



RARE AND INTERESTING PLEUROCARPOUS MOSSES OF INDIA

D. Subramanian

277, I South Cross Road, Mariappa Nagar, Annamalai Nagar - 608 002 (Tamil Nadu), India.

Abstract

From a large collection of a few hundred Mosses from hill stations of Tamil Nadu and thick forests of Nilgiris hills, more important, rare and interesting taxa of them have been described in this paper with illustrations. The plants studied are *Waymouthia barbelloides* sp. nov., *W. barbelloides* var. *densifolia* var. nov.; *Pseudotrachypus kothagirianus* D.S. var. *pinnata* var. nov.; *Aerolindigia barbelloides* D.S. var. *pterobryopsida* var. nov. *Cryptoleptodon nervata* D.S. var. *spatulata* var. nov. *C. nervata* var. *himantocladoides* var. nov.; *C. ovata* D.S. var. *nilgiriensis* var. nov. *C. himantocladoides* D.S. var. *lanceolata* var. nov.; *Kanagambigai barbelloides* gen. et. sp. nov.; *Himantocladium grenulosum* (Mitt) Fl. var. *aerobryoides* var. nov.; *Neckeropsis crinata* (Griff.) Fleisch var. *thamnobryoides* var. nov.; *Neckera bipinnata* sp. nov. *Homalia filiformis* sp. nov.; *Homaliadelphus feruginea* (Gough) Dix & Varde. var. *pulneyensis* var. nov.; *Categorium indicum* sp. nov.; *Pinnatella foreauana* (Mitt.) Broth. var. *minutifolia* var. nov.; *Handeliobryum himalayanam* (Gough) Dix & Varde var. *bipinnata* var. nov.; *Thamnobryum fasciculatus* (Hedw) I. Sastre and *T. keralensis* sp. nov.

Key words : Pleurocarpous Mosses, floristic studies, rare and interesting species of India.

Introduction

Studies on morphological characters of rare and interesting species and varieties of Indian Mosses, supplemented with illustrations of whole plants in natural sizes and magnified plant parts have been made from remote and dangerous places of Western Ghats of Karnataka and Tamil Nadu. So far, enumeration of the species, or sometimes description of family or genus characters without any diagrams of them have been made on Indian species. Mosses are homogeneous plants and all of them look alike and identification of them is very difficult. For this diagrams of the species are necessary. Nowadays, Mosses are important plants as anticancer and antibacterial agents, because of their more water absorbing capacities than any other group of plants. Therefore, understanding of each and every species of Mosses in India is necessary. So far, only 20 to 30% Mosses are alone known to Indian Bryologists. Almost all the places of India particularly Western Ghats of South India, Silent valley and other thick forests of Kerala and Karnataka and from Western to Eastern Himalayas must be thoroughly investigated and actually how many species and varieties are present in India must be estimated.

In the present study, the Pleurocarpous Mosses coming under the families Meteoriaceae and Neckeraceae alone are described.

Materials and Methods

Plants were collected mostly from Western Ghats of Tamil Nadu like Coonoor, Avalanche and Naduvattam. Plant parts were examined first under Dissection Microscope (X 20) and then under compound microscope (X 100 and X 250). Abbe camera lucida diagrams were drawn.

3 to 4 sets of herbarium specimens for each type of plant have been prepared and duely labelled. A set of holotypes have been deposited at Botanical Survey of India (BSI), Southern Circle at Coimbatore (CBE), Tamil Nadu (TN) and a set of isotypes are kept with author's home laboratory at Mariappa Nagar, Annamalai Nagar, Tamil Nadu.

Observations and Discussion

Under the family Meteoriaceae the following varieties and species of *Waymouthia*, *Pseudotrachypus* and *Aerolindigia* have been described.

1. *Waymouthia barbelloides* sp. nov (plate 1)

This epiphytic plant was collected near Coonoor of Tamil Nadu recently. It resembles *Waymouthia mollis* (Hedw.) Broth. described by Scott and Stone (1976) from Australia. Both *Papillaria* and *Waymouthia* are more related genera and Scott and Stone have given the important differences of characters in these 2 genera.

Plants hanging down from the branches of trees, epiphyte, 10 to 12 cm. long, unipinnately branched, branches bent down and short. Leaves oblong with undulate and sharply pointed tips, nerve upto $\frac{3}{4}$ of the leaf blade, alar cells almost rectangular, middle cells rectangular spherical and tip cells elongated spherical; no capsule seen.

So far, *Waymouthia* has not been recorded from India and so it is a first record. There are no lamellae inside the cells in this genus but there are lamellae in each cell in *Papillaria*. The species *barbelloides* is named as this plant resembles *Barbella* of Meteoriaceae.

Holotype No. 167 dated 13-10-2015 and deposited at B.S.I., C.B.E., T.N. and isotype no. 2016 at author's home laboratory.

2. *W. barbellides* var. *densifolia* var. nov. (plate 2)

The previous type species and this plant were collected in the same place. In this present variety, plants are thicker with more crowded leaves when compared to the previous type species; but in all other characters both these plants are similar.

Holotype No. 166. dated 13.10.2015 and deposited at B.S.I. CBE., T.N. and Isotype No. 2015 at author's home laboratory.

Of the two species of *Waymouthia* described by Scott and Stone (1976) from Australia. *W. cochlearifolia* (Schwaegr) Dix. is a peculiar plant with rounded leaves. The present plants of this genus resembles the other species, *W. mollis* in having oblong or elongated oblong leaves and smooth laminar cells. But, the present plants have pointed leaf tips instead of obtuse tip of leaves of *W. mollis*. But, further clarifications are necessary as to the correct identifications, of these plants, as Scott and Stone have not provided diagrams of the two species described. Anyhow, the present plants belong to the family Meteoriaceae and differs mostly from related genera of this family like *Papillaria* and *Meteorium*.

3. *Pseudotrachypus kothagirianus* D.S. var. *pinnata* var. nov. (plate 3)

This plant was collected from Yercaud of Shervarayan Hills of Eastern Ghats of Tamil Nadu at an elevation of 5000 feet as epiphyte on braches of trees.

Plants 9 to 11 cm tall, pinnately branched, robust, lateral branches short; leaves spirally arranged, oblong with undulate margin at the tip, midrib almost reaching the leaf tip, laminar cells diamond shaped each with a lamella in the center; capsule not seen.

W.R. Buck (1998) had described from West Indies *Pseudotrachypus martinicensis* (Brother) W.R. Buck

with illustrations under the family Meteoriaceae in his book "Pleurocarpous Mosses of West Indies". Afterwards, the author described a species "Pseudotrachypus Kothagirianus D.S. in his book" Studies on Indian Mosses (in press) and already this plant had been described in a conference (Subramanian, 2011).

Now, the present species is different from *P. martinicensis* in plant morphology, leaf characters and nature of laminar cells and the type species in plant morphology and leaf characters.

Holotype No. 668 dated 13.10.2015 and deposited at B.S.I., CBE, T.N. and isotype No. 2017 kept at author's home laboratory.

4. *Aerolindigia barbelloides* D.S. var. *Pterobryopsida* var. nov. (plate 3)

This plant was collected as epiphyte on branches of trees, near Avalanche of Nilagiri Hills, Tamil Nadu.

Plants 6 to 8 cm tall, pinnately or rarely bipinnately branched, branches longer and thicker with more crowded leaves; leaves lanceolate, spirally arranged, margins of leaves slightly undulate and minutely serrate from the middle of leaves, midrib reaching $\frac{3}{4}$ of the leaf, basal laminar cells rectangular spherical, middle leaf cells elongated spherical and tip cells slightly elongated spherical, no capsule.

W.R. Buck (1998) had described "*Aerolindigia capillacea* (Hornsch) M. Menzel under the family Meteoriaceae from West Indies with illustrations of plant and plant parts in his book "Pleurocarpous Mosses of West Indies". The author described "*Aerolindigia barbelloides* D.S. in a National Conference in 2011 and included in his book "Studies on Indian Mosses" (in press).

The present plant resembles *Pterobryopsis* of Pterobryaceae in its external appearance and so named as var. *pterobryopsida*". This variety is different from type species in plant morphology, leaf and nature of lamellar cells. The presence of this genus "*Aerolindigia*" is a first record for India.

Holotype No. 169 dated 13.10.2015 and deposited at B.S.I., CBE, T.N. and isotype No. 2018 kept at author's home laboratory.

The species and varieties described below belong to the family Neckeraceae. *Cryptoleptodon* is a simple genus with 3 species in India as pointed out by Chopra (1961) under the first sub-family Leptodontoideae of Neckeraceae. The other two sub-families of this family are Neckerioideae and Thamnioideae. The author has collected so far, particularly from Western Ghats of Tamil Nadu, a large number of species and varieties of

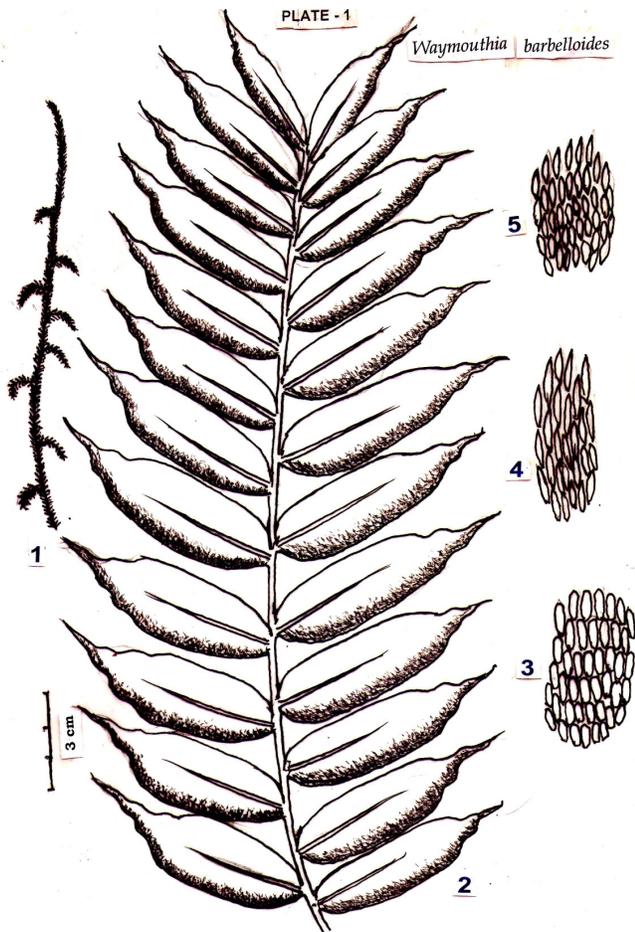


Plate 1 : *Waymouthia barbelloides*.

Fig. 1 = A plant x 1.5, 2 = A portion Enlarged x 100; 3 = Basal leaf cells x 250, 4 = Mid leaf cells x 250, 5 = Tip leaf cells x 250.

Cryptoleptodon. Therefore, the number of species may be more than 3 as claimed by Chopra (1961) along with a large number of varieties and forms. This shows that a through study of Mosses in India has not been undertaken so far. Most of the Scientists in India accepted this view. But a few scientists proclaim that describing a new species or new variety of Mosses is wrong.

The variations of plant morphology and characters of plant parts in *Cryptoleptodon* are so much as we cannot accommodate all the members under a single genus of Leptodontideae. It will be decided after some more studies in this group of plants.

5. *Cryptoleptodon nervata* D.S. var. *spathulata* var. nov. (plate 4)

Plants 4 to 5 cm tall, pinnately branched, epiphyte on branches of trees. Leaves thickly crowded, spatulate, two ranked on sides, leaf base narrow, middle leaf enlarged and tip again narrow, nerve upto $\frac{1}{2}$ of the leaf blade, margin linear, laminar cells spherical above the leaf and



Plate 2 : *Waymouthia barbelloides* var. *densifolia*.

Fig. 1 = A plant x 2; 2 = A portion of Plant enlarged x 100; 3 = A leaf x 100; 4 = Laminar cells x 250.

elongated spherical at leaf base, no capsule.

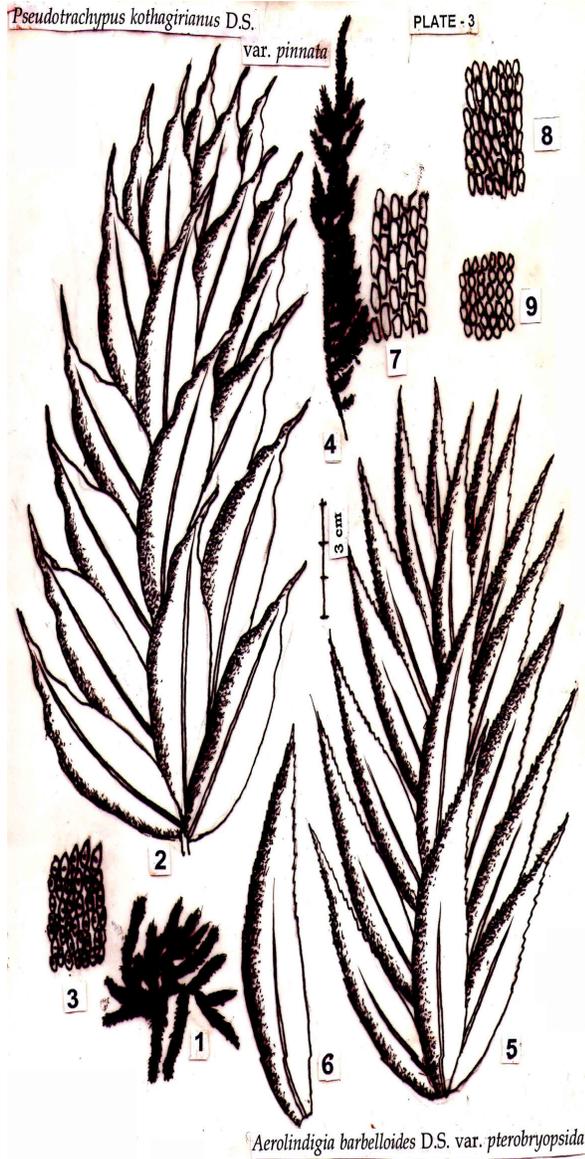
Plants collected at thick forests near Naduvattam, Nilagiri Hills Holotype No. 12 dated 13.10.2015 and deposited at B.S.I., CBE, T.N. and isotype No. 2019 kept at author's home laboratory.

This plant resembles *Cryptoleptodon nervata* D.S. but differs from it in plant and leaf morphology.

6. *Cryptoleptodon nervata* D.S. var. *himantocladoides* var. nov. (plate 4)

Plants epiphytes on tree trunks, 6 to 8 cm tall, pinnately or rarely bipinnately branched, branches long and delicate; leaves oval, loosely arranged resembling to those of *Himantocladium* of Neckeraceae, linear margin, tip blunt, nerve percurrent, laminar cells spherical; capsule not seen.

This variety is different in plant morphology and leaf characters, when compared to the type species, *C. nervata*. D.S. (Studies on Indian Mosses - in Press).

**Plate 3 :**

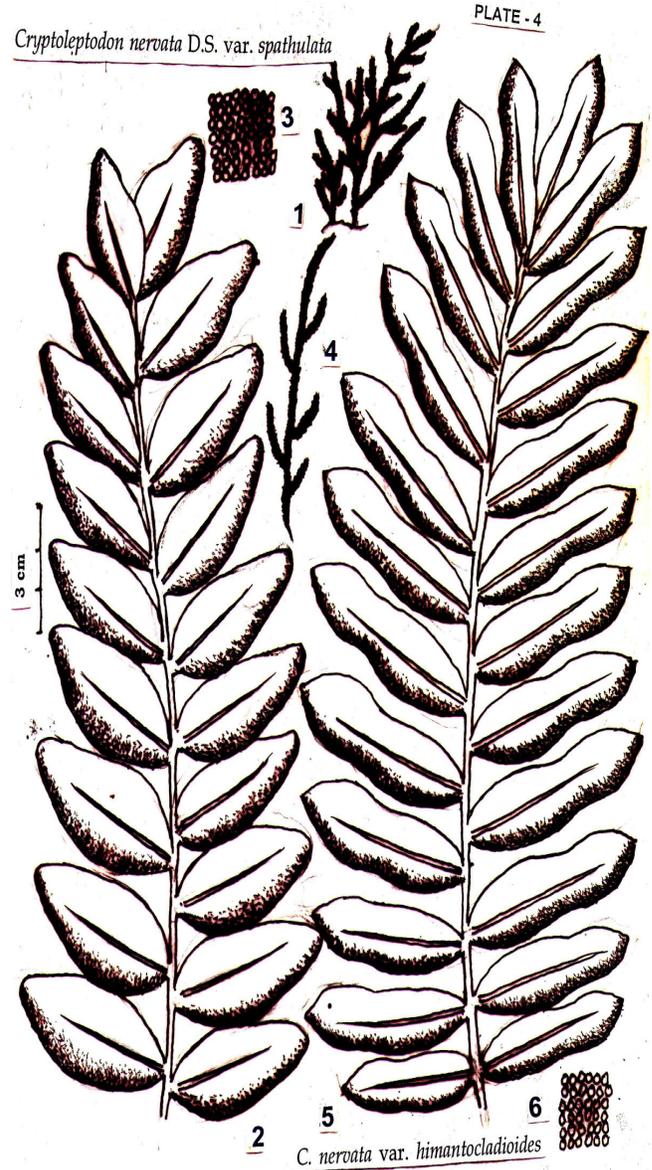
Figs. 1 to 3 = *Pseudotrachypus kothagirianus* var. *pinnata*.
Fig. 1 = A plant x 1.5; 2 = A portion of plant enlarged x 100;
3 = Laminar cells x 250.

Figs. 4 to 9 = *Aerolindigia barbelloides* var. *pterobryopsida*.
Fig. 4 = A plant x 1.5; 5 = A portion of plant enlarged x 100;
6 = A leaf x 100; Basal leaf cells x 250; 8 = Mid-leaf cells x 250; 9 =
Tip leaf cells x 250.

Holotype No. 171, dated 13.10.2015 and deposited at B.S.I., CBE, T.N. and isotype No. 2019. kept at author's home laboratory.

7. *Cryptoleptodon ovata* D.S. var. *nilgiriensis* var. nov. (plate 5)

Plants epiphytes, 4 to 5 cm. tall, rarely branched, thickly clothed with leaves; leaves more than 3 rows but complanate, oval shaped, nerve upto $\frac{3}{4}$ of the leaf blade,

**Plate 4 :**

Figs. 1 to 3 = *Cryptoleptodon nervata* var. *spathulata*
Fig. 1 = A plant x 1.5; 2 = A portion of plant enlarged x 100;
3 = Laminar cells x 250.

Figs. 4 to 6 = *Cryptoleptodon nervata* var. *himantocladoides*
4 = A plant x 1.5; 5 = A portion of plant enlarged x 100;
6 = Laminar cells x 250.

tip acuminate, linear margin, blade narrow below but broader at the tip, lamellar cells spherical; capsule not seen.

This plant differs from the type species *C. ovata* D.S. in unbranched or rarely branched main axis.

Holotype No. 172 dated 13.10.2015 and deposited at B.S.I., CBE, T.N. and isotype No. 2200. Kept at author's laboratory. Plants collected near Avalanche, Nilagiri Hills.

C. ovata D.S. var. *nilgirensis* PLATE - 5 C. *himantocladioides* D.S. var.

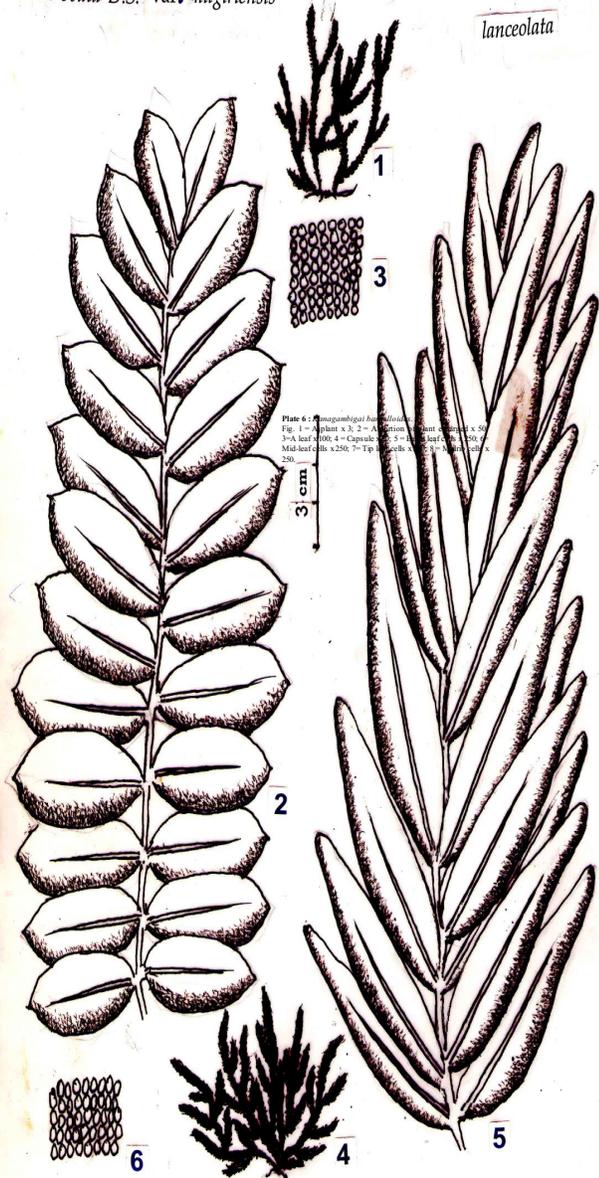


Plate 6: Kanagambigai barbelloides
Fig. 1 - A plant x 1.5; 2 - A portion of plant enlarged x 50;
3 - A leaf x 100; 4 - Capsule x 3 = 1.5; 5 - Leaf x 100;
6 - Leaf x 250; 7 - Fig. 8 - Spore x 1000.

PLATE - 6

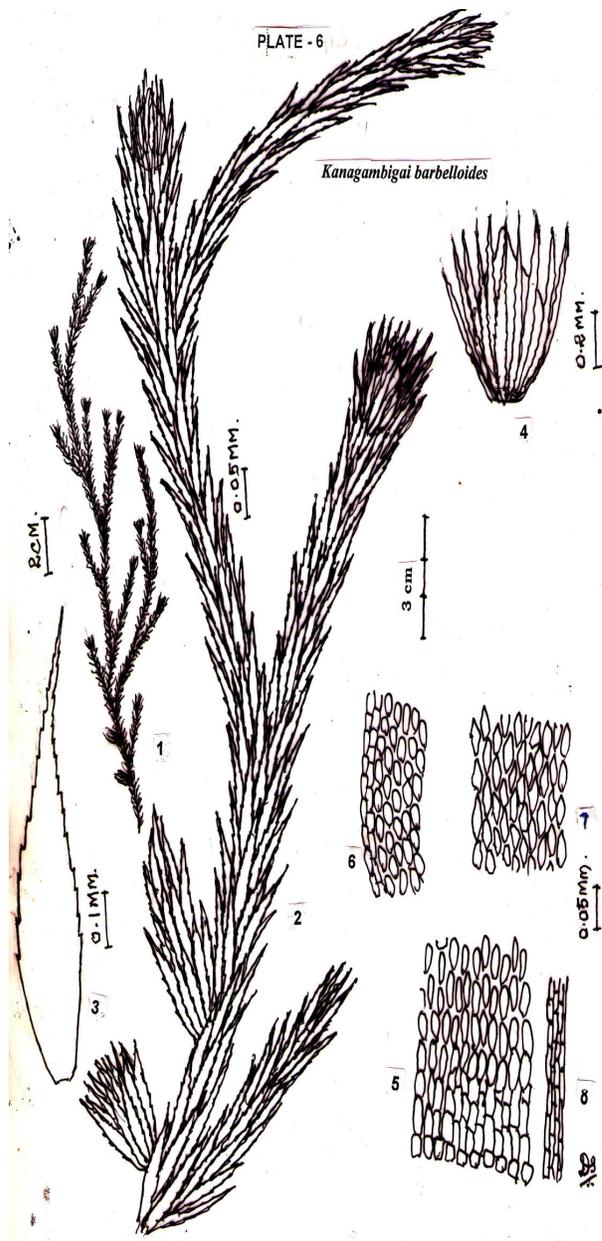


Plate 5 :

Figs. 1 to 3 = *Cryptoleptadon ovata* var. *nilgirensis*
Fig. 1 = A plant x 1.5; 2 = A portion of plant enlarged x 100;
3 = laminar cells x 250.
Figs. 4 to 6 = *Cryptoleptadon himantocladioides* var. *lanceolata*
Fig. 4 = A plant x 1.5; 2 = A portion of plant enlarged x 100;
3 = Laminar cells x 250.

8. *Cryptoleptadon himantocladioides* D.S. var. *lanceolata* var. nov. (plate 5)

Plants epiphytes like thick cotton threads, short and bushy, 3 to 4 cm tall; leaves lanceolate, crowded but complanate, margin linear, nerve percurrent, laminar cells almost spherical, capsule not seen.

This plant resembles *Himantodadium* of Neckeraceae in plant appearance but leaf shape and arrangement are different.

Plants collected in thick forests near Avalanche, Nilagiri Hills

Holotype No. 173 dated 13.10.2015 and deposited at

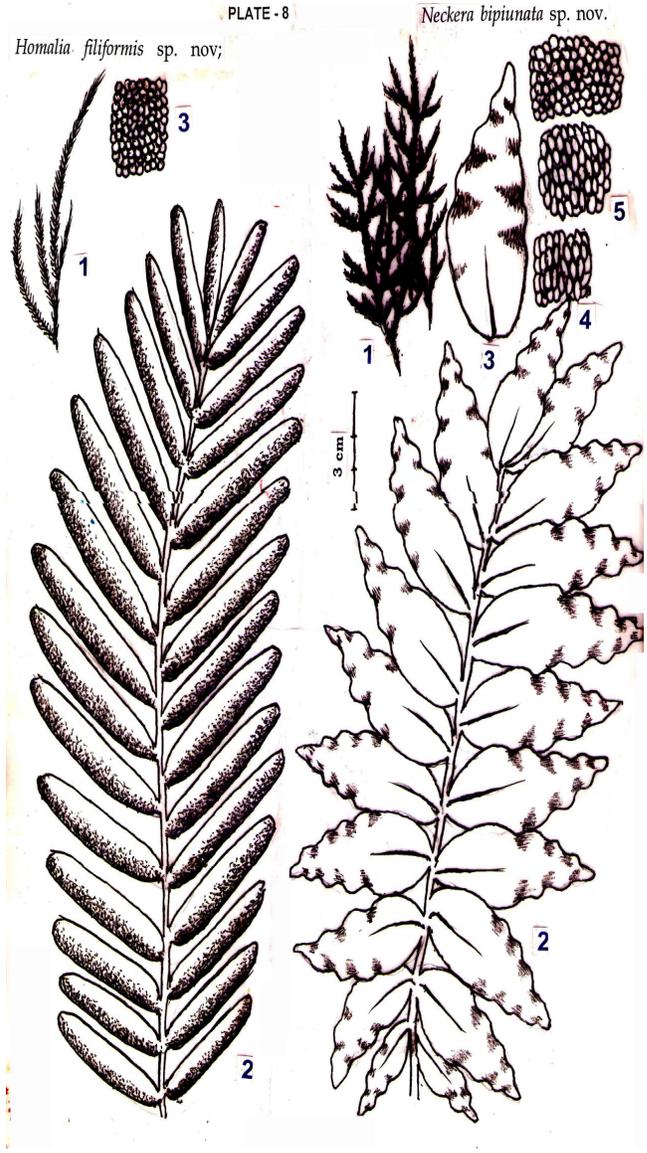
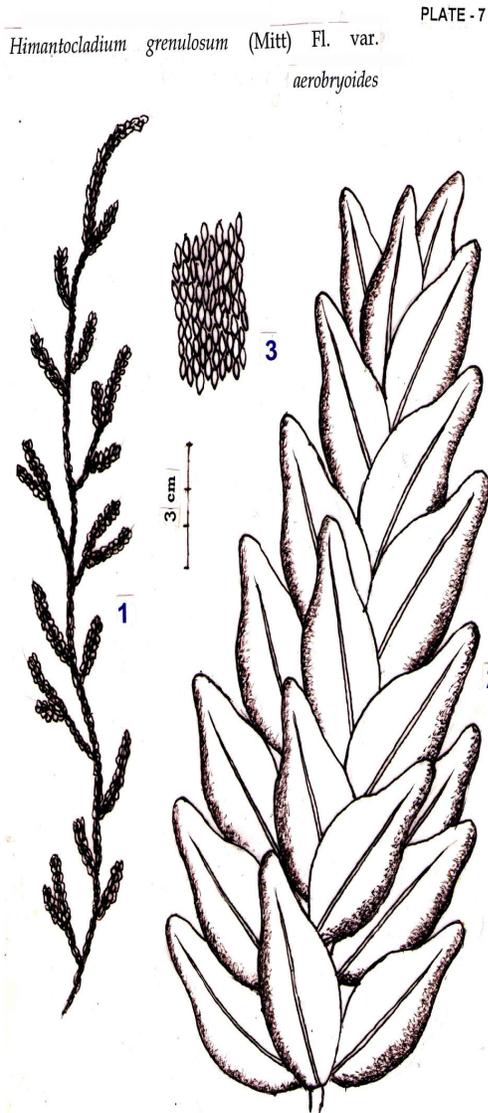


Plate 8 :

Figs. 1 to 3 = *Homalia filiformis* Fig. 1= A plant x 2; 2 = A portion of plant enlarged x 100; 3= Laminar cells x 250.

Figs. 4 to 9 = *Neckera bipinnata*

Fig. 4= Plants x 2; 5=A portion of plant enlarged x 100; 6=A leaf x 100; 7= Basal leaf cells x 250, 8= Mid-leaf cells x 250; 9= Tip leaf cells x 250.

Plate 7 : *Himantocladium grenulosum* var. *aerobryoides*.

Fig. 1 = A plant x 3; 2 = A portion of plant enlarged x 100; 3 = Laminar cells x 250.

B.S.I., CBE, T.N. and isotype No. 2201 kept at author's laboratory.

9. *Kanagambigai barbelloides* gen. et. sp. nov. (plate 6)

This plant and its parts were already described by the author with illustrations in National Conference on future perspective of botanical research in 2011 held at Botany Department, Annamalai University, Tamil Nadu.

Plants 8 to 10 cm long, crawling on barks of large trees at Monkey's Rock of Valparai Hills of Tamil Nadu

at an elevation of 6000 feet.

Plants intermittently branched; Leaves spirally alternate, lanceolate with serrate margin, no midrib, tip sharply pointed; leaves more crowded at the tip; laminar cells elongated spherical at the base of the leaf, slightly elongated spherical at middle and almost spherical at the tip of the leaf; capsules rarely observed and they are immersed at the tip of the branches, dome shaped, sessile. As plants were not so much available, the study of capsule has not been made in detail. "Kurangu Parai" is a very

Neckeropsis crinata (Griff.) Fleisch var. *thamnobryoides*

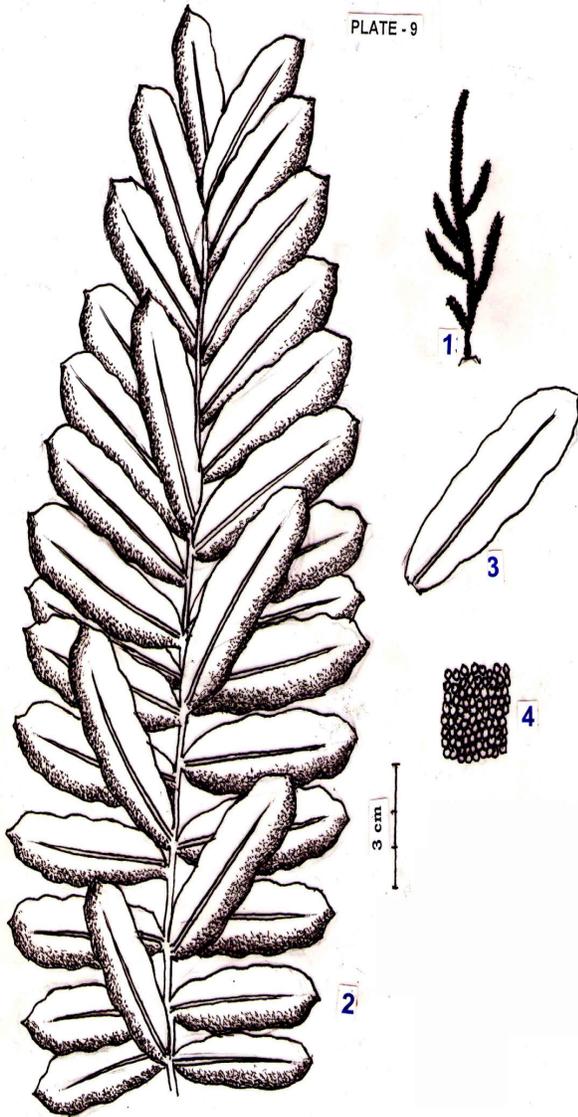


PLATE - 9

Plate 9 : *Neckeropsis crinata* var. *thamnobryoides*.

Fig. 1= plant x 2; 2= A portion of plant enlarged x 100; 3= A leaf x 100, 4= Laminar cells x 250.

dangerous forest with full of panthers, tigers and elephants.

This plant resembles *Barbella* species of Meteoriaeae in general appearance and so the species name “barbellides” was given. Because of the presence of veinless leaves, spherical lamellar cells, immersed capsules and leaf morphology this plant is kept under Neckeraceae. This proposed new genus is distinct from all other known genera of Neckeraceae like *Cryptolepton*, *Neckera*, *Neckeropsis*, *Himantocladium*, *Homalia*, *Homaliopsis*,

Homaliadelphus feruginea (Gough) Dix & Varde
var. *pulneyensis*

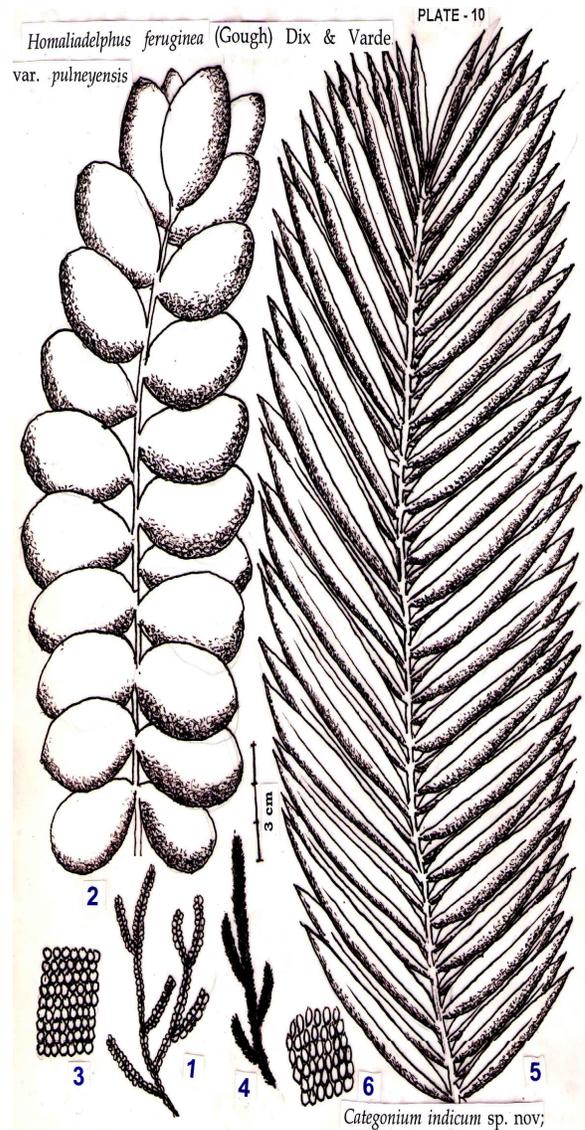


PLATE - 10

Plate 10 :

Figs. 1 to 3 = *Homaliadelphus feruginea* var. *pulneyensis*.

Fig. 1 = A plant x 2; 2= A portion of plant enlarged x 100;

3= Laminar cells x 250. Fig. 4 to 6 = *Catagonium indicum*.

Fig. 4 = A plant x 2; 5 = A portion of plant enlarged x 100;

6= Laminar cells x 250.

Homaliadelphus, *Thamnobryum*, *Handeliobryum*, *Isodrepanium*, *Pinnatella*, *Porotrichum*, and *Porotrichodendron* in plant morphology, leaf morphology, plant habit and nature of capsule.

Holotype No. 71 dated 5.2.2015 and deposited at B.S.I., CBE, T.N. and isotype No. 947 kept at author’s home laboratory.

10. *Himantocladium grenulosum* (Mitt.) Fl. var. *aerobryoides* var. nov. (plate 7)

This is a long climber on tree trunks in thick forests

near Avalance, Nilagiri Hills.

Plants epiphytes, 12 to 15 cm long, main stem adpressed on bark of trees, the secondary stem crawling on branches or hanging down, producing thicker and shorter lateral braches intermittently; Leaves complanate, flask shaped, nerve percurrent, margin linear, tip acuminate laminar cells elongated spherical at the base but almost spherical at the tip of the leaf; capsule not seen.

In all the characters this plant resembles *Himantocladium grenulosum* but in pinnate arrangement of lateral branches, leaf shape and percurrent nerve, it is different from the above type species. In general appearance of plants, this present plant resembles *Aerobryum* of Meteoriaceae and so it is named here in as var. *aerobryoides*".

Holotype No. 174 dated 13.10.2015 and deposited at B.S.I., CBE, T.N. and isotype No. 2202 kept at author's home laboratory.

11. *Homalia filiformis* sp. nov. (plate 8)

This is an epiphyte on large tree trunks in thick forests near Naduvattam, Nilagiri Hills. From the main stem, aerial branches arise vertically, 7 to 9 cm. long filiform like a thread, rarely branched; leaves complanate, rectangular – lanceolate, tip almost rounded, no midrib linear margin, lamellar cells spherical, capsule not seen.

Rev. Fr. Foreau (1961) has enumerated 2 plants *Homalia pygmaea* and *H. Pygmaea* var. *repens* from Pulney hills of Tamil Nadu. The author could get the dried specimens of the former plant from the collections of Rev. Fr. Foreau and then herbarium specimen was preferred by the author for this species. The present plant has smooth margin unlike the serrate margin of leaf of *H. Pygmaea* and the morphology of the present plant is totally different from that of *H. pygmaea*. Chopra (1967) has enumerated *Homalia obtusata* Mitt from Western Himalayas and Western Tibet. This plant has obovate leaves and slightly serrate margin. The author has not seen this plant or diagram of this plant. But, the present plant is distinct from it, based on the more important characters of them. Buck (1998) has described *Homalia glabella* (Hedw) Brunch. and Schimp from West Indies in his look "Pleurocarpous Mosses of West Indies." A.J. Grout (1924) has described in his book with illustrations *Homalia trichomanoides* (Schreb.) B.S. var. *Jamesii* (Schimp) Holz. from North Eastern United States. The present plant is different from all the above mentioned species of *Homalia*. This genus is very rare in this world, peculiar and more beautiful.

Holotype No. 175 dated 13.10.2015 and deposited at B.S.I., CBE, T.N. and isotype No. 2203 kept at author's home laboratory.

12. *Neckera bipinnata* sp. nov. (plate 8)

This species was colleted from thick forests near Coonoor of Nilagiri Hills. Plants epiphyte, 3 to 4 cm tall, aerial stem bipinnate, stipitate dendroid; leaves complanate, oblong, broad at the base of the leaf and gradually narrowing into a sharp point above; transversally undulate, margin linear, nerve only at the base of the leaf blade, basal lamellar cells elongated spherical and upper ones spherical; capsule not seen.

In plant morphology, lamellar cells and leaf morphology, this plant is different from all the species of *Neckera* so far recorded from the world.

Holotype No. 176. dated 13.10.2015 and deposited at B.S.I., CBE, T.N. and isotype No. 2204 kept at author's home laboratory..

13. *Neckeropsis crinata* (Griff) Fleisch var. *thamnobryoides* var. nov. (plate 9)

This is a small, beautiful and peculiar plant, epiphyte on large branches of trees under thick forest near Avalanche, Tamil Nadu. Secondary branches short but thicker, with a few lateral branches; leaves 4 to 6 ranked, thickly adpressed on both sides, complanate; leaves longer than broad, with parallel margins transversally undulate a few times, tip acuminate and blunt, midrib failing to reach the leaf tip. Recently, the author has presented 2 members of *Neckeropsis* namely *N. crinata* var. *tomentosa* var. nov. and *N. lepiniana* var. *pterobryopsida* var. nov. in Indian Science Congress Conference held at Mysore University from January 3 to 7, 2011, along with some more members Neckeraceae.

Holotype No. 177 dated 13.10.2012 and deposited at B.S.I., CBE, T.N. and isotype No. 2205 kept at author's home laboratory.

14. *Categorium indicum* sp. nov. (plate 10)

This plant was collected near thick forests of Avalanchi, Tamil Nadu. The leaves are more than 4 rows, but saked together into a bifarious arrangement and given the appearance of a ribbon; leaves lanceolate with a median nerve, smooth margin, short tip, laminar cells elongated spherical; no capsule. The present plant differs from the Australian species, *C. politum* (Hook f. and wils) Dus. ex. Broth in leaf shape, and morphology, presence of thin midrib and laminar cells.

Scott and Stone (1976) has given the diagram of the plant and laminar cells of *Categorium politum* in the same page along with *Neckera pennata* (Page No. 516) of their book. "The Mosses of Southern Australia". *C. politum* has leaves tetrastichous, crowded but they are saked together to be complanate and to give the appearance of a ribbon, as in the case of *Neckera*, *Neckeropsis* and *Himantocladium* of Neckeraceae.

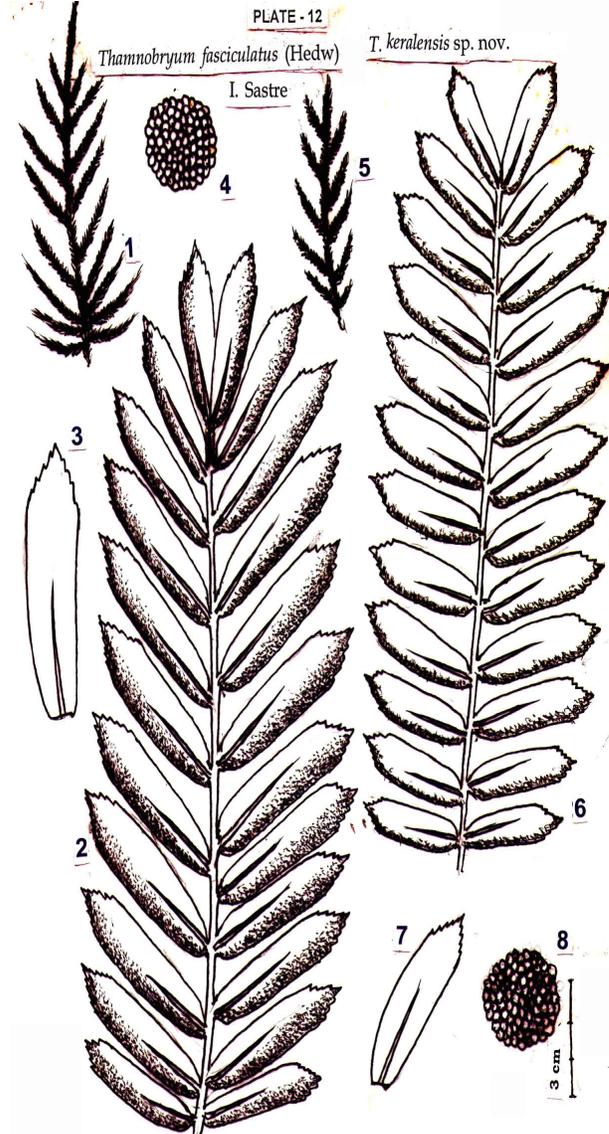
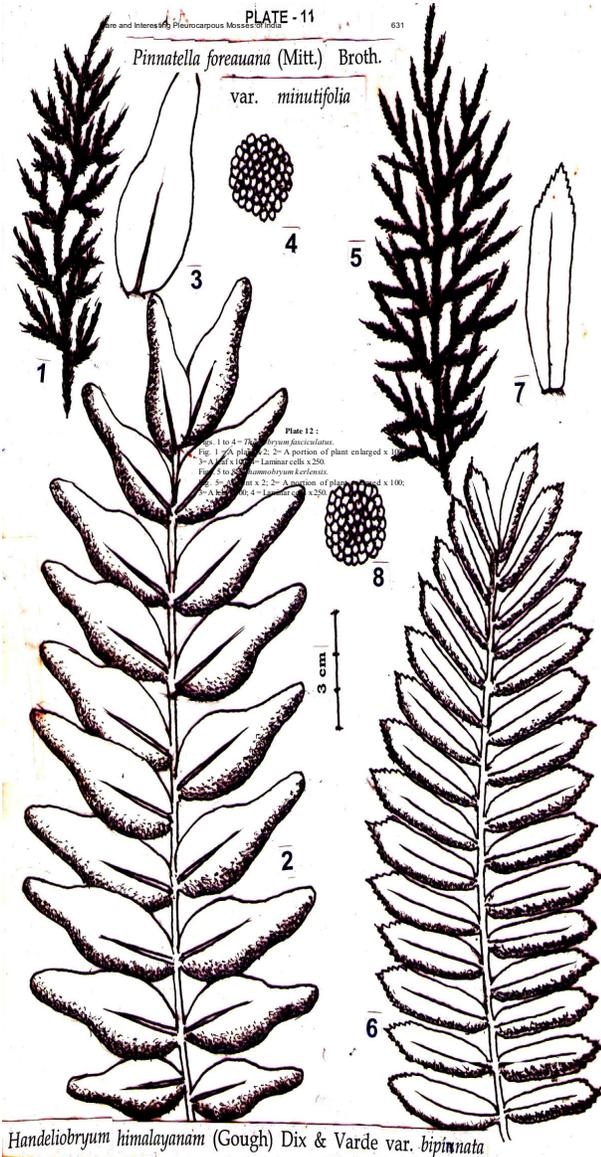


Plate 11 :

Figs. 1 to 4 = *Handeliobryum himalayanum* var. *bipinnata*.
Fig. 1 = A plant x 3; 2= A portion of plant enlarged x 100;
3= A leaf x 100; 4= Laminar cells x 250.
Figs. 5 to 8 = *Pinnatella foreauana* var. *minutifolia*.
Fig. 5= A plant x 3; 2= A portion of plant enlarged x 100; 3= A
leaf x 100; 4= Laminar cells x 250.

But, Scott and stone described this plant under plagiotechiaceae, another Moss family, as the Australian hand look on Mosses preferred this plant under this family. Brotherus included this plant in *Neckeraceae*. Lastly Scott and Stone concluded that this plant neither belongs to *Neckeraceae*, nor to plagiotechiaceae.

The study of this species from Western Ghats is a first record for India.

Holotype No. 178 dated 13.10.2015 and deposited at

B.S.I., CBE, T.N. and isotype No. 2206 kept at author's home laboratory.

15. *Homaliadelphus feruginea* (Gough) Dix & vard. var. *pulneyensis* var. nov. (plate 10)

This plant was collected at Ariyur-Cholaikkadu forests of Kollimalai Hills, a dangerous and large forest with all kinds of wild animals.

This plant looks like a thalloid Liverwort, *Targionea* in external appearance. Dixon and Pottier de la Varde

collected this plant from Tiger Shola of Kodaikanal and published in a journal *Annals. Cryptogamic Exotica* in 1928. With a name *Homaliopsis targioniana* (Gough) Dix & Varde. Later Rev. Fr. Foreau (1961) enumerated this species in his paper "The Moss Flora of Pulney Hills". But, afterwards, the name of this plant has changed, into *Homaliadephus feruginea*. The present author has found out this plant in a pocket from a large number of pockets of masses collected and given to Dr. C. Srinivasan, Professor and Head of the Department of Botany Annamalai University by Rev. Fr. Foreau in 1960. The present author has described this species with illustrations in his book "Mosses of Tamil Nadu" in 2008. Now, the present plant "var. pulneyensis" differs from the above type species in plant morphology, branching pattern of plants and leaf characters.

Holotype No. 179 dated 13.10.2015 and deposited at B.S.I., CBE, T.N. and isotype No. 2207 kept at author's home laboratory.

16. *Thamnobryum fasciculatum* (Hedw.) I Sastre (plate 11)

Thamnobryum schmidii is already known from Kodaikanal. The present plant resembles to some extent the above plant in stipitate dendriod habit but differs in unipinnate branching.

Leaf oblanceolate with apex enlarged and toothed and the nerve failing to reach the middle of the leaf. The lamellar cells spherical rhomboid; no capsule.

Buck (1998) has studied 2 species from West Indies namely *Thamnobryum fasciculatum* (Hedw.) I. Sastre and *T. tumidicaule* (K.A. Wagner) F.D. Bowers. The present plant is closely resembling the former species.

Holotype No. 180 dated 13.10.2012 and deposited at B.S.I., CBE, T.N. and isotype No. 2208 kept at author's home laboratory.

17. *Thamnobryum fasciculatum* (Hedw.) I. sastre var. keralensis var. nov. (plate 11)

It is an epiphyte with short pinnate branches on either side of the aerial stem, 12 to 15 cm tall; leaves in bifarious arrangement, stem stipulate dendriod; leaves narrow below but broader above, nerve failing to run beyond middle, apex toothed, laminar cells spherical hexagonal. This plant differs from the type species described above in general appearance of plants, leaf shape and laminar cells.

Plants collected at thick forests near Avalache Tamil Nadu and near Thiruvananthapuram, Kerala.

Holotype No. 181 dated 13.10.2015 and deposited at B.S.I., CBE, T.N. and isotype No. 2209 kept at author's home laboratory.

18. *Handeliobryum himalayanum* D.S. var. bipinnata var. nov. (plate 11)

This is a pinnately branched epiphyte, aerial branches almost stipitate dendriod; Leaf flask shaped, midrib failing to reach the tip of the leaf, laminar cells spherically spindle shaped; Capsule not seen.

This plant differs from the type species in plant morphology, leaf shape and laminar cells.

Plants collected in thick forests Naduvattam of Nilagiri Hills.

Holotype No. 182 dated 13.10.2015 and deposited at B.S.I., CBE, T.N. and isotype No. 2210 kept at author's home laboratory.

All the plants and the parts of them were drawn by the author after examination under dissection and compound microscopes.

19. *Pinnatella foreauana* var. minutifolia var. nov. (plate 11)

Plants, epiphyte, 6 to 7 cm tall, main stem crawling on bark of trees from which aerial branches arising vertically, each with 4 to 6 lateral branches on either side, in pinnate pattern; branches bipinnate; Leaf oblanceolate, tip enlarged and serrate, midrib almost percurrent, laminar cells spherical diamond shaped, capsule not seen.

This plant resembles to some extent *P. foreauana* but plant appearance, minute leaves in contrast to large size of plants and lamellar cells differ from those of above species. The author has described *Pinnatella foreauana* with diagrams for the first time in his book "Mosses of Tamil Nadu" in 2008.

Holotype No. 183, dated 13.10.2015 and deposited at B.S.I., CBE, T.N. and isotype No. 2211 kept at author's home laboratory.

Plants collected at coonoor of Nilagiri Hills.

References

- Buck, W. R. (1988). *Pleurocarpous Mosses of West Indies*.
 Chopra, R. S. (1976). *Taxonomy of Indian Mosses—An Introduction*. Publication and Information Directorate (CSIR), New Delhi.
 Foreau, G. (1961). The Moss Flora of the Palni Hills. *Jour. Bombay Nat. Hist.*, **58** (1) : 13-47.
 Scott, A. M. and G. Stone (1976). *The Mosses of Southern Australia*. Academic Press. London, New York, San Francisco.
 Subramanian, D. (2008). *Mosses of Tamil Nadu*. Bishen Singh Mahendra Pal Singh Publication, Dehra Dun, India.
 Subramanian, D. (2015). *Studies on Indian Mosses* (In press).
 Subramanian, D. (2016). "Studies on some interesting members of South Indian *Neckeraceae*. *Abs. 103rd Indian Sci. Cong. Conf. Plant Sci. Sec.* p. 105.