INTRODUCTION

The investigation was undertaken in order to get a revised and proper idea of the mosses under the order Funariales and Tubryales of Eastern India.

So far we have no consolidated idea of the moss flora of India, because there is no such monograph. In 1859 Litten first published a monograph "Husi Indiae orientalis". Since then there are only some scattered works, published in foreign papers which are sometimes even unapproachable. It is necessary to prepare a full scale monograph to form a basis for any future work on the muscology of this region. The investigation undertakes the study of all species of Funariales and Tubryales hither to known from Eastern India.

The area under investigation is shown bounded by a thick line in Map I. In the north this area spreads from Kathmandu Valley in Nepal over Eastern Nepal (16), Darjeeling-Sikkim (1), Bhutan (4) and TTA (6) right up to the northeastern tip of India. The north boundary is the snowy axis of the Himalaya with the highest peaks Mt. Everest in eastern Nepal and Mount Kinchiningba in Sikkim. The ranges above 4,500 m shows alpine type of vegetation. The ranges between 1,600 m and 4,500 m may be termed temperate. Between 1,600 and 1,000 m Vegetation is sub-tropical region ranging between tropical and temperate.
Map no. I - Area under review shown outlined in black.
The Himalayan ranges bend southwards below Tirap Division of VFA and passes on to the Saga hills (11), Manipur (10), Khasia and Jaintia hills (7), Tripura hills (9), Gero and Lusai hills (8) and Chittagong (East Pakistan) hill. Tracts ultimately passing on to the Arakan Yoma in Burma (27).

South to the Himalayan area is the plains of Ganges and the Brahmaputra Valleys. Here are North Bihar (12), West Bengal plains (2), Assam (6), East Pakistan plains (26). The western part of South Bengal is covered by dry deciduous forests. This area passes on to Chhotanagpur (13) on the West. Orissa (14) is south to Chhotanagpur. Adjacent Madhya Pradesh (15 - Bastar, Raigarh, Ambikapur, Bilaspur) has a moss flora similar to Chhotanagpur and Koraput. The Andaman (24) and Nicobar (25) Islands have been included in this area, because these are in "eastern" India, although these islands are very far. These islands form a link between Burma and Sumatra.

CHRONOLOGICAL LIST OF PREVIOUS COLLECTION FROM AREA
UPPER REVIEW

Looking into the previous collection of this area, the pioneer collector was Dr. Francis Buchanan Hamilton, who collected some Nepalese mosses during 1802-1803, before he became the Superintendent of Shibpur.
East India Company Botanical Garden. This was the first collection of mosses from India sub-continent. His collections were mainly from Kathmandu Valley of Nepal.

Dr. Nathaniel Wallich next Superintendent explored Nepal, Lower Burma and the Himalaya. 114 moss species are listed in Wall. Catalogue entries Nos. 7546 - 7658. A complete list of these mosses was published by W.H. Harvey and J.D. Hooker, while many of these were illustrated in Hooker's "Icones Plantarum" Vol - 1. (1837).

Next Assistant Surgeon of the East India Company Dr. William Griffith (1835-45), made many collections mainly from Assam and described in the Calcutta Journal of Natural history (1842-43). His collections mainly from upper Assam, Khasia, Burma, Bhutan, Sikkim, Central India and "Alacca.

Dr. J. D. Hooker (Hooker fil) accompanied by Dr. Thomas Thomson made intensive collections in Sikkim (including present Darjeeling with east Nepal) and Khasia Hills during 1847-1851.

During 1867-1871 Sulpitz Kurz, curator of the Indian Botanical Garden, collected from all over Eastern India including Rajmahal hills, Burma, Bengal and Bihar and even the Andaman Islands.
G. A. Gammie (1896-1897) collected from Sureil - Mungpoo region and from Bhutan.

In 1933-1936 Dr. N. L. Bor collected 208 species of mosses from Aka Hills in "E.F.A.," the Saga hills and some places on the way in Assam.

Walter Koelz (1949-1953) collected from Khasia hills.

In 1952 & 1954 Zimmermann made collections from Eastern Nepal.

Mr. A. H. Norkett of British Museum collected mosses from North-West hilly regions of Midnapore district and from the Sunderbans in 1966.

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The class Bryopsida is the largest class of Bryophyta, containing about 14,500 species, and has been divided into three sub-classes - (1) Sphagnidae, (2) Andreaeidae and (3) Bryidae.

The order Funariales and Eubryales the subject matter of this dissertation fall under the last series of Diplolepideae under the sub-class Bryidae and the families occurring in Eastern India may be put as follows.
Subclass - Bryidae
Series III - DIPLOLEPIDEAE
Subseries - a) Epicranoideae
ORDER - FUNARIALES
Family - 1) Ephemericaceae
2) Funneriaceae
3) Splachnaceae

Subseries - b) Metacranioideae
ORDER - EUBRYALES
Family - 1) Bryaceae
2) Opisciaceae
3) Rhizogoniaceae
4) Mesaceae
5) Bertramiaceae

The species reported from the area under investigation are described (with necessary keys etc.) and illustrated in the text.
Series III - DIPOLEPIDAE
Subseries - a) Epicranoidae
ORDER LUNARIALES

Acrocarpous diplolepideous mosses, plants usually terrestrial, small, often annual biennial, leaves often forming a terminal rosette, broad, ovate or spatulate, cells very lax, thin walled, smooth. Capsule not cylindrical and the operculum without beak. Calyptra often inflated. Peristome teeth usually in two epicranoid rings but may be in one ring or absent by reduction.

This order contains 6 (six) families of which only three are represented in Eastern India.

Key to the Eastern Indian families

1. Capsule not well differentiated
   Capsule well differentiated

2. Apophysis not clearly distinguished
   Apophysis distinct

Family 1. Ephemeraceae

Plant minute, perennial, developed on a persistent much branched green protonema, protonema may be aerial or subterranean, stem small, sometimes without a central strand, leaves lax, more or less ovate, lanceolate, lower leaves small upper ones narrow and lanceolate, may or may
not long acuminate, ribs weak or even absent. Sometimes dioicous, male plant very small, bud like, paraphyses when present thread like. Seta very small, capsule sphaerical or ellipsoidal, without neck, stomata present.

Only one Genus is represented in Eastern India.

**GENUS - NANOJTRIUM** Lindb., Not Sællsk.


**GENUS - Micromitrium** Aust. in Musci Appal. 10. (1870) hom. illeg.

Lectotype: N. austini (Gull.) Lindb. fid Grout in Moss. Fl. N. Am. 2: 70. (1935)

Plant small with persistent protonema. Leaves few, erect, laxly areolate, lower oval, upper lanceolate tapering, nerveless, entire or very slightly and obtusely serrate above. Cells thin walled, lower rectangular, upper rhomboidal to hexagonal. Seta absent. Capsule without apiculus, present of a rudimentary lid, absence of spore sac, calyptra usually very minute. Stomata none.

**GEOGRAPHICAL DISTRIBUTION OF THE GENUS NANOJTRIUM**

Index Museorum 2 (1964) records 9 valid species distributed all over the high, cool and moist regions of the earth. The distribution pattern shows greater condensation in the temperate and sub-arctic regions. Of
Map no. II - Showing the number of recorded species of *Nanomitrion* in each zone and also the distribution of *Nanomitrion tenerum* (B.S.G.) Lindb. Not reported from zones where not shown.
the 2 species known to occur in As. 3, only one species
(N. tenerum) occurs in As. 3b, and other species (brisbanicam)
occurs in Annam (As. 3c). This genus is totally absent from
Africa. In Europe only one species is present and in As. 2
also, only one species occurs. The distribution showing the
number of species in each zone is depicted in Map No. II.

Nanomitrium tenerum (B.S.G) Lindb. in Not Saellsk F. Fl.

Phascum tenerum B.S.G. in Bryol. Eur. (fasc. 1 Mon.):
6. (1836).

Ephemerum longifolium Phflib. in Rev. Bryol. 5 : 48.
(1878) hom. illeg.

Nanomitrium longifolium Limpr. in laubm. Deutschl.
1 : 164. (1885) nom. inval. in Eynon.

Plant very small about 1.3 mm. long. Stem erect,
minute, rhizoid present on base. Grows on mud near ponds.
Leaves few, laxly oriented, lower ovate, upper lanceolate
tapering, about 0.8 m.m. long and 0.12 m.m. broad. Margin
flat, entire lower, very slightly and obtusely serrate above.
Costa absent. All cells thin walled, lower cells large
wide, rectangular + .12 to .14 m.m. long and + .038 m.m.
broad, gradually becoming shorter and narrower towards apex
where they are + .076 to 0.1 m.m. long and + .022 m.m. broad.
Perichaetial leaves not differentiated. Seta very short,
Fig. 1. *Nanomitrium tenerum* (B.S.G.) Lindb.
(Drawn after charrier 333).

LBC = leaf base cells. LA = leaf apex.
about 0.13 m.m. long. Capsule immersed, globose, about 0.29 m.m. long and + 0.022 m.m. broad. When fresh minutely apiculate, pale brown. Calyptra very small. Spores small, sub-tetrahedral 20/4 to 30/4 in diameter.

The plant though superficially resembling Ephemerum, is rightly separated on account of some structural differences of some considerable importance. In Ephemerum the capsule is always more or less differentiated into outer case and spore sac, the enveloping membrane consisting at least of two layers; in Nanomitrium there is only a single layer of cells, thus representing a stage at least as simple as in Archidium. The only approach to a capsule apiculus is a single cell or at the most three or four, forming a slight thickening at the summit of the capsule.

A rim of small differentiated cells round the upper part of the capsule forms a line of least resistance where, upon a slight pressure, the upper part separates in the form of a lid. This was also noted by Salmon (1900) and Dixon (1924).

Distribution of Nanomitrium tenerum
(map no. II)

As3b - Assam Cole. 7. 13. 21 (Jorhat)
Europe, North America, China, Japan and Korea (Eur.; As.2, 3b.; Am.1).
Family 2. **Funariaceae**

Plants may be small or large usually with wide soft leaves and lax areolation, upper leaves large sometimes forming rosette, ribs thin small acuminate, capsule globose, oval or pyriform, erect and symmetrical or cernuous and unequal, usually with a distinct neck, narrower than the capsule, cleistocarpous, gymnostomous or peristome, inner peristome when present of 16 separate processes, entirely without a basal membrane and opposite to the teeth, not alternating. Calyptra usually inflated smooth with a long beak, lobed or cucullate, spores large.

**TAXONOMIC TREATISE**

This family Funariaceae is somewhat related to the family Ephemeraceae, specially in the case of species, which have immersed capsules, but there is some clear distinction between these two families in the following points - in Ephemeraceae "plants exceedingly minute and inconspicuous, generally stem-less plant growing from a persistent much branched protonema which consists mainly of a bud like cluster of leaves" (Grout 1935), but in Funariaceae protonema is not persistent and gametophyte is completely differentiated.
Brotherus (1924) reported 9 genera in Funariaceae and another genus Eackymeniopsis was added later (1929) by him. In this present paper only 2 genera (Physcomitrium & Funaria) have been considered because these two only are represented in Eastern India. Brotherus (l.c.) included the genus Entosthodon in Funaria. This has been followed in this paper although Grout (l.c.), Crum & Anderson (1955), Nyholm (1956), Crum, Steere & Anderson (1965) and Ochi (1968) kept Entosthodon separate.

Key to the Eastern India genera

1. Operculum not differentiated ... 1. Physcomitrium
   Operculum well differentiated ... 2. Funaria

GENUS - PHYSCOMITRIUM (Brid.) Fuernr., in Flora 13 (2 Erg. bl.) : 9. (1829).

Subgenus - Gymnostomum Brid. in Bryol.

univ. 1 : 97 (1826).

(Lectotype : Physcomitrium sphaericum (Ludw.) Fuernr.

Plant erect, small, leaves lax, when dry contracted, erect when moist, leaves obovate, concave or ovate, acuminate, calyptra small, covering about half the capsule, fugacious, symmetrical, 2-3 lobed (rarely more) at base,
Map no. III - Showing the number of recorded species of Physcomitrium in each zone.
capsule erect, symmetrical, lid apiculate or rostellate, cells arranged in straight lines from the centre to the circumference, peristome none.

**GEOGRAPHICAL DISTRIBUTION OF THE GENUS PHYCOMEITRIUM**

Index *fuscorum* 4 (1967) records 20 valid species distributed all over the high, cool and moist regions of the earth. The cosmopolitan distribution showing the number of species in each zone in *fcp no. III, shows dispersed distribution of the species in tropical, temperate and sub-arctic regions of the earth. 8 species occur in India (As. 3) of which 5 species are from eastern India (As. 3b). One species *saharanpurense* is recorded from western Himalaya (As. 3a) near Saharanpur, other species *insigne* from South India (As. 3d). Ceylon seems to be too warm for *Phycomitrium*.

**GENUS - PHYCOMEITRIUM** (Brid) Fuernr., in *Flora* 13 (2 Erg. bl.) : 9, (1829).

**Subgenus - Phycomitrium**

**Section I - CRYPTOXYXIS** C. 'uell., in *Gen. *fusc. 110. (1900).

1. *P. indicum* (Dix. in) Gangulee
2. *P. cyathicarpum* litt.
Section II - PHYSCO:ITRIUM (brid) Fuer.rr.

3. P. coarzense Broth.
4. P. japonicurn (Hedw) Mitt.
5. P. repandum (Griff) Mitt.

Key to the Eastern Indian species

1. Seta short, not projected beyond perichaetial leaf - 2
   Seta long, capsule projected beyond perichaetial leaf - 2

2. Plant thin delicate 1. indicum
   Plant sturdy 2. cysticarpum

3. Capsule mouth wide, cells near urn 2 to 4 rows, transversely wide
   Capsule mouth not wide, when dry contracted near urn and many rows of small rectangular cells present near urn - 4

4. Leaves clearly acuminate, basal portion not folded 4. japonicum
   Leaves acuminate, basal portion folded 5. repandum
Fig 2. *Physcomitrium viridum* (Dix in Gupta) Gangulee Drawn from Gangulee 6049. Sp is a young sporophyte without any line of dehiscence of operculum from Gangulee 6052. P3 is a sterile plant. L shows a lower and an inner leaf.
GENUS - *PHYSCOMITRIUM* (Brid) Fuernr. in Flora 13 (2 Erg. b1) : 9 (1829)

Subgenus - *Gymnostomum* Brid in Bryol. univ. 1 : 97 (1826)

(Lectotype - *P. sphaericum* (Lud.) Fuernr. fid Grout. in Moss Fl. N.Am. 2 : 74 (1935)

SUBGENUS - *PHYSCOMITRIUM* (Brid) Fuernr.


Calypttra larger, covering upper half of capsule.

SECTION I - *CRYPTOPYXIS* C. Müll. in Gen. Musc.

Fr. 110. (1900)

Seta short, capsule immersed within perichaetal leaf.

1. *Physcomitrium indicum* (Dix. in Gupta) Gangulee Comb. nov.


Basionym: *Physcomitrellopsis indica* Dix. in Gupta


Plant small, slender, weak, closely gregarious, bright green. Stem small 2 m.m. long, tomentose below, erect, soft. Leaves laxly arranged, lower smaller, upper larger, narrow, erecto-patent, both moist and dry, concave, from a narrow base obovate, acuminate, serrated above, sometimes whole leaf serrated, lower leaves smaller 1.3 m.m. long and ± .3 m.m. broad, nerve vanishes well below apex and in mature leaf costa ended just at apex, narrow but distinct. Upper leaves recurved,
Fig 3 Physcomitrella patens Mott. Drawn from Gs.340a L. and
larger ± 2.1 m.m. long. Cells thin walled, wide, rectangular at base, ± .09 m.m. long and ± .02 m.m. broad, gradually becoming narrower towards apex ± .14 m.m. long and ± .018 m.m. broad, rhomboid to hexagonal, marginal cells not distinct. Calyptra erect, 2 to 3 lobes, smooth. Seta erect ± .8 m.m. long, short, not projected beyond leaf. Capsule globose, roundish, oval, ± 1 m.m. long and ± .5 m.m. in diameter. Operculum small, conical ± .43 m.m. long, has a distinct line of dehiscence. Spores round and flat, brown, papillose .032 m.m. to .035 m.m. in diameter.

**Distribution of the species**

(Map no. IV)

As3b - Hoogli (Champadanga) - G 6042, 6173
Nadia (Ranaghat) - G 6052
Murshidabad - G 6054, 6055
Maldah (Khojuriaghat)- G 6056

Only in As3b.

2. Physcomitrium cysthecarpum Mitt. in Musci. Ind. or : 54 (1859)

Plant sturdy, (small but robust) closely cregarious, often in wide patches, bright green, smaller, stem slender short, erect, soft, generally 4.5 m.m. long. Leaves several, smaller and distantly arranged on the lower part of stem, more clustered above, erect spreading both dry and moist,
Map no. IV - Showing the distribution of *Physcomitrium indicum* (Dix. in Gupta) Gangulee. (●) and *P. cyathicarpum* Mitt. (■).
+ 3.6 m.m. long, oblong-obovate, acuminated, lower entire, obtusely serrulate above. Costa strong, ending just at apex. Perichaetial leaves not differentiated. Lamina cells thin walled, rectangular to rhomboidal + .18 m.m. long and + .04 m.m. broad, becoming more narrower and shorter, and sometimes hexagonal to ovo-rostrate apical region + .09 m.m. long, border cells not differentiated. Seta slender, short + .6 m.m. long.
Capsule globose with thick neck + 1 m.m. x + .8 m.m., mouth small. Operculum apiculate, calyptra not lobed, smooth. Exothecial cells thin walled, hexagonal to collenchymatous + .024 m.m. to .028 m.m. in diameter, round, flat and papillose.

Distribution of the species
(Map no. IV)

As3b - Calcutta ... - G 6064
24 Pgs. (Barasat) - G 6133
Hoogli (Champadanga) - G 6053
Nadia (Kalyani) - G 6074
Rajasthan, Jaipur, Swai Madhopur. (As. 3a. 3b.)

SECTION II - PHYSCOMITRIUM (Erid.) Fuernr.

Section - Physcomitrium (Erid.) C. Fowell.

Linnaea 12 : 694. (1845)

Seta long, capsule projected beyond perichaetial leaf.
Map no. V - Showing the distribution of *Physcomitrium* coarserose Broth. (▲).
Fig. 4. *Physcomitrium coorgenese* Broth.
(Drawn after G 2403)

$P_2$ and $P_D$ = magnified normal and dry plant.

$P_1$ = natural size plant. $L$ = leaf, $C$ = capsule.

$L_{bc}$ = leaf base cells. $L_A$ = leaf apex.

$C_c$ = capsule cell. $op$ = operculum. $Sp$ = spore.

Closely gregarious, stem simple, very short up to 4 m.m. bounded by rhizoids at base. Stem little branched, leaves close, erecto-patent or spreading, rather large, concave, from a narrow base obovate lanceolate, acuminate, margin clearly serrulated, lower leaves small, upper leaves large ± 2.8 m.m. long and ± .42 m.m. wide, margin strong, continuous, ended at apex, small acuminate cells at base large, rectangular ± .11 m.m. long and ± .03 m.m. wide, becoming shorter and rhombooidal towards apex ± .03 m.m. long and ± .01 m.m. wide, cells gradually becoming narrower towards margin. Perichaetal leaves larger. Seta long, red about 5 m.m. Capsule sphaerical, about 1 m.m. long and 1 m.m. in diameter, capsule mouth wide. Peristome none, cells of exothecium transversely wide up to 2 to 4 rows compressed, thick walled. Spores medium sized .022 m.m. to .026 m.m. in diameter, outer surface rough.

**Distribution of the species**

(Map no. V)

As3b - Darjeeling - 0 2403

South India (Coorg)

Endemic in India (As. 3b, 3d)
Fig. 5. Physcomitrium japonicum (Hedw) Mitt.
(Drawn after G 3563)
P₂ and P₃ = magnified normal and dry plant.
L₁₋₃₀ = leaf base cells. L₄ = leaf apex.
Cc = capsule cell. op = operculum. Sp = spore.

Physcomitrium subacuminatum Broth. in Hedwigia, 38: 217 (1899)

Gymnocitum japonicum Hedw. in Spec. Masic. 34. 1f. 7-9 (1891)

Physcomitrium pulchellum (Griff) Mitt. in Masic. Ind. or: 54 (1899)

Plant simple. Stem very short about 5 m.m. long with rhizoids at base, stem unbranched. Leaves closed, congested, erecto-patent, spatulate-lanceolate + 2.1 m.m. long and + 1 m.m. wide at base, margin little serrulate, leaves flat, without border rows, nerve narrow distinct, ends at apex, small acuminated and excurrent, cells long, rectangular and wide at base + .1 m.m. long and + .038 m.m. wide, smaller and rhomboidal towards apical region + .045 m.m. long and + .022 m.m. wide, slightly narrower towards margin. Seta short 5 m.m. long. Capsule small, pear shaped, + 2 m.m. long and + 2 m.m. in diameter, mouth not wide, constricted when dry, near capsule mouth many rows small rectangular cells present, operculum conical, spores 19μ - 22μ in diameter, outer surface rough.
Fig. 6. *Physcomitrium repandum* (Griff) Mitt.
(Drawn after H. Ben 2499)


*Lbc* = leaf base cells. *La* = leaf apex.
Distribution of the species

(Map no. VI)

As3b - Assam - Griffith.
Darjeeling - G 3563

Korea, Japan, China, Western India (Gorakhpur), Formosa.
(As 2, 3a, 3b) An-indo-Sino-Japanese species.

5. Physcomitrium repandum (Griff) Mitt. in Musc. ind., orientalis 1: 54 (1859)
Gymnostomum repandum Griff. in Calcutta. J. Nat. Hist. 2: 418 (1842)

Stem simple, very short up to 5 mm long bounded by rhizoids at base. Leaves close, erecto-patent congested above, spatulate, lanceolate, ovate or obovate ± 2 mm long and ± .3 mm broad, acuminate, folded at the basal region, margin entire in the lower portion and serrulated above, margin not clearly bordered, nerve prominent and thin, vanishing just below apex, cells irregular large and more or less rectangular at base ± .057 mm long and ± .019 to .03 mm wide, becoming hexagonal - rhomboidal at apical region ± .038 mm long and ± .026 mm wide, narrower towards margin. Seta short ± 5 mm long, reddish brown.
Capsule reddish brown ± 2 mm long and ± 1.5 mm in diameter, turbinated, operculum convex, mamillate, neck of
Map no. VI - Showing the distribution of Physcomitrium japonicum (Hedw) Mitt. ( • ) and P. repandum (Griff) Mitt. ( •• ).
the capsule rather short but distinct. Calyptra erect with 3 to 4 fissures.

**Distribution of the species**

(Map no. VI)

As3b - Upper Assam - Griffith
Nepal ... - Wallich
Tonkin, China (As 2, 3b, 3c).

**GENUS - FUNARIA** Hedw. in Spec. Musc. 172 (1801)

(Lectotype - Funaria hygrometric Hedw.)

Short stemmed plants, leaves rather wide, cells large, resembling *Physcomitrium* in the vegetative part, calyptra inflated at base, covering most of the mature fruit, finally oblique, cucullate, otherwise entire at base, yellowish. Capsule pyriform, erect, and symmetrical or oblique and curved, lid plano-convex, rarely distinctly apiculate, cells arranged in spiral lines from the centre to the circumference. Peristome may be single, double or none; outer teeth 16, often twisted obliquely to the left, sometimes united near tips; inner peristome when present of 16 processes opposite the teeth, without a basal membrane.

**GEOGRAPHICAL DISTRIBUTION OF THE GENUS FUNARIA**

Index Muscorum 2 (1962) records 227 valid and nom. nud species distributed all over the high, cool and moist
Map no. VII - Showing the number of recorded species of Funaria in each zone.
regions of the earth. The cosmopolitan distribution showing the number of species in each zone is depicted in Map no. VII. The distribution pattern seems to show greater condensation in the tropical and temperate zone towards South, gradually spreading above along the sub-arctic zones of the north. Of the 18 species occur in As 3, only 3 species Funaria hygrometrica var. lentopoda, F. wallichii and F. nutans are known in the Eastern Himalayas (As 3b). 14 species are known to occur in As 3d of which 11 species occur in South India and 3 species from Ceylon, one species (Capillipes) from Kashmir. 8 species are known to occur in As 2, and 11 species from As 4. F. hygrometrica is a cosmopolitan species.

\[\text{Subgenus I} \quad \text{FUNAPIA Hedw.}\]

\[\text{Section} \quad \text{FUNARIA Hedw.}\]

1. Funaria hygrometrica Hedw.

\[\text{Subgenus II} \quad \text{ENTOSTHODON (Schwaegr) Lindb.}\]

\[\text{Section 1} \quad \text{ENTOSTHODON (Schwaegr) Braithw.}\]

2. F. wallichii (Mitt) Broth.

\[\text{Section 2} \quad \text{MICROPXYIDIUM Broth.}\]

3. F. nutans ("Mitt") Broth.
A complete Key to the Eastern Indian Species:

1. Capsule strongly asymmetric, deeply furrowed when dry with oblique mouth and double peristome (Subgenus Lunaria) Lid convex
   - 1. hygrometrica

Capsule nearly symmetric, with horizontal mouth and single or no peristome
(Subgenus Entosthodon) - 2

2. Medium sized plant, capsule about 1.5 mm. long without evident teeth - 2. wallichii

Minute plants, a few millimeters high, urn of capsule short, hemisphaerical, membranous - 3. nutans

GENUS - LUNARIA Hedw. in Spec. Musc. 172. (1801)
(Lectotype - F. hygrometrica Hedw.)

SUBGENUS I - FUNARIA Hedw.

Subgenus - Funaria Lindb. in Musc. : cand., 18. (1879) nom. illeg.

Capsule asymmetrical

SECTION - FUNARIA.

Section - Funaria Sitt. in J. Linn. Soc. Bot. 12 : 246 (1869) not. illeg.
Fig. 7. Funaria hygrometrica Hedw.
$P_1$ = natural size normal plant. $P_2$ and $P_D$ = magnified normal and dry plant. $P_m$ = male plant. 
$P$ = Funaria leptopoda Griffith. $C$ = capsule.
$L$ = leaf. $L_p$ = perichaetial leaf. $L_{bc}$ = leaf basal cells. $L_A$ = leaf apex. $P_T$ = peristome teeth.
$O_n$ = operculum.
Section - Annulatae Kindb. in Eur. N. Am. Bryin

Capsule deeply furrowed when dry.

1. *Furaria hygrometrica* Hedw. in Spec. Musc. 172. (1801)

*Furania hygrometricum* (Hedw.) L. ex with, in Syst.

*Furaria endroga* Brid. in Bryol. Univ.

F. campylopus Brid. in Bryol. Univ. 2 : 739. (1827).
F. ramificans Brid. in Bryol. Univ. 2 : 738. (1827).

5 : 175. (1897)

n. Ser. 5 : 161. (1898).
F. pracilescens Schimp. ex C. Muell. in Bot. Zeit.

16 : 154. (1858).
F. marcinate Kindb. in Bih. K. 5 vensk. vet. Ak.

Handl. 7(9) : 79. (1883).
F. angustifolia Brid. in Spec. Musc.

2 : 71. (1817).
F. lonchopelma C. Muell. in Hedwigia

38 : 61. (1899).
F. leptopoda Griff. in Calcutta J. Nat. Hist. 2 s 512. (1842).


Stem short about 10 m.m. in height, loosely or closely tufted in large patches bounded by rhizoids at base growing on earth, little bunched. Leaves yellowish green, upper leaves imbricated into a bulbiform tuft, concave, large, widely oblong, shortly pointed, entire, leaves uneven size, lower leaves small, costa strong ended at apex, cells sub-hexagonal, longer at base ± .18 m.m. long and ± .027 m.m. broad, somewhat shorter towards apical region ± .04 m.m. long and ± .02 m.m. wide, little narrower at margin ± .01 m.m. broad, marginal cells obtusely protruding above but not forming acute serratures. Seta long 21 m.m. long, flexuose, variously arcuate when young, lastly becomes reddish flexuose, strongly twisted and hygroscopic when dry. Capsule pyriform, unequal, oblique, gibbous at back ± 4 m.m. long and ± 2 m.m. in diameter, strongly incurved at mouth, deeply sulcate when dry, yellow with a deep red mouth, finally becomes brown, annulus broad, lid convex, large, peduncle arcuate. Peristome teeth arranged closely, obliquely and spirally, outer teeth ± .58 m.m. long and ± .09 m.m. broad at base, inner ones almost of equal length with the outer, spines united by a
Map no. VIII - Showing the distribution of Funaria hygrometrica Hedw. (○) and F. nutans (Mitt) Broth. (●)
small central disc, processes shorter than the teeth. Spores rather small. Autoicous, male flower discoid with spreading bracts.

Funaria leptopoda Griffith, has been reported that the capsules are more erect, but sometimes may be pendulous also, though considered as separate species, should be considered as a variety of Funaria hygrometrica Hedw., and found commonly on semiexposed ground, though it can grow on rocks, walls etc. It is often found as the first vegetation on burnt upland in these areas, specially where ashes present.

**Distribution of the species**

(Map no. VIII)

As3b - Sikkim ... - J.D. Hooker - 334, 365
Khasia hills - J.D. Hooker and T. Thomson 343, 349
Western Himalaya (Simla), Ceylon, West Tibet.

Cosmopolitan.

**SUBGENUS II - ENTOSTHODON** (Schwaegr) Lindb. in Musci
Scan. 18. (1879).

**Genus - Entosthodon** Schwaegr in Spec.
Musc. Suppl 2(1) : 44. (1823).

Peristome either absent or rudimentary, when present simple.
Fig. 8. Funaria wallichii (Mitt.) Broth.
(Drawn after G 3538)

Lₑc = leaf base cells. Lₐ = leaf apex.
Cₑ = capsule cell.
SECTION I - ENTOSTHODON (Schwaegr) Braithw. in Brit. Moss Fl. 2: 130. (1890).


Section - Entosthodon Broth. in Nat. Pfl. 1(3): 522. (1903).

- Plant medium size.

Furnaria wallichi (Mitt.) Broth. in Nat. Pfl. 1(3): 525. (1903).


- Stem laxly gregarious or tufted, upto 6 m.m. long, rhizoidus. Upper leaves forming a rosette, spreading when moist, erect when dry, distantly arranged in the lower portion of the stem, leaves rather narrow, ovate, lanceolate, acuminate ± 1.2 m.m. long and ± .2 m.m. wide, nerve thin delicate ending above apex forming a short arista. Perichaetial leaves somewhat larger than vegetative leaf, upto ± 1.4 m.m. long and ± .4 m.m. wide, cells of leaf base wide, rectangular to rhomboidal ± .022 m.m. long and ± .015 m.m. broad, thin walled, gradually becomes longer and narrower towards apical region, apical cells hexagonal to rhomboidal thin walled ± .076 m.m. long and ± .007 m.m. wide, tip acuminate, about
Map no. IX - Showing the distribution of *Funaria wallichii* (Mitt) Broth.(a).
+ .18 m.m. long, and + .02 m.m. broad, cells near margin narrower forming a distinct but less pronounced border; cells at margin obtusely protruding above, but not forming acute serratures. Seta + 14 m.m. long, reddish brown, slender, flexuose, slightly inclined. Capsule erect or slightly inclined reddish brown, solid opaque texture, oblong, + 3 m.m. long and + 1 m.m. in diameter with a long tapering neck, contracted below the mouth when dry. Peristome rudimentary, cells of exothecium rectangular.

Distribution of the species

(Map no. IX)

As3b - Nepal - wellich
Darjeeling - G 3538
K + J hills - Griffith (Lalylankot 6,000 ft.)

Koelz, 23310

Shillong - Bor. 200

Western India (Tehri U.P.)

An Indo-Nepalese species.

(As 3a, 3b).
Fig. Panama nitens (Mitt.) Broth Drawn from Gasquez 5009 & 6048. 
C = capsule mouth cells.
MINUTE PLANT WITH MINUTE CAPSULE.

Funaria nutans (Mitt.) Broth. in Nat. Pfl. 1(3): 522 (1903).

Entosthodon nutans Mitt. in Musc. ind. or.: 55 (1859).


(1857) nom. nud.

Plant small, slender. Stem small about 2 mm. in length, bounded by rhizoids at base. Leaves closely arranged to the stem, leaf narrow long about 4 mm. long and .39 mm. broad, lanceolate, leaf margin entire, erecto-patent when moist, slightly reflexed when dry, nerve thin, delicate and continuous forming a long capillary tip ± .46 mm. long. Cells laxly arranged, rhomboidal ± .07 mm. long and ± .01 mm. wide at apical region, somewhat longer and wider at base ± .11 mm. long and ± .02 mm. broad, leaf not bordered, all cells more or less thin walled. Seta short thin glossy and reddish about 5 mm. long. Capsule small about 1 mm. long and 1 mm. in diameter, half sphaerical, mouth large with a small neck, mouth slightly contracted below when dry. Peristome absent, cells of exothecium upto 2 to 3 layers, transversely elongated, rest cells wide rectangular to hexagonal, operculum plane.
Distribution of the species (Map no. VIII)

As3b - Chhotnagpur (Pareshnath) - G 5009
Hoogli - G 6048, 6050, 6174
Nadia (Ranaghat) - G 6051

Northeastern India (U.P.), W. Pakistan (Lahore), Rajasthan, Jaipur, Africa (Sudan).
(AF, As 3a, 3b).

Family 3 - Splachnaceae

Small or medium sized plants, leaves broad, flaccid with lax, more or less hexagonal and smooth areolation, leaves shrunk when dry, costa ending below apex or excurrent. Seta elongated. Capsule erect symmetrical with a short or long neck, and with a distinct apophysis. Peristome none or when present single, composed of 16 teeth with the teeth usually in pairs, lid conic or rostrate. Calyptra naked or pilose, entire, conical or cucullate.

This family again divided into 4 subfamilies -
1. Splachnocybroideae. 2. Voitioideae. 3. Taylorioideae
4. Splachnoideae.
Key to the Subfamilies
(after Engler)

A. Small plant, capsule with small neck, operculum differentiated - I Splachnobryideae

B. Plant compact, capsule with small neck, operculum not differentiated, calyptra large, cucullate, capsule and upper end of seta closely enveloped - II Voitidioideae

C. Capsule with long neck, operculum differentiated, calyptra small, conical.
   1. Capsule without apophysis - III Tayloriideae
   2. Capsule with apophysis - IV Splachnoideae

Subfamily: I Splachnobryideae

Dioicus, male flower bud-like, small plant, leaf with blunt apex, capsule with very small neck, operculum differentiated, calyptra small, conical. Minute plants, leaf apex broadly rounded.

Key to the Eastern Indian Genera

1. Upper leaf cells papillose, peristome none - 1.
2. Leaf cells smooth, peristome present - 2.
Map no. X - Showing the number of recorded species of Gymnostomiella in each zone. Not reported from zones where not shown.

(Lectotype : G. vernicosa (Hook) Fleisch.)


Two species found in India, of which only one is the representative of Eastern India.

GEOGRAPHICAL DISTRIBUTION OF THE GENUS GYMNOSTOMIELLA

Index Muscorum (vol. -2) 1962 recorded 6 valid species of Gymnostomiella, distributed all over the world, except Europe and Australia. This genus is distributed in tropical and temperate regions, being completely absent in the frigid zones. The distribution showing the number of species in each zone in Map no. X. Out of 6 species 2 species are known to occur in India of which only 1 species occurs in Eastern India (vernicosa) other species (burmensis) occurs in Burma (As. 3c). Two species are known in As. 2 and two in As. 4.
Fig. 10. Gymnostomiella vernicosa (Hook) Fleisch.
(Drawn after G 3095)
P = sterile plant both natural size and magnified.
P_1 = natural size fertile plant. P_2 and P_3 = magnified normal and dry plant. C = capsule. L = leaf.
G = gemmae. L_Bc = leaf base cells. L_A = leaf apex.
C_0 = capsule cell. L_m = merichaetial leaf.

Gymnostomum vernicosum Hook. in Icon pl. Har 17 f. 4. (1836).


Pottia vernicosa (Hook) Hamp. in C. Muell., in Syn 557. (1849).


Minute delicate plants in thin mats. Stem delicate upto 2 m.m. long, branched, bounded by rhizoids at base. Leaves distant, except in comal tuft, where the leaves are closely aggregated together, leaves minute ± .2 m.m. long and ± .06 m.m. broad, obovate, concave erect when moist, closely appressed to stem when dry, lower portion of leaf entire, upper half dentate-crenulate, costa short and faint, ending near midleaf; basal cells elongated, rectangular, smooth and hyaline ± .02 m.m. long and ± .008 m.m. in breadth, upper cells rectangular to hexagonal with firm yellowish walls ± .01 m.m. long and .01 m.m. wide also sparsely but coarsely papillose. Perichaetial leaves spathulate, larger than the vegetative leaf ± .71 m.m. long and ± .15 m.m. broad. Sterile plants found with numerous club-shaped gemmae ± .22 m.m. long.
Map no. XI - Showing the distribution of *Gymnostomiella vernicosa* (Hook) Fleisch. (Δ)
and + .073 m.m. broad on the stems and rhizoids. Seta solid yellowish 4 m.m. long, twisted on the right side, vagina ovoidisch. Capsule regular erect, ovoidisch, solid membraneous reddish brown, 1.5 m.m. long and .5 m.m. in diameter without neck, lid rostrate. Capsule mouth small. Peristome absent, cells of exothecium thin walled parenchymatous hexagonal and regular, columnella present. Spores irregular, sphaerical, yellowish brown, papillose. Dioicous, male flower terminal through innovation. Antheridia small, thick and stalked.

**Distribution of the species**

(Map no. XI)

As3b - In Nepal - wallich cat. n. 7549
Calcutta - Gangulee 3095, 3082
Ranchi - 6 2466

N.W. Himalaya, (United Province), Bombay, Burma, Singapur, Ambaina, Philippines, (As 2, 3a, 3b, 3c, 4). An Indo-Malayan species.


(Lectotype: **SPLACHNOBRYUM OBTUSUM** (Brid) C. Vuell. fid Braithw. J. Bot. 10 : 194. (1871).

Dioicous. Small plants in soft, lax tufts, male flower bud like, terminal and without paraphyses. Stems laxly foliate,
Map no. XII - Showing the number of recorded species of *Splachnobryum* in each zone. Not reported from zones where not shown.
bounded by rhizoids at base. Leaves oblong or spatulate, rounded and usually crenulate at apex; costa slender ending below apex, cells lax, smooth, thin walled, sub-hexagonal above, larger and rectangular at base. Seta long, slender and erect. Capsule ovoid or cylindric, erect. Peristome teeth 16, papillose, deeply inserted, lid short, conical. Calyptra cucullate.

**GEOGRAPHICAL DISTRIBUTION OF THE GENUS SPLACHNOBRYUM**

Index luscorum (Vol. -4, 1967) recorded 41 valid species of *Splachnobryum* distributed all over the world, except in a few regions. It was found that maximum number of species distributed in the Tropical region, less amount of species are found in Temperate and Sub-arctic regions. In arctic region no species was found. The distribution showing the number of species in each zone in Map no. XII. Out of 41 species, 5 species are known to occur in As 3, of which only 3 species (*S. indicum*, *S. flaccidum* and *S. assamicum*) occur in As3b (Eastern India). One species (*siamense*) occurs in Siam (As 3c). 3 species are known to occur in As2 and 8 in As4. Only one species in As5.

**Key to the species of the regions**

1. Leaf margin recurved
   Leaf margin plane

   ... 1. *S. indicum*

   ... 2.
Fig. 11. *Splachnobryum indicum* Hamp. et. C. Muell.
(Drawn after G 5959)
2. Leaf pale, delicate, soft  ...  2. S. flaccidum
Leaf not pale.  ...  3.
3. Nerve reaching close to  ...  3. S. asaeamicum
the apex


Plant slender, delicate, soft in dense tufts, pale green without lustre. Stem short, soft, delicate about 5 m.m. long, laxly foliate and sparingly radiculose below. Leaves when moist erecto-spreading; slightly contorted, and appressed to stem when dry, simple, 1 m.m. long and .3 m.m. broad, cymbiform, concave, oblong, lingulate, with obtuse tip to pointed tip, margin narrowly revolute on one or both side from near base about 2/3 up, leaf cells lax, basal cells prosenchymatous, hexagonal, wide upto .1 m.m. long and .01 m.m. broad, gradually becomes smaller and thick walled towards apex, chlorophyllose, ± .045 m.m. long, ± .008 m.m. broad, marginal rows become sub-quadrate and short rectangular ± .028 m.m. long and ± .008 m.m. broad; costa slender ending below tip. Perichaetial leaf narrow and constricted backwards. Seta 4 m.m. long, reddish yellow. Capsule erect, small, almost cylindric 2 m.m. long and 1 m.m. in diameter, somewhat crooked, thin membranous with small neck, mouth contracted. Peristome present, simple, deeply inserted into the mouth, narrow, linear lanceolate,
Fig. 12. *Splanchnobryum fleccidum* (Harv) Braithw.
(Drawn after Parish 4)

$P_1$ = natural size normal plant. $P_2$ and $P_D$ =
magnified normal and dry plant. $C$ = capsule.
$L = leaf. L_{BC} = leaf base cells. L_A = leaf apex.
papillose ± .13 m.m. long and ± .01 m.m. broad at base, distantly placed, articulated. Calyptra conical, cells of exothecium wide, thin walled, rectangular to hexagonal. Dioicous, male flower bud like, first terminal later becomes lateral, through innovations. Antheridia ± .46 m.m. long and ± .08 m.m. broad without paraphyses.

**Distribution of the species**

(Map no. XIII)

- **As3b** - In Bengal - (Calcutta) - Gangulee 5959
- **Orissa** - (Puri) - G 3682

India and Java (As3b, 4).

2. *Sphagnum flaccidum* (Harv) Braithw. in *Grevillea 1(2) : 28 (1872) (VIII)


Plant tufted, slender, delicate, soft, full green. Stem short, delicate with innovations about 8 m.m. long, laxly foliate and sparingly radiculose below. Leaves erect spreading when moist, and closely appressed to the stem when dry, leaves very flaccid, thin and pellucid, simple ± 1 m.m. long and ± .2 m.m. broad, concave, oblong, linsulate with obtuse to pointed tip, margin flat, plane, entire, upper half slightly
Fig. 13. *Sphagnum aspericulum* Dix.
(Colored after Dix, 162 co-type specimen)
P<sub>2</sub> and P<sub>D</sub> = magnified normal and dry plant.
P<sub>L</sub> = natural size normal plant. L = leaf.
L<sub>BC</sub> = leaf base cells. L<sub>A</sub> x 40 = showing acute leaf apex. L<sub>A</sub> x 100 = leaf apex cells.
serrulate, cells lax, basal cells prosenchymatous, rectangular to hexagonal, ± 0.06 m.m. long and ± 0.007 m.m. broad, gradually becomes smaller and thick walled at apex, chlorophyllose, ± 0.015 to 0.019 m.m. long and ± 0.007 m.m. broad, marginal rows sub-quadrate to short rectangular ± 0.007 m.m. long and ± 0.003 m.m. wide; costa slender, thin ending below apex. Seta 5 m.m. long, reddish yellow. Capsule erect, cylindric, small 2 m.m. long and 0.5 m.m. in diameter, somewhat crooked when dry. Capsule mouth wide; operculum conical. Peristome present simple, deeply inserted into the capsule mouth, narrow, linear, lanceolate, papillose, distantly placed, articulated, cells of exothecium wide, thin walled, rectangular to hexagonal.

Distribution of the species
(Map no. XIII)

In As3b - In Nepal - Dr. Wallich 2688
India and Burma (Asia 3b, 3c).


Plant small, delicate, soft, loosely tufted, pale green, without lustre. Stem erect, soft, delicate, 12 m.m. long, simple, laxly foliate and radiculose below. Leaves erect spreading, slightly contorted when dry about, 1.6 m.m. to 2 m.m. long and 1 m.m. broad, very narrow lingulate, shortly well
Map no. XIII - Showing the distribution of *Splachno-
brvum indicum* Hamp. et C. Muell. (©), *S. flaccidum* (Harv) Braithw (▲) and *S. assamicum* Dix. (●).
acuminated, concave, margins narrowly recurved on one or both side in lower half, minutely crenulate at apical region. Costa strong, continuous, green ended just at apex, cells lax, with thin, delicate walls, chlorophyllose, basal cells prosenchymatous, quadrate to rectangular ± 0.011 m.m. to 0.049 m.m. long and ± 0.007 m.m. to 0.011 m.m. broad, gradually becoming shorter near apex, obliquely rhomboidal to quadrate ± 0.007 m.m. in diameter and marginal row ± 0.009 m.m. in diameter. Sporophyte not seen.

**Distribution of the species**

(Map no. XIII)

As3b - Assam - (Charduar) - Bor 162, 176

Only in Eastern India. (As3b).

**Subfamily - II Voitiaideae**

This subfamily has a single genus *Voitia*.

The genus *Voitia* has a single Indian species *hookeri*.

**GENUS - VOITIA** Hornsch., in Voitia Systylio Nov.

*Musc. Fr. Gen. 5,9. (1818).*

(Type - *V. niveola* Hornsch)

Autoicous, plant tall compact, sometimes more tall, soft, rhizoidous, light green. Leaves when moist erect, concave, ovoid, leaf tip long acuminated, flat, ribs strong,
Map no. XIV - Showing the number of recorded species of *Voitia* in each zone and also the distribution of *V. hookeri* Mitt. (*A*).
Not reported from zones where not shown.

**GEOGRAPHICAL DISTRIBUTION OF THE GENUS VOITIA**

Index Muscorum (Vol. 5, 1969) recorded only one valid species of Voitia, which occur in Temperate and Sub-artic regions. That same species occurs in As3b also. The distribution showing the number of species in each zone in Map no. XIV.

*Voitia hookeri* Mitt. in Musci, ind. orientalis. : 56. (1859).

*Voitia nivalis* Forstsch. var. *stenocarpa* Par. fid. Par.

in Ind. Bryol. 1342 s (1898).

Plant compact, large, thickly matted, cushion shaped.

Stem about 7 m.m. long, bounded by rhizoids at base, light green. Leaves compactly arranged to the stem, when moist erect, when dry closely appressed to the stem and slightly contorted, leaves sub-panduriform, large about 5.4 m.m. long and 2 m.m. broad, lower leaves small ± 3.5 m.m. long and ± 1.5 m.m. broad at middle, margin entire, slightly revolute at the upper half, ribs strong, continuous forming a long bristle like arista.
Fig. 14. Voitia hookeri Mitt.
(Drawn after J.D. Hooker 379 isotype specimen)

$P_1$ = natural size normal plant. $P_2$ and $P_D$ = magnified normal and dry plant. $C$ = capsule. $L$ = leaf.

$L_{bc}$ = leaf base cells. $L_A$ = leaf apex.


± .4 m.m. long and ± .03 m.m. broad, smooth, margin complete, flat at basal portion, cells smaller with firm cell walls, elongated at base ± .11 m.m. long and ± .03 m.m. wide parallelograms, apical cells somewhat shorter ± .05 m.m. long and ± .01 m.m. broad. Perichaetial leaves not differentiated. Seta long, strong about 22 m.m. long, erect. Capsule erect, conical 5 m.m. long and 2 m.m. in diameter, clavate, when dry slightly sulcate, calyptra persistent, capsule short necked.

**Distribution of the species**

(Map no. XIV)

As3b - Sikkim - J.D. Hooker No. - 379

(As 3b)

**Subfamily - III Taylorioideae**

This subfamily consists of one genus *Tayloria*, which is found in India.


(Lectotype - *T. splachnoides* (Schwae) Hook).

Plant robust and densely tufted. Stems erect. Leaves broad and laxly areolate, leaf when moist erect, when dry slightly contorted, long acuminate, ribs excurrent, cells
Map no. XV - Showing the number of recorded species of *Tayloria* in each zone. Not reported from zones where not shown.
hexagonal, smooth, large. Seta long fleshy. Capsule erect gradually narrowed to a short neck. Peristome teeth 16 in 8 pairs. Calyptra conical either papillose or pilose.

**GEOGRAPHICAL DISTRIBUTION OF THE GENUS TAYLORIA**

Index Muscorum (Vol. - 5, 1969) recorded 61 valid species of *Tayloria*, which is distributed all over the high, cool and moist regions of the earth. The distribution pattern shows greater condensation in all climate, tropical, temperate and sub-arctic regions.

In certain areas this genus is completely absent, not due to climatic conditions. The distribution showing the number of species in each zone is depicted in Map no. XV. Of the 6 species known to occur in As 3, only 2 species *T. indica* and *T. subglabra* occur in As3b (Eastern India). 3 species (*frolichiana*, *tornella* and *jacquemontii*) are known to occur in Western India (As 3a). One species (*imbricata*) occurred in Ceylon. No species occurred in South India. 10 species occurred in As 2 and 7 in As 4.

**Key to the Eastern Indian species**

<table>
<thead>
<tr>
<th>Calyptra long pilose</th>
<th>...</th>
<th>1. <em>T. indica</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Calyptra papillose</td>
<td>...</td>
<td>2. <em>T. subglabra</em></td>
</tr>
</tbody>
</table>
Fig. 15. *Tayloria indica* Mitt.
(Drawn after G 725)
Tayloria indica Witt. in Musci. ind. orientalis 57 (1859).

Octoblepharum serratum Hook. in Musci. Exot. 2 : 5. (1819) hom. illeg.

Plant large, robust, tufts, yellowish green above, brown below. Stem long about 20 m.m. high, densely readish tomentose below which matted together with radicles growing on ground. Lower leaves small and placed distantly, upper leaves large, crowded ± 4.2 m.m. long and ± .9 m.m. broad, wide spreading and erect when moist and appressed to the stem when dry. Leaves bordered, acuminated, upper half slightly revolute, lower portion entire and upper portion coarsely toothed; costa well developed, strong, yellowish, continuous ending in a long arista (± .41 m.m. long), basal cells rectangular, larger, thick walled ± .032 m.m. long and ± .024 m.m. broad, apical cells oval, hexagonal to rhomboidal ± .049 m.m. long and ± .024 m.m. broad, gradually the marginal cells become narrower. Perichaetial leaves not differentiated. Seta stout, reddish yellow 8 m.m. long, somewhat curved. Capsule erect, cylindric gradually narrowed to a distinct neck, ± 4.5 m.m. long and ± 2 m.m. in diameter, greenish when young with a red mouth, later the whole capsule becomes reddish. Peristome present, simple, outer peristome teeth 16 in 8 pairs, ± .63 m.m. long and ± .2 m.m. broad, erect when dry, lid conic short. Calyptra conical ± 2.1 m.m. long and ± 1.3 m.m. broad at base, pilose with long pale jointed hairs, especially towards laciniate.
Fig. 16. *Tavloria subclabra* (Griff) Mitt.
(Drawn after G 4922)

$P_1 =$ natural size normal plant, $P_2$ and $P_D =$ magnified normal and dry plant, $C =$ capsule, $L =$ leaf.

$L_{bc} =$ leaf base cells, $L_A =$ leaf apex, $P_T =$ perisome teeth, $op =$ operculum, $Cal =$ calyptra.
base, cells of exotheclium oval to hexagonal, thick walled.
Spores 12 to 20 μ in diameter. Dioicous.

Distribution of the species
(Map no. XVI)

As3b - Sikkim - J.D. Hooker No. 386, 387, 389
Nepal - Gardner, wallich, J.D.Hooker No. 388
Darjeeling - Ganeulée 725
Khasia and Jayentia hills - Bor 265, 268, 284
Java, Philippines, Indonesia and Malaysia. Only in Asia.
(As 3b, 4).

Tayloria sub-glabra (Griff) Litt. in Musci. ind. orientalis
57 (1856).

Orthodon subglaber Griff. in Calcutta J. Nat. Hist. 2:
483. (1842)

Plant large, robust in dense tufts, dull yellowish green
above, lower portion brown. Stem long 17 m.m. long densely
reddish tomentose and matted together with radicles below.
Lower leaves small and distant, upper leaves less crowded than
T. indica and more widely spreading both moist and dry, leaves
± 4.3 m.m. long and ± .8 m.m. broad, erect, oblong, aristate
bordered, lower one-third of leaf margin entire, but upper
two-third coarsely toothed, nerve yellowish strong, continuous
ending in a long atista ± .39 m.m. long, basal cells rectangular,
larger, thick walled ± .096 m.m. long and ± .028 m.m.
Map no. XVI - Showing the distribution of *Tayloria indica* Mitt. (•) and *T. subglobra* Mitt. (•).
wide, apical cells oval, hexagonal to rhomboidal + .069 m.m. long and + .016 m.m. broad. Perichaetial leaves not differentiated. Seta 10 m.m. long, deep reddish, capsule erect about 4 m.m. long and 2 m.m. wide, cylindric, gradually narrowed to a distinct neck, reddish. Peristome present, simple, peristome teeth 16 in 8 pairs + .53 m.m. long and .18 m.m. broad, erect when dry, cells of exothecium oval to hexagonal, thick walled, lid conic short. Calyptra conical + .3 m.m. long, deeply laciniate at base, papillose, naked and smooth below, scabrous in the upper half with short blunt unicellular hyaline teeth. Spores 16 to 20 μ in diameter.

Distribution of the species
(Map no. XVI)

As3b - In mount Khasia - For 346 J.E.Hooker and T. Thomson 330.

Darjeeling - Tenzulce 4922

Korea, China, Japan, Formosa, Philippines, Java, Indonesia and Malaysia.
(As 2, 3b, 4)

Subfamily - IV Splachnoideae

This subfamily includes one Indian Genus Tetraplodon.

(1844) (fasc. 23-24 Mon.1)

Autoicous. Plant compact thick cushion shaped, rhizoidous.
Map no. XVII - Showing the number of recorded species of Tetraolodon in each zone. Not reported from zones where not shown.
Stem thickly covered with leaves with 1 or 2 innovations, usually narrower longly tapering leaves. Leaves are alike, only upper leaves somewhat larger, long, lanceolate with long tapering apex, margin may be flat or crenulated, rarely toothed above, sometimes ribs continuous upto the apex. Seta long thick. Capsule erect, oval, cylindrical, apophysis of the same colour and texture, more solid, narrower and more tapering not much wider than the capsule, obconical, obovate or obovoid, somewhat longer than the urn. Peristome deeply inserted, at first arranged in fours, finally in pairs, rarely equidistant, of two layers only without interior vertical and oblique lines, columella not exerted. Spores small, operculum truncated, cone-shaped, sometimes deciduous. Calyptra cone shaped or cuculate.

**Geographical Distribution of the Genus *Tetraplodon***

Index Muscorum (Vol. - 5, 1969) have been recorded only 11 species of *Tetraplodon*, which is distributed all over tropical, temperate and sub-arctic regions of the earth. In Africa and Australia it is completely absent. The distribution showing the number of species in each zone depicted in map no. XVII. The distribution showing greater condensation in sub-arctic regions.

Only two species (*T. angustatus*, *T. mnioides* and *T. mnioides var. cavifolius*) occur in As 3 and in As3b also
Fig. 17. *Tetraplodon angustatus* (Hedw) B.S.G.  
(Drawn after J.D. Hooker 375)  
P2 and P_D = magnified normal and dry plant.  
P_1 = natural size plant. L = leaf. L_Bc = leaf base  
cells. L_A = leaf apex. L_C = central leaf cells.  
P_T = peristome teeth. sp = spore.
(Eastern India). Two species occurred in As 2 and 3 species from As 4.

Key to the Eastern Indian species of Tetraplodon

1. Leaves toothed above, Seta
   scarcely longer than the upper leaves
   - 1. angustatus
2. Leaves not toothed,
   - 2. nanaeides
3. Seta longer
   - 2. cavifolius
4. Seta yellowish red
   - 2. nanaeides
5. Seta yellow
   - Var. cavifolius


Densely tufted. Plant small or large, growing on rocks. Stem short about 5 mm. long, densely covered with leaves, pale green, lower portion sessile with dense tomentose. Leaves crowded, soft, bordered, erect when moist and closely appressed and somewhat twisted when dry, leaves narrowly lanceolate 3 mm. to 5 mm. long and ± .6 mm. broad, gradually becomes acuminate or tapering to a short flexuose subulate, leaves somewhat falcate, lower half of margin entire, upper half, sharply spinulose-corrugate, nerve yellowish, stroma, coriace, forming
Fig. 18. *Tetraplodon epiglumis* (Hedw) B.S.G.
(Drawn after J.D. Hooker 372)
the greater part of the subula, cells loosely arranged, basal cells sub-rectangular ± 0.064 m.m. long, ± 0.015 m.m. in breadth, thick walled, gradually becomes shorter towards apical region ± 0.057 m.m. long and ± 0.019 wide, rhomboid to hexagonal. Perichaetial leaves larger. Seta pale, very short, 5 m.m., erect, almost immersed into the plant, Capsule erect, 4 m.m. long, 2 m.m. in diameter, pale reddish brown, cylindrical, hardly raised above the leaf, blackish, apophysis wide, long, pear shaped, pale, reddish brown. Capsule when dry slightly contracted below the 1/10. Peristome deeply inserted near its mouth, simple, teeth ± 0.39 m.m. long and ± 0.57 m.m. broad, reddish yellow, finely dotted. Spores ± 9.5 μ to 13.3 μ in diameter. Autoicous.

Distribution of the species

(Map no. XVIII)

As3b - Sikkim - J.D. Hooker No. 375

Europe, Soviet Union, China, Japan, Korea and North America

(Sur.; As 1, 2, 3b.; Am 1). Tetraphodon mnioides (Hedw) B.S.G. in Bryol. Eur. 3: 215. (1844) (fasc 23-24 Mont).

Splechnum mnioides Sw. ex. Hedw. in Spec. Musc. 51 (1801)

Densely tufted plants. Stem 12 m.m. long, yellowish brown, stout, tomentose below, growing on rocks densely crowded
Map no. XVIII - Showing the distribution of *Tetraplodon angustatus* (Hedw) B.S.G. (○), *T. unioideus* (Hedw) B.S.G. (▲) and *T. unioideus* (Hedw) P.S.G. var. cavigulius Schimm. (★).
with leaves. Leaves ovate-lanceolate or obovate lanceolate, soft, flat, entire and suddenly acuminate and tapering to a long flexuose subula, erect when moist, closely appressed to the stem and twisted when dry, leaves ± 3 m.m. long and ± .8 m.m. broad, nerve yellowish forming the greater part of the subula, cells loose, basal cells sub-rectangular, thick walled ± .041 m.m. long and ± .01 m.m. broad, gradually becomes smaller towards apical region, rhomboid to hexagonal, thick walled ± .03 m.m. long and ± .01 m.m. wide, marginal cells often narrower, not always. Seta stout red 14 m.m. in length. Capsule shortly cylindrical 3 m.m. long and 2 m.m. in diameter, when dry contracted below its mouth, first greenish with green apophysis, lastly both become dark black, apophysis pyriform, slightly narrower above and tapering at base, thick walled. Peristome present, simple, thickly inserted, ± .46 m.m. long and ± .07 m.m. broad, entire at margin, highly papillose, orange red.

Autoicous, male flower terminal, soon becoming lateral by innovations.

Distribution of the species
(Map no. XVIII)

As3b - Sikkim - J.D. Hooker No. 372, 377, 381, 385

In Nepal - (Chukhung) Zimmerman 354

Europe, U.S.S.R., China, Japan, Korea, North America and New Guinea (Eur.; As 1, 2, 3b; Am 1, 4).
g. 19. *Tetrapodön miniciflora* (Hedw.) B.S.G.

*var. carifolius* Schimp.

(Drawn after J.D. Hooker 373)

Tetraploïdon mnioides (Hedw.) B.S.G. var. cavifolius Schimp. in Syn. 304. (1860).

Splachnum urceolatum Hedw. in spec. Musc. 52 (1801).

Tetraploïdon urceolatus (nee Hedw.) in Bryol. eur. fasc 23/24 lzon. P. 7, t. 3 (1844).

Densely tufted plants. Stem about 9 m.m. long, soft, sometimes with short innovations, upper yellowish green, lower pale brown and tomentose, growing on rocks. Leaves closely arranged, concave, obovate, almost cochleariform, suddenly acuminate and tapering to a short flexuose subula, erect, margin entire, dry leaves not twisted, leaves 3 to 4 m.m. long and ± 1 m.m. wide, nerve yellowish, thin, delicate, complete, cells loose, basal cells sub-rectangular, thick walled ± .057 m.m. long and ± .01 m.m. broad, chlorophyllose, gradually becomes smaller towards apical region, rhomboid to hexagonal, ± .038 m.m. long and ± .01 m.m. broad, becoming narrower towards margin. Perichaetial leaves larger. Seta long 16 m.m., sulcate, weak, erect, brownish yellow. Capsule erect, small, cylindrical 5 m.m. long and 2 m.m. broad reddish brown, with a reddish brown apophysis, apophysis pyriform, tapering at base, thick walled, lastly both become dark black, capsule mouth not contracted when dry. Peristome present, simple, thickly inserted, ± .209 m.m. long and ± .09 m.m. broad like T. mnioides. Plant autoicous, male flower terminal, soon becoming lateral by innovations, antheridia club shaped with long paraphyses.