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THE GENUS *STIPA* IN TASMANIA

PART 3 - REVISED TAXONOMY

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(with four tables, 15 text-figures and two plates)

ABSTRACT

The twelve indigenous *Stipa* species occurring in Tasmania are revised. These are *S. aphylla* (Rodway) Townrow (endemic), *S. bigeniculata* Hughes, *S. clelandii* Summerhayes and Hubbard, *S. falcata* Hughes, *S. flavescens* Labillardière, *S. nervosa* var. *neutralis* Vickery, *S. mollis* R. Brown, *S. semibarbata* R. Brown, *S. pubinodis* Trinius and Ruprecht, *S. stipoides* (Hooker) Veldkamp, *S. stuposa* Hughes (endemic) and *S. variabilis* Hughes.

A key to species is based on both floral and vegetative characters. Emended species descriptions are based on type and/or matched specimens augmented by extensive Tasmanian collections. Detailed figures produced at standard magnifications of each species illustrate new characters of specific significance including adaxial leaf surface ornamentation figured in scanning micrographs and numerous details of floret structure.

S. elatior Hughes and *S. compacta* Hughes are reduced to synonymy with *S. flavescens* Labillardière. *S. aphanoneura* Hughes, *S. setacea* R. Brown, *S. pubescens* R. Brown, *S. elegantissima* Labillardière, *S. laeviculmis* Nees, *S. eremophila* Reader, and *S. hemipogon* Bentham are excluded names.

The appendix includes a collectors' index (Tasmanian specimens), text tables and descriptions, and figures of *S. nervosa* Vickery, *S. pubescens* R.Br. and *S. blackii* C.E. Hubbard closely allied to and previously confused with *S. nervosa* var. *neutralis*, *S. pubinodis* and *S. stuposa* respectively.

INTRODUCTION

The genus *Stipa*, first proposed by Linnaeus in 1753, commonly known as "spear-grass", belongs to the tribe Stipeae (Dumortier 1823) which is placed second by Stebbins and Crampton (1961) in the sub-family Festucoideae between Amplodesmeae and Brachyelytreae.

Stipa, with at the latest estimate some 300 species (Johnson in Younger and McKell 1972, p.30), is the largest genus in that tribe. The species are mostly xerophytic, many having inrolled or even bristle-like blades. They are widely distributed in temperate or warm temperate regions of the world including parts of North and South America, Russia, Europe, Asia and Australia. Between 60-70 species have been described for Australia, where they are typically constituents of desert grassland. Twelve native species, of which two are endemic and two introduced species, are known to occur in Tasmania.

The genus includes a number of useful forage species which contribute to animal feed in spring and autumn in otherwise unproductive arid areas of the world. In the native pastures of Southern Australia *Stipa* is co-dominant with *Danthonia*, and together the two form the most characteristic disclimax of the savannah woodlands.

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Such grassland, although never producing large quantities of feed, has the reputation of maintaining healthy sheep with high quality wool (Leeper 1970). During the flowering season however the sharp pointed fruits of *Stipa* can be very troublesome, especially to sheep, piercing mouths and feet and causing sores or even death (Mulham and Moore 1970).

A survey of all the Australian members of the genus would have wide implications of great taxonomic interest. It should include all the classical morphological and, more particularly, the nonmorphological characters which in the last quarter century have proved of such significance in the natural classification of the Gramineae (tabulated by Prat 1960, p.34 *et seq.*). For instance a knowledge of embryo structure regarding the presence or absence of an epiblast, and lodicule morphology and number (two or three), will give insight into the relationship of Australian species with other *Stipa* floras in North and South America, in Africa and in Eurasia.

The presence of an epiblast in Stipeae has been noted by most authors, including Reeder (1957), Jacques-Félix (1962), de Winter (1965) and Matthei (1965). Gould however (1968) states that "the embryo [in Stipeae] is festucoid, except in the absence of an epiblast". He could simply have made a printing error, but may have had evidence, to which he does not refer, to support his opposing claim. The present author, in a preliminary investigation of the embryo of the single Australian *Stipa* so far examined, could find no epiblast (see fig. 6, H). Obviously much more careful and detailed study is required before the facts can be fully discovered and appreciated, but it appears at least a possibility that an epiblast is not universally present in *Stipa* and may be absent from some North American and Australian species.

The systematic importance of the lodicules, those minute scales at the base of the ovary between the lemma and the palea, is beyond dispute (review, Jirasék 1969). Several recent authors on *Stipa* including de Winter (1965) and Matthei (1965) have recognised the significance of lodicules. Matthei (*loc. cit.*) in his descriptions of Chilean *Stipa* based his primary grouping of species on a lodicule number of two or three per floret. The present author on the other hand has found that the number of two or three lodicules per floret may be related to the occurrence of cleistogamy and may vary within the species, as for example in *S. mollis*. The number of lodicules should not therefore be used as a character for grouping Australian *Stipa* (unpublished drawings and data).

Future anatomical studies should include not only a survey of leaf anatomy, but also awn anatomy. Serial sectioning of awns may for instance be used to produce supporting evidence if some of the Australian species now included in *Stipa* are in reality species of *Aristida* with fused lateral awns. (See Elias 1942, de Winter 1965).

The genus is of considerable significance in palaeogeographical studies. *Stipa*-like grasses are among the earliest known fossil grasses with an origin perhaps as far back as the mid-Cretaceous (Elias 1942), and the genus is at present distributed in virtually all the great land masses. By virtue of its palaeohistory and its relation to other parts of the world as indicated by theories of continental drift and tectonic plate movements (see Cox, Healey and Moore 1973), Australia occupies a key position in the development of distribution patterns of many forms of plants and animals having their origins in Cretaceous times before the complete breakup of Gondwanaland and Laurasia. A study of Australian *Stipa* species covering all the aspects associated with 'Omega' taxonomy would contribute to a wider knowledge of present day variations within the genus as a whole, and could provide valuable clues to the history of the tribe, so helping to clarify the possible migration routes taken by the earlier progenitors.

The genus is of minor importance in Tasmania, where nine of the twelve native Australian species recorded for the State contribute to the familiar roadside flora

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of the drier lowland and coastal areas. It is noticeable that in Tasmania *Stipa* is largely confined to roadside and similar ungrazed areas, and is mostly absent from the unimproved pastures possibly having been grazed out by sheep.

Apart from papers by the author (1969, 1970, 1974) no information has been published on *Stipa* in Tasmania since Rodway's treatment of the genus in THE TASMANIAN FLORA (1903), except that Willis records eleven species for Tasmania in A HANDBOOK TO PLANTS IN VICTORIA (1962, 1970).

The introduced species *Stipa miliacea* (L.) Hoover and *Stipa trichotoma* Nees are more familiarly known in Australia as *Oryzopsis miliacea* (L.) Benth. and Hook. f. ex Aschers and Schweinf. (Rice Millet), and *Nassella trichotoma* (Nees) Hack. ex Arech. (Serrated Tussock) respectively.

In Tasmania at least, they are very distinct from the native Australian *Stipa* species, and had there been no contribution to the taxonomy of the tribe Stipeae from American researchers (Corti 1951; Hoover 1966; Caro 1966) they would certainly be regarded as belonging to genera different from *Stipa*. In recent Australian taxonomic literature (Willis 1970, p.188; Burbidge 1970, p.56; Burbidge and Gray 1970, p.54) the two species still appear under their older epithets though in the last named work it is noted that "*Nassella* is placed under *Stipa* in current works on South American grasses but left under *Nassella* here to avoid confusion in popular usage". *S. trichotoma* also appears as *Nassella trichotoma* in recent weed control publications (e.g. Watson and Morris 1973). Both introduced species are of significance in Tasmania, *S. trichotoma* is a scheduled noxious weed which poses a threat to grazing lands which through great effort has been confined to small areas in the south and east of the State (Watson and Morris, *op. cit.*). *S. miliacea* is a familiar inhabitant of waste areas and roadsides in the drier lowland areas associated with human habitation. Apart from appearing in the key to related genera and the key to species, these two species have been excluded from this revision which covers the native species of *Stipa* only.

Future taxonomic investigation of Tasmanian *Stipa* species should include studies on the variability of populations, chromosome numbers, breeding systems, structural heterozygosity, the presence and type of polyploids, the degree to which the species can be crossed, the detection of hybrids (*c.f.* Johnson *et al.*, 1943 *et seq.*) and the presence and extent of introgression (*c.f.* Anderson, 1949, 1956), plus detailed habitat studies.

The appearance of apparently hybrid swarms of plants in the field, with characters intermediate between putative parent species, e.g. *S. semibarbata*/*S. stuposa*, *S. mollis*/*S. semibarbata*, suggests that some of the Tasmanian species are inter-fertile. Chromatographic techniques such as those used by Alston and Turner on hybrid populations in the genus *Baptisia* (1963) could be used to identify the parent forms and reveal other hybrids (see Solbrig 1970, p.165).

The extent and phenotypic effects if any of cleistogamy and associated anther and lodicule sizes requires investigation. The breeding mechanisms and the kinds and effects of isolating barriers within and between the species, including an analysis of the sorts and amounts of hybridization must be understood before the true biological situation in Tasmanian and Australian *Stipa* as a whole can be clarified.

Materials and Methods

Specimens examined.

The revision is based on a reappraisal of the type material supported by examination of collections made in Tasmania between 1966 and 1971. The majority of type specimens of Australian *Stipa* formerly unavailable in Australia, is contained in the Australian *Stipa* collection at Kew Herbarium (K). These were examined by the author

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in England in 1970, when type and matched specimens were selected and subsequently loaned for study in Hobart between 1971 and 1976. Drawings of 15 of these specimens are included in the species descriptions.

The Tasmanian species in the *Stipa* collection at the British Museum (BM), also examined in 1970, were found to be mostly useless for detailed study because of re-mounting methods used in repairing war damage. Whole specimens including delicate inflorescences and culms are completely stuck down to the mounting sheet, rendering diagnostic features obscure and inaccessible. Dr. Launert of the Botany Section (European Flora) made a preliminary set of micrographs of adaxial leaf surface ornamentation of ten species using the British Museum's Scanning Electron Microscope unit.

Other type specimens examined were loaned from Florence (*S. flavescens* Labill. (FI)), Leningrad (*S. pubinodis* Trin. and Rupr. (LE)) and Adelaide (*S. semibarbata* var. *gracilis* Black (AD)).

The Tasmanian species in the *Stipa* collections in the eastern Australian State Herbaria of Adelaide (AD, ADW), Canberra (CANB, CBG), Hobart (HO), Sydney (NSW), and Melbourne (MEL) were examined during a preliminary study in August 1969.

Apparatus and techniques. Herbarium and fresh specimens were examined by means of an Olympic Zoom Stereo microscope mounted on a Universal Stand VS/IV and a Leitz Monla Universal Lamp fitted with a Bausch and Lomb Fiber Optics Stereo-Microscope Illuminator; measurements were made with an objective micrometer and an eyepiece micrometer at x10 and x40, and a Leitz x8 Measuring Lens. Floret parts were soaked for 5-10 minutes in dilute "Teepol" solution before dissection. The dilution of "Teepol" is not critical; in the usual procedure the tip of the dissecting needle was dipped in commercial "Teepol" and then stirred in about 5ml water. Lodicules, stamens and gynaecium parts were stained with dilute Methylene Blue.

The species drawings were based on type or matched specimens.

A survey of the adaxial leaf surface ornamentation (A.L.S.O.) of Australian species using the specimens loaned from Kew was made in collaboration with the late Dr. N.T. Burbidge (Plant Industry Division, C.S.I.R.O., Canberra) (February 1971). Polaroid Polapan Land Film was used to record A.L.S.O. viewed with the JSM-U3 Scanning Electron Microscope operated by Dr. B. Filshie and Mr. C. Beaton (Division of Entomology, C.S.I.R.O., Canberra).

For examination under the electron microscope, a fragment of blade about 3mm long and 2-3 ribs across, as plane as the curvature of the dry leaf would allow, was cut from the second or third leaf up from the culm base. The fragment was cut from the blade about 1mm up from the ligule with a slanting edge at the distal end to aid orientation. It was mounted on a stub using clear nailvarnish and then coated all over with Gold/Palladium (70%/30% by weight) in a vaporising chamber. Accelerating voltages of 12.5 and 5KV were used in viewing the specimens at magnifications of x80, x140 and x800. After examination, the coated specimens were replaced on the herbarium sheets for future reference.

The A.L.S.O. drawings in the species figures are tracings of x140 polaroid micrographs of part of the same areas represented in the relevant x80 plates of A.L.S.O., reduced by one half (plates 1 & 2).

Herbaria. Key to abbreviations (from Holmgren and Keuken, *Index Herbariorum*, 1, ed. 6 (Regnum Vegetabile, 92 (1974))).

AD State Herbarium of South Australia, Adelaide.

ADW Waite Agricultural Research Institute, Adelaide.

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BM	British Museum (Natural History), London.
CANB	Herbarium Australiense, C.S.I.R.O., Canberra.
CBG	Herbarium, Canberra Botanic Gardens, Canberra City.
FI	Herbarium Universitatis, Florentinae, Firenze (Florence).
HO	State Herbarium of Tasmania, The University of Tasmania, Hobart.
K	The Herbarium, Royal Botanic Gardens, Kew.
LE	Herbarium of the Department of Higher Plants, Leningrad.
MEL	National Herbarium of Victoria, Melbourne.
NSW	National Herbarium of New South Wales, Sydney.
US	United States National Herbarium, Department of Botany, Smithsonian Institution, Washington.

Key to distinguish *Stipa* from related genera in Tasmania

1. a. Awn persistent, more than 20mm long; lemma cigar shaped or obovate2.
b. Awn deciduous, less than 10mm long; lemma cylindrical-ovoid*Onyzopsis*
2. a. Lemma cigar-shaped, the callus sharp pointed and with its hair tuft
less than half as long as the lemma; awn often massive*Stipa*
b. Lemma obovate, broad and flat at summit, the callus blunt and with
a hair tuft about half as long as the lemma; awn delicate*Nassella*

Stipa L. Sp. Pl. ed. 1, 78 (1753); Gen. Pl. ed. 5, 34 (1754)

Tufted, shortlived perennial, rarely annual grasses with convolute, sometimes flat leaf blades and with sheaths free to the base. *Ligule* membranous, often torn, or a membranous ciliate rim. *Inflorescence* a loosely spreading or contracted terminal panicle. *Spikelets* pedicelled, 1-flowered, hermaphrodite, chasmogamous and/or cleistogamous in the same inflorescence, very narrowly ellipsoid or terete; rachilla not produced beyond the base of the floret. *Glumes* hyaline or membranous, papery, often with long delicate tips, the lower 3-nerved, the upper 5-and-7-nerved, unequal, often several cm long. *Lemma* convolute, narrow, terete, indurated at maturity, hairy or glabrous, with a retrorsely hairy, pungent or rarely obtuse callus, tapering at the tip or minutely 2-lobed, terminating in a prominent awn; awn usually persistent, often disarticulating after dispersal, single, once- or twice-geniculate with a twisted column and delicate bristle, glabrous, plumose or variously hairy. *Palea* shorter than or equalling the enveloping hardened lemma, dorsally indurated and more or less hairy with membranous ventral margins, or hyaline; 2-nerved. *Lodicules* 2-3, hyaline, equal and large, or posterior member reduced, usually rounded at the apex, glabrous, indistinctly nerved. *Stamens* 3, the anthers elongate, often hairy at the tips, sometimes dimorphic (1 long, 2 short; rarely 1 short, 2 longer). *Caryopsis* tightly enclosed by the lemma and palea, free, fusiform-terete; hilum linear, nearly as long as the grain. (This description covers the native species in Australia. It does not include the introduced species *S. neesiana* Trin. et Rupr. which has a crowned lemma).

Type species: *Stipa pennata* L.

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Note: i. The species are numbered on the right hand side of the key in the order in which they are subsequently described as listed below. Figure and plate numbers correspond with the species numbers. In the species list, the brackets enclose species apparently with close affinities:

1. *S. aphylla* (Rodway) Townrow
2. *S. flavescens* (Labillardière) Townrow (= *S. compacta* Hughes)
(= *S. elatior* Hughes)

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3. *S. mollis* R. Brown
4. *S. semibarbata* R. Brown
5. *S. nervosa* var. *neutralis* Vickery
6. *S. pubinodis* Trinius and Ruprecht
7. *S. bigeniculata* Hughes
8. *S. clelandii* Summerhayes and Hubbard
9. *S. stuposa* Hughes
10. *S. stipoides* (Hooker) Veldkamp
11. *S. variabilis* Hughes
12. *S. falcata* Hughes

ii. *Stipa miliacea* (L.) Hoover, *Leafl. West. Bot.*, 10 (16), 340 (1966) = *Oryzopsis miliacea* (L.) Benth. and Hook. F. ex Aschers and Schweinf. *Mém. Inst. Égypt. (Égypte)* 2, 169 (1887). *Stipa trichotoma* Nees in *Mart. Flor. brasil.* 2¹ (*Agrostologia brasiliensis*), 375 (1829) = *Nassella trichotoma* (Nees) Hack. ex Arech., *An. Mus. nac. Montevideo* 1⁴, 336 (1896) [Caro 1966].

These species appear in the key but are not described in the text. They are not native to Tasmania so fall outside the scope of this paper. Caro, on the basis of the wide range of species available to him in South America, considers that *Stipa* and *Oryzopsis* should be merged, and he also supports Corti (1951) in placing *Nassella trichotoma* in *Stipa* in the section *Nassellopsis* Corti (Caro 1966).

In Tasmania these two species are very distinct from the other *Stipa* species and would not be considered to be in the same genus (see key to related genera.)

iii. Characters printed in "Elite" type may be determined in the field using a hand lens (x15); determination of characters in "Script" type requires higher magnifications (x40) and the use of a dissecting microscope.

1. a. Lemma cylindrical-ovoid, 2mm long; awn deciduous, less than 10mm long *Stipa* (= *Oryzopsis*) *miliacea*
 b. Lemma cigar-shaped or obovate; awn persistent, more than 20mm long 2.
2. a. Lemma obovate, broad and flat at the summit, 1.5-2.0 mm long, the callus blunt with a hair tuft about half as long as the lemma; awn delicate *Stipa* (= *Nassella*) *trichotoma*
 b. Lemma cigar shaped, 5mm or more long, the callus sharp pointed and with a hair tuft less than half as long as the lemma; awn often massive 3.
3. a. Blades rigid, cylindrical, sharp pointed; a caespitose strandline plant up to 1m high, growing also in marginal areas of saltmarsh; A.L.S.O. of dense finger-like macrohairs 10. *S. stipoides*
 b. Blades expanded, flat or folded; or blades absent 4.
4. a. Blades absent or very tiny on flowering specimens, the culm leaves becoming reduced to brown sheaths and very small shrivelled ultimately shed blades; culms green, cane-like, 1-2mm diameter... 1. *S. aphylla*
 b. Blades expanded and well developed, leaves not reduced and shed; A.L.S.O. of prickly hairs and/or macrohairs 5.
5. a. Blades densely or moderately hairy on top surface (adaxial); A.L.S.O. composed of fine macrohairs about 0.01mm (less than 0.02mm) diameter only 6.
 b. Blades hairless or only sparsely hairy on top surface; A.L.S.O.

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- of minute hooks and/or straight sided prickly hairs with or without macrohairs 0.02mm or more in diameter8.
6. a. Ligule a densely bearded irregularly shaped membrane 1.5-2.0mm long; blades involute; awn plumose, the hairs about 2mm long3. *S. mollis*
 b. Ligule fingernail shaped or less than 1mm long7.
7. a. Ligule a somewhat hardened, rotund-obtuse (fingernail shaped), minutely hairy membrane about 2mm long (occasionally longer, sometimes lop-sided) on the lower leaves, the upper ligules shorter with fringed margins; blades convolute; lemma without crown hairs6. *S. pubinodis*
 b. Ligule a membrane less than 1mm long with a ciliate margin; blades involute; lemma crowned with hairs 2.5-5.0mm long.....8. *S. clelandii*
8. a. A.L.S.O. of minute antrorse prickly hair hooks only9.
 b. A.L.S.O. of sparse macrohairs in addition to minute prickly hairs10.
9. a. Lemma-crown hairs 2-3 (-4)mm long; lemma lobes minute (up to 0.05mm) or absent; mature lemma light tan coloured (Munsell Hue reddish-yellow 7.5 YR 6/6); A.L.S.O. hooks 0.02-0.03mm long7. *S. bigeniculata*
 b. Lemma-crown hairs up to 0.5mm long; lemma lobes usually present but minute (0.1-0.6mm); mature lemma copper coloured (Munsell Hue dark reddish-brown 5YR 3/4); A.L.S.O. hooks 0.03-0.05mm long2. *S. flavescens*
10. a. Blades narrow, 1-2mm wide when unrolled, flexuous; lemma (body + callus) about 5mm long; awn falcate when dry; inflorescence very delicate11.
 b. Blades broad 2-5mm wide when unrolled; lemma (body + callus) about 10mm long; awn twice geniculate when dry12.
11. a. Blades needle-like, somewhat rigid, 40-80mm long; awn column above articulation 0.25-0.32mm diameter12. *S. falcata*
 b. Blades linear-involute, 50-150 (-250)mm long; awn column above articulation 0.27-0.35mm diameter11. *S. variabilis*
12. a. Blades involute; awn column minutely scabro-pubescent; A.L.S.O. macrohairs up to 0.6mm long with swollen bases up to 0.04mm diameter5. *S. nervosa* var. *neutralis*
 b. Blades convolute; awn column obviously pubescent13.
13. a. Lemma-crown hairs present, 1.5-3.0mm long; column hairs up to 1.0mm long; A.L.S.O. of prickly hair hooks and macrohairs, the hooks up to about 0.05mm long, mostly retrorse, the macrohairs up to 0.05mm long, ca. 0.020mm diameter, antrorse and retrorse, arising almost at right angles to the costal surfaces then bending ± sharply, shaggy on the lowest blade but becoming shorter and sparser on successive blades9. *S. stiposa*
 b. Lemma-crown hairs absent, column hairs up to 1.6mm long; A.L.S.O. of fine peg-like straight-sided prickly hairs and macrohairs, the prickly hairs ca. 0.01mm long; the macrohairs up to about 0.4mm long, and about 0.025mm diameter, mostly antrorse, erect, becoming shorter and sparser on successive blades4. *S. semibarbata*

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SPECIES DESCRIPTIONS

Notes

1. All specimens cited have been examined unless it is otherwise stated. An index to collectors is given in Appendix 1. Maps of floristic regions and/or divisions currently used in Western Australia, South Australia, New South Wales are available from the State herbaria. Tasmanian floristic zones are those defined in Specht, R.L. 1974: *Aust. J. Bot.* Suppl. Ser. 7, 320; those of Victoria in Specht (*loc. cit.*), 451.
2. Useful diagnostic characters are underlined _____.
3. Apart from anthers and lodicules which were measured wet after a short soaking in dilute "Teepol" solution, all measurements were made on dry material.
4. The ranges of dimensions are based on a sample size of 25, the 25 composed of 5 measurements of each item for each of 5 plants of each species (2 only for *S. clelandii*). It is appreciated that this is a small sample on which to base conclusions. The sample size was determined in this case by practical considerations, and it does at least provide a starting point for further studies on species variation.

Dimensions of features of adaxial leaf surface ornamentation were determined from the X140 scanning micrographs using a Leitz measuring lens with scale intervals representing 7μ (1/140 mm) read with an accuracy of $\pm 3.5\mu$ (i.e. half a scale interval). The dimensions are mostly quoted in whole scale intervals.

Where dimensions are expressed to two decimal places in mm the accuracy claimed is 0.01 (± 0.005)mm based on measurements made with the Stereomicroscope at X40 using a slide micrometer and an eyepiece micrometer with scale intervals representing 0.025mm (1/40 mm) read to the nearest half interval (± 0.01 mm).

In stating dimensions the word "length" is to be understood following the first figures given for each structure (in conformity with present European practice, see Heywood 1958).

In an effort to gain a preliminary idea of the range of morphological variation within the species across the State, the specimens measured were chosen from localities as widely geographically dispersed as the existing Tasmanian collection would allow from as widely contrasting habitats as possible.

In the case of every species, the dimensions of the type specimens came within the range of dimensions given in the descriptions.

5. The terms used to describe the adaxial leaf surface ornamentation (A.L.S.O.) are those of Metcalfe (1960) and follow the system of nomenclature used by Stewart (1965), and where applicable the lettering system developed by Prat (1932, 1960, 1961) and Prat and Vignal (1968) (stated in [] brackets):
 - (a) Composition of ornament: This consists of macrohairs [P], prickle hairs [short P] and prickle hair hooks [P_1, P_2] alone or in combination. Microhairs and papillae are rarely found in Australian *Stipa*. *S. verticillata* Nees ex. Spreng. is the only Australian species which has apparently 2-celled microhairs [B_3] in addition to single-celled hairs.
 - (b) Macrohairs and prickle hairs: The longest and shortest hairs visible were measured to give the range of length and approximate diameter at the base; the density of hairs varies from sparse to moderately to very dense; the direction of the long axis of the hair relative to the blade axis may be antrorse (towards the tip) or retrorse (towards the base of the blade), strongly or weakly ascending in various typical attitudes; most are single celled but some have a swollen basal cell or 'collar' protruding slightly from the surrounding epidermis.
 - (c) Prickle hair hooks: The length was measured between the tip of the barb and the end of the base furthest from the barb, the diameter is the length of the base, both measurements made of hooks viewed at the sides of the costae where the effects of foreshortening are least troublesome.
 - (d) Epidermal long cells: The approximate dimensions were determined from the scanning micrographs (x140). Some species have long cells with convex surfaces

which give the surface the appearance of the weave of a willow-stem or 'withy' basket [I₂]. This appearance can be recognised at x 40 magnification.

Note:

1. Silica cells: The shape, dimensions and arrangement of silica cells in the adaxial epidermal layer can be roughly ascertained from scanning micrographs (x140). Their proper study, not attempted in this project, would require the use of epidermal preparations (Stewart 1965, p.64). However, examination of the scanning micrographs indicates that the silica cells are dumb-bell shaped [S₄] as in all the Australian species and that in addition some species have irregularly rounded and/or nodular bodies. (Appendix 2A). The presence of cross to dumb-bell or nodular silica bodies is used as a key character to *Stipa* by Watson and Milne in their key to sterile material of Black Mountain (A.C.T.) grasses (1972, p.346).
2. Wax platelets: These structures have been omitted from the descriptions although most species have numerous wax platelets scattered all over the epidermal surface. In some species the platelets may even obscure much of the minute surface detail.
3. Hairs in the furrows: These may be visible on scanning micrographs if the ribs are sufficiently wide apart and the furrows between them are not too obscure and deep.
6. Lemma colour is described using the Munsell Color chart System (Munsell 1954). Other lemma characters include those suggested in Townrow 1970, table 1.
7. Useful diagnostic features of the palea (usually neglected in descriptions) include (i) its length, the tip reaching to the top of the lemma or to some distance below it, (ii) the texture of the dorsal surface whether hardened like the lemma or more delicate, (iii) the tip whether hardened, or delicate and hyaline.
8. The Tasmanian species all have florets with dimorphic anthers, mostly one long and two shorter per set, but some species have in addition florets with either three equal anthers or a pair of equal longer anthers and a single shorter anther. At the same time the florets may be either chasmogamous or cleistogamous.
9. Although lodicule morphology is of established taxonomic significance (Jirásek and Jozifová 1968; Jirásek 1969) the author has followed the examples of Matthei (1965) and de Winter (1965) in recording lodicule number only for each species. Lodicules are figured, but at too low a magnification for depiction of structural detail.

1. *STIPA APHYLLA* (Rodway) Townrow, *Pap. Proc. R. Soc. Tasm.*, 104, 96 (1970).

(Figure 1; Plate 1, figure 1)

Syntype: Tasmania, Huon Road, Hobart; Rodway 995 (HO).

Syn. *S. pubescens* var. *aphylla* Rodway, TASMANIAN FLORA, 262 (1903).

Perennial, slender, erect, caespitose, up to 0.9m high, with very short condensed rhizomes about 3mm in diameter, the nodes about 3mm apart; culms rigid, cane-like, up to 1 (occasionally 2) mm in diameter, finely striate, smooth, glabrous, 3-4 noded, mostly light green but pale-yellow for 2mm above the node; nodes minutely pubescent. Leaf sheaths 4-18mm (about half the length of the internodes, finely striate, glabrous, becoming straw-coloured and somewhat inflated, ultimately shed after the blades; ligule up to 0.1mm, a minute membrane with a crenate minutely ciliate margin; blades up to 45mm in juvenile growth, stiff, involute, pointed, 1mm wide at the base when flattened, shrivelling and shed as the inflorescence emerges, abaxial surface smooth, adaxial surface ribbed, ribs c. 0.05mm wide (one half to one third width of ribs in other Tasmanian *Stipa* species), A.L.S.O. coarse moderately dense antrorse macrohairs and sparse antrorse prickly hair hooks, the macrohairs 140-350 x 15-20µ diameter at base, spikey with slightly swollen bases, alternating more or less regularly with the epidermal long cells in more or less regular rows, the prickly hair hooks 20-30 x c. 10µ diameter at base, the long cells 70-130 x c. 15µ wide. Panicle narrow, very loose, somewhat contracted when dry, with about 30 spikelets, 170 x 30mm wide, the main rachis

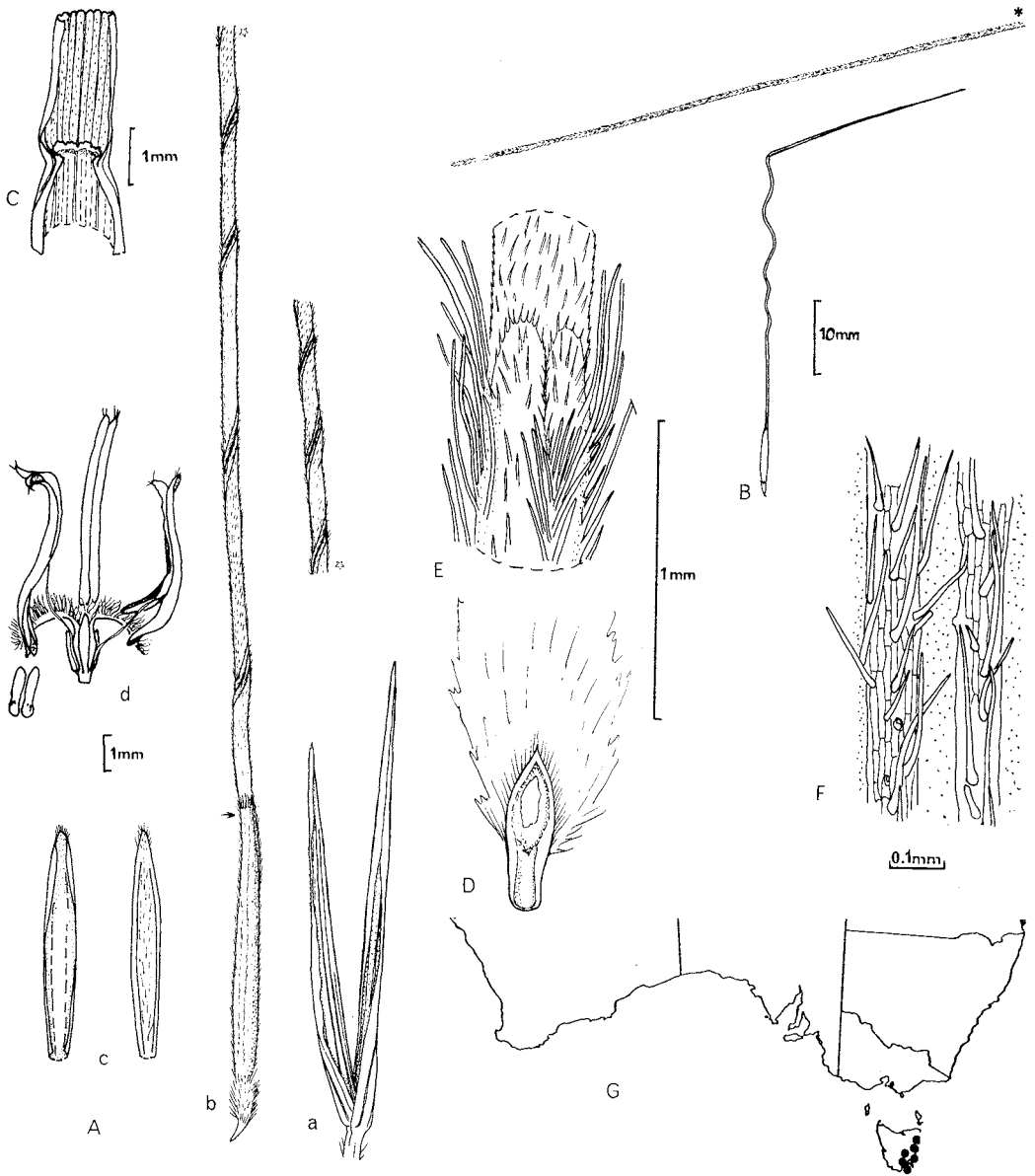
Revised Taxonomy of *Stipa* in Tasmania

FIG. 1. - *Stipa aphylla* (Rodway) Townrow, "Townrow 4B" (HO) (matched with type specimen). Spikelet Characters:- A. a. glumes; b. lemma; c. palea, adaxial and abaxial views; d. lodicules, anthers, ovary x5. B. Lemma x1. D. Callus scar x 40. E. Lemma lobes x 40. Leaf characters:- C. Ligule (blade 1 from culm base) x7.5. F. A.L.S.O. x c. 80 (tracing of micrograph of part of area shown in Plate 1, fig. 1). G. Species distribution (cited specimens).

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minutely scabrous, the branches very slender, upright, scabrous, 1-2-nate, the pedicels 10-20mm and clavate above. *Spikelets* with single floret, usually chasmogamous, pale-green to straw coloured above and purple below, with glumes widely divergent at maturity. *Glumes* thin, chaffy, unequal, narrowly linear-attenuate, slightly inrolled, *lower glume* 13.5-15.0 (-18.0) x c. 0.7mm wide when flattened, faintly 3-nerved, *upper glume* 12.5-15.0 (-15.5) x 1.0mm wide when flattened, 3-5 nerved, the lateral nerves of both glumes as strong as the mid-nerve. *Lemma* (7.5-) 8.0-11.0 (including callus tuft and tip) x 0.6-1.0mm wide, firm, linear, very dark greyish brown (Munsell 10 YR 3/2-2/2), margins overlapping, body surface minutely pimped (pimples c. 10 μ diameter at base; *callus tuft* including sharp tip 1.6-3.5mm, pale yellow (Munsell 2.5Y 8/4), the *callus scar* (0.55-) 0.58-0.82 x c. 0.25mm wide; *lemma lobes* 0.10-0.37 (-0.60)mm (varying with maturity), minutely ciliate, the cilia up to 0.15mm, rarely absent; *lemma crown hairs* 0.10-0.80mm or absent; *awn* terminal, minutely pubescent, *the column* (38-) 40-51(-58) x 0.30-0.55mm diameter above articulation, dark brown, once (twice) kneed, (27-) 30-45mm to lower knee, *the bristle* up to 28mm, straw coloured, the awn hairs c. 0.1mm on column, 0.05mm and very dense on bristle. *Palea* (4.5-) 5.2-7.8mm, tip membranous, minutely hairy, reaching to c. 1.0mm below top of lemma, margins hyaline, dorsal surface as hard and hairy as the lemma between the two nerves. *Anthers* 2.5-5.1mm, three, either equal in length or 1 longer plus 2 shorter, or 1 shorter plus 2 longer. *Lodicules* c.1.5mm, three equal in length, the two anterior with swollen bases, the posterior not swollen at base.

TASMANIA. - East: 2 miles N of Bicheno, Jan 1965, *Townrow 298* (HO); Maria Is., Darlington, Nov 1968, *Townrow 205* (HO); Prosser R. near Orford, Nov 1967, *Townrow 24* (K); Copping, Jan 1949, *Blake 18277* (K); Eaglehawk Neck, Feb 1947, *Curtis 128* (K). South-East: Fern Tree, Ridgeway, June 1967, *Townrow 4B* (HO), Lower Pipetrack, Mar 1965, *297* (MEL); Hobart, Waterworks, Jan 1895, *Rodway* (HO), Huon Road, Univ. Tas., *995* (HO), Nov 1967, *Townrow 77* (HO), Jan 1970, *246* (K); Huonville, Anonymous (CANB 13186); Bruny Is., Barnes Bay, Dec 1968, *Townrow 147* (H); Channel Highway opposite Alonnah, S of Huon Pt., Jan 1967, *Townrow* (HO); Without definite locality, *Rodway* (K 484).

Distribution: apparently endemic and confined to SE Tasmania.

Ecology: marginal more open areas of undisturbed dry sclerophyll, below 330m altitude; often closely associated with, or growing out of clumps of *Lomandra longifolia* Labill.

Notes: *S. aphylla* closely resembles *S. muelleri* Tate (1885) of Victoria and South Australia, except that it is about half the size of the latter in all features, and may prove to be closely related, e.g., a member of a polyploid series containing both species.

2. *STIPA FLAVESCENS* Labill., *Fl. Nov. Holl.*, 1, 24 (1804); Hooker, *Fl. Tasm.*, 2, 110 (1856); Bentham, *Fl. Austral.*, 7, 566 (1878); Hughes, *Kew Bull.*, 1921, 6 (1921).

(Figures 2, 2a; Plate 1, figure 2)

Lectotype: Tasmania, *Labillardiere*, Webb (K35) [Here designated]. Syn. *Stipa scabra* var. *elatior* Bentham, *Fl. Austral.*, 7, 571 (1878). (Lectotype: Swan River, *Drummond 959* (K),) *Stipa elatior* (Bentham) Hughes, *Kew Bull.*, 1921, 24 (1921). *Stipa compacta* Hughes, *Kew Bull.*, 1921, 24 (1921); Townrow, *Pap. Proc. R. Soc. Tasm.*, 104, 85 (1970). (Holotype: Tasmania, 1837, *Gunn 996* (K).)

Perennial, robust, often caespitose; *culms* 0.4-0.8m, erect or somewhat geniculate, terete, 3-4 (-5)noded, the upper nodes exserted; *nodes* finely densely retrorse pubescent with felt of pale yellow hairs extending c. 10mm below node. *Leaf sheaths* slightly striate, eventually becoming loose, lower sheaths finely retrorse-hairy, grey brown, upper sheaths glabrous, yellowish green, outer sheath margins shortly ciliate or smooth; *ligule* c. 0.5mm, truncate, membranous, the margin minutely crenulate, ciliolate, with sparse white hair tufts up to 1.5mm on either side in the position of auricles; *blades* 90-540 x 2-5mm wide, linear, convolute, with long drawn out tips, somewhat harsh

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and stiff, yellowish green, one or both margins often with orange coloured stripe about one third width of blade, *abaxial surface* smooth, occasionally sparsely retrorse-hairy below on lower culm leaves, *adaxial surface* hairless, very occasionally with a few scattered hairs near ligule, A.L.S.O. *abundant antrorse prickly hair hooks* 35-50 μ with long oval bases 35 μ x 15 μ wide, the hooks progressively finer on blades higher up culms, epidermal long cells 20-90 μ x c. 7 μ wide with "withy basket" appearance at sides of costae. *Panicle* 150-300 x c. 20mm wide, exserted, open at flowering, afterwards dense and contracted, the longest branches 30-50mm to base of furthest spikelet occurring at lowest node, pedicels 2-12mm, branches and minor branches minutely scabrid hairy. *Spikelets* chasmogamous or cleistogamous, pale green tinged with maroon below, straw coloured above, with glumes widely divergent at maturity. *Glumes* sub-equal, subhyaline, acuminate, minutely scabrid on backs of mid-nerve, very minutely hairy between nerves, *lower glume* (9.8-) 11.0-15.0mm, conspicuously 3-nerved, *upper glume* (8.5-) 9.2-12.0mm, conspicuously 5-nerved. *Lemma* (7.5- 7.9-10.5 (-12.0) (including callus and tip) x 0.7-1.1mm wide, firm, spindle shaped, the colour varying with maturity, the immature brownish yellow (Munsell 10YR 6/8), the more mature dark reddish brown (Munsell 5YR 3/4) to dark brown (Munsell 7.5YR 4/4), with a *coppery sheen* produced by the indumentum of moderately, dense reddish yellow hairs (Munsell 7.5YR 7/6), the hairs 0.25-0.90 x 0.01mm diameter at base arising at c. 10° to body surface; lemma margins overlapping, upper one third of lemma surface minutely papillose; *callus tuft* including sharp tip 2.1-3.5 (-3.8)mm, varying in colour with maturity from white (Munsell 10YR 8.2) to strong brown to reddish yellow (Munsell 7.5YR 5/8 to 8/6), the *callus scar* (0.50-) 0.57-0.80 (-0.85) x 0.15-0.17mm wide; *lemma lobes* 0.05-0.38 mm, lanceolate, minutely hairy, margin ciliate, or lobes absent; *lemma crown* of *about twelve hairs* 0.5-1.3mm, uneven in length; *awn* twice kneed, minutely moderately densely hairy, the *column* 17.0-30.0 (-45.0) x 0.25-0.35mm diameter above articulation and 10.0-18.0 (-19.0)mm to first knee, hairs c. 0.12mm closely adpressed over whole column extending along bristle angles. *Palea* 4.5-6.5(-6.7)mm, the tip membranous, reaching to 0.4-0.75mm below top of lemma, dorsal surface between the nerves hard and hairy like the lemma, margins hyaline. *Anthers* usually 1 larger plus 2 smaller, more rarely equal; in chasmogamous florets the larger (1.0) 1.5-1.9 (-3.2)mm, the smaller 0.8-1.5 mm, in cleistogamous florets the larger 0.8-0.9mm, the smaller 0.4-0.6mm. *Lodicules*, three, of which the two anterior are longer and swollen, the posterior a tiny delicate thin membrane, in chasmogamous florets the anterior 2.0-2.5mm, the posterior 1.0-1.5 mm, in cleistogamous florets the anterior c. 1.5mm, the posterior c. 0.5mm.

WESTERN AUSTRALIA. - Darling: Claremont near Perth, sandhills near coast, Sept 1902, *Andrews* (K); Bow River, sandhills, Nov 1912, *Jackson* (K); Swan River, *Drummond 959* (NSW); Swan River, *Collie* (K). Warren: King George III Sound, *Brown 6202* (BM).

SOUTH AUSTRALIA. - Eyre Peninsula: Port Lincoln district, *French* (ADW 28130). Southern Lofty: Encounter Bay, Strand, Nov 1930, *Cleland* (K); Hindmarsh Is., Lower Murray River, Oct 1945, Anonymous (AD96323274).

NEW SOUTH WALES. - Central Coast: Sydney, Port Jackson, 1804, *Brown* (BM).

VICTORIA. - Western Coastal Plains; Port Fairy, dune on beach front, Nov 1959, *Symon 141* (ADW); Tower Hill at trigpoint (104m) more or less 3 km SSE of Koroit, Nov 1963, *Willis* (MEL). Central (Melbourne): Brighton Beach, Sept 1929, *Sonenberg* (K).

TASMANIA. - King Is.: SE coast at Grassy, Jan 1949, *Blake 18437* (K). North: Somerset, on sand dunes, Feb 1948, *Curtis 130* (K); Devonport, sandy foreshore, Dec 1931, *Davies* (K). South-East: South Bruny Is., Alonnah Beach, Nov 1966, *Townrow 15* (HO); Hobart, Nov 1929, *Rodway* (H), Upper Domain on E side of Radio Transmitter, Nov 1967, *Townrow 41* (HO); Lower Sandy Bay, sandy area by Nutgrove Car Park, Dec 1966, *Townrow 16* (HO), Dune to West of Nutgrove Car Park, Nov 1967, *28* (HO); Kingston, margin of brackish swamp, Brown's R., Dec 1944, *Curtis 20* (HO); Kingston Beach, Nov 1935, *Rodway 25* (HO); Blackmans Bay, sand dunes, Jan 1928, *Rodway* H117 (HO); North Bruny Is., Sandy bank near Shangri La Tea Gardens, S of Dennes Point, Jan 1968, *Townrow 144* (HO), Great Bay, sandy strip between road and beach, Jan 1970, *Townrow* (K), Variety Bay, old pilot station, Jan 1968, *157* (HO). North-East: Tomahawk, low dune beside beach, Dec 1967, *Townrow 112* (HO). East: Hobart, Old Beach, Eastern Shore,

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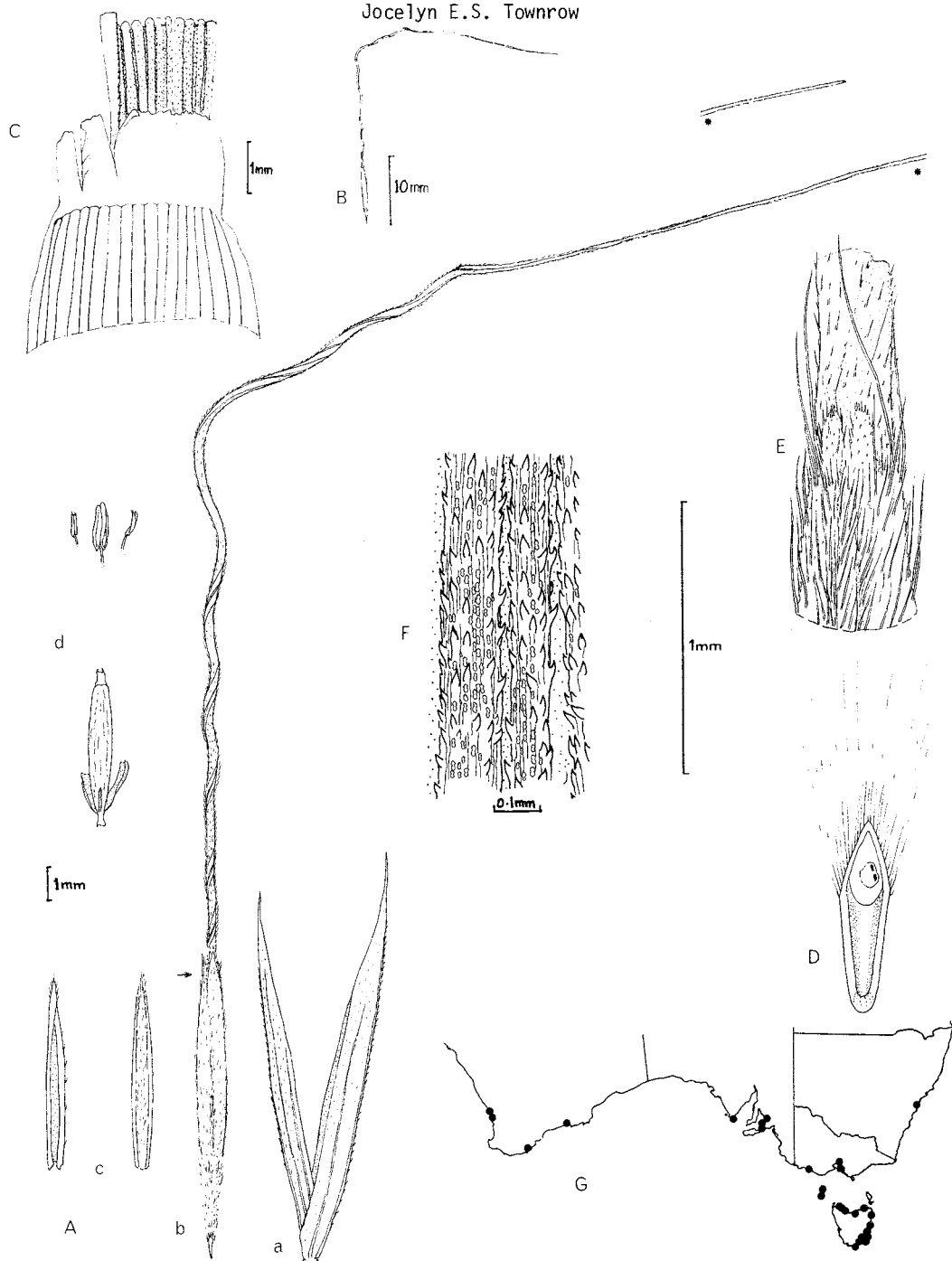


FIG. 2. - *Stipa flavescens* Labillardière, "Labillardière, Webb" (K. 35) (type specimen). Explanation as for figure 1 (p.236) except: C. Ligule (blade 2 from culm base). F. Tracing of micrograph of part of area shown in Plate 1, fig. 2.

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roadside bank on north side of bridge, Dec 1967, *Townrow 94* (HO); South Arm, Opossum Bay, bank at end of road, Nov 1967, *Townrow 42* (HO). Roadside $\frac{1}{4}$ ml E of Ralphs Bay, Nov 1967, *Townrow 55, 56* (HO); Slopen Is., by old hut foundations, Dec 1967, *Townrow 83* (HO). Without definite locality: 1837, *Gunn 996* (K); *Labillardière*, Webb (K35).

Distribution: Coastal localities in Western Australia, South Australia, Victoria, New South Wales, Tasmania.

Ecology: In Tasmania, mostly in low lying coastal sandy areas, predominantly below 300m above sea level on low stabilised dunes, sandy beach ridges and sandy road verges.

Notes: 1. The great variability of this species makes identification difficult: the size of plant varies with age from one or two culms in the first year to a dozen or more inflorescences in a clump after several years; inflorescence shape varies through the flowering season from compact to open to compact; the very distinctive coppery colour of the lemmas (Munsell 5YR 3/4, dark reddish brown) is only fully developed in florets containing ripening caryopses whether they be chasmogamous or cleistogamous, and florets produced towards the base of the inflorescence or early or late in the season usually remain pale in colour. Young specimens with pale coloured florets have previous to this work been identified as *S. elatior*, (e.g. Hughes 1921, 1922).

From the limited data available cleistogamy in *S. flavescens* seems associated with floret position in the inflorescence, while lemma colour development seems associated with size of the developing caryopsis. Some specimens have both chasmogamous and cleistogamous florets e.g. *Townrow 94*, while other specimens are apparently wholly chasmogamous e.g. *Townrow 56*.

2. The A.L.S.O. of antrorse prickly hair hooks 35-50 μ long, which is visible with a hand lens (x15), is a character which has proved most useful in identification of difficult specimens. Some specimens have a few macrohairs in the vicinity of the ligule, but the most usual form is without macrohairs. The hooks are much coarser than those found in *S. bigeniculata*, the only other species collected in Tasmania which has an A.L.S.O. of hooks only, in which the hooks measure 20-35 μ long.

3. The type specimen (fig. 2), with cleistogamous florets, varies from the usual situation in that its ligules are hairless membranes up to 4mm instead of truncate ciliate membranes up to 0.5mm long, and its leaf blades are slightly harsher and more needle-like. *S. compacta* type specimen (fig. 2A) with chasmogamous florets is more representative of the majority of specimens.

Specimens occasionally collected have variations in ligule development. Sometimes the ligule of the older culm leaves is lopsided, one side an elongated hairless membrane up to about 3mm long, the other more normal. These specimens are frequently cleistogamous or without developing caryopses and may possibly be of hybrid origin.

4. The lamina section of *S. flavescens* as drawn by Hughes (Hughes 1921, p.19, fig. 6a) differs essentially from that of the type of *S. compacta* (*op. cit.*, p.29, fig. 31a) only in the continuous sclerenchymatous hypodermis both under and between the vascular strands. In the type of *S. compacta* the lignified tissue is not continuous under the epidermis. However, a section of the second blade from the base of the flowering culm of the type specimen of *S. flavescens* cut dry and stained in phloroglucinol shows very clearly the same distribution of sclerenchyma as that in Hughes' drawing for *S. compacta*, not as that for *S. flavescens*. In material of *S. flavescens* sclerification does increase somewhat with age. Blades lower down the culm and blades collected later in the season have a greater degree of thickening, but the hypodermal layer is never, so far as I have found, thickened in a continuous layer right round the section. It is possible that Hughes either sectioned a blade not from the type specimen (perhaps from *S. stipoides*, a species which grows in very close proximity to *S. flavescens* at

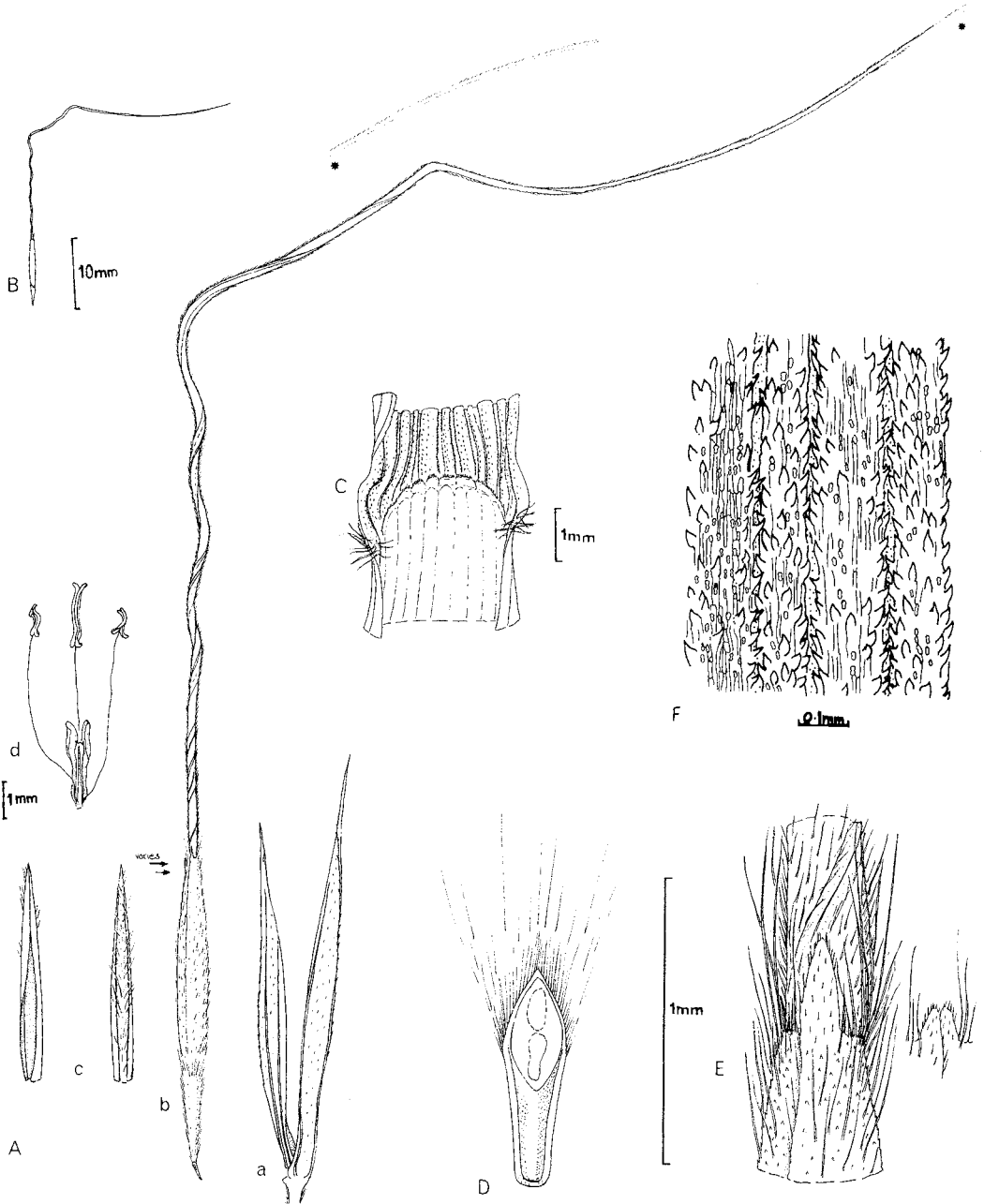


FIG. 2A. - *Stipa compacta* Hughes, (= *S. flavescens* Labillardière) "Gunn 996" (K) (type specimen). Explanation as for figure 1 (p.236) except: F. A.L.S.O. x c. 80 (tracing of scanning micrograph of "Townrow 244" (K) (matched with type specimen), blade 3 from culm base.

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the present time at the type locality of the latter (see Townrow 1978), or that she misinterpreted the rather large dark epidermal cells on the abaxial side of the section as being sclerised. All leaf sections of *S. flavescens* I have examined agree with Hughes' drawing for *S. compacta*.

5. Other minor differences between the type specimens of *S. flavescens*, *S. compacta* and *S. elatior* are no more than the variations to be found in some specimens even on the one plant, and include variation in compactness of inflorescence, the presence of lemma lobes up to 0.3mm long, lemma hair colour, length of the awn to the first "knee", and the presence of ciliate sheath margins.

3. *STIPA MOLLIS* R. Brown, *Prodr.*, 174 (1810); Hughes, *Kew Bull.*, 1921, p.18; Townrow, *Pap. Proc. R. Soc. Tasm.*, 104, p.85 (1970).

(Figure 3; Plate 1, figure 3)

Lectotype: New South Wales, Port Jackson, *Brown 8205* (K). Syn. *Stipa semibarbata* var. *mollis* (R. Brown) Bentham, *Fl. Austral.*, 7, p.569 (1878). *Stipa semibarbata* var. *gracilis* Black, *Trans. R. Soc. S. Aust.*, 67, p.36 (1943). (Lectotype: South Australia, Encounter Bay, Nov. 1930, *Cleland* (AD.97244092) [Here designated].)

Short-lived perennial, robust often caespitose in open habitats, more slender in shaded places; culms 0.3-1.5m, up to 3.5mm diameter at base, erect, terete, 3-6 noded; nodes densely minutely pubescent, upper nodes exerted, pubescence white, retrorse on the lower nodes and internodes, the hairs c. 0.3mm, antrorse on the upper internodes and inflorescence axes, the hairs c. 0.1mm. *Leaf sheaths* lightly striate, becoming loose, lower sheaths minutely retrorse-pubescent especially above, outer sheath-margins smooth or minutely ciliate, orifice and collar densely bearded with fine white hairs c. 1mm; *ligule* 1-2mm, firm, ± ovate, the margin irregularly sinuate and fringed with hair, densely bearded on the back, the hairs 0.5-1.0mm; *blades* 150 - 450mm x 1.5-3.0mm wide at the base when flattened, involute, tapering with long drawn out tips, stiff and harsh, silvery green, *abaxial surface* weakly or strongly grooved, culm blades ± hairless, innovation blades minutely sparsely glandular-hairy in the grooves, *adaxial surface* deeply grooved, densely pubescent, A.L.S.O. of very dense oval-based macrohairs 60-140 x 7-17µ diameter at base, finely tapering, springing out almost perpendicular to the rib surfaces, curving sharply mostly antrorsely for c. one third length, macrohair bases 30-50µ apart, epidermal long cells c. 9µ diameter, obscured by macrohairs. *Panicle* 140-280 x c.50mm wide loosely contracted, the base later exerted, the main axis and branches minutely antrorse-scabrid, the main axis with 5-10 bearded nodes each with 3-5 slender 2-3-nate branches up to c. 70mm, the spikelets mostly towards the ends of the branches on filiform minutely scabrous pedicels 3-5mm long. *Spikelets* chasmogamous and/or cleistogamous in the same inflorescence, very pale green, soon pale straw-coloured, narrow, the glumes not widely divergent. *Glumes* subequal, lanceolate-acuminate, hyaline above, the tips very delicate and usually torn, chaffy below, margins ciliate in the type but not in Tasmanian material, very minutely hairy on and between the nerves, the microhairs c. 30µ, *lower glume* 17.4-23.0mm (when torn 14.0-19.0mm), delicately 3-nerved, *upper glume* 18.0-21.5mm (when torn 12.0-21.0mm), delicately 5-sub7-nerved. *Lemma* (6.6-) 7.1-10.5 (including callus tuft and tip) x 0.6-1.2mm wide, firm, narrowly obovate, the margins overlapping, pubescent, brown to dark brown (Munsel 10YR 3/3-4/3), the body beneath the hairs dark reddish brown (Munsel 5YR 2/2-3/3) and minutely scabrid towards the top, the hairs c. 0.75 x 0.01mm diameter at base, moderately dense, closely appressed to and curving diagonally round body, pinkish white to very pale brown (Munsel 5 YR 8/2-10YR 7/4); *callus tuft* including sharp tip 2.2-3.9mm, very pale brown to yellow (Munsel 10YR 8/3-8/6), the *callus scar* 0.40-0.60 x c. 0.07mm wide; *lemma lobes* 0.06-0.20mm, oval, minutely ciliate; *lemma crown hairs* absent, occasionally a few body hairs extend c. 0.3mm beyond awn base; *awn* once (-twice) kneed, plumose, the bristle curving gently from the knee, the *column* 16.5-32.0 x 0.25-0.37mm diameter above articulation and 10.0-22.0mm to first knee, the column hairs to 2.0mm in a double spiral, the bristle with a single sparse

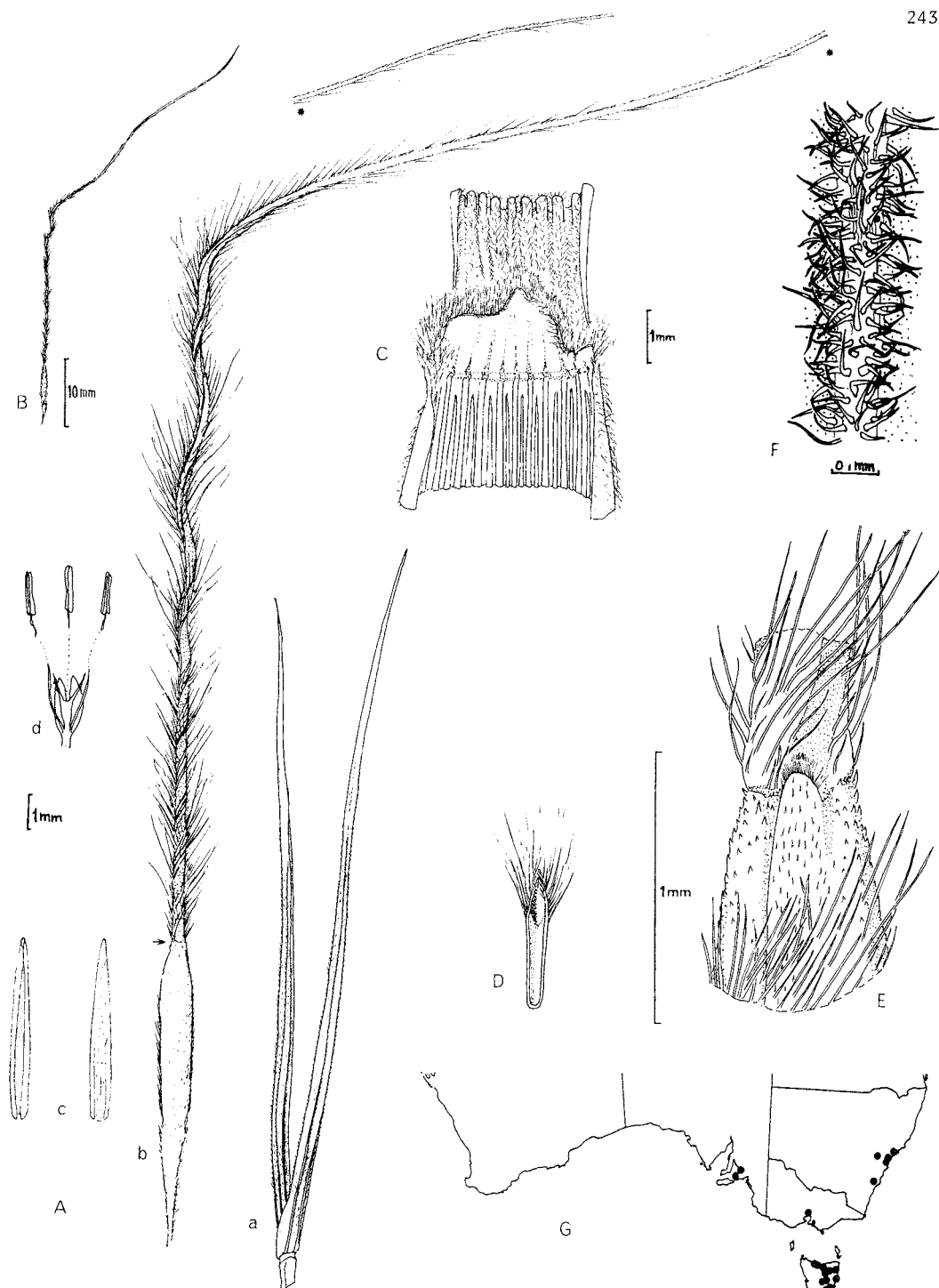


FIG. 3. - *Stipa mollis* R. Brown, "Brown 6205" (K) (type specimen). Explanation as for figure 1 (p.236) except: C. Ligule (blade 4 from top of culm *Cleland* (K.487) x 7.5. F. Tracing of micrograph of part of area shown in Plate 1, fig. 3.

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row of hairs c. 1.5mm extending ± along whole length and minutely hairy on the bristle-angles. *Palea* 5.0-6.5mm, the tip hyaline reaching to top of lemma, the margins hyaline, the dorsal surface similar to the lemma in texture and hairiness between the nerves. *Anthers* usually 1 larger + 2 smaller, rarely 1 smaller + 2 larger; in chasmogamous florets the larger 3.2-3.4-4.7mm, the smaller (2.6-)3.2-4.6mm; in cleistogamous florets the larger 1.1-2.5mm, the smaller 0.6-1.8mm. *Lodicules* two large anterior c. 1.5mm, with or without a minute delicate membrane c. 0.5mm in posterior position.

SOUTH AUSTRALIA. - Flinders Ranges: Wilpena Pound, Nov 1930, *Cleland* H98 (K). Southern Lofty: Pinery near Grange, ? *Cleland* H.487 (K); Grange near Adelaide, Oct 1927, *Cleland* 72 (K); National Park, Belair, Nov 1932, *Cleland* (AD 97244903); Happy Valley, Nov 1926, *Cleland* (K); Compass Mt., Oct 1920, *Cleland* (K); Bach Valley, Encounter Bay, Nov 1930, *Cleland* H61 (K), (AD 97244092). Kangaroo Is.: Vivonne Bay, Nov 1924, *Cleland* (AD 97244091).

NEW SOUTH WALES. - Western district (?): Franco-British Exhibition, exhib. by Director Bot. Gdns. Sydney (K). Southern Tablelands: Summit area of Mt. Budawang, E of Braidwood, Dec 1965, *Pullen* 4126 (K, ex. CANB). Central Tablelands: Lithgow, Jan 1936, *Vickery* (NSW). Central Coast: Maroubra, frequent in seacliff scrub, Oct 1946, *Johnson* (NSW); Tempe District, Oct 1899, *Boorman* (K431, NSW); Port Jackson District, auf sandhügeler unweit Sydney, Oct 1900, *Meersnücke* (K), Port Jackson, *Brown* 6205 (K, BM); South Coast: Bowen Is., Jervis Bay, Dec 1931, *Rodway* (K, ex NSW 662).

VICTORIA. - Eastern Highlands: Wendu [? Wando] Vale, forestland, Nov 1843, *Robertson* 529 (K). Central[Melbourne]: Ringwood, (2 sheets), Oct 1929, *Sonenberg* (K), Sheet 2, Oct 1891, *Morrison* (K); Port Phillip Bay, Ricketts Point, Nov 1935, *Sonenberg* (K).

TASMANIA. - North: Cressy, Nov 1948, *Moore* (CANB); Cataract Gorge, South Esk River, on rocky cliffs, Oct 1943, *Curtis* (K); Launceston, Nov 1912, *Cleland* (NSW). South East: Domain, Jan 1895, *Rodway* (HO); Hobart Town, *Gunn* 1452 (K, HO); University of Tasmania, roadside bank by Agric. Science Glasshouse, Jan 1970, *Townrow* (HO); Blackmans Bay: Sandy heath, Jan 1945, *Curtis* 22(K), Sandy hillside, Jan 1947, *Curtis* (K); North Bruny Island, Roadside, Dennes Point road at second steep corner opposite the "Iron Pot" travelling N from Barnes Bay, Jan 1968, *Townrow* 139 (HO), Great Bay, roadside through wooded area at N end, Jan 1970, 243 (K), Variety Bay, Cape Queen Elizabeth track at turn off to ruined homestead, Jan 1968, 158 (HO). North East: Bridport, road to Entally, Nov 1952, *Curtis* (HO), Cliff top, Nov 1952, *Curtis* (HO); Waterhouse Estate, stabilised dune slack, Dec 1967, *Townrow* 110 (HO); St. Helens, track to flagstaff, on dry hillside, Nov 1945, *Curtis* (K); East Coast roadside, nine km S of St. Helens, Jan 1968, *Townrow* 187 (HO). East: Risdon, Jan 1949, *Vickery* (K, HO, NSW 7492); Road to South Arm (Goat Hill) near Hobart, Dec 1946, *Curtis* (K); two km N of Ralphs Bay, open eucalypt woodland, Nov 1967, *Townrow* 57 (HO); three km S of Richmond on Cambridge road, Nov 1967, *Townrow* 75 (HO); Road to Port Arthur between mileposts 39 and 40, Nov 1966, *Townrow* 9 (HO); Runnymede Post Office, roadside, Nov 1967, *Townrow* 63(HO); Slopen Island, very open sandy ground at edge of eucalypt scrub, Dec 1967, *Townrow* 81 (HO), East side, Dec 1967, 82 (HO); Eaglehawk Neck, Nov 1951, *Curtis* (HO); Beside Prosser River, Steep, rocky bank 4.3 km W of Orford, Nov 1967, *Townrow* 70 (HO), Rough hillside 3.4 km W of Orford, Nov 1967, 71 (HO); Orford, roadside 1.2 km N of camping ground, Jan 1968, *Townrow* 171 (HO); Coles Bay 10 km N of Ranger's house, Jan 1968, *Townrow* 180 (HO).

Distribution: South-eastern states of Australia; eastern half of Tasmania.

Ecology: In Tasmania, lightly shaded wooded areas mostly below 300m above sea level with annual rainfall below 1140mm.

Notes: 1. *Stipa mollis*, and *S. semibarbata* R. Br. with which it is much confused, belong to a complex which on the Australian mainland also includes *S. plagiopogon* Black, *S. densiflora* Hughes, *S. hemipogon* Bentham, and *S. nobilis* Pilger. This complex

needs much further detailed taxonomic investigation before the existing chaos can be unravelled.

2. Localities recorded on herbarium sheets of specimens, clearly either *S. mollis* or *S. semibarbata*, indicate that both grow in the south-eastern states of Australia, but only the latter occurs in south-western Australia (fig. 3G, fig. 4G). In Tasmania where most populations can be ascribed to one or other species on the basis of awn hair character (*S. mollis* hairs c. 2.0mm, continuing along the bristle ± to end; *S. semibarbata* hairs c. 1.0mm on the column only; fig. 3Ab, fig. 4Ab), and A.L.S.O. (fig. 3F, fig. 4F), the complex occurs almost exclusively in the eastern half of the island. (see Townrow 1974, p.24).
3. Bentham (1878) and Willis (1962) regard *S. mollis* as a more robust, more hairy form of *S. semibarbata* although the type specimens (*S. mollis*, Port Jackson, *Brown 6205*, fig. 3; *S. semibarbata*, Port Dalrymple, *Brown 6204* [the figured specimen *Townrow 248*, fig. 4, closely matches *6204*]) can be differentiated on lemma dimensions, the shape and hair ornamentation of the glume nerves, the A.L.S.O., the number and development of anthers and lodicules, and the mode of leaf blade venation.
4. The three specimens of *S. semibarbata* var. *gracilis* designated by Black (1943) as types, have lemmas which are quite distinct from those of the type of *S. semibarbata*. Whereas the latter is characterised by lemmas with awn columns 26.0-30.5mm to the first knee with hairs 0.3-1.6mm long, and bristles with only minute dense hairs about 0.1mm long, the three type specimens of *S. semibarbata* var. *gracilis* have awn columns 10-13mm to the first knee with hairs up to 2mm long. They are therefore much closer to the type of *S. mollis* and differ from it only in minor characters of indumentum and dimension, coming well within the range of variation of *S. mollis* as it is represented in Tasmania. The lectotype of *S. semibarbata* var. *gracilis* which has not previously been published as such, was selected from the three designated specimens, as it is the one most distinct from *S. mollis*. It has awn hairs about 1.6mm long which do not extend beyond the top of the column. In both the other specimens the awn bristles bear a few long hairs almost to the tip as do those of *S. mollis*.
5. Morphologically intermediate forms occur in several areas of distribution-overlap where *S. mollis* and *S. semibarbata* exist in close proximity, (e.g. 14 km and 5 km west of Bothwell on the Bothwell/Ouse road, on North Bruny Is. at Dennes Point and on Maria Is., Chinamans Bay, "Neck" region. This suggests that an incomplete genetic barrier exists. Either the taxa are distinct but have some degree of sympatric introgression, or they belong to two partially differentiated and isolated sets of populations of the same taxon.

The range of variation in spikelet dimensions of five specimens selected for *S. mollis* and *S. semibarbata*, separated on the basis of awn hair character and A.L.S.O., shows substantial overlap in all characters except callus scar dimensions and length of the awn column, with a tendency in most characters towards larger dimensions in *S. semibarbata*. Numerical taxonomic treatment together with evidence from cytological investigations could be used to determine whether the taxa are discrete entities or belong to a variable continuum. So far it is known that some specimens of *S. mollis* have reduced pollen fertility whereas none has been observed in *S. semibarbata*. Cleistogamy has been observed in specimens of both taxa. A proper investigation of the breeding systems and reproductive capacities of the two sets of populations would clarify the existing relationships. Further research is necessary, but in Tasmania at least, it is useful to maintain *S. mollis* and *S. semibarbata* as separate taxa, because each occupies a distinct although overlapping ecological niche. *S. mollis* is more closely associated with shaded wooded areas, and seems adapted to cooler summer and warmer winter temperatures than *S. semibarbata*. *S. semibarbata* is more associated with open areas in woodland and scrub (see Townrow 1974, p.25).

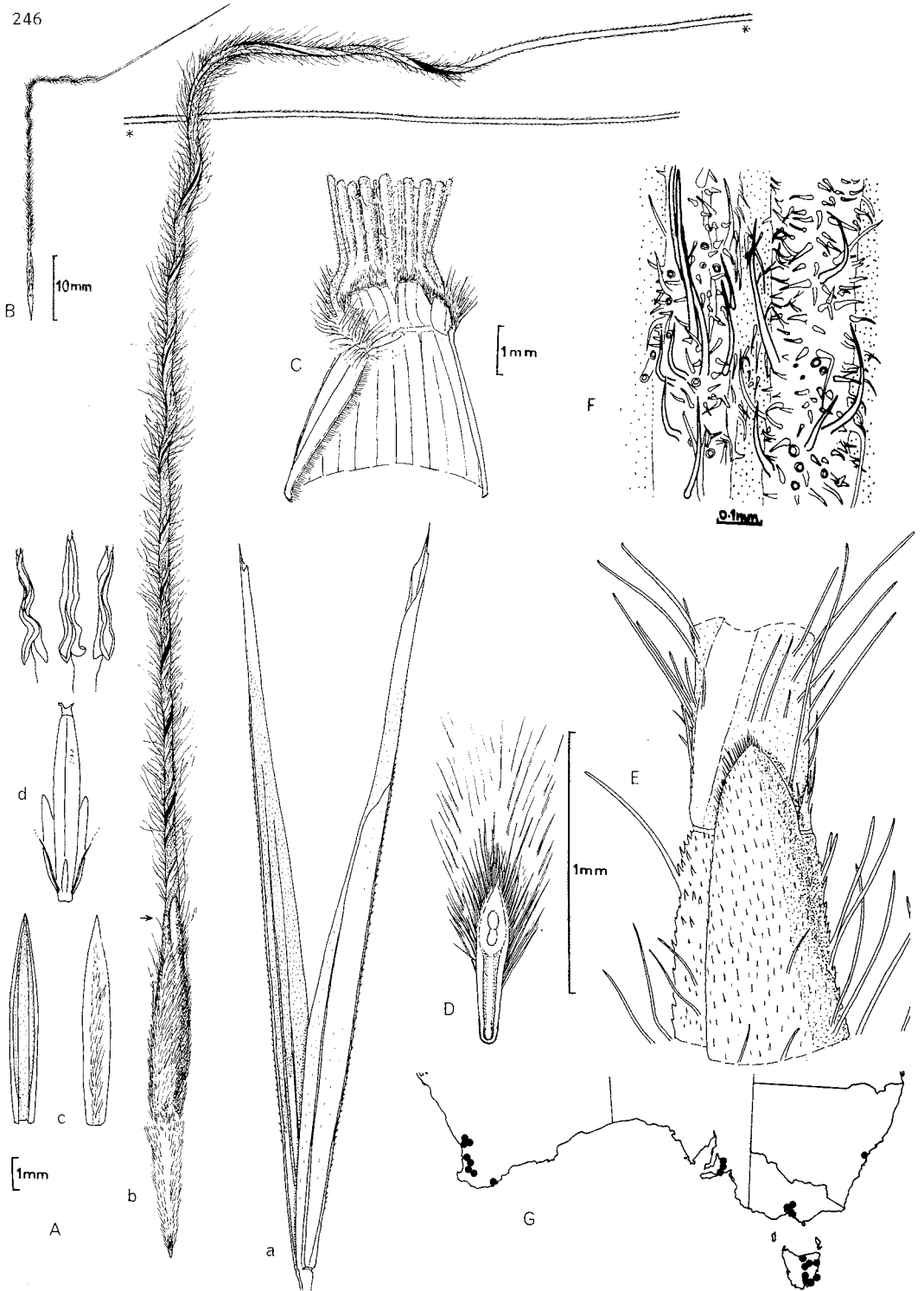


FIG. 4. - *Stipa semibarbata* R. Brown, "Townrow 248" (K) (matched with type specimen).
 Explanation as for figure 1 (p.236) except: C. Ligule (blade 2 from culm base);
 F. Tracing of micrograph of part of area shown in Plate 1, fig. 4.

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4. *STIPA SEMIBARBATA* R. Brown, *Prodr.*, 174 (1810); Hughes, *Kew Bull.*, 1921, p.20 (1921); Townrow, *Pap. Proc. R. Soc. Tasm.*, 104, p.86 (1970).

(Figure 4; Plate 1, figure 4)

Lectotype: Tasmania, Port Dalrymple, *Brown 6204* (BM).

Short-lived perennial, robust, caespitose; culms 0.3-1.5m, 2.0-5.0mm diameter at base, erect, terete, 3-5 noded; nodes ± exserted, densely finely retrorse pubescent with a felt of white hairs c. 0.1mm (occasionally to 1.0mm) extending c. 2mm below the nodes, the internodes smooth or minutely pubescent, the hairs c. 0.05mm, retrorse on the lower internodes and antrorse on the upper internodes and inflorescence axes. *Leaf sheaths* lightly striate, becoming loose, minutely retrorse-pubescent below becoming ± smooth or minutely scaberulous above, outer sheath-margins shortly ciliate at least towards the orifice, orifice and collar densely bearded with fine white hairs 0.5-1.0mm; *ligule* 1-2(-4)mm, firm, ± ovate, the margin irregularly sinuate and fringed with hair, densely bearded on the back, the hairs 0.1-0.4mm; *blades* 150-350 x 2.0-4.0mm wide at the base when flattened, convolute, tapering with long drawn out tips, stiff and harsh, light green, *abaxial surface* weakly striate, culm blades minutely retrorse-hairy in the shallow grooves towards the collar, smooth and hairless above, innovation blades sparsely minutely antrorse- or retrorse-scabrous, *adaxial surface* deeply grooved, sparsely hirsute, *A.L.S.O.* of moderately dense somewhat coarse macrohairs and frequent peg-like prickle hairs, the macrohairs mostly antrorse or ascending, 30-320 x 7-21μ diameter at base with a basal collar, the prickle hairs 10-14 x 10-14μ diameter at base, mostly blunt tipped, some pointed, arising perpendicular to the rib surfaces then curving retrorsely or antrorsely, epidermal long cells c. 7μ diameter with sinuous walls. *Panicle* 140-350 x c. 20(100)mm loosely contracted, the base later exserted, the main axis and branches minutely antrorse-scabro-pubescent, the main axis with 5-8 nodes each, with 3-5 slender 2-3-nate branches up to c. 70mm the spikelets mostly towards the ends of the branches on filiform minutely scabro - pubescent pedicels up to 150mm long. *Spikelets* chasmogamous or cleistogamous, very pale green, soon straw coloured, narrow, the glumes diverging at c. 30°. *Glumes* subequal, linear attenuate, hyaline above, the tips delicate and usually torn, chaffy below, minutely hairy between the nerves, minutely scabrous with prickle-hairs on the nerves, *lower glume* 19.5-24.2 mm (when torn 16.5-19.5mm), clearly 3-nerved, *upper glume* 17.5-20.0mm (when torn 14.0-17.5mm), clearly 5-nerved. *Lemma* 9.0-11.4 (-11.8) (including callus tuft and tip) x 0.7-1.2mm wide, firm, narrowly obovate, the margins overlapping, pubescent, very dark greyish brown (Munsell 10YR 3/2), the body beneath the hairs very dark brown (Munsell 10YR 2/2) and densely minutely scabrid in the upper hairless part, minutely pimpled under the hairs to half way down, the hairs c. 0.64 x 0.01mm diameter at base, moderately to very dense, closely appressed to and curving round body at c. 15° to vertical, white (Munsell 10YR 8/2); *callus tuft* including sharp tip 3.2-4.5mm, white (Munsell 10YR 8/1), the *callus scar* 0.60-0.67 x c. 0.13mm wide; *lemma lobes* absent or 0.05-0.17 mm, ciliate, the hairs up to 0.12 (-0.25)mm; *lemma crown hairs* absent, or in two lateral tufts each of 1-6 uneven hairs exceeding awn base by 0.2-0.5mm; *awn twice kneed, shortly plumose to the second knee*, the *column* (30.0-) 32.0-42.5 x 0.27-0.45 (-0.50)mm diameter above articulation and 20.0-30.5mm to first knee, the *column hairs 0.3-1.6mm over the whole length of the column*, the *bristle without long hairs but with minute dense hairs c. 0.1mm* on the bristle-angles. *Palea* (6.1-) 6.3-7.8mm, the tip hyaline, reaching to top of lemma or down to 0.5mm below top of lemma, the margins hyaline, the dorsal surface as hard and hairy as the lemma. *Anthers* equal in length, or 2 larger + 1 smaller, or 2 smaller + 1 larger; in chasmogamous florets the larger 2.9-6.1mm, the smaller 2.6-6.0, or if equal c. 6.0mm; in cleistogamous florets the larger 1.3-1.9mm, the smaller 1.0-1.8mm, or if equal 1.1-2.0mm. *Lodicules* three, the two anterior large, c. 3.0mm, the posterior a delicate membrane c. 1.0mm.

WESTERN AUSTRALIA. - Darling: Bullsbrook, 1930, *Palmer* (K); Swan River, Herb. Hooker 1867 (K); Leederville, 2 sheets, recd. 18.4.1916, *Stoward 935* (K); Kelmescott, Sept 1924, *Carne* (K); Harvey [2 specimens], Oct 1932, *Davies* (K); Araluen, Darling Range, Dec 1951, *Burbridge 13641* (CANB 26696); Three miles W of Mayanup, Sept 1947,

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Burbidge 2551 (CANB 15827); Kojonup, "Glen Lossie", Sept 1947, *Burbidge 2517* (K); Bridgetown to Kojonup and Slab Hut Gully, 1910, *Dorrien Smith* (K).

SOUTH AUSTRALIA. - Southern Lofty: Belair, Oct 1902, *Koch* (K); Aldgate, Nov 1913, *Cleland S.25* (K); Mylor (3 sheets), Nov 1930, *Bailey* (K); Mount Lofty, Dec 1947, *Burbidge* (CANB 16575); Mount Lofty Bot. Garden, c. 12km SE of Adelaide, Dec 1963, *Kuchel 1494* (K); Mount Lofty Range, Sterling West, c. 15km SE of Adelaide, Dec 1960, *Ising* (K. AD); Compass Mt., Oct 1920, *Cleland S4* (K); Kuitpo, Nov 1912, *Cleland* (K426), Nov 1922, (2 sheets), *S18* (K); Basket Range, Nov 1930, *Bailey* (K).

NEW SOUTH WALES. - Central Coast: Bondi, Oct 1912, *Blakely* (K428).

VICTORIA. - Central [Melbourne]: Studley Park, Oct 1958, *Muir 519* (NSW); Colony of Victoria (2 sheets), Sept-Dec 1854, *Harvey* (K); *Muir 1956* (MELB); Ricketts Point, Nov 1935, *Sonenberg* (K). Eastern Coastal Plains: Gippsland, *Campbell* (K).

TASMANIA. - North East: Penquite (SE Launceston), Dec 1845, *Gunn 1480* (K); Port Dalrymple, *Brown 6204* (RM). South East: Dromedary, Jan 1895, *Rodway* (HO); Domain, Nov 1928, *Rodway* (HO); Alluvial gravel bank, roadside opposite Agric. Science Dept. Glasshouse, Univ. of Tasmania, Jan 1970, *Townrow 248* (K); Shallow soil on hill above Derwent Estuary, Jan 1949, *Burbidge 3184* (HO, CANB); Sorell/Orford road, rest area 10km N of Sorell, Jan 1968, *Townrow 166* (HO), Millar's Causeway, 16km N of Orford campsite, Jan 1968, *Townrow 175* (HO).

Distribution: South western and south eastern states of Australia; eastern half of Tasmania.

Ecology: In Tasmania, open areas in woodland and scrub below 300m with annual rainfall below 1140mm.

Notes: 1. It proved possible to make only a superficial study of the lectotype at the British Museum because of the mounting technique employed and the inadequacy of equipment provided for examination of specimens. The whole plant was pasted to the sheet and many diagnostic features were obscured. The specimen drawn in fig. 4 (*Townrow 248* (K, HO)) closely matches the type specimen except that the lemmas are slightly shorter (10.7mm instead of 11.0mm) and the awn column to the first knee measures 1mm less than in the type.

2. Further notes on *S. semibarbata* are included in the discussion on *S. mollis*.

5. *STIPA NERVOSA* var. *NEUTRALIS* Vickery, *Contrib. N.S.W. natl Herb.*, 1(6), p.337 (1950); Townrow, *Pap. Proc. R. Soc. Tasm.*, 104, p.86 (1970).

(Figure 5; Plate 1, figure 5)

Holotype: New South Wales, Katoomba, 22 Dec 1939, *Blake 13915* (NSW 8569).

Perennial, robust, erect, caespitose; culms up to 1.2(-1.8)m high, rigid, stout, up to 4mm in diameter, lightly striate, smooth, glabrous, 3-4-noded, the uppermost node often exerted at flowering; nodes finely retrorse pubescent with a felt of minute white hairs. Leaf sheaths slightly striate, scaberulous in the grooves, glabrous but pubescent round the back of the orifice, the outer margins sometimes ciliate, light green; ligule up to 1.3mm, firm, truncate, minutely ciliate, pubescent on the back, the hairs extending c. 0.3mm beyond marginal cilia; blades up to c. 400 x 3-5mm wide at the base when flattened, involute, with long, tapering, curving tips, dark green, abaxial surface hardly grooved, sparsely recurved-hairy, the hairs c. 0.8mm, adaxial surface deeply grooved, scabro - pubescent, A.L.S.O. coarse, moderately dense ± ascending macrohairs and frequent to abundant slightly antrorse prickly hair hooks, the macrohairs 70-450 (-600) x 14-28 (-40)µ diameter at base, finely tapering with swollen often humped bases bending at about 45° to ribs, and basal collars, the prickly hair hooks 20-40 x 14-21µ diameter at base, epidermal long cells 35-70 x 10-15µ wide with "wither basket" appearance. Panicle 200-400mm, very lax,

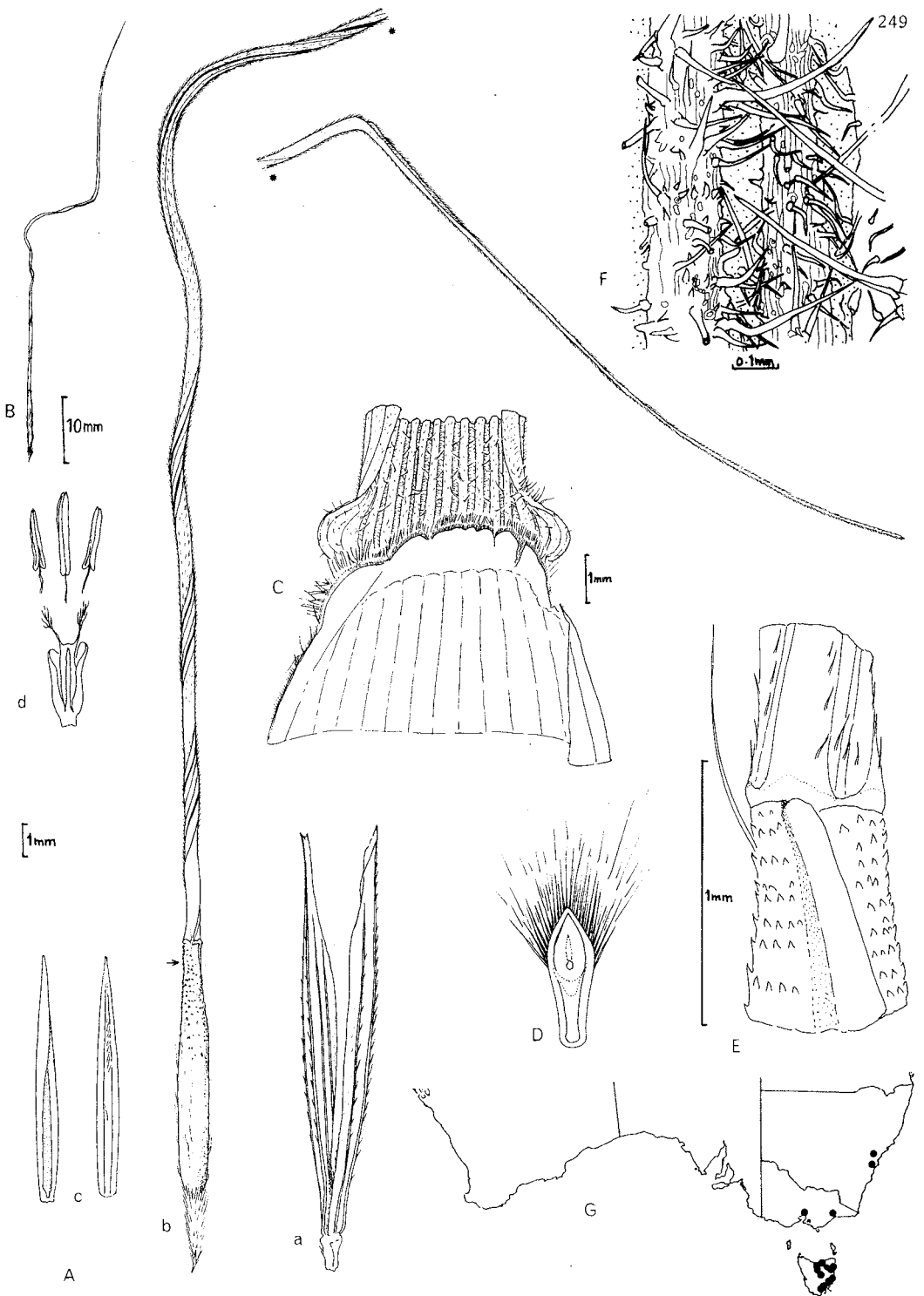


FIG. 5. - *Stipa nervosa* var. *neutralis* Vickery, "Burbidge 2935" (K) (matched with type specimen). Explanation as for figure 1 (p.236) except: C. Ligule (blade 3 from culm base). F. Tracing of micrograph of part of area shown in Plate 1, fig. 5.

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spreading, loosely contracted when dry, the base included in uppermost sheath in early stages of flowering but later exerted, the main rachis slightly scabrous, with very slender branches arising from 4-5 nodes, the branches several times divided with spikelets mostly towards the ends of the branchlets, the pedicels 2-15mm. *Spikelets* chasmogamous and/or cleistogamous in the same inflorescence, pale green to maroon below and straw coloured above, with somewhat divergent glumes. *Glumes* thin, chaffy, with hyaline, usually torn tips, narrow, linear attenuate, the lateral nerves as strong as the mid nerves, nerves minutely scabrid on backs, *lower glume* 11.1-13.0+ (when torn 10.0-13.0)mm, conspicuously 3-nerved, *upper glume* 10.0-13.0+ (when torn 8.5-13.1)mm, conspicuously 5-nerved. *Lemma* 8.1-11.0 (including callus and tip) x 0.7-1.1mm wide, firm, linear, the body reddish brown to very dusky red at maturity (Munse11 5YR 4/4 to 2.5YR 2/2) with sparse vertically appressed hairs on lower three quarters of length, the hairs in chasmogamous florets white (Munse11 2.5Y 8/0), and in cleistogamous florets yellow (fulvous) (Munse11 2.5Y 8/6), c. 0.7 x 0.02mm diameter at base, lemma margins overlapping, upper one quarter of surface (above the hairs) minutely hooked, lower three quarters papillose beneath hairs, the papillae diminishing towards the callus tuft; *callus tuft* including sharp tip (2.1-) 2.3-3.0mm, yellow (Munse11 2.5Y 8/4 - 8/6), the *callus scar* 0.50-0.62 x c. 0.18mm wide; *lemma lobes* absent; *lemma crown hairs* absent; *awn* twice kneed, moderately densely minutely hairy over entire length, the hairs on the column c. 0.12mm at c. 25° to awn surface, the *column* 30.0-46.0 x 0.37-0.46mm diameter above articulation (which is itself c. 0.51mm diameter) and 20.0-36.0mm to first knee. *Palea* 6.0-8.0 (-8.3)mm, the tip hyaline reaching to c. 0.5 mm below top of lemma, slightly less horny than lemma, dorsal surface with very few minute hairs above between the nerves. *Anthers* usually 1 larger plus 2 smaller, rarely equal; in chasmogamous florets the larger (1.1-) 2.2-5.6mm, the smaller (0.9-) 1.5-5.3mm, in cleistogamous florets the larger 1.1-2.2mm, the smaller 0.6-1.7mm. *Lodicules* three, c. 2.0mm, the two anterior swollen and the posterior very thin, delicate and hyaline.

QUEENSLAND. - Darling Downs: Grazing bush, Bedford's place nr. Wyberba, Nov 1944, *Clemens 44760* (K); Wyberba, 2500-3000ft, among acid rocks in mixed open forest, Jan 1933, *Blake 4638* (K).

NEW SOUTH WALES. - Central Tablelands: Katoomba, Dec 1939, *Blake 13915* NSW 8569). Central Coast: Milperra, Georges R., Sheet 2, Oct 1930, *Vickery* (K). South Coast: Ulladulla, 67km S of Nowra, Dec 1932, *Rodway* (K, NSW 1005).

VICTORIA. - Eastern Highlands: Christmas Hills, 40km NE of Melbourne, *Aston* (MEL). Eastern Coastal Plains: Orbost, ex herbarium Beauglehole 7955, Nov 1937 *Robbins* (NSW).

TASMANIA. - North: Devonport, Feb 1948, *Curtis 131* (K); Roadside 10km E of Launceston, Jan 1949, *Burbidge Herb. Austral. 2935* (K.CANB.HO.); Roadside 1km E of O'Connors Peak/Campbelltown road junction, Dec 1967, *Townrow 124* (HO); Evandale, beside South Esk bridge, Dec 1967, *Townrow 114* (HO). Central Plateau: Near Derwent Bridge (Bronte), Jan 1949, *Burbidge 3390* (CANB). South East: Dromedary, Jan 1895, *Rodway* (HO); Domain, roadside parallel to Brooker Highway, Oct 1966, *Townrow 3* (HO); Kingston, Junction of main road with Lesleyvale road, Jan 1968, *Townrow 165* (HO), Feb 1932, Sheets 1, 2 and 3, *White 8336* (K); N Bruny Is, Dennes Point road, second steep corner opposite Iron Pot (facing N), Jan 1968, *Townrow 137* (HO), Roadside N side of Bull Bay, Dennes Point road, Dec 1966, *18a* (HO), Roadside, steep corner 1km S of Quarantine Station, Jan 1968, *181* (HO); Barnes Bay, Mar 1967, *Townrow 19* (HO); Roadside, Great Bay, Jan 1970, *Townrow 245* (K). East: Lindisfarne/Risdon Road, dry hillside above Bus Stop 18, Dec 1967, *Townrow 91* (HO); Richmond/Cambridge road, roadside 5km S of Richmond, Nov 1967, *Townrow 76* (HO); Pittwater, Jan 1926, *Black 1193* (K); Dunalley/Copping roadside, 5km W of Dunalley Bridge, Dec 1967, *Townrow 104* (HO), 1.5km W of Dunalley Bridge, Dec 1967, *Townrow 103* (HO); East Coast, in dry bush between Cape Bernier and Cockle Bay, Jan 1945, *Curtis 18A* (K). North East: Fingal Valley, about 2km E of Tullochgorum, roadside, Feb 1968, *Townrow 196* (HO); Mathinna, c. 270m, Jan 1962, *Phillips and Vickery* (CBG 001268); 3km E of Mathinna, roadside, Feb 1968, *Townrow 197* (HO).

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Distribution: Central and Southern Victoria, eastern half of Tasmania.

Ecology: In Tasmania, roadsides in cleared areas near the east coast between altitudes of 30-180m with annual rainfall below 1140mm.

Notes: 1. *S. nervosa* var. *neutralis* has been confused with *S. pubinodis* (fig. 6) (wrongly identified as *S. pubescens* R.Br.) in Tasmania, and with *S. pubescens* (Appendix 3B; Plate 2, fig.B) on the Australian mainland. It may be most easily distinguished from these species by means of its ligule, and the very characteristic A.L.S.O. of coarse swollen-based hairs, teeth and hooks, which differs markedly from the dense fine hairs of *S. pubinodis* and the very fine teeth of *S. pubescens*.

2. Evidence exists of association between fulvous lemma hair colour and cleistogamy. Chasmogamous florets appear to retain the white lemma hair colouration typical of the early flowering stages whereas cleistogamous florets may be white or fulvous haired, e.g. *Townrow 18a* has both cleistogamous (fulvous-haired) and chasmogamous (white haired) florets; *Townrow 181* has only cleistogamous florets, some white haired (lower down the inflorescence, so younger) and some fulvous haired; *Townrow 19* and *137*, both cleistogamous with white lemma hairs, might have been expected to develop fulvous colouration as the caryopsis developed to full size (c. 5.5mm). An alternative possibility is that the development of fulvous colouration is associated with a *fully developed* caryopsis whether the floret be chasmogamous or cleistogamous. Chasmogamous material with fully developed caryopses has yet to be collected.

6. *STIPA PUBINODIS* Trinius and Ruprecht, *Mém. Acad. Sci. St. Petersb.* sér. 6, *Sci. Nat.* 5 (1), p.50 (1843) preprinted as *Species Graminum Stipaceorum* (*Gramina Agrostidea*. III. *Callus obconicus* (*Stipacea*), etc.) Petropoli (1842); Hughes, *Kew Bull.*, 1921. p. 28 (1921); Townrow, *Pap. Proc. R. Soc. Tasm.*, 104, p. 86 (1970) (as "*S. pubescens*").
(Figure 6; Plate 1, figure 6)

Holotype: Terra Van Dieman labelled "V.D.L.11" (LE).

Short-lived perennial, caespitose in open habitats, less robust in shaded places; culms up to c. 1.1m, up to 4mm diameter at base, rigid, terete, 3-(5) noded; exserted upper nodes, minutely velvety retrorse pubescent towards the inflorescence, otherwise smooth. Leaf sheaths finely striate, densely minutely retrorse-pubescent on the striae towards the nodes, ± smooth above, outer sheath margins minutely ciliate or smooth, upper sheaths shortly bearded in the auricle position and round the collar; ligule, lower ligules 1.5-2.0(-4.0)mm, firm, rotund-obtuse, sometimes lopsided, very minutely hairy on the backs, upper ligules shorter, truncate, with hairy backs and margins, the hairs c. 0.07mm; blades 150-500 x 1.0-2.5mm wide at the base when flattened, convolute, filiform, fairly stiff, dark green, somewhat silvery below, abaxial surface hardly grooved, the lower blades and innovations moderately densely antrorse- (rarely retrorse) hairy, the hairs up to c. 0.2 x 0.02mm diameter at base, the upper blades smooth, adaxial surface deeply grooved, moderately densely minutely shaggy-pubescent, A.L.S.O. of moderately dense, strongly antrorse-ascending, finely tapering macrohairs and frequent prickly hairs, the macrohairs on the lower blades 70-280 x 10-15µ diameter at base, becoming shorter and finer on successive blades up the culm, the prickly hairs 20-43 x 10µ diameter at base, antrorse on the outer rib surfaces, vertical on the surfaces between the ribs, some straight-sided, some slightly antrorse-ly curved, epidermal long cells 35-57 x 10-15µ wide with "withy basket" appearance. Panicle 150-260mm, slightly contracted, the base long exserted from uppermost sheath at flowering, the main rachis with up to 6 minutely bearded nodes, the lower nodes c. 40mm apart with 6-10 slightly scabrid 1-2(-3)-nate slender branches up to 6.0(7.5)cm each bearing 3-4(-5) spikelets towards the ends on filiform minutely scabro-pubescent pedicels 3-20mm long. Spikelets chasmogamous or cleistogamous, very pale green, soon straw coloured, narrow, the glumes not widely divergent. Glumes unequal, chaffy below, hyaline above, the tips delicate and usually torn, very minutely sparsely hairy between

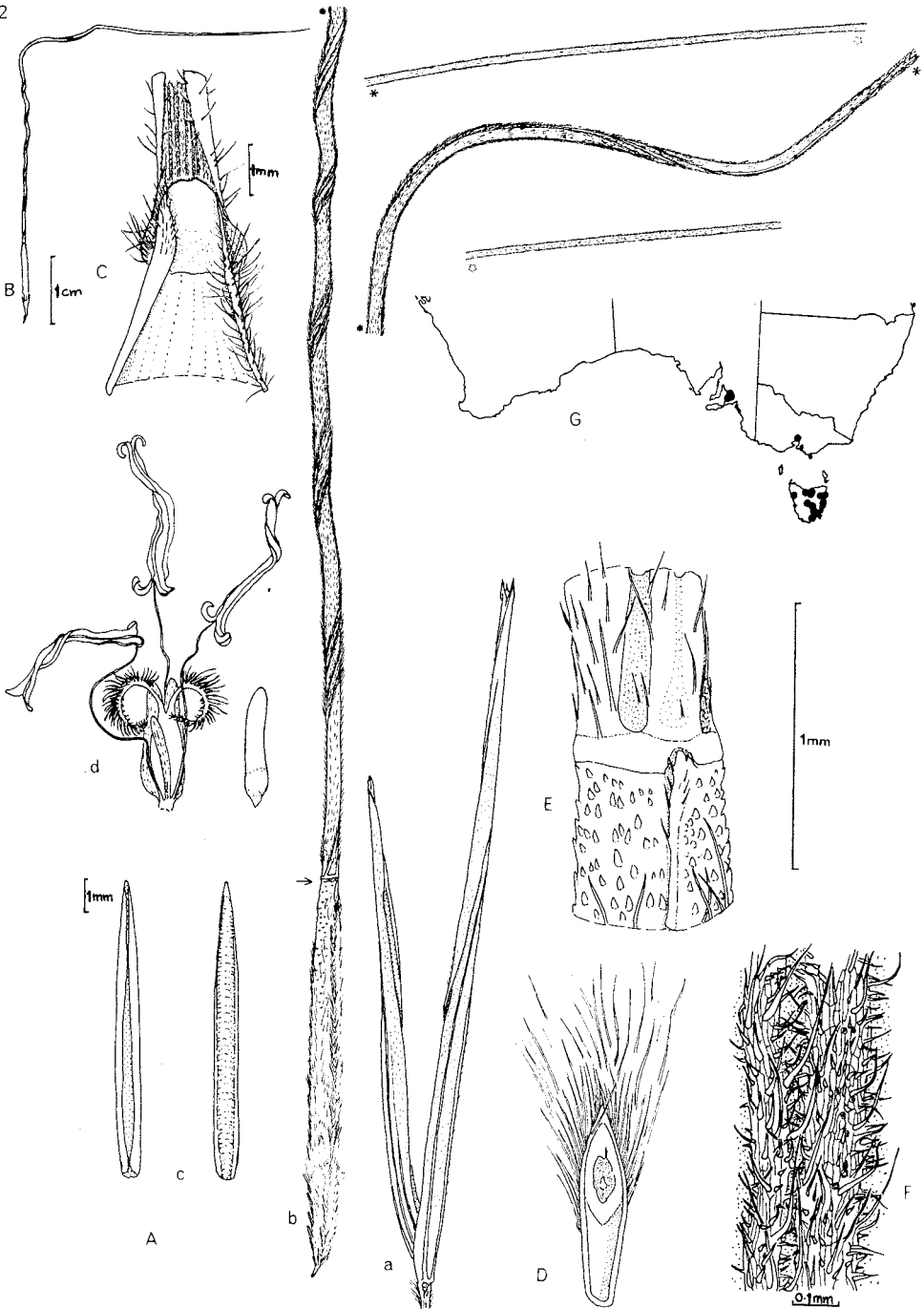


FIG. 6. - *Stipa pubinodis* Trinius and Ruprecht, '1. "Gunn 588" (K) (type specimen). '2. "Townrow 247" (HO) (matched with type specimen). '3. "Flowering specimen cultivated at University of Tasmania, Oct. 1970 (matched with type specimen). Spikelet characters:- A. a. glumes (specimen '1.); b. lemma (specimen '2.); d. lodicules, anthers, ovary (specimen '3.)x 5. B. Lemma x1 (Specimen '1.) D. Callus scar x40 (Specimen '1.). E. Lemma lobes x40 (Specimen '1.) Leaf characters:- C. Ligule (blade 2 from culm base x7.5 (Specimen '1.). F. A.L.S.O. x c.80 (tracing of micrograph of part of area shown in Plate 1, fig. 6). G. Species distribution (Cited specimens) H. Longitudinal section of embryo (specimen '3, 1976).

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the nerves, *lower glume* 20.0-25.0mm (when torn 15.0-23.0mm), clearly 3-nerved, *upper glume* 16.0-20.9+mm (when torn 14.0-20.9mm) clearly 5-nerved. *Lemma* 11.0-13.0 (including callus tuft and tip) x 0.7-1.1mm wide, firm, linear, the margins overlapping, densely hairy below and sparsely hairy above, dark yellowish brown (Munsell 10YR 3/4), the body dark reddish brown (Munsell 5YR 2/2) and minutely dentate over the upper one third, the barbs c. 0.03mm moderately dense and irregularly spaced, the hairs c. 0.90 x 0.02mm diameter at base, vertically appressed, white becoming reddish yellow (Munsell 7.5YR 6/8); *callus tuft* including sharp tip 3.5-4.6mm, reddish yellow to strong brown (Munsell 7.5YR 6/8-5/8), the *callus scar* (0.57-)0.62-0.74 x c. 0.15mm wide; *lemma lobes* absent, or rarely present, 0.20-0.45mm; *lemma crown hairs* absent, rarely up to 3 hairs on one side of lemma margin exceeding awn base by 0.37-0.40mm; *awn* twice kneed, *stout, very minutely densely pubescent*, the *column* 35.0-54.0(-57.0) x 0.45-0.50mm diameter above articulation and (25.0-)26.0-37.0(-41.0)mm to first knee, the column hairs 0.26 x 0.02mm diameter, moderately dense below, very dense above, the bristle with eight rows of lemma 0.1mm long. *Palea* (6.8-)7.2-8.0(-8.8)mm, the tip and margins hyaline, *reaching to c. 0.4mm below top of lemma*, and dorsal surface horny and completely hairless. *Anthers* usually 1 larger + 2 smaller, sometimes equal in chasmogamous florets, bright yellow; in chasmogamous florets the larger 5.4-6.6mm, the smaller 5.3-5.6mm, when equal 2.3-4.8mm; in cleistogamous florets the larger 1.2-1.3mm, the smaller 1.0-1.3mm. *Lodicules* three, the two anterior c. 3.0mm swollen, the posterior c. 2mm, thin and delicate.

SOUTH AUSTRALIA. - Southern Lofty: Mount Lofty, Nov 1924, *Ising* (K); Dec 1954, *Hilton 1170* (ADW); Euchunga near Kinchina, Sept 1922, *Cleland S16* (K).

VICTORIA. - Central [Melbourne]: Ringwood, Sheet 1, Oct 1891, *Morrison* (K), Oct 1934, comm. *Sonenberg* (K), Dec 1929, Sheets 1 and 2, *Sonenberg* (K); Without definite locality: May 1899, *Williamson 692* (MEL).

TASMANIA. - West: Pieman River bridge, cliffs, Jan 1937, *Davis and Davis 10578* (NSW). North: Latrobe River, 1854, *Mueller* (K, BM). Central Plateau floristic zone: Mount Field National Park road, banks of Tyenna River, Dec 1967, *Townrow* (HO). South East: New Norfolk, 2 sheets, Nov 1840, *Gunn 996* (K, HO); Goat Hill, Dec 1946, *Curtis 120* (K); Middle slopes of Mt. Wellington, Jan 1949, *Burbidge 25116* (CANB, HO), Jan 1949, ? *3189* (K); Near Longley, Jan 1962, *Phillips and Vickery* (CBG); Hobart, Domain, Beside recreation ground above Brooker Highway, Oct 1966, *Townrow 1* (HO), On NNE side of T.C.A. Ground, Nov 1967, *39* (HO), Oct 1968, *205* (HO), Nov 1928, 2 sheets, *Rodway* (HO); Jan 1930, *Rodway* (HO); University of Tasmania, Bank by Agric. Science Glasshouse, Nov 1967, *Townrow 79* (HO), Sir John Fisher College, cliff above road, Dec 1967, *80* (HO); Mount Nelson, Jan 1947, *Curtis 124* (K); Taroon, Quarantine Station, cliff top outside fence, Nov 1966, *Townrow 5a* (HO); Kingston Beach, Nov 1935, *Rodway 10577* (NSW); Channel Highway opposite Alannah, Jan 1967, *Townrow 27* (HO); North Bruny Island, Roadside near Quarantine Station entrance, Jan 1968, *Townrow 146* (HO), Dennes Point/Barnes Bay road, second steep corner travelling N (opposite the "Iron Pot"), Jan 1968, *138* (HO), Roadside, Ferry/Barnes Bay signpost, Dennes Point road, Jan 1968, *135* (HO), Great Bay, Jan 1970, *247* (K). North East: Roadside E of Launceston, Jan 1949, *Burbidge 2945* (K); Waterhouse Estate (W of Tomahawk), by shelter but on reclaimed dunes, Dec 1967, *Townrow 111* (HO); Roadside 6km NW of St. Helens on Goshen road, Jan 1968, *Townrow 193* (HO); Ansons Bay road, 10km N of Priory, Jan 1968, *Townrow 191* (HO). East: Roadside, Midland Highway, 2km SE of Powranna, Dec 1967, *Townrow 130* (HO); South Arm, Goat Bluff, roadside opposite small lagoon, Nov 1967, *Townrow 58* (HO); East Coast Highway, Sloping roadside opposite quarry 3km N of Sorell, Nov 1967, *Townrow 60* (HO), Roadside in open eucalypt woodland 6km W of Runnymede Post Office, Nov 1967, *62* (HO), Roadside 8km E of Buckland Post Office, Nov 1967, *67* (HO), Roadside beside tall sclerophyll at Coles Bay turnoff, Jan 1968, *178* (HO), Roadside by Millars Causeway, 8km N of Triabunna, Jan 1968, *176* (HO), Roadside 100m S of Raspin's Creek, 5km N of Triabunna, Jan 1968, *173* (HO); Between Cape Bernier and Cockle Bay, Jan 1945, *Curtis 18B* (K); Tasman Highway, Copping, Jan 1949, *Vickery* (NSW), Jan 1949, *Blake 18278* (K), Roadside by Carlton River Bridge, SE of Copping, Dec 1967, *Townrow 107* (HO), Rough ground on W side of Dunalley Bridge, Dec 1967, *Townrow 102* (HO), Roadside near Dunalley,

Revised Taxonomy of *Stipa* in Tasmania

Nov 1959, *Curtis* (HO), Eaglehawk Neck, Jan 1949, *Vickery 8565* (NSW), Eaglehawk Neck, Feb 1947, *Curtis 129* (K). Without definite locality: *Gunn 588* (K); *Archer* (HO).

Distribution: Vicinities of Adelaide in South Australia and Melbourne in Victoria, widespread in eastern Tasmania.

Ecology: In Tasmania, woodland scrub and heath and roadsides in flatter areas at altitudes mostly below 270m, rarely above 700m.

Notes: 1. *S. pubinodis* has been much confused with *S. pubescens* R. Br. of New South Wales and Southern Queensland (Appendix 3B). Hooker (1856) included *S. pubinodis* with *S. pubescens* R. Brown (1810) and cited the Tasmanian specimens *Gunn 588*, *966* and *1453*. Hughes (1921) regarded *S. pubinodis* as a dubious species closely allied to *S. pubescens* stating that the Tasmanian specimens *Gunn 588* and *996*, Mount Direction *Gunn*, Latrobe *Mueller*, Port Dalrymple *Paterson* and Van Diemens Land *Llotsky* all agree with the type of *S. pubescens* (*Brown 6203*). Hubbard, in a note dated July 1939, on the sheet *S. pubinodis* *Gunn 588* (fig. 6, specimen '1) affirmed that the specimen "represents the same species as the type of *S. pubinodis* Trin. and Rupr. (V.D.L. 11) in Leningrad Herbarium", which however he identified as *S. pubescens*. Morris in a further note on the sheet *Gunn 588* commented that "I have studied this mountain form. The outer glumes are softer and more hyaline when growing on the lee sides of forest clearings".

Reexamination of *Gunn 588* and the type of *S. pubescens* (*Brown 6203*) showed differences in several characters (Appendix 3B) the most striking dissimilarities being between the paleas, the ligules and the A.L.S.O. In *S. pubinodis* the palea is horny-backed with an acute tip and equal to the lemma in length, the lower ligules especially are hard, rotund-obtuse and up to 4mm long, and the A.L.S.O. is of moderately dense antrorse *macrohairs*, whereas in *S. pubescens* the palea is a delicate hyaline blunt-tipped membrane only about three-quarters the length of the lemma, the ligules are crose membranes c. 0.5mm long, and the A.L.S.O. is of dense antrorse *prickle hair hooks*.

Hubbard, after further examination in August 1970 of the ligule and spikelet characters of the Leningrad type-specimen of *S. pubinodis*, and of the A.L.S.O. of a gathering made by *Gunn* in Tasmania representing the same species as the type, confirmed my observations. In his report (*pers. comm.*) Hubbard noted that it was not possible to determine who wrote the label "V.D.L.11" which appears on the type sheet but that a small slip with drawings in ink of the spikelet and its parts attached to the type-sheet is labelled in Trinius's hand "Stipa pubinodis m". He noted that there seems little doubt that the Tasmanian specimens, including the specimen subsequently designated by Trinius to *S. pubinodis*, sent to Trinius by Sir W.J. Hooker, were duplicates from Ronald *Gunn*'s extensive collections. He also stated that the type [of *S. pubinodis*] is very similar to specimens gathered by *Gunn*, no. 966, at New Norfolk, Tasmania in November 1840 and on Mt. Direction, Tasmania in December 1841, and represents the same species. He agreed that this material, included in *Stipa pubescens* by Hughes and by Hooker, may be distinct as I suggest.

Gunn 588 and *Gunn 996* are correctly identified as *S. pubinodis* and the Tasmanian populations belong to this species and not to *S. pubescens* (as formerly stated by Townrow 1970, p.84).

Of the other specimens cited by Hooker and/or Hughes Latrobe River, 1854, *Mueller* (K.BM) belongs to *S. pubinodis*; New Norfolk, 15.11.1840, *Gunn 996* (K) and New Holland, *Llotsky* (K) vary from the type of *S. pubinodis* in having sparse closely adpressed hairs c. 0.5mm long on the awn columns; *Gunn 1453* (K) and Van Diemens Land, *Llotsky* (K) are both immature specimens of *Stipa stuposus* Hughes having the A.L.S.O. and lemma crown hairs characteristic of that species; I have not seen Mount Direction, *Gunn* or Port Dalrymple, *Paterson*.

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2. Complete discontinuity between *S. pubinodis* and *S. pubescens* cannot confidently be claimed as a number of specimens (New South Wales, Blackheath, Jan 1950, *Constable* (K); Brisbane River, May 1827, *Cunningham* (K)) have intermediate lemma and A.L.S.O. characters.

7. *STIPA BIGENICULATA* Hughes, *Kew Bull.*, 1922, p. 20 (1922); Burbidge and Gray, *Fl. A.C.T.*, p. 52 (1970); Burbidge, *Austral. Grasses*, 1, p. 70 (1966).

(Figure 7; Plate 1, figure 7)

Holotype: New South Wales, Cooma, Jan 1887, *Baker* (US).

Perennial, densely caespitose; culms up to 0.5m, erect, terete, 2-4 noded, the nodes exerted; nodes densely retrorse-pubescent with a felt of minute white hairs. Leaf sheaths 15-30mm, finely striate, pale green, the lower sheaths lightly retrorse-pubescent, the hairs up to 1mm, fine and silky, the upper sheaths glabrous; ligule up to 0.5mm, minutely ciliate, with sparse fine tufts of silky hairs up to 3mm on either side in position of auricles; blades up to 450 x 2mm wide at base when flattened, setaceo-convolute, somewhat pungent pointed, abaxial surface lightly grooved, lower blades moderately densely antrorse-scabrous, the hairs to 0.5mm, upper blades smooth, adaxial surface deeply grooved, hairless, A.L.S.O. of abundant, mostly antrorse, some retrorse, oval-based prickle hair hooks 20-35 x 15µ diameter at base, the hooks in regular rows alternating with several silica bodies and short cells within the rows, epidermal long cells c. 70 x 10µ wide. Panicle up to 250 x 30mm wide, the base long exerted from uppermost sheath, slightly contracted, the main rachis slightly scabrous with up to 7 nodes, the lower nodes up to c. 60mm apart with 2-4 slightly scabrid 1-3-nate slender branches up to 60mm each bearing 1-10 spikelets on slender minutely scabrous pedicels up to 1 cm long. Spikelets chasmogamous or cleistogamous, yellowish-green soon straw coloured, the glumes somewhat spreading. Glumes unequal, chaffy below with delicate often torn tips, lower glume 15.0-20.5mm (when torn 15.0-17.0mm), 3-nerved, glabrous, upper glume 13.0-14.0+mm (when torn (8.9-)10.0-14.0mm), 5-nerved, very minutely hairy between the nerves in the upper quarter, otherwise glabrous. Lemma (7.3-)7.8-10.5 (including callus tuft and tip) x 0.7-1.2mm wide, firm, narrowly obovate, the margins meeting, velvety, hairy, reddish-yellow (Munsel 7.5YR 6/6), the body beneath the hairs slightly darker (7.5YR 7/6) and minutely scabrid in the neck region, the hairs c. 0.63 x 0.01mm diameter at base, at an acute angle to the body, forming a dense pinkish-white felt (Munsel 7.5YR 8/2); callus tuft including sharp tip 2.7-3.8mm, pinkish-white (Munsel 7.5YR 8/2), the callus scar 0.55-0.70 x c. 0.15 mm wide; lemma lobes absent or 0.02-0.07 (-0.37)mm, obtuse, minutely ciliate, the cilia 0.05-0.07mm, lemma crown hairs (2.2-)2.4-4.4mm of c. 20 hairs; awn twice kneed, very minutely hairy to the tip of the bristle, the hairs c. 0.22 mm, erect and closely adpressed, the column 20.0-25.0 x 0.30-0.37mm diameter above articulation and 12.0-18.0 mm to first knee. Palea (4.8-)5.0-7.0(-7.4)mm, the tip delicate and level with the top of the lemma, thinner than the lemma, very minutely hairy between the two faint dorsal nerves. Anthers usually 1 larger and 2 smaller, rarely equal; in chasmogamous florets the larger 3.4-4.4mm, the smaller 3.3-3.6mm; in cleistogamous florets the larger 1.0-2.8mm, the smaller 0.8-2.5mm. Lodicules two large anterior c. 2.4mm and one small posterior c. 1.4mm.

SOUTH AUSTRALIA. - Southern Lofty: Adelaide, Oct 1928, *Cleland* (AD96323194); Beaumont, Oct 1926, *Cleland* (K); Belair, Oct 1935, *Eardley*.

NEW SOUTH WALES. - Southern Tablelands: Cooma (K462); Canberra Cambage 3069 (K); Jan 1948, *Thomas* (K); Black Mountain, lower E slopes, Dec 1962, *Pullen 3735* (K); Black Mountain, lower E slopes, C.S.I.R.O. grounds, Nov 1968, *Pullen 3955* (K).

VICTORIA. - Central [Melbourne]: St. Albans, Feb 1932, *Sonenberg* (K); St. Albans, Nov 1929 (2 sheets), *Patton* (K).

TASMANIA. - South East: Queens Domain, Dec 1943, *Curtis 126* (K); North Bruny Island, Bull Bay, S end, Jan 1968, *Townrow 162* (HO). East: Hobart, Eastern Shore near Bowen Park, roadside 1km N of Old Beach turnoff, Dec 1967, *Townrow 96* (HO); Evandale, by South Esk Bridge, Dec 1967, *Townrow 115* (HO).

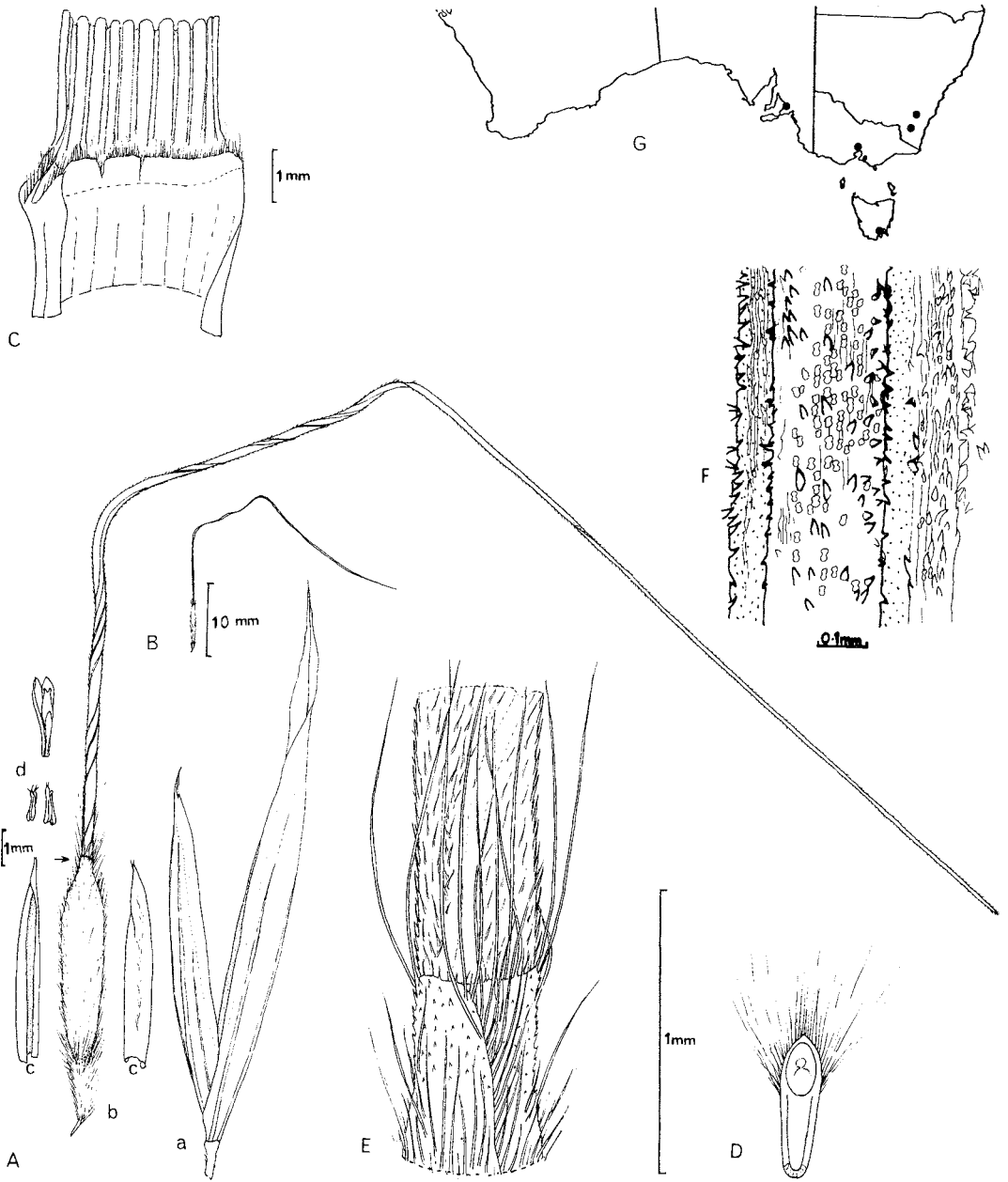


FIG. 7. - *Stipa bigeniculata* Hughes, Jan. 1948 "Thomas" (K) (matched with type specimen). Explanation as for figure 1 (p.236) except: C. Ligule (2nd of 3 culm blades). F. Tracing of micrograph of part of area shown in Plate 1, fig. 7.

Distribution: South eastern Australia in vicinities of Adelaide Canberra and Melbourne; southern New South Wales; Tasmania.

Notes: 1. *S. bigeniculata* in Tasmania may have been confused with the abundant and probably related *S. stuposa* (fig. 9) which also has a hair tuft round the awn base. It differs from *S. stuposa* in its shorter, reddish-yellow lemma body, the more minute hairiness of its awn, and in its A.L.S.O. (compare fig. 7 with fig. 9).

2. *S. bigeniculata* may be distinguished from *S. flavescens* by the A.L.S.O., the almost hairless palea, and the stouter, less twisted awn column, and in mature specimens the lemma colour (compare fig. 7 with fig. 2).

3. Suspected *S. stuposa*/*S. flavescens* hybrids are very similar to *S. bigeniculata* but have a coarser A.L.S.O. of prickle hair hooks 0.05mm long instead of 0.025mm long.

4. On the basis of both lemma characters and A.L.S.O., *S. bigeniculata* has most morphological resemblances to *S. aristiglumis* Muell., which has not been recorded in Tasmania.

8. *STIPA CLELANDII* Summerhayes and Hubbard, *Kew Bull.*, 1927, p. 362.

(Figure 8; Plate 1, figure 8)

Holotype: South Australia, Kinchina, Nov 1924, *Cleland S40* (K).

Caespitose perennial; culms c. 1m, moderately slender, unbranched, firm, terete, glabrous, smooth, 4-noded; nodes and just below nodes retrorse short-white-silky hairy. Leaf sheaths close, shorter than internodes, lower sheaths rough with short stiff hairs, upper sheaths hairless, smooth, sheaths ciliate, collar region with white hairs; ligule 0.5-1.0mm, truncate, ciliate, the cilia c. 0.2mm; blades 110-360 x 3-3.5mm wide at the base when flattened, involute narrow-linear, with long fine tip, firm, rigid, slightly rough to touch, abaxial surface setoso-pillose becoming smooth, adaxial surface shortly densely pubescent, A.L.S.O. of moderately dense macrohairs and very few prickle hair hooks, the macrohairs (35-)70-210 x c.15 μ diameter at base, with collar and \pm swollen bases, slightly tangled, springing \pm at right angles to the ribs then sharply bending, mostly retrorse over the spaces between the ribs, the antrorse hooks 20-30 x c. 10 μ diameter at base, epidermal long cells obscured by wax platelets. Panicle 200-250 x 15-35mm wide, sub-dense, the rachis terete, slightly striate, scabrous, lower nodes silky-hairy, branches \pm erect, up to 6cm, c. 4-nate, slender rough to touch. Spikelets chasmogamous, moderately turgid, pale straw coloured or purplish. Glumes unequal with delicate often torn tips, lower glume 16.0-20.0mm, thinly papery, narrow lanceolate, clearly 3-nerved, minutely scabrous on the mid-nerve otherwise smooth, glabrous, upper glume 12.0-16.0mm, narrow lanceolate-oblong, 5-nerved, minutely densely scabrid between the nerves, the nerves scabrous on the backs. Lemma 7.0-8.0 (including callus tuft and tip) x c. 1.2mm wide, cylindrical, moderately turgid, the margins overlapping, pubescent, yellowish brown (Munsell 10YR 5/4), the body beneath the hairs reddish-brown (Munsell 5YR 2/2) and minutely pimpled (the pimples c. 0.05mm diameter) over the upper 1/7, the hairs c. 1.1 x 0.02mm diameter at base, very dense, twisting clockwise round the back of the lemma at c. 45°, pale yellow (Munsell 2.5Y 7/4); callus tuft including sharp tip 2.5-3.6mm, very pale brown (Munsell 10YR 7/4), the callus scar 0.62-0.70 x c. 0.12mm wide; lemma lobes absent, a few cilia c. 0.5mm on free edge of lemma in lobe position; lemma crown hairs 2.5-5.0 mm, dense, the hairs uneven, long at sides, short at back; awn bigeniculate, addressed sparsely-densely pubescent, the column 18.0-21.0 x 0.35-0.37mm diameter above articulation and 9.0-10.0mm to first knee, the column hairs of two lengths c. 0.25mm and c. 0.12mm, the shorter hairs also along the bristle-angles. Palea 5.0-6.2mm, equalling lemma in length, slightly thinner in texture than lemma, tip firm membranous, densely pillose on the back like the lemma. Anthers c. 1.0mm. Lodicules three \pm equally developed, two of them c. 2.25mm, the other c. 1.75mm.

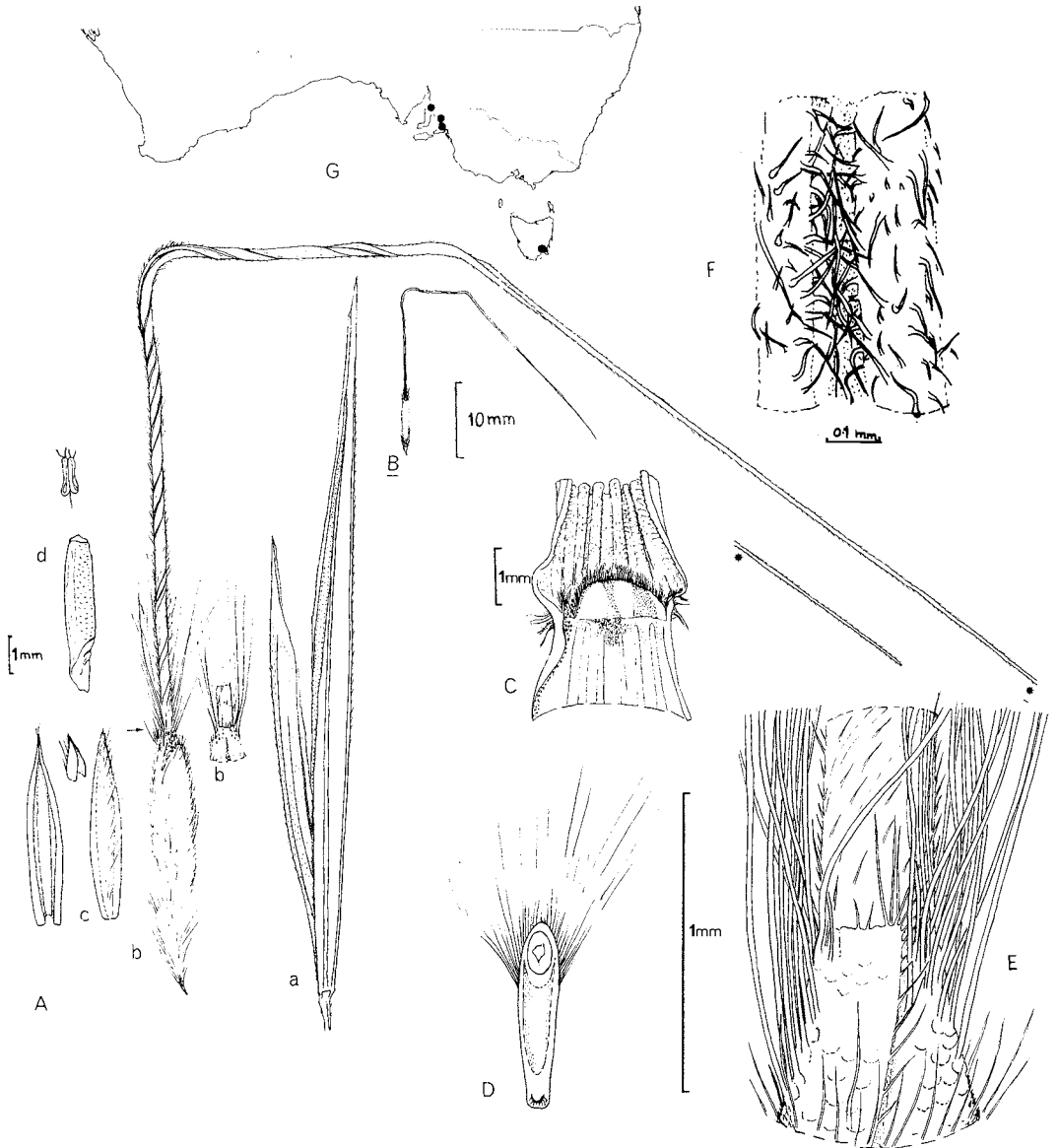


FIG. 8. - *Stipa clelandii* Summerhayes and Hubbard, "Sheet 2, Cleland S.40" (K) (type specimen). Explanation as for figure 1 (p.236) except: C. Ligule (blade 2 from culm base). F. Tracing of micrograph of part of area shown in Plate 1, fig. 8.

SOUTH AUSTRALIA. - Southern Lofty: Kinchina, Nov 1924, (2 sheets), *Cleland S40* (K).
 TASMANIA. - East: Richmond, Oct 1966, Comm. *Morris* (HO).

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Notes: On the basis of spikelet characters and A.L.S.O., this apparently rare species has phenetic relationships with the mainland species *S. blackii* Hub. and the Tasmanian species *S. stuposa* Hughes, occupying a median position between them (see Appendix 2C; Appendix 3C; fig. 8; fig. 9).

9. *STIPA STUPOSA* Hughes, *Kew Bull.*, 1921, p.20 (1921); Townrow, *Pap. Proc. R. Soc. Tasm.*, 104, p.86 (1970).

(Figure 9; Plate 2, figure 9)

Holotype: Tasmania, New Norfolk, Jan 1840, *Gunn 1480* (K).

Short-lived perennial, caespitose, culms 0.8-1.4m, up to 3.5mm diameter at base, erect or geniculate, 3-5 noded; nodes exserted, nodes and upper parts of internodes minutely densely retrorse-pubescent, the hairs c. 0.3mm, white. Leaf sheaths lightly striate, the lower sheaths moderately pubescent with spreading hairs c. 0.5mm, outer sheath margins ± ciliate at least below, orifice and collar bearded with fine white hairs up to 1mm, finally breaking down into long twisted fibres; ligules c. 0.2mm, truncate, ciliate, the hairs c. 0.3mm, minutely hairy on the back; blades 190-300 x up to 5.0mm wide at the base when flattened, linear, convolute, tapering with long drawn out tips, stiff and harsh, silvery green, abaxial surface lightly striate, ± minutely hoary with stout swollen-based macrohairs c. 0.8 x 0.05mm diameter at base and retrorse prickly hairs c. 0.08 x 0.01mm diameter at base between the veins, adaxial surface deeply grooved, sparsely shaggy-pubescent, A.L.S.O. of macrohairs and prickly hairs, the macrohairs 100-450 x 15-20µ diameter at base, and moderately dense on the lower blades, becoming shorter and sparser on higher blades, kneed, both antrorse and retrorse, tapering finely from somewhat swollen bases, the prickly hairs 20-30 x 10-15µ diameter at base, abundant, more frequent towards the rib margins, mostly of retrorse hooks, some straight prickles vertical to rib surfaces, epidermal long cells 35-55 x 10-15µ wide, straight sided, relatively short. Panicle 170-350 x c. 70mm wide, narrowly contracted, exserted, the main axis terete, minutely hairy, with c. 6 nodes each with c. 6 slender 1-3-nate minutely hairy branches up to 100mm, the spikelets towards the ends of the branches on minutely scabro-pubescent pedicels 2-8mm. Spikelets chasmogamous or cleistogamous, pale-coloured, somewhat gaping. Glumes unequal, chaffy with delicate often torn tips, very minutely rough on and between the nerves, lower glume 18.0-24.0+ mm (torn 15.0-24.5mm), clearly 3-nerved, upper glume 15.0-20.0mm (torn 11.5-19.0mm), clearly 5-nerved. Lemmas (7.6-7.9-11.5 (including callus tuft and tip) x 0.7-1.2mm wide, firm, narrowly obovate, the margins overlapping, pubescent, dark reddish brown (Munse11 5YR 3/4), the body beneath the hairs dark reddish brown and minutely rough with prickly hairs c. 0.02mm on upper 1/10 of length, the hairs c. 1.0 x 0.01mm diameter at base, moderately dense at 30-40° to body, very pale brown (Munse11 10YR 8/4); callus tuft including sharp tip (3.0-3.2-4.3mm, brownish yellow (Munse11 10YR 6/6), the callus scar 0.52-0.75 x c. 0.13mm wide; lemma lobes 0.10-0.25 (-0.27)mm, ovate, ciliate; lemma crown hairs tuft of c. 20 uneven hairs, the longest extending (1.2-1.5-3.0mm beyond base of awn; awn twice kneed, the column 19.0-36.5 x 0.32-0.42mm diameter above articulation and 11.0-25.0mm to first knee, hairy, the hairs uneven, 0.7-1.0mm, moderately dense at 35° to awn surface, becoming shorter towards the bristle, the bristle very minutely hairy to the tip, the hairs c. 0.1mm. Palea 6.0-7.8mm, horny with very narrow hyaline margins, the membranous tip reaching to 0.4mm below top of lemma, the dorsal surface between the two nerves as hard and hairy as the lemma. Anthers in chasmogamous florets usually equal in length, 4.0-6.0mm, in cleistogamous florets usually one larger + two smaller, the larger 0.9-2.0mm, the smaller 0.4-1.6mm. Lodicules three, the two anterior c. 3.0mm, the posterior c. 1.0mm.

TASMANIA. - Central: Poatina, two bends down from Penstock, Dec 1967, *Townrow 131* (HO). South East: New Norfolk, Jan 1840, *Gunn 1480* (K); Austins Ferry, N Boundary, roadside, Dec 1968, *Townrow 228* (HO); Queens Domain, Dec 1943, *Curtis 125* (K); Domain, roadside near Tennis Courts, Nov 1967, *Townrow 35* (HO); Sandy Bay, Jan 1902, *Maiden and Cambage K460* (NSW); Hobart, Jan 1930, *Rodway* (HO); Mt. Nelson, Jan 1947, *Curtis 127*

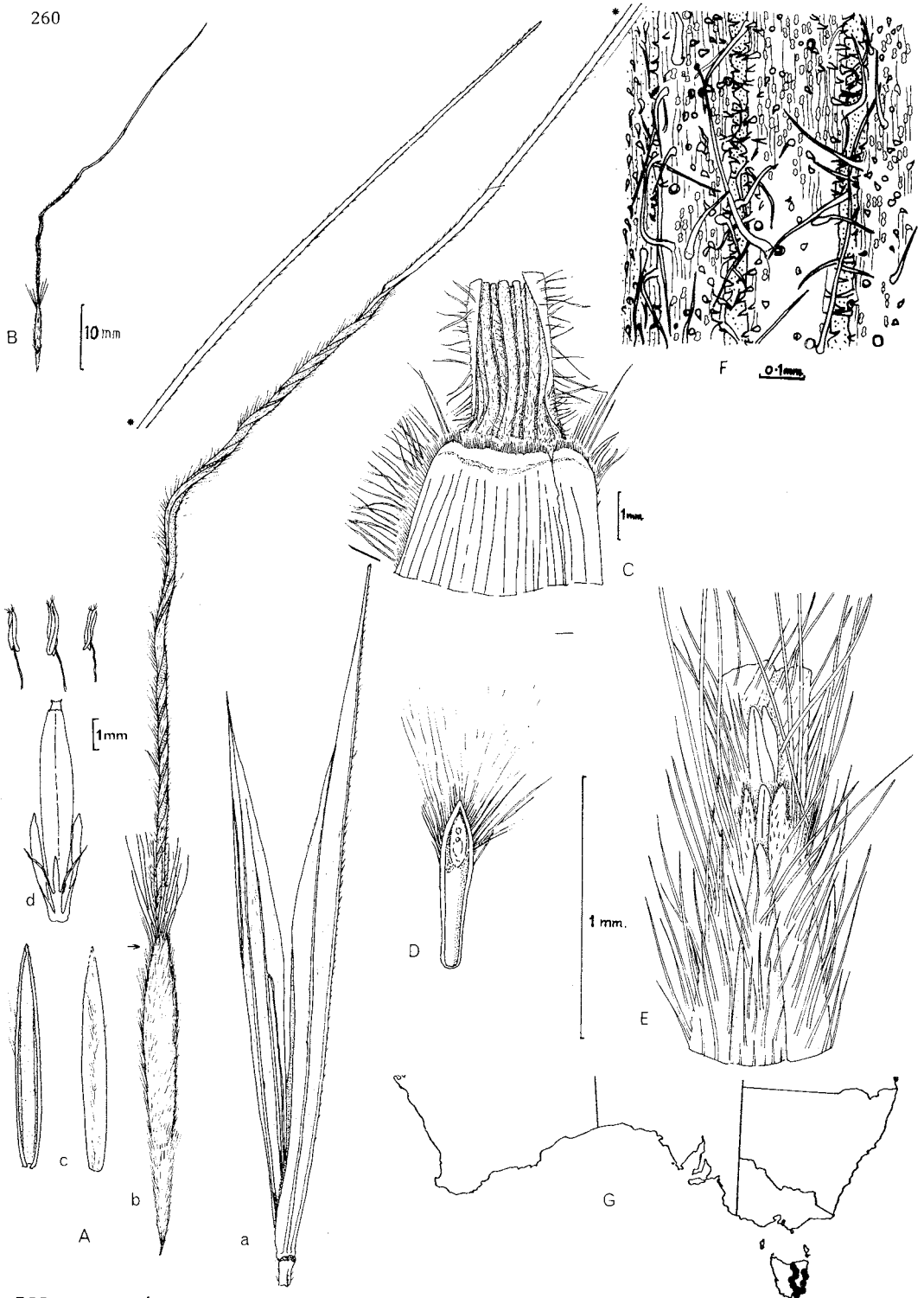


FIG. 9. - *Stipa stiposa* Hughes, "Gunn 1480" (K) (type specimen). Explanation as for figure 1 (p.236) except: C. Ligule (blade 2 from culm base). F. Tracing of micrograph of part of area shown in Plate 2, fig. 9.

(K); University of Tasmania, by Agric. Science Glasshouse, Jan 1970, *Townrow* (K); Bonnet Hill, roadside N of stone quarry, Jan 1968, *Townrow 164* (HO); Kingston Beach, Nov 1935, *Rodway 2058* (K); North Bruny Island, Great Bay, low sandy strip between road and beach, Jan 1970, *Townrow 249* (K). North East: 9.5km E of Launceston, Jan 1949, *Burbidge 2934* (CANB). East: "Levendale" near O'Connors Peak, c. 24km W of Conara Junction, outside shearing shed, Dec 1967, *Townrow 116* (HO); Derwent River, Eastern Shore opposite Cadbury's Factory, Dec 1967, *Townrow 98* (HO), Half mile along Old Beach/Bowen Park road, Dec 1967, *95* (HO); Risdon, Hill above Derwent, Jan 1949, *Burbidge 3186* (CANB), Jan 1949, *3185* (CANB, K), Jan 1949, *Blake 18324* (NSW, K); South Arm, Bank opposite "Karanga", Opossum Bay, Nov 1967, *Townrow 44* (HO), Roadside 5km S of Opossum Bay, Nov 1967, *50* (HO); Eastern Shore, Warrane, roadside E boundary, Nov 1966, *Townrow 7* (HO); Slopens Island, cliff top SW side, Dec 1967, *Townrow 86* (HO); Bust-Me-Gall Hill, Nov 1967, *Townrow* (K); Carlton River Bridge roadside, 5km SE of Copping, Dec 1967, *Townrow 105* (HO); Port Arthur, 1848, *Home* (BM); Beside Prosser River, 5km W of Orford, Nov 1967, *Townrow 69* (HO); "Double Creek", 3km N of Orford, Jan 1968, *Townrow 172*. Without definite locality: *Gunn 1453* (K); Van Diemens Land, *Flotsky* (K).

Distribution: Endemic in eastern Tasmania.

Ecology: Frequent in open and cleared areas of low and grassy woodland, open woodland, scrub and heath, mostly between altitudes of 30-180m with annual rainfall below 1140mm.

Notes: *S. stiposa*, the most common speargrass in Tasmania, has morphological resemblances to *S. bigeniculata*, *S. clelandii* (fig. 8) and to *S. blackii* (Appendix 3C) all of which possess a lemma hair crown about 3mm long. The four species are closely similar in several other features e.g. the ligule, and may form a series in which other diagnostic characters vary in a regular way e.g. decreasing length of lemma body plus callus tuft, and length, hairiness and texture of the palea (compare figs. 7, 8, 9 and Appendix 3C).

A comparison of the type specimens (Appendix 2C) suggests that morphologically *S. stiposa* is more closely allied to *S. clelandii* than to *S. blackii*. *S. stiposa* is distinguished from *S. clelandii* by its longer glumes, its longer brownish lemma with more hairy column and lemma lobes, the longer, more densely hairy, horny palea and the A.L.S.O.

A comparison of A.L.S.O. in conjunction with spikelet characters suggests that *S. bigeniculata* provides a possible morphological link between the series *S. stiposa*, *S. clelandii*, *S. blackii* and the series *S. aristiglumis*, *S. puberula*, *S. flavescens* (compare Plate 1, figs. 2, 7, 8, 9; Plate 2, fig. C, and figs. 2, 7, 8, 9; Appendix 3C).

10. *STIPA STIPOIDES* (Hooker f.) Veldkamp, *Blumea*, 22, p.11 (1974). Syn. *Dichelachne stipoides* Hooker, *Fl. Tasm.*, 1, p.294 (1853); Hooker, *Fl. Tasm.*, 2, p.112 (1858).

(Figure 10; Plate 2, figure 10)

Lectotype: New Zealand, Bay of Islands, *Hooker* (K). [Here designated]

Stipa teretifolia Steudel, *Synops.Plant.Glum.*, 1, p.128 (1854); Bentham, *Fl. Austral.*, 7, p.567 (1878); Hughes, *Kew Bull.*, 1921 p. 12 (1921); Willis, *Handbook to Plants in Victoria*, p.182 (1962); Townrow, *Pap. Proc. R. Soc. Tasm.*, 104, p.86 (1970). (Type: Australia, Western Port, *D'Urville*.)

Long-lived perennial; caespitose often forming large tussocks; culms 0.3-0.9m, erect, terete, wiry, yellow, smooth and polished, 3-4-noded, the upper node exerted; nodes and internodes grading imperceptibly, smooth and shining. Leaf sheaths lightly striate, glabrous, pale green, soon turning yellow or light brown; ligule up to ?mm, white, membranous, pointed, hairless; blades 200-700 x 1mm wide, stiff, erect, needle-like, pungent pointed, extending beyond the inflorescences and culms, tightly inrolled,

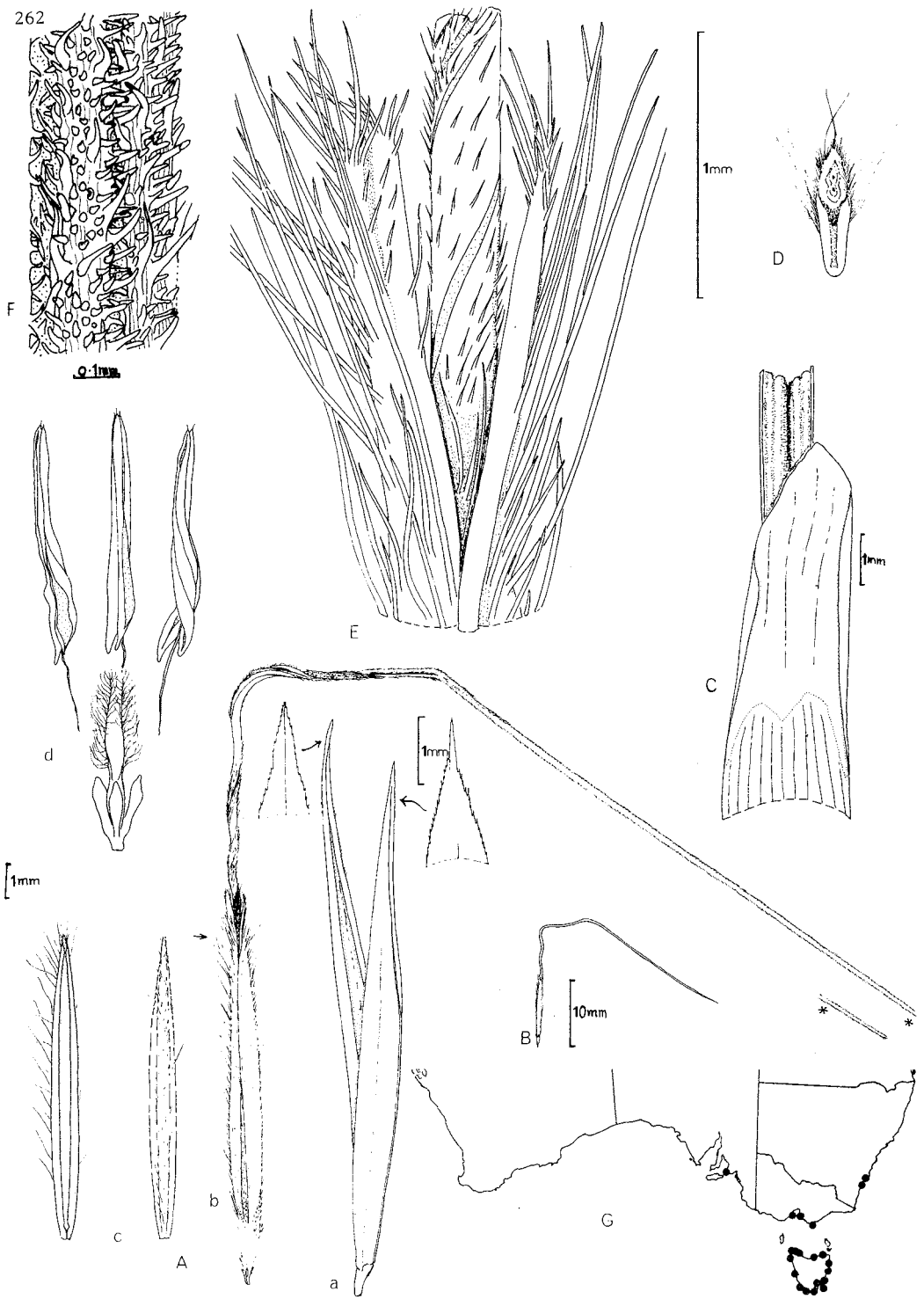


FIG. 10. - *Stipa stipoides* (Hooker) Veldkamp, "Tilden 754" (K). Explanation as for figure 1 (p.236) except: Spikelet characters:- A. a. glumes (tips x10). C. Ligule (blade 2 from culm base). F. Tracing of micrograph of part of area shown in Plate 2, fig. 10.

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the margins apposed, *abaxial surface smooth*, shining, *adaxial surface* deeply grooved, *densely covered with finger-like hairs*, A.L.S.O. of macrohairs and prickly hairs, the macrohairs 35-150 x 14-35 μ diameter at base, blunt tipped, mostly somewhat ascending, the longer hairs sinuous with slightly swollen bases, the prickly hairs 14-21 x c.14 μ diameter at base, like smaller versions of the macrohairs, the epidermal long cells c.57 x 8 μ wide, straight-sided. *Panicle* 110-220 x c.20mm wide, contracted, finally exserted, *strict, erect, few flowered and sparingly branched*, c. 6-noded, the lower nodes 20-50mm apart with 1-3 smooth, glabrous, slender 1-3-nate branches up to 40mm each bearing 1-5 spikelets towards the end on filiform glabrous pedicels 2-9mm long. *Spikelets* chasmogamous, soon straw-coloured, narrow. *Glumes* about equal, the upper occasionally longer than the lower, chaffy, white or yellow, glabrous, thin and shining, lanceolate with a long slender delicate point, *lower glume* 15.0-21.0mm (when torn 14.0-19.5mm), delicately 3-nerved, the lateral nerves weakly developed, *upper glume* 15.0-21.0 mm (when torn 16.0-20.5mm), delicately 5-nerved. *Lemma* (8.5-)10.0-12.5 (including callus but excluding lemma lobes) x 0.8-1.2mm wide, firm, narrowly obovate, the margins meeting above, gaping below, pubescent, reddish brown (Munsell 5YR 4/4), the body yellowish red (Munsell 5YR 5/6) and smooth, the hairs 1.0-2.0 x 0.01-0.02mm diameter at base, moderately dense, shorter and finer below, becoming longer and stouter above, at c. 15° to body, white (Munsell 5YR 8/1); *callus tuft* including sharp tip 2.0-2.6mm, yellow (Munsell 2.5Y 8/8), the *callus scar* (0.37-)0.45-0.50 x c. 0.12mm wide; *lemma lobes* (1.4-)1.8-3.2(-3.6)mm, *visible to the naked eye*, acute, long ciliate, the hairs up to 1.5mm; *lemma crown hairs* absent, body hairs exceed awn base by c. 1.8mm; *awn* twice kneed, stout, minutely pubescent, the *column* 10.0-14.0 x 0.20-0.25mm diameter above articulation and *4.5-7.0mm to first knee*, the column hairs 0.1-0.2mm, moderately dense in bands on either side of the nerve grooves, extending to the end of the bristle. *Palea* 8.0-12.0mm, similar to lemma in texture and hairiness, the tip extending 0.5mm beyond the top of the lemma plus the palea hairs extending a further 0.9mm. *Anthers* three, maroon coloured, equal or 2 large and 1 small or 1 large and 2 small, the larger 7.5-8.2mm, the smaller 7.3-7.6mm, or when equal 6.0-7.9mm. *Lodicules* three equal, c. 2.0mm.

SOUTH AUSTRALIA. - Southern Lofty: Encounter Bay, Waitpinga, Jan 1932, *Cleland* (K).

NEW SOUTH WALES. - South Coast: N Jarvis Bay, Point Perpendicular exposed cliff face 0.5km N of lighthouse overlooking ocean, Oct 1960, *Constable* (K, NSW 52366); Burrewarra Pt., S of Batemans Bay, sand above high water mark, Oct 1965, *Craven 614* (K).

VICTORIA. - Central [Melbourne]: Point Lonsdale, Oct-Nov 1912, *Tilden 754* (K); Point Lonsdale, Nov 1929, *Robb* (K); Ricketts Point, Oct 1931, com. *Sonnenberg* (K); Wilsons Promontory 1877, *Mueller* (K).

TASMANIA. - North: Beach on road from Rocky Cape to Black River, on margin of rocks, Feb 1948, *Curtis* (K). South East: Claremont, Dec 1923, *Lucas* (K); Cornelian Bay, Feb 1894, *Rodway 27* (K); Taroon, rocky crevices above tidemark, beside Quarantine Station, Nov 1966, *Townrow 6* (HO); Kingston Beach, Nov 1935, 2 sheets, *Rodway 2057* (K); N Bruny Island, Great Bay, old jetty at Smootheys Point, Jan 1970, *Townrow 250* (K); Southport, Jan 1962, *Phillips* and *Vickery 001274* (CBG). North East: George Town, *Gunn 1490* (K). East: Hill above Derwent Estuary, shallow soil, Jan 1949, *Burbidge 3183* (K, HO); Risdon, shore rocks, Jan 1949, *Blake 18322* (K), Harbour fore-shore, Jan 1949, *Vickery 7491* (K, HO); South Arm, Ralphs bay, one third way round from W end, Nov 1967, *Townrow 54, 54a* (HO); Boomer, Dunalley, Nov 1943, *Curtis 17* (K); Eaglehawk Neck, Jan 1949, *Blake 18280* (K). Without definite locality: 1850, *Archer* (HO).

Distribution: Coasts of south eastern Australia, Tasmania, and North Island of New Zealand.

Ecology: In Tasmania, strictly confined to the strandline and rocks of the coast within the reach of salt spray, and salt water inlets usually associated with rocky shores. On Curtis Island, Bass Strait a constituent of tussock grassland (Kirkpatrick *et al.*, 1974).

Revised Taxonomy of *Stipa* in Tasmania

Notes: 1. *S. stipoides* is a highly distinct and uniform species with considerable morphological resemblances to *S. junceifolia* Hughes from the Swan River in Western Australia. Both species, with highly distinctive and remarkably similar lemma and A.L.S.O. characters, are markedly xeromorphic and are associated with coastal saline habitats. Both have stiff needle-like, strongly thickened blades with a most distinct A.L.S.O. of finger-like outgrowths (fig. 10F) and well developed, membranous, ligules up to 7mm long which are glabrous in *S. stipoides* but minutely ciliate in *S. junceifolia*. Both have similarly shaped white-silky-hairy lemmas with lobes visible to the naked eye, relatively short blunt callus scars and strongly twice-geniculate, short-columned awns. The lemma body of *S. stipoides* is about twice the length of that of *S. junceifolia*. The floret structure of *S. stipoides* is further notable because of the three large equally developed lodicules and the palea which in the majority of specimens examined, is longer than the lemma.

2. The lectotype designated above has not previously been published as such, and has been selected on the following grounds. Dr V.D. Zotov, D.S.I.R., New Zealand, supplied the information (*pers. comm.*) that Hooker's citation: "*Avena angustifolia*, Banks et Sol. Mss (Tab. LXVI). Hab. Northern Island on rocks near the sea. East coast Banks and Solander, Bay of Islands and Auckland, Sinclair, etc.," included three specimens which are:

- (i) Banks and Solander - *Avena angustifolia* (by MS - from Mercury Bay and Bay of Islands) (BM).
- (ii) Hooker - Bay of Islands, New Zealand (K).
- (iii) Dr Sinclair - Auckland, clay banks near the sea. 403. New Zealand (K).

The Banks and Solander material (labelled *S. teretifolia* Steud.) held at BMNH is in poor condition having been repaired after war damage (Second World War). Dr. Zotov suggests that Hooker's specimen (ii above), which has dissections on it, be made the lectotype of the species. With this I concur.

3. Veldkamp (1974) places *Dichelachne setacea* Nees (*Pl. Priess.*, 2, p.98 (1846), non *Stipa setacea* R. Brown (*Prodr.*, p.174; 1810) in synonymy with *Stipa stipoides* giving as its type *Priess 1854* (BM). But, as was drawn to my attention by P.S. Green, Keeper of the Herbarium, Kew (*pers. comm.*) Nees based his binomial *Dichelachne setacea* on *Stipa setacea* R. Brown, citing it as the only synonym and repeating Brown's diagnosis word for word as his description. *Dichelachne setacea* cannot be a synonym of *Stipa stipoides* as Robert Brown's type specimen of *S. setacea* (Port Jackson, *Brown 6202* (K)) which I have studied, is a distinctly different taxon.

11. *STIPA VARIABILIS* Hughes, *Kew Bull.*, 1921, p.15 (1921); Willis, *Handbook to Plants in Victoria*, p.185 (1962); Townrow, *Pap. Proc. R. Soc. Tasm.*, 104, p. 86 (1970).
(Figure 11; Plate 2, figure 11)

Holotype: Western Australia, Swan River, *Drummond 961* (K).

Perennial, caespitose; culms, 0.3-0.8m, 1.0-1.5mm diameter at base, terete, 1-3 (-4)-noded, minutely densely retrorse-pubescent for c. 1mm below nodes; nodes light brown, mostly exserted and smooth or minutely pubescent. Leaf sheaths striate, minutely antrorse- or retrorse-hairy or smooth, the outer margins usually ciliate, with white tufts of hairs 1.0-1.5mm in the position of auricles, smooth or minutely hairy in the collar region; ligules up to 2mm, minutely ciliate with hairs c. 0.1mm, often lopsided; blades 90-250 x 1-3mm wide at base when flattened, involute, linear, attenuate, moderately stiff, silvery green, slightly rough, minutely pubescent, abaxial surface lightly grooved, minutely hoary with antrorse and retrorse moderately dense long and short hairs c. 0.50 x 0.05mm diameter and 0.20 x 0.02mm diameter at base, adaxial surface deeply grooved with 9 or more ribs, thick and thin ribs alternating, scabrid, very sparsely hairy, A.L.S.O. of a few scattered macrohairs and frequent prickly hairs, the macrohairs up to 215 x 15-30µ diameter at base, antrorse, finely tapering, arising at c. 45° to rib surface, usually absent from upper culm blades, the

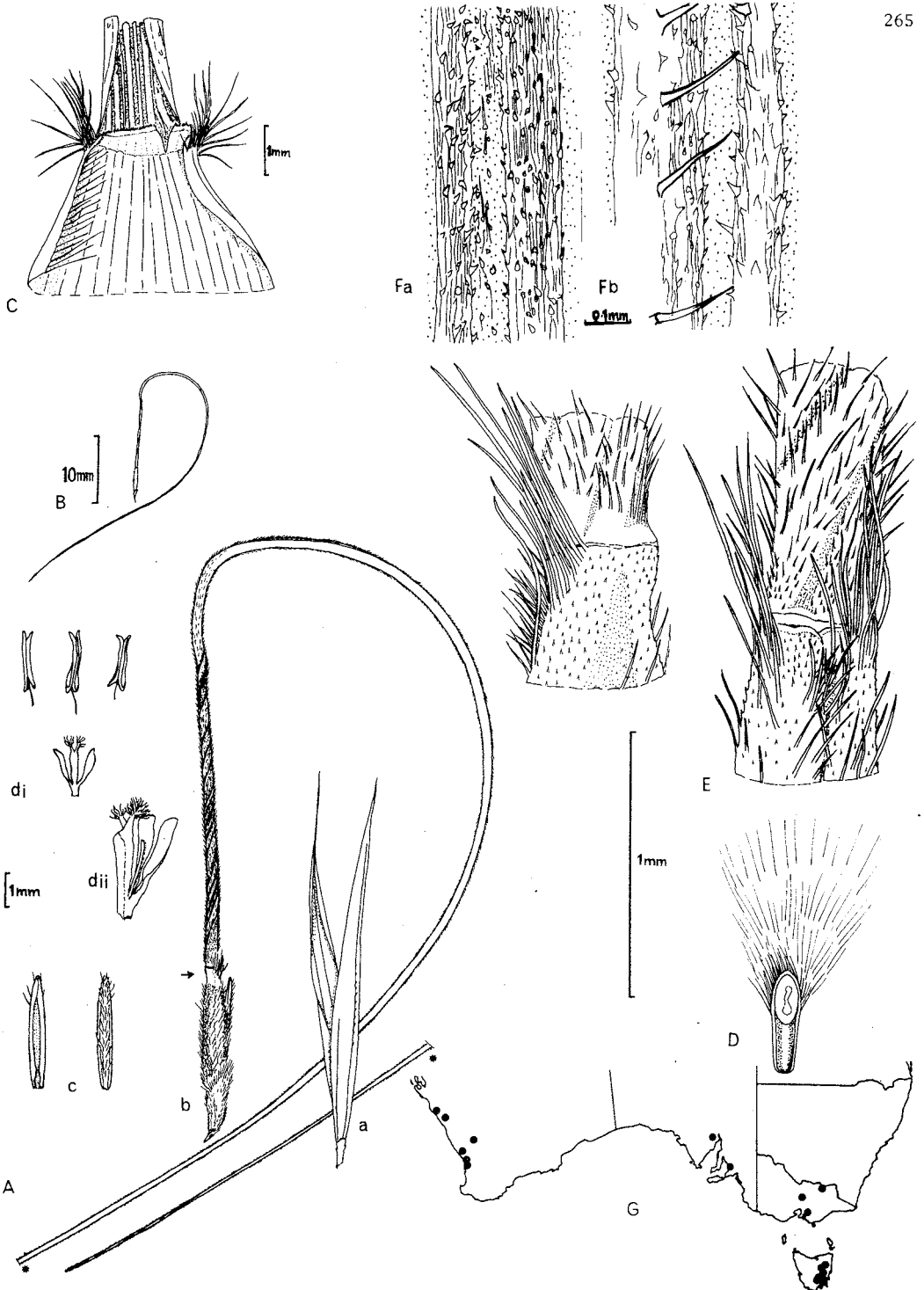


FIG. 11. - *Stipa variabilis* Hughes, Left hand specimen, Sheet A, "Drummond 961" (K) (type specimen). Explanation as for figure 1, (p.236) except: C. Ligule (blade 2 from culm base) "Blake 18049" (matched with type specimen). F. a. tracing of micrograph of part of area shown in Plate 1, fig. 11. b. tracing of micrograph of blade 3 from culm base of "Blake 18049".

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prickle hairs 20-40 x 15-20 μ diameter at base, mostly with straight points, some antrorsely hooked, in rows alternating with long cells, epidermal long cells 60-90 x 7-14 μ wide, spindle-shaped, with 'withy basket' appearance. *Panicle* 150-250 x 20-30mm wide, primary axis terete below, flattened above, smooth or minutely scabrous-hairy, 7-10-noded, the nodes shortly pubescent where branches arise, each node with 2-4 branches, the branches 20-30(-50)mm, immediately and again towards the ends 1-3-nate, bearing 3-5 slender spikelets on minutely scabrous delicate pedicels 2-5mm long. *Spikelets* chasmogamous, narrow, violet coloured. *Glumes* sub-equal, hyaline with long delicate often damaged tips, violet coloured below, *lower glume* 10.7-13.5mm, delicately 3-nerved, minutely hairy down mid-nerve, *upper glume* 10.0-12.0mm, 5-nerved, very minutely and sparsely rough between nerves above the mid-point. *Lemmas* 5.0-7.0(-7.5) (including callus tuft and tip) x (0.45-)0.50-0.70mm wide, firm, cylindrical, the margins meeting, pubescent, *dark brown* (Munsell 7.5YR 3/2), the body dark brown and minutely pimpled and toothed, the teeth 0.02mm sparse and even over top half to third of lemma, the hairs c. 0.50 x 0.01mm diameter at base, moderately dense at c. 20° to body surface, pinkish white (Munsell 7.5YR 8/2); *callus tuft* including sharp tip 1.8-2.5mm, the hairs very dense and fine, very pale brown (Munsell 10YR 8/3), the *callus scar* 0.27-0.42 x c. 0.10mm wide; *lemma lobes* absent or (0.02-)0.05-0.27mm; *lemma crown hairs* in two tufts in lateral position each of 3-4(-8) hairs exceeding awn base 0.20-0.40(-0.8)mm; *awn* once-kneed, *the bristle falcate*, the *column* (8.5-)9.0-11.5 x 0.27-0.35 (-0.43)mm diameter above articulation, minutely, moderately densely hairy, the hairs adpressed over whole column and 0.17-0.25mm long, the bristle triangular in section and densely ciliate on the angles, the cilia 0.05mm. *Palea* (3.3-)3.5-4.7 (-4.9)mm, the same texture and hairiness as the lemma on the back, the tip reaching to 0.3mm below the top of the lemma, tip and margins membranous. *Anthems* three, usually 1 larger and 2 smaller, occasionally all equal, when unequal the larger 0.6-2.5(-2.9)mm, the smaller 0.4-2.2(-2.7)mm, when equal 2.1-2.6mm. *Lodicules* two, c. 3.0mm.

WESTERN AUSTRALIA. - Irwin: Northampton, Oct 1898, *Helms* (K.202); Mingenew, Aug 1934, *Holmes* (K.205). Darling: Swan River, *Drummond* 961 (K); Kelmscott, Sept 1897, *Helms* (K.204); Moora, in railway enclosure, Sept 1947, *Blake* 18049 (K). Eyre: Bremer Bay, 1900, *Wellstead* (K.220).

SOUTH AUSTRALIA. - Eyre Peninsula: Caroonna [Corunna], June 1885, *Cleland* S7 (K). Southern Lofty: Beaumont, Oct 1936, *Cleland* S39 (K); Hills near Waterfall Gully, *Cleland* H.553 (K).

VICTORIA. - Western Volcanic Plains: Mitre Rock near Mt Arapiles, Sept 1960, *Hicks* 312 (K). Central: Avenel, Dec 1934, comm. *Sonnenberg* (K); Melbourne: Observatory grounds, Domain, South Yarra, Jan 1947, *Morris* (K); Yarra River, *Mueller* (K). Eastern Highlands: Wodonga, sheet 1, Dec 1936, *Black* 1190 (K).

TASMANIA. - South East: On Dobson Highway at "fossil-forest" road cutting, 1km east of Macquarie Plains Railway Station, Nov 1966, *Townrow* 12 (HO); Macquarie Plains, Dec 1952, *Curtis* (HO); Hobart, Cascades, Dec 1890, *Rodway* (HO), Nov 1905, *Rodway* (HO); Domain, Nov 1905, *Rodway* (HO), Dec 1943, 2 sheets, *Curtis* 21 (K), Right hand side of Olympic Pool turnoff, Nov 1967, *Townrow* 33 (HO), Dec 1923, *Lucas* (K.492). East: Eight km N of Perth near Launceston, Dec 1968, *Townrow* 233 (K); 14 km W of Campbell Town on Cressy road, c. 11km SW of Conara Junction, Dec 1967, *Townrow* 128 (HO).

Distribution: South western Australia, South Australia, Victoria, South and Central midlands of Tasmania.

Ecology: In Tasmania, roadsides in comparatively dry open woodland and open scrub mostly between 180-300m altitude above sea level with less than 500mm annual rainfall.

Notes: 1. *S. variabilis* belongs to a group of phenetically related species characterised by lemmas c. 5mm long bearing more or less falcate awns, with only two lodicules per floret instead of the more usual three per floret.

The group, replete with taxonomic difficulties, occurs on the Australian mainland and includes *S. falcata* Hughes a rare member of the Tasmanian flora (see fig. 12) and *S. scabra* Lindley, *S. nitida* Summerhayes and Hubbard, *S. incurva* Hughes, *S. leptophylla* Hughes, and *S. pycnostachya* Benthams, none of which occur in Tasmania.

2. Hughes' cited type material of *S. variabilis* consists of three sheets A, B and C, (A and B each have two specimens) all varying slightly from each other. The specimen she figures (sheet A) (fig. 11) has mature lemmas c. 5mm long. The plants on sheet B differ in lemma body length from each other and from those on sheet A. The left hand specimen (sheet B) has immature lemmas c. 7mm long (including callus) while those of the right hand specimen are c. 6mm long and more mature, i.e. more coloured and slightly swollen. The variation of lemma body length with different stages of maturity has yet to be determined for a single plant during one growing season. The A.L.S.O. is identical for plants on both A and B sheets.

3. *S. variabilis* and *S. falcata* have very similar culms and inflorescences, but the type specimens at least are distinguishable on vegetative characters, *S. variabilis* having longer wider leaf blades and *S. falcata* having a basal clump of short stiff, needle-like innovations. Ecological variants occur which are very difficult to place in either taxon. *S. variabilis* growing in dry situations has innovations approaching those in *S. falcata*; the basal needle-like innovations characteristic of *S. falcata* grown in very dry situations, grow out in damper habitats producing plants easily confused with *S. variabilis*.

4. Five specimens of *S. variabilis* and three of *S. falcata* were examined in an attempt to split the material into two distinct taxa, and were segregated on leaf characters including the number of costae per blade, the mode of folding of the blade and the A.L.S.O. The lemmas of the two groups showed considerable overlap in dimensions of several characters, but the *S. variabilis* lemmas tended to have awns with stouter, less twisted columns, shorter or no lemma lobes, shorter callus tufts but longer lemma bodies, and longer broader callus scars than the *S. falcata* lemmas (Appendix 2D). A detailed and extended numerical and/or chemical and cytological evaluation of characters is required to test the relationship of these and other phenetically related taxa.

12. *STIPA FALCATA* Hughes, *Kew Bull.*, 1921, p.14 (1921).
(Figure 12; Plate 2, figure 12)
Holotype: New South Wales, Murrumbidgee, *McArthur 141* (K).

Perennial, caespitose; culms 0.3-0.5m, 1.0-1.3mm diameter at base, erect, terete, 2(-3) noded; nodes ± exserted and glabrous, very minutely downy immediately beneath the nodes otherwise smooth. Leaf sheaths finely striate, glabrous or sub-retorse-pubescent below, outer margins ciliate, the cilia c. 0.2mm, with a few hairs up to 1mm in the position of auricles; ligule up to 1mm, oval, densely minutely ciliate; blades setaceous-convolute, the innovation blades 90-180 x c. 0.3mm diameter, the cauline blades 40-60 x 0.4-0.6mm diameter, abaxial surface especially of the innovations minutely antrorse-scabrous, whitish green, adaxial surface deeply grooved with 5-7 ribs, scabrid hairy, A.L.S.O. of ascending macrohairs and antrorse prickle hair hooks both moderately dense, the macrohairs (35-)50-140 x 7-14µ diameter at base, long and slender with a collar-like base, the prickle hair hooks 20-30 x 1-2µ diameter at base, the costal epidermal long cells c. 90 x 4µ wide with thickened, straight walls. Panicle up to 250 x 20-30mm wide, primary axis smooth or minutely scabrous, subtriquete, c. 7-noded, the lower nodes c. 30mm apart, smooth and hairless, each node with 1-3 branches, the branches slender, minutely scabro-pubescent, immediately 2-nate, then 1-3-nate towards the ends, bearing 1-3(-5) slender spikelets on minutely scabrous delicate pedicels 6-16mm long. Spikelets chasmogamous, narrow, a little gaping. Glumes subequal, acuminate, delicate, violet below and hyaline above, very minutely

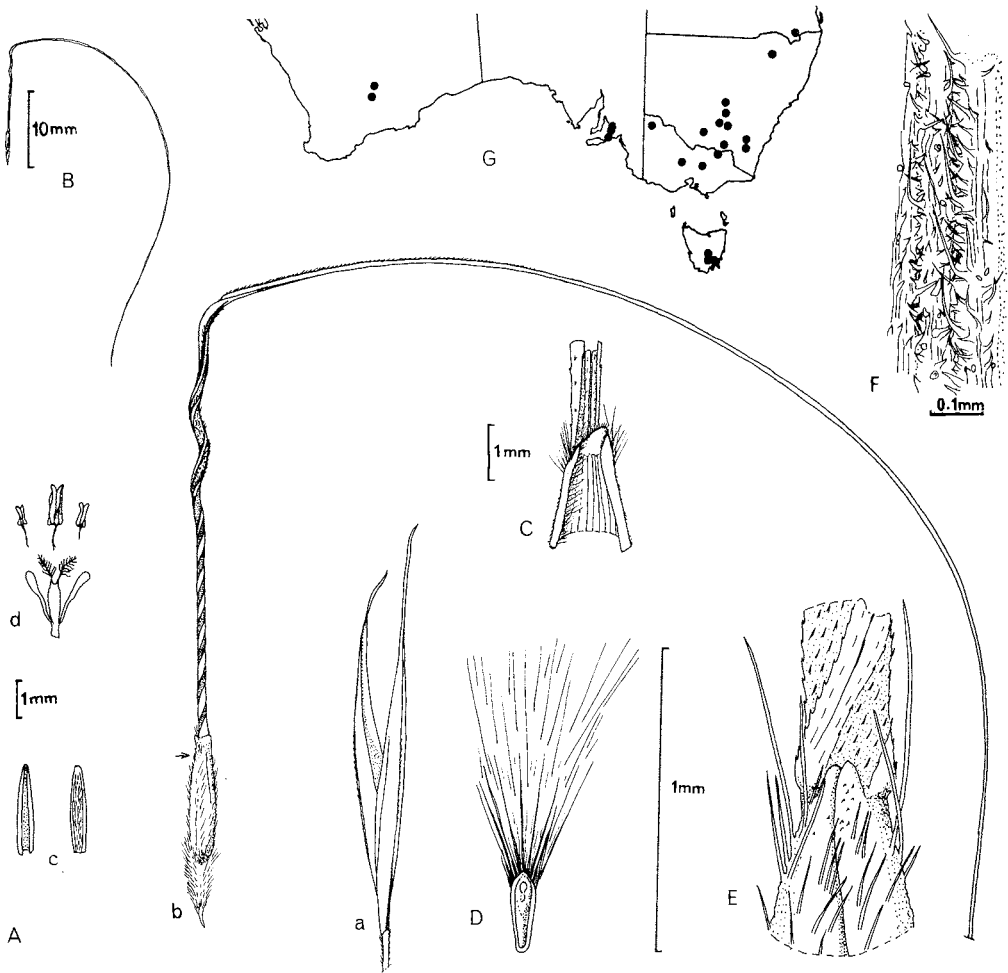
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FIG. 12. - *Stipa falcata* Hughes, "Burbidge 1817" (K) (matched with type specimen).
 Explanation as for figure 1 (p.236) except: C. Ligule (blade 2 from culm base) x7.5 F. Tracing of micrograph of part of area shown in Plate 2, fig. 12.

scabrous on middle of central nerves and between nerves above the mid point, *lower glume* 10.5-17.0 (-19.0)mm, delicately 3-nerved, *upper glume* 10.0-14.1(-15.2)mm, delicately 5-nerved. *Lemmas* 5.9-6.8 (including callus tuft and tip) x 0.5-0.8mm wide, firm, narrowly ovate, the margins gaping over developing caryopsis, sparsely-moderately pubescent, dark reddish brown (Munsell 5YR 3/4), the body beneath the hairs dark brown (Munsell 7.5YR 4/4), smooth, very minutely hairy on upper 1/5 of abaxial surface with hairs c. 0.01mm, the body hairs c. 0.36 x less than 0.01mm diameter at base, sparse, at angle of 35° to body surface, white (Munsell 2.5YR 8/2); *callus tuft* including sharp tip (1.8-)2.1-2.8mm, white like the body hairs, the *callus scar* 0.25-0.37 x c. 0.07mm wide; *lemma lobes* 0.12-0.32mm, smooth, oval, entire; *lemma crown hairs* in lateral tufts of 1-3 hairs on either side, exceeding awn base by 0.1-0.5mm; *awn* once-

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kneed, the bristle falcate, the *column* 8.5-12.5 x 0.25-0.32 mm diameter above articulation, minutely moderately densely hairy over whole column and on the bristle angles, the hairs c. 0.05mm. *Palea* (2.3-)3.6-4.4mm, a thin membrane with a membranous tip reaching to 0.5mm below top of lemma, minutely hairy on the back between the veins. *Anthers* three, one large (0.9-)1.2-2.5mm and two smaller 0.5-2.1mm. *Lodicules* two, c. 1.5mm.

WESTERN AUSTRALIA. - Coolgardie: Coolgardie, Aug 1897, *White* (K.200); Kalgoorlie, Sept-Nov 1909, *Maiden* (K.495).

SOUTH AUSTRALIA. - Eyre Peninsula: Kinchina, Sept 1922, *Cleland S12* (K); Southern Lofty: Beaumont, Oct 1926, *Cleland S3911* (K); Milang, Nov 1896, *Menzel* (K.442); MacLaren Vale, Oct 1925, *Cleland S31* (K); Encounter Bay, Aug 1924, *Cleland S29* (K), Sept 1924, *S28* (K), Sept 1927 (H.133).

QUEENSLAND. - Darling Downs: Three miles from Ballandean, Nov 1944, *Clemens 44657* (K).

NEW SOUTH WALES. - South Western Slopes: Corowa, Dec 1946, *Moore 474* (K; CANB. 13232); Roadside about 16 km N of Albury, Oct 1933, *Rodway* (K; NSW. 1201); Wagga, Oct 1889, *Fletcher* (K); Cootamundra, per Glenfield Veterinary Research Station, Oct 1932, Anonymous (K.517). North Western Slopes: Plains, near Baradine, Oct 1899, *Forsyth* (K. 491). Central Western Slopes: Temora, Oct 1915, *Dwyer* (K.441), Oct 1912, *Elliot* (K. 518); Bowan Park near Cudal, Oct 1906, *Blakely* (K.510); Cowra, Sept 1913, *Breakevell* (K.443). Southern Tablelands: Black Mountain, stony slopes, dry sclerophyll forest, Nov 1945, *Hartley* (K; CANB. 124); Uriarra Crossing, Murrumbidgee River, Jan 1948, *Burbidge 1809, 1817* (K); Open eucalypt forest, Oct 1960, *McKee 7492* (K); Open grassland, April 1947, *Browne*, (K; CANB. 13230); Murrumbidgee, *McArthur 141* (K). North Western Slopes: Warialda, Jan 1932, *Vickery* (K; NSW 18447).

VICTORIA. - Little Desert: Nov 1957, *Hicks 110A* (K). Western Highlands: Inglewood, Sept 1929, *Sonenberg* (K). Eastern Highlands: Euroa, on main road to Albury, Oct 1933, *Rodway* (K; MEL. 21). Near Mount M'Ivor, *Blandowski* (K).

TASMANIA. - East: About 11 km SW of Conara Junction on Cressy Road, 16 km W of Campbell Town, Dec 1967, *Townrow 127* (HO); Brighton, Nov 1900, *Rodway* (HO); Richmond, Oct 1971, *Townrow 252* (HO); 3 km W of Sorell/Orielton road on road to Richmond, Nov 1967, *Townrow 72* (HO).

Distribution: Western Australia (goldfield area), South Australia (Adelaide), central Victoria, south central New South Wales, Tasmania (rare).

Ecology: In Tasmania, confined to roadsides in very dry open scrub.

Notes: 1. *S. falcata* has been much confused with both *S. variabilis* and with *S. scabra* Lindley (1848), by botanists who have not had recourse to the type material. *S. falcata* is distinguishable from *S. variabilis* (as described under *S. variabilis*) but its distinction from *S. scabra* is far from clear. Lindley's type specimen of *S. scabra* - "New South Wales, Bogan River, 32°S 147°E. *Mitchell 125*" has been mislaid in the Botany Department Herbarium of Cambridge University (Dr. Max Walters *pers. comm.*). The type material at Kew is fragmentary and consists of a few lemmas and damaged glumes taken from "*Mitchell 125*".

Hughes (1921) cites specimens from Western and South Australia and Queensland in addition to the type from New South Wales. Of these I have examined "*Koch 371*", "Elder Exploring Expedition", and "Gawler River, *Mueller*" from South Australia, and "Fraser's Range, *Dempster*" from Western Australia. Only Mueller's specimen possibly matches the Kew Lindley type material and its lemmas are very immature which makes positive identification difficult. The others apparently belong to a single taxon but differ from the Kew Lindley type in lemma characters, and from Lindley's description in vegetative characters, having long, glabrous, almost pungent pointed blades. I suggest that *S. scabra sensu* Hughes is not the same as *S. scabra sensu* Lindley.

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If one accepts as representing *S. scabra sensu* Lindley a specimen collected from New South Wales "Wyngan, Nov 1912, *E. Breakwell*" which has lemmas exactly matching the Kew Lindley type lemmas of *S. scabra*, and which agrees with Lindley's description of "leaves scabrid hairy and involute, culms short and pubescent nodes, ligules ciliate and oblong", then *S. falcata* differs from *S. scabra* in the hair ornament of the abaxial leaf surfaces of the innovations. Whereas in *S. falcata* the blades have an indumentum of coarse ascending hairs 0.2mm long, while the sheaths are covered with retrorse minute hairs 0.05mm long, appearing scabrid but not obviously hairy, in *S. scabra* both blades and sheaths are coarsely obviously retrorse-hairy with hairs more or less the same length.

Further work is needed to sort out the *S. falcata/S. scabra* complex in both the Australian and the Kew collections.

EXCLUDED NAMES

1. *S. pubescens* R. Brown, *Prodr.*, p.174 (1810) - see note under *S. pubinodis*.
2. *S. elegantissima* Labillardière, *Fl. Nov. Holl.*, 1, p.23 (1805). Labillardière recorded the habitat of this species as Capite Van Diemen. J.H. Willis in *Muelleriana*, 1, p.136 (1967) referred to Labillardière's confusion of habitat labels "Capite Van Diemen" (Tasmania) and "Terra Van Leuwin" (Western Australia) in the case of *Leptospermum glaucescens*, a West Australian species ascribed to Tasmania by Labillardière. It is apparent that a similar mistake was made in the labelling of *Stipa elegantissima* which does not occur in Tasmania.
3. *S. laeviculmis* Nees in Lehmann, *Pl. Priess.*, 2, p.99 (1846). Lehmann (1846) suggested that this taxon be ignored because the type specimen "In insula Van Diemen?" is of uncertain locality.
4. *S. aphanoneura* Hughes, *Kew Bull.*, 1921, p.25 (1921). Type: Kent's Group, *Brown 6202* (K). I have examined two sheets labelled "Kent's Group, *Brown 6202*" one at K, the other at BM. The specimen at K with very immature inflorescences and underdeveloped lemmas is practically indeterminable. Its A.L.S.O. most closely resembles that of the type of *S. clelandii* Summerhayes and Hubbard (fig. 8F) but its lemmas although closely similar to those of *S. clelandii* in dimensions, differ in hair crown length and density and hairiness of the awn. The specimen at BM I identify as immature *S. flavescens*.

DISCUSSION

It has been established that the following native *Stipa* species occur in Tasmania - *S. aphylla*, *S. flavescens*, *S. nervosa* var. *neutralis*, *S. mollis*, *S. semibarbata*, *S. pubinodis*, *S. stiposa*, *S. stipoides*, *S. variabilis*, *S. falcata*, *S. bigeniculata*, and *S. clelandii*, and that *S. aphylla* and *S. stiposa* are endemic species.

From my examination of types of about 55 taxa (K) I suggest tentatively that Australian *Stipae* may be grouped on morphological characters into eight series (unpublished drawings and data of types and/or matched specimens) which differ from Hughes' (1921) subgeneric groups:

1. *S. aphylla*, *S. muelleri*, *S. elegantissima*, *S. tuckeri*, *S. verticillata*, *S. ramosissima*, ? + *S. acrociliata* and *S. platychaeta*.
2. *S. nervosa*, *S. nervosa* var. *neutralis*, *S. pubinodis*, *S. pubescens*, *S. nivicola*.
3. (a) *S. compressa*, *S. macalpinei*.
(b) *S. hirsuta*, *S. eriopus*, *S. fusca*, *S. eremophila*.
4. *S. flavescens*, *S. tenuiglumis*.
5. (a) *S. aristiglumis*, *S. bigeniculata*.
(b) *S. puberula*, *S. brachystephana*, *S. oligostachya*, *S. blackii*, *S. tenuifolia*, *S. setacea*.
(c) *S. stiposa*, *S. clelandii*.

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6. *S. nobilis*, *S. hemipogon*, *S. mollis*, *S. semibarbata*, *S. plumigera*, *S. densiflora*, *S. drummondii*.
7. (a) *S. variabilis*, *S. trichophylla*, *S. incurva*.
(b) *S. falcata*, *S. scelerata* (= *S. nodosa*), *S. nitida*, *S. leptophylla*, *S. pycnostachya*.
8. *S. stipoides*, *S. juncifolia*.

The Tasmanian flora contains representative species of all but one of the above series and so represents a cross section of the native Australian *Stipae*. The Tasmanian species are therefore admirably suited for selection as a representative group for preliminary investigation as forerunner of an extended experimental taxonomic study of all the Australian *Stipae*, pending the completion of a classical revision of Australian *Stipae* which has been undertaken by Dr. J.W. Vickery (*pers. comm.*, November 1974).

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APPENDIX I

INDEX TO COLLECTORS

The numbers in italics are the collectors' specimen numbers, the numbers in parentheses () refer to the corresponding species as numbered in the text e.g. (1) refers to *S. aphylla*, (2) refers to *S. flavescens* etc. The other numbers refer to the number of specimens of the particular species. Tasmanian specimens are indicated by the suffix *.

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- Andrews 1 unnumbered (2).
 Archer 1 unnumbered (3); 1 unnumbered* (6); 1 unnumbered* (10).
 Aston 1 unnumbered (5).
 Bailey 2 unnumbered (4).
 Black 1193 sheet 1* (5); 1190 (11).
 Blake 18277* (1); 18437* (2); 17323* (4); 13915, 4638 (5); 18278* (6); 18324* (9);
 18280*, 18322* (10); 18049 (11).
 Blakely 1 unnumbered (4); 1 unnumbered (12).
 Blandowski 1 unnumbered (12).
 Boorman 431 (3).
 Breakwell 1 unnumbered (12).
 Brown 6202, 1 unnumbered (2); 6205 (3); 6204 (4).
 Browne 1 unnumbered (12).
 Burbidge 13641, 16575, 2517, 2551, 3184* (4); 2390*, 2935* (5); 25116*, 2954*, 23189*
 (6); 2934*, 3185*, 3186* (9); 3183* (10); 1809, 1817 (12).
 Cambage 3068 (7).
 Campbell 1 unnumbered (4).
 Carne 1 unnumbered (4).
 Cleland 1 unnumbered (2); H61, 72, H98, H487, 3 unnumbered, 1 unnumbered* (3); S4, S18,
 S25, 1 unnumbered (4); S16 (6); 2 unnumbered (7); S40 (8); 1 unnumbered (10); S7,
 S39, H553 (11); S12, S28, S29, S31, S3911, 1 unnumbered (12).
 Clemens 44760 (5); 44657 (12).
 Collie 1 unnumbered (2).
 Constable NSW 52366 (10).
 Craven 614 (10).
 Curtis 128* (1); 20*, 130*, 2 unnumbered* (2); 22*, 7 unnumbered* (3); 184*, 131* (5);
 18B*, 120*, 124*, 129*, 1 unnumbered* (6); 126* (7); 125*, 127* (9); 17*, 1 un-
 numbered* (10); 21*, 1 unnumbered* (11).
 Davies 1 unnumbered (2); 2 unnumbered (4).
 Davis and Davis 10578* (6).
 Dorrien Smith 1 unnumbered (4).
 Drummond 959 (2); 961 (11).
 Dwyer 1 unnumbered (12).
 Eardley 1 unnumbered (7).
 Elliot 1 unnumbered (12).
 Fletcher 1 unnumbered (12).
 Forsyth 1 unnumbered (12).
 French 28130 (2).
 Gunn 996*, 1 unnumbered (2); 1452* (3); 1480* (4); 588*, 996*, 996* (6); 1453*, 1480*
 (9); 1490* (10); 1487* (11).
 Hannaford 2 unnumbered (4).
 Hartley 1 unnumbered (12).
 Harvey 1 unnumbered (4).
 Helms 2 unnumbered (11).
 Hicks 312 (11); 110A (12).
 Hilton 1170 (6).
 Holmes 1 unnumbered (11).
 Home 1 unnumbered* (9).
 Ising 1 unnumbered (4); 1 unnumbered (6).
 Jackson 1 unnumbered (2).
 Johnson 1 unnumbered (3).
 Koch 1 unnumbered (4).
 Kuchel 1 unnumbered (4).
 Labillardière 1 unnumbered* (2).
 Lotsky 1 unnumbered* (9).
 Lucas 1 unnumbered* (10); 1 unnumbered* (11).
 Maiden K495 (12).

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- Maiden and Cabbage *K460** (9).
 McArthur *141* (12).
 McKee *7492* (12).
 Meeresnake 1 unnumbered (3).
 Menzel 1 unnumbered (12).
 Moore 1 unnumbered* (3); *474* (12).
 Morris, D.I. 1 unnumbered (8).
 Morris, P.F. 1 unnumbered (11).
 Morrison 1 unnumbered (3); 1 unnumbered (6).
 Mueller 1 unnumbered* (6); 1 unnumbered (10); 1 unnumbered (11).
 Muir *519, 1956* (4).
 Palmer 1 unnumbered (4).
 Paterson 1 unnumbered (2).
 Patton 1 unnumbered (7).
 Phillips and Vickery *001268** (5); 1 unnumbered (6); *001274** (10).
 Pullen *4126* (3); *3735, 3955* (7).
 Robb 1 unnumbered (10).
 Robbins 1 unnumbered (5).
 Robertson *529* (3).
 Rodway *995**, 2 unnumbered (1); *25**, *H117*, 1 unnumbered (2); 1 unnumbered, 1 unnumbered* (3); 2 unnumbered* (4); 1 unnumbered, 1 unnumbered (5); *10577**, 2 unnumbered* (6); *2058**, 1 unnumbered (9); *27**, *2057**, 1 unnumbered* (10); *25**, 3 unnumbered* (11); 2 unnumbered, 1 unnumbered* (12).
 Sonenberg 1 unnumbered (2); 3 unnumbered (3); 1 unnumbered (4); 2 unnumbered (6); 1 unnumbered (7); 1 unnumbered (10); 1 unnumbered (11); 1 unnumbered (12).
 Stoward *935* (12).
 Symon *141* (2).
 Thomas 1 unnumbered (7).
 Tilden *754* (10).
 Townrow *4B**, *24**, *77**, *147**, *205**, *246**, *297**, *298**, 1 unnumbered* (1); *15**, *16**, *28**, *41**, *42**, *55**, *56**, *83**, *94**, *112**, *144**, *157**, 1 unnumbered* (2); *9**, *57**, *63**, *70**, *71**, *75**, *81**, *82**, *110**, *139**, *158**, *171**, *180**, *187**, *243**, 1 unnumbered (3); *166**, *175**, *248**, (4); *3**, *18a**, *19**, *76**, *91**, *103**, *104**, *114**, *124**, *137**, *165**, *181**, *196**, *197**, *245**, (5); *1**, *5a**, *27**, *39**, *58**, *60**, *62**, *67**, *79**, *80**, *102**, *107**, *111**, *130**, *135**, *138**, *146**, *173**, *176**, *178**, *191**, *193**, *205**, *247**, 1 unnumbered* (6); *96**, *115**, *162** (7); *7**, *35**, *44**, *50**, *69**, *86**, *95**, *98**, *105**, *116**, *131**, *164**, *172**, *228**, *249**, 2 unnumbered* (9); *6**, *54**, *54a**, *250** (10); *12**, *33**, *128**, *233** (11); *72**, *127**, *252** (12).
 Vickery 1 unnumbered, 1 unnumbered* (3); 1 unnumbered (5); *8565** 1 unnumbered* (6); *7491** (10); 1 unnumbered (12).
 Wellstead 1 unnumbered (11).
 White *8336** (5); 1 unnumbered (12).
 Williamson *692* (6).
 Willis 1 unnumbered (2).

APPENDIX 2
TABLE A
TASMANIAN *STIPA* SPECIES. COSTAL CHARACTERS OF THE ADAXIAL LEAF SURFACE - SILICA BODIES
Observations and measurements made on scanning micrographs x140:

Species	Frequency	Dimensions μ length x diameter	Shape	Arrangement
Silica bodies				
1. <i>S. aphylla</i>	None seen			
2. <i>S. flavescens</i>	Very abundant	15-20 x 7-10	Dumbbell, some nodular [S ₄]*	In obvious rows between and within rows of epidermal long cells. 3-9 in a row alternating with short cells with prickle hair hooks above and below.
3. <i>S. mollis</i>	None seen			
4. <i>S. semibarbata</i>	None seen			
5. <i>S. nervosa</i> var. <i>neuralis</i>	Abundant	10-18 x 7-10	Dumbbell, some irregularly oval [S ₄]	In irregular rows, alternating with long cells macrohairs and prickle hairs.
6. <i>S. pubinodis</i>	Scattered	15-20 x 10-15	Irregularly oval with raised margins, approaching [S ₄]	In rows with long cells, often alternating regularly with macrohairs: long cell, macrohair, long cell, silica body, long cell.....
7. <i>S. bigeniculata</i>	Abundant	15-30 x 10-15	Dumbbell, some nodular [S ₄]	In separate rows of silica bodies and short cells, and in rows with prickle hair hooks and short cells.
8. <i>S. clelandii</i>	Moderately frequent	20-30 x c.15	Dumbbell, some irregular [S ₄]	Obscured by wax platelets.
9. <i>S. stuposa</i>	Abundant	15-20 x c.10 c.30 x c.10	Dumbbell [S ₄]	In rows alternating within the row with epidermal long cells.
10. <i>S. stipoides</i>	None seen			
11. <i>S. variabilis</i>	Scattered singly	10-15 x 7-10	Dumbbell [S ₄]	Alternating with long cells.
12. <i>S. falcata</i>	None seen			

* Prat's classification (1960, 1968)

TABLE B
DIFFERENCES BETWEEN *S. PUBINODIS* TRIN. AND RUPR. AND *S. PUBESCENS* R.BR.

Character	<i>S. pubinodis</i>	<i>S. pubescens</i>
A.L.S.O.	Moderately dense fine macrohairs 70-280 x 10-15 μ diam., plus antrorse prickle hairs 20-43 x 10 μ diam. at base on the rib surfaces, macrohairs strongly ascending, becoming shorter and finer on successive blades; trough between the ribs very narrow.	Dense minute antrorse prickle hair hooks 15-25 μ long on the rib surfaces; dense minute tapering macrohairs 35-46 x 7 μ diam. at base in wide troughs between the ribs, the hairs retrorse and swollen based.
Ligule	Lower ligules up to 2mm long, hard, finger-nail shaped (sometimes lop-sided), ciliate margined and minutely hairy on the back; upper ones shorter with fimbriate margins.	Minutely ciliate-margined, erose membrane about 0.5mm long.
Glumes	Very minutely sparsely hairy between the veins; glume margins hairless, the tips torn.	Hairy on and between the veins; lower glume acute with densely ciliate margins; upper glume emarginate, margins smooth.
Lemma	Surface of upper 1/3 minutely dentate, the teeth irregularly spaced and moderately dense, c. 0.03mm long.	Surface very minutely bumpy in hairless region below the awn.
Body hairs	Sparse above, dense below, 0.9 x 0.02mm, white to reddish-yellow.	Sparse, 0.5-1.0mm long x 0.01mm diam., white.
Awn hairs	0.26 x 0.02mm, moderately dense on lower column, very dense on upper column; bristle with 8 rows of hairs 0.1mm long.	0.1 x 0.01mm, moderately-very dense over whole column, bristle with 2 rows of hairs 0.01mm long.
Callus tuft	3.5-4.6mm, reddish yellow-strong brown.	3.0-3.5mm, pale yellow.
Palea	Up to 8.8mm long, equalling lemma, acute, with a horny central yellowish portion similar in texture to the lemma, and relatively broad thinly membranous margins.	About 5.2mm long, about 3/4 length of lemma, a delicate, hyaline, blunt-tipped membrane entirely enclosed in the lemma.
Lodicules	3: 2 ovate above and swollen below, c. 3.0mm long, 1 linear, c. 2.0mm long.	3 leaf-shaped: 2 more or less truncate, c. 1.0mm long, 1 acute, c. 0.6mm long.

TABLE C
 A COMPARISON OF *S. STUPOSA* WITH *S. CLELANDII* AND *S. BLACKII*
 based on spikelet measurements and leaf characters from the type specimens

Character	<i>S. stiposa</i>	<i>S. clelandii</i>	<i>S. blackii</i>
A.L.S.O. μ			
Macrohairs	Sparse-frequent, 100-450 long x 15-20 base diameter.	Frequent, 70-210 long x c.15 base diameter.	Dense macrohairs, grading to prickly hairs, 20-70 x 10-15 diameter.
Prickle hair hooks	Frequent, 20-30 x 10-15 diameter.	Very few, 20-30 x c. 10 diameter.	None.
Ligule mm	Ciliate membrane, 0.5	Ciliate membrane, 0.7	Ciliate membrane, 0.4
Glumes approx. length mm			
Lower	21.0 (torn)	19.0 (torn)	15.5
Upper	17.0	12.5 (torn)	11.5
Lemma mm			
Colour	Dark reddish brown.	Yellowish brown.	Reddish-light reddish brown.
Body and callus	MunSELL 5 YR 3/4	MunSELL 10 YR 5/4	MunSELL 5 YR 4/3
Callus tuft	9.0-10.0 x 1.0	7.2-7.7 x 1.3	6.3 x 1.2
Callus scar	3.2-3.5	2.5-3.0	2.5
Crown hairs	0.64 x 0.13	0.63 x 0.13	0.63 x 0.20
Body hairs	2.0-3.0	2.5-5.0	3.0-3.8
Lobes	Moderately dense, 1.0 x 0.01, very pale brown.	Very dense, 1.1 x 0.02, yellow.	Moderate to very dense, 1.5 x 0.01, yellow.
Awn Column mm	0.20-0.12	Absent.	Absent.
Length	19-21	14-21	14-16
Diameter	0.32	0.32	0.32
Length to 1st knee	12-15	9-12	6-8
Hair ornament	Moderately dense, 1.0-0.7	Dense, 0.25-0.12	Dense and adpressed, c.0.25
Palea mm	Horny on back like lemma, 6.8	Slightly thinner than lemma, 5.0	Slightly thinner than lemma, 4.3

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TABLE D

RANGE OF VARIATION IN DIMENSIONS OF DISTINGUISHING LEMMA CHARACTERS found in five specimens of *Stipa variabilis* and three specimens of *Stipa falcata* segregated on leaf blade characters.

The figures in square brackets refer to the corresponding dimensions in *S. variabilis* type specimen A, and *S. falcata*, *Burbridge 1817*, the specimen matched with the type specimen of *S. falcata*.

	<i>S. variabilis</i>	<i>S. falcata</i>
Blade folding	involute	setaceo-convolute
Number of costae/blade	9+	5-7
A.L.S.O.	see fig. 11, p.168	see fig. 12, p. 175
Lemma awn column diameter mm	0.27-0.43 [0.36-0.43]	0.25-0.32 [0.25-0.33]
Lemma lobes mm	(0.02-)0.05-0.27 [absent]	0.125-0.325 [0.15-0.28]
Callus scar mm	0.275-0.420 x c. 0.10 [0.38 x c. 0.10]	0.250-0.375 x c. 0.07 [0.25 x c. 0.07]

APPENDIX 3

Notes and drawings of Australian mainland species *S. nervosa*, *S. pubescens* and *S. blackii* are appended for comparison with those of the Tasmanian *S. nervosa* var. *neutralis*, *S. pubinodis* and *S. clelandii* respectively, (see text pp. 251, 254, 259).

The main points of comparison are:

1. *S. nervosa* is shorter in lemma body, callus tuft, awn column and palea than the var. *neutralis*, and has two lodicules not three. The A.L.S.O. of both are essentially similar.
2. *S. nervosa* var. *neutralis* differs especially in ligule and A.L.S.O. characters from *S. pubinodis* and *S. pubescens*.
3. *S. pubinodis* differs from *S. pubescens* in palea, ligule and A.L.S.O. characters.
4. *S. blackii* occupies an intermediate position between *S. clelandii* and *S. stuposus* regarding lengths of glumes, lemma bodies and awn columns, and hairiness of paleas. (See Appendix 2C).

S. NERVOSA Vickery

(Figure 13; Plate 2, figure 13)

Floret and leaf blade characters

"Pennant Hills, Dec 1953, *Vickery*" (K) matched with type specimen.

Blades involute, up to 3.5mm wide at base.

A.L.S.O. of sparse more or less ascending macrohairs and moderately dense slightly antrorse prickle hairs and prickle hair hooks, the macrohairs up to c. 300 x 40µ diameter at the swollen bases, finely tapering, the prickle hairs up to c. 50µ, mostly arising straight from the rib surface.

Lemma dark brown (Munsell 10YR 3/3), margins overlapping to base.

Lemma body 7.7-8.8 x 0.7-0.9mm (including callus), dark reddish brown (Munsell 5YR 2/2) minutely hooked above, smooth-minutely pimpled beneath the hairs below, the body hairs c. 0.8 x 0.02mm diameter at base, sparse, erect, adpressed, yellow (Munsell 2.5Y 6/8).

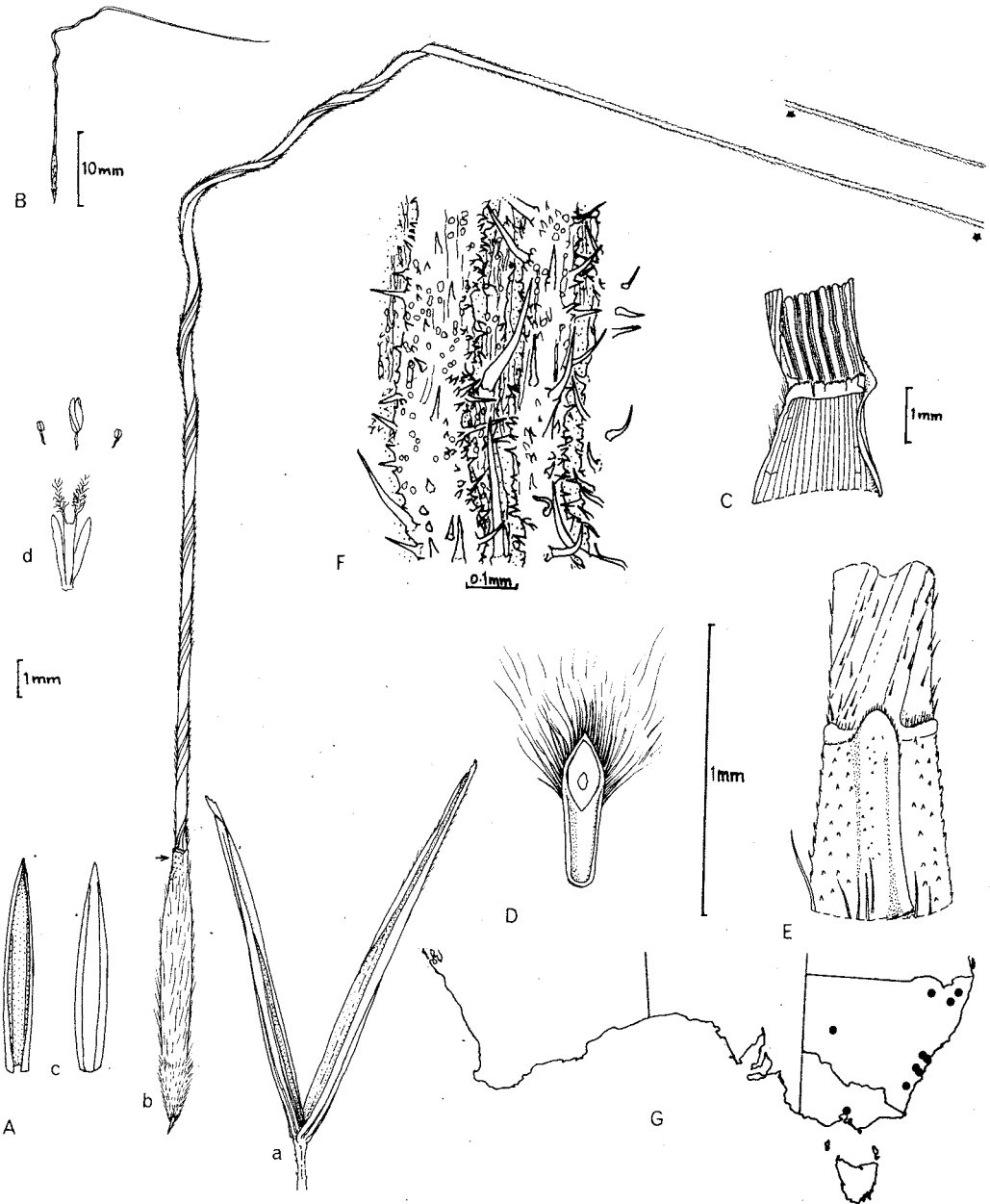


FIG. 13. - *Stipa nervosa* Vickery, "Dec. 1953, Vickery" (K) (matched with type specimen). Explanation as for figure 1 (p.236) except: C. Ligule (blade 3 from culm base) F. Tracing of micrograph of part of area shown in Plate 2, fig. A.

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Callus tuft and tip c. 2.0mm, brownish yellow-yellow (Munsell 10YR 6/8-2.5Y 8/6).

Callus scar 0.51 x 0.15mm.

Lemma lobes c. 0.10mm, oval, minutely ciliate.

Lemma crown hairs absent.

Awn twice kneed; the column c. 29 x 0.38mm diameter above articulation and c. 15mm to first knee, sparsely hairy to the end of the bristle, the hairs c. 0.05mm becoming denser on the upper column between the 'knees'.

Palea 5.8-6.2mm, hyaline tip reaching to 0.2mm below top of lemma, entirely enveloped by lemma, hairless, slightly thinner than lemma.

Anthers three, of which two 0.2mm, one 0.9mm.

Lodicules two, 2mm.

S. PUBESCENS Brown

(Figure 14; Plate 2, figure 14)

Floret and leaf blade characters

"Brown 6203" (K) type specimen.

(Single value measurements are necessarily taken from a single spikelet due to the inadvisability of mutilating the type specimen).

Blades involute.

A.L.S.O. of abundant antrorse prickly hair hooks on the costal surfaces, and dense retrorse macrohairs between the costae; the prickly hair hooks 15-25 μ , the macrohairs 35-46 x c. 1 μ diameter at base, strongly tapering and swollen based.

Lemma dark reddish grey (Munsell 5YR 4/2), margins overlapping.

Lemma body 10.3 x 1.0mm (including callus), reddish brown (Munsell 5YR 4/4) beneath the hairs, minutely rugose below the awn in hairless region, the body hairs 0.5-1.0 x 0.01mm diameter at base, sparse, almost vertical to body, white (Munsell 5YR 8/1).

Callus tuft and tip 3.0-3.5mm, pale yellow (Munsell 2.5Y 8/4).

Callus scar 0.64 x 0.18mm.

Lemma lobes absent, lemma margin free above for c. 0.1mm.

Lemma crown hairs absent.

Awn twice kneed; the column c. 47 x 0.5-0.6mm diameter above articulation and c. 35mm to first knee, moderately-very densely hairy, the hairs 0.1 x 0.01mm diameter at base, continuing along the bristle angles.

Palea 5.2mm, membranous with a hyaline tip reaching to 2.1mm below top of lemma, completely enclosed by lemma.

Anthers three each 5.2mm.

Lodicules three equal of which two are more or less truncate, one acute.

S. BLACKII Hubbard

(Figure 15; Plate 2, figure 15)

Floret and leaf blade characters

"Jamestown, Black 2" (K) type specimen.

(Single measurements are necessarily taken from a single spikelet due to the inadvisability of mutilating the type specimen).

A.L.S.O. of moderately dense intergrading more or less antrorse macrohairs and prickly hairs 2-70 μ , finely tapering from somewhat swollen bases, the larger hairs wavy, the shorter hairs peg-like.

Lemma reddish brown to light reddish brown (Munsell 5YR 4/3-6/4); margins inrolled and meeting; very hard.

Lemma body 6.3 x 1.2mm (including callus), reddish brown and minutely densely pimped under the hairs, the pimples c. 0.025mm diameter, the body hairs c. 1.5 x 0.01mm diameter at base, moderate to very dense, acutely angled to body at 10°-15°, yellow (Munsell 2.5Y 8/4).

Callus tuft and tip c. 2.5mm, yellow (Munsell 2.5Y 8/4).

Callus scar 0.625 x 0.20mm.

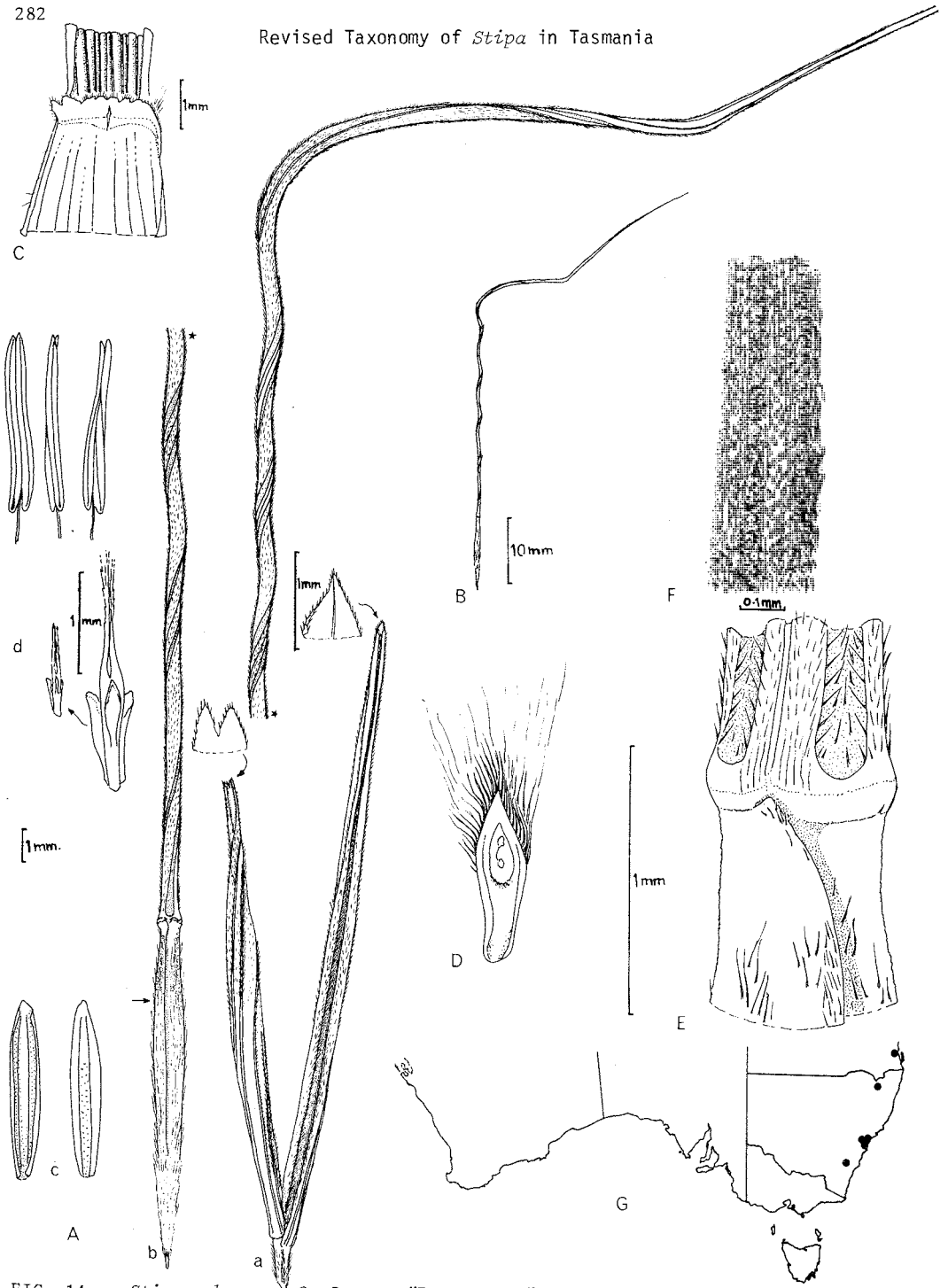


FIG. 14. - *Stipa pubescens* R. Brown, "Brown 6203" (type specimen). Explanation as for figure 1 (p.236) except: A. a. glumes (tips x15); C. Ligule (blade 2 from culm base); F. Tracing of micrograph of part of area shown in Plate 2, fig. B.

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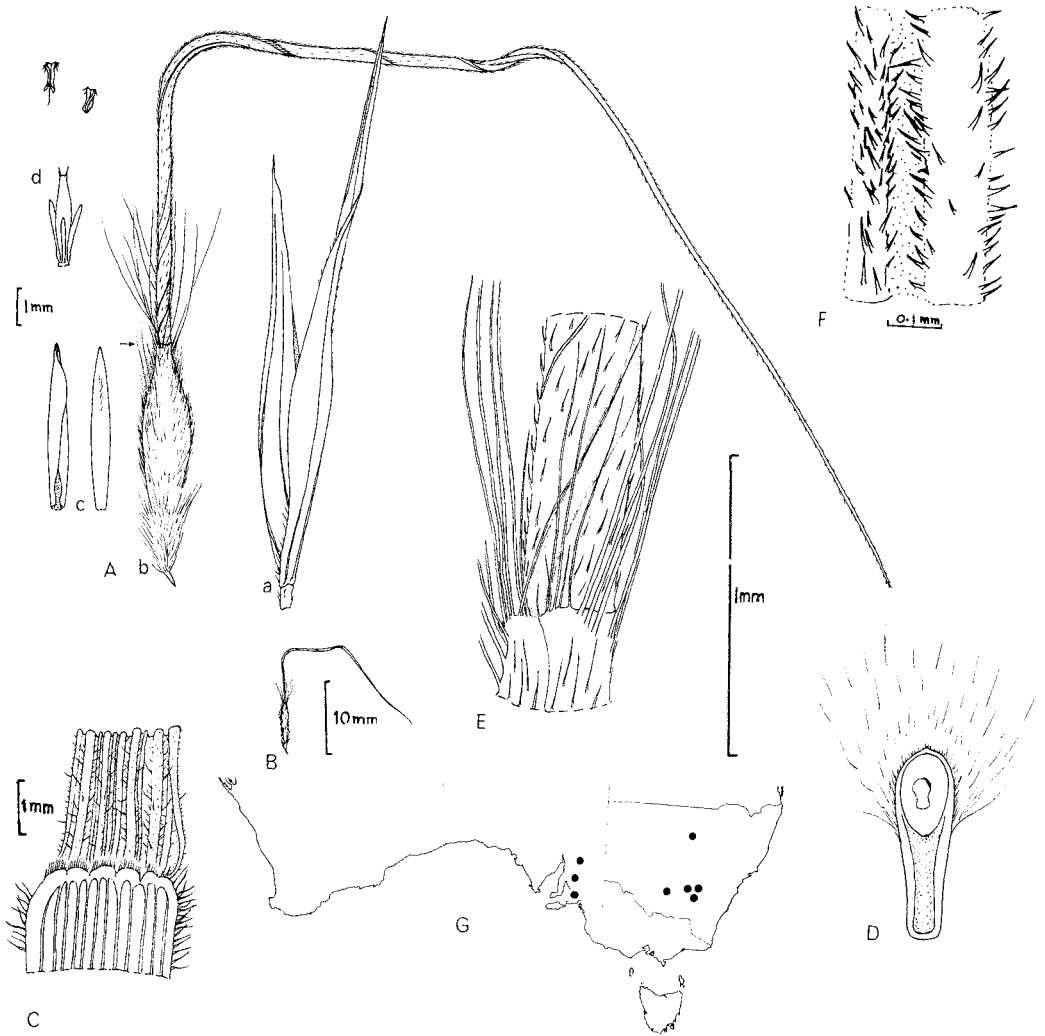


FIG. 15. - *Stipa blackii* Hubbard, "Black 2" (K) (type specimen). Explanation as for figure 1 (p.236) except: C. Ligule (blade 2 from base) F. Tracing of scanning micrograph of part of area shown in Plate 2, fig. C.

Lemna lobes absent, lemma margin free at top, densely ciliate along top margin, the hairs 0.15-1.00mm.

Lemna crown hairs 3.0-3.8mm, very fine c. 0.01mm diameter, sparse, of c. 20 hairs.

Awn twice kneed, the column c. 16.0 x 0.30mm diameter above articulation and 6.0-8.0mm to first knee, densely hairy, the hairs c. 0.25mm and closely appressed to column, moderately dense on bristle angles.

Palea 4.3mm, the tip hard and reaching to the top of lemma, slightly thinner than lemma with a minute line of hairs on upper 1/3 of back.

Anthers three, of which two 0.65mm, one 0.85mm.

Lodicules three, of which two 1.6mm, one 1.2mm.

Revised Taxonomy of *Stipa* in Tasmania

PLATE 1. - Scanning micrographs of Adaxial Leaf Surface Ornamentation within 10mm of ligule; x 80 (approx.).

Figures 1-8 Species growing in Tasmania.

FIG. 1. - *Stipa aphylla* (Rodway) Townrow, "Townrow 246" (HO) (matched with type specimen), blade 3 from culm base.

FIG. 2. - *S. flavescens* Labillardière, "Labillardière, Webb" (K. 35) (type specimen), blade 2 from culm base.

FIG. 3. - *S. mollis* R. Brown, "Oct 1932, Cleland" (K. 487) (matched with type specimen), blade 3 from culm base.

FIG. 4. - *S. semibarbata* R. Brown, "Townrow 248" (K) (matched with type specimen), blade 2 from culm base.

FIG. 5. - *S. nervosa* var. *neutralis* Vickery, "Burbidge 2935" (K) (matched with type specimen), blade 3 from culm base.

FIG. 6. - *S. pubinodis* Trinius and Ruprecht, "Townrow 247" (HO) (matched with type specimen), blade 2 from culm base.

FIG. 7. - *S. bigeniculata* Hughes, "Jan 1948, Thomas" (K) (matched with type specimen), blade 2 from culm base.

FIG. 8. - *S. clelandii* Summerhayes and Hubbard, "Sheet 2, Cleland S. 40" (K) (type specimen), blade 3 from culm base.

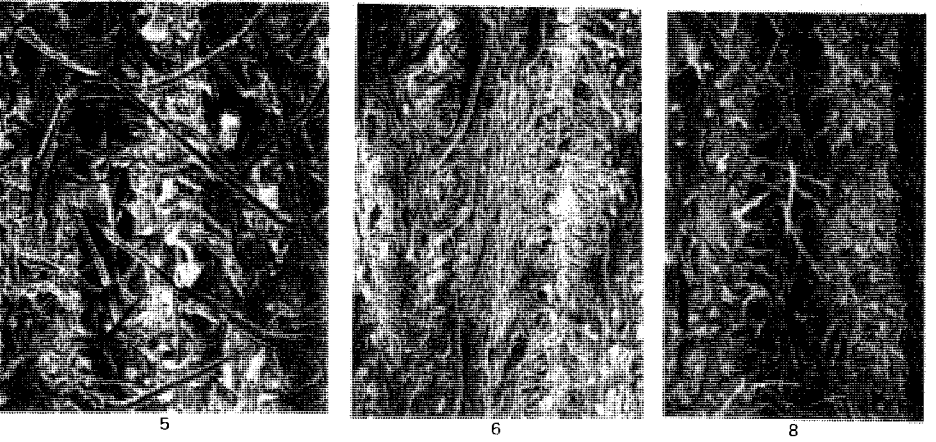
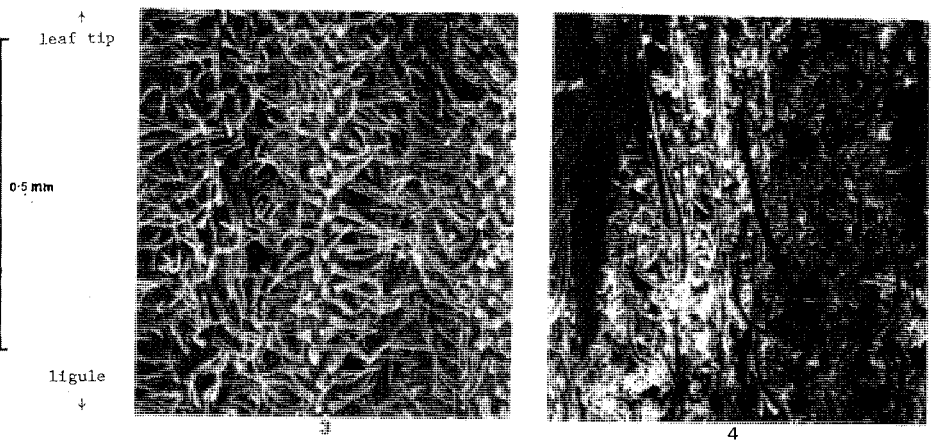
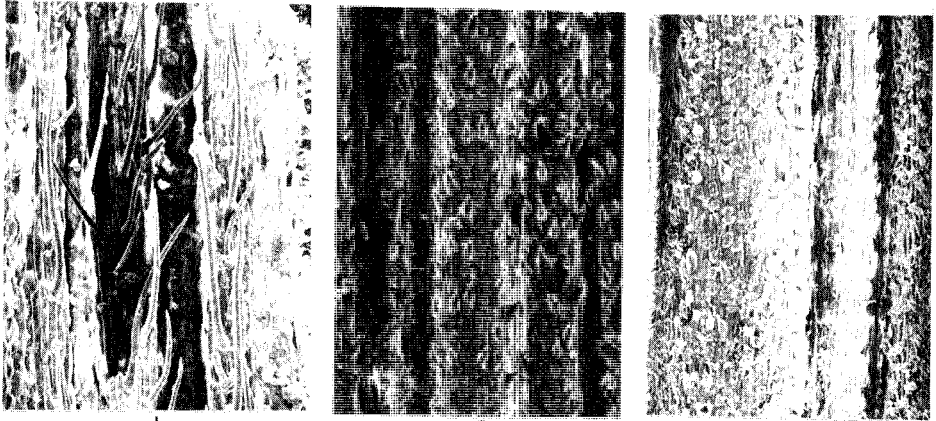


PLATE 1

Revised Taxonomy of *Stipa* in Tasmania

PLATE 2. - Scanning micrographs of Adaxial Leaf Surface Ornamentation within 10mm of ligule; x 80 (approx.).

Figures 9-12 Species growing in Tasmania.

Figures 13-15 Species not recorded in Tasmania.

- FIG. 9. - *Stipa stiposa* Hughes, "Jan 1902, Maiden and Cambage" (K) (matched with type specimen), blade 3 from culm base.
- FIG. 10. - *S. stipoides* (Hooker) Veldkamp, "Tilden 754" (K), blade 3 from culm base.
- FIG. 11. - *S. variabilis* Hughes, "left hand specimen, Sheet A, Drummond 961" (K) (type specimen), blade 2 from culm base.
- FIG. 12. - *S. falcata* Hughes, "Burbidge 1817" (K) (matched with type specimen), blade 2 from culm base.
- FIG. 13. - *S. nervosa* Vickery, "Dec 1953, Vickery" (K) (matched with type specimen), blade 3 from culm base. Compare with *S. nervosa* var. *neutralis* (Plate 1, fig. 5).
- FIG. 14. - *S. pubescens* R. Brown, "Fullen 3997" (K) (matched with type specimen), blade 2 from culm base. Compare with *S. pubinodis* (Plate 1, fig. 6) and *S. nervosa* var. *neutralis* (Plate 1, fig. 5).
- FIG. 15. - *S. blackii* Hubbard, "Nov 1934, Butchee" (K) (matched with type specimen), blade 2 from culm base. Compare with *S. clelandii* (Plate 1, fig. 8) and *S. stiposa* (fig. 9 above).

