A STUDY

OF THE SOUTH AFRICAN SPECIES

OF ANDROPOGON LINN.

WITH SPECIAL REFERENCE

TO LEAF ANATOMY

By

W.J.Louw B.A.

CONTENTS

	Page
Preface	I
Introduction	1
General Notes on the Genus	7
Method and Material	14
Diagnostic Characteristics of the Genus	18
Description of the Genus	35
Key to the Species	36
Description of the Species	38
An Unidentified Specimen	70
Summary	72
References	73

- I -

PREFACE

The present restrictions on travelling facilities have limited field observation to a relatively small area. Consequently, a number of species (A.filifolius, A. distachyus, A.tumidulus and A.gayanus var.squamulatus) could not be studied in their natural habitats, nor could fresh material be obtained in these cases. It is regretted too, that as a result of the present war, it was not possible to procure the various types and co-types from overseas herbaria for comparison and verification and it is fully realised that for this reason the value of this study is not what it might have been. I had, however, at my disposal all the available material of nearly all South African Herbaria, which enabled me to study and compare plants from widely different localities and growing conditions.

My sincere thanks and appreciation are tendered to the Curators and Directors of the Mc Gregor Museum, Kimberley, the South African Museum, Cape Town, The Albany Museum, Grahamstown, the Natal Herbarium, Durban and the National Herbarium, Pretoria; to the Professors of Botany of the Natal University College, Pietermaritzburg, the University College of the Orange Free State and the Potchefstroom University College for the loan of specimens.

In particular, I wish to express my gratitude:
to Dr. E.P.Phillips, Chief of the Division of Botany
and Plant Pathology, for the many facilities afforded during
my frequent visits to the National Herbarium,

to Miss L.Chippendall, agrostologist to the National Herbarium, who helped to clear many difficult points, and

to Miss M.D.Gunn who kindly placed at my disposal literature from the National Herbarium Library.

To Prof. A.P. Goossens of the Potchefstroom University College, I am indebted for the loan of the

unpublished typescripts of Dr. Fisher and Messrs. M.C.
Papendorf and T.J.Steyn as well as other literature.
Furthermore, his sympathetic encouragements throughout the course of the present study and many little acts of generosity will always be recalled with gratitude.

INTRODUCTION

(a) Historical 1)

In this country, <u>Bews</u> (1918) may be regarded as the pioneer of anatomical agrostology. His "Grasses and Grasslands of South Africa", though primarily an ecological treatise, contains illustrated descriptions of the leafanatomy of the most important native grasses. He also introduced an economical aspect by pointing out that, to a degree, palatability to stock varies inversely with the amount of sclerenchyma present in the leaf.

Phillips (1931) included, amongst text figures, diagrammatic sketches of grass leaves as seen in transverse section, but made no comment upon their anatomy.

The differences encountered in the leaf-anatomy of the varieties of <u>Themeda triandra</u> Forsk., enabled <u>Goossens</u> and <u>Theron</u> (1934) to compile a diagnostic key, based chiefly on the characters revealed by the epidermis in surface view.

The leaf-anatomy of the South African species of Aristida Linn. was investigated by Theron (1936). He was able to construct a key to the species based solely on anatomical characters. The outline of the leaf as seen in transverse section and the features of the motor cells afforded a basis for primary and secondary grouping in the key.

Phillips and Bredell (1937) resorted to rootand leaf-anatomy in an attempt to separate the South African species of Elyonurus Humb. & Boupl. and supplied an anatomical key.

¹⁾ Accounts of the earlier contributions to the study of the grass leaf were given by Grob (1896), Papendorf (1940), Steyn (1943) and others, and repitition here would be superfluous. A brief outline of the work hitherto done on South African grasses, however, may be useful.

In 1938 a monograph on the monotypic genus Ctenium Panz., including an anatomical description, appeared by Goossens and Theron.

A revision of the material of the South
African species of Sporobolus R.Brown, was undertaken
by Goossens in 1938. This genus did not lend itself
to a classification based on anatomical characters alone,
and in the key these were employed in conjunction with
external morphological features. The most significant
features for taxonomical purposes were the absence or
presence of colourless parenchyma, arrangement of the
chlorophyll tissue, the nature and distribution of the
motor cells and the structural features of the epidermis.

Fisher (1938) described and figured the (Tricholaena Schrad) leaf-anatomy of a number of Natal grasses, and in 1939 this publication was followed by a study of the genera Chloris Schwartz and Eustachys Desv. Subsequently 61940) both these papers were incorporated in a comprehensive work on the tribe Chlorideae, which to date, has not appeared in print.

The publication by Goossens (1940) of Bewsia biflora, formerly a species under Diplachne Beauv., was supplemented by a figured account of the anatomy of the leaf and shoot.

Papendorf (1940) studied the leaf-anatomy of the South African species of Agrostis Linn. He also was not able to construct a key based on intermal morphological characters alone.

The South African members of the genus

Setaria Beauv. were revised by De Wit (1941). He devoted a few pages to the anatomy of the genus, but anatomical descriptions and text figures were lacking. He came to the conclusion that Setaria did not provide an accurate means of identifying closely related species anatomically.

- 3 -

Schweikerdt (1942), in his revision of the genus Elytrophorus Beauv., supplied anatomical descriptions and text figures. An anatomical key was not given, but anatomical features (surfaces of the leaf in transverse section and characters of the motor cells) were employed in the morphological key.

Steyn (1942) gave a critical review of the work done by Phillips and Bredell (1937) on Elyonurus Humb. & Boupl. He endeavoured to show that the distinctions recognised by these authors were not justified either on anatomical or on external morphological grounds.

(b) Anatomy as a Taxonomic Method

Considering that the detailed study of the anatomy of grasses is a very recent innovation in Systematic Botany, it is not surprising that a diversity of opinion exists as regards its values and limitations as a taxonomic method. Much has been contributed to our knowledge of the grass leaf, especially during the last decade, but the results are varied and the conclusions often conflicting.

Arber (1925), for instance, confidently asserts, "In many cases genera, even species, can be determined on structural grounds alone", and again, "... ancestral properties of the leaf are not obliterated by environment", and she laments the fact that "..... Systematic Botany ignores the vegetative parts and concentrates on flowers and fruits". In het "Gramineae" (1934) she states: "Indeed, the study of the leaves of the Gramineae awakens continual surprise at the range of variation which they represent. They show so many

constant anatomical differences that transverse sections often give critical help in cases of doubtful identification. Goossens and Theron (1934) quote, and presumably endorse, the statement of Prat (1932) that, "the epidermis supplies sufficient differences to distinguish not only groups of plants, but also genera, species and varieties."

Other investigators again, have not met with the same success, and their conclusions are less reassuring, especially when it comes to dealing with closely related species. Thus De Wit (1941), while admitting that Fisher in the study of Chloris and Eustachys was able to distinguish species by anatomical characters alone, points out that the number of species in these genera is small and easily separated macroscopically. In the genus Setaria he found anatomy of no assistance in determining closely allied species and stated that their classification should be carried out independently of anatomy. In support of his views, he quotes Lewton-Brain (1904): "In many cases the anatomical structure of leaves of nearly related species is very similar if not practically identical", and further, "we must not rely too much on leaf-sections for separating closely allied species". He finally sums up with the statement, "When a typical specimen is selected and investigated it may be found to differ from a related species when again compared to a typical representative. as soon as less characteristic individuals are drawn into the picture, the characters vary to such an extent that no decision as to name seems warranted. This does not apply, of course, to species of remote relationship in the genus, as clear differences exist in that case".

Vickery (1935) too, regards anatomical keys with caution. In discussing the work done by

Breakwell (1914, 1915) on Australian grasses, she warns that, though his anatomical key should be of assistance to ecologists and pasture workers, it should be remembered that such identification is only provisional until complete flowering material is available. Closely allied species may have an almost identical anatomical structure, particularly in similar habitats, and even widely separated species may strongly resemble each other in transverse section.

The divergence of views just cited may be attributed to the nature of the material investigated; some may even refer to the thoroughness of the investigators - vide Steyn (1943). Whatever views we may hold, it seems clear that a great deal of research and more convincing results are needed before unanimity is reached on the question of whether anatomy can be called to aid in distinguishing plants of close affinity.

Another consideration of perhaps more practical significance confronting the systematic anatomist to-day, is that despite the fact that anatomical keys to the species of a considerable number of genera are already in existence, such keys can only be used if the genus to which a particular specimen belongs for which the specific name is to be determined, is known. That anatomy reveales no generic distinctions, was already noted by Hackel (1889): "Neither are the Andropogoneae to be separated from related, or even from the very remote tribe of the Chlorideae on anatomical grounds, nor does there exist any anatomical feature or combination of features which is peculiar to one genus alone". 1) To this he adds that the sub-genera may

¹⁾ The translation is mine.

occasionally manifest a uniform anatomical structure, only when they consist of less than ten species.

The desirability of a key for South
African grasses based on vegetative parts has been
emphasized by John Phillips (1935) and Fisher (1940).
As the natural relationships between grasses are not
reflected in their anatomy, such a key must necessarily
be highly artificial. This was well illustrated by
Schweikerdt (1941) in discussing Theron's anatomical
classification (1936) of the genus Aristida.

A more profitable method of approaching the problem would seem to compile a key for the most important grasses within each ecological or geographical area (vide Burr and Turner (1933)), rather than to concentrate on the species of each genus separately. The advantages of such a key are obvious, and may best be illustrated by means of typical case. A farmer is interested in a certain pasture grass, or suspects a particular grass of poisoning his stock during spells of drought. He is desirous to obtain certain information and takes a specimen, without flowering culms, to a botanist for identification. If the genus to which the specimen belongs cannot be recognised offhand, no attempt at the identification could be made, even if a key for that particular genus existed. On the other hand, with a vegetative key for all the common grasses of the area from which the specimen was taken, after a few preliminary questions the identification could be proceeded with in the normal way.

It is not intended, however, to minimize the results already achieved in this field, but the knowledge so far accumulated, would in my opinion be of greater practical value if incorporated in a key of the type suggested above.

GENERAL NOTES ON THE GENUS

The genus Andropogon (andpos, a man+πώγων, a beard) was described by Linnaeus in 1753 with A. distachyus as the type. The name evidently refers to the conspicuous white hairs fringing the joints and pedicels. With the numerous subsequent additions to Andropogon in the Linnaean sense, the genus became a very large and unwieldy one, embracing elements of a very diverse and heterogeneous nature. Consequently, from time to time various authors have pruned away different natural groups within the genus and promoted them to generic rank. Thus the majority of the 12 species originally described by Linnaeus have subsequently been separated, e.g. A.contortus is now referred to Heteropogon, A.divaricatus and A.alopecuroides to Miscanthidium, A.schoenanthus and A. nardus to Hyparrhenia, while the last species, A.fasciculatus, is unidentifiable.

Thunberg's "Flora Capensis" (1823) makes mention of 5 species under Andropogon, all of which to-day are grouped under other generic heads.

Nees (1853), who worked on the material collected by Drege, Ecklon and Zeyher in this country, described 6 species under Andropogon. Of these these, only A.eucomus, A.amplectens and A.appendiculatus have remained in the genus.

In Steudel's work on grasses (1855),

5 species of Andropogon were described from South Africa

(A.distachyus, A.amplectens, A.filifolius, A.appendiculatus
and A.eucomus), not including many which have subsequently
been separated from the genus:

Hackel (1889), in his excellent monograph on the Andropogoneae, gave a very wide definition of the genus and included elements like <u>Sorghum</u>, <u>Chrysopogon</u> and <u>Heteropogon</u> which Bentham and Hooker (1883) have

previously described as distinct genera. Of the 193
species described, 7 were from South Africa, viz. A.eucomus,
A.appendiculatus, A.schirensis, A.amplectens, A.filifolius,
A.Schinzii and A.distachyus, not counting those which
to-day are referred to other genera.

Stapf (1900), in Dyer's "Flora Capensis", followed Hackel's classification. In all, 32 species were recognised of which to-day only 7 (the same as quoted in the preceding paragraph) are still retained in the genus.

Wood (1908) described and figured 5 species of Andropogon, of which only A.distachyus belongs to the genus in its modern conception. A.pertusus has been transferred to Bothriochloa and A.Schimperi and A.Buchanii to Hyparrhenia. A.Schlechteri must be referred to Hypogynium Nees, but after careful perusal of the relevant literature, I have come to the conclusion that it has not yet been published under this genus. 1)

In "Flora of Tropical Africa" (1934) the genus underwent a drastic revision by Stapf, who not only restored many genera of Bentham and Hooker's classification, but went even further in the creation of new genera. Consequently, the genus was left with about 100 species Yet in this restricted of which 10 occur in South Africa. sense, the genus Andropogon is probably more heterogeneous than any other other genus of the Andropogoneae, as Stapf He points out further that the himself observed (1934). species fall into three fairly natural groups besides the They are only loosely connected sub-genus Eu-Andropogon. with it and may even be entitled to rank as distinct All four groups have representatives in South genera. Africa.

The genus is of tropical origin and the

¹⁾ This has subsequently been confirmed in a letter from Mr. C.E. Hubbard, Kew.

bulk of the species are confined to the tropics of both hemispheres. They are an advanced group and show some interesting adaptations. Hackel (1889) observes that the first leaf of the seedling is broad and falls almost horizontally, whereas the leaves of the older plants usually are much narrower and strict. From this he concludes that the Andropogoneae are a recent group which has adapted itself to adverse climatic conditions, drought and sunlight.

Bews (1929), in considering the evolutionary trends of the family, lays much stress on the protective devices of the reproductive organs and the reduction of the various elements of the inflorescence. Both these tendencies contribute either directly or indirectly to the efficiency with which the various functions relating to the production of seed and the propagation of the species, are performed. Accepting these trends as the criterion of evolutionary advance, the Andropogoneae on whole must be regarded as a highly specialised and a much advanced tribe.

The inflorescence in <u>Andropogon</u> is subtended by a spathe or spatheole - a modified leaf sheath - which envelopes the whole inflorescence in the young state. As the spikelets mature, they are gradually pushed out of the spathe by the elongating peduncle. The primitive panicle - in other genera of the tribe, e.g. <u>Sorghum</u>, it is wide and open - <u>in Andropogon</u> is reduced to paired *rarely solitary) or fascicled spike-like racemes.

The genus falls into two groups with regard to the characters of the joints and pedicels. In Stapf's sections (1934) Leptopogon and to a lesser degree in Eu-Andropogon the more primitive condition prevails with these members linear to finely filiform. The more advanced condition is met with in the sections Piestium and Notosolen. Here the joints and pedicels are distinctly widened upwards,

with the tips deeply hollowed and cupular, serving as a receptacle for the succeeding joint and pedicel or for the pedicelled spikelet respectively. These modifications facilitate in the disarticulation of the rachis and the liberation of the spikelets which fall entire.

The spikelets are one-flowered and arranged in pairs: one is pedicelled and male, the other sessile and bisexual. Assuming that the manyflowered wondition spikelet represents the primitive state, the one-flowered condition was arrived at by reduction of the number of flowers in the spikelet. In the Andropogoneae the reduction proceded from below, the lower flowers being represented by the lower valve In the section Leptopogon the reduction has gone even further, and has resulted in the complete suppression of the pedicelled spikelet in A.eucomus Nees. In A. huillensis Rehdle, though the pedicel is often barren as in A.eucomus Nees, usually the degenerate lower glume marks the only vestige of the missing spikelet. would therefore seem that in this respect A.eucomus Nees is the more advanced of the two; the fact also, that it has migrated much further away from the tropics, lends support to this view. An interesting point is raised by the fact that specimens of A. huillensis Rendle recorded for the Witwatersrand area (Hutton 254, Cohen 653 and Louw 922) all possess perfectly developed pedicelled (male) spikelets, thus completing the evolutionary chain between the normal pedicelled spikelet as found in the other species of the genus and its complete absence in A.eucomus Nees. Now assuming that this species is of tropical origin (as indeed we take the whole genus to be), and assuming that reduction marks evolutionary advance, the problem presents itself why the more advanced condition (with the spikelet in question absent or reduced to an

- 11 -

empty glume) should occur in or near the tropics, while
the more primitive form (with the spikelet complete)
occurs at the Witwatersrand, practically the most extreme
point of its migration southwards. No answer, unless it is
purely speculative, seems possible at the present moment.

The pale is very variable in size, often represented by a minute scale only, or entirely absent.

The genus has succeeded in evolving very effective means of protecting the vital organs. The rôle of the spathe has already been referred to. The sessile spikelet - the one destined to produce the future seedis firmly wedged in between the joint and pedicel and protected by them in a very efficient way.

The valves, having ceased to aid in the protection of the spikelet, are hyaline and extremely delicate. The protective function, however, is assigned to the glumes, particularly the lower, which is of a firm, hard texture and considerably longer than the valves which it embraces. When the grain is mature and the spikelet is shed entire as already noted, it functions as an extra pericarp.

An awn is produced from the upper valve.

Being hygroscopic, twisting movements are effected by changes in humidity, eventually causing the spikelet containing the grain to be buried in the soil. Other genera of the tribe, however, have evolved larger and probably more efficient awns, e.g. Themeda and Heteropogon.

In South Africa, the various species form a characteristic feature of the climax stages of the Eastern Grassveld¹⁾, though they seldom assume dominance

¹⁾ See Bews (1918) for the grass regions of South Africa.

in any considerable area. A.eucomus Nees is confined mainly to moist situations like strem banks and shallow depressions where it often forms small clans. A.Schinzii Hack., A.amplectens Nees and A.schirensis Hochst. var. angustifolia Stapf are more characteristic of the open grass veld and hillsides, where they usually occur in societies with Themeda triandra Forsk., Cymbopogon spp. or Hyparrhenia spp. A.appendiculatus Nees grows chiefly in vleis and along temporary streams in the areas with which I am acquainted, but Bews (1918) states that it is usually a mountain species.

Hackel (1889) notes that shaded situations are essential to the germination of seeds of the Andropogoneae and Bews (1918) points out that deep-rooted, light-demanding pioneer grasses afford the shade necessary for the germination of grasses of the climax stages and are ultimately ousted by them. In the course of my observations, species of Andropogon were frequently observed on dead, or partly dead, tufts of Eragrostis spp. and Aristida spp.

Most of the species enjoy a very wide distribution in South Africa and seem to be indefferent to altitude. Though the genus as a whole is characteristic of the Eastern Grassveld, some species penetrate into the South Western Region (A.eucomus Nees and A.appendiculatus Nees) or into the Sand Veld Region A.eucomus Nees, A.amplectens Nees, A.Schinzii Hack. and A.schirensis Hochst. var angustifolia Stapf.).

A. huillensis Rendle occurs in the Eastern Grassveld Region and again in the Western Region. The invasion course followed by A.gayanus Kunth var.scamulatus Stapf seems to have been along the Western side of the continent, as the only known records (for South Africa) are for S.W.Africa and Bechuanaland. A.filifolius Steud. is more localised and extends from the Eastern High Veld

of Transvaal southwards as far as Kei Mouth. As regards

A.tumidulus Stapf, a record for Barberton is the only
collection made from South Africa. A.appendiculatus

Nees and A.filifolius Steud. are the only species not
recorded for Tropical Africa, and therefore appear to
be endemic to this country.

Economically, the genus is not regarded as of great importance, partly because, despite its wide distribution, the individual plants are usually too sparsely scattered to exert any appreciable influence. As pasture grasses, the species of Andropogon are usually referred to as "sour", i.e. they lose their nutritional value and become unpalatable in the advanced state. Australian species again, described by Turner (1895) all make good pasturage except one or two species which are relished only in the young state. Of the 7 species indagenous to New South Wales, four are regarded as excellent pasture and hay grasses while three species have good feeding qualities only when young (Maiden (1898)). It must be borne in mind, however, that the genus has a wider interpretation with these authors, and that at least some of the species referred to may be excluded from the genus as defined by Stapf (1934). The same applies to the Americam species reputed for their feeding qualities (Hitchcock (1936)).

METHOD AND MATERIAL

Whenever possible, plants collected in the veld were separated into three or four parts for preservation, so that the herbarium duplicates as well as a specially selected shoot and leaf destined for sectioning, are representative of the same individual plant. Living specimens were preserved in 70 - 80% alcohol, and in most cases it was necessary to remove excessive chlorophyll prior to sectioning.

Several authors (e.g. Vickery (1935), Fisher (1940)) have pointed out that the anatomical features of the leaf vary from base to apex and also according to the position of the leaf on the culm, and that therefore, for comparative purposes, sections should always be cut in the same region of the blade and the leaves selected from the same part of the plant. The principle underlying this rule becomes apparent in the light of Zalenski's law 1) according to which the anatomical structure of the individual leaves of a shoot is a function of their distance from the root system. Zalenski founded this generalisation on his observations which indicate that the total length of vascular bundle per unit area increases from the lowest leaf upwards. The upper leaves of a shoot - those further away from the water supply - possess a more xeromorphic structure than the lower ones. My own observations are in agreement with this statement. In the specimens examined, there is a gradual reduction of water storage tissue and a corresponding increase of vascular tissue

¹⁾ Discussed by Arber (1934) pp. 305 - 306.

in the culm leaves as one proceeds upwards from the base. The same applies to an individual leaf if a series of sections is cut from the base upwards (vide p.25). Following Burr and Turner (1933), Vickery (1935), Goossens (1938) and Fisher (1940), I have used only mature basal leaves 1) in the present study, and the sections were cut in the upper portion of the basal third of the blade. 2)

Transverse sections were all hand-cut, as microtome sections have not proved entirely satisfactory (Burr and Turner (1933), Vickery (1935), Goossens (1938) etc.). A safety razor blade of the "Gillette" type gave better results than the hollow ground razor. A relatively thick section will in most cases reveal the different tissues with sufficient clearness, but it is essential that it should be cut absolutely transverse.

Leaves of herbarium specimens were boiled in water for about 5 minutes in order to render the tissues soft for sectioning. The recovery of the tissues of dried material is on the whole satisfactory except for the chlorenchyma which is generally in a state of collapse. This is in agreement with Hackel's observation (1889) that when leaves of the Andropogoneae are dried and subsequently soaked, recognition of the assimilating tissue becomes practically impossible.

¹⁾ This was not possible in the case of A.Schinzii Hack., as in this species basal leaves are almost invariably wanting in the flowering state. The lowermost culm leaf was selected instead. No appreciable anatomical difference was found, however, between the basal leaves and the lowermost culm leaf.

²⁾ In the case of <u>A.gayanus</u> Kunth var. <u>squamulatus</u> Stapf, in which the leaf is often long petioled, the section was taken at a point one-third of the length of the lamina above its basal expansion.

Yet I found that the chlorenchyma of some specimens recovered remarkably well. The extent of recovery varies with the different species, but in my opinion depends it watries a great deal on the drying process.

Prolonged drying in a damp atmosphere promotes the growth of moulds and the decay of tissues. Old, brown leaves also give very poor results.

Shoots with at least two sheaths were selected for sectioning. A section was made a few millimeters below the ligule of the outermost sheath and again at its base, in order to ascertain whether the sheath was split throughout its length.

For the study of the epidermis a strip was taken from the basal third of the leaf blade, between the margin and midrib. It is easily pared off with a sharp razor blade, if the leaf is folded lengthwise and held in the left hand, stretched tightly over the left thumb-nail.

In order to clarify the tissues, sections were immersed in Chodat's Eau de Javelle for a few minutes. Permanent mounts were then transferred to 50% glycerine and after a while to 100% glycerine. Sections were mounted in glycerine jelly containing a little safranin which stains lignified tissue bright red within a few hours.

Camera lucida drawings of representative mounts were executed in India ink on white board (bristol board being unobtainable at present) and photographed by me for duplication. Drawings of the low-power magnifications are partly schematic and intended to show the shape of the leaf and the distribution of the various tissues. Solid black indicates stereome and the shaded portions (which unfortunately do not show up in some photographs) chlorenchyma, while colourless tissue is

left blank. Third order bundles are represented by a small circle, while those of a higher order are shown with vessels. As regards the transverse sections of the shoot, a similar scheme has been followed except that chlorenchyma is not shown. The drawings of high-power magnifications are more exact, and assimilating cells are stippled over part of the illustration.

DIAGNOSTIC CHARACTERISTICS OF THE GENUS

(a) Macroscopic Vegetative Characters.

All the species studied are perennials and the tufted habit is a constant feature of the genus.

Distinct rhizomes are seldom produced (except occasionally by individuals of A.appendiculatus Nees), hence the innovation shoots are crowded together into a dense tuft.

The culms, generally 3-6-noded (many-noded in A.gayanus Kunth var.sqaamulatus Stapf) are usually slender (stout in A.gayanus Kunth var.squamulatus Stapf and A. huillensis Rendle), always erect, and leafy in A. amplectens Nees, A. gayanus Kunth var. squamulatus Stapf and A.Schinzii Hack .; in the remaining species the culm leaves are much reduced upwards. Simple culms are characteristic of A.schirensis Hochst.var.angustifolia Starf and A.filifolius Steud .: in the other species branches are usually produced from the middle and upper Secondary branching seldom occurs except in nodes. A. eucomus Nees, A. huillensis Rendle and A. Schinzii Hack. The branching habit is strongly developed in the latter, often giving the plant a suffrutescent appearance. The internodes are terete and glabrous in all species. are confined mainly to the base, except in A. Schinzii Hack., which usually has no basal leaves in the reproductive stage - a feature also used by Stapf (1900) in his key.

Basal leaf sheaths are distichous and prominantly keeled in A.appendiculatus Nees, A.eucomus

Nees and A.huillensis Rendle, a condition associated with permanently folded leaf blades and a strongly compressed shoot (Figs.3,6,9). (The shoot of A.eucomus Nees is usually much more compressed than is shown in Fig.6). In the the sheaths, remaining species,/though keeled in most cases, are tight and have their margins distinctly overlapping - a feature of rounded and cylindrical shoots as was also noted by

Fisher (1940). In this respect, mention must also be made of A.tumidulus Stapf with its peculiar inrolled sheath-margins (Fig. 23). It is regretted that more material of this species could not be obtained, but all the shoots available for sectioning showed the same peculiarity; that this feature is diagnostic for the species, would, however, be a rash statement. Leaf sheaths are split throughout their length in all species.

rounded. It shows very little variation from species to species, and is consequently of small diagnostic importance.

Except in a few cases, the leaf blades show little variation. In A.amplectens Nees the culm leaves are characteristically amplexicaul and broad, rounded and subcordate at the base. The leaves of A.filifolius Steud. are long, wiry and convolute; A.gayanus Kenth var. squamulatus Stapf is the only South African species of which the leaves are frequently long petioled. The leafblades of the remaining species (including the basal leaves of A.amplectens Nees) are linear and usually permanently folded in A.appendiculatus Nees, A.eucomus Nees and A. huillensis Rendle. In A.amplectens Nees, A.schirensis Hochst. var angustifolia Stapf, A.Schinzii Hack. and A.distachyus Linn. the blade tapers into a fine setaceous In all the species the leaf-margins are scabrid owing to microscopic emergences, but the degree of roughness varies much within the species, even in the leaves of the same plant. Hairs and other emergences will be discussed under the head "Leaf-anatomy".

Although Burr and Turner (1933) attach some importance to the features of the roots, no specific variations were found in these organs. It may be noted too, that the root system is usually very incomplete and poorly represented in herbarium specimens.

(b) Leaf-Anatomy

Outline and Thickness of the Blade

The outline of the leaf as seen in transverse section is regarded by Burr and Turner (1933),

Vickery (1935) and Fisher (1940) as a major diagnostic feature. In Andropogon, however, the outline shows so little variation as to be relatively unimportant.

Usually both surfaces are flat, or the adaxial surface slightly undulating (A.eucomus Nees, A.huillensis Rendle, A.schirensis Hochst.var. angustifolia Stapf - Figs.4,27).

In A.Schinzii Hack. and A.schirensis Hochst. var. angustifolia Stapf a narrow groove frequently occurs abaxially adjacent to the main bundles and not between them (Figs.24, 27). This feature is, however, not constant.

Folded leaves appear distinctly V-shaped in transverse section and are generally associated with an acute keel (Fig. 4). A narrow "V" is characteristic of A.appendiculatus Nees, A.eucomus Nees and A.huillensis Rendle Figs. 1, 4, 7). In the other species the "V" is usually much wider and sometimes vaguely distinguishable, especially so in the almost fully expanded leaf of A. gayanus Kunth var. souamulatus Rendie Stapf (Fig. 13). The typical leaf of A.filifolius Steud. is unique in this respect and distinct from any other species in the genus in that it is keel-less and appears circular in outline, with a deep, narrow groove opposite the midvein, representing the adaxial surface (Fig. 19). Fig. 19A represents a broad-leaved specimen (Pole-Evans 1009) of the same species in transverse section. (1935) mentions three Australian species of which the leaves are broad in one locality and filiform in another.

All the species are thin-leaved. In relation to the width of the blade, the leaves of A.huillensis Rendle, A.distachyus Linn. and A.tumidulus Stapf are the thickest, while the thinnest leaves occur in A.gayanus Kunth var.squamulatus Stapf.

Vascular Bundles

The vascular bundles are situated at more or less regular intervals, and run parallel through the mesophyll from the base to the apex of the blade. can be classified into different orders according to their degree of development. Pee Laby (Vickery 1935) recognised five different orders, but since the distintions between his third, fourth and fifth orders are somewhat arbitrary, his system has not been followed by succeeding Burr and Turner (1933) again, distinguish three orders, viz. the midrib, the principal and secondary bundles, but as Fisher pointed out, the midrib bundle does/differ appreciably from the principal bundles, this division also not satisfactory. The sheme of Lewton-Brain (1904), which was also adopted by Vickery (1935), Goossens (1938) and Fisher (1940), seems to be the most practicable and is used in the present study. Three bundle-orders are regognised, viz. 1) those of the first order which are characterised by the presence of both protoxylem and metaxylem vessels, 2) second order bundles with only metaxylem vessels and 3) bundles of the third order in which neither protoxylem nor metaxylem vessels are present.

Even this system, though hitherto the most satisfactory for practical purposes, does not always eliminate the difficulties presented by borderline cases. Several authors (Vickery (1935), Goossens (1938) and Steyn (1942) have drawn attention to the fact that bundles

Anastomoses are, however, not infrequent. See Fig. I, p.25.

of a lower order show a tendency to develop into those of a higher order. In Andropogon such transitional stages (usually from the third to the second order) are not infrequent, which often makes it difficult to decide to which order a bundle belongs. Some large third order bundles approach the condition of the second order so are at the same time closely and/xxx so remote from the small third order bundles in appearance (e.g. Fig.1), that one feels tempted to make a distinction between them. thus establishing The various bundle orders represent four orders. different stages in the development of the vascular bundles, and as growth does not take place by a series of abrupt changes, but is rather the result of an infinite number of infinitesimal changes, one stage passes imperceptibly into the next. Any attempt, therefore, to delimit various stages of development of a growing entity, must necessarily be arbitrary. For this reason bundle orders can be multiplied ad Steyn (1942), for instance, distinguishes libitum. six bundle orders in Elyonurus, but notes that this classification has little or no practical value.

Normally, the bundles are surrounded by an inner or mestome sheath which is thick-walled and an outer parenchymatous sheath. In the Maydeae, Andropogoneae and some Paniceae, however, the mestome sheath is absent (Schwendener (1890), Arber (1934)), in which case the outer sheath often becomes thick-walled and assumes the character of the inner sheath. This is the condition which prevails in the present genus. The sheaths of possibly all third order bundles (at least in the species for which fresh material could be obtained) contain chloroplasts. In some species also those of the fist order bundles are chlorophyllaceous. Chlorophyll in the bundle-sheaths cannot always be clearly recognised in dried material and is consequently of little use in

an anatomical key. The shape and structure of the vascular bundles show no constant variation in the species of the genus.

The ratio of the first to the third order bundles is sometimes regarded as a useful guide in the identification of grasses. Theron (1936), for instance, makes extensive use of it in his key. Fisher (1940), though attaching some value to this feature, warms that it is not of prime importance and should be used in conjunction with other characters. In Andropogon this ratio is very variable and in most species varies from 3-7. A.gavanus Kunth var.squamulatus Stapf is the only species which, in this respect, can in most cases readily be distinguished from the others. It usually has a large number of third order bundles between those of the first order (generally 7-13), but as few as 5 have also been observed.

Midrib

In Andropogon the leaves of all the species are distinctly keeled with the exception of A.filifolius

Steud., in which case the midvein can be distinguished only by reference to its position (Figs. 19, 19A). In all the other species the keel is accompanied by an adaxial tissue of colourless parenchyma which is roughly triangular in transverse section. The amount of colourless tissue is variable within the same species, especially so in the species of which the leaf in cross section shows a narrow "V" (A.eucomus Nees, A.huillensis Rendle and A.appendiculatus Nees). In these species that tissue is also less abundant than in the others (Figs. 1,4,7). In the former group the keel is small and acute, while the wide "V" is associated

associated with an obtuse, rounded keel.

The presence of absence of an adaxial stereome strand above the midvein is a reliable fax feature and of diagnostic importance. This strand may, however, be continuous or interrupted in the same species. In A.appendiculatus Nees and A.filifolius Steud. it is invariably absent. The position of the motor cells in the midrib region is determined by the absence or presence of an adaxial stereome strand: in the former case they are situated opposite the midvein, and in the latter they are arranged on either side of the stereome strand and are said to be flanking the midrib.

Besides giving mechanical strength to the blade, the adaxial stereome opposite the midvein also prevents the loss of water from the water storage tissue It is interesting to note that in Andropogon in those species which show a considerable development of colourless parenchyma at the midrib, this stereome strand is invariably present (e.g.Figs.10,13). appendiculatus Nees, with colourless tissue at the midrib relatively small or sometimes absent, the motor cells are opposite the midvein and the stereome is lacking (Fig.1). It is therefore possible that the stereome in this region is not so much an innate, specific character, but a response to climatic conditions in leaves which contain a large amount of water storage tissue at the midrib. This view receives support from facts observed in A. eucomus Nees and A. huillensis Rendle. In these species, a section cut at a point one-third of the length of the blade above the ligule, usually shows an arrangement similar to that in A.appendiculatus Nees. In many cases, however, a series of sections lower down shows a gradual transition towards the other condition, viz. with the motor cells in a flanking position, and

interrupted by a stereome strand. Fig.I shows how the conspicuous motor cells at D (just below the middle of the blade) gradually lose their prominence as the amount of colourless parenchyma increases towards the base of the leaf, until they are finally replaced by stereome tissue (Fig.IA).

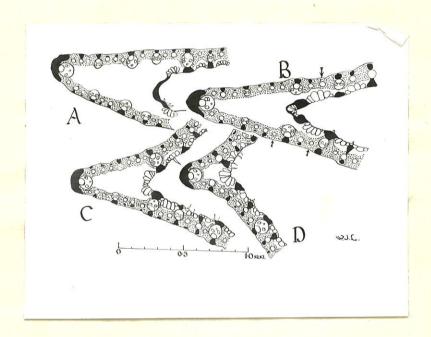


Fig. I

A.eucomus Nees: Four sections from the same leaf cut at different hights from A upwards, showing the arrangement of the motor cells at the midrib in relation to the amount of colourless parenchyma.

Note also anastomoses: from A to B three new bundles, indicated by arrow-heads, have appeared.

Other leaves of the same plants do not show this transition, but retain the same arrangement of tissues throughout the blade. In the latter case, water storage tissue at the midrib is small throughout. If the presence of a stereome strand above the midvein is the dependent on the amount of water storage tissue below it, as the above observations tend to indicate, then as a diagnostic feature, its value is only relative.

Lysigenous cavities in the colourless

parenchyma at the midrib have been observed in the

leaves of A.eucomus Nees and A.huillensis Rendle.

Their taxonomic value in the present genus is doubt
ful as _____all the leaves of the same plant/reveal

this feature.

Chlorenchyma

Grasses can be divided into two groups depending upon the arrangement of the chlorenchyma in In the first group the cells are irregularly the leaf. packed, without conforming to any distinct pattern; in the second class the cells are regularly arranged around the vascular bundles with their long axes radiating from the centre. Intermediate forms, however, frequently occur as was observed by Fisher (1940). arrangement of the chlorophyll tissue is considered to be a valuable diagnostic character (Vickery (1935), Goossens (1938), Fisher (1940)), but in the present genus it shows no appreciable variation between the different species and is consequently of no systematic The typical condition is an arc (usually a single layer) of cells surrounding each vascular bundle and extending irregularly towards either epidermis. Two adjacent arcs of chlorenchyma may be either adjoining or separated by a single row of larger, rounded cells, stretching across the width of the blade, which are less densely packed with chloroplasts or even colourless. In A.Schinzii Hack. this occurs very seldom. Intercellular spaces do not occur except under the stomata.

The radiating arcs of chlorenchyma are always interrupted in the case of girdered bundles.

The arcs surrounding ungirdered (third order) bundles

may be interrupted by an abaxial stereome if present.

A water storage tissue consisting of one or more rows or irregular clusters of colourless cells in the lateral part of the blade below the motor cells (e.g. Figs.1,4,7) occurs in most species, but poorly developed or absent in A.amplectens Nees, A.Schinzii Hack., A.distachyus Linn. and A.tumidulus Stapf. It is more abundant in the region adjoining the midrib and gradually diminishes as the blade narrows down towards the margin. Though variable in amount within the same species, this tissue may serve as a guide in recognising certain species.

Margin

The features of the maggin are regarded by Fisher (1940) to be of considerable diagnostic value in the Chlorideae. The variations met with in Andropogon are also remarkably constant and may be employed with advantage in the identification of species.

Seen in transverse section, the blade gradually tapers from the midrib towards the margin, where it terminates in a variety of shapes. The tip may lie on the line intermediate between the two surfaces, giving it a symmetrical outline (e.g. A. distachyus Linn., A.schirensis Hochst. var.angustifolia Stapf, Figs.10,27), or towards the adaxial surface in which case it appears bevelled (e.g.A.appendiculatus Nees, A.eucomus Nees, Figs. 1,4). The tip may be obtuse or rounded (A.gayanus Kunth var.squamulatus Stapf., Figs.13...), or acute (A. amplectens Nees, Figs.16).

The margin is reinforced with a sub-

epidermal stereome, a mechanical tissue which is independent of the ultimate vascular bundle and varying in extent. In A.amplectens Nees and A.huillensis Rendle, for instance, it usually extends to below or beyond the ultimate bundle abaxially (Figs.16,7), while in others, e.g. A.distachyus L. and A.Schinzii Hack. there is no appreach to encirclement (Figs.10,24). A submarginal stereome as described by Fisher (1940) has not been observed in the genus.

Epidermis

Several authors (e.g.Goossens and Theren (1934), Phillips and Bredell (1937) and Fisher (1940)) have employed the features revealed by the epidermis with remarkable success in their identifications.

In all the species under discussion the epidermis is complex in the structure and arrangement of the elements of which it consists. The following elements can be distinguished: ripple-walled cells, suberised and silicified cells, stomata, motor cells and emergences.

(i) Ripple-walled Cells.

In the stripped abaxial epidermis these elements stand out conspicuously both as regards their size and the area they occupy. They occur in wide bands between the files of short elements, are rectangular in shape and arranged with their long axes parallel to the **xxxxiixx* vascular bundles. The lateral walls are strongly rippled, thus increasing the surface of contact and adding to the rigidity of the *bissue*. The width of the individual cells gradually decrease towards the outer files of each band. A file of ripple-walled cells is frequently interrupted by one or two small cells which belong to a

different catagory and will be discussed later. Outgrowths from or excessive arching of the outer cell walls give rise to papillae in some species. Tubercle-based hairs also occur in the region of the ripple-walled cells.

(ii) Suberised and Silicified Sells.

Short elements are arranged in longitudinal files adjacent to the vascular bundles. One file is characteristic for third order bundles, but one to several files usually occur adjacent to those of the first order. In the same file a more or less square cell, often with undulating lateral walls and with a dense content, usually alternates with a smooth-walled cell which is clear and transparent. The former is a suberised and the latter a silicified cell. Files of ripple-walled cells are at intervals interrupted by either one ENERT suberised short cell or by two cells of which the upper is silicified and the lower suberised.

The shape of silicified cells is variable and has been used in the identification of species in the Chlorideae (Fisher (1940)) and Sporobolus (Goossens (1938)).

In Andropogon, however, the dumb-bell shape is characteristic of all the species, although the lateral walls may occasionally show a small bulge (A.Achinzii Hack.

Fig.25), or the shape may be so modified as to become almost cruciform in some specimens of A.gayanus Kunth var.

squamulatus Stapf.

A frequent modification of the short cell is the bulbous-based hair or asperity, which will be considered under the head "Emergences".

(iii) Stomata

In all the species studied, stomata are more numerous abaxially. In <u>A.schirensis</u> Hochst. var. angustifolia Stapf, <u>A.Schinzii</u> Hack., <u>A.distachyus</u> Linn.,

A.gayanus Kunth var. squamulatus Stapf and A.tumidulus
Stapf stomata on the adaxial surface were absent inpractically
every specimen investigated, while in A.amplectens Nees
they were only once observed in a very hairy specimen.

Fisher (1940) observes that in the Chlorideae those species without adaxial stomata have a considerable development of water storage parenchyma. In Andropogon this applies only to the colourless tissue at the midrib; as regards the lateral part of the blade, just the reverse appears the be the case. The only species in which adaxial stomata occur regularly (A.appendiculatus Nees, A.eucomus Nees and A.huillensis Rendle) are usually characterised by a (sometimes conspicuous) water storage tissue in the lateral region of the blade. In this genus the absence of adaxial stomata seems to be correlated, perhaps quite incidentally, with open leaf-blades which exhibit a wide "V" in transverse section.

A.amplectens Nees) longitudinal rows between the nerves; their structure in the genus under consideration is very uniform and where variations occur, they are not specific. That their distribution is of no systematic value was asserted by Hackel (1882) and quoted by Grob (1896). This statement is, however, somewhat open to question in view of Fisher's observations (1940) with regard to the Chlorideae and the features revealed in Andropogon.

(iv) Motor Cells

Bews (1918) remarks that in Andropogon
the thin-walled cells between the patches (strands) of
sclerenchyma on the upper surface function rather as
water storage cells than as motor cells. Though this
is no doubt true, because the rolling of leaf-blades is
not a characteristic of this genus, I propose the term
"motor cells" by virtue of their position and not of their

function. The term "water storage cells" would also include hypodermal water storage parenchyma. The leaf may, however, fold from the midrib in some species, in which case the term "motor tissue" for the parenchymatous epidermal cells of this region is appropriate both as regards position and function.

Duval-Jouve, who first described these cells, believed that the rolling and folding of the leaf was caused by their degree of turgescence. His theory was convincing in his time, but has been disputed by recent writers. Arber (1934) believes that at least in some cases movements are due to changes in the leaf fibres and points out that sometimes movements take place perfectly well after the motor cells have been removed.

leaves regulate water loss by shutting off the stomata from direct sunlight and a dry atmosphere, is a view expressed by some authors (e.g. Eames and Macdaniels (1925)). That this is not always compatible with observed facts, has been shown by Vickery (1935), Fisher (1940) and De Wit (1941) by pointing out that in most of the Australian grasses and in all the South African species studied, the abaxial epidermis is more copiously provided with stomata than the adaxial surface; and this also applies to all the species of Andropogon as noted above. The stomata are therefore no less exposed in the rolled or folded leaf than in the expanded blade.

The position, relative size and shape of the motor cells constitute reliable diagnostic characters which were used by Theron (1936), Goossens (1938) and Fisher (1940). In Andropogon the motor cells at the midrib occur in groups of 4-9 either opposite the midvein or on either side of the midrib as already noted (p.24). In the lateral part of the blade they are interrupted by adaxial stereome strands. In A.distachyus Linn. and A.amplectens Nees (Figs. 10, 16), in which usually only the

first order bundles are associated with an adaxial stereome strand, the motor cells form a continuous band between these bundles. In others (e.g. A.huillensis Rendle and A.Schinzii Hack., Figs.7, 24) the interruptions occur at shorter intervals. In the former case they show but little variation in shape and size (except those in the extreme files of each band), but in the latter form, where the group is small, a greater degree of differentiation takes place. In most cases a central cell (sometimes twp) which is deeper than its neighbours and usually pear-shaped, can be clearly distinguished.

The relative depth to which motor cells penetrate into the leaf is often a reliable character in identification. In A.distachyus Linn., A.tumidulus Stapf and A.Schinzii Hack. (Figs.10,21,24) the larger cells occupy about one-half of the thickness of the blade; in A.eucomus Nees, A.huillensis Rendle and A.amplectens Nees this fraction is from one-fifth to one-third (Figs. 4,7,16).

In surface view motor cells are large and rectangular or hexaginal in shape, usually straight-walled in some species (e.g. <u>A.amplectens</u> Nees and <u>A.tumidulus</u> Stapf, Figs. 17,22)) and rippled to a varying degree in others.

(v) Emergences

Various authors (Hackel (1882), Burr and Turner (1933), Vickery (1935) and Fisher (1940)) have found epidermal hairs to be very variable and warned that not too much reliance be placed upon them. Most species of Andropogon are glabrous and hairs, when they do occur, are never very abundant. A.amplectens Nees, however, shows every conceivable degree of hairiness, from quite glabrous individuals to forms with a thick, downy cover of tubercle-based hairs. Asperities are more frequently

met with in the genus.

- (a) Asperities (Bulbous-based Hairs). These microscopic, unicellular emergences are responsible for the roughness of the blade along the margins and also on the The basal part of an asperity is globular or oval and/tapers rapidly to a sharp point at the apex. The points are usually directed towards the apex of the blade, but in A. huillensis Rendle and to a lesser extent in A.eucomus Nees, they have often been found to point in and directions. Asperities are more frequent in the files of short elements where an asperity replaces a silicified cell, but they also occur where a file of ripple-walled cells is interrupted by short elements. In A.huillensis Rendle, A.eucomus Nees and A.appendiculatus Nees two distinct forms occur (though not always in the same specimen), viz. one with a large, oval base representing a modified silicified cell and confined mainly to the files of short elements; the other is much smaller, with a square base (or frequently shorter than broad) observed only in the regions of ripple-walled or motor cells. form is evidently a modification of a suberised cell.
- (b) Tubercle-based Hairs have been found in a nimber of species, but they occur more regularly in A.eucomus Nees, A.huillensis Rendle and in the hairy forms of A. amplectens Nees. They are usually more abundant on the upper surface. On the adaxial surface they are confined to the motor cell regions, and to the ripple-walled cell areas on the abaxial epidermis. In either case, the surrounding epidermal cells are thick-walled and irregular and so modified/to form a cushion into which the base of the hair (sometimes two) is embedded.
 - (c) Bicellular Hairs have been observed only on the

the adaxial epidermis of <u>A.distachyus</u> Linn. The basal cell is small and globose and subtends a delicate, sharp-pointed hair.

(d) Papillae - Where these occur, they are much more constant in the same species than hairs and of real systematic importance. They are confined to the outer walls of the ripple-walled cells and are therefore a feature of the abaxial epidermis. In Andropogon two forms can be distinguished. The large, round papilla, covering the entire width of the ripple-walled cell, is formed by the excessive arching of the outer cell wall and is characteristic of A.schirensis Hochst., var. angustifolia Stapf, A. Schinzii Hack. (Fig. 25), A.distachyus Linn. and A.tunidulus Stapf (omitted in other figures for sake of clarity). In these species, the papillae alternate regularly with the stomata in the same files of ripple-walled elements. The papillae of A.gavanus Kunth var. squamulatus Stapf, again, are slender outgrowths of the outer cell wall and as many as eight may be counted on a single ripple-walled cell seen in surface view (Fig. 14). These papillae seen in transverse section usually attain a greater length than indicated in Fig. 13.

DESCRIPTION OF THE GENUS ANDROPOGON Linn.

Inflorescence of digitate spike-like racemes terminating the culm, or when the culm is branched, the branches of the culm; racemes 2-nate (rarely solitary or 3-nate) or corymbose. subtented by a spathe or spatheole and frequently collected into a false panicle, ciliate to densely villous. Spikelets 2-nate, those of each pair differing in sex and usually also in shape and size, or those of the lowest pair of the lowest raceme homogamous (Sor imperfect), one sessile, the other pedicelled on the articulate fragile rachis. Joints and pedicels filiform or thickened upwards, if stout then the tips more or less cupular or auricled. Sessile spikelets falling with the pedicel of the pedicelled spikelet and the adjacent internode of the rachis; dorsally or laterally compressed, nearly always awned; callus short, mostly obtuse, shortly bearded; glumes equal or subequal, enclosing the valves, the lower varying from coriaceous to membranous, flat or concave or channelled on the back, with, at least from the middle upwards, sharply inflexed marging, 2-keeled; the upper boat-shaped, keeled upwards, 1-3-nerved, entire or 2-toothed, sometimes produced into a short bristle; valves 2, hyaline, ciliate or ciliolate, rarely glabrous; lower lanceolate, acute, empty; upper 2-fid or 2-lobed with an awn from the sinus, subtending the bisexual flower; pale a hyaline nerveless scale, Lodicules 2, minute, glabrous. Stamens 3. laterally exserted; styles terminal. Grain narrowly lanceolate to oblong in outline, subterete to plano-convex; embryo about Pedicelled spikelets o, half the length of the grain. sometimes barren, or represented by the pedicel only; always more or less dorsally compressed. Glumes enclosing the valves, the lower herbaceous-chartaceous to membranous, usually several-nerved, often ciliate; the upper thinner in texture, acute. <u>Valves</u>, when present, 2, hyaline, ciliate, muticous.

KEY TO THE SPECIES

It was not possible to construct a key based on anatomical features alone. These, where taxonomically reliable, have been used in conjunction with external morphological characters, as Goossens (1938), Papendorf (1940) and Fisher (1940) have done.

	1.	Racemes 3-many, fascicled; shoot compressed; leaf	
		blades folded in the bud	2
}		Racemes paired, very rarely solitary or 3-nate;	
		shoot cylindrical or rounded; leaf blades rolled	
		in the bud, or if apparently folded, then blades	
		filiform (A.filifolius)	4
	2.	Racemes silvery plumose; pedicelled spikelet	
		often suppressed or barren	3
		Racemes purplish or straw-coloured, not silvery	
		plumose; pedicelled spikelets always of (1) APPENDICUIATUS	
	3.	Delicate plants, usually small; pedicelled spikelets	
		completely suppressed; cilia on joints and pedicels	
		several times longer than these (2) EUCOMUS	
		Course, usually robust plants; pedicelled spikelets	
		suppressed or reduced to an empty glume oro"; cilia	
		on joints and pedicels as long as these or slightly	
		longer (3) <u>HUILIENSIS</u>	
	4.	Lower glume of sessile spikelets dorsally flattened,	
		not wedged in between joint and pedicel, not deeply	
			5
		Lower glume of sessile spikelet laterally compressed,	
		wedged in between joint and pedicel, deeply grooved	
		on the narrow back with the keels often approaching	
and the			6

5.	Lower glume flat on the back; Keels winged;	
	as seen in surface view a single large papilla	
	is borne on a ripple-walled cell, papillae	
	alternating with the stomata in the same file	
	of ripple-walled cells (4) DISTACHYUS	
	Lower glume with a shallow median groove; keels	
	not winged; as seen in surface view several	
	slender papillae are borne on a ripple-walled	
	cell, papillae not alternating with the stomata (5) GAYANUS	
6.	Leaf blades broad, rounded or subcordate and	
	subamplexicaul at the base (6) AMPLECTENS	
	Leaf blades narrow at the base	7
7.	Leaf blades distinctly filiform, convolute,	
	(very rarely flat), not keeled, circular in	
	transverse section with the adaxial surface	
	represented by a deep groove; pedicelled spikelets	
	12-15 mm. long, rarely shorter 07) FILIFOLIUS	
	Leaf blades linear, 2-10 mm. broad, distinctly	
	keeled, arms of the blade well developed;	
	pedicelled spikelets 7-12 mm. long	8
8.	Joints ciliate up to two-thirds on one side and	
	almost up to the middle on the other (8) TUMIDULUS	
	Joints ciliate throughout on both sides	9
q	Culms branched from the middle and upper nodes;	

leaves scattered along the culm; glumes of the

pedicelled spikelets aristulate (9) SCHINZII

glumes of the pedicelled spikelets not aristulate
(10) SCHIRENSIS

Culms simple; leaves mostly crowded near the base;

DESCRIPTION OF THE SPECIES

Note - The bracketed symbols following the specimens cited, refer to the respective herbaria where the specimens are deposited. The following abbreviations have been a used:-

- A. Albany Museum Herbarium, Grahamstown.
- D. Natal Herbarium, Durban.
- M. McGregor Museum, Kimberley.
- N. National Herbarium, Pretoria.
- NU. Natal University College Herbarium, Pietermaritzburg.
- O. University College of the Orange Free State Herbarium, Bloemfontein.
- P. Potchefstroom University College Herbarium.
- S. South African Museum, Cape Town.

LEGEND

- a. asperity (bulbous-based hair)
- a.s. air space
- c. chlorenchyma
- c.c. suberised cell
- k. keel
- 1.c. long ripple-walled cell
- 1.e. abaxial epidermis
- m. margin
- m.c. motor cells
- m.v. midvein bundle
- p. colourless parenchyma (water storage tissue)
- s. stereome
- s.c. silicified cell
- sh. bundle sheath
- st. stoma
- u.e. adaxial epidermis

1b. - first order vascular bundle

2b. - second order vascular bundle

3b. - third order vascular bundle

- stereome (sclerenchyma)

- colourless parenchyma

and chlorenchyma

@ -first order vascular bundle

@ - second order vascular bundle

O - third order vascular bundle

(1) A.APPENDICULATUS Nees, Fl.Afr.Austr.105; Steud.Syn.Pl. Glum. 1.379; Hack. Androp.in DC.Monogr.Phan.vi.436.

A. Ischaemum Thunb. Prodr. Pl. Cap. 20, and Fl. Cap. ed. Schult. 108, not Linn. ex Nees.

Perennial, densely tufted; culms erect, 40-90 cm.long, glabrous, compressed or terete, 4-7-noded, simple below, remotely branched from the upper 2-3 nodes; branches solitary, long, strict, glabrous: Leaves mostly crowded near the base; sheaths glabrous or bearded at the mouth, lower very firm, strongly compressed, keeled, persistent, upper shorter than the internodes, tight; ligules membranous, very short, truncate, ciliolate; blades linear, acute, usually folded, lower 10-30 cm. by 2-5 mm., uppermost very short or obsolete, rigid, glabrous, or hairy at Peduncles generally the base, acutely keeled, margins scabrid. long exserted, glabrous; racemes 2-15, fascicled, unequal, 3-10 cm. long, flexuous, slender, loose; joints 4-6 mm. long, thicker upwards, hairy along the margins, hairs white, tips subcupular with irregularly toothed margins, pedicels similar, more slender, produced into a subulate appendage facing the upper glume. Sessile spikelets lanceolate, 5-7 mm. long, often purplish; glumes subcoriaceous to chartaceous, glabrous, lower acute or acuminate, dorsally concave, keels acute, scabrid or rigidly ciliate, callus scantily to densely bearded; upper glume boatshaped, 1-nerved; lower valve oblong lanceolate, nerveless-3nerved (usually 2-nerved), softly ciliate; upper valve 31/2-41/2 mm. long, bifid, 1-3-nerved, lobes very narrow, ciliate, awn 10-20 mm., kneed below the middle; pale 1-1% mm. long, ciliate; Pedicelled spikelets of, narrowly anthers 1-2 k mm. long. lanceolate, 41/27 mm. long, purplish, glabrous; lower glume acuminate, with a median keel in the upper part; upper 1-3nerved; valves lanceolate, ciliate, lower acuminate, upper muticous.

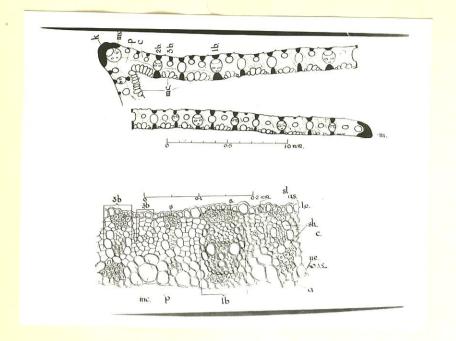


Fig.1

Transverse section of leaf.

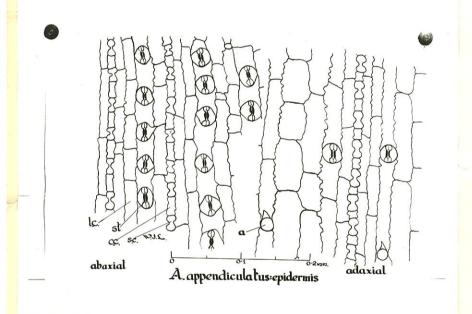


Fig.2

Epidermis

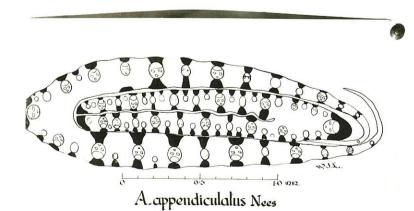


Fig. 3

Transverse section of shoot.

LEAP ANATOMY (Figs, 1, 2).

Leaf distinctly V-shaped, of medium thickness; both surfaces flat or adaxial surface slightly undulating; keel prominent, acute.

Vascular bundles: 3-8 first order bundles; sheath strongly lignified, chlorophyllaceous, interrupted by an adaxial stereome strand; 3-7 bundles of a lesser order between those of the first order; second order bundles girdered; sheath of third order bundles of 5-8 usually unequal parenchymatous cells containing chloroplasts, frequently associated with an abaxial stereome strand and sometimes girdered.

Midrib: Colourless parenchyma very variable in amount, sometimes almost absent; no stereome strand above the midvein.

Chlorenchyma arranged in arcs around the bundles, but not confined to them; arcs often separated by a row of larger cells; 1-2 rows or irregular clusters of water storage cells below the motor cells.

Margin tapering to a (sometimes acute) point on the adaxial side; well-developed subepidermal patch of sclerenchyma present.

Stereome well developed in the keel and margin; first, second and some third order bundles girdered.

Epidermis: Motor cells opposite the midvein and in groups of 5-12 between the adaxial stereome strands, more or less similar, but the outer cells of a group smaller, rounded or oval, rarely pear-shaped, occupying ½-½ of the leaf thickness, usually strongly rippled in surface view; stomata more numerous in the abaxial epidermis, 1-3 rows between the nerves abaxially, 1 row in an outer file of a band of motor cells; 1-2 files of short elements adjacent to first order bundles, 1 file adjacent to lesser nerves, silicified cells dumb-bell-shaped to almost rectangular; asperities on the adaxial epidermis between the nerves.

SHOOT (Fig.3) strongly compressed; leaf sheaths keeled; leaf blades folded in the bud.

DISTRIBUTION :-

Basutoland: Maluti Mts., up to 8,000 ft., Staples 158(N); Mont Aux Sources, Bayer & Mc Clean 317 (N, NU); Leribe, Dieterlen 349 (S); Drakensbergen Stokoe 8343 in N. (N).

Cape Province: King Williams Town: Amatola Mts., 4000 ft., Dver 268 (N); Queenstown: Everett 34 (N), Intabamagwele Mtn., Galpin 2634 (N, A), Fincham's Nek, Galpin 2379 (A, N); Jarrow, near Grahamstown, Burtt Davy 11620; Barkly East; Ben Mc Dhui, Galpin 6896 (A,N,D,S); Barkly East, Greyvenstein 14 (N); Knysna, Farleigh, Keet 12 (N), Groot River, Scott 20198 in N (N); Koude Bokkeveld, Skurfdebergen, Schoongezicht, Schlechter 4500 (2); Grahamstown, Mac Owen 1314 (A), Mountain Drive, Britten 5222 (A); Du Toitskloof, Tyson ? (A,S); Keiskamma Hoek, near Ghulu Kop, Dyer 268 (A,N); Kei River, grassy slopes, Flanagan 1021 (A,N); Bethelsdorp, Paterson 349 (A); Fort Cunynghame, Sim 2731 (A); Komgha, grassy slopes near, Flanagan 1020 (A,S); King William's Town, Perie, Sim 2822 (A); Hex River Valley, Tyson (?)(A); Herschel, Majuba Nek, Sterkspruit, Hepburn 284 (A,N); Rivierzonderend, Schlechter 9895 (A); Mountains near Molteno, Bews 80 in NU(NU); Albert Div., near Gaatje, 5000 ft., Drege ? (S); Transkei, Bazija, 2,500 ft., Baur 2956 Stutterheim, Rogers 12701 (N); Kentani dist., Pegler 82 (N); Herschell Dist. Hepburn 399 (N); Koude Bokkeveld, Skurfdebergen, Schoongezicht, Schlechter 10175 (N); Queenstown, Everett 5 (N).

Natal: Vants Drift, Dundee, Codd 186 (N); Nqutu Hill, mountain sour veld, Codd 239 (N); Umgeni, Rehmann 8652 (A); Van Reenen, Bews 16, 276 and 81 in NU (NU), Wood 7217 (D); Nkandhla, Qudeni Forest Reserve, Fisher & Schweikerdt 40 (D); near Durban, Wood 6049 (D); Estcourt, Pasture Research Stn., 4,000 ft., West 236 (N); Acton Homes, Doidge H20565 in N (N); Mtunzini, Mogg H20027 in N (N); Balgowan, Mogg 3546 (N); Meteor Ridge, Mooi River, Mogg 3388 (N).

Orange Free State: Heilbron, Goossens 438 (N,P,O), 456 (N), Brandmuller 3 (N); Harrismith, Nevadavaal, Rose Innes 6 (N); Senekal, Wonderkop, Goossens 865 (N,P); Bethlehem, Phillips? (N), 3099 (A,N); Kroonstad, Pont 152 (N,O)M; Ficksburg, Raven Hill Farm, Potts 3687 (N,O), Lootsberg, Bosman 128 (P); Senekal, Groot Doornkop, Goossens 885 (N,P), Ferrara, Goossens 952 (P,N).

Transvaal: Pretoria, Muckleneuk Hill, Cronje 14 (N), in vlei, black clay, Louw 863 (N), Skinners Court, Stent 148 in N (N), Wolwekloof, Mogg 15909 (P); Irene, Pole Evans 382 (P,N), 338 (N), 669 (N), Hector? (N); Standerton, Beginsel, Burtt Davy 926 (N); Wakkerstroom, Mountain side, Galpin 10217 (N); Belfast, Dullstroom, Galpin 13030 (N); Between Belfast and Dullstroom, Pole Evans & Van Rensburg? (N); Ermelo, Nooitgedacht, Henrici 1362, 1299, 1284, (all in N), Mavieriestad, Pott 5208 (N), Experimental farm, Burtt Davy 3914 (N), Athole Pasture Research Stn., Norval 52 (N); Lake Chrissie, Pole Evans 1046 (N); Tzaneen, Sampson 141 in N (N); Zwartuggens, Sutton 933 (N); Witwatersrand, Canada, Cohen 871 in Univ. of Witwatersrand Herb. (N), Benoni, Bradfield 372 (P,N), Johannesburg, Burtt Davy 832 (N); Pilgrims' Rest, Pole Evans 3787 (N), Wolmaransstad, Oersonskraal, Sutton 77 (N); Heidelberg, Henley-on-Klip, Stent H21584 in N (N), Leeukuil Pasture Research Stn., Story 3 (N); Riet Valley, Pole Evans 560 (N); Schweizer Reneke, Burtt Davy 1697 (N); Potchefstroom, Boskop, Louw 574 (P), Gerhardminnebron, Louw 893 (P), Wonderfontein, Louw 889 (P,N).

Without precise locality: Boschberg, Mac Owen 116 (A); without to locality, Zeyer 1801(S)

(2) A. EUCOMUS Nees, Fl.Afr.Austr. 104; Steud. Syn.Pl. Glum. ixim i.390; Oliv. in Trans.Linn.Soc.xxix.176; Ficalho & Hiern. in Trans.Linn.Soc.Ser.2, Bott., ii.34; Hack. in Bolet. Soc. Brot. iii(1884)137, and in DC. Monogr. Phan. vi.421; Durand & Schinz, Consp. Fl.Afr. v.711; K.Schum. in Engl. Pfl. Ost-Afr. C.97; Rendle in Cat. Afr. Pl. Welw. ii.146; Stapf in Dyer, Fl.Cap. vii.338; Eyles in Trans. Roy. Soc. S.Afr. v.(1916) 295; Stapf in Prain, Fl.Trop.Afr. ix.230.

Eriopodium Kraussii Hochst. ex Kraus in Flora, 1846, 115 in Beitr. Fl. Cap. - und Natal. 186.

Perennial, densely tufted, slender, 30-90 cm. long, glabrous, 4-6-or more-noded, simple to or beyond the middle, then distantly branched; branches long, very slender, solitary or 2-3-nate, simple or again branched. Leaves mainly basal; sheaths shorter than the intermodes, glabrous or hairy near the mouth, rarely lower down, the lower compressed, keeled, the upper distant, subtumid; ligules membranous, very short, truncate, ciliolate; blades linear, acute, folded, 7-30 cm. by 2-4 mm., glabrous or hairy, pale green; spathe linear, setaceously acuminate, 2-6 cm. long, glabrous, usually exceeding the filiform glabrous peduncle. Racemes 2-8, 2 1/2-4 cm. long, very slender, flexuous, subcrect or nodding, silvery plumose, joints filiform, shorter than the spikelets, silky with soft long (about 10 mm.) hairs; pedicels similar, exceeding the spikelets, barren. Spakelets lanceolate-oblong, 2-3 mm. long, often purplish; glumes membranous, acute; lower nerveless between the scabrid keels, callus minute, long bearded; upper 1-nerved; lower valve nerveless, ciliate; upper lanceolate-oblong, lobes very fine, awn a fine bristle, 12-18 mm. long; pale very minute; anthers % mm. long; grain about 1% mm. long.



Fig. 4
Transverse section
of leaf.

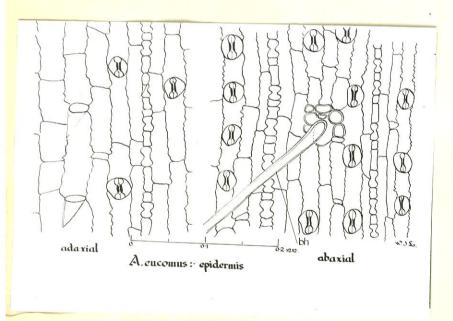


Fig.5
Epidermis

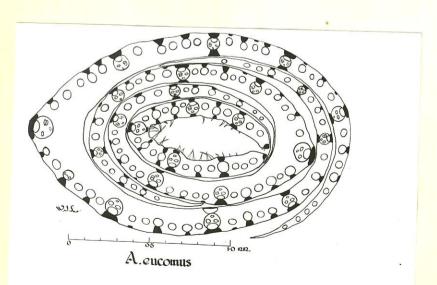


Fig.6
Transverse section
of shoot

LEAF ANATOMY (Figs. 4, 5).

Leaf thin, V-shaped in transverse section, adaxial surface flat or slightly undulating, abaxial surface usually flat; keel acute, prominent.

Vascular bundles - 3-4 first order bundles, girdered, horseshoe-shaped; sheath strongly lignified, interrupted by an
abaxial stereome strand; 3-7 lesser order bundles between those
of the first order; sheath of third order bundles round or
oval and of 6-8 parenchymatous cells, containing chloroplasts.

Midrib - Colourless parenchyma well developed to almost absent
above the midvein; adaxial stereome strand usually absent.
Chlorenchyma arranged in arcs round the bundles but not
confined to them, the arcs often separated by a row of palegreen or colourless cells; rows or small clusters of colourless
cells usually below the motor cells, gradually decreasing in
size and prominence towards the margin.

Margin - The tip usually acute, on the adaxial side; a well developed subepidermal patch of sclerenchyma present.

Stereome - All first, second and large third order bundles girdered; third order bundles, if not girdered, usually associated with an abaxial stereome strand; strongly developed in the keel region, rarely above the midvein (if section is not cut too low); present in the margin.

Epidermis - Motor cells usually opposite, but sometimes flanking the midrib; in groups of 3-14 between the first order bundles, sometimes poorly differentiated; stomata more numerous abaxially, 1-4 rows between the nerves in the abaxial epidermis, usually 1 row in one of the outer files of a band of motor cells; adjacent to the first order bundles 1-2 files of short elements, silicified short cells dumb-bell-shaped; asperities more numerous on the adaxial surface, sometimes heteromorphous, sometimes pointing in different directions; tubercle-based hairs present on both surfaces.

SHOOT (Fig. 6) compressed; leaf sheaths keeled; leaf blades folded in the bud.

DISTRIBUTION: -

Basutoland: Tejatejaneng, Hill Hope, Dieterlen 816 (N).

Bechnanaland: N'gamiland, Curson 216, 651, 245, 61 (all in N); Vlei near Toakhe River at Gomare, Erens 261 (N).

Cape Province: Humansdorp, Kareedouw village, 1000 ft., Fourcade 2533 (N); East London, marshy hollows, Galpin 5850 (A,N); Port St Johns, Wager 8429 in N (N); Port Shepstone, Mogg 13,201 (N); Tulbagh Kloof, Pole Evans 454 (N); Tulbagh, New Kloof, on wet rocks, 900 ft., MacOwan 1691 (A,S); Komgha, grassy places near Kei Mouth, Flanagan 2362 (N); Vryburg, Armoedsvlakte, Mogg 8123 in N (N); Takoon, Burtt Davy 13,948 (N); Clanwilliam, at Olifants River and Villa Brakfontein, Zeyher 47 (N); Port Elizabeth, Schoemanskop, Paterson 548 (A,N), Walmar, Drege 420 (A); Hay Div., at Griquatown, Burchell 2102(A), Witsand, damp hollows, Acocks 2175 (M); Steenbras River, sandy place at top of cliffs, Acocks 3936 (M).

Natal: Durban, 50 ft., Wood, 6004 (D,N), Rehmann 8650 (A); Umbogimtwini, Agronomist at Umbogintwini (N); Eshowe, Kotze 417 (N); Strydhoek, Tintiva Mts., Doidge 19823 in N (N); Dundee, Vant's Drift, Codd 185 (N); Howick, Shafton, Hutton 122 (A); Estcourt, streambank, West 1601 (D); Zululand, Nohgoma, Gerstner 3875 (D), Enselini, Halse 65 (D,N); Abundant on coastal flats, at 1000 ft., Buchanan 211 (D,N); near Oribi Gorge, in open grassland on Murchison Flats, Mc Clean 293 (D,N); Umlazi River, Drege (S); Champagne Castle, 6,000 ft., Bayer 1246a (N, NU); Signal Hill, near Pietermaritzburg, open grassy slope, rather moist, Bews 37 in NU (NU).

Orange Free State: Heilbron, sandveld, wet situations, Brandmuller 44 (N); Viljoensdrift, Rogers 4816 (A,S)

Tanganvika Territory Kondoa Irangi Dist., Lake Haubi, 5,000 ft., Burtt 1356 (S).

Portuguese East Africa: Mozambique, low-lying sandy soil near river bank, Coster 4573 in 0 (0).

Transvaal: Pretoria, Burtt Davy 1023 (N), fringing vlei, black clay, Mogg 12401 (N); Premier Mine, Rogers 25325 (A,S); Nelspruit, fairly wet land, Liebenberg 2321 (N); Devil's Kantoor, Kaapsche Hoop, Pole Evans 1008 (N); Buffelsspruit, Pole Evans 570 (N); Ermelo, Athole Pasture Research Stn., Norval 137 (N); Pietersburg, Vaalwater, Skead 31 (N); Belfast, Schoemanskloof, Smuts 336 (N); Middelburg, Panplaats, Burtt Davy 13260 (N); Lichtenburg, Malmanie Oog, Burtt Davy 80 (N); Pretoria, Waterkloof, Verdoorn 832 (N,P); Johannesburg, Hutton 249 (A,N), Ormonde, moist, clayey banks of river, Cohen 652 in Wik Univ. of Witwatersrand (N); Potchefstroom, Welverdiend, confined to streambank, often on dead tufts of Eragraostis spp., Louw 9030 Mooi River, in dry vleis, V.d.Westhuizen 250 (P), Le Roux 254 in P (P).

Southern Rhodesia: Salisbury, Eyles 1540 and 1558 (both in 1 N and S); Bulawayo, Gardner 47 (A); without precise locality, Hitchcock 24352 (N).

South West Africa: Otjosongombe, moist clay, Volk 1170 (D).

Howisons Poort, Glass 767 (A,N,S); Dal Josaphat, Tyson 6050 in S (S); Warm Baths, Edwards 677; Dukudukéd, Bayer & Henkel 679; without precise locality, Buchanan 18,108 in N (N); Prior 26448 in S (S).

Bulerland.

(3) A.HUILLENSIS Rendle in Cat.Afr.Pl.Welw. ii.146; Stapf in Prain, Fl.Trop.Afr. ix.231.

Perennial, caespitose, Culms erect, 75-180 cm. high, stout, terete, 5-10-noded, glabrous, smooth, simple up to the third or fourth node. Leaf sheaths firm, tight, glabrous, smooth, , the lowest 8-22 cm. long, compressed, keeled, the remainder terete; ligules short, firm, scarious, ciliclate; blades linear, very long tapering to a fine point, usually folded, up to 30 cm. long and up to 4 mm. wide, firm, hard, the upper much reduced, smooth, glabrous, or sparingly hairy towards the ligules; spathes glabrous, the lowest resembling the preceding leaves; spatheoles narrow, linear-lanceolate to linear, tapering to an acute point, up to 7 mm. long, reddish, at length tightly inrolled. Peduncles at length exceeding the spatheoles or permanently shorter. Racemes 5-12, subdigitate, very slender, 5-8 cm. long, very loose, plumose, flexuous and often nodding with the bare bases up to 6 mm. long, or sessile: joints finely filiform, as long as or slightly shorter than the spikelets, often curved, with fine long (4-6 mm.) silky hairs; pedicels similar, barren or with a subulate glume 1 1/24 mm. long, or with the pedicelled spikelet fully developed. spikelets linear-lance olate, 4-5% mm. long, more or less tinged with purple, glabrous, callus minute; glumes firmly membranous, the lower 2-mucronulate, nerveless, more or less sunk between the slightly scaberulous keels, the upper 1-nerved, mucronulate; lower valve linear-oblong, 3-4 mm. long, hyaline, ciliate; upper narrowly linear-lanceolate, 2-dentate or 2-lobed, 3 mm. long, ciliolate; awn a fine bristle, 8-16 mm. long, usually twisted and bent below the middle; pale minute; anthers 1 1/2 mm. Pedicelled spikelets (if fully developed) of, narrowly long. lanceolate, 5-6 mm. long, purplish, glabrous; lower glume mucronate, 5-7-nerved, keels rigidly ciliate from the middle upwards; upper lanceolate, acuminate, 1-nerved, ciliate; lower valve lance olate, faintly 1-3-nerved, ciliolate; upper 1-nerved, ciliolate, muticous; pale nerveless, truncate; anthers 2 mm.long.

A.HUILLENSIS RENDIE

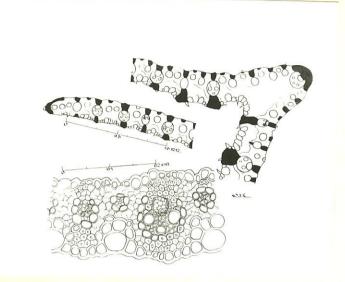


Fig.7
Transverse section of leaf.

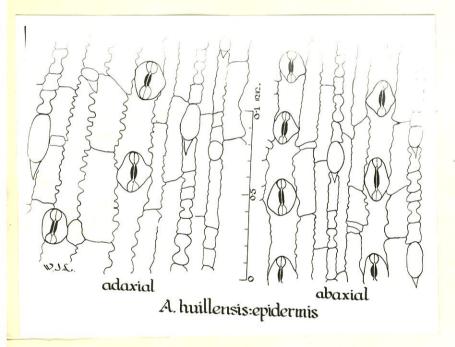


Fig.8
Epidermis

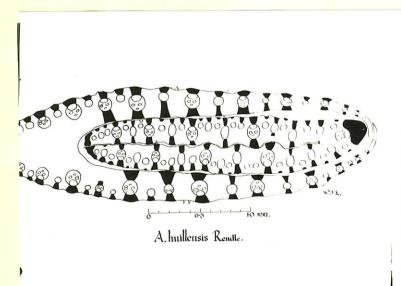


Fig.9
Transverse section of shoot.

LEAF ANATOMY (Figs. 7. 8).

Leaf of moderate thickness, V-shaped, abaxial surface flat or slightly undulating; large, acute keel.

Vascular bundles - About 5 first order bundles, sheath strongly lignified, horse-shoe-shaped, interrupted by an abaxial stereome strand; 2-5 bundles of a lesser order between those of the first order; sheath of third order bundles of 5-8 assimilating parenchymatous cells, not interrupted.

Midrib - Colourless parenchyma usually well developed above the midvein, very rarely absent; stereome strand accasionally present above the midvein.

Chlorenchyma regularly arranged but not confined to the radiating cells round the vascular bundles; water storage tissue in the lateral part of the blade usually well developed below the motor cells, 1-3 cells deep.

Margin obtuse or rounded and tapering towards the adaxial surface; a well developed subepidermal patch of sclerenchyma. Stereome well developed in the keel; first, second and large third order bundles girdered; adjacent to some smaller third order bundles.

Epidermis - Motor cells opposite, rarely flanking the midrib, and in groups of 5-7 between the main bundles, central cell pear-shaped or rounded, occupying \$-\frac{1}{2}\$ of the leaf thickness; stomata in 1-2 rows between the nerves in the abaxial epidermis, in the adaxial epidermis occasional in the outer files of motor cells; 2 files of short elements adjacent to most first order bundles, 1 file adjacent to bundles of the third order; silicified cells dumb-bell-shaped; asperities on both surfaces but more numerous adaxially, often distinctly heteromorphous and pointing in all directions; tubercle-based hairs on both surfaces.

SHOOT (Fig. 9) compressed; leaf sheaths keeled; leaf blades folded in the bud.

DISTRIBUTION: -

South West Africa: Okavango River, Anderna, Volk 2154 (D).

Southern Rhodesia: Salisbury, 4800 ft., swamp grass, Eyles 2935 (N).

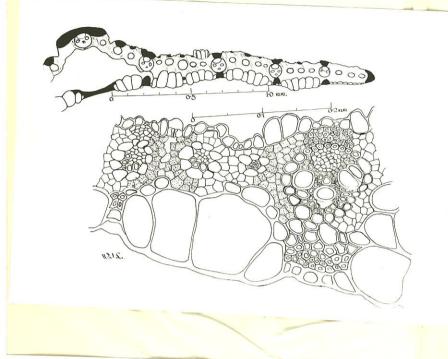
Transvaal: Johannesburg, Hutton 254 (A,D,S); Witwatersrand, on mine dump, Crown Mine, Cohen 653 (N); Krugersdorp,
Louw 922 (N,B); Middelburg, Pan Plaats, Pan Stn., Burtt
Davy 13264 (N); Between Lydenburg and Dullstroom, Pole Evans
3811 (N); Potgieters Rust, Riebeeck West, in vleis, Mac
Donald 60 (P), Pyramid Estate, on granite soil, \$ 5600 ft.,
Galpin 8884 (N); Warm Baths, Bell 8125 in N (N); Nelspruit,
wet land or low-lying ground, Liebenberg 2320 (N);

Natal: Mhlambanyati Pan, Zululand, Michelmore 50.

On anatomical grounds, this species is inseparable from A.eucomus Nees to which it is closely allied, but from which it differs in its more robust growth, much shorter hairs on the joints and pedicels and the presence of empty glumes on the pedicels. It is also, though though more remotely, related to A. appendiculatus Nees in which the pedicelled spikelets, are, however, always fully developed.

(4) A.DISTACHYUS Linn. Sp.Pl. ed. I.1046; Jacq.Ic.iii.630; Hochst, Gram. Austr. iii.2; Sibth. & Sm.Fl. Graec.i.53.t.69; Kunth, Enum.i.491; Steud. SynPl. Glum.i.372; Hook.f.in Journ. Linn. Soc. Bot. vii.231; Hack. in DC. Monogr. Phan. vi.461; Durand & Schinz, Consp.Fl. Afr. v.710; Klatt in Jahrb. Hamb Wiss. Anst.ix.121; Penzig in Atti Congr. Bot. Genova, 364; Schweinfurth in Bull. Herb. Boiss. ii. App. ii. 10 and 93; Klatt in Durand & De Wild. Mat.Fl. Congo, i.44; Stapf in Dyer, Fl. Cap. vii.343; De Wild & Durand, Contr.Fl. Congo, i.fasc.2,75 and Reliq. Deivevr. 254; Th. & Hel. Durand, Syll. Fl. Congol. 625; Chiov. in Ann. Istit. Bot. Roma. viii. 24, 280; Stapf in Prain, Fl. Trop. Afr. ix.218.

Perennial, tufted. Culms erect, slender, 30-75 cm. long, glabrous, terete, about 3-noded, simple or branched below. Sheaths terete, tight, glabrous or, particularly the lower, hairy, lowest reduced to villous scales; <u>ligules</u> membranous, about 1-1% mm. long, ciliolate; blades linear, tapering to a long and sometimes very fine point, 5-20 cm. isng by 11/23 mm., flat, subrigid to flaccid, more or less hairy to villous or subglabrous. margins rough or smooth, Racemes 2-nate, very rarely 3-5-nate, distant from the uppermost sheath, 5-10 cm. long, rather stout, strict or curved: joints cuneate, 4-5 mm. long, stout, translucent along the middle, finely pubescent on the back, ciliate along the outer margin, tips denticulate; pedicels similar, slightly longer, firmer and less translucent, tips produced into a denticulate lobe facing the upper glume. Sessile spikelets 10-11 mm. long, pale green, tips often purplish, callus short, obtuse, bearded. Lower glume subherbaceous, breadly lanceolate, dorsally flattened, glabrous or puberulous, rarely villous, keels broadly winged above, wings membranous, whitish or purplish, intercarinal nerves about 7-11 (or more), partly evanescent below; upper glume distinctly shorter than the lower, rigidly membranous, boat-shaped, 3-nerved, softly ciliate, tips minutely 2-toothed with an interposed bristle, about as long as the upper glume, valves equal, 6 mm. long; lower 2nerved, ciliate: upper oblong, 2-fid, firmer below, 3-nerved, lobes lanceolate, glabrous, awn slender, about 2% cm. long, kneed much below the middle, scaberulous below the knee; pale minute or obsolete; anthers 3 mm, long; grain oblong, 2 mm, long. Pedicelled spikelets &, similar to the sessile, about 8 mm.long, but narrower; lower glume less acuminate and less distinctly winged, with a short terminal bristle; upper thinly membranous; both valves delicately hyaline, upper shortly bifid, muticous.



ransverse section of leaf.

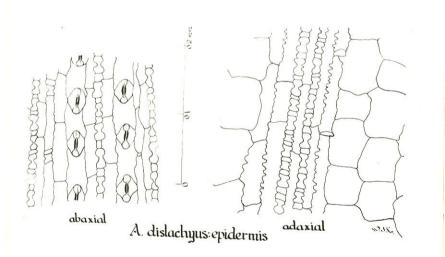


Fig.11
Epidermis

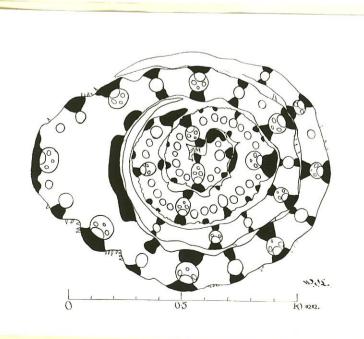


Fig.12
Transverse section of shoot

LEAF ANATOMY (Figs. 10, 11).

Leaf of moderate thickness, broadly V-shaped, both surfaces flat; large obtuse keel.

Vascular bundles - 3-4 first order bundles; sheath ovate, lignified, interrupted by an abaxial stereome strand; 3-4 third order bundles between those of the first order, sheath more or less round, of 6-9 parenchymatous cells, usually associated with a small abaxial stereome strand.

Midrib - Colourless parenchyma well developed; small stereome strand above the midvein.

Chlorenchyma arranged in arcs round the vascular bundles but not entirely confined to them; occasionally a row of lighter green cells separating the arcs; water storage tissue poorly developed in the lateral part of the blade.

Margin tapering gradually to a rounded or acute tip; subepidermal patch of sclerenchyma present.

Stereome on the whole poorly developed except in thek keel; present above the midvein and in the margin; first order bundles girdered; small strands below some third order bundles. Epidermis - Groups of 4-6 motor cells flanking the midrib and between the main bundles, deeper than broad and occupying about ½ of the leaf thickness; stomata not seen in the adaxial epidermis, 1-2 rows between the nerves abaxially; adjacent to first order bundles usually 2 files of short elements, silicified short cells dumb-bell-shaped; tubercle-based hairs, and occasionally, also bicellular hairs on the adaxial surface; large papillae on the ripple-walled cells alternating with the stomata in the same file.

SHOOT (Fig.12) rounded; leaf sheaths keeled with the margins well overlapping, split throughout; asperities on the outer surface; leaf blades rolled in the bud.

DISTRIBUTION :-

Natal: Underberg, in open grasslands, Mc Clean 601 (D).

Though one of the first species to be recorded for South Africa, it is poorly represented in our herbaria and evidently very rare. Bews 3539 in NU (NU) is near it but differs in some important respects, chiefly as regards the features of the joints and pedicels. The specimen is rather poor and in view of the difficulties in procuring authentic material from overseas herbaria for comparison, it seems advisable next to withhold opinion for the time being.

(5) A. GAYANUS Kunth, Rev. Gram. i. 163 (name only); Enum. Pl. i. 491, VAR. SQUAMULATUS Stapf in Frain, Fl. Trop. Afr. ix. 263.

A.gayanus, Anderss.in Peters, Reise Mossamb.Bot.563; Rendle in Cat.Afr.Pl.Welw.ii.148, and in Journ.Linn.Soc.Bot. xl.225; Eyles in Trans.Roy.Soc.S.Afr. v.295. A.gayanus, var cordofanus, Hack. in DC.Monogr.Phan. vi.448(partly); Chiov. in Ann.Istit.Bot.Roma, viii.279. A.squamulatus, Hochst. in Flora 1884, 244; Steud. l.c.374; A.Rich.Tent.Fl.Abyss.ii.454. A.helophilus, K.Schum.in Engl.Pfl.Ost-Afr.C.98. A.hylophilus, Engl.Glied.Veg.Usambara,38.

Perennial, tufted. Culms 1-3 m. high, terete, more or less stont stout, up to more than 6 mm. in diam., glabrous, smooth, manynoded, producing flowering branches from the third node or above Leaves glabrous or softly pubescent, rarely villous or tomentose; sheaths tight, terete, striate; ligules truncate, glabrous or more or less hairy on the back, rarely exceeding 2 mm.; blades linear to lanceolate-linear, the lower usually from a much attenuated base, tapering to a fine point, over 30 cm.long, from a few to 16 mm. wide, moderately firm, glaucescent or at length reddish, margins scabrid, midrib stout, flat above, much projecting and rounded below, often forming a terete petiole at the base. Spathes except the uppermost usually well developed blades, glabrous spatheoles herbaceous, membranous towards the edges, lanceolateoblong with a short or often minute and subulate or setaceous blade, or quite bladeless and acute, 6-7% cm. long, pale-green, at length more or less tightly inrolled, rarely turning red. Peduncles stoutly filiform, at length terminally exserted, straight. Racemes 2-nate, 3-6 cm. long, one sessile, the other with a bare base about 4 mm. long, both more or less erect and straight; joints stout, cuneate-clavate, 31-6 mm. long, terminating in an unequally dentate cupule, villously ciliate on both margins, usually glabrous on the back; pedicels similar with the tips produced on each side into a tooth. Sessile spikelet, including the obtuse callus which is bearded at the base, 7-10 mm. long, oblong, greenish or sometimes tinged with brown or red; glumes equal; the lower obtuse or subobtuse, entire or minutely 2-toothed, flat on the back with a longitudinal groove, corresponding to a projecting ridge on the inside, whitish or thinly membranous in the groove, otherwise firmly chartaceous with numerous close nerves between the groove and the keels, smooth or variously scabrid on the back, spinously ciliolate

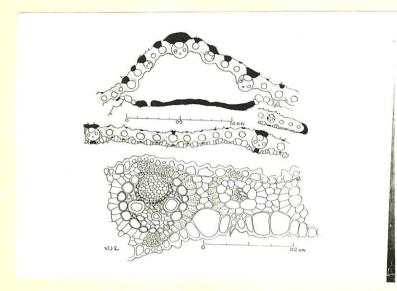


Fig.13

Transverse section of leaf.

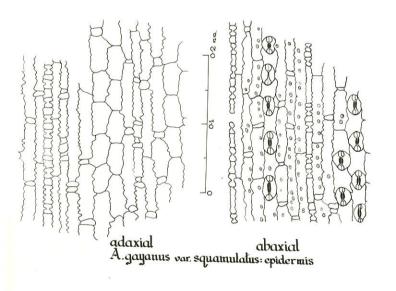


Fig.14
Epidermis.

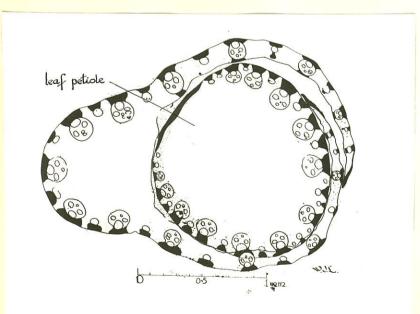


Fig.15

Transverse section of shoot.

ciliolate on the keels; upper glume subchartaceous, boat-shaped, scute or minutely mucronate, 1-3-nerved, spinously ciliolate on the keel, villously ciliate on the maggins; lower valve hyaline, linear-oblong or linear-lanceolate, 2-3-nerved, ciliate, somewhat shorter than the glumes; upper oblong, 5-7 mm. long, more or less 2-fid, 1-3-nerved at the base, lobes acute and ciliate; awn 13-30 mm. long, kneed and twisted well below the middle, scaberulous; pale half the length of the valve, oblong, truncate or subacute, 2-nerved or nerveless; anthers 3-5 mm. long. Pedicelled spikelets &, similar to the sessile, scaberulous to puberulous; lower glume herbaceous, acute, many-nerved, flat, continued into a bristle 1-2 mm. long; upper glume membranous, 3-3-nerved, acute, mucronate or shortly aristulate; Walves and pale similar to those of the sessile spikelet, except that the upper valve is acute and awnless.

LEAF ANATOMY (Figs. 13, 14).

Leaf thin, broadly V-shaped to fully expanded; both surfaces flat or with a shallow groove between the vascular bundles adaxially; large obtuse or rounded keel.

Vascular bundles - 5-7 bundles of the first order; bundle sheath lignified, round or oval, usually interrupted by an abaxial stereome strand. 5-13 third order bundles between those of the first order, sheath round, of 7-10 assimilating parenchyma cells, sometimes interrupted by an abaxial stereome strand in the keel region.

<u>Midrib</u> - Colourless parenchyma well developed; stereome strand above the midvein.

Chlorenchyma regularly arranged, forming arcs of radiating cells round the bundles, often separated by a row of lighter coloured cells; water storage tissue poorly developed in the lateral part of the blade.

Margin - Tip obtuse or rounded; subepidermal patch of sclerenchyma present.

Stereome poorly developed; present above the midvein, in the keel and in the margin; in association with third order bundles

Epidermis - Groups of 4-8 motor cells between the main vascular bundles and flanking the midrib, central cell(s) large, deeper than broad, occupying nearly ½ of the leaf thickness; stomata not seen on the adaxial surface, 1-2 rows between the nerves abaxially; adjacent to first order bundles usually 2 files of short elements, silicified cells dumb-bell-shaped to almost crusiform; numerous slender papillae, often longer than broad on the ripple-walled cells; hairs not seen.

SHOOT (Figs 15) rounded; leaf sheaths prominently keeled, asperities and short bulbous-based hairs sometimes on the outer surface; leaf-blades folded in the bud.

DISTRIBUTION: -

Bechuanaland: In Makarikari Pan, Pole Evans 3269 (N,P); Nata River, 60 miles from Makarikari Pan, Pole Evans 3303 (N); Between Tutumi and Bushman Mine, Pole Evans 3267 (N).

Northern Rhodesia: Chilanga, Sandwith 43, 70 (both in N); Mazabuka, sandy loam, Vet.Research 20 (N,P).

South West Africa: Waterberg, Volk 423, 1078 (both in D); Kleiner Waterberg, Volk 999 (D); Otjehenena, Omuramba, Volk 523 (D).

Southern Rhodesia: Umtali, Perrott 3070 (N); Salisbury, 4,900 ft., Eyles 1530 (N); Livingstone, S. bank of Zambesi, Rogers 5673 (S); Makurio, Mainwaring 2424 (S); near Victoria Falls, open forest land, Pocock 77g; without precise locality, H.J.M.2847 in Govt. Herb., S. Rhodesia; Tycho Norlindh & H. Weimarck 5106.

Stapf (1934) distinguishes 3 varieties of A.gayanus, a tropical species. His variety squamulatus differs from the others in having the joints and pedicels ciliate on both margins.

(6) A.AMPIECTENS Nees, Fl.Afr.Austr., 104; Steud.Syn.Pl.Glum.

1.372; Hack. in DC.Monogr.Phan. vi.453; Durand &
Schinz, Consp.Fl.Afr.v.705; Stapf in Dyer Fl.Cap.
vii.342; Chiov.in Ann.Istit.Bot.Roma, vii.(1898)60;
Wood, Natal Pl.t.116; Eyles in Trans.Roy.Soc.S.Afr.
v.@1916)295; Stapf in Prain, Fl.Trop.Afr. ix.243.

Perennial, densely tufted. Culms erect, slender, 60-75 cm.long, glabrous, terete, 3-5-noded, simple or with 1-3 flowering branches from the upper nodes. Leaves mostly crowded at the base; sheaths terete, tight, glabrous or hairy, lowest widened, subpersistent; ligules short, truncate or rounded; blades linear, tapering to a long setaceous point, culm leaves rounded at the base or subcordate and subamplexicaul, 10-20 cm. long, 6-10 mm. wide, flat, or comvolute above, rather firm, glabrous or hairy, margins smooth or Racemes 2-nate (rarely 3-nate), rather slender, 5-11 scabrid. cm. long, strict or subflexuous; joints and pedicels very similar, sublinear, 5-6 mm. long, shortly ciliate along the margins, tips hollowed, denticulate. Sessile spikelets laterally compressed, wedged in between the pedicel and the joint, 6-8 mm. long, glabrous, callus short, acute, bearded, sunk in the hollow of the preceding joint; glumes coriaceous; lower linearlance olate, acuminate, 2-toothed, keels rounded and broad below. acute and scabrid near the tips, with a distinct groove (fold) extending between them to the acumen and with 2 fine lateral furrows in the upper third; upper 1-nerved, mucronate or aristulate; valves subequal; lower lanceolate, 2-3-nerved, softly ciliate; upper linear-lanceolate, 1-3-nerved, deeply bifid, lobes lanceolate, ciliolate, awn stout, 30-50 cm. long, kneed and pubescent below the middle; pale linear-oblong, 1-5 mm. long, nerveless, ciliate; anthers 3-5 mm. long. Pedicelled spikelets o, dorsally compressed or subterete, lanceolate, 8-12 mm. long; glumes subherbaceous, acuminate, often aristulate; lower acutely 2-keeled, keels scabrid or rigidly ciliate above, intercarinal nerves many, middle nerve stronger; upper linear-lanceolate 1-3-sub-5-nerved, ciliate; valves linear; lower acuminate, 3nerved, ciliate; upper 5-9 mm. long, 1-nerved, often 2-toothed; pale linear, 1 1/2-4 mm. long, nerveless.

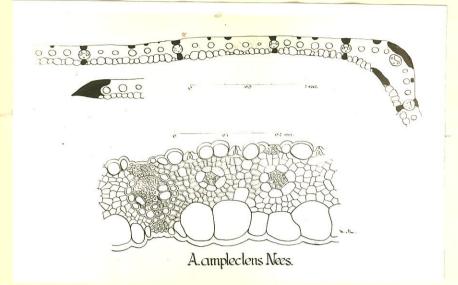


Fig.16
Transverse section of leaf.

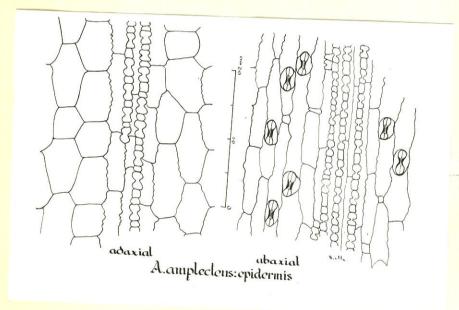


Fig.17
Epidermis.

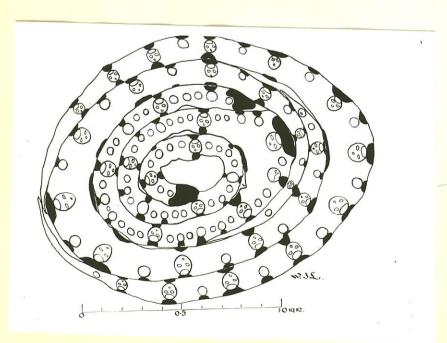


Fig.18
Tramsverse section of shoot.

LEAF ANATOMY (Figs. 16, 17).

Leaf thin, both surfaces flat; keel obtuse.

Vascular bundles - 4-6 first order bundles, bundle sheath lignified, round, chlorophyllaceous, interrupted by an abaxial stereome strand; 3-9 third order bundles between those of the first order, sheath round or oval, of 6-8 assimilating cells.

Midrib - Colourless parenchyma present; small stereome strand above the midvein.

Chlorenchyma arranged in arcs round the vascular bundles but not confined to them, arcs occasionally separated by a row of larger pale-green cells; water storage tissue poorly developed in the lateral part of the blade, or absent.

Margin tapering to an acute tip; subepidermal patch of sclerenchyma well developed, filling the entire tip and sometimes projecting beyond the ultimate (third order) bundle. Stereome poorly developed, present in the keel and in the margin; first order bundles girdered, slightly developed adjacent to some third order bundles.

Epidermis - Motor cells flanking the midrib and usually continuous between the first order bundles, more or less similar but decreasing in size towards the flanks of each group and above some third order bundles, the larger cells occupying 1/4 of the leaf thickness, straight-walled or slightly undulating in surface view; stomata in 3-5 rows in the abaxial epidermis between the nerves; in the adaxial epidermis almost invariably absent; adjacent to the first order bundles 1-several files of short elements, usually 1 file adaxially, silicified short cells dumb-bell-shaped; a few scattered asperities in the motor cell regions; tubercle-based hairs, if present, on both surfaces.

SHOOT (Fig.18) rounded; leaf sheaths only slightly keeled, margins well overlapping; leaf blades rolled in the bud.

DISTRIBUTION: -

Cape Province: Kei Mouth, Flanagan 981(A,N,S); Vryburg, quartzite ridge, Mogg 8311 (N), Henrici 44 (N); Kuruman, plateau east of, Pole Evans 2414 (N), Marloth 1114 (A); Kentani dist., Pegler 1056 (A,N); Griqualand East, Clydesdale, Tyson 932 (S).

Natal: Div. Tsolo, Galpin 6893 (A,D,N,S); Alexandra, Rudatis 884 (N); Oribi Flats, Mc Clean 528 (D,N); Research Stn., Estcourt, growing on hillsides, West 697 (N); Sand River, Schlechter 6896 (A); Pietermaritzburg, George 33 (D); Umpumulo, Buchanan 194 (A,D).

Orange Free State: Maccauwvlei, (not liked by stock), Brandmuller 42 (N); Kroonstad, Pont 27 (N), Vals River, Pont 143 (N).

Bulawayo, Gardner 21 (A). Southern Rhodesia:

Swaziland: Forbe's Kloof, Codd & Muller 305 (N).

Transvaal: Ermelo, Henrici 1424(N), Potter 1575 (N); Athole P.R.Stn., Codd & Muller 266 (N); Pretoria, Groenkloof, Phillips 7639 in N (N), Pole Evans 399 (N), Skea 51 (N), Fourtains Valley, Skea 24 (N), Curtis Bournes Hill, Pole Evans 140 (N), Onderstepoort, Smith 6169 (N), Mogg 12354 (N), Strubenskop, Mogg 16291 (N), Wolwekloof, Mogg 15967 (N), Rietondale, Chippendall 92, 174 (both in N), Rissik, Robinson 27064 in N (N), Waterkloof, Bews 84 in NU (NU), Meintjes Kop, Gower 18 (A), on black clay, Dickson 52 (N); Heidelberg, Uitgevallen, Burtt Davy 13667 (N), Henley-on-Klip, Stent 21792 in N (N); Nelspruit, Research Stn., Liebenberg 2493 (N); Zoutpansberg, open veld, Junod 4096 (N); Bushveld, Rocikop, Pole-Evans 619 (N); Nylstroom, Warmbaths, Pole-Evans & Smuts 690 (N); Irene, Doornkloof, Pole Evans 351 (N); Johannesburg, Houghton Koppie, N. slopes, Cohen 650 (N), Turffontein, Bryant D8 (N); Kaalfontein, Pole Evans 19040H (N); Waterberg, Towoomba P.R.Stn., Irvine 27 (N), Nocitgedacht, Acocks & Naude 31 (N); Lichtenburg, Grasfontein, Sutton 392 (N); summit of Krantzberg, Dyer & Verdoorn 4242 (N); Ventersdorp, Palmietfontein, Botha 26 (P,N); Marico, Oberholzer 107 (P); Potchefstroom, Burtt Davy 2700 (N), Stent 26483 in N (N), Le Roux 261 in P (P), Dassiesrand, V.d.Westhuizen 607 (P), Le Roux S303 in P (P), Vyfhoek, Le Roux S274 in P (P), Boskop, on stony ground, Louw 683, 684 (both in P), Welverdiend, Louw 898, 901 (both in P), Town Blijvooruitzicht Mine, Louw 878 (P); Johannesburg, Lintner 45 (D,N).

Without precise locality: Bews 85 in NU (NU).

A distinct, yet very variable species as regards hairiness, colour of the wains leaves (which may be dark-green, glaucus or reddish), and the characters of the These variations cannot be merely ecological, spikelets. as different forms occur side by side and the same forms in different climatic and edaphic habitats. The various forms, however, tend to merge into one another so that no clear distinction can be drawn between them. The culm leaves are characteristic and cannot be confused with those of any other species of the genus.

(7) A.FILIFOLIUS Steud.Syn.Pl.Glum. i.374; Hack.Androp. in DC.
Monogr.Phan.vi.453; Durand & Schinz, Consp.Fl.Afr.v.712;
Heteropokon filifolius, Neek, Fl.Afr.Austr.102.

Perennial, densely tufted. Culms erect, slender, 20-75 cm. long, glabrous, terete, about 3-noded, simple. mainly crowded at the base; sheaths shorter than the internodes, terete, tight, glabrous, lowest persistent, at length breaking up into fibres; ligules membranous, very short, truncate; blades very narrow, convolute, filiform, very rarely open, acute, lowest 20-30 cm. long, upper very short, firm, flexuous, glabrous or hairy at the base. Racemes 2-nate, rarely solitary, 4-9 cm. long, stout, strict; joints and pedicels subequal and similar, cuneate-linear, 5-7 mm. long, densely and shortly villous along the margins, tips hollowed, unequally toothed. Sessile spikelets laterally compressed, wedged in between joint and pedicel, 6-7 mm. long, callus slender, 2-3 mm. long, acute, densely bearded; glumes subcoriaceous, glabrous, smooth; lower linear, obtuse, tips hyaline, keels narrow, rounded, smooth, almost contiguous, with a deep, very narrow groove (fold) between them; upper boat-shaped, 1-sub-3-nerved, ciliate; valves subequal, lower oblong-linear, 2-3-nerved or nerveless, ciliate; upper linear, deeply bifid, 3-nerved, lobes oblong, ciliate, awn stout, 3-5 cm. long, kneed at the middle, pubescent below; pale ovate, acute, 3 mm. long, nerveless, glabrous; anthers 3-4% mm. long. Pedicelled spikelets &, dorsally compressed or subterete, lanceolate, 12-16 mm. long, rarely shorter, glabrous; lower glume herbaceous, 2-toothed, one tooth often prolonged into a bristle (up to 6 mm. long), acutely 2-keeled, intercarinal nerves many upper finely acuminate, 1-3-nerved, ciliate; lower valve linear-oblong, acute, 7-10 mm. long, 1-3-nerved, ciliate; upper linear, 1-nerved, glabrous; pale linear, 2-4 mm. long, nerveless; anthers 4-7 mm. long.

A FILIFOLIUS STEUD.

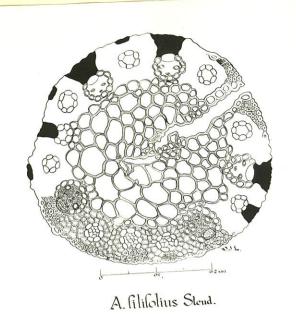


Fig.19

Transverse section of leaf.

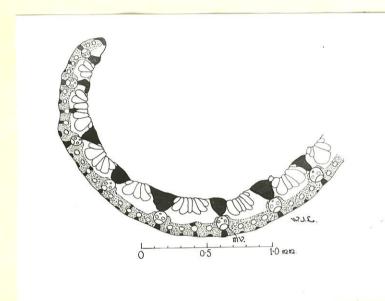
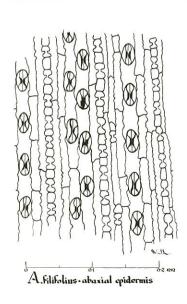


Fig. 19A

Transverse section of leaf of the open-leaved form (Specimen Pole Evans 1009).



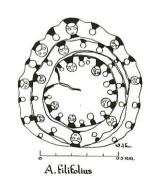


Fig.20

Epidermis

Transverse section of shoot.

LEAF ANATOMY (Figs. 19, 20A).

Leaf permanently folded and circular in transverse section; abaxial surface sometimes slightly undulating; keel absent.

Vascular bundles - 5-7 first order bundles, bundle sheath strongly lignified, round or slightly oval, interrupted by an abaxial stereome strand; third order bundles usually alternating with either a bundle of the first order or with a conspicuously large third order bundle; bundle sheath round, with 6-7 assimilating parenchyma cells, rarely interrupted by an abaxial stereome strand.

Mitrib - Colourless parenchyma present above the midvein, which can only be determined by reference to its position.

Chlorenchyma not confined to the radiating arcs round the bundles; arcs often separated by a row of lighter coloured cells.

Margin - Usually an acute or almost right angle is formed by the ad- and abaxial surfaces; subepidermal patch of sclerenchyma present.

Stereome moderately developed; present in the margin and as abaxial strands adjacent to all first order bundles and some of these of the third order.

Epidermis - Motor cells not differentiated; stomata in 1-2 rows between the nerves abaxially; adjacent to all vascular bundles 1 file of short elements, silicified short cells dumb-bell-shaped; emergences not seen.

SHOOT (Fig. 20B) cylindrical or rounded; leaf sheaths very slightly keeled; leaf blades folded in the bud.

Open-leaved Form (Pole-Evans 1009: Fig. 19A).

Leaf crescent-shaped, keel absent. 8-9 first order bundles, girdered, 3-5 third order bundles between those of the first order, sometimes girdered. Chlorenchyma confined to the abaxial region, about \$\frac{1}{2}\$ of the leaf thickness; water storage tissue well developed below the motor cells. Margin with a subacute tip. Stereome well developed in the adaxial arms of the girders, otherwise moderate. Motor cells well differentiated, about 3 times deeper than broad, occupying about \$\frac{1}{2}\$ of the leaf thickness, central cells usually pear-shaped.

DISTRIBUTION: -

Basutoland: Leribe, Dieterlen 397a (D).

Cape Province: Komgha, grassy slopes near Kei Mouth, Flanagan 2348 (A,N); Claremont, Schlechter 3092 (A) p Grahamstown, Daly & Sole 109 (A); Kokstad, Mt.Currie, frequent on mountain slopes, Goossens 268 (N); Bathurst Div., near Theopolis, Burchell 4096 (S).

Natal: Rittylei, 4000-5000 ft., Buchanan 197 (A); Giant's Castle, Drakensberg Mts., 8000-9000 ft., Wood 10546 (A,N,S); Qudeni, in open grassland, Qudeni Forest Reserve, 5000 ft., Fisher & Schweikerdt 30 (D,N); between Zwartberg and Underberg, Lintner 9 (D); Bergville, Natal National Park, Galpin 10360 (N); Melcor Ridge, Mooi R.,5000 ft., Mogg 3269 (N); Zululand, Nkandhla Dist., Codd 235.

Transvaal: Ermelo, Mavierstad, Pott 5196 (N), Spicenkop, Burtt Davy (?) (P); Carolina, near Bossies, Burtt Davy 2959 (N); Belfast, Burtt Davy 1336 (N); Kaapsche Hoop, Devil's Kantoor, Pole Evans 1009 (N); Barberton, Barberton Mtn., Burtt Davy 87 in N (N).

Without precise locality: Olifantshoek, Zeyher 45866 in S (S); Drege 44375(S); Zeyher 44374 in S (S).

No reference is made to this species in "Flora of Tropical Africa"; it is therefore probably native to this country. The broad-leaved form (Pole Evans 1009) of which a text figure and an anatomical description is given, does not differ from the typical form in other respects, and may therefore be regarded as an ecological variation.

(8) A.TUMIDULUS Stapf in Prain, Fl. Trop. Afr. ix. 252.

Perennial, forming small tufts with slender innovations, 45-90 cm. high. Culms very slender, simple, 2-4-noded, glabrous, smooth, internodes long exserted. Leaf sheaths terete, very tight, striate, smooth, glabrous, produced at the mouth into a narrow, acute auricles; ligules scarious, adnate to the auricles of the sheath, 1 to over 3 mm. long, truncate; blades very narrow, linear, tapering to a fine point, up to 10 cm. by 1-2 mm., pale-green to or purple, glabrous or very sparingly hairy towards the base, scabrid or scaberulous on both sides and along the margins; subtending leaf with a spathaceous sheath which soon becomes very narrow and convolute and a setaceous rudimentary blade. Peduncles finely filiform, striate, firm, imperfectly articulated and bearded at the tips. Racemes 2-nate, one sessile, the other or both with a short base, slender, rather dense, 2-4 mm. long; joints cuneate-oblong, 3 mm. long, shortly ciliate up to two-thirds on one side and almost up to the middle on the other (cilia 1 mm. long), subobliquely truncate, the pedicels less convex on the back than the joints. Sessile spikelets tightly wedged in between joint and pedicel, linear in front view, about 5 mm. long, including the minute obtuse shortly bearded callus. Glumes unequal, lower slightly shorter than the upper, firmly chartaceous, minutely truncate, deeply and narrowly grooved between the keels which are smooth and abtuse below and scabrid to spinously ciliolate about the middle, intercarinal nerves 2, rather stout, 1 on each side of the bottom of the groove, keel nerves 1, if 2 very close; upper glume boat-shaped, acuminate, mucronate or subaristulate, subchartaceous, 1-nerved, broadly rounded on the back below, keeled upwards, keel rigidly ciliolate, margins minutely ciliolate; lower valve narrow, oblong, 2-nerved, ciliate, subhyaline, 4 mm. long; upper oblong, 3 mm. long, very shortly 2lobed, acute, margins conspicuously ciliate, awn fine, about 18-25 mm. long, flexuous, kneed at and twisted below the middle; pale a hyaline nerveless linear-oblong scale, 2 mm. long. Pedicelled spikelets of for neuter, and more or less reduced, lanceolate-oblong, acute, 4-6 mm. long; glumes equal, mambranous,

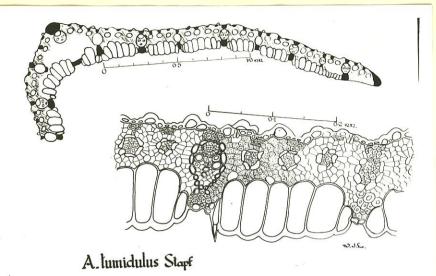


Fig.21
Transverse section of leaf.

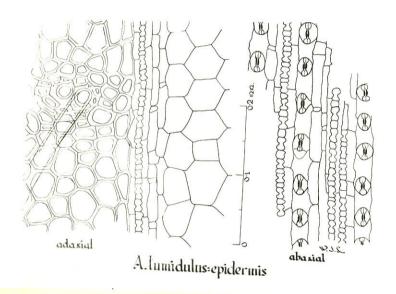


Fig.22 Epidermis

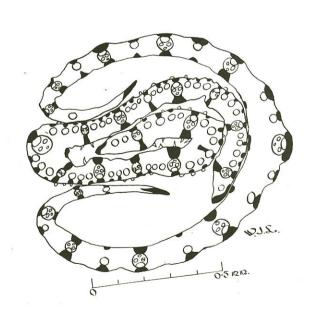


Fig.23
Transverse section of shoot

the lower with about 7-9 scaberulous intercarinal nerves, shortly aristulate, keels rigidly ciliate; upper glume acuminate, sub-3-nerved; valves, if perfectly developed, hyaline, oblong, acute, ciliolate, up to 4 mm. long, the lower 2- the upper sub-3-nerved and with a ciliolate pale almost half as long.

LEAF ANATOMY (Figs.21, 22).

Leaf moderately thin, broadly V-shaped; both surfaces flat; small obtuse keel,

Vascular bundles - About 3-4 first order bundles, bundle sheath strongly lignified, oval; 5-9 third order bundles between those of the first order, sheath more or less round, of thin parenchyma cells, usually associated with a small stereome strand.

<u>Midrib</u> - Colourless parenchyma present but variable; stereome strand opposite the midvein.

Chlorenchyma arranged in radiating arcs round the bundles but not entirely confined to them; water storage tissue poorly developed in the lateral part of the blade.

Margin tapering gradually to a rounded tip; subepidermal patch of sclerenchyma present.

margin and as abaxial strands adjacent to third order bundles; first order bundles and large third order bundles girdered.

Epidermis - Groups of 6-8 motor cells flanking the midrib and between the main bundles, about twice as deep as broad and occupying about % of the leaf thickness, straight-walled or rippled in surface view; stomata not seen in the adaxial epidermis 1, rarely 2 rows between the nerves abaxially; 1-2 files of short elements adjacent to the first order bundles, 1 file opposite those of the third order, silicified cells dumb-bell-shaped; tubercle-based hairs on the adaxial surface; large papillae on the ripple-walled cells, alternating with the stomata.

SHOOT (Fig.23) rounded; leaf sheaths slightly or prominently keeled with margins (always?) inrolled; leaf blades rolled in the bud.

DISTRIBUTION: -

Southern Rhodesia: Salisbury, Brain 4172 (N).

Transvaal: Barberton, Thorncroft 73a (N).

There is a close anatomical resemblance between this species and AxAskinzii A.Schinzii Hack. and A.schirensis Hochst. var. angustifolia Stapf, the chief distinguishing feature being the joints and pedicels which are not ciliate throughout.

(9) A.SCHINZII Hack. in DC.Monogr.Phan.vi.458; Durand & Schinz, Consp.Fl.Afr.v.721; Hack.in Bull.Herb.Boiss.iv.App.iii.11; Stapf in Dyer,Fl.Cap.vii.341 and in Prain,Fl.Trop.Afr.ix.245.

Perennial. Culms erect, slender, 50-120 cm. long, glabrous, terete terete, branched from the middle (sometimes lower) upwards; branches simple or again branched, long, erect, flowering. Leaves scattered along the culm; sheaths exceeding the internodes except the uppermost, terete, tight, glabrous, auricled at the mouth; ligules membranous, reddish, truncate, laterally produced and adnate to the auricles of the sheath, 1-2 mm. long; blades linear from a slightly narrower base, long tapering to a fine point, 10-20 cm. by 4-7 mm., flat, rigid, glaucus, turning reddish, glabrous or hairy at the base, margins scabrid or smooth. Racemes 2-nate, 4-7 cm. long, rather stout, strict or flexuous, rather long exserted from the uppermost sheath which bears a subsetaceous blade; joints and pedicels equal or subequal and similar, cuneate-linear, 3 1/2-5 mm. long, stout, long and rigidly ciliate along the margins, tips hollowed, scarious, 2-lobed and unequally toothed. Sessile spikelets laterally compressed, wedged in between joint and pedicel, 51-7 mm. long, glabrous, callus short, obtuse, shortly bearded, sunk in the hollow of the tip of the preceding joint; lower glume subcoriaceous to chartaceous, linear, minutely 2toothed, keels narrow, acute, spinously ciliate above, with a deep narrow groove (fold) between them, and with 2-4 nerves close to each keel; upper glume firmly membranous, boat-shaped, 1-3-nerved, with a terminal bristle about as long as the spikelet, keel scabrid, margins ciliate; valves equal, lower linear-oblong, obtuse, 2-nerved, ciliate; upper broadly oblong, deeply bifid, 3nerved, lobes lanceolate, ciliolate, awn slender, 20-35 mm. long, knwed just below the middle, scaberulous below the knee; pale linear, half to almost as long as the valve, nerveless, glabrous; anthers 2 1/2-3 % mm. long. Pedicelled spikelets of, dorsally compressed, linear-lanceolate, acute, 5-8 mm. long, purplish or reddish; lower glume herbaceous, minutely 2-toothed with an interposed bristle 2-7 mm. long, 2-keeled, keels scabrid, intercarinal nerves 7-12; upper glume lanceolate, 3-nerved, ciliolate, aristulate like the lower; valves oblong-linear, acute or mucronulate; lower finely 2-keeled, 2-3-nerved, keels rigidly ciliate;

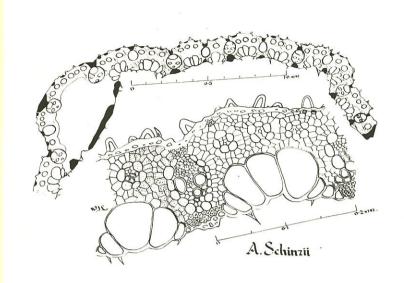
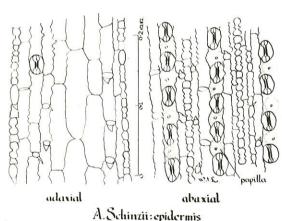


Fig.24 Transverse section of leaf



A. Schinzii: epidermis

Fig.25

Epidermis

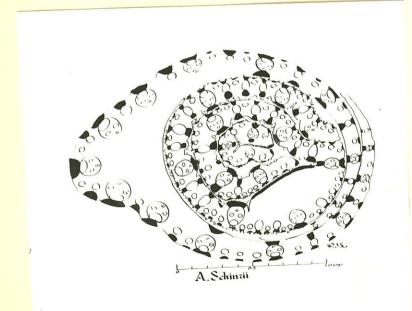


Fig.26

Transverse section of shoot.

upper long,

3-nerved, softly ciliate; pale 3-4% mm. long, obtuse.

LEAF ANATOMY (Figs. 24, 25).

Leaf relatively thin, broadly V-shaped; both surfaces flat, or often with a narrow abaxial groove adjacent to the main bundles; large rounded or obtuse keel.

Vascular bundles - 3-5 first order bundles, girdered; sheath oval, strongly lignified, assimilating; about 7 third order bundles between those of the first order, sheath of 5-10 assimilating parenchyma cells, round in the smaller bundles and oval in the larger; stereome may be absent or present either abaxially or on both sides.

Midrib - Colourless parenchyma usually well developed but variable; stereome strand above the midvein.

Chlorenchyma not confined to the radiating arcs round the bundles; water storage tissue absent in the lateral part of the blade, except for an occasional colourless cell adjacent to and below the motor cells,

Margin tapering towards the adaxial surface; tip acute; small subepidermal patch of sclerenchyma present.

Stereome poorly developed on the whole; present above the midvein and adjacent to some third order bundles; first order and exceptionally large third order bundles girdered.

Epidermis - Groups of 4-9 motor cells between the main vascular bundles and flanking the midrib; central cell(s) large, usually pear-shaped, deeper than broad and occupying about ½ of the almost invariably leaf thickness; stomata/absent on the adaxial surface, 1 row between the nerves abaxially; adjacent to first order bundles 2-3 files of short elements, silicified short cells dumb-bell-shaped, sometimes with a small bulge in the lateral walls; prominent papillae in rows of the stomata and alternating with them; asperities on both surfaces.

SHOOT (Fig.26) rounded; leaf sheaths keeled; leaf blades rolled in the bud.

DISTRIBUTION: -

Bechuanaland: Francistown, Gordon 87, 102 (both in N); between Tutumi and Bushman Mine, Pole Evans 3266 (N).

Cape Province: Hay Div., Floradale, Ferrar 47 (N), Ferrar 6098 in M (M,P), Bingap, Acock 5730 in M (M), Klipfontein, Griqualand West, Burchell 2164/2 (S); Postmasburg, Kaapstewel, on manganese and other koppies, Cook 6335 in M (M); Kuruman, Broncote, Asbestos Hills, Esterhuyzen 1152 (M); Barkly West, Klipvlei, amongst rocks

South West Africa: Auros, slatey soil, dwarf-shrub community, Volk 594b (D); Ozondjache, Granitberge, Volk 517 (D); without precise locality, Volk 30810 in D (D).

Southern Rhodesia: Vistoria Falls, Hitchcook 24161 (N).

Transvaal: Rustenburg, Pillansberg, Pole Evans 8124 in N (N), Buffelspan, Pole Evans, 633 (N), Koster, Burtt Davy 151 (N); Nelspruit, Liebenberg 2376 (N); Potgieters-rust, Pyramid Estate, plateau on mountain top, granite soil, Calpin 8885 (N); Pretoria, Klapperkop, Mogg 16231 (N), Meintjes Kop, N.aspect, Louw 933 (N,P).

Without precise locality: Du Plessis 26484 in N (N).

A.schirensis Hochst. var. angustifolia Stapf. Although superficially similar and anatomically indistinguisable,

A. Schinzii is characterised by its branching habit and the absence of basal leaves in contrast with the simple culms and the dense tuft of basal leaves of the other; furthermore, the aristulate glumes are a constant feature.

(10) A.SCHIRENSIS Hochst. in A.Rich.Tent.Fl.Abyss.ii.456,

VAR.ANGUSTIFOLIA Stapf in Dyer, Fl.Cap.vii.340; Wood,

Natal Pl.t.115; Stapf in Prain, Fl.Trop.Afr.ix.246.

A.amplectens var.natalensis, Hack. in Mem.Herb.

Boiss. No.20,9.

Perennial, tufted. Culms erect, slender, 60-90 cm. long, glabrous, 3-4-noded, simple, rarely with an additional flowering branch from one of the uppermost nodes. Leaves mainly crowded near the base; sheaths terete, tight, glabrous, lowest more or less persistent; <u>ligules</u> membranous, very short, truncate; <u>blades</u> narrow, linear, tapering to a fine, sometimes setaceous point, 10-20 cm. by 2-4 mm., rather firm, glabrous, rarely hairy below, margins scabrid or smooth. Racemes 2-nate, rarely solitary, rather slender, 5-10 cm. long, strict or subflexuous; joints and pedicels very similar, cuneate-linear, 4-6 mm. long, tips deeply hollowed and produced into a short irregularly toothed appendage, long ciliate along the margins. Sessile spikelets strongly laterally compressed, wedged in between the pedicel and the joint, 4-7 mm. long, callus slender, pungent, densely bearded, 1-2 mm. long, sunk in the hollow of the preceding joint; glumes subcoriaceous to chartaceous, glabrous, smooth, lower linear, subacute, keels narrow with a deep groove (fold) between them, smooth or scaberulous above; upper boat-shaped, finely mucronate, 1-nerved, keel usually scabrid above; lower valve oblong-linear, obtuse, 2-(rarely 3-)nerved, ciliate; upper deeply bifid, 1-3-nerved, lobes lanceolate, acute, ciliatate, awn 20-40 cm. long, slender, kneed and pubescent below the middle; pale oblong, 2-4 mm. long, nerveless or sub-2-nerved; anthers 2 1/2-4 mm. long. Pedicelled spikelets o, dorsally compressed, lanceolate, 7-9 mm. long, greenish, reddish or purple; glumes subherbaceous, acuminate, glabrous; lower acutely 2-keeled, keels scabrid or rigidly ciaiate above or throughout, intercarinal merves 8-many; upper linear-lanceolate, 3-nerved, ciliate; lower valve as in the sessile spikelet; upper linear, usually shortly 2-toothed, muticous; pale linear, 1岁5 mm. long.

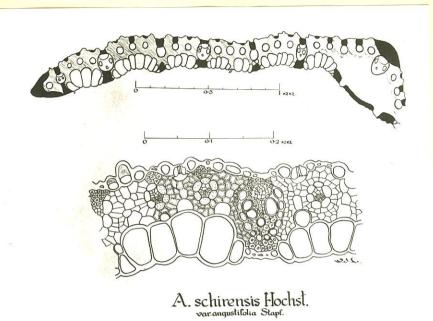


Fig.27
Transverse section of leaf.

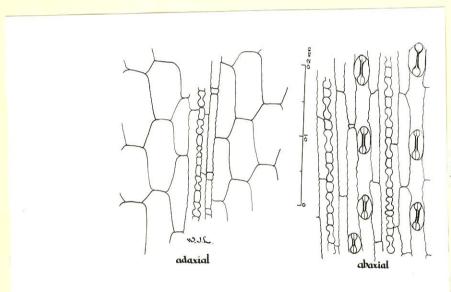


Fig.28
Epidermis

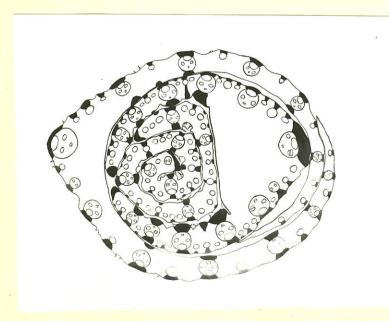


Fig.29
Transverse section of shoot.

LEAF ANATOMY (Figs. 27, 28).

Leaf thin, broadly V-shaped; both surfaces more or less flat, often with a narrow groove in the abaxial surface adjacent to the main bundles; large obtuse keel.

Vascular bundles - 4-5 first order bundles, bundle sheath ovate, strongly lignified, assimilating, interrupted by an abaxial stereome strand; 3-6 lesser bundles between those of the first order, bundles sheath of third order bundles more or less rounded and rarely interrupted, of 5-7 parenchyma cells with chloroplasts.

Midrib - Colourless parenchyma well developed; stereome strand above the midvein, continuous or interrupted.

Chlorenchyma not confined to the arcs of radiating cells round the bundles; arcs rarely separated by a row of larger cells; large colourless **Exx* cells below the motor cells rather frequent, especially in the region adjacent to the midrib.

Margin with a well developed subepidermal patch of sclerenchyma; tip acute.

Stereome present in the keel, above the midvein and adjacent to most third order bundles; all first order bundles girdered.

Epidermis - Groups of 5-8 motor cells flanking the midrib and between the main vascular bundles, more or less similar but diminishing in size towards the flanks of the group, usually deeper than broad, occupying about % of the leaf thickness; usually straight-walled in surface view; stomata not seen in the adaxial epidermis, 1-2 rows between the merves abaxially; several files of short elements adjacent to first order bundles adaxially, 1-2 files abaxially, silicified short cells dumbbell-shaped; hairs not seen; large papillae on the ripplewalled cells alternating with the stomata in the same file.

SHOOT (Fig. 29) rounded; leaf sheaths keeled with the margins well overlapping, asperities, if present, on the outer surface; leaf blades rolled in the bud.

DISTRIBUTION: -

Leribe, slopes, stony spots, Dieterlen 397b Basutoland: (D,N,S); Mont-Aux-Sources, 7000 ft., Bayer & Mc Clean 179 (N).

Cape Province: Barkly West, Klipvlei, Asbestos Hills, Esterhuysen 2089 (N), Ferrar 6075 in M (M), Danielskuil, Esterhuysen 2044 (N), Ouplaas, Asbestos Hills, Ferrar 6077 in M (M,P); Vrybutg, Burtt Davy 13803 (N).

Natal: Pietermaritzburg, Table Mtn., Mc Clean 195 (N), War Dept. Reserve, Bews 75, 77 (both in NU); Amajuba, Burtt Davy 7760 (N); Ladysmith, Phillips 8728 in N (N); Lidgetton, ridges, open veld, Mogg E538 (N); Estcourt Pasture Research Stn., thornveld, West 1781 (D); Nkandhla, Qudeni Forest Reserve, in open grassland, Fisher & Schweikerdt 28 (D,NU); Weenen, Skurfdepoort, near Colenso, in semi-deciduous bush, West 1799 (D); near De Beers, Drakensberg, Wood 6002 (D); Rietvlei, Buchanan 196 (D); Nottingham Rd., on steep slopes of hills, roadsides and margins of bush, Mc Clean 948 (D); near Newcastle, Buchanan 195 (D); Dundee, 4000-5000 ft., Green 92 (D); Zululand, Babanango, King 433.

Orange Free State: Kroonstad, Vals R. Pont 131 (N);
Parys, Brakfontein, on Witwatersrand Beds, J. Phillips 101(N); near Thaba Unchu, Burke 434 (S).

Waterberg, southern plateau, Volk 1077(D); South West Africa: Klein Waterberg, in deep sand on plateau, Volk 2336 (D); Otavi, Dinter 5745 (D).

Transvaal: Irene, along river valley, Mc Clean 18 (N),
Doornkloof, Pole Evans 355; Pretoria, N,N-E. slopes of Curtis
Hill, Pole Evans 108 (N), Meintjes Kop, S. aspect, Pole Evans
364 (N), Wonderboom Stn, Smith 6183 (N), Sunnyside Hill,
Stent 8100 in N (N), Groenkloof, Skea 39, 46 (both in N),
Pole Evans 398 (N), Apies R., Bolus 10851 (N), Witfontein,
Bews 78 (NU), Premier Mine, Menzies 9 (N); Brits, stony
quartzite, Mogg 14277 (N); Ermelo, Billy's Vlei, Burtt Davy
9264,(N), Nooitgedacht, Potter 1586; Kaalfontein, Pole Evans
17563H, 19045H (both in N); Machadodorp, Pole Evans H16922 (N);
Heidelberg, Douglas, Henley-on-Klip, Stent H21140 in N (N);
Pilgrims'Rest, Mt.Anderson, Pole Evans 3795 (N); Zoutpansberg,
dolomites, 4000 ft., Junod 4092 (N); Middelburg, Burtt Davy
13295 (N); Witwatersrand, Houghton Koppie, Cohen 655 (N),
Hutton 1035 (A), Schoemansdrift, J.Phillips 100 (N); Potgetersrust, Tycho-Norlindh & Weimarck 5241 (N); Zoutpansberg, Junod
27 (N); Athole Pasture Research Stn., Norval 130 (N);
Potchefstroom, Le Roux S45 in P (P), Welverdiend, Louw 900 (P),
Louw 899 (N,P).

Without precise locality: Zeyher 1802 (N).

AN UNIDENTIFIED SPECIMEN

Note: The specimen of which a description is given below, cannot be referred to any of the foregoing South African species and all the literature consulted indicate that it has not been described previously. The available material is, however, rather scanty and perhaps not in all respects representative of the species. The following description must therefore be regarded as provisional until more material can be procured.

Perennial, tufted. Culms erect, simple, 12-25 cm. high, slender, terete, about 2-noded, striate, glabrous. Leaves mainly basal; sheaths rather loose, upper tighter, terete, striate, covered with numerous glandular hairs, lower persistent, glabrous; ligules membranous, very short, truncate; blades linear, flat, tapering to a fine point, 3-7 cm. by 2-3 mm., nerves much pronounced, hairy like the sheaths, margins cartilaginous, smooth or finely scaberulous. Racemes 2-nate, 4-6 cm. long, strict or subflexuous; joints and pedicels similar, linear, convex on the back, 5 mm. long, ciliate on both margins, cilia 1-1% mm. long, tips Sessile spikelets dorsally compressed, subcupular, truncate. lanceolate, 7-8 mm. long, callus short, obtuse, bearded; lower glume coriaceous and firm lower down, pitted, upper part less firm, 2-toothed, glabrous, keels minutely scaberulous from the middle upwards and with a distinct median groove between them, 6 intercarinal nerves, margins ciliate; upper glume 6 mm. long, boat-shaped, 3-nerved, mucronate, ciliate; lower valve linear-lance clate, obtuse, sub-2-nerved, ciliolate; upper valve linear, 1-nerved, bifid to f, lobes acute, ciliolate, awn slender, 15 mm. long, kneed and pubescent Pedicelled spikelets d', lanceolate, below the middle. subterete, 8 mm. long; lower glume herbaceous, mucronate, ribbed longitudinally, keels scaberulous, intercarinal nerves many, close, margins ciliate; upper glume lanceolate, mucronate, 3-nerved, ciliate; lower valve oblong-lanceolate, acuminate, 5 mm. long, sub-2-nerved, ciliolate; upper

<u>valve</u> oblance olate, minutely 2-toothed, nerveless, finely ciliolate; <u>pale</u> 0; <u>anthers</u> 4 mm. long.

Norval 8/ Ermelo: Athole Pasture Research Station, near Amsterdam. Vlei grass on sandy soil.

Rare. Alt. 5800 ft. 24/10/1935.

SUMMARY

- 1. An historical sketch and a synoptic account of the work hitherto done on the anatomy of grasses in this country, is given.
- 2. Various views on anatomy as a taxonomic method are cited.

 At this early stage, opinion is still divided on many points.
- 3. Brief notes on the history, ecology and economic importance of the genus are given and the main evolutionary trends referred to.
- 4. An account of the methods and material used in the present study, is given.
- 5. The macroscopic and microscopic vegetative characters are discussed and their relative value for taxonomic purposes considered.
- 6. A key based on a combination of external morphological characters and anatomical features of the leaf and shoot, is put forward.
- 7. The vegetative and floral characters of the different species with the anatomical features of their leaves are described, and text figures supplied. An account of their synonomy and distribution in South Africa is given.
- 8. A tentative description of an unidentified specimen is given.

REFERENCES

A DOTED	(4007)	HT
ARBER, .	(1923)	"Leaves of the Gramine ae." Bot. Gaz. Vol. LXXVI, No. 4.
ARBER, A.	(1925)	"Monocotyledons. A morphological Study". Cambridge University Press.
ARBER, A.	(1934)	"The Gramineae. A Study of Cereal Bamboo and Grass". Cambridge University Press.
BEWS, J.W.	(1918)	"The Grasses and Grasslands of South Africa". Pietermaritzburg.
BEWS, J.W.	(1929)	"The World's Grasses, Their Differentiation, Distribution, Economics and Ecology". London.
BURR,S & TURNER, D.M.	(1933)	"British Economic Grasses". London.
DE WIT, H.C.D.	(1941)	"Contributions to the Knowledge of the Genus <u>Setaria</u> Beauv. in South Africa". Bulletin of the Botanic Gardens, Buitenzorg, Series III. Vol.XVII.
EAMES, A.J. & MACDANIEIS, L.H.	(1925)	"Introduction to Plant Anatomy". New York.
FISHER, B.S.	(1938)	"A Contribution to the Leaf Anatomy of Natal Grasses: <u>Tricholaena Schrad.</u> " S. Afr. Journ. Sci. Vol. XXXV.
FISHER, B.S.	(1939)	"A Contribution to the Leaf Anatomy of Natal Grasses: Series I. Chloris Schwattz and Eustachys Desv." Ann. of Nat. Mus. Vol. IX Pt.2.
FISHER, B.S.	(1940)	"The Leaf Anatomy and Vegetative Characters of Certain South African Grasses: The Chlorideae. (Unpublished)
GOOSSENS, A.P.	(1938)	"A Study of the South African Species of Sporobolus R.Br., with special Reference to Leaf Anatomy". Trans. Roy.Soc.S.A., XXVI, Pt.2.
GOOSSENS, A.P.	(1940)	"A New Genus of South African Gramineae". S.A. Journ. Sci. Vol. XXXVII.
GOOSSENS, A.P. Z THERON, J.J.	(1934)	"An Anatomical Study of Themeda triandra Forsk." S.A. Journ. Sci. Vol. XXXI.
GOOSSENS, A.P. & THERON, J.J.	(1938)	"A Study of the South African Species of Ctenium Panz. S.A. Journ. Sci. Vol.XXXV.
GROB, A.	(1896)	"Beitrage zur Anatomie der Epidermis der Gramineenblätter. Bibl. Bot. Heft.36.

HACKEL, E.	(1889)	"Andropogoneae". De Candolle Prodromus. Vol.VI. Paris.
HITCHCOCK, A.S.	(1936)	"The Genera of Grasses of the United States with Special Reference to the Economic Species". U.S. Dept. of Agriculture, Bull. 772. Washington.
HITCHCOCK, A.S.	(1936)	"Manual of Grasses of the West Indies." Miscellaneous Publication No. 243. Washington.
LEWTON-BRAIN, L.	(1904)	"On the Anatomy of the Leaves of British Grasses." Trans. Linn. Soc. London Ser. 2. Bot. Vol.VI, Pt. 7.
MAIDEN, J.H.	(1898)	"A Manual of the Grasses of New South Wales". Sydney.
NEES, C.J.	(1841)	"Florae Africae Australioris."
PAPENDORF, M.C.	(1940)	"In Studie van die Suid-Afrikaanse Species van Agrostis L. (Unpublished)
PHILLIPS, E.P.	(1926)	"The Genera of South African Flowering Plants." Bot. Survey Mem. No. 10. Cape Town.
PHILLIPS, E.P.	(1931)	"South African Grasses". Central News Agency, Ltd. S.A.
PHILLIPS, E.P. & Bredell, H.C.	(1937)	"The Genus Elyonurus Humb. & Bonpl. in South Africa." Bothalia Vol. III, Pt.2.
PHILLIPS, J.	(1935)	"Some Problems Presented by South African Grasses & Grass Communities." Journ. S.A. Bot. Vol.I, Pt.II.
POOLE, R.J.	(1923)	"Xerophytism and Comparative Leaf Anatomy in Relation to Transpiring Power." New Phyt., 24.
SCHWEIKERDT, H.G.	(1941)	"An account of the South African Material of <u>Aristida</u> Linn. in certain European and South African Herbaria. Bothalia, Vol.4.
SCHWEIKERDT, H.G.	(1942)	"A Taxonomic and Anatomical Study of Elytrophorus Beauv." Ann. Natal Mus. Vol.X, Pt.2.
STAPF, O.	(1900)	"Gramineae: Dyer's Flora Capensis. Vol. VII.
STAPF, O	(1934)	"Gramineae: Prain's Flora of Tropical Africa." Vol. IX.
STENT, S.M.	(1924)	"Grasses of the Transvaal as Represented in the National Herbarium." Bothalia Vol.I, Pt.4.
STEYN, T.J.	(1942)	"Die Genus <u>Elyonurus</u> Humb. & Bonpl, in Suid-Afrika, met spesiale Verwysing na die Anatomie." (Unpublished).

STEUDEL, E.G.	(1855)	"Synopsis Plantarum Graminearum.
THERON, J.J.	(1936)	" Anatomisch-systematische Untersuchung der Laubblätter südafrikanischer Aristida-Arten. Berlin.
TURNER,	(1895)	"Australian Grasses." Vol. I. Syaney.
VICKERY, J.W.	(1935)	"The Leaf Anatomy and Vegetative Characters of the Indigenous Grasses of New South Wales 1." Linn. Soc. N.S.W. Vol. lx, Pts. 5-6.
WOOD, J.M.	(1899 - 1908)	"Natal Plants." Durban.