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JAMES HECTOR, M.D., C.M.G., F.R.S., DIRECTOR.

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THE  
INDIGENOUS GRASSES  
OF  
NEW ZEALAND.

ILLUSTRATED BY  
JOHN BUCHANAN, F.L.S.,  
Draftsman to the Geological Survey Department.

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SIXTY-FOUR PLATES.

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Published by Command.

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THE  
INDIGENOUS GRASSES  
OF  
NEW ZEALAND.





## P R E F A C E.

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THE preparation of this work was ordered by Government, in consequence of a resolution carried in the House of Representatives, on the 29th June, 1876, on the motion of Sir George Grey, K.C.B., to the effect that a work on the native grasses of the Colony should be prepared, with nature-printed plates, and descriptions of each species, the work to be accompanied by an essay on the grasses and forage-plants likely to prove useful in New Zealand.

In the course of the discussion relative to this resolution, it was urged that prizes should be offered for essays on the subject, and that the best essay should be selected for incorporation with this work.

It was, however, pointed out that, until the publication was accomplished of an illustrated work to facilitate the accurate recognition of the different species, many persons who might possess a practical knowledge of the subject, but be at the same time unacquainted with the botanical nomenclature of the grasses, would be precluded from joining in the competition.

The publication of the systematic portion of the proposed work was, therefore, committed to this department in January, 1877, but the actual printing could not be commenced until December last, owing to the want of proper lithographic stones and other appliances, which could not be procured in the Colony.

The whole of the illustrations have been drawn from nature by Mr. Buchanan. To insure accuracy of form, the specimens of the various grasses were lightly inked and faintly impressed on the prepared surface of the lithographic stone; but the details were filled in by hand, together with the enlarged drawings showing the anatomical characters of the inflorescence in each species, all of which are from original microscopic dissections made by Mr. Buchanan, whose excellent botanical knowledge, combined with his skill as a draftsman, peculiarly fitted him for the work. For the satisfactory manner in which the plates have been printed, the work is indebted to the skilful supervision of Mr. J. Earle, the Government Lithographer.

The descriptive letter-press accompanying each plate has been collected from the best authorities, but, in many instances, structural details have been furnished by Mr. Buchanan, which have not been previously published; and many of his remarks on the growth and value of the grasses, founded on experience acquired during twenty-seven years' residence in the Colony, possess great value, although, in view of the expected essay on this branch of the subject, they have been made as brief as possible.

For the general system of classification the work is indebted chiefly to Sir Joseph Hooker's works on the New Zealand Flora, but the method in which the generic and specific characters have been arranged is adopted from a more recent work on the British Flora by the same author.

The condition imposed, that the plates should be nature-printed, has rendered it necessary to publish the work in this large size, which is both inconvenient and expensive; but, as only a small edition will be issued in this form, it is proposed to reduce the plates by photo-lithography, and reproduce the book in octavo form, together with such additional information relative to the economic value of the grasses as may be elicited through the distribution of the present work.

The complete work will contain fifty-five plates, and will be published in five parts, of which the two first are now issued.





## POSTSCRIPT.

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THE circumstances which led to this publication, and the general plan of the work, have already been mentioned in the preface that appeared with the first *fasciculus* which was issued in June, 1877, containing twenty plates. A second portion of the work, with twenty-two plates, was issued in June, 1879; and now, after the lapse of another year, the third part, containing twenty-one plates, is presented to the public, and concludes the work. The complete work thus contains sixty-four instead of fifty-five plates as originally contemplated, the extra number being required to include new species of grasses that have been discovered during the period that has been occupied in preparing this volume. These extra plates and the accompanying letter-press have been numbered in a manner that will allow of their being found in their proper systematic position in the volume.

The total number of species of grasses which are in this work considered to be indigenous to New Zealand, or to have been introduced previous to the first botanical exploration of the country, is eighty-seven, and, of each of these, natural-sized figures with descriptive letter-press are now given.

While the work has been in the Press the seventh volume of Bentham and Mueller's "Flora Australiensis" has been received, in which the grasses of Australia are described, and this work contains a few changes in nomenclature which are unimportant, in so far as they affect the grasses which are found to occur both in Australia and New Zealand. It has been possible only in a few instances to adopt these changes in the present work, as in most cases the plates and descriptions of species under their previously-accepted names had already been printed off. To the practical agriculturist, for whose assistance this work is chiefly designed, the alteration of the scientific names is of comparatively little importance; but, in order to enable botanists to refer to the above-mentioned work, a list of the recent alterations in the nomenclature is appended.

JAMES HECTOR,

Wellington, June, 1880.

*Director.*



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## INTRODUCTION.

### SYSTEMATIC DESCRIPTION OF THE ORDER GRAMINEÆ.

GRASSES.—Roots tufted and fibrous; large succulent-rooted tussocks, or creeping rhizomes. Culms hollow, knotted and closed at the joints, rounded. Leaves alternate, usually distichous, very long or short, sheathing part of leaf split longitudinally on one side, with generally a membranous appendage at the summit called a ligule. Florets mostly perfect, imbricated on a common axis within a calyx, the latter composed of two or more empty glumes, the whole forming a spikelet. Flowers (stamens, pistil, and ovary) enclosed within two glumes, the lower (flowering glume) generally keeled with one or more nerves, the upper (palea) two-nerved, rarely one-nerved. Perianth probably represented by two to three small scales, situated beneath the ovary. Stamens usually three, filaments capillary, anthers attached by the back, versatile. Ovary one-celled, with one erect ovule. Styles two, united at the base, stigmas feathery, with sometimes branched stigmatic hairs. Fruit a grain, sometimes adhering to the palea. Seed closely adhering to the pericarp, embryo on one side at the base of the albumen, generally pear-shaped.

A most important order of phaenogamous plants abundantly spread over the surface of the earth, and exceeding in number of individuals any other order of plants. The grain of several species form important articles of food for man, and the aggregation of species as pasture supplies food for numerous herbivorous animals, and in many the fibrous part of their structure also offers an abundance of economic material for the manufacture of various products, such as paper.

### ARRANGEMENT OF THE GENERA ACCORDING TO THE NATURAL SYSTEM.

Spikelets with 1 fertile terminal flower, with or without a male or imperfect flower below it.

1. *ORYZÆ*.—Flowering glumes hardening, and enclosing the grain. Empty glumes 4 or 5, unequal, laterally compressed, lower smaller.—1. *Ehrharta*; 2. *Mierolæna*.

2. *PHALARIDÆ*.—Flowering glume and palea hardening, and enclosing the grain. Empty glumes 2, equal, laterally compressed, keeled, longer than the flowering.—3. *Alopecurus*; 4. *Hierochloë*.

3. *PANICÆ*.—Flowering glume and palea hardening, and enclosing the grain. Empty glumes 2–4, outer smaller, often dorsally compressed.—5. *Spinifex*; 6. *Paspalum*; 7. *Panicum*; 8. *Isachne*.

4. *ANDROPOGONÆ*.—Flowering glume small, thin, transparent, or 0.—9. *Zoysia*.

Spikelets with 1 or more perfect flowers, the male or imperfect flowers, if present, above the perfect ones, the axis or rachis often ending in a point or bristle.

5. *AGROSTIDÆ*.—Spikelets, 1-flowered. Flowering glume, awnless, or with a simple awn, grain free.—10. *Echinopogon*; 11. *Dichelaëne*; 12. *Apera*; 13. *Sporobolus*; 14. *Agrostis*; 14<sup>2</sup>. *Deyeuxia*.

6. *STIPACÆ*.—Spikelets, 1-flowered. Flowering glume firm, with a simple or 3-cleft awn jointed on to its tip, closely enveloping the grain.—12<sup>2</sup>. *Stipa*.

7. *ARUNDINÆ*.—Spikelets usually 2- or more-flowered, rachis with long silky hairs. Glumes all membranous, free.—15. *Arundo*.

8. *AVENACÆ*.—Spikelets 2- or more-flowered. Flowering glumes on a slender rachis, usually shorter than the empty ones, membranous, shining, split at the top with an intermediate awn that is often twisted at the base (rarely awnless).—16. *Danthonia*; 17. *Desehampsia*; 18. *Koeleria*; 19. *Trisetum*.

9. *FESTUCACÆ*.—Spikelets usually 4- or more-flowered. Flowering glumes usually longer than the empty ones, on a flexuous rachis.—20. *Glyceria*; 21. *Catabrosa*; 22. *Poa*; 23. *Festuca*; 24. *Bromus*.

10. *HORDEACÆ*.—Spikelets, 1- or more-flowered (spiked), sessile on opposite sides of a simple rachis, solitary or 2 or 3 together, the glumes standing right and left to the axis of the spike.—25. *Triticum*; 26. *Gymnostichum*.



## ARTIFICIAL KEY TO THE GENERA REPRESENTED IN NEW ZEALAND.

A. Spikelets on the spines of globose, polygamous, involucrate heads. 5. Spinifex.

B. Spikelets sessile, in 1 or 2 series, on one or both sides of a flattened rachis. Empty glumes 0 or 1-3.

Empty glumes 2 or 3, short; flowering solitary, hard	...	...	...	6. Paspalum.
Empty glume 1, margins connate; flowering solitary, Palea 0	...	...	...	9. Zoysia.
Empty glumes 2, lanceolate; flowering 3-16 awned	...	...	...	25. Triticum.
Empty glume 0, or 2 bristles; flowering 1-3 awned	...	...	...	26. Gymnostichum.

C. Spikelets never sessile and distichous, pedicelled, paniced or racemed.

I. Empty glumes 3 or more, below the solitary hermaphrodite flowering one.

Glumes 5: 4 empty, acuminate, 1 flowering, obtuse	...	...	...	1. Ehrharta.
Glumes 5: 2 empty, minute, 2 empty, awned, 1 flowering, acuminate	...	...	...	2. Microlaena.
Glumes 4 short, obtuse: 2 empty, 1 male, upper hermaphrodite	...	...	...	8. Isachne.
Glumes 4, mucronate or awned: 2 empty, 1 male, upper hermaphrodite	...	...	...	7. Panicum.

II. Empty glumes 2, below the solitary flowering one.

(a.) Panicle dense, cylindric, spike-like (see *Poa anceps* and *Danthonia* in III.)

Empty glumes equal, flattened, Palea 0, Panicle soft, spiciform	...	...	...	3. Alopecurus.
Empty glumes rigid, acuminate, Panicle reduced to an ovoid, spinulose head	...	...	...	10. Echinopogon.

(b.) Panicle effuse or contracted.

Flowering glume on a bearded pedicel, tip bifid, awned	...	...	...	11. Dichelachne.
Flowering glume pedicelled, ending in a long rigid awn	...	...	...	12. Apera.
Flowering glume sessile, short, acute; seed loose in pericarp	...	...	...	13. Sporobolus.
Flowering glume sessile, truncate, awned at back or awnless	...	...	...	14. Agrostis.
Flowering glume pedicelled, with a short dorsal awn	...	...	...	14 <sup>2</sup> . Deyeuxia.
Flowering glume rigid, rolled round the flower, awn bent and articulated	...	...	...	12 <sup>2</sup> . Stipa.

III. Empty glumes 2, below the 2- or more-flowering ones. Flowering glumes rarely 1 in *Poa*, *Danthonia*, and *Deschampsia*.(a.) Flowering glumes awned, sometimes awnless in *Hierochloe* (see *Festuca* in b).

Flowering glumes 2-5, silky; awn at the bifid tip, slender	...	...	...	15. Arundo.
Flowering glumes 2-8, 2 cuspidate, with stout dorsal awn, and long hairs on sides and at base	...	...	...	16. Danthonia.
Flowering glumes 2-4, silky at base, 3-awned, middle one longest	...	...	...	19. Trisetum.
Flowering glumes 2 or 3, shining, truncate, or 4-toothed	...	...	...	17. Deschampsia.
Flowering glumes 3, shining, obtuse, 2 lateral male flowers 3-androus, central flower, male and female, 2-androus	...	...	...	4. Hierochloe.
Flowering glumes 3-7, shining, bifid, with a short obtuse awn or 0; Panicle spiciform	...	...	...	18. Koeleria.
Flowering glumes 4-10, bifid, with an intermediate awn; ovary villous at top	...	...	...	24. Bromus.

(b.) Flowering glumes not awned except in some *Festucas* (see *Hierochloe* and *Koeleria* in a).

Flowering glumes 6-14, short, obtuse, green, scales connate	...	...	...	20. Glyceria.
Flowering glumes 2, short, truncate, erose, membranous	...	...	...	21. Catabrosa.
Flowering glumes 2-10, compressed, keeled, obtuse or acute	...	...	...	22. Poa.
Flowering glumes 2-10, convex or keeled at back, often awned at the entire tip	...	...	...	23. Festuca.

(c.) Remarks on the Distribution of Grasses in New Zealand.

The distribution of the species of grasses is controlled by many circumstances, of which the most obvious are the following: The amount of rainfall and the degree of moisture of the atmosphere, the average and extreme temperatures, altitude and distance from the influence of the sea-coast, and the mineral composition and mechanical condition of the surface-soil.

Thus in New Zealand we find that, out of the eighty-seven species, twenty-eight only have a general distribution, and take part in forming the pasture which covers the plains, terraces, and hill-slopes of the valuable pastoral areas:—



<i>Dichelachne crinita.</i>	<i>Danthonia semi-annularis (alpina).</i>
<i>Dichlachne sciurea.</i>	<i>Danthonia semi-annularis (gracilis).</i>
<i>Agrostis æmula.</i>	<i>Danthonia Buchanani.</i>
<i>Agrostis parviflora.</i>	<i>Deschampsia cæspitosa.</i>
<i>Agrostis pilosa.</i>	<i>Trisetum antarcticum.</i>
<i>Agrostis Billardieri.</i>	<i>Trisetum subspicatum.</i>
<i>Agrostis avenoides.</i>	<i>Poa anceps (elata).</i>
<i>Agrostis quadriseta.</i>	<i>Poa anceps (foliosa).</i>
<i>Deyeuxia scabra.</i>	<i>Poa australis (lævis).</i>
<i>Danthonia Cunninghamsii.</i>	<i>Poa intermedia.</i>
<i>Danthonia Raoulii.</i>	<i>Poa Colensoi.</i>
<i>Danthonia pilosa.</i>	<i>Festuca duriuscula (Linnæus).</i>
<i>Danthonia pilosa (stricta).</i>	<i>Triticum multiflorum.</i>
<i>Danthonia pilosa (racemosa).</i>	<i>Triticum scabrum.</i>
<i>Danthonia semi-annularis.</i>	

Twenty-eight species are restricted to alpine and sub-alpine situations, when for a certain part of each year plant-growth is arrested by a covering of snow :—

<i>Ehrharta Colensoi.</i>	<i>Catabrosa antarctica.</i>
<i>Hierochloe redolens.</i>	<i>Poa foliosa, var. b.</i>
<i>Stipa Petrici.</i>	<i>Poa foliosa, var. c.</i>
<i>Agrostis Muclleri.</i>	<i>Poa anceps (densiflora).</i>
<i>Agrostis Youngii.</i>	<i>Poa anceps (minimé).</i>
<i>Danthonia ovata.</i>	<i>Poa acicularifolia.</i>
<i>Danthonia australis.</i>	<i>Poa pygmæa.</i>
<i>Danthonia flavescens.</i>	<i>Poa exigua.</i>
<i>Danthonia semi-annularis.</i>	<i>Poa albida.</i>
<i>Danthonia nuda.</i>	<i>Poa Mackayi.</i>
<i>Danthonia pauciflora.</i>	<i>Poa Kirkii.</i>
<i>Danthonia Thomsonii.</i>	<i>Poa Lindsayi.</i>
<i>Trisetum Youngii.</i>	

Fourteen species affect moist situations, such as river-sides and swampy bottoms, and seem unable to survive any drought in the soil or atmosphere :—

<i>Microlæna polynoda.</i>	<i>Agrostis canina.</i>
<i>Alopecurus geniculatus.</i>	<i>Arundo conspicua.</i>
<i>Hierochloe redolens.</i>	<i>Arundo fulvida.</i>
<i>Hierochloe alpina.</i>	<i>Glyceria stricta.</i>
<i>Paspalum distichum.</i>	<i>Poa anceps (debilis).</i>
<i>Isachne australis.</i>	<i>Poa breviglumis.</i>
<i>Apera arundinacea.</i>	<i>Festuca scoparia.</i>

On the other hand, there are eight species which thrive on dry and light soils :—

<i>Microlæna stipoides.</i>	<i>Sporobolus elongatus.</i>
<i>Paspalum scrobitulatum.</i>	<i>Agrostis æmula.</i>
<i>Zoysia pungens.</i>	<i>Koeleria cristata.</i>
<i>Echinopogon ovatus.</i>	<i>Poa anceps.</i>

Of grasses that like shade, and are confined to forests and woodlands, where they have protection from the glare of the sun, there are four species :—

<i>Microlæna avenacea.</i>	<i>Poa imbecilla.</i>
<i>Panicum imbecille.</i>	<i>Gymnostichum gracile.</i>

Lastly, there are five species that grow only by the sea-side, thriving best within the influence of air charged with saline moisture, even if the soil consists of the most barren sandhills :—

<i>Spinifex hirsutus.</i>	<i>Festuca littoralis, var. triticoides.</i>
<i>Dichelachne stipoides.</i>	<i>Bromus arenarius.</i>
<i>Poa foliosa.</i>	

The distribution of these characteristic groups is undergoing rapid change by the indirect influence exercised by the clearing of forest land and rank vegetation chiefly by the agency of fire, which not only modifies the climate, but likewise changes the nature of the surface-soil, so that pasturing replaces the premature growth of fern and scrub. In the South, where the winter climate is severe, this replacement takes place with facility; but in the North, where the winter is mild and open, the establishment of pasturage requires the sowing of grass seed, and judicious management in stocking, in order especially to prevent the re-establishment of fern. Even in the South, overstocking at all seasons, and still more repeated burnings, tend to deteriorate the pasturage,

as the more valuable and suitable species springing on the naked soil are selected by the sheep and cattle, and exterminated, while the worthless grasses remain and are propagated. It is therefore highly important that in the North a proper selection of varieties of seed should be made, and that in every case attention should be paid to resting the pastures at the proper seasons, for encouraging the growth of the valuable kinds, and restraining the growth of those which are worthless. Pasturage of high value should, it must be borne in mind, contain an admixture of many other plants besides grasses. Leguminous plants, for instance, being richer in albuminoids than any grasses, have therefore greater fattening capabilities, while many umbelliferous herbs and plants containing saline constituents are absolutely necessary as condimental elements of mixed pasture, in order that stock may be maintained in sound health. With regard to the selection of native grasses for cultivation, the subject yet requires experimental investigation. The most likely species will require to be grown on varied soils, the composition of which should be determined by analysis, and the grasses themselves should also be chemically examined.

The leading varieties of soil prevailing in the different parts of the colony have been chemically determined (*see* Report of Analyses of Soils, Lab. Rep., 186), but the composition of the grasses growing in them has not yet been ascertained.

Meanwhile, with the view of facilitating the making of such experimental researches, the following lists have been drawn up of the native grasses that appear, from the present state of our knowledge, to be most worthy of cultivation for the purposes stated.

The following alpine species are worthy of experimental cultivation as pasture grasses on low lands :—

<i>Ehrharta Colensoi</i> .	<i>Danthonia australis</i> .
<i>Agrostis Muelleri</i> .	<i>Danthonia ovata</i> .
<i>Agrostis setifolia</i> .	<i>Poa foliosa</i> , var. b.
<i>Catabrosa antarctica</i> .	<i>Poa Mackayi</i> .

The following species are recommended for cultivation as ornamental grasses :—

<i>Microlæna polynoda</i> .	<i>Danthonia Cunninghamii</i> .
<i>Hierochloë redolens</i> .	<i>Trisetum antarcticum</i> .
<i>Apera arundinacea</i> .	<i>Poa Lindsayi</i> .
<i>Arundo conspicua</i> .	<i>Poa breviglumis</i> .
<i>Arundo fulvida</i> .	<i>Stipa Petrici</i> .

The following species are recommended for cultivation as pasture grasses :—

<i>Microlæna stipoides</i> .	<i>Danthonia Thomsonii</i> .
<i>Hierochloë alpina</i> .	<i>Trisetum antarcticum</i> .
<i>Isachne australis</i> .	<i>Trisetum subspicatum</i> .
<i>Dichelachne crinita</i> .	<i>Poa anceps</i> (varieties).
<i>Dichelachne sciurea</i> .	<i>Poa intermedia</i> .
<i>Sporobolus elongatus</i> .	<i>Poa Colensoi</i> .
<i>Agrostis canina</i> .	<i>Poa uniflora</i> .
<i>Agrostis parviflora</i> .	<i>Poa breviglumis</i> .
<i>Agrostis avenoides</i> .	<i>Poa Kirkii</i> .
<i>Agrostis Youngii</i> .	<i>Poa Lindsayi</i> .
<i>Danthonia semi-annularis</i> .	<i>Festuca duriuscula</i> .
<i>Danthonia semi-annularis</i> (varieties).	<i>Festuca seoparia</i> .
<i>Danthonia pilosa</i> .	<i>Triticum scabrum</i> (varieties).
<i>Danthonia pilosa</i> (varieties).	<i>Triticum multiflorum</i> .
<i>Danthonia nuda</i> .	<i>Deyeuxia scabra</i> .

The following species are recommended for cultivation as fodder grasses :—

<i>Dichelachne crinita</i> .	<i>Trisetum antarcticum</i> .
<i>Dichelachne sciurea</i> .	<i>Poa anceps</i> , var. <i>elata</i> .
<i>Agrostis avenoides</i> .	<i>Poa intermedia</i> .
<i>Agrostis Youngii</i> .	<i>Poa uniflora</i> .
<i>Danthonia Cunninghamii</i> .	<i>Festuca duriuscula</i> .
<i>Danthonia Raoulii</i> .	<i>Triticum scabrum</i> .
<i>Danthonia flavescens</i> .	<i>Arundo conspicua</i> .
<i>Danthonia semi-annularis</i> .	<i>Arundo fulvida</i> .
<i>Danthonia Buchanani</i> .	



## ADDENDA ET CORRIGENDA.

- PLATE I. *Ehrharta Colensoi*, Hook. fil., has been recently collected in the South Island, on Mount Arthur, 6000 feet altitude, by Mr. McKay, of the Geological Survey Staff, and also on the mountains above Arthur's Pass, by J. F. Cheeseman, F.L.S., Auckland Museum. *Ehrharta Thomsonii*, Petrie, n. sp., a recent discovery by Mr. Petrie, on Stewart Island.
- PLATE VII. *Hierochloa alpina*, Røem and Schultes. This species has been incorporated with *Hierochloa redolens*, R. Brown, as var. *Fraseri*. As regards New Zealand this change appears injudicious, as they form here two distinct species without intermediate forms.
- PLATE XI. *Panicum imbecille*, Trinius. This grass is now *Oplismenus setarius*, Røem and Schultes.
- PLATE XIV. *Dichelachne stipoides*, Hook. fil. This grass is now *Stipa teretifolia*, Steud, being separated from *Dichelachne* and placed in *Stipa*, from the awn articulating on the glume. The present species, with the recent discovery of *Stipa Petriei*, adds a new genus to the Order Gramineæ in New Zealand.
- PLATE XVIII. *Sporobolus elongatus*, R. Brown, is now *Sporobolus indicus*, R. Br. The New Zealand plant has the flowering glume 3-nerved, and more robust than that of Australia.  
Genus *Agrostis*. This genus must be subdivided, and all the species having a pencil or tuft of hairs rising from the base of the flowering glume should be transferred to the genus *Deyeuxia*, described in connection with the new species *D. scabra*.
- PLATE XIX. *Agrostis canina*, Linn., var. B, gelida, is now *Agrostis Muellieri*, Benth. *Agrostis canina*, Linn., var. C, subulata, is now *Agrostis subulata*, Hook. fil.
- PLATE XX. C. *Agrostis parviflora*, R. Brown, is now *Agrostis scabra*. Willd.
- PLATE XXI. For *Agrostis æmula*, R. Brown, read *Deyeuxia Forsteri*, Kunth.  
*Agrostis æmula*, R. Brown, add var. C, *spathacea*, n. sub-spec., Berggren, Report Royal Society, Lund, 1878.
- PLATE XXII. For *Agrostis pilosa*, A. Rich, read *Deyeuxia pilosa*.
- PLATE XXIII. For *Agrostis Billardieri*, R. Brown, read *Deyeuxia Billardieri*, Kunth.
- PLATE XXIV. A. For *Agrostis avenoides*, Hook. fil., read *Deyeuxia avenoides*.
- PLATE XXIV. B. For *Agrostis setifolia*, Hook. fil., read *Deyeuxia setifolia*, Hook. fil.
- PLATE XXV. For *Agrostis Youngii*, Hook. fil., read *Deyeuxia Youngii*.
- PLATE XXVI. For *Agrostis quadriseta*, R. Brown, read *Deyeuxia quadriseta*.
- PLATE XXVII. *Arundo conspicua*, second page, second line from bottom, for 8. *Pistils*, read 8. *Styles*; and on bottom line add Fig. 10. Leaf sheath with hairy ligule.
- PLATE XXIX. 2. *Danthonia ovata*, bottom line, for *pistils*, read *styles*.
- PLATE XXXII. Line 17 from bottom, delete "generally the largest and."  
*Poa pusilla*, Berggren, Report Royal Society, Lund, 1878. This equals *Poa anceps*, var. *minimé*, of the present work.  
*Poa sclerophylla*, Berggren, Report Royal Society, Lund, 1878. This equals *Poa anceps*, var. E, alpina, Hook. fil., Hand. N.Z. Flora, I., 339, also *Poa albida* of the present work.
- PLATE LIII. For *Poa imbecilla*, Forst., read *Eragrostis imbecilla*, Benth.
- PLATE LIV. For *Festuca littoralis*, Labill, read *Schedonorus littoralis*, Beauv. This species is not so common on the coasts of New Zealand as a larger form, *Schedonorus littoralis*, var. *triticoides*. This variety is the *Festuca triticoides*, Steud. Both plants are figured on Plate LIV.
- PLATE LVII. For *Triticum scabrum*, R. Brown, read *Agropyrum scabrum*, Beauv.
- PLATE XX. A. For *Agrostis canina*, var. B, gelida, read *Agrostis Muellieri*.
- PLATE XX. B. For *Agrostis canina*, var. C, subulata, read *Agrostis subulata*.  
For Plate XXXII., *Danthonia australis*, read Plate XXXI.

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[The Synonyms are printed in Italics.]

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## GENUS I.—EHRHARTA, Thunberg.

*Spikelets* paniced, 1-flowered. *Empty glumes* 4, keeled, compressed, acuminate. *Flowering glume* terminal, obtuse. *Palea* linear, obtuse. *Scales* 2, 2-lobed. *Stamens* 2—6. *Ovary* glabrous, sessile. *Styles* short. *Stigmas* with short hairs. *Grain* free within the hardened glume. DISTRIBUTION OF GENUS: AUSTRALIA, SOUTH AFRICA, NEW ZEALAND. *Etymology*: Named in honour of FREDERICK EHRHART, a Swiss Botanist.

## 1.—EHRHARTA COLENSOI.

ALPINE RICE GRASS.

(Plate 1.)

EHRHARTA COLENSOI, Hook. fil. Fl. N.Z., I., 288, t. 65A; Handb. N.Z. Flora, I., 319.

A TUFTED, glabrous, alpine grass, growing at 5000 feet altitude. *Flowers* in January. Perennial. *Root* fibrous, wiry. *Stems* 4—10 inches high. *Leaves* erect, distichous, 2—4 inches long, contracted at the sheath,  $\frac{1}{8}$ — $\frac{1}{4}$ -inch broad, linear-subulate, scaberulous above, smooth below, nerves faint, ligule short, lacerate. *Panicle* contracted,  $1\frac{1}{2}$ —2 inches long, erect or inclined. *Spikelets* on slender pedicels, compressed, linear-oblong,  $\frac{1}{4}$ — $\frac{1}{3}$ -inch long. *Empty glumes*, lower pair short, oblong, acute, 5—7-nerved, central nerves stout; upper pair twice as long as the lower, narrow-lanceolate, almost awned, 7-nerved, and with a tuft of silky hairs at the base. *Flowering glume* shorter, linear-oblong, obtuse, 9-nerved. *Palea* narrow-linear, obtuse, 2-nerved, and with a small bristle at the base. *Scales* 2-lobed, irregularly serrate on the lobes, and nerved below. *Stamens* 2. *Anthers* short, stout. *Ovary* ovate-oblong. *Styles* short. *Stigmas* feathery. *Grain* ovate-oblong. DISTRIBUTION OF SPECIES: NEW ZEALAND.

This grass has only been found on the Ruahine and Tararua Mountains, in the North Island; it grows in flat tufts or tussacs on the open land above the limits of bush. Very little is known of its value as a pasture grass, its limited distribution preventing opportunities for observation or experiment as to its fitness for cultivation at lower levels. From the known fact, however, that many of these alpine grasses are very succulent and fattening, and much relished by sheep during the summer months, this species may prove valuable when the extensive sub-alpine country in the neighbourhood of these mountains is opened up for settlement. DISTRIBUTION IN NEW ZEALAND: NORTH ISLAND: RUAHINE MOUNTAINS—Colenso; TARARUA MOUNTAINS—H. H. Travers.

Reference to Plate I.: Fig. 1. Plant. 2. Spikelet. 3. Upper pair of empty glumes and floret. 4. Floret. 5, 5'. Nervation of lower pair of empty glumes. 6, 6'. Nervation of upper pair of empty glumes. 7. Nervation of flowering glume. 8. Nervation of Palea. 9. Scales. 10. Ovary. 11. Grain.







*Ehrharta Colensoi*, Hook fil.







## GENUS II.—MICROLÆNA, Brown.

*Spikelets* racemed or paniced, 1-flowered. *Empty glumes* 4: two lowermost opposite, minute; two following awned, much larger. *Flowering glume* terminal, acuminate, or awned. *Palea* short, linear, hyaline. *Scales* 2. *Stamens* 2—4. *Ovary* sessile. *Styles* short. *Stigmas* feathery. *Grain* free within the hardened glumes. DISTRIBUTION OF GENUS: AUSTRALIA, TASMANIA, NEW ZEALAND. *Etymology*: Named from two Greek words meaning “small” and a “covering,” in allusion to the small outer glumes.

## ARRANGEMENT OF THE SPECIES:—

- I.—*Two lowest glumes distant from the following* ... .. 1. *M. stipoides*.  
 II.—*Two lowest glumes close to the following* (Diplax)—  
     *Spikelets* paniced. *Leaves* scaberulous,  $\frac{1}{4}$ — $\frac{1}{2}$ -inch broad. *Stamens* 2 2. *M. avenacea*.  
     *Spikelets* racemed. *Leaves* smooth,  $\frac{1}{12}$ — $\frac{1}{6}$ -inch broad. *Stamens* 4 ... 3. *M. polynoda*.

## 1.—MICROLÆNA STIPOIDES.

## MEADOW RICE GRASS.

(Plate II.)

EHRHARTA STIPOIDES, Brown. Labill. Fl. Nov. Holl., I., 16, t. 118.

MICROLÆNA STIPOIDES, Brown. Hook. fil. Fl. N.Z., I., 289; Handb. N.Z. Flora, I., 320.

A SLENDER grass, on low grounds. *Flowers* November—January. Perennial. *Root* fibrous. *Stems* 18—24 inches high. *Leaves* glabrous or sparingly hairy, 2—6 inches long; *ligule* very short, obtuse, entire or lacerate; mouth of sheath with silky hairs. *Panicle* slender, upright or inclined; branched below. Lower *spikelets* on long pedicels, upwards of one inch in length, awns included. *Empty glumes*, lowest pair very minute, acute, deciduous; two following seated at distant intervals on the bearded rachis, scabrid, 7-nerved. *Flowering glume* acuminate or obtuse, with a short awn, 7-nerved. *Palea* linear, obtuse, 1-nerved. *Scales* large, triangular, incised at top and nerved at bottom. *Stamens* 4. *Anthers* long, very narrow. *Styles* short, nearly connate at the base. *Stigmas* feathery. *Grain* long, narrow, linear. DISTRIBUTION OF SPECIES: AUSTRALIA, TASMANIA, NEW ZEALAND.

A valuable pasture grass, and affording sufficient bulk to add value to mixed fodder. It is confined, as far as at present known, to the north and middle parts of New Zealand, and, although abundant in certain localities, is apparently not widely distributed. This grass is highly spoken of by Mr. Bacchus, in Australia, in the Second Annual Report of the Secretary for Agriculture in Victoria, where he says: "It is a good fattening grass, affording nutriment for stock during winter, and does not suffer so much from overstocking as the Kangaroo grass." No doubt this is due to its deep-seated roots, which enable it to withstand the dry heats of summer. Mr. Kirk also reports favourably of this grass in Auckland, "as being closely cropped by horses, cattle, and sheep," and points out that it grows there with equal luxuriance on the light scoria and tertiary clay soils. Its most frequent habitat near Wellington is on the river-flats near the sea-shore, and it is obviously a grass that thrives best in moist places. As an early spring grass it is worthy of cultivation, and deserving of a wider distribution, but, from its having few fertile florets, and consequently producing a small amount of seed, experiments in this direction will require much attention and labour. Failing success by seed, propagation by the roots may be recommended in this case and others where the plants do not seed freely. DISTRIBUTION IN NEW ZEALAND: NORTH ISLAND: EAST CAPE, HAWKE'S BAY, and CAPE PALLISER—Colenso; AUCKLAND—Sinclair, Kirk; WELLINGTON—

Reference to Plate II.: Fig. 1. Plant. 2. Spikelet. 3. Floret. 4. Nervation of upper pair of empty glumes. 5. Nervation of flowering glume. 6. Nervation of Palea. 7. Scales. 8. Ovary. 9. Grain.





*Microlæna stipoides*, Br.





## 2.—MICROLÆNA AVENACEA.

BUSH RICE GRASS.

(Plate III.)

DIPLAX AVENACEA, Raoul, Choix des Plantes, p. 11, t. 3. Fl. N.Z., I., 289.

MICROLÆNA AVENACEA, Hook fil. Handb. N.Z. Flora, I., 320.

A TALL handsome grass, growing at low elevations. *Flowers* December—March. Perennial. *Root* fibrous, wiry. *Stems* 2—4 feet high, densely tufted, compressed and leafy at the base, forming tussocks of erect drooping leaves. *Leaves* 18—24 inches long,  $\frac{1}{4}$ — $\frac{1}{3}$ -inch broad; margins scabrid. *Ligule* very short, obtuse, entire, or lacerate; mouth of the sheath with silky hairs. *Panicle* glabrous, pale-coloured, 10—15 inches long, with many long capillary branches. *Spikelets* on capillary pedicels  $\frac{1}{2}$ -inch long, awns included. *Empty glumes*, lower pair very minute, unequal, persistent; upper pair close to the last, with long awns, 7-nerved. *Flowering glume* acuminate or blunt, with a short awn, 7-nerved. *Palea* narrow, linear, acuminate, 1-nerved. *Scales* large, waved on the upper margin, and nerved at bottom. *Stamens* 2. *Anthers* long, narrow. *Styles* nearly connate at the base. *Stigmas* penicillate, longer than the styles. *Grain* long, narrow. DISTRIBUTION OF SPECIES: NEW ZEALAND.

Common in forest lands, and usually found there in small tussocks, which, by their confluence, often form large patches of a close, harsh sward, especially in the more open places. This grass is greedily eaten by cattle during winter, when it then becomes valuable in supplementing the more nutritious leaf food from certain trees, such as Karaka (*Corynocarpus laevigata*), Mahoe (*Melicytus ramiflorus*), and several others which form their chief food during that season in many places. This species can hardly be recommended for cultivation, as in open country it would very probably become harsher and less succulent; but settlers living in the neighbourhood of forests would be repaid the trouble of collecting seed and sowing it among the trees, and by that means increasing the amount of winter food for their cattle. DISTRIBUTION IN NEW ZEALAND: NORTH AND SOUTH ISLANDS; abundant in forests.

Reference to Plate III.: Fig. 1. Plant. 2. Spikelet. 3. Upper empty glumes and floret. 4. Fertile floret. 5. Nervation of upper empty glumes. 6. Nervation of flowering glume. 7. Nervation of palea. 8. Scales. 9. Ovary. 10. Grain.







*Microlæna avenacea*, Hook. fil.

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## 3.—MICROLÆNA POLYNODA.

KNOT-JOINTED RICE GRASS.

(Plate IV.)

DIPLAX POLYNODA, Hook fil. Fl. N.Z., I., 290.

MICROLÆNA POLYNODA, Hook. fil. Handb. N.Z. Flora, I., 320.

A LARGE, glabrous, tufted grass, on open land, rambling among scrub, 3—6 feet long, ascending to 1000 feet. Perennial. *Flowers* December—February. *Culms* slender or stout, rigid, terete, branched, with knots at the joints. *Leaves* 4—8 inches long, narrow; *ligule* acute, fringed with long hairs. *Racemes* simple, few-flowered; upper *spikelets* sessile, lower shortly pedicelled,  $\frac{1}{2}$ -inch long, awns included. Lowest pair of *empty glumes* minute, unequal, persistent; upper pair shortly awned, 7-nerved. *Flowering glume* very shortly awned, 7-nerved. *Palea* narrow, acute, 1-nerved. *Scales* large, ovate, acuminate, ciliate at top. *Stamens* 4. *Anthers* long, narrow. *Ovary* and *grain* not seen. DISTRIBUTION OF SPECIES: NEW ZEALAND.

This grass has a very limited distribution, and, having only been collected in a few localities, and found nowhere abundantly, little is known of its value either in pasture or as fodder. Its tough wiry leaves are never likely to form a sward that will afford food for sheep, while its sparse habit does not recommend it as fit for being cut as fodder. The larger cattle, however, seldom refusing the coarsest herbage, and often relishing several of the harshest-cutting *Cyperaceæ*, may find in this grass, especially when in flower, sufficient to induce them to eat it. As an ornamental grass it has much to recommend it, and it might be judiciously introduced where ponds or streams require decoration. DISTRIBUTION IN NEW ZEALAND: NORTH ISLAND: AUCKLAND NORTH—Kirk; BASE OF THE RUAHINE MOUNTAINS AND EAST COAST—Colenso. SOUTH ISLAND: CANTERBURY—Armstrong; DUNEDIN—Buchanan.

Reference to Plate IV.: Fig. 1. Plant. 2. Spikelet. 3. Floret. 4, 5. Nervation of upper pair of empty glumes. 6. Nervation of flowering glume. 7. Nervation of Palea. 8. Scale.







*Microlæna polynoda*, Hook. fil.





## GENUS III.—ALOPECURUS, Linnæus.

CREEPING or erect, glabrous or downy grasses. *Spikelets* laterally compressed, imbricated in spike-like cylindrical panicles, 1-flowered. *Empty glumes* sub-equal, keeled, usually connate at the base; awn straight, dorsal. *Palea* 0. *Scales* 0. *Stamens* 3. Grain free within the hardened glumes. DISTRIBUTION OF GENUS: NORTH AND SOUTH TEMPERATE COUNTRIES. *Etymology*: From two Greek words signifying “a fox” and “a tail.”

## 1.—ALOPECURUS GENICULATUS.

KNEE-JOINTED FOX-TAIL GRASS.

(Plate V.)

ALOPECURUS GENICULATUS, Linnæus. English Botany, 1250.

ALOPECURUS PANICEUS, Oeder.

ALOPECURUS AUSTRALIS, Nees. In Mitchell's “Australia.”

ALOPECURUS GENICULATUS, Linnæus. Hook. fil., Fl. N.Z., I., 290; Handb. N.Z. Flora, I., 320.

A GRASS of moist habitats or shallow water-pools, often floating on the water, where it presents when in flower, a conspicuous display of pale flesh-coloured spikes. Found from near sea-level to 3500 feet altitude. *Flowers* November—December. Perennial. *Roots* fibrous. *Culms* creeping at the base, ascending, bent at the joints, and often rooting at the nodes, 1—2 feet high. *Leaves* glabrous, flat, soft, slightly scabrous on the edges; sheaths large, grooved; *ligule* long, membranous. *Panicle* spike-like, cylindric, obtuse,  $1\frac{1}{2}$ — $2\frac{1}{2}$  inches long; *rachis* woolly. *Spikelets* numerous, 1-flowered. *Empty glumes* connate at the very base, membranous, compressed; keel with long bristles, 3-nerved. *Flowering glume* ovate, 7-nerved; awn variable in length and position. *Palea* 0. *Anthers* large. *Styles* nearly connate at the base. *Stigmas* with short simple hairs. *Ovary* glabrous. DISTRIBUTION OF SPECIES: EUROPE, NORTH AMERICA, NORTH ASIA, AUSTRALIA, TASMANIA, NEW ZEALAND.

Opinions of authors, regarding the value of this grass in pasture, are conflicting. Lowe, in his work on British grasses, says of it, “A common grass, rejected by cattle.” Again, Charles Johnson, in a work on British grasses, says, “Most of the grazing animals devour this grass with avidity.” And again, Sinclair, in his “Hortus Gramineus Woburnensis,” gives the following opinion regarding its value: “It does not appear to be eaten with much relish by either horses, cattle, or sheep; its nutrient powers are not considerable, and, from its sub-aquatic habit, it cannot be recommended for cultivation.”



This latter opinion is probably a fair estimate of its value as a pasture grass, and, as it has also little bulk to recommend it as a fodder plant, it may be left to its own natural power of increase in New Zealand, as there are superior grasses equally adapted for wet situations, which will better repay the expense attending aided propagation.

*Glyceria fluitans*, R. Brown, can be recommended as a valuable grass for wet land. This exotic species is already not uncommon in several parts of New Zealand, and the following comparative values of it with *Alopecurus geniculatus* may prove interesting. They are taken from the Woburn experiments of Mr. Sinclair, see "Hortus Gramineus Woburnensis," pp. 349, 353 :—

"*Alopecurus geniculatus*: The produce per acre was 6806 lb., which, when dry, amounted to 2892 lb., and, on analysis, yielded of nutrient matter 292 lb."

"*Glyceria fluitans*: The produce per acre was 13,612 lb., which, when dry, amounted to 4083 lb., and, on analysis, yielded of nutrient matter 372 lb." Cows eat this grass greedily near Wellington, and give more milk when fed upon it.

*Glyceria aquatica* is also a most valuable grass in wet places, and worthy of introduction to New Zealand, as the following analysis from the Woburn experiments prove :—

"*Glyceria aquatica*: The produce per acre was 126,596 lb., which, when dry, amounted to 75,957 lb., and, on analysis, yielded of nutrient matter 4945 lb. At the time of flowering the produce contains more nutrient matter than when the seed is ripe, in the proportion of 19 to 17. In the fens of Cambridgeshire and Lincolnshire immense tracts are covered by this grass, which not only affords rich pasturage in summer, but forms the chief part of the winter fodder."

The best method of propagating these grasses will probably be by the roots, as the only species yet introduced does not always ripen its seed. It also shows a capacity for growing on dry ground, and may, therefore, prove valuable on the farm in mixed fodder crops.

DISTRIBUTION IN NEW ZEALAND: NORTH ISLAND: EAST COAST—Colenso; AUCKLAND—Kirk; KAWAU (probably introduced)—Buchanan. SOUTH ISLAND: NELSON (Sub-alpine)—H. H. Travers; CANTERBURY—Lyall, Armstrong; LAKE OHAU—Haast; OTAGO LAKE DISTRICT (Sub-alpine)—Hector and Buchanan.

Reference to Plate V.: Fig. 1. Plant. 2. Spikelet. 3. Floret. 4. Nervation of empty glumes. 5. Nervation of flowering glume. 6. Ovary with long feathery stigmas.





*Alopecurus geniculatus*, Linn.





## GENUS IV.—HIEROCHLOE, Gmelin.

*Spikelets* paniced, large, broad, pedicelled, laterally compressed, shining, 3-flowered, two lower staminiferous, upper fertile. *Empty glumes* sub-equal, keeled, obtuse, or acute. *Flowering glumes* similar, awnless, or with a terminal or dorsal short awn. *Palea* 1 or 2-nerved. *Scales* 2. *Stamens* 2—3. *Grain* terete, free. DISTRIBUTION OF GENUS: COLD CLIMATES OF BOTH HEMISPHERES. *Etymology*: Named from two Greek words meaning “sacred grass.”

## ARRANGEMENT OF THE SPECIES:—

- |   |              |     |     |     |                        |
|---|--------------|-----|-----|-----|------------------------|
| I.— <i>Outer glumes as long as the flowering.</i>                                     |              |     |     |     |                        |
| Culms 2—4 feet.   | Leaves long  | ... | ... | ... | 1. <i>H. redolens.</i> |
| Culms 1—2 feet.   | Leaves short | ... | ... | ... | 2. <i>H. alpina.</i>   |
| II.— <i>Outer glumes much longer than the flowering</i> ... .. 3. <i>H. brunonis.</i> |              |     |     |     |                        |

## 1.—HIEROCHLOE REDOLENS.

## SWEET-SCENTED SACRED GRASS.

(Plate VI.)

HIEROCHLOE ANTARCTICA, Brown.

DISARRHENA ANTARCTICUM, Labill. Fl. Nov. Holl., II., 83, t. 232.

TORRESIA REDOLENS, A. Cunn.

HIEROCHLOE REDOLENS, Brown. Hook. fil., Fl. N.Z., I., 300; Handb. N.Z. Flora, I., 321.

A BEAUTIFUL sweet-scented grass, ascending to 3000 feet altitude. *Flowers* December—February. Perennial. *Root-fibres* few, wiry. *Stems* 2—4 feet high. *Leaves* flat, smooth, or slightly scabrid; *ligule* broad, membranous. *Panicle* effuse, 6—12 inches long, nodding, shining brown, branches capillary, slightly hairy, lower 2—3 inches long; *ligule* long or short, obtuse, serrate. *Spikelets* numerous,  $\frac{1}{4}$ -inch long and broad, pale, shining. *Empty glumes* ovate, acute, 3-nerved; two lower flowering glumes (staminiferous) obtuse, bearded below, downy above, margins with long cilia, 5-nerved, shortly awned below the top. *Palea* (staminiferous) bifid, 2-nerved. Upper flowering glume (fertile) obtuse, 5-nerved, very shortly awned. *Palea* (fertile) obtuse, 2-nerved, seldom 1-nerved. *Scales* oblong-lanceolate, of the lower florets bifid, and of the upper floret acute; the two scales are sometimes united as one by the margins at bottom, and appearing as a 2-lobed scale. *Stamens* 2—3. *Anthers*

long, stout. *Ovary* glabrous. *Styles* shorter than the *stigmas*, nearly connate at the base. *Stigmas* long, narrow, feathery. *Grain* ovate-oblong. DISTRIBUTION OF SPECIES: CAMPBELL ISLAND, FALKLAND ISLANDS, TERRA DEL FUEGIA, TASMANIA, ALPS OF SOUTH-WEST AUSTRALIA, NEW ZEALAND.

This grass is widely distributed over the Islands in wet places. It was, some years ago, found abundantly in Otago and Southland, from the sea-level to 3000 feet altitude. When found at low altitudes it is always larger and coarser than when under sub-alpine influences. It is often found growing luxuriantly among sand-hills near the sea, where its long wiry roots penetrate to a considerable depth in the soil. It is, apparently, a soda-loving plant, being partial to littoral swamps, where, in such places, it often attains four feet in height, the large graceful plume-like panicles forming conspicuous objects, and emitting, in warm weather, a strong perfume. When found in upland pastures it is of much smaller size, and more succulent, forming a valuable component of the pasture, and eaten by cattle and sheep with apparent relish. This grass, with many others, has suffered much in the South Island in the general deterioration of the pasture during the last fifteen years; and, although its deep-seated roots might have enabled it to resist the effects of repeated burnings, yet, where burning has been combined with over-feeding, it has nearly been destroyed. It is probable that this grass has been somewhat over-rated as regards its nutrient qualities, but it would be an impossible task to lay down a constant value for any grass, as this must continually vary, according to the different conditions in which it is placed as regards soil, moisture, and heat.

In sub-alpine situations, both in New Zealand and in Australia, the settlers do not recognize much difference between this species and *H. alpina*; and in such situations the value of both in pasture is nearly equal, neither being considered as a first-class grass.

Reference to Plate VI.: Fig. 1. Plant. 2. Spikelet. 3. Florets with the empty glumes removed. 4, 4'. Nervation of empty glumes. 5. Nervation of staminiferous flowering glumes. 6. Nervation of staminiferous Palea. 7. Nervation of fertile flowering glume. 8. Nervation of fertile Palea. 9. Scale of staminiferous floret. 10. Scale of fertile floret. 11. Ovary. 12. Grain.





*Hierochloa reddolens*, Br.







## 2.—HIEROCHLOE ALPINA.

THE HOLY GRASS.

(Plate VII.)

HIEROCHLOE BOREALIS, Schröder.

HOLCUS ODORATUS, Linnæus.

HIEROCHLOE ODORATA, Koch.

HIEROCHLOE BOREALIS, Rœm. and Schultes. Hook. fil., Fl. N.Z., I., 300; Fl. Tasm., II., 108.

HIEROCHLOE ALPINA, Rœm. and Schultes. Hook. fil., Handb. N.Z. Flora, I., 322.

A SLENDER sub-alpine grass, ascending to 3500 feet. *Flowers* December—February. Perennial. *Roots* fibrous, creeping. *Stems* 1—2 feet high. *Leaves* 4—8 inches long, smooth, flat; *ligule* long or short, obtuse, serrate. *Panicle* ovate, 2—4 inches long, branches few, capillary. *Spikelets*  $\frac{1}{5}$ -inch long and broad, shining. *Empty glumes* large, acute or slightly obtuse, 3-nerved. *Flowering glume* pubescent, margins long-ciliate, 5-nerved; awn variable in length and position, usually inserted above the middle in the staminiferous, and in the fertile floret very short and terminal. *Palea* obtuse, 2-nerved in the staminiferous florets, and 1-nerved in the fertile. *Scales* narrow-lanceolate, ciliate and bifid at top, and often united as one by the lower margins on one side only. *Stamens* 3. *Anthers* long. *Ovary* glabrous, narrow, acute. *Styles* short, connate at the base. *Stigmas* penicillate. *Grain* oblong-ovate, narrowed at both ends. DISTRIBUTION OF SPECIES: SCOTLAND, NORWAY, SWEDEN, LAPLAND, ICELAND, ITALY, FRANCE, GERMANY, KAMTSCHATKA, ALASKA. AUSTRALIA, TASMANIA, NEW ZEALAND.

This species, according to Sir J. Hooker, is identical with *H. borealis*, or the "Holy grass" of the Northern Hemisphere. It is very sweet scented, the odour being very similar to that of the previous species. Much historical interest is attached to this species in some parts of Europe, from a long-prevailing custom of strewing it before churches on certain festivals. In Sweden it is hung over beds, in the belief that it induces sleep; and in Iceland it is used to scent the clothes and apartments of the inhabitants. According to Cuthbert W. Johnson, its nutritive qualities are greater than in most of the early spring grasses; but, from the paucity of its foliage, it cannot be recommended in agriculture. From this opinion it may be concluded that this species will be valuable in the sub-alpine pastures of New Zealand as an early and nutritious food, and, from its small growth, be well adapted for sheep. DISTRIBUTION IN NEW ZEALAND: NORTH ISLAND: RUAHINE MOUNTAINS—Colenso. SOUTH ISLAND: NELSON—Monro, Travers; HOPKINS RIVER, 2000—3500 feet altitude—Haast; OTAGO LAKE DISTRICT, 3000 feet altitude—Hector and Buchanan.

Reference to Plate VII.: Fig. 1. Plant. 2. Spikelet. 3. Florets with empty glumes removed, 4, 4'. Nervation of empty glumes. 5. Nervation of staminiferous flowering glumes. 6. Nervation of Palea (staminiferous). 7. Nervation of fertile flowering glume. 8. Nervation of Palea (fertile). 9. Scales (staminiferous florets). 10. Scale (fertile floret). 11. Ovary.







*Hierochloa alpina*, *Rœm. and Schultes*.





## GENUS V.—SPINIFEX, Linnæus.

Inflorescence diœcious. Male *spikelets* spiked on rigid peduncles, which are collected into umbels, with sheathing or spathaceous leaves at their base, 1 or 2-flowered. *Empty glumes* 3. *Flowering glume* membranous. *Stamens* 3. *Anthers* very long. Female *spikelets* solitary or few, in the sheathing bases of very long, pungent leaves, which are extremely numerous, and collected into very large globose masses, 1 or 2-flowered; 3 *empty glumes*, as in the male, but larger. *Flowering glume* coriaceous. *Scales* 2. *Grain* free within the glumes and palea. DISTRIBUTION OF GENUS: INDIA, CHINA, AUSTRALIA, TASMANIA, PACIFIC ISLANDS, NEW ZEALAND. *Etymology*: From the Latin "Spina," in allusion to the termination of the *rachis*.

## SPINIFEX HIRSUTUS.

SPINY ROLLING GRASS.

(Plates VIII., IX.)

SPINIFEX HIRSUTUS, Labill. Flora, Nov. Holl., II., 81, t. 230—231.

SPINIFEX SERICEUS, Raoul. En. Plant.

SPINIFEX INERMIS, Banks et Sol., M.S.S.

IXALUM INERME, Forst., Prodr., fid. Raoul.

SPINIFEX HIRSUTUS, Labill. Hook. fil., Fl. N.Z., I., 292; Handb. N.Z. Flora, I., 322.

A COURSE, rambling, much-branched, rigid, spinous, silky or woolly, perennial grass. Habitats near the sea on sand-hills, or saline soils more inland. *Flowers* January—February. *Culms* stout, knotted, creeping. *Leaves* 1—1½-inches long, coriaceous, lower sheaths shining, both sides of leaf silky, or villous. Male spikes with the *rachis* 1—3 inches long, numerous, peduncled, silky. *Spikelets* 1—2-flowered, shortly pedicelled, ⅓-inch long. *Empty glumes*: First and second 7-nerved, third 5-nerved. Androus *flowering glume* 5-nerved. *Palea* 2-nerved. *Scales* 2, large, fleshy, with membranous borders, 2-nerved. *Stamens* 3. *Anthers* long, narrow. Female *spikelets* 1—2-flowered at the membranous basis of leaves, which terminate in rigid, slender spines, 3—8 inches long. *Empty glumes*: First shortly awned, 9-nerved; second shortly awned, 7-nerved; third 5-nerved. *Flowering glume* 7-nerved. *Palea* 4-nerved. *Scales* 2, large, fleshy, with membranous borders, 2-lobed, and 2-nerved. *Ovary* compressed. *Stamens* 3, abortive. *Styles* very short, connate at the base. *Stigmas* very long, with short simple hairs. DISTRIBUTION OF SPECIES: INDIA, PACIFIC ISLANDS, AUSTRALIA, TASMANIA, NEW ZEALAND.



The present grass has no claim whatever as a food-plant for stock, and can only be recommended as a sand-binder in fixing drift sands when encroaching on valuable land. For this purpose it deserves more attention than has hitherto been bestowed upon it. It is a plant of comparatively rapid growth, and with the aid of other indigenous plants, such as *Desmoschoenus spiralis*, of similar habit, would give effectual aid in checking the inroads of wind-driven sand, conditionally that the plants be carefully conserved from fire. From the ravages of this element alone, since the settlement of New Zealand, may be ascribed the increased spread of wind-driven sand, and, under such inflictions, the indigenous plants are overlooked in reclothing the sand dunes with vegetation, seed of exotic plants inferior for this purpose being often imported at considerable expense.

This grass may be propagated by seed, as also by roots; the seed may be collected in February, March, and April. It is probable, however, that the trouble incurred in collecting native grass seed, when compared with the ease with which exotic seed may be procured by purchase, will account for the neglect of such valuable sand-binders as the grass under notice. **DISTRIBUTION IN NEW ZEALAND: COMMON ON THE COASTS EVERYWHERE.**

Reference to Plate VIII.: Fig. 1. Male plant. 2. Spikelet. 3. Nervation of first and second empty glumes. 4. Nervation of third empty glume and flowering glume. 5. Nervation of Palea. 6, 6'. Scales of lower Palea. 7, 7'. Scales of upper Palea. 8. Variety of scales with stamens. 9. Diagram showing the arrangement of the glumes in floret, in which the third empty glume holds the position of flowering glume to the upper Palea, and may be considered as a flowering glume.

Reference to Plate IX.: Fig. 1. Female plant. 2. Spikelet. 3. Nervation of first empty glume. 4. Nervation of second empty glume. 5. Nervation of third empty glume. 6. Nervation of flowering glume. 7. Nervation of Palea. 8, 8'. Scales. 9, 9'. Ovary, with three abortive stamens, and long stigmas. 10. Grain.





*Spinifex hirsutus*, *Labill.*  
MALE.

Cornell  
University  
Library









*Spinifex hirsutus*, Labill.  
FEMALE.





## GENUS VI.—PASPALUM, Linnæus.

*Spikelets* in the New Zealand species ovoid, much compressed, arranged in two rows on one side of a flat *rachis*, 1-flowered, short, acute, or obtuse, without a callus at the base. *Empty glumes* 2—3, unequal; lower glume usually very small. *Flowering glume* hardening, and enclosing the palea and grain; all obtuse or acute, awnless. *Scales* 2, short, fleshy. *Stamens* 3. *Grain* free within the hardened glume. DISTRIBUTION OF GENUS: EAST INDIES, WEST INDIES, NORTH AMERICA, PERU, WEST AFRICA, AUSTRALIA, NEW ZEALAND. *Etymology*: One of the Greek names for “Millet.”

## ARRANGEMENT OF THE SPECIES:—

Erect. Leaves flat. Spikelets obtuse	...	...	...	1. <i>Paspalum scrobitulatum</i> .
Creeping. Leaves involute. Spikelets acute	...	...	...	2. <i>Paspalum distichum</i> .

## 1.—PASPALUM SCROBITULATUM.

DITCH MILLET.

(Plate X. A.)

PASPALUM ORBICULARE, Forster.

PASPALUM SCROBITULATUM, Linnæus. Hook. fil., Fl. N.Z., I., 291; Handb. N.Z. Flora, I., 323.

A GLABROUS, erect, dark-brownish-green grass, ranging from the sea-level to 500 feet altitude. *Flowers* December—January. Perennial. *Culms* tufted, 1—3 feet high, often forming small tussacs. *Leaves* broad, flat, or wrinkled, rough at the margin, often hairy at the base; *ligule* short, broad, rounded at top. *Spikes* 2—6, alternate, 1—2 inches long; *rachis* flat, bristly at the base. *Spikelets* imbricate, in two series, sessile, orbicular,  $\frac{1}{12}$ — $\frac{1}{10}$ -inch long. *Empty glumes* 2, membranous, 1-nerved. *Flowering glume* concave, faintly 3-nerved. *Palea* flat, faintly 2-nerved. *Scales* 2, short, fleshy, truncate. *Stamens* 3, large. *Styles* long. *Stigmas* penicillate, shorter than the styles. *Grain* round, thin, plano-convex, free within the hardened glume and palea. DISTRIBUTION OF SPECIES: EAST INDIES, AUSTRALIA, NEW ZEALAND.



The value of this grass in pasture is probably insignificant, and, therefore, its limited distribution in New Zealand is not much to be regretted. It appears to be chiefly confined to the Auckland District and the Islands to the Eastward. It may be noticed as a reason why this grass should not be cultivated in New Zealand, that this species, or a variety of it, is in very bad repute in the East Indies. Quoting from Lindley's "Vegetable Kingdom," p. 113, "A variety of *Paspalum scrobiculatum*, called 'Hureek' in India (Graham's 'Bombay Plants,' p. 234), which is, perhaps, the Ghohona grass, a reputed Indian poisonous species, is said to render the milk of cows that graze upon it narcotic and drastic." ("Madras Journal," 1837, p. 107.) It does not follow, however, that the same species of any tropical poisonous plant, grown in the temperate climate of New Zealand, would prove equally noxious, as it is well known that the poisonous principle of many plants, such as the opium poppy, is considerably modified by cultivation under a reduced temperature. In New Zealand this species is not much relished by cows, where other grasses can be got, therefore its reputed evil effects on milk, if any, may not be worth consideration. DISTRIBUTION IN NEW ZEALAND: NORTH ISLAND: BAY OF ISLANDS—Banks and Solander; ISTHMUS OF AUCKLAND and GREAT BARRIER ISLAND—Kirk; TITIRANGI—Cheeseman; KAWAU ISLAND—Buchanan.

Reference to Plate X. A: Fig. 1. Plant. 2. Spikelet open. 3, 3'. Spikelet closed, front and side view. 4. Palea. 5. Nervation of empty glumes. 6. Ovary with penicillate stigmas and stamens. 7. Scale. 8, 8'. Grain, front and side views.

## 2.—PASPALUM DISTICHUM.

SEA-SIDE MILLET.

(Plate X. B.)

PASPALUM LITTORALE, Brown.

PASPALUM DISTICHUM, Burmann. Fl. N.Z., I., 291. Handb. N.Z. Flora, I., 323.

A CREEPING, glabrous, littoral grass. *Flowers* December—February. Perennial. *Culms* branched, compressed, ascending; 4—10 inches high, covered with leaf-sheaths to the top. *Leaves* distichous, strict, involute; *ligule* short, broad, rounded at top; mouth of sheath with a tuft of silky hairs on each side. *Spiques* in pairs, 1 inch long; *rachis* narrow. *Spikelets* loosely imbricate, glabrous, pedicelled, ovate, acute,  $\frac{1}{8}$ -inch long. *Empty glumes* 2, membranous, 5-nerved. *Flowering glume* slightly concave, faintly 3-nerved. *Palea* flat, faintly 2-nerved. *Scales* 2, fleshy, truncate. *Styles* long. *Stigmas* feathery, shorter than the style. *Stamens* 3. *Grain* ovate, flat, thin, free within the hardened glume. DISTRIBUTION OF SPECIES: NEW ZEALAND, also a common Tropical and Sub-Tropical Grass.

This is a grass of considerable value, and is commonly found on littoral swamp land, and wet bottoms among sand-hills on the coast-line of Auckland and Islands on the East Coast—localities where superior grasses are seldom found. It is also common in similar situations in Australia, where, according to Mr. Bacchus, “its nutrient properties are considerable, horses and cattle eating it readily.” From the fact that this grass supplies valuable food for stock in localities where species of value are never abundantly found, is obtained an argument in favour of its introduction to similar places in other parts of New Zealand, where the climate would permit its growth. At the proper season seed could, no doubt, be collected in sufficient quantity to sow down a few square yards of fenced ground adapted for the purpose, as an experiment, and, if this should prove a failure, inoculation by plants is always possible with grasses which have creeping roots, as in this species.

There are also exotic species of this Genus of great value, which might be introduced with much probability of success in the swamps of the Waikato, or Isthmus of Auckland;—one of these (quoting from “Lindley’s Vegetable Kingdom,” p. 113), is “*Paspalum exile*, a species common on the West Coast of Africa, and from which a fine-grained corn is gathered and sold there under the name of Fundi.”

This species would, in addition to improving the pasture, furnish a large food-supply for native wild fowl and introduced game birds, the millets being often sown in copses in England for that purpose. DISTRIBUTION IN NEW ZEALAND: NORTH ISLAND: BAY OF ISLANDS—Cunningham; AUCKLAND—Sinclair; WAIKATO and GREAT BARRIER ISLAND—Kirk; TITIRANGI—Cheeseman; KAWAU—Buchanan.

Reference to Plate X. B: Fig. 1. Plant. 2, 2'. Spikelet open and closed. 3. Palea with feathery stigmas and stamens. 4. Nervation of empty glumes. 5. Nervation of flowering glume. 6. Nervation of Palea. 7. Ovary with feathery stigmas and stamens. 8. Scale. 9, 9'. Grain, front and side views.







A. *Paspalum scrobitulatum*, Linn.

B. " *distichum*, Burmann.

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## GENUS VII.—PANICUM, Linnæus.

*Spikelets* variously arranged, naked, or with bristles at their base; spiked, racemed, or paniced; 1-flowered, or, if 2-flowered, the lower male. *Glumes* 4, awned or awnless; lowest small or minute, empty; second larger, empty; third empty, or male-flowered, uppermost with a hermaphrodite flower, fainter-nerved, smooth, hardening and enclosing the palea and grain. *Palea* like the glume, but smaller, 2-nerved. *Scales* 2, truncate. *Stamens* 3. *Grain* free. DISTRIBUTION OF GENUS: TROPICAL AND SUB-TROPICAL CLIMATES. *Etymology*: From the Latin name "Panis" (Bread).

## 1.—PANICUM IMBECILLE.

SLENDER PANICK GRASS.

(Plate XI.)

ORTHOPOGON ÆMULUS, Brown

HEKATEROSACHNE ELATIOR, Steudel.

OPLISMENUS ÆMULUS, Kunth. Hook. fil., Fl. N.Z., I., 291.

PANICUM IMBECILLE, Trinius. Hook. fil., Handb. N.Z. Flora, I., 323.

A WEAK, slender, decumbent grass, rooting at the nodes, culms erect, 6—18 inches long, sparingly branched, ascending to 1000—1500 feet altitude. *Flowers* December—February. Perennial. *Leaves* 1—6 inches long,  $\frac{1}{4}$ —1 inch broad, lanceolate; sheaths of leaves and knots of culms more or less pilose. *Spikelets* spiked, in distant clusters of 2—6, nearly sessile,  $\frac{1}{12}$ -inch long, glabrous or pilose, naked, or with a brush of hairs at base. *Empty glumes* 3, often pilose on the back, membranous; first *empty glume* shortest, 3-nerved, and with a long flexuose, stout, obtuse awn; second *empty glume* larger, sharply acute, 5-nerved, and with a very short awn; third *empty glume* acute, 7-nerved. *Flowering glume* obtuse, coriaceous, white, 2-nerved. *Scales* 2, truncate or bilobate. *Ovary* glabrous. *Styles* long. *Stigmas* shorter, penicillate. *Grain* linear. DISTRIBUTION OF SPECIES: TROPICS OF ASIA, AFRICA, AND AMERICA; AUSTRALIA, NEW ZEALAND.

A sparse foliaged grass, not adapted for pasture, its usual habitat being under the shelter of bush. It may be termed an unsocial grass, as it is most commonly found growing in isolated patches, and it probably could not exist under a struggle for place with grasses of more robust habit on open land. Cattle eat this grass readily, but their relish for it must be greatly lessened by the large amount of foreign matter, such as dead leaves, with which it is usually associated; it may, therefore, be classed with other bush grasses, such as *Microlæna avenacea*, as an auxiliary to supplement neighbouring pastures during dry seasons.



This grass is the only representative in New Zealand of the genus *Panicum*, a family containing several species of the greatest value as corn and fodder plants, such as *Panicum frumentaceum*, cultivated in India as a corn plant, and *Panicum spectabile*, indigenous to Brazil, and valuable as a permanent summer grass, the latter being highly recommended as adapted to the temperate climate of New Zealand. Experiments with this grass in Australia prove its capacity to resist the driest seasons, which is pointed out by Dr. Schomburg in his paper on introduced grasses, read before the Chamber of Manufactures, Adelaide, and also as the result of experiments by Dr. Curl, of Rangitikei, in relation to its value in pasture. (Trans. N.Z. Institute, Vol. IX., page 531.)

Regarding the capacity of grasses to resist drought, it may be accepted as a rule in the improvement of pastures that the permanence of every grass will be in exact proportion to the stoutness of its roots, and depth to which they extend. Species with deep-seated, stout roots, like *Panicum spectabile*, and *Sporobolus elongatus*, will be enabled to resist the driest seasons; whilst species such as *Lolium perenne*, and *Dichelachne crinita*, having fine fibrous roots ramifying near the surface, must inevitably perish under the same circumstances. DISTRIBUTION IN NEW ZEALAND: NORTH ISLAND: COMMON IN WOODS—Banks and Solander; AUCKLAND ISTHMUS, GREAT BARRIER ISLAND, THAMES—Kirk; TITIRANGI—Cheeseman; KAWAU ISLAND, WELLINGTON—Buchanan. SOUTH ISLAND: NELSON—Travers; CANTERBURY—Lyell and Armstrong.

Reference to Plate VII.: Fig. 1. Plant. 2. Spikelet. 3. Nervation of first empty glume. 4. Nervation of second empty glume. 5. Nervation of third empty glume. 6. Nervation of flowering glume. 7. Nervation of Palea. 8, 8'. Scales. 9. Ovary with stamens and penicillate stigmas. 10. Grain.



*Panicum imbecille*, *Trinius*.





## GENUS VIII.—ISACHNE, Brown.

*Spikelets* paniced, 2-flowered, lower flower usually male, upper hermaphrodite. *Empty glumes* 2, nearly equal, often deciduous. *Flowering glumes* nearly equal, the fertile glume hardening and including the palea and grain. *Palea* nearly as large as the glumes, also hardening. *Scales* 2. *Stamens* 3. *Ovary* linear. *Grain* free within the hardened glume and palea. DISTRIBUTION OF GENUS: TROPICAL AND SUB-TROPICAL CLIMATES. *Etymology*, from two Greek words signifying "equal" and a "glume."

## 1.—ISACHNE AUSTRALIS.

EQUAL-GLUMED MILLET.

(Plate XII.)

ISACHNE AUSTRALIS, Brown. Hook fil., Fl. N.Z., I., 291; Handb. N.Z. Flora, I., 324.

A TUFTED grass, usually on swampy land. *Flowers* December—January. Perennial. *Root* fibrous. *Stems* 6—18 inches high; slender, decumbent, and creeping at the base. *Leaves* scaberulous, 3—5 inches long,  $\frac{1}{8}$ — $\frac{1}{4}$ -inch broad, flat; mouth of the sheath with silky hairs. *Panicle* erect, ovoid, 1—2 inches long, lax, branches long, flexuous, sparingly divided. *Spikelets* few, pedicelled, obtuse,  $\frac{1}{2}$ -inch long. *Empty glumes* glabrous, 11- and 9-nerved. *Flowering glumes*: lower, sessile, glabrous, 5-nerved, *Palea* 2-nerved; upper, stipitate, pubescent, 5-nerved, *Palea* 2-nerved. *Scales* truncate. *Anthers* large. *Ovary* glabrous. *Styles* very long. *Stigmas* penicillate, shorter than the styles. DISTRIBUTION OF SPECIES: INDIA, CHINA, AUSTRALIA, NEW ZEALAND.

Little is known of this grass in New Zealand, except in the District of Auckland, where, according to Kirk, it is abundant in swampy places, and is greedily eaten by all kinds of stock. So valuable a grass is worthy of attention by settlers, and, although it might not thrive in the colder parts of the colony, it could, no doubt, be extended over a larger area of the North Island than that to which it is at present restricted. Many of our most valuable indigenous grasses have a very limited distribution, while their cultivation is much neglected, a preference being given to exotic species, apparently from the greater facility with which their seed can be procured by purchase. The difficulty in procuring seeds of our native grasses will not be overcome until a few enterprising settlers commence their cultivation chiefly for the sale of seed, which would certainly prove remunerative. DISTRIBUTION IN NEW ZEALAND: NORTH ISLAND, BAY OF ISLANDS—A. Cunningham; AUCKLAND—Sinclair; LAKE TAUPO—Colenso; ISTHMUS OF AUCKLAND, THAMES, NORTH CAPE to WAIKATO, &c.—Kirk.

Reference to Plate XII.: Fig. 1. Plant. 2. Spikelet. 3. Stamiferous floret. 4. Fertile floret. 5. Palea of fertile floret. 6, 6'. Nervation of empty glumes. 7. Nervation of flowering glumes. 8. Nervation of Paleæ. 9. Scales. 10. Ovary, &c.







*Isachne australis*, Br.





## GENUS IX.—ZOYSIA, Willdenow.

*Spikelets* few (1—10), sessile, or shortly pedicelled, alternate, and imbricating on a stiff, erect, flattened flexuous rachis. *Empty glume* 1, mucronate or awned. *Flowering glume* solitary, included. *Palea* membranous or none. *Scales* 0. *Stamens* 3. *Ovary* oblong. *Styles* short, terminal. *Stigmas* long, feathery. *Grain* free. DISTRIBUTION OF GENUS: INDIA, MAURITIUS, CHINA, AUSTRALIA, NEW ZEALAND. *Etymology*: Named in honor of Baron Charles de Zoys, a Carniolian ecclesiastic, and collector of plants.

## 1.—ZOYSIA PUNGENS.

(Plate XIII. A.)

ROTTBOELLIA UNIFLORA, A. Cunningham.

ZOYSIA PUNGENS, Willdenow. Hook. fil., Fl. N.Z., I., 312; Handb. N.Z. Flora, I., 324.

A SMALL, creeping, rigid, usually littoral grass. *Culms* branched, 1—3 inches high, tufted, glabrous. *Flowers* December—January. Perennial. *Roots* wiry, striking downwards from the prostrate rhizome. *Leaves* erect or spreading, filiform or subulate, involute, 1—4 inches long; sheaths tumid, grooved; *ligule* 0. *Spike*  $\frac{1}{8}$ — $\frac{1}{2}$ -inch long, often reduced to a solitary spikelet. *Spikelets*  $\frac{1}{10}$ — $\frac{1}{5}$ -inch long, shortly pedicelled. *Empty glume* ovoid, convolute, rigid, very coriaceous, glabrous, tip produced to a short awn, 7-nerved. *Flowering glume* solitary, sessile, included, membranous, convolute, 1-nerved. *Palea* 0. *Stamens* 3, large. *Ovary* sessile, glabrous. *Grain* long, narrow. DISTRIBUTION OF SPECIES: THE SAME AS THE GENUS.

A grass of considerable value on littoral swamps and dry flats near the sea. According to Kirk, "It is found sometimes forming a compact turf on dry land, and affording a large supply of succulent herbage for horses, cattle, and sheep." Its value, however, in such localities, if bulkier grasses would grow there, must be comparatively little, as, from its close-growing habit, it chokes out all other species. This may be observed near Tauranga, where, on the dry littoral flats above high water, the constant cropping of this grass by horses and cattle has formed so close a turf as to be impervious to all other

vegetation. It is evidently much relished by stock, and is worthy of introduction in sand-hill districts near the sea, or saline soil inland, of little value for other herbage, as it would clothe the wet flats with a valuable sward. This is another of those grasses, similar to *Paspalum distichum*, which will be easiest propagated by roots, the close-matted wiry fibres forming coherent masses of turf, which are easily conveyed in fragments to a distance without injury. DISTRIBUTION IN NEW ZEALAND: NORTH ISLAND: BAY OF ISLANDS—Sinclair; WAIKATO, MAKETU, AND LAKE DISTRICT—Kirk; TITIRANGI—Cheeseman; TAURANGA—Buchanan. SOUTH ISLAND: NELSON—Monro; CANTERBURY—Armstrong.

Reference to Plate XIII. A: Fig. 1. Plant. 2. Spikelet. 3. Floret. 4. Nervation of empty glume. 5. Nervation of flowering glume. 6. Ovary with feathery stigmas. 7, 7'. Grain, front and side views.



## GENUS X.—ECHINOPOGON, Palisot.

*Spikelets* sub-sessile, on short branches closely arranged into an oblong or ovoid, dense spike-like panicle,  $\frac{1}{2}$ — $1\frac{1}{2}$ -inches long, bristling with rigid spreading awns, 1-flowered. *Empty glumes* 2, equal. *Flowering glume* as long as the empty, with a pencil of silky hairs at the base; awn terminal. *Palea* nearly equal in length to the flowering glume, with a short stiff pedicel at the base. *Scales* 2. *Stamens* 3. *Ovary* bearded at the top. *Grain* free. DISTRIBUTION OF GENUS: AUSTRALIA, TASMANIA, NORFOLK ISLAND, NEW ZEALAND. *Etymology*: Named from two Greek words meaning “scabrid” and a “beard.”

## 1.—ECHINOPOGON OVATUS.

## ROUGH-BEARDED GRASS.

(Plate XIII. B.)

AGROSTIS OVATA, Forster. Labill., Fl. Nov. Holl., I., 19, t. 21.

HYSTERICINA ALOPECURIOIDES, Steudel.

ECHINOPOGON OVATUS, Palisot. Hook. fil., Fl. N.Z., I., 297; Handb. N.Z. Flora, I., 325.

A HARSH scabrid grass, 6—24 inches high, ascending to 3000 feet altitude. Annual. *Flowers* November—January. *Leaves* scabrid on the edges. Sheath of upper leaf long; *ligule* short. *Spikelets* green, nearly horizontal, 1-flowered. *Empty glumes* equal, rigid, acuminate, 1-nerved. *Flowering glume* with a pencil of silky hairs at the base, 2-fid at top, 3-nerved; awn terminal, long, rigid, not twisted, involute, flattening out when wet and pressed, as if a continuation of the glume. *Palea* nearly as long as the flowering glume, 1-nerved, and with a short stiff pedicel at the base. *Scales* 2, ovate-lanceolate. *Anthers* large. *Ovary* bearded on top. *Styles* short. *Stigmas* long, feathery. *Grain* long, narrow. DISTRIBUTION OF SPECIES: SAME AS THE GENUS.

A grass widely distributed throughout the Islands, but never found abundant anywhere. It is eaten by sheep and cattle, but is of little value from its harsh non-succulent foliage and straggling habit. Commonly found on dry banks and other waste places, it can only be recommended as an early grass, but would probably not repay cultivation. DISTRIBUTION IN NEW ZEALAND: COMMON IN NORTH AND SOUTH ISLANDS.

Reference to Plate XIII. B.: Fig. 1. Plant. 2. Spikelet. 3. Floret. 4. Nervation of empty glumes. 5. Nervation of flowering glume. 6. Nervation of Palea. 7. Scale. 8. Ovary with feathery stigmas. 9. Grain.







A. *Zoysia pungens*, Willdenow.  
B. *Echinopogon ovatus*, Palisot.





## GENUS XI.—DICHELACHNE, Endlicher.

*Spikelets* long, narrow, 1-flowered, shining. *Empty glumes* 2, membranous, acuminate. *Flowering glume* as long, on a bearded pedicel, scabrid or silky, 2-fid, or entire at the tip, with a straight, twisted, or flexuose awn from the back or between the lobes, which is not jointed or thickened at the base. *Palea* shorter, linear, 2-fid. *Scales* 2. *Stamens* 3. *Grain* long, terete, free. DISTRIBUTION OF GENUS: AUSTRALIA, NORFOLK ISLAND, TASMANIA, NEW ZEALAND. *Etymology*: From two Greek words signifying a “cloven hoof” and “chaff,” in allusion to the bifid *Palea*.

## ARRANGEMENT OF THE SPECIES:—

Perennial. Culms stout, 1—3 feet high. Spikelets $\frac{1}{2}$ — $\frac{3}{4}$ -inch long	... 1. <i>D. stipoides</i> .
Annual. Culms slender. Panicle dense. Spikelets $\frac{1}{3}$ -inch long	... 2. <i>D. crinita</i> .
Annual. Culms slender. Panicle lax. Spikelets $\frac{1}{4}$ -inch long	... 3. <i>D. sciurea</i> .

## 1.—DICHELACHNE STIPOIDES.

## WIRY DICHELACHNE.

(Plate XIV.)

AGROSTIS RIGIDA, A. Richard.

DICHELACHNE RIGIDA, Steudel.

DICHELACHNE STIPOIDES, Hook. fil. Flora, N.Z., I., 294, t. 66. Handb. N.Z. Flora, I., 325.

A DENSELY-TUFTED or tussac grass, its habitat being near the sea, on banks or rocks. Perennial. *Flowers* December—January. *Culms* 1—3 feet high, wiry, smooth. *Leaves* longer than the culms, very slender, erect, involute. *Panicle* strict, erect, 4—6 inches long, branches few, short, erect. *Spikelets*  $\frac{1}{3}$ — $\frac{1}{2}$ -inch long. *Empty glumes* membranous,  $\frac{1}{2}$ — $\frac{3}{4}$ -inch long, narrow, lanceolate, acuminate, 3-nerved. *Flowering glume* shorter, bifid, covered with silky spreading hairs, 5-nerved; awn flexuose, two and a half times the length of the glume, glabrous. *Palea* narrow, bifid, covered with silky hairs, 2-nerved. *Scales* large. *Anthers* very long, narrow. *Ovary* glabrous. *Styles* short. *Stigmas* plumose. *Grain* long, narrow. DISTRIBUTION OF SPECIES: AUSTRALIA, TASMANIA, NEW ZEALAND.

This grass, which is only found near the sea or saline estuaries, is of little value as food for stock ; and, from its very rigid, non-succulent habit, is not likely to be improved by cultivation. It is only grazed by horses and cattle during its flowering and seeding season ; and the hard wiry nature of its foliage renders it worthless, either in pasture or as fodder. It might, however, be utilized in the manufacture of paper, as it possesses a strong fibrous structure, and is apparently as well adapted for that purpose as the tussac *Danthonias* of the South Island, the latter, from experiments, having proved to be eminently suited for paper-making. DISTRIBUTION IN NEW ZEALAND : NORTH ISLAND : EAST COAST—Banks and Solander ; BAY OF ISLANDS AND AUCKLAND—Sinclair ; ISTHMUS OF AUCKLAND, THAMES, WAIKATO, GREAT BARRIER ISLAND—Kirk ; TITIRANGI—Cheeseman ; KAWAU ISLAND—Buchanan.

Reference to Plate XIV.: Fig. 1. Plant. 2. Spikelet. 3. Floret. 4, 4'. Nervation of empty glumes. 5. Nervation of flowering glume. 6. Palea. 7. Scale. 8. Ovary, scale, stamens, and feathery stigmas.





*Dichelachne stipoides*, Hook. fil.





## 2.—DICHELACHNE CRINITA.

LONG HAIR PLUME GRASS.

(Plate XV.)

DICHELACHNE VULGARIS, Trinius.

DICHELACHNE FORSTERIANA, Trinius.

MUHLENBERGIA MOLLICOMA, Nees.

AGROSTIS CRINITA, Brown.

APERA CRINITA, Palisot.

ANTHOXANTHUM CRINITUM, Labill. Fl. Nov. Holl., II., 115, t. 263.

DICHELACHNE CRINITA, Hook, fil. Fl. N.Z. I. 293; Handb. N.Z. Flora, I., 326.

A GLABROUS, downy, or scabrid grass, growing in small tufts, ascending to 3000 feet altitude. *Flowers* November—April. *Root* fibrous. Perennial. *Stems* 1—3 feet high, slender or stout, leafy. *Leaves* flat or involute; *ligule* short, obtuse, entire, or lacerate. *Panicle* elongate, contracted, spike-like, 3—6 inches long, branches nearly hidden by the long awns. *Spikelets*  $\frac{1}{3}$ -inch long. *Empty glumes* long-acuminate, 3-nerved. *Flowering glume* 2-fid at top, 5-nerved; awn capillary, inserted at the back above the middle, flexuose, not twisted, nearly four times as long as the glume. *Palea* 2-fid, with a short awn, 2-nerved. *Scales* large, oblong, long-acuminate. *Anthers* long. *Ovary* glabrous. *Styles* short, wide apart. *Stigmas* long, plumose. *Grain* long, linear. DISTRIBUTION OF SPECIES: AUSTRALIA, TASMANIA, NEW ZEALAND.

A valuable grass, abundantly distributed throughout the islands, and forming, when in flower, a prominent feature in pasture. As a pasture grass when grown under favourable circumstances, on rich valley bottoms with perennial moisture, it is very succulent, but when on dry clay hills it is harsh and scanty; its nutrient qualities may be admitted, forming as it does a large constituent of pastures famous for fattening stock. As a fodder grass it possesses considerable bulk, and would add much value to a mixed crop of hay. In sheltered situations near Wellington, this species has a very extended period of flowering, as a succession of scattered panicles may generally be found during eight months of the year. This is not, however, a singular circumstance, as some native and introduced species, such as *Poa annua* and *Danthonia semi-annularis*, may be found flowering during the whole year. A variety of *D. crinita*, figured on Plate XV., Fig. 1', was collected in the Domain, Wellington, the spike-like panicle of which is more open and the awns purple. It is a very graceful grass when in flower, and a very different looking plant from the species, but by the details of its inflorescence cannot be distinguished. DISTRIBUTION IN NEW ZEALAND: Everywhere from the North Cape to Stewart Island, from sea-level to 3000 feet altitude.

Reference to Plate XV.: Figs. 1, 1'. Plants. 2. Spikelet. 3. Floret. 4, 4'. Nervation of empty glumes. 5. Nervation of flowering glume. 6. Nervation of Palea. 7. Scales. 8. Ovary. 9. Grain.









*Dichelachne crinita*, Hook. fil.

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### 3.—DICHELACHNE SCIUREA.

SHORT-HAIR PLUME GRASS.

(Plate XVI.)

DICHELACHNE SIEBERIANA, Trinius and Ruprecht.

AGROSTIS SCIUREA, Brown.

STIPA MICRANTHA, Nees.

MUHLENBERGIA SIEBERIANA, Trinius.

DICHELACHNE SCIUREA, Hook. fil. Fl. N.Z., I., 294; Handb. N.Z. Flora, I., 326.

A SMALL tufted glabrous grass of low altitudes. *Flowers* December—January. *Root* fibrous. Perennial. *Stems* 1—2 feet high, slender. *Leaves* flat or involute; *ligule* very short, obtuse, entire, or lacerate. *Panicle* elongate, contracted, 3—6 inches long, branches more open and with fewer spikelets than the former. *Spikelets* less than  $\frac{1}{4}$ -inch long. *Empty glumes* narrow, long-acuminate, 3-nerved. *Flowering glume* as long, 2-fid at top, 5-nerved; awn flexuose, twisted,  $2\frac{1}{2}$  times longer than the glume, inserted at the back above the middle. *Palea* narrow, 2-fid, 2-nerved. *Scales* large, oblong, long-acuminate. *Anthers* short, stout. *Ovary* glabrous, oblong. *Styles* very short, nearly connate at the base. *Stigmas* short, plumose. DISTRIBUTION OF SPECIES: AUSTRALIA, TASMANIA, NEW ZEALAND.

A very different-looking grass from *D. crinita* in its extreme forms, but connected with that species by intermediate varieties, which, though differing in outward form, cannot be separated by the details of the inflorescence. These varieties are, as far as at present known, limited to the North Island. The three specimens figured in Plate XVI. are: Fig. 1, collected by Mr. Kirk, near Auckland. Fig. 1', from a specimen collected on the Island of Kawau, which in outward form resembles *D. crinita*, but in microscopical details of inflorescence agrees entirely with the present species. Fig. 1" is from a specimen collected in the Domain, Wellington, which appears to be only a small form of the species. All the varieties are valuable pasture grasses, and, from their slender succulent habit, would become valuable as fodder grasses if cultivated. Regarding the doubtful perennial habit of this and other species, it may be remarked that, under the mild climate which obtains in the North Island of New Zealand, grasses which under a more rigorous climate would die down annually, possess a continuous growth during nearly the whole year, unless when, owing to a dry season, they flower and seed early, and before forming new stoles or branches at the roots, in which case they inevitably die out. This takes place frequently with perennial Ray grass (*Lolium perrene*), when it is allowed to flower and seed the first year. DISTRIBUTION IN NEW ZEALAND: NORTH ISLAND: BAY OF ISLANDS and AUCKLAND—Cunningham, Colenso, Sinclair; THAMES DISTRICT—Kirk; TITIRANGI—Cheeseman; KAWAU ISLAND and WELLINGTON—Buchanan.

Reference to Plate XVI.: Fig. 1. Plant. 2. Spikelet. 3. Floret. 4. Nervation of empty glumes. 5. Nervation of flowering glume. 6. Nervation of Palea. 7. Scale. 8. Ovary. 9. Grain.







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*Dichelachne sciurea*, Hook. fil.





## GENUS XII.—APERA, Palisot.

*Spikelets* minute, 1-flowered, in large diffuse panicles. *Empty glumes* 2, nearly equal, longer than the flowering. *Flowering glumes* terete, coriaceous, acuminate, and ending in a slender, straight, not twisted awn. *Palea* membranous. *Scales* 2. *Stamens* 1—3. *Grain* terete, enclosed in the hardened glume. DISTRIBUTION OF GENUS: EUROPE, NORTH AMERICA, AUSTRALIA, NEW ZEALAND. *Etymology*: From the Greek, signifying “without mutilation,” in reference to the constant presence of the floral awn.

## 1.—APERA ARUNDINACEA.

## NEW ZEALAND WIND GRASS.

(Plate XVII.)

APERA ARUNDINACEA, Palisot. Hook. fil., Fl. N.Z., I., 295, t. 67; Handb. N.Z. Flora, I., 326.

A LARGE, densely-tufted, glabrous, ornamental grass, ascending to 1000 feet. *Flowers* December—January. Perennial. *Culms* slender, rigid, arising from creeping, scaly, rhizomes, 2—5 feet high, branching. *Leaves* coriaceous, narrow, involute, slightly scabrid; sheaths long; *ligule* short, truncate. *Panicle* drooping, 8—16 inches long; pedicels alternate, on the long whorled branches. *Spikelets*  $\frac{1}{12}$ — $\frac{1}{10}$ -inch long, pale, shining. *Empty glume* with a scabrid keel, 3-nerved. *Flowering glume* sessile, on a small glabrous callous, thickened and rough at the top; awn scabrid, deciduous,  $\frac{1}{3}$ -inch long. *Palea* oblong-linear, acute, 2-nerved. *Scales* linear, acute. *Stamen* 1. *Ovary* shortly pedicelled. *Style* very short. *Stigmas* short, feathery. *Grain* linear, terete, truncate. DISTRIBUTION OF SPECIES: SUB-TROPICAL, EAST AUSTRALIA, NEW ZEALAND.

This graceful, nodding, plume-like grass is not found abundant anywhere in New Zealand. Although scattered over several districts, its wiry knot-jointed culms and hard non-succulent foliage preclude it from ever being recommended as food for stock; neither, in an economic point of view, could it, from its sparse distribution, unless cultivated, ever be utilized as a fibre-product in the manufacture of paper, to which it is otherwise well adapted. It can only, therefore, be classed as ornamental; and, certainly, the whorled arrangement of the primary branches and branchlets on the long slender culms of this New Zealand Wind Grass presents a very beautiful tussac object for the decoration of lawns, banks of streams, or margins of ponds. DISTRIBUTION IN NEW ZEALAND: NORTH ISLAND: CAPE TURNAGAIN—Colenso; WAIRARAPA—Buchanan. SOUTH ISLAND: AKAROA—Raoul; CHRISTCHURCH—Armstrong; DUNEDIN—Buchanan.

Reference to Plate XVII.: Fig. 1. Plant. 2. Spikelet. 3, 4. Nervation of empty glumes. 5. Nervation of flowering glume. 6. Nervation of Palea. 7. Scale. 8. Ovary, stamen, and feathery stigmas.







*Apera arundinacea, Hook. fil.*





## GENUS XIII.—SPOROBOLUS, Brown.

*Spikelets* minute, 1-flowered, in spike-like contracted panicles. *Empty glumes* 2, unequal, awnless. *Flowering glume* sessile, awnless. *Palea* large. *Scales* 2. *Stamens* 1—3. *Grain* free, terete, with a lax pericarp. DISTRIBUTION OF GENUS: TROPICAL and SUB-TROPICAL CLIMATES, southern parts of AUSTRALIA, NEW ZEALAND. *Etymology*: From two Greek words meaning “a seed,” and “casting forth,” from the grain being easily shaken out.

## 1.—SPOROBOLUS ELONGATUS.

RAT-TAIL, OR CHILIAN GRASS.

(Plate XVIII.)

SPOROBOLUS ELONGATUS, BROWN. Hook. fil., Fl. N.Z., I., 295; Handb. N.Z. Flora, I., 326.

A HARD, wiry, tough, glabrous grass, at low altitudes. *Flowers* November—January. Perennial. *Roots* wiry, fibrous, creeping. *Stem* 1—2 feet high. *Leaves* spreading, flat or involute; *ligule* short, sheaths furrowed. *Panicle* 6—12 inches long, spike-like, much contracted, sometimes lobed below. *Spikelets* pedicelled. *Empty glumes* small, unequal, 1-nerved. *Flowering glume* much larger, oblong-acuminate, 3-nerved. *Palea* oblong-acuminate, 1-nerved. *Scales* narrow, acute. *Ovary* abrupt at top, sessile. *Anthers* stout, short. *Stigmas* nearly sessile, feathery. *Grain* terete, truncate at top, and pointed at base; often found adherent to the mouth of the floret. DISTRIBUTION OF SPECIES: THE SAME AS THE GENUS, probably introduced to New Zealand.

This grass affords good pasture for horses and cattle, but, from its tough fibrous structure, is not adapted for sheep; and, as it spreads with great rapidity by the roots, it would be injudicious to introduce it on sheep-runs. In the neighbouring Colony of Victoria much ground has been overrun by this grass within the last few years, to the great detriment of the pasture, as it chokes out better grasses; and, however nutritious its tough foliage may be, it cannot be eaten in sufficient quantity by sheep, and especially by broken-mouthed ewes. In New Zealand this grass was, until within a few years, confined to the District of Auckland, but it has now spread as far south as Napier and Wellington. Although a tropical grass, it appears to have an extensive range of temperature within which it ripens seed; and it will be interesting to observe, in its further progress southwards, into the colder latitudes of New Zealand, if its ability to ripen seed continues co-extensive with the plant's growth. The moist atmosphere of Auckland has already produced a curious change in this grass,



the ripe seed being more firmly attached, so that it is no longer shed freely. Conflicting as this does with the etymology of the generic name *Sporobolus*, which means that the grain is easily shaken out, it is worthy of notice. In the illustration of the floret, Plate XVIII., the grain is shown adhering to the mouth of the floret, being attached by the viscid pericarp, which has become softened by the moist atmosphere at the period of shedding, or, more probably, the adhesion of the seed is the result of continued rains at that time; the spike-like panicles also present a very reddish appearance, due to the exserted dark-orange-coloured seed. This is a hardy grass, and grows freely on dry clay hills where other species would fail; and, from its having deep-seated roots, it defies the driest seasons. It can also be recommended as a fibre material in the manufacture of paper. DISTRIBUTION IN NEW ZEALAND: NORTH ISLAND: AUCKLAND, HAWKE'S BAY, WELLINGTON.

Reference to Plate XVIII.: Fig. 1. Plant. 2. Spikelet, with grain adhering. 3. Floret. 4, 4'. Nervation of empty glumes. 5 Nervation of flowering glume. 6. Nervation of Palea. 7. Scales. 8. Ovary. 9. Grain.





*Sporobolus elongatus*. Br.





## GENUS XIV.—AGROSTIS, Linnæus.

*Spikelets* small, in an open or contracted panicle, 1-flowered, often pedicelled on long capillary whorled branches. *Empty glumes* 2, nearly equal, acuminate or acute, usually longer than the flowering. *Flowering glume* sessile, or shortly pedicelled, with or without an awn, obtuse, acute, or truncate. *Palea* membranous, nearly as long as the glume; very small or none. *Scales* 2. *Stamens* 2—3. *Grain* terete, free. DISTRIBUTION OF GENUS: TEMPERATE AND COLD CLIMATES. *Etymology*: Named from the Greek word for a “field.”

## ARRANGEMENT OF THE SPECIES:—

I.—*Glumes* membranous, flowering one much shorter than the empty, truncate and jagged at the tip. *Palea* membranous, and much shorter than the flowering glume, or absent, without the pedicel of a second glume at its base.

Flowering glume wholly glabrous, truncate. Panicle usually contracted.

Spikelets $\frac{1}{6}$ -inch, on hispid pedicels	...	...	...	...	1. <i>A. antarctica</i> .
Spikelets $\frac{1}{12}$ — $\frac{1}{10}$ -inch; pedicels scarcely scabrid; branches of panicle whorled					2. <i>A. canina</i> .
Spikelets $\frac{1}{16}$ — $\frac{1}{12}$ -inch; pedicels scarcely scabrid; branches of panicle few, opposite or 3-nate	...	...	...	...	3. <i>A. parviflora</i> .

Flowering glume silky. Panicles very broad.

Leaves narrow, usually involute and filiform	...	...	...	4. <i>A. æmula</i> .
Leaves broad, flat	...	...	...	5. <i>A. pilosa</i> .

II.—*Glumes* membranous; flowering one much shorter than the empty; usually bearded at the base, and jagged at the tip. *Palea* shorter than the flowering glume, with the silky pedicel of a second glume at its base. Branches of panicle whorled, capillary. *Spikelets*  $\frac{1}{6}$ — $\frac{1}{4}$ -inch long. 6. *A. billardieri*.

III.—*Glumes* hard, coriaceous; flowering nearly as long as the empty, often pedicelled, silky at the base. *Palea* hard, as long as the flowering glume, with a rigid bearded pedicel of a second glume at its base. *Panicle* contracted, branches very short.

Leaves filiform; spikelets $\frac{1}{10}$ — $\frac{1}{8}$ -inch; awn exserted	...	...	...	7. <i>A. setifolia</i> .
Leaves filiform; spikelets $\frac{1}{6}$ — $\frac{1}{4}$ -inch; awn exserted	...	...	...	8. <i>A. avenoides</i> .
Leaves concave; spikelets $\frac{1}{6}$ — $\frac{1}{4}$ -inch; awn very short	...	...	...	9. <i>A. youngii</i> .
Leaves concave; spikelets $\frac{1}{6}$ — $\frac{1}{4}$ -inch; awn exserted	...	...	...	10. <i>A. quadrisetata</i> .



## 2.—AGROSTIS CANINA.

THE BROWN BENT GRASS.

(Plate XIX., XX.)

AGROSTIS CANINA, Linnæus. Hook. fil., Fl. N.Z., I., 296; Handb. N.Z. Flora, I., 328.

TRICHODIUM CANINUM, Schröder.

A TUFTED glabrous grass, ascending to 3000 feet altitude. *Flowers* December—February. *Root* perennial, creeping. *Stem* 1—24 inches high, slender. *Leaves* flat or involute, glabrous, short, sheaths smooth; *ligule* oblong, obtuse, entire or lacerate. *Panicle* 2—4 inches long, upright, open when in flower, contracted when in seed; *branches* slender, lower whorled, slightly scabrid. *Spikelets*  $\frac{1}{10}$ — $\frac{1}{12}$ -inch long; pedicels scabrid. *Empty glumes* nearly equal, 3-nerved, lanceolate, acuminate, glabrous; keel ciliate. *Flowering glumes* oblong, truncate, 3-nerved; awn dorsal, or 0. *Palea* 0. *Scale* entire, acute. *Ovary* linear-oblong. *Stamens* 3, short, broad. *Styles* very short. *Stigmas* short, feathery. *Grain* narrow-oblong, obtuse at both ends. DISTRIBUTION OF SPECIES: EUROPE, AMERICA, FALKLAND ISLANDS, FUEGIA, AUSTRALIA, NEW ZEALAND.

VAR.  $\beta$ .—AGROSTIS GELIDA, F. Mueller; Handb. N.Z. Flora, I., 328.

(Plate XX. A.)

Tufted; found at 5000 feet altitude in the South Island. *Stems* 3—5 inches high. *Panicle* much contracted, 1—1 $\frac{1}{2}$  inches long. DISTRIBUTION OF VAR.  $\beta$ : SCOTTISH MOUNTAINS, AUSTRALIAN ALPS, NEW ZEALAND.

VAR.  $\gamma$ .—A. SUBULATA, Hook. fil., Fl. Ant., I., 95, t. 53.A. PARVIFLORA, Brown, VAR.  $\beta$ .—PERPUSILLA, Fl. N.Z., I., 296.

(Plate XX. B.)

Densely tufted and moss-like; found at 5000 feet altitude in the North Island;  $\frac{1}{2}$ —2 inches high. *Leaves* flaccid. *Panicle* very short, hidden altogether, or projecting from amongst the leaves at their base. DISTRIBUTION OF VAR.  $\gamma$ : CAMPBELL ISLAND, NEW ZEALAND.

An abundant and wide-spread grass in Europe, and also common in New Zealand; but it has always been regarded in Britain as of little value, either in pasture or agriculture. It is found abundant in boggy situations, where its graceful upright panicle may be seen early in the season; and therefore, although not a first-class grass, it is still very valuable as an early food for stock. Like many other grasses, this species has a wide range of value according to the existing conditions of its growth, being harsh, dry, and unpalatable on dry clay land, whilst on rich moist soil, even with a low temperature, it is more succulent and agreeable to stock. It is variable, to a considerable extent, in



size and closeness of panicle, passing in some places into Var.  $\beta$ . It may prove interesting to compare the value of this species with *Agrostis stolonifera*, the Fiorin of agriculturists as regards bulk and amount of nutrient matter, premising that no analysis can ever be constant as regards a species, unless the varieties of the species, as well as the soil and the moisture, be considered. The varieties of Fiorin, according to Sinclair's experiments, "Hortus Gramineus Woburnensis," range in value between 6125 lb. and 16335 lb. bulk per acre; and the nutrient matter contained, from 287 lb. to 930 lb.; therefore it may reasonably be supposed that the following analysis given of the grass now under notice, *Agrostis canina*, by the same authority, would stand higher as regards both bulk and nutrient matter, if grown under favourable circumstances in the superior climate of New Zealand. The value as grown in England is as follows: 5546 lb. per acre, and the nutrient matter 148 lb; the weight of nutrient matter when the seed is ripe is superior to that when it is in flower, as 10 to 7. DISTRIBUTION IN NEW ZEALAND: NORTH ISLAND: MOUNTAINOUS PARTS, Colenso. SOUTH ISLAND: NELSON, H. H. Travers; MILFORD SOUND, Lyall; ALPS OF CANTERBURY (2000—4000 feet altitude), Sinclair, Haast, Armstrong; OTAGO LAKE DISTRICT (3000 feet altitude), Hector and Buchanan; SOUTHLAND (1000 feet), Buchanan.

Var.  $\beta$  seldom exceeds 5 inches in height, and microscopical drawings of the inflorescence do not, when compared with those of the typical species, show much difference even in size, so that probably local influences may be sufficient to account for the varying length of stem, and constriction of panicle. DISTRIBUTION IN NEW ZEALAND: NORTH ISLAND: RUAHINE MOUNTAIN, Colenso. SOUTH ISLAND: NELSON MOUNTAINS, H. H. Travers; KAIKOURA MOUNTAINS (5000 feet), Buchanan; MOUNT DARWIN, Haast; OTAGO LAKE DISTRICT (4000 feet), Hector and Buchanan.

Var.  $\gamma$  has differentiated from the species to a greater extent than the last. The great reduction of the stems might have been explained by depauperation, but the change in form of some parts of the inflorescence is considerable, while increased in size; the differences on the whole being, probably, sufficient to require the formation of a new species. DISTRIBUTION IN NEW ZEALAND: NORTH ISLAND: RUAHINE MOUNTAIN, Colenso; TARARUA MOUNTAIN, H. H. Travers; SOUTH ISLAND: LAKE TENNYSON (5000 feet altitude), H. H. Travers.

Reference to Plate XIX.: Fig. 1. Plant. 2. Spikelet. 3. Floret. 4. Nervation of empty glumes. 5. Nervation of flowering glume. 6. Scale. 7. Ovary. 8. Grain enclosed in flowering glume.

Reference to Plate XX. A, Var.  $\beta$ : Fig. 1. Plant. 2. Spikelet. 3. Floret. 4. Nervation of empty glumes. 5. Nervation of flowering glume. 6. Scale. 7. Ovary.

Reference to Plate XX. B, Var.  $b$ : Fig. 1. Plant. 2. Spikelet. 3. Nervation of empty glumes. 4. Nervation of flowering glume. 5. Scale. 6. Ovary.

## AGROSTIS PARVIFLORA.

SLENDER BENT GRASS.

(Plate XX. C.)

AGROSTIS PARVIFLORA, BROWN. Hook. fil., Flora Tasmania, II., 113, t. 158B.

AGROSTIS PARVIFLORA, BROWN. Hook. fil., Fl. N.Z., I., 296; Handb. N.Z. Flora, I., 328.

A SLENDER, tufted, glabrous grass, 6—12 inches high, ascending to 3000 feet altitude. *Flowers* January—February. Perennial. *Leaves* narrow, flat or involute, scabrid on the edges; *ligule* oblong, truncate, lacerate. *Panicle* 3—5 inches long, of few short capillary scabrid branches, opposite or 3-nate. *Spikelets*  $\frac{1}{12}$ — $\frac{1}{10}$  inch long, slender, narrow. *Empty glumes* nearly equal, spreading, glabrous, scabrid on the keel, 1-nerved; inner glume with two short lateral nerves. *Flowering glume* truncate, 5-nerved; awn (when present) dorsal, very short. *Palea* 0. *Scales* linear-oblong, tapering to a sharp point. *Ovary* oblong. *Styles* very short. *Stigmas* short, feathery. DISTRIBUTION OF SPECIES: AUSTRALIA, TASMANIA, NEW ZEALAND.

A valuable grass, common on the upland pastures of the South Island, also found at lower levels in both Islands. It is sometimes confounded with *Agrostis canina*, with which it is often associated, and from which it may be best distinguished by its more slender constricted panicle and few narrow spikelets. The abundance of both species may be best observed when they are in flower, which is generally late in the season, when most of the other grasses have ceased growing, thus providing abundance of food when most required. Species of *Agrostis* occupy a prominent place everywhere in the pastures of temperate and cold climates, but their adoption in cultivation has generally been unpopular with agriculturists, from their proving very inconstant in bulk and nutrient value. This defect, to a great extent, is, no doubt, occasioned by the great susceptibility of these grasses to the influence of differences in soil, heat, and moisture. Variation in species from this cause may also be accepted as an important element of difference in value, superior varieties being sometimes produced, of which the well-known Fiorin, *Agrostis alba*, may be cited as an example. A comparison of the slight difference in structural form which may exist between two grasses, while yet differing considerably in value as food, may be made between the species now under notice, —*Agrostis parviflora*, a grass of a delicate succulent habit, and *Agrostis canina*, one more harsh and much less succulent, and of which the first is probably only a variety. The value of the *Agrostis* family in pasture has been very logically argued by Cuthbert W. Johnson, in his “Farmers’ Encyclopædia,” where, under the article “*Agrostis*,” he says, “There has been much prejudice existing against the different species of *Agrostis* in general, but let the proprietor of a rich ancient pasture divest a part of it of these grasses entirely, and the value of the plants will be demonstrated in the comparative loss of late and early herbage.” DISTRIBUTION IN NEW ZEALAND: NORTH ISLAND: SHORES OF COOK STRAIT—Colenso. SOUTH ISLAND: NELSON—H. H. Travers; CANTERBURY—Armstrong; OTAGO LAKE DISTRICT—Hector and Buchanan; SOUTHLAND—Buchanan.

Reference to Plate XX.: Fig. 1C. Plant. 2. Spikelet. 3. Floret. 4. Nervation of empty glumes. 5. Nervation of flowering glume. 6. Scale. 7. Ovary, pistil, and stamens.







*Agrostis canina*, Linn.







A. *Agrostis canina*, Linn. Var.  $\beta$ -*gelida*.  
 B. " " Var.  $\gamma$ -*subulata*.  
 C. " *parviflora*, Brown.







## AGROSTIS ÆMULA.

TOOTHED BENT GRASS.

(Plate XXI.)

AGROSTIS FORSTERI, Rœmer and Schultes.

AGROSTIS LYALLII, Hook. fil. Flora N.Z., I., 297.

AGROSTIS LEPTOSTACHYS, Hook. fil. Flora Antarct., I., 94.

LACHNAGROSTIS FORSTERI, Trinius.

LACHNAGROSTIS ÆMULA, Nees.

DEYEUXIA ÆMULA, Kunth.

AVENA FILIFORMIS, Forster.

DEYEUXIA FORSTERI, Kunth. Hook. fil.; Flora N.Z., I., 298.

AGROSTIS ÆMULA, Brown. Hook. fil.; Handb. N.Z. Flora, I., 329.

A VERY delicate glabrous grass, ascending to 2000 feet altitude. *Flowers* November—March. *Root* fibrous. *Annual*. *Culms* tufted, 6—24 inches high. *Leaves* very narrow, involute, scaberulous on the edges; *ligule* narrow, oblong, lacerate at top. *Panicle* large, very open, branches capillary, scaberulous, whorled, 3—6 inches long. *Spikelets*  $\frac{1}{6}$ — $\frac{1}{10}$ -inch long, on very slender, scaberulous pedicels. *Empty glumes* nearly equal, smooth; keel scabrid, 1-nerved. *Flowering glume* shorter, sessile, truncate, with scattered silky hairs, 5-nerved, awn proceeding from the middle of the back. *Palea* (when present) linear-oblong, bifid at top, 2-nerved, and frequently with the silky pedicel of a second glume at base. *Scales* entire, narrow-lanceolate. *Anthers* short, stout. *Styles* very short. *Stigmas* short, feathery.

DISTRIBUTION OF SPECIES: AUSTRALIA, TASMANIA, CAMPBELL ISLAND, NEW ZEALAND.

A widely distributed grass in New Zealand, often forming a prominent part of the pasture on dry, stony, or sandy soils, especially in the North Island. It is valuable as a sheep grass in such places, probably proving perennial when prevented by grazing from ripening its seed, the permanence of such grasses often depending on their capability to stolon or form offsets or branches at the roots before flowering and seeding. This grass possesses a large adaptation of growth to varied soils, although most abundant on arid clay land, probably from the absence there of larger grasses; yet, on good soil, when sheltered by shrubs, it attains its greatest height, and is greedily eaten by horses and cattle. On several of the smaller islands off the East Coast of Napier and Auckland, this grass, with its congeners *A. billardieri* and *A. pilosa*, form, when in flower, a prominent feature of the open land, attaining under the shelter of *Muhlenbeckia* or *Coprosma* shrubs, a height of 2 feet. In such situations it is succulent and nutritious, and closely cropped by stock when present, many of the islands where it abounds being still unstocked with large cattle. DISTRIBUTION IN NEW ZEALAND: FOUND EVERYWHERE FROM SEA-LEVEL TO TWO THOUSAND FEET ALTITUDE.

Reference to Plate XXI.: Fig. 1. Plant. 2, 2'. Spikelet. 3. Nervation of empty glumes. 4. Nervation of flowering glume. 5. Scales. 6. Grain.







*Agrostis æmula*, Br.









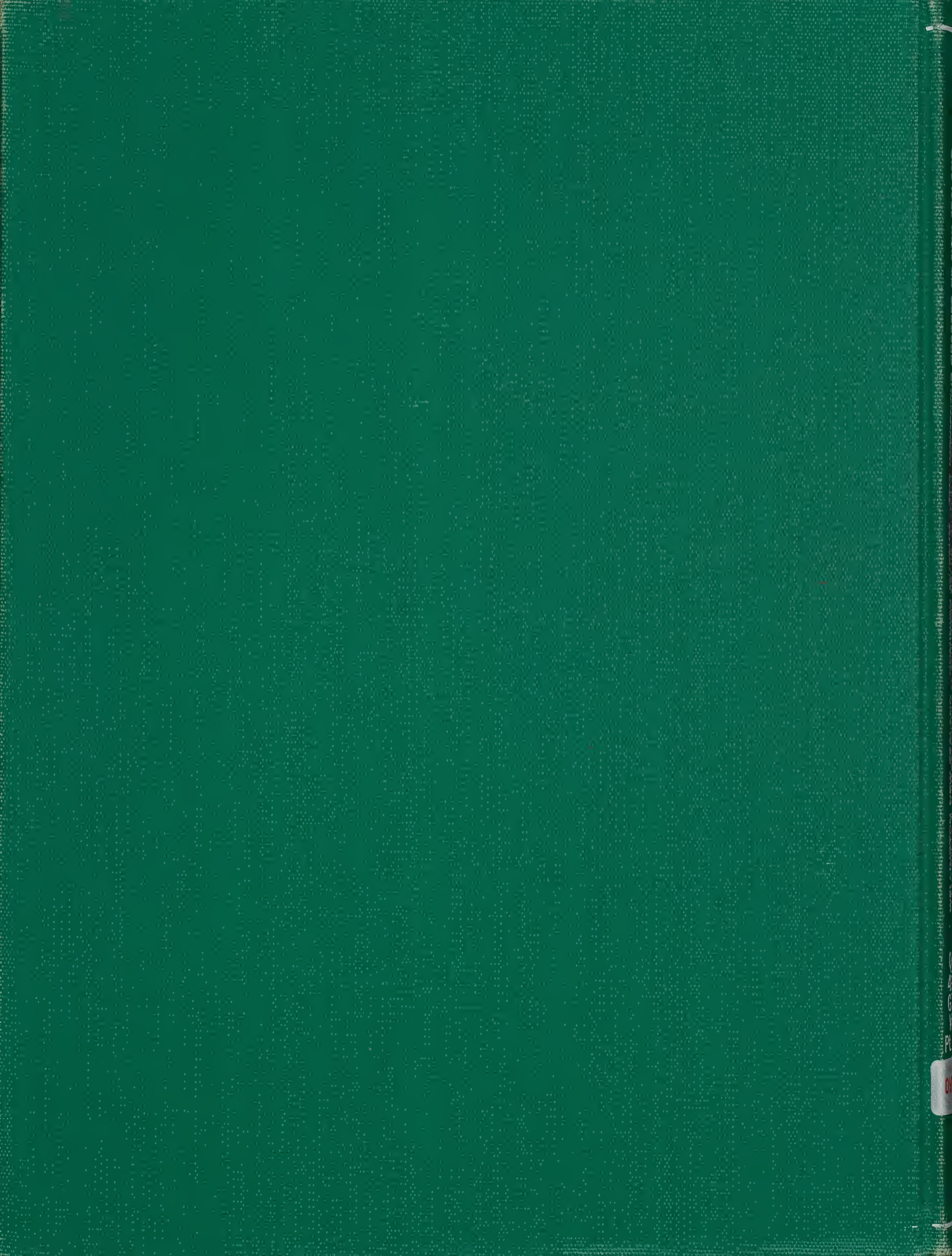












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