Myzodendraceae.

by

c. Skottsberg.

With 4 Figures

Important Literature.

A. P. De Candolle in Coll. Mem. VI. (1830) 12; Prodr. IV. (1830) 286. Poeppig et Endlicher, Nov. gen. I. (1835) 1. J. D. Hooker in Ann. sc. nat. 3. sér V. (1846) 193, Fl. antarct. II. (1847) 289. – Bentham et Hooker f., Gen. pl. III. (1880) 229. – Hieronymus in E. P. 1. Auf III. 1. (1889) 198. – Ph. van Tieghem in Bull. Soc. bot. France XLIII. (1896) 556. – C. Skottsberg in K. Svenska Vet.-Akad. Handl. 51 n. 4 (1913) u. 56 n.5 (1916) 206; in Englers Bot. Jahrb. L. (1913) 384; in Pflanzenreich Heft 62 (1914).

Characteristics. Flowers dioecious, 3 -, rarely 2-merous, naked. ♂ flowers with 2 or 3 stamens and central disk; anthers terminal, unithecal, with terminal, opening by a tangential slit. ♀ flowers with three staminodia sitting in longitudinal furrows of the ovary, which, when the fruit attains full ripeness, growth to long feathery bristles. Carpels 3; ovary triangular, on which are sulcated edges, lower part more or less clearly loculed (chambered); ovules 3, atropous, without integuments, hanging down at the point of the central placenta; styles very short or nearly missing, surrounded by a circular disk; stigmas 3, with papillose interiors. Fruit a dry closed fruit (achene). Seed 1, without seed coat, germinating out of the fruit, with endosperm. Endosperm haustorium well- developed; embryo straight, with the root end upward; in place of the primary root a holdfast, from whose lower surface the haustorium arises. - small shrubs, which like the genera of Loranthaceae parasitize trees of the genus *Nothofagus*. Leaves alternate, glabrous, normally green, or scale-like [flabellate] and yellow, annotinous. Flowers very small, without prophylls, in compound spikes.

Vegetative Organs. The Myzodendraceae are found, nearly without exception, as high, hemispheric bushes (or dwarf short-stemmed shrublets) from 1 to few decimeters on *Nothofagus*-species[1], (only once with certainty another host plant was determined, *Caldcluvia paniculata* [Cunoniaceae]; further data could not be confirmed). From the lower surface of the sticky disk (Fig. 47 K, L) the haustorium enters into the host plant, where it branches out. In the beginning place the stricken beech branchlet swells up gall-like or remains unchanged.

The ramifications are sympodial, the branch point dies in the autumn and starting in the spring develops from upper sidebuds into innovation shoots or inflorescences. There is often only 2-3 innovations present, which stand close together, so that the ramification becomes candelabra-like (Fig. 44 C) and the number of the sequential branch generations also designates the number of the older years of the individual concerned. With the subgenus *Eumyzodendron* (Fig. 47 A) and the foliage leaf bearing species of the subg. *Gymnophyton* the innovations sit below, with the species with only scale leaves (Fig. 44 C) above the floral region.

1) See Skottsberg in Karsten and Schenck, Vegetations bilder IV. (1906) t. 17; G. Macloskie, Fl. Patagon., in Repoet Princeton Univ. Exped. Patagon. 1896-99. VIII. 2. (1904) 337 t. 14 *(M. brachystachyum;* colored illustration.)

The buds are pseudoendogenous, are normally put on and due to uneven growth into the cortex encompassed and even by it to over-grow. With the subg. *Eumyzodendron* break out of it after the winter dormancy, with the subg. *Gymnophyton* already before this; here, however, the leaves are developed as hard scales. With *Eumyzodendron* the bark is brown or grey, the leaves are green and of normal appearance; with *Gymnophyton* the whole plant is yellow to rust brown and either all leaf forms are scale-like or we find heterophylly, by the development of leaves from the innovations as small green, deciduous foliage leaves. The phyllotaxy is 2/5.

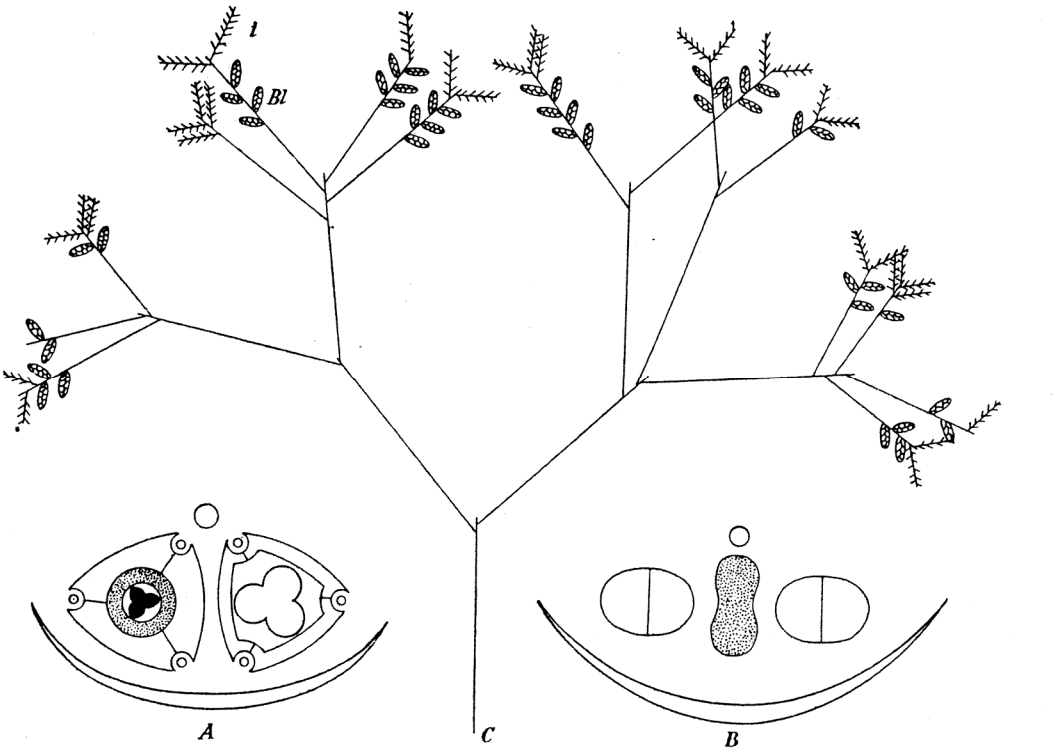

Fig. 44. *Myzodendron punctulatum* Banks & Sol. A diagram of the ♀ spikelet, showing on the left the disk (stippled) and the stigmas (black). B diagram of the ♂ spikelet; disk stippled. C schematic picture of a 4-year old plant in the summer with inflorescences (Bl) and innovations (i). - after Skottsberg.

Anatomical Conditions. A) Stem - with subg. *Eumyzodendron* the epidermis is soon replaced by periderm with lenticels; in the outside cortex one finds groups of stone cells in a circular arrangement. With subg. *Gymnophyton* the stem is closely beset with hemispheric warts, at whose apex a gap opening is present and below these a large air space. The epidermis remains covered by a thick cuticle even after the periderm is formed. The epidermal cells and the outside cortical cells are filled with brown-yellow globules of an unknown material, which causes the characteristic coloring of the plant; the internal cortical layers in *Eumyzodendron* carry chlorophyll. With *Eumyzodendron* a loose circle of vascular bundles develop in the first year, of which each one is provided with a mechanical strand outside. In the second year forms a second, stem-borne circle, which stands in connection at the nodes with the first. The two circles grow in usual way, so that, if the internal shows two yearly zones, the outside exhibits its 3, etc. The broad ray initials and rays remain unlignified; thus no closed wood cylinder develops and the

stem therefore is soft and fragile. With *M. quadriflorum* the internal bundle circle is replaced by 1-2 bundles; with *M. linearifolium* it is missing completely, here arises in its place a circle of purely mechanical strands. Such a circle is present also with *Gymnophyton*. Here the vascular bundles are separated by close primary ray initials, and the secondary are present in small number; a major, almost closed wood cylinder is formed and also lignified rays. The clear difference between early and latewood is the prominent annual rings. With all species calcium oxalate druses are frequent as inclusions.

b) Leaf. - the leaves are simply built; they show undifferentiated mesophyll with more or less isodiametric cells with small intercellular [spaces]. Stomata are on both sides of the upper epidermis. The scale leaves of the subg. *Gymnophyton* have a very thick cuticle, and the epidermal cells store the yellow-brown material mentioned above.

Floral Conditions. All inflorescence types can be traced back to a compound spike or raceme. With section *Archiphyllum* the monopodium is elongated and carries foliage leaves, each one of which support a many-flowered spikelet (Fig. 47 A). These subtending bracts are shifted up to the lowest flower (Fig. 47 C, D). With the section *Telophyllum* (Fig. 45 B) the subtending bract is moved up to the apex of the axis and the flowers seem to arise from a "petiole". With section *Angelopogon* the spikelet is limited to two sessile axillary flowers (Fig. 45 A). With section *Heterophyllum* the M spikelet is 2-, the ♀ 3-6-flowered and small and head-like (Fig. 45D). Finally, with section *Ephedranthus* the spikes are strobiliform and each subtending scale support with the ♀ spikes 2, with the ♂ spikes only one flower, so that we apparently find a simple spike with the ♂ inflorescence (Fig. 44 B). All species are dioecious. With *M. linearifolium* monoecious exemplars are found.

The ♂ flower consists in subgenus *Eumyzodendron* (Fig. 47C) of 3, in subg. *Gymnophyton* (Fig. 44 B) 2 yellow stamens and forming in the center between this a median disk, which can probably be interpreted as vestige of the ovary. The filament is in section *Ephedranthus* very short, otherwise well-developed. The anthers (Fig. 47 E, F) are monothecal and open at the apex by a short, tangential crevice. The theca divides by a thin, anxiolytic tangential septum during dehiscence of the anthers from their wall. The pollen grains are spherical, also the exine is covered by fine pointed warts. - the ♀ flower (Fig.44 A, 45 A, 47 D) consists of 3 staminodia and 3 carpels. Along each groove of the ovary one sees in the beginning a shallow, soon deepened and covered furrow, which protects the young plasma-rich, fast growing staminodia, developed into long, hairy bristles (setae) (Fig. 47 H, J). The homology of these bristles with the stamens was uncovered by finding hermaphrodite flowers (in *M. linearifolium*). There is no jug-shaped receptacle or a perianth adnate to the ovary; the disk itself then belongs to the ovary. The ovary is from the outset one locular with a central placenta; the hanging ovules are naked and atropous. By increasing in size, three pockets form at the thick base of the ovary, which with the considerable dilation of the ovary deepen ever more, so that this becomes 3-locular below. Only one ovule develops into the seed, which fills out the whole concavity, pressing the placenta against the wall (Fig. 47 G). The embryosac lies at the nucellar apex and is of normal construction. After fertilization the secondary embryo sac nucleus divides; by the two cells formed thereby the spatially lower one becomes the large, amyliferous [starch-rich] endosperm, the upper one becomes a haustorium, which penetrates into the ascidiform placenta and grows up to the base of the flower, where it branches out. Nourished by the haustorium, the endosperm quickly becomes larger and soon breaks through the nucellus. The embryo lies at the upper internal edge, the root end is arranged upward. One can distinguish a hypocotyl, two cotyledons

and formed between radially stretched out cells a holdfast, which takes the place of the primary root.

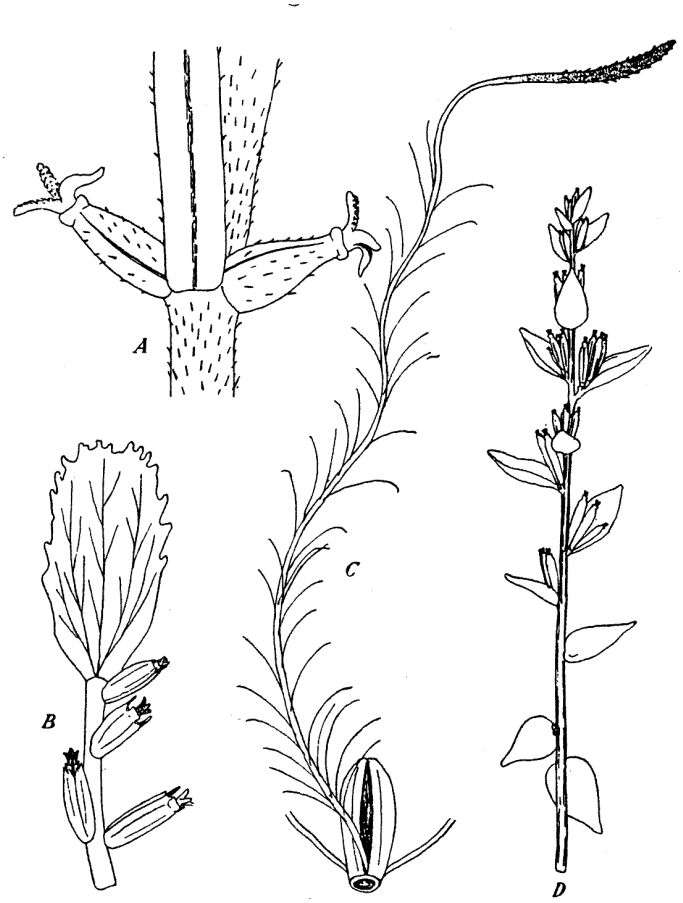

Fig. 45. A *Myzodendron linearifolium* DC. ♀ partial inflorescence (10/1). - *B M. quadriflorum* DC. ♀ partial inflorescence (5/1); *C* ripe achene, only one seta completely drawn (5/1). - *D M. macrolepis* Phil. ♀ complete infloresence (2/1). - after Skottsberg.

Pollination. The flowers are very small, not showy, and up to few millimeters long, the ♂ yellowish, the ♀ green with brownish stigmas. Because of the small stigmas, the stiff stamens, the pollen-kit and the presence of a disk, entomophily (*Salix* type) is assumed. Visitors were not observed. *M. gayanum* flowers in autumn, all other species in the late winter or spring.

Fruit and seed. The triangular achene has, because of its long (up to 85 mm with *M. oblongifolium*) feathery bristles[1] a very characteristic appearance (Fig. 47 B, J, 45 C). The bristles (setae) grow out from the furrows of the ovary; anatomically they are akin to the filaments. The long hairs are evaginations of the epidermal cells and have no transverse walls. The bristles serve as suspension devices to anchor the fruits. During germination the hypocotyl presses the holdfast out between the apices of the carpels and against the bark of the host plant (Fig. 47 M). If necessary, the active green hypocotyl can become several millimeters long and curve, until a favorable position is reached. As rule it is considered that on other than recent *Nothofagus* branches further development fails. The cotyledons remain in the endosperm until they are absorbed and the pericarp drops.

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1) O. Warburg (Pflanzenwelt I. [1913] 505) calls the family feathery mistletoe plants.

Geographical Distribution. The family is endemic to temperate forest areas in andean South America. The north border is at 33° in the coastal Cordillera, the south border is at Cape Horn. Some species are also very common in the eastern deciduous forests of the Andean chain. - see also Hauman et Irigoyen, Catal Phanér. Argentine, in Anal. Mash. Nac. Buenos Aires XXXII. (1923-25) 38-40.

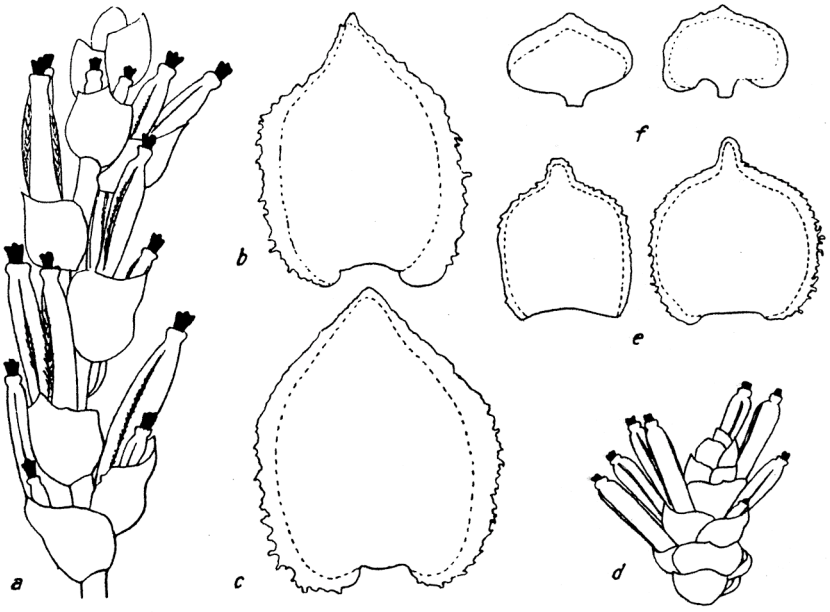

Fig.46. *a–c Myzodendron Commersonii* van Tiegh. ♀ inflorescence (X 5) and two scale leaf innovations (X 10).-d-f *M. imbricatum* Poepp. & Endl *d* ♀ inflorescence (X 5), *f* two subtending bracts (X 10) and *e* of two leaves of an innovation (X 10). The dotted line suggests the demarcation of the thinner tissue edge. - after Skottsberg.

Phylogenetic Relationships. The small, sharply described family set up by Hieronymus points to a clear relationship with Santalaceae (construction of the ovary, placenta, ovules, endosperm haustoria, etc.), particularly to the genera *Arjona* and *Quinchamalium* (ovary, disk), which are regarded, by the way, by van Tieghem as representatives of their own family, Arjonaceae. In their habit and by their way of life as tree-inhabiting half parasites, the Misodendraceae also approach the Loranthaceae.

Only 1 genus:

Myzodendron Banks et Solander ex G. Forster, Fase. pl. magell. in Comment. Gotting. IX. (1789) 45 nomen *(Myzodendrum punctulatum),* DC. in Coll Mem. VI. (1830) 12 t. 11, 12 *(Misodendrum),* Prodr. IV. (1830) 286.

11 species. - the name of the genus is derived from μυζεω or μυζω (suck) and δεδρου (tree); it refers to the way of life of the plant. (The subgenera specified below can be understood as good genera; the section *Heterophyllum* is, however, a link between the two subgenera and all sections form to a certain extent a continuous series, so that one can let the genus exist just as well to its old extent.)

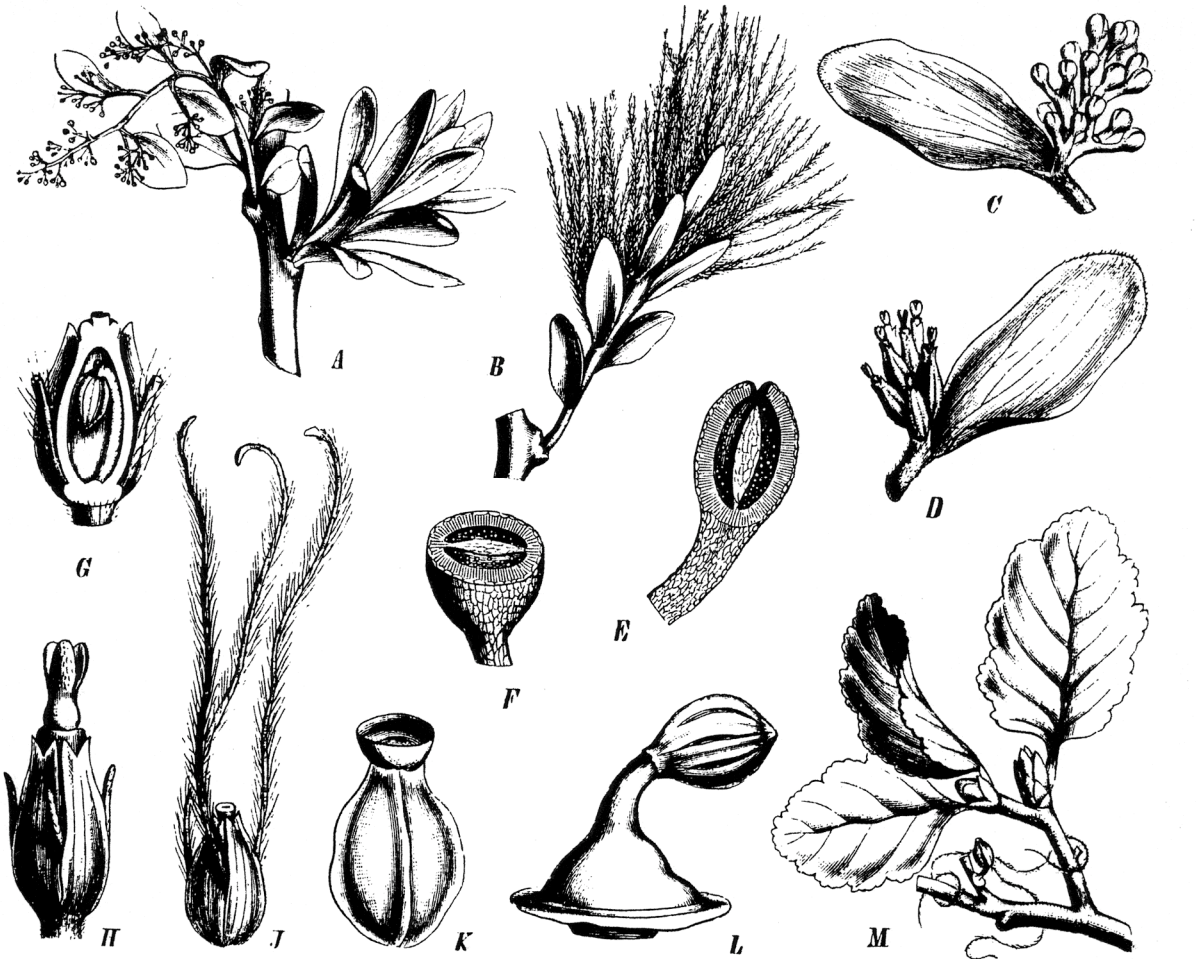

Fig. 47. *Myzodendron brachystachyum* DC. *A* piece of branch of the ♂ plant, on the right of a renewal branch (innovation), on the left an inflorescence, natural size. *B* piece of a branch of the ♀ plant with infructescence, natural size. *C* ♂ and *D* ♀ partial inflorescence (3/1). *E* median longitudinal section of a stamen (20/1). *F* lower half of an anther, shown in cross section (20/1). *G* longitudinal section of the unripe fruit (5/1, ovarian cavity too largely drawn). *H* ♀ flower (5/1, stigmas incorrectly posed). *J* fruit (3/1). K embryos enclosed by endosperm, at the apex the holdfast) 12/1). *L* germling [germinating plant], cotyledons sticking in the remainder of the endosperm (7/1). *M* branch of *Nothofagus antarctica*, with a germinating, feathery-bristle anchoring fruit, natural size. - from E. P. 1. Aufl.

Subgenus I. *Eumyzodendron* Hook. f. Fl. antarct. (1845–47) 297. – Bark smooth. Leaves green. Subtending bracts foliage leaflike. Stamens 3.

Section 1. *Angelopogon* (van Tiegh.) Engl. in E. P. 1. Aufl. Nachtr. (1897) 141 *(Angelopogon* van Tieghem in Bull. Soc. bot. France XLIII. [1896] 558). – Leaves linear. Spikelet 2-flowered. - *M. linearifolium* DC on *Nothofagus obliqua* of 33° S. (Cerro del Roble, northern limit of the family) to Valdivia, a variety on *Nothofagus pumilio* and *N. antarctica* from Chillán to the Magellan route.

Section 2. *Archiphyllum* (van Tiegh.) Engl. l. c.140 (*Archiphyllum* van Tiegh. in Bull. Soc. bot. France XLIII. [1896] 557). – Leaves narrowly elliptical. Spikelet many-flowered, subtending bract at the lowest bloom of the spikelet. - *M. oblongifolium* DC on *N. pumilio*, Cordillera from Chillán to 44°20' and *M. brachystachyum* DC on several *Nothofagus* species, from Valdivia to the Tierra del Fuego archipelago. - cross section at the axil of *M. oblongifolium* DC: Solereder, Syst. Anat. Dikotyl. (1899) 828 Fig. 178.

Section 3. *Telophyllum* (van Tiegh.) Engl.1. c. 140 (*Telophyllum* van Tiegh. in Bull Soc. bot. France XLIII. [1896] 558). – Leaves ovate. Subtending bract at the apex of the 2-6-flowered spikelet axil. Bristles (setae) with naked, thickened point (Fig. 45C). - *M. quadriflorum* DC on *Nothofagus pumilio*, in the mountains of south Chile (Antuco) to Patagonia and Tierra del Fuego.

Subgenus II. *Gymnophyton* Hook. f. Fl. antarct. (1844-47) 289 *(Myzodendron* strictly speaking, van Tiegh.). – Bark thickly warty. Subtending bract scale-like. Stamens 2.

Section 4. *Heterophyllum* Skottsberg in Engler's Bot. Jahrb. L. (1913) 391. – Foliage leaves linear, green, spikelet elongated with the ♂ inflorescence 2 -, with the ♀ inflorescence many-flowered. - *M. macrolepis* Phil., Valdivia, Cord. Pelada and andean Patagonia, Nahuelhuapi. - *M. angulatum* Phil., Valdivia, Cord. Pelada to Western Patagonia, Skyring Water, both on *N. betuloides*.

Section 5. *Ephedranthus* Skottsberg 1. c. 391. – Spikes strobiliform, spikelets with the M inflorescence 1 -, with the F 2-flowered. - **A**. foliage leaves narrowly linear, green: *M. gayanum* van Tiegh. on *Nothofagus dombeyi* and *N. nitida*, Valdivia to Western Patagonia and Patagonia. - **B**. all leaves scale-like, whole plant yellow to brown-yellow, chlorophyll-poor: *M. imbricatum* Poepp. et Endl. in mountain forests of Chile around 36°-37° on *Nothofagus dombeyi*; *M. punctulatum* bank et Sol., Cord. Nahuelbuta to Patagonia and up to the the Tierra del Fuego archipelago, frequently on several *Nothofagus* species and sometimes ocurring in great quantities; *M. recurvum* van Tiegh., Cord. Nahuelbuta to Chonos islands on *Nothofagus dombeyi* and *N. nitida*; *M. Commersonii* van Tiegh., very closely related to *M. punctulatum*, from Commerson who discovered it on the Magellan road, never found again.