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Four new species of the Genera *Eudesme* and *Sphaerotrichia* (Chordariaceae, Heterokontophyta) from the Chinese Coast

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Abstract

Four new species, *Eudesme huanghaiensis* Ding et Lu, *E. qingdaoensis* Ding et Lu, *E. shandongensis* Ding et Lu and *Sphaerotrichia huanghaiensis* Ding et Lu, from the western Yellow Sea coast of China are described. *Eudesme huanghaiensis* is mainly characterized by its spherical or sub-spherical sub-cortical cells, its rhizoidal filaments developing from the basal cells of sub-cortex and its broad sub-cortical and medullary layers. *E. qingdaoensis* is mainly characterized by its long medullary cells, generally hollow center of the medulla, short sub-cortex with only 3–4 cylindrical cells and long, slender and clavate terminal cells of the rhizoidal filaments. *E. shandongensis* is mainly characterized by its hollow frond, thick cell walls of both medulla and inner sub-cortical layers and the spherical terminal cells of the rhizoid filaments. *Sphaerotrichia huanghaiensis* is mainly characterized by its cylindrical, sparsely branched frond with acute angle, and its thick 5–6 layered sub-cortex with long assimilating filaments of 6–10 cells.

Introduction

The genera *Eudesme* Agardh (1880) and *Sphaerotrichia* Kylin (1940) belong to the family Chordariaceae. In China, Tseng & Bailing Zheng (1954) first reported *E. virescens* (Carm.) J. Agardh, collected from Qingdao City, Shandong Province, eastern China. Lu & Tseng (1983) reported *E. virescens* from north China coasts. In our research on the genus *Eudesme* from China, we identified four species including *E. virescens* and three other species which we believed have never been found elsewhere before.

Gepp (1904) reported a new species belonging to the genus *Chordaria*, collected from Weihai City, Shandong Province, and named it *Chordaria firma* Gepp. Collins (1919) reported two species from the coast of Beidaihe, Hebei Province, *C. flagelliformis* (Fl. Dan) Ag. and *C. cladosiphon sensu* Collin. Cowdry (1922) reported two species from the coast of Beidaihe again, *C. firma* and *C. cladosiphon sensu* Okam. Howe (1924) reported *C. firma* and *C. chordaria* (Harv.) Howe from Yantai City, Shandong Province and Beidaihe, Hebei Province. Howe believed that the *C. cladosiphon* Kuetz. reported by Cowdry (1922) is *C. chordaria*. Howe (1934) reported *C. firma* again from Qingdao City and Penglai County, Shandong Province. In 1958, J.JI 3nhoba studied some specimens of the genus *Chordaria* from Qingdao and concluded that the report of *Chordaria* from China should be changed to *Sphaerotrichia* (3nhoba, 1958). According to her views, she divided these materials into two species, *Sphaerotrichia dissessa* (S. *et* G.) Zinova and *S. firma* (Gepp) Zinova. Tseng & Chang (1964) agreed with her and Lu & Tseng (1983) reported *S. firma* again from Huanghai Sea coast of China. Previous studies of the genus *Sphaerotrichia* in China were fragmentary. We carried out an exhaustive study and identified three species of *Sphaerotrichia*, including a new record and a new species. The latter is described in this paper.

Materials and methods

Dried and wet herbarium specimens from the Herbarium of the Institute of Oceanology, Chinese Academy

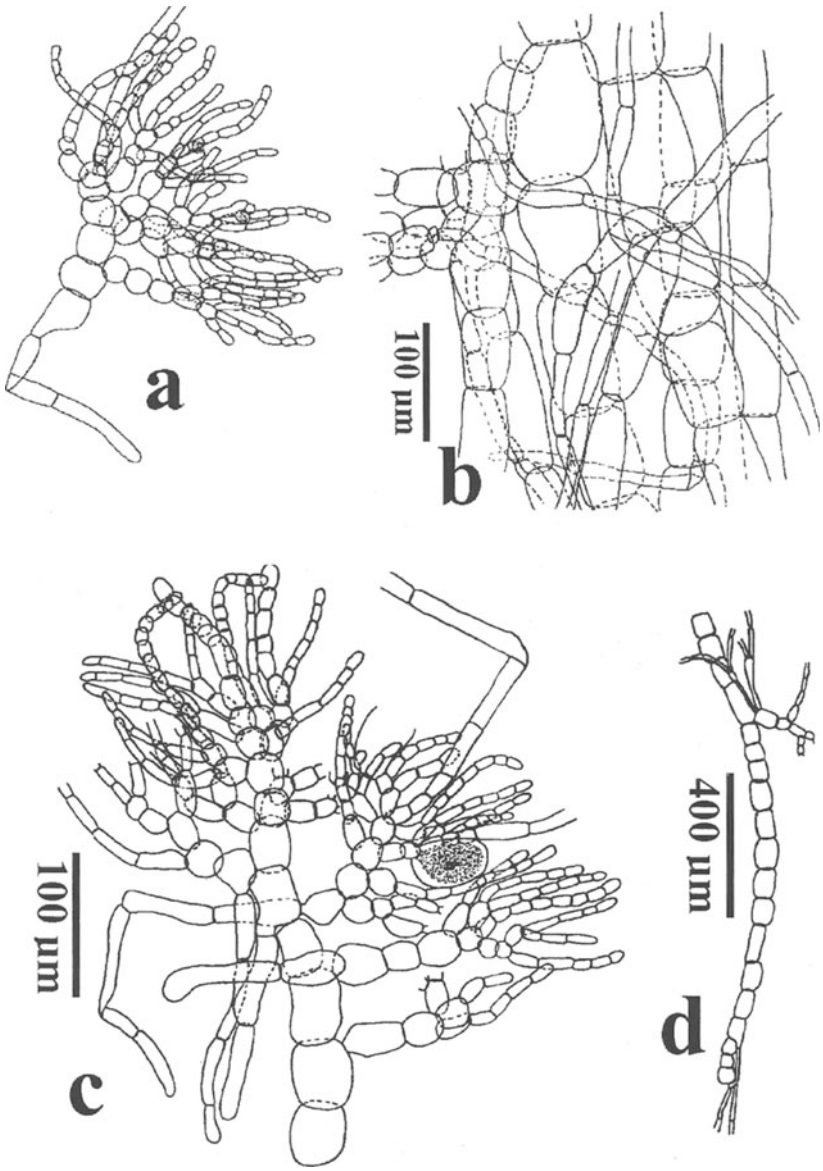

Figure 1. Eudesme huanghaiensis Ding *et* Lu sp. nov. Based on the holotype AST 56-3699. **(a)** whole branch of cortical filaments; **(b)** medullary filaments and part of the sub-cortical filaments; **(c)** longitudinal section of frond top; **(d)** medullary filament and sub-cortical filaments.

of Sciences (AST) were studied. Sections of the specimens were cut by hand using a razor blade or by a freezing microtome. Sections of the specimens were observed under an Olympus microscope.

Description of the new species

1. ***Eudesme huanghaiensis*** **Ding** ***et*** **Lu sp. nov.** (Fig. 1, Plate I: 1)

Frons mediocris, 5–20 cm alta, 1.5–3 mm diametro. Cellulae subcorticales sphaericae vel subsphaericae. Fila rhizoidea ex cellulis basalibus sub-corticalis oriunda. Strata sub-corticalia et medullosa lata.

Holotype: AST 56-3699, collected by Zheng Shudong and Xia Enzhan at Xiazeizi, Rongcheng, Shangdong Province, China, on May 23, 1956.

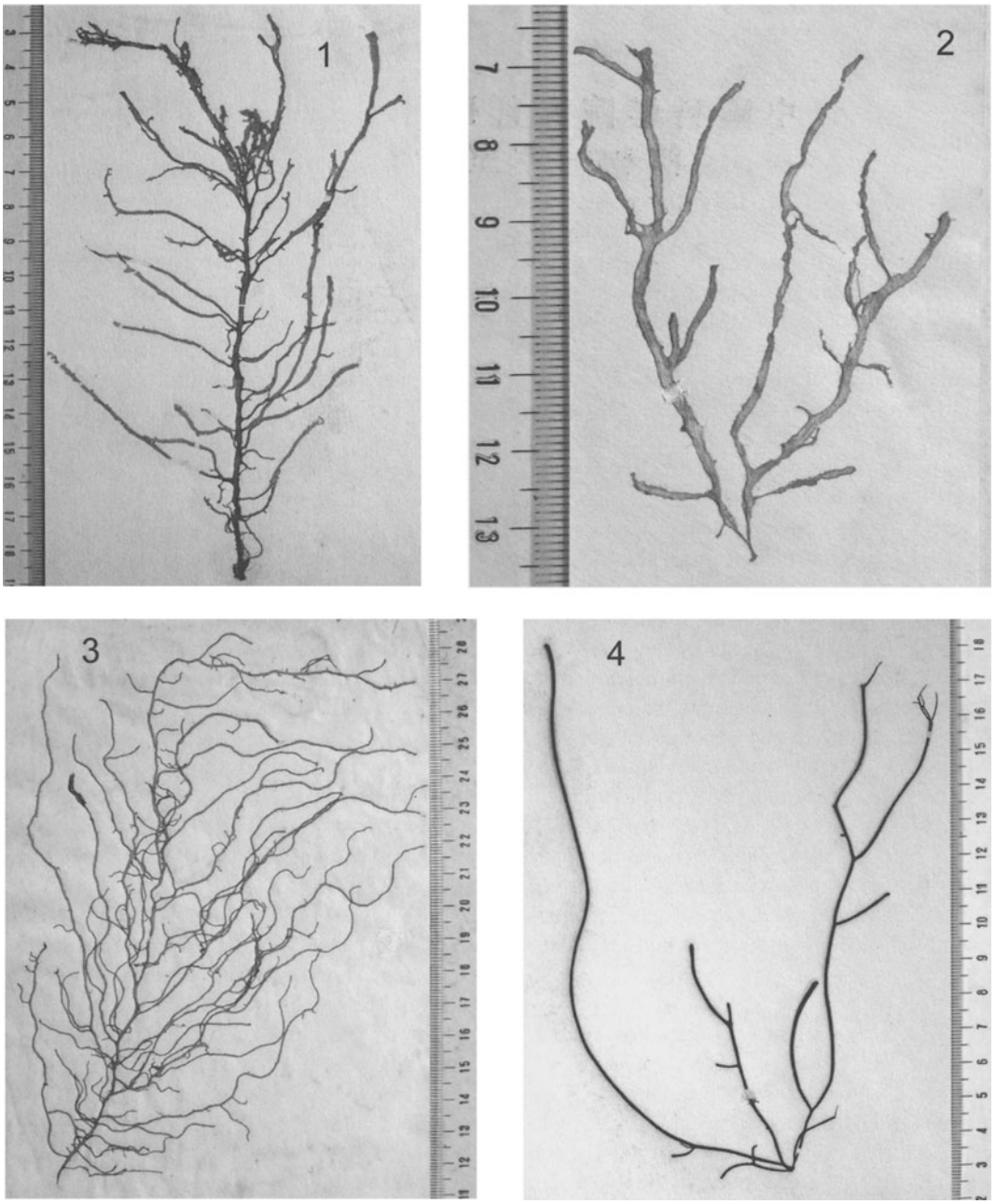

Plate I. 1. Habit of *Eudesme huanghaiensis* Ding *et* Lu sp. nov. (AST 56-3699). 2. Habit of *Eudesme qingdaoensis* Ding *et* Lu sp. nov. (AST 63-0586) 3. Habit of *Eudesme shandongensis* Ding *et* Lu sp. nov. (AST 63-0519). 4. Habit of *Sphaerotrichia huanghaiensis* Ding *et* Lu sp. nov. (AST 57-0534).

Frond yellowish brown, adhering completely to paper when dried, single or tufted, erect, 5–20 cm high, 1.5–3.0 mm thick, solid, embedded in gelatine, slimy, soft, single main axis, alternately branched 1–3 times. Holdfast discoid. Branches and branchlets patent, dense or sparse, 1.5–8.0 cm long, blunt at apex. Medullary layer composed of a bundle of cells arranged in lengthwise rows, polysiphonous, loosely, easily separated from each other. Medullary cells cylindrical, 80–110 μm long, few up to 130 μm, 39–78

μm in diameter. Sub-cortical filaments narrow, several cells long, developed transversely from outer medullary filaments, basal cells giving rise to rhizoidal filaments around outer medullary layer. Sub-cortical cells spherical or sub-spherical, 20 × 20–75 × 45 μm in size, divided bifurcately or trifurcately. Assimilating filaments simple, length with some cells, borne on the ultimate cells of sub-cortical layer, slightly curved, with swollen terminal cells. Chromatophores densely distributed in the assimilating filaments cells, gathering each other to patch. Unilocular sporangia ellipsoidal, 50–74 × 25–45 μm in size, sessile, growing on a side of basal cells of assimilating filaments. Plurilocular sporangia unknown. Hair hyaline, except its base colored, up to 2 mm long, 11 μm in diameter, growing on the basal cell of assimilating filaments or ultimate cells of sub-cortical layer.

This new species is mainly characterized by its spherical or sub-spherical sub-cortical cells, rhizoidal filaments developing from the sub-cortical basal cells and broad sub-cortical and medullary layers.

It appears to belong to the genus *Mesogloia* on the basis of its inner construction with monopodial-like medullary filaments. But it has some characteristics such as sub-cortical layer, transverse growth of sub-cortical filaments, laterally unilocular sporangia of basal cells of assimilating filaments and cylindrical assimilating filamentous cells with no swollen ultimate cells, which placed it clearly under the genus *Eudesme*. It is mainly related to *Eudesme virescens*, differing from it in its spherical or subspherical sub-cortical cells and broader sub-cortical and medullary layers.

2. *Eudesme qingdaoensis* **Ding** *et* **Lu sp. nov.** (Fig. 2, Plate I: 2)

Frons mediocris, 10 cm alta, 2.5 mm diametro. Cellulae medullosae longae. Generatim medulla cava ad centrum. Sub-cortex brevis, cellulis cylindricis non nisi 3–4. Cellulae terminales filiorum rhizoideorum langae, graciles et clavatae.

Holotype: AST 63-0586, collected by Xia Enzhan and Hua Maosen at Jianggezhuang, Qingdao, Shandong Province on May 24, 1963. Growing in intertidal rock-pool.

Frond greyish-brown, single, erect, embedded in gelatine, adhering to paper except basal stem when dried, 10 cm high, 2.5 mm in diameter, main axis evident, with branches. Holdfast discoid, small, stem 4–9 mm long and 0.4 mm in diameter. Branches sparse, usually with large angle, sometimes nearly right angle, main branch thick, cylindrical, upper part narrow tapering, obtuse at apex. Center of the medulla generally hollow, its filaments longitudinally loosely arranged, cells cylindrical, 90–230 μm long, 38–65 μm in diameter, some rhizoidal filaments around medulla. Sub-cortical layer narrow, consisting of 2–3 or even 4 cells, cylindrical, growing transversely along outer filaments of the medulla, 75 μm long, 35 μm in diameter at lower frond, 30–40 μm long, 20–30 μm in diameter at upper part, bifurcate or trifurcate, rhizoidal filaments usually descending from basal cells. Assimilating filaments very simple, single or bifurcate, borne on the basal cells of the assimilating filaments, cells mostly ellipsoidal, oblong or cylindrical, 20–25 μm long, 8–12 μm in diameter, ultimate cells spherical or oval. Hair unknown. Unilocular sporangia ellipsoidal, 70–75 × 28–41 μm in size, developed from the basal cells of assimilating filaments, sessile or petiolate. Plurilocular sporangia unknown. Chromatophores present in assimilating filamentous cells.

This new species' main features are its long medullary cells, medulla generally hollow in the center; short sub-cortex, consisting of 3–4 cylindrical cells; with terminal cells of rhizoidal filaments clavate, long and slender.

3. *Eudesme shandongensis* **Ding** *et* **Lu sp. nov.** (Fig. 3, Plate I: 3)

Frons simplex, ad 18–25 cm alta, 1–1.5 mm diametro, cava. Parietes cellularum stratorum medullosorum et sub-corticalium interiorum crassi. Cellulae terminales filiorum rhizoideorum sphaericae.

Holotype: AST 63-0519, collected by Zhang Junfu and Lu Baoren at the shore of Maidao, Qingdao, Shandong Province, China on May 22, 1963. Growing in the intertidal rock-pool.

Frond greyish-brown, single, erect, with branches completely adhering to paper when dried, 18–25 cm high, 1–1.5 mm in diameter, generally hollow, embedded in gelatine, surface smooth, soft, alternately furcate 1-3 times. Holdfast discoid. Main axis evidently elongating to the apex. Branches long or short, densely arranged. Primary branches growing from main axis mostly at right angle, 15 cm long, 1 mm in diameter. Secondary branches short, slender, 3 cm long. Terminal branchlets very short, usually with 1–2 ramulis, 5 mm long, 0.4–0.5 mm in diameter. Branches or branchlets usually curved, blunt at apex. Medullary

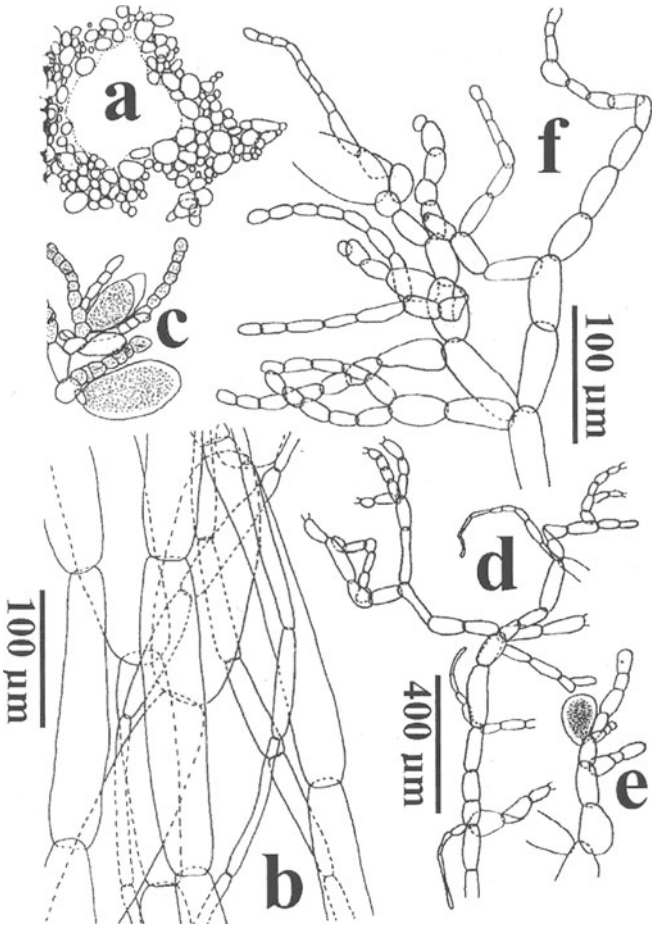

Figure 2. Eudesme qingdaoensis Ding *et* Lu sp. nov. Based on the holotype AST 63-0586. **(a)** transverse section of frond; **(b)** medullary filaments; **(c)** growth point and unilocular sporangia; **(d)** medullary filaments and its sub-cortical filaments and rhizoidal filaments; **(e)** unilocular sporangia; **(f)** assimilating filaments.

layer consisting of longitudinal bundle of cylindrical filaments. Medullary cells, 80–195 μm long, 32–85 μm in diameter, cell wall thick. Medullary filaments loosely arranged, easily separable from each other. Sub-cortical layer not evident. Sub-cortical filaments growing out transversely from outer medulla, bifurcate, trifurcate or multi-furcate, its inner cells with thick wall larger than outer ones, cylindrical or ellipsoidal, somewhat spherical, 20–60 μm long, 21–35 μm in diameter, the rhizoid filaments descending from basal cells generally transversely developed, ultimate cell short and near to spherical. Assimilating filaments simple, 2–8 cells, cylindrical or monoform or subspherical, ultimate cells mostly ordinary. Hair few, colorless except its base, 12 μm in diameter, borne on terminal cells of sub-cortical filaments.

Chromatophores mostly containing in assimilating filaments cells, sub-cortical filaments also contain few chormatophores. Unilocular sporangia ellipsoidal or ovate, borne on the basal cell of assimilating filaments, sessile or pedicellate with 1–2 cells, 42–60 μm long, 30-40 μm in diameter. Plurilocular sporangia unknown.

This new species is mainly characterized by its hollow frond, cell walls of both medullary and inner subcortical layers thick, terminal cells of rhizoid filaments spherical. It is closely related to *E. virescens*, differing from it in its slender frond, nearly at right angle between branches and main axis, hollow medulla, thick wall of medullary and sub-cortical cells, and spherical terminal cells of rhizoid filaments.

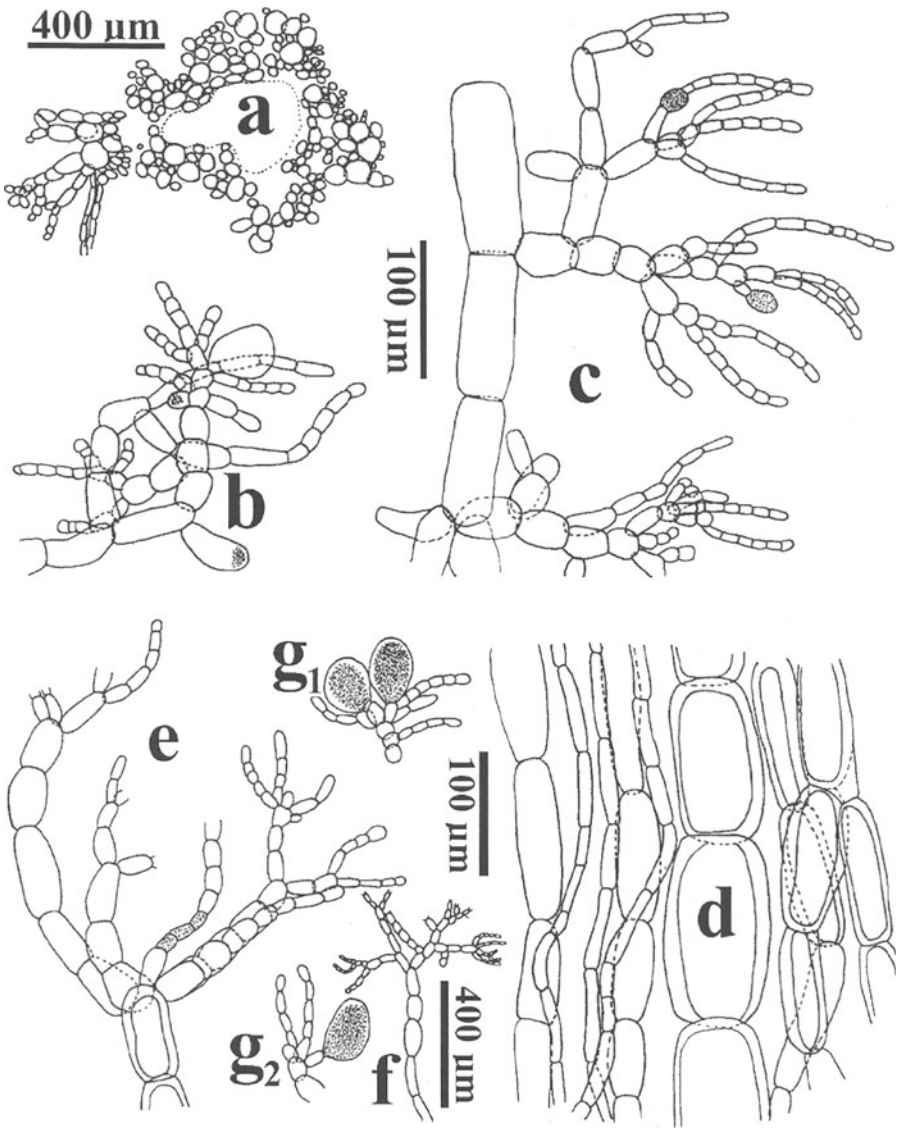

Figure 3. Eudesme shandongensis Ding *et* Lu sp. nov. Based on the holotype AST 63-0519. **(a)** transverse section of frond; **(b)** growth point; **(c)** medullary filaments with some of them developing into cortical filaments; **(d)** rhizoid filaments descending from medullary filaments; **(e)** hair; **(f)** whole cortical filaments; **(g)** (g_1, g_2) unilocular sporangia.

4. *Sphaerotrichia huanghaiensis* **Ding** *et* **Lu sp. nov.** (Fig. 4, Plate I: 4)

Frons cylindrica, ramis sparsis acutatis. Sub-cortex crassus 5–6 stratis et filis assimilantibus longis ex 6–10 cellulis constatis.

Holotype: AST 57-0534. Collected by Zhang Junfu and Wang Liming at Maidao, Qingdao, Shandong Province, on 28 Aug., 1957. Growing on low-tidal rocks washed by strong wave. Other materials examined: AST 53-1147, 55-0362, 55-0402.

Frond brown or light brown, tufted, sparsely branched, filiform, cylindrical, adhering to paper when dried, 6–23 cm high, slightly soft, gelatinous, smooth. Holdfast small discoid. Main branch evident, usually flexible, 1–1.5 mm in diameter, alternately or laterally branched 1–2 times. Primary branch alternate, ordinarily trifurcate or multifurcate at upper portion, branching few, short and evidently curved, the tips of the branch more or less swollen or giving rise to slender divaricated branchlets. Medulla hollow, except terminal and base of frond, composed of longitudinal

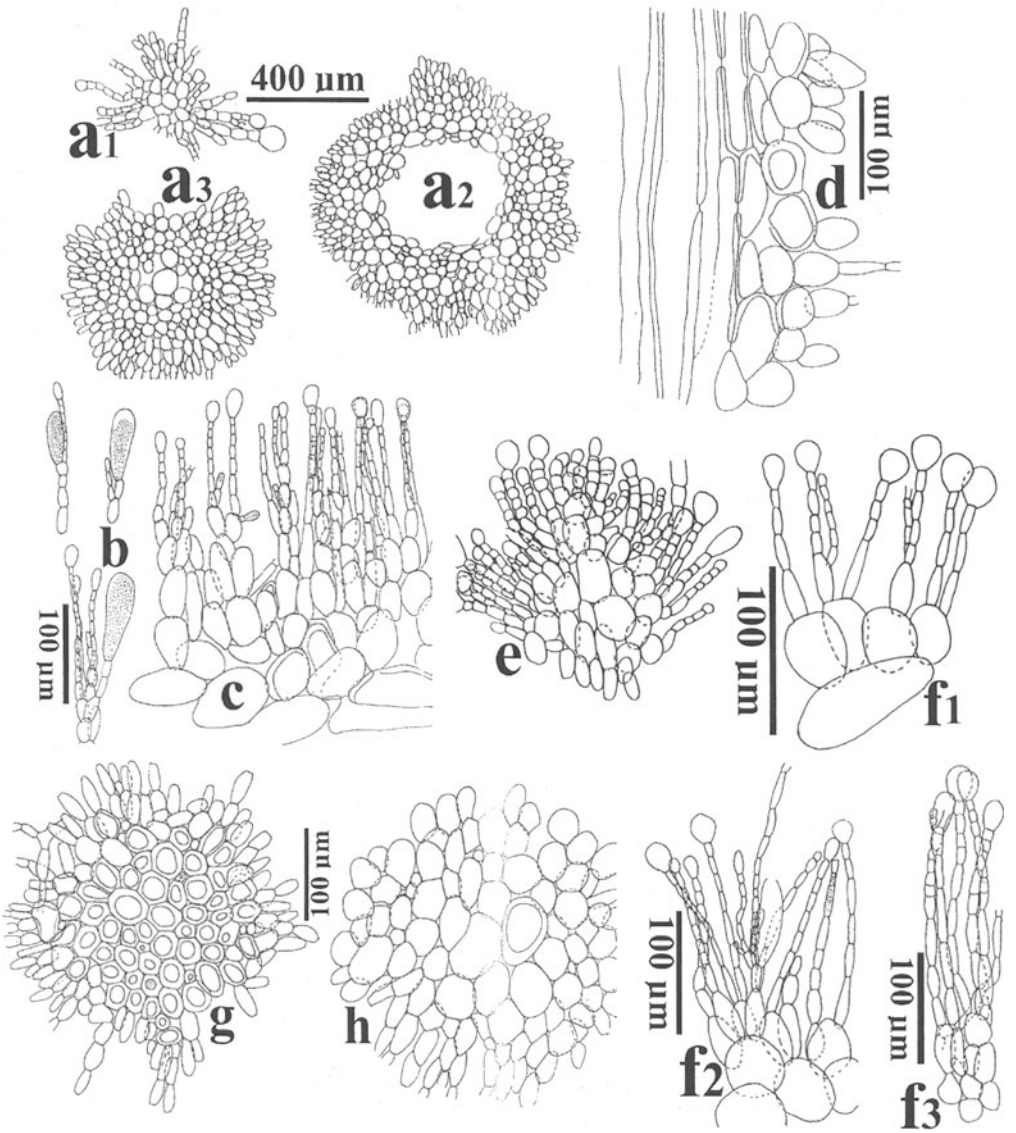

Figure 4. Sphaerotrichia huanghaiensis Ding *et* Lu sp. nov. Based on the holotype AST 57-0534. **(a)** transverse section of frond ($\mathbf{a}_1$. terminal part, $\mathbf{a}_2$. middle part, $\mathbf{a}_3$. basal part); **(b)** assimilating filaments and unilocular sporangia; **(c)** cortical filaments; **(d)** middle longitudinal section of frond; **(e)** terminal longitudinal section of frond; **(f)** assimilating filaments ($\mathbf{f}_1$. younger frond, $\mathbf{f}_2$. middle part of frond, $\mathbf{f}_3$. basal part of frond); **(g)** transverse section near; **(h)** transverse section near tip.

long fusiform cells, 160–270 μm long or more, 29–32 μm in diameter, cell walls thick and pits near the inner lateral of sub-cortical layer. Sub-cortical layer at adult frond thick, consisting of 5–6 layers. The cells of the sub-cortical layer polygonous, sub-ellipsoidal or sub-spherical, ellipsoidal near outer side, 30–60 μm long, 30–40 μm in diameter. Assimilating filaments very simple, densely arranged, consisted of 6–10 cells, cylindrical or monoform, about 10–30 μm long, a few up to 40 μm long, 5–8 μm in diameter, except terminal cell varying in size; terminal cell swollen, cylindrical or pyriform, generally 24–22 × 30–26 μm in size. Hair hyaline, very long, up to 2 mm, 10 μm in diameter, basal cells slender and colored. Unilocular sporangia borne on the base of assimilating filaments, sessile or short stipe, pyriform or obovate, 50–90 μm long, 20–30 μm in diameter. Plurilocular sporangia unknown.

This new species is mainly characterized by its cylindrical frond, sparse branches with a sharp angle,

thick subcortical layer, 5–6 layers with very long assimilating filaments. This species is closely related to *S. japonica* Kylin, differing from it in its very long assimilating filaments generally composed of 6–10 cells.

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