

Hiroshi KAWAI : First report of *Phaeosaccion collinsii* FARLOW (Chrysophyceae, Sarcinochrysidales) from Japan

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An alga referable to *Phaeosaccion collinsii* FARLOW (Chrysophyceae, Sarcinochrysidales, Phaeosaccionaceae) was collected in March 1987 at Isoya, Hokkaido, facing to the Sea of Japan (leg. Mr. Y. Sumita). It occurred as tuft on subtidal rocks at a depth of about 4 m below Mean Low Water Level. The thallus was olive-brown, saccate, to 20 mm in length (Fig. 1). It resembled young thallus of some brown alga such as *Punctaria* or *Petalonia* but was distinguished by the hollow habit (Fig. 2), brighter colour and soft texture. The holdfast was small and disc-shaped, composed of several cells (Fig. 3). Rhizoidal filaments were not observed. The thallus was polystichous (Figs. 4 and 5), becoming saccate and monostromatic with increased size (Fig. 2). The cells of the thallus showed no morphological differentiations and, in surface view, arranged in packets of two to four cells. These cells are $6-8 \times 6-9 \mu\text{m}$, each of which contained a parietal chloroplast with a prominent pyrenoid (Figs. 6 and 7). An inner lamella was observed in the pyrenoid (Fig. 6). When mature, all cells of the thallus were transformed into zoospores. After the release of the zoospores, only a gelatinous membrane remained (Figs. 8 and 9). Zoospores were pyriform and typically flagellated with a longer anterior flagellum and a shorter posterior one (Fig. 10). They contained a chloroplast provided with an eyespot and a pyrenoid (Figs. 11 and 12). Transitional helices were observed in the transitional region distal to the basal plate (Fig. 13). [For TEM observations, material was

fixed in 3% glutaraldehyde in 0.1 M cacodylate buffer, postfixed in 2% OsO_4 in 0.1 M cacodylate buffer, dehydrated in an acetone series and embedded in Spurr's epoxy resin (SPURR 1969), sectioned with a diamond knife, and stained with uranyl acetate and lead citrate. Observations were made using Hitachi H-300 TEM at the Institute for Algological Research, Faculty of Science, Hokkaido University]. The posterior flagellum of this alga showed the greenish autofluorescence as seen in many phaeophycean zoospores (KAWAI 1988). My specimens agree well with the original description and previous reports of *Phaeosaccion collinsii* FARLOW (FARLOW 1882, McLACHLAN *et al.* 1971), and with the specimen of this species in Phycotheca Boreali-Americana (COLLINS *et al.* 1895) in the general habit and the morphology. Accordingly, it was identified as *Phaeosaccion collinsii*.

Although *Phaeosaccion collinsii* has been reported from various localities in cold-water areas of the North Atlantic Ocean, this is the first report for the Pacific Ocean. The species was first described as a brown alga and included in the Punctariaceae (FARLOW 1882). Later, PARKE and DIXON (1964) suggested that it be transferred to the Chrysophyceae, which was supported by the studies of McLACHLAN *et al.* (1971), CRAIGIE *et al.* (1971), and CHEN *et al.* (1974) on the life history, morphology, chemical composition and fine structure of the species.

Cultures were started from zoospores, released from the field-collected thalli, by the pipetting method. They were cultured in polystyrene petri-dishes, 90 mm in diameter, using PESI medium (TATEWAKI 1966).

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Culture conditions were 5°C SD (short day; 8:16hLD), 5°C LD (long day; 16:8hLD), 10°C SD, 10°C LD, 15°C SD, 15°C LD, 20°C SD and 20°C LD, under white fluorescent light of about $28 \mu\text{Mm}^{-2}\text{s}^{-1}$ (5°C) or $46 \mu\text{Mm}^{-2}\text{s}^{-1}$ (10°C, 15°C, 20°C). (Lux values were measured using a photocell illuminometer and converted to quantum irradiance by the following relation: $250 \text{ lux} = 4.6 \mu\text{Mm}^{-2}\text{s}^{-1}$.) The zoospores became rounded and formed walls after settlement on the substratum. They germinated in a unipolar, direct type of germination and developed into prostrate branched filaments (Fig. 15) or directly into erect thalli (Fig. 14). Erect thalli were first uniseriate, then formed longitudinal walls (Fig. 14) and became saccate (Fig. 16). Well-developed erect thalli attained a length of 5 mm. At 5°C, erect thalli developed into saccate thalli similar to the plant in nature. However, they only formed filamentous thalli at 10°C. At 15°C and 20°C, they did not grow well. Mature thalli formed zoospores at 5°C and 10°C. There were no obvious effects of photoperiod on morphogenesis or maturation of the thalli. The results of my culture experiments agree with those of McLACHLAN *et al.* (1971) on the life history pattern in response to the temperature.

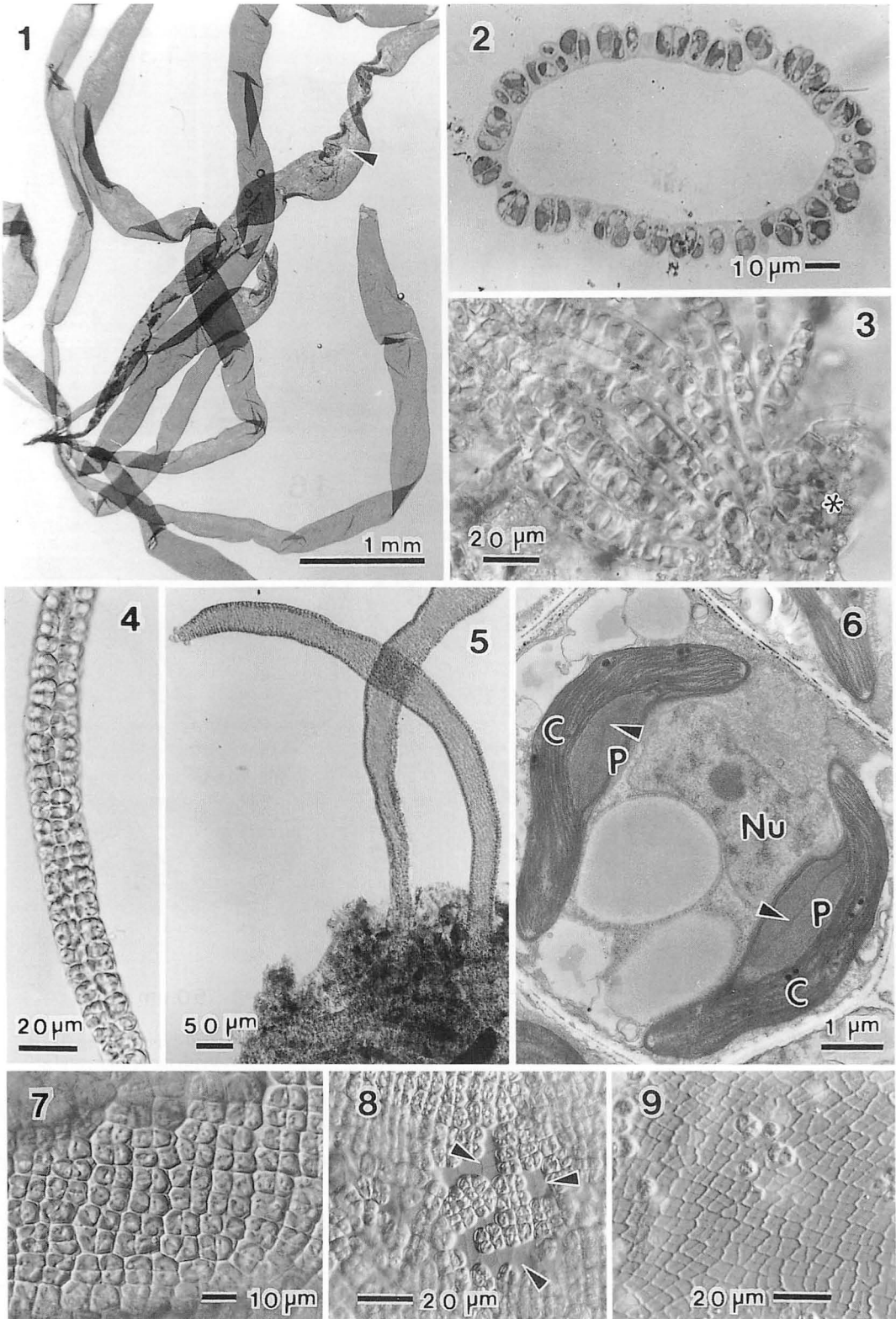
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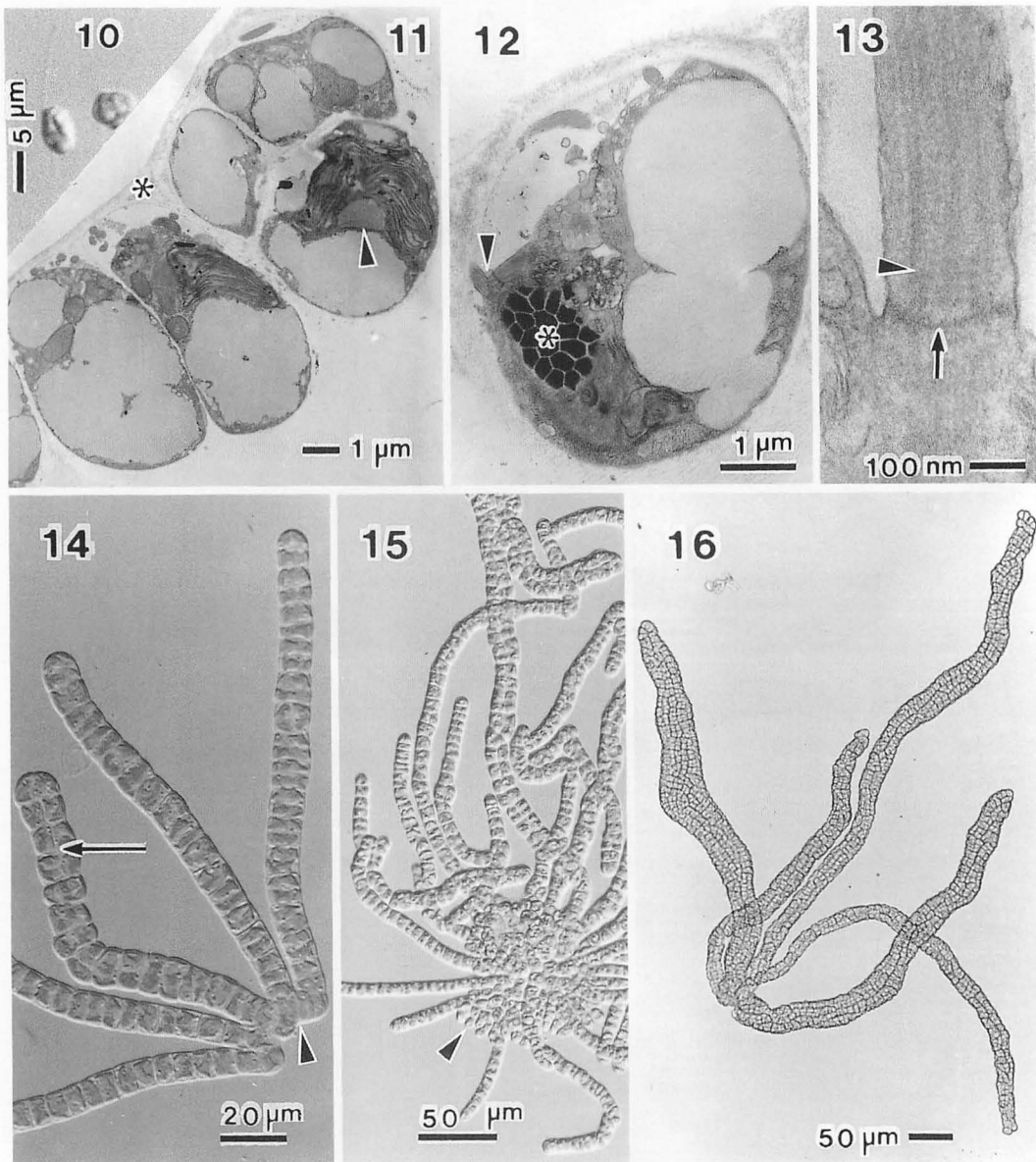
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References

- CHEN, L. C.-M., McLACHLAN, J. and CRAIGIE, J. S. 1974. The fine structure of the marine chrysophycean alga *Phaeosaccion collinsii*. *Can. J. Bot.* **52**: 1621–1624, 4 pls.
- COLLINS, F. S., BRIDGEPORT, I. H. and SETCHELL, W. A. 1895. *Phycotheca Boreali-Americana*. A collection of dried specimens of the algae of North America. Fascicle I. Malden, Massachusetts.
- CRAIGIE, J. S., LEIGH, C., CHEN, L. C.-M. and McLACHLAN, J. 1971. Pigments, polysaccharides and photosynthetic products of *Phaeosaccion collinsii*. *Can. J. Bot.* **49**: 1067–1074.
- FARLOW, W. G. 1882. Notes on New England algae. *Bull. Torrey Bot. Club* **9**: 65–68.
- KAWAI, H. 1988. A flavin-like autofluorescent substance in the posterior flagellum of golden and brown algae. *J. Phycol.* **24**: 114–117.
- McLACHLAN, J., CHEN, L. C.-M., EDELSTEIN, T. and CRAIGIE, J. S. 1971. Observations on *Phaeosaccion collinsii* in culture. *Can. J. Bot.* **49**: 563–566, 2 pls.
- PARKE, M. and DIXON, P. S. 1964. A revised check-list of British marine algae. *J. mar. biol. Ass. U.K.* **44**: 499–542.
- SPURR, A. R. 1969. A low-viscosity epoxy resin-embedding medium for electron microscopy. *J. Ultrastruct. Rec.* **26**: 31–43.
- TATEWAKI, M. 1966. Formation of a crustose sporophyte with unilocular sporangia in *Scytosiphon lomentaria*. *Phycologia* **6**: 62–66.

Figs. 1–9. *Phaeosaccion collinsii* FARLOW in nature. Fig. 1. Habit of the thallus (arrowhead shows mature part of the thallus). Fig. 2. Cross section of the saccate thallus (embedded in Spurr's epoxy resin and stained with toluidine blue). Fig. 3. Basal part of the thallus (asterisk) and young uniseriate erect filamentous thallus. Fig. 4. Young polystichous filament. Fig. 5. Young saccate thallus. Fig. 6. TEM micrograph of a vegetative cell (C, chloroplast; Nu, nucleus; P, pyrenoid; arrowheads, inner lamella). Fig. 7. Surface view of vegetative part of thallus. Fig. 8. Surface view of mature part of thallus (arrowheads show emptied area). Fig. 9. Surface view of almost emptied thallus after releases of zoospores.





Figs. 10–16. *Phaeosaccion collinsii* FARLOW in nature and in culture. Fig. 10. Released typically flagellated zoospore. Fig. 11. TEM micrograph of mature part of the thallus (asterisk shows gelatinous membrane, and arrowhead shows pyrenoid). Fig. 12. TEM micrograph of a zoospore before release (arrowhead shows basal part of flagella, and asterisk shows eyespot). Fig. 13. TEM micrograph of a flagellum in longitudinal section (arrow shows basal plate, and arrowhead shows transitional helices). Fig. 14. Young erect filamentous thallus in culture without prostrate filaments (arrow shows longitudinal wall, and arrowhead shows basal part). Fig. 15. Young erect filamentous thallus with prostrate filaments (arrowhead). Fig. 16. Saccate thallus in culture.

川井浩史：日本新産黄金色藻 *Phaeosaccion collinsii* FARLOW (フクロコガネモ：新称)

北海道磯谷において採集された比較的大型の葉状体を形成する黄金色藻を *Phaeosaccion collinsii* FARLOW (サルソノクリシス目, フクロコガネモ科; 新称) と同定した。藻体は袋状で1層の細胞層からなり, 細胞は表面観で $6-8 \times 6-9 \mu\text{m}$ で, 1個のピレノイドを伴った色素体を含む。成熟すると藻体の全体の細胞がそれぞれ1個の遊走子に変成する。遊走子は涙滴形で, 典型的な褐藻型の側生する2鞭毛, 1個の色素体と眼点を有する。透過型電顕による観察の結果ピレノイドには内膜構造が, また鞭毛基部にはらせん構造が見られた。本種は北大西洋の冷水域の広い範囲から報告されているが太平洋沿岸からの報告はこれが初めてである。本種の遊走子を $5-20^{\circ}\text{C}$ の長日, 短日条件で培養した結果, 直接型の発芽の後, 分枝した糸状体を経て, 直立体を生じた。直立体は初め単列で, 次いで縦の隔壁を生じ, 袋状の藻体に発達した。 5°C , 10°C で藻体は成長, 成熟し自然藻体と同様の遊走子を生じた。(060 札幌市北区北10条西8丁目 北海道大学理学部植物学教室)