British Hepaticae : containing descriptions and figures of the native species of Jungermannia, Marchantia, and Anthoceros / [Benjamin Carrington].

[1874-75]

BRITISH HEPATICÆ.

TRIBE I.—JUNGERMANNIDEÆ.

Sporangium solitary, quadrivalved, rarely with more numerous valves, or opening irregularly. Elaters mingled with spores.

SUB-TRIBE A.—FOLIOSÆ.

Fronds clothed with distinct leaves.

* *Leaves succubous.*

SECTION I.—Haplomitrieæ.

Fructification terminal, gynomitrious. Colesule wanting. Calyptra completely enclosing the sporangium, much longer than the involucral bracts. Fronds ascending, rhizomatous. Leaves trifarious.

I. SCALIUS, *Gr. & B.*

Jungermannia, Lyell, in Eng. Bot. t. 2555 (1813).
Scalius, Gray & Bennett, Nat. Arr. Brit. Pl. p. 704 (1821).
Mniopsis, Dum. Comm. Bot. p. 114 (1823); Syll. Jung. p. 75, n. xiv. (1831).
Lejennia, Spreg. in L. Syst. Veg. 16 ed. iv. p. 234 (1827).
Gymnomitrium, Corda, in Opiz. Beitr. i. p. 651, n. 1 (1829).
Haplomitrium, N. ab E. Eur. Leberm. i. p. 98 et 109 (1833); Gottsche de Haplomit. N. Act. Ac. Nat. Cur. xx. i. p. 265, sqq. c. t. 8.

Dioicous. Colesule wanting. Calyptra longer than the involucral bracts, chartaceous. Capsule oblong, 2-4-valved, elaters persistent, apical.

OBS.—"*Scalia*, SIMS, Bot. Mag. xxiv. t. 956 (1806), and *Podolepis* were published in the same year, and are synonyms (*vide* BENTH. & HOOK., Gen. Pl. ii. p. 1). But since *Podolepis* has been accepted by all authors, *Scalia* is free for use amongst the Hepaticæ."—*Dr. Lindberg in Sched.*

There is also some doubt whether *Mniopsis*, MART., Nov. Gen. Sp. Braz. i. p. 3, t. 1; and *Mniopsis*, DUMORT., were not published in the same year.

Although, for the sake of convenience, I have arranged *Scalius* near the *Gymnomitreæ*, its true affinity seems to be with the *Codonieæ*.

In the irregular form and lax texture of the leaves, the axillary development of the *pistillidia*, and the exposed *antheridia*, it approaches *Fossombronia*. Again, in the

form of the capsule, and the attachment of the elaters to the apex of the valves, and the apparent irregularity of the latter (for, as observed by *Mr. Lyell*, they "frequently appear as but two, their tips being held together by the elastic filaments, which turn upwards, and form a tuft on the open capsule"), we trace a resemblance to *Aneura* and *Mitzgeria*. These affinities did not escape *Sir W. Hooker*, who, in his classical work on British Jungermanniæ (t. 54), remarks: "In the form of the capsule, and the situation of the spiral filaments, there is a close analogy with *J. pinguis* and *multifida*, between which and the *Jungermanniæ foliosæ*, *J. Hookeri* may be considered as holding the middle rank."

1. Scalius Hookeri, *Gr. & B.*

Pl. I. Fig. 1.

Jungermannia, Lyell, in Eng. Bot. t. 2555, 2 ed. 1808; Hook. Br. Jung. t. 54; Brit. Flor. v. i. p. 107, n. 1.

Hab. Heaths and damp places. Very local. Discovered by *C. Lyell, Esq.*, near the private road from Cadnam to Poultons, in the New Forest, Dec. 21, 1812!* and Kinnordy, Aug. 1813! Barnaby Moor, near York, *R. Spruce*, Nov. 1842! Chyanhall Moor, Penzance, *W. Curnow*, Aug. 1844! Fruit, summer.

Fronds creeping at the base; *rhizomatous shoots* fleshy, divaricate, destitute of capillary rootlets. Dr. Gottsche, in his exhaustive monograph de Haplomitrio, appears to consider these the true roots; but they differ in no respect from the subterranean stolons of other species, except in the absence of fibrillæ. Professor Hofmeister (Higher Cryptogamia, p. 64–5, t. vii. f. 1–2—Ray Soc.) states that the growing end of these shoots coincides with that of the end of the stem: "They grow by continually-repeated division of a single apical cell by means of septa alternately inclined in different directions. These shoots are also remarkable from the fact that in the older portion of them each epidermal cell grows out into a short papilla, which may serve as a compensation for the absence of rootlets."

Stems erect, 1 to 6 lines long, simple, or occasionally furcate, thick and succulent.

Leaves pale-green, distant, laxly imbricated, subtrifarious, variable in outline, near the base of the stem smaller and roundish-ovate; upper ones ovate-oblong, or lingulate, obtuse, repand, or distantly lobed and dentate, sometimes entire, patent, obliquely decurrent at the base (Pl. I. t. i. f. 2–3). Sir W. Hooker observes "that near the extremity of a leaf two opposite lateral notches are frequently seen, which thus form a large terminal lobe; and that, in other leaves, are formed smaller lobes or projections, as well acute as obtuse, which give the margins a very jagged appearance." In connection with this fact, Dr. Gottsche remarks that "the leaf,

* The mark (!) after stations indicates that I have examined specimens from the places indicated.

when quite young, and consisting only of few cells, bears at its apex (or when multi-angular at each of its angles) a clavate, bent, retort-shaped cell, which in a fully-developed leaf, consisting of a great number of cells, is still found in the corresponding position." This fact proves that the leaf of Jungermannia is not the result of the division of a single apical cell, but that there is a tendency in the longitudinal halves of the young leaf-rudiments to develop independently, and often unequally.

Posterior row of leaflets (amphigastria) somewhat smaller, but otherwise resembling the rest.

Texture of the leaves soft, laxly and somewhat coarsely reticulate, shrinking considerably when dry, and recovering their form very slowly and imperfectly.

Cells uniform, destitute of 'trigones,' those near the apex irregularly quadrangular, from $\frac{1}{700}$ to $\frac{1}{585}$ of an inch long, and $\frac{1}{1170}''$ to $\frac{1}{1750}''$ broad. The lower cells are longer, and hexagonal. They contain numerous chlorophyll-corpuscles of a bright-green colour.

Involucral leaves resembling those of the stem, but larger, at first erect and connivent, so as to enclose the pistillidia, at length patent or reflexed.

Colesule wanting. *Calyptra*, when mature, linear oblong, fleshy, equalling the stem in length. *Pedicel* an inch long, succulent, white.

Capsule cylindric-oblong, pale-brown, opening by two or four valves, which are frequently held together by the *Elaters*, which are bi-spiral, and attached to the apex of the valves, and persist until the decay of the capsule, spreading out in a flabellate manner.

Spores roundish or tetragonous, cristate-crenate, reticulate, reddish-brown.

Antheridia globose, shortly stipitate, golden-yellow or olive, seated to the number of 5 or 6 in the axils of the superior leaves of the male plant.

The *perigonial leaves* are recurved, and scarcely ventricose at the base, so that the antheridia are exposed, and from their orange colour form a very beautiful object under the lens, nestling among the green leaves, like the fruit of the orange- or lime-tree.

Pl. I. Fig. 1.—1. Scalius Hookeri, *fronds natural size.* 2. *Fertile shoot* ×16 *diam.* 3. *Male shoot* × 16 *diam.* 4. *Elater and spores* × 250. 5. *Antheridium.*

Section II.—Cœlocaules.

G. L. & N. ab E. Syn. Hepat. p. 13 (1844) ex parte.
Thalamomitrieæ, *Lindberg on Zoopsis, Jour. Lin. Soc.* v. xiii. p. 193, &c. (1872).

Calyptra combining with the hollow apex of the stem, and involucral bracts, to form a "rachideal pouch," within which the sporangium lies. Fructification terminal, sub-terminal, or arising from the axil of an amphigastrium, at length lateral.

II. Gymnomitrium, *Corda.*

Jungermannia, Lightf. Fl. Scot. ii. p. 786 (1777). *Cesius*, Gray & Bennett, Nat. Ar. Brit. Pl. I. p. 705 (1821). *Schisma*, Dum. Com. Bot. p. 114, p. p. (1823). *Gymnomitrium*, Corda, in Opiz. Beitr. i. p. 651, n. 1, p. p. (1829); N. ab E. Naturg. der Eur. Leberm. i. p. 98, n. 17 (1833). *Acolea*, Dum. Syll. Jung. Eur. p. 76, n. xv. (1831); Observ. Jung. p. 23 (1835).

Dioicous. Colesule wanting. Involucre double, the inner shorter, composed of two or more involute deeply-cleft and dentate leaves, which enclose the short campanulate calyptra. Base of the young fruit immersed in the hollow apex of the stem. Capsule globose, 4-valved, when empty reflexed. Elaters bi-spiral, caducous.

Androecium distinct. Antheridia oval, stipitate, seated in the axils of the perigonial leaves.

Fronds fasciculate, ascending or erect, julaceous. Leaves distichous, closely imbricated, emarginate-bidentate, glaucous-green, creeping at the base; flagellæ radiculose; examphigastriate. (*Derivation—γυμνός, naked; μιτρίον, a little cap.*)

Obs.—The name *Cæsia* was given by R. Br. Prodr. Fl. N. Holl. i. p. 277 (1810), to a genus of *Liliaceæ*.

Considerable diversity of opinion exists as to the import of the inner covering of the fruit,—whether it should be considered an imperfect *colesule*, or an inner *involucre*. Typically, the *colesule* is supposed to be formed by the union of two or three modified leaves; but this is never really the case, since its development is always posterior to the appearance of the *pistillidia*, which it surrounds with a simple cellular ring. The after-development varies in different species. I have hitherto been unable to find any trace of the inner involucre in Gymnomitrium, except where pistillidia were already present. The leaves are so deeply lobed, that it is difficult to make out the exact structure (Pl. I. t. 2, f. 6); but I think it is generally formed of three bracts; two anterior, and much broader than the third, which is posterior, and either simple or bi-lobed (amphigastriate?). They are usually connate at the base. In one specimen I observed a smaller bract, interior to the rest, and inserted about halfway up the calyptra, exactly as shown in fig. 7 of *Gottsche's* beautiful drawing of *G. concinnatum* (*Gott. & Rab. Hep. Eur. Ex.* n. 423). *Hooker's* figures and description are inaccurate. He describes the involucral leaves as "imbricated on all sides" (*Br. Jung.* t. iii. f. 3), whereas their insertion is bifarious, like the ordinary ones. The innermost are said to "form a cylindrical tube, scarcely distinguishable from a true calyx, except by the longitudinal suture formed by the involuted margins: in colour and texture they resemble the other leaves," and in figs. 6 and 7 they are represented with simple inflexed margins, bluntly emarginate, and not at all toothed at the apex. *Spruce* (*Musc. et Hepat. Pyr.* p. 127) first gives an accurate description of the parts. "In some true Gymnomitria (*e. g.* G. concinnatum) I observe" (he writes) "within the perichætium two leaves (rarely only one) which are much shorter, wider, and more tender than the perichætial leaves, and unequally trifid with toothed segments; but these are neither *connate* with each other, nor concrete with the perichætium; hence they cannot be called a perianth (colésule), although obviously supplying the place of one."

The Gymnomitria are readily distinguished by the rigid julaceous thickly-matted roots, resembling (as Lightfoot well remarks), under the microscope, the texture of a braided lock of hair, or the plaited thong of a whip. The colour, too, is characteristic, silvery-olive, or cream-white, rarely darker gray, or smoky-brown.

1. Gymnomitrium concinnatum, *Corda*.

Plate I. Fig. 2.

Barren shoots erect, simple or fasciculately branched, slightly compressed, thicker and obtuse at the apex; leaves imbricated, ovate, bidentate, sinus and lobes acute, border narrow, membranous. Fertile shoots clavate; involucral leaves larger, with reflexed margins, upper ones connivent, irregularly dentate-lobate.

Jungermannia concinnata, Lightf. Fl. Scot. ii. p. 786; Eng. Bot. t. 2229, ed. 2, 1820; Hook. Jung. p. 11, t. iii.; Fl. Danica, t. 1002; Musc. Brit. ed. 2, p. 229; Br. Fl. v. i. p. 110.

Gymnomitrium concinnatum, Corda, in Sturm. Fl. Germ. Cr. xix. xx. p. 23, t. 4; N. ab E. Eur. Leberm. i. p. 115 (*et seq.*); Gottsche & Rab. Hep. Eur. Ex. n. 423 (c. icon.); Syn. Hepat. p. 3, n. 1.

Acolea concinnata, Dum. Syll. p. 76, n. 108, t. 2, f. 15; Recueil d'Obs. Jung. p. 23.

Jung. gymnomitrioides, N. ab E. l. c. ii. p. 52.

Hab. Frequent in barren spongy places near the summits of most of the mountains of Scotland. More rare in England, and confined to the sub-alpine northern districts:—Helvellyn, *Nowell*, 1857! Cronkley Scar, Teesdale, *J. G. Baker!* Snowdon, *G. E. Hunt!* Glyder, *W. Wilson!* Cader Idris, *Mr. Ralfs*. Irish localities refer to *G. crenulatum*. Fruit, Summer. Found on primary rocks in Northern and Central Europe.

Fronds growing in thickly matted tufts, sometimes a foot or more in diameter, "conspicuous at a considerable distance from its silvery hue."

Primary shoots creeping, flagelliferous, at length ascending, radiculose on the underside, half an inch or more in length, simple, or bearing a few suberect branches, which are thinner and cylindrical below, but compressed and incrassated near the apex (f. 2). From the upper part of the old shoots innovations are frequently produced, which are at first slender, but at length attain the ordinary form. Sometimes the stems assume a remarkable interrupted appearance from repeated prolification. *Flagellæ* creeping, densely matted together, rigid, filiform, of a brownish colour; either naked or squamose at the extremity, at length ascending, and producing true leaves.

From the densely cæspitose habit of the older patches, the original ramification is imperfectly seen, since the rhizomatous shoots and lower portions of the stem soon decay, and crumble away, leaving only the upper even-topped stratum visible and intact.

Rootlets white, capillary, rare on the upright stems, but more frequent on the decumbent shoots and flagellæ.

Leaves erect, closely and bifariously imbricated, so as to entirely conceal the stem, ovate, concave, acutely emarginate, the lobes and sinus acute (f. 2), or in some specimens rather obtuse. *Margin* entire, with a narrow scariose diaphanous border. Surface minutely papillose.

Texture thin but firm, scarcely altered when dry. *Colour* pale glaucous silvery-olive, sometimes with an ochraceous or brown tinge; when old nearly white.

Reticulation "guttulate," pellucid near the margin. Cells in the upper third of the leaf hexagonal, with a clear ill-defined outline; interior filled with an oval yellowish mass of endochrome, size from $\frac{1}{1170}''$ to $\frac{1}{1750}''$. On treating with liquor potassæ and the iodine reagent, the undefined broad border is replaced by a delicate double contour, and the interior occupied by a violet-coloured six-sided figure, the contracted 'membrana secundaria.' Near the base and central part of the leaf the cells are oval or oblong, $\frac{1}{1173}''$ to $\frac{1}{500}''$ long, by $\frac{1}{1750}''$ broad.

Dioicous. Fertile shoots more tumid, and clavate. *Involucral leaves*, 3 to 4 pairs, larger than the ordinary ones, their margin more or less reflexed; upper pair broadly ovate, connivent, bi- or tri-dentate at the apex; sometimes with a third entire or bifid lobe (*amphigastrium*), (f. 7); margin irregularly recurved-denticulate. On removing the outer leaves, the organs of fructification are found to be closely surrounded by an *inner involucre* (f. 5), composed of 2 or 3 smaller leaves, of thinner texture and more open reticulation. These are inserted into the thickened base of the calyptra, and adnate for a short distance with each other. The two anterior leaves are larger, convolute, more or less deeply cleft into six or eight irregularly-dentate segments (f. 2). The posterior leaflet (amphigastrium) is not always distinguishable; ovate, either entire or lobate denticulate.

Calyptra campanulate, thickened at the base, where it unites with the cellular tissue of the receptacle to supply a pouch for the growing capsule. *Barren pistillidia*, 6 or 8 in number, scattered over the lower half of the calyptra.

Capsule rather small (f. 2, 8), spherical, chocolate-brown, polished; valves four (f. 5), ovate, annulate-punctate, recurved when empty.

Peduncle two to four lines in length, white, succulent.

Spores dark fulvous, sphæroidal, $\frac{1}{1750}''$ in diameter.

Elaters bi-spiral, length $\frac{1}{350}''$ to $\frac{1}{206}''$, breadth $\frac{1}{4000}''$.

Male shoots more slender, fastigiate.

Perigonial leaves (f. 4) obliquely amplexicaul, sub-secund, ventricose at the base, complicate-concave, bi-lobed, the lobes acute, connivent, dorsal margin reflexed.

Antheridia axillary, 1 to 3 together, oval, seated on a slender footstalk.

The enlarged figure of the stem in Brit. Jung. t. iii. f. 3, is very characteristic, except where the involucral leaves are represented as imbricated on all sides of the stem. The inner involucral leaves (f. 6, 7) are also incorrect in outline. Nor are some of my own figures more accurate. The barren shoot (t. ii. f. 2) is badly shaded, so that the outline appears four-sided, and the involucral leaf (f. 5) should have been more deeply emarginate. When the engraver is ignorant of the minute structure of the plants he delineates, it cannot be expected that he should comprehend the importance of reproducing every minute line and cell. Unfortunately few possess the industry or artistic skill of Dr. Gottsche, who has learnt the art of the engraver, so as to reproduce his own accurate drawings the more faithfully.

A longitudinal section through the apex of the fruiting stem will prove that it is dilated and hollowed as far as the third pair of leaves.

The "Lichenastrum alpinum, bryi julacei argentei facie" (Dill. Musc. p. 506, t. lxxiii. f. 38), as far as respects the figures, which are very characteristic, should be referred to *J. julacea*. The description may comprehend both species; and as they grow together on Snowdon and Glydr, where Dillenius collected his specimens, it is not improbable he looked upon them as forms of the same species. The comparison with *Bryum argenteum* is more applicable to our species. The white pruinose or floccose appearance sometimes met with in *J. julacea* depends on the presence of a microscopic confervoid growth which is parasitic on the leaves. The true colour is olive-brown, and it differs further in the trifarious arrangement of the leaves, which are cleft almost to the base into lanceolate lobes, and in possessing a perfect colesule.

Fl. Danica, t. 1002, was published under the name of *J. julacea;* indeed, until the time of Lightfoot the two were generally confounded.

The male plant seems to be comparatively rare; I have only met with it twice, and it was unknown to Hooker. *Nees. ab Es.* (*Leberm. Eur.* ii. p. 52) published it as a distinct species, under the name of *Jung. gymnomitrioides.*

Pl. I. Fig. 2.—1. *Stems natural size.* 2. *The same* × 16 *diam.* 3. *Stem-leaf* × 60. 4. *Perigonial leaf enclosing two antheridia.* 5. *Capsule arising from the convolute involucre, one of the bracts removed* (*the form of the outer leaf is incorrect*). 6. *Inner involucre laid open, showing the young capsule invested by the calyptra, and abortive pistillidia.* 7. *Outer involucral leaf, to which is attached a bifid supplementary lobe* (*amphigastrium*). 8. *Young capsule.* 9. *Spores and elaters.*

2. Gymnomitrium coralloides, *N. ab E.*

Pl. I. Fig. 4.

Barren shoots irregularly fasciculate, much compressed, lanceolate, subfalcate, sometimes deformed; leaves crowded, closely imbricated, roundish-ovate, retuse; margin broad, scariose, seldom entire. Fertile shoots clavate; involucral leaves obscurely emarginate; margin plane erose-denticulate.

N. ab Esen. Europ. Leberm. i. p. 418, *et seq.*

Hartm. Scand. Fl. ed. x. 2, p. 128 (1871); *Gottsche & Rab.* Ep. Eur. Ex. n. 79, 383, 513.

Hab. Very rare, or overlooked as a form of G. concinnatum. Found among duplicates of the latter in *Dr. Greville's* Herbarium; collected on Ben Nevis and the Sutherland mountains, 1830! Lochnagar, *A. Croall*, July, 1856!

It occurs sparingly in Sweden (*Funck*), Styria (*Welwitsch*), Finland (*Dr. Lindberg*), and Lapland (*Angstrom*).

Resembling the last species in habit, but more strikingly julaceous and compressed. *Stems* (f. 4, 2) ascending, rigid, irregularly branched; fertile shoots tumid and obtuse at the apex, strongly compressed, the remainder lanceolate or scimitar-shaped, pointed, but presenting a stunted or deformed appearance from the sudden recurvation of the apex; sometimes attenuate or interrupted. In colour and habit bearing a close resemblance to stunted forms of *Sphærophoron coralloides*. *Flagellæ* creeping, entangled, dark-brown, clothed sparingly with delicate flax-coloured rootlets, which are seldom found on the erect shoots.

Leaves (f. 3, 5) so closely imbricated that their outline is made out with difficulty even under the lens, and so brittle in texture that an entire specimen is rarely obtainable. *Form* broadly ovate, obtuse, very concave, amplexicaul, bluntly and irregularly emarginate, sometimes almost entire, at others appearing erose or crenulate from fracture of the brittle scariose border, or the outgrowth of gonidial cells from it (f. 3, 7).

Texture thin and fragile. Colour glaucous, silvery-olive. Areolation guttulate. The true form of the cells can only be ascertained by boiling in water to which a few drops of liquor potassæ have been added, and then tinting with zinc biniodide. Marginal cells hyaline, subquadrate, $\frac{1}{1750}''$ to $\frac{1}{1400}''$ long, and $\frac{1}{2333}''$ broad. Those of the centre larger, chlorophyllose, and hexagonal, $\frac{1}{1000}''$ by $\frac{1}{1250}''$ * Basal cells more elongate, $\frac{1}{777}''$ by $\frac{1}{1000}''$. Trigones indistinct. *Prof. Lindberg* states that they are not papillose like those of *G. concinnatum*. The borders of the leaves are often obscured by minute pellucid 4- or 5-angular proliferous cells resembling the so-called *gemmæ* of many species.

Dioicous. Fertile shoots shorter, clavate, or sub-pyriform; more compressed (f. 2, right-hand fig.).

Involucral leaves (f. 4, 6) closely imbricated, and scarcely differing from the rest, except in their greater breadth and more obscure emargination. (The second pair has been removed in the drawing (f. 6), so as to show the upper leaves more distinctly.)

Outer involucral leaves (f. 4, 7) convolute, appressed, broader than long; margin entire or erose-denticulate, not recurved. *Inner involucral leaves* two in number, shorter, pellucid; margin obscurely lobate-dentate, closely embracing each other, and surrounding the sporangium.

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* For the measurement of the leaf-cells and spores I am indebted to the kindness of my friend Dr. J. W. Edmond, of Inveresk.

Calyptra obovate-turbinate, bearing at the apex the withered style; texture thin, areolæ rhomboid. At its base a few withered pistillidia are seated.

Capsule spherical, reddish-brown. *Seta* short, succulent.

Spores roundish or trigonous, brown, granular. *Elaters* bi-spiral (f. 4–8).

Perigonial leaves terminal on more slender stems; broadly ovate (f. 3), sub-complicate, with a shallow acute notch; the lobes unequal, connivent, broader and ventricose at the base; margin hyaline, seldom perfect. *Antheridia* conspicuous, round or obovate; one or two together; pedicel slender, jointed, of 4–6 cells (f. 4).

G. coralloides is intermediate in character between the former and following species. *G. crenulatum* may be distinguished from it by its different habitat, on walls and rocks at lower elevations (not the summit of mountains); its smaller size, depressed, circinate, sub-terete stems, of a dark glaucous olive-brown colour, and by the boat-shaped leaves, the margin of which is regularly crenulate.

Pl. I. Fig. 4.—1. *Stems natural size.* 2. *The same* × 16 *diam.: the right-hand drawing is taken from the original specimen described by N. ab E.; the left, from Scotch specimens.* 3. *Perigonial leaves: the border is more deeply crenate than it should be.* 4. *Antheridium.* 5. *Stem-leaves.* 6. *Apex of fertile stem, showing the involucral leaves.* 7. *Upper involucral leaf.* 8. *Elater and spores: their outline should be rounder and darker* × 250

3. Gymnomitrium crenulatum, *Gottsche.*

Pl. I. Fig. 3.

Tufts depressed, lurid-brown; barren shoots slender, sub-terete, acute, arcuate; leaves broadly ovate, complicate-concave, closely imbricated; apex bidentate, sinus narrow, lobes acute, connivent; margin crenulate, hyaline. Fertile shoots ovate, acute at the apex; outer involucral leaves convolute-conoid.

Carrington, Gleanings among Irish Cryp. p. 18, t. i. f. 5 (Trans. B. S. Ed. 1863); Gott. et Rab. Hep. Eur. Ex. No. 478. *G. coralloides*, Taylor's MSS.

Hab. Not unfrequent in the sub-alpine districts of Ireland on the mortar of walls, and rocks by the road-side, where it takes the place of our *G. concinnatum.* Stations quoted in *Fl. Hibern.* probably all belong to it. Dunkerron, and Knockavohila, *Dr. Taylor.* Cromagloun, and Glengariffe, co. Kerry! Carrantuol, May, 1851, *Dr. Moore!* Lugnaquilla, co. Wicklow, and Galtymore, *A. Carroll.* Mardale, Westmoreland, *G. Stabler!* Pass of Llanberis! Tyfry, July 28, 1828, *W. Wilson!* Dartmoor, Devon, 1864, *G. Davis!* Fr. May and June.

Patches flat, depressed, smoky-brown or olive, 2 to 4 inches in diameter. *Stems* rhizomatous at the base, densely matted together, radiculose. Branches ascending, arcuate, of nearly equal diameter, pointed at the apex, rigid, terete, or slightly compressed, two or three lines in length, by $\frac{1}{4}$th of a line in diameter. *Flagellæ* ser-

pentine, flexuose, attached to the ground, here and there, by fascicles of rootlets.

Leaves distichous, scarcely broader than the stem, amplexicaul, vertically imbricated, ovate, sub-complicate, acutely notched, the lobes short, connivent; apex rounded, and resembling the prow of a small boat; margin narrow, scariose; cells prominent, crenulate.

Texture thin but firm, scarcely altered when dry. *Colour* dark olive-brown, sub-lævigate. *Cells* minute (f. 3), the two or three marginal rows hyaline; outer row conoid in form (f. 4), $\frac{1}{875}''$ long by $\frac{1}{1750}''$ broad; cells of upper third hexagonal, $\frac{1}{875}''$ by $\frac{1}{1166}''$; basal cells oval-oblong, $\frac{1}{700}''$ by $\frac{1}{1166}''$. The marginal cells are most prominent near the apex; those of the inferior border are more tabular, and obscurely crenate. Endochrome brown, distinct.

Dioicous. Involucral leaves 3 to 4 pairs, double the size of the stem-leaves and less concave, upper pair remarkably convolute, so closely embracing each other, that without care they may be mistaken for a colesule. *Inner involucre* of two smaller leaves, bi- or tri-lobed, the lobes dentate; areolation pellucid, rhomboid.

Calyptra obovate, delicately reticulate, surmounted by the narrow style; barren pistillidia oblong, pale, striated, 8 to 12 in number.

Capsule spherical, buff-coloured; valves ovate, of firm texture, punctate, striate. *Spores* round, irregular in outline, reddish-brown, $\frac{1}{2333}''$ to $\frac{1}{1750}''$ in diameter. *Elaters* bi-spiral, length from $\frac{1}{350}''$ to $\frac{1}{175}''$, and from $\frac{1}{3500}''$ to $\frac{1}{4700}''$ broad in the centre.

Perigonial leaves on separate shoots, shorter and more gibbous at the base than the ordinary leaves. *Antheridia* axillary, generally solitary, round, seated on a short footstalk.

Pl. I. Fig. 3.—1. *Shoots unmagnified.* 2. *Barren and fertile shoots,* × 16 *diam.* 3. *Leaf from the stem, lateral view.* 4. *Fragment of margin more highly magnified, to show the 'crenulate cells.'* 5. *Inner involucral leaf, enclosing young fruit.* 6. *Spores and elaters.* 7. *Perigonial leaf.*

III. Nardia, *Gr. & B.*

Jungermannia, Ehrh. Beitr. p. 80 (1788).
Nardius, Gray & Bennett, Nat. Arr. Br. Pl. II. p. 694 (1821).
Marsupella, Dum. Com. Bot. p. 114, p.p. (1823); Recu. d'Obs. Jung. p. 24 (1835).
Sarcoscyphus, Corda, in Opiz. Beitr. i. p. 652, n. 5 (1829).
Marsupia, Dum. Syll. Jung. Ent. p. 77, n. xvii. (1831).
Mesophylla, Dum. Com. Bot. p. 112 (1823); Syll. Jung. Eur. p. 80, n. xix. (1831); Recu. d'Obs. Jung. p. 24 (1838). *Alicularia*, Corda, in Opiz. Beitr. i. p. 652, n. 2 (1829); Dum. Syll. p. 79, n. xviii. (1831).
Southbya, Spruce, Musc. Pyr. Trans. Bot. Soc. Ed. v. iii. p. 197 (1850).

Dioicous. Colesule connate with the involucral leaves, and connective tissue of the receptacle, to form an urceolate involucre; stoloniferous at the base. Shoots ascending or erect, simple or furcate; innovations from the ventral aspect. Leaves distichous,

subvertical, emarginate or entire. Amphigastria present only in the species with round leaves. Androœcium terminal, sub-spicate.

Obs.—A section of Peziæ was named *Sarcoscyphus* (Fries, Syst. Mycol. ii. p. 78 (1823). *Nardius* is perhaps too much like *Nardus*, a genus of Grasses (Lin. Syst. Nat. 1 ed. (1735)). Still the two are distinct, and unlikely to be confounded with each other.

After repeated dissections of the involucre, I cannot find any essential distinction between *Sarcoscyphus* and *Alicularia*, except what depends upon the form of the leaves, which in the former are emarginate, and somewhat compressed from before backwards, whilst in the latter they are entire, nearly plane, and laterally compressed. On section through the lower third of the involucre, it will be seen that in both cases it is terete and fleshy. Amphigastria enter into its composition in all the species.

Southbya, again, is only a connecting link between *Nardia* and *Jungermannia*, in which the colesule is a little more free.

Under the sub-tribe *Cœlocaules* the authors of Synop. Hepat. place only *Gottschia*, N. ab E. (1844) = *Schistochila*, Dumort. (1835) ! and yet nearly the same structure, the perforated thalamium is found in various genera of the Foliose and Frondose Hepaticæ, and supplies a valuable character, whether for the discrimination of species, or their classification.

Whenever the capsule is covered partly by the calyptra, and partly by the hollow apex of the stem, and its investing leaves, we find the colesule either wanting or rudimentary. To this modification, Dr. Lindberg (*On Zoopsis*, p. 193) proposes the name of *calyptra thalamomitrieæ*. The same type is in Synop. Hepat. called "calyptra cum perianthiis," vel "involucro," vel "toro concreta vel connata." That the affinities of the species had not escaped the author of Brit. Jung., the following note under *J. compressa* (t. lviii.) will prove :—"In the present species, as well as in *J. scalaris* and *J. emarginata*, and probably in all the Jungermanniæ which have an immersed calyx, this part has the appearance of being nothing more than the extremity of the stem incrassated, and hollowed out for the reception of the pistillæ ; for the texture of the calyces always resembles that of the stem, and they are never deciduous, as is the case with exserted calyces."

α. *Marsupella*, Dumort.

1. Nardia sphacelata.

Pl. II. Fig. 5.

Stoloniferous; stems slender, flexuose; leaves rather distant, vertically patent, obovate, from a narrower vaginate base, emarginate, lobes ovate, rounded, sinus acute, margin plane or inflexed; involucre oblong, connate only at the lower third, segments deeply lobed.

Jung. sphacelata, Giesecke, in Lindenb. Syn. Hep. p. 76, t. i. f. 9, 13, *bene !* Hübener, Hep. Germ. p. 122.

Marsupia sphacelata, Dum. Syll. p. 78, n. 113.

Sarcoscyphus sphacelatus, N. ab Es. Europ. Leberm. i. p. 129 ; Gott. & Rab. Hep. Eur. Ex. no. 519, & 255, c. icone (upper figs. only).

Fl. Danica, t. 2812. *Sarcoscy. Sullivantii*, De Not. Musc. Alleg. n. 216.

Nardia sphacelata, Carring. Tr. Ed. Bot. S. v. x. p. 378 (1870).

Hab. Discovered by my late friend *Mr. G. E. Hunt* on Ben-mac-dhui! and by Loch Kandor, July, 1868! Lough Bray, Ireland, July, 1873, *Dr. Lindberg!* Found also in Greenland, *Giesecke!* Shafto, *Retzius!* Styrian Alps, *Lindenberg.* Switzerland, *Jack! Dr. Lindberg* sends it from Ratavuori, Finland, where it was collected in fruit July, 1871, by *Dr. J. P. Norrlin.* In America it occurs on the Catskill Mountains, *Cleve!* and Alleghanies, *Sullivant!*

Forming extensive livid tufts on the borders of alpine streams.

Stems (Pl. II. fig. 5, 1) stoloniferous at the base, erect, rather tender and flexuose, pale-brown. *Shoots* 1″ to 3″ in height, by a line in diameter, simple, but appearing branched from the growth of innovations, which are frequent from the apex of annual shoots, especially from old involucra, at other times axillary. *Stolons* extensively creeping, naked, or beset here and there with fascicles of rootlets; at length ascending, and forming new shoots. *Rootlets* rare on the erect shoots; in the specimens from Loch Kandor of a purple colour.

Leaves smaller, and often defective at the base of shoots, more crowded near the apex, but generally rather distant (fig. 5, 2), and of nearly equal size, very concave, vertically patent from an erect somewhat contracted sheathing base. *Form* obovate (5, f. 3, 4) to obcordate, bilobed, lobes equal, ovate-obtuse, sinus narrow, sometimes reflexed, equal to about $\frac{1}{4}$th of the length of the leaf. *Margin* plane, sometimes undulate, inflexed (not reflexed) at the base.

Texture thin and tender, not at all shining, shrinking and crisped when dry. *Colour* pale pellucid olive when moist, apex brownish-purple or sphacelate. *Cells* with better defined thinner walls than in the following species. Those of the margin (f. 5, 5) quadrangular, smaller, $\frac{1}{1750}$″ in diameter. Cells of the upper third of the leaf hexagonal, with a double outline (f. 5, 5 b), $\frac{1}{1160}$″ by $\frac{1}{1400}$″. Those of the base oval or oblong, $\frac{1}{700}$″ to $\frac{1}{583}$″ by $\frac{1}{1166}$″. *Trigones* distinct at the angles, $\frac{1}{4667}$″ in diameter.

Dioicous. Fertile stem incrassate at the apex. *Involucral leaves* (f. 5, 6) larger than the rest, patent, cordate, deeply and less obtusely lobed, sometimes with a smaller ventral lobe, margin repand. *Involucre* a line in length, urceolate-oblong, formed of two convolute leaves scarcely differing from the involucral leaves in form, as may be seen by compressing a specimen laterally (f. 5, 7); connate only at the lower third; lobes more acute, erect, or a little patent, inflexed.

Colesule (f. 5, 7) adnate with the walls of the hollow receptacle, the apex only free, divided into 4 or 5 broad acute segments. It is much shorter than the involucre, and confined to its lower third, the lobes rising far above it, and hiding it from view.

Calyptra campanulate, bearing at the apex an unusually long style (f. 5, 8). *Abortive pistillidia* resembling those of *Scalius Hookeri* in their length and slenderness, attached to the walls of

the calyptra, and like it elevated by the growing fruit. Old pistillidia are not unfrequently metamorphosed into innovations within the involucre. *Capsule* very small, spherical, blackish-brown.

Spores round, reddish-brown, $\frac{1}{1750}''$ in diameter. *Elaters* about $\frac{1}{100}''$ long, composed of a double helix, about $\frac{1}{2333}''$ broad.

Perigonial leaves (f. 5, 9) usually crowded into a short terminal spike, more tumid at the sheathing base; lobes patent or reflexed, enclosing 1 to 3 olive-green *antheridia;* pedicel slender, of about six quadrate cells.

No. 135, in my copy of G. & R. Hep. Eur. is not *N. sphacelata*, but some undescribed species, allied to *Cephalozia catenulata*, Dum. (*C. turgida*, Mss.).

The distinction between this species and *N. emarginata* is well expressed by *Dr. Lindenberg* (l. c. p. 76): "Differere nostrum puto colore, caule flexuoso, nec incrassato, subsimplice, radiculis paucis tenuissimis vel nullis, foliis magis remotis erectis, apice tantum patentibus, lobis rotundatis apice sphacelatis, reticulo foliorum." Moreover, in *N. emarginata* the texture of the leaves is firmer, polished, scarcely altered when dry, and the dorsal margin usually reflexed at the base.

The only other species with which it is likely to be confounded is *J. inflata*, which is smaller, but approaches it in the shape and discoloration of the leaves; but their insertion is more oblique, and they are plane or slightly concave, more narrowed at the base, and not at all sheathing. The cells too are thinner-walled, and without trigones. When the colesule is present, there can be no danger of confusing them. Scotch specimens are much more gracile (3 to 4 inches), and with more remote leaves than those from Finland. Only barren plants have been met with.

Pl. II. Fig. 5.—1. *Barren shoot unmagnified.* 2. *Portion of stem* × 16 *diam.* 3, 4. *Stem-leaves.* 5 & 5 β. *Cellular structure* × 120. 6. *Involucrum with upper involucral leaves, and capsule.* 7. *Transverse section through involucre.* 8. *Calyptra enclosing young capsule.* 9. *Perigonial leaves* × 8.

2. Nardia emarginata, *G. & B.*

Pl. II. Fig. 7.

Stems rigid, simple or innovant from the apex; leaves loosely imbricated, round or sub-cordate, base broad amplexicaul, emargination shallow, lobes obtuse or apiculate, basal margin reflexed, texture firm and polished; involucre urceolate, connate for more than half its length, segments retuse.

Jungermannia emarginata, Ehrh. Beitr. iii. p. 80; Mart. Fl. Erlang. p. 156, t. 4. f. 32; Hook. Br. Jung. t. xxvii; Br. Fl. v. i. p. 110; Mackay, Fl. Hibern. ii. p. 59, n. 20; Musc. Brit. 2 ed. p. 229; Fl. Danica, t. 1945, f. 1; Eng. Bot. i. t. 1022. *J. macrorhiza*, Dicks. Cryp. Fasc. ii. p. 16, t. 5, f. 10.

Nardius emarginatus, Gray & B. Nat. Arr. Br. Pl. i. p. 694, n. 3.

Marsupella, Dum. Com. p. 114; Obs. Jung. 23, 4.

Sarcoscyphus Ehrharti, Corda, in Sturm. Fl. Germ. ii. 19, 20, p. 25; N. ab E. Eur. Leberm. i. p. 125; Syn. Hep. p. 7; Gott. et Rab. Hep. Eur. Ex. n. 256, c. icone (forma acuta), n. 255, c. icone (forma obtusa), lower figs. only, not upper, which represents *N. sphacelata.*

α *major*. Shoots 1½″ to 3″, by a line in diameter, compressed; stems rigid, sub-ligneous; leaves rather distant, patent-divergent, less concave, cordate emarginate, rounded and reflexed at the base, colour olive, olive-brown, or purple, sometimes nearly black, polished.

* *Forma acutiuscula*. Lobes divergent, abruptly apiculate.

** *Forma obtusa*. Lobes rounded, obtuse.

J. emarginata β grandis, N. ab E.; Hübener, Hep. Eur. p. 128. *Nardia robusta*, Lindb.

β *aquatica*. Shoots long, straggling, repeatedly innovant, naked or ramentose at the base, leaves irregular in outline, often erose, 2- or 3-lobed, undulate, sordid olive-green.

J. emarginata β aquatica, Ldg. Hep. Eur. p. 75. *Jung. aquatica*, Schrad. Fl. Germ. p. 75.

γ *minor*. Smaller in all its parts, shoots sub-terete; leaves more closely imbricated, erecto-patent, sub-complicate, round or sub-quadrate, lobes bluntly apiculate, margin nearly plane, olive-brown, or fawn-coloured, sometimes livid-green.

Jung. fusca, Hübener, Hep. Eur. p. 122. *Sarcos. Ehrharti γ julacea*, N. ab E. Leberm. Eur. i. p. 125.

δ *picea*. Densely cæspitose, stems rigid, leaves patent, approximate, orbiculate, vertically concave, lobes obtuse, connivent, sinus acute, equal to ¼th of the length; involucral leaves larger, convolute; involucre short, nearly immersed; cells smaller, colour glossy pitch-black; dioicous.

Sarcoscyphus piceus, De Not. Com. Soc. Crittog. Ital. (1861).
Sarcoscyphus alpinus, Gottsche, in G. & Rab. Hep. Eur. Ex. n. 453 & 535. *J. ustulata*, Hüben. Hep. Eur. p. 132 (♂ plant?).

Hab. One of our commonest sub-alpine liverworts, abundant by the borders of streams or spots watered by the spray of waterfalls; the var. *aquatica* is found even in running water. γ *minor* occurs on more exposed rocks; and δ *picea* I have only seen from rocks by Loch Kandor, *G. E. Hunt;* and Ben Macdhui, *A. Croall. Fruit.* Near the Moraine Glen Esk, April 1862, *A. Croall!*

Tufts creeping at the base, more or less crowded, conspicuous from the glossy orange-brown or purple fronds.

Stems rather stout, rigid, sub-ligneous, terete, somewhat incrassated near the apex, especially in fertile specimens (f. 7, 8), simple, but appearing branched from the growth of innovations "from the bosom of the terminal leaves," and from the base or interior of old *involucra*.

The shoots (f. 7, 1), as in most cosmopolitan species, are extremely variable; some are scarcely half an inch, others 3 or 4 inches in height, and from half a line to a line in breadth, more or

less compressed, naked at the base, or when prostrate, clothed with rootlets on the underside. *Stolons* about the thickness of horse-hair, branched and rigid, here and there attached to the ground by capillary fibres.

Leaves $\frac{1}{4}$ to $\frac{1}{2}$ a line in length, usually broader than long, cordate-orbiculate, occasionally sub-quadrate, in the smaller forms nearly circular; apex divided by an acute but shallow notch into two equal obtuse (f. 7, 5, 6) or abruptly-pointed lobes (f. 7, 3, 4) equal to $\frac{1}{4}$th or $\frac{1}{6}$th of the length of the leaf.

On the lower part of the stem (f. 7, 2) the leaves are more distant, and patent or divergent, but towards the apex more closely imbricated, nearly vertical, very concave, rounded at the base, amplexicaul, the lateral margins narrowly recurved, except at the upper third.

Texture firm and sub-cartilaginous, polished, little altered when dry; pellucid punctate. *Marginal cells* smaller, sub-quadrate, $\frac{1}{875}''$ by $\frac{1}{1166}''$; cells of the upper third hexagonal (f. 7, 12), $\frac{1}{700}''$ to $\frac{1}{583}''$ by $\frac{1}{875}''$; near the base the cells elongate, and the trigones are less regularly disposed, $\frac{1}{437}''$ by $\frac{1}{950}''$. *Trigones* about $\frac{1}{1750}''$. In the var. *robusta* the measurements are nearly the same, $\frac{1}{1750}''$ to $\frac{1}{500}''$ in length and $\frac{1}{1166}''$ broad. In var. *minor* the cells are somewhat smaller, and the marginal ones less regularly disposed.

Colour variable, pale olive-yellow, or olive-brown, sometimes tinged with red or purple. Specimens growing in water are of a dark sordid green, or nearly black.

Dioicous. Involucral leaves, 2 to 4 pairs, sometimes smaller and more erect than the upper stem-leaves, but generally larger and more deeply and acutely emarginate, occasionally with a third lobe, the upper leaf frequently adnate at the base with the walls of the involucre.

Involucre terminal, or from the growth of innovations appearing axillary, urceolate, formed of two leaves united together for half or two-thirds of their length, and adnate with the colesule, the teeth of which alone are free (f. 7, 7). On longitudinal section, the fruit rudiment seems to be placed within a hollow scooped out of the apex of the stem, and surmounted by the involucral bracts. If we compress this organ, so as to view it laterally by transmitted light, the structure is very evident (f. 7, 7, 8). The lobes of the involucre resemble ordinary leaves, and between them, on the ventral aspect, a smaller lobe may be observed, ovate, and entire or bifid at the apex (*amphigastrium*).

Teeth of the *colesule* at first connivent, afterwards splitting into 4 or 5 triangular lobes.

Capsule spherical, rather small for the size of the plant, of a pale brown colour, dividing into four ovate valves, which are of firm consistence. *Pedicel* succulent, white, seldom exceeding half an inch in length.

Occasionally more than one capsule is found in the same involucre. This variation is figured in *Brit. Jung.* t. xxvii. f. 11.

Spores round, fulvous, $\frac{1}{1750}''$ in diameter. *Elaters* shorter than in the last species, bi-spiral, $\frac{1}{175}''$ to $\frac{1}{140}''$ long by $\frac{1}{1350}''$ broad.

Andræcium spicate, terminal on distinct plants, sometimes interrupted from the growth of innovations. Perigonial leaves closely imbricated (f. 7, 10), gibbous at the base, the lobes acute, connivent.

Antheridia 2 or 3, axillary, oval or obovate, olive-green, seated on a slender 4- to 6-jointed pedicel (f. 7, 11).

Gemmæ are occasionally met with at the apex of the stem and terminal leaves; their form is elliptic, 2- or 3-septate, and they are of a pale brown colour.

Nardia emarginata is one of the most easily distinguished of our common Hepaticæ. Ehrhart compared the form of leaf to a heart cut out of paper, and although somewhat vague, this description is not inapt. When occurring in mass, on the face of some waterfall, or covering with its warm tints the rocks by a mountain stream, it is one of the most beautiful and conspicuous of species. To me it bears the greeting of an old friend, since it was the first Jungermannia I learnt to name, on my only visit to the Clova district.

N. robusta, Lindberg, seems to me only a stouter variety, with nearly black stems and more distant cordate leaves, which are seated at right angles with the stem, less concave, sometimes plane or slightly convex, and of firmer texture. The colour is an obscure indigo-green, turning black, but otherwise scarcely altered when dry. I have received specimens of this form from Braemar, *Mr. A. Croall!* Micklefell, *J. G. Baker!* Twll Dhu, and Snowdon, *G. E. Hunt!* It appears common in Finland. I feel doubtful whether this is the *β grandis*, N. ab E.

Some of the small forms from the Clova Mountains, &c. have a very distinct appearance; the stems in these seldom exceed half an inch. In *γ julacea*, N. ab E., the barren shoots are prostrate or ascending, and nearly terete; the fertile ones are shorter, and the involucre ovate, for the greater portion of its length immersed (t. 7, 8). Another var. from Allen Water (*R. Spruce*, 1835) is repeatedly and fasciculately innovant, the terminal branches very slender and terete, and the leaves minute, obovate, deeply and obtusely lobed, erect, and closely imbricated. This approaches *Nardia densifolia γ fascicularis* (G. & R. Hep. Eur. Ex. n. 458. c. icone); but in that species the leaves are roundish-ovate, with shallow acute segments; and the margins decidedly reflexed.

δ picea (f. 7, 7) looks like a distinct species, as Dr. Gottsche, undoubtedly our first authority on all matters relating to the Hepaticæ, has determined. I have not received the last part of the Hep. Eur. Ex., where it is published (n. 535). My late friend *G. E. Hunt* collected it by Loch Kandor, Aberdeen! and Mr. *A. Croall* on rocks near the Moraine Glen Esk. The fronds are intensely black, a warm brown by transmitted light, barren shoots ($\frac{1}{2}$ in.) prostrate at the base, with pectinate-pinnate leaves, exactly round, inflexed obtuse lobes, and acute sinus, equal to $\frac{1}{3}$rd or $\frac{1}{4}$th of the length, very convex, and narrowed at the base; fertile shoots stouter, with large involute involucral leaves, which nearly hide the short roundish involucre; leaf-cells smaller than in *γ minor*; the marginal ones more minute; the perigonial leaves are fewer in number and terminal.

On comparison with an original specimen of *Sar. piceus*, De Not., I find it identical with *Sar. alpinus*, Gottsche. The name therefore should be *Nardia picea*. I hope to give a more detailed description and figure in a later part.

Another form (Ravine of Janira, Forfar, *A. Croall*) resembles γ *minor* in size, but is more densely tufted, compressed, and erect; the leaves are nearly uniform, of a dull green, sometimes sphacelate at the apex. The upper part of the leaf resembles *N. sphacelata*, but it wants the vaginate base.

Sarcoscy. Ehrharti δ *saccata*, N. ab E., is only the male plant of *N. emarginata*.

No. 255, G. & R. Hep. Eur. (Silesia, *Hilse*), with the upper fig. *V. major viridis*, belong to *N. sphacelata*.

Pl. II. Fig. 7.—*N. emarginata*. 1. *Natural size*. 2. *Stem* × 8 *diam*. 3, 4. *Leaves with apiculate lobes*. 5. *Lobes obtuse*. 6. *Leaf of var.* β. 7. *Involucre of var.* γ *viewed laterally*. 8. *The same part of* β *minor laterally compressed*. 9. *Longitudinal section of involucre*. 10. *Perigonial leaves*. 11. *Antheridium*. 12. *Leaf-cells*.

3. Nardia Funckii.

Pl. II. Fig. 6 (*ex parte*).

Densely cæspitose; stems very short, erect, rigid, fastigiately innovant; leaves approximate, erecto-patent when moist, erect when dry, sub-rotund, carinate-concave, acutely emarginate, lobes acute; involucral leaves much larger; involucre ovate, lower half connate, acutely bilobed, the segments incurved; 2 to 4 lines.

Jungermannia Funckii, Web. & Mohr. Bot. Taschenb. p. 422, n. 27 (1807); Mart. Fl. Erlang. p. 159, t. 5, f. 35; Lindenb. Hep. Eur. p. 77, n. 8; Eckart, Syn. Jung. p. 14, t. 13, f. 112, 113 ε (poor); Hüben. Hep. Germ. p. 133.

Marsupia Funckii, Dum. Syll. p. 79, n. 114.

Sarcoscyphus Funckii, N. ab E. Leberm. Eur. i. p. 135, β *minor* (1833); Synop. Hepat. p. 8, n. 6; Gott. & Rab. Hep. Eur. Ex. no. 86, 254, 461, α, β, 459, *forma robustior*; Spruce, Hep. Pyr. Tr. Ed. Bot. Soc. v. iii. p. 197.

Jung. excisa, Funck, Cryp. Gew. ix. n. 90.

J. bicornis, Mull. Fl. Dan. t. 888, f. 6. (excl. spec. fructif.).

β *robustior*. Shoots compressed, stouter; leaves approximate, twice the breadth of the stem, elliptic-obovate, complicate; lobes inflexed, dark-brown, polished, 2 to 6 lines.

β* *diffusa*. Stems longer, intricately and repeatedly innovant, fastigiate; leaves more remote, sub-vertically patent, not unfrequently sub-secund, lobes divergent; reddish-brown or dark-brown, polished; ½ in. to 1 in.

Hab. Forming extensive (for the size of the plant) dark brown or nearly black patches on shady siliceous or argillaceous rocks, in habit resembling the rigid form of *J. divaricata*. Tilgate Forest, Apr. 1858, *G. Davis!* Black Mountains, Ireland, *Dr. Moore!* Bettws-y-Coed! Ben Challum, Breadalbane, Sept. 1863, *A. O. Black!* Ben Voirlich, Craig-na-Gour, and Ben Lawers, *A. McKinlay!* β Wastdale, side of Great Gable, *J. G. Baker*, 9, 70! Loch Kandor, May 1868, and Ben-mac-dhui, *G. E. Hunt!* Ben Lawers! Lochnagar, male and fertile shoots, 1873. *T. Sim!*

Stems creeping (f. 6, 2), and intricately matted together at the base, which is naked or beset only with the ramenta of old leaves, ascending or erect, rather thick for the size of the plant, rigid, subligneous, at first simple, but producing innovations from the terminal axis of the shoots, or from the axillæ of leaves; 2 to 6 lines long, of a brown or nearly black colour. Shoots (f. 6, 3, 8) slightly compressed, catenulate when dry, pectinate-pinnate when moist, sub-clavate at the apex, or in barren innovations attenuate.

Rootlets confined to the creeping portion of the stem and stolons.

Leaves scarcely wider than the stem, of nearly uniform size, somewhat smaller and more distantly placed near its base, and on innovant shoots, whilst they are more crowded at the apex; round or sub-quadrate (f. 6, 4), sometimes roundish-ovate, acutely emarginate; sinus equal to a third or fourth of the length; lobes equal, acute or a little obtuse, divergent. The leaves are of nearly uniform size, laxly and sub-vertically imbricated, semi-amplexicaul, very concave, inflexed (but not vaginate) at the base.

Texture firm and compact, scarcely altered when dry. *Colour* olive-brown, lurid-brown, or rarely a paler olive; the leaves are smooth, but scarcely polished, except in var. *diffusa*.

Areolation minute, obscurely punctate, the cell-walls thick, appearing crenate from the projecting 'trigones;' but after the application of re-agents the true roundish-hexagonal form is developed; marginal cells sub-quadrate, but not differing perceptibly in size from those of the upper third, $\frac{1}{1750}''$ to $\frac{1}{875}''$ by $\frac{1}{1100}''$. The wall is thickened at the angles which unite with neighbouring cells, but the trigones are smaller than in allied species. Basal cells $\frac{1}{700}''$ long by $\frac{1}{1750}''$. The interior is filled with brownish endochrome, and often contains 2 or 3 chlorophyll bodies (zellenbläschen), resembling those noted under *N. scalaris*.

Dioicous. Fertile shoots (f. 6, 2) much thickened upwards, abbreviate (2-3 lines); *involucral leaves* two or three pairs, suddenly and remarkably enlarged, broadly ovate, the lobes rather obtuse, sinus acute.

Involucre conspicuous, ovate, formed of two convolute leaves, connate for half their length; lobes acute, at first connivent, but after the egress of the capsule erect.

Colesule adnate with and hidden by the outer involucral bracts and connective tissue of the dilated stem, only the apex remaining free, which is at first entire, but afterwards split into irregular lobes (f. 6, 6). Its texture is more laxly cellular than the outer portion.

Calyptra obovate, hyaline, cells rhomboidal, bearing at its base the abortive pistillidia.

Capsule very minute, round or oval, pale reddish-brown; valves ovate, thick-walled; pedicel about 2 lines long, rather thick, succulent.

Spores brown, $\frac{1}{1750}''$; elaters bi-spiral, serpentine-flexuose.

Perigonial leaves terminal, sub-spicate, broadly ovate, more tumid and closely imbricated, so that the shoots are julaceous, sinus narrow and lobes connivent. They enclose generally a solitary spherical shortly stipitate antheridium.

Obs.—*Nardia Funckii* varies considerably in the length of the shoots, and the imbrication of the leaves, whether distant and patent, or more erect and appressed. But the differences depend for the most part upon age and habitat: luxurious specimens producing copious innovations, and assuming a more irregular and straggling appearance, the normal habit being densely and uniformly cæspitose.

In the male plant the shoots are terete or catenulate, and the leaves imbricated even when moist, whilst the fertile tufts have a very different aspect, the remarkably developed involucra contrasting with the ordinary slender shoots.

The var. *diffusa* bears a striking resemblance to small forms of *Jung. minuta*, Crantz; so that in the absence of fructification it is difficult to describe the difference between them. On careful examination, old involucres may however generally be found, either at the apex of the shoots, or at points of annual growth, innovations frequently arising not only from one or both sides of the involucral bracts, but from the centre of the involucre itself, when they seem to be a continuation of the old axis. From this peculiarity of growth shoots are met with bearing three or four *involucra*, only one appearing terminal; whilst a second appears lateral, a shoot having been formed on one side only; and a third axillary between two innovations.

Jung. minuta is less stoloniferous, the shoots are of the same width throughout and the leaves equidistant, patent, divergent, and the lobes unequal. The colour too is a glossy golden-brown, and the plant altogether larger.

N. Funckii is rarely met with in fruit, a circumstance not unusual with dioicous species. Recently, through the kindness of Mr. Sim, I have received a fine tuft from Lochnagar, of the var. *robustior*, containing both male and fertile shoots. Stems from $\frac{1}{5}''$ to $\frac{1}{4}''$ long by $\frac{1}{40}''$ broad. Rootlets confined to the base of the stems, of a reddish colour. Male shoots naked below, compressed, sub-spicate, the perigonial leaves occupying the upper portion, more erect, closely imbricated, and gibbous at the base.

Fertile shoots somewhat stouter, but both the involucral bracts and involucre relatively much smaller than usual. *Involucre* roundish-ovate, after the emission of the capsule (which it is only just large enough to contain), wider and truncate at the apex. It consists of two broad leaves, connate only at the lower third, obtusely emarginate, the lobes short and obtuse; texture compact as in the cauline leaves. *Colesule* free except at the base, funnel-shaped, the apex contracted, and nearly entire, at length irregularly ruptured by the ascending capsule. The texture thin and membranous, areolæ large, rhomboidal. The apex of the stem also was less thickened and hollowed than usual; in this respect, and the more free colesule, affording a connecting link between Nardia and Jungermannia.

Sarcoscyphus Funckii, α major, N. ab E., must not be confounded with our *β robustior*; the former, according to Dr. Lindberg, is identical with *Nardia sparsifolia*, in which the inflorescence is paroicous.

Pl. II. Fig. 6.—*Nardia Funckii.* 1. *Natural size.* 2. *Fertile stem with involucre.* 3. *Shoot of larger variety* × 16. 4. *Stem-leaf.*

4. Nardia adusta.

Pl. II. Fig. 6 (*ex parte*).

Paroicous. Shoots very minute, clavate, terete; leaves few, vertically imbricated, accrescent, sub-complicate, round, or broadly ovate, from a ventricose sheathing base, acutely bilobed, the sinus angular; cells large, hyaline; involucre ovate, conspicuous, the segments erect, acute, lower half adnate.

Gymnomitrium adustum, N. ab E. Leber. Eur. i. p. 120 (1833); G. L. N. Synop. Hepat. p. 3, n. 4. *Acolia brevissima*, Dum. Syll. p. 76, n. 109 (1831).
Sarcoscyphus adustus, Spruce, Hep. Pyr. p. 196, n. 2; Trans. Ed. Bot. Soc. iii. (1850); Hartm. Scand. Fl. ed. ii. p. 129.
Nardia sparsifolia, β *adusta*, Lindb. MSS. (1873).

Hab. Blackdown, Sussex, June 1855, *Mr. Jenner!* Castle Howard in saxis umbrosis, *R. Spruce!* Rocks, Fairy Glen, Bettws-y-Coed, 1871!

In England *N. adusta* is generally found in thinly-scattered tufts, intermingled with *Brachyodus trichodes* and other species, on sandstone rocks. But the Welsh specimens were more densely pulvinate, forming shallow patches of a lurid-brown colour, and looking as if scorched, as the name implies. Numerous capsules are met with in early summer.

Primary shoots stoloniferous, creeping, attached to the ground by numerous white rootlets. Stems ascending or erect, about a line, or at most two lines in height, thick, fleshy, the cortical stratum consisting of a single row of cells (fig. 6, 9), fasciculate; the older ramuli innovant from the apex. *Barren shoots* (fig. 6, 8) scarcely a third the diameter of the fertile ones, terete, of nearly the same thickness throughout, or only slightly incrassated at the summit; fertile ones stouter, clavate.

Leaves increasing in size upwards, except on the barren shoots, distant, fewer in number and comparatively larger than in *N. Funckii*, seldom more than 5 to 8 pairs, bifariously imbricated, vertical, near the base smaller, orbiculate, concave, amplexicaul, upper ones gradually enlarging, erect and closely appressed to each other, complicate-concave, elliptic-ovate (fig. 6, 5) or broadly ovate, from a dilated saccate sub-vaginate base, within which the antheridia often nestle.

Apex acutely emarginate, the lobes angular, slightly inflexed, sinus acute, equal to one-fourth of the length: sometimes the lobes are more obtuse.

Texture firm but translucent, little altered when dry. *Colour* pale yellow or olive near the base, tips of the leaves and apex of stem sphacelate.

Cells hyaline, punctate, two or three times larger, and with thinner, better defined walls than in *N. Funckii*. Marginal cells only differing from the rest in their quadrate form, $\frac{1}{1400}''$ to $\frac{1}{700}''$

by $\frac{1}{1160}''$. Trigones small but distinct. The contents consist of minute granules, and I have not observed the chlorophyll or amylaceous bodies in that species.

Inflorescence paroicous, the antheridia occupying the same perichætium as the pistillidia, but arising from the axil of the lower bract, so that the two are not intermingled, as in synoicous species.

Fertile shoots much thickened, clavate. Involucral leaves about half the length of the involucre, erecto-patent, broadly-ovate, the lobes rather obtuse, connivent. *Involucre* equal to the rest of the stem (about half a line) in length, urceolate-ovate, consisting of two leaves resembling the involucral ones, erect, and connate at the lower third, or sometimes higher. The lobes are acute, and somewhat inflexed, and the texture thinner than in the ordinary leaves, and composed of larger rhomboidal or oblong cells.

Colesule not more than half the length of the involucre, and entirely concealed by it, campanulate, adnate at the base with the outer walls, apex free, conical, at first contracted and simply crenate at the mouth, after the egress of the capsule irregularly lobed. *Mr. Spruce*, who first pointed out the true affinities of this species, states that he always finds "a true perianth present, the origin of which is derived from the union of two leaves quite concealed by the perichætial leaves, with which it is concrete for nearly half its length : it is pale, and of very delicate texture (cellules three times larger than those of the perichætium), erose and inflexed at the summit, and sometimes two-lipped."

Calyptra large, obovate, hyaline (fig. 6, 7), bearing at its junction with the axial portion 6–8 abortive pistillidia.

Capsule (fig. 6, 7) minute, rather longer than broad, cinnamon-brown, seated on a pedicel one or two lines in length.

Spores rufous, punctate, $\frac{1}{1750}''$; elaters bispiral, long, flexuose.

Antheridia solitary or in pairs, olive-green, oval, shortly stipitate, arising from the ventricose axillæ of the second and succeeding leaves, beneath the terminal one which invests the pistillidia.

In a recent letter (Nov. 24, 1873) Prof. Lindberg states that *N. adusta* must be classed as a variety of his *N. sparsifolia* (*Musc. Nov. Scand.*, 1868), "differing abundantly from *N. Funckii* in having few larger accrescent leaves, with cellules thrice the size, and paroicous inflorescence." I agree with him as to the distinction between the two, but I cannot see why the original name of N. ab E. should be superseded by a more recent one, even if the colour of the larger form (*N. sparsifolia*) is sometimes of too light a green to be described as *adustus*. The original specimen from Kongsburg, Norway, *P. T. Cleve*, June 1864, is quite as dark-coloured as our *N. adusta*. I append the diagnosis from *Notiser pro Fauna et Flora Fenniæ*, ix. 1868, so that the reader may compare the two :—

"*Sarcoscyphus sparsifolius*, Lind. — Paroicous, rather robust, few-leaved, cortical stratum of the stem simple, leaves acutely incised, lobes rather acute, margin erect,

bracts (involucral) connate to near the middle, lobes slightly inflexed, very concave, those of the involucre acute, calyptra large.

"*Plants* rather stout, densely cæspitose, '*nigræ, apicibus viridifuscis.*' *Stems* ascending, entangled, slender, flexuose, fastigiate-ramose, radiculose at the base, and producing long stolons, few-leaved, cortical stratum simple.

"*Leaves* accrescent, margin erect, inferior ones patent from a somewhat contracted base, quadrate-ovate, sub-amplexicaul, acutely emarginate, lobes rather acute, plane; superior ones with a broader base, sub-vaginate and saccate, broadly ovate, erecto-patent, bearing two antheridia in their axils; cells pentagonous- or hexagonous-rotund, trigones distinct. *Involucral bracts* resembling the upper leaves, erect, connate below the middle, lobes slightly inflexed, rather concave. *Involucre* 4- vel 5-fid, lobes acute.

"All the other species are dioicous. Moreover, *S. Funckii* differs in slenderness, leaves denser, erect, the texture of the involucre, cortical stratum of stem 'quincu-octuplici,' &c.; in *S. emarginatus* the leaves are dense, erecto-patent, emarginate, lobes very obtuse, involucral bracts highly connate, and cortical stratum of the stem double, &c." This form has not yet been met with in England.

Pl. II. Fig. 6, *n.*—5. *Stem-leaf of N. adusta.* 6. *Section of involucre.* 7. *Calyptra and capsule.* 8. *Barren shoot* × 16. 9. *Section of stem.*

5. Nardia revoluta, *Lindb.*

Stems matted and stoloniferous at the base, densely tufted; leaves sub-complicate, erecto-patent, imbricated when dry, rigid, round or elliptic from a narrower semi-amplexicaul base, deeply and acutely bidentate, margin narrowly reflexed throughout; involucral leaves resembling those of the stem but larger.

Sarcoscyphus revolutus, N. ab E. Leberm. Eur. ii. p. 419, iv. p. 34 (1836); G. L. N. Synop. Hepat. p. 8, n. 3; Hartm. Skand. Fl. x. ed. ii. p. 84; Flor. Danica, Sup. t. 119, f. 2 (1865).

Jung. atrata, Mitt. Hepaticæ of East Indies (Journ. Lin. Soc. 1859, p. 90).

Nardia revoluta, Carring. in Grevillea, No. 18, p. 88, pl. 18, f. 19–25 (Dec. 1873); Lindb. Revis. Crit. Fl. Dan. p. 113 (1871).

Hab. Sent to *Prof. Lindberg*, of Helsingfors, Aug. 1873, among specimens of *Andræa*, by *Mr. David Orr*, of Glasnevin, who collected it at Luggielaw, co. Wicklow, 1851! This rare species was first discovered in the Tyrol (*Funck*); it is also found at Dovre, Norway, *Bergyren* (Herb. Lindberg); and in the Himalaya Mountains, *Hooker & Thompson* (1306).

Fronds densely cæspitose, of an intense shining black colour, creeping at the base. *Stolons* branched and entangled, of a brownish colour, brittle, somewhat thinner than the stems, sparingly radiculose. *Stems* ascending or erect, rigid, from half an inch to an inch in length, stout, subligneous, sometimes producing from the axillæ of the terminal leaves two or more innovations, which are clothed with smaller more erect leaves.

Rootlets scanty, confined to the stoloniferous shoots.

Leaves distichous, alternate, separated from each other by about

their own half-diameter, vertically patent, or erecto-patent when moist, erect when dry, but otherwise unaltered, very concave, round or elliptic-obovate, the base contracted and clasping the stem, from $\frac{1}{3}'''$ to $\frac{1}{2}'''$ long; sinus deep, angular, equal to a third of the length; lobes equal, acutely cuspidate; margin with a uniform narrow revolute border, so that it appears thickened. Near the base of the shoots, and on the innovations, the leaves are scarcely broader than the diameter of the stem, but on the main shoots they gradually increase in size towards the apex.

The texture is firm and dense, lævigate. *Colour* deep black, by transmitted light a warm brown. *Cells* minute, dotted, the walls thick. Marginal cells subquadrate, $\frac{1}{1750}''$ each way; near the centre they are about $\frac{1}{1166}''$ by $\frac{1}{1750}''$; basal cells $\frac{1}{700}''$ by $\frac{1}{1750}''$.

Dioicous. Fructification ?

Dr. Lindberg, whose eye nothing seems to escape, states "that at the base of the leaves of *N. revoluta* from Dovrefjeld, he has observed that the cells in the mid-line are arranged in two layers," the only instance of an approach to a nerve, as in Mosses, known among the Foliose Hepaticæ. In *Diplophyllum albicans*, what appears to be a nerve is merely a series of more elongated cells, and we observe a similar enlargement of the basal cells in *Frullania* and other species. To Dr. Lindberg we owe the identification of this rare species, which, with his accustomed liberality, he at once communicated to me; thus enabling me to publish another species of *Nardia* new to our Flora. *N. revoluta* was collected by Mr. David Orr so far back as 1851, but mistaken for *Andræa alpina*, which it resembles in habit and colour. Only barren specimens have been met with.

Himalayan specimens, collected by Dr. Hooker, differ only in their greater luxuriance, in the leaves being sub-secuud, and the shoots recurved at the apex. In some respects it is intermediate between *N. emarginata* and *N. Funckii*, but it cannot well be confounded by any one who attends to the diagnosis. No other species, with which I am acquainted, has the margin of the leaf uniformly revolute.

The leaves of *N. emarginata* are reflexed at the base only, but the lobes are always plane; and in *N. picea*, which resembles it most closely in size and colour, the margin is somewhat incurved. The leaves of *N. densifolia* are more crowded, the segments shorter and less acute, and the external borders only are recurved, not the lobes.

I hope to supply a figure of *N. revoluta* before the completion of this work, meanwhile I would refer to *Grevillea*, pl. 18, f. 19—25, where the enlarged shoot (f. 20) is very correctly lithographed.

β. *Mesophylla*, Dumort.

6. Nardia scalaris, *G. & B.*

Dioicous. Shoots creeping or erect, radiculose, slightly compressed; leaves sub-vertical, arcuately imbricated, orbiculate, concave, upper ones retuse; amphigastria broadly subulate; involucre compressed, obovate, urceolate; capsule oval.

Jung. scalaris, Schrad. Cryp. Gew. ii. p. 4 (1796); N. ab E. Leber. Eur. i. p. 281 (1833).

J. lanceolata, Eng. Bot. t. 605.

α major. Stems incrassated, naked, for the most part erect; leaves more distant, less convex, patent, and often recurved at the apex; involucral leaves emarginate; amphigastria distinct, triangular-subulate, entire. Deep green, sometimes red or purplish, generally fertile.

J. scalaris, Hook. Brit. Jung. t. 61; Lindenb. Hep. Eur. p. 27; Fl. Brit. v. i. p. 116, n. 43.

α major, N. ab E. l. cit. i. p. 281 (1835); G. & R. Hep. Eur. Ex. n. 106, 362.

Nardius, Gray & Bennett, Nat. Arr. i. p. 694, n. 1 (1821).

Mesophylla, Dum. Com. Bot. p. 112 (1823).

Alicularia, Corda, in Sturm. Fl. Cryp. xix. p. 32, t. 8 (1829); G. L. & N. Syn. Hep. Eur. p. 10; Dum. Syll. p. 29, n. 115.

α distans*. Stems elongated; leaves distant, more convex, erecto-patent, ventricose, sordid green, shrinking when dry.

β rigidula. Shoots rigid, creeping, subterete; leaves roundish-ovate, closely imbricated, semi-vertical; male stems terete, subspicate; amphigastria frequent, subulate; involucre half-immersed; olive-green, brown, or purple.

*Alic. scalaris, α** rigidula*, G. & R. Hep. Eur. Ex. 223, c. icon.; N. ab E. l. cit. ii. p. 449.

Alic. rufescens, Dum. Syll. n. 116.

J. subapicalis, Hüben. Hep. Germ. p. 83 (excl. syn. præter Lindenb.).

β rigens*. Shoots erect, gracile, interrupted, two or three times innovant from the upper amphigastria; leaves appressed, scalate, imbricated, entire; amphigastria frequent, subulate.

N. ab E. l. cit. ii. p. 281.

γ compressa. Stems short, erect, rigid; leaves orbiculate, plane, near the apex more crowded and compressed; amphigastria broadly subulate, patent; involucral bracts larger, entire, connivent, pale-green.

Jung. Walrothiana, Hüben. l. c. p. 85.

Hab. One of our commonest species, growing on shady banks, rocks, or in wet places, from the sea-level to the summits of our highest mountains. Fruit, spring and autumn.

Like the majority of species with a creeping habit, *Nardia scalaris* forms extensive tufts, either creeping and depressed, or more crowded and ascending. Its appearance varies much according to locality. From the banks of the Findhorn, *Mr. Croall* has sent me specimens which almost attain the proportions of *N. compressa;* submerged specimens are more slender, and their leaves distant and smaller; whilst on dry moors and rocks the habit is rigid and creeping, and the colour tinged with brown or purple. On the higher mountains *γ compressa* is met with, with fewer rigid, appressed leaves, and compressed shoots, the colour very pale olive, and almost destitute of chlorophyll

corpuscles. Another form, β* *rigens*, has also slender elongated shoots and small leaves, and occurs in dense erect tufts from repeated prolification of the apex.

Stolons mostly subterranean, less conspicuous than in allied species, viticulose, fleshy. *Stems* (f. 8, 2) half an inch to an inch in length, sometimes longer, simple or rarely furcate, the rejuvenescence of the plant being maintained by the growth of innovations from the axils of the apical amphigastria. The stems are stout, sub-ligneous, in the *var.* α trigonous on section; colour from brown to dark purple. *Barren shoots* sub-terete, or laterally compressed, of nearly equal diameter, curved at the summit, either creeping, the apex only ascending, or erect,

Rootlets numerous on the stolons and creeping stems, or disposed in a fasciculate manner at the base of the amphigastria; rarer on the erect or fertile shoots, white, capillary.

Leaves smaller and more distant at the base of the stems and innovations, more crowded, and of nearly equal diameter upwards (f. 8, 2, 3), distichous, scalately imbricated, erecto-patent or erect, obliquely amplexicaul, concave, especially at the base, from $\frac{1}{4}''$ to $\frac{1}{2}''$ in length, orbiculate (f. 8, 3), sometimes a little broader than long, sub-marginate (the border a little inflexed and formed of smaller cells), terminal leaves of fertile shoots emarginate.

Amphigastria conspicuous on the upper portion of the shoots, ovate, or triangular-subulate (f. 8, 5), patent or reflexed, frequently connate with the margin of the adjacent left-hand leaf (*spira dextrorsa*), rarely with the leaves on each side; subulate, deformed, or obsolete at the lower part of the stem, or hidden by the capillary rootlets; margin entire, in some specimens reflexed.

The texture of the leaves is rather thick and succulent, little altered when dry.

Colour deep green, olive, reddish-brown, or purple.

Cells with continuous rather thick walls, but obscured by the presence of numerous chlorophyll-granules, and large translucent corpuscles of a round, oblong, or curved shape: these refract the light like air-bubbles, and are very characteristic of the species (f. 8, 4). The structure becomes clearer when the leaf has been prepared by boiling with liq. potassæ, and tinting with iodide of zinc. The marginal cells are smaller, longer than broad, $\frac{1}{875}''$ by $\frac{1}{1400}''$; in the upper third the cells are uniform, hexagonal, with double contour, $\frac{1}{778}''$ to $\frac{1}{1166}''$; near the base of the leaf the form is oval, $\frac{1}{583}''$ by $\frac{1}{780}''$. Trigones minute, occupying the angles of adjacent cells.

Dioicous. Fertile stems ascending, stouter and incrassated at the apex, trigonous on section, the flat surface being ventral. Leaves in the var. *major* distant, plane, and often recurved at the apex, the basal portion remaining ventricose. *Involucral leaves* (f. 8, 6) two or three pairs, double the size of the ordinary leaves,

either entire or emarginate, vaginate, and embracing the base of the involucre; apex erect or reflexed.

Involucre obovate (f. 8, 7), thick-walled, formed by the dilated and hollow apex of the stem, and the combined bases of the two involucral leaves, and amphigastrium. Frequently a lower leaf, or pair of leaves, with their amphigastria, are attached to its walls, proving that it is only a modified portion of the stem. The lobes of the involucre are roundish-ovate (f. 8, 6) or cordate, sharply emarginate, sometimes undulate, erect or connivent, imparting a compressed appearance to the organ. The amphigastria, which are connate with the lobes, are ovate, entire or sub-dentate, and with reflexed margins.

Colesule (f. 8, 7) immersed and adnate with the involucre, the apex only free, cleft into five broad equal segments, but conoid (as in *N. hyalina*, &c.) before the egress of the fruit.

Calyptra obovate, with large pellucid reticulation, bearing on its lower half 10 to 12 abortive *pistillidia*.

Capsule oval (f. 8, 6, 7), chocolate-brown; valves 4, elliptical, of thick texture, beautifully annulate-striate.

Peduncle $\frac{1}{2}''$ or more in length, rather stout and succulent, its base sunk into the hollowed receptacle, and surrounded by four fleshy lobes, a modified form of *vaginula*.

Spores dark-brown, round or obscurely three-angled, epidermis rough, $\frac{1}{1750}''$ in diameter (f. 8, 8).

Elaters long and flexuose, dark-brown $\frac{1}{70}''$ in length by $\frac{1}{1750}''$ broad.

Andræcium terminal, spicate, on distinct shoots.

Perigonial leaves exactly round, more concave, closely and arcuately imbricated, bearing at their bases 2-4 conspicuous, dark-olive, spherical or obovate *antheridia*, seated on a slender stalk about equal to their length.

Sir W. Hooker states that the leaves of this species, like those of *Mylia Taylori*, Gr. & B., "produce a minute, black, hispid, nearly spherical fungus," which is attached to the surface or margin.

In the barren state *Nardia scalaris* resembles closely some of the round-leaved Jungermanniæ, but it may be recognized by the triangular-subulate amphigastria, and the presence within the leaf-cells of the peculiar corpuscles already described. When fructification is present, it is not likely to be mistaken for any other species, except *N. obovata*, in which the colesule is connate for half its length with the involucral leaves, and *N. hyalina*, where the colesule is immersed. From both, however, it may be known by the colour of the rootlets, which in *N. scalaris* are *white*, whereas in the others they are *purple*.

A revision of the forms named *N. scalaris* in my own herbarium (assisted by original specimens from Professors De Notaris and Lindberg), has convinced me that at least three species are confounded under that name:—1. The true *N. scalaris*, which is *dioicous*; 2. *N. repanda*, Lindb.; and 3. *N. geoscypha* (De Not.), which are *monoicous*. This discovery was made too late to allow of the species being engraved. Already the

delays in the production of the work have been most vexatious, so that it is not to be wondered at that the publisher objects to any change of plan. He has, however, promised that figures of any new species shall appear in a supplementary part.

Below I append a brief diagnosis of the new species :—

NARDIA REPANDA, Lindb. : Paroicous, stems more slender, fragile, ascending, innovant, ramuli gracile ; leaves distant, subvertical, orbiculate, concave, saccate, and amplexicaul at the base ; margin erect, more or less undulate, emarginate ; texture thin, hyalne, the cells larger, thin-walled ; involucre obovate-clavate, bracts sub-reniform, repand-lobate ; upper amphigastria ovate, 3–4 dentate ; pale green, $\frac{1}{3}$ to $\frac{1}{2}$ inch.

Jung. scalaris, β repanda, Hüben. Hep. Germ. p. 81 (ex parte). 1834.

Jung. Silvrettæ, Gott. & Rab. Hep. Eur. Ex. n. 470 ! (Barren.) 1869.

Prof. Lindberg states that this is the common form in Finland. It should be looked for here, since I have received it from Cleveland, Yorkshire ; and from Forfar, under the name of *J. capitata*, the large variety of which it resembles in the delicate, crisped, hyaline leaves, and large areolæ. Ben Lawers, near Loch-na-ghat, Sept. 1862, *A. McKinlay !* Canlochen, July 1868, *G. E. Hunt !*

N. GEOSCYPHA (De Not.), Lindb. : Autoicous, smaller, barren stems very slender, terete, creeping, radiculose ; fertile stouter, ascending only at the apex ; leaves accrescent, lower ones entire or emarginate, orbiculate, involucral leaves broader, repand-lobate ; amphigastria rare on the barren stems ; upper ones lanceolate, trifid ; involucre immersed, seated at right angles with the stem, gibbous at its base, the cortical layer, and rootlets purple ; colour reddish-brown or purple, 2‴ to 6‴.

Alicularia geoscypha, De Not.*

Alicularia scalaris, β minor, N. ab E. Leb. Eur. i. p. 281. Gott. & R. Hep. Eur. n. 416. Syn. Hep. p. 11.

Jung. scalaris, Schrad. Cr. Gew. ii. n. 4 (ex parte). Hübener, l. c. p. 81.

New Forest, April 1813, *C. Lyell, Esq.*, with capsules ! Rocks near Barmouth !

Resembling *J. Genthiana* in size and colour, but differing in the immersed colesule, and peculiar structure of the involucre.

N. geoscypha is one of those transitionary forms which are the puzzle and torment of the systematist. Except for the rudimentary colesule, the structure is nearly identical with that of *Acrobolbus*.

The position of the parts may be better understood if we compare the creeping shoot to the stem of a clay pipe, the head representing the involucre, and its tumid base the knob beneath.

PL. III. FIG. 8.—*Nardia scalaris.* 1. *Natural size.* 2. *Magnified figure of shoots (the fertile one badly done).* 3. *Leaf from stem.* 4. *Leaf-cells* × 250 *diam.* 5. *Amphigastrium.* 6. *Involucre and involucral leaves from var. a.* 7. *Section of involucre.* 8. *Elaters and spores.*

7. NARDIA CARRINGTONII, *Balfour.*

PL. X. FIG. 31.

Shoots erect, flagelliferous, laterally compressed, of nearly uniform width, sub-circinate at the apex ; leaves of firm texture, pro-

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* A friend informs me that *Sarcoscyphus piceus*, De Not. (p. 14), has never been published, so that *Dr. Gottsche's* name *N. alpina* must have preference. *S. robustus* (p. 14) is also a MS. form of *De Notaris*, not *Lindberg*.

jecting backwards, obliquely sub-reniform, very concave, vertically appressed, glossy, the margins of opposite leaves meeting, anterior border remarkably narrow and decurrent, posterior abruptly rounded, deflexed; amphigastria long, subulate. Fr. ?

Adelanthus Carringtoni, Balfour, Carring. in Trans. Bot. Soc. Ed. v. x. p. 378 (1870).
Jung. compressa, Herb. Greville.
Alicularia occlusa, Dr. Striton's MSS.

Hab. This fine species was first recognized as distinct by *Dr. Striton*, of Glasgow, who collected it on Ben Lawers, July 1866, and Ben Voirlich, 1869 !

It is probably not unfrequent in the Scottish Highlands, whence I had previously received specimens labelled *J. compressa*, from rocks above Loch Avon, Aug. 1830, *Dr. Greville !* and from *Mr. A. Croall*, July 1856 ! Loch Marée Ross, July 1857, *Mr. C. Howie !*

It seems to prefer wet, boggy places, forming extensive patches, either alone, or associated with *J. Donniana*, *J. orcadensis*, *Bazzania tricrenata*, &c. Only barren plants have hitherto been met with.

Stems slender, rigid, flexuose, of a brownish colour, and dense texture, for the most part naked, but bearing a few scanty white rootlets at the bases of amphigastria, and on the creeping shoots. *Flagella* few in number, arising from the ventral aspect of the stems, either naked or clothed with very minute entire leaflets. *Barren shoots* (f. 31, 1) 2 to 4 inches high, by a line in width, simple, or producing occasional innovations from the axillæ of amphigastria, or the summit of old shoots, laterally compressed, the apex a little recurved.

Leaves of nearly uniform size, a little smaller and more distant at the base, sub-vertically imbricated, appressed, coarctate, from $\frac{1}{15}''$ to $\frac{1}{20}''$ in diameter, obliquely orbicular or reniform (f. 31, 4, 5), entire or obscurely truncate at the apex, very concave, so that the margins of opposite leaves touch before and behind, two-thirds of the surface projecting posteriorly (f. 31, 2), the ventral border rounded and inserted at right angles to the stem; anterior border remarkably narrow and decurrent (f. 31, 4).

The texture is firm, membranous, sub-pellucid, altering little when dry. *Colour* uniform, stramineous, or pale olive-green, lævigate.

Areolation 'guttate,' the walls very thick, each larger cell seeming to be surrounded by a row of smaller ones, 'the interstitial trigones' of authors; but on the application of a drop or two of strong sulphuric acid, or the reagents previously mentioned, the cells are resolved into clear hexagons (f. 31, 7), separated from each other by a pellucid line, and the trigones are seen to consist of three portions, each occupying the corner of a contiguous cell. Marginal cells smaller, sub-quadrate, $\frac{1}{1166}''$ by $\frac{1}{1750}''$, those of the intermediate portion hexagonal, $\frac{1}{1166}''$ to $\frac{1}{777}''$ each way. Basal cells elongated, $\frac{1}{583}''$ to $\frac{1}{390}''$, by $\frac{1}{1166}''$ to $\frac{1}{875}''$. Trigones very dis-

tinct, divided into three parts, each $\frac{1}{3500}''$ in diameter, the whole equal to $\frac{1}{1750}''$.

Amphigastria rare, except at the apex of young shoots (f. 31, 6), long and slender, subulate, erect, resembling the leaves in texture.

Inflorescence dioicous. Fructiferous shoots unknown.

Andræcium spicate, terminal. *Perigonial leaves* (f. 31, 8) more rounded and convex, gibbous at the base, the posterior lobe subquadrate, inflexed.

Antheridia 2 or 3 in each leaf, round or obovate, shortly stipitate. Sometimes, from the growth of innovations, the male spikes are interrupted, or seated below the summit. They are narrower, and less compressed than the ordinary shoots.

The cell-structure alone will suffice to distinguish this species from *Nardia compressa*, the trigones being remarkably large in the former, whilst in the latter the walls of the cells are thinner and more translucent, and contain the peculiar roundish corpuscles I have described under *N. scalaris*. In *N. compressa* the leaves are nearly plane, so that, but for the interposed stem, the whole surface would come in contact with the opposite leaves; they project equally on each side of the stem; their texture is more tender, shrinking when dry; the colour a pale translucent green, often tinged crimson or purple, and not polished.

In the absence of fructification, I was led, from the resemblance between *N. Carringtonii*, and the antarctic *Adelanthus occlusus* (H. f. & T.) Mitt., to refer it to the same genus. But the discovery of terminal perigonial leaves proves that it cannot belong to *Adelanthus;* and until fertile plants are met with, I think it better to associate it with *N. compressa.*

Pl. X. Fig. 31, *Nardia Carringtonii.*—1. *Shoots natural size.* 2. *Stem-leaves* ×16 *diam.* 3, 4, 5. *Leaves* × 16. 6. *Amphigastria.* 7. *Leaf-cells* × 250. 8. *Perigonial leaf, enclosing antheridia.*

8. Nardia compressa, *Gr. & B.*

Pl. III. Fig. 9.

Shoots stoloniferous, erect, innovant from the ventral aspect, laterally compressed; leaves projecting equally on each side the stem, roundish or reniform, decurrent, plane, vertically appressed; involucre obovate-oblong, hidden by the involucral leaves; amphigastria triangular-subulate; capsule oval.

Jung. compressa, Hook.Brit. Jung. t. lviii.; Musc. Brit. 2 ed. p. 229; Lindenb. Jung. Eur. p. 33, n. 22; Eng. Bot. t. 2587; Flor. Brit. i. p. 109, n. 13; Fl. Hibern. ii. p. 50, n. 18; Fl. Danica, t. 1774, f. 2; N. ab E. Leberm. Eur. i. p. 289, ii. p. 453.

Nardius, Gray & Ben. Nat. Arr. Br. Pl. I. p. 694, n. 2 (1821).

Mesophylla, Dum. Comm. Bot. p. 112 (1822); Syll. p. 80, n. 117, t. 2, f. 19; Recueil d'Obs. Jung. p. 24.

Alicularia, Synop. Hepat. p. 12, n. 4; Hartm. Scand. Fl. ix. ed. ii. p. 129; Gott. & Raben. Hep. Eur. Ex. n. 443, c. icon. 472, et 537.

Lichenastrum alpinum purpureum, Dill. Musc. t. lxix. (ex parte) f. 1, F. G.

Hab. Not unfrequent by the borders of mountain rills, or spots moistened by the spray of waterfalls. Discovered by *Miss Hutchins* at Bantry Bay. Lough Bray, *Dr. Taylor!* Baysdale, and Howden Gill, Cleveland, 1862, *W. Mudd!* Near Todmorden, fr. April 1860, *J. Nowell!* Dartmoor, *E. M. Holmes!* Moors west of Ingleburgh! Succoth Hill, Arroquhar, *A. McKinlay!* Ben Sligott, Ross, *C. Howie!* Ben Mac Dhui, ♂ and ♀, *G. E. Hunt!* Ffynnon Faer, ♂, and Llyn Ogwin, ♀, North Wales, *W. Wilson!* Snowdon! Fruit, spring.

This fine species is semi-aquatic, occurring only in spots moistened by the drip from rocks or waterfalls, or fringing the borders of mountain rills, or growing intermixed with other species in Sphagnum beds. Conspicuous from the compressed habit and the pellucid foliage, tinged with purple or claret.

Stems (fig. 9, 1) ascending or erect, filiform, flexuose, from $1\frac{1}{2}''$ to $3''$ in length, in luxuriant specimens sometimes twice as long, of a pale brown colour, simple or proliferous, from the ventral aspect.

Stolons long, branched, entangled, resembling the stems in texture, naked, or sparingly radiculose.

Rootlets confined to the subterranean portions of the stems, and stolons, rarely found on the terminal shoots, white, capillary.

Innovations numerous, arising from the axils of amphigastria, or rarely from the involucral bracts. Normally a single branch is produced from the ventral apex of old shoots, which follows the direction of the main axis, and without care may be thought continuous with it; and which becomes the fertile shoot of the following year.

Leaves $\frac{1}{20}''$ to $\frac{1}{12}''$ in diameter, smaller and more distant near the base, terminal ones (except on barren stems) more crowded and larger, "imbricating each other in a very regular and beautiful manner" (fig. 9, 2), erect, appressed to the stem, plane or slightly concave, so that the inner surfaces of opposite leaves meet.

Form (fig. 9, 2, 3) orbiculate to reniform, sub-marginate, entire; dorsal margin decurrent for a short distance, insertion either at right angles with the stem or more oblique; ventral margin rounded at the base.

Texture thin and membranous, especially in submerged specimens, shrinking and incurved when dry, sometimes more compact and firm; remarkably pellucid, "so as to suffer the stem to be seen through them, dividing each of them, as it were, into two nearly equal halves." * *Colour* of the inferior leaves pale green, or yellowish-brown, upper ones of a purple or maroon colour.

Cells (fig. 9, 5) with thickened walls, the marginal row uniform in size, sub-quadrate, $\frac{1}{875}''$ in diameter. Those of the upper third polygonal, $\frac{1}{700}''$ to $\frac{1}{583}''$ by $\frac{1}{875}''$. Near the base of the leaf larger and more oblong, $\frac{1}{500}''$ to $\frac{1}{300}''$ by $\frac{1}{700}''$. Trigones indistinct.

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* Br. Jung. t. lviii.

Within the cells we find two or three round or oblong amyloid bodies, but less conspicuous than in *N. scalaris*.

Amphigastria ovate-subulate, rare except near the apex of stems and innovations, resembling the ordinary leaves in texture.

Dioicous. *Fertile stems* (fig. 9, 2) thickened at the apex.

Involucral leaves (fig. 9, 3) terminal, two or three pairs, larger and more decidedly reniform; terminal pair compressed, adnate with the upper portion of the oblong-clavate involucre, entire, or slightly undulate and retuse. The lower leaves are also attached to the thickened walls, and base of the involucre. *Involucral amphigastria* ovate, irregularly lobate, the margin reflexed.

Colesule (fig. 9, 6) immersed, connate with the involucral walls, the apex alone free: at first entire and rostellate, but after the egress of the capsule divided into four acute segments.

Capsule (fig. 9, 6) dark brown, somewhat variable in form, but generally longer than broad, roundish-oval, splitting into four oblong valves.

Pedicel rather short, succulent, white.

Spores (fig. 9, 7) minute, reddish-brown, roundish, from $\frac{1}{1400}''$ to $\frac{1}{1166}''$.

Elaters (fig. 9, 7) hyaline, enclosing a double spiral thread $\frac{1}{140}''$ to $\frac{1}{100}''$ long, by $\frac{1}{2300}''$ to $\frac{1}{1750}''$ broad.

Male shoots more slender, of nearly uniform diameter.

Perigonial leaves (fig. 9, 4) terminal, sub-spicate, or interrupted, roundish, more concave, the base ventricose, enclosing 2–3 ovate, olive *antheridia*.

Obs. To the late *Miss Hutchins*, of Bantry, who was the first to investigate in earnest the rich cryptogamic flora of the South of Ireland, we owe the recognition of this fine species.

It seems, however, to have been collected by *Dillenius* in North Wales, since it is figured at T. 69, f. 1, F. G. of the Historia Muscorum.

The "*Lichenastrum alpinum purpureum*" has been referred by most authors to *Pleurozia cochleariformis*, Dum.; but Dr. Lindberg, who has recently examined the specimens contained in the Dillenian Herbarium, states that not a vestige of that species is to be found there; but that the figures A. and I. represent *Nardia obovata* (barren), B. D. E. H. *Scapania undulata*, C. *Nardia emarginata*, and F. G. *N. compressa*.

In a letter to Sir W. Hooker, enclosing specimens of *N. compressa*, from Loch Bray, the late *C. Lyell, Esq.*, described the species very happily:—

"The leaves are bifarious, and the insertion is nearly at right angles with the stalk; so that, when viewed laterally, they project on both sides of it (about two-thirds towards the front, and one-third towards the back). When moist, the leaves are plane, and the insides of the opposite ones touch each other, which gives the plant a singularly compressed appearance, and makes it refuse (*sic*) to lie in any position except its side."

I have more than once referred to the peculiar ramification of Nardia. Instead of the ordinary furcate division of the stem, met with in most Jungermanniæ, the

annual shoots spring from the ventral aspect, and may be called adventitious. Thus if we isolate one or two colesuliferous stems from a luxuriant tuft, at first view the central axis appears continuous, and the shoots interrupted at pretty regular intervals, each of which bears an involucre at the apex. But on careful examination we find that the axis is not continuous, but that each younger stem originates from the axil of an amphigastrium beneath the involucre of the former season. Other innovations may spring from different parts of the ventral aspect, or very rarely from the axil of a leaf, but only one of these is continued in the line of the main stem.

Whilst examining this, and allied species, I have sometimes attempted to estimate the age of the shoots. Nearly all Liverworts are described as perennial, rejuvenescence taking place from the apex, whilst the older parts gradually wither and crumble away. The annual shoots are limited in growth, the first leaves being smaller, and the terminal ones usually colesuliferous, or bearing perigonial leaves; so that if we can count the number of these interruptions, they may be looked upon as representing the growth of so many years.

Although *N. compressa* is so delicate a species, the leaves and stems seem to withstand decay longer than usual. In remarkably fine shoots, I have been able to find as many as ten to twelve intervals of growth; and (supposing the fructification to be annual, which is not always the case) this would give an age of twelve years for the individual shoots, not, of course, for the whole plant. Specimens of *Nardia emarginata*, and *Gym. concinnatum* may also be met with, bearing traces of from six to nine involucra. I fear, however, the inquiry can never be of practical value.

Pl. III. Fig. 9.—1. *Shoot natural size.* 2. *Portion of the same* × 8. 3. *Stem-leaves.* 4. *Perigonial leaf and antheridia.* 5. *Leaf-cells* × 250. 6. *Involucre, the lower portion laid open, showing the base of the calyptra, and the manner in which the involucral leaves are attached to the walls.* 7. *Spores and elaters.*

γ. *Southbya*, Spruce (*Eucalyx*, Lindb.).

9. Nardia obovata (*N. ab E.*).

Pl. XI. Fig. 35.

Paroicous; stems ascending, simple or fasciculately innovant, clothed with rootlets of a claret colour; leaves rather distant, roundish-ovate, immarginate, vertically patent-divergent, from a contracted, concave, sheathing base; involucral leaves larger, obovate, recurved at the apex, connate with each other, and with the colesule for ⅔rds of its length; colesule obovate, obtusely 5-6-plicate, at length quadrifid; capsule rotundate; amphigastria confined to the involucre.

Jungermannia obovata, N. ab E. Leberm. Eur. i. p. 332, ii. p. 474; G. L. N. Synop. Hepat. p. 95, n. 44; Flor. Danica, Sup. t. 118, n. 2; Hartm. Skand. Fl. 9, ed. ii. p. 88; Moug. & Nestl. Stirpes Voges. Rhen. n. 935; G. & R. Hep. Eur. Ex. n. 266, c. icon. n. 352.

J. atrovirens, Dum. Syll. p. 51, n. 52 (?).

J. tersa, N. ab E. l. c. ii. p. 471 (ex parte); et Syn. Hep. p. 94, n. 40 (ex parte).

Southbya obovata, Lindb. Revis. Crit. Fl. Dan. p. 113 (1871).

Eucalyx obovata, Lindb. Aftryck ur Botaniska Notiser, p. 15 (1872).

β *minor*. Shoots crowded, erect, $\frac{1}{2}''$ in length, by $\frac{1}{15}''$ to $\frac{1}{25}''$; leaves ovate, sub-squarrose, upper ones saccate; capsule spherical.

Carring. Irish Cryptog. p. 21, Pl. II. f. 1.

γ *flagellifera*. Fertile stems only ascending; flagellæ numerous, very slender, creeping, radiculose.

Hab. Garn precipice, near Snowdon, Mar. 1830, *W. Wilson!* Guthrie woods, Glen Esk, *A. Croall!* Wet rocks, Kentmere, Oct. 1872, *G. Stabler!* Llanberis, *G. E. Hunt.* Killarney, Torc Mountain, 1823, *W. Wilson!* β Cromaglan, fr. June 1861! Kildale, North York, *W. Mudd!* Banks of Forfar Burn, fr. 1862, *A. Croall!* γ near Romach, Murray, 1848, *A. Croall.* Strachan, Aberdeen, Nov. 1872, *J. Sim!*

Met with in various parts of Northern and Central Europe.

Forming compact tufts on damp rocks, of a deep green colour, and producing abundant fructification in early summer.

Primary stems rather stout, herbaceous, radiculose, creeping. Fertile shoots (f. 35, 2) erect, simple, or innovant from below the apex, $\frac{1}{2}''$ to 1″ long, by $\frac{1}{10}''$ to $\frac{1}{20}''$ in diameter, clothed on the underside with purple or claret-coloured rootlets.

Flagella at first very slender, arising either from the primary stems, in which case they are prostrate and rooted to the ground, at length ascending, or from below the apex of the fertile shoots, normally from their inferior aspect.

Leaves (f. 35, 4, 5) rather distant, about $\frac{1}{20}''$ in length, subvertical, distichous, patent or patent-reflexed, round, roundish-ovate, or ovate, upper half plane or recurved, from a ventricose or subvaginate base; margin entire, rarely retuse or undulate, incumbent in the upper leaves, lower ones more obliquely amplexicaul, less saccate at the base, and decurrent for a short space. On the innovant stems the leaves are much smaller. From the contraction and convexity of the base, the upper part appears relatively broader than it really is (f. 35, 4), and the form may be mistaken for obovate, whereas only in the involucral ones is it truly so.

Texture firm, not much altered when dry, less thick and undulate than in *N. hyalina*, and wanting the peculiar frosted lustre of that species.

Colour deep green, sometimes tinged with brown or purple, turning nearly black when dry. When recent, the plant gives out an aromatic smell like *Lophocolea heterophylla*, but fainter.

The *leaf-cells* (f. 35, 6) are well defined, with thin walls, and distinct trigones at the angles; within the cells are numerous green chlorophyll granules. Marginal cells pretty uniform in size, $\frac{1}{880}''$, quadrate, the walls thicker; those of the upper third hexagonal, $\frac{1}{880}''$ by $\frac{1}{700}''$; basal cells more elongate, $\frac{1}{700}''$ broad by $\frac{1}{350}''$ long.

Dr. Gottsche (in Hep. Eur. Ex. n. 266) states "that the cuticle of the leaves is delicately striate-papillose (*gestrichelt-blattrig*), which

only disappears after prolonged (24 hours) treatment with strong sulphuric acid."

Inflorescence paroicous. Fertile shoots thickened at the apex; colesule terminal, or rarely from the presence of innovations appearing lateral.

Involucral leaves (f. 35, 2, 3) two pairs, larger than the ordinary ones; upper pair equal, obovate, nearly opposite, connate with each other, and with the walls of the colesule (which they closely embrace) for more than half its length, patent or recurved at the apex. *Sub-involucral leaves* vaginate at the base. On section the base of one of these was found to correspond with the position of the hollow *torus pistillorum*, whilst the axil of the succeeding leaf enclosed two or three *antheridia*.

Amphigastria:—one or two, lanceolate in form, may be perceived attached to the involucral walls, and adnate with the adjacent leaves; they are absent from all other portions of the plant.

Colesule (f. 35, 3) obovate-oblong, about equal to the involucral leaves, but from their recurvation the upper third is generally free and exserted, slightly compressed, obtusely 5-6-plicate, apex conoid, at length splitting into four acute lobes.

Calyptra thickened at the base, and surrounded by numerous abortive pistillidia, hyaline, reticulate, obovate.

Capsule round, or roundish-obovate, dark brown, opening by four ovate valves.

Pedicel 6‴ to 8‴ long, white, hyaline-cellulose.

Spores yellowish-brown, granulose, $\frac{1}{880}''$ in diameter.

Elaters enclosing a double spiral fibre, $\frac{1}{170}''$ long, by $\frac{1}{1750}''$ broad.

Antheridia axillary, inserted within the ventricose bases of the sub-involucral and succeeding leaves, ovate to obovate, olive-green, seated on a delicate stipe of four to six cells.

Obs.—*Nardia obovata* is found in similar situations to *N. hyalina*, and has probably not unfrequently been mistaken for that species. The diagnosis between the two is sometimes far from easy, but in *N. obovata* the shoots are more erect and slender, the leaves more ovate, distant, sub-squarrose, and saccate at the base, with entire margins, and the involucral leaves adnate for more than half their length with the colesule.

From *Jung. nana, sphærocorpa*, &c., it may be distinguished by the white rootlets, and free colesules of those species.

From *N. scalaris* by the absence of amphigastria, except those that enter into the composition of the involucre, and the colour of the rootlets.

Dr. Gottsche (Hep. Eur. Ex. n. 266) has shown that N. ab Es. understood this species imperfectly, since in Leberm. Eur. ii. p. 471, several forms with purple rootlets are referred to *Jung. tersa*, and this error is repeated in Syn. Hep., p. 94, n. 41. The vars. *α densa* (*V. Flotow*), *β explanata*, *γ rivularis*, and *δ attenuata*, Dr. Gottsche states to be truly forms of *N. obovata*.

Pl. XI. Fig. 35.—1. *Stems unmagnified.* 2. *Fertile shoot of* β MINOR, *with capsule* × 16. 3. *Upper portion of shoot of the larger form, viewed laterally* (after GOTTSCHE). 4, 5. *Stem-leaves* (5 *viewed laterally*). 6. *Portion of leaf more highly magnified.*

10. NARDIA HYALINA, *Lyell.*

PLATE XI. FIG. 36.

Polyoicous. Stems creeping, the apex only ascending, innovant, ramuli dichotomo-fastigiate, clothed beneath with numerous claret-coloured rootlets. Leaves loosely and bifariously imbricated, lower ones obliquely explanate, upper erecto-patent, roundish, sub-marginate, repand-undulate, decurrent; involucral leaves broader, appressed to and surrounding the colesule, with the lower third of which one of them is connate; colesule obovate, sharply plicate, the angles rough, somewhat exserted, rostellate, at length quadrifid; capsule roundish-ovate.

Jungermannia hyalina, Lyell in Hook. Jung. t. lxiii.; Brit. Flor. v. i. p. 109; Flor. Hibern. ii. p. 58; Eng. Bot. Sup. t. 2678; Lindenb. Hep. Eur. p. 67; N. ab E. Leberm. Eur. i. p. 322, ii. p. 468; G. L. N. Syn. Hep. p. 104; Dumort. Syll. p. 50; Hüben. Hep. Ger. p. 104 (γ *colorata*, N. ab E.); Hartm. Skand. Fl. ix. ed. ii. p. 136; De Not. Prim. Fl. Ital. p. 36, n. 45; G. & R. Hep. Eur. Ex. 189 (α *major*, ♀), 469, and 234; Thed. Musc. Suec. Ex. 137.

Jung. Schmideliana, Hüben. Hep. Germ. p. 99, n. 29 (α *major*, N. ab E.).

HAB. Found on moist rocks of an argillaceous or schistose nature. Discovered by the late *C. Lyell, Esq.* in boggy places, New Forest, Hants, Feb. 1813! Kinnordy! and near Stockgill Force, Ambleside! Near Snowdon, 1828, *W. Wilson!* Glen Esk, Forfar, 1830, *Dr. Greville!* Brandon Mount, 1823, *W. Wilson!* Eskdale, Yorkshire, 1842, *R. Spruce!* Braemar, fr. July 1853, *A. Croall!* Banks of the Rye, North York, *J. G. Baker!* Kentmare waterfall, *G. Stabler!* Hebden Bridge, April 1868, fr. *G. E. Hunt!* Dumbarton, May 1865, fr. *A. McKinlay!* Alum shale, Whitby! Ingleburgh! Ayton Moor, Cleveland, *W. Mudd!* Fruit, early summer.

Forming more or less dense, depressed tufts, on wet slaty rocks, or intermingled with bog mosses; remarkable for the crystalline, glaucous-green, semi-pellucid foliage, and reddish rootlets.

Shoots (f. 36, 1) from a quarter of an inch to an inch long, by $\frac{1}{15}''$ to $\frac{1}{20}''$ in diameter, procumbent or erecto-procumbent, densely radiculose, simple or innovant; ramuli springing from the axils of the involucral leaves, causing the colesule to appear lateral, but more commonly from the ventral aspect of the stem, simple or dichotomo-fastigiate, geniculate at the base, ascending.

Rootlets more numerous, and of a paler claret or reddish colour than in *N. obovata*, in some shoots almost colourless.

Leaves (f. 36, 2) $\frac{1}{15}''$ to $\frac{1}{20}''$ long, laxly disposed, semi-vertical, roundish, sometimes broader than long; broad and obliquely decurrent at the base, plane and nearly horizontal, except on the upper

part of the stem, where they are more concave, erecto-patent, and often crowded into a rosulate tuft. Margin entire, rarely retuse, a little inflexed so as to appear thickened, subundulate-repand. When dry the margin is more distinctly repand, and from the greater translucency of the exterior row of cells, appears cartilaginous.

Texture thick and parchment-like, except in immersed specimens, in which it is thinner and more translucent. *Colour* pale glaucous-green, sometimes deeper green, or tinged in *γ colorata*, N. ab E., of a delicate reddish-brown. Not aromatic.

The leaves are described by *Mr. C. Lyell* "as extremely thin, membranous, shining, sub-diaphanous"; but they appear to me neither so thin, nor translucent, as in many species, e. g. *J. cordifolia*, and *Kantia trichomanis*. Still, the large hyaline cells reflect the light in a similar manner to *Cephalozia connivens*, and impart a characteristic frosted, diaphanous appearance.

Leaf-cells (f. 36, 8) well defined, with thin distinct walls. Marginal cells sub-quadrate, with thicker walls, regularly disposed, resembling the rest in size, about $\frac{1}{1750}''$; those of the upper third hexagonal, $\frac{1}{1170}''$ to $\frac{1}{1750}''$; basal cells oval or oblong, $\frac{1}{880}''$ long by $\frac{1}{1750}''$ broad. The trigones are more distinctly seen after boiling in liq. potassæ, and staining with zinc biniodide; a hyaline line then divides one cell from another, a punctiform thickening appearing within the angles only. The violet-coloured central portion consists of the contracted cell-contents.

The delicate epidermic layer investing the cells is covered with minute papillæ.

Inflorescence autoicous, or dioicous. *Fructification* terminal, or from the growth of innovations apparently lateral.

Involucral leaves (f. 36, 4, 5) larger than the rest, broader than long, $\frac{1}{15}''$ by $\frac{1}{10}''$, more distinctly waved, sometimes emarginate, recurved at the apex, coarctate, closely investing, and in a young state hiding the colesule, with the lower fourth of which the superior leaf is connate. Lower leaf free.

Amphigastria (one or two) adnate with the bases of the involucral leaves, ovate-subulate. They are absent elsewhere.

Colesule (f. 36, 4) not much exceeding the involucral bracts, at first ovate, but when mature obovate, boldly 5-6-plicate (f. 36, 6, 7), the angles obscurely tuberculose, mouth contracted, rostellate, at length splitting into 4-5 acute hyaline segments.

Calyptra obovate, translucent, surrounded above the base by 15–20 abortive pistillidia.

Capsule (f. 36, 2) globose (a little longer than broad), dark brown, shining, composed, according to *Dr. Gottsche*, of two layers only, the outer consisting of larger hyaline cells, crossed by irregular brown parietal bands, the inner layer consisting of yellowish-brown cells, strengthened by annular brown fibres.

Spores round, yellowish-brown, smooth, $\frac{1}{1750}''$ to $\frac{1}{1170}''$.

Elaters tubular hyaline, enclosing two brown spiral fibres, $\frac{1}{175}''$ by $\frac{1}{1750}''$.

Andræcium sub-spicate, either seated on distinct shoots (*dioicous*), or on special branches attached to the ventral surface of fertile shoots (*autoicous*).

Perigonial leaves (f. 36, 3) smaller, erecto-patent, more closely imbricated, saccate at the base; margin entire, nearly plane.

Antheridia two or three together, axillary, deep green, roundish, shortly stipitate.

Obs.—*Nardia hyalina* affords one of those connecting links between genera, so interesting to the philosophic botanist, but, it must be confessed, inconvenient to the systematist.

Desiring, as far as possible, to simplify the classification, the alternative offered, either to reunite all the species classed under Nardia with Jungermannia (a plan formerly advocated by Mr. Mitten, but now abandoned) or to choose an intermediate course.

It seemed impossible to dissever species so closely allied as *N. hyalina* and *N. obovata*, or to class them under any other type than *Nardia*.

Alicularia Haskarliana, N. ab E. (which is the nearest ally to *N. obovata*), *Southbya tophacea*, Spruce, and *S. fennica*, Gott., should also be placed under this section.

I cannot refrain from quoting an extract from a letter by *Dr. Gottsche* (11 Dec. 1865), because it shows how careful we should be about judging from indigenous species only: "In my 'Hepaticæ Novo-Granatensis' I have been very puzzled about the difference between *Jg. obovata* and *Jg. hyalina*; and if I have been able to distinguish the European patches of these plants, as far as I have seen them, I cannot say the same about the American specimens. In *Jg. obovata* the perianth is really connate with its two *folia involucralia* for half their length; in *Jg. hyalina* one involucral leaf is commonly free, the other is connate with the lower portion of the perianth. The roots of *Jg. obovata* are purple and few; in *Jg. hyalina* they are more plentiful, and white or red."

Whether *Dr. Lindberg's* character derived from the inflorescence will prove more decisive time must decide. Certainly *N. hyalina* is not always *dioicous*.

Pl. XI. Fig. 36.—*N. hyalina*. 1. *Shoots natural size.* 2. *Fertile shoot* × 8. 3. *Perigonial leaf and antheridia.* 4. *Colesule, the lower involucral leaf removed.* 5. *Involucral leaf* × 16. 6. *Section of colesule below the apex.* 7. *Section from upper third.* 8. *Leaf-cells* × 120.

IV. Trichocolea, *Dumort.*

Jungermannia, Ehrh. in Harm. Mag. 1783, p. 277; et Beitr. ii. p. 150 (1788). *Thricholea*, Dumrt. Comm. p. 113 (1822). *Thricolea*, Syll. Jung. p. 66, n. 8 (1831). *Tricholea*, Obs. sur les Jung. p. 20 (1835). *Trichocolea*, N. ab E. Leberm. Eur. iii. p. 103 (1838); Gottsche in G. & R. Hep. Eur. Ex. n. 272 (1863).

Dioicous. Involucre terminal, or from the growth of innovations axillary. Colesule wanting. Calyptra, when mature, either free, naked, and not incrassate, surrounded only at the base or a little beyond by the abortive pistillidia, and the narrow ring of

involucral scales (*T. tomentosa*, Sw.). Or undergoing more complete metamorphosis, in which the cortical layer of the tomentose receptacle invests and becomes blended with the calyptra, so as to form a cylindrical, coriaceous, hirsute involucre, bearing at the apex the abortive pistillidia (*T. tomentella*). Capsule oblong, cleft to the base into four coriaceous valves. Pedicel bulbous at the base, inserted deep within the receptacle. Antheridia large, axillary in the terminal leaves of separate shoots. Leaves setaceo-multifid, succubous. Amphigastria multipartite. Fronds glaucous-green, conspicuous, pinnate compound or decompound.

Etym.—Θρὶξ, τριχὸς, *hair;* and κολεὸς, *a sheath.*

Obs.—Dumortier has spelt the name differently in each of the three works quoted, and I think the emendation of N. ab E. will be accepted rather than any of these, in spite of the protest in *Obs. sur les Jung.*, p. 20: "Il est plus correct d'écrire *Tricholea*, par contraction pour *Trichocolea*, qui serait contraire au génie et à l'harmonie de la langue latine."

In N. ab Es. Eur. Leberm., Synopsis Hepat., and most later works, *Trichocolea* is arranged with *Ptilidium*, under the section with "folia incuba." But in *Hepat. Novo-Granatensis* (Ann. des Sc. Nat. 5ème Série, tome i.), Dr. Gottsche states that the leaves are succubous, "and proceed from the higher ventral point of attachment with the stem, to the lower dorsal point, as in *Lophocolea;*" and he places the genus between *Leioscyphus* and *Gymnanthe.*

The structure of the involucre differs from *Nardia*, in the absence of all trace of colesule, so that the calyptra itself is connate, to a greater or less extent, with the involucral stratum. In the latter character it comes nearer *Aneura*, and some species of *Schistochila*, Dum. (*Gottschia*), *e. g.* Hook. Musc. Exot. t. 39 (*S. glaucescens*).

Dr. Lindberg (Lin. Soc. Journ. Bot. v. viii. p. 193) selects *Trichocolea tomentella* as the type of the *calyptra thalamomitrica*, and gives the following account of the development of the fruit: "The perichætium is at first small and short, everywhere covered by a felt of small bracts, filiform, branched, and intricate, like some Cladophoræ, without any constant position, size, or form; the top also, which is somewhat convex, possesses a pretty dense tomentum of similar, but smaller, conferva-like bracts (paraphyses!). Among them are fixed on the top of the rachis or receptacle an unusually large number of pistillidia of different degrees of ripeness, the central of which are most mature. When one of these has been impregnated, not only its central cell increases in size, but also the very rachis itself (*ubi irritatio, ibi affluxus!*), so that the cellular cover of the central cell (calyptra) with its style and stigma, together with all the sterile pistillidia, will be raised up. The young fruit is now completely enclosed in a fig-like obconical pouch," bearing at its apex the barren pistillidia.

When mature, the seta elongates, and pushes out the fruit from the rachideal pouch, lifting up the top of the calyptra like a lid, which soon disappears.

From two observations made upon nearly mature involucra, I am led to suspect that the connection between the outer stratum, and calyptra, is not always very intimate, since, on carefully laying open the former, I had no difficulty in detaching the capsule surrounded by what seemed an entire calyptra! In specimens of *T. mollissima*, Tayl., from New Zealand, we not unfrequently find two mature capsules within one involucre; but I have never observed this in the European species.

TRICHOCOLEA TOMENTELLA, *Dumort.*

PL. X. FIG. 32.

Jungermannia tomentella, Ehrh. Beitr. Band ii. p. 150 (1793); Dicks. Pl. Cryp. Fasc. ii. p. 14; Eng. Bot. t. 2242; Hook. Jung. t. xxxvi.; Musc. Brit. ed. ii. p. 237, n. 65; Mackay, Fl. Hibern. ii. p. 66, n. 67; Fl. Danica, t. 2193, c. fr.; Gray's Nat. Arr. i. p. 703.

Jung. ciliaris, Weis. Pl. Cryp. p. 189; Weber, Spic. Fl. Gott. p. 150; Huds. Fl. Ang. p. 515; Lamarck, Enc. Bot. p. 284; With. Arr. p. 861.

Tricholea, Dum. Com. p. 113; Syll. Jung. p. 66, t. i. f. 8; Obs. des Jung. p. 20.

Trichocolea, N. ab E. Leberm. Eur. iii. p. 105; N. ab E. L. & G. Syn. Hep. p. 237; Jensen, Cons. Hep. Dan. p. 113; Horn. Fl. Œcon. ii. p. 467; Hartm. Scand. Fl. ix. ed. ii. p. 147; G. & R. Hep. Eur. Ex. n. 32, 272, c. icon.; Moug. et Nestl. Fl. Cr. Vog. Rhen. l. n. 52.

Muscus palustris absinthii folio insipidis, Tourn. H. Par. p. 505; Vaill. Bot. Par. p. 141, t. 26, f. 11.

Lichenastrum filicinum pulchrum villosum, Dill. Musc. t. lxxiii. A. B.

HAB. Plentiful on moist rocks, under the shadow of trees, in many parts of Britain, but rarely fertile :—Bishop's Castle, Salop, and Dorking, Surrey, *Dillenius*, 1741. Allen's Ford, Durham, *Mr. Thornhill.* Stock Gill, Ambleside, young fr. 15 Aug. 1813, *C. Lyell!* Cotterell Clough, Cheshire, fr. 8 Nov. 1821, and Aber River, North Wales, ♂, *W. Wilson!* Devon, fr. *Sir W. Hooker!* Loch Tay, *Dr. Greville!* Barmouth! Bolton woods! Woods of Cawder, Forfar, 1844, *A. Croall!* Glen Cluny.

Fronds pinnate-decompound, forming dense tufts, sometimes several feet in diameter, conspicuous from the very pale glaucous-green colour, and tomentose habit.

Stems (f. 32, 1) from 2″ to 6″ in height, and about $\frac{1}{40}$″ in diameter, erect, flexuose, primary branches stouter, furcate; secondary ramuli alternately pinnate, patent, more or less crowded, often beset with shorter pinnules. *Ultimate shoots* cylindrical, of nearly equal diameter throughout ($\frac{1}{20}$″), the geniculate rachis being hidden by the closely-imbricated multifid leaves, resembling the ramification of *Ceratophyllum*, or *Batrachospermum*. Apex of the principal shoots thickened and sub-falcate, from the crowding together of undeveloped branches.

Texture of the stems loosely cellular, the cortical layer composed of columnar elongated cells, so as to appear fluted, as in *Callithamnion;* colour pale green, brownish near the base. In a dry state the stems shrink, and the lower part appears fistulose (as described by Dillenius), from the shrinking of the intermediate cells.

Rootlets scanty, a few pellucid fibres arising from the bases of amphigastria, near the inferior portions of the shoots.

Leaves (f. 32, 2) of nearly uniform size, $\frac{1}{20}$″, patent, inflexed at the apex, and, in the words of Hooker, "scarcely larger on the main part of the stem than on the secondary branches; thus appearing

as if these stems had outgrown the leaves." On the ultimate ramuli we find them very regularly and closely imbricated, forming a beautiful object under a low power of the microscope. At the apex of the main shoots (especially in fertile individuals), the leaves are remarkably crowded together, forming a kind of ball or tuft. *Form.* From a contracted entire base, each leaf divides into two multifid main lobes, the anterior smaller and ovate in outline, the posterior larger and rounded; each lobe again is cleft into numerous setaceous capillary segments (f. 32, 3), the main ramules bearing short opposite lateral processes, so as to "give a peculiar tomentose appearance to the whole plant, and render the true figure of the leaf difficult to define."

Amphigastria. Between each pair of leaves, and generally confluent with the left-hand one, we find an amphigastrium (f. 32, 5), subquadrate in form, about equal in diameter to the stem, the lower half entire, and the margin cut into numerous ciliary processes, but shorter and less branched than those of the leaves.

Texture. The terminal segments of the leaf consist of a series of 3 to 5 oblong cells (f. 32, 3), which are jointed in outline, as in *Jung. tricophylla* and many confervæ, the larger segments consisting of two, or four rows of cells. The walls are clear, and not thickened at the angles, the interior filled with pale green chlorophyll granules. Length of apical cells $\frac{1}{350}''$ to $\frac{1}{250}''$, breadth about $\frac{1}{1400}''$; the basal cells are about $\frac{1}{1166}''$ in diameter. The epidermic layer covering the cells is delicately striate-punctate, which may account for the dull frosted appearance under direct light.

Inflorescence dioicous. Fertile shoots thickened at the apex.

Involucre (f. 32, 1, 6) $\frac{1}{10}''$ to $\frac{1}{15}''$ in length, clavate, sub-carnose, resembling the stem in texture, of which, indeed, it may be considered a hollow prolongation, clothed more or less densely by jointed tomentose bracts, which are most abundant at the base (f. 32, 4).

Calyptra connate with the involucral walls, and bearing at the apex the abortive pistillidia (f. 32, 4).

Pistillidia very numerous, at first naked, and surrounded by the circle of involucral bracts, as shown in Dr. Gottsche's figure, Hep. Eur. Ex. t. 272. After impregnation, by the rapid upgrowth of the cortical layer of the stem, only the dome-like apex of the calyptra remains free, and is pushed outwards by the emerging capsule. In one or two instances of nearly mature fructification, I have found no difficulty in separating the calyptra from the involucral walls, but generally (invariably in *T. tomentosa* and other exotic forms) the two are so blended together as to constitute only one membrane.

Capsule (f. 32, 6) ovate-oblong, of a deep purple-brown, longitudinally and transversely striate, dividing into four oblong valves.

Peduncle fleshy, an inch or more in length, dilated at the base, where it is inserted into the substance of the thalamium.

Spores dark-brown, $\frac{1}{233}''$ in diameter, roundish.

Elaters bi-spiral, $\frac{1}{230}''$ to $\frac{1}{175}''$ long, by $\frac{1}{1750}''$ broad.

Male shoots more slender and divided. *Perigonial leaves* terminal on the ultimate shoots, scarcely differing from the rest, except in their more connivent lobes, which embrace the antheridia like the fingers of a hand.

Antheridia unusually large, solitary, globose, the outer wall distinct, composed of tabular translucent cells; contents of a deep-green colour; pedicel slender, jointed.

Obs.—One of the noblest and most interesting of our native Hepaticæ, reminding us of some tropical types, and not likely to be confounded with any local species.

Considering the characteristic figures of both species in the *Historia Muscorum*, it seems, indeed, astonishing that British authors, such as Hudson and Withering, should have confounded *T. tomentella* with *J. ciliaris*, the fronds of which are of a rich purple-brown colour, and with incubous leaves, which are ciliated at the margins only.

The description of Dillenius is very accurate, but he seems to have thought the amphigastria intended to attach the plant to the ground, having, probably, overlooked the rootlets at their base.

"Rami secundarii (he writes) nervos tenues habent, et foliolis frequentissimis vestiuntur, primarii verò, seu caules, pro plantæ ratione crassi sunt, foliis non æquè crebris cincti supernè et per margines, infernè autem geniculati sunt, foliis latisculis villosis, quibus humi figitur, tecti."

Pl. X. Fig. 32.—1. *Portion of fertile shoot natural size.* 2. *Stem-leaf* × 8. 3. *Part of one of the lobes more highly magnified.* 4. *Scale detached from apex of immature perichætium, and abortive pistillidium.* 5. *Amphigastrium* × 60. 6. *Involucre longitudinally divided, showing the included capsule.*

V. Acrobolbus, *N. ab E.*

Acrobolbus, N. ab E. in G. L. N. Syn. Hep. p. 5, n. iii. (1844).

Gymnanthe (ex parte), Taylor, in Hook. Lond. Journ. Bot. iii. p. 377 (1844), et Hook. fil. Cryp. Antarct. p. 41, n. 7 (1845); Lehm. Pugill. viii. p. 1 (1844); Gottsche, in Nov. Act. Acad. Cæs. Leop. xxi. P. II. p. 425, t. 32, f. 22, 27 (1845); G. L. N. Syn. Hep. p. 192, n. xvi. (1845).

Involucre terminal, obovate, seated at right angles with the stem, bulbous and rooting on the ventral aspect. Colesule wanting.

Calyptra attached to the bulbous base of the receptacle, surrounded by, and concrete with, the entire portion of the involucre, and bearing around the apex the abortive pistillidia.

Antheridia terminal on separate shoots.

Fronds small, creeping, semi-parastic, with the habit of *Jung. capitata*, Hook.

Leaves succubous, ascending, bi-lobed. Amphigastria absent from the ordinary stems.

Derivation—ἀκρός, *summit;* and βολβός, *a bulb.*

Obs.—*Acrobolbus* differs from *Gymnanthe*, with which it is generally united, by the less perfect metamorphosis of the "torus genitalis," so that it is simply bulbous at

the base, not changed into a cylindrical saccate pouch, resembling that of *Saccogyna*. Dr. Taylor's name had already been preoccupied by the Tricoccaceous genus *Gymnanthes*, Sw. Prodr. Fl. Ind. Occ. (1788), which, although subsequently conjoined by *J. Müller* with *Sebastiania*, Spreg. Neu. Entoleck. ii. (1821), still ought to claim priority.

Mr. Mitten, in Hook. fil. Handb. N. Zeal. Fl. ii. pp. 751–753 (1867), divides *Gymnanthe*, Tayl., into *Tylunanthus*, *Acrobolbus*, *Lithocolea*, and *Balantiopsis*.

A comparison with the description of *Nardia geoscypha*, De Not., p. 27, will prove how closely the two agree in structure; indeed, but for the absence of the rudimentary colesule in *Acrobolbus*, they might justly be placed under the same genus.

Lindigia, Gottsche, De Mexikan. Leverm., p. 120, n. xi. (1863), differs from *Acrobolbus* chiefly in the calyptra, "tota libera (nec incrassata)," and entire leaves.

1. Acrobolbus Wilsonii, *N. ab E.*

Pl. X. Fig. 33.

Jungermannia Wilsonii, Taylor *in schedis*.
Acrobolbus Wilsonii, N. ab E.; G. L. & N. Synop. Hepat. p. 5 (1844).
Gymnanthe Wilsonii, Taylor, l. c. p. 192.

Hab. Originally discovered by *Miss Hutchins* near Bantry, 19 Nov. 1812, young fr.! (Herb. *C. Lyell, Esq.*, named by Hooker "*J. capitata.*") Banks of a ravine near the Hunting Tower, Cromagloun, co. Kerry, Nov. 1829, fr. *W. Wilson, Esq.!* Torc mountain, Killarney, Sep. 1841, *Dr. Taylor!* Glengariffe, Sep. 1869, growing on *Frullania germana*.

This rare and curious species seems to be confined to the south-west of Ireland (Kerry); and only one or two fragments have been picked since Mr. Wilson was fortunate enough to collect it in some abundance, and in a fertile state. He, indeed, first defined the species, but specimens had been collected seventeen years earlier by *Miss Hutchins*, a fact discovered recently, when, through the kindness of Sir C. Lyell, I was enabled to examine his father's collection, and came upon a packet labelled "new," and "*J. capitata*," in Sir W. Hooker's writing, but which proved to be the Acrobolbus.

Acrobolbus Wilsonii occurs in scattered tufts, epiphytic on the fronds of *Radula* or *Frullania*, to which it clings by scattered fascicles of pale short *rootlets*, which are most numerous towards the apex of the fertile branches.

Stems (f. 33, 1) $\frac{1}{4}$ to $\frac{1}{2}$ an inch in length, flexuose, creeping; texture cellular; colour olive, or olive-brown; viticulose.

Innovations ventral or sub-lateral, slender, patent or divaricate. *Barren shoots* about $\frac{1}{35}''$ to $\frac{1}{25}''$ in diameter, decumbent, serpentine, with smaller and more distant nearly horizontal leaves.

Fertile shoots suddenly accrescent at the apex, often interrupted from the growth of innovations, and bearing much larger erect leaves.

Leaves (f. 33, 2, 3) approximate, semivertical, roundish or obovate ($\frac{1}{40}''$), divided for one-third or even half their length into two acute, unequal lobes, the ventral somewhat larger, rarely tri-lobate; sinus acute; margin entire, except in the involucral leaves.

The leaves (f. 2) are inserted obliquely, contracted at the base, nearly plane, horizontal at the inferior portion of the shoots, but more concave (f. 4), ascending, and connivent near the apex.

Amphigastria wanting on the barren stems, although I have observed minute ones once or twice at the apex of innovations (f. 33, 8), either lanceolate, or ovate and bi-dentate in form.

Texture of the leaves thin but not translucent, little altered when dry; colour yellowish-green, the basal leaves darker.

Leaf-cells (f. 33, 5) roundish-hexagonal, with well-defined, equal walls, the marginal cells having no special form. Diameter in the upper part of the leaf about $\frac{1}{700}''$; near the base the cells are oval, $\frac{1}{440}''$ by $\frac{1}{880}''$. Trigones imperceptible. Within the cells we find numerous minute chlorophyll granules. On the exterior of the involucral leaves of one specimen I observed the cells remarkably prominent, resembling those of *Lejeunia echinata*, and some of them prolonged into rootlets. In *Jung. capitata* the cells are larger and more translucent, and the walls thinner.

Fructification terminal, but from the growth of innovations sometimes appearing lateral.

Involucral leaves (f. 32, 3) originally free, two in number, much larger than the rest, broadly ovate or cordate, 2- to 3-lobed, the lobes repand-dentate, so as to have a crisped appearance, convolute-concave, base saccate-amplexicaul. Between the two a semi-ovate, acuminate *amphigastrium* is interposed (f. 33, 3), irregularly dentate at the margin. The *involucral leaves* are originally free, surrounding the convex apex of the stem, on which 15–20 pistillidia are crowded. But after impregnation, the rapid cell-growth of the young germ extends to the 'torus pistillorum,' and the bases of the adjacent leaves, so that the whole are blended together, forming an involucre (f. 33, 4) about a line in length, the lower half of which is ob-conic and entire, projecting below the level of the stem, and forming a kind of bulb, from which numerous rootlets proceed. The mouth of the involucre is surmounted by the connivent involucral leaves, which retain their old form; whilst its base is hidden by the sub-involucral leaves (which approach the terminal ones in size), and are toothed in a similar manner.

On longitudinal section (f. 33, 6) the structure will be better understood. The capsule is found occupying a cavity, composed in part of the metamorphosed apex of the stem and bases of the involucral leaves, and in part of the calyptra, which, with the exception of its dome-like apex, is concrete with the outer walls, bearing around it the remains of the abortive pistillidia, which, intermingled with minute bracts, surround the mouth of the involucre like a fringe.

Colesule wanting.

Calyptra campanulate, of thin hyaline texture, adnate (except at the apex) with the fleshy involucre (f. 33, 6, 7).

Capsule (f. 33, 6) oval, dark brown, dividing into four valves.

Pedicel stout, fleshy, white, 2 to 4 lines long, bulbous at the base, and inserted into the thickened gibbous portion of the involucre. Respecting this, Dr. Gottsche observes (Syn. Hep. p. 6): "Pedunculus in fundo hujus bursæ eodem modo insertus apparet, quo pedunculus *Aneuræ*, scilicet bulbulo quodam radicali sursum nonnihil constricto."

Spores reddish-brown, minutely granular, from $\frac{1}{1170}''$ to $\frac{1}{880}''$ in diameter.

Elaters obscurely bi-spiral, $\frac{1}{140}''$ long by $\frac{1}{3500}''$ broad.

Male inflorescence autoicous. *Perigonial leaves* 2 or 3 in number, terminal, sub-complicate and saccate at the base, enclosing one or more oval shortly stipitate *antheridia*.

An excellent account of the evolution of *Acrobolbus* will be found in Syn. Hep., p. 6, communicated by *Dr. Gottsche*, from which the following paragraph is taken :—

"In fere perfectis denique speciminibus, quorum capsula semina quaterna cohærentia et elateres bispiros exhibebat, pistilla sterilia et sicca semper inter folia involucralia vidi mixta lobulis phylloideis, quo colligitur, superiorem partem floris, foliis involucralibus interjectam, in pristino statu situque persistere, illum vero, quæ foliis dictis subjecta est, sacculi seu bulbi forma in solum descendere radiculisque conspergi.

"Deest igitur perianthium non aliter atque in *Aneura*, testibus relictis pistillis abortivis in vertice inter folia involucri."

Pl. X. Fig. 33. — Acrobolbus Wilsoni. 1. *Stems unmagnified.* 2. *Lower portion of stem* × 16 *diam.* 3. *Upper portion of fertile shoot, showing involucral leaves* × 16. 4. *Fertile shoot, lateral view.* 5. *Apex of leaf* × 120. 6, 7. *Involucre laid open, showing the calyptra and capsule.* 8. *Leaves and amphigastria from apex of barren shoot.*

VI. Saccogyna, *Dumort.*

Jungermannia, L. Sp. Pl. I. ed. ii. p. 1131, n. 2 (1753).
Lippius (haud L.), Gr. & B. Nat. Arr. Brit. Pl. V. i. p. 706 (1821).
Saccogyna, Dum. Com. Bot. p. 113 (1822); Syll. Jung. Eur. p. 74, n. xiii. (1831); Obs. sur les Jung. p. 21 (1835).
Sykorea, Corda, in Opiz. Beitr. i. p. 653, n. 7 (1829), et Sturm. Deutsch. Fl. ii. fasc. 19 et 20, p. 41 (1830).
Lophocolea, Mart. Pl. Cell. Ins. Cunar. p. 50 (1840).
Calypogeia, Raddi, MSS. ex auct. Cord.
Geocalyx, N. ab E. Leberm. Eur. i. p. 97, n. 13 (1833).

Obs.—Genus *Verbenacearum* tamen *Lippia*, L. Syst. Nat. i. ed. (1735).

Dioicous. Perigynium (*torus*) at first bud-like, inferior, proceeding from the axil of an amphigastrium, at length oblong, pendulous, fleshy, sub-lateral, shortly stipitate, surmounted by the remains of the involucral bracts. Colesule wanting. Calyptra connate for most of its length with the outer walls, the dome-like apex alone free. Capsule oblong, valves 4, straight, erect.

Male spikes minute, inferior, arising from the amphigastria of separate individuals.

Plants with the habit of *Chiloscyphus*, procumbent, sparingly radiculose; leaves succubous, horizontal, entire or emarginate; amphigastria triangular, adnate with the adjacent leaves.

Derivation—σάκκος, *a little sac;* and γυνή, *female* (pistil).

Obs.—*Geocalyx*, N. ab E., seems to bear the same relation to *Saccogyna*, that the species of Jungermannia with entire leaves, bear to those in which the leaves are bilobed; and I cannot consider that a valid generic character. Moreover (as Dr. Lindberg points out), the leaves of *S. australis* and *S. jugata* (Mitten, in Fl. Nov. Zealand. and Fl. Vitiensis) are dentate.

From the other *Geocalyceæ* with saccate inferior fructification, *Calypogeia*, Raddi (haud N. ab E.) is distinguished from *Saccogyna* by the succubous leaves, and the spiral arrangement of the valves of the capsule; whilst in *Kantia*, Gr. & B., the leaves are incubous, and the valves of the capsule spirally twisted.

Much confusion has arisen from *N. ab Es.* (Leberm. Eur. ii. p. 388, &c.) having transposed the nomenclature of *Raddi*, an error perpetuated in the Synop. Hepat., pp. 196, 197, and by succeeding authors.

Calypogeia, Raddi, Jung. Etrusca (1820), p. 43, contains two sections, A. examphigastriata=(*C. ericetorum*, et *C. flagellifera*, Tab. 6, f. 1, 2), and B. amphigastriata = *C. fissa* (Tab. 6, f. 3)=*Mnium Trichomanis facie, foliis bifidis*, Dill. Hist. Musc. t. 31, f. 6. *Jung. trichomanis*, Eng. Bot. t. 1875.

It is difficult, therefore, to understand why N. ab E. should have named the first section *Gonglyanthus*, and restricted *Calypogeia* to *J. trichomanis* and its allies, the more so, since Gray and Bennett had in 1821 named the latter *Kantia*.

1. Saccogyna viticulosa, *Dumort.*

Pl. IX. Fig. 28.

Jungermannia viticulosa, L. Sp. Pl. II. p. 1597, n. 2? Eng. Bot. 1 ed. t. 2513; Lindenb. Hep. Eur. p. 28, n. 19; Hook. Brit. Jung. t. lx.; Fl. Britt. v. i. p. 117, n. 46; Mackay, Fl. Hibern. ii. p. 53, n. 51; Musc. Brit. 2 ed. p. 235, n. 51.

Saccogyna viticulosa, Dum. Comm. Bot. p. 113 (1822); Syll. Jung. p. 74, t. 2, f. 13; N. ab E. Leberm. Eur. ii. p. 389, iii. p. 571; G. L. N. Syn. Hep. p. 194; Gott. & Rab. Hep. Eur. Ex. n. 166.

Jungermannia terrestris, viticulis longis, Michel. Nov. Gen. p. 8, t. 5, f. 4 (haud Dill. Musc. t. 69, f. 7).

Sykoria viticulosa, Corda, in Sturm. Fl. Germ. ii. fasc. 19, 20, p. 41, t. 11.

Hab. Shady rocks in woods, and heaths in sub-alpine districts. Fructification exceedingly rare. First discovered by *Miss Hutchins* near Bantry, 1813. Kinnordy Angus, young fr. April 1813, *C. Lyell, Esq.!* Near Bangor, Mar. 1835, fr. *W. Wilson!* Galway, *J. Nowell!* Loch Bray, co. Wicklow, *Dr. Moore!* Glengaroffe, Sept. 1868! Cromagloun and other places near Killarney, June 1861! Near Barmouth, N. Wales, Oct. 1867! Dules Gate, Todmorden, *J. Nowell!* Tunbridge Wells, *G. Davis!* Banks of Lune, near Orton, July 1859! O'Sullivan's Cascade, Killarney, fr. 22 July, 1873, *Dr. Lindberg!* Neath, S. Wales, 1872!

Fronds attached to tufts of Sphagnum, or the surfaces of rocks, forming shallow, depressed patches, several inches in circumference.

Shoots (f. 28, 1) one or two inches in length by a line broad, of nearly equal diameter throughout, and from the regular imbrication of the leaves, having a very neat appearance. *Stems* filiform, subligneous, slightly flexuose, but rigid and brittle when dry. *Innovations* distant, ventral from the axils of amphigastria, patent, only differing from the main shoots in size. *Rootlets* sparse, white, most numerous at the bases of the amphigastria.

Leaves (f. 28, 3) about half a line in length, distichous, closely and regularly imbricated, alternate, or in some specimens nearly opposite (f. 28, 2), horizontal, plane, or slightly convex on the upper side, ovate to elliptic-ovate, obtuse, from a broad sub-decurrent base; margins entire.

Texture firm, dense, opaque. *Colour* green, ochraceous, or olive-brown. *Cells* uniform, hexagonal, the walls not thickened; in the upper part of the leaf about $\frac{1}{1170}''$ in diameter; near the base $\frac{1}{880}'' \times \frac{1}{700}''$. *Trigones* absent. The cells contain numerous green granules, and a distinct nucleus.

Amphigastria (f. 28, 4, 5) equal to half the diameter of the leaves, broadly ovate-triangular, pointed, irregularly 2–3 dentate, those near the base of the shoots being most divided; margin reflexed, connate with the ventral border of the left-hand leaf, rarely with opposite leaves.

The cell structure resembles that of the leaves.

Inflorescence dioicous.

Fertile shoots (f. 28, 3) producing at intervals from the axils of the amphigastria, minute, ovate, bud-like receptacles, clothed externally with irregularly-dentate bracts (f. 28, 7), thick and succulent at the base, and at first nearly sessile. On section from 6 to 12 fusiform pistillidia are found lurking within.

After impregnation rapid cell-multiplication commences in the tissues surrounding the young germ (calyptra) and the inferior portion of the receptacle, during which the fleshy base elongates and descends into the earth, forming, at length, "a hollow oblong pouch or sac nearly a line long," and attached to the stem by a short lateral pedicel proceeding from its upper border. When mature the *perigynium* (f. 28, 6) is cylindrical in form, smooth or irregularly striate, and of a brownish colour without, a little expanded at the mouth, and surmounted by the modified involucral bracts. After the egress of the capsule the sac becomes more fusiform, and the mouth contracts.

Calyptra immersed, adnate with the walls of the sac for two-thirds of its length. In young perigynia the hollow part above the calyptra is contracted by the growth of clavate processes from the walls, so that only a narrow channel remains; and the fruit-rudiment, from the rapid growth at the base of the perigynium, lies in a hollow cavity, invested by a stratum of mucus.

Capsule (f. 28, 6) oblong, reddish-brown, cleft into four narrow, patent, straight, coriaceous valves.

Pedicel about an inch long, white, parenchymatous, bulbous at the base, where it is inserted into the walls of the sac.

Spores minute, reddish-brown, round, $\frac{1}{1750}''$ in diameter.

Elaters slender, bi-spiral, $\frac{1}{175}''$ by $\frac{1}{2300}''$.

"*Inflorescentia masculina* in ramulis propriis microphyllis ex amphigastriorum angulo nascentibus." *Syn. Hep.* p. 194.

I have not yet met with the male plant; but probably the antheridia are contained in minute spikes arising from the amphigastria, as in *Kantia trichomanis*.

Obs.—Although *S. viticulosa* was accurately figured by *Michelius*, the species seems to have been confounded by most of the early writers with *Chil. polyanthos*. The figure of *Dillenius* (Hist. Musc. lxix. 7, A. & B.) clearly belongs to the latter.

Hooker (l. c. t. lx.) observes: "As *Linnæus* refers to the Michelian figure, there is reason to believe he intended the same plant; yet, how strange it is that he should have described it in Sp. Plant. '*foliolis subulatis*,' and in Syst. Naturæ '*foliis planis nudis linearibus*.'"

Miss Hutchins was the first to discover perfect fructification, although *Mr. C. Lyell* had already found young perigynia.

Saccogyna appears to be exceedingly rare on the Continent, since in G. & R. Hep. Eur. Ex. the only specimen met with was communicated by Mr. Curnow, of Penzance.

Pl. IX. Fig. 28.—*Saccogyna viticulosa*. 1. *Fertile shoot natural size*. 2. *Portion of shoot* × 8. 3. *Leaves and amphigastria more highly magnified* (*the drawing was intended to represent the young fructification, but is imperfectly engraved*). 4, 5. *Amphigastria*. 6. *Perigynium, lower part laid open to show the adnate calyptra and insertion of the pedicel*.

VII. Harpanthus, *N. ab E.*

Jungermannia, Web. & Mohr. Bot. Taschenb. p. 408, n. 10 (1807); N. ab E. in Regensb. Bot. Zeit. xvi. P. II. p. 408 (1833).

Harpanthus, N. ab E. Leberm. Eur. ii. p. 351, n. vii. (1836); Spruce, Musc. et Hep. Pyren. in Trans. Ed. Bot. S. iii. p. 209 (1859).

Pleuranthe, Tayl. in Hook. Lond. Journ. Bot. v. p. 282 (1846).

Obs.—Est Pleuranthe, Salisb. MSS. Proteæ, L. species. Pleuranthus, Rich. MSS. tamen Dulichium, Rich. in Pers. Syn. Pl. I. p. 65 (1805).

Dioicous. Fertile shoots very short, ventral (issuing from the axils of amphigastria), at length sub-lateral. Colesule exserted, terete, the lower half incrassate; mouth contracted, 3-4 dentate. Calyptra fleshy, confluent for two-thirds of its length with the walls of the colesule. Involucral leaves consisting of one or two pairs, with interposed amphigastria. Leaves succubous, ovate, emarginate, semi-vertically imbricated, secund. Amphigastria lanceolate, connate with the adjacent leaves, free margin reflexed, uni-dentate at the base. Male shoots more slender; perigonial leaves terminal, more concave, enclosing 1-2 oval antheridia.

Plants of small size, cæspitose, the stems decumbent, and root-

ing on the underside; growing on rocks, and the trunks of trees, in sub-alpine districts.

Etym.—ἅρπη, *a sickle;* and ἄνθος, *a flower.*

Obs.—Under *Harpanthus*, N. ab E. placed only *H. Flotovianus*, the name being derived from the curved fusiform colesule of that species.

But, as our gifted countryman *R. Spruce* pointed out (Hepat. Pyr. in Trans. Ed. Bot. S. v. iii. p. 210) *J. scutata*, Web. & M., ought also to be included in the genus. Since the early volumes of the Transactions are now scarce, I need not apologize for quoting the passage :—

"The fructification of this plant is *truly lateral* (ramulo fertili e ventre caulis exeunte), and not as described in Synopsis Hepaticarum, p. 101, 'perianthio terminali, mox dorsali,' for an instance of which I have in vain searched perhaps a hundred fertile stems." (Mr. Spruce is, I think, mistaken in describing the colesule as truly lateral; in mature specimens it appears lateral, but originally the 'torus pistillorum' springs from the axil of an amphigastrium. Indeed, it is a curious fact that true axillary involucra, as in pleurocarpous mosses, are never met with in the Hepaticæ (Lindb. Lin. Soc. Journ. v. xiii. p. 195).) "*The involucral leaves are normally two, with an interposed stipule*, and the uppermost leaf is concrete with the perianth for one-third of its length. *The perianth is very thick below* (=3–4 cellules), and should perhaps be rather regarded in this part as *a hollowing out of the apex of the stem. The calyptra is concrete with the inner surface of the perianth for more than half its length*, as correctly represented in Hooker's figure, but not alluded to in 'Synopsis Hepaticarum.' All these characters bring this species very close to *Harpanthus Flotovianus*, N. ab E. (Syn. Hep. p. 170), the sole tangible difference being that in the former the perianth is obovate, and in the latter fusiform, while they separate it widely from *Jung. acuta*, and *J. Bantriensis.*" "The leaves of *H. Flotovianus* are bi-dentate in the same manner, only with a shallower sinus; the stipules are proportionally narrower, but *equally acuminate*, falcate and slightly *twisted*, and *toothed on one side at the base*, just as in the other."

Pleuranthe, Taylor, Lond. Journ. of Bot. 1846, p. 282, from the diagnosis, evidently differs in no material respect from Harpanthus :—

"*Calyx* basi radicans, solidus, incurvus, folia tria perichætialia ferens, e caulis ventre oriens, medio carnosus, teres, cylindricus, apice membranaceus, conicus, subcompressus, ore subplicato, bi-tri-lacero-laciniato. *Calyptra* calycis fauci insidens. *Elateres* bispiri." Capsula subquadrivalvis.

Only one species is described, *P. olivacea*, Tayl. "Fructus junior" (he continues) "primum in stipulæ axilla apparet, minutus, globularis, albidus,"—which accords exactly with the young receptacle of *H. scutatus.*

In strict sequence, the remaining species, with more or less immersed fructification, should be inserted here; e. g., *Kantia*, *Aneura*, &c. But my object has been to depart as little as possible from the classification adopted by N. ab E.; and, as will be seen, any modifications in the nomenclature, which I have felt bound to adopt, have been made in accordance with the laws of priority—laws which it should be the interest of all scientific men to maintain.

1. Harpanthus scutatus, *Spruce.*

Pl. XVII. Fig. 52.

Jung. scutata (Flörk); Web. & M. Taschenb. p. 408, n. 10 (1807); Web. Prodr. p. 41; Mart. Fl. Cr. Erl. p. 141; Lindenb. Hep. Eur. p. 38, n. 31; Dumort. Syll. Jung. p. 56, n. 68; Hüb. Hep. Germ. p. 151, n. 58; N. ab E. Leberm. Eur. iii. p. 546; G. L. N. Syn. Hep. p. 101, n. 58; Eng. Bot. 2nd ed. t. 1854; Mackay, Fl. Hib. ii. p. 65, n. 54; Hook. Brit. Fl. ii. p. 118, n. 50.

Jung. stipulacea, Hook. Brit. Jung. t. xli.; Musc. Brit. ed. ii. p. 235; Eng. Bot. 1 ed. t. 2536 (1813); N. ab E. Leber. Eur. ii. p. 18, n. 45; Gray, Arr. Br. Pl. I. p. 696, n. 7.

Harpanthus scutatus, Spruce, Tr. Ed. Bot. Soc. iii. p. 209; Boul. Fl. Cryp. p. 818; Dumort. Hep. Eur. p. 67 (1874).

Exs. Moug. et Nest. St. Cr. Vog. Rhen. vii. n. 632 (v. *α*); G. & R. Hep. Eur. Ex. n. 218–354 (*α imbricata*), 466 *β*; Del. et Grav. Hep. Arden. n. 34.

Hab. Shady rocks Laharn Wood, near Bantry, 1812, *Miss Hutchins.* Near Loch Bray, 1814, *Dr. Taylor!* Scotland, *G. Don!* Galway River, Killarney, 4 Aug. 1829, fr. *W. Wilson!* Near Llanberis, *W. Wilson!* Eagles Nest, Cromagloun, Glena, &c., fr. very rare, June 1861! Tunbridge Wells, *G. Davis!* Rocks near the Strid! Bolton Woods, c. *Jung. exsecta*, 2 May, 1868!

Growing in dense compact tufts resembling the smaller forms of *Jung. acuta*, v. *laxa*, N. ab E. on rocks, or the decayed trunks of trees.

Stems (f. 52, 1) $\frac{1}{4}$th to $\frac{1}{3}$rd of an inch in length by $\frac{1}{3}$rd of a line in diameter, filiform, decumbent, the apex only ascending, or erect from the crowding together of the shoots, generally simple, but producing occasional innovations from the ventral aspect, brownish, rather rigid.

Rootlets numerous, white, proceeding from the bases of the amphigastria throughout the entire length of the shoot.

Leaves (f. 52, 2, 3) bifariously imbricated, semi-vertical, erecto-patent, smaller at the apex and base of the shoots ($\frac{1}{40}''$), more distant and spreading below, but generally secund: approximate, and connivent towards the summit. In form they are roundish-ovate, concave, sharply bidentate, the sinus lunate or acute, and equal to $\frac{1}{4}$th to $\frac{1}{5}$th of the length; margins entire, the dorsal decurrent for a short distance.

Texture firm, but thin and translucent.

Colour pale olive, olive-brown or brown.

Cells (f. 52, 3, 4) small, roundish, the walls rather thick: those of the margin somewhat flattened, $\frac{1}{1770}''$ by $\frac{1}{700}''$; near the base $\frac{1}{580}''$ to $\frac{1}{440}'' \times \frac{1}{880}''$. *Trigones* $\frac{1}{3500}''$, contents granular, coloured near the wall.

Amphigastria (f. 52, 3, 5) large for the size of the plant, closely placed, patent, ovate- or lanceolate-acuminate, sub-falcate, connected by one border with the adjoining (usually left-hand) leaf; the free border recurved, "slightly twisted and toothed at each

side near the base." *Texture* not differing from that of the leaves.

Inflorescence dioicous. Fertile receptacle resembling at first a minute bud, almost hidden by the amphigastria, afterwards, from the growth of the colesule, curving upwards, and apparently lateral.

Involucral bracts two (f. 52, 8); the upper one adnate at the base with the colesule, 2–3-fid (f. 52, 4), the segments acute, connivent, distantly and sharply dentate; connate with these on the ventral aspect we find an irregularly trifid-toothed bracteole.

One or rarely two minute sub-involucral bracts are generally present at the base of the shoot.

Colesule (f. 52, 8) at first ovate, contracted at the mouth, but after the maturity of the capsule obovate, terete, obscurely 3–4-plicate, from a contracted thickened base, so as to appear apophysate. Apex slightly crenate, splitting on one side at the exit of the capsule.

Calyptra (f. 52, 7) connate (except at the campanulate apex) with the lower half of the colesule; the combined walls thickened, and composed of 4–8 layers of cells.

Capsule oval, deep-brown, splitting into four equal elliptic valves.

Peduncle $\frac{1}{4}''$ to $\frac{1}{2}''$ long, white, succulent.

Spores small, spherical, $\frac{1}{2300}''$, rufous-brown.

Elaters bi-spiral, $\frac{1}{140}''$ in length, by $\frac{1}{2300}''$ broad.

Male plants distinct, densely cæspitose; shoots more slender, generally simple; leaves closely imbricated, sub-secund.

Perigonial leaves (f. 52, 5) terminal, elliptic-ovate, acutely notched, ventricose, enclosing one or two spherical, olive-green shortly stipitate *antheridia.*

Pl. XVII. Fig. 52.—*Harpanthus scutatus.* 1. *Fronds unmagnified.* 2. *Portion of barren shoot* × 8. 3. *Stem-leaves and amphigastria seen from below* × 16. 4. *Apex of involucral bract, showing the cells* × 120. 5. *Perigonial leaf containing antheridia.* 6. *Fertile receptacle and capsule* × 8. 7. *Transverse section of colesule, showing the adnate calyptra and young capsule.* 8. *Mature colesule* (*ventral aspect*).

Section III.—Jungermannidæ.

Colesule and calyptra free. Capsule solid, dividing to the base into four valves. Fructification terminal on primary or secondary shoots, or sublateral from short proper ventral shoots (amphigastriate).

VIII. Plagiochila, *Dumort.*

Jungermannia, L. Sp. pl. i. ed. ii. p. 1131, n. 1 (1753).
Dinckleria, Necker, Elem. Bot. iii. p. 337, n. 1754 (ex parte) ? 1790.
Candollea, Raddi in Mem. Soc. Moden. xviii. p. 23, sect. A* (1820).
Martinellia, G. & B. emend. in Nat. Arr. Br. pl. i. 690, ex parte (1821).

Radula, Dumort. Comm. Bot. p. 112, ex parte (1822).
Radula sect. *Plagiochila*, Dmrt. Syll. Jung. p. 42 (1831).
Plagiochila, Dmrt. Rev. Jung. p. 14 (1835); Nees et Mont. in Ann. Sc. Nat. ii. ser. v. p. 52 (1836); Lindenb. Sp. Hep. Fasc. i. (1839).
Plagiochila, Sect. I. *Asplenioideæ*, N. ab E. in Lindl. Intr. Nat. Syst. ii. ed. pp. 414 et 452, n. 91 (1835), et Leberm. Eur. iii. p. 518 (1838).

Fructification terminal, or from the growth of innovations axillary, autoicous or dioicous. Colesule laterally compressed, ancipital, erect or decurved at the apex; mouth obliquely truncate, bilabiate, entire or ciliate dentate.

Involucral bracts two, larger than the cauline leaves, erect.

Pistillidia numerous. Capsule of thick texture, quadrivalved.

Elaters bi-spiral, attached to the centre of the valves.

Androecium spicate, terminal or interrupted.

Perigonial leaves smaller, ventricose, closely imbricated in two rows, enclosing 2–3 oval antheridia.

Plants conspicuous, growing on rocks or the trunks of trees.

Primary shoots leafless, creeping, radiculose; branches ascending or procumbent, simple, dichotomously branched, or dendroid. Leaves succubous, distichous, or subsecund; dorsal margin decurrent, reflexed, entire, ventral arcuate, apex decurved, entire or variously cut and fringed.

Amphigastria inconspicuous.

Derivation—πλάγιος, *oblique*, and χεῖλος, *lip*.

Obs.—The present genus is one of the most natural among the modern groups of Hepaticæ. Indeed, there is a strong family likeness running through all the species, so that the cultured eye can pick out a Plagiochila as readily as a Rose, or Willow. But this very circumstance renders the separation of one species from another a matter of no small difficulty, so that we find much difference of opinion as to which are to be looked upon as permanent forms, and which varieties only.

From allied genera *Plagiochila* may be distinguished by the laterally-compressed colesule, dimidiate leaves, which are neither auriculate (*Porella*), or lobed either on the dorsal (*Scapania*), or ventral aspect (*Radula*).

The genus is represented in Europe by five species only, the whole of which are inhabitants of the British Isles, and special to our western shores.

But in tropical and sub-tropical regions the species are much more numerous, and constitute an important part of the cryptogamic vegetation. In the Synop. Hepat. p. 625, 32 species are described as Asiatic; 12 African; Northern and tropic America, 89; Cape Horn, 9; and New Zealand, Australia, and the Antarctic Isles, 30.

But numerous additions have been made to this list since the publication of that celebrated work. Thus Dr. Gottsche, in his Mexican Hepaticæ (1863), describes as natives of that country only 168 species; and probably Dr. Spruce, from his rich Amazonian gatherings, could add an equal number.

Many of the Plagiochilæ are noted for the elegance of their fronds, their fern-like delicacy of form, and the variety and richness of their colouring. Such species as *P. arbuscula*, *P. Stephensoniana*, *P. gigantea*, and *P. superba* may well claim comparison

with the noblest representatives of the order. Nor do I envy the man who can pass without admiration our own familiar wood species, *P. asplenioides.*

The compressed colesule in some of the Liverworts appears at an early period to have attracted attention. Thus we find Necker, Elementa Botan. iii. p. 337 (1790), introduce a section, *Dinckleria*, "Colesula compressa, angulata, ex apice lateribusque surculorum prodiente, foliis distichis exappendiculatis," which defines very fairly the present group, but under which are arranged species of Radula, Cephalozia, &c.

Hooker, although declining to divide the Jungermanniæ, in the synopsis to his great work indicates the natural affinities of the species, and limits the principal genera.

Following him, *Raddi* (*Jung. Etrusca*, 1820), arranges under Candollea—1. the Jung. asplenioideæ; 2. J. nemoroseæ; and 3. J. complanata. De Candolle's name had, however, been already appropriated by 4 or 5 botanical writers.

In *Gray's Nat. Arr.* (1821) we find the same species included under *Martinellia*, but in reversed order, as in the succeeding work.

The year following, ignorant of the labours of his contemporaries, *Dumortier* (*Comment. Bot.* p. 112) published his first classification, grouping under *Radula*,—1. J. complanata; 2. Jung. nemorosæ; and 3. J. asplenioideæ. In the *Sylloge Jung.* (1831) he makes *Radula* a sub-tribe with sections 1. *Radulotypus*, 2. *Scapania*, 3. *Plagiochila.* Later (*Revision des Genres*, 1835) we find the three genera—*Radula*, *Scapania*, and *Plagiochila* perfected. This arrangement has been adopted by all later writers.

Whether, therefore, upon the question of priority only, Martinellia, G. & B., should be substituted for one of Dumortier's names, becomes a nice question. And if so, which segregate should it replace? Because Martinellia cannot be considered the equivalent of any one of them, although including the whole. If admitted, it should surely supersede *Radula*, because *J. complanata* is first described. Prof. Lindberg appears to have felt this difficulty, but I fail to understand the grounds for his having first substituted it for Plagiochila, and more recently for Scapania! Under the circumstances, I think it wiser to let well alone.

α. Shoots leafy throughout.

1. Plagiochila interrupta, *Dumort.*

Pl. III. Fig. 11.

Stems viticulose, horizontally ramose, depressed, leafy throughout; leaves distichous, closely imbricated, nearly plane, elliptic-ovate to subquadrate; apex obtuse, truncate, or emarginate, margin entire; involucral bracts larger, ovate-oblong, erect, margins recurved, undulate; colesule obovate compressed, mouth bilabiate, irregularly crenate-denticulate; capsule oval.

Jungermannia interrupta, N. ab E. Eur. Leberm. i. p. 165 (1833); De Notaris, Prim. Hep. Ital. p. 39.

J. Dumortieri, Lib. Pl. Cryp. Ard. iv. n. 311 (1837).

J. vagans, Wils. Mss.

Plagiochila interrupta, Dumort. Rev. Jung. p. 15 (1835); Lindenb. Spec. Hep.

Fasc. i. p. 61, t. x. (1839); G. L. N. Syn. Hep. p. 48, n. 63 (1844); Boul. Musc. p. 769; Cogn. Hep. Belg. p. 23; Dumort. Hep. Eur. p. 44, n. 3 (1874); G. & Rab. Hep. Eur. Ex. n. 48, 109, 136. et 316.

Plag. microstoma, Sull. Musc. Allegh. p. 53, n. 221 (1846); Mosses of U. S. p. 96, n. 4 (1856); G. & N. Syn. Hep. p. 659, n. 104 (1847).

Plag. Pyrenaica β interrupta, Lindb. Manip. Musc. Secund. Notiser pro Faun. et Flor. Fenn. xiii. p. 367 (1874).

β Pyrenaica. Barren stems humifuse, serpentine-flexuose, horizontally branched; leaves ovate-oblong, obliquely truncate, bi-, tri-, or sometimes quadri-dentate; colesule obovate, mouth acutely dentate.

Plag. Pyrenaica, Spruce, Hep. Pyr. n. 9 (1847), et Trans. Bot. S. Ed. iii. p. 200, n. 9 (1849); Dumort. Hep. Eur. p. 44, n. 4 (1874).

Plag. interrupta β Pyrenaica, Carr. Mss. Lindb. in Hartm. Scand. Fl. x. ed. ii. p. 130 (1871).

Plag. (*Pedinophyllum*) *pyrenaica*, Lindb. Man. Musc. Secund. p. 366 (1874).

Jung. polymorpha, Carr. in Flora of West Riding, p. 188 (1862).

Hab. Abundant on dry shady rocks; near the Strid and other parts of Bolton woods, Wharfdale! Found with capsules, May 1857! Ardingly Rocks, Sussex, *W. Mitten* (sub-nom. *J. trichomanoides*)! β Bolton woods! Malham Moor, July 10, 1857! Windermere, July 1859! Fr. Summer. Originally discovered on the Krenzacher Horn, near Baden, 18 April 1813, by the brother of Nees v. Es. Salzburg, *Sauter!* Baiern, *Arnold!* Baden, *Jack* — β. Pyrenees, *R. Spruce!*

Tufts broad, depressed, densely humifuse, attached to the surface of (calcareous) rocks, and having the habit of *Saccogyne viticulosa.*

Stems serpentine-flexuose, creeping, depressed or arcuate, simple and prolonged from the apex, or irregularly branched, olive-brown, purplish near the base, brittle when dry.

Rootlets numerous from the bases of the leaves, translucent, tawny.

Shoots leafy throughout (f. 11, 2), complanate, depressed, or ascending only at the apex, rarely fertile, from $\frac{3}{4}''$ to $1\frac{1}{2}''$ long by a line in breadth, tapering a little towards each extremity, in older plants interrupted from the annual growths, the earlier leaves being smaller and more distant. Branches more or less numerous, axillary or proceeding from the ventral aspect, growing in the same plane as the main shoots, sometimes producing shorter ramuli.

Leaves elliptic-ovate (f. 11, 3) or quadrilinear (f. 11, 5), about $\frac{1}{20}''$ in length, distichous, alternate, horizontally imbricated, subcomplanate, the terminal ones ascending and connivent; apex rounded and obtuse, retuse, or emarginate (f. 11, 3, 4, 5) in β bi-, tri-, or even quadri-dentate (f. 9); dorsal margin scarcely decurrent, ventral entire, plane or waved, and like the summit a little recurved, so that the surface is slightly convex, but much less so than usual in this genus.

Amphigastria generally present on the barren shoots, distant, very minute, 1–3-partite, the segments subulate.

Texture of the leaves firm, scarcely altered when dry.

Colour paler at the summit, yellowish-green to olive-brown, in some specimens tinged with purple; sub-pellucid, with a slight oily lustre.

Cells with distinct walls (f. 11, 5, 7), of pretty uniform size, slightly thickened at the angles, the interior (especially near the walls) filled with chlorophyll granules. Marginal cells quadrangular, $\frac{1}{875}''$ by $\frac{1}{1167}''$; those of the upper third from $\frac{1}{700}''$ to $\frac{1}{1167}''$ each way. Basal cells $\frac{1}{700}''$ to $\frac{1}{440}''$ long, by $\frac{1}{1167}''$ broad.

Trigones, after preparation, more distinct, about $\frac{1}{2833}''$ in diameter.

In β *Pyrenaica* the cells are slightly larger, but resembling the former in shape; the Malham specimens are occupied by fewer purplish granules.

Inflorescence autoicous. Fertile shoots rarely developed, short, lateral, ascending (f. 11, 2).

Involucral bracts two, double the size of the ordinary leaves, but shorter than the colesule, ovato-oblong, apex emarginate, and like the margins recurved and repand; base erect, appressed.

Colesule (f. 11, 6) $\frac{1}{8}''$ in length, obovate, compressed, ventricose at the base, mouth broad, obliquely rounded, bilabiate, curved to one side, irregularly crenulate-lobate. In var. β more acutely dentate.

Calyptra campanulate, hyaline-reticulate, surrounded at the base by barren pistillidia.

Capsule rather small, oval, dark brown, valves 4, ovate.

Pedicel white, succulent, about double the length of the colesule.

Spores $\frac{1}{1750}''$ in diameter, roundish, reddish-brown, granular. *Elaters* bi-spiral, $\frac{1}{140}''$ to $\frac{1}{117}''$ by $\frac{1}{2300}''$.

Andrœcium terminal or interrupted (f. 11, 2, *central shoot*), spicate, either arising from the same stems as the fertile shoots, or distinct.

Perigonial leaves smaller (f. 11, 7), closely imbricated in two rows, so as to hide the stem, very convex, bi-lobate, ventral lobe roundish-ovate, entire, saccate at the base; dorsal much smaller, obliquely ovate, incumbent. Dr. Spruce describes var. β, "folia lobulo involuto spinuloso, vel laciniato-dentato, stamina obtegente prædita."

Antheridia usually solitary (f. 11, 8), globose, dark-green, surrounded by a layer of larger tabular cells; stipes slender, jointed.

Obs.—In July 1857 I collected at Gordale, Malham, a form which I submitted to my friend Dr. Gottsche, who thought it probably distinct, and which was described in *Myall & Carrington's Flora of the West Riding*, p. 88 (1862), under the name of *Jung. polymorpha.*

At that time I was not acquainted with *Plag. Pyrenaica*, Spruce. The shoots

were long and arcuate, rooting only at the apex and base, and not so densely radiculose as usual, probably from growing among mosses, &c.

They are described as "serpentine flexuose, purplish, incurved at the apex; leaves rotund-quadrate, spreading in the lower half of the stem, connivent above; variously and unequally lobed, bi-dentate, the sinus obtuse, segments short, acute, sometimes 3 to 4-toothed, and sometimes entire or bluntly emarginate."

Subsequently I collected the same form in Wharfdale, growing along with the ordinary state of *P. interrupta*, and satisfied myself of the identity of the two. Indeed, specimens may be found in which the leaves of some shoots are entire or simply emarginate, and in others 2 to 3-dentate.

I am sorry therefore to dissent from my friend Prof. Lindberg, who proposes to replace the characteristic name of Nees ab E., and constitute *P. Pyrenaica* the typical form. Because, though it is true Spruce's original specimens are larger and better developed than British ones of *P. interrupta*, we observe no such difference in native plants, and the toothing of the leaves is exceedingly sportive, even on the same stem.

Dr. Spruce appears not to have had much faith in its specific claims, since he states (*Hep. Pyr.* p. 200): "Although I have lately had Dr. Gottsche's sanction for retaining *Plagiochila Pyrenaica*, I think it not improbable that it may one day be proved a variety of *P. interrupta*, a striking one certainly, and perhaps confined to the Pyrenees. The Plagiochilæ are so liable to variation in the toothing of the leaves, that it is scarcely possible to suppose all the generally-received species genuine."

Care must be taken not to confound *P. interrupta* with *Chiloscyphus polyanthos*, which sometimes grows intermingled with it in the Wharfe valley, although generally preferring a moister habitat.

The leaves of the latter are of a very pale green colour, entire or simply truncate, and the texture thinner, larger celled, and translucent. When ♂ or ♀ fructification is present there can be no difficulty in separating them.

Pl. III. Fig. 11.—1. *Plag. interrupta natural size.* 2. *Fertile, male, and sterile shoots* × 16. 3, 4. *Stem-leaves.* 5. *Leaf showing the cell-structure.* 6. *Colesule.* 7. *Perigonial leaf.* 8. *Antheridium.* 9. *Portion of shoot of var. β.*

B. *Primary shoots rhizomatous, leafless.*

2. Plagiochila asplenioides, *Dumort.*

Pl. IV. Fig. 12.

Shoots ascending, dichotomously branched, creeping and radiculose at the base; leaves obliquely patent, approximate, decurved, obovate-rotund, entire or denticulate, dorsal margin decurrent, reflexed; colesule much longer than the involucral bracts, obconic-oblong, compressed; apex recurved, truncate, dentato-ciliate; capsule ovate.

Jungermannia asplenioides, L. Sp. Pl. p. 1597 (1753); Hedw. Theor. Gen. t. 16 et 17 (1784); Flor. Dan. t. 1061; Eng. Bot. 1 ed. t. 1788; Hook. Jung. t. 13; Musc. Brit. 2 ed. p. 227; N. ab E. Leber. Eur. i. p. 161; Mart. Fl. Elang. p. 177, t. 6, f. 51; Hüben, Hep. Germ. p. 111, n. 36; Hook. Brit. Fl. v. i. p. 107; Fl. Hibern. ii. p. 57.

Radula (*Plagiochila*) *asplenioides*, Dumort. Syll. Jung. p. 42, n. 28 (1831).

Plagiochila asplenioides, Dumort. Rev. Jung. p. 14 (1835); Mont. et Nees in Ann. des Sc. Nat. Janv. 1836, p. 52, et Leberm. Eur. iii. p. 518 (1838); Lindenb. Sp. Hep. Plag. p. 110, t. 23 (1839); G. L. N. Syn. Hep. p. 49, n. 67; Rabenh. Kryp. Fl. p. 341 (1863); Cogn. Hep. Belg. p. 22; Dum. Hep. Eur. p. 43 (1874); Lind. in Hart. Skand. Fl. x. ii. p. 130 (1871); Jenson, Hep. Dan. p. 149, n. 67 (1866); G. et R. Hep. Eur. Exs. n. 20, 271, et 320, cum icone; Del. et Grav. Hep. Ard. n. 13.

Lichenastrum asplenii facie pinnis laxioribus (et confertioribus).—Dill. Hist. Musc. p. 482, t. 69, f. 5 et 6.

Muscus trichomanis facie, foliis utrinque splendentibus rotundis.—Hist. Ox. iii. p. 627, n. 41.

α *major*. Shoots 2″ to 4″ by 3‴, sparingly branched, leaves loosely imbricated, nearly horizontal, less rigid and convex, obovate-trapezoid, more or less closely denticulate; colesule obconic.

Eng. Bot. t. 1788; Hook. Jung. t. xiii.; Lindenb. Plag. p. 111, t. 23, f. 1, 7.

β *minor*. Shoots $\frac{1}{2}$″ to $1\frac{1}{2}$″, by $\frac{1}{12}$″ to $\frac{1}{8}$″; summit decurved, densely cæspitose, leaves erecto-patent, approximate, sub-secund, roundish; margins strongly reflexed, ciliate-denticulate, entire, or emarginate; colesule oblong, mouth less dilatate.

β* *humilis*, scarcely $\frac{1}{2}$″. Shoots attenuate, leaves ovate, entire, obtuse or notched.

Lindenb. Plag. p. 111, γ *minor*, δ *humilis*, et ε *heterophylla*, Pl. xxiii. f. 7 to 15.

Plag. Dillenii, Tayl. in Hook. Jour. of Bot. p. 260 (1846); Dumort. Hep. Eur. p. 43.

δ *devexa*. Shoots compressed, sub-circinnate, $1\frac{1}{2}$″ by 2‴, 2 or 3 times innovant-furcate; leaves secund, roundish, ciliate-dentate, closely imbricated, erect; dorsal margin straight, strongly recurved, ventral projecting backward, so as to form a crest with the opposite leaves; colesule short, oblong, scarcely exceeding the involucral leaves, and like them densely ciliate at the apex.

Hab. Frequent about the roots of trees in shady woods and plantations. Capsules rare. Early summer. Snowdon, *Dillenius!* Bolton woods, ♂ and ♀, May 1860! Auchindenny woods, 1830, *Dr. Greville!* Strachan, Feb. 1874, *T. Sim!* β *minor* on rocks in subalpine districts, such as the scar-limestone of Craven, and oolitic moorlands of Yorkshire; mostly barren. β* *humilis*, Craigendaroch, Aberdeen, *T. Sim*, 1871! δ *devexa*, Dingle Bay, Ireland, July, 1861!

Fronds (f. 12, 1) either straggling among mosses, or forming dense erect tufts.

Primary shoots leafless, creeping, entangled, naked, or bearing near the apex minute scale-like bracts, radiculose, about the thickness of black thread, dark brown or nearly black, polished, and composed of elongated pleurenchymatous cells.

Rootlets confined to the rhizomatous shoots, white, capillary.

Secondary shoots (f. 12, 1) less rigid, and of a paler brown, as-

cending or erect, flexuose, simple or dichotomously branched, in older plants innovant from below the apex, which is generally recurved; from 1″ to 4″, or even 6″ in length, the breadth varying from a line to $\frac{3}{10}$ths of an inch. In the large form sub-complanate, and with thinner, less convex leaves, closely imbricated near the summit; whilst in β *minor* the leaves are sub-vertically patent, and from the recurvation of their margins appear narrower and distinct from each other.

Leaves (f. 12, 3) $\frac{1}{12}$″ to $\frac{1}{8}$″ in length, by $\frac{1}{15}$″ to $\frac{1}{10}$″ broad, bifariously imbricated, alternate, horizontally or semi-vertically patent, roundish, obovate, deltoid-ovate, or trapezoid, with a broad obtuse, rounded, or truncate apex, obliquely adnate to the stem, dorsal margin decurrent, entire, strongly reflexed, ventral rounded, decurved, sub-undulate, and like the summit dentate, ciliate-dentate, or rarely entire. With the exception of a saccate spot at the base, the superior aspect of the leaf is decidedly convex.

Texture thin and semi-pellucid, of a fresh pale green to dark olive, sub-lævigate, undulate and reflexed when dry; in β more rigid and deflexed, and of a lighter glaucous yellowish-green.

Cells (f. 12, 7) with distinct, well-defined walls, those of the margin smaller, quadrangular, $\frac{1}{1167}$″ in diameter; cells of the upper third hexagonal, $\frac{1}{875}$″ to $\frac{1}{700}$″ by $\frac{1}{1000}$″ to $\frac{1}{875}$″; basal cells $\frac{1}{440}$″ by $\frac{1}{700}$″.

Trigones (f. 12, 4) inconspicuous. Interior crowded with chlrophyll granules, which are most abundant near the walls.

Teeth unicellular, or composed of 2–3 cells.

Amphigastria generally present, but distant and irregular, best seen at the base of the shoots; minute, subulate, bifid, or digitate.

Dr. Gottsche (G. & R. Hep. Eur. Ex. 320) describes at the base of the terminal leaves of the growing axis, a bundle of minute, jointed, hair-like bodies, resembling the *paraphyses* of mosses, which he considers rudimentary amphigastria, but they resemble more closely the "retort-shaped hairs," which always accompany the ultimate cells of the stem.

Inflorescence normally *dioicous*, but sometimes with the male and fertile shoots springing from the same stolon (*autoicous*).

Fertile shoots (f. 12, 1) erect, rarely exceeding two inches in height. Fructification terminal, central between dichotomous shoots, or sub-lateral.

The var. major is always barren with us, and fructification is confined to the form with *pinnis confertioribus!* (Dill. l. c. t. 69, f. 6.)

I append the capital description of the colesule from Dillenius (*pinnis laxioribus*, t. 69, f. 5, a, b, c), which is applicable to both varieties:—

"E surculorum extremitatibus hyeme folliculos pallidos, satis

magnos exerit, primum cernuos, dein rectos, in summitate apertos et quasi bivalves (e membrana pellucida convoluta formatos) e quibus verno tempore pedunculi enascuntur albicantes pellucidi, longitudine semunciali et unciali, grana gerentes ovata, nigricantia et splendentia, in quatuor lacinias fusco-rufescentes dehiscentia, et pulverem tenuem fundentia" (l. c. p. 482).

Involucral leaves (f. 12, 2) slightly larger than those of the stem, erecto-patent, embracing the base of the colesule; lateral margins often revolute.

Colesule (f. 12, 1, 2) 2 to 3 lines long by a line broad, obconic-oblong, laterally compressed, from a narrow sub-terete base; curved to one side (except during the egress of the capsule), bilabiate, obliquely truncate, ciliate-dentate.

Calyptra (f. 12, 2) pyriform, tipped with a short style, texture delicately reticulate, the base surrounded by numerous barren pistillidia.

Peduncle white, shining, loosely cellular, from one to two inches in length, "inserted into the receptacle by means of a fibrous bulb of an obconical shape, which is with ease drawn out along with the peduncle."—*Hook.* l. c. t. xiii. f. 10. This structure resembles the *vaginula* of mosses, and it is not uncommon to find the calyptra ruptured at its junction with the bulb, and carried up with the growing capsule (f. 12, 2).

Capsule (f. 12, 2) ovate, purplish-brown, lustrous, dividing into four ovate valves.

Spores spherical, reddish-brown, $\frac{1}{1400}''$ to $\frac{1}{1167}''$ in diameter.

Elaters bi-spiral, $\frac{1}{175}''$ to $\frac{1}{117}''$ long by $\frac{1}{2800}''$ to $\frac{1}{2300}''$ broad.

Andrœcium terminal or interrupted, ovate, spicate, either connected with the fertile shoots or distinct.

Perigonial leaves (f. 12, 5) 6 to 8 pairs, erect, closely imbricated in two rows, roundish, very concave, so as to surround and hide the stem, saccate at the base, margins denticulate, reflexed at the apex.

Antheridia (f. 12, 6) in clusters of two to four, axillary, oval, of a greyish-green colour, seated on a jointed slender peduncle nearly as long as the anther.

Obs.—The perigonial leaves, according to Hedwig, fall off when they are no longer wanted to protect the antheridia, "calvus est in caule locus, ubi flos fuerat, nam tegmina antherarum subinde cadunt, vel consumuntur." In this state the shoots have a very bare, rigid, peculiar aspect, bearing at the apex only a few young leaves, and at length developing new shoots from the axils of the old leaves.

The Lichenastrum Asplenii facie pinnis confertioribus (Dill. Musc. p. 483, t. 69, 6), although quoted by Dr. Taylor as a synonym of *Plag. Dillenii*, appears to be only a more slender form of *a major*, depending for its characteristics upon a more exposed and drier habitat than the large barren form so common among the undergrowth of moist woods. In the original figure the shoots are represented as from two to three

inches in length. Indeed, Dillenius seems to have described it as distinct, in deference to preceding botanists, rather than his own convictions. "Simillima (he writes) est hæc præcedenti nec ab ea distinguitur, nisi quod folia densius nascantur, et magis imbricatim invicem imponantur, nervum magis protegentia."

Like most widely-distributed species, *Plagiochila asplenioides* assumes many forms, dependent for the most part upon differences of soil and exposure. But, as stated by Hooker, "these little differences in the leaves are to be found not only upon plants growing in the same patch, but are even to be met with on the same individual, so that I have not thought it proper to retain these even as varieties."

The compact, stunted, glaucous-yellow tufts of *β minor* appear distinct enough on casual examination, but intermediate forms may easily be collected.

My late friend *John Nowell* found near Austwick, W. Yorksh., a very graceful variety, in which the shoots were mostly simple, 2″ to 3″ long by not more than $\frac{1}{10}$″ in diameter, with closely-set, small, semi-horizontal leaves, the fronds bearing a close resemblance to those of *Saccogyna viticulosa;* whereas *Mr. T. Sim* has recently forwarded me from Craigendaroch, Aberdeen, specimens (apparently growing on the bark of trees) scarcely half an inch in height, and with shoots less than half a line broad. These probably belong to the var. *humilis*, Lindg. The leaves are roundish-ovate, entire, or emarginate at the apex, and without any trace of toothing.

I feel doubtful whether Dr. Taylor, under *Plag. Dillenii*, intended to describe the small form of *P. asplenioides* or the variety I have named *δ devexa*, which was collected in the west of Ireland, and appears far more deserving to be considered distinct. It grew in dense cushion-like tufts of a pale olive-yellow colour. Shoots sub-compressed, accrescent, curved at the apex (1½″ by $\frac{1}{10}$″), two or three times innovant-furcate; leaves broad, deltoid-rotund, closely imbricated, erect; dorsal margin oblique, entire, strongly reflexed, ventral decurved, and forming with the bases of the opposite leaves a crest, closely ciliate-dentate. Colesule not much exceeding the involucral leaves in length, compressed, oblong, ciliate at the apex. In the compressed, innovant habit, and decurvation of the leaves, so as to form a crest at the back of the shoots, this form reminds us of some foreign species, e.g. *P. bifaria* or *P. retrospectans.*

Pl. IV. Fig. 12.—*Plagiochila asplenioides.* 1. *Barren and fertile shoots natural size.* 2. *Apex of fertile shoot* × 16, *showing the involucral leaves, colesule, and capsule covered (as rarely happens) by the calyptra.* 3. *Stem-leaf magnified.* 4. *Leaf-cells* × 250. 5. *Perigonial leaf enclosing antheridia.* 6. *Antheridium magnified.* 7. *Part of apex of leaf* × 120.

3. Plagiochila spinulosa, *Dumort.*

Pl. IV. Fig. 14.

Stolons creeping, radiculose; shoots densely tufted, dichotomously ramose; leaves approximate, semi-vertical, erecto-patent, deltoid-ovate to obovate, dorsal margin strongly decurrent, reflexed, entire, apex 2–3-dentate, ventral margin irregularly toothed; colesule urceolate, compressed, bilabiate, ciliate-dentate.

Jungermannia spinulosa, Dicks. Cryp. Fasc. ii. p. 14 (1790); E. Bot. t. 2228; Hook. Br. Jung. p. 9, t. 14; Hüben. Hep. Germ. p. 113; N. ab E. Leberm. Eur. i. p. 157, ii. p. 423; Hook. Br. Fl. v. i. p. 103; Mackay, Fl. Hibern. ii. p. 58, n. 10.

Radula (*Plagiochila*) *spinulosa*, Dumort. Syll. Jung. p. 43, n. 29.
Martinellia spinulosa, G. & B. (Emend.) in Nat. Arr. i. p. 692, n. 8.
Plagiochila spinulosa, Dumort. Rev. Jung. p. 15 (1835); Mont. et Nees in Leberm. Eur. iii. p. 518 (1838); Lindenb. Sp. Hep. p. 6, n. 1, t. i.; G. L. N. Syn. Hep. p. 25; Boul. Musc. p. 770; Cogn. Hep. Belg. p. 25; G. & R. Hep. Eur. Ex. p. 500.
Lichenastrum ramosius foliis trifidis, et
L. pinnulis alternis quasi spinosis, Dill. Musc. p. 489, t. 60, f. 15, 16.

β *punctata*, smaller, densely cæspitose, repeatedly ramose, ultimate branches flagelliform; leaves punctate, loosely imbricated, patent-divergent, roundish-ovate from a contracted less decurrent base, apex and ventral margin spinose-dentate; colesule axillary, obcordate, alate, truncate-bilabiate, alæ distantly toothed, apex densely spinulose.

β* *flagellifera*, most of the branches flagelliferous, intertwined, fastigiate, naked or microphyllous; leaves not much broader than the stems, obovate-cuneate, patent, recurvo-convex, scarcely decurrent, 2–3-dentate; amphigastria frequent.

Plagiochila punctata, Taylor in Lond. J. of Bot. 1844, p. 371 (sub n. 10), et 1846, p. 261; G. L. N. Syn. Hep. p. 626; Dumort. Hep. Eur. p. 45, n. 7; G. & R. Hep. Eur. Ex. n. 211.
Plag. spinulosa β *punctata*, Carr. Irish Cryp. p. 19, t. 2, f. 3 (1863); Mackay, Fl. Hib. p. 58, n. 10.

δ *inermis*, closely tufted, shoots slender, leaves roundish-ovate, obliquely retuse or bidentate at the apex, margins recurved, mostly entire.

Hab. Not unfrequent in sub-alpine districts throughout the British Isles. Rare in the south of England:—Devon, and Rufus-stone, New Forest, 1812, *C. Lyell!* Penzance, *W. Curnow!* Jersey, 1860, *Mrs. McKenzie* ♀*!* Bolton wood ♀ *J. Nowell*, and Ingleboro, rare! Always barren.

β. One of the most abundant species about Killarney and the S. W. of Ireland generally. Cromagloun, *Dr. Taylor*, 1829! Scotland, Bowling, *A. McKinlay!* Snowdon, *G. Davies!*

γ. Glengariffe, Sep. 28, 1869! Galloway, 1843, *R. Spruce* (named "possibly *P. decipiens*"). Head of Mardale, Westmoreland, May 1869, *G. Stabler!*

♂ plants rare, Head of the Upper Lake, Killarney, and Cromagloun, 1861!

Fronds either intermingled with other hepaticæ and mosses, or forming dense cushion-like tufts on rocks, or investing the trunks of trees.

Rhizomatous shoots creeping, entangled, leafless, sub-lignose, of a dirty-brown colour, radiculose on the under side.

Rootlets white, capillary, irregularly distributed, and confined to the creeping stems.

Stems upright or reclinate (f. 14, 1), about the thickness of ordinary sewing-thread, of firm texture, reddish-brown, flexuose, simple or dichotomously branched (f. 14, 2), or emitting irregular innovant shoots from the axils of the terminal leaves. Texture sub-lignose,

composed of elongated thickened cells, in which the cavity is nearly obliterated.

Shoots from one to four inches in length, by $\frac{1}{20}''$ to $\frac{1}{8}''$ in diameter (f. 14, 1, 2), clothed with rather distant or more closely imbricated distichous alternate leaves: in some specimens the leaves are so much decurved as to appear secund. Barren shoots are of nearly equal width throughout, but the ultimate flagellæ are much more slender, and clothed with minute caducous leaves, so that at certain times of the year they appear almost as bare as the stolons.

Leaves (in the larger English form (f. 14, 1, 3, 8)) from $\frac{1}{12}''$ to $\frac{1}{20}''$ in length, broadly-ovate, deltoid-ovate or obovate, rather distant, semi-vertically patent, insertion broad oblique, dorsal margin entire, decurrent for some distance, reflexed, apex obtusely pointed, 2–3-dentate, ventral margin irregularly dentate, strongly recurved.

In β *punctata* (f. 14, 2) the leaves are more variable in size and shape, those of the main shoots (f. 14, 5) broadly-ovate, very convex, boldly decurrent, patent-divergent, or sub-secund, and fringed with closer and more rigid spinose teeth.

On the ultimate flagellæ the leaves are not much broader than the stem, sub-vertically patent, cuneiform, 2–3-dentate, the base narrow and scarcely decurrent.

In δ *inermis* the leaves are roundish-ovate, truncate or unequally bidentate, with short segments and obtuse sinus, margins reflexed, and for the most part entire, although, on careful examination, one or two irregular teeth may generally be found at the base of the older ones.

Amphigastria usually present, but distant and irregular, except on the innovations, minute, deeply 2–3-fid.

Texture firm, little altered when dry, in α pale yellowish-green, sub-pellucid, in β more rigid, of a warmer olive-brown tint, and punctate-reticulose.

Areolation "dotted or guttate" (f. 14, 1, 5), trigones large, conspicuous, so that under a low power the true cells appear to be surrounded by a border of smaller ones, and the leaf must be prepared before the true outlines are developed.

Marginal cells smaller, sub-quadrate, $\frac{1}{875}''$ by $\frac{1}{1167}''$; in the lower part of the leaf (f. 14, 11) hexagonal, $\frac{1}{583}''$ to $\frac{1}{467}''$ by $\frac{1}{1167}''$.

Those of the spines are from $\frac{1}{700}''$ to $\frac{1}{1400}''$ long by $\frac{1}{1167}''$ to $\frac{1}{1400}''$ broad. *Trigones* about $\frac{1}{1750}''$ in diameter.

The cells of *Plag. spinulosa* differ in no respect from those of *P. punctata*, Tayl., except that the latter are filled with a more abundant golden-brown chlorophyll, so that the interior is more distinctly defined, and the leaf appears 'dotted.'

This kind of tissue, 'textura porosa,' resembles under the mi-

croscope distant hollow cells, surrounded by an ill-defined border. "On boiling the leaf for a few moments in weak liquor potassæ, and then staining with a drop of zinc biniodide, the true form of the cell is displayed, and its different membranes defined (f. 14, 11). Externally is the translucent hexangular wall, 'membrana primaria,' at each of the corners of which we observe a triangular clear space, 'trigonum interstitiale' of authors; within that the contracted six-angled 'membrana secundaria,' containing the protoplasm, and coloured violet by the solution (*vide* f. 31, 7): this again includes the 'nucleus,' generally yellow-coloured,—the 'primordial utricle' of Mohl."—(*Irish Cryp.* p. 19, t. ii. 3.)

Inflorescence dioicous.

Fertile shoots accrescent. *Involucral leaves* (f. 14, 1, 4) terminal, but soon superimposed by proliferous ramuli, larger but not differing in shape from the ordinary leaves, erecto-patent, margins revolute, densely spinose-dentate.

Colesule (f. 14, 1, 9) laterally compressed from a ventricose base, urceolate, about $\frac{1}{10}''$ long, bilabiate, the lips rounded, ciliate-dentate, enclosing 10 to 15 *pistillidia*, which are flask-shaped or linear (f. 14, 10), "of a greyish colour, with longitudinal reddish streaks," but always barren.

In β *punctata* the colesule is shorter, inversely heart-shaped, distinctly alate, and fringed with longer and more closely-set spines.

Male shoots distinct, more slender ($\frac{1}{20}''$), irregularly fasciculate, with distant secund bidentate leaves, the ventral margin beset with fewer (2–3) teeth.

Andrœcium (f. 13, 6) terminal or interrupted, ovate-lanceolate, spicate, not unfrequently flagelliferous at the apex.

Perigonial leaves (f. 13, 7) 6–12 pairs, closely imbricated, erect, compressed, broadly ovate, saccate at the base, dorsal margin incumbent, slightly reflexed, entire, apex acute or bi-dentate, ventral margin irregularly denticulate, recurved.

Antheridia in groups of 2 or 3 (f. 13, 7), oval, greyish-green, seated on a slender stipes.

Obs.—The enlarged figure in *British Jung.* (t. xiv. f. 3) represents an attenuate and abnormal condition of the species, with narrow distant leaves, apparently dentate at the apex only (from the recurvation of the leaves it is difficult to show the ventral toothing), and with the colesules (five of which are shown on one shoot), comparatively larger and more naked than usual. Dr. Gottsche suggests that the figure may represent a new species, but I have examined from the herbarium of the late *C. Lyell, Esq.*;*

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* These specimens were most likely sent by Miss Hutchins from Bantry, who first discovered the barren calyces. "The greater part of these were old and entirely empty; others had barren pistilla, but none had the fructification further advanced."—*Hooker, l. c.*

a slender variety of *P. spinulosa*, the shoots of which had evidently grown amongst dense herbage, and formed probably part of the tuft communicated to Hooker. In this form the leaves are narrower, more distant, and irregularly denticulate; and some ot the colesules (especially near the base) appear naked from the decay of the involucral bracts.

It is a curious circumstance that fructification has never been met with, although in the south of Ireland ♂ and ♀ plants are not unfrequently found together. Probably, if looked for at an earlier period of the year, the capsules would be found; but few skilled botanists visit the likeliest spots until later in the season.

Those who have formed their opinion of the species from English specimens only, can form no idea of the variety and luxuriance of its development in the Killarney woods. There, within a few feet of each other, it is possible to collect not only the forms I have attempted to describe, but numberless others. Like most plants propagated by flagellæ or gemmæ, the species is subject to much variation. Some of the minute, microphyllous forms are especially puzzling. Looking at the diversities which undoubtedly occur in the same species, it is impossible to receive without donbt many of the exotic species formed from single or barren specimens only.

P. punctata, Taylor, appears to me to be the typical form, in which the leaves are more crowded, of firmer texture, more distinctly spinose, and filled with chlorophyll, so as to appear punctate under the lens.

Pl. IV. Fig. 14. *P. spinulosa.* 1. *Portion of var. α* × 8. 2. *Terminal shoot of β* × 16, *inferior aspect.* 3, 8. *Stem-leaves* × 16. 4. *Leaf from β, showing the punctate areolæ.* 5. *Involucral leaf.* 6. *Apex of ♂ shoot.* 7. *Perigonial leaves enclosing antheridia.* 9. *Colesule.* 10. *Pistillidium (barren).* 11. *Leaf-cells* × 250.

N.B.—The line separating the middle from the lower right-hand figures should have been left out.

4. Plagiochila tridenticulata, *Taylor.*

Plate III. Fig. 10.

Stolons creeping, rigid, radiculose; shoots loosely tufted, ascending, irregularly branched; leaves rather distant, alternate, obliquely patent-divergent, cuneate-obovate; margins entire, apex deeply bi–tri-fid, segments acute, divergent; male spikes ovate; fructification ?

Jung. spinulosa β tridenticulata, Hook. Jung. p. 9, t. xiv. ff. 9, 10 (exclus. syn. J. tridenticulata, Mich.); H. British Flora, ii. p. 108; Lindenb. Hep. Eur. p. 78, n. 73; Mackay, Fl. Hib. ii. p. 58, n. 10, v. *minuta.*

Radula corniculata, Dumort. Syll. Jung. p. 15.

Plag. spinulosa β, Lindenb. Spec. Hep. Plag. p. 6 et p. 154, t. i. f. 7, 8.

Plag. tridenticulata, Dumort. Rev. Jung. p. 15 (1835); Taylor in G. L. N. Syn. Hep. p. 26 (1844); Carr. Irish Cryp. Tr. Ed. Bot. s. vii. p. 446, t. xi. f. 5; Dum. Hep. Eur. p. 45, n. 6 (1874); G. & R. Hep. Eur. Ex. n. 212.

Martinellia spinulosa β tridenticulata, Gr. Nat. Arr. i. p. 692, n. 8.

J. spinulosa γ foliis minutis apice bidentatis*, C. Lyell.

Hab. Mountains near Bantry, *Miss Hutchins* and *Mackay!* Scotland, *W. Wilson!* Kenswick, *C. Lyell*, 1812! Torc Cascade and Upper Lake, Killarney, &c., 1861; Glengariffe, Sept. 1869! Brandon Mountain, *Dr. Moore!* Aberwater, and Dolgelly, N. Wales, *W. Wilson.*

Fronds (f. 10, 1) either creeping loosely among the tufts of *Frullania*, *Radula*, &c., or forming dense fasciculate patches of a dark indigo-green colour.

Stems about the thickness of horse-hair, of a purplish-black colour when mature, paler when young, rigid, polished, flexuose, brittle when dry, erect or reclinate.

Rootlets few, distant, white, confined to the creeping stems.

Shoots (f. 10, 2) $\frac{1}{2}''$ to 1″, rarely 2″ in length, rigid, recurved at the apex, very slender, from $\frac{1}{25}''$ to $\frac{1}{30}''$ in diameter, branches alternate, divaricate, recurved at the apex, of nearly uniform size throughout, sometimes attenuate.

Leaves (f. 10, 3, 4) distant, alternate, distichous, sub-vertically patent, obovate or cuneate, from a contracted scarcely decurrent base; dorsal margin entire, apex bi-dentate, the segments acute, unequal and divergent, sinus acute but shallow, ventral margin reflexed, either entire or unidentate near the summit. From the recurvation of the upper half of the leaf the foliage appears at right angles with the stem, or squarrose; the terminal leaves only are erect.

Texture firm, rigid, sub-opaque; *colour* dark olive or indigo-green, appearing nearly black when dry. From the narrow insertion of the leaves they are readily detached when dry, but less so than in the following species.

Amphigastria (f. 10, 8) generally present, minute, distant, recurved, bi-dentate.

Cells (f. 10, 3, 7) distinct without preparation, roundish, containing numerous chlorophyll corpuscles, thickened somewhat at the angles.

Marginal cells $\frac{1}{1167}''$ by $\frac{1}{1000}''$; those of the upper third $\frac{1}{875}''$ to $\frac{1}{778}''$; basal cells $\frac{1}{700}''$ to $\frac{1}{580}''$ by $\frac{1}{1167}''$.

Trigones $\frac{1}{4660}''$ in diameter.

Andrœcium spicate, ovate (f. 10, 2).

Perigonial leaves (f. 10, 5) 3 to 6 pairs, larger than those of the stem, closely imbricated, saccate at the base and concealing the stem, ovate, multi-dentate.

Antheridia 1 or 2, roundish, pale olive-yellow, shortly stipitate.

Obs.—*Plag. tridenticulata* appears to have been looked upon by Hooker and Lindenberg as the male plant of *P. spinulosa*, until Dr. Taylor discovered the perigonial shoots of the latter, and pointed out the differences between them. The species, indeed, is a very distinct one, but hitherto only male and barren fronds have been met with.

Setting aside the much smaller size and distant cuneiform divergent leaves, the shape of the andrœcium is very characteristic, forming in *P. tridenticulata* short tumid, ovate spikes of few leaves, wider than the ordinary ones, and nearly always terminal; whilst in *P. spinulosa* the perigonial leaves are more numerous, laterally compressed, and forming a narrower lanceolate spike, beyond which the stem is often continued in a proliferous manner.

Pl. III. Fig. 10.—P. tridenticulata. 1. *Shoots natural size.* 2. *Upper portion of ♂ shoot* × 20. 3, 3, 4. *Stem-leaves.* 5. 5. *Perigonial leaves.* 6. *Antheridium.* 7. *Leaf-cells* × 250. 8. *Amphigastria.*

5. Plagiochila exigua, *Taylor.*

Pl. IV. Fig. 13.

Stolons filiform, serpentine, decumbent; shoots laxly cæspitose, ascending; leaves few, erecto-patent, distant, ovate-cuneate, plane, from a contracted base; apex bidentate, the segments and sinus rather acute.

Jungermannia exigua, Tayl. in Trans. Bot. Soc. Ed. i. p. 179.
Plagiochila exigua, Tayl. in Lond. Jour. Bot. v. p. 264, n. 14 (1846); G. L. N. Syn. Hepat. p. 659; Dumort. Hep. Eur. p. 46, n. 8 (1874).

Hab.—Epiphytic on tufts of *Frullania*, *Radula*, &c.; on wet rocks, Knockavohila and Dunkerron, *Dr. S. Taylor*, 1840! Torc mountain on *F. Tamarisci*, Sep. 1841, *Dr. Taylor.* Killarney, 1861! Cromagloun, 1865, *Dr. Moore.* Glengariffe, Sep. 1869!

Fronds (f. 13, 1) forming minute scattered or more dense tufts, creeping over the surface of *Frullania*, &c., and resembling in size *Jung. turbinata*, or *J. cuneifolia.*

Primary stems creeping, filiform, flexuose, about the thickness of human hair, pale olive or brown, and composed of lax, rectilinear cellules.

Rootlets (f. 13, 2) short, translucent, produced in a fasciculate manner at intervals from the underside of the creeping stems, and sometimes from the amphigastria of the ascending shoots.

Shoots very minute, scattered, simple, declinate or ascending, 2 to 3 lines in length, by $\frac{1}{40}''$ in diameter, naked at the base, the apex compressed and recurved.

Leaves (f. 13, 3) few, distantly placed, alternate, erecto-patent, sub-vertical, from a very narrow attachment, roundish-ovate, obovate or cuneate; dorsal margin slightly reflexed; apex bidentate, the sinus acute but shallow (equal to $\frac{1}{4}$th of the length), lobes acute, slightly divergent, upper surface plane.

Texture tender, laxly reticulate, pellucid, on which account, and because of the narrow insertion, the leaves are easily detached, so that in the dry state only a few of the terminal ones are found adherent, which are compressed and secund (f. 13, 6). Colour pale green or olive.

Amphigastria (f. 13, 6, 7) generally present, minute, subulate, and toothed on one side, or acutely bidentate.

Leaf-cells (f. 13, 4, 5) large for the size of the plant, hexagonal, with thick prominent walls, but destitute of angular thickenings. Marginal cells slightly flattened, $\frac{1}{1617}'' \times \frac{1}{1750}''$; those of the upper third $\frac{1}{875}''$ to $\frac{1}{700}''$ by $\frac{1}{1167}''$; basal cells $\frac{1}{700}''$ to $\frac{1}{500}'' \times \frac{1}{1750}''$.

Obs.—No trace of either male or fertile fructification has been found on this plant. Whether, therefore, it should be associated with the present genus, or deserves to be looked upon as generically distinct, is still questionable.

The specimens which have come under my examination have been very meagre, and when mingled with *P. tridenticulata*, which is not unfrequently found associated with it, creeping among the fronds of *Frullania*, &c., it is no easy matter to discriminate between the two.

In the creeping habit, size, and the form of its leaves, it approaches *J. cuneifolia*, another rare Irish species, the position of which is doubtful, from the absence either of ♂ or ♀ inflorescence.

Pl. IV. Fig. 13.—P. exigua. 1. *Natural size.* 2. *Shoot* × 20. 3, 3. *Stem-leaves.* 4, 5. *The same showing cell-structure.* 6. *Apex of shoot and terminal amphigastria.* 7. *Amphigastria.*

IX. Mylia, *Gr. & B.*, emend.

Pl. IX. Figs. 29, 30.

Jungermannia, Hook. Brit. Jung. p. 15, nn. 46 and 47, tt. 24 et 57 (1816).
Mylius, Gr. & B. in Gray's Nat. Arr. i. p. 690 (1821).
Aplozia, Dumort. Syll. Jung. p. 48 (1831).
Leptoscyphus, Mitt. in Hook. Lond. Jour. of Bot. iii. p. 358 (1851).
Leioscyphus, Mitt. in Hook. Fl. Nov. Zeal. ii. p. 134 (1855).
Coleochila, Dumort. Hep. Eur. p. 105 (1874).

Dioicous. Colesule terminal (or from the growth of innovations axillary), ovate-oblong, laterally compressed from a subterete base; apex contracted, truncate, at length bilabiate, denticulate.

Involucral bracts two, patent from a clasping base; bracteole lanceolate, unidentate, free.

Capsule ovate, coriaceous, quadrivalved.

Elaters deciduous, bispiral.

Perigonial leaves usually narrower, ventricose, clustered near the apex of distinct shoots. Antheridia two, roundish.

Plants forming dense tufts in alpine bogs, or more thinly scattered and clinging to the stems of Sphagnum. Shoots simple or innovant below the apex, erect or creeping, tomentose beneath. Leaves succubous, bifariously imbricated, alternate, semi-vertical, either circular or ovate and pointed. Amphigastria subulate, obscured by the rootlets, except at the apex of the shoots.

Etym. *Mylius*, the name of a botanist mentioned in the *Nova Genera* Michelii (1729).

Obs.—In *Mylia* we find the compressed colesule of *Plagiochila*, associated with the general habit of *Jungermannia*.

Under *Leioscyphus* Mitten has grouped together plants differing widely in character. I have been favoured by Dr. Spruce (14th July, 1874) with the subjoined synopsis of species in which the colesule is compressed, wide-mouthed, truncate, and more or less bilabiate :—

* Leaves opposite (connate at the base).
Stipules none, or entire : Bracts adnate to the perianth = *Southbya*, Spr.
Stipules bifid : Bracts free = *Leioscyphus*, Mitt.
** Leaves alternate.
Stipules entire : Bracts free = *Mylia*, Gr. & B.

From which it will be seen that *Southbya* is restricted to those species in which the leaves are opposite ("inter se et cum amphigastriis coalitis"), and the colesule compressed laterally, and adnate with the involucral bracts. No British specimen agrees with this diagnosis, but three European species are recorded by Lindberg,—*S. stillicidorum* (Raddi), Lindb. ; *S. tophacea*, Spruce ; and *S. fennica*, Lindb. *Nardia obovata* and *N. hyalina* are placed by Professor Lindberg in the section *Eucalyx*, under *Southbya*.

On consulting the latest work of the celebrated Dumortier (Hepaticæ Europæ, 1874), presented to the Belgic Academy of Sciences on the fiftieth anniversary of the publication of his Commentationes Botanicæ (1822), and which may be looked upon as a revised edition of the Sylloge Jungermannidearum (1831), I was sorry to find that he altogether ignores the classification of Gray and Bennett (1821), because the nomenclature is "barbaric," many of the generic names derived from persons having a masculine instead of feminine terminology. "Nomenclatura Grayi" (he writes) "ad normam regni animalis, nec plantarum est confecta, contra botanices regulam, et igitur postponenda." I have elsewhere (Trans. Ed. Bot. Soc. vol. x. 2, p. 305–9 (1870). stated my views on this question. Gray's arrangement had the misfortune to be in advance of its time ; it was the earliest attempt to introduce the Natural System to English botanists, and partly from the suspicion which always clings to new methods, but chiefly from the inveterate animosity called forth by anything French at that period, the disciples of Linnæus were powerful enough to discredit, and effectually "damn" one of the best handbooks ever produced.

I confess, therefore, to a feeling of disappointment that an author so tenacious of the claims of priority as far as they affect his own works, and bitterly conscious (and not without reason) of the sins of omission and commission committed against himself, should refuse to render the scant justice now within our power to Gray and his fellow-workers. Moreover, if the slight rectification I have ventured to make in their nomenclature robs them of their vested right to priority, at least in the preseut instance my emendation, published in 1870, might have been respected, since *Millia*, Lin., could never be mistaken for *Mylia*. Lastly, the genus *Coleochila* of Dumortier is not identical with *Mylia*, since it is described with the "perichætium oligophyllum, phyllis basi connatis," and the leaves "estipulatæ," whilst the figure (Pl. III. f. 26) represents the bracts as joined together for half their length, and the colesule tubulose, and cleft for about a third of the way down. Indifferent as the figures generally are, it is to be presumed they were intended to represent living specimens. What the author may have had before him when the drawing of *Coleochila* was made, I am unable to say ; but since *Southbya stillicidorum* is quoted, it may be meant for that species, certainly not *M. Taylori*. *Jung. cuneifolia* is also placed in this genus, although differing *toto cœlo* in character.

1. Mylia Taylori, *Gr. & B.*, emend.

Sub-sp. A, *Taylori.* Shoots densely cæspitose, erect, innovant; leaves orbicular, coriaceous, horizontally patent-reflexed from a saccate base; colesule ovate, as long again as the roundish involucral bracts.

Jungermannia Taylori, Hook. Brit. Jung. t. 57 (1818); Eng. Bot. Sup. t. 2691 (1831); Hook. Eng. Fl. v. i. p. 116, n. 42; Mackay, Fl. Hibern. ii. p. 63, n. 47; Spreg. Syst. Veg. iv. p. 221; Lindenb. Syn. Hep. p. 26; Dumort. Syll. Jung. p. 48; Hüben. Hep. Germ. p. 75; N. ab E. Leberm. Eur. i. p. 299; G. L. N. Syn. Hep. p. 82; Hartm. Skand. Fl. x. ed. ii. p. 133; Hüben. & Genth, Exs. n. 33; Raben. Hep. Eur. Ex. n. 14, 112, *a* et *β*; Cogn. Hep. Belg. p. 26.

Mylius Taylori, G. & B. in Nat. Arr. Br. Pl. i. p. 693 (1821).

Leptoscyphus Taylori, Mitt. in Hook. Jour. iii. p. 358 (1851).

Leioscyphus, Mitt. Fl. Nov. Zeal. ii. p. 134 (1855).

Coleochila Taylori, Dumort. Hep. Eur. p. 105 (1874).

Hab.—Moist rocks and boggy places in alpine districts, forming extensive patches, of a purplish-brown colour. Wicklow mountains, *Dr. Taylor.* Near Bantry, *Miss Hutchins.* Ambleside and Patterdale, *C. Lyell!* Summit of Ingleburgh, 1857! Cairn Gorum range, *Sir W. Hooker.* Sutherland mountains, *Dr. Greville!* Snowdon!

Fruit very rare. Spring. Ben-na-Board and Glen Dole, Forfar, *A. Croall!* Ayton Moor, Yorkshire, *W. Mudd!*

It occurs in similar situations throughout the North of Europe—Sweden, Finland, Germany, and Switzerland, and in North America.

Sub-sp. B, *Anomala.* Shoots scattered, creeping, mostly simple; leaves rather distant, sub-secund, diversiform, roundish ovate, obtuse to ovate-acuminate, concave; texture thinner; colesule ovate-oblong, thrice the length of the involucral bracts, which are ovate.

Jungermannia anomala, Hook. Brit. Jung. t. 34; Eng. Bot. t. 2518; Lindenb. Syn. Hep. p. 24; Dumort. Syll. Jung. p. 48; Hüben. Hep. Germ. p. 73; Hook. Eng. Fl. v. ii. p. 116, n. 41; Sommf. Cryp. Norv. n. 37, et Sup. Fl. Lapp. p. 72; Fl. Danica, t. 1895; Jensen. Cons. Hep. Dan. p. 127; Hartm. Skand. Fl. x. ed. ii. p. 134.

Jung. Taylori, var. *anomala*, N. ab Es. Leberm. Eur. ii. p. 455; G. L. N. Syn. Hep. p. 82; Rab. Hep. Eur. Exs. nn. 113, 236, 414, 415.

Mylia anomala, G. & B. emend. in Nat. Arr. i. p. 693; Carring. in Tr. Bot. Soc. Ed. x. p. 309; Lindb. Manip. Musc. Prim. et Acta Soc. Sc. Fennicæ, x. p. 237 (1872).

Leptoscyphus anomalus, Mitt. l. cit. Lindb. Revis. Crit. Fl. Dan. t. 1895, p. 40 (1871).

Coleochila anomala, Dumort. Hep. Eur. p. 106 (1874).

Jung. lanceolata, Mart. Fl. Erl. p. 182, t. vi. f. 57.

J. Sphagni, Wahl. Fl. Lapp. p. 717.

Hab.—Forming scattered tufts, of a green or ochraceous colour, creeping among and clinging to the fronds of Sphagnum, &c. Frequent in boggy places and turbaries throughout the British Isles. Shoots mostly barren, or gemmiparous.

First detected by the *Rev. R. B. Francis* on Holt Moss, Norfolk.

The fertile state was unknown to *Hooker*, although plants with immature calyces were sent to him from Ambleside, 1813, *C. Lyell!* The late *W. Wilson, Esq.*, found it in fruit at Wybenbury Bog, Cheshire, July 1863!

Obs.—*Sir W. Hooker*, who first published *J. anomala* and *J. Taylori* as distinct species, states that the principal difference between them "consists in the ovate and acute leaves of the former, which are wholly wanting in the latter: other marks, although much less to be depended upon, may be found in the densely crowded patches in which I have always seen *J. Taylori* grow, so that the individuals are forced into a nearly erect position, and in the colour, which in all the specimens which have fallen under my observation, has been far deeper, and generally with a purplish tinge throughout." *C. Lyell, Esq.*, in a letter dated Ambleside, July 1813, also states:—"Here and everywhere else it [*J. anomala*] retains the characters assigned to it, and no one finds any difficulty in distinguishing it from *J. Taylori*. I think the leaves are more thin and membranous, and that the cellules are larger when compared with the size of the leaf." It will be better, however, to examine the forms in detail.

Sub-Sp. Taylori.

Pl. IX. Fig. 30.

Stems (f. 30, 1) densely cæspitose, ascending or erect, flexuose, stout, herbaceous, brownish at the base, green or purple near the summit, tomentose on the under side.

Rootlets proceeding from the bases of the leaves and amphigastria throughout the length of the stem, long, capillary, translucent or of a flaxen colour; sometimes, as mentioned by Lyell, "termined by a minute bulb or vesicle."

Shoots (f. 30, 1, 2) 2″ to 4″ or more in length, by $\frac{1}{10}$″ in diameter, gradually increasing in size towards the apex, simple, or innovant from the ventral aspect, or the axils of the involucral bracts (f. 30, 6).

Leaves (f. 30, 2, 3) bifariously imbricated, alternate, orbiculate to obovate, $\frac{1}{15}$″ to $\frac{1}{12}$″ in diameter, horizontally patent, rarely secund, the base obliquely amplexicaul, saccate, shortly decurrent, upper portion convex; margin entire, sub-undulate, apex slightly recurved. Upper leaves crowded together so as to form a rosulate tuft.

Amphigastria (f. 30, 5) subulate, mostly entire, from the dense rootlets distinguishable only near the summit of the shoots.

Texture thick, sub-carnose, when dry cartilaginous, repand.

Colour ferruginous, of a deeper purplish-brown near the summit, rarely green; lower leaves dirty-brown.

Mr. Lyell observes that "this species has an agreeable odour, resembling that arising from the flowers of the heath."

Areolation grossly reticulate, dotted; from the large size of the trigones, "the cells present a curiously-punctated appearance, observable even to the naked eye" (f. 30, 4, dextral figure).

Marginal cells longer than broad, $\frac{1}{580}''$ by $\frac{1}{880}''$, forming a distinct border. Near the upper third the cells are about $\frac{1}{500}''$ each way, polygonal. Basal cells $\frac{1}{350}''$ by $\frac{1}{600}''$ or $\frac{1}{500}''$. Trigones (f. 30, 4) $\frac{1}{1750}''$, large, so as almost to touch each other. The cells contain numerous greenish granules. When prepared with the zinc solution, the appearance of the leaf is very beautiful (f. 4, left hand). The cells are divided by a translucent line passing through the trigones, and the contents (except the yellowish nucleus) are stained of a fine purple colour. The cuticle, especially on the outside of the leaves, is covered with obtuse papillæ.

Inflorescence dioicous. Fructification terminal, but from the growth of innovations at the base of the colesule (f. 30, 6), which rapidly elongate, it not unfrequently appears lateral.

Involucral bracts (f. 30, 6) two, distinct, orbiculate, larger than the ordinary leaves with which they otherwise agree, basal portion clasping, apex recurved, undulate. *Bracteole* ovate-lanceolate, bifid on one side near the base.

Colesule (f. 30, 7) ovate, twice as long as broad ($\frac{1}{8}''$), apex truncate, laterally compressed, regularly denticulate, curved to one side. On section near the upper third the angles are rounded (f. 8, *a*, *b*), whilst the base is sub-terete. After the egress of the capsule, the mouth is frequently cleft, so as to appear bilabiate. In texture and colour it agrees with the ordinary leaves, except that the cells are more oblong.

Capsule (f. 30, 2) ovate-rotund, dark brown, longitudinally striate, cleft into four ovate, coriaceous valves.

Pedicel an inch or more in length, white, succulent.

Spores dark brown, spherical, $\frac{1}{1170}''$ in diameter.

Elaters bispiral, $\frac{1}{100}''$ long, by $\frac{1}{1750}''$ broad.

Perigonial leaves forming sub-terminal or interrupted spikes, more crowded, and tumid at the base, than the ordinary leaves.

Antheridia normally two, spherical, stipes slender jointed.

Sir W. Hooker states that "upon the leaves of this species a small black tuberculated fungus is frequently present," such as was previously described as infesting *Nardia scalaris*. The borders of the leaves, near the apex of the shoots, are sometimes beset with gemmiferous cells, either detached, or aggregated into spherical masses, and which resemble the leaves in colour.

Sub-Sp. Anomala.

Pl. IX. Fig. 29.

Tufts loosely entangled, creeping over the surface of peat-mosses, or thinly scattered amongst the fronds of Sphagnum.

Shoots (f. 29, 2) more slender, flexuose, succulent, mostly simple, clothed with dense white radicles on the under side.

Leaves more distant, sub-secund, or near the summit patent-divergent. In form they vary from circular (f. 29, 3) to ovate-obtuse, or ovate-acuminate (f. 29, 2). "The orbicular leaves are in almost every instance concave on the upper surface, and convex beneath; those of the second description are likewise slightly concave; whilst those which are ovate and acute are either plane, slightly concave, or have their sides incurved" (*Hook.* l. c. t. xxxiv.). The rounded leaves are generally found near the base of the shoots, whilst the acute ones, whether plane or complicate, are confined to the extremity, and are more distant and divergent. *Hooker* also states that, "at the extreme apex" (f. 29, 1) "three or four leaves (before their expansion) often embrace each other so closely as to form an oblong acute mass, which may, without due examination, be readily mistaken for a calyx." The base of the leaves is less decurrent and sheathing, and the margins normally entire, but from the growth of proliferous cells often jagged and erose.

Amphigastria always present, broadly subulate, readily overlooked from the surrounding radicles.

Texture of the leaves thinner and more pellucid than in *M. Taylori*. Colour pale green, ochraceous, tinged with reddish-brown towards the summit.

Cells (f. 29, 5) remarkably large and translucent, from hexagonal to oblong, with thinner walls, and less developed trigones.

Marginal cells sub-quadrate, $\frac{1}{440}''$ in diameter. Those near the centre of the leaf $\frac{1}{600}''$ by $\frac{1}{400}''$. Basal cells arranged in linear series, oblong, $\frac{1}{350}''$ to $\frac{1}{230}''$ long, by $\frac{1}{500}''$ broad. Trigones not confined to the angles of the cells. In the upper cells a single intermediate incrassation is met with, but in the lower ones, two, or even three, conical thickenings of the wall are found, smaller than and interposed between the regular trigones. The cells, when fresh, contain numerous greenish chlorophyll granules, and three to six lenticular granular bodies (f. 29, 3), such as were described under *Nardia*. Treated with the iodide of zinc solution, the cells are stained of a uniform deep purple, with the exception of the clear margin and trigones. Cuticle smooth, free from papillæ.

Involucral bracts roundish-ovate, patent from a vaginate base, not at all connate. *Bracteole* lanceolate, patent, bearing a shorter acute segment near the lower third.

Colesule narrower, linear-ovate (three or even four times longer than broad, $\frac{1}{8}'' \times \frac{1}{25}''$), mouth truncate, twisted to one side, minutely denticulate, the teeth composed of 3 or 4 cells, the apical one rounded.

Capsule ovate, with thick walls, seated on a short pedicel.

Spores fulvous, $\frac{1}{1170}''$ in diameter. *Elaters* about $\frac{1}{3500}''$ wide, by $\frac{1}{175}''$ to $\frac{1}{140}''$ long.

Male spikes frequent, mostly terminal.

Perigonial leaves (f. 29, 1, 2) ovate-acute, boat-shaped, erecto-patent, more rarely orbiculate, with the base ventricose.

Antheridia geminate, spherical, shortly stipitate, greyish-green.

Gemmæ, of a pale-green or yellowish colour, abundant, especially in the spring and autumn, forming roundish balls on the terminal leaves, and more distantly scattered over the margins of the lower ones. In form the cells are oval (f. 29, 4) or angular, either simple or 2–3-septate. When detached, the border of the infested leaf appears erose-dentate.

To the *Rev. R. B. Francis* belongs the honour of first detecting the distinctive characters of *M. anomala*, although *Dillenius* must have been acquainted with it, since a shoot is figured in the *Hist. Musc.*, Pl. 69, fig. 1, I., along with *Nardia compressa*, &c., which sometimes grows along with it, but may be distinguished by the compressed sub-reniform leaves, the absence of radicles on the stems, and the different structure of the involucre.

Although abundant on the Continent, it was long confounded with *Jung. lanceolata*, as in Mart. Fl. Erl. t. 6, f. 57; but in that species the leaves are horizontally disposed, amphigastria are wanting, and the colesule is cylindrical throughout, the mouth being curiously contracted and umbilicate.

In many respects *J. Schraderi* is a still nearer ally, but differs in its smaller size, the uniformly ovate, sub-secund leaves, more delicate and minute areolæ, and cylindrical colesule. In specimens of this rare species, recently collected at Barrow Field, Westmoreland, some of the colesules appeared compressed at the summit, and I was doubtful whether to include *J. Schraderi* under *Mylia*; but my friend *Mr. G. Stabler* informs me that in a recent state they are always cylindrical.

By the exercise of a little care, there can be no difficulty in discriminating between *M. Taylori* and other round-leaved species. The purple variety of *Nardia* (*Eucalyx*) *hyalina* seldom exceeds an inch in height, and the rootlets are purple, not white.

Professor Lindberg has recently published a remarkable addition to this genus, the *Mylia verrucosa*, Lindb. (Musci Sachalin, 1872), in which the leaves are densely verruculose, and the lower half of the colesule clothed with conical hairs, not unlike those of *Lophocolea muricata*, N. ab E.

Pl. IX. Fig. 29.—Mylia anomala. 1. *Apex of shoot, with perigonial leaves.* 2. *Shoot in which the leaves are more obtuse* × 8. 3. *Leaf from the lower portion of the stem.* 4. *Part of the apex of a leaf, showing the gemmæ.* 5. *Leaf-cells* × 250, *showing the lenticular granular bodies.* (*The two latter figures are copied from a drawing by Dr. Gottsche.*)

Fig. 30.—M. Taylori. 1. *Shoots natural size.* 2. *Apex of fertile shoot* × 8. 3. *Sub-involucral leaf* × 16. 4. *Leaf-cells, left-hand figure* × 250. 5. *Amphigastria.* 6. *Involucral leaves and colesule—on one side the innovant bud is seen.* 7. *Colesule* × 16. 8. *Section of colesule*—a *from upper third*, b *from lower third* (*after Gottsche*).

X. SCAPANIA, *Dumort.*

Jungermanniæ sp. Lin. Sp. Pl. I. ed. ii. p. 1132 (1753).
Richardsonieæ sp. (haud *L. et Kunth*) Neck. Elem. Bot. iii. p. 337 (1790).
Candolleæ sp. Raddi (nec. *Labill.* 1805) Jung. Etr. in Mem. Soc. Moden. p. 22 (1820).
Martinellii sp. Gray, Nat. Arr. Brit. Pl. i. p. 690 (1821).
Radulæ sp. Dumort. Comm. Bot. p. 112 (1822); Sect. 2, *Scapania*, Dumort. Syll. Jung. Eur. p. 38, t. 1, f. 6 (1831).
Scapania, Dumort. Rev. des Jung. p. 14 (1835); Montagne in Voy. Astrolab. t. 16 (1842); Lindenb. in G. L. N. Syn. Hep. p. 61 (1844).
Plagiochila, Sec. 2, *Scapania*, N. ab Es. in Lindl. Intr. Nat. Syst. Bot. 2nd ed. p. 414 (1835); et Naturg. Eur. Leberm. iii. p. 518 (1838).

Dioicous. Colesule terminal, smooth, obovate, compressed from before backwards, from a contracted ventricose base; mouth truncate, bilabiate, entire or toothed, decurved.

Involucral bracts two, free, resembling the ordinary leaves, but more equally lobed.

Capsule ovate, of thick texture, cleft to the base into four equal valves.

Elaters attached to the centre of the valves, long, bispiral.

Androecium terminal or interrupted. Perigonial leaves smaller, ventricose at the base, the lobes shorter and nearly equal.

Antheridia (3–12) axillary, oval, seated on a slender pedicel.

Plants growing in woods, on moist rocks, or boggy places.

Tufts conspicuous. Primary shoots creeping, perennial, naked, rhizomatous, entangled. Secondary shoots foliose, ascending, decurved at the apex, simple or dichotomously branched.

Leaves disticho-declinate, alternate, conduplicate, unequally bilobed; inferior lobe larger, convex, superior (lobule), incumbent: margins entire, dentate or ciliate.

Amphigastria wanting.

Etym.—From Σκαπανίον, *a shovel*, alluding to the form of the colesule.

OBS.—I have already, under Plagiochila (p. 52), stated my reasons for retaining Dumortier's nomenclature, rather than that of Gray.

The credit of first proposing *Scapania* as a distinct genus has generally been assigned to Lindenberg (Monogr. Plagioch., 1843), whilst, in the Synop. Hepat. (1844), the initials of Nees ab Es. are placed after the majority of species.

But from a comparison of the dates, it will be seen how little justice was done to Dumortier, who not only originated the name, in the first instance as a section of Radula (Syll. Jung., 1831), but subsequently (Rev. Jung., 1835) elevated it to generic rank, adding a list of the known species. In the Hepaticæ Europæ (1874) *Scapania* is placed under Tribe V. Raduleæ, along with *Radula*, *Plagiochila*, and *Adelanthus*, between Tribe IV. Jubuleæ, and VI. Jungermannieæ. The characters of the genera are derived altogether from the fructification, unlike the plan followed in the Sylloge, where the habit was also considered, and the species were grouped under three divisions, with 1. folia incurrentia (*incuba*, N. ab E.); 2. folia transversalia; and 3. folia subcurrentia (*succuba*, N. ab E.).

Mitten, in his numerous contributions to Hepaticology, follows Dumortier in associating *Scapania* with *Radula*, in the division with *incubous* leaves.

The leaves of Scapania are peculiar, inasmuch as both the larger and smaller lobes are attached to the stem by distinct decurrent roots, which are nearly opposite to each other, so that it is difficult to say which is inserted lowest. But by careful dissection and comparison with other species, I think little doubt can remain that the leaves are truly *succubous*. On the other hand, the spiral is reversed in *Radula*, which has undoubtedly *incubous* leaves. Upon this question, I may quote a passage from a letter of Dr. Spruce (July 1874), whose critical remarks are always worthy of attention. After stating that he is inclined to place Scapania in an intermediate section with transverse leaves, he continues,—"the *folia transversalia* often (not always) correspond to the 'folia verticalia' of Martius and Nees. But the actual insertion is (as you know) rarely in a straight line, whether transverse, longitudinal, or diagonal, and cannot be correctly described by a single word. It has seemed to me that *Blepharostoma* was well distinguished from *Lepidozia* by its transversal leaves—neither succubous nor incubous. Scapania has its leaves succubous as to the larger, incubous as to the smaller lobe; so that how you call them depends on 'which side you look at the shield.' I consider them succubous."

A few words as to the limits of the genus. Mr. Mitten, in his later works, has reunited the Scapanoid Jungermanniæ (*Diplophyllum*, Dumort.) with Scapania, because the colesule, in some species of the latter, is imperfectly compressed. But in none of the species is it contracted at the mouth, or (with the exception of *S. curta*) plicate-angulate, as in *D. albicans*, &c. Moreover, the naked, persistent, rhizomatous shoots of *Scapania* are never met with in *Diplophyllum*. The same remark applies to Jungermannia proper, in which growth is strictly acrogynous, the lower part of the stem decaying, as new shoots are formed at the apex.

The *Scapaniæ* constitute a small group, confined, for the most part, to the northern temperate zone, the genus being replaced in the southern hemisphere by *Schistochila*, Dumort. (Gottschia). Such forms as *J. densifolia*, Hook., *J. chloroleuca*, Tayl., &c., in habit approach *Diplophyllum*, but when the fructification is known, will probably be found to constitute a distinct genus. In the *Synopsis Hepat.*, N. L. G., fourteen species are described as European (or if Dr. Lindberg's statement is correct that *S. Tyrolensis* N. ab E. is only a variety of *S. æquiloba*, thirteen) of which twelve are natives of Britain. The estimation in Dumortier's Hep. Eur. (1874) is larger, twenty-two species being enumerated. But several of these have hitherto been accounted varieties, and of others, recently described by De Notaris, our knowledge is yet imperfect.

α. Leaves longer than broad, lobes more or less acute.

1. Scapania nemorosa, *Dumort.*

Pl. V. Fig. 15.

Laxly cæspitose; shoots erect, decurved; leaves pale-green, smooth, accrescent, remote, unequally bilobed; inferior lobe obovate, convexo-recurved; lobule scarcely half as large, cordate, acute, incumbent; margins densely ciliate-dentate; colesule half immersed, obovate; mouth truncate, ciliate; capsule ovate.

Jungermannia memorosa, Linn. Sp. Pl. 3rd ed. p. 1598; Hedwig, Theor. p. 156, t. 17; Eng. Bot. t. 607; Hook. Brit. Jung. t. 21 (excl. var. omn.); Musc. Brit. 2nd ed. p. 232; Brit. Flor. ii. p. 113; Mackay, Fl. Hibern. ii. p. 61; Mart. Fl. Cryp. Erl. p. 152, t. 4, f. 27 et 28; Lindenb. Syn. Hep. p. 51; De Not. Prim. Hep. Ital. p. 10; N. ab E. Leberm. Eur. i. p. 203.

Jungermannia nemorea, Lin. Syst. Nat. ii. p. 706.

Martinellia nemorosa, G. & B. emend. in Nat. Arr. i. p. 692; Lindb. Manip. Musc. 2nd, p. 366.

Radula nemorosa, Dumort. Comm. Bot. p. 112; et Sect. *Scapania*, Syll. Jung. p. 41.

Scapania nemorosa, Dumort. Rev. Jung. p. 14 (1835); G. L. N. Syn. Hep. p. 68 (1844); Fl. Danica, t. 2756, f. 2; Cogn. Hep. Belg. p. 21; Gott. & Rat. Hep. Eur. Ex. nn. 92, 224, 279, and 331; Del. et Grav. Hepat. Arden. n. 29; Moug. et Nest. St. Voges. Rhen. n. 51 (lower tuft).

Jungermannia nemorosa, foliis acutioribus, auritis, tenuissime denticulatis, Micheli Nov. Gen. p. 7, t. 5, f. 8.

Lichenastrum auriculatum, pinnis minoribus crenatis, Dill. Musc. p. 490, t. 71, f. 18.

Hab.—Shady banks and woods, comparatively local. New Forest, Hants, fr. April 1812, and Cadnam Bog, *C. Lyell, Esq.!* Bolton woods, abundant, fr. June 1860! Teesdale, *R. Spruce.* Jersey, *Mrs. McKenzie!* Clapdale, Craven, Yorkshire! Penzance (gemmæ), *W. Curnow.* Airyholme wood, and Bilsdale, Yorkshire, *W. Mudd!*

Generally distributed throughout Europe and North America.

Tufts 2 or 3 inches in diameter, compact, but not densely matted together by rootlets, as in the following species.

Stems rather stout, flexuose, of a brownish colour; nearly black, naked, entangled, and creeping at the base.

Rootlets scanty, white, pellucid, proceeding in bundles from the bases of the lower leaves, and rhizomatous shoots.

Shoots (f. 15, 1) ascending or erect, from one to two inches high, by $\frac{1}{6}''$ in diameter, simple or irregularly branched, the ramuli patent, complanate, recurved at the apex; producing innovations from the involucral bracts and summits of the annual shoots, which in turn produce fructification the following season.

Leaves (f. 15, 2) rather distant, bifarious, alternate, increasing in size upwards, carinate-complicate, semi-amplexicaul and decurrent on both ventral and dorsal aspects, divided for two-thirds of their length (rarely half) into two unequal lobes, which are vertically patent, and parallel with each surface of the stem, but somewhat decurved. Lower lobe (f. 15, 3) obovate, obtuse or bluntly pointed, $\frac{1}{10}''$ to $\frac{1}{12}''$ long, by $\frac{1}{20}''$ broad, slightly convex, the ventral margin reflexed, and decurrent for some distance; lobule equal to the diameter of the larger lobe, cordate, acute, concave, incumbent, or in the lower leaves occasionally reflexed, embracing and hiding the stem, but rarely projecting beyond it; margins of both lobes (excepting the carina) closely and regularly ciliate-dentate.

Texture thin but not translucent, shrinking and crisped when dry.

Colour pale dull-green or yellowish-green, the lower leaves brownish.

Cells (f. 15, 4) with uniformly thickened walls, discrete, the

marginal ones sub-quadrate, $\frac{1}{1166}''$ in diameter; middle cells polygonal, $\frac{1}{875}''$ each way; those near the base of the leaf $\frac{1}{437}''$ by $\frac{1}{875}''$. Epidermis smooth. Contents uniformly granular; trigones inconspicuous. The cilia are composed of four to six cells, the terminal one acute, and those at the base double.

Inflorescence generally on distinct shoots (dioicous), rarely autoicous (Hook. Jung. t. xxi. f. 3).

Involucral bracts (f. 15, 2) two, differing from the ordinary leaves only in size.

Colesule (f. 15, 3) conspicuous, $\frac{1}{8}''$ to $\frac{1}{6}''$ in length, by a line broad, obovate from a contracted ventricose base, from which it becomes thinner and broader to the truncate densely ciliate apex. At an early stage both the margins and summit are recurved (the latter remarkably so), but as the capsule matures, the colesule becomes more tubulose and erect. Colour paler than the leaves, ochraceous; cells oblong-polygonal. Like other species producing innovations, the colesule frequently appears lateral, or central between dichotomous shoots.

Calyptra pyriform, white, delicately reticulate, tipped with a short style, and bearing at the base a few fusiform pistillidia.

Capsule large ($\frac{1}{12}''$), roundish-ovate, reddish-brown (f. 15, 2); valves four, elliptic-ovate, coriaceous. On section the walls of the capsule are found to be composed of five layers of cells, the outer thin and tabular, the two following ones thickened and crossed by brownish bands, and the two inner rows of looser texture and not incrassate. *Pedicel* short, succulent.

Spores minute, round, cinnamon-coloured, $\frac{1}{1750}''$ in diameter.

Elaters bispiral, filiform, $\frac{1}{200}''$ by $\frac{1}{3500}''$.

Andrœcium terminal, sub-spicate, or interrupted.

Perigonial bracts smaller and more closely imbricated, saccate at the base; lobes united for more than half their length, nearly equal; margins recurved,

Antheridia (f. 15, 5) axillary (3–6), ovoid or spherical, olive-green; pedicel slender, transversely striate, about as long as the anther.

Intermingled with the antheridia we find, as noted by *Hooker*, a few "pointed, simple, or slightly-branched filaments," resembling the *paraphyses* of mosses, but apparently peculiar to *S. nemorosa*.

Gemmæ are frequently present on barren individuals, forming dark-brown or black warty masses at the apices of the growing stems and terminal leaves. Under the microscope they appear to be composed of particles of a clavate or elliptic form, either unicellular or 2–3-septate, and of a yellowish-brown colour.

Obs.—I have felt some hesitation whether *β purpurascens* (Hook. l. c. t. xxi. f. 16) should be described as a variety of *S. nemorosa*. But, upon the whole, I incline to the opinion of *Dr. Gottsche*, that it is more nearly allied with *S. undulata*. "I cannot"

(adds that careful observer) "yet define the limits of these species, and if I believe myself for a time in order with the genus, new forms confuse me again. In *β purpurascens* the leaves are more closely imbricated, the lobes rounded and shortly denticulate, texture thinner and more pellucid, areolæ larger, and the colour always some shade of pink or purple."

The ciliate leaves of *S. nemorosa* should enable us to distinguish it from all British species, with the exception of *S. planifolia*, and perhaps *S. nimbosa*, both of which are rare alpine forms, having the lobes divided to the base, and the leaves of a chestnut-brown colour.

Whether our species is the *Jung. nemorosa* of *Dillenius* and *Linnæus* it would perhaps be impolitic to inquire too closely, since the name is now thoroughly established. There needs a "statute of limitations" with respect to old names, as well as other possessions. It is certainly more local, and of rarer occurrence than *S. resupinata*, which, I suspect, is frequently confounded with it.

Pl. V. Fig. 15.—Scapania nemorosa. 1. *Fertile shoot natural size.* 2. *The same* × 16. 3. *Upper portion of fertile shoot* (*ventral aspect*), *showing colesule and involucral bracts.* 4. *Portion of leaf more highly magnified.* 5. *Antheridium and paraphyses* (?).

2. Scapania resupinata, *Dumort.*

Pl. VIII. Fig. 26 (ex parte).

Densely cæspitose; shoots slender, of uniform diameter, radiculose, zonate (ochraceous, olive-brown, or olive); leaves closely imbricated, equal, pellucid, smooth, divided for one-third of their length into two lobes; inferior lobe roundish-obovate, obtuse or apiculate, convex, strongly reflexed; lobule half the size, obliquely reniform, crossing the stem, apex rounded, concave, incumbent or antiflexed; margins equally dentate; colesule obconic, truncate, inciso-dentate; capsule small, oval, shortly stipitate.

Jungermannia resupinata, Lin. Sp. Pl. 1599, *fide syn. Dillenii* (1753); Huds. Fl. Ang. p. 512; With. Arr. Br. Pl. 3, ed. iii. p. 875 (1796); Weber, Prodr. Hep. p. 84 (1815); Eng. Bot. t. 2437 (*non Hook.*); Lindenb. Syn. Hep. p. 53 (1829); Hüben. Hep. Germ. p. 236; Ekart, Syn. Jung. p. 26, t. xi. f. 88 (excl. f. 3).

Radula (*Scap.*) *dentata*, Dumort. Syll. Jung. p. 40 (1831).

Scapania dentata, Dumort. Rev. Jung. p. 14 (1835); Cogn. Hep. Belg. p. 21.

Scapania resupinata, Dumort. Rev. Jung. p. 14; et Hep. Eur. p. 34 (1874).

Scapania undulata, α. G. L. N. Syn. Hep. p. 65.

S. æquiloba, var. *foliis lævibus*, Gottsche MSS.; Jenson, in Bot. Tidsskr. ii. p. 288 (1868); G. & R. Hep. Eur. Ex. nn. 92, 169, 225.

Martinellia gracilis, Lindb. Manip. Musc. Secund. p. 365 (1874).

Lichenastrum auriculatum, pinnulis rotundis, crispum, Dill. Musc. p. 491, t. 71, f. 19 (1741).

β laxifolia: Caule laxiori, foliis remotioribus, lobulo minus obtuso.

J. resupinata β. Lindenb. l. c. p. 53; Dumort. Syll. p. 40; et Hep. Eur. p. 34.

γ recurvifolia: Foliorum lobis lobulisque recurvatis.

Jung. nemorosa γ recurvifolia, Hook. Jung. t. xxi. f. 8.

Hab.—Shady rocks and walls in sub-alpine districts throughout the British isles. Common on the Irish mountains, and often in fruit, *Dr. Lindberg!* Equally frequent

in Scotland and Wales. Westmoreland (whence I have received a most interesting series of specimens), *G. Stabler, Esq.* Moorlands of North and West Yorkshire. Ilkley wells, fr. ! Eridge Rocks, *R. Spruce !* Penzance, fine fruit, Feb. 1860, *W. Curnow !*

It has also been found in Sweden and Finland, *Dr. Lindberg !* Switzerland, Asturia, and Teneriffe, *Bourgeau !*

Tufts extensive, compact, cushion-like, not easily separated, of an olive-yellow or olive-brown colour, disposed in bands corresponding with the annual innovations, well described by Lindberg,—"flavo-ochracea vel ferruginea, vulgo zonata, inferne expallens, superne flavidulo- vel ochraceo-viridula."

Primary shoots creeping, naked, sub-ligneous, nearly black, entangled, radiculose beneath, and producing at short intervals the foliose shoots.

In old dense tufts the stolons perish after a time from damp or pressure, and only fragmentary portions remain.

Stems rigid, erect, sparingly branched, flexuose, reddish-brown.

Rootlets numerous, long, white, fasciculate, proceeding from the bases of the leaves.

Secondary shoots densely foliate, and of nearly equal diameter throughout, 2″ to 4″ long, by $\frac{1}{10}$″ to $\frac{1}{15}$″ broad, slender, but having a crisped and secund appearance (especially on the inferior aspect), from the recurvation of the larger lobes, decurved at the summit, interrupted at intervals, showing the annual periods of growth, and at such points producing innovations which take the direction of the original axis, and are nearly parallel with each other.

Leaves (f. 26, 6) of uniform size, bifariously patent, amplexicaul, approximate in the lower portion of the stem, closely imbricated above, $\frac{1}{25}$″ to $\frac{1}{20}$″ in length, carinate, divided for one-third or at most half their length into two lobes, which in the upper leaves are nearly equal.

Posterior lobe obliquely roundish-ovate to obovate, obtuse or abruptly pointed, very convex, deflexed (f. 26, 8), the ventral margin recurved and decurrent, regularly serrate-dentate, the terminal teeth scarcely exceeding the rest.

Lobule about half the size of the larger lobe, obliquely reniform, apex rounded and obtuse, projecting beyond the stem, incumbent or reflexed, distantly toothed, the apical teeth largest.

In β the leaves are not so closely imbricated, and the lobes, especially the anterior one, more acute (f. 26, 4), so as to approach *S. nemorosa* in habit, but the leaves are of uniform size and simply serrate, not accrescent and ciliate.

The var. γ is frequent on dry exposed (calcareous) rocks, and in it the leaves are more irregular and crisped, the inferior lobe strongly deflexed and standing at right angles with the stem, whilst the lobule is erecto-patent or recurved in an opposite direction.

Texture thin but firm, little altered when dry, semi-pellucid. Colour yellowish-green, olivaceous, ferruginous or dark-brown.

Leaf-cells much smaller than in *S. nemorosa*, pellucid-punctate, discrete, arranged in concentric series. Marginal cells smallest, sub-quadrate, $\frac{1}{1750}''$ to $\frac{1}{1400}''$; those of the middle hexagonal, $\frac{1}{1400}''$ to $\frac{1}{1167}''$; basal cells $\frac{1}{875}''$ to $\frac{1}{500}''$ by $\frac{1}{1400}''$. Walls thick, especially at the angles; epidermis smooth (not papillose), contents granular.

Inflorescence dioicous.

Fertile shoots scarcely differing from the rest.

Involucrat bracts (f. 26, 8) two, with rounded lobules approaching the inferior lobes in size, repand-denticulate.

Colesule (f. 26, 8) half-immersed, smaller ($\frac{1}{10}''$), cuneate-obovate, compressed in the plane of the leaves, from a contracted sub-terete base, apex truncate, irregularly incised, and fringed with long close teeth, in some forms minutely denticulate, decurved. Colour paler than the leaves, with which it otherwise agrees in structure.

Calyptra obovate, hyaline-reticulate, the cells large and translucent.

Capsule minute for the size of the plant, oval, cinnamon-coloured, dividing into four elliptic valves, thinner than in *S. nemorosa.*

Pedicel about twice the length of the colesule, white, slender.

Spores rufous, minute, sphæroidal, $\frac{1}{1400}''$ in diameter.

Elaters bispiral, $\frac{1}{175}''$ long, by $\frac{1}{2300}''$ broad.

Male plants more slender.

Perigonial leaves collected in short terminal or interrupted spikes, closely imbricated, erecto-patent; lobes nearly equal, ventricose at the base.

Antheridia three to four, olive-green, ovate; stipes slender, striate, about equal to the anther in length.

Gemmæ abundant during the autumnal and winter months, either forming balls on the terminal axis, or scattered irregularly over the margins of the leaves, so that they appear erose-dentate. They generally resemble the leaves in colour, so as to escape attention unless looked for carefully. Detached particles golden-brown, elliptic or sub-clavate, sometimes quadrangular.

Obs.—I have done my best to investigate the synonomy of the present species, devoting several days to the task, but the result has been anything but satisfactory, and my sensations may, not inaptly, be compared with the bewilderment of a man who has just landed from an experimental trip on the centrifugal railway. To the botanists of this country, since the publication of Hooker's Jung., *J. resupinata* has been an enigma. By some strange misconception, that author described another species under the name (*J. compacta*, Roth.), whilst he looked upon the true plant as a variety of *S. nemorosa.* Later, Nees ab E., in Leber. Eur. i. p. 184 (1833), associated it with *S. undulata* A, an error perpetuated in the Synopsis Hepat. of Nees, Lindenb. and

Gottsche (1844), all the more strange because of Lindenberg's careful description of *J. resupinata*, in his earlier work (Syn. Hep. Eur. p. 53, 1829).

Under these circumstances, we owe a debt of gratitude to Professor Lindberg for rescuing the species from the limbo of forgotten things; but how far he was justified in describing it under a new name, *Martinellia gracilis*, and transferring the old one to *Jung. saxicola*, Schrad., requires further consideration. For the present I hesitate to accept these changes for the following reasons:—

1. According to Smith and Hooker, the plant preserved in the Linnæan Herbarium is identical with t. 71, f. 19 of the Hist. Musc. (Eng. Bot. t. 2437). It seems to be proved, however, that Linnæus confounded more than one species under the name. Thus Wahlenberg affirms that the *J. resupinata* of Fl. Suec .ed. 1, p. 338, was *J. saxicola*. In the Sp. Pl. and his later works (all of which contain the reference to Dillen.) the true species was probably described. Dumortier (Hep. Eur., 1874) pertinently remarks:—"Nullo dubito quin sit vera Linnæi *J. resupinata*, quod jam plurimi auctores admittunt. In herbario Linnæano deficit, sed synonymon Dillenii allegatum, et '*foliola crenulata, imbricata rotunda*' a Linnæo laudata, omne dubium solvunt."

Moreover, the deserved reputation of Linnæus must not blind us to the fact that his acquaintance with cryptogamic plants was superficial, and for the most part second-hand; so that to understand his meaning it is necessary to consult the authorities from whom he copied.

2. The statement of Professor Lindberg (Manip. Musc. Secund., p. 354) that t. 71, f. 19 (Dill. l. c.) consists of two species, A. B. C. *J. saxicola*, and D. E. *J. resupinata*, has caused some astonishment, no doubt having hitherto arisen as to their identity. But for the well-known accuracy of Professor Lindberg, I should have been inclined to suspect some error. It is possible that Dillenius may have received specimens from Sweden, where the two sometimes grow together. British specimens of *J. saxicola* could not have been known to him. On the other hand, Hooker, from examination of the herbarium at Oxford, states of t. 71, f. 19, "It is certain that it only represents a small variety of *J. nemorosa*. It requires, however, to be remarked that in the original specimen there are no traces of any lateral fructification, as the plate and description would lead us to imagine" (Brit. Jung., t. xxiii.). Lindenberg also, referring to the position of the colesule "in surculis *peculiaribus brevibus*"—"pro plantæ ratione magnæ *ventricosæ*," suggests that some other species may have been intermingled with *J. resupinata*. After stating that no lateral fructification is found in the Oxford herbarium, he continues, "Dilleniusque l. c. ipse dicat, 'unam alteramque plantam observavi cum folliculo latiore, compresso e summitate prodeunte.' We must not forget also that the presence of lateral colesules, from the growth of proliferous shoots, is common to all the species.

About the description (Hist. Musc., p. 491) I suppose no doubt can exist. The leaves, under the lens, are described—"acutissime crenatos margines exhibent," and the enlarged figure of the leaf (19 h.) shows this structure clearly; whereas the leaves of *J. saxicola* are always entire.

"Who then shall decide when doctors disagree?"

3. The term *resupinatus* (turned backwards) is devoid of meaning when applied to *J. saxicola*, in which the leaves are concave and arched forward, not deflexed, the back of the shoots, from the close imbrication of the leaves, looking almost as smooth and round as the back of a millipede,—whereas it accords well with the present species.

Nor can the newly-proposed name *gracilis* be considered a happy one; the shoots are longer and more slender than in *S. nemorosa*, but the adjective expresses badly the habit of a plant which Smith termed "crisped and turgid," and Hooker "crisped and inelegant." Suppose it necessary to change the name, Hooker's term "*recurvifolia*" would be better, not to mention Dumortier's old synonym "*dentata*."

Space will not permit me to pursue the subject further, but enough has been adduced to show how much doubt envelops the question, and to tamper with names which have been current for more than a century, except on the clearest evidence, seems to me something more than a mistake.

Pl. VIII. Fig. 26.—Scapania resupinata. 6. *Upper leaves of normal form, showing the reflexed lobes.* 8. *Apex of fertile stem seen from below, with the colesule (apex recurved) and perichætial leaves. The teeth of colesule are relatively too small.* 4. *Leaf from var. β.* 7. *Another seen from below.*

3. Scapania æquiloba, *Dumort.*

Pl. VIII. Fig. 26 (ex parte).

Stems shorter, gracile, loosely tufted; leaves approximate, equidistant; texture firm, olive-brown, verrucose, divided for a short distance into two nearly equal sub-dentate lobes; inferior lobe roundish-ovate, from a contracted, reflexed base, shortly pointed, apiculate; lobule obliquely ovate, crossing the stem, patulous; colesule half immersed, obovate-oblong, truncate, inciso-denticulate; capsule ovate.

Jungermannia æquiloba, Schwægr. Prodr. Hep. p. 214 (1814); Lindenb. Syn. Hep. Eur. p. 55 (excl. syn. Schl.); N. ab E. Leberm. Eur. i. p. 183; Ekart, Syn. Jung. p. 55, t. 11, f. 90 (mala); Hüben. Hep. Germ. p. 242; De Not. Prim. Hep. Ital. p. 17, n. 16.

Jung. montana, Mart. Fl. Cryp. Erl. p. 155, t. iv. f. 31; Wallr. Cryp. Germ. i. p. 61.

Radula æquiloba, Dumort. Syll. Jung. p. 39.

Plagiochila æquiloba, M. et N. in Leberm. Eur. iii. p. 520.

Scapania æquiloba, Dumort. Rev. Jung. p. 14 (1835); et Hep. Eur. p. 36; G. L. N. Syn. Hepat. p. 64 (1844); Cogn. Hep. Belg. p. 20; Boul. Musc. p. 373; Rabenh. Cryp. Flor. p. 341 (1863).

Scapania Tyrolensis, N. ab E. Syn. Hep. p. 69 (fide Lindberg).

α dentata, leaves broader, irregularly denticulate, apical teeth largest, G. et R. Hep. Eur. Ex. n. 92–331 *icon;* Del. et Grav. Hep. Ard. n. 24.

β inermis, lobes obovate-oblong, arenate, sometimes cultriform, entire, Gottsche in Hep. Eur. Ex. n. 80, 404, 408.

Hab.—Crevices of rocks in sub-alpine districts; rather rare. Hitherto only barren plants have been collected. Glen Callater, Aug. 1844, Leg. *Drummond!* Outer Hebrides, 1841, *Prof. Balfour!* Ben Muic Dhui, ♂; and West Warren, Forfar, ♂, *A. Croall!* Little Craigen Dal, *Rev. J. Fergusson!* Bolton woods, Yorkshire, ♂, *R. Spruce!* Ingleburgh, Aug. 1858! Giggleswick Scar, *J. G. Baker!* Mulham Cove! Teesdale, *R. Spruce!* Barmouth, Oct. 1867.

Found also on the mountains of North and Central Europe, where fertile specimens are not uncommon.

Tufts of a dark olive or olive-brown colour, loosely cæspitose, generally found growing on calcareous rocks, and often scattered among mosses.

Rhizomatous shoots creeping, leafless, brittle, dark brown.

Stems ascending, rigid, somewhat flexuose, simple or irregularly innovant-ramose, ramuli patent or divergent.

Rootlets capillary, white, pellucid, scanty on the foliose stems, but more frequent on the stolons.

Shoots gracile (f. 26, 2), of nearly equal diameter throughout ($\frac{1}{15}''$ to $\frac{1}{10}''$), and from an inch to two inches in length, complanate except at the apex, where the leaves are deflexed, in some specimens sub-secund, having a peculiarly neat appearance from the pectinate-pinnate leaves, which are scarcely altered when dry.

Leaves (f. 26, 2) of nearly uniform size ($\frac{1}{20}''$), the upper ones closely imbricated, erecto-patent, the lower ones more distant, alternate, patent-divergent, amplexicaul, divided for about a third of their length into two conduplicate lobes, which are nearly equal (f. 26, 5).

Lower lobe roundish-ovate to ovate-oblong; base somewhat contracted, decurrent and reflexed; apex abruptly pointed or apiculate; surface slightly convex, but not decurved (as in the last species) except in the apical leaves; margin irregularly denticulate, the terminal teeth largest. In β the margin is nearly plane.

Lobule obliquely ovate or ovate sub-quadrate, shortly pointed, the outer margin frequently at right angles with the base so as to appear truncate; base rounded and decurrent, crossing the stem, which is thus hidden; surface concave, erecto-patent or reflexed; margin obscurely denticulate.

The *plica*, which extends to a third or fourth of the length of the leaf, is arcuate, and reflexed at the sinus, so that the lobes project a little below it, and the leaves appear sub-falcate.

Texture firm, chartaceous, little altered when dry, dull from the presence of papillæ.

Colour a sub-opaque olive or olive-brown, in specimens from exposed rocks nearly black.

Areolation guttate, coarctate, the marginal cells very minute, roundish, but increasing in size towards the centre of the leaf. Cells polygonal, with a double outline, those of the margin sub-quadrate, $\frac{1}{1750}''$ to $\frac{1}{1160}''$ in diam. Basal cells hexagonal, $\frac{1}{1160}''$ to $\frac{1}{700}''$ by $\frac{1}{1400}''$. Trigones inconspicuous.

Epidermic layer verrucose, the papillæ broad and flat, and resembling (as stated by Lindberg) groups of *Cocconeis* on the frond of some water-weed.

Inflorescence dioicous.

Fertile shoots (f. 26, 1) somewhat stouter, and of a paler green colour, probably from a more sheltered habitat, but not differing otherwise from the barren stems.

Involucral bracts broader, roundish-ovate or trapezoid; lobes nearly equal, obtusely pointed, irregularly denticulate; ventral margin reflexed, entire or lobate and repand; lobule incumbent, half concealing the colesule.

Colseule (f. 26, 3) obovate-oblong, compressed in the plane of the leaves, contracted and trigonous at the base. When young convexo-concave, the margins and apex curved backwards, but after the egress of the capsule more plane; apex truncate, bilabiate, laciniate-dentate.

Capsule small, ovoid (f. 26, 3), dark brown, seated on a short pedicel.

Spores roundish, reddish-brown, granulose, $\frac{1}{1400}''$ in diameter.

Elaters bispiral, $\frac{1}{175}''$ to $\frac{1}{100}''$ in length, by $\frac{1}{2300}''$ broad.

Andrœcium terminal, sub-spicate on more slender shoots ($\frac{1}{20}''$ to $\frac{1}{15}''$).

Perigonial leaves (f. 26, 7) five to ten pairs, more closely imbricated, erecto-patent, ventricose and vaginate at the base, entire for three-fourths of their length; lobes nearly equal, short, acute, denticulate.

Antheridia (f. 26, 9) axillary, oval, seated on a slender stipe.

Gonidial cells (gemmæ) rare, attached to the terminal leaves, which they resemble in colour. Cells more or less densely aggregated, elliptic-clavate, entire or bilocular, the interior filled with minute olive-yellow chlorophyll granules.

Obs.—To *Prof. Lindberg* is due the credit of first pointing out the distinctive character derived from the papillose leaves, which separates *S. æquiloba*, not only from *S. resupinata* with which it was generally confounded, but from all other *Scapaniæ*. "*S. æquiloba*," he writes, "optime diognoscenda videtur: cellulis foliorum minoribus, rotundis, valde incrassatis, spatia trigona supremis quoque ostendentibus, omnibus præsertim mediis papillas verrucæformes et in pariete cellulæ confertas maximas gerentibus." It is a more gracile species than *S. resupinata*, the shoots more slender, never zonate or having the tumid, squarrose habit of that species; the leaves are more remote, narrower; lobes nearly equal, and of similar shape, acute and opaque, irregularly dentate or entire; ventral lobe slightly convex, not deflexed, and the colour generally darker.

Pl. VIII. Fig. 26.—Scapania æquiloba. 1. *Shoots natural size.* 2. *Portion of barren shoot* × 16. 3. *Fertile shoot, with colesule and capsule* × 16. (The leaves are more deeply dentate than they should be.) 5. *Stem-leaf magnified.* 7. *Perigonial leaf laid open, showing the antheridia.* 9. *Antheridium* × 250.

4. Scapania Bartlingii, *N. ab E.*

Pl. IX. Fig. 27.

Shoots small, depressed, creeping, apex only ascending; leaves entire, repand, patent from an erect vaginate base, shortly and equally bilobed; lobes roundish-ovate, cuspidate or mucronate,

patulous; involucral leaves somewhat broader, obtusate; colesule half immersed, oblong; apex obliquely truncate, entire.

Jungermannia Bartlingii, Hampe in Nees ab E. Leb. Eur. ii. p. 425 (1836).
Scapania Bartlingii, G. L. N. Syn. Hep. p. 64, n. 4 (1844); Carring. in Tr. Phil. Soc. Manc. p. 187 (Feb. 1867); Lindb. in Hartm. Skand. Fl. x. ed. ii. p. 132, n. 7 (1871); G. & R. Hep. Eur. Ex. 292 (*c. icon*), 424, and 483.
Jungermannia cuspiduligua, N. ab E. Leberm. Eur. i. p. 186.
Plagiochila Bartlingii, M. et N. in Leberm. Eur. iii. p. 520.
Jung. rupestris, Schleich, Cat. Ex. (1821).
Scapania rupestris, Dumort. Rev. Jung. p. 14, et Hep. Eur. p. 36.
Jung. subalpina, var. Angstr. in Lindblom's Notiser, viii. p. 96.
Jung. resupinata, N. ab E. in Sylloge Ratisb. i. p. 132.
β obtusata, leaves obtuse, entire.
Scapania Carestiæ, De Not. Nuov. Epat. Ital. in Mem. Acad. Torin. xxii. p. 337, t. iii. f. 17.
Scap. Bartlingii, Dumort. Hep. Eur. p. 35, n. 4 (1874).

Hab.—Rare, on damp shady rocks by streams. First recognized as British from specimens collected on rocks near the Strid, Bolton woods, Yorkshire, April 1858! Egleston, Tees-side, *J. G. Baker*, 1856! Teesdale, *W. Mudd!*

Originally discovered by Funck in Carinthia, and found sparingly in Switzerland, *Hampe;* and Savoy, *Dr. Mueller*, fr.!

Tufts depressed, scattered, resembling *Jung. ventricosa* or *Jung. capitata* in habit, of a sordid green colour, frequently creeping among other mosses and hepaticæ, e. g. *J. riparia*, *J. Mulleri*, and *Chiloscyphus polyanthos*.

Stems (f. 27, 1) stout, succulent, pale-brown, simple or innovant-furcate; lower two-thirds creeping, the upper third ascending, generally concealed by the amplexicaul bases of the leaves; stoloniferous at the base, the stolons naked or ramentose.

Rootlets white, capillary, abundant on the creeping portions of the stems.

Shoots (f. 27, 2) about $\frac{1}{2}''$ in length, by $\frac{1}{15}''$ broad, of nearly equal diameter throughout except in fertile individuals, where the terminal leaves are somewhat larger. Undulate and tumid, especially when dry; rounded and smooth on the ventral aspect, the lower lobes of the leaves not being at all reflexed.

Leaves (f. 27, 3, 4) loosely imbricated, alternate, with an upward and forward direction, so as to appear slightly secund; when opened out cordate in form, about half a line long, the base saccate and amplexicaul; divided for a short distance, not exceeding one-fourth of their length, into two nearly equal concave lobes, which are either cuspidate and apiculate or obtuse.

Inferior lobe (f. 27, 5) roundish-ovate, concave, the basal angle contracted, but not at all reflexed. *Lobule* (f. 27, 4) ovate, acute, crossing and concealing the stem, patulous, the margin erect or reflexed, and, as in the larger lobe, more or less repand-undulate.

The base of the leaf is generally vaginate and erect, whilst the upper portion is patent, and the lobes project slightly below the line of the carina, which is ill-defined in this species.

Texture thin and herbaceous, shrinking and crisped when dry.

Colour sordid green, sub-opaque, chlorophyllose, more rarely ochraceous; the base of the shoots dirty-brown.

Areolation (f. 27, 7) minute, dotted, the cells resembling *S. æquiloba* in size and disposition, but with the epidermic layer quite smooth (not papillose). Marginal cells smallest, sub-quadrate, $\frac{1}{1750}''$ in diameter; cells about the upper third of the leaf $\frac{1}{1160}''$ to $\frac{1}{875}''$; basal cells $\frac{1}{700}''$ by $\frac{1}{1160}''$. When prepared and tinged with zinc biniodide the walls appear somewhat thickened at the angles, but the combined trigones are very small, less than $\frac{1}{3500}''$. The younger cells are crowded with minute chlorophyll granules, associated with which we generally find from one to three larger oval granular corpuscules (zellenkörper), like those noted in *N. scalaris*. In older leaves I have observed the granules (after the leaves had been revived by placing in water), which are fewer and of a brownish colour, revolving within the cell-walls like phytozoa. It is difficult to understand this motion in leaves which have been kept in the herbarium for years, yet the phenomenon is not confined to the present species.

Inflorescence dioicous.

Involucral bracts somewhat larger and broader, lobes obtuse, the inferior one decurved, whilst the lobule is appressed to the colesule, which it half conceals.

Colesule (f. 27, 6) oblong from a contracted sub-terete base, about a line in length by $\frac{1}{20}''$ in diameter, complanate; apex recurvate, slightly contracted, obliquely truncate, entire.

Calyptra obovate, bearing at the apex a short style, the walls composed of polygonal hyaline cells, and the base surrounded by a few abortive pistillidia.

Capsule undescribed.

Gonidial cells crowning the apex of the growing stem, and attached to the apiculate lobes of the upper leaves; free cells, collected together in roundish reddish-brown masses, or in a more scattered state, are not unfrequent. Under the microscope their colour is golden-brown, and their form oval or clavate, the cell-contents being divided by a central septa.

Obs.—*S. Bartlingii* adds another item to the list of rarities, which have made Bolton woods classical ground to the cryptogamic botanist. But pleasant as the place must always be to me, I can no longer visit it with the unalloyed gladness of old days. Those ancient woods are haunted by the shades of friends who are now no more, and the murmur of the Wharfe has lost its old jubilance, and sounds like a dirge. On my last visit to this spot in May, 1868, my companion was the late *G. E. Hunt*, of Bowden, one of the most earnest and promising bryologists it has been

my pleasure to know; and I well remember, after a long and fruitless search for *S. Bartlingii*, his pardonable exultation when he was the first to meet with it in some abundance. "Requiem æternam dona eis, Domine."

Scapania Bartlingii presents one of those transitional links connecting allied genera which are always interesting to the student of nature. It is the only Scapania (except *S. rosacea*) in which the posterior lobe of the leaf is concave; thus approaching in habit the section of Jungermannia which Dumortier has named *Diplophyllum*, some species of which, e. g. *D. Dicksoni* and *D. obtusifolium*, it resembles in many respects, but is distinguishable by the compressed colesule.

From small forms of *S. æquiloba* it may be known by the darker colour and firmer texture of the leaves in that species, which are always tuberculate.

From *S. curta* by the smaller size of its lobule, the reflexed inferior lobe and the leaves, which are generally dentate, and scarcely repand.

The complicate leaves and compressed habit at once enable us to separate it from *Jung. ventricosa* and its allies.

In Dumortier's latest work we find *Scapania Bartlingii* described under three different names:—

1. *S. Bartlingii*, Nees (?)—"lobis æqualibus semi-rotundatis subrepandis integris"; 2. *S. rupestris*, Dumort. — "lobis rotundato-ovatis cuspidatis integerrimis"; and 3. *S. Carestiæ*, De Not.—"breviter bilobis integris, lobo dorsali subelliptico undulato, ventrali semi-ovato, colesulâ elongata ore integro."

According to original specimens from the Neesian herbarium, generously communicated by Dr. Gottsche, it appears doubtful whether *S. Carestiæ*, De Not., differs materially from the ordinary continental form of *S. Bartlingii*. (Compare with G. & R. Hep. Eur. n. 424, 483, and the drawing attached to n. 292, from Funck's Carinthian specimens.) Gottsche's figure represents the colesuliferous shoot, but in the tuft sent me from the same locality, which is barren, the leaves are all acute and cuspidate. Our British specimens agree with Dumortier's *S. rupestris*, having decidedly cuspidate lobes; but even in them we generally find the terminal leaves obtuse.

Pl. IX. Fig. 27.—Scapania Bartlingii. 1. *Shoot natural size.* 2. *Apex of barren shoot* × 16. 3, 4. *Stem-leaves.* 5. *Leaf from ventral aspect.* 6. *Colesule.* 7. *Portion of leaf showing the dotted cells.*

5. Scapania curta, *Dumort.*

Pl. VII. Fig. 23.

Shoots minute, ascending, simple or innovant-fasciculate; leaves distichous, approximate, cleft for half their length into two unequal lobes; inferior lobe obliquely obovate, apiculate, nearly plane; lobule much smaller, sub-quadrate, acute, erecto-patent; margins entire or sub-dentate; colesule half immersed, ovate, compressed, sub-plicate, apex truncate, inciso-dentate.

Jungermannia nemorosa, δ *denudata*, Hook. Brit. Jung. t. xxi. ff. 17–19 (1814).
Jungermannia curta, Mart. Fl. Cryp. Erlang. p. 148, t. iv. f. 24 (excl. syn.) (1817); Spreg. Syst. Veg. iv. p. 227; Lindenb. Syn. Hep. p. 56, n. 52 (1829); Ekart, Syn. Jung. p. 27, t. xi. f. 89, *mala* (1832); Hüben. Hep. Germ. p. 244 (1834); Nees ab E. Leberm. Eur. i. p. 214 (1833).

Radula (*Scapania*) *curta*, Dumort. Syll. Jung. p. 40.

Plagiochila curta, M. et N. in Leberm. Eur. iii. p. 525.

Scapania curta, Dumort. Rev. Jung. p. 14 (1835); G. L. N. Synop. Hep. p. 69 (1844); Lindb. in Hartm. Skand. Fl. 10 ed. p. 132; Gottsche, in Flor. Danica, t. 2690, f. 1; Cogn. Hep. Belg. p. 22; G. & R. Hep. Eur. Exs. nn. 93, 195, 382, and 395.

β spinulosa, shoots longer, erect, recurved at the apex; leaves yellowish-green, more closely imbricated; lobes ovate, acute, distinctly spinose-dentate; inferior lobe convex, slightly recurved; lobule obliquely ascending, half as large.

Jung. curta, *α* 3, *spinulosa*, Nees ab E. l. c. i. p. 215; G. & R. Hep. Eur. n. 196.

γ rosacea, erecto-procumbent, claret-coloured, innovant-furcate; leaves approximate, narrower; inferior lobe cultriform, shortly cuspidate, plane, or slightly concave; lobule about a third as large, obliquely ovate to cuneiform, acute, ascending; margins entire, repand or minutely denticulate.

Jung. rosacea, Corda, in Sturm. Flor. Germ. ii. 22, 23, p. 96, t. 29; N. ab E. Leber. Eur. p. 211.

Scapania rosacea, Dumort. Rev. Jung. p. 14; G. L. N. Syn. Hep. p. 71.

Jung. curta, *β procumbens*, Lindenb. Hep. Eur. p. 56.

Hab.—Frequent on banks, shady places in woods, walls, &c., often associated with J. albicans, Dicranella varia, D. heteromella, &c.

Trossachs, *J. Cruikshank!* Snowdon, *G. E. Hunt!* Ben-Muic-Dhi, *A. O. Black!* Near Stirling, fr. May 1831, *Dr. Greville!* Ardingley rocks, *G. Davies.* Sussex, *W. Mitten!* Forfar Burn, 1862, *A. Croall!* Yeadon, Yorkshire; Barton Moss.

β Esholt woods, Yorkshire, fr. Oct. 26, 1860. Glenbush, *A. Croall!*

γ Donne, Feb. 1867, *A. McKinlay!*

Plants inconspicuous, growing in diffuse loosely-tufted patches of a pale-green or yellowish-green colour.

Stems rather stout, herbaceous, creeping and naked at the base, afterwards ascending or erect, at first simple, but after attaining their full development producing innovations from one or both sides of the terminal shoots. Under favourable conditions, from repeated prolification, the stems become fasciculate, and attain a height of an inch or more, whereas the annual shoots seldom exceed two lines, or a quarter of an inch.

Rootlets long, white, fasciculate, confined to the lower portion of the shoots and stolons.

Shoots (f. 23, 2, 3) erect, complanate, $\frac{1}{20}''$ to $\frac{1}{15}''$ in diameter, increasing in breadth towards the apex, which is generally recurved; innovations at first more slender, but at length resembling in all respects the ordinary shoots.

Leaves (f. 23, 3) approximate, distichous, alternate, semi-amplexicaul, vertically patent, smaller and more distant near the base of the stems, more crowded and gradually increasing in size towards the summit, carinate-complanate, divided for about half their length into two unequal lobes.

Inferior lobe (f. 33, 4) $\frac{1}{25}''$ to $\frac{1}{40}''$ in length, ovate, roundish-ovate, or obovate from a contracted, slightly decurrent base, abruptly pointed or cuspidate, sometimes obtusate or apiculate; ventral margin a little recurved, but in some specimens plane

or nearly so; margin entire, undulate, sub-dentate or distantly spinose-dentate.

Lobule much smaller ($\frac{1}{2}$ to $\frac{1}{3}$), adnate with the lower lobe for half or even two-thirds of its length, often gibbous at the sinus, obliquely deltoid-ovate, sub-quadrate or cuneiform, acute, concave, the base narrow, not crossing the stem, erecto-patent, reclinate, or in the lower leaves occasionally reflexed, "nunquam vero caulem tegens nec ei appressus." Margin entire or irregularly toothed.

β *spinulosa* (f. 23, 5) approaches *S. umbrosa* in habit; the leaves are more crowded, pale yellowish-green, little altered when dry; lobes ovate, acute, spinose-dentate; ventral more convex and recurved, united with the dorsal lobe for half its length; lobule erecto-patent, obliquely ovate, concave; not cleft to near the base, incumbent, and hiding the stem as in the following species.

In γ *rosacea* (f. 23, 4) the stems are creeping, the leaves are narrowed at the base, elliptic-spathulate or broadly acinaciform, obliquely pointed; lower lobe slightly concave (not at all reflexed), and the lobule wedge-shaped, adnate for two-thirds of the length of the ventral lobe, and ascending. The colour is red or purplish-brown.

Texture thin, semi-translucent, undulate when dry.

Colour very pale-green, stramineous, or in γ of a tawny claret tint; lower leaves faded brown.

Cells small, polygonal, with thickened walls; contents granular, pale-green. Marginal cells compressed, quadrangular, $\frac{1}{1750}''$ in diameter; near the centre of the leaf, oval, $\frac{1}{875}''$ by $\frac{1}{1750}''$; basal cells larger, oblong, $\frac{1}{438}''$ by $\frac{1}{875}''$. Trigones inconspicuous. Epidermic layer smooth.

Inflorescence dioicous.

Fertile shoots stouter and more ramose; branches short, innovant from one of the involucral bracts, so that the colesule is frequently hidden, and (like the persistent perianths of former years) appears lateral. Leaves more closely imbricated, accrescent; lobule ovate, relatively broader.

Involucral bracts (f. 23, 2) somewhat larger, obovate-rotund, mucronate; lobule approaching the lower lobe in size, ovate, acute; margins entire, undulate, sub-dentate, or in β spinulose.

Colesule (f. 32, 2) about a line long, ovate to obovate, compressed from a slender terete base, slightly contracted at the truncate ciliate-dentate apex; margins recurved, dorsal surface convex, obscurely 3–4-plicate, the opposite surface being concave and triplicate, with the central fold larger and more ventricose.

Calyptra pyriform, delicately reticulate, crowned with a short style, and bearing at the base a few barren pistillidia.

(*Capsule* unknown to me, but described as follows by Hübener in Hepat. Germ., p. 215 :—"Der Fruchstiel 4–6‴ lang, [illegible]issmässig stark, glebweiss. Die Kapsel

Fig 1.

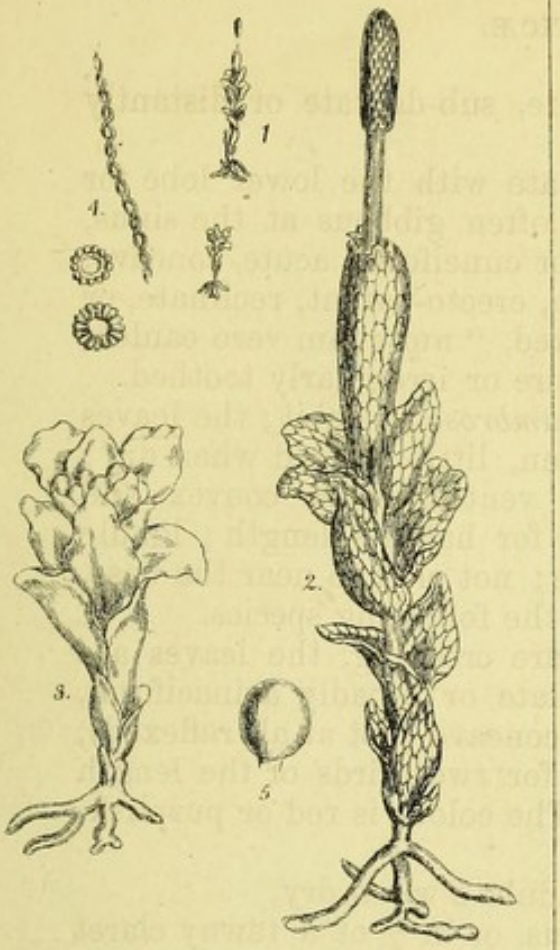


Fig 2.

Fig 3.

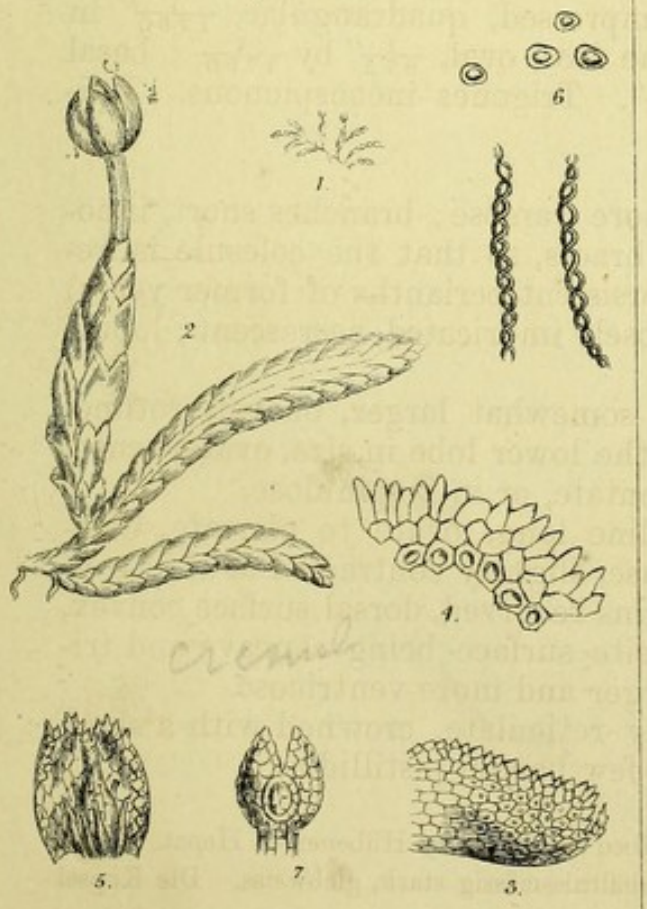
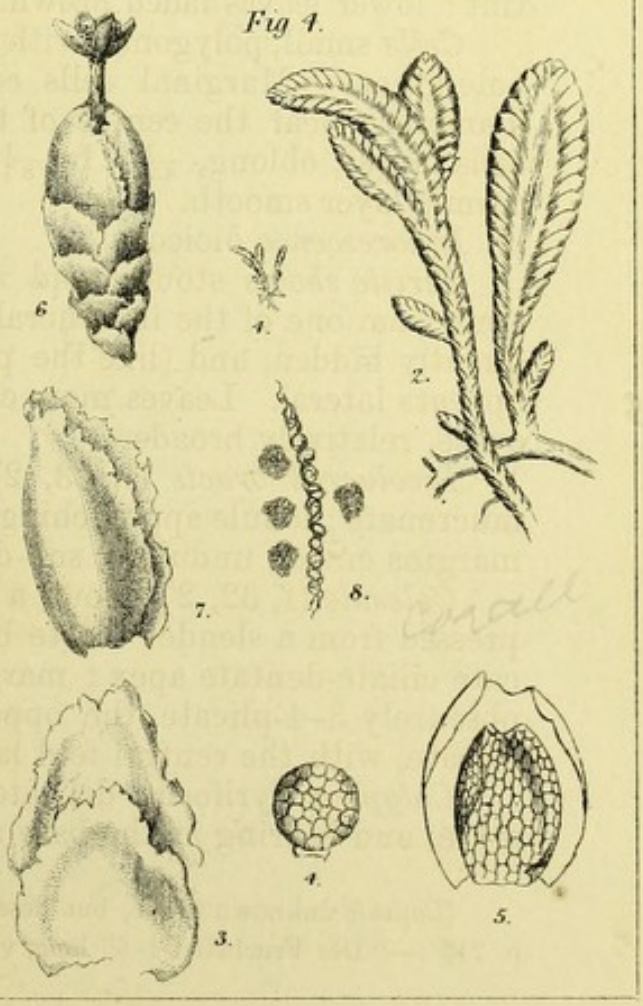


Fig 4.



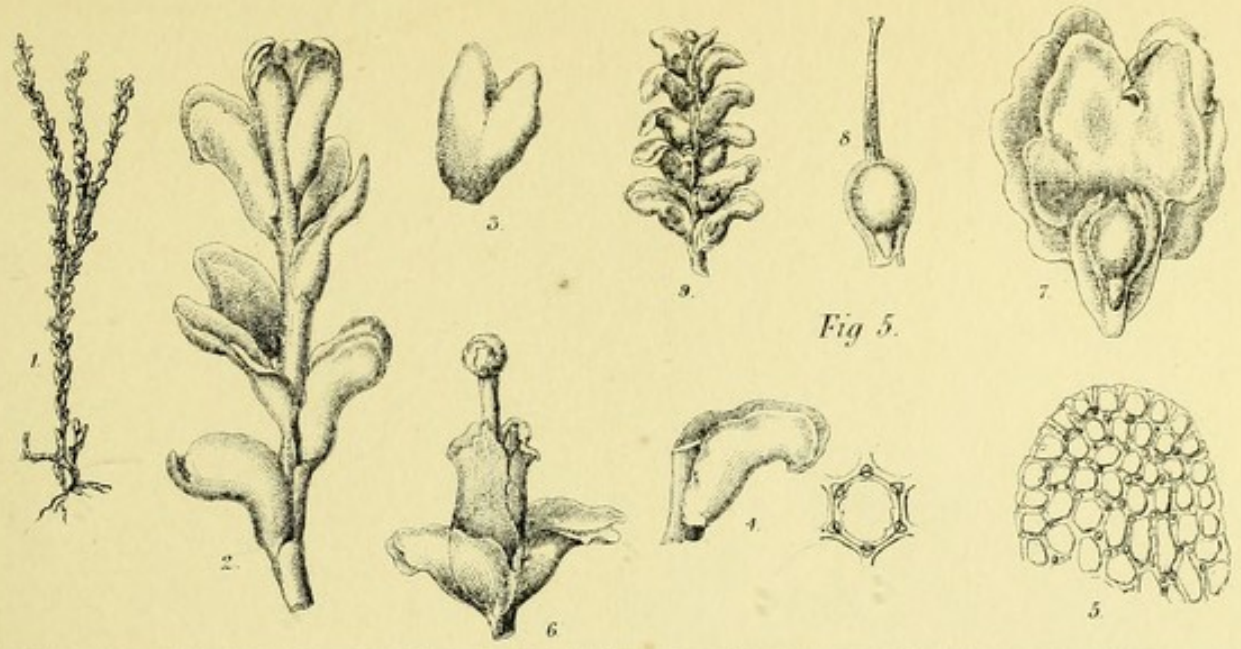


Fig 5.

Fig 6.

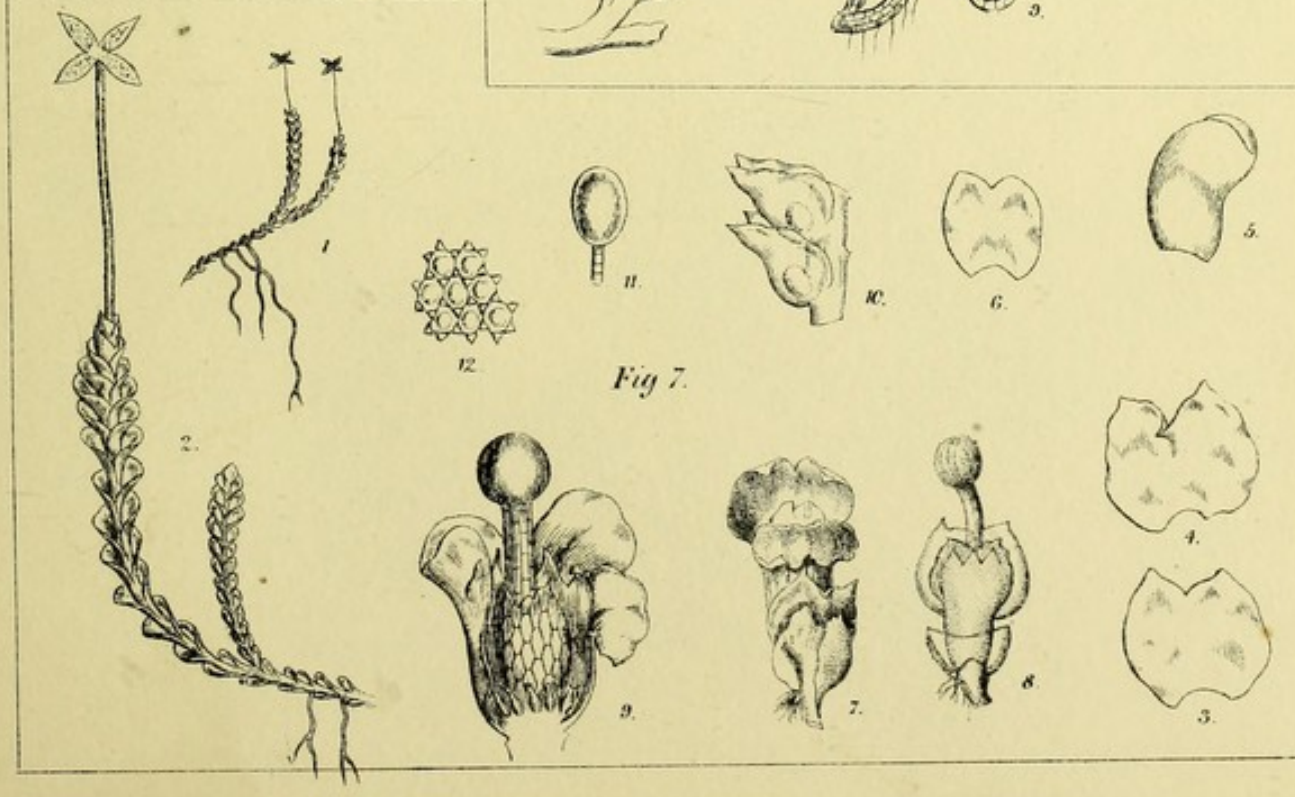


Fig 7.

Fig 8.

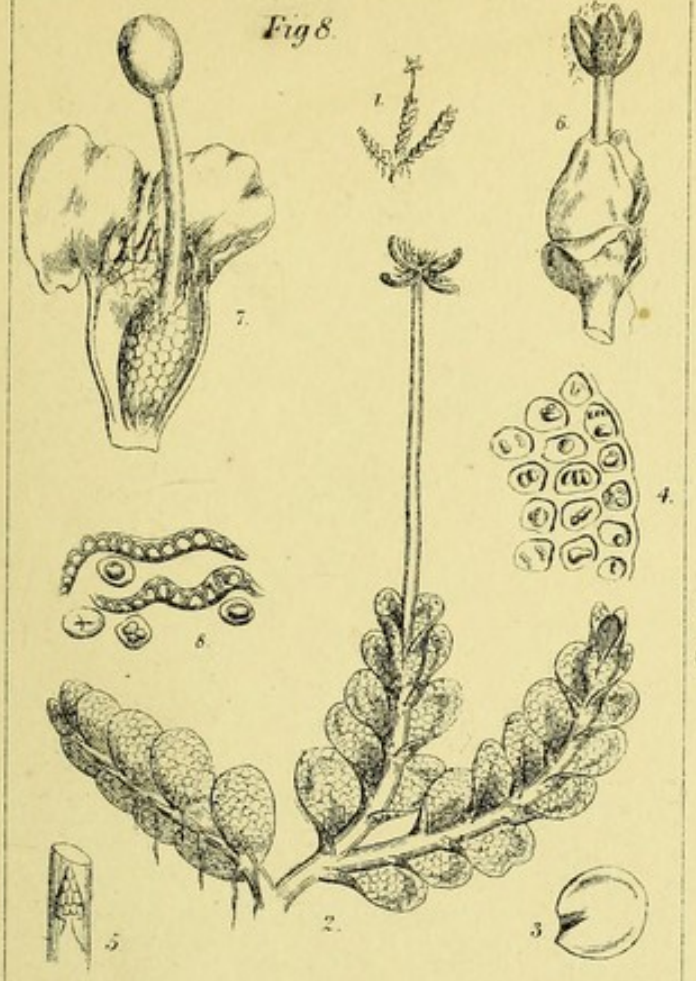


Fig 9.

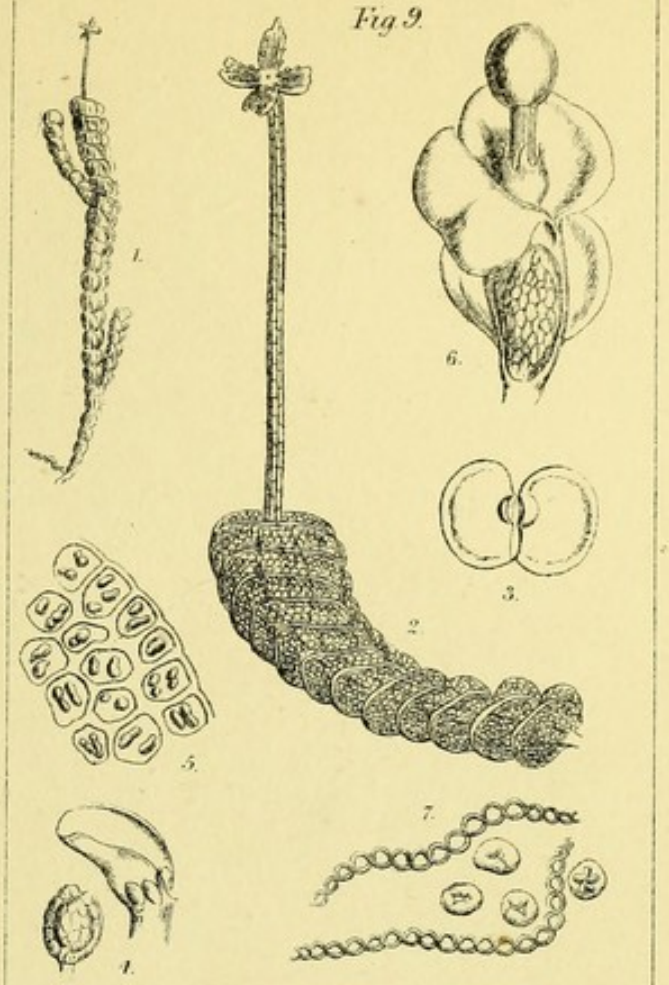


Fig 10.

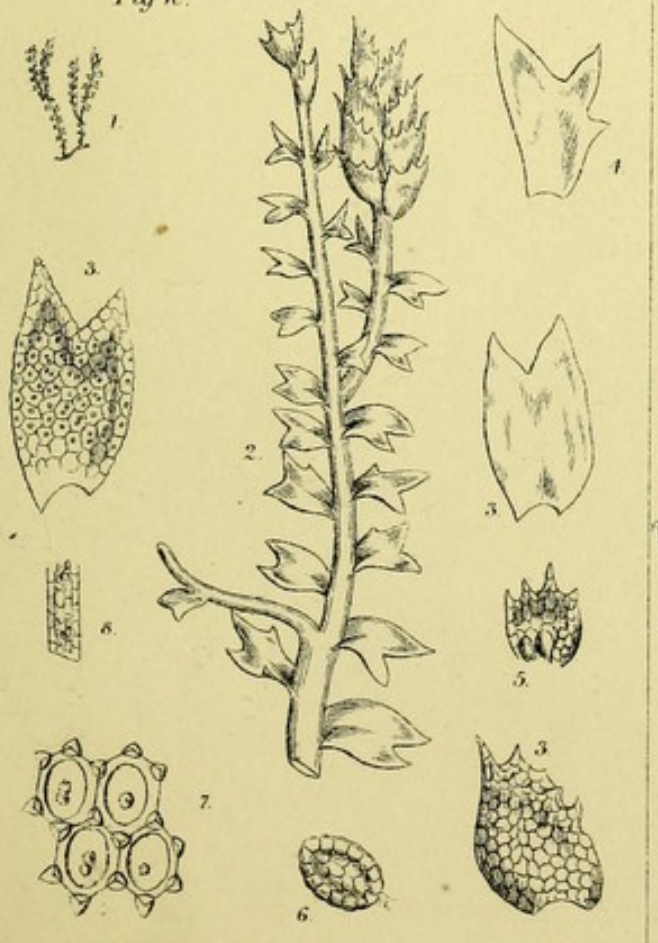


Fig 11.

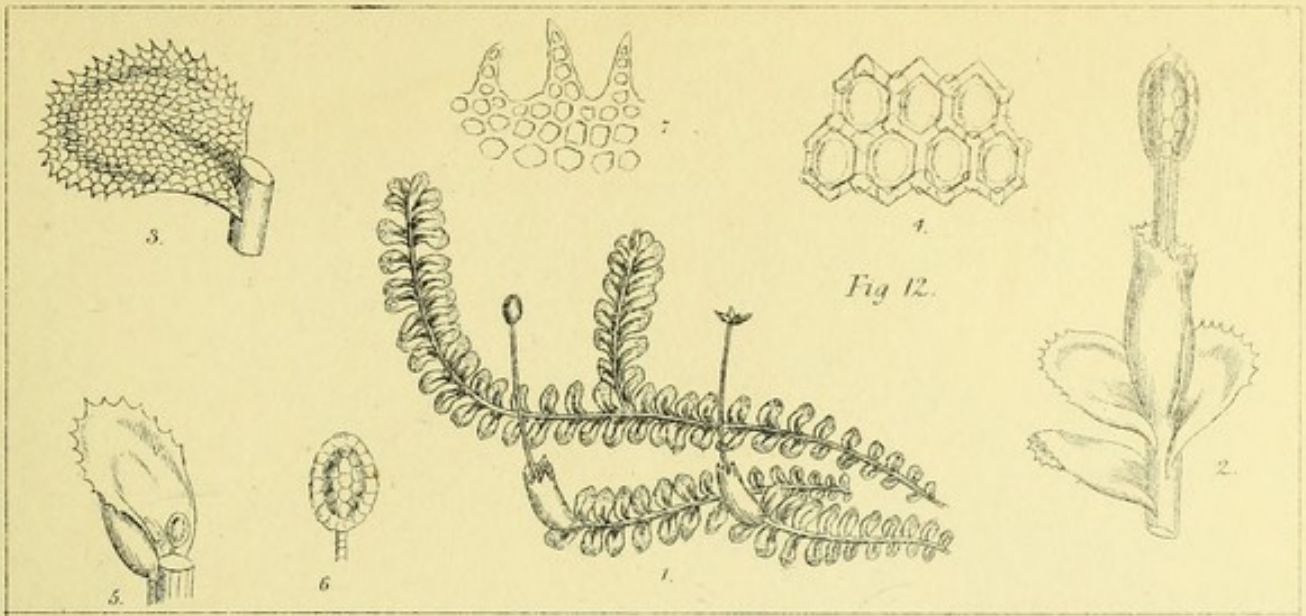

3.
7.
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Fig 12.
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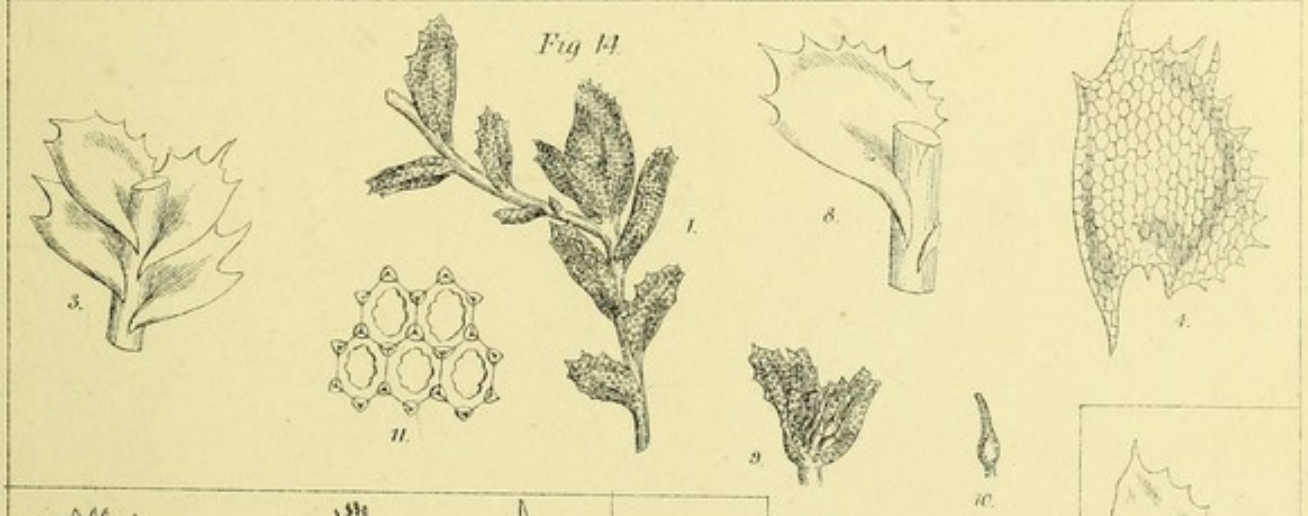
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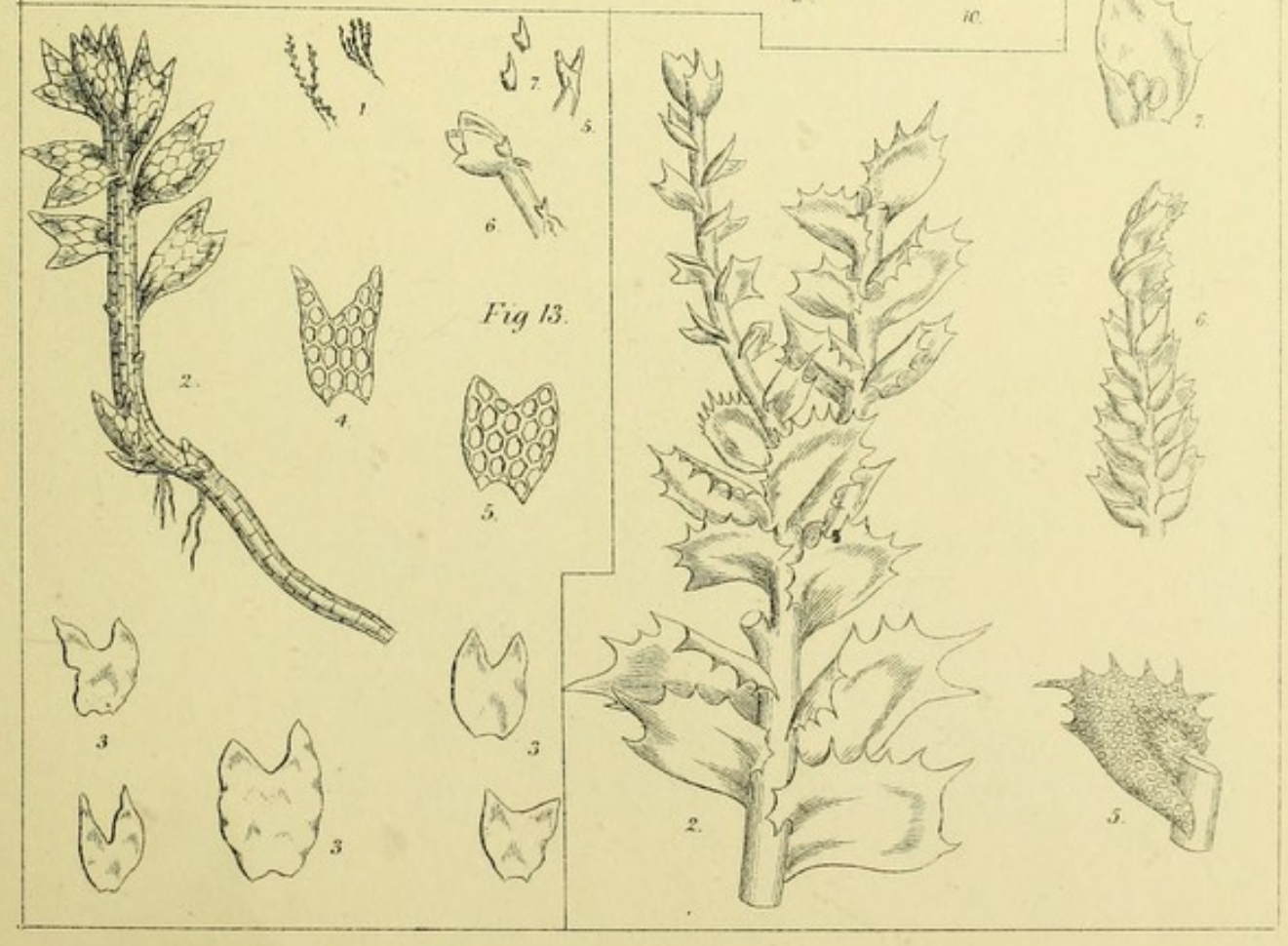
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Fig 13.
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Fig 15.

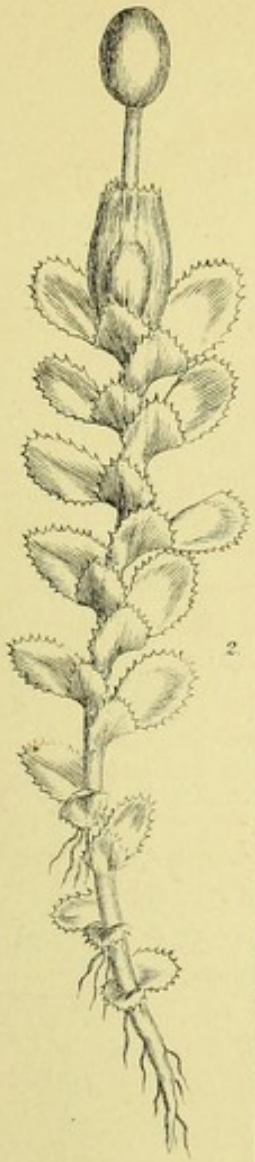
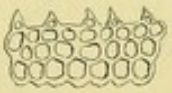






Fig 16

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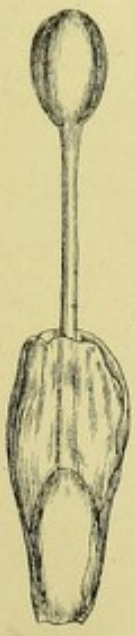



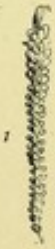


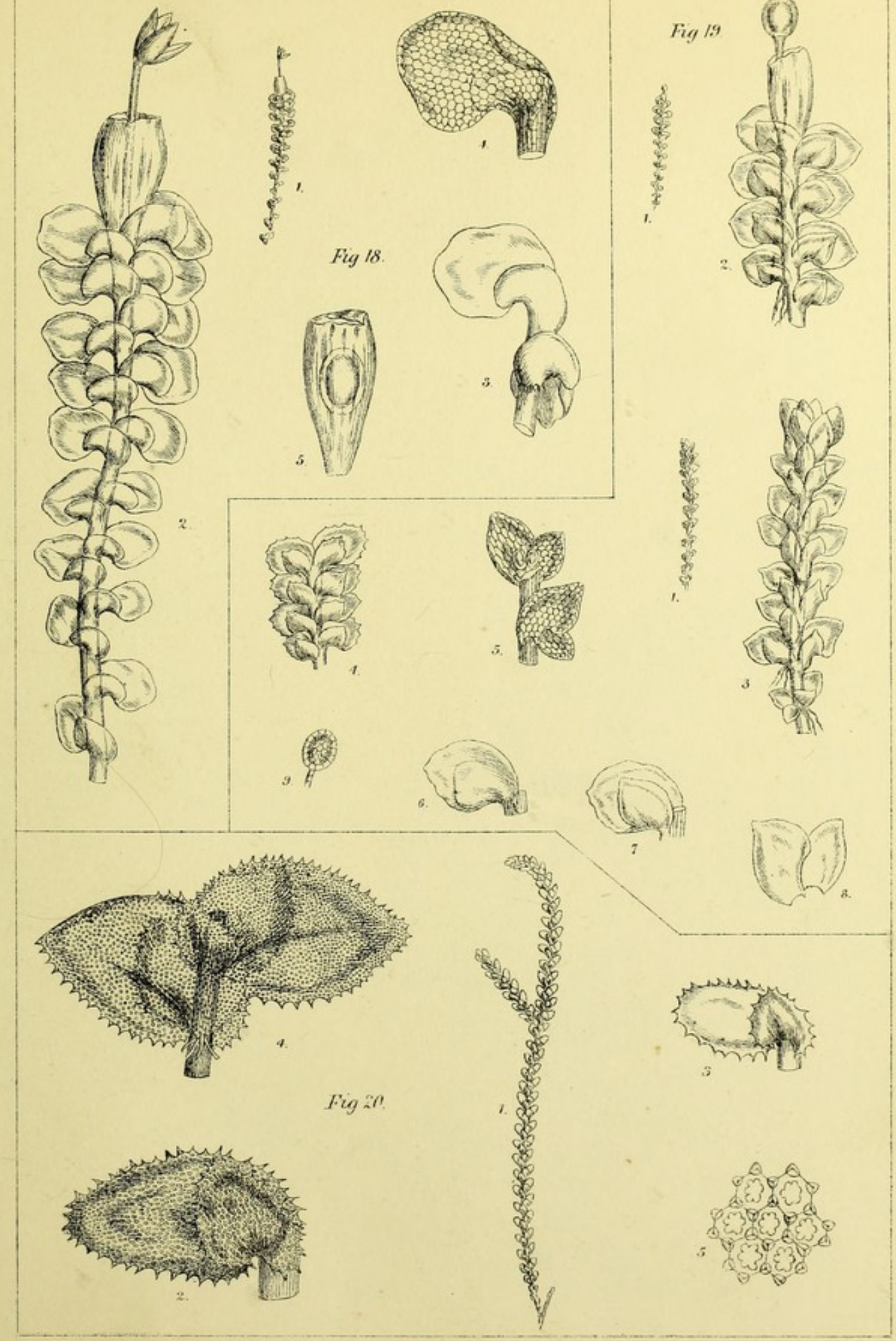
Fig 18.
Fig 19.
Fig 20.

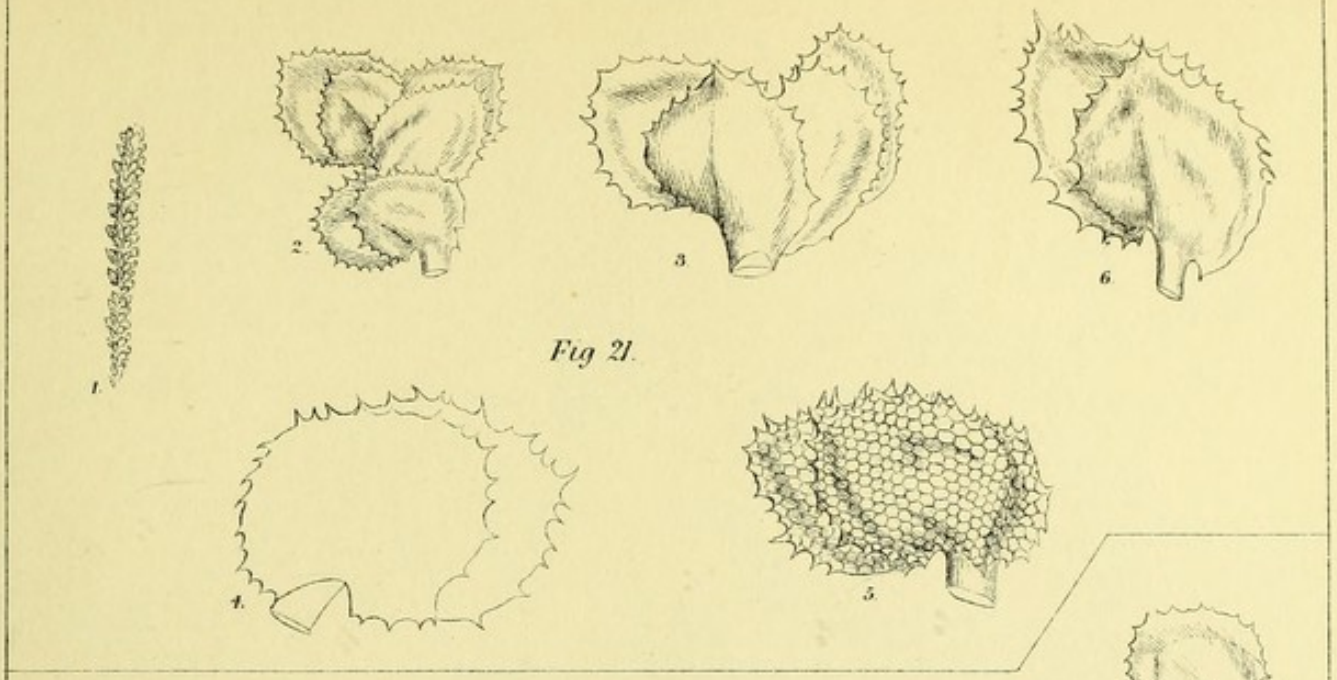

Fig 21.

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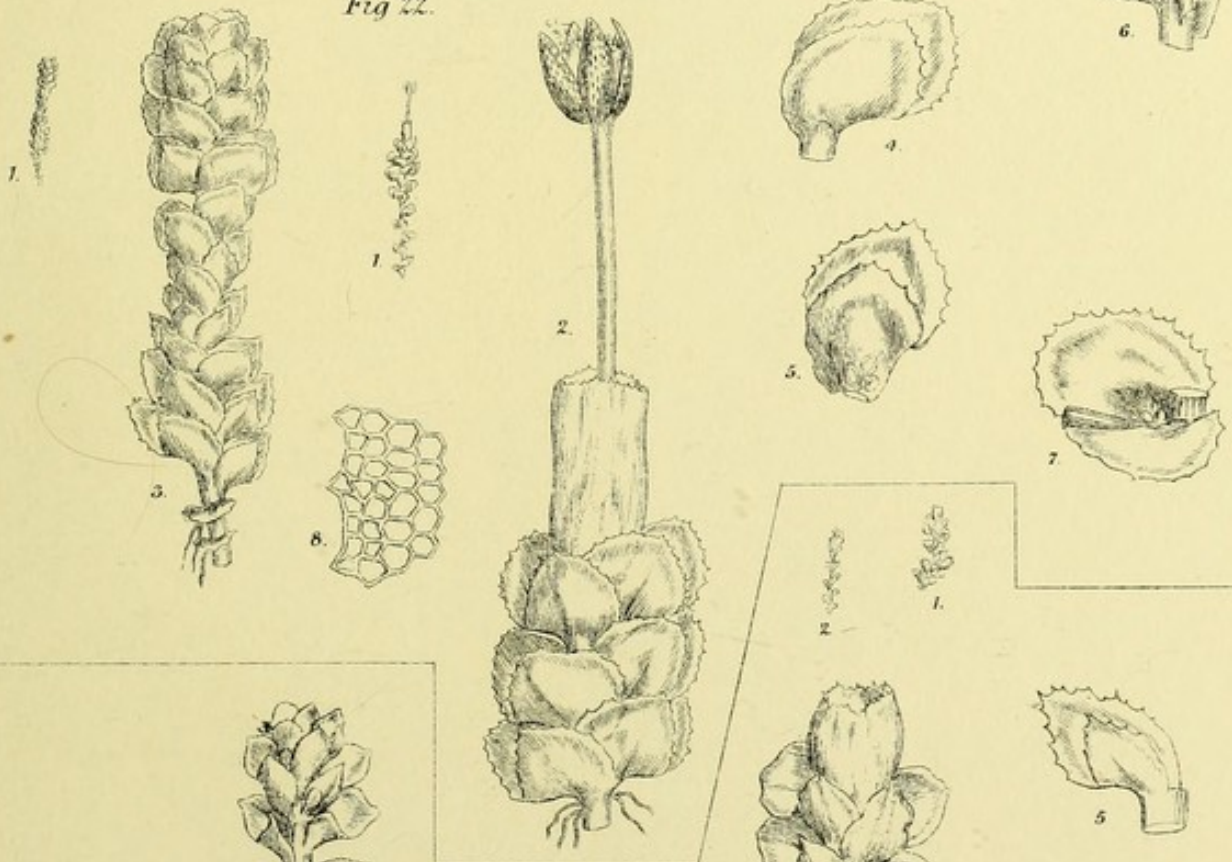


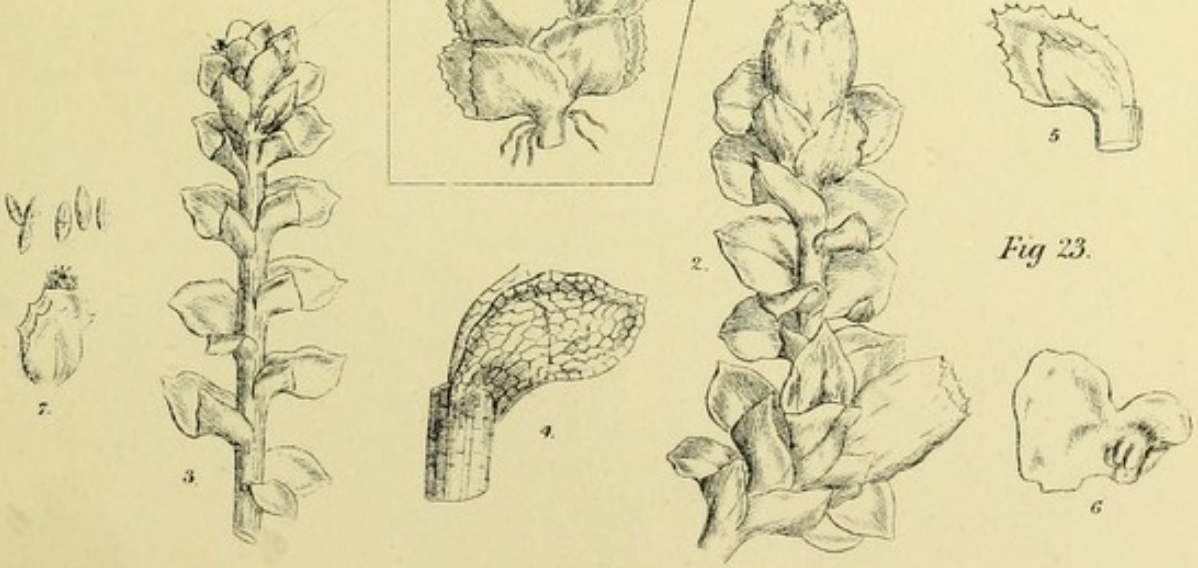
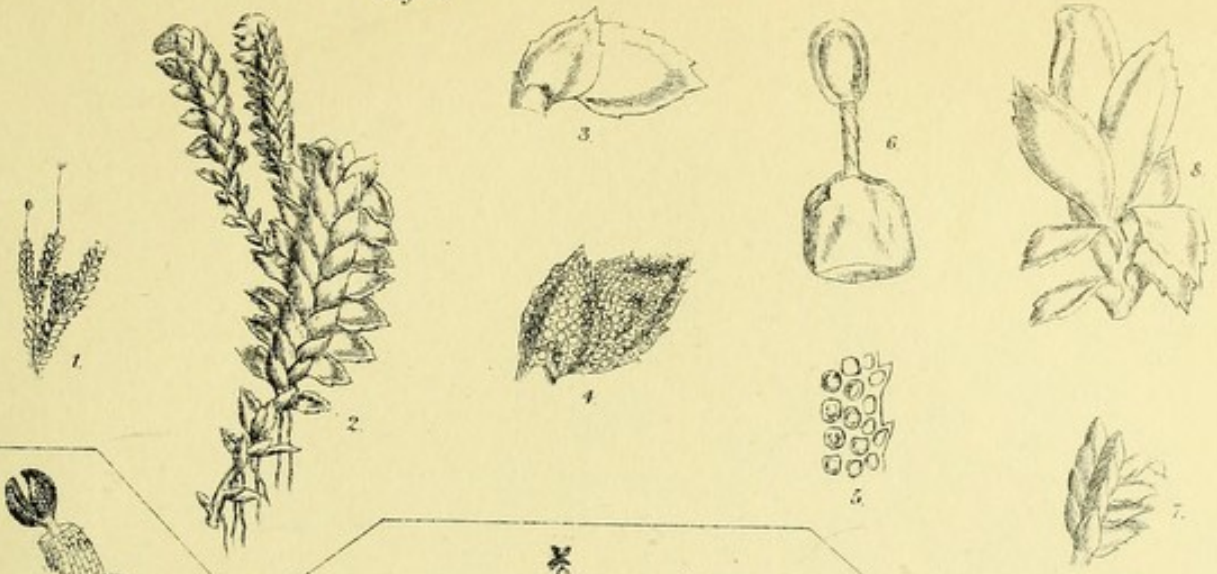


Fig 23.

Fig 24.



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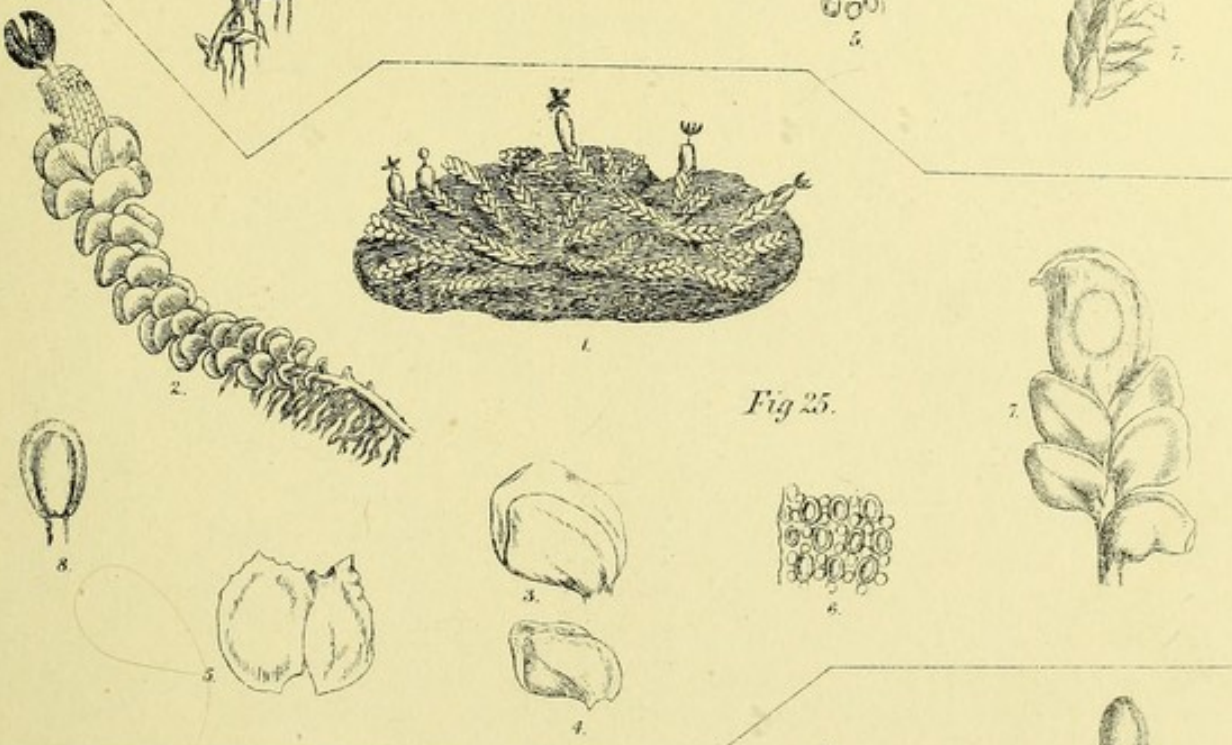

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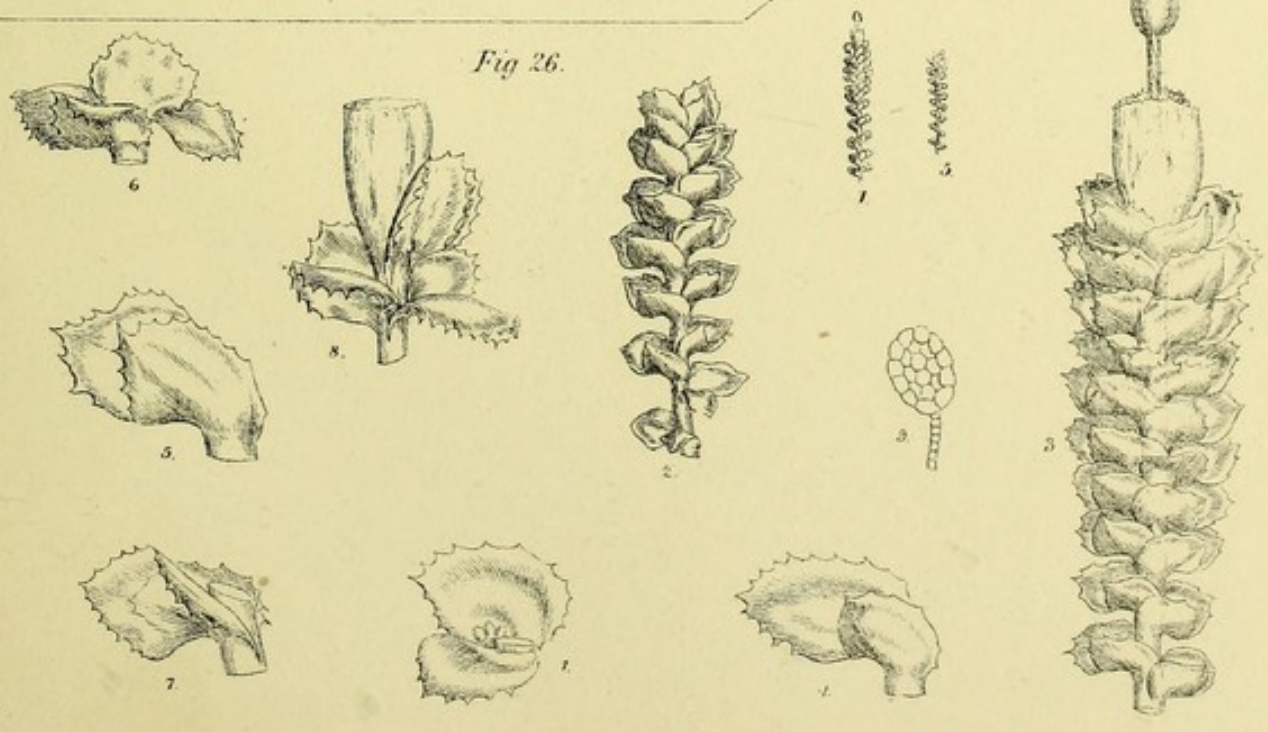

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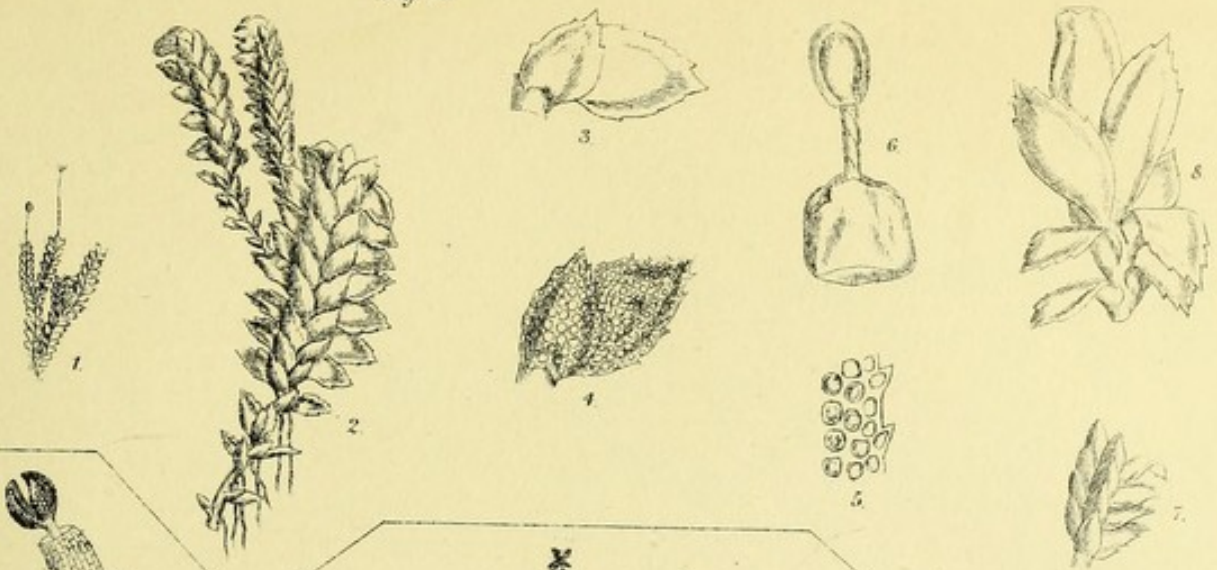

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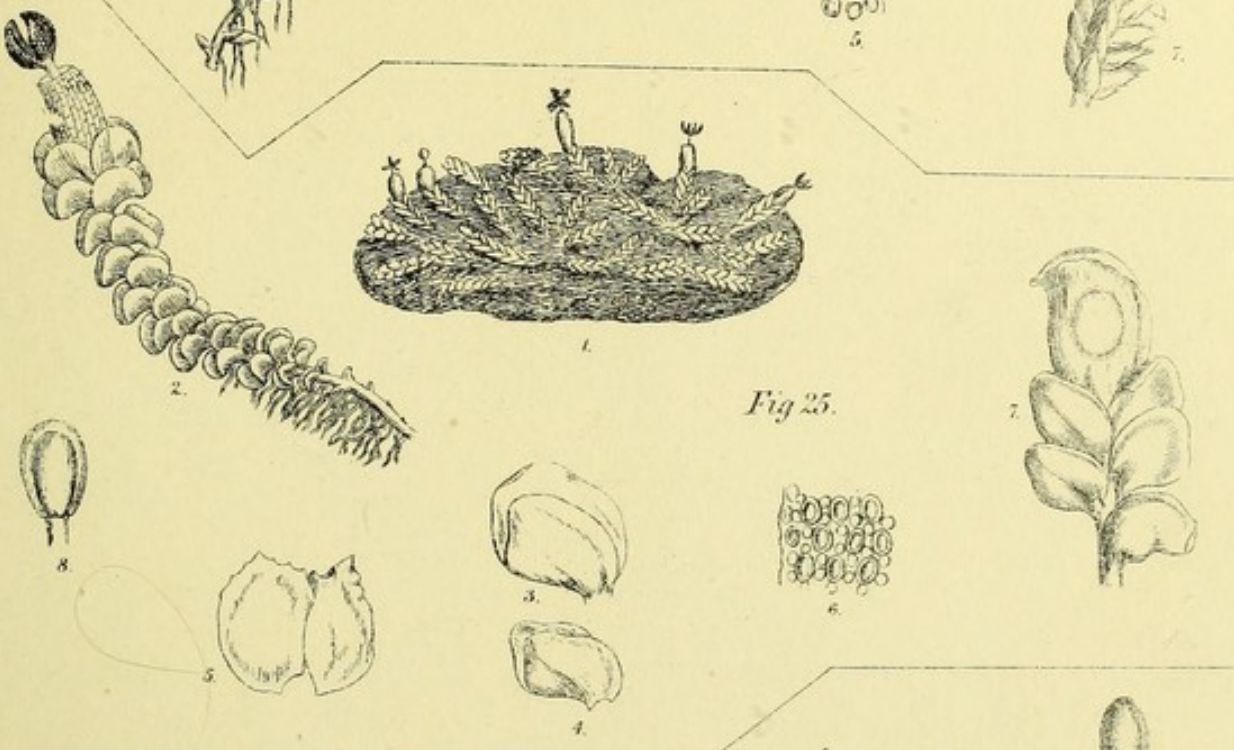

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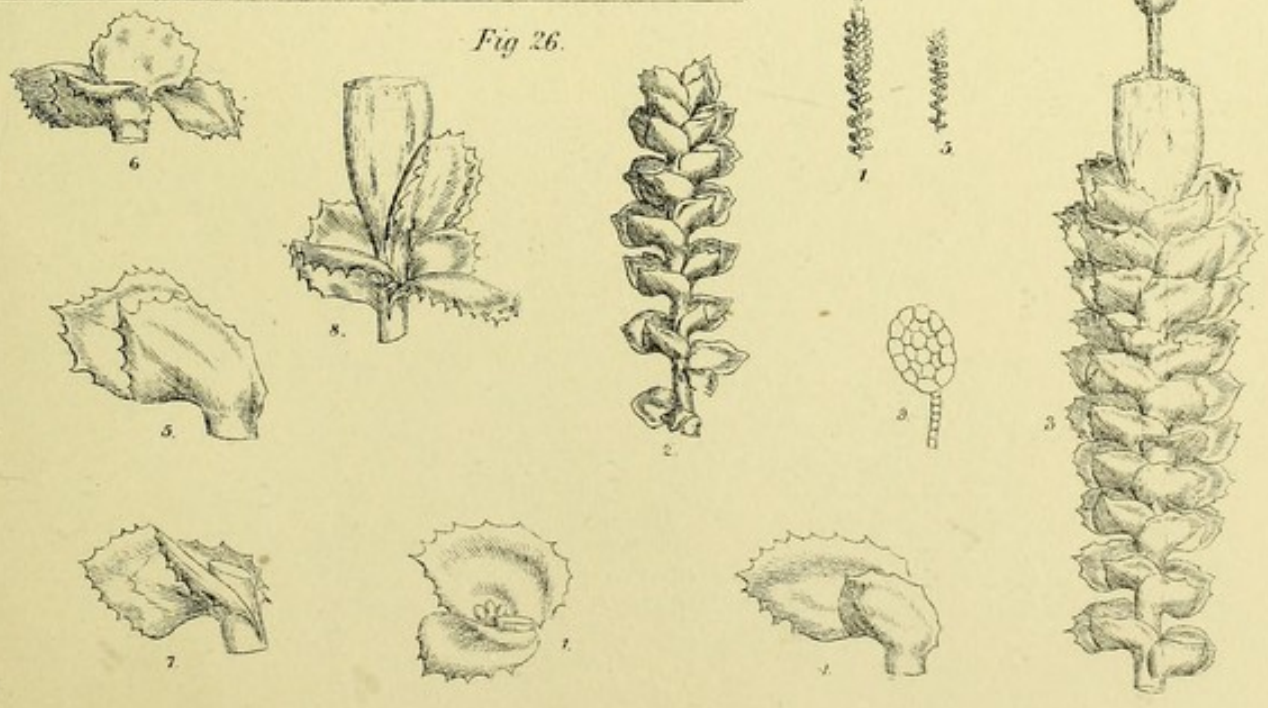

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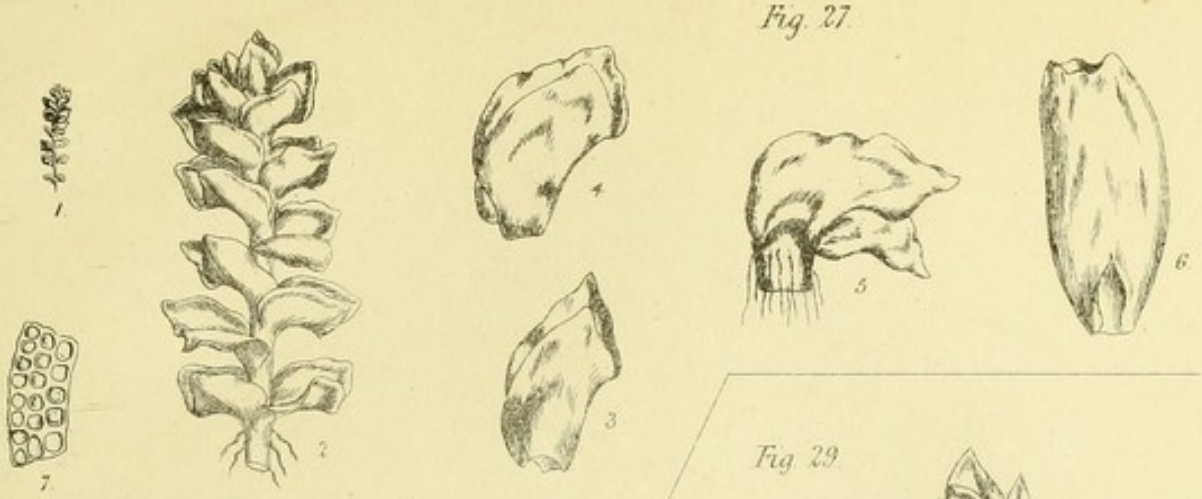

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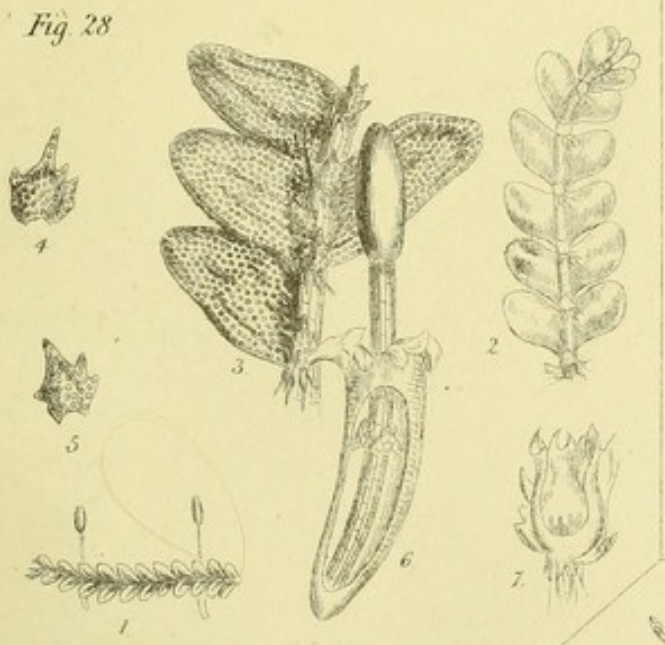

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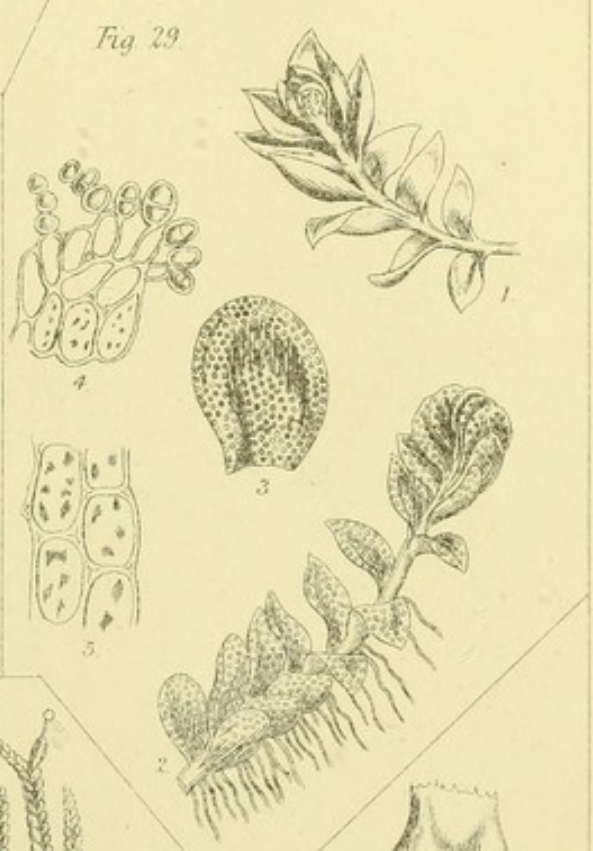

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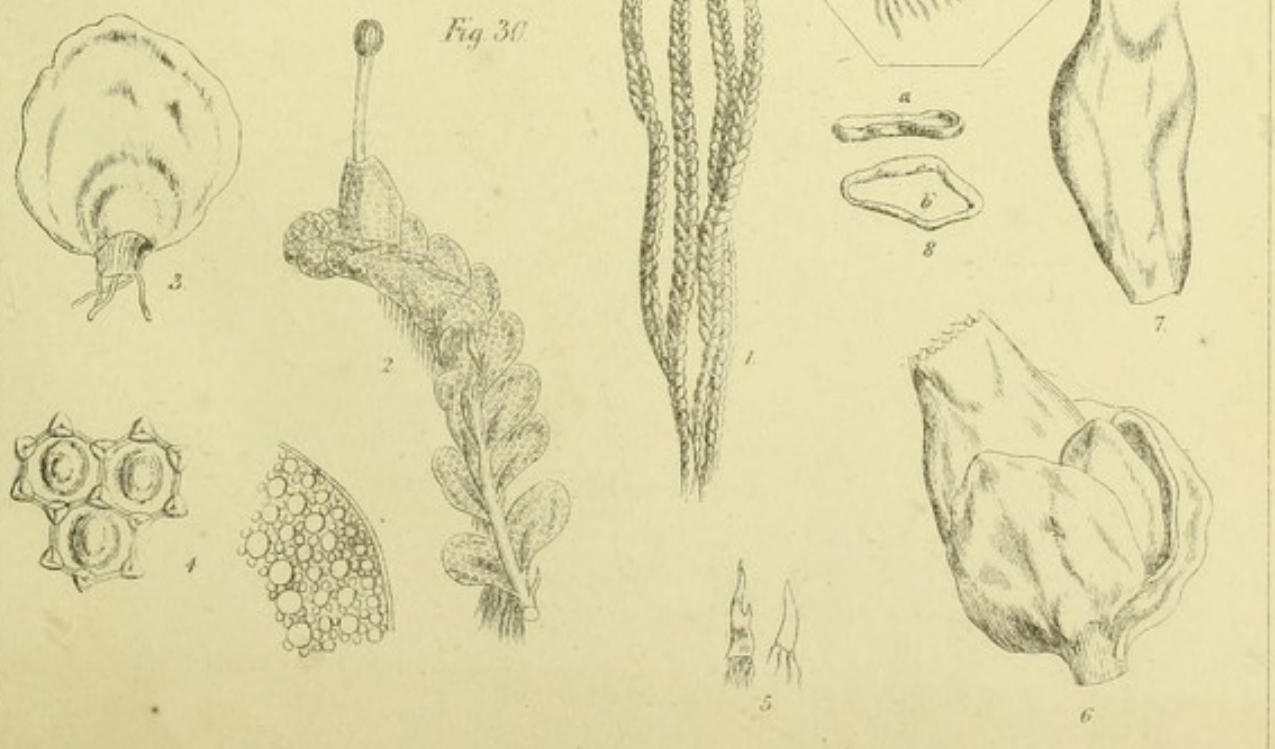


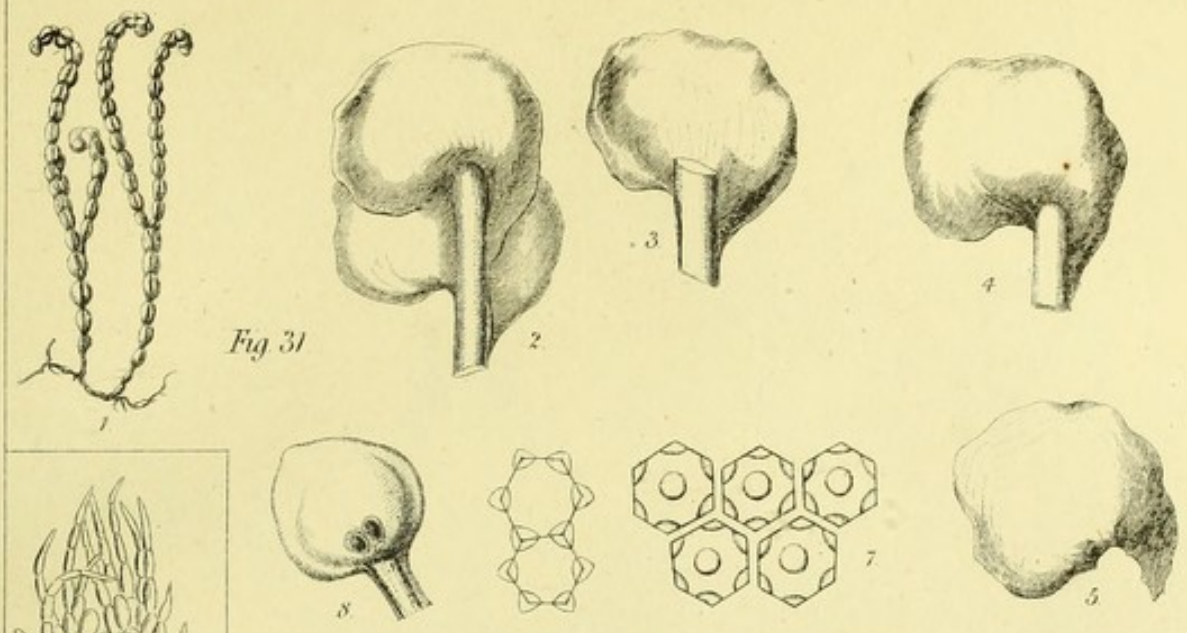
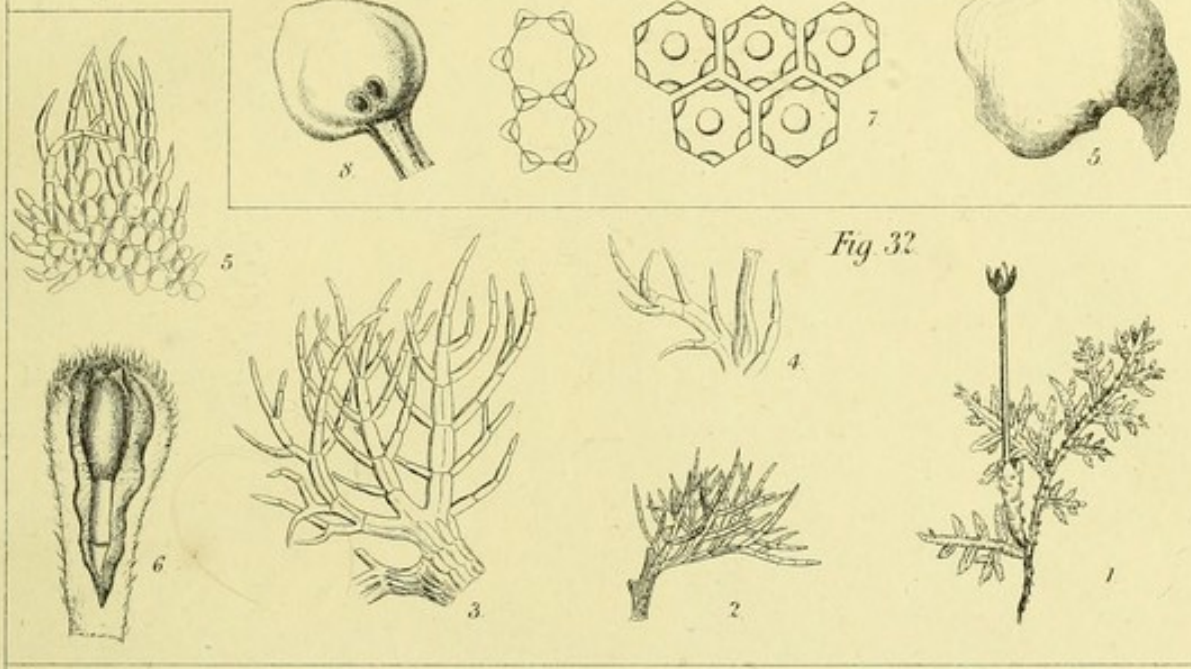


Fig 31



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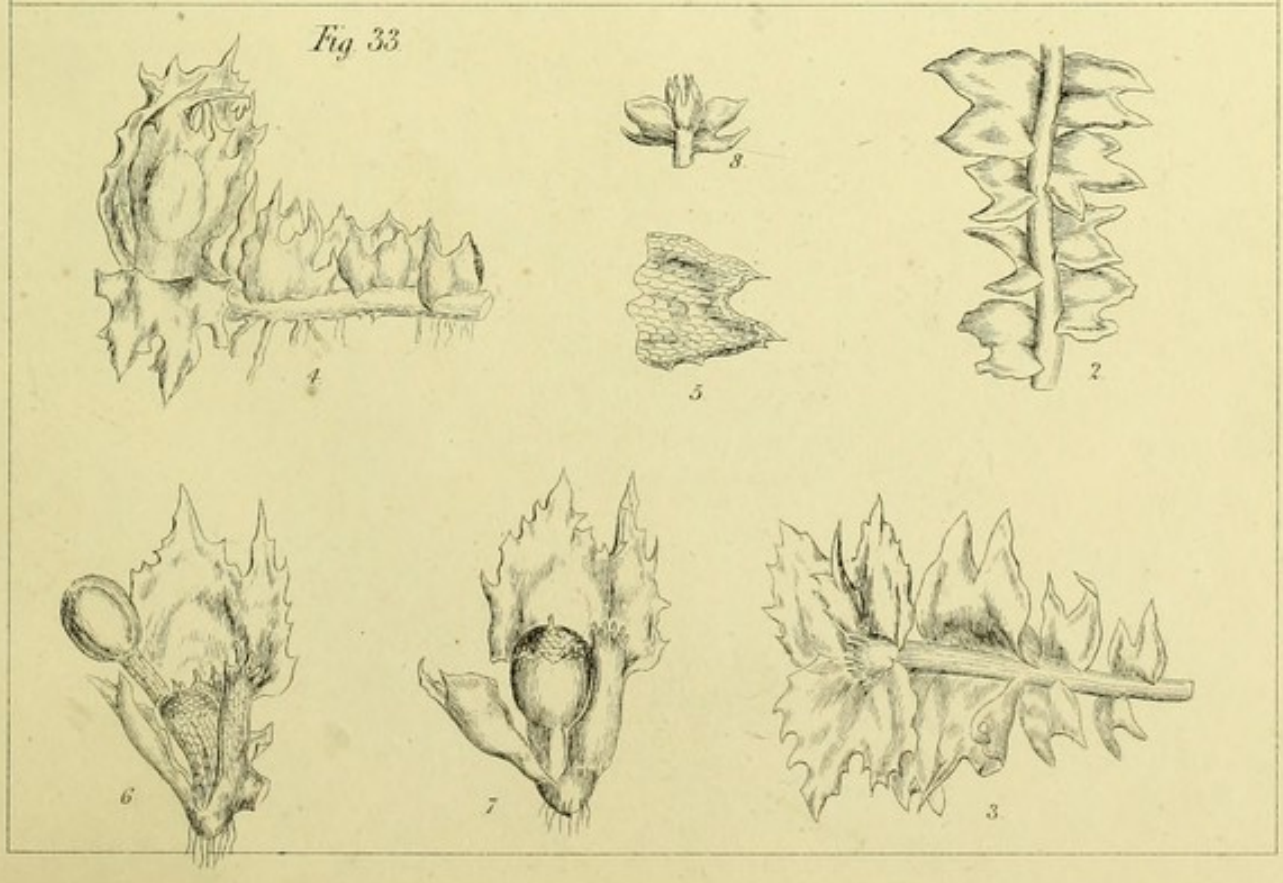
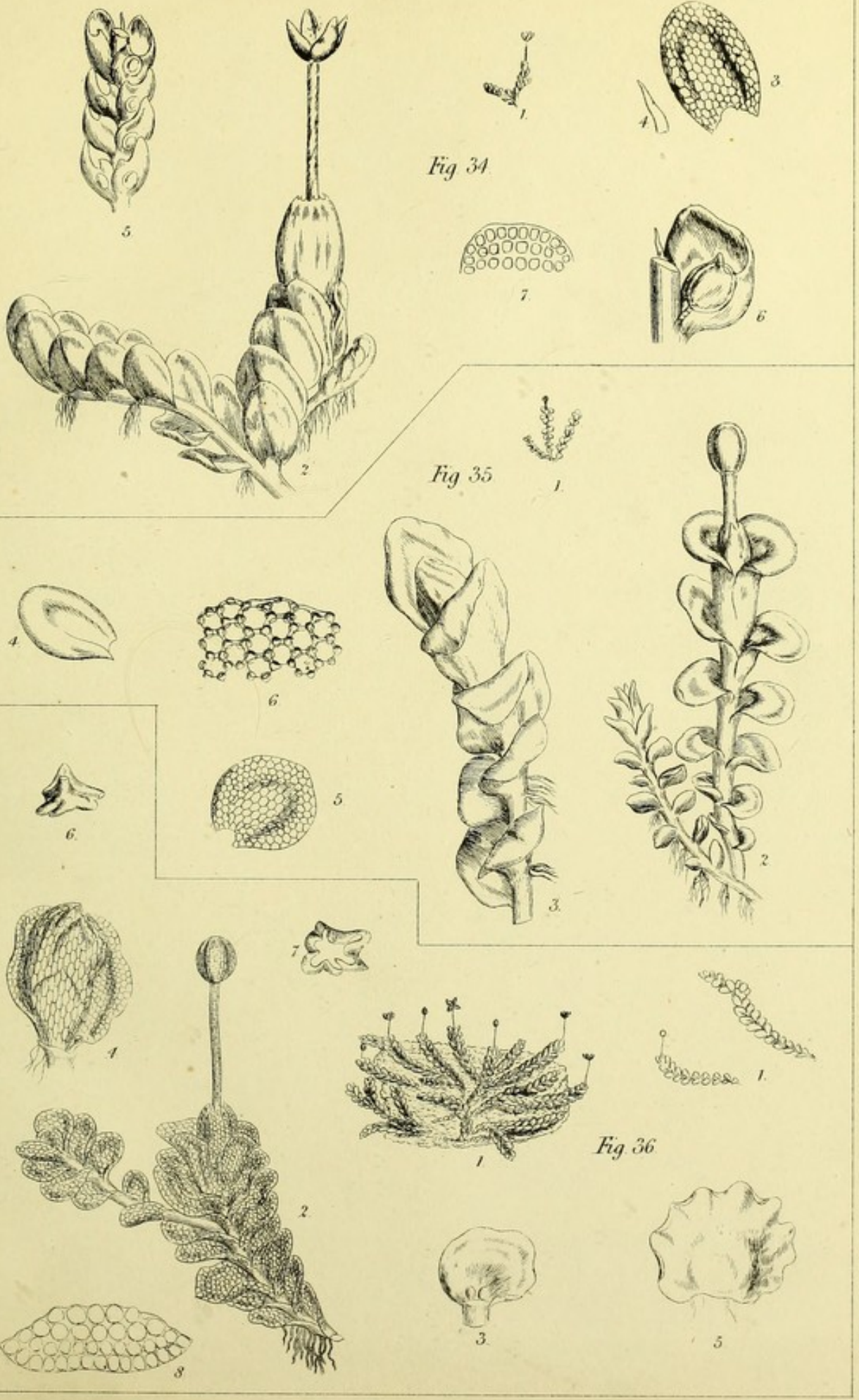


Fig 33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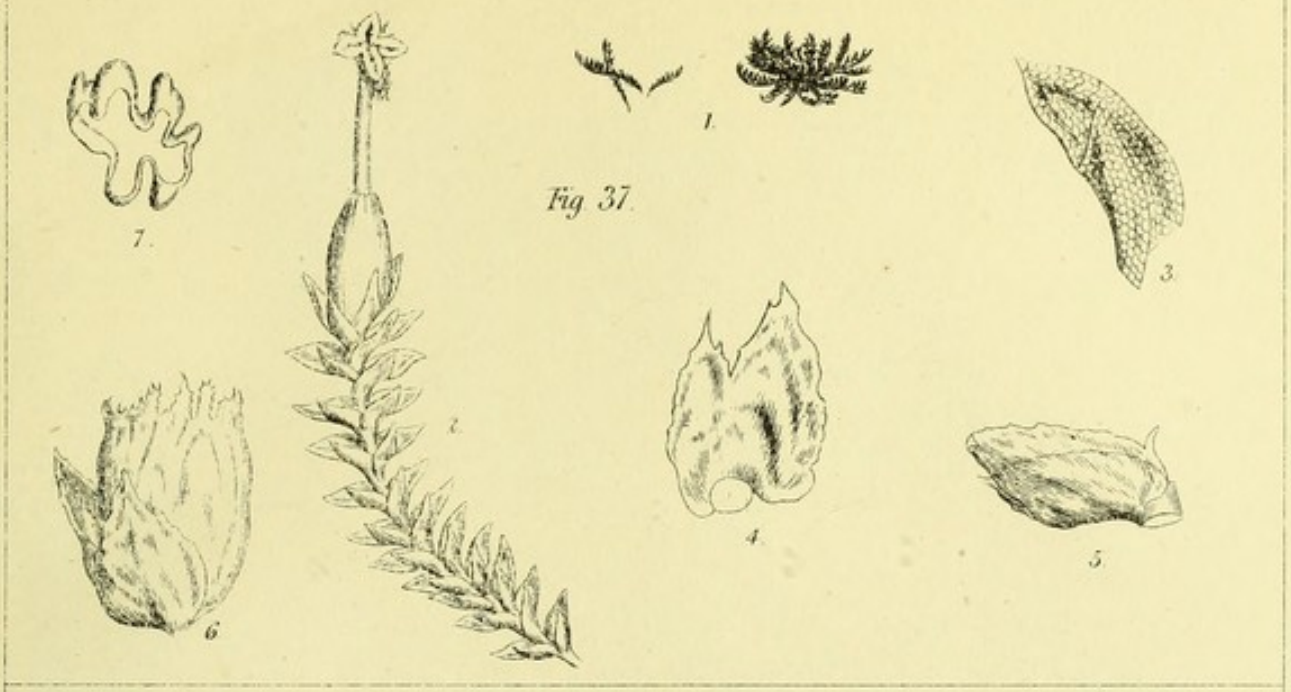

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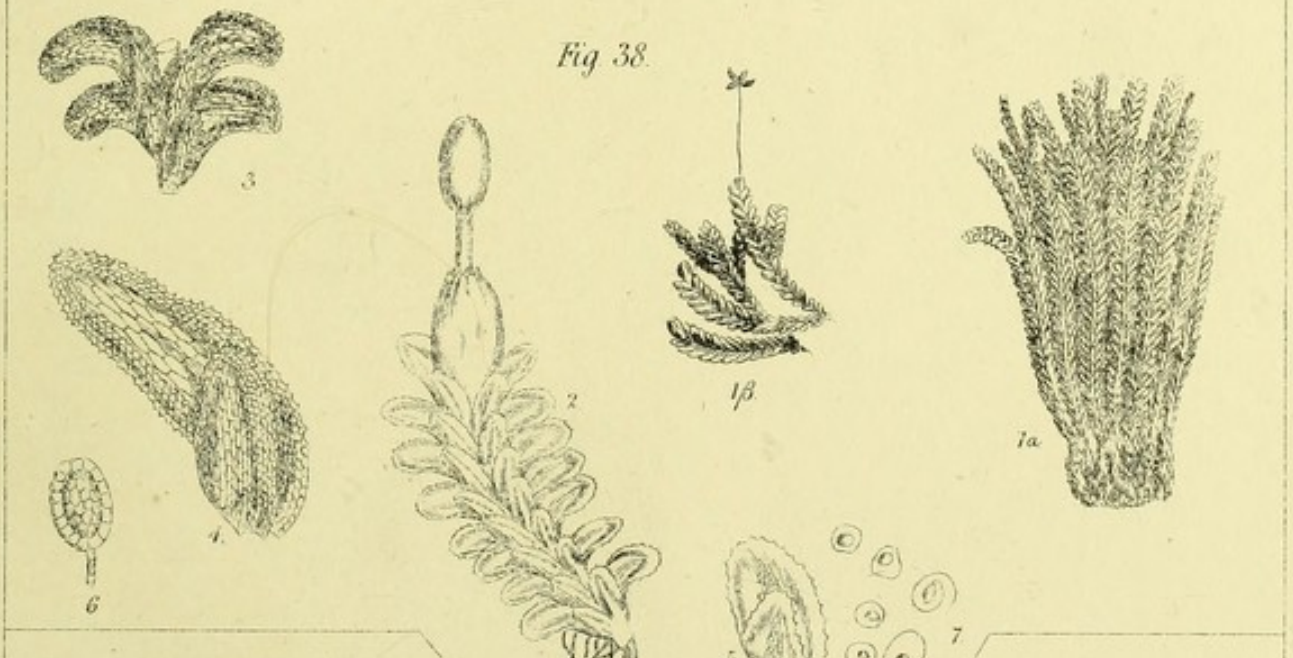

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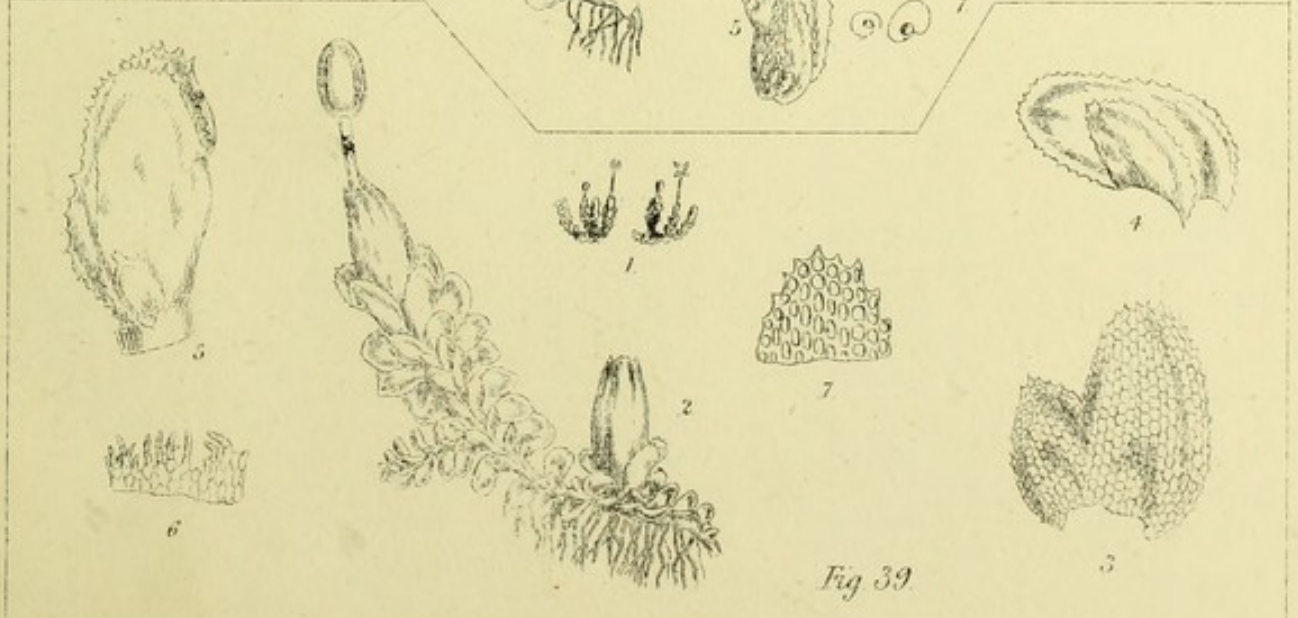

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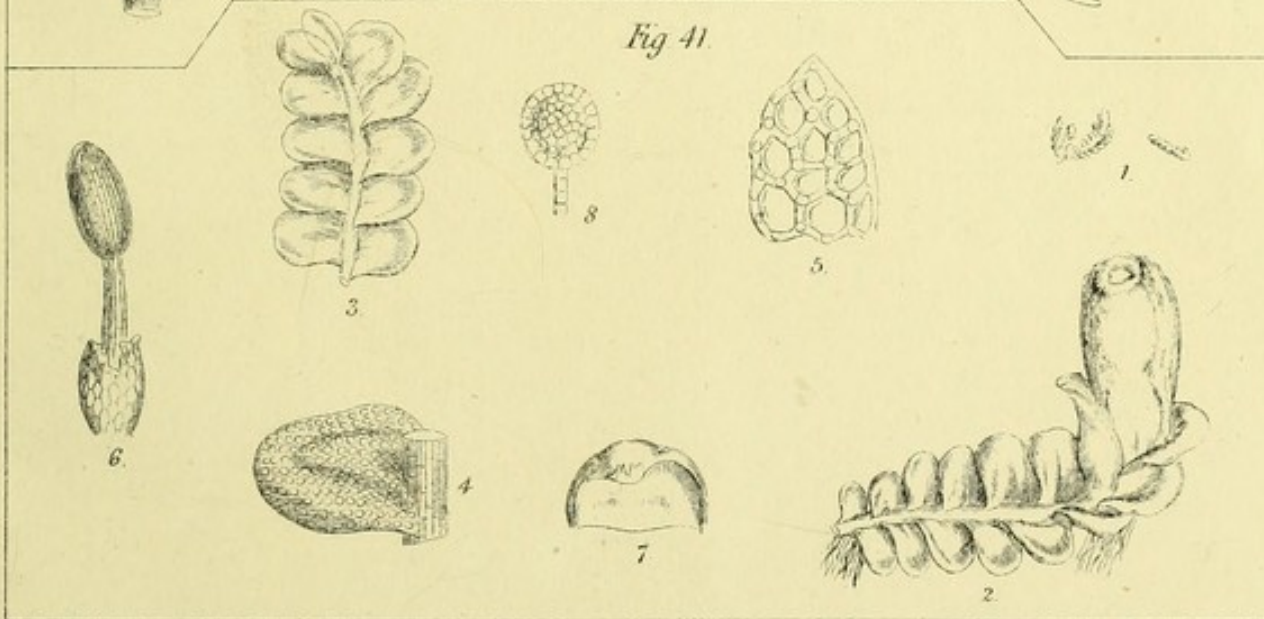

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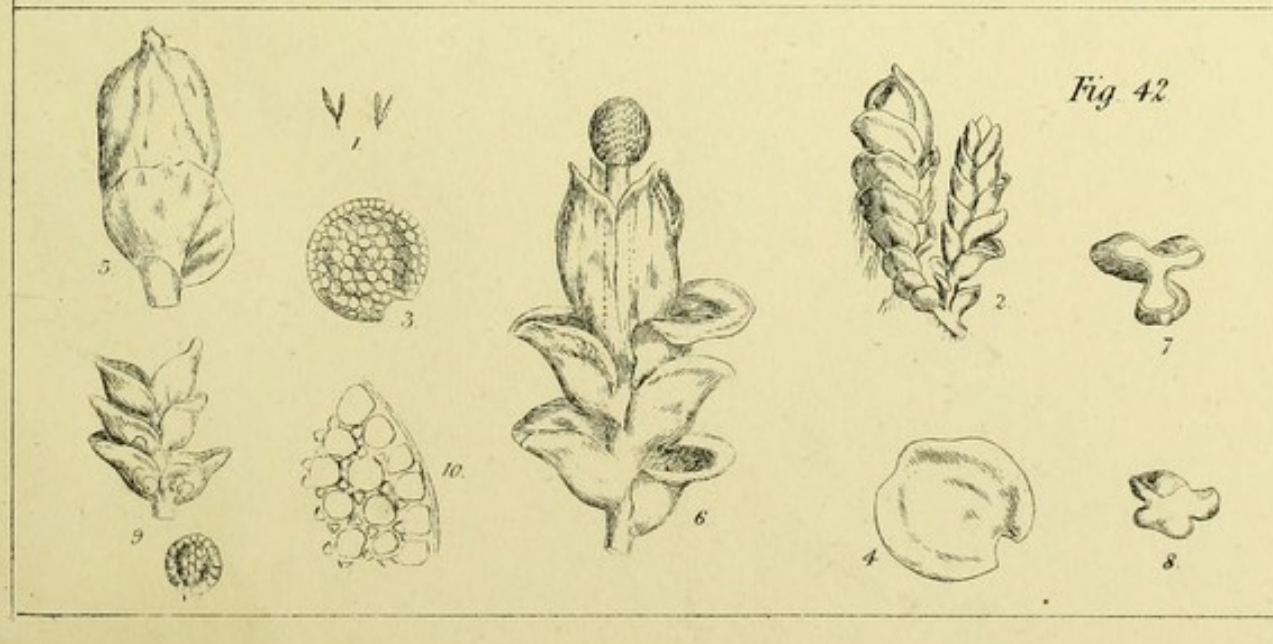

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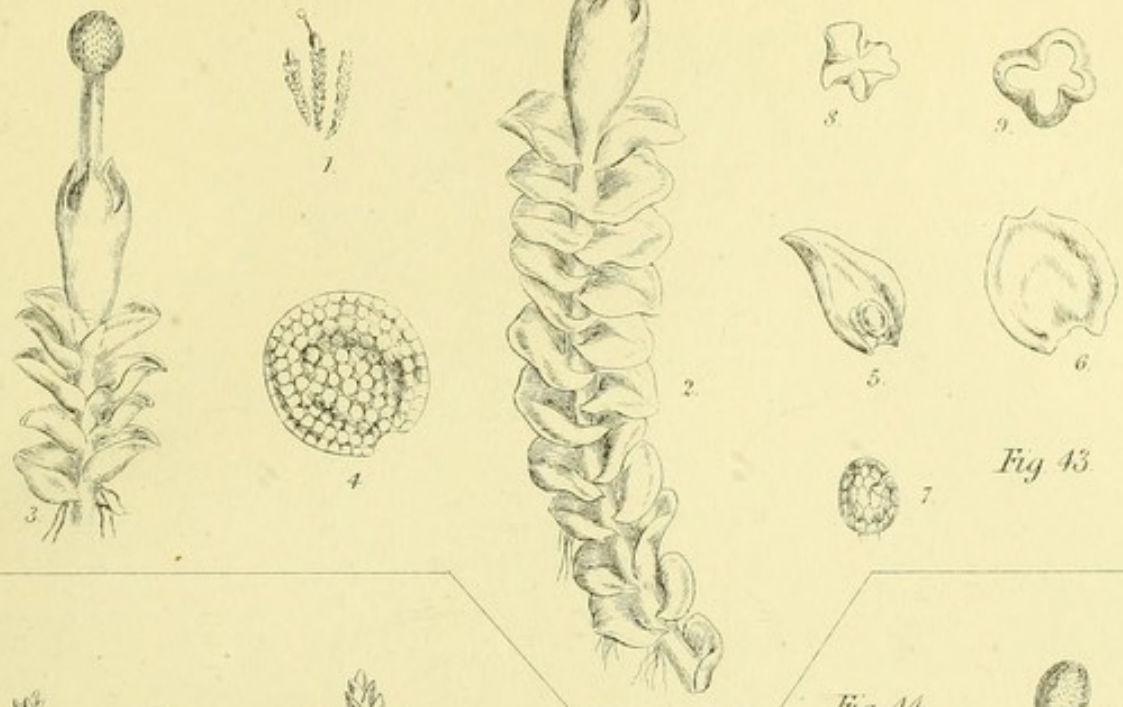

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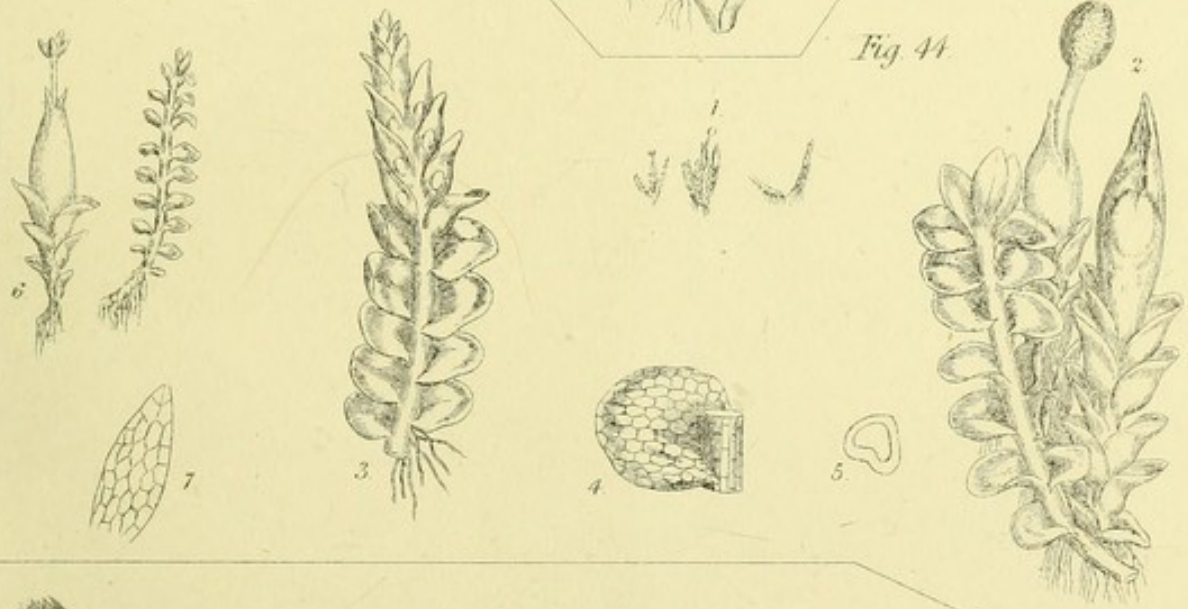

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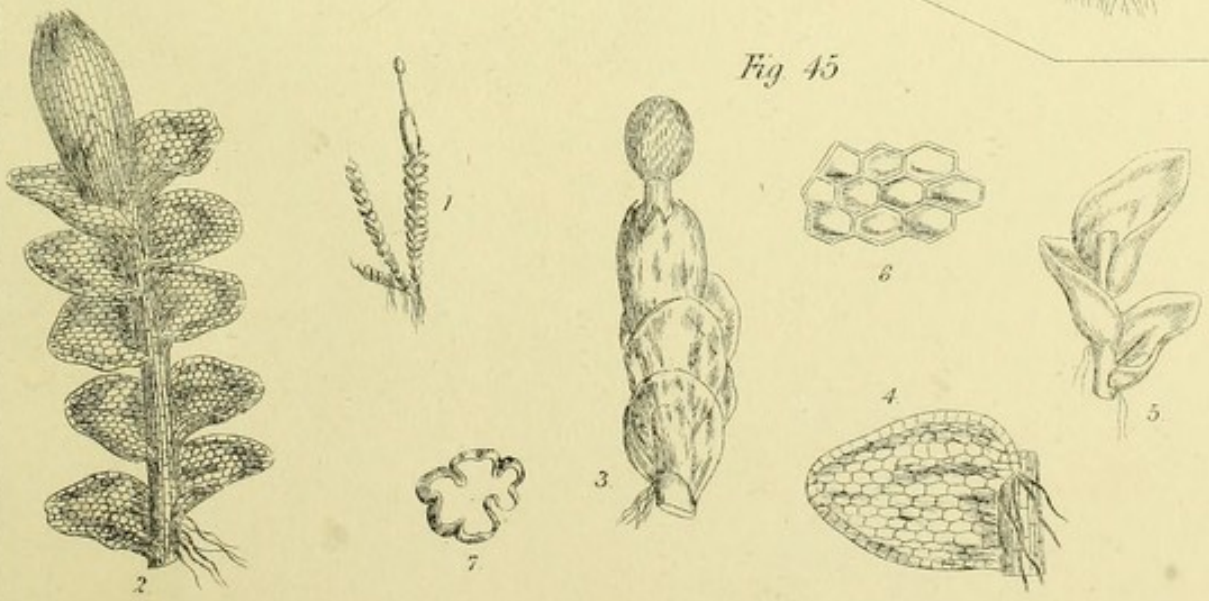


Fig 45

Fig 46

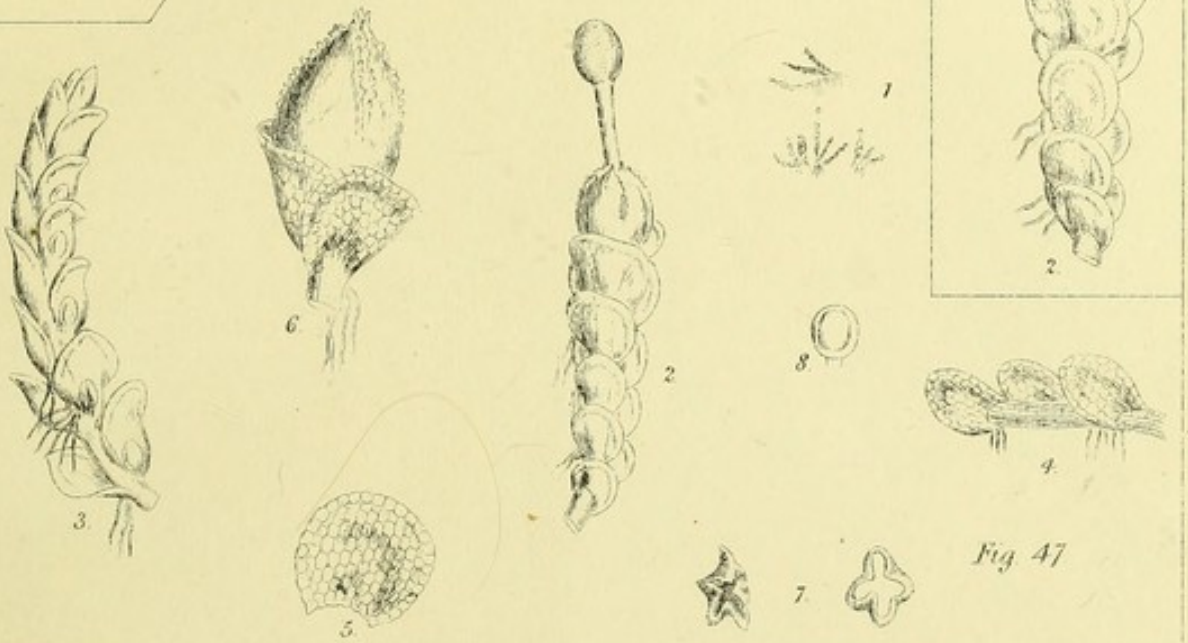
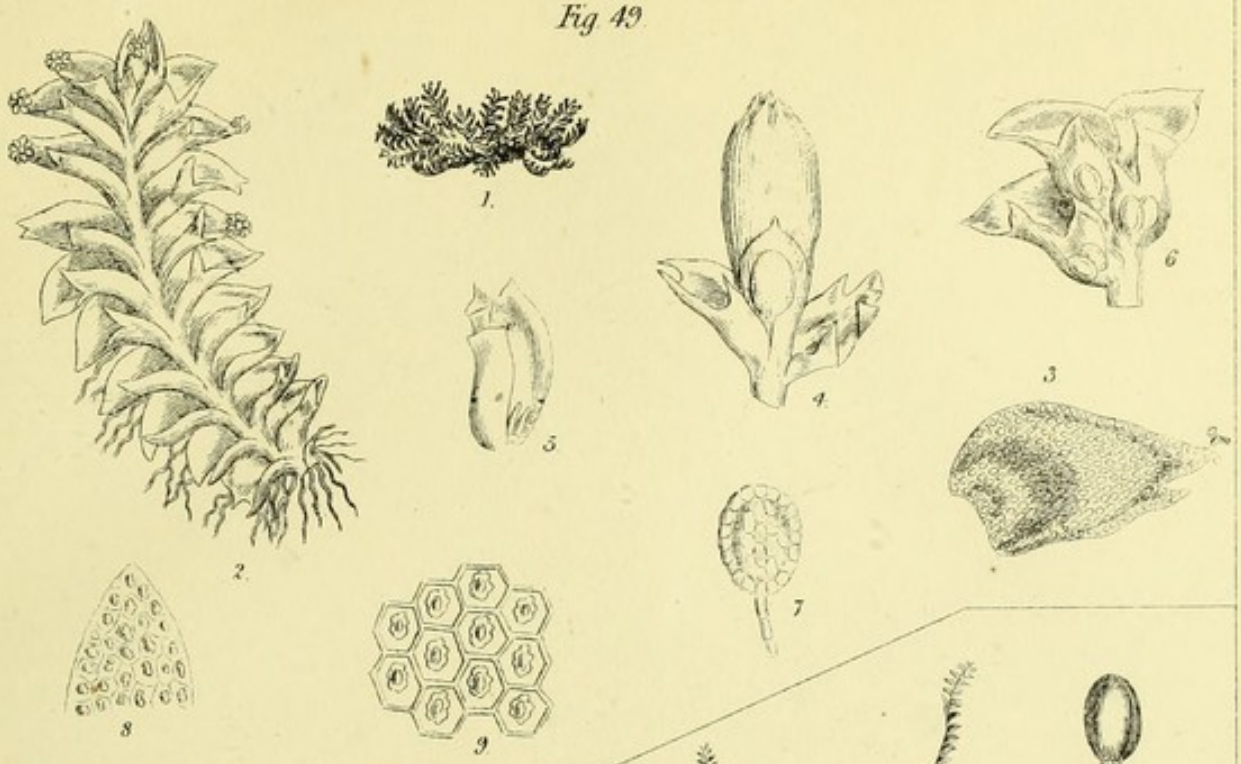


Fig 47

Fig 48

Fig 49



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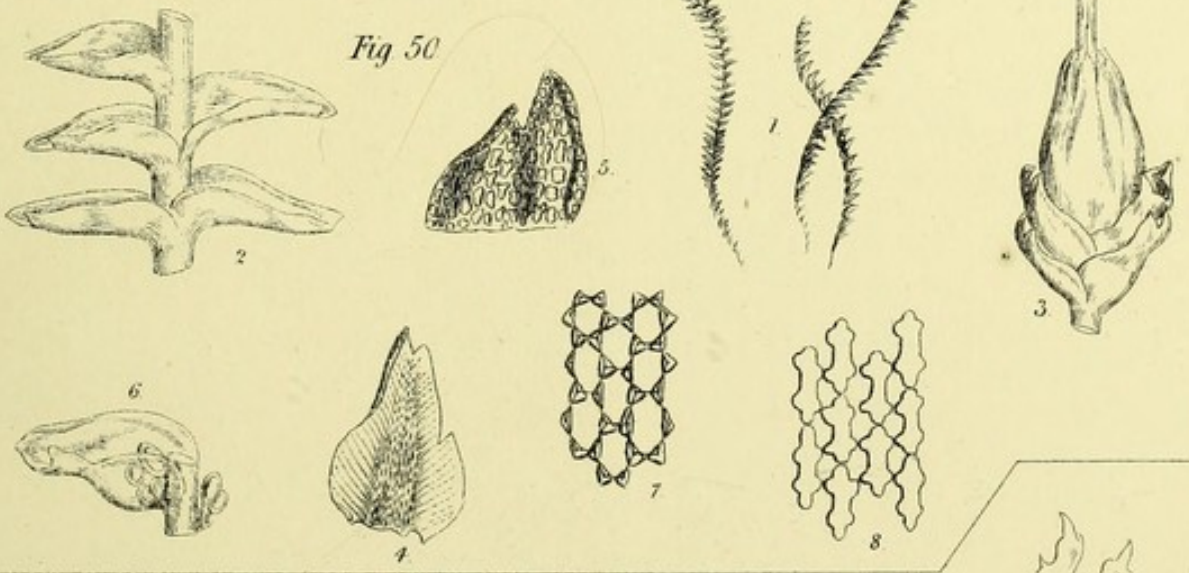

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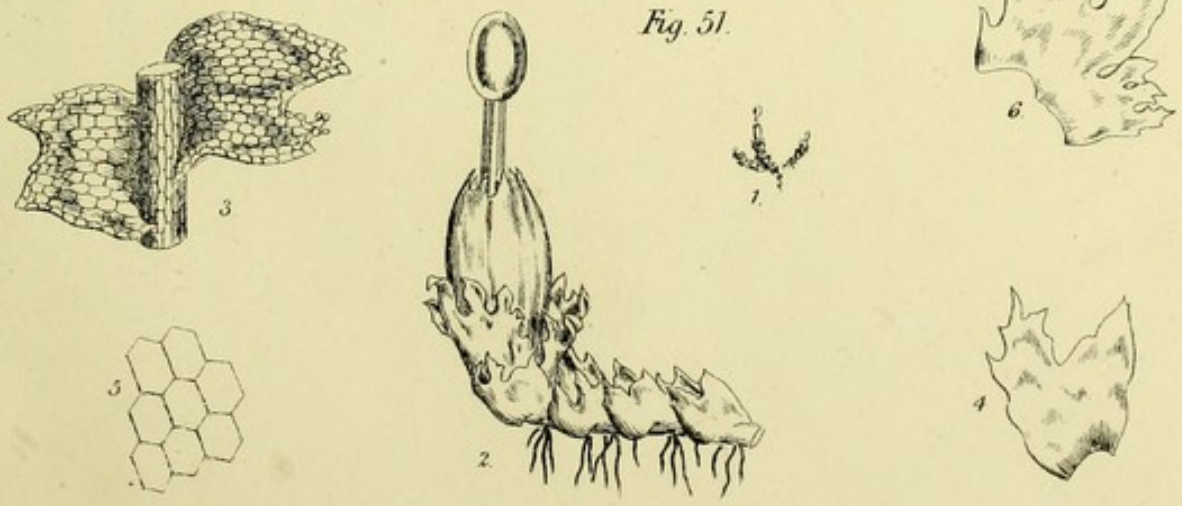

Adelanthus Lindenbergii
Ben Voirlich by Loch Lomond

2/3 way up boggy ground near lake
D Carr

Ly calyptrifolia Waterfall Rhaidr Aber
wet Shady rocks Nr Cascade
Type 9 spors

Jub Hutchinsiae
by Side Stream 1 Mile Dalmally
abundant