

Some observations on *Batrachospermum intortum* JAO and
B. sinense JAO (Rhodophyta, Nemalionales)
from Szechwan in China

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Observations on the reproductive organs of *B. intortum* and *B. sinense* are presented. The carpogonium-bearing branch of *B. intortum* is spiral, arising from the basal cell and also from the terminal cell of the primary branchlets, and provides many monosporangia laterally. *B. intortum* resembles *B. pseudocarpum* REIS in having monosporangia but differs from the latter in the shape and the size of monosporangia. The trichogyne of *B. sinense* is cuneate, later becomes enlarged and subpyriform. *B. sinense* seems to resemble more closely taxa of the section *Moniliformia* rather than taxa of the section *Turficola*, because the carpogonium-bearing branch of this species provides many elongated bracts, addition to the shape of the mature trichogyne.

Key Index Words: *Batrachospermum intortum*; *Batrachospermum sinense*; *China*; *freshwater Rhodophyta*; *monosporangia*.

JAO (1941) described *B. intortum* from Szechwan in China and assigned this species to the section *Contorta* characterized in having a twisted carpogonium-bearing branch. Among the taxa of the section *Contorta*, four taxa resemble each other in having monosporangia. An attention is given to the taxonomic distinction among these four taxa. On the other hand, JAO (1941) described *B. sinense* and assigned it to the section *Turficola* on the basis of the shape of the trichogyne. The status of this species is also discussed in the present paper.

Specimens used in the Present Study

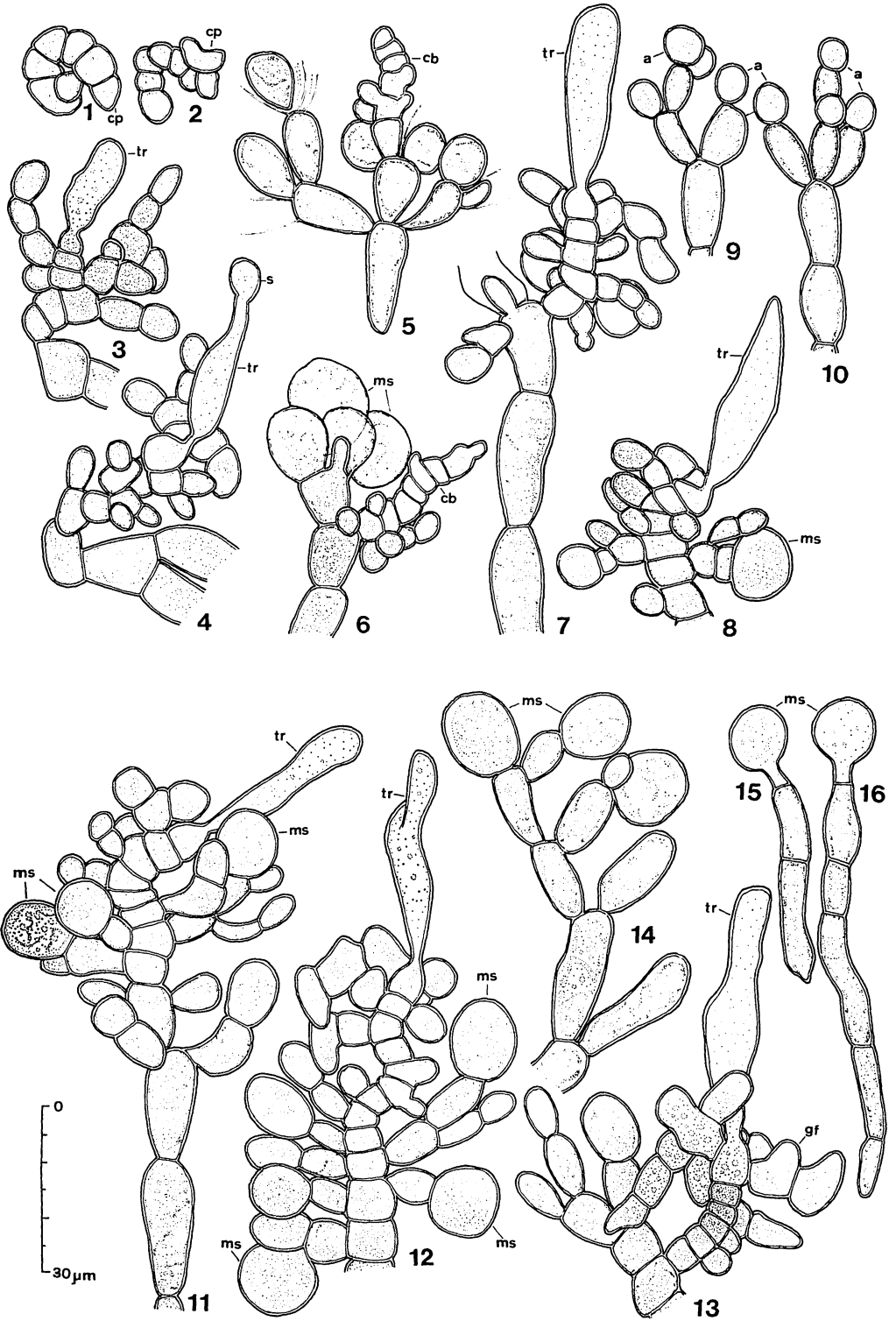
Herbarium specimens used in the present study were collected from China by Dr. JAO Chin Chih of Institute of Hydrobiology, Academia Sinica. Specimen of *B. intortum* was collected from the submerged roots of willow in a pond connected with springs

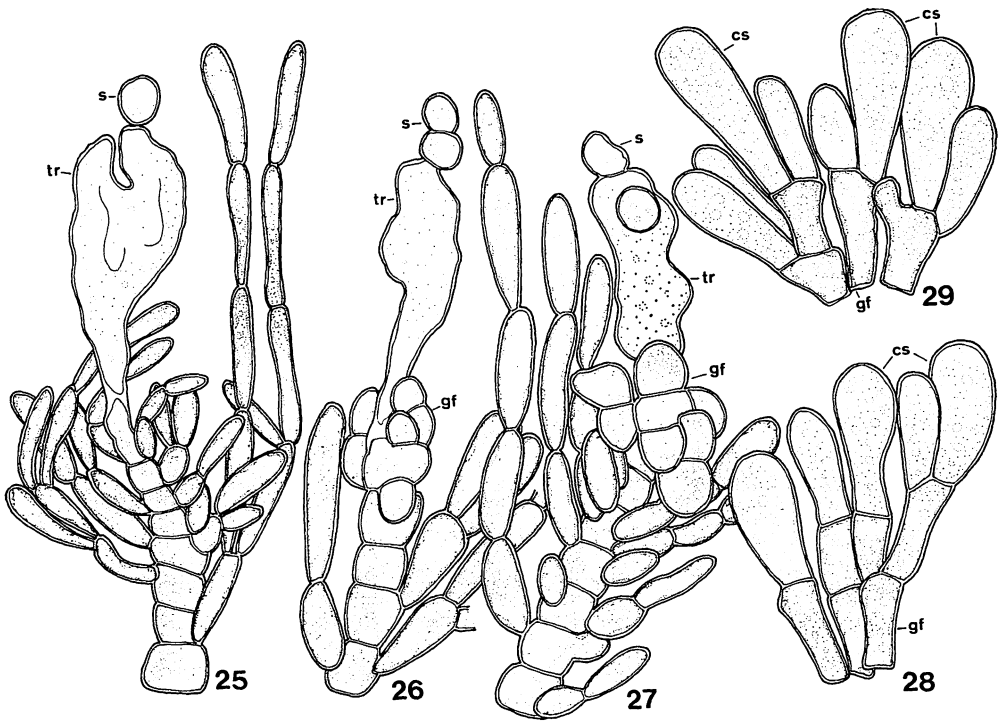
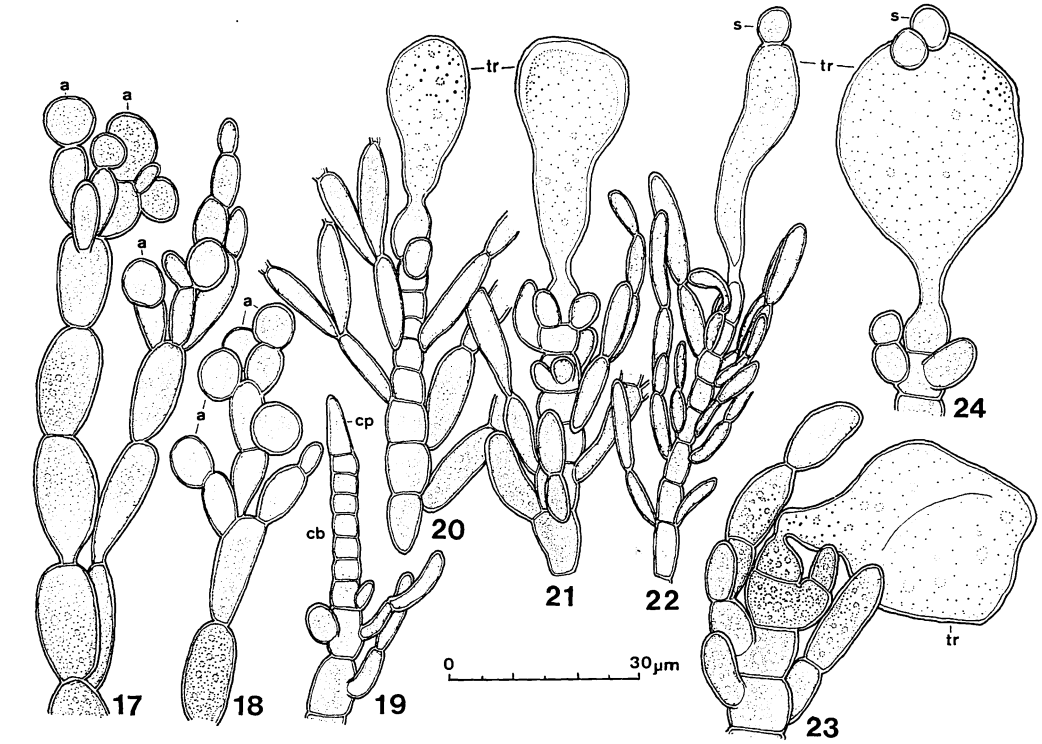
near Lung-chu-sze, Pa-hsien, Szechwan on January 9th in 1940: Herbarium Number SC-1114. Specimen of *B. sinense* was collected from rocks in a mountain stream, about four miles south of Hwang-kuo-shu, Pehpei, Szechwan on February 25th in 1940: Herbarium Number SC-1148.

Observations and Discussions

1. *Batrachospermum intortum* JAO (Figs. 1-16)

The carpogonium-bearing branch of this species arises from the basal cell and also from the terminal cell of the primary branchlets. The carpogonium-bearing branch, which arises from the basal cell of the primary branchlets, is spirally coiled and composed of 4-6 disc-shaped cells. The terminal portion of carpogonium sticks out (Fig. 2), club-shaped trichogynes are formed symmetrically (Fig. 3), sometimes asymme-





trically (Fig. 4). The carpogonium-bearing branch, which arises from an obovoid cell of the terminal portion of the primary branchlets, is less spiral and composed of 4-12 disc-shaped cells. In the early stage in development (Fig. 5), the terminal portion of carpogonium sticks out (Fig. 6), becomes an initial of the trichogyne and gives rise to a club-shaped trichogyne (Fig. 7-8). Gonimoblast filaments are observed to be produced not only from the basal portion of the carpogonium but also from the hypogynous cell (Figs. 7, 11-12). The carpogonium-bearing branch produces short bracts composed of a few cells, some of which may elongate to produce spherical monosporangia (Fig. 8, 11-12). Monosporangia are also formed terminal on the primary and secondary branchlets (Figs. 5-6, 14). The mediate filamentous type (INOH 1947) of germination of monospores is observed in the present specimen (Figs. 15-16). Antheridia are globose, terminal or lateral on the primary and secondary branchlets and 5-7 μm in diameter, smaller than monosporangia.

Among the taxa belonging to the section *Contorta*, four species of *Batrachospermum* have been reported to furnish monosporangia besides carposporangia. *B. lusitanicum* REIS

1965 and *B. waitapense* KUMANO 1983 were reported to furnish the monosporangia terminating the primary and the secondary branchlets. On the other hand, *B. intortum* JAO 1941 and *B. pseudocarpum* REIS 1973 are alike in having the monosporangia terminating the laterals of the carpogonium-bearing branch. In the present paper, it is confirmed that *B. intortum* JAO differs from *B. pseudocarpum* REIS in the size and the shape of the monosporangia. The monosporangia are 20-23 μm long and obovoidal in shape for *B. pseudocarpum*, while the monosporangia are 11-15 μm long and spherical for *B. intortum*.

2. *Batrachospermum sinense* JAO (Figs. 17-29)

Antheridia of this species are terminal or lateral on the primary branchlets, globose and 5-8 μm in diameter (Figs. 17-18). The carpogonium-bearing branch arises from the basal cell of the primary branchlet and consists of 3-9 barrel-shaped cells. In the early stage of development, the carpogonium-bearing branch has few laterals, soon many elongated bracts are produced and embrace the gonimoblast. The terminal portion of a carpogonium sticks out (Fig. 19), then gives rise to a subpyriform trichogyne

Figs. 1-16. *Batrachospermum intortum* JAO

1-4. Carpogonium-bearing branches arising from the basal cells of the whorls; 1, 2. Carpogonium-bearing branches at very early stages; 3. A carpogonium bearing branch with short laterals and a mature trichogyne; 4. A fertilized carpogonium from which a few gonimoblast filaments are developed; 5-8, 11-13. Carpogonium-bearing branches arising from the terminal cells of the whorls; 5, 6. Carpogonium-bearing branch in early stage of development and monosporangia formed terminal on the primary and secondary branchlets; 7. A carpogonium-bearing branch with a mature trichogyne and short laterals; 9, 10. Antheridia terminal on the primary and secondary branchlets; 8, 11-12. Monosporangia formed terminal on short laterals of the carpogonium-bearing branches; 12. Gonimoblast filaments arising from a hypogynous cell; 13. A fertilized carpogonium from which gonimoblast filaments are formed; 14. Monosporangia terminal on the primary branchlets; 15-16. Germinating monospores. (a: antheridium, cb: carpogonium-bearing branch, gf: gonimoblast filament, ms: monosporangium, s: spermatium, tr: trichogyne)

Figs. 17-29. *Batrachospermum sinense* JAO

17-18. Antheridia terminal on the primary branchlets; 19. A carpogonium-bearing branch at very early stage in development; 20-21, 23. Different stages in development of trichogyne; 22. A fertilized carpogonium with a cuneate trichogyne; 24. A fertilized carpogonium with a roundish trichogyne like a balloon; 25-27. Development of gonimoblast filaments arising from the fertilized carpogonium; 28-29. Subcuneate carposporangia terminal on the gonimoblast filaments. (a: antheridium, cb: carpogonium-bearing branch, cp: carpogonium, cs: carposporangium, gf: gonimoblast filaments, s: spermatium, tr: trichogyne)

with an indistinct stalk (Figs. 20-21). The mature trichogyne becomes inflated like a balloon (Fig. 23). The trichogyne is cuneate (Fig. 22), sometimes it is roundish or obovate (Fig. 24). After fertilization, the connection between the trichogyne and the basal portion of the carpogonium is closed (Fig. 25) and the manner of the development of the gonimoblast filaments is the same as those observed in the other taxa of *Batrachospermum* (Figs. 26-27). The gonimoblast grows out into radially branched filaments, on which carposporangia are terminated. Carposporangia are subcuneate, 10-11 μm wide and 24-27 μm long (Figs. 28-29).

To the section *Turficola* SIRODOT (1884) assigned one species, *B. vagum*, with ten varieties, most of which are regarded as nothing but modifications of species by ISRAELSON (1942). KYLIN (1912) divided *B. vagum* into two subspecies, *keratophytum* and *flagelliforme*. ISRAELSON (1942) mentioned that the former is alike *B. vagum* itself and the latter must be called *B. vogesiacum* T. G. SHULTZ accordance with SKUJA (1938). Two varieties of *B. vagum*, *periplocum* SKUJA 1963 and *undulato-pedicellatum* KUMANO et WATANABE 1983, have been described. Three species belonging to the section *Turficola* have been described, viz., *B. sinense* JAO 1941, *B. globosporum* ISRAELSON 1942 and *B. gulbenkianum* REIS 1965. Among the above-mentioned taxa, *B. globosporum* seems better to be assigned to the section *Contorta* rather than to the section *Turficola*, because the carpogonium-bearing branch for *B. globosporum* strongly curved and the trichogyne is formed asymmetrically.

The section *Turficola* is characterized by the trichogyne which is sessile or indistinctly stalked, elongate conical with the largest diameter distal. JAO (1941) observed that the trichogyne of *B. sinense* is cuneate in shape before fertilization, and it becomes subpyriform after fertilization. JAO (personal communication) considered that the shape of trichogyne before fertilization is regarded as an original and typical character and seems to be more important to the taxonomic judge-

ment, thus JAO (1941) assigned this species to the section *Turficola*. In the present study, it is observed that the young trichogyne of *B. sinense* is cuneate, however, the mature trichogyne becomes roundish or obovate, sometimes inflated like a balloon before fertilization. The carpogonium-bearing branch of this species is composed of barrel-shaped cells and provides many elongated bracts. These characters are also observed in the taxa of the section *Moniliformia*, so that, *B. sinense* resembles more closely those of the section *Moniliformia* rather than those of the section *Turficola*.

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References

- INOH, S. 1947. Development of seaweeds. Hokuryukan, Tokyo. (in Japanese).
- ISRAELSON, G. 1942. The freshwater Florideae of Sweden. *Symbolae Botanicae Upsalienses* 6: 1-134.
- JAO, Chin Chih 1941. Studies on the freshwater algae of China VIII. A preliminary account of the Chinese freshwater Rhodophyceae. *Sinensia* 12: 245-290.
- KUMANO, S. 1983. Studies on freshwater Rhodophyta of Papua New Guinea II. *Batrachospermum woitapense*, sp. nov. from the Papuan Highlands. *Jap. J. Phycol.* 31: 76-80.
- KUMANO, S. and WATANABE, M. 1983. Two new varieties of *Batrachospermum* (Rhodophyta) from Mt. Albert Edward, Papua New Guinea. *Bull. Natn. Sci. Mus., Tokyo, ser. B*, 9: 85-94.
- KYLIN, H. 1912. Studien über die Schwedischen Arten der Gattungen *Batrachospermum* und *Sirodotia*. *Nova Acta Regiae Societatis Scientiarum Upsaliensis ser. 4*, 3: 1-40.
- REIS, M. P. 1965. Subsídios para o conhecimento

- das Rhodoficeas de agua doce de Portugal V. Bol. Soc. Brot. Coimbra 34 (ser. 2) : 137-156.
- REIS, M. P. 1973. Subsidios para o conhecimento das Rhodoficeas de agua doce de Portugal VIII. Bol. Soc. Brot. Coimbra 47 (ser. 2) : 139-157.
- SIRODOT, S. 1884. Les Batrachospermes. Libraire de l'Academie de Medecine. Paris.
- SKUJA, H. 1938. Die Süßwasserrhodophyceen der Deutschen Limnologischen Sunda-Expedition. Arach. f. Hydrobiologie suppl. Bd., 15: 603-636.

熊野 茂： 中国四川省産カワモツク属の2種, *Batrachospermum intortum* JAO と *B. sinense* JAO (紅藻・ウミゾウメン目) について

鏡欽止 (1941) の記載した表記2種の模式標本を詳細に観察し、生殖器官について若干の知見を再確認し、分類上の地位を考察した。

1. *Batrachospermum intortum* JAO (中国名, 絞紐串珠藻) 本種の造果器をつける枝はコイル状に巻き、輪生枝基部細胞と先端の細胞の両方から発出する。また多数の単孢子嚢が形成される。単孢子嚢の大きさと形とによって *B. pseudocarpum* REIS と区別することができる。

2. *Batrachospermum sinense* JAO (中国名, 中華串珠藻) 本種の若い受精毛はくさび形であるが成熟すると膨張して逆西洋梨形になる。また造果器をつける枝は長い樽形の細胞からなり、長い側枝が嚢果を包むように伸びる。これらの形質は本種がモニリフォルミア節に近いことを暗示している。(657 神戸市灘区六甲台町1-1 神戸大学理学部生物教室)