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Notothylas levieri (Notothyladaceae, Anthocerotophyta) New to Myanmar

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Abstract *Notothylas levieri* Schiffn. ex Steph. known from India, Nepal, Thailand and China, is reported as new to Myanmar. The description and illustration based on Myanmar plants are given. This species is characterized by the absence of a columella, dehiscence lines consisting of 4-8 rows of thick-walled cells, lining layer of the capsule wall with transverse, spiral or annular thickening bands, dark brown spores and elaters with spiral thickening bands. Details of the unique spore dispersal are described.

Key words: bryophytes, capsule dehiscence, Myanmar, *Notothylas levieri*.

Introduction

The genus *Notothyas* is a small hornwort of the family Notothyladaceae, being mainly distributed in tropical to temperate regions of Africa, Asia and America. The genus is mainly characterized by (1) thallus solid, (2) chloroplast 1(–3) per cell, (3) sprophytes short, lying horizontally in the thallus, mostly or totally enclosed within the involucre, (4) stomata absent, (5) sutures elaborate, rudimentary or absent, (6) columella present or absent, (7) spores yellow to blackish, (8) elaters absent or sub-quadrate with tickenings (Renzaglia et al, 2009; Villarreal et al., 2010), including 23 species at present (cf. Villarreal et al., 2010; Peng and Zhu, 2014; Chantanaorrapint, 2015) and showing the highest species diversity in the Indian subcontinent (Singh, 2002).

In November 2017, the first author collected a *Notothylas* in Chin Hills, Myanmar, where two species of *Notothylas*, *N. verdoorni* and *N. indica*, have been reported (Khanna, 1933; Hasegawa, 1979; Singh, 2002). Through a close examination confirmed that the plants are *Notothylas levieri* Schiffn. ex Steph. which is the third species of the genus in Myanmar.

Notothylas levieri Schiffn. ex Steph., Spec. Hep. 5: 1021. 1917. (Figs. 1, 2)

The following description is based on the Myanmar plants.

Plants shiny pale green, prostrate, repeatedly dichotomously branched; thalli 3–9 mm long, 0.5–3 mm broad, deeply laciniate, ecostate, 4–6 cell layers thick in the middle, 1–2 cell thick at the margins; dorsal epidermal cells subquadrate, 40–120×40–70 μm; inner cells subquadrate-elongated 120–320×40–100 μm. Tubers absent. Involucres marginal, horizontal, between lobes. Sporogonia immersed in involucres, 0.8–2.3 mm long in mature, differentiated into a bulbous foot, a short meristematic zone and an oblong deep brown capsule. Capsules dehiscing longitudinally from apex downwards, along a upper-sided suture only; sutures 4–8 cells thick; capsule wall

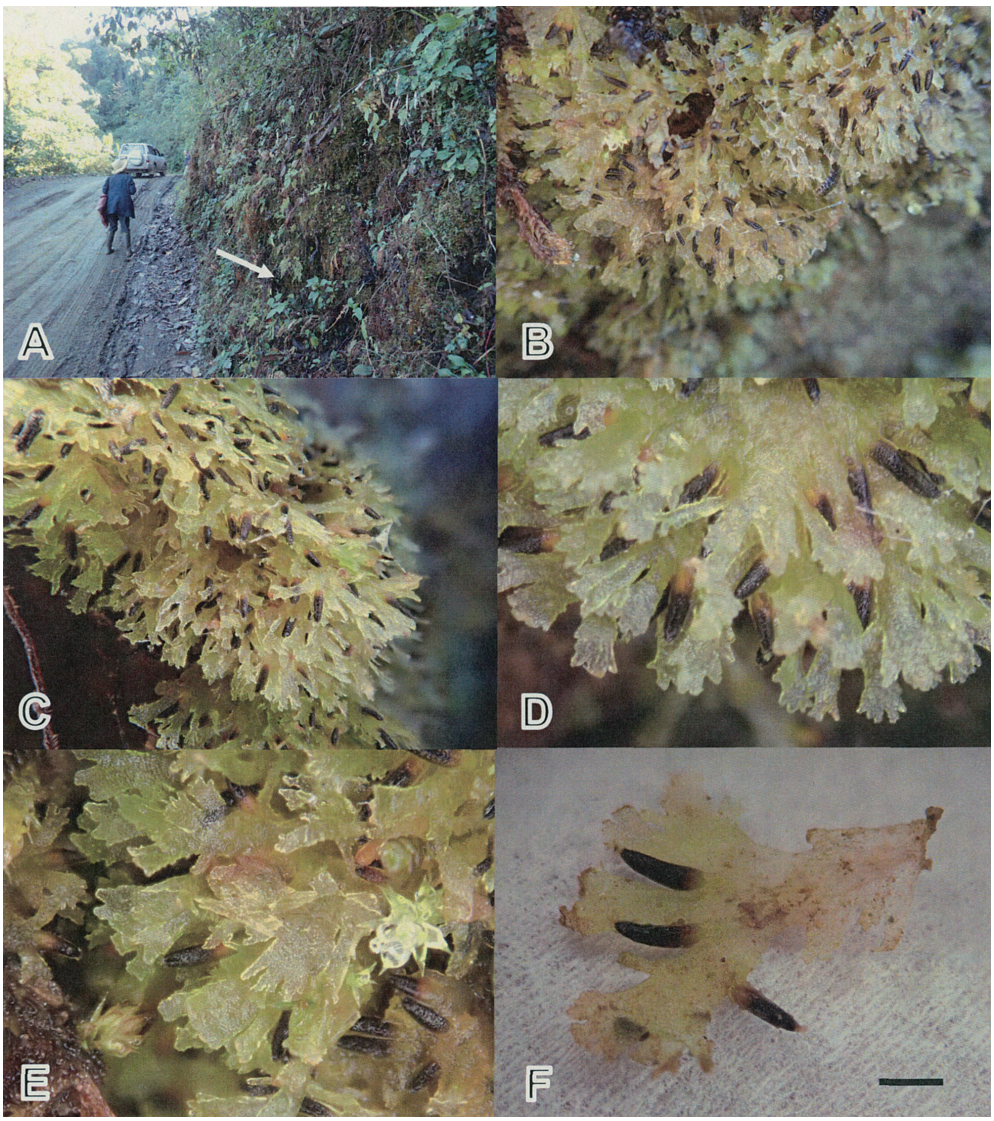

Fig. 1. *Notothylas levieri* Schiffn. ex Steph. A. Habitat in Chin Hills, Myanmar. Arrow shows a place where *N. levieri* is growing on vertical rock surface. B–E. Thalli with sporophytes. F. Thallus with sporophytes. Scale = 1 mm.

3–5 cell layers thick; epidermal cells reddish brown, elongated-rectangular, thick-walled; inner cells hyaline, thin-walled; cells of the lining layer brown, thin-walled, with transverse, spiral or annular thickened bands; stomata absent; columella absent. Spores dark brown, tetrahedral, 30–42 µm in diameter, tuberculate; proximal surface with triradiate mark. Elaters subquadrate, subglobose or linear, 30–60×20–32 µm, with spiral thickening bands.

Specimen examined. Myanmar. Chin State, Chin Hills, south of Matupi, 1840 m alt., on moist vertical rock surface at roadside, November 26, 2017, coll. M. Higuchi 56328 (RAF, TNS).

Distribution. India, Nepal, Thailand and China (cf. Singh, 2002; Peng and Zhu, 2014; Chanta-

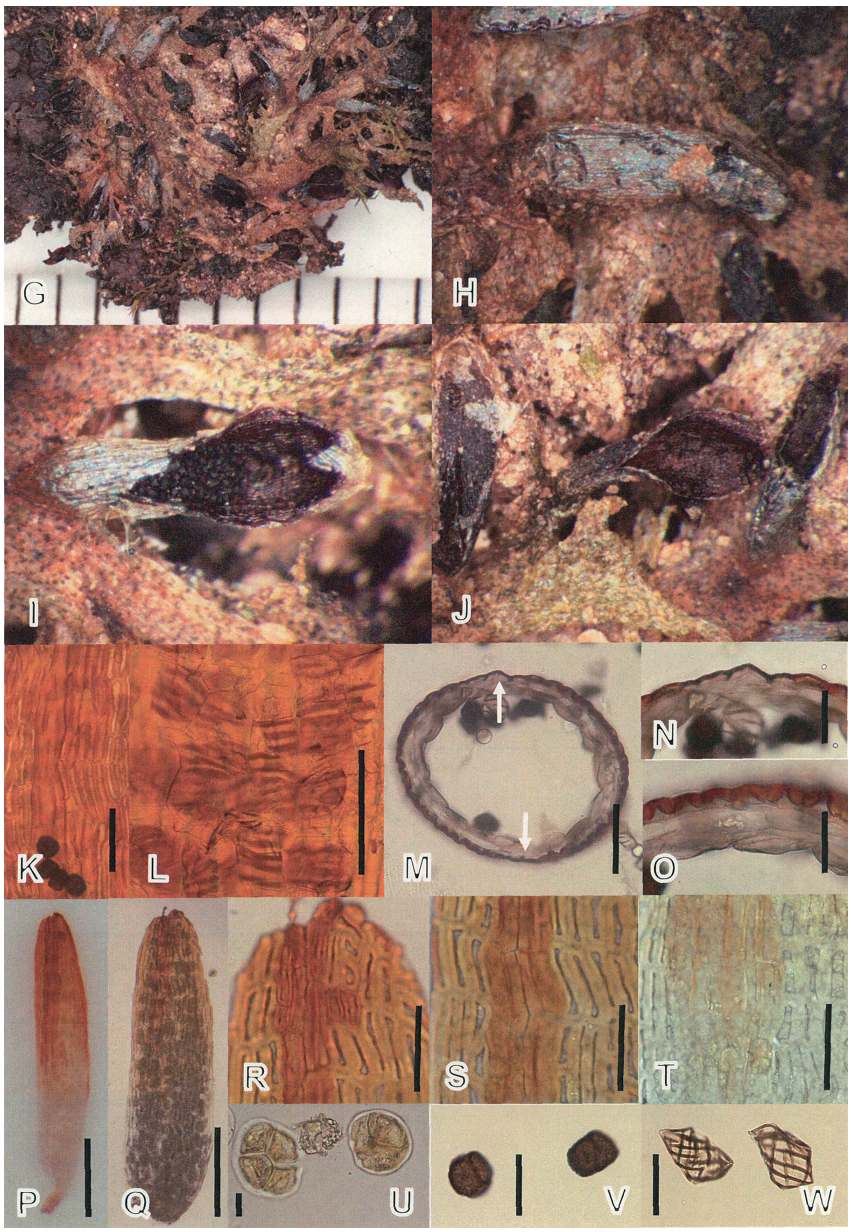

Fig. 2. *Notothylas levieri* Schiffn. ex Steph. G. Dried thalli with mature sporophytes. Scale = 1 mm. H. Capsule with involucre. I. Dehiscing capsule. Spores are seen. J. Dehiscing capsule after releasing spores. K. Epidermal cells of the capsule showing dehiscence line of thick-walled cells. L. Cells of lining layer with transverse, spiral thickening bands. M. Transverse section of young capsule. N. Transverse section of a part of dehiscence line of young capsule. O. Transverse section of a part of young capsule. P. Young capsule with dehiscence line. Q-T. Epidermal cells of young capsule (R: upper part with dehiscence line, S: middle part, T: lower part). U. Tetrads of young spores. V. Spores. W. Elaters. Scales for K, L, M, R, S & T in 0.1 mm, for N, O, V & W in 50 µm for P & Q in 1 mm and for U in 25 µm. All from Higuchi 56328.

naorrapint, 2015). New to Myanmar.

Notothylas levieri is characterized by the absence of a columella, dehiscence lines consisting of 4–8 rows of thick-walled cells (Fig. 2: K, P, Q, R, S, T), lining layer of the capsule wall with transverse, spiral-annular thickening bands (Fig. 2: L), dark brown spores (Fig. 2: V) and elaters with spiral thickening bands (Fig. 2: W). *Notothylas levieri* grows on moist vertical rock surface facing north at roadside (Fig. 1: A), being mixed with *Lopholejeunea* sp., *Ectropothecium* sp. and *Bryum* sp.

Notothylas verdoorni Khanna, endemic to Myanmar, differs from *N. levieri* by the non-valved capsules. *Notothylas indica* Kashyap, known from India, Pakistan and Myanmar, is distinguished from *N. levieri* by having capsules with columella.

Spore morphology is one of the important features to distinguish the species for *Notothylas*. In *N. levieri* Singh (2002) described that the spores have well defined denticulate flange. However, the spores in Myanmar plants are lacking such flange (Fig. 2: V). The SEM photographs of spores of *N. levieri* based on the type (Fig. 1: 3) by Hässel de Menéndez (1976) show that they are lacking flange. There may be some variations on the spore morphology in this species.

One of the unique features of *Notothylas levieri* is the way of the spore dispersal. Pandé (1934) noted "The capsule generally opens like a follicle that is along one suture" and described that it is also seen in *N. indica*. The details of the spore dispersal are, however, little known in *Notothylas levieri*, though Singh (2002) described in *N. levieri* "The capsule opens like a follicle, dehiscing usually along one suture only from apex downward". I observed the process of the spore dispersal in the dried specimen (Fig. 2). When the sporogonia are mature and dry, capsules dehisce from apex downwards along the upper-sided suture, and involucres dehisce simultaneously (Fig. 2: H, I). As a result, capsules are bivalved and open, and thus the spores are exposed and released (Fig. 2: I, J). The valves are closed when wet, that is, the valves are hygroscopic as Pandé (1934) pointed out. Although Pandé (1934) noted that in some cases capsules may dehisce along both the sutures, seventeen capsules which I examined dehisced along the upper-sided suture without exception. In the young capsules, two sutures, namely upper-sided and under-sided ones, were already present on opposite sides of the capsule (Fig. 2: M). It might be of interest to investigate whether the under-sided suture fulfils any function in the opening of the capsule.

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