

GENUS *CEPHALOZIA* IN EASTERN HIMALAYAS

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ABSTRACT

In the present paper five species of *Cephalozia* have been described. Except *C. gollani* St. (an earlier described species), four new species viz., *C. darjeelingensis*, *C. pandei*, *C. laxifolia* and *C. indica* have been described from eastern Himalayas.

INTRODUCTION

In India the genus *Cephalozia* has so far been represented by the following five species: *C. andreana* St. from Madura (STEPHANI, 1924), *C. willisana* St. from South India, *C. gollani* St. from Darjeeling (STEPHANI, 1908) as well as from western Himalayas (KASHYAP & CHOPRA, 1932), *C. herzogiana* Pande and Srivastava from Pachmarhi (PANDE & SRIVASTAVA, 1955) and *C. himalayana* Schiffn and Pande (MS) from eastern Himalayas (PARIHAR, 1961-1962). Of these, *C. andreana* St. and *C. willisana* St. are conspecific and should belong to *Cephaloziella willisana* (St.) Kitagawa (KITAGAWA, 1969). The validity of *Cephalozia herzogiana* Pande and Srivastava is also doubtful as the plants approach *Cephaloziella* in their overall features and should now be known as *Cephaloziella herzogiana* (Pande and Srivastava) comb. nov. *Cephalozia himalayana* is only a manuscript species and would await critical investigation for finally settling its status. In the present state of our knowledge only *Cephalozia gollani* is known from India as the sole representative of the genus *Cephalozia*.

The plants of *Cephaloziella* as well as *Cephalozia* are very small and are not only difficult to identify but also liable to be overlooked in the field. It appeared extremely surprising that there should be only one species of *Cephalozia* for a large sub-continent as India. This doubt proved true by a careful examination of the plants recently collected from Darjeeling in the eastern Himalayas. There are atleast five clear-cut species of *Cephalozia* in this area which have been investigated in detail in the present study.

The genus *Cephalozia* is characterised by its small-sized plants with bilobed leaves usually obliquely inserted on the axis, lacking underleaves and with large leaf cells having uniform thickness. The branches are ventral. The female inflorescence occurs on short ventral branch or is terminal on the main axis. The stalk of the antheridium is biseriate. The seta has four inner and eight outer rows of cells. The gemmae are unicelled. The genus *Cephaloziella*, on the other hand, is characterised by comparatively longer plants with bilobed leaves generally transversely inserted on the axis and with underleaves usually present. The leaf cells are small and thick walled. The branches are mostly lateral. The female inflorescence is terminal on the stem or on elongated branches (cladogynous). The stalk of the antheridium is uniseriate. The seta has four small inner and four large outer rows of cells. The gemmae are mostly bicelled.

Key to the East Himalayan species of *Cephalozia*

1. Leaves closely arranged on stem. Cortical cells in 12 longitudinal rows.....2
 2. Stem flattened, medullary cells slightly thickened. Leaves sub-orbicular with much connivent lobes. Gemmae not known.....*C. gollani* St.
 2. Stem spherical, medullary cells thin walled. Leaves not sub-orbicular. Lobes not connivent, slightly preading. Gemmae present....*C. darjeelingensis* sp. nov.
1. Leaves distantly arranged on stem. Cortical cells not in 12 longitudinal rows.....3
 3. Stem flattened, cortical cells in 8 longitudinal rows, medullary cells yellowish and thick walled. Gemmae spherical.....*C. pandei* sp. nov.
 3. Stem spherical, cortical cells varying in number, medullary cells not pigmented, thin walled. Gemmae unknown.....4
 4. Cortical cells and medullary cells varying, leaf lobes connivent, 3-4 cells wide at base. Sinus descends 1/2 of the leaf length....*C. laxifolia* sp. nov.
 4. Cortical cells in 5 longitudinal rows, leaf lobes spreading, only 1-2 cells wide at base. Sinus descends 1/5—1/4 of the leaf length.....*C. indica* sp. nov.

TAXONOMIC DESCRIPTION

1. ***Cephalozia gollani*** St. (Text-figs. 1-5)

Description—Plants small, yellowish green to yellowish brown, 5.00—10.00 mm long, 700—890 μm wide including leaves, prostrate, sparsely branched, branches ventral, delicate, with smaller leaves. Stem in cross section 126-220 μm in diameter, more or less flattened. Cortical cells large in 12 longitudinal rows, varying in size usually 23-70 μm in diameter, thin walled, medullary cells numerous, small, 20-36 μm in diameter, slightly thick walled. Leaves closely (succubously) to slight distantly and nearly longitudinally inserted on the stem, spreading, sub-alternate, sub-orbicular, 392-450 μm long and 400-500 μm wide, bilobed; sinus descending 1/5-1/4 of the leaf length, rounded. Lobes small, acute, connivent end with single row of two cells, usually 2-3 cells wide at base. Underleaves absent. Leaf cells large polygonal, thin walled, pellucid, 35-90 μm long and 20-65 μm wide, without trigones. Rhizoids simple, sparsely scattered on ventral surface of stem. Gemmae unknown. Sporophyte not available.

The description of *C. gollani* St. is based on the study of the type specimen No. G 13501 collected by A. C. HARTLESS from Senchal Range, Darjeeling in October, 1900.

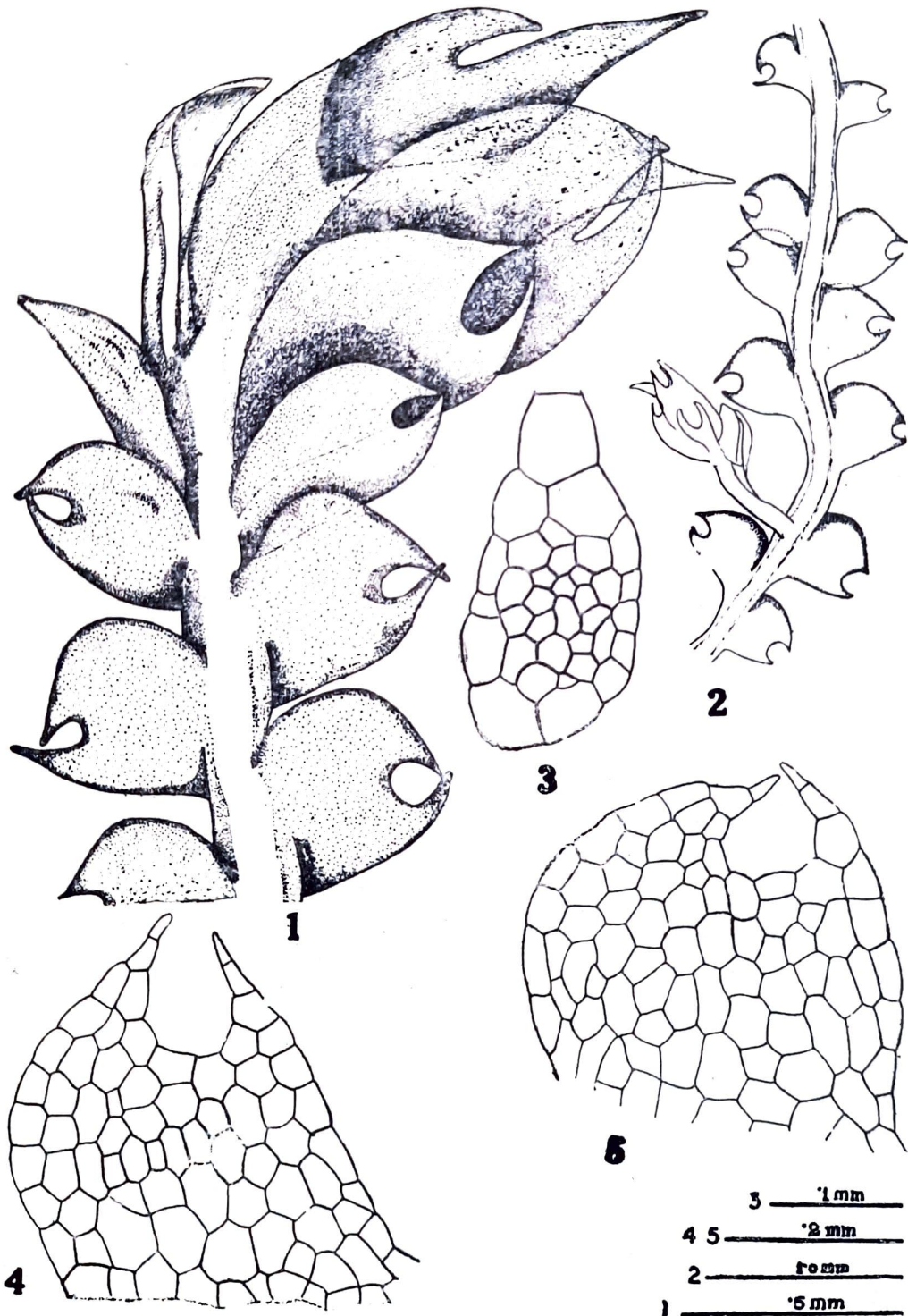
Characteristics of the species:

1. Plants small with more or less flattened stem.
2. Cortical cells in 12 longitudinal rows, medullary cells comparatively thick walled.
3. Leaves closely (succubously) and longitudinally inserted, orbicular to sub-orbicular with more or less rounded sinus, descending 1/5-1/4 of leaf length.
4. Bracts very large, usually bilobed or sometimes trilobed.
5. Gemmae absent.

2. ***Cephalozia darjeelingensis*** sp. nov. (Text-figs. 6-21)

Diagnosis—Plantae parvae; caulis cylindricus, cellulis corticalibus in series longitudinales 12 dispositis, cellulis medullosis tenuitunicatis; folia dense in caule ordinata, lobis non conniventibus, leniter patentibus; gemmae praesentes, unicellulares, oblongae.

Description—Plants small, greenish white to greenish yellow, 4.00 mm—12.00 mm long, prostrate, sparsely branched, branches ventral, delicate. Stem, 113.96—142.45 μm in diameter, cortical cells in 12 longitudinal rows, thin walled, 33.4—57.1 μm in diameter, those towards dorsal surface having larger cells while those on ventral surface with smaller cells. Medullary cells numerous, small, 24.0—50.0 μm in diameter, thin walled. Leaves in two rows, simple, bilobed, closely (succubously) arranged, sub-alternate to opposite, asymmetrical ovate to broadly ovate, always longer than wide, 183.15—313.39 μm long and 138.38—252.34 μm wide, widest at middle and become slightly narrower at the distal end, obliquely inserted, lying in a single plane. Sinus in the leaf descending $1/3$ — $1/2$ of the leaf length, slightly rounded to oval shaped, leaf lobes not connivent, acute and four celled high, base of the lobe 3-4 cells wide, cells of the leaf thin walled, large, pellucid,



Text-figs. 1-5. *Cephalozia gollani* St., 1. Plant showing larger bracts at the apex, 2. A portion of plant showing leaves, 3. Cross section of the stem, 4-5. Leaves.

leptodermous, non trigonous, 36.63—48.84 μm long and 20.35—36.63 μm wide; underleaves absent. Rhizoids simple, sparsely scattered on ventral surface of the stem. Dioecious; plants with antheridia not represented. Archegonia terminal either on main axis or on branch axis, protected by large bracts, bracts usually bilobed, rarely trilobed, 1.00—1.2 mm long and 0.85—1.00 mm broad, erect; cells thin walled, large, similar to leaves, sinus descending up to $3/4$ of the length. Perianth 2.00—2.2 mm long, yellowish white, cylindrical fusiform, trigonous above, the mouth hyaline, irregularly lobate, margin more or less smooth, surface smooth. Capsule oblong oval, 0.6—0.8 mm long and 0.5 mm broad, black. Spores 12-15 μm , elaters, smooth yellowish brown with broad ends having two to three spirals. Capsule wall two layered. Outer layer with nodulated thickening bands and inner layer with semi-annular transverse thickening bands. Seta 0.13—0.17 mm in diameter with 4 central and 8 peripheral cells. Gemmae terminal, on main shoot or short postical branches, oblong, unicelled.

Holotype—Type specimens deposited in Lucknow University Hepatic Herbarium. Collection of Liverworts from eastern Himalayas No: 255 A. *Cephalozia darjeelingensis* sp. nov. (female plants). *Loc.* Lebong road, Darjeeling (ca. 6000 ft.), eastern Himalayas, India. *Leg.* R. Udar and Dinesh Kumar. *Date* 31.12.69. *Det.* R. Udar and Dinesh Kumar, 1974.

Ecology—The plants of *Cephalozia darjeelingensis* grow in small tufts in association of *Lophocolea*, *Plagiochila*, *Scapania*, *Jungermannia* in very shady and moist condition on the soil over rock surface.

Characteristics of the species:

1. Plants small, white to yellowish green.
2. Leafy axis is spherical with 12 vertical rows of peripheral cells.
3. Numerous postical shoots having gemmae at their terminal ends; gemmae are oblong and unicelled.
4. Sinus of the leaf descending $1/3$ - $1/2$ of the leaf length.
5. Perianth cylindrical fusiform with mouth irregularly lobate.
6. Bracts bi- to trilobed.
7. Spores 12-15 μm long.

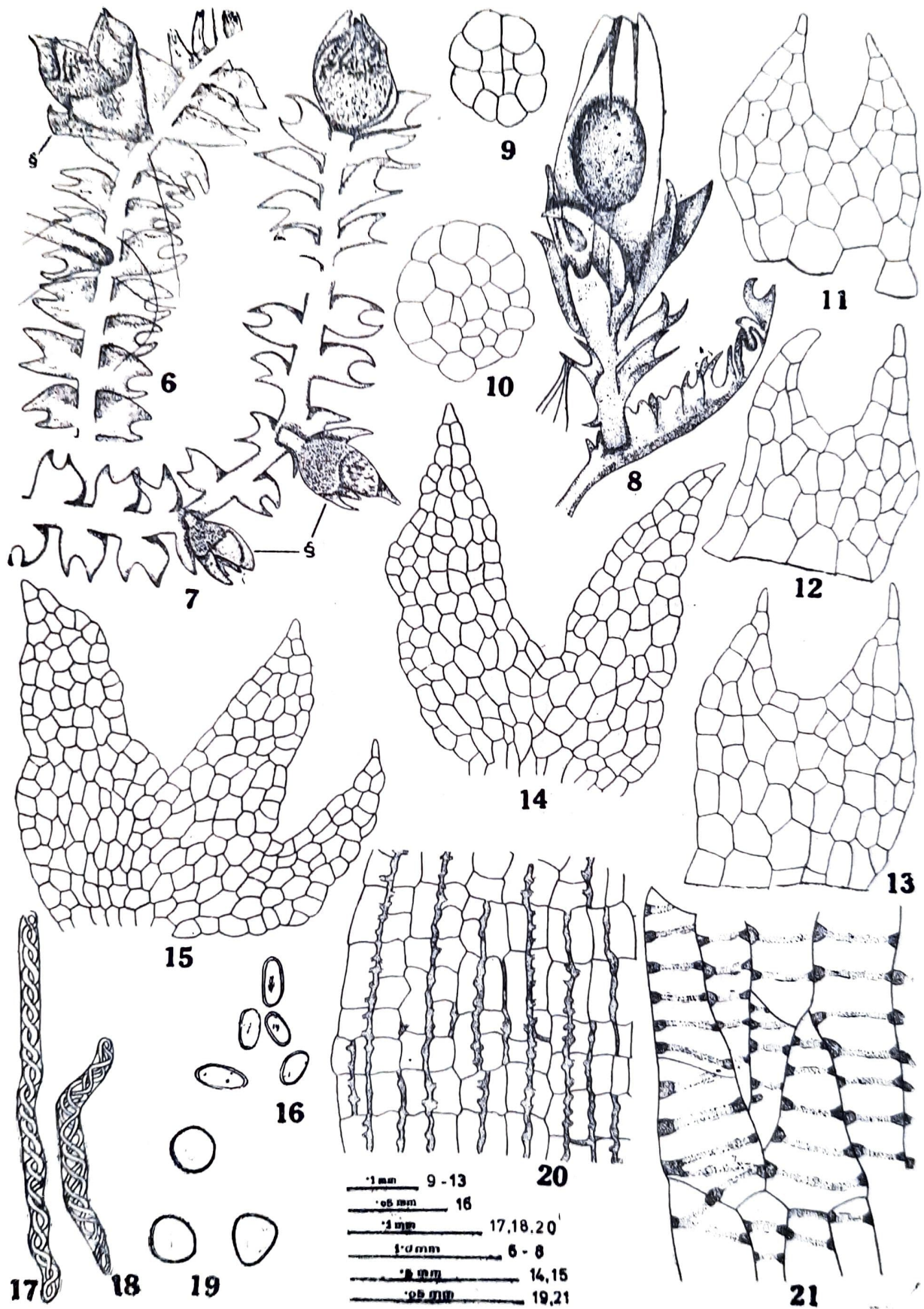
Discussion—*C. darjeelingensis* sp. nov. is closely related to *C. gollani* St. in the spherical stem with 12 longitudinal rows of cortical cells, but differs in not having orbicular to sub-orbicular leaves which is the unique and most striking feature of *C. gollani*. Leaf lobes in *C. darjeelingensis* are not so connivent as they are in *C. gollani* where they form a rounded sinus which descends only $1/5$ of the leaf length against *C. darjeelingensis* where sinus descends $1/3$ - $1/2$ of leaf length. Besides the leaf shape, *C. darjeelingensis* also has oblong gemmae which are absent in *C. gollani*.

3. *Cephalozia pandei* sp. nov. (Text-figs. 22-24)

Diagnosis—Plantae pervissimae; caulis applanatus, cellulis corticalibus in series longitudinalibus 8, medulla pigmentifera flavidula crassitunicata; folia non dense in caule disposita, parva, lobis non conniventibus; gemmae praesentes, sphaericae, unicellulares.

Description—Plants small, 7.00—9.00 mm long, yellowish brown, not forming patches, sparsely branched, branches ventral, delicate. Stem 73.26—101.75 μm wide, flattened, cortical cells in 8 longitudinal rows, large, thin walled, non-pigmented, larger than wide, 20.0—60.0 μm long and 26.6—50.0 μm wide, medullary cells smaller, pigmented, thick walled,

pentangular, more or less iso-diametrical, 16.6—30.0 μm in diameter. Branches with lesser dimension than the stem, 61.05—73.26 μm in diameter and bear normal leaves. Leaves distantly arranged on stem, alternate, simple, bilobed, broadly quadrate or quadrately ovate, uniformly on the axis, 223.85—329.67 μm long and 162.80—199.43



Text-figs. 6—21. *Cephalozia darjeelingensis* sp. nov., 6-7. Plants from ventral view, showing short gemmiferous branches (g), 8. Plant with a perianth showing capsule, 9. Cross section of the seta, 10. Cross section of the stem, 11—13. Leaves, 14-15. Bracts (bilobed and trilobed), 16. Gemmae, 17-18. Elaters, 19. Spores, 20. Outer layer of the capsule wall, 21. Inner layer of the capsule wall.

μm wide, slightly narrower at apex. Sinus descending $1/2$ of the leaf length, obtuse or rounded, lobes rarely connivent, usually slightly diverging, mostly single row of three cells, sometimes lobe base is two cells wide. Leaf cells large, thin walled, leptodermous, non trigonous, middle cells $24.42\text{--}48.84\ \mu\text{m}$ long and $24.42\ \mu\text{m}$ wide, marginal cells $48.84\ \mu\text{m}$ long and $14.24\text{--}20.35\ \mu\text{m}$ wide. Leaf insertion oblique, lying in a single plane. Underleaf absent. Rhizoids few on ventral surface of axis. Spherical unicelled gemmae on shoot apex. Sterile.

Holotype—Type specimens deposited in Lucknow University Hepatic Herbarium: Collection of Liverworts from eastern Himalayas No: 40 D. *Cephalozia pandei* sp. nov. (Sterile plants). *Loc.* In the vicinity of Senchal Lake, Darjeeling (ca. 7000 ft.), eastern Himalayas, India. Leg. R. Udar and Dinesh Kumar. Date 2.1.70. Det. R. Udar and Dinesh Kumar, 1974.

Ecology—Plants of *C. pandei* grow in association of *Jungermannia*, *Scapania* and other species of *Cephalozia* on very moist soil.

Characteristics of the species:

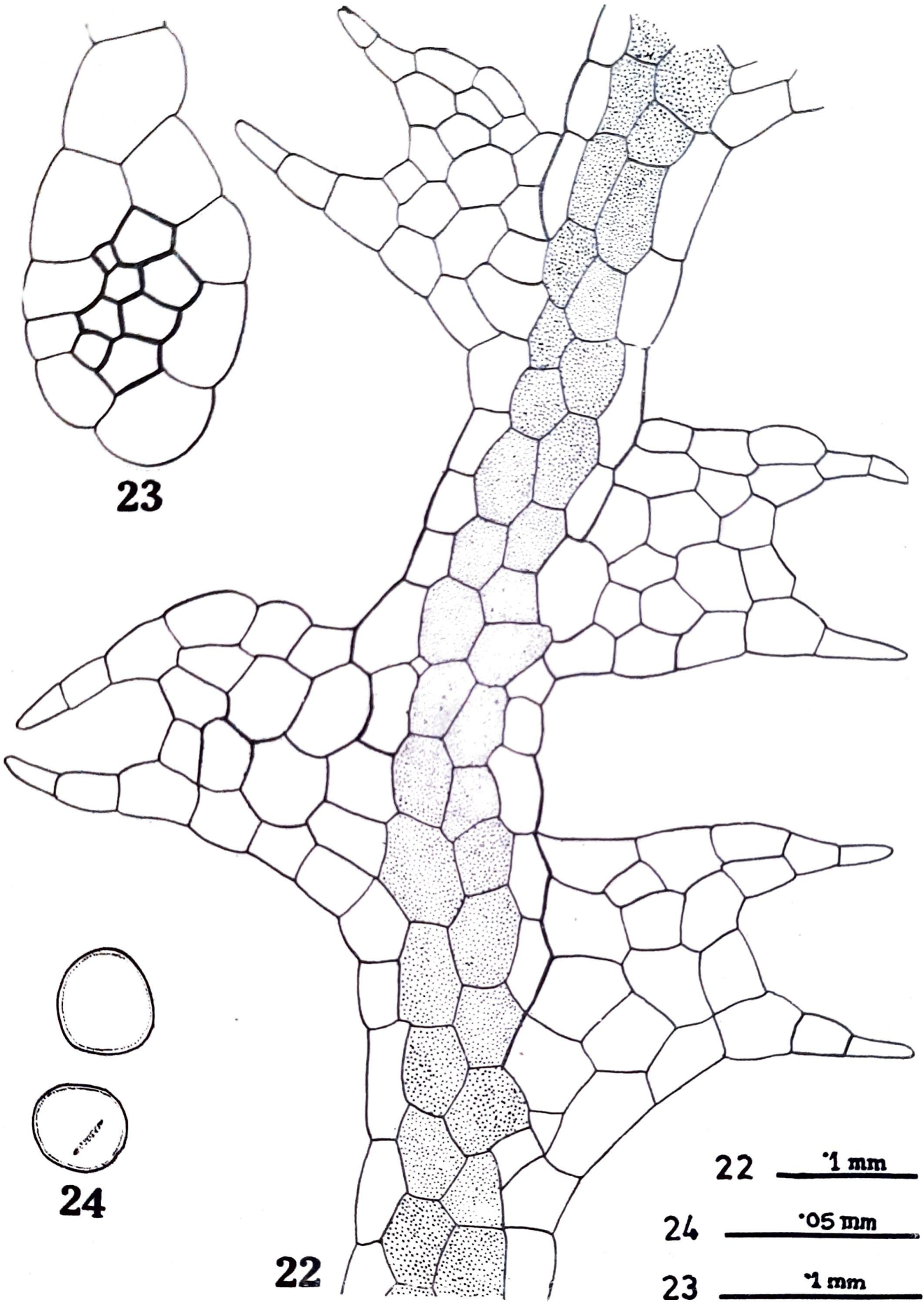
1. Plants small, yellowish brown.
2. Stem flattened with 8 longitudinal rows of cortical cells; medullary cells smaller, pigmented, thick walled.
3. Leaves small, broadly quadrate; sinus descending $1/2$ of the leaf length. Lobes only 3 cells high.
4. Spherical unicelled gemmae at the shoot apex.

Discussion—*Cephalozia pandei* is a highly characteristic species absolutely distinct from *C. gollani* St. and *C. darjeelingensis*. This species has flattened stem with 8 longitudinal rows of cortical cells and numerous pigmented medullary cells and broadly quadrate small leaves which are entirely different from those of the latter two species. The leaf lobes in this species are only 3 celled high and usually with a base single to two celled wide with the sinus descending $1/2$ of leaf length and obtused. In *C. gollani* and *C. darjeelingensis*, on the other hand, the leaf lobes and the sinuses are entirely different.

4. *Cephalozia laxifolia* sp. nov. (Text-figs. 25-36)

Diagnosis—Plantae parvae, dense ramosae; caulis cylindricus, cellulis corticalibus et medullis variabilibus, tenuitunicatis; folia in caulibus dissita, lobis conniventibus, ad basim 3-4-cellulis latis; sinus usque ad $1/2$ longitudinis folii descendens; gemmae ignotae.

Description—Plants large, pale green, delicate, $7.00\text{--}16.00\ \text{mm}$ long, prostrate, much branched, branches postical, delicate, thin, becoming flagelliform, $6.00\text{--}8.00\ \text{mm}$ long and $24.42\text{--}48.84\ \mu\text{m}$ wide. Stem $93.61\text{--}134.00\ \mu\text{m}$ in diameter, cortical cells in eight longitudinal rows, thin walled, cells larger towards dorsal surface, smaller towards ventral, $33.3\text{--}75.0\ \mu\text{m}$ in diameter; medullary cells thin walled, several and $13.3\text{--}33.3\ \mu\text{m}$ in diameter. Axis anatomically highly variable, young plants with five to six longitudinal rows of cortical cells of which three dorsal cells are larger and three ventral cells are smaller. Branches with small leaves show six longitudinal rows of cortical cells with three medullary cells in the centre. Flagelliform branches with very minute leaves show cortical cells only in 5 longitudinal rows and medullary cell is only one, thus has variable axis and branch anatomy in the same plant. Leaves on main axis distantly arranged, alternate, ovoid to obovoid, obliquely inserted, longer leaves towards base, smaller ones in the middle and smallest at the apex, $154.66\text{--}358.16\ \mu\text{m}$ long and $32.56\text{--}211.64\ \mu\text{m}$ wide. Sinus de-



22 1 mm

24 0.05 mm

23 1 mm

22

24

23

Text-figs. 22—24. *Cephalozia pandei* sp. nov., 22. A portion of the plant, 23. Cross section of the stem, 24. Gemmae.

scending 1/2-2/3 of leaf length, obtuse; leaf lobes connivent, 4-celled high and 3-4 cells wide at base. Leaf cells large, thin-walled, leptodermous, middle cells 32.56—61.05 μm long and 28.49—32.56 μm wide while marginal cells 40.70—61.05 μm long and 20.35—28.49 μm wide. Young plants and branches have small leaves, bilobed, sinus descending 3/4 of leaf length, lobes narrow, long, flagelliform branches with very small, linear often one or two celled leaves. Gemmae absent. Sterile.

Holotype—Type specimens deposited in Lucknow University Hepatic Herbarium, Collection of Liverworts from eastern Himalayas No. 40D.24. *Cephalozia laxifolia* sp. nov. (Sterile plants). *Loc.*: In the vicinity of Senchal lake, Darjeeling (ca. 7000 ft.), eastern Himalayas, India. Leg. R. Udar and Dinesh Kumar. Date 2.1.70. Det. R. Udar and Dinesh Kumar, 1974.

Ecology—Plants of *C. laxifolia* grow in association of *Jungermannia*, *Scapania* and *Cephalozia pandei* on the shady and moist rocky soil.

Characteristics of the species:

1. Plants large and copiously branched, branches becoming flagelliform.
2. The presence of a great degree of variation in the anatomy of axis of mature plant, young plant and branches.
3. Leaves distantly arranged on the stem, ovoid to obovoid; sinus descends 1/2-2/3 of leaf length. Leaf lobes not diverging but connivent, four cells high and 3-4 cells wide at the base.
4. Gemmae not present.

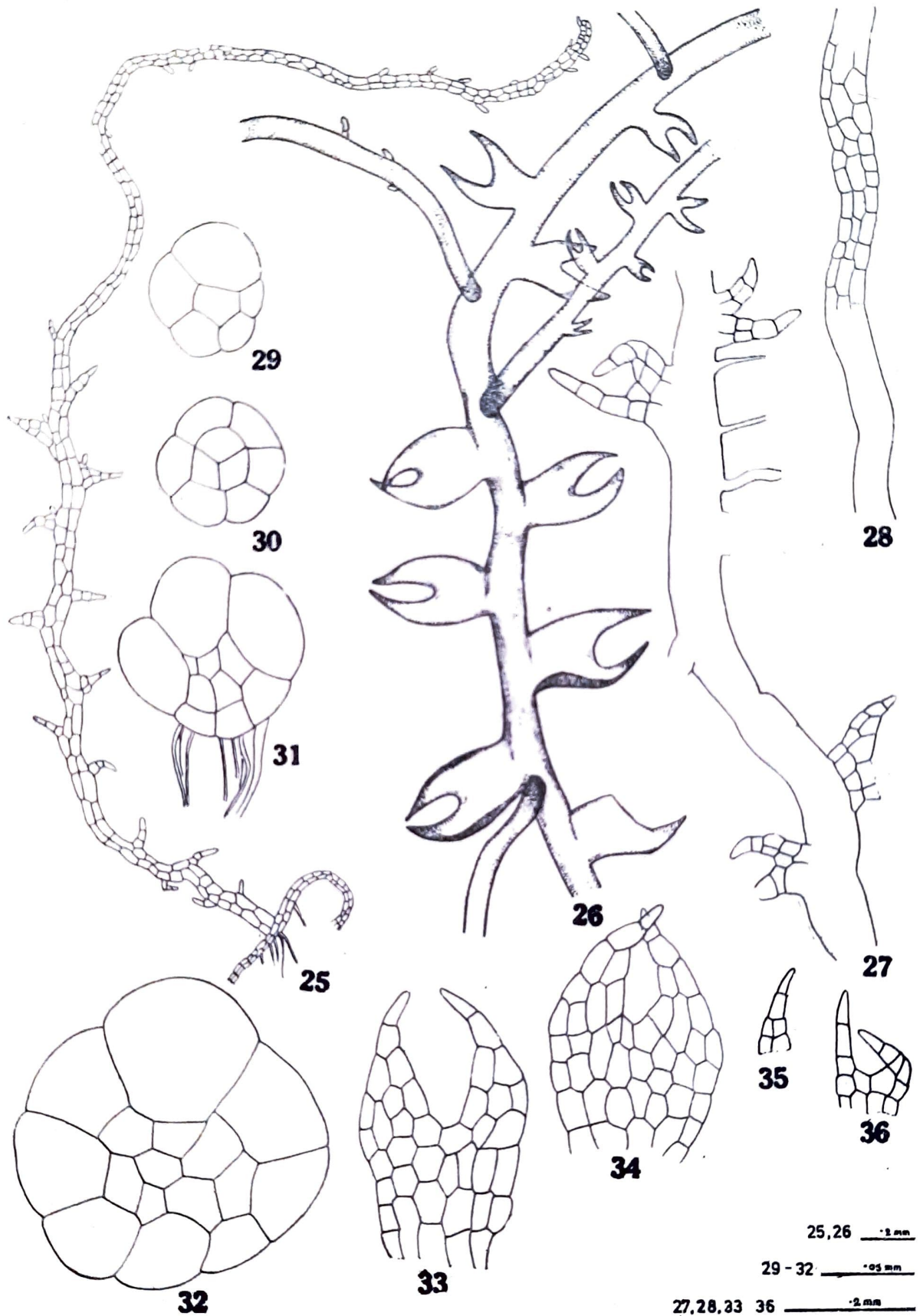
Discussion—*Cephalozia laxifolia* is a distinct species from *C. gollani* and *C. pandei* but approaches *C. darjeelingensis* in some features of the leaves. In both the species leaf lobes are more or less similar but in *C. laxifolia* the lobes are usually connivent while in *C. darjeelingensis* they are not connivent and slightly diverging. *C. laxifolia* has much branched stem with distantly arranged leaves and lacking gemmae while *C. darjeelingensis* has stem which isched with leaves closely arranged and having oblong unicelled gemmae.

5 *Cephalozia indica* sp. nov. (Text-figs. 37-42)

Diagnosis—Plantae parvae; caulis cylindricus, cellulis corticalibus in series longitudinales 5 dispositis, tenuitunicatis; folia parva, lobis patentibus, 2-3-cellulis altis, ad basim 1-2 cellulis latis; sinus 1/5-1/4 longitudinis folii descendens; gemmae ignotae.

Description—Plants small, whitish green to yellowish green, 6.00—8.00 (—10.00) mm long, growing sparsely, rarely branched. Stem 73.26—93.61 μm wide, cortical cells in five longitudinal rows, thin-walled, 15.0—38.3 μm in diameter, medullary cells usually only one or two, thin walled, 16.6—21.6 μm in diameter. Branches ventral, delicate, 65.12—69.19 μm wide having similar anatomy as of the stem. Leaves distantly arranged on stem, alternate to subalternate, small, variable in shape in some plants, lower leaves larger than the upper, in others the upper leaves larger than the lower. Small leaves linear to rectangular, 48—84 μm wide, larger leaves ovoidal, widest at its lower 1/4 portion, narrower at its distal end, 93.61—284.90 μm long, 65.12—162.80 (—180.15) μm wide at middle and base and 52.91—81.40 μm wide at the distal portion, always longer than wide, bilobed. Sinus descending only 1/4 of the leaf length, neither obtuse nor rounded but angular, lobes not connivent but diverging, short, only 2-3 cells high and 1-2 cells wide at base. Leaf cells thin walled, leptodermous, nontrigonous, marginal cells 52.91—56.98 μm long and 16.28—

20.35 μm wide; median cells 44.77—52.91 μm long and 32.56—36.63 μm wide. Underleaves absent. Gemmae absent. Sterile.



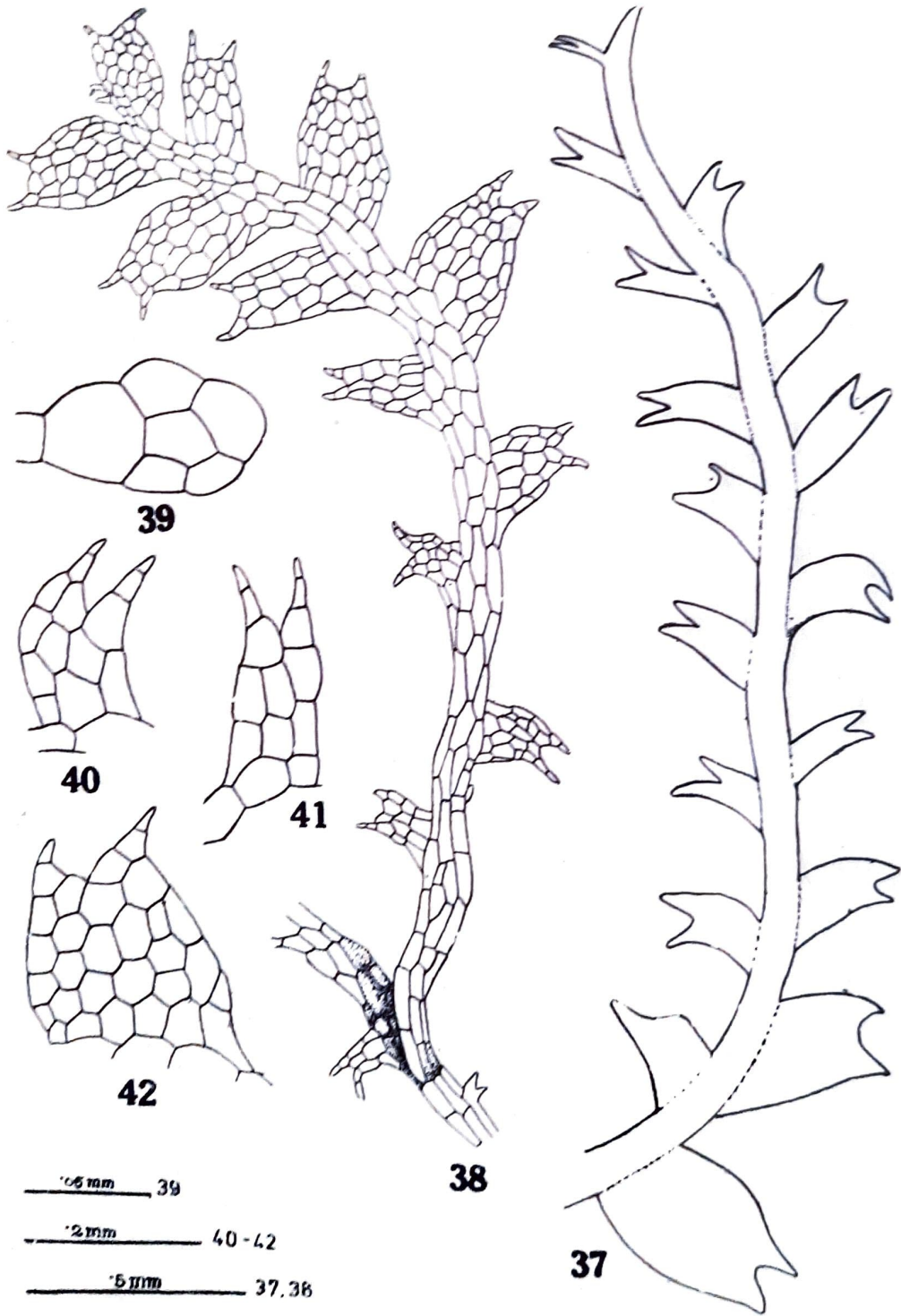
Text-figs. 25—36. *Cephalozia laxifolia* sp. nov., 25. Flagelliferous branch with very minute leaves, 26. Plant with many ventral branches, 27-28. Portions of young plants, 29. Cross section of a flagelliferous branch, 30. Cross section of the stem of young plant, 31. Cross section of the branch of main plant, 32. Cross section of the stem of main plant, 33-34. Leaves from main axis, 35. Leaf from flagelliferous branch, 36. Leaf from branch axis.

Holotype—Type specimens deposited in Lucknow University Hepatic Herbarium. Collection of Liverworts from eastern Himalayas No: 40D5. *Cephalozia indica* sp. nov. (Sterile plants). *Loc.* In the vicinity of Senchal lake, Darjeeling (ca 7000 ft), eastern Himalayas, India. Leg. R. Udar and Dinesh Kumar. Date. 2.1.70. Det. R. Udar and Dinesh Kumar, 1974.

Ecology—The plants of *C. indica* grow on the moist soil over rocks in association with *Lejeunea*, *Scapania* and *Jungermannia*.

Characteristics of the species:

1. Plants small and rarely branched.



Text-figs. 37—42. *Cephalozia indica* sp. nov., 37. Plant with smaller leaves towards upper portion of axis, 38. Plant with smaller leaves towards lower portion of axis, 39. Cross section of the axis showing five cortical cells and one medullary cell, 40-42. Leaves from axis.

2. The cortical cells of the stem only in 5 longitudinal rows with only one or two celled medulla.

3. Leaf size variable; in some plants lower leaves are larger while in other upper ones are larger. Leaf lobes are short and not connivent but diverging forming the angular sinus.

4. Gemmae absent.

Discussion—Only few plants were isolated from the mixture of associates. The formation of a tuft or a patch is not noticed in this species. Since the gemmae are absent, chances of vegetative propagation are considerably minimised. The presence of larger leaves either towards apex or towards base of the axis may be due to altered microecology of the litter. The portion of the axis bearing small leaves may be partially shaded or covered by other plants growing in its association. The uncovered portion of axis develops full grown leaves. The variable shape of leaves in *C. indica* with the typical sinus and lobes does not correspond to any of the species and is clearly distinctive.

ACKNOWLEDGEMENTS

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NOTE—*Cephaloziella herzogiana* (Pande et Srivastava) Udar et Kumar comb. nov. [Basionym—*Cephalozia herzogiana* Pande et Srivastava: Pande, S. K. and Srivastava, K. P., *Feddes Repert.* **58** (1/3): 75, 1955].