

Regular article

Leafy Hepatics from Regions of Western Ghats

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The present study reports ten taxa of leafy hepatics (Jugermanniales) viz. *Lejeunea cavifolia*, *L. flava*, *Taxilejeunea indica*, *Cololejeunea lanciloba*, *C. himalayensis*, *Ptycanthus striatus*, *Frullania ericoides*, *Jugermannia tetragona*, *Notoscyphus pandeii* and *Plagiochilla chopraii* from the ranges of Western Ghats lying in Maharashtra. These ten taxa belonged to eight genera under four families. The descriptions of each specimen, illustrations and localities of collection are presented. Among these *Cololejeunea lanciloba*, *C. himalayensis* are epiphyllous, *J. tetragona* is terricolous, while rest of them are corticolous.

Keywords: Amphigastria, *Cololejeunea*, *Lejeunea*, lobules.

Members of leafy Jugermanniales of bryophytes are characterized in having leafy thallus, along with specific numbers of neck canal cells (six) and high degree of sterile spores in the form of multispiral thickened elaters or elaterophores. Study of such fascinating group was first initiated by Mitten (1860, 1861) on anacrogynous Jugermanniales from different localities in India. Further, exhaustive study was followed by Stephani (1906, 1909, 1912, 1917, 1924) on Indian hepatics, in the form of voluminous work entitled "*Species Hepaticarum*". Sizeable work entitled "Liverworts of Western Himalayas and Punjab Plains" was carried out by Kashyap (1929, 1932), who recorded some new genera such as *Sewardiella tuberifera* Kash., thereafter Chopra (1938, 1943) had made a survey of Indian hepatics and reported *Nowellia orientalis* from Eastern Himalayan region. The school of Prof. Ram Udair has made an excellent monographic work on the group Jugermanniales, such as Kumar, A. (1970) on Notoscyphoideae, Awasthi (1982) on Ptycanthoideae, Nath, V.

(1971) on Frullaniaceae and Agarwal (1986) on Lejeuneaceae. Extensive studies were also carried out by Hattori S (1978) on the asiatic species of genus *Frullania*, while Asthana and Srivastava (2003) reported a taxonomic studies on Indian *Cololejeunea*, Alam *et al.* (2009) reported new species of *Jugermannia* from Nilgiri hills of Western Ghats and Pradhan (2014) reported three new species of *Jugermannia* from Nepal in the Eastern Himalayas.

The reviews of several studies on Jugermanniales in India indicate that very little attention has been focused on thalloid and leafy hepatics of Western India. Mahabale (1966) reported the occurrence of epiphyllous taxa namely *Leptocolea lanciloba* from Khandala – Mahabaleshwar region. Joshi and Biradar (1984) listed some new members such as *Jugermannia tetragona* Lindenb., and *Ptycanthus striatus* (Lehm. and Lindenb.) Nees. from western ghats. Besides these reports, there is an overall lack of studies on Jugermanniales of Western India.

Therefore, an attempt has been made to carry out an extensive taxonomic reinvestigation of leafy hepatics from different localities viz Matheran, Lonavala, Khandala, and Panhala fort in the ranges of Western Ghats in Maharashtra. During the survey, after a critical study of the collected material, ten species belonging to eight genera of Jungermanniae have been recorded.

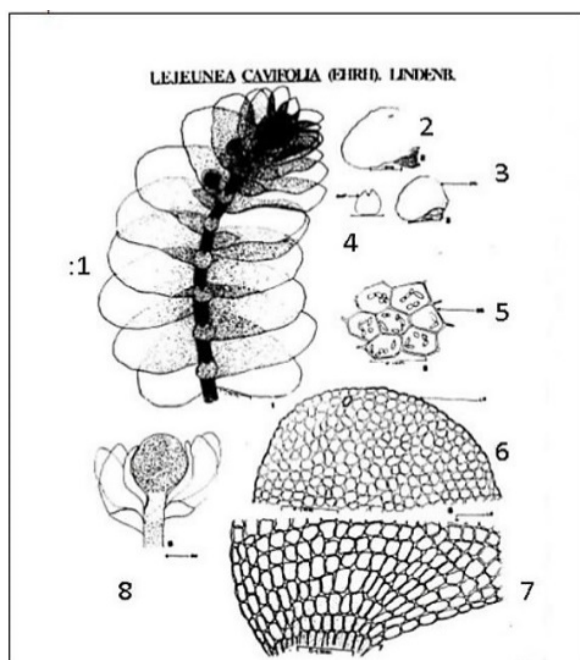
MATERIALS and METHODS:

For the study, materials have been collected from different localities of Western ghats viz Lonavala, Khandala, Mahabaleshwar, Kanakavli, Panhala Fort, Sinhagad Fort and Purandhar. The collections were deposited in the Herbarium of Botany department,

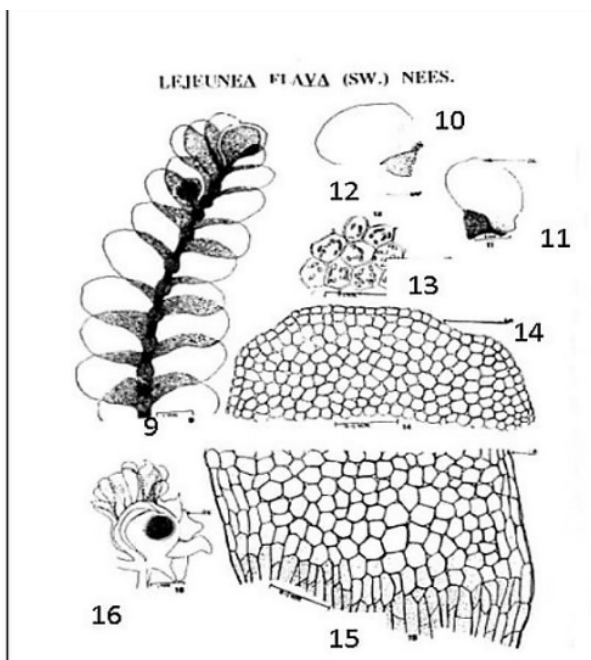
Lucknow University, Lucknow. Investigation on the nature of oil bodies was made from freshly collected specimens. Measurements of at least 20 counts with help of micrometer and sketches were made using Camera Lucida. Rare specimens were preserved in form permanent slides.

RESULTS AND DISSCUSSION: In the present investigation, ten species belonging to eight genera of Jungermanniae were recorded as follows:

Genus *Lejeunea* Libert (family Lejeuneaceae; sub family Lejeuneoideae) is represented by two species: *L.cavifolia* (Ehrh) Lindenb. and *L. flava* (Sw.) Nees.



PlateNo:1(TextFigs:1-8)LEJEUNEA CAVIFOLIA
:1.entire plant x 50, 2.dorsal leaf basal side, 3.dorsal leaf apical side, 4.amphigastria x 50,5.oil bodies,6. leaf apexcell x 400, 7. leaf base cell x 400, 8. male inflorescence.



PlateNo:2(TextFigs:9-16).L.FLAVA:9. entire plant x 50,10.dorsal leaf basal side,11.dorsal leaf apical side,12.amphigastria x 50,13.oil bodies,14.leaf apexcell x 400,15.leaf base cell x 400,16.male inflorescence.

1. *Lejeunea cavifolia* (Erhh). Lindenb. (PlateNo.1, Text Figs: 1-8): The specific name *cavifolia* has been derived from the word "cavi" meaning cavet or shield like. Plants

were pale green, growing on the bark of the tree (corticolous) in association with *Metzgeria himalayensis* Kash. and moss viz. *Stereophyllum*

tavoyense. This species is distinguished by the following characters:

i) Irregular pinnate branching ii) Under leaves (Amphigastria) with more width than length, Sinus wide; iii) Homologous oil bodies.

Distribution: Recorded on the bark of *Ficus benghalensis* tree on the way to Ambenali ghats (Fitzgerald ghats) at Mahabaleshwar and pipe line at Khandala.

2. *Lejeunea flava* (Sw.) Nees.(sub family Lejeuneoideae) (Plate No.2,Text Figs:9-16): The specific name of *Lejeunea flava* (sw.) Nees have been derived from word flava meaning flavescent, having yellow or yellow- green spots mingled with normal green surface. These are Pale green, corticolous plants. The

species is distinguished from the other species by the following characters: i) Widely spreading leaves; ii) Sinus narrow; iii) Perianth beaked; iv) Oil bodies finely segmented.

Distribution: On the bark of trees at Panhala, Khandala, Mahabaleshwar and Kasara Ghat, found especially on branch of *Vitex negundo* at Arthur seat point in Mahabaleshwar and Monkey point at Khandala.

Genus *Taxilejeunea* (Spruce) Schiffn.emend. Schust.(sub family Lejeuneoideae) yellowish brown or yellowish green with finely segmented 5-12 oil bodies. This genus was represented by *T. indica*.

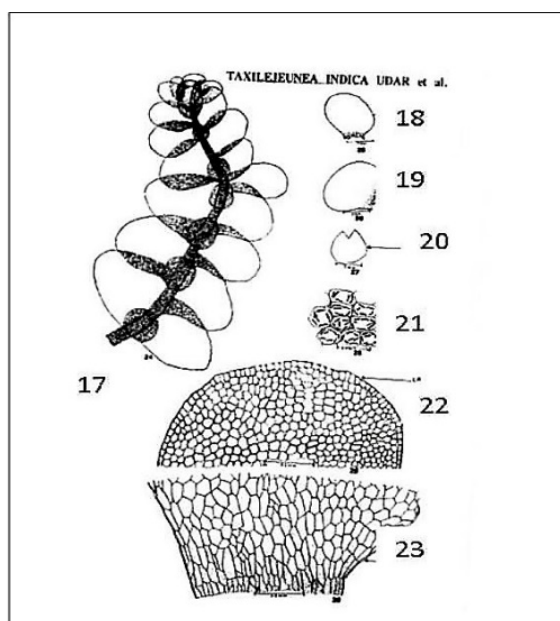


Plate No:3 (Text Figs: 17-23) TAXILEJEUNEA INDICA: 17. entire plant x 50, 18. dorsal leaf basal side, 19. dorsal leaf apical side, 20. amphigastria x 50, 21. oil bodies, 22. leaf apex cell x 400, 23. leaf base cell x 400.

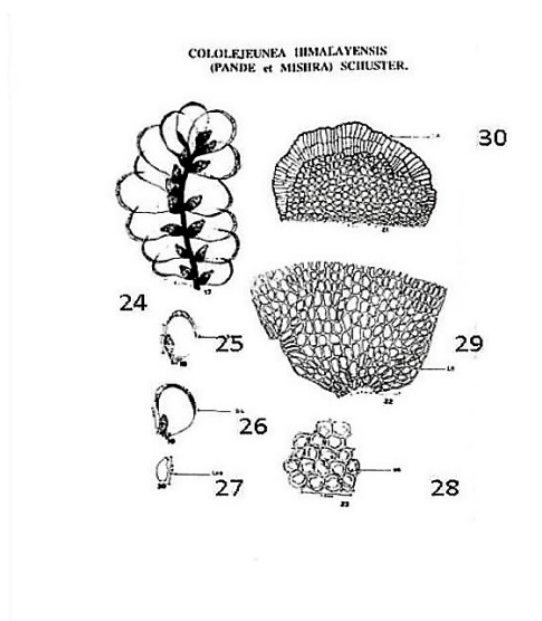


Plate No:4 (Text Figs: 24-30) COLOLEJEUNEA HIMALAYENSIS: 24. entire plant x 50, 25. dorsal leaf basal side, 26. dorsal leaf apical side, 27. amphigastria, 28. oil bodies x 400, 29. leaf base cell x 400, 30. leaf apex cell x 400.

3. *Taxilejeunea indica* Udar et al., 1970 (Plate No.3, Text Figs: 17-23): Plants pale green, monoecious with minute lobule along with hyaline papilla and indistinct first tooth. They are corticolous as well as epiphyllous with **Lejeunea type** of branching (copiously and

irregularly branched, the branches are obliquely to widely spreading often with slightly smaller leaves than the stem but were not microphyllous, Evans, A. 1917, Thiers, B. 1984). This plant is distinguished from other species by the following characters: i) Margin

entire; ii) Acute apex; iii) Under leaves bifid, ovate-orbicular; iv) Perianth ovate, 5-plicate.

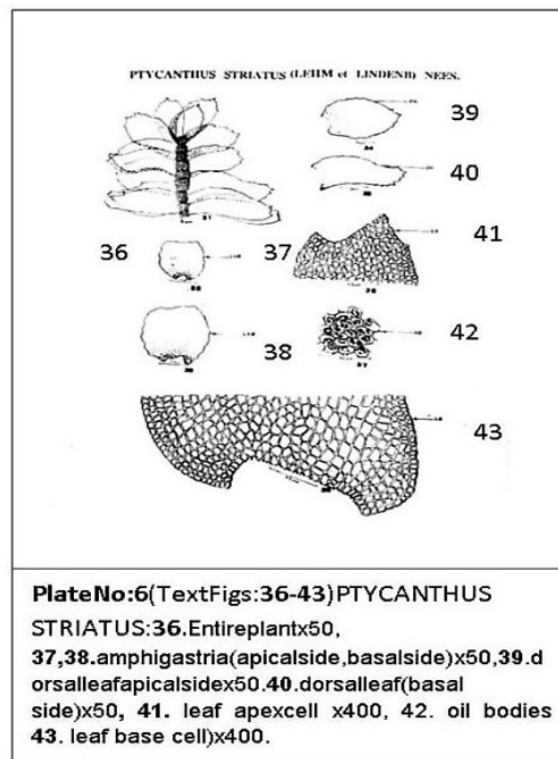
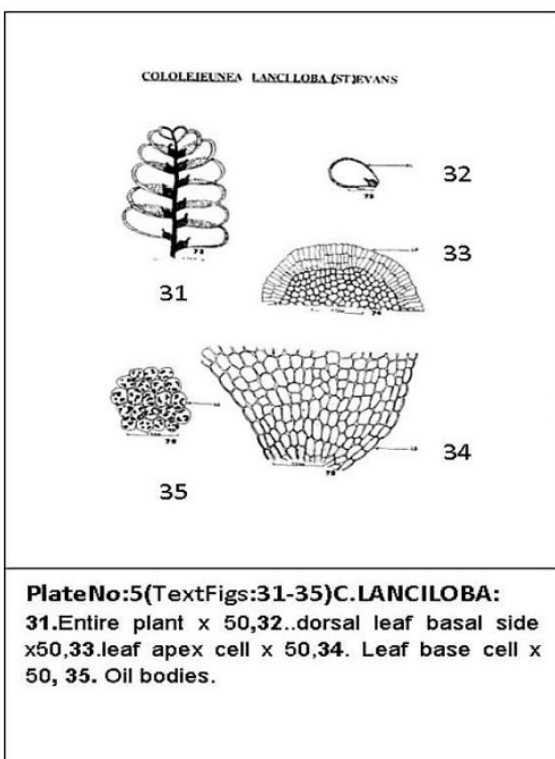
Distribution: This leafy hepatics were found growing on the leaves of the tree *Artocarpus heterophylla* and *Eucalyptus* sp, with *Notoschyphus* sp. and *Radula* sp. near Lingmala stream and Arthur Seat point at Mahabaleshwar.

Genus *Cololejeunea* Schiffne. Spruce (sub family Cololejeuneoideae) is represented by two species: *C. himalayensis* (Pande and Mishra, 1943) Schuster and *C. lanciloba* (St.)Evans. The generic name *Cololejeunea* has been derived from two words "colo" and "lejeunea". Colo means collar like, this is due to presence of collar like hyaline cells at apical margin of leaf in Lejeunea type of thallus

4. *Cololejeunea himalayensis* (Pande and Mishra, 1943b) Schuster (Plate No.4, *Text Figs*: 24-30): Plants foliaceous or epiphyllous found on the dorsal side of the leaves. This species have the following distinguishing characters:

i) Leaf lobe margin bordered by hyaline cells on antical margin up to apex; ii) Lobule ligulate, lanceolate triangular without second tooth; iii) Apical hyaline papilla; iv) Papillose cuticle.

Distribution: Found on the dorsal side of leaves of *Eugenia jambolana* at Lingmala stream, Pratapgad garden, Wilson Point at Mahabaleshwar and also at Lonawala garden. Also found on the *Opuntia* stem



5. *Cololejeunea lanciloba* (St.) Evans (Plate No. 5, *Text Figs*: 31-35). The specific name "lanciloba" has been derived from the word "lancet" meaning flattened with blunt apex of the leaves. Plants were epiphyllous and yellowish green. This hepatic is distinguished by the following characters: i) 2-4 rows of hyaline cells up to the base of leaves; ii) Apex

blunt, depression absent at the apex; iii) Leaf lobule ovate bilobed with two teeth.

Distribution: On the leaves of *Eugenia jambolana* and *Cinnamomum tamala* at Mahabaleshwar and Khandala. This hepatic was already reported by Mahabale (1966).

Genus *Ptycanthus* Nees (sub family Ptycanthoideae). Plants were corticolous

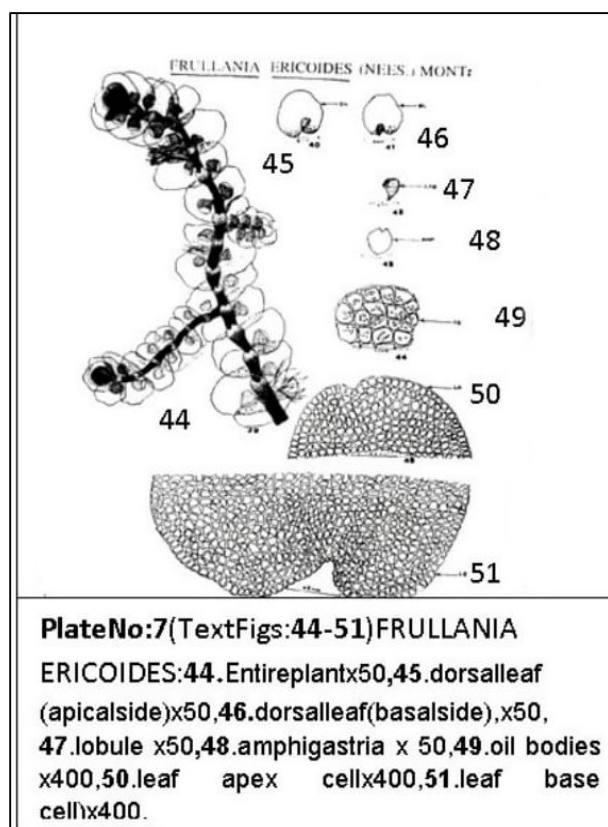
green or brown large with **Frullania type** of branching. (Branching often regularly pinnate, occasionally bipinnate, Evans A., 1912, & Kront 2001) This genus was represented by *Ptycanthus striatus* (Lehm.et Lindenb.) Nees.

6 *Ptycanthus striatus* (Lehm.et Lindenb.) Nees. (Plate No. 6, **Text Figs:** 36-43): This corticolous leafy hepatics. This species is characterized by following features: i) **Frullania type** of branching; ii) Leaf lobes with dentate margins; iii) Under leaves

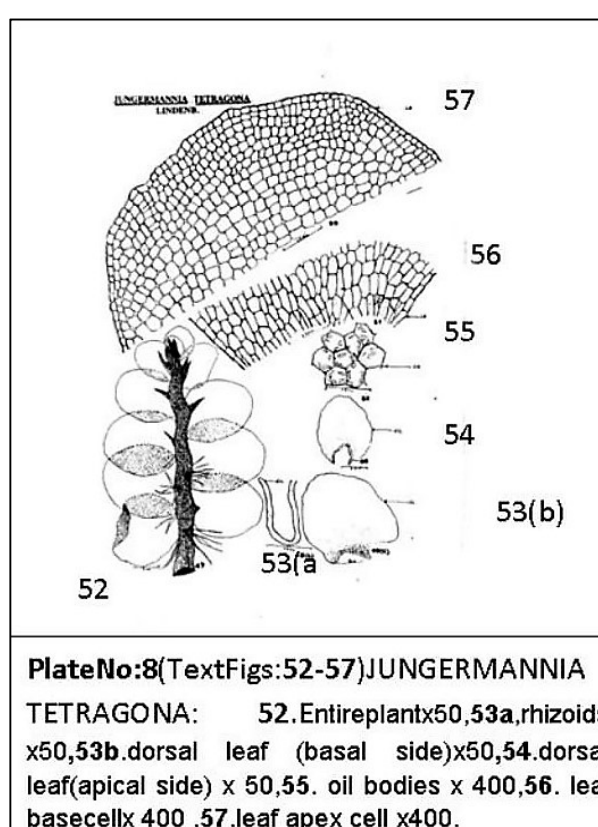
dentate, as long as wide; iv) Elaters with wide mouth and narrow base.

Distribution: This hepatic were growing on the bark of the hanging branch of trees in association with mosses *Fissidens* and *Sterophyllum* at Arthur Seat Point and on the way to Ambenalli ghat, Mahabaleshwar also at Matheran.

Genus *Frullania* Raddi (Family Frullaniaceae): Plants medium green or reddish brown, pinnate. This genus was represented by only one species *Frullania ericoides* (Nees) Mont.



7. *Frullania ericoides* (Nees) Mont. (Plate No. 7, **Text Figs:** 44-51): The plant is terricolous, reddish brown to black appearing as a dense patch on bark or on soil. This plant is distinguished from other species and characterized as follows: i) Plants dioecious; ii) Under leaves bilobed; iii) Lobule saccate; iv) Leaves squarrosa; v) Perianth wings papillate or mamillate.



Distribution: It was found growing on the bark of Jackfruit tree trunk with moss at Kankavli in Sindudurgh District.

Genus *Jungermannia* L. Spec. Pl. 1131 (1753) (Family- Jungermanniaceae) was represented by two subfamilies viz. Jungermannioideae and Notoscyphoideae. *Jungermannia tetragona* Lindenb, was the only species found representing the subfamily Jungermannioideae

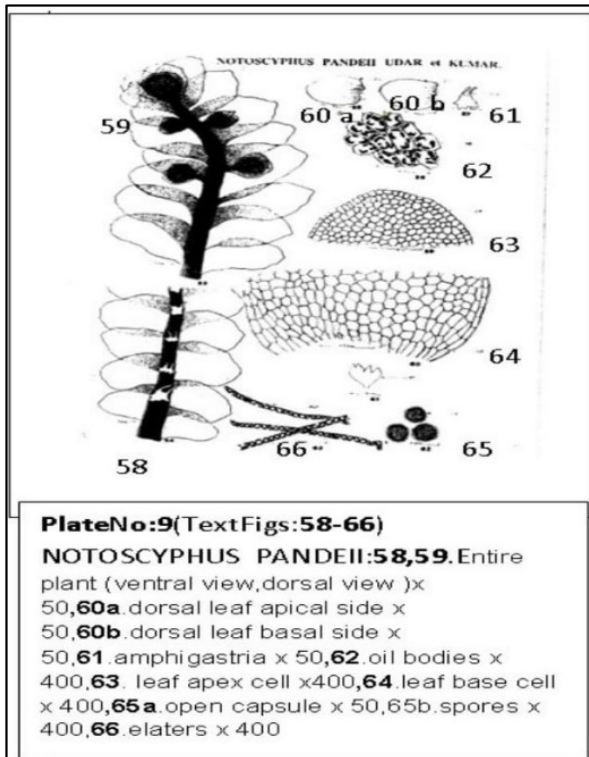
and *Notoscyphus pandeii* representing Notoscyphoideae.

8. *Jungermannia tetragona* Lindenb. (Plate No.8, Text Figs: 52-57): Plants terricolous growing on moist soil in association with *Anthoceros* sps., *Cyathodium* sps. The plant is distinguished by the following characters: i) Plant leaf large, cells without trigones; ii) Oil bodies 1 to 7; iii) Rhizoids purple; iv) Under leaves absent; v) Terminal male and female

inflorescence; vi) Bispiral elaters found throughout.

Distribution: On the moist soil, near the Gureghar stream, way to Ambenalli Ghats, Mahabaleshwar and in Lonavala Gardens at Lonavala.

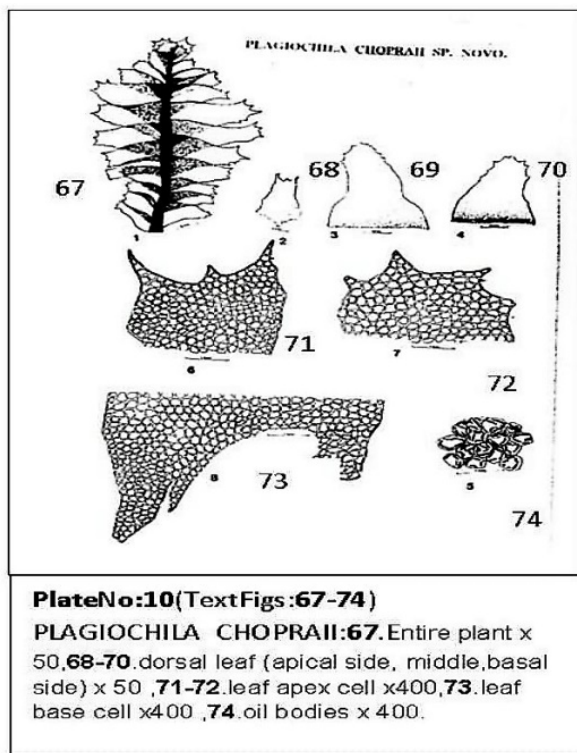
Genus *Notoscyphus* Mitt. (subfamily Notoscyphoideae). Corticolous plant growing in shady places forming pure populations on the soil surface. This genus was represented by only one species *Notoscyphus pandeii*



9. *Notoscyphus pandeii* Udar and Kumar, 1970 (Plate No.9, Text Figs: 58-66): It was found growing as corticolous (epiphyte) and distinguished by following characters: i) Leaves entire with obtuse apex; ii) Under leaves present.

Distribution: Epiphytic on branches of *Euphorbia* species near Lingmala stream at Mahabaleshwar.

Genus *Plagiochila* Dum.: Plants terricolous or corticolous large, reddish or green coloured with robust rhizome. This genus was represented by *Plagiochila chopraii*.



10. *Plagiochila chopraii* (Plate No.10, Text Figs: 67-74): The plant is corticolous on the bark of trees. This species is named after the eminent Indian Bryologist Prof. R. S. Chopra for his valuable contribution in the field of Bryology, especially Indian bryophytes. It can be distinguished from other species of *Plagiochila* Dum. by following characters: i) The teeth of the upper leaves at the apex are long (3-4 celled), pointed and few in number where as teeth on the apex of the lower leaves are single celled (1-2) and short; ii) Antical and postical margins of the leaf are slightly wavy;

iii) Both margins of upper leaf base are inflexed; iv) Presence of two types of trigones, concave and bulging.

Distribution: Corticolous on the trees found at Arthur Seat Point, Mahabaleshwar.

The regions selected for the study, Mahabaleshwar (alt. 1353 m), Khandala (alt. 550m), Lonavala (624 m), Matheran (800 m) are some typical upland hilly regions of the Western Ghats with average rainfall (approx.240 inches) and high humidity. These regions are rich in all angiospermic, ferns and bryological flora representing very rich biodiversity. The places like Panhala fort (754 m) and Sinhgad fort (760 m) in these hilly terrains have rainfall of approx. 400.cm exhibited diverse bryological flora. The hepatic flora with special reference to leafy Jungermanniales may be considered as representative of the above said groups in the Western ghats. It also appeared that the leafy hepatics were much abundant and flourished at Mahabaleshwar than at Khandala region. This may be attributed to the high altitude, more precipitation and the presence of high humidity at Mahabaleshwar. Leafy hepatics viz. species of *Cololejeunea*, *Ptycanthus*, *Taxilejeunea*, *Frullania*, *Lejeunea*, *Notoscyphus* and *Plagiochila*, those studied are epiphytic (corticolous /foliacolous) whereas species of genus *Jungermannia* is terrestrial (terricolous). Among the epiphyllous taxa species, *Cololejeunea* were found growing on the dorsal surface of the leaves of angiospermic trees.

It appears that these leafy hepatics have adapted to varied habitats from terrestrial to epiphytic as well as epiphyllous and such adaptations must have taken place in course of time under the influence of various environmental factors. Thus the epiphytic taxa of Jungermanniales may be considered as evolved than that of terrestrial taxa. Moreover, among the epiphytic taxa, the epiphyllous form viz. *Cololejeunea* sp. are considered to be much more highly evolved than that of any other Jungermanniales. Also

the *Frullania* type of branching (*Ptycanthus striatus*) is considered as primitive to the *Lejeunea* type of branching (*Taxilejeunea indica*). Moreover, in the present report *Lejeunea cavifolia* (Ehrh.) Lindenb, *L. flava* (Sw.) Nees and *Cololejeunea himalayensis* (Pande and Mishra) were newly reported by us in the area under study.

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