

Species of *Plagiochila* (Dum.) Dum. (Plagiochilaceae) from Lilam in Kumaon, Western Himalayas, India*

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Taxonomic account of ten species of genus *Plagiochila* (Dum.) Dum., *P. phalangea* Tayl., *P. gollanii* St., *P. semidecurrans* (Lehm. et Lindenb.) Lehm. et Lindenb., *P. ferruginea* St., *P. nana* var. *robusta* var. nov., *P. vygensis* St., *P. richteri* St. from Lilam (Western Himalayas) has been provided. *P. phalangea*, *P. semidecurrans*, *P. vygensis*, *P. mundaliensis* St., *P. accedens* St., *P. chinesis* St., and *P. richteri* are being reported for the first time, showing a considerable extension of range in the Western Himalayas from their previously known distribution.

Key-words: Bryophyta; Hepaticae; Plagiochilaceae; *P. phalangea* Tayl., *P. gollanii* St., *P. semidecurrans* (Lehm. et Lindenb.) Lehm. et Lindenb., *P. ferruginea* St., *P. nana* var. *robusta* var. nov., *P. vygensis* St. and *P. richteri* St. (Ms).

INTRODUCTION

THE genus *Plagiochila* (Dum.) Dum. (Plagiochilaceae) with nearly 1800 (Inoue & Schuster, 1971; Bonner listed about 1600 species in "Index Hepaticarum": 1962) binomials (of which many undoubtedly need reduction) is one of the largest and most difficult genus of the Hepaticae and has been raised to its present rank from *Radula* sect. *Plagiochila* by Dumortier (1835). The genus *Plagiochila* embraces a relatively specialized ensemble of species and has been represented in Hepatic flora of India by 117 species (Chopra, 1943; Hattori, 1966, 1971, 1975; Kachroo, 1973; Parihar, 1961-62; Parihar *et al.* 1994; see also Udar, 1976). *Plagiochila* is essentially cosmopolitan in distribution (Kachroo, 1969; Schuster, 1980) and exhibits very high degree of endemism in small area. The only limitation within the genus is infrequent occurrence of sporogonia probably due to dioecious nature of plants and failure of gametic union (Srivastava & Dixit, 1993). Unfortunately reliance on vegetative characters becomes necessary since many species are not known with perianths or sporophytes.

The taxonomy of *Plagiochila* has been generally considered to be a forbidding complex. This is chiefly so because of the prior treatment which has been either so

superficial and confused or have omitted many or most taxonomically relevant criteria. Consequently; majority of taxa are inadequately known at least in the Indian sub-continent. The genus has maximum preponderance in India, yet only very little information is available so far except some work on South eastern Asian *Plagiochila* (Inoue 1962, 1965, 1966, 1967, 1969, 1984). However, *Plagiochila* of Japan (Inoue 1958), North America (Schuster, 1959-60), Tropical Africa (Jones, 1962), New Zealand, Tasmania (Inoue & Schuster, 1971), Ceylon (Inoue, 1979), Samoa (Inoue 1981), and Australia (Inoue, 1986) have received considerable attention.

Several species of *Plagiochila* grow luxuriantly in the Western Himalayan region and many of these have never been critically investigated except for the fragmentary account given by Stephani (1906, 1917-24) and Kashyap (1932). This region (W.H.) hosts nearly 15 species (see Chopra, 1943; Parihar, 1961-62; Parihar *et al.* 1994), which are at present under detailed taxonomic revision.

Fortunately critical survey of a recent collection by Dr. Deepak Sharma from Lilam to Bogdiyar (*alt.* ca 1850-2450m), a high altitude area of the Western Himalayas has yielded ten species of *Plagiochila*, which

are being described here with relevant details. These include *P. phalangea* Tayl., *P. gollanii* St., *P. semidecurrrens* (Lehm. et Lindenb.) Lehm. et Lindenb., *P. ferruginea* St., *P. nana* var. *robusta* var. nov., *P. vygensis* St., *P. mundaliensis* St., *P. accedens* St., *P. chinensis* St. and *P. richteri* St. Out of these Kashyap (1932) described only three species, *P. ferruginea* St., *P. mundaliensis* St. and *P. accedens* St., the latter not seen by him. *P. chinensis* has been recently reported from Pindari and neighbouring areas (3100-4000m) in the Western Himalayas (Tewari et al. 1993-94.). *P. phalangea* Tayl. earlier known

only from East Himalayan territory, *P. semidecurrrens* (Lehm. et Lindenb.) Lehm. et Lindenb. from East Himalaya and South India both, *P. vygensis* St. referred from South India, and *P. richteri* St. a manuscript species referred by Stephani in his Icones from India orientalis (Kudremukh) based on Pfeleiderer's collection (Pande, Bharadwaj & Udar, 1949) are being reported from the western Himalayas. The plants referable to *P. nana* show certain characteristic variations which on critical evaluation deserve the status of a new variety, *P. nana* var. *robusta* var. nov.

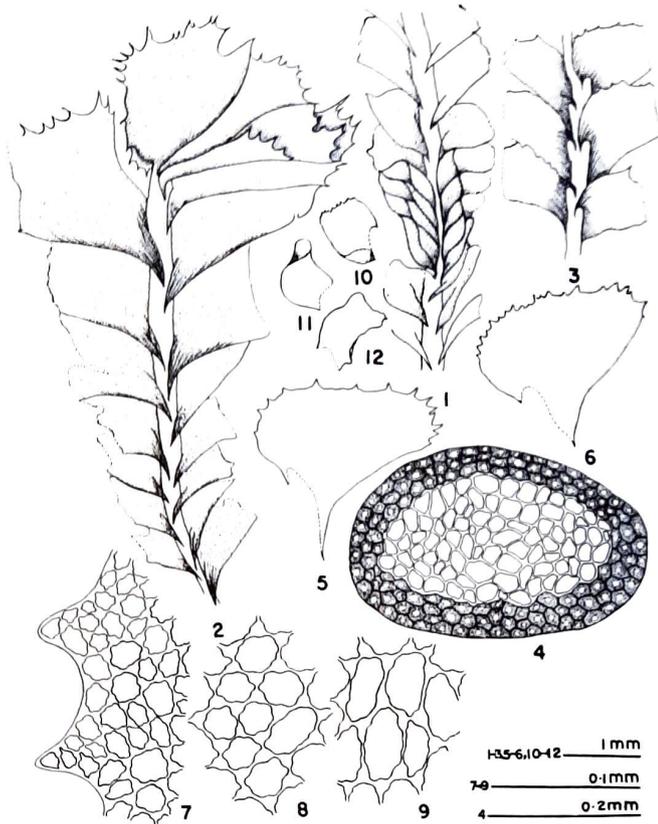
Key to the species of the genus *Plagiochila* from Lilam (W.H.)

1. Plants robust, long (upto 10 cm long), typically copiously branched, branches intercalary, terminal and pseudodichotomous-type 2.
2. Leaves closely imbricate, antical base longly decurrent 3.
3. Leaves (distal portions) caducous or fragmented 4.
4. Leaves with maturity, fragmenting, triangular in shape, dentition upto 20 in number, trigones large, nodulose *P. phalangea*.
4. Leaves only fragmented at the base, ovate-oblong, dentitions upto 15 in number, trigones smooth, but at the base may be bulging *P. gollanii*.
3. Leaves (all) persistent, never fragmented 5.
5. Leaf marginal, teeth upto 35 (40) in number and upto 9 cells long, trigones nodulose (much bulging), vitta-like cells present at the base *P. semidecurrrens*.
5. Leaf marginal, teeth upto 15 in number and upto 2-5(7) cells long, trigones sub-cordate, nodular, vitta-like cells absent 6.
6. Leaves triangular-ovate, trigones sub-cordate, dentitions irregular, 2- 5(7) cells long, *P. ferruginea*.
6. Leaves oblong-ovate, trigones nodulose, dentitions regular, small, 2-3(4) cells long *P. nana* var. *robusta*.
2. Leaves slightly imbricate or distantly arranged, antical base shortly decurrent 7.
7. Leaves obovate or ovate-obcuneate, teeth upto 7 cells long, trigones nodulose, cortical cells 2- layered thick *P. vygensis*.
7. Leaves oblong-ovate, teeth upto 4 cells long, trigones smooth -sub-cordate, cortical cells 3- layered thick 8.
8. Teeth small and less (2-10) in number, trigones cordate *P. mundaliensis*.
8. Teeth coarse and numerous (28), trigones smooth (concave-sided) *P. accedens*.
1. Plants slender, small-medium-sized (upto 5 cm long), infrequently branched, branches typically lateral-intercalary type 9.
9. Leaves distantly arranged, dentitions numerous (24), small (upto 4 cells long), trigones smooth *P. chinensis*.
9. Leaves contiguous to imbricate, dentitions less in number (2-10), large (upto 7 cell long), trigones nodulose (much bulging) *P. richteri*.

The present study is based on a collection from Lilam to Bogdiyar (*alt. ca.* 1850-2450 m) available in LWU, and the type specimens of the taxa described were obtained (on loan) from the Conservatoire et Jardin Botaniques, Geneva (G), Farlow Herbarium, U.S.A. (F.H.), Hepaticae Asia, The Hattori Botanical Laboratory, Nichinan, Japan (NICH) for comparison with the West Himalayan plants.

TAXONOMIC DESCRIPTION

1. *Plagiochila phalangea* Tayl., *Lond. Journ. Bot.* 5: 264(1846); St., *Spec. Hepat.* 2 : 379(1906); Hatt. *FL.E.Himal.* 518(1966). Figures 1-12.



Figures 1-12: *Plagiochila phalangea* Tayl. 1. Male plant (Dorsal View). 2. Dorsal view of the plant (With perianth). 3. Ventral view of the plant. 4. T.S. of stem. 5,6. Leaves. 7. Apical cells of leaf. 8. Median cells of leaf. 9. Basal cells of leaf. 10-12. Male bracts.

Plants dark-brown to blackish-brown, large in size, 40-80(100)mm long and 2-4 mm wide (with leaves), rigid, erect, shoot apices sub-hamate or coiled, the basal 2/3 of the shoot, almost denuded because of the very caducous and fragmenting leaves. Branches irregular, frequent, pseudodichotomous- dichotomous in origin, as vigorous as leading stem. Stem deep-brown 17-19 cells across diameter, the cortical cells in 3-4 layers with very thickened and deep-brown walls usually tangentially flattened, the interior cells with pale-yellowish,

thin-walls. Leaves succubous, closely imbricate (the long-decurrent and juxtaposed dorsal leaf-bases hiding the stem), often all leaves (except near shoot apex), drooped off except for basal and sub-basal portion thus becoming denuded. Leaves strongly revolute, before fragmentation, broadly triangular-sub-triangularly ovate-oblong, 1.5-3.5 mm long and 1.3-2.0 mm wide, dorsal margin long decurrent at base, ventral margin moderately to short decurrent, marginal teeth coarse, spinose or triangular-acuminate, large, 15-20 in number, (1) 2-4 cells wide at base, 4-6(-8) cells long, the apical cells nearly as long as wide, 10-15 x 12-20 μm , middle cells of leaf 20-28 x 25-30 μm , and those of leaf base elongated (30) 35-45 x 40-50 μm , trigones large, nodulose. Underleaves absent.

Dioecious. Androecia intercalary or terminal, 2-3 in number, bracts closely imbricate in 6-10 pairs, with 2-5 small teeth. Female plants not seen.

Locality: Lilam to Bogdiyar, District Pithoragarh, Western Himalayas, India.

Range: India-Eastern Himalayas -Sikkim, Western Himalayas- Lilam to Bogdiyar; Nepal.

Specimens examined : FH- ? Herbarium of Thomas Taylor, *Plagiochila phalangea* Tayl. (as *Jungermannia*), Loc: Nepal, Date: 1820, Leg. : Wallich. LWU 9662/88, 9663/88, 9668/88: *P. phalangea* Tayl., Loc.: Lilam to Bogdiyar, *alt. ca.* 1850- 2450m (Western Himalayas), India, Date : 18.6.88, Habitat : On soils in association with *Metacalypogeia sternifolia*, *Jungermannia* sp. and *Scapania* sp., Leg.: D. Sharma, Det.: S.C. Srivastava and Renu Dixit.

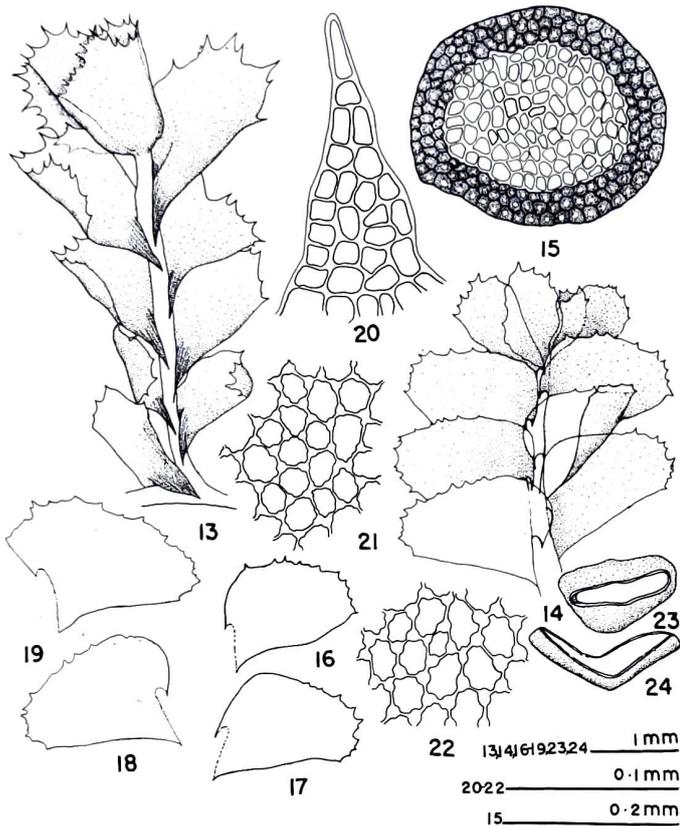
Discussion: *Plagiochila phalangea* Tayl. was instituted by Taylor (1846) from Nepal and subsequently known from Eastern Himalayas (Hattori, 1966). Its occurrence in Western Himalayas extends its range of distribution within the Indian subcontinent although it still maintains endemic nature.

Plagiochila phalangea is an extremely sharply defined and distinctive species, which can hardly be confused with other species of the genus, except perhaps *P. subsymmetrica* St., known from Darjeeling (Eastern Himalayas). Both the species resemble each other, in having moderately imbricate leaves with dorsally long decurrent bases, broadly triangular leaf shape, rather regularly toothed margin of leaves and nodulose trigones, but differ from each other in nature of leaf. The former (*P. phalangea*) has fragmented leaves (all leaves except near the shoot apex) drooped off except for basal and sub-basal portion thus resulting in a denuded aspect, and profusely branched, while the latter (*P. sub-*

symmetrica) has leaves which are not fragile, but persistent and rarely branched.

2. *Plagiochila gollanii* St., *Spec. Hepat.* 2 : 368(1906); Carl, *Ann. Bryol. Suppl.* 2 : 108 (1931); Inoue, *J. Hattori bot. Lab.* 23: 29, (1960). Figures 13-24.

Syn.: *P. makinoana* Hatt., *J. Jap. Bot.* 26 : 179 (1951); Inoue, *J. Hattori bot. Lab.* 20 : 71, (1958).



Figures 13-24: *Plagiochila gollanii* St. 13. Dorsal view of the plant (with perianth). 14. Ventral view of the plant. 15. T.S. of leaf. 16-19. Leaves. 20. Apical cells of leaf. 21. Median cells of leaf. 22. Basal cells of leaf. 23, 24. T.S. of perianth (from middle and basal region, respectively).

Plants pale yellowish-green, medium or rather robust in size., 30-50(60) mm long 2.5-3.5 (4.0) mm wide (with leaves). Branches rarely developed exclusively lateral, intercalary, axillary branches usually as vigorous as leading stems. Stem thick, pale to bright brown, 12-15 cells across diameter, cortical cells in 2-3 layers with thickened and pale brown walls, medullary cells pale yellowish and with thin -walls. Leaves succubous, loosely to closely imbricate, obliquely spreading, revolute and decurved along entire dorsal margin, some time postically secund, ovate-oblong, 2.5-2.9 mm long and 1.9-2.7 mm wide, dorsal margin long decurrent at base or slightly convexly arched, fragmented only at base, marginal teeth 8-12 (15), broadly triangular, as wide as long, 4-6 cells long and 2-3 cells wide at base; apical cells 13-20 x 18-22 μ m, medium cells 23-30 x 30-35

μ m and basal cells 25-35 x 35-50 μ m, trigones medium-large, triangular, acute or sometimes nodulose (especially at the base). Underleaves absent.

Dioecious. Gynoecia terminal on shoot, with 1-2 innovations; bracts similar to leaves in shape, broadly oblong, 1.6-2.3 mm long and 1.1-1.6 mm wide, toothed along entire ventral margin to distal half of dorsal margin, teeth much stronger than those of leaves, 1-3 cells wide at the base and (2) 3-5 cells long. Perianth abovate, about 1.6 mm wide and 2.5 mm long, mouth bilabiate, arched, margin spinosely dentate, teeth (2) 3-6 cells wide at the base and 5-11 cells long, with acute terminal cells. Sporophyte and male plants not seen.

Locality : Lilam to Bogdiyar, District Pithoragarh, Western Himalayas, India.

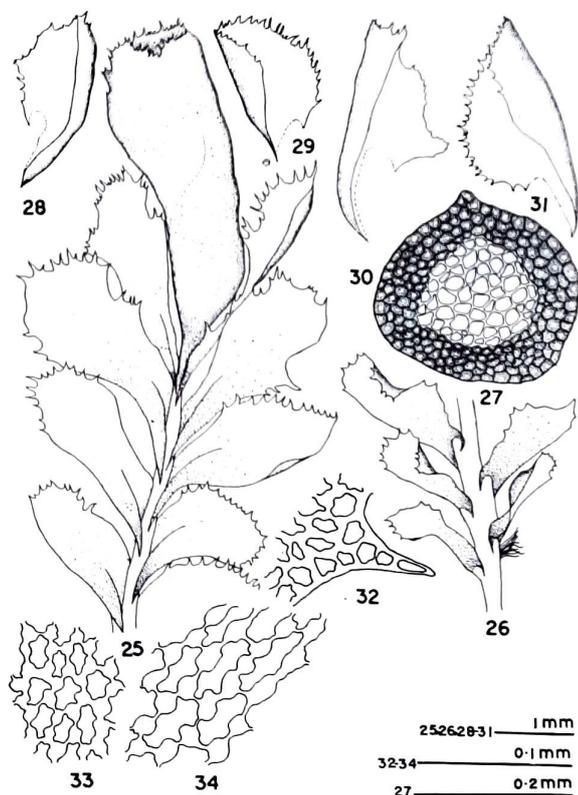
Range : India-Eastern Himalayas-Sikkim, Bengal, Western Himalayas-Mussoorie, Lilam to Bogdiyar, Punjab and Rajasthan plains - Punjab, Gangetic plains - Bengal; China-Formosa; Taiwan; Japan-Honshu, Shikoku, Kyushu; Nepal.

Specimens examined : G.3232 (TYPE), *Plagiochila gollanii* St., Loc.: Mussoorie (N.W.Himalaya), Date: 6 Dec. 1900, Legit: Bahadru; G. 327, *Plagiochila gollanii* St. Loc.: Mussoorie (6-7000), Dehradun (N.W.Himalaya), Date: Jan. 1892, Legit: J.T. Duthie; NICH 358805/77, 358783/77, 358784/77, *P. gollanii* St., Himalayan Expedition of Chiba University, *alt.* ca 2430 m, on fallen tree in association with *P. fruticosa*, Loc.: E. Nepal, Coll.: S. Takiguchi; LWU 9827/88, 9828/88, 9829/88 9831/88, *P. gollanii* St., Loc.: Lilam to Bogdiyar, *alt.* ca 1850-2450m (W.H.) India, Date: 18.6.88, Habitat: on soil in association with *Metacalygopogea alternifolia*, *Jungermannia* sp. and *Scapania* sp., Leg.: D. Sharma, Det. : S.C. Srivastava and Renu Dixit.

Discussion: *Plagiochila gollanii* St. was recorded from Himalayas by Stephani (1906). This species approaches *P. ferruginea* St. in large and robust habit of plants, ovate-oblong leaves with regularly dentate margin, subfloral innovation (present in both species) and stem cortical cells, which are in 2-3 layers, but the latter differs from the former in shape of trigones [sub-cordate in *P. ferruginea* and smooth (at the base) or bulging in *P. gollanii*]. In the former species the leaves are fragmented at the base but in the latter the leaves are never fragmented.

P. gollanii is also similar to a Ceylonese species, *P. parvidentata*. However, the leaves of *P. parvidentata* are remote or rarely approximate, obliquely spreading and the underleaves are filiform, composed of 2-4 elongated cells, which are 2(-3) cells wide at the base.

3. *Plagiochila semidecurrans* (Lehm. et Lindenb.) Lehm. et Lindenb., in Lindenb., *Monogr. Hepat. gen. Plagiochilae* 142 (1844), *Jungermannia semidecurrans* Lehm., *Pug. Stirp nov.* 4 : 21 (1831); *P. hirsuta* Nees (in Sched.); *P. kamounensis* Tayl., *Lond. Journ. Bot.* 5 : 262 (1846); *P. semidecurrans* var. β *major* Lindenb., *Monogr. Hepat. gen. Plagiochilae* 142 (1844); *P. yuennanensis* St., *Mem. Soc. Nat. Math. Cherbourg* 29: 255 (1844); *P. longicalyx* St., *Spec. Hepat.* 2 : 336 (1906); *P. grossivittata* St., *Spec. Hepat.* 6 : 161 (1924); *P. schauliana* Schiffn., *Spec. Hepat.* 6: 210 (1924); *P. semidecurrans* var. *undulata* Carl., *Ann. Bryol. Suppl.* 2: 98(1937); *P. semidecurrans* f. *undulata* (Carl.) Inoue, *J. Hattori bot. Lab.* 20 : 81 (1958); *P. nidulans* Herz., *Ann. Bryol.* 5 : 23, f.1 (1932); *P. semidecurrans* var. *grossidens* Herz., *Hedwigia* 78 : 241 (1938); *P. semidecurrans* subsp. *grossidens* (Herz.) Schust., *Amer. Midl. Nat.* 62 : 268 (1959); *P. semidecurrans* var. *yakusimensis* Hatt., *J. Hattori bot. Lab.* 3 : 29 (1948); *P. sharpii* subsp. *yakusimensis* (Hatt.) Schust., *Amer. Midl. Nat.* 62: 274 (1959); *P. robustissima* Horik., *J. Sci. Hiroshima Univ., Ser. B,* 1 : 78 (1932). Figures 25-34



Figures 25-34: *Plagiochila semidecurrans* (Lehm. et Lindenb.) Lehm. et Lindenb. 25. Dorsal view of the plant (with perianth). 26. Ventral view of the plant. 27. T.S. of stem. 28-31. Leaves. 32. Apical cells of leaf. 33. Median cells of leaf. 34. Basal cells of leaf.

Plants dark-brown or brownish-black, in compact patches, medium or robust in size, (30)40-60 (80) mm long and (2.5)3.5-5.0 (6.0)mm wide; vegetative branches

rarely developed (often absent), if present exclusively lateral-intercalary. Stem deep brown, about 20 cells across the diameter; stem cortical cells in 4-5 layers with thickened and dark brown walls, with indistinct trigones, medullary cells pale yellowish, thin-walled with trigones. Leaves succubous, closely imbricate, ventrally secund, dorsal margin revolute and recurved long decurrent along dorsal stem mid line (about half or more of dorsal stem surface covered with leaf bases), ventral margin short decurrent margin of leaf wavy on the ventral side, leaves broadly ovate or ovate-oblong, suborbicular when flat, 1.5-3.0 mm long and 1.8-2.2 mm wide, rather regularly toothed throughout (or some times except for basal 1/3), apex rounded, teeth on margin of leaf usually (20)30-40 (45) in number irregular in size; terminal cells 15-18 x 15-20 μ m, cells of leaf middle 20-28 x 22-35 μ m trigones large, nodulose, cells of the base forming distinctly differentiated basal vitta, 22-30 x (50)60-75 (80) μ m; walls moderately to distinctly thickened, trigones subnodulose, much bulging. Rhizoids present on ventral and lateral sides, colourless. Underleaves absent.

Dioecious. Gynoecia terminal on shoot, bracts suborbicular, 2.5-3.0 mm long and 2.2-2.8 mm wide, margins minutely toothed than those of leaf. Perianth large, campanulate, 4.0-6.0 mm long and 2.0-3.0 mm wide, mouth bilabiate rather regularly spinose-dentate.

Locality: Lilam to Bogdiyar, District Pithoragarh, Western Himalayas, India.

Range: India-Eastern Himalayas-West Bengal-Darjeeling, Sikkim, Kurseong, Western Himalayas-Lilam to Bogdiyar, Kumaon; South India -Kudremukh; Ceylon; Nepal; China- Formosa, Taiwan, Yunnan; Mt. Daibusan; Philippines; Mt. Puloglove; Japan-Mt. Koya; Thailand; Western North America.

Specimens examined : G.284, *Plagiochila semidecurrans* (Lehm. et Lindenb.) Lehm. et Lindenb., Loc.: Nepal, inter *Ptychanthus striatum*, Herb. : Hooker, Kurz. NICH 358658/77, 358732/77, 358832/77, 358638/77, 358766/77. 358782/77, 358779/77, 358848/77, 359060/77. *P. semidecurrans* (Lehm. et Lindenb.) Lehm. et Lindenb, Himalayan Expedition of Chiba University alt. 2820- 3400m, On forest floor, Loc.: E. Nepal, Apr. 18, 1977-June 3, 1977., Coll.: S. Takiguchi; G. 010742, 010744, *P. longicalyx* St., Loc.: Sikkim- Himalaya Prope-Kurseong, (alt. ca. 1000m), 1897, Leg.: Tev., Bretandeu. G. 011002 (Type). *Plagiochila grossivittata* St., Loc. : Kudremukh, Date: April, 1911, Leg. : Pfliderer; LWU 9794/88, 9795/88, 9825/88, 9888/88, *P. semidecurrans* (Lehm., et Lindenb.) Lehm. et Lindenb., Loc.: Lilam to

Bogdiyar, alt. ca 1850-2450 m (W. H.), India, Date.: 18.6.88, Habitat: on soil, in association with *Jungernania* sp. and *Scapania* sp., Leg. : D. Sharma, Det.: S.C. Srivastava and Renu Dixit.

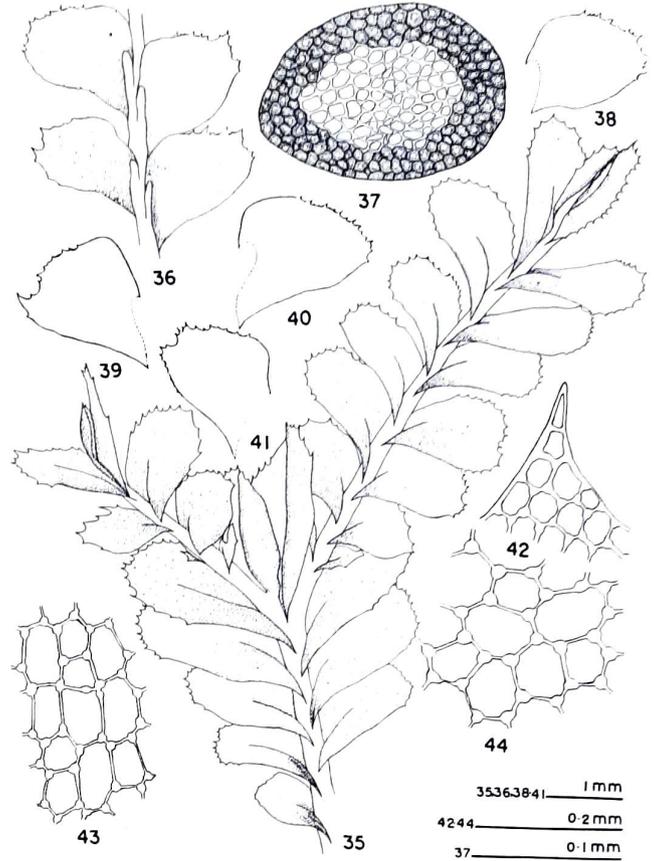
Discussion. : *P. semidecurrens* (Lehm. et Lindenb.) Lehm. et Lindenb. was originally described from Nepal and is well characterized by the large sized robust plants, mostly without branches, the oblong-ovate to suborbicular leaves with strongly and narrowly recurved spinose dorsal margin and vitta-like cells in the basal region of leaf.

A careful examination of the specimen of *P. longicalyx* St. (G. 010742, 010744) and *P. grossivittata* St. (G. 011002 Type) firmly confirmed the synonymy of *P. longicalyx* St. and *P. grossivittata* St. under *P. semidecurrens* as suggested by Inoue (1965).

P. semidecurrens is most distinctive species without any close allies in Western Himalayas. It somewhat resembles *P. asymmetrica* St. and *P. vittifolia* St. (of India), *P. sharpii* Blomquist (of U.S.S.R., Southern Appalachians) and *P. magna* Inoue (of Japan). In all the species leaf bases are distinctly vittate, and the plants are rarely branched with closely imbricate leaves and (25) 34-40(45) dentitions but the former can be convincingly differentiated from the latter four species in some important characteristics. *P. asymmetrica* possesses paraphyllia and the teeth are 2-4 cells long, while *P. semidecurrens* is without paraphyllia and the teeth are 2-7 (9) cells long. From *P. magna*, *P. semidecurrens* differs in leaf-shape (the former has triangular and more wider than longer leaves, while the latter has oblong-ovate and suborbicular leaves). *P. semidecurrens* differs from *P. sharpii*, in the absence of underleaves and unwinged perianth keel, the latter has however, minute underleaves and winged perianth keel. In *P. vittifolia* the trigones are absent in the apical leaf cells while in *P. semidecurrens* the apical leaf cells have well developed trigones.

4. *Plagiochila ferruginea* St., *Spec. Hepat.* 2 : 364(1906); Kashyap, *Liverworts of the Western Himalayas and the Panjāb Plain* 2; 72-73 (1932). Figures 35-44.

Plants yellowish-brown to brown, medium to large sometimes robust, 40-60(70) mm long and (3.5) 4-6 mm wide. Vegetative branches moderate in number, usually as vigorous as leading stem, branching lateral and ventral intercalary-type, apices of branches often attenuate, leaves become gradually smaller towards apices of branches. Stem brown or deep brown, about 15 cells across diameter, the cortical cells in 2-3 layers



Figures 35-44: *Plagiochila ferruginea* St. 35. Dorsal view of the plant. 36. Ventral view of the plant. 37. T.S of stem. 38-41. Leaves. 42. Apical cells of leaf. 43. Median cells of leaf. 44. Basal cells of leaf.

with very thickened and deep brown walls, medullary cells thin-walled. Leaves closely imbricate, succubous, dorsal margin weakly revolute (especially along basal half), narrowly recurved, long decurrent along dorsal stem midline, ventral margin short decurrent, ovate-oblong, 1.5-2.9 mm long and 1.3-1.5 mm wide, with 13-19(21) dentitions generally present on apical portion, dentitions slender and acuminate, 2-4(7) cells long and 2-4(5) cells wide; cells of leaf apex 15-20x20-25 μ m, median cells 20-28 (30) x 25-35 μ m and the cells at the base hardly elongated 24-33 (36) x 35-46 (50) μ m, trigones medium-sized-large, triangular and cordate. Underleaves absent.

Dioecious. Gynoecia usually terminal on very short (less often long) terminal branches (main axis often ending in a gynoeceium) with 1 or 2 innovations; bracts similar to leaves in shape, approximately 3.3-4.0 mm long and 2.0-2.4 mm wide, more coarsely and closely spinose dentate along ventral margin than on leaves. Perianth terminal, about 4-5 mm long and 1.1-1.5 mm wide (widest at sub-basal portion and becoming gradually narrower to the mouth where 0.6-0.8 mm wide). Mouth obliquely truncate, bilabiate, irregularly spinose-dentate. Male Plants and sporophyte not seen.

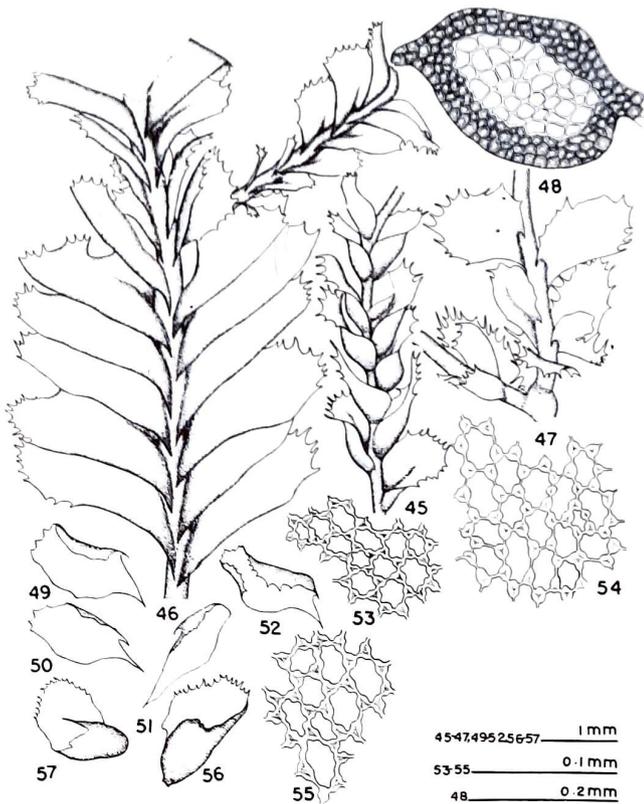
Locality : Lilam to Bogdiyar, District Pithoragarh, Western Himalayas, India.

Range : India-Eastern Himalayas -Darjeeling, Sikkim, Bengal, Western Himalayas - Dalhausie (Khajiar road), Mussoorie, Lilam to Bogdiyar; Nepal.

Specimens examined : G. 010999, *P. ferruginea* St., Loc. : Darjeeling (Sikkim), Ghoom (6800 ft), Date: 28 Oct. 1900, Legit: A.C. Hartless; G. 328. *P. ferruginea* St., Loc.: Dehradun, Mussoorie (6 - 7000ft) N.W. Himalaya, Date: 2 Jan. 1892, Legit: J.T. Duthie. LWU 9705/88, 9795/88, *P. ferruginea* St., Loc.: Lilam to Bogdiyar, alt. ca. 1850-2450 m (W.H.), India, Date: 18.6.88, Habitat: On soil in association with *Jungermannia* sp., Legit: D. Sharma, Det.: S.C. Srivastava and Renu Dixit.

Discussion : *Plagiochila ferruginea* St. was originally recorded from Himalayas (Sikkim) by Stephani (1906) and from Dalhausie and Mussoorie by Kashyap (1932). This species now commonly occurs both in the Eastern Himalayas and the Western Himalayas and is most closely related to *P. gollanii* St. another Himalayan species (as earlier discussed under *P. gollanii*).

5. *Plagiochila nana* var. *robusta* var. nov. Figures 45-57.



Figures 45-57: *Plagiochila nana* var. *robusta* var. nov. 45. Male plant (Dorsal view) . 46. Dorsal view of the plant. 47. Ventral view of the plant. 48. T.S. of stem. 49-52. Leaves. 53. Apical cells of leaf. 54. Median cells of leaf. 55. Basal cells of leaf. 56, 57. Male bracts.

Varietas diversus *P. nana* in planta plus-minus robusta, 4-6(8) mm longa et 4-5 (7)mm lata; ramificationes intercalares laterales; Folia caulina imbricates ovate- oblongus, margin anti codecurrento, pluridentato, dentibus 8-10 (15); trigonis nodulosis.

Plants pale yellowish- brown to dark-brown, medium -robust in size, 40-60 (80) mm long and 4-5 (7) mm wide. Sterile branches moderately frequent, always lateral - intercalary arising from lateral leaf axils. Stem dark-brown to blackish-brown, 17-19 cells across diameter, the cortical cells in (2) 3-4 layers with very thickened brown walls, the interior cells with thin pale yellowish walls. Leaves \pm closely imbricate nearly horizontally or obliquely spreading, ventrally recurved, ovate-oblong, usually as long as wide, variable in size, but usually 2.6-3.2 (4.0) mm long and 2.0-2.5 (3.2)mm wide, dorsal margin \pm long decurrent, ventral margin arched or nearly straight, slightly decurrent, marginal teeth 8-10 (15) in number, usually 2-3(4) long and 1-2 (3) cells wide at base; cells of leaf apex 18-20 x 22-25 μ m, leaf middle 23-28 x 28-35 μ m and of leaf base 20-25 x 40-50 (55) μ m, trigonous, trigones medium sized, nodulose. Underleaves absent.

Dioecious. Male plants branched, branches usually intercalary, inflorescences terminal and intercalary both, bracts 6-14 pairs, closely imbricate, strongly saccate at the base, margin with few teeth. Female plants not seen.

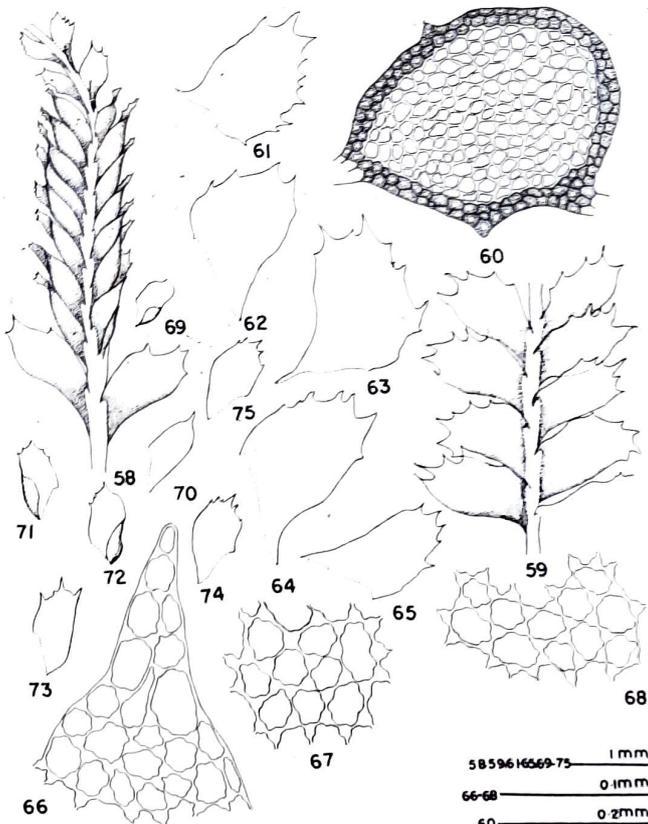
Locality: Lilam to Bogdiyar, District Pithoragarh, Western Himalayas, India.

Range: India- Western Himalayas-Simla, Lilam to Bogdiyar. Endemic to India.

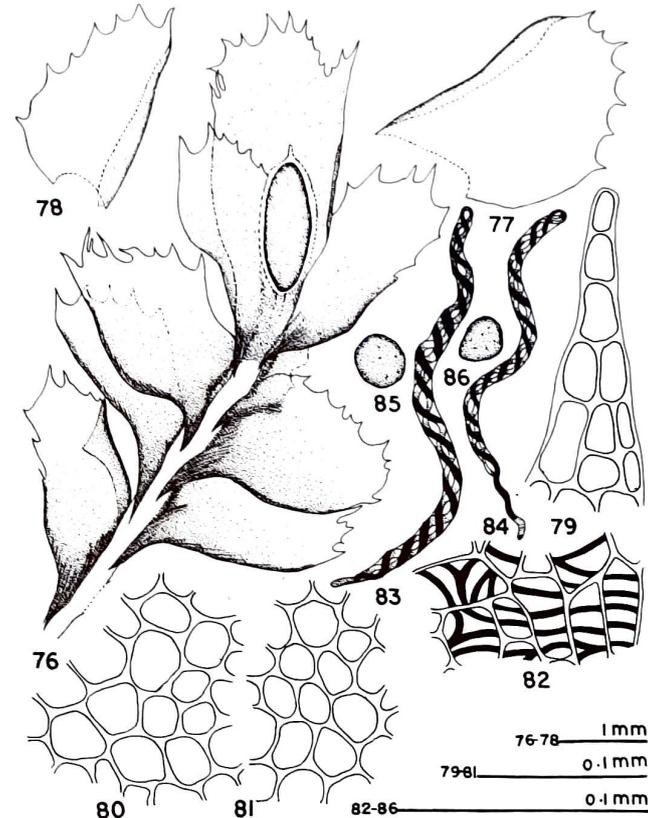
Specimens examined : G. 6161 (TYPE) *Plagiochila nana* St., Loc.: Simla, N.W. India, Habitat : on wet rocks, Date: Apr. 1908, Legit: E. Long; LWU 9804/88, 9805/88, *P.nana* var. *robusta* var. nov. Loc.: Lilam to Bogdiyar, alt. ca. 1850-2450m. (W.H.), India, Date: 18.6.88, Habitat : on soil in association with *Jungermannia* sp., Legit : D. Sharma, Det.: S.C. Srivastava and Renu Dixit.

Discussion : *P. nana* St. was recorded from Simla by Stephani (1921) and is closely related to *P. nana* var. *robusta* var. nov. but differs in the habit of plant and number of dentitions on leaf margin. The plants of *P. nana* are small-medium in size (20-40 mm in length and 2-3 (4)mm in width) with 4-8 dentitions which are 1-2(3) cells long and 1-2 cells wide at the leaf margin; while the plants of *P. nana* var. *robusta* var. nov. are medium-robust in size [40-60(80)] mm long and 4-5(7) mm wide and with 8-10(15) teeth which are 3-4(5) cells long and 1-2(3) cells wide at the leaf margin.

6. *Plagiochila vygensis* St., *Spec. Hepat.* 6 : 237(121). Figures 58-86.



Figures 58-75. *Plagiochila vygensis* St. 58. Male plant (Dorsal view). 59. Ventral view of the plant. 60. T.S. of stem. 61-65. Leaves. 66. Apical cells of leaf. 67. Median cells of leaf. 68. Basal cells of leaf. 69-75. Male bracts.



Figures 76-86. *Plagiochila vygensis* St. 76. Dorsal view of the plant (with Perianth). 77, 78. Female bracts. 79. Apical cells of leaf. 80. Median cells of leaf. 81. Basal cells of leaf. 82. T.S. of capsule wall. 83, 84. Elaters. 85, 86. Spores.

Plants erect or suberect, yellowish green to pale-brownish-green, medium, 30-40 (50) mm long and 2.0-2.8 (-3.5) mm wide. Vegetative branches frequent, always lateral intercalary. Stem dark-brown, thick, 17-20 cells across diameter, cortical cells in 2 layers, with very thickened brown-walls, medullary cells thin-walled. Leaves slightly imbricate, nearly horizontally or, slightly obliquely spreading, ovate-obcuneate, obovate, 3-5 mm long and 1.5-2.4 mm wide, dorsal margin nearly straight or slightly convexly arched, short decurrent, ventral margin not decurrent, usually with a few teeth, marginal teeth (4) 7-10 per leaf, very varied in size, spinose and triangular, acuminate, (3) 4-8 cells long and (1) 2-4 (5) cells wide at base, the terminal cell strongly elongated (22) 30-35 × 10-15 μm, middle cells 20-28(30) × 15-20 (25) μm and cells of the leaf base elongated 15-20(25)-(35) 40-50 μm, trigones medium-sized and triangular. Rhizoids and underleaves absent.

Dioecious. Male plants as vigorous as or little smaller than female plants, mostly 30-50 mm long and 2.5-3.0 mm wide, androecial branches 1-2 in number, bracts usually imbricate in 6-11 pairs, strongly saccate at dorsal portion, bearing 1-3(5) small teeth. Gynoecia terminal on leading main axis or on long vigorous branches, bracts oblong or oblong-ovate, usually 1.8-2.3 mm long and 1.3-1.5 mm wide, spinose - dentate along ventral margin to apex and distal half to dorsal margin. Perianth oblong, 3.5-6.0 mm long and 1.3-2.7 mm wide, mouth bilabiate, irregularly dentate, teeth 2-4 (5) cells long and (1) 2-3 cells wide at base. Spores light yellow, 16-18 μm in diameter, minutely papillate. Elaters 50-60 μm long and 7-10 μm wide, bispiral except at extremities where only unispiral.

Locality : Lilam to Bogdiyar, District Pithoragarh, Western Himalayas, India.

Range: India-Eastern Himalayas-Sikkim, Western Himalayas-Lilam to Bogdiyar, South India-Madura, Shembaganur. Endemic to India.

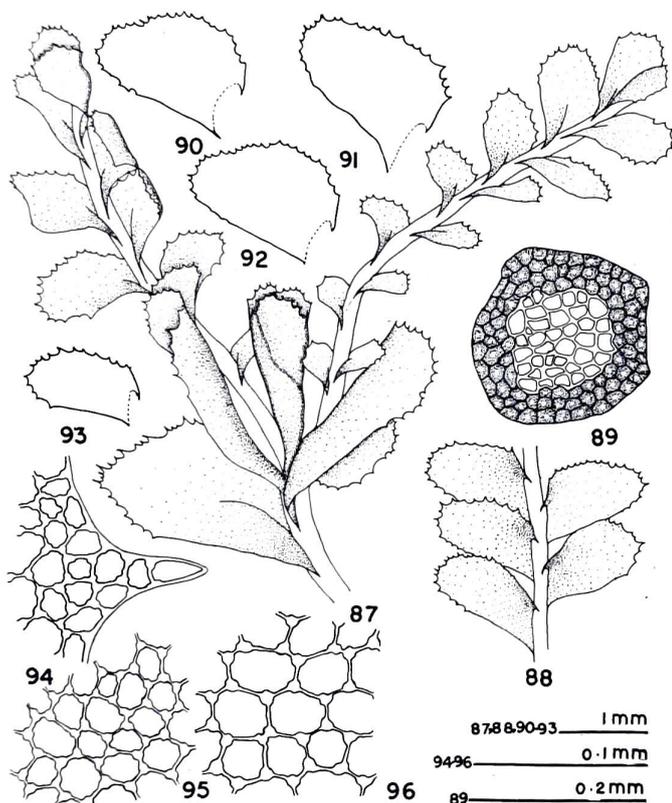
Specimens examined : G. 010958 (Type) *Plagiochila vygensis* St., Loc.: Shembaganur, Madura, British India, Leg.: Foreau; LWU 9832/88, 9834/88, 9835/88, Loc.: Lilam to Bogdiyar, alt. ca 1850-2450 m (W.H.), India, Date: 18.6.88, Habitat : on soils in association with *Scapania* sp., Legit: D. Sharma, Det.: S.C. Srivastava and Renu Dixit.

Discussion: *Plagiochila vygensis* St. was reported by Stephani (1921) from Shembaganur, Madura. Chopra (1943) listed it from Sikkim. *P. vygensis* St. earlier known from South India and Eastern Himalayas, has been now recorded from Western Himalayas (Bogdiyar to Lilam), thus extending its present range of distribution within

the country although it still maintains its endemic nature.

P. vygensis St. is very close to *P. mundaliensis* St. but it is distinct from the latter in leaf-shape (obovate-ovate-obcuneate in *P. vygensis*, and oblong-ovate in *P. mundaliensis*), length of dentitions on leaf margin (upto 7 cells long in *P. vygensis*, and upto 4 cells long in *P. mundaliensis*), and thickness of cortical cells (2-layered in *P. vygensis* and 3-layered in *P. mundaliensis*). The trigones are nodulose in the former and cordate in the latter.

7. *Plagiochila mundaliensis* St., *Spec. Hepat.* 2 : 340(1906); Kashyap, *Liverworts of the Western Himalayas and the Panjab Plain* 2: 71 (1932). Figures 87-96.



Figures 87-96. *Plagiochila mundaliensis* St. 87. Dorsal view of the plant (with perianth). 88. Ventral view of the plant. 89. T.S. of stem. 90-93. Leaves. 94. Apical cells of leaf. 95. Median cells of leaf. 96. Basal cells of leaf.

Plants pale green, caespitose flaccid, 30-50 mm long and 2-3 mm wide (with leaves). Vegetative branches sparsely branched, predominantly lateral -intercalary. Stem blackish - brown, 14-15 cells across diameter, the cortical cells in 3- layers, with thickened and deep-brown walls the interior cells with pale yellowish thin walls. Leaves loosely imbricate, but towards apex distantly arranged (Stem widely exposed dorsally and ventrally), often postically secund, ovate - oblong or

obovate-ovate -triangular, 2.0-4.0 mm long and 1.5- 2.5 mm wide, antical margin shortly decurrent, postical margin also slightly decurrent on stem, marginal teeth few, spinose or triangular-acuminate, 2-10 (15) in number, 1(-2) 4 cells long and 1-2(3) cells wide; cells of leaf apex 20-23 x 18-20 μm , cells of leaf middle 23-30 x (25) 30-40 μm , cells of leaf base 20-25 x 40-50 μm , wall thin throughout, trigones medium-sized to large, triangular, cordate. Underleaves absent.

Dioecious. Gynoecia terminal on short lateral branches, with 1-2 innovations, bracts oblong or oblong-ovate, 2.4-2.6 mm long and 1.8-2.1 mm wide; + inflated at the base, marginal teeth 7-10, more slender, (1) 2-4 (5) cells long and 2-3 (4) cells wide at the base. Perianth oblong, about 4-5 mm long and 1.1-1.5 mm wide, mouth truncate bilabiate, irregularly spinose -dentate. Male plants and sporophyte not seen.

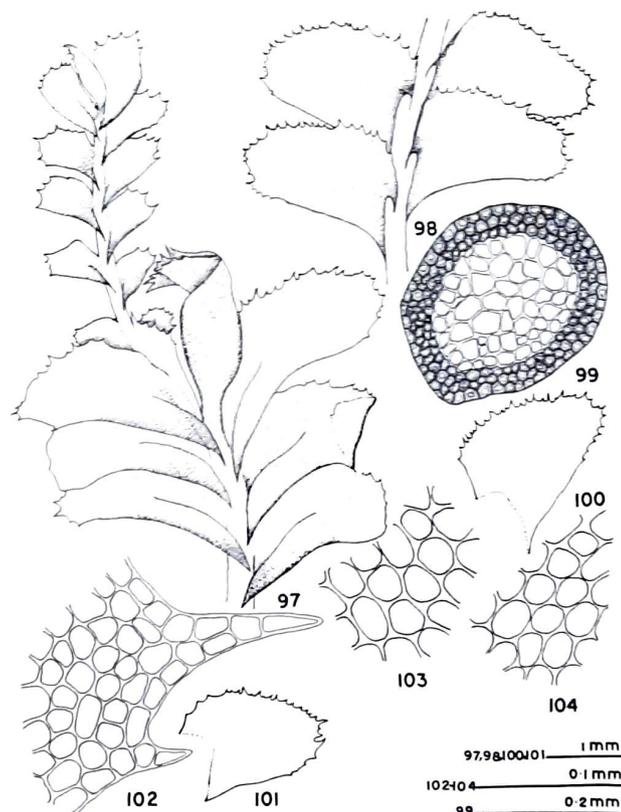
Locality: Lilam to Bogdiyar, District Pithoragarh, Western Himalayas, India.

Range: India-Western Himalayas-Mundali, Lilam to Bogdiyar, Eastern Himalayas -Sikkim. Endemic to India.

Specimens examined : G. 010966 (TYPE), *Plagiochila mundaliensis* St., Loc.: Mundali (8000), N.W. Himalaya, Date: 5/1892, Leg.: J.S. Gamble; LWU 9826/88, 9827/88, *P. mundaliensis* St. Loc.: Lilam to Bogdiyar, alt. ca 1850-2450 m (W.H.), India, Date: 18.6.88, Habitat: on soil in association with *Scapania* sp. and *Jungermannia* sp., Legit: D. Sharma, Det.: S.C. Srivastava and Renu Dixit.

Discussion : *Plagiochila mundaliensis* St. is reported from Mundali (Western Himalayas) (Stephani, 1906; Kashyap, 1932; Chopra, 1943; Kachroo, 1973), but its adequate details are not known so far. Its occurrence in Lilam to Bogdiyar indicates that the species is widely distributed in the Western Himalayas and that too at higher altitudes. *P. mundaliensis* is close to *P. accedens* St. in imbricate leaves, shortly decurrent antical base, oblong -ovate leaf-shape, upto 4 cells long marginal teeth and 3-layered cortical cells, but the latter differs in coarse and numerous dentitions at the leaf margin and smooth trigones (concave sided).

8. *Plagiochila accedens* St., *Spec. Hepat.* 2: 341(1906); Kashyap, *Liverworts of the Western Himalayas and the Panjab Plain* 2: 73 (1932). Figures 97-104.



Figures 97-104. *Plagiochila accedens*. 97. Dorsal view of the plant. 98. ventral view of the plant. 99. T.S. of stem. 100 - 101. Leaves. 102. Apical cells of leaf. 103. Median cells of leaf. 104. Basal cells of leaf.

Plants pale to bright-brown, medium to large (30)40-50 mm long and 2.5-4.0 (6.0) mm wide. Branches moderate in number, mostly of lateral intercalary-type, sometimes ventral intercalary also. Stem thick, deep-brown, 14-15 cells across the diameter, the cortical cells in 3 layers with extremely thickened bright-brown walls, the interior cells thin-walled. Leaves slightly imbricate never caducous, oblique to nearly horizontally spreading, dorsal margin shortly decurrent, ventral margin also shortly decurrent at the base, broadly ovate or ovate-oblong, 3.0-3.4 mm long and 1.4-2.4 mm wide, teeth numerous, about 28 in number, 2-4 cell long and 2-3 (5) cells wide; terminal cells acute, 10-15 x 20-25 μ m, cells of leaf middle usually 25-33 x (25) 30-38 μ m, those of base 25-35 x 40-45 μ m. Trigones medium-large, smooth, concave sided. Under leaves absent.

Dioecious. Gynoecia terminal with 1-2 innovations, bracts oblong-ovate, 2.5-2.9 mm long and 1.5-1.9 mm wide, margin rather regularly toothed throughout. Perianth large, 2.0-3.5 (4.5) mm long and 1.8-2.2 mm wide, mouth bilabiate, margin of the mouth more or less regularly toothed, teeth usually broad at the base, 3-4 cells wide at base and 4-6 cells long. Male plants and sporophyte not seen.

Locality: Lilam to Bogdiyar, District Pithoragarh, Western Himalayas, India.

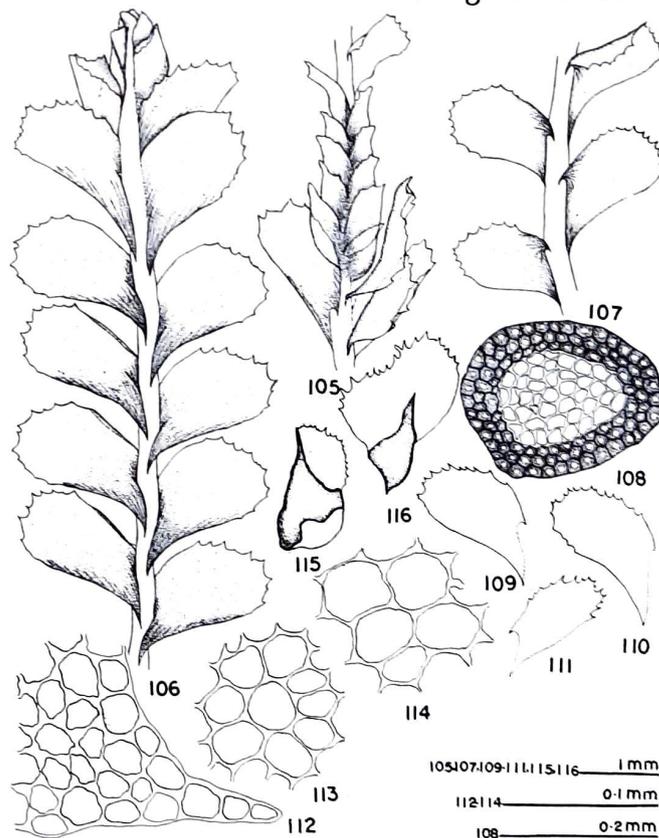
Range : India-Western Himalayas -Dalhausie, Garhwal, Mussoorie, Lilam to Bogdiyar; S. Andamans; Java.

Specimens examined : G. 001298, *Plagiochila accedens* St., Loc.: South Andaman, Leg.: Kurz; LWU 9823/88 9829/88, *P. accedens* St., Loc.: Lilam to Bogdiyar, alt. ca 1850-2450 m. (W.H.), India, Date: 18.6.88, Legit: D. Sharma, Det.: S.C. Srivastava and Renu Dixit.

Discussion : *Plagiochila accedens* St. was originally instituted from Java (Stephani, 1906). Kashyap (1932) reported it from Mussoorie, Garhwal and Dalhausie. Its occurrence in Lilam to Bogdiyar extends the range of distribution in the Western Himalayas.

P. accedens St. is very close to *P. mundaliensis* (as already discussed earlier under *P. mundaliensis*), but differs in the number of dentitions and nature of trigones. In the former species the dentitions on leaf margin are numerous (upto 28) and trigones are smooth (concave-side) while in the latter the dentitions on leaf margin are less in number (upto 10) and trigones are cordate.

9. *Plagiochila chinensis* St., *Mem. Soc. Sci. Nat. Math. Cherbourg*. 29 : 223 (1894); St., *Spec. Hepat.* 2 : 296 (1906); Hatt., *Fl.E. Himal.* 514 (1966). Figures 105-116.



Figures 105-116. *Plagiochila chinensis* St. 105. Male plant (Dorsal view). 106. Dorsal view of the plant. 107. Ventral view of the plant. 108. T.S. of stem. 109-111. Leaves. 112. Apical cells of leaf. 113. Median cells of leaf. 114. Basal cells of leaf. 115&116. Male bracts.

Plants pale brown -yellowish brown, medium, forming loose, often interwoven patches on rocks, 30-50 mm long and usually 1.8-2.4 (3.0) mm wide. Branches rare. Stem dark-brown, 9-13 cells across the diameter, the cortical cells in (1)2-3 layers with distinct thickened and brown walls, the medullary cells pale yellowish and with thin walls. Leaves distant (stem widely exposed dorsally and ventrally), widely spreading and sub horizontally oriented, ovate-obovate, oblong-ovate, 1.5-2.6 mm long and 1.1 -1.5 mm wide, dorsal margin long decurrent, strongly curved, ventral margin only slightly decurrent; marginal teeth small, 10-24 in number, 2-4 cells long and 1-2 cells wide at the base; apical cells small, 14-18 μm x 20-22 μm , median cells 17-24 x 22-28 μm and basal cells (25) 30-34 x 34-50(55) μm , trigones medium or large, nodulose, often confluent in the middle to basal portion of leaf. Underleaves absent. Male and female plants not seen.

Locality : Lilam to Bogdiyar, District Pthoragarh, Western Himalayas.

Range : India-Eastern Himalayas - Sikkim, Western Himalayas - Lilam to Bogdiyar, Pindari, Madhari, Kaphani, Namic; China-Formosa, Taiwan, Yunnan; Japan; E. Nepal.

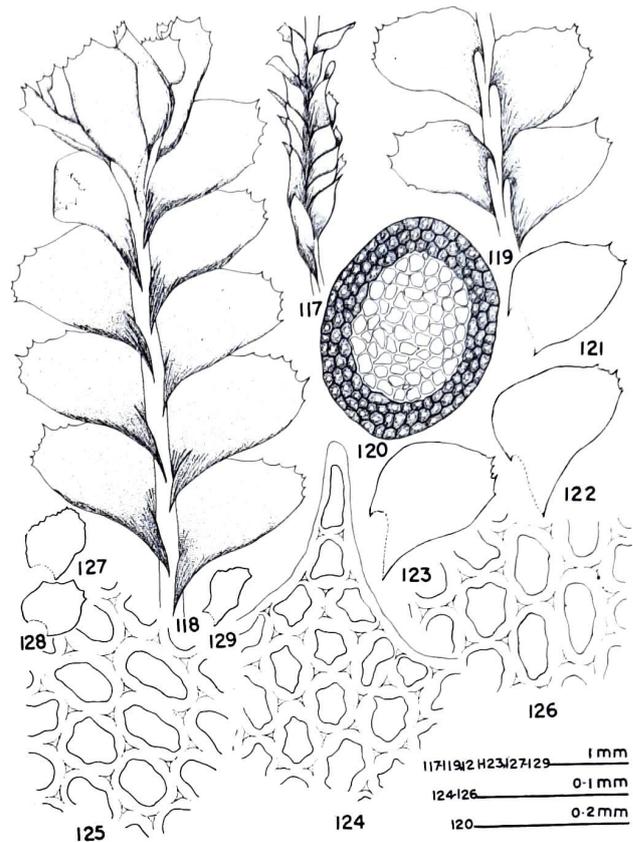
Specimens examined : G.198 (Type), *Plagiochila chinensis* St., Loc.: China (Yunnan, Tsang-Yang, Tchang), Date :24.5.1889; LWU 9839/88, *Plagiochila chinensis* St., Loc: Lilam to Bogdiyar, alt. ca 1850 2450 m (W.H.) India, Date : 18.6.88, Legit : D. Sharma, Det. S.C. Srivastava and Renu Dixit.

Discussion : *Plagiochila chinensis* St. was instituted by Stephani (1894) from China (see also Stephani, 1906). Hattori (1966) listed it from Eastern Himalayas. Tewari *et al.* (1993-94) listed it from Western Himalayas, but did not describe the details.

P. chinensis is very close to *P. nana* var. *robusta* in long decurrent antical margin of the leaf and numerous, small teeth (upto 4 cell long) on the leaf margin, but differs in the arrangement of leaf (*P. nana* var. *robusta* has imbricate leaves, while *P. chinensis* has distantly arranged leaves), the shape of leaf (obovate in the former and oblong-ovate in the latter) and nature of trigones (smooth in the former and nodulose in the latter).

10. *Plagiochila richteri* St. (MS) sp. nov.

Figures 117-129



Figures 117-129. *Plagiochila richteri* St.(MS) sp. nov. 117. Male plant (Dorsal view) . 118. Dorsal view of the plant. 119. Ventral view of the plant. 120. T.S. of stem. 121-123. Leaves. 124. Apical cells of leaf. 125. Median cells of leaf. 126. Basal cells of leaf. 127-129. Male bracts.

Planta (20) 30-50 mm longa et (2.5) 3-4 mm lata; culis pauciramosus, ramis intercalaribus; fola caulina imbricata obovata vel ovata, margin dorsali long decurrente, ventral margin parum decurrent, dentibus marginalibus 2-10, 2-5 (7) cellulas longis, trigonis magnis, nodulosis.

Plants green to dull green, (20) 30-50 mm long and (2.5) 3-4mm wide. Vegetative branches infrequent lateral intercalary. Stem bright brown 12-15 cells across the diameter, the cortical cells in 2-3 layers with thickened and often brown walls, the interior cells pale yellowish with thin-walls. Rhizoids often scattered on the ventral side throughout, but mostly restricted to lower portion of stem and flagella. Leaves \pm closely imbricate, sub-obliquely to obliquely spreading, obovate-ovate, ventrally recurved, (1.2) 1.6-2.0 (2.2) mm long and 1.2-1.6 mm wide, dorsal margin nearly straight or slightly arched, long dcurent, ventral margin straight short decurrent; marginal teeth 2-10 in number in some leaves only 2 teeth present (restricted at apex only); leaves present towards base of the stem without teeth, teeth usually 2-5 (7) cells long and (1) 2-3 cells wide; cells of leaf apex 14-20 x 22-28 μm , of leaf middle 20-28 x 30-35 μm , those of leaf base (25) 30-35 (37) x 40-60 μm , trigone large, nodulose. Underleaves absent.

Dioecious: Male Plants as vigorous as female plants or little smaller than female plants, androecia usually spicate and terminal, rarely intercalary; bracts in 5-9 (10) pairs, closely imbricate, somewhat yellowish or whitish brown, strongly involute along dorsal margin, margin entire to denticulate like leaves. Female plants not seen.

Locality : Lilam to Bogdiyar, District Pithoragarh, Western Himalayas, India.

Range : India ± South India, Western Himalayas -Lilam to Bogdiyar. Endemic to India.

Specimens examined: LWU 6046/81 (TYPE) *Plagiochila richteri* St. (MS) sp. nov., Loc. : Vagavurrai (S.I.), India, Date: 1.6.1981, Legit : U.S.A. and A.K., Det.: S.C.Srivastava and Renu Dixit; LWU 9806/88, 9807/88, *Plagiochila richteri* St. (MS) sp. nov., Loc. : Lilam to Bogdiyar, alt. ca. 1850-2450m (W.H.), India, Date: 18.6.88, Legit:" D.Sharma, Det.: S.C. Srivastava and Renu Dixit.

Discussion: *Plagiochila richteri* St. (MS) sp. nov. is a manuscript species of Stephani, who reported it from India orientalis, based on the collection made by Pfeleiderer. It is illustrated in Stephani's Icones but not included in his world monograph on the genus *Plagiochila*. Stephani's Icones 5118/31 shows the structure of a leaf illustrated from the type specimens which correctly represents the feature of this taxon. Pande *et al.* (1949) also reported this species from South India (See also Parihar 1961-62, Parihar *et al.* 1994 and Dixit, 1995). The plants of *Plagiochila* discovered in the collection from Lilam to Bogdiyar (W.H.) clearly typify the characters of *P. richteri* illustrated in Stephani Icones.

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