Taiwania 61(2): 165–171, 2016
DOI: 10.6165/tai.2016.61.171

NOTE

Jungermannia gollanii Steph. (Jungermanniaceae, Marchantiophyta) - A new report from Terai region in Uttar Pradesh (U.P.), India

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(Manuscript received 26 Janunary 2016; accepted 11 May 2016)

ABSTRACT: This article reports the occurrence of the leafy liverwort *Jungermannia gollanii* Steph. from the Sohelwa forest in Sravasthi District located in Terai region of the state of Uttar Pradesh, India. The plants are found growing at low altitude. The species is characterized with creeping, simple plants bearing rhizoids arising ventrally all along stem, succubous and dorsally secund leaves, a non-beaked, long exerted, plicate perianth with contracted mouth and lacking a perigynium. The plants of this new locality have been retained under subgenus *Luridae* (Spruce) Amak. of genus *Jungermannia* L.

KEY WORDS: India, *Jungermannia gollanii*, Liverworts, Perianth, Secund, Sravasthi.

INTRODUCTION

The genus *Jungermannia* was instituted by Linnaeus in 1753 based on characters of the type species *Jungermannia lanceolata* L. It belongs to the family Jungermanniaceae (subfamily Jungermannioideae). Some 125 species of this genus have been reported worldwide by Amakawa (1959, 1960), Váňa (1975a, 1996), Hong (1997, 2003) and Váňa and Hong (1999). Out of these, 54 species are known to occur in India (Bapna and Kachroo, 2000). The Indian species of this genus have been described mainly by Kashyap (1932), Amakawa (1963, 1966, 1967, 1968, 1969, 1970, 1972), Váňa (1972a, b, 1974), Udar and Kumar (1981, 1983), Srivastava and Singh (1986a, b, 1988, 1995), Srivastava and Amakawa (1991), Srivastava et al. (2003), Alam et al.(2007), Singh and Nath (2007), Srivastava (2008) and Singh and Singh (2008, 2009).

Earlier the genus *Jungermannia* L. was believed to be equivalent to *Liochlaena* Nees (Jørgensen**,** 1934; Müller, 1951 – 1956; Schuster, 1953) while *Solenostoma* Mitt. and *Plectocolea* Mitt. were regarded as independent genera by Müller (1956) and others. Later, Amakawa (1960) proposed to combine all these genera as subgenera in the large genus *Jungermannia* L. as subgenera *Plectocolea*, *Luridae*, *Solenostoma* and *Jungermannia* as they were closely similar to each other and could be recognized only with the help of their female inflorescences.

The plants described in the present article have been assigned to *J. gollanii* Steph. of the subgenus *Luridae* on account of their pale to olive green or brownish color; colourless or light brown rhizoids; obliquely inserted to widely spreading, rarely conduplicately concave, ovate to rarely rotundate leaves with cell walls thin to slightly thickened; trigones not bulging. Perianth not beaked, exerted, fusiform, plicate or with few furrows for upper ⅓ – ½ region, gradually narrowed towards crenulated mouth; cells usually isodiametric to elongated, walls thin without trigones. Perigynium absent. Female bracts one pair. Seta composed of many cell rows, epidermal cells often larger than inner ones.

Jungermannia gollanii Steph. appears to show a limited distribution pattern in India as so far it has been reported only from the Western and Eastern Himalayas (Dandotiya et al., 2011; Bapna and Kachroo, 2000). The present paper reports occurrence of the species from a new area, the Sohelwa forest near Sravasthi in the Terai region of the state of Uttar Pradesh.

MATERIALS AND METHODS

Specimens collection and observation

Study area:

The Sohelwa forest is situated between 27°30'1" N to 27°55'42" N latitude and 81°55'36" E to 82°48'33" E longitude in Sravasthi, Uttar Pradesh. The forest is in the form of a strip about 120 km long and 5–8 km wide along the Indo-Nepal border and is situated at an altitude of 120 to 200 m above sea level (Fig. 1). It is a subtropical dry deciduous Sal (*Shorea robusta*) forest (Jaiswal & Bhattacharya, 2013). The soil is Gangetic alluvium type, ranging from sandy to loam and silt to clay loam in texture (Singh, 2010).

Description:

Jungermannia gollanii Steph.Sp. Hepat. 6: 86. 1917; Amakawa, J. Hattori Bot.Lab. 29: 264. 1966.

Figs. 2 & 3

Plants 6.00 – 11.25 mm long (sometimes upto 25 mm long) and 2 – 4 mm wide (with leaves), pale to

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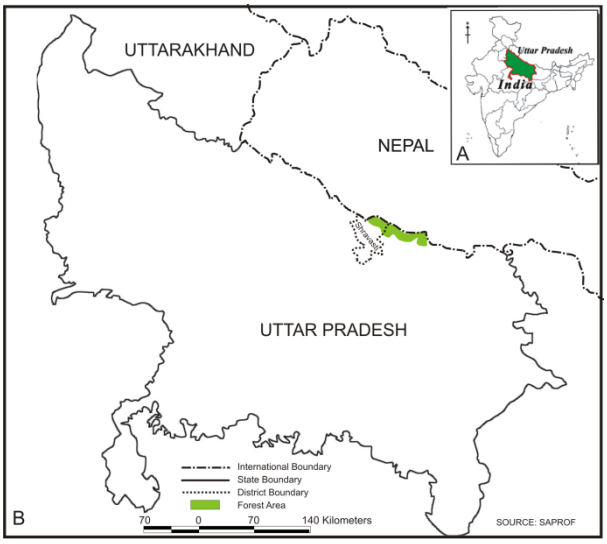


Fig. 1. A: Map of India showing Uttar Pradesh in Grey color. **B:** Part of the map in A magnified to show the location of collection site in Sohelwa forest, Sravasthi, Uttar Pradesh, India.

olive green, in mats. **Stem** creeping, simple (rarely branched) 0.1 – 0.3 mm thick, pale to light brown in color, cylindrical to slightly flattened, 7 – 12 cells across. Cortical and medullary cells undifferentiated, polygonal to isodiametric. Epidermal cells larger, thick walled and pigmented 14 – 28 × 9 – 22 µm in size, inner cells thin walled, non collenchymatous, 17 – 46 × 11 –38 µm, non – pigmented. **Rhizoids** numerous, pale to light brown, 9 – 12 µm thick, scattered along postical part of axis arising from ventral epidermal cells of stem, not forming fascicles. **Leaves** entire, alternate, slightly imbricate, obliquely and widely inserted, slightly decurrent on both sides, succubous, dorsally secund, ovate to somewhat rotundate, 1.5 – 1.8 mm long and 1.4 – 2.0 mm wide (at middle), upper leaves somewhat conduplicately concave, margins sometimes incurved, apex obtuse to occasionally emarginated. Marginal cells rectangular to polygonal 22 – 30 × 20 – 22 µm, middle cells polygonal, 33 – 38 × 12 – 23 µm, basal cells elongated 94 – 135 × 26 – 37 µm, walls thin. Trigones inconspicuous. Oil bodies scattered, granular to obscure. Underleaves absent. Dioecious, **male** inflorescence intercalary on main stem with 2 or 3 pairs of bracts, smaller than cauline leaves, 1.3 – 1.5 mm long, 1.3 – 1.8 mm wide, ventricose. Antheridia generally solitary per bract. Antheridial head globular about 150 – 190 µm wide, jacket single layered of isodiametric to polygonal slightly thick walled cells. Stalk biseriate, 115 µm long and 25 µm wide. **Perianth** emergent, well developed generally not hidden by perichaetial bracts, terminal on main shoot, fusiform, ⅔rd exerted, 2.7 – 3.0 mm long, 1.4 mm wide, upto 5 plicate in upper half, mouth gradually narrowed towards crenulated apex, not beaked, surface unistratose, cells isodiametric as well as elongated, non-collenchymatous, without trigones, apical cells 29 – 68 µm long and 29 – 45 µm wide, middle cells 41 – 75 µm long and 25 – 36 µm wide. **Perigynium** absent. **Female** inflorescence terminal, bracts generally in 1 pair, similar to cauline leaves but larger in size, 2.5 – 2.9 mm long and 2.0 – 2.3 mm wide (uppermost pair). Archegonia terminal on main shoot, in groups of 8 – 10. **Sporophyte** generally young in our specimens, single within a perianth, young capsule oblong to ovoid 0.8 – 1.0 mm long and 0.5 – 0.7 mm wide, capsule wall bistratose, cells of outer layer elongated, inner layer cells isodiametric. Seta in young sporophyte cylindrical, 0.8 – 1 mm long and 0.2 – 0.4 mm wide, of many rows of cells, epidermal cells larger than inner ones. Foot anchor shaped with dagger – like apex. Calyptra narrow, smooth, ovoid to rounded, often showing unfertilized archegonia of female inflorescence. Spores 15 – 19 × 14 – 16 µm, unicellular, thin walled, brown, delicate with feebly developed poorly sculptured exine showing irregular folding with probable vermiculate ornamentation. Elaters brown, 138 – 168 µm long and 11 – 13 µm wide.

Habitat and Ecology: Terricolous, on moist rocks covered with a thin layer of soil, in association with *Fissidens* sp., in shaded places of the Terai region.

Specimens examined: **INDIA**: Uttar Pradesh, Sravasthi district, Sohelwa forest, Bankati, ca. 161m, Jan. 26, 2014, leg. N. Bhowmik & S. Sinha, det. N. Bhowmik, 5000AUL/14, Duthie Herb. Alld. Univ.; same locality, Oct. 10, 2015, leg. N. Bhowmik & S. Sinha, 5502 AUL/15, Duthie Herb. Alld. Univ.; Bhagvanpur, Sohelwa Forest, ca. 170m, Jan. 28, 2014, leg. N. Bhowmik & S. Sinha, det. N. Bhowmik, 5001AUL/14, Duthie Herb. Alld. Univ.

Distribution: Bhutan, China, Siwalik Range; In India-Western Himalayas, Dehradun-Mohand Pass, Mussoorie, East India.

DISCUSSION

Although a good number of species of *Jungermannia* L. have been reported from time to time from various regions of the Indian sub-continent (see Introduction), the species *Jungermannia gollanii* Steph. to the best of our knowledge has not been described in the recent past from any new locality other than those mentioned in Amakawa (1966) whose description includes *J. gollanii* under the subgenus *Luridae* Spruce. Later, adopting nomenclatural changes Váňa (1973, 1996), Váňa & Hong (1999), Grolle (1983a, b) assigned *J. gollanii* Steph. to the subgenus *Jungermannia* (as subgenus *Luridae* Spruce was replaced by *Jungermannia* because it contained the type of this genus). As a result most of the following publications included *J. gollanii* under the subgenus *Jungermannia* (Bapna & Kachroo, 2000).

But, quite recently Bakalin (2014) after studying Stephani's type specimens of 75 hepatic taxa in the type collection of Genève replaced the generic status of *J. gollanii* Steph. from *Jungermannia* L. to *Plectocolea*(Mitt.) and instituted a new combination

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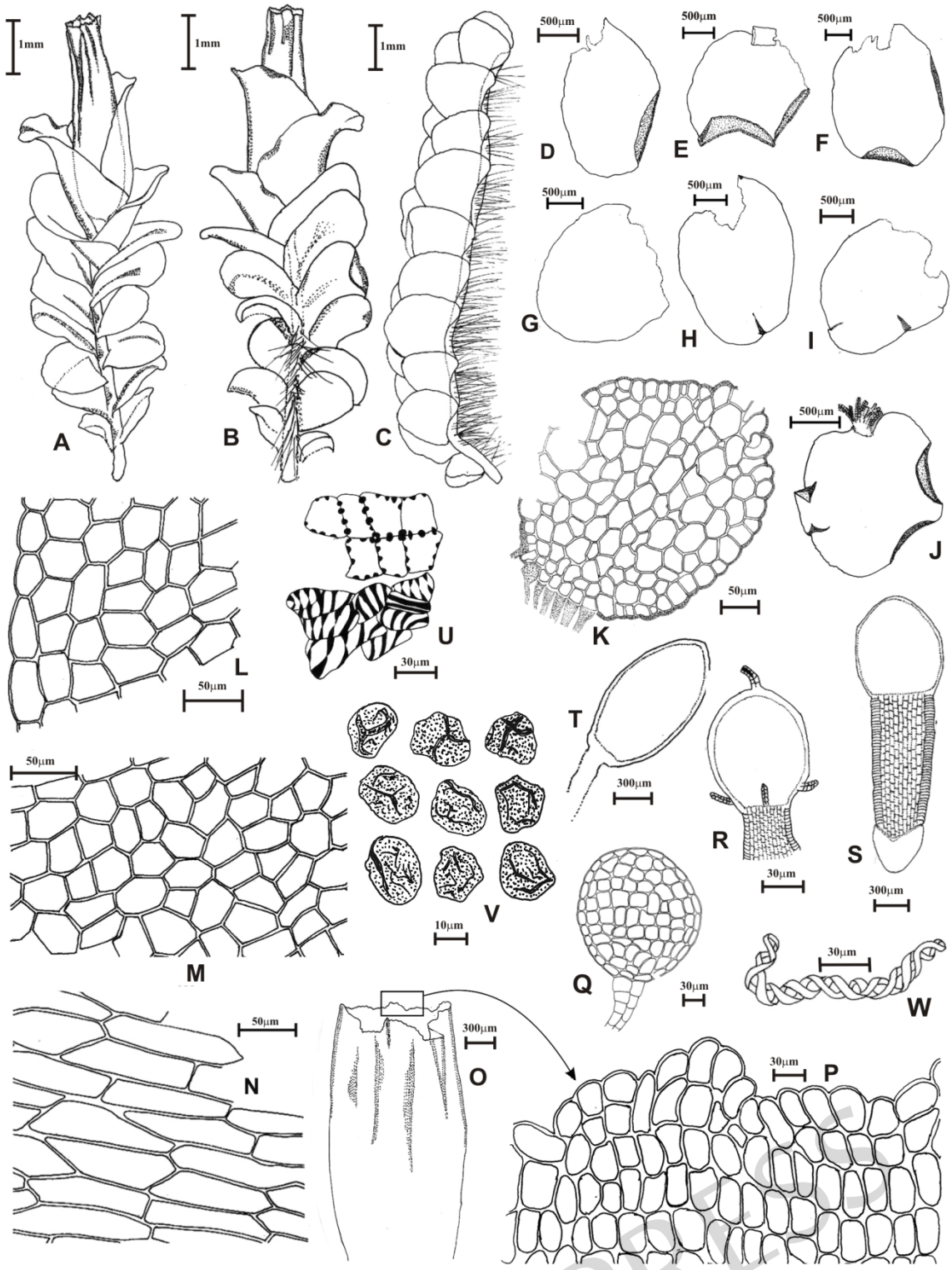


Fig 2. ***Jungermannia gollanii*** Steph. **A:** Female plant with perianth (dorsal view). **B:** same (ventral view). **C:** Sterile plant (lateral view). **D-H:** Leaves. **I, J:** Female bracts, J showing a group of archegonia. **K:** T.S. of axis. **L:** Marginal cells of leaf. **M:** Middle cells of leaf. **N:** Basal cells of leaf. **O:** Apical part of perianth. **P:** Mouth cells of perianth in O enlarged. **Q:** Antheridium. **R:** A young sporophyte showing a few unfertilized archegonia. **S:** Immature sporophyte showing capsule, seta and foot. **T:** Mature capsule. **U:** Cells of capsule wall. **V:** Spores. **W:** An Elater (**A-P; Q; R-W** drawn from 5001AUL/14, 5000AUL/14 & 5502AUL/15 respectively).

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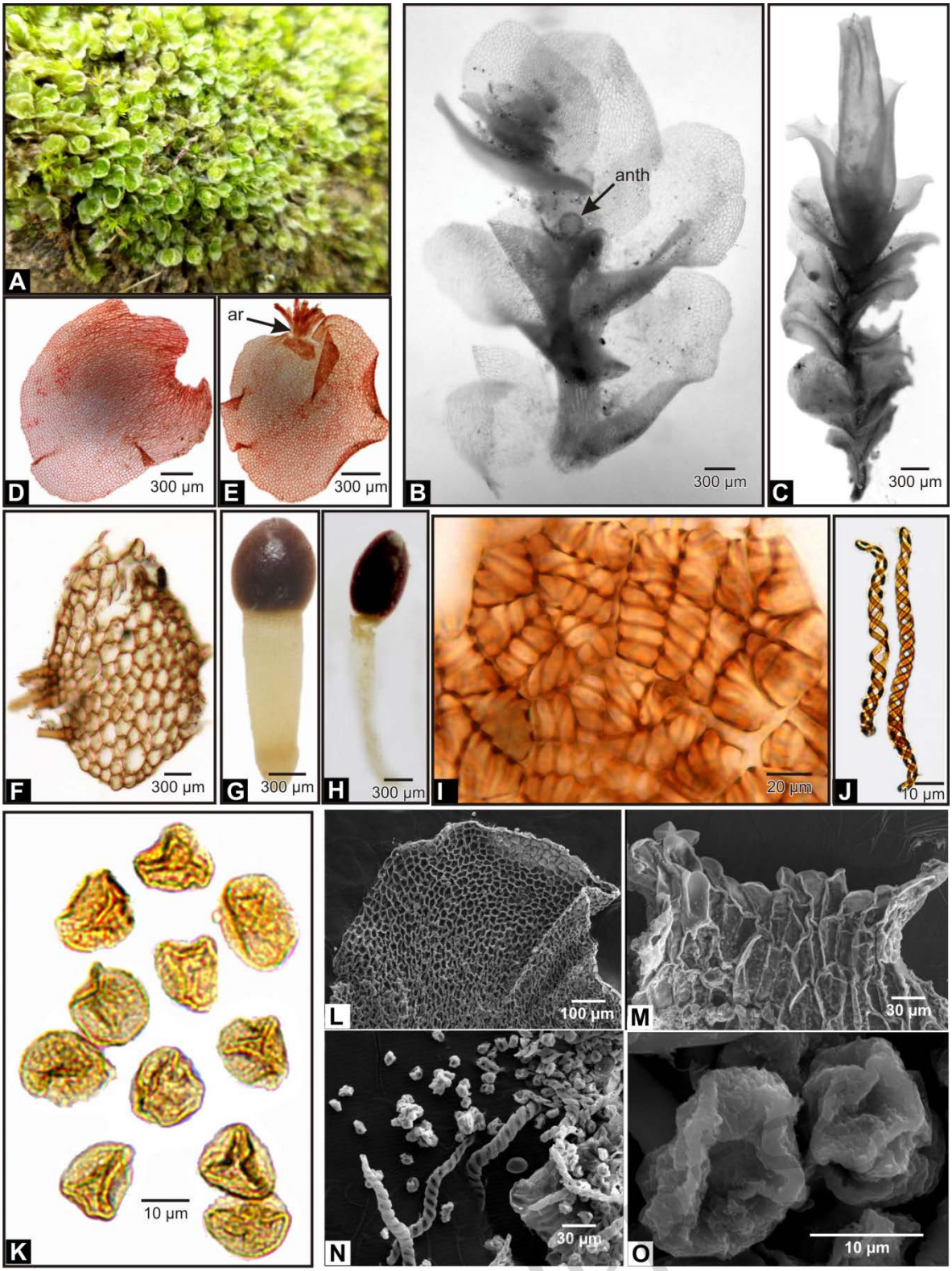


Fig 3. (**A-K**) LM and (**L-O**) SEM of *Jungermannia gollani* Steph. **A:** Plants on rock. **B:** A portion of male plant magnified to show an intercalary antheridium. **C:** A female plant with perianth. **D, E:** Female bracts, E showing an archegonial cluster. **F:** T.S. of axis. **G:** Immature sporophyte. **H:** Mature capsule with a portion of seta. **I:** A portion of capsule wall. **J:** A pair of elaters. **K:** Spores. **L**: Apical portion of leaf. **M:** Apical cells of perianth. **N:** Ruptured capsule wall, spores and elaters. **O:** A pair of spores magnified. anth, antheridium; ar, archegonia (**A, C-F**; **B**; **G-O** photographed from 5001AUL/14; 5000AUL/14; & 5502AUL/15 respectively).

Plectocolea gollanii (Steph.) Bakalin comb. nov. In support of his new combination Bakalin (2014) has mentioned features like (1) mostly unistratose perianth, (2) perianth composed of elongated cells, (3) leaf cells large (upto 75 µm long which is unsuitable for taxa of *Jungermannia* L. s.str.). Out of the three features mentioned above, Bakalin (2014) has laid special emphasis on the size of middle leaf cells which are too large for the taxa of *Jungermannia* L. in the case of Amakawa's (1966) plants from India. We too, disapprove the inclusion of *J. gollanii* Steph. into the subgenus *Jungermannia* because features of the perianth also do not agree with those mentioned for the subgenus. While in subgenus *Jungermannia* the cylindrical perianth besides lacking plicae is abruptly contracted apically to form a tubular beak on a truncate or slightly depressed tip, it is not so in the perianth of *J.*(Luridae) *gollanii* Steph. Here it is fusiform, plicate or with few furrows and apex is gradually narrowed towards crenulated mouth and not beaked. We, at the same time, also do not agree with Bakalin's (2014) reference of *J. gollanii* Steph. to *Plectocolea* Mitt. as a new combination *Plectocolea gollanii* (Steph.) Bakalin comb. nov. merely on the basis of features like large leaf cells, mostly unistratose perianth and elongate perianth cells. To the best of our knowledge, in the taxon *Plectocolea* Mitt., the perianth is ± reduced and closely sheathed by bracts forming perigynium. It is ovoid, narrowed in a conical fashion distally and contracted to a slender mouth, 4 to several plicate distally, unistratose and not beaked. The perigynium is distinct and shortly tubular. Besides this, plants are pale green or purplish or vinaceous tinged on ventral side. Rhizoids are usually tinged and the leaf base usually has purplish pigmentation (Singh & Nath, 2007).

We regret to state that but for the non-beaked and unistratose feature of perianth most other characters of *Plectocolea* Mitt. seem to be lacking in the plants described by Bakalin (2014). The perianth is almost cylindrical, not ovoid and narrowed in a conical fashion distally. It is exerted ⅔ its length and a shortly tubular perigynium is virtually absent. In support of his new combination Bakalin (2014) has considered the presence or absence of perigynium, a feature not very valuable.

However, refraining from all above mentioned controversies we would still prefer to retain the presently described plants under *Jungermannia gollanii* Steph. of the subgenus Luridae because of the following reasons:- (a) Perianth fusiform, not beaked, long exerted, plicate, gradually narrowed towards crenulated mouth; perigynium absent; (b) leaves ovate, obliquely inserted, dorsally secund, cell walls thin to slightly thickened, trigones inconspicuous; (c) axis creeping, simple; (d) rhizoids colorless to light brown not purple tinged arising almost at right angles from ventral cells of axis, not forming fascicles; (e) seta composed of many cell rows (see Appendix 1).

ACKNOWLEDGEMENTS

We are grateful to Dr. S. N. Srivastava for helping us in identifying the plants and kindly allowing us to use his personal library. We thank Mr. Deepak Mishra for help in plant collection. We also thank the esteemed reviewers for appreciating the interesting report and providing valuable suggestions after reviewing an earlier version of the manuscript. We thank the Editor-in-Chief, Taiwania for appreciating the contribution. One of the authors (S.S) is thankful to the U.G.C for providing financial support.

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Appendix 1: A Comparison chart mentioning features of ***Jungermannia gollanii*** Steph. in present article and those described by Amakawa, 1966 and Bakalin, 2014.

Taxon\ Characters		***Jungermannia gollanii* Steph. (Amakawa, 1966)**	***Plectocolea gollanii* (Steph.) Bakalin (Bakalin, 2014)**	***Jungermannia gollanii* Steph. (present material)**
Plant	Size	20 mm long x 1.2 mm wide.	10–15 mm long x 2–2.7 mm wide.	6–11.25 mm long x 2–4 mm wide.
	Color & Habit	Pallid, yellowish green, creeping.	Pale greenish-brownish, prostrate to ascending.	Pale to olive green, creeping.
Stem		0.4 mm thick.	Brownish, not branched (even as subfloral innovations), 200 – 250 µm in diameter.	Simple, 0.1 – 0.3 mm thick, 7 – 12 cells across.
Rhizoids		Numerous, light brown.	Numerous, colorless to brownish, erect to (rarer) obliquely spreading.	Numerous, pale to light brown, scattered on postical stem.
Leaves	Shape	Ovate	Ovate to obliquely ovate, very obliquely inserted, flattened to very loosely concave or slightly convex, dorsally not or barely decurrent, ventrally arcuately inserted.	Ovate, seldom rotundate, obliquely and widely inserted, slightly decurrent, margin often incurved, somewhat conduplicately concave.
	Size	1.5 mm long x 1.4 mm wide. Marginal cells 32–56 x 24 – 40 µm. Mid leaf cells 64–88 x 32–48 µm. Basal cells 80–120 x 32–48 µm.	1.7–2.5 mm long x 1.5–2 mm wide. Marginal cells 50–69 µm, trigones vestigial to small. Mid leaf cells 50–75 x 31–44 µm, trigones small.	1.5–1.8 mm long x 1.4–2 mm wide. Marginal cells 22–30 x 20–22 µm. Mid leaf cells 33–38 x 12–23 µm. Basal cells 94–135 x 26–37 µm, trigones inconspicuous.
Sexuality		Dioecious	Dioecious ?	Dioecious
Male		Not mentioned	Not mentioned	Intercalary on main stem with 2–3 pairs of perichaetial bracts, ventricose.
Antheridia		Not mentioned	Not mentioned	Antheridia solitary, stalk biseriate, head globular, jacket single layered, cells isodiametric to polygonal, slightly thick walled.
Female		Perichaetial bract 1 pair.	Similar to leaves but commonly larger and slightly emarginated at apex.	Perichaetial bract 1 pair, similar to leaves but commonly larger.
Archegonia		Not mentioned	Not mentioned	Terminal on main stem, 8–10 in number.
Perianth		Fusiform, long exerted, 4.8 mm long and 1.2 mm wide, 2 – 3 furrows, cells isodiametric at apex, elongated in middle.	Almost cylindrical, ½ – ⅔ exerted, 3 mm long x 1 mm wide, not or loosely plicate, only slightly narrowed to mouth, mouth crenulate due to protrudent ob-pyriform cells with slightly thick walls. Middle cells 112–200 x 37–50 µm, thin walled with vestigial trigones, perigynium virtually absent.	Fusiform, ⅔rd exerted, 2.7–3 mm long and upto 1.4 mm wide, upto 5 plicate in upper half, gradually narrowed towards crenulated mouth, not beaked; cells thin walled, isodiametric as well as elongated. Middle cells 41–75 x 25–36 µm, isodiametric as well as elongated, cells non-collenchymatous, without trigones, perigynium absent.
Calyptra		Not mentioned	Not mentioned	Ovoid to rounded, smooth, upto 50 µm wide.
Sporophyte		Not mentioned	Not mentioned	Capsule oblong to ovoid, 0.7–1 mm long x 0.5–0.6 mm wide.Seta cylindrical and long. Foot anchor-shaped.
Spores		Not mentioned	Not mentioned	Brown, 14.6–19.3 x 13.8–15.8 µm.
Elaters		Not mentioned	Bispiral, sometimes branched.	Brown, bispiral, 138–168 µm long and 11–13 µm wide.

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