

Oil Bodies and Oil Droplets of Some Hepatics from Sichuan, China

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Abstract The oil bodies and the oil droplets are described for 40 species in 24 genera of hepatics collected from Sichuan, China. Among them the oil bodies of 14 species are described for the first time. *Radula gedena* Steph. is new to China.

Key words: oil body, oil droplet, hepatics, Sichuan, China.

The hepatic flora of Sichuan, China, was summarized by Piippo et al. (1997) who reported 139 species of 55 genera. However, the oil bodies have been scarcely described for hepatics in Sichuan as well as in China. The present paper deals with the morphological observations of the oil bodies and the oil droplets of hepatics collected from Sichuan by the second author from August to September, 1996.

Materials and Methods

The materials and methods used for this study follow those of Furuki and Higuchi (1996). The specimens examined are deposited in the herbarium of the National Science Museum, Tokyo (TNS), and duplicates in the herbaria of the Natural History Museum and Institute, Chiba (CBM) and the Kunming Institute of Botany, Academia Sinica (HKAS).

Results

The cells may include a greater number of oil bodies and oil droplets than those recognizable in the photographs because some oil bodies are out of the focal plane. Four types of oil bodies were recognized: (1) homogeneous type—oil bodies homogeneous, (2) granulose type—oil bodies composed of minute granules, (3) botryoidal type—oil bodies segmented and composed of distinct granules and (4) absent type—oil bodies absent. The number of oil droplets is too many to count in many species, but few in others.

The arrangement of families and of genera in each family follows Grolle (1983). Each species name is followed by the description of the oil bodies and the oil

droplets, specimen(s) examined and notes.

Jungermanniales

Herbertaceae

1. *Herbertus aduncus* (Dicks.) Gray, Nat. Arr. Brit. Pl. 1: 705 (1821). (Pl. I: 1, 2)

Oil bodies homogeneous type, 8–15 per cell of vitta, 1–5 per submarginal cell of disc, globose to oval, $3\text{--}5 \times 2\text{--}4 \mu\text{m}$, often turbid, colorless. Oil droplets homogeneous type, many per cell, spherical, less than $1 \mu\text{m}$ dia., colorless.

Specimen examined. Kangding County, south of Jiagenba, 3250 m, $29^{\circ}50'N$, $101^{\circ}30'E$, on boulder, 8 Sept. 1996, *Higuchi 30609*.

2. *Herbertus delavayi* Steph., Hedwigia 34: 43 (1895). (Pl. I: 3, 4)

Oil bodies homogeneous type, 6–15 per cell of vitta, 1–5 (8) per submarginal cell of disc, globose to oblong, $4\text{--}8 \times 3\text{--}6 \mu\text{m}$, colorless. Oil droplets homogeneous type, many per cell, spherical, less than $1 \mu\text{m}$ dia., colorless.

Specimen examined. Jiulong County, Jicoushan Pass (north of Jiulong), 4200 m, $29^{\circ}20'N$, $101^{\circ}30'E$, on humus, 10 Sept. 1996, *Higuchi 30829*.

3. *Herbertus dicranus* (Tayl.) Trev., Mem. R. Ist. Lombardo Sci. 4: 387 (1877).

(Pl. I: 5, 6)

Oil bodies homogeneous type, (3) 5–10 (15) per cell of vitta, 1–10 per submarginal cell of disc, oval to oblong, $2\text{--}7 \times 1\text{--}4 \mu\text{m}$, colorless. Oil droplets homogeneous type, many per cell, spherical, less than $1 \mu\text{m}$ dia., colorless.

Specimens examined. Luding County, Mt. Gonggashan, Hailuogou, 2500 m, $29^{\circ}30'N$, $102^{\circ}00'E$, on rotten log, 27 Aug. 1996, *Higuchi 30206*; Kangding County, Shad–Lugba, 3350 m, $29^{\circ}30'N$, $101^{\circ}30'E$, on rock-cliff, 9 Sept. 1996, *Higuchi 30768*; Jiulong County, north of Jiulong, 3540 m, $29^{\circ}10'N$, $101^{\circ}30'E$, on trunk, 11 Sept. 1996, *Higuchi 30976*.

4. *Herbertus kurzii* (Steph.) Chopra, J. Indian Bot. Soc. 22: 247 (1943).

(Pl. II: 1, 2)

Oil bodies homogeneous type, 18–30 per cell of vitta, 2–9 per submarginal cell of disc, oval to oblong, $2\text{--}5 \times 2\text{--}4 \mu\text{m}$, colorless. Oil droplets homogeneous type, many per cell, spherical, less than $1 \mu\text{m}$ dia., colorless.

Specimen examined. Kangding County, south of Jiagenba, 3250 m, $29^{\circ}50'N$, $101^{\circ}30'E$, on boulder, 8 Sept. 1996, *Higuchi 30607*.

Pseudolepicoleaceae

5. *Blepharostoma minus* Horik., Hikobia 1 (2): 103 (1951). (Pl. II: 3)

Oil bodies granulose type, 1–3 (5) per cell of segment, globose, $2\text{--}3 \mu\text{m}$ dia., composed of indistinct granules, colorless. Oil droplets homogeneous type, many per

cell, spherical, less than 1 μm dia., colorless.

Specimen examined. Jiulong County, Jicoushan Pass (north of Jiulong), 3800 m, 29°20'N, 101°30'E, on soil, 11 Sept. 1996, *Higuchi 30943*.

6. *Pseudolepicolea trollii* (Herz.) Grolle et Ando, *Hikobia* 3: 177 (1963).

(Pl. II: 4)

Oil bodies not seen. Oil droplets homogeneous type, many per cell, spherical, 1–2 μm dia., colorless.

Specimen examined. Luding County, Mt. Gonggashan, Hailuogou, 3000 m, 29°30'N, 102°00'E, on rock-cliff, 9 Sept. 1996, *Higuchi 30100*.

Lepidoziaceae

7. *Lepidozia reptans* (L.) Dum., *Recueil Observ. Jungerm.*: 19 (1835). (Pl. II: 5)

Oil bodies homogeneous type, 5–15 per cell, globose to oval, 3–8 \times 3–5 μm , colorless. Oil droplets homogeneous type, many per cell, spherical, less than 1 μm dia., colorless.

Specimen examined. Kangding County, Shad–Lugba, 3350 m, 29°30'N, 101°30'E, on rotten stump, 9 Sept. 1996, *Higuchi 30728*.

The above description of oil bodies are nearly the same as those reported from Japan (Hattori 1953), except for shape (rice grain-like in Japanese plants).

8. *Lepidozia robusta* Steph., *Mem. Soc. Sci. Nat. Cherbourg* 29: 217 (1894).

(Pl. II: 6)

Oil bodies homogeneous type, 5–20 per cell, globose, 2–4 μm dia., colorless. Oil droplets homogeneous type, many per cell, spherical, less than 1 μm dia., colorless.

Specimen examined. Jiulong County, Jicoushan Pass (north of Jiulong), 4200 m, 29°20'N, 101°30'E, on soil, 10 Sept. 1996, *Higuchi 30845b*.

9. *Lepidozia subtransversa* Steph., *Bull. Herb. Boiss.* 5: 95 (1897). (Pl. III: 1)

Oil bodies homogeneous type, 5–15 per cell, globose, 2–4 μm dia., colorless. Oil droplets homogeneous type, many per cell, spherical, less than 1 μm dia., colorless.

Specimens examined. Luding County, Mt. Gonggashan, Hailuogou, 3050 m, 29°30'N, 102°00'E, on trunk, 2 Sept. 1996, *Higuchi 30308*; Jiulong County, Jicoushan Pass (north of Jiulong), 4200 m, 29°20'N, 101°30'E, on humus, 10 Sept. 1996, *Higuchi 30848*.

Cephaloziaceae

10. *Cephalozia bicuspidata* (L.) Dum., *Recueil Observ. Jungerm.*: 18 (1835).

(Pl. III: 2)

Oil bodies and oil droplets not seen.

Specimen examined. Jiulong County, Jicoushan Pass (north of Jiulong), 4200 m, 29°20'N, 101°30'E, on humus, 10 Sept. 1996, *Higuchi 30806*.

Antheliaceae

- 11. *Anthelia juratzkana*** (Limpr.) Trev., Mem. R. Ist. Lombardo, Ser. 3. Cl. Sci. 4: 416 (1877). (Pl. III: 3)

Oil bodies not seen. Oil droplets homogeneous type, many per cell, spherical, less than 1 μm dia., colorless.

Specimen examined. Jiulong County, Jicoushan Pass (north of Jiulong), 4200 m, 29°20'N, 101°30'E, on soil, 10 Sept. 1996, *Higuchi 30842*.

Jungermanniaceae

- 12. *Anastrepta orcadensis*** (Hook.) Schiffn. in Engler & Prantl, Nat. Pfl.-fam. 1(3): 85 (1893). (Pl. III: 4)

Oil bodies homogeneous or botryoidal type, 3–12 per cell, globose to oval, 2–6 \times 2–4 μm , often turbid, sometimes composed of indistinct, large granules, colorless. Oil droplets homogeneous type, many per cell, spherical, less than 1 μm dia., colorless.

Specimens examined. Kangding County, Shad–Lugba, 3350 m, 29°30'N, 101°30'E, on decaying log, 9 Sept. 1996, *Higuchi 30792*; Jiulong County, Jicoushan Pass (north of Jiulong), 4200 m, 29°20'N, 101°30'E, on humus, 10 Sept. 1996, *Higuchi 30808*.

- 13. *Anastrophyllum joergensenii*** Schiffn., Hedwigia 49: 396 (1910). (Pl. III: 5)

Oil bodies granulose type, 2–6 per cell, globose to oval, 2–6 \times 2–4 μm , composed of minute granules, colorless. Oil droplets homogeneous type, many per cell, spherical, less than 1 μm dia., colorless.

Specimen examined. Jiulong County, Jicoushan Pass (north of Jiulong), 4200 m, 29°20'N, 101°30'E, on humus, 10 Sept. 1996, *Higuchi 30840*.

- 14. *Barbilophozia lycopodioides*** (Wallr.) Loeske, Verh. Bot. Ver. Brandenburg 49: 37 (1907). (Pl. III: 6)

Oil bodies granulose type, 1–5 per cell, nearly globose, 3–7 μm dia., composed of minute granules, colorless. Oil droplets homogeneous type, few per cell, spherical, less than 1 μm dia., colorless.

Specimen examined. Jiulong County, Jicoushan Pass (north of Jiulong), 4200 m, 29°20'N, 101°30'E, on humus, 10 Sept. 1996, *Higuchi 30846*.

- 15. *Chandonanthus birmensis*** Steph., Bull. Soc. Roy. Bot. Belgique 38: 43 (1899). (Pl. IV: 1)

Oil bodies granulose type, 2–5 per cell, nearly globose, 2–6 μm dia., composed of minute granules, colorless. Oil droplets homogeneous type, few per cell, spherical,

less than 1 μm dia., colorless.

Specimen examined. Jiulong County, north of Jiulong, 3540 m, 29°10'N, 101°30'E, on soil, 11 Sept. 1996, *Higuchi 30990*.

16. *Chandonanthus hirtellus* (Web.) Mitt., J. Proc. Linn. Soc. London 22: 321 (1887). (Pl. IV: 2, 3)

Oil bodies granulose type, 2–5 per cell, nearly globose, 2–6 μm dia., composed of minute granules, colorless. Oil droplets homogeneous type, few per cell, spherical, less than 1 μm dia., colorless.

Specimen examined. Jiulong County, north of Jiulong, 3540 m, 29°10'N, 101°30'E, on boulder, 11 Sept. 1996, *Higuchi 30994*.

17. *Jamesoniella nipponica* Hatt., J. Jpn. Bot. 19: 350 (1943). (Pl. IV: 4)

Oil bodies granulose type, 3–6 per cell, globose to oval, 4–7 \times 3–5 μm , composed of minute granules, colorless. Oil droplets homogeneous type, many per cell, spherical, less than 1 μm dia., colorless.

Specimens examined. Kangding County, south of Jiagenba, 3250 m, 29°50'N, 101°30'E, on base of tree, 8 Sept. 1996, *Higuchi 30568*; Kangding County, Shad–Lugba, 3350 m, 29°30'N, 101°30'E, on soil, 9 Sept. 1996, *Higuchi 30720*; on rotten stump, *Higuchi 30756*; on rotten log, *Higuchi 30781*.

The above description of oil bodies is nearly the same as those given for Japanese plants (Hattori 1951 as *Jamesoniella autumnalis* var. *nipponica*). The plants examined have strong verrucae on the surface of leaves, which suggests that this species is distinct from *Jamesoniella autumnalis* with smooth leaf surface.

18. *Jungramannia clavellata* (Steph.) Amak., J. Hattori Bot. Lab. 22: 69, (1960). (Pl. IV: 5)

Oil bodies granulose type, 1–3 per cell, oblong, 5–12 \times 3–8 μm , composed of minute granules, colorless. Oil bodies in rhizoid cell homogeneous type, many, occupied cell lumen, oval, 2–4 \times 1–2 μm , often turbid, colorless. Oil droplets homogeneous type, few per cell, spherical, less than 1 μm dia., colorless.

Specimen examined. Jiulong County, Jicoushan Pass (north of Jiulong), 4200 m, 29°20'N, 101°30'E, on soil, 10 Sept. 1996, *Higuchi 30845a*.

19. *Lophozia excisa* (Dicks.) Dum., Recueil Observ. Jungerm.: 17 (1835).

(Pl. IV: 6)

Oil bodies granulose type, 5–14 per cell, globose to oblong, 3–8 \times 3–5 μm , composed of minute granules, colorless. Oil droplets homogeneous type, many per cell, spherical, less than 1 μm dia., colorless.

Specimen examined. Kangding County, south of Jiagenba, 3250 m, 29°50'N, 101°30'E, on rotten log, 8 Sept. 1996, *Higuchi 30536*.

- 20. *Lophozia longidens*** (Lindb.) Macoun, Geol. Survey Canada: Cat. Canad. Pl. 7: 18 (1902). (Pl. V: 1)

Oil bodies granulose type, 8–20 per cell, nearly globose, 3–7 μm dia., composed of minute granules, colorless. Oil droplets homogeneous type, few per cell, spherical, less than 1 μm dia., colorless.

Specimen examined. Kangding County, south of Jiagenba, 3250 m, 29°50'N, 101°30'E, on boulder, 8 Sept. 1996, *Higuchi 30544*.

- 21. *Lophozia morrisoncola*** Horik., J. Sci. Hiroshima Univ., Ser. B, Div. 2, Bot. 2: 150 (1934). (Pl. V: 2)

Oil bodies granulose type, 3–6 per cell, nearly globose, 5–12 μm dia., composed of minute granules, colorless. Oil droplets homogeneous type, few per cell, spherical, less than 1 μm dia., colorless.

Specimen examined. Kangding County, Shad–Lugba, 3350 m, 29°30'N, 101°30'E, on rock-cliff, 9 Sept. 1996, *Higuchi 30738*.

- 22. *Tritomaria quinquentata*** (Hud.) Buch, Memoranda Soc. fauna Fl. Fenn. 8: 290 (“1932” 1933). (Pl. V: 3)

Oil bodies granulose type, 5–10 per cell, oval to oblong, 4–10 \times 3–6 μm , composed of minute granules, colorless. Oil droplets homogeneous type, many per cell, spherical, less than 1 μm dia., colorless.

Specimens examined. Kangding County, Daxueshan Pass (between Kangding and Xindugiao), 4300 m, 30°00'N, 101°50'E, on soil, 7 Sept. 1996, *Higuchi 30494*; Jiulong County, Jicoushan Pass (north of Jiulong), 4200 m, 29°20'N, 101°30'E, on soil, 10 Sept. 1996, *Higuchi 30828*.

Gymnomitriaceae

- 23. *Marsupella commutata*** (Limpr.) H. Bernet, Cat. Hep. S.-O. Suisse: 29 (1888). (Pl. V: 4)

Oil bodies granulose type, 2–3 per cell, globose to oblong, 4–8 \times 4–6 μm , composed of minute granules, colorless. Oil droplets homogeneous type, many per cell, spherical, less than 1 μm dia., colorless.

Specimen examined. Jiulong County, Jicoushan Pass (north of Jiulong), 4200 m, 29°20'N, 101°30'E, on rock-cliff, 10 Sept. 1996, *Higuchi 30812*.

- 24. *Marsupella revoluta*** (Nees) Dum., Bull. Soc. Roy Bot. Belgique 13: 126 (1874). (Pl. V: 5)

Oil bodies granulose type, 1–3 per cell, nearly globose, 2–4 μm dia., composed of exceedingly minute granules, colorless. Oil droplets homogeneous type, many per cell, spherical, less than 1 μm dia., colorless.

Specimen examined. Luding County, Mt. Gonggashan, Hailuogou, 3000 m, 29°30'N, 102°00'E, on rock-cliff, 9 Sept. 1996, *Higuchi 30117*.

Scapaniaceae

25. **Scapania ciliata** Sande Lac. in Miquel, Ann. Mus. Bot. Lugduno-Batavum [Procl. Fl. Jap.] 3: 209 (1867). (Pl. V: 6)

Oil bodies granulose type, 20–30 per cell, globose to oblong, 3–8×3–5 μm , composed of minute granules, colorless. Oil droplets homogeneous type, many per cell, spherical, less than 1 μm dia., colorless.

Specimen examined. Luding County, Mt. Gonggashan, Hailuogou, 3000 m, 29°30'N, 102°00'E, on boulder, 9 Sept. 1996, *Higuchi 30090*.

Geocalyceaceae

26. **Lophocolea bidentata** (L.) Dum., Recueil Observ. Jungerm.: 17 (1835). (Pl. VI: 1)

Oil bodies botryoidal type, 2–3 per cell, globose, 2–5 μm , composed of large granules, colorless. Oil droplets homogeneous type, few per cell, spherical, less than 1 μm dia., colorless.

Specimen examined. Kangding County, Daxueshan Pass (between Kangding and Xindugiao), 4300 m, 30°00'N, 101°50'E, on humus, 7 Sept. 1996, *Higuchi 30465*.

Plagiochilaceae

27. **Plagiochila elegans** Mitt., J. Proc. Linn. Soc. Bot. 5: 97 (“1860” 1861). (Pl. VI: 2)

Oil bodies homogeneous type, 4–9 per cell, oval to oblong, 3–7×3–4 μm , often turbid with septa, colorless. Oil droplets homogeneous type, few per cell, spherical, less than 1 μm dia., colorless.

Specimens examined. Kangding County, south of Jiagenba, 3250 m, 29°50'N, 101°30'E, on soil, 8 Sept. 1996, *Higuchi 30532*; Jiulong County, north of Jiulong, 3540 m, 29°10'N, 101°30'E, on base of tree, 11 Sept. 1996, *Higuchi 31008*.

28. **Plagiochila semidecurrans** (Lehm. et Lindenb.) Lehm. et Lindenb. in Lindenb. et Gott., Spec. Hepat. (fasc. 5): 142 (1843). (Pl. VI: 3–5)

Oil bodies granulose type, 3–8 per cell, oval to oblong, 3–6×3–5 μm , 6–10 per cell of leaf-base, 5–8×3–4 μm , composed of minute granules, colorless. Oil droplets homogeneous type, many per cell, spherical, less than 1 μm dia., colorless.

Specimen examined. Jiulong County, north of Jiulong, 3540 m, 29°10'N, 101°30'E, on boulder, 11 Sept. 1996, *Higuchi 31021*.

Radulaceae

29. **Radula gedena** Steph., Hedwigia 23: 146 (1884). (Pl. VII: 1)

Oil bodies granulose type, 1 (2) per cell, oval to oblong, like meniscus with con-

vex-concave faces, 8–15×6–10 μm , composed of minute granules, light brown. Oil droplets not seen.

Specimen examined. Kangding County, south of Jiagenba, 3250 m, 29°50'N, 101°30'E, on boulder, 8 Sept. 1996, *Higuchi 30562*.

Radula gedena is characterized by (1) the abundant discoid gemmae occurring on the margin of leaf-lobes, (2) the pronounced mammilliform rhizoid-initial area on the inflated carinal region of leaf-lobes and (3) the uniformly thin-walled cells of leaf-lobes which are very irregular in form and size (Yamada 1979). The distribution of this species extended northward from the known range, including Java, Borneo, Thailand and Japan (Yamada 1979).

Porellaceae

30. *Macvicaria ulophylla* (Steph.) Hatt., J. Hattori Bot. Lab. 5: 81 (1951).

(Pl. VII: 2)

Oil bodies homogeneous type, many per cell, oblong, 3–5×2–3 μm , colorless. Oil droplets not seen.

Specimen examined. Kangding County, Shad–Lugba, 3150 m, 29°30'N, 101°20'E, on boulder, 9 Sept. 1996, *Higuchi 30663*.

31. *Porella gracillima* Mitt., Trans. Linn. Soc. London, Ser. 2, 3: 202 (1891).

(Pl. VII: 3)

Oil bodies homogeneous type, many per cell, oblong, 2–5×2–3 μm , colorless. Oil droplets not seen.

Specimens examined. Kangding County, south of Jiagenba, 3250 m, 29°50'N, 101°30'E, on boulder, 8 Sept. 1996, *Higuchi 30601*; Kangding County, Shad–Lugba, 3350 m, 29°30'N, 101°30'E, on rock-cliff, 9 Sept. 1996, *Higuchi 30739, 30770*.

32. *Porella revoluta* (Lehm.) Trev., Mem. Real. Ist. Lombardo, Ser. 3, 4: 407 (1877).

(Pl. VII: 4)

Oil bodies homogeneous type, many per cell, oblong, 1–2×1–4 μm , colorless. Oil droplets not seen.

Specimens examined. Kangding County, south of Jiagenba, 3250 m, 29°50'N, 101°30'E, on boulder, 8 Sept. 1996, *Higuchi 30600*; Kangding County, Shad–Lugba, 3150 m, 29°30'N, 101°20'E, on boulder, 9 Sept. 1996, *Higuchi 30671*.

Frullaniaceae

33. *Frullania davurica* Hampe fo. *dorsoblastos* (Hatt.) Hatt. et Lin, J. Hattori Bot. Lab. 59: 132 (1985).

(Pl. VII: 5).

Oil bodies granulose type, 4–10 per cell, oblong, 3–8×3–5 μm , composed of minute granules, colorless. Oil droplets homogeneous type, few per cell, spherical,

less than 1 μm dia., colorless.

Specimens examined. Kangding County, south of Jiagenba, 3250 m, 29°50'N, 101°30'E, on boulder, 8 Sept. 1996, *Higuchi 30587*; Kangding County, Shad–Lugba, 3150 m, 29°30'N, 101°20'E, on trunk, 9 Sept. 1996, *Higuchi 30629*; Kangding County, Shad–Lugba, 3350 m, 29°30'N, 101°30'E, on root, 9 Sept. 1996, *Higuchi 30758*; on trunk, *Higuchi 30765a*; Jiulong County, north of Jiulong, 3540 m, 29°10'N, 101°30'E, on trunk, 11 Sept. 1996, *Higuchi 30979*.

The above description of oil bodies are nearly the same as that of *F. davurica* fo. *davurica* reported by Hattori (1951) from Japan.

34. *Frullania handelii* Verd. in Handel-Mazzetti, Symb. Sinic. 5: 36 (1930).

(Pl. VII: 6)

Oil bodies granulose type, 4–6 per cell, oblong, 2–5 \times 2–3 μm , composed of minute granules, colorless. Oil droplets homogeneous type, few per cell, spherical, less than 1 μm dia., colorless.

Specimen examined. Kangding County, Shad–Lugba, 3350 m, 29°30'N, 101°30'E, on trunk, 9 Sept. 1996, *Higuchi 30790*.

35. *Frullania nepalensis* (Spreng.) Lehm. et Lindenb., Nov. Minus Cogn. Strip. Pugillus 4: 19 (1832).

(Pl. VIII: 1)

Oil bodies granulose type, 4–7 per cell, oblong, globose to oval, 4–8 \times 3–5 μm , composed of minute granules, colorless. Oil droplets homogeneous type, few per cell, spherical, less than 1 μm dia., colorless.

Specimens examined. Kangding County, south of Jiagenba, 3250 m, 29°50'N, 101°30'E, on boulder, 8 Sept. 1996, *Higuchi 30521, 30564, 30570, 30604*; on decaying log, *Higuchi 30540*.

36. *Frullania parvistipula* Steph., Spec. Hepat. 4: 397 (1910).

(Pl. VIII: 2)

Oil bodies granulose type, 2–5 per cell, nearly globose, 3–5 μm dia., composed of minute granules, colorless. Oil droplets homogeneous type, few per cell, spherical, less than 1 μm dia., colorless.

Specimens examined. Kangding County, south of Jiagenba, 3250 m, 29°50'N, 101°30'E, on boulder, 8 Sept. 1996, *Higuchi 30560*; on trunk, *Higuchi 30569*; on trunk, *Higuchi 30571*.

37. *Frullania tamarisci* (L.) Dum. subsp. *obscura* (Verd.) Hatt., J. Hattori Bot. Lab. 35: 216 (1972).

(Pl. VIII: 3)

Oil bodies granulose type, 3–7 per cell, oblong, 2–5 \times 2–3 μm , composed of minute granules, colorless. Oil droplets homogeneous type, few per cell, spherical, less than 1 μm dia., colorless.

Specimen examined. Jiulong County, Jicoushan Pass (north of Jiulong), 4200 m, 29°20'N, 101°30'E, on base of tree, 10 Sept. 1996, *Higuchi 30827*.

38. *Frullania tubercularis* Hatt. et Lin., J. Jpn. Bot. 60: 107 (1985).

(Pl. VIII: 4)

Oil bodies granulose type, 3–8 per cell, oblong, 3–7 \times 2–3 μm , composed of minute granules, colorless. Oil droplets homogeneous type, few per cell, spherical,

less than 1 μm dia., colorless.

Specimens examined. Kangding County, Shad-Lugba, 3350 m, 29°30'N, 101°30'E, on rotten stump, 9 Sept. 1996, *Higuchi 30727*; on trunk, *Higuchi 30765b*.

Lejeuneaceae

39. *Lejeunea parva* (Hatt.) Mizut., Misc. Bryol. Lichenol. 5: 178 (1971).

(Pl. VIII: 5)

Oil bodies granulose type, 2–6 per cell, oblong, 3–12 \times 3–5 μm , composed of minute granules, colorless. Oil droplets homogeneous type, few per cell, spherical, less than 1 μm dia., colorless.

Specimen examined. Luding County, Mt. Gonggashan, Hailuoguo, 2500 m, 29°30'N, 102°00'E, on trunk, 28 Aug. 1996, *Higuchi 29845*.

Metzgeriales

Metzgeriaceae

40. *Apometzgeria pubescens* (Schrank.) Kuwah., Rev. Bryol. Lichénol. 34: 214 (1966).

(Pl. VIII: 6)

Oil bodies and oil droplets not seen.

Specimen examined. Kangding County, Shad-Lugba, 3350 m, 29°30'N, 101°30'E, on rock-cliff, 9 Sept. 1996, *Higuchi 30746*.

Discussion

The oil bodies of 14 species were described for the first time (Table 1). Among the remained 26 species most of species have the oil bodies which agree with the descriptions of oil bodies in the previous reports. However, in *Lophocolea bidentata* the type of oil bodies of Chinese plants differ from that of North American plants which Schuster (1980) described as “finely granular-segmented type.” Also in *Lepidozia reptans* their shape is different from that of North American plants which Schuster (1969) described as “homogeneous and 2–3 segmented ones,” although it agrees with that of Japanese plants reported by Hattori (1953). In these species the careful comparative study of oil bodies will be needed.

This is the first report of the oil droplets in Chinese hepatics. The oil droplets were recognized in the cells of most of species examined in this study, except for *Cephalozia bicuspidata*, *Radula gedena*, *Macvicaria ulophylla*, *Porella gracillima* and *Porella revoluta*. Oil droplets were almost uniformly similar in all the taxa examined, that is, they are spherical, homogeneous and colorless. In *Chandonanthus hirtellus* oil droplets were recognized in Chinese plants, although Furuki & Higuchi (1996) reported the absence of oil droplets in New Caledonian plants. As noted by Furuki & Higuchi (1996) the taxonomic significance of oil droplets in hepatics may

Table 1. Types of oil bodies in 40 species of hepatics examined.

Species	Type of oil bodies	Locality	References
<i>Herbertus aduncus</i>	homogeneous	Japan	Hattori (1951, 1952)*
	homogeneous	China	present study
<i>Herbertus delavayi</i>	homogeneous	China	present study
<i>Herbertus dicranus</i>	homogeneous	China	present study
<i>Herbertus kurzii</i>	homogeneous	China	present study
<i>Blepharostoma minus</i>	granulose	Japan	Hattori (1951, 1953)
	granulose	China	present study
<i>Pseudolepicolea trollii</i>	absent	China	present study
<i>Ledidozia retans</i>	homogeneous	Japan	Hattori (1953)
	homogeneous	N. America	Schuster (1969)
	homogeneous	China	present study
<i>Lepidozia robusta</i>	homogeneous	China	present study
<i>Lepidozia subtransversa</i>	homogeneous	Japan	Hattori (1951)
	homogeneous	China	present study
<i>Cephalozia bicuspidata</i>	absent	N. America	Schuster (1974)
	absent	China	present study
<i>Anthelia juratzkana</i>	absent	N. America	Schuster (1974)
	absent	China	present study
<i>Anastrepta orcadensis</i>	homogeneous	Japan	Kitagawa (1966)
	homogeneous, botryoidal	China	present study
<i>Anastrophyllum joergensenii</i>	granulose	China	present study
<i>Barbilophozia lycopodioides</i>	granulose	N. America	Schuster (1974)
	granulose	China	present study
<i>Chandonanthus birmensis</i>	granulose	Japan	Kitagawa (1966)
	granulose	China	present study
<i>Chandonanthus hirtellus</i>	granulose	Japan	Hattori (1951)
	granulose	Japan	Kitagawa (1965)
	granulose	New Caledonia	Furuki & Higuchi (1996)
	granulose	China	present study
<i>Jamesoniella nipponica</i>	granulose	Japan	Hattori (1951)
	granulose	China	present study
<i>Jungermannia clavellata</i>	granulose	China	present study
<i>Lophozia excisa</i>	granulose	N. America	Schuster (1969)
	granulose	China	present study
<i>Lophozia longidens</i>	granulose	N. America	Schuster (1969)
	granulose	China	present study
<i>Lophozia morrisoncola</i>	granulose	Japan	Kitagawa (1966)
	granulose	China	present study
<i>Tritomaria quinquedentata</i>	granulose	Japan	Kitagawa (1965)
	granulose	China	present study
<i>Marsupella commutata</i>	granulose	Japan	Hattori (1953)
	granulose	China	present study
<i>Marsupella revoluta</i>	granulose	N. America	Schuster (1974)
	granulose	China	present study

Table 1 (continued)

Species	Type of oil bodies	Locality	References
<i>Scapania ciliata</i>	granulose	Japan	Hattori (1951)
	granulose	China	present study
<i>Lophocolea bidentata</i>	granulose	N. America	Schuster (1980)
	botryoidal	China	present study
<i>Plagiochila elegans</i>	homogeneous	China	present study
<i>Plagiochila semidecurrans</i>	granulose	Japan	Hattori (1951)
	granulose	China	present study
<i>Radula gedena</i>	granulose	China	present study
<i>Macvicaria ulophylla</i>	homogeneous	Japan	Hattori (1951)
	homogeneous	China	present study
<i>Porella gracillima</i>	homogeneous	Pakistan	Furuki (1993)
	homogeneous	China	present study
<i>Porella revoluta</i>	homogeneous	China	present study
<i>Frullania davurica</i> fo. <i>dorsoblastos</i>	granulose	China	present study
<i>Frullania handelii</i>	granulos	China	present study
<i>Frullania nepalensis</i>	granulose	Japan	Hattori (1953)
	granulose	China	present study
<i>Frullania parvistipula</i>	granulose	China	present study
<i>Frullania tamarisci</i> subsp. <i>obsucra</i>	granulose	Japan	Hattori (1951)
	granulose	China	present study
<i>Frullania tubercularis</i>	granulose	China	present study
<i>Lejeunea parva</i>	granulose	Japan	Inoue (1976)
	granulose	China	present study
<i>Apometzgeria pubescens</i>	absent	Japan	Hattori (1951)
	absent	China	present study

* Previous reports are also included, but voucher specimens are not examined.

be much less than that of oil bodies.

Acknowledgments

We wish to express our sincere thanks to Dr. Hiroshige Koyama of the National Science Museum, Tokyo, for giving us the opportunity to study Chinese hepatics. Junior author is also indebted to Mr. Liu Peigui and Mr. Li-Song Wang of the Kunming Institute of Botany, Academia Sinica for their kind help in the field research. This study was partly supported by a Grant-in-Aid for Overseas Scientific Survey (no. 07041151) from the Ministry of Education, Science, Sports and Culture, Japan.

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Explanation of Plates

- Plate I. Oil bodies, oil droplets and chloroplasts in cells at leaf-vitta (1, 3, 5) and at submargin of leaf-disc (2, 4, 6). 1, 2. *Herbertus aduncus* (Dicks.) Gray (Higuchi 30609). 3, 4. *Herbertus delavayi* Steph. (Higuchi 30829). 5, 6. *Herbertus dicranus* (Tayl.) Trev. (Higuchi 30206). Scales all 10 μm .
- Plate II. Oil bodies, oil droplets and chloroplasts in cells at leaf-vitta (1), at submargin of leaf-disc (2), at leaf-segment (3), at margin of disc (4) and at middle of leaf-disc (5, 6). 1, 2. *Herbertus kurzii* (Steph.) Chopra (Higuchi 30607). 3. *Blepharostoma minus* Horik. (Higuchi 30943). 4. *Pseudolepicolea trollii* (Herz.) Grolle et Ando (Higuchi 30100). 5. *Lepidozia reptans* (L.) Dum. (Higuchi 30728). 6. *Lepidozia robusta* Steph. (Higuchi 30845b). Scales all 10 μm .
- Plate III. Oil bodies, oil droplets and chloroplasts in cells at middle of leaf-disc (1–3) and at leaf-middle (4–6). 1. *Lepidozia subtransversa* Steph. (Higuchi 30848). 2. *Cephalozia bicuspidata* (L.) Dum. (Higuchi 30806). 3. *Anthelia juratzkana* (Limpr.) Trev. (Higuchi 30842). 4. *Anastrepta orcadensis* (Hook.) Schiffn. (Higuchi 30808). 5. *Anastrophyllum joergensenii* Schiffn. (Higuchi 30840). 6. *Barbilophozia lycopodioides* (Wallr.) Loeske (Higuchi 30846). Scales all 10 μm .
- Plate IV. Oil bodies, oil droplets and chloroplasts in cells at middle of leaf-disc (1, 2), at apex of leaf (3) and at leaf-middle (4–6). 1. *Chandonanthus birmensis* Steph. (Higuchi 30990). 2, 3. *Chandonanthus hirtellus* (Web.) Mitt. (Higuchi 30994). 4. *Jamesoniella nipponica* Hatt. (Higuchi 30720). 5. *Jungermannia clavellata* (Steph.) Amak. (Higuchi 30845a). Arrow shows a rhizoid cell. 6. *Lophozia excisa* (Dicks.) Dum. (Higuchi 30536). Scales all 10 μm .
- Plate V. Oil bodies, oil droplets and chloroplasts in middle cells at leaf (1–5) and at ventral leaf-lobe (6). 1. *Lophozia longidens* (Lindb.) Macoun. (Higuchi 30544). 2. *Lophozia morrisoncola* Horik. (Higuchi 30738). 3. *Tritomaria quinquedentata* (Hud.) Buch. (Higuchi 30828). 4. *Marsupella commutata* (Limpr.) H. Bern. (Higuchi 30812). 5. *Marsupella revoluta* (Nees) Dum. (Higuchi 30117). 6. *Scapania ciliata* Sande Lac. (Higuchi 30090). Scales all 10 μm .
- Plate VI. Oil bodies, oil droplets and chloroplasts in cells at leaf-middle (1–4) and at leaf-base (5). 1. *Lophocolea bidentata* (L.) Dum. (Higuchi 30465). 2. *Plagiochila elegans* Mitt. (Higuchi 31008). 3–5. *Plagiochila semidecurrans* (Lehm. et Lindenb.) Lehm. et Lindenb. (Higuchi 31021). 4. Another focus of Fig. 3. Arrows show oil droplets. Scales all 10 μm .
- Plate VII. Oil bodies, oil droplets and chloroplasts in middle cells at leaf-lobe (1–6). 1. *Radula gedena* Steph. (Higuchi 30562). 2. *Macvicaria ulophylla* (Steph.) Hatt. (Higuchi 30663). 3. *Porella gracillima* Mitt. (Higuchi 30770). 4. *Porella revoluta* (Lehm.) Trev. (Higuchi 30600). 5. *Frullania davurica* Hampe fo. *dorsoblastos* (Hatt.) Hatt. et Lin. (Higuchi 30765a). 6. *Frullania handelii* Verd. (Higuchi 30790). Scales all 10 μm .
- Plate VIII. Oil bodies, oil droplets and chloroplasts in middle cells at leaf-lobe (1–5) and at wing of thallus. 1. *Frullania nepalensis* (Spreng.) Lehm. et Lindenb. (Higuchi 30604). 2. *Frullania parvistipula* Steph. (Higuchi 30571). 3. *Frullania tamarisci* (L.) Dum. subsp. *obsucra* (Verd.) Hatt. (Higuchi 30827). 4. *Frullania tubercularis* Hatt. et Lin. (Higuchi 30765b). 5. *Lejeunea parva* (Hatt.) Mizut. (Higuchi 29845). 6. *Apometzgeria pubescens* (Schrank.) Kuwah. (Higuchi 30746). Scales all 10 μm .

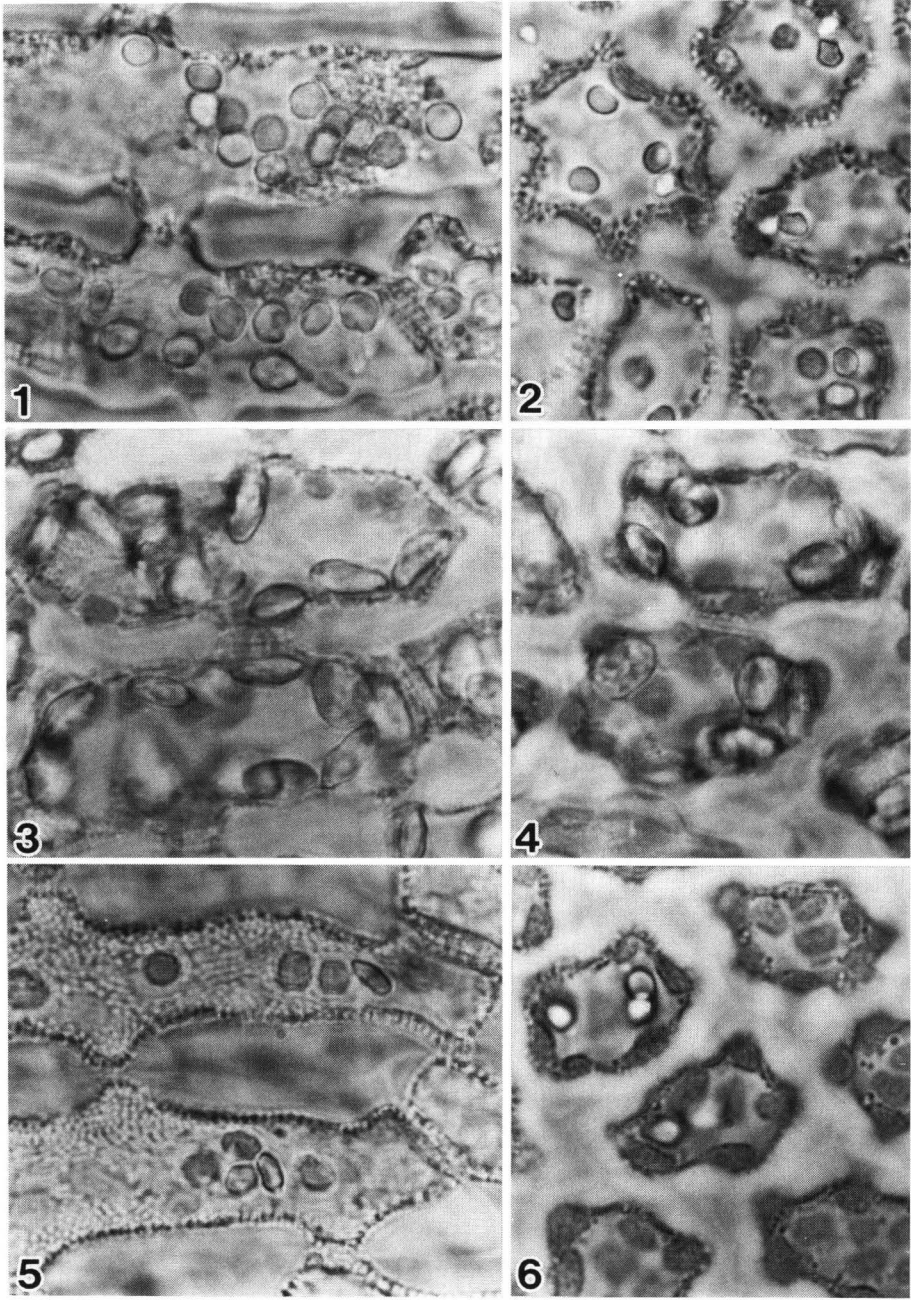


Plate I

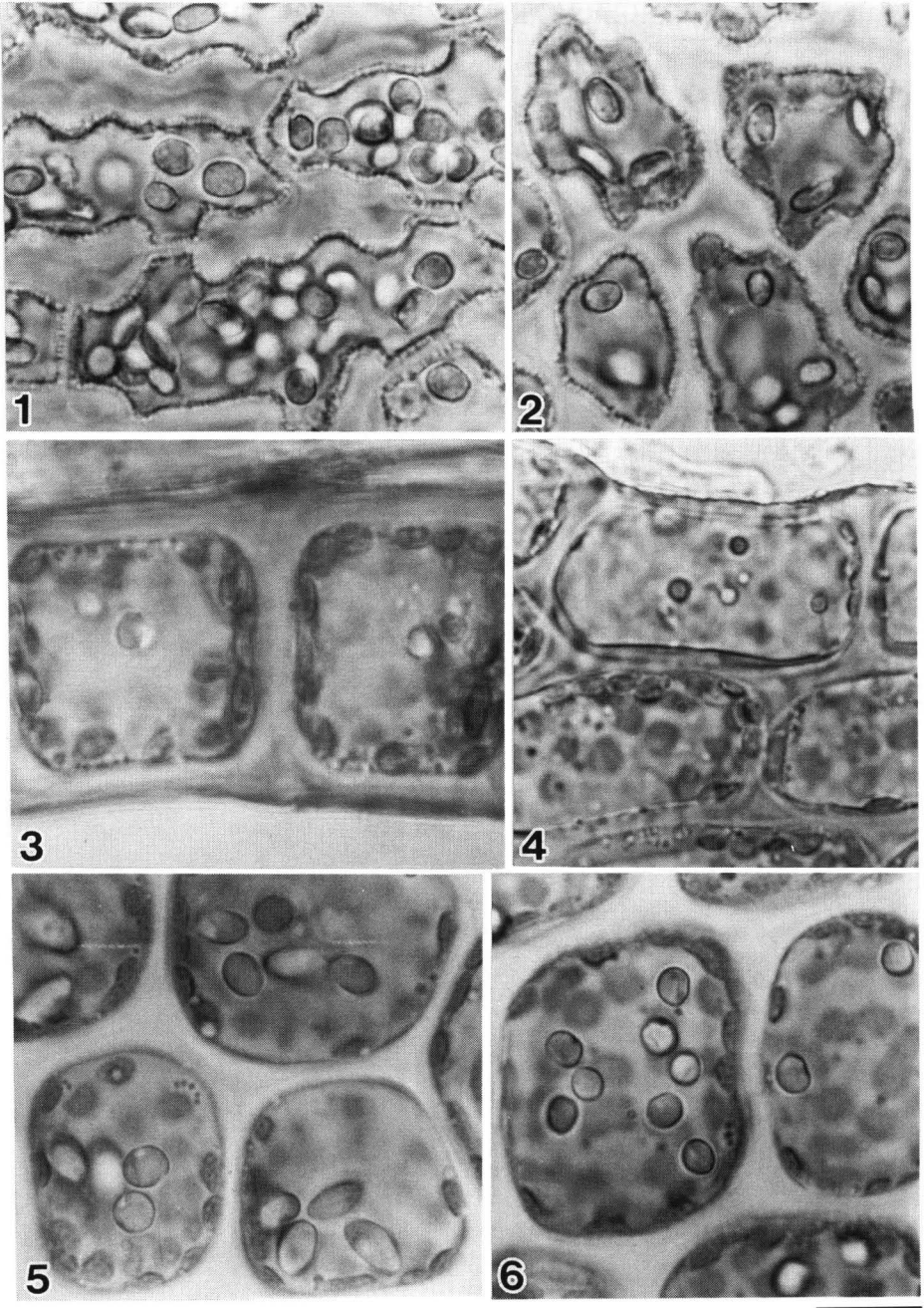


Plate II

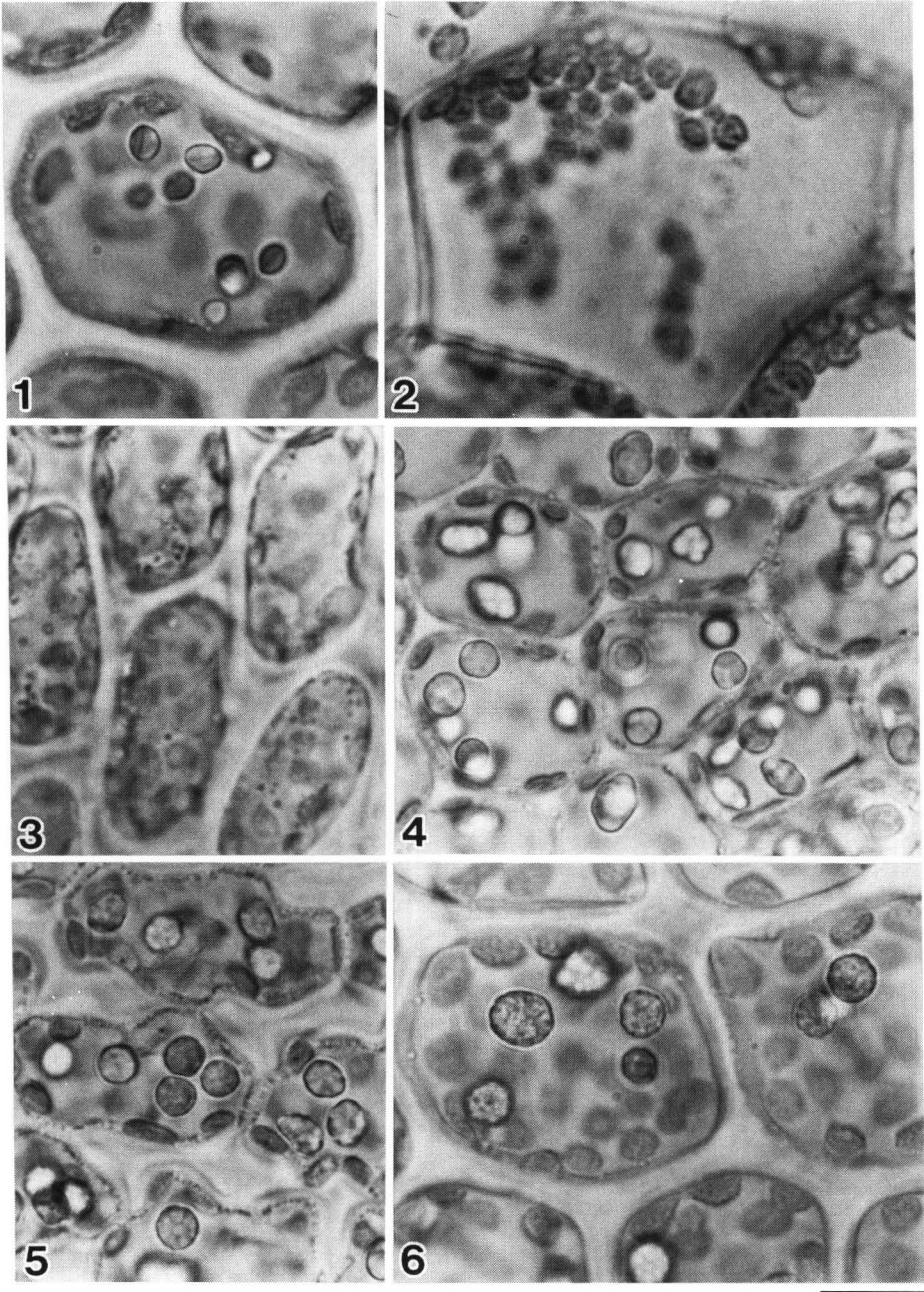


Plate III

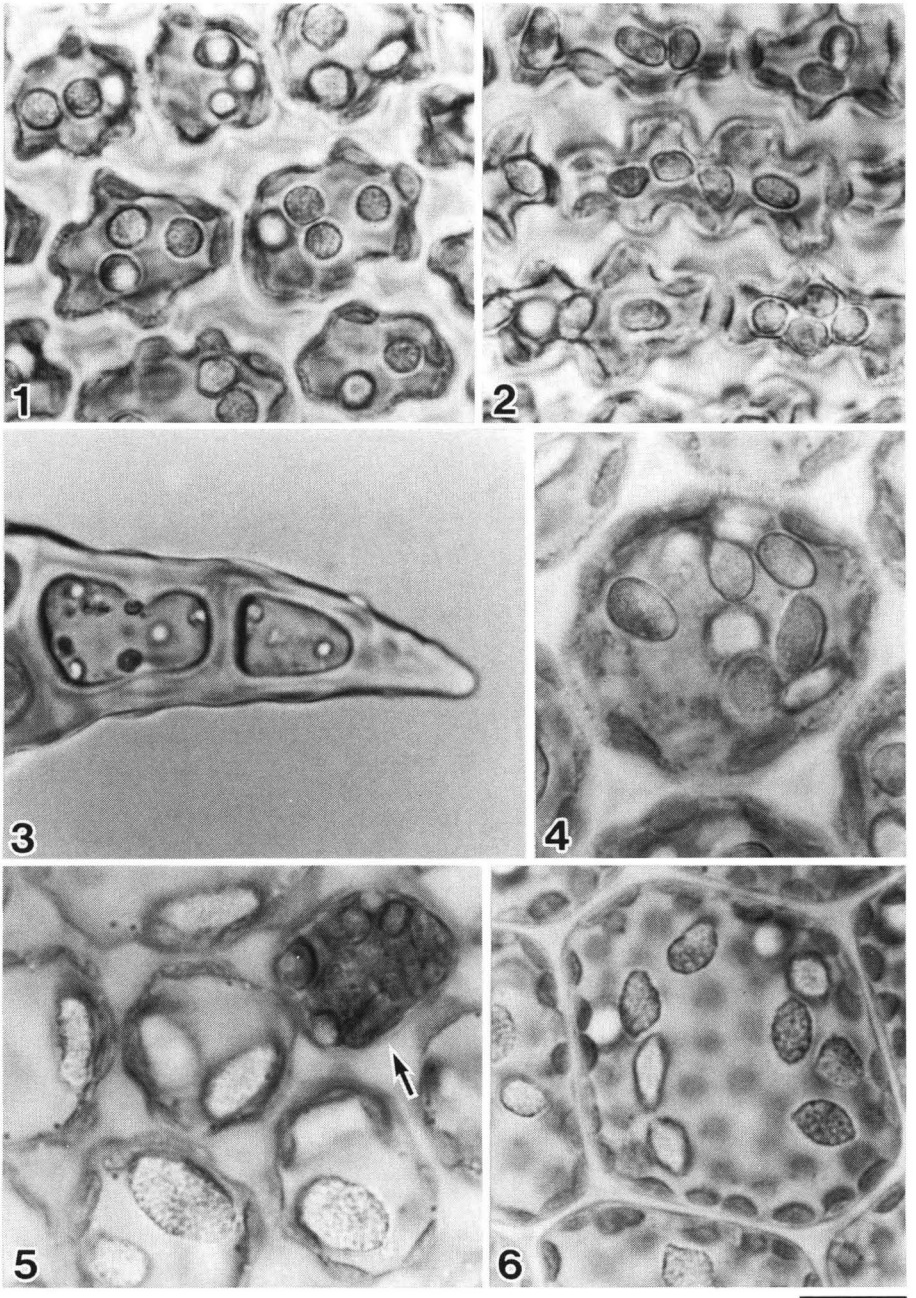


Plate IV

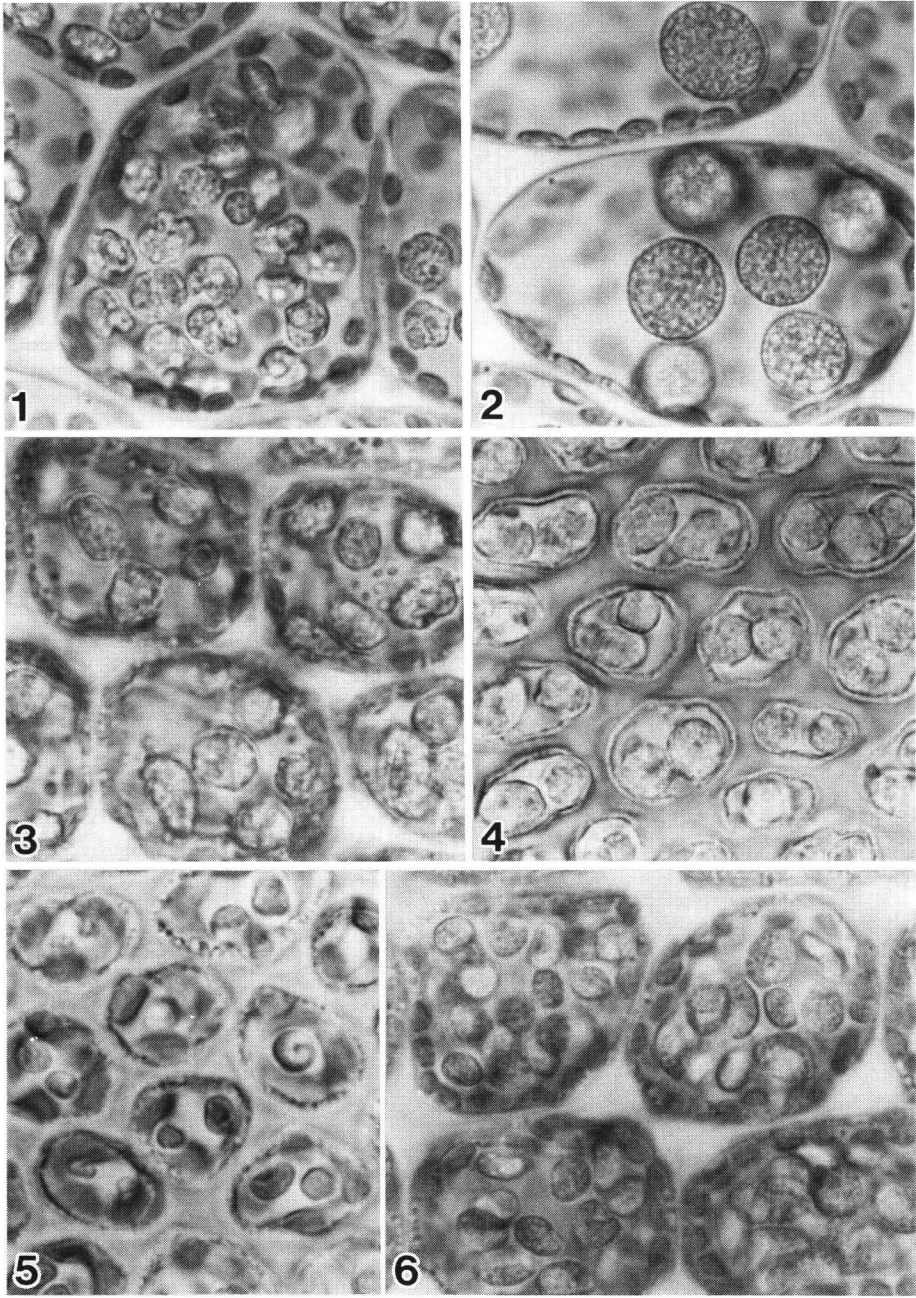
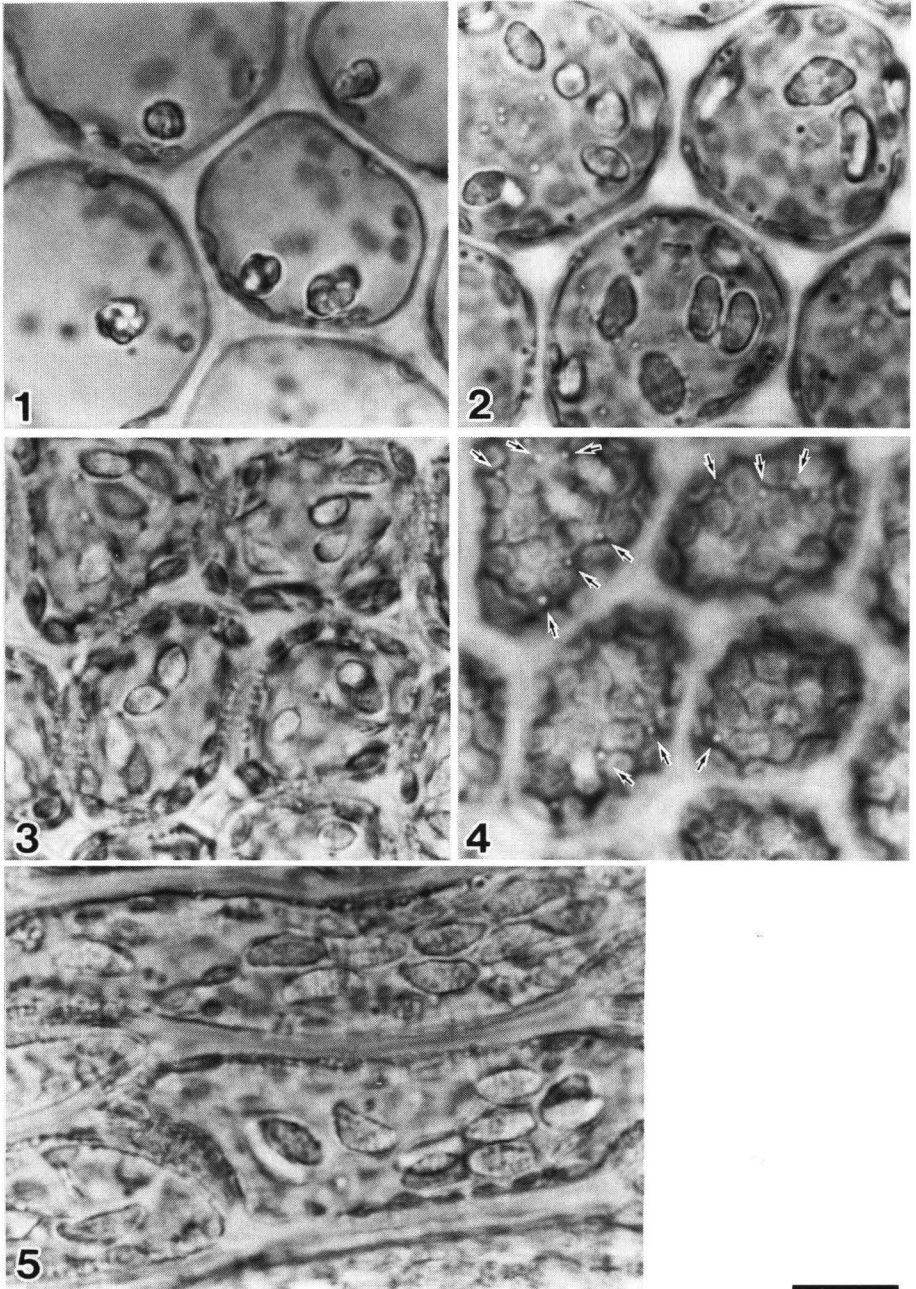


Plate V



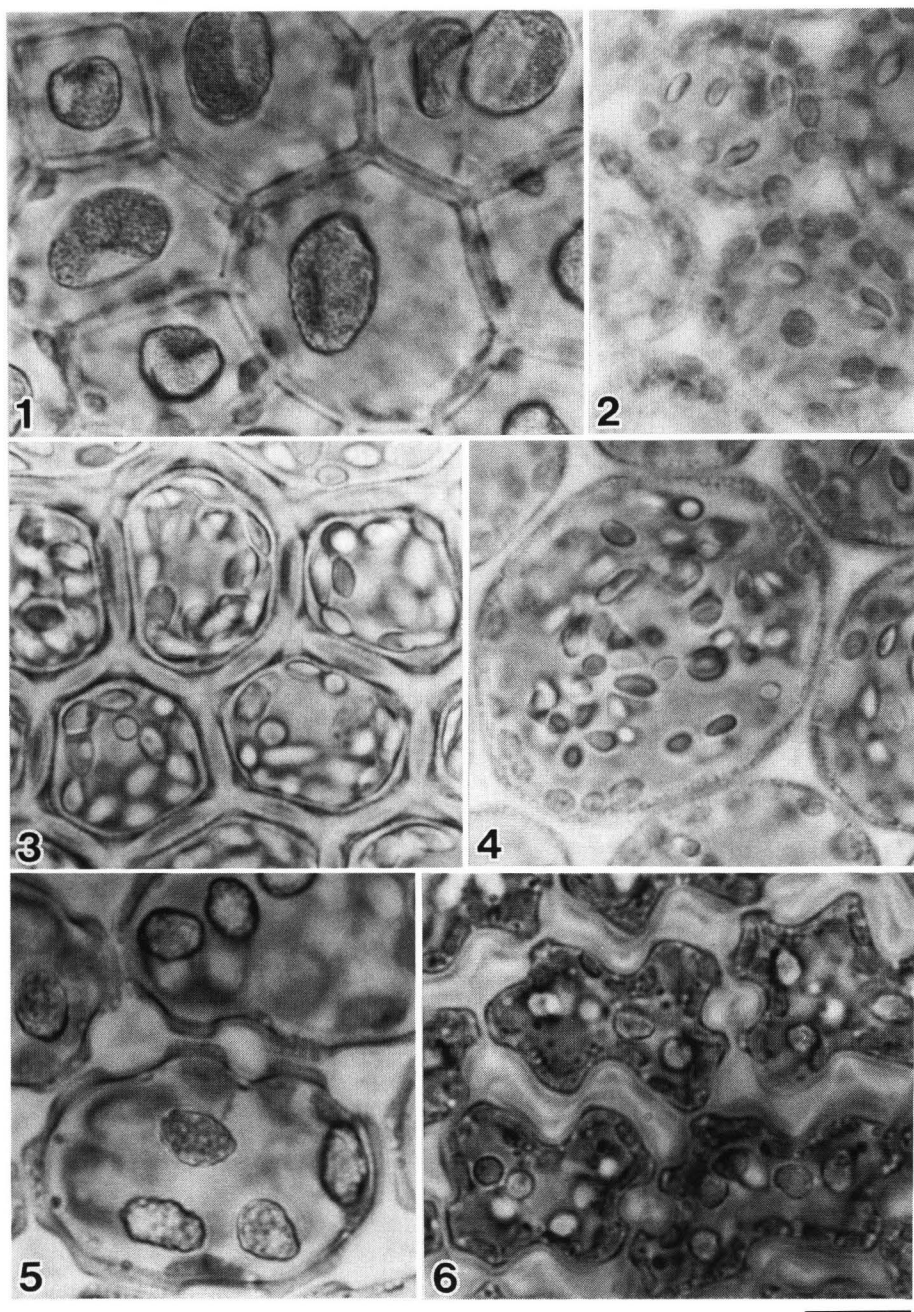


Plate VII

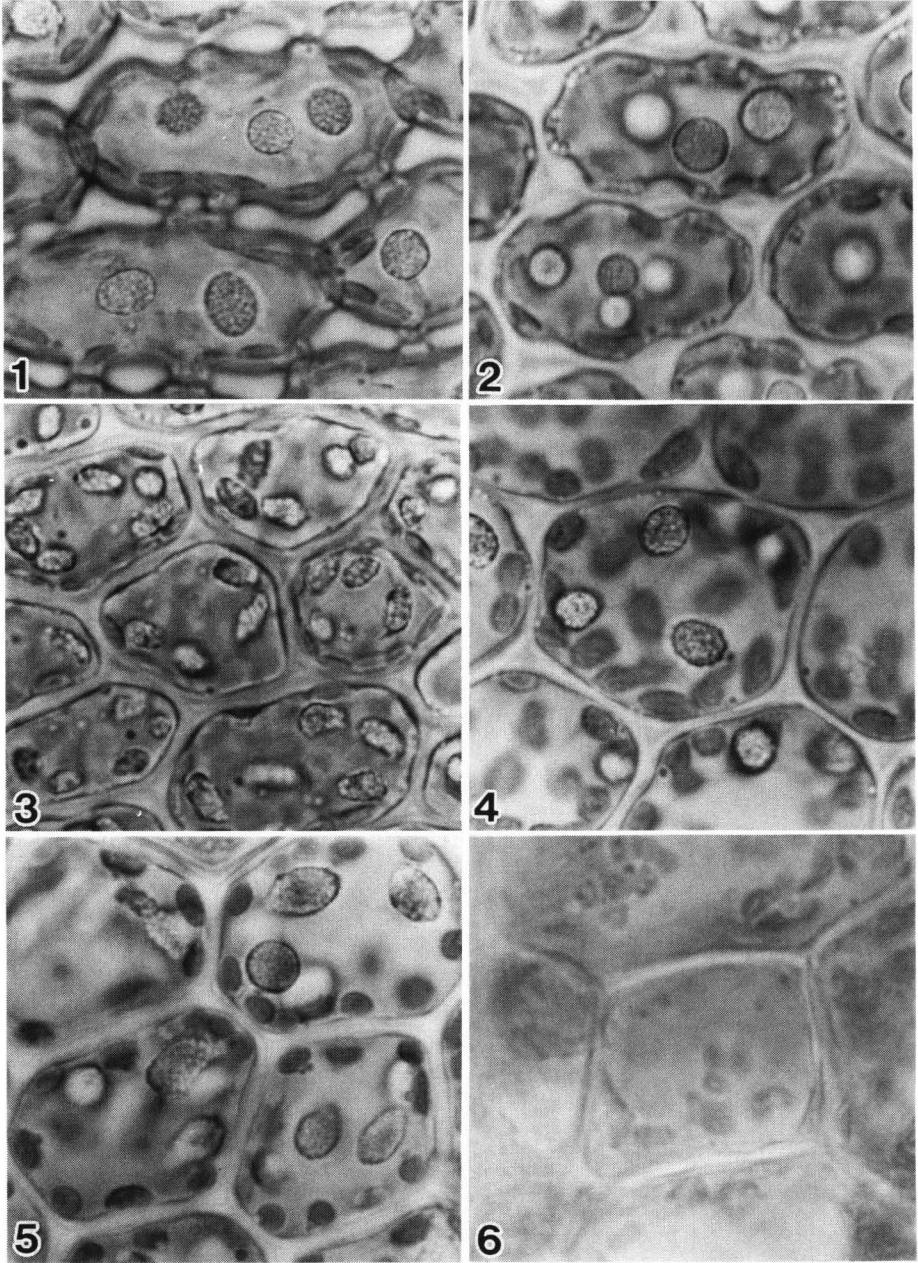


Plate VIII