The Genus *Trichocolea* in New Zealand

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Abstract

Introduction—Description of Genus—Key to species—Description of four species including one new species, *T. julacea*—Notes on ecology and distribution records for each species.

Introduction

The genus *Trichocolea,* with four species in New Zealand, is of nearly world wide distribution. It is best represented in the tropics and, while only a single species is known from the North Temperate Zone, more than a dozen have been described from the South Temperate Zone.* Formerly a member of the Ptilidiaceae, the genus has more recently been segregated as a new family, the Trichocoleaceae (K. Müller, 1954, p 586) based upon the development of a coelocaule or stem parianth and the absence of a true parianth.

I wish to express my appreciation to Prof. W. R. Philipson, of the Botany Department, University of Canterbury, for his generous co-operation and assistance in this work; to Mrs. E. A. Hodgson, of Wairoa, and Mr. K. W Allison, of Dunedin, for the loan of their extensive collections; and to the Botany Division, Department of Scientific and Industrial Research, Christchurch, for permitting me to examine their collections. I am indeed grateful to Mrs Hodgson for her many valuable suggestions and for the use of her library.

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Thanks are due also to the Farlow Herbarium, Harvard University, for the loan of the original material of Stephani's *Trichocolea australis* and to the Herbarium, Royal Botanical Gardens, Kew, for the loan of the original material of *Jungermannia mollissima* and *Jungermannia lanata.*

The collections cited of Kirk, Allison, Matthews, Moore, Welch, West, Zotov, McMahon, Veale, Henny, Martin, Langridge, Kidson, Haskell and Hodgson are in the private herbarium of Mrs. E. A. Hodgson. Duplicate collections of Kirk, Allison, Matthews, Zotov, Martin and Kidson, along with those of Berggren, are in the herbarium of the Botany Division, Christchurch. The collections of Simpson, Thomson, and Allison are in the private herbarium of Mr. K. W. Allison.

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* A history of the genus will appear in a forthcoming paper by the author on the genus *Trichocolea* in North, Central and South America

Trichocolea

Trichocolea Dumort., corr. Nees, Naturg. Eur. Leberm. 3: 103. 1838.
Thricholea Dumort., Comment. Bot 113. 1822.
Tricholea Dumort., Anal. Fam. 69. 1829.
Thricolea Dumort., Syllog. Jungerm. 24, 28, 66. 1831.
Tricolea Dumort., *op. cit.*, p. 99.
Leiomitra Lindb., Soc. Sci Fenn. Acta 10: 515. 1875.
Basichiton Trev., R. Ist. Lombardo Mem. Sci. Math. Nat. 13: 394. 1877

Plants in tufts, mats, or scattered among other plants, prostrate to suberect; stems filiform to robust, simple to tripinnately branched; cells of the stem little differentiated, mostly thin-walled, the cortical cells of a varying number of rows, in one to several layers, usually shorter and with a smaller diameter than the cells of the medulla, the cuticle thickened and striolate-papillose; rhizoids when present colourless, arising in clusters from a unistratose, disc-shaped pad on the lamina of underleaves: paraphyllia sometimes present on stems and branches: leaves succubous, alternate, attached in an oblique line, ovate to reniform in outline, asymmetrical to subsymmetrical, deeply divided into 3–9 unequal, simple or divided segments, the segments triangular in outline, sparsely to densely ciliate with whorled or opposite, usually long, simple or branched cilia; the lamina 1–18 cells long, cells rectangular to quadrate or hexagonal; the cuticle striolate-papillose: underleaves smaller, symmetrical, attached transversely on the stem, deeply bifid and divided to one half or nearly to the base into usually four segments, ciliate as in the leaves: dioicous; male inflorescence terminal or intercalary on a main stem or branch, the male branch similar to the vegetative branch, the bracts in 15 or more series, concave, similar to the leaf; antheridia large, globose, solitary or in pairs in the axils of bracts; bracteoles similar to the underleaves: female inflorescence terminal on a main stem or branch, becoming axillary or lateral by development of subfloral innovations; bracts and bracteoles in three series, the innermost series the largest; bracts mostly symmetrical, larger than the leaves and divided into usually more segments; bracteoles similar to the underleaves but larger: true perianth absent, the sporophyte enclosed in a club-shaped or globose, thick-walled prolongation of the stem tissue (coelocaule or stem parianth), usually covered with paraphyllia and bearing numerous archegonia in the upper part: the sporangium oblong, dark brown, the sporangium stalk long and thick, elaters long, slender, reddish-brown, with 2–3 spirals, the ends rounded or tapering; spores reddish-brown, oval to rounded, smooth or minutely punctate.

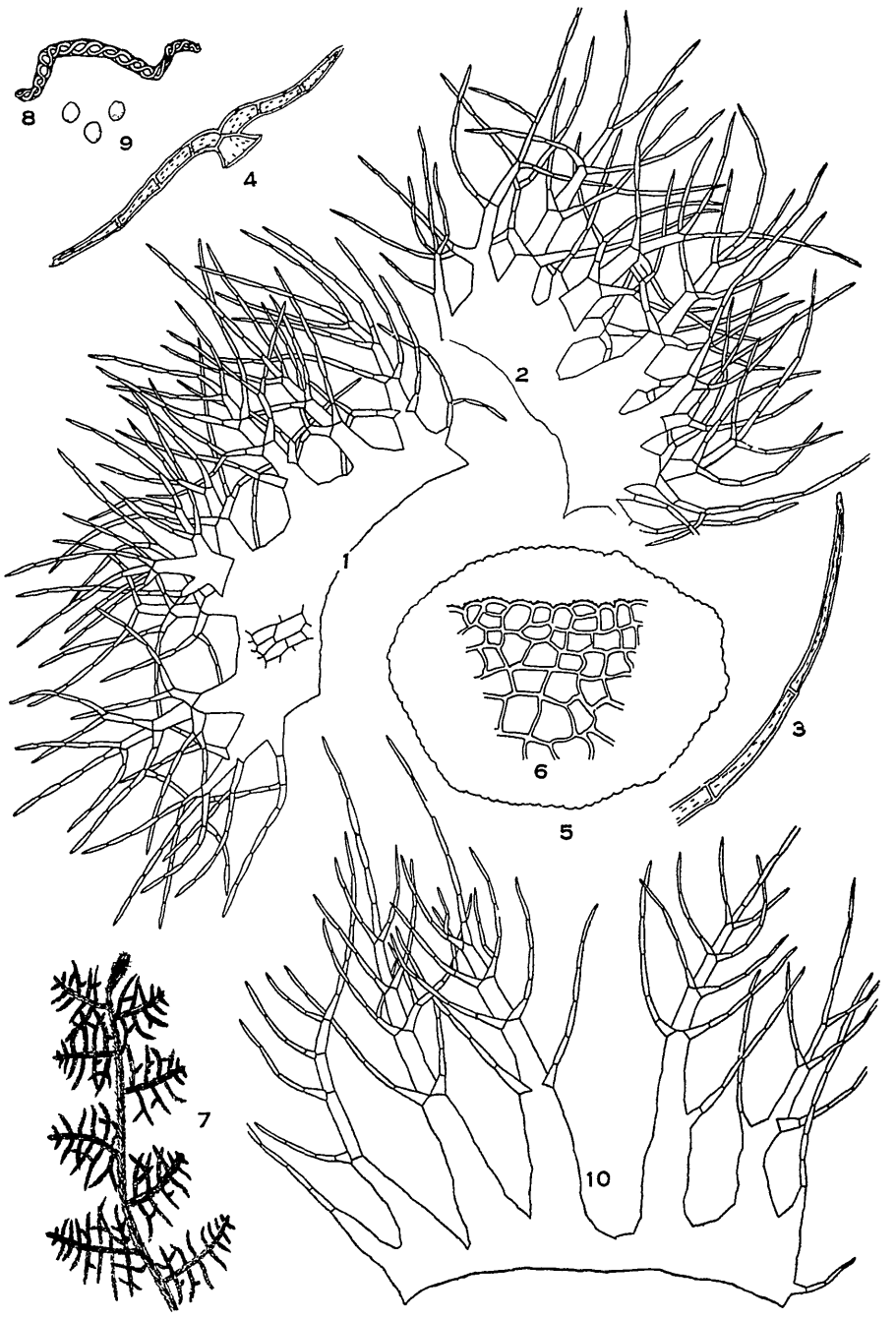
Key to the Species

I. Plants regularly bipinnate to tripinnate with a well defined axis and smaller branches, lamina of the leaf 2–5 cells long.
  a. Plants robust, usually conspicuously tripinnate, lamina of the leaf 3–5 cells long, lamina of the female bract usually only one cell long — *T. australis*
  aa. Plants smaller, regularly bipinnate to only rarely tripinnate, lamina of the leaf 2–3 cells long, lamina of the female bract 2–4 cells long — *T. mollissima*

II. Plants irregularly pinnate to bipinnate, often without a well defined axis, the stem and branches nearly equal in diameter, lamina of the leaf 5–8 cells long.
  b. Lamina of the leaf 6–8 cells in length at the longest point, the segments ciliate with straight or slightly curved cilia — *T lanata*
  bb Lamina of the leaf 5–6 cells long at the longest point, the segments densely ciliate with decurved cilia — *T julacea*

Trichocolea australis Stephani, Spec. Hepat. 4: 62. 1909.

Plants robust, in tufts or mats, pale yellowish-green: stems with leaves to 1 5 mm wide, 3–8 cm long, usually tripinnate: stems in cross-section. oval to orbicular, 20–24 cells in diameter; cells of the medulla averaging 32μ, cells of the cortex in 2–4 layers,



FIGS. 1–10.—*Trichocolea australis* Steph. 1—Stem leaf, × 40. 2—Stem underleaf, × 40. 3—Portion of a cilium of a leaf, × 180. 4—Stem paraphyllium, × 180. 5—Cross-section of a stem, × 40. 6—Portion of a stem cross-section, × 180. 7—Portion of a plant showing growth habit, × 2. 8—Elater, × 180. 9—Spores, × 180. 10—Female bract, × 40. Nos 1–10 drawn from material collected by R. Hatcher.

averaging 22μ, with a thickened, striolate-papillose cuticle; branches mostly 1 cm long; rhizoids not seen; paraphyllia present, small, 3–5 cells long, usually branched: leaves distant to imbricated, asymmetrical, to 0·8 mm long, 1 mm wide, divided into 5–7 unequal, often divided segments; the segments triangular in outline, long ciliate with simple or branched cilia, segments and cilia mostly curved and appressed to the stem, but a few segments recurved towards the dorsal side of the leaf; lamina asymmetrical, 3–5 cells in length, cells averaging 61μ long, 29μ in diameter, cells of the cilia averaging 98μ long, 12μ in diameter; the cuticle striolate-papillose: underleaves smaller, to 0·6 mm long, 0 6 mm wide, bifid nearly to the base and divided into 4–6 branched segments, cilia similar to those of the leaf: male inflorescence not seen: female inflorescence terminal on a main stem or branch, bracts and bracteoles symmetrical, in three series, the innermost series the largest, bracts to 1·6 mm long, 1·2 mm wide, divided nearly to the base into 5–7 long, occasionally divided, sparingly ciliate segments, cilia as in the leaves, lamina 1, rarely 2 cells in length; bracteoles to 1·2 mm long, 0·8 mm wide, deeply divided into 4–6 ciliate, often divided segments, lamina to 4 cells long: the stem perianth or coelocaule club-shaped and densely covered with paraphyllia, 4–5 mm long; the sporangium oblong, dark brown, dehiscing by four valves; elaters to 160μ long, 12μ in diameter, with 2 spirals, reddish-brown, slightly tapering and rounded at the ends; spores 12–15μ, reddish-brown, oval to rounded, minutely punctate

HABITAT: Usually in dense " bush " at the base of trees, on the ground or, occasionally, epiphytic on leaves and stems of higher plants.

The distinguishing characteristics of this species include its regular branching habit which is usually conspicuously tripinnate, its leaves deeply divided into 5–6 often divided segments, and its female bracts divided nearly to the base into 5–7 long, sparsely ciliate segments, and with a lamina one or occasionally two cells in length.

DISTRIBUTION. North Island: Great Barrier Island, Kirk, 4992; Little Barrier Island, collector unknown; Waipoua Forest, Allison, H 1729; Waitakere Hills, near Auckland, Hatcher, 513; Bay of Plenty, Haskell; Manganui, Matthews; Coromandel Peninsula, Matthews, 145; near Atiamuri, South of Rotorua, Allison; East of Taupo, Allison, H.4617; Moungapohatu Mt, Urewera, Moore; near Taihape, Hodgson, 535; Mt. Ruapehu National Park, Moore; Tauranga, Berggren; Lake Waikaremoana, Hodgson, 7535; Pukeiti Bush, near New Plymouth, Hatcher, 286; Mt. Bruce, Masterton, Welch, 31; near Upper Hutt, West; Tararua Mts., Zotov, 9288.

South Island: Marlborough, McMahon, H.337; near Greymouth, Berry & Hodgson, 7577; Arthurs Pass, Veale; Lake Kaniere, Westland, Veale, 37; near Haast Pass, Matthews; Head of Lake Manapouri, Simpson; Conical Hill Plantation, Blue Mts, Otago, Allison, H.1216; near Milford Sound Hotel, Hatcher, 357; near Lake McKerrow, Hatcher, 564; Stillwater Camp, Fiordland, Henny; Mt. Cargill, Dunedin, Allison, H. 4936; Leith Valley Bush, Dunedin, Allison, H.5763; Bligh Sound, Southland, collector unknown; Blue Mts, Otago, Allison, H 1216; Otago Peninsula, Martin, 401.

Stewart Island: Track to Tin Range, Martin; Pegasus Creek, Martin; Paterson's Inlet, Martin; Port William, Martin, 704

New Zealand: Without locality, Petrie (the original collection).

Colenso, in 1887, described a species *Trichocolea elegans* from New Zealand The original collection upon which Colenso based this name cannot be located and, while his description of *T. elegans* fits the characteristics of *T. australis*, the name *T. elegans* Colenso is a later homonym of *T. elegans* Lehmann (1857) from Chile. In 1893, Stephani reduced Colenso's species to synonymy under a form, *minor*, of the north temperate species, *T tomentella*. However, he later described the New Zealand plants under the name *T. australis* in 1909.

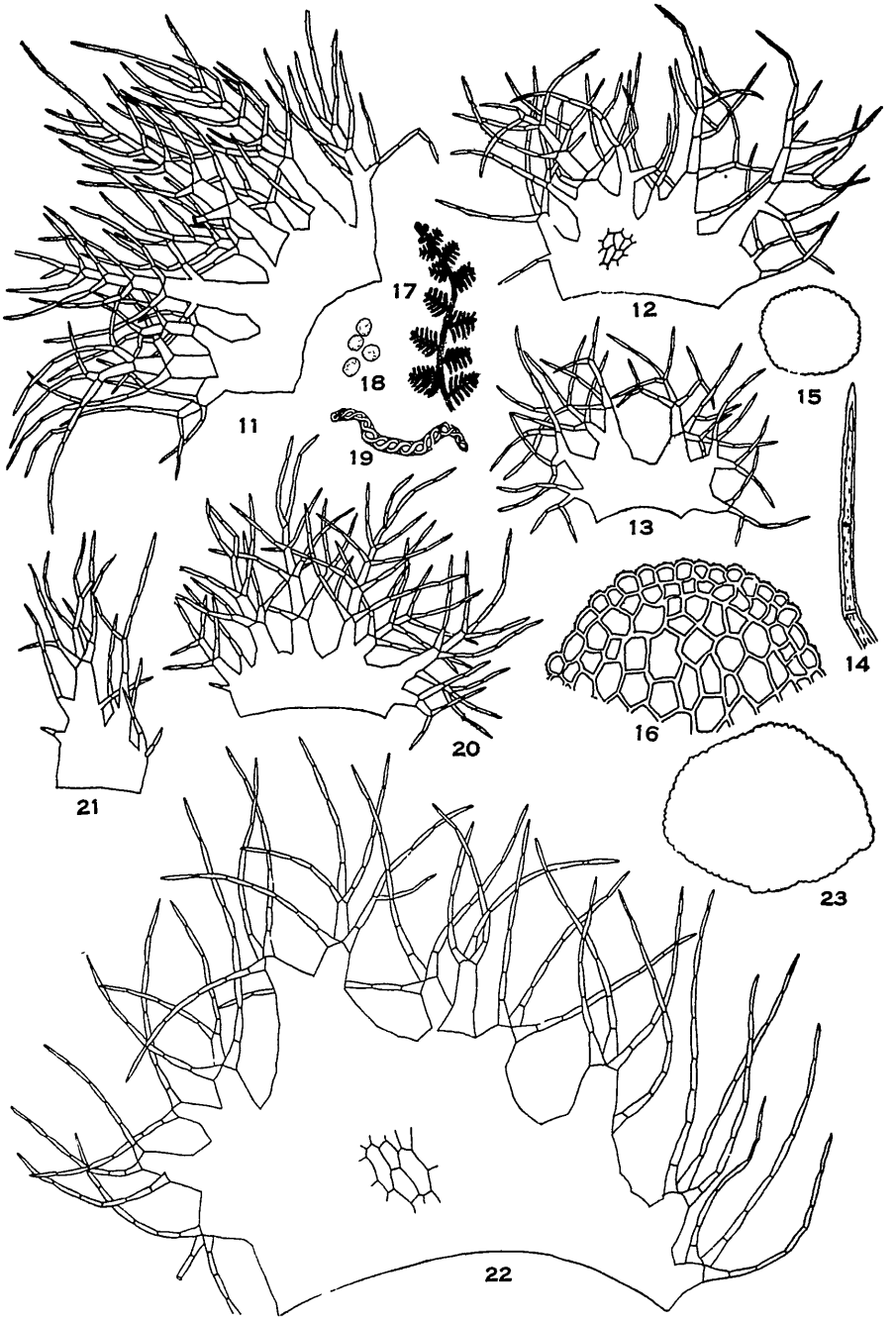


FIG. 11.—*Trichocolea australis* Steph. 11—Female bracteole. × 40.

FIGS 12–21.—*Trichocolea mollissima* (Hook., f. & Tayl.) Gottsche 12—Stem leaf, × 40 13—Stem underleaf, × 40 14—Portion of a cilium of a leaf, × 180 15—Cross-section of a stem, × 40. 16—Portion of a cross-section of a stem, × 180. 17—Portion of a plant showing habit of growth, × 2 18—Spores, × 180 19—Elater, × 180 20—Female bract, × 40 21—Female bracteole, × 40

FIGS 22–23.—*Trichocolea lanata* (Hook.) Nees 22—Stem leaf, × 40 23—Cross-section of a stem, × 40. Nos. 11–23 drawn from material collected by R. Hatcher

Trichocolea australis is the most common and most widespread species of this genus in New Zealand. It shows a wide degree of variation and tolerance and occupies a broad range of ecologically diverse habitats. Under conditions of high rainfall and cool temperatures, the plants usually occur in deep, loose, ascending tufts or mats and are conspicuously tripinnate with the primary branches generally rather distant. Under more adverse conditions, as on rocks or soil in exposed areas or in areas of low rainfall, the plants often occur in small, tangled mats closely appressed to the ground and may be bipinnate to occasionally tripinnate, with the primary branches crowded.

Trichocolea mollissima (Hooker, f & Taylor) Gottsche, Ann. Sci Nat. Ser. V 1: 132. 1864.

Jungermannia (Sect. Trichocolea) *mollissima* Hooker, f & Taylor, London Journ. of Botany 3: 390. 1844.

Plants in tufts or mats, yellowish-green to brownish or bluish-green: stems with leaves to 0 6 mm wide, 3–6 cm long, regularly bipinnate to rarely tripinnate; stems in cross-section, oval to orbicular, 14–16 cells in diameter; cells of the medulla averaging 23μ, cells of the cortex in 1–2 layers, averaging 16μ, with a thickened, striolate-papillose cuticle; branches mostly 4 mm long; rhizoids not seen; paraphyllia, when present, small, 3–6 cells long and usually branched; leaves imbricated, tending to be asymmetrical, to 0 6 mm long, 0 8 mm wide, divided into 5–6 unequal, often divided segments, the segment triangular in outline, long ciliate with simple or branched cilia, the segments and cilia not appressed to the stem, a few segments recurved towards the dorsal side of the leaf; lamina scarcely asymmetrical, 2–3 cells in length, cells averaging 45μ long, 21μ in diameter, cells of the cilia averaging 104μ long, 14μ in diameter; the cuticle striolate-papillose: underleaves smaller, to 0·5 mm long, 0·6 mm wide, deeply bifid and divided into usually 4 branched segments, cilia similar to those of the leaf: male inflorescence not seen: female inflorescence terminal on a main stem or branch, bracts and bracteoles symmetrical, in three series, the innermost series the largest, bracts to 1 mm long, 0 8 mm wide, divided into 5–6 often branched segments, ciliate as in the leaves, the lamina 2–4 cells in length; bracteoles to 0·7 mm long, 0 6 mm wide, deeply divided into 2–4 occasionally divided segments, lamina 2–3 cells in length: the stem perianth or coelocaule 3–4 mm long, club-shaped and densely covered with paraphyllia; the sporangium oblong, dark brown, dehiscing by four valves; elaters to 123μ long, 12μ in diameter, with 2 spirals, reddish-brown, slightly tapering and rounded at the ends; spores to 12μ, reddish-brown, oval to rounded, minutely punctate.

HABITAT: In dense "bush" on decaying wood or on the ground.

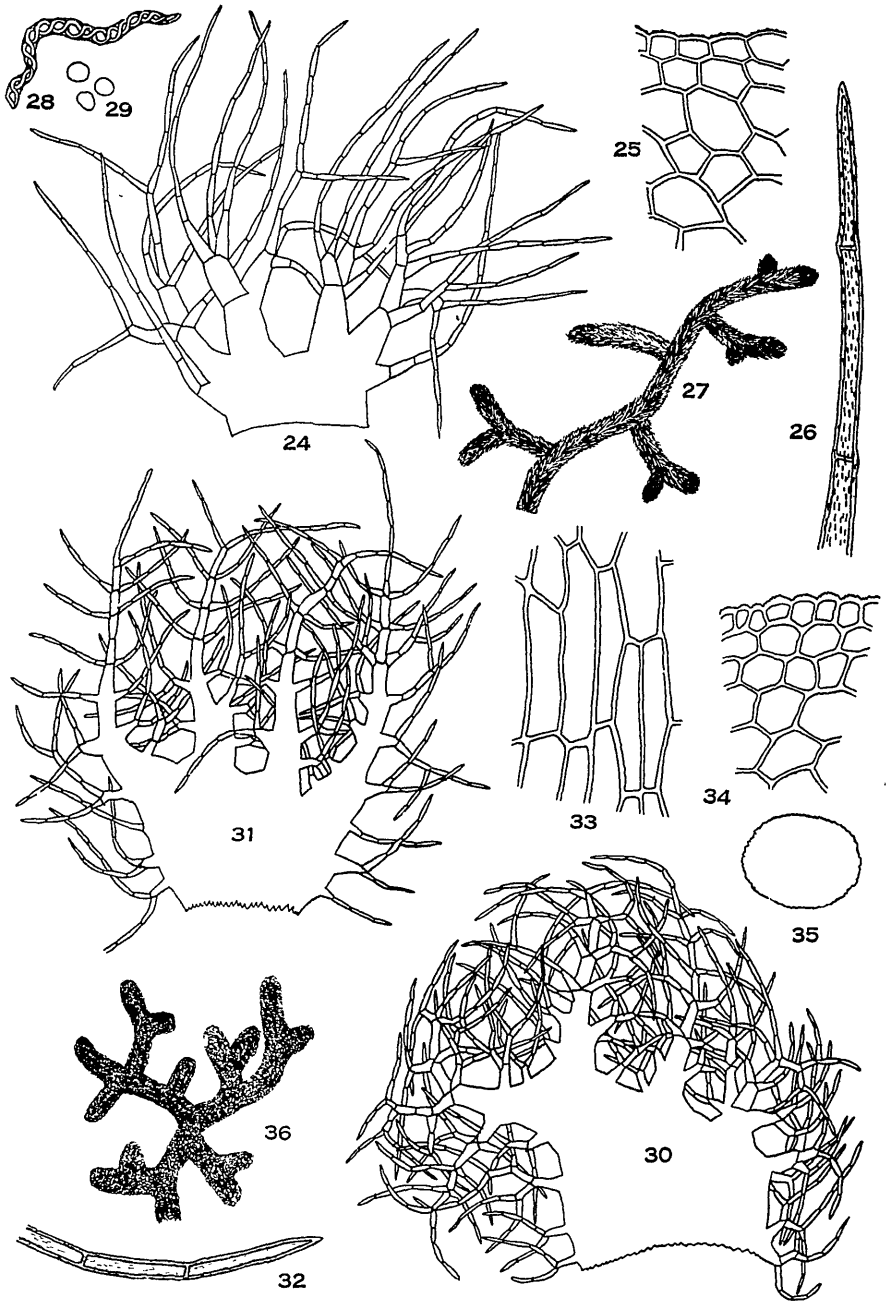
The distinguishing characteristics of this species include its relatively small size and usually compact growth habit; its regularly bipinnate (rarely tripinnate) branching; the leaves divided into 5–6 segments; and the female bracts divided to three-fourths into 5–6 often branched segments

DISTRIBUTION. North Island: Great Barrier Island, Kirk, 4993; Waipoua Forest, Allison, H.1728; Waitakere Range, Auckland, Langridge, 192; near the Morere Hotel, Hatcher, 20; near Rotorua, Allison, H.334; near Atiamuri, south of Rotorua, Allison, H.4608; Roto-a-Kui Bush, east of Taupo, Allison, H.4616; Tararua Mts., Zotov, 9274; Mt. Bruce, Masterton, Welch, 29.

South Island: Marlborough, McMahon, 87; near Nelson, Kidson; Kaituna Valley, Banks Peninsula, Hatcher, 720.

Auckland Islands: Without locality, Hooker (the original collection).

In 1845, Gottsche, Lindenberg and Nees von Esenbeck reduced this species to synonomy under a form, *javanica,* of the north temperate species *Trichocolea tomentella* and, in 1867, J. D. Hooker relegated both *T. mollissima* and *T. tomentella* f. *javanica* to synonymy under *Trichocolea tomentella.* However, since *Trichocolea*



FIGS 24–29.—*Trichocolea lanata* (Hook.) Nees. 24—Stem underleaf, × 40. 25—Portion of a cross-section of a stem, × 180. 26—Portion of a cilium of a leaf, × 180. 27—Portion of a plant showing habit of growth, × 2. 28—Elater, × 180. 29—Spores, × 180. Figs 30–36—*Trichocolea julacea* R. Hatcher. 30—Stem leaf, × 40. 31—Stem underleaf, × 40. 32—Portion of a cilium of a leaf, × 180. 33—Cells from the lamina of a leaf, × 180. 34—Portion of a cross-section of a stem, × 180. 35—Cross-section of a stem, × 40. 36—Portion of a plant showing habit of growth, × 2. Nos 24–29 drawn from material collected by R. Hatcher. Nos 30–36 drawn from a portion of the original material.

tomentella is not known to occur in New Zealand and since neither Gottsche, Lindenberg and Nees von Esenbeck's nor J. D. Hooker's type collections have been seen, their combinations have been omitted from the synonymy of *Trichocolea mollissima* in this paper.

Trichocolea mollissima is most commonly found growing on decaying wood in deep shade and exhibits a rather narrow range of variation. It generally occurs in small, closely appressed mats of densely interwoven plants. The plants are usually regularly bipinnate, although a few tertiary branches may be found on well-developed stems. In this respect, *T. mollissima* may sometimes be confused with small, poorly developed specimens of *T. australis*. The branch leaves of *T. mollissima,* however, are very closely imbricated so that the branches are smoothly terete while the branch leaves of *T. australis* tend to be spreading so that the branches are coarser in appearance The close approach to symmetry in the leaves of *T mollissima* also aids in differentiating it from *T. australis* in which the leaves are strongly asymmetrical.

Trichocolea lanata (Hooker) Nees, Naturg Europ Leberm. 3: 116. 1838.

Jungermannia lanata Hooker, Musci Exotici 2: 116. 1820.

Plants robust, in tufts or mats, yellowish-green to green: stems with leaves to 3 mm wide. 3–6 cm long, distantly and irregularly branched; stems in cross-section, oval to orbicular, 15–18 cells in diameter; cells of the medulla averaging 37μ, cells of the cortex in 1–2 layers, averaging 25μ, with a thickened, striolate-papillose cuticle; branches 1–3 cm long; rhizoids not seen; paraphyllia absent; leaves mostly closely imbricated, asymmetrical, to 2 mm long, 2·5 mm wide, divided into 5–6 short, unequal, often divided segments, the segments triangular in outline, long ciliate with simple or branched cilia, the segments and cilia spreading, not appressed to the stem; lamina asymmetrical, 6–8 cells in length, cells averaging 90μ long, 33μ in diameter, cells of the cilia averaging 103μ long, 16μ in diameter; the cuticle striolate-papillose: underleaves smaller, to 1 mm long, 0 5 mm wide, deeply bifid and divided into usually 4 branched segments, cilia similar to those of the leaf: male inflorescence not seen: female inflorescence terminal on a main stem or branch, bracts and bracteoles symmetrical, in three series, the innermost series the largest; bracts to 2 mm long, 2 3 mm wide, divided into 5–7 short, branched segments, ciliate as in the leaves, lamina 12–14 cells in length; bracteoles to 2 mm long, 1 mm wide, divided into 4–6 ciliate, branched segments, the lamina 6–10 cells in length: the coelocaule or stem perianth spherical to broadly club-shaped, 3–4 mm long and densely covered with paraphyllia; the sporangium oblong, dark brown, dehiscing by four valves; elaters to 144μ long, 12μ in diameter, with 2 spirals, reddish-brown, slightly tapering and rounded at the ends; spores 12–16μ, reddish-brown, oval to rounded and punctate.

HABITAT: In dense " bush " on decaying wood or on the ground.

The distinguishing characteristics of this species include its irregularly pinnate to bipinnate branching with the stem and branches nearly equal in diameter, and its large spreading leaves with the lamina 6–8 cells in length and divided into 5–6 short, broad segments bearing straight or slightly curved cilia.

DISTRIBUTION. North Island: Waipoua Forest, Allison, H.713; Coramandel Peninsula, Matthews, 51; Bay of Plenty, Haskell; Waitakere Hills, near Auckland, Hatcher, 193; Pukemako, King Country, Moore; Waikaremoana, Hawke's Bay, Hodgson; near Wairoa, Hodgson, 7542. Pukeiti Bush near New Plymouth, Hatcher, 277.

South Island: Near Nelson, Kidson, 28; vicinity of Lake Kaniere, West Coast, Veale, 92; Martin's Bay, North of Milford Sound, Hatcher, 939; Dunedin, Simpson & Thomson, 322; in the vicinity of Dusky Bay, Menzies, 1791 (the original collection).

Trichocolea lanata is widely distributed throughout New Zealand, but appears to be most abundant along the west coast of both North and South Islands in areas

of heavy rainfall. It shows little variation and its large size and irregularly pinnate to bipinnate habit with the stem and branches equal or nearly equal in width, immediately distinguish it from *T. australis* and *T. mollissima.*

Trichocolea julacea R. Hatcher, n. sp.

Sterilis. Plantae mediocris, julaceus, fuscus ad fusco-virens, corticola, caulis cum foliis ad 2 mm lata, 2–3 cm longa, nudus, irregulariter bi-tripinnatus. Folia caulina imbricata, oblique patula, alternatia, asymmetrica, ad 1·3 mm longa, 1·8 mm lata, disco basali ad 6 cellulae longa, 28 cellulae lata, apice inaequaliter 5–6 lobato, lobis longissimis, supra basim verticillatim 2–3 fidis, laciniis conferte setosis, setulis oppositis longis accuminatis simplicibus vel ramosus. Cellulae disci 129μ longa, 31μ lata, cuticula striolata Amphigastria caulina magna, symmetrica, quadrifida, laciniis ut in folio.

Plants in tufts or mats, brown to brownish-green: stems with leaves to 2 mm wide, 2–3 cm long, irregularly branched; stem in cross-section, oval to orbicular, 10–12 cells in diameter; cells of the medulla averaging 38μ in diameter, those of the cortex in 1 layer, averaging 16μ, with a thickened, striolate-papillose cuticle; branches to 3 cm long; rhizoids not seen; paraphyllia absent: leaves asymmetrical, to 1 3 mm long, 1 8 mm wide, divided into 5–6 unequal, often divided segments, the segments narrowly triangular in outline, densely ciliate with long, much branched, decurved cilia; the lamina asymmetrical, 5–6 cells long at the longest point, 26–28 cells wide, median cells averaging 120μ long, 31μ in diameter, cells of the cilia averaging 87μ long, 16μ in diameter; the cuticle striolate-papillose: underleaves symmetrical, to 1·3 mm long, 1 6 mm wide, twice bifid to 2/3 into four often branched and densely ciliate segments, cilia similar to those of the leaf but little or not at all decurved: male and female inflorescence not seen.

HABITAT: Epiphytic; on forest trees.

The distinguishing characteristics of this species include its irregularly bipinnate habit and its 5–6 densely ciliate leaf segments with the cilia decurved

DISTRIBUTION. New Zealand: Stewart Island, Port Pegassus, Sawmiller's Arm (the type locality), leg. William Martin, 1949.

Portions of the original collection are in the following private herbaria: William Martin (621) Dunedin; Mrs. E. A. Hodgson (2187) Wairoa; R. E. Hatcher (1064) Cincinnati; and in the herbarium of the University of Cincinnati.

Trichocolea julacea is immediately distinguished from *T. australis* and *T. mollissima* by its irregularly bipinnate branching, and, while its growth habit resembles that of *T. lanata,* it may easily be distinguished from the latter by its brown colour, its more numerous branches and the abundant, decurved cilia on the long, narrowly triangular segments of the leaf.

ADDITIONAL NOTES

In 1844, Hooker, f. and Taylor described *Jungermannia* (Sect. Trichocolea) *polycantha* from the Auckland Islands. Since the original collection of this species has not been located and since no plants which match the original description of the species have been found in New Zealand, the species has not been included in this paper.

I should like to express my appreciation to Dr. Margaret Fulford, of the University of Cincinnati, for her kindness in reading and criticizing the manuscript.

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