this species is similar to *U. tenuifolia* described above, but in that species, the frond is differently shaped and not fragile, the cortical filaments are more loosely arranged and are almost completely calcified in those of the middle and lower parts of the frond.

3. *Udotea xishaensis* sp. nov.²⁾

The present species is characterized by the conspicuously longitudinally plicate, moderately calcified and unevenly marginated sometimes strongly lacerate frond the cortical filaments of most parts of which (excepting the basal portion near the stipe) are clearly visible under an ordinary 10—20 × hand-lens, and the filamentous laterals are simple rod-shaped without constrictions in the upper and middle parts of the fronds while the lower part of the frond bears laterals, dichotomous or unilateral above and constricted below, reaching 160 μ in length. This species is related to *U. tenuifolia* and *U. fragilifolia* described above in the sizes of the cortical and medullary filaments and in the simplicity of the filamentous laterals; however, the laterals of the present species are more complex, denser and twice as long as those of the other two species. As far as the shape and the other external characteristics are concerned, this species is very different from the other two species.

4. *Udotea reniformis* sp. nov.³⁾

The present species is characterized by its thick (about 700 μ), kidney-shaped, quite heavily calcified frond with entire margin, the cortical filaments of the upper and middle parts of the frond clearly visible under an ordinary 10—20 × hand-lens, and the laterals of the lower frondal filaments commonly furcate and those of the

1) For the Latin diagnosis, See p. 4.

2) For the Latin diagnosis, See p. 6.

3) For the Latin diagnosis, See p. 7.

lower frondal filaments 1—4 times dichotomously branched, reaching 250μ or over in length. This new species is undoubtedly related to *U. xishaensis* as described above, differing from the latter, however, in shape, thickness and degree of calcification of the frond, and the laterals much more profusely branched and longer, about twice as long.

5. *Udotea velutina* sp. nov.¹⁾

The present species is characterized by its greenish yellow, evenly velvet, lightly calcified reniformo-flabellate frond the middle and basal parts of which are so densely covered by the very long and much branched laterals of the algal filaments that the cortical filaments are not visible under an ordinary 10—20 × hand-lens, despite its light calcification. These characteristics make this a very distinctive species. In its long, repeatedly dichotomously branched laterals of the algal filaments, it resembles *U. reniformis* described above, but its laterals of the upper filaments are much longer, almost twice as long as those of the latter species.

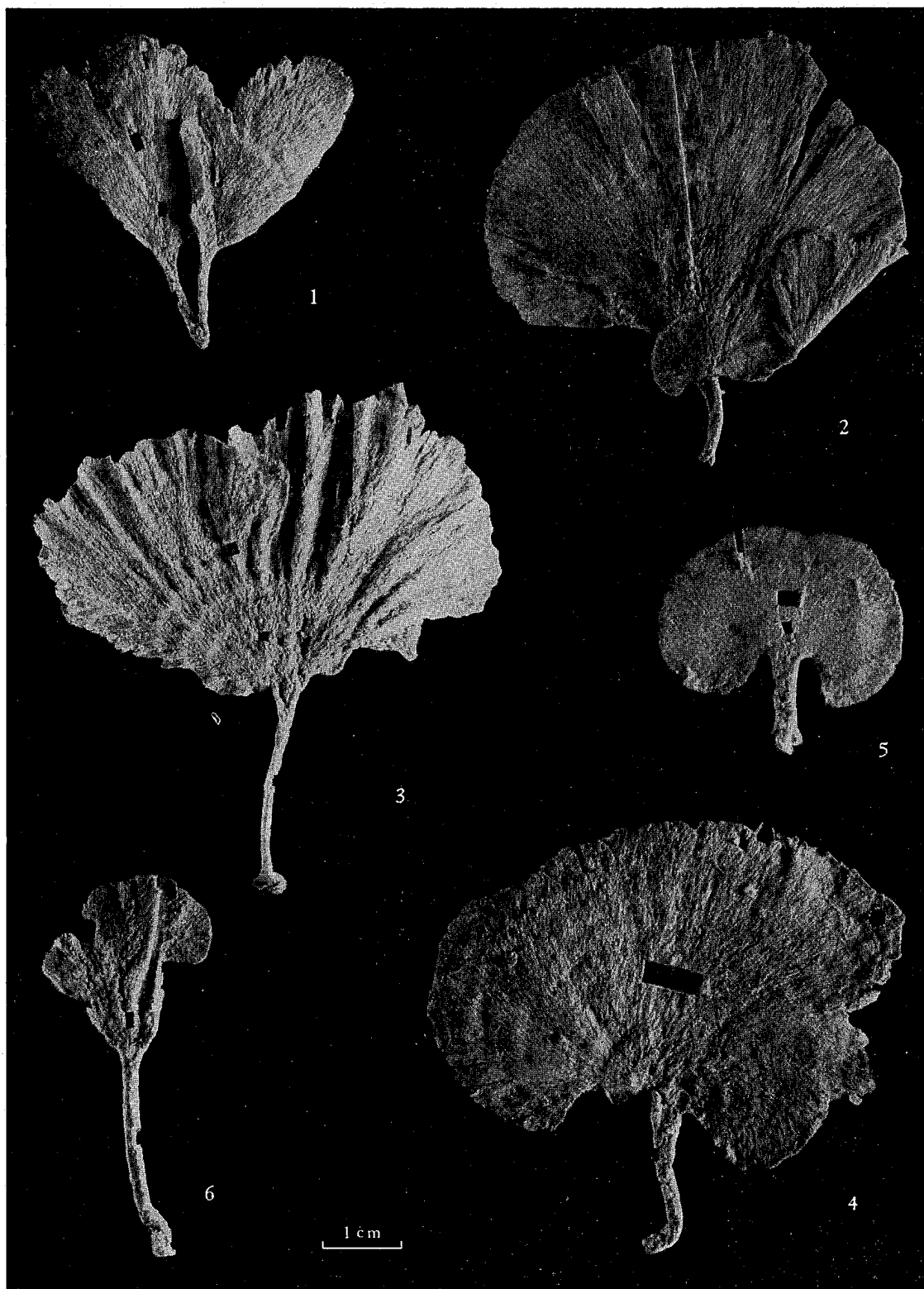
6. *Udotea tenax* sp. nov.²⁾

The present species is characterized by its long-stipitate, obcampanulate, very heavily calcified thick, azonate frond, most of its cortical filaments not visible under an ordinary 10—20 × hand-lens and its very long (as much as 330μ in length) and repeatedly dichotomously branched laterals of the algal filaments, these being so dense and intricately interwoven with each other that it is extremely difficult to separate them, after decalcification, without breaking some of their parts. Only two other Xisha species have similarly long and repeatedly dichotomously branched laterals; this species is however easily recognized by its very heavily calcified, differently shaped azonate frond. It is also similar to the tropically cosmopolitan *U. flabellum* (Ell. et Sol.) Lamx. in the characteristics of the laterals of the filaments but the latter species has no supra-dichotomial constriction and has an entirely different kind of fronds with distinctly zonate, smooth and evenly calcified frond.

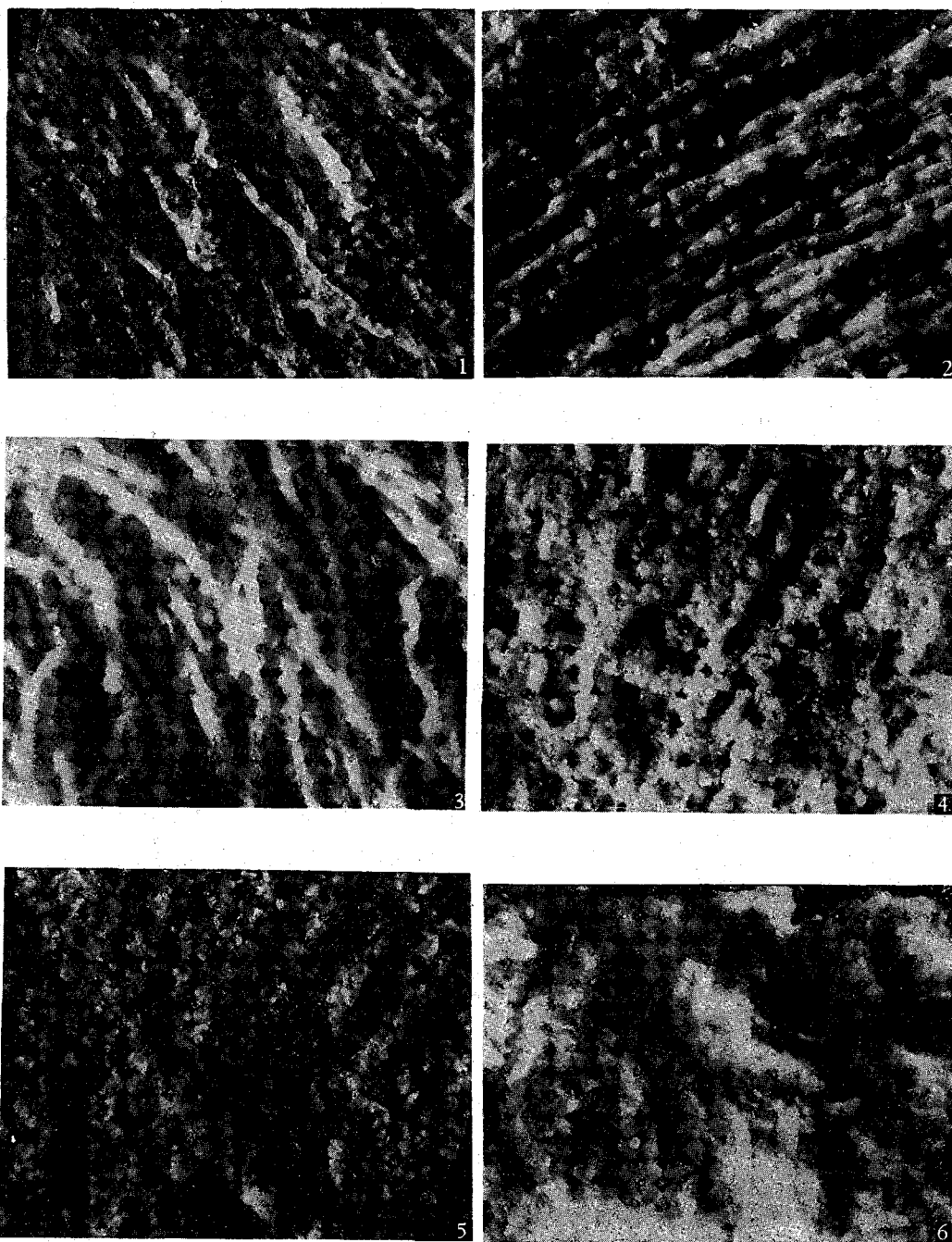
Comparative studies of the above described six new species of *Udotea* reveal several distinctive characteristics which they have in common, thus showing their probable common origin: (1) Their supra-dichotomial constrictions are uneven, one of them always right at the dichotomy and the other always somewhat higher up; this was duly emphasized by the Gepps as characteristic of the East Indian species (Gepp, 1911, p. 106); it must be added that trichotomy occurs in at least three of the six species. (2) There is a distinct difference between the cortical and the medullary filaments, more numerous constrictions resulting in bead-like structures in the former and few constrictions in the latter. (3) The medullary filaments are provided with lateral growths, generally scantier but definitely longer when compared with those of the cortical filaments; these grow out beyond the cortical filaments and combine in various ways with those of the cortical filaments forming together the cortices, which may be very complicated and tough in some species. (4) The laterals of the algal filaments in all these species are of unequal length, a characteristic in common with

1) For the Latin diagnosis, See p. 9.

2) For the Latin diagnosis, See p. 10.



新种钙扇藻的模式标本照片： 1.薄叶钙扇藻。(标本号 AST 57-5313)； 2.脆叶钙扇藻。(标本号 AST 58-4570)；
3.西沙钙扇藻。(标本号 AST 58-4563)； 4.肾形钙扇藻。(标本号 AST 57-5332)； 5.茸毛钙扇藻。(标本号
AST 58-4885)； 6.韧皮钙扇藻。(标本号 AST 58-4122)。



几种钙扇藻的叶片中部表面观,显示皮丝的可见程度,钙化程度及其排列。×65。

1. 薄叶钙扇藻,显示清晰可见,疏松而多少弯曲的皮丝,大部分不完全钙化,具乳头突起。
2. 脆叶钙扇藻,显示其皮丝几乎平行,整齐的排列,清晰可见,不完全钙化,具乳头侧生长。
3. 西沙钙扇藻,显示其疏松,多少弯曲,可见的皮丝,其侧生长具乳头或棒状侧生长。
4. 肾形钙扇藻,显示其隐约可见,钙化重,多少疏松,弯曲的皮丝。
5. 茸毛钙扇藻,显示其非常密生的皮丝,皮丝全被侧生长遮盖而看不清,无数小孔为侧生长的凹形端。
6. 韧皮钙扇藻,显示其叶片钙化很重,不均匀,皮丝钙化重,看不清,侧生长的凹形端隐约可见。

the tropically universal *Udotea flabellum* (Ell. et Sol.) Lamx., the only species among the already published ones possessing this feature. (5) The laterals in all these species are unifariiously, bifariiously or irregularly disposed on the filaments, unlike those of *Udotea indica* A. et E. S. Gepp and *U. palmetta* Decaisne which have unifariiously arranged laterals or *U. verticillosa* A. et E. S. Gepp and *U. wilsonii* Gepp et Howe which have regularly bifariiously or verticillately arranged laterals. (6) Four out of the six species have the upper parts of the lateral growths of the frondal filaments one to three or four times dichotomously branched and their lower parts constricted forming stalk-like structures, a characteristic possessed, among the published species, by *Udotea flabellum* (Ell. et Sol.) Lamx. and to a less extent by *U. argentea* Zanard. (7) Under an ordinary 10—20 × hand-lens, all or some of the cortical filaments are clearly visible, even in such heavily calcified forms as *Udotea tenax* Tseng et Dong, a few filaments are here or there visible.