A TAXONOMIC REVISION OF THE GENUS *VIGNA* SAVI (FABACEAE) IN SOUTHERN AFRICA

by

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To my children and grandchildren,
the source of inspiration to go on with my life,
...and Benjamin.

ABSTRACT

Taxonomic investigation of *Vigna* Savi in southern Africa indicated the diagnostic importance of ridging of stems, pubescence type, stipule shape, presence or absence of heterophylly, extrafloral nectaries, structure of standard callosities and legume size/shape. Micromorphology focused on style prolongations, wing morphology and pollen sculpture. Taxa recognized: subgenus *Vigna*, with sections *Vigna* (*V. luteola, V. marina, V. oblongifolia* [varieties *oblongifolia* and *parviflora*]); *Comosae* (*V. comosa* subsp. *comosa* var. *comosa*); *Macrodontae* (*V. friesiorum* var. *friesiorum*); *Reticulatae* (*V. pygmaea*) and *Liebrechtsia* (*V. frutescens* subsp. *frutescens* var. *frutescens*); subgenus *Catjang*, with species, *V. nervosa* and *V. unguiculata,* the latter comprising subspp. *protracta, stenophylla, dekindtiana* (varieties *dekindtiana* and *huillensis*), *tenuis* (varieties *tenuis* and *ovata*); subgenus *Haydonia*, with sections *Haydonia* and *Microspermae*, comprising two undescribed species, *V. mudenia* and *V.* sp. nov. A.; subgenus *Plectrotropis* including sections *Plectrotropis*, with *V. vexillata* having new combinations varieties *ovata* and *davyi* (previously *V. davyi),* and section *Pseudoliebrechtsia* with *V. lobatifolia.*

VIGNA VEXILLATA var. VEXILLATA

Hybrid of the typical purple form and the white form

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PART 1

FORMAL TAXONOMIC TREATMENT

INDEX TO SCIENTIFIC NAMES

Only scientific names of taxa mentioned in the formal taxonomic treatment (CHAPTER 5 and the ADDENDA) are listed. Names in bold type refer to new taxa; those in Roman type are the accepted names. Italics are used for synonyms, misapplied names and all other names of non-southern African taxa mentioned in the text.

SCIENTIFIC NAME

CHAPTER 1

INTRODUCTION

> "Taxonomy is dynamic, beautiful, frustrating, and challenging all at the same time. It is demanding philosophically and technically, yet it offers intellectual rewards to the able scholar and scientist. It can be manifested in works of incredible detail as well as in logical and philosophical conceptualisations about the general order of things. It has strong implications for interpreting the reality of the world as we can ever hope to know."
>
> Tod F. Stuessy (1990): 3.

The genus *Vigna* Savi is pantropical and comprises about 160 species, most of them African. Six species are cultivated, five of these being Asiatic forms (Steele & Mehra 1978). There is an extreme paucity in this genus of so-called `good' taxonomic characters by which natural groupings may be clearly defined (Maréchal *et al.* 1978a).

As a group, *Vigna* is seemingly *a piori* fairly heterogeneous (Baudoin & Maréchal 1985), and numerous infrageneric and infraspecific taxa have been proposed. Yet the different infrageneric groups show a certain cohesion within the genus. The relations of similarity (Figures 1 & 2) provide a working hypothesis of the phyletic relationships, as graphically represented by Maréchal *et al.* (1978a). The entire *Phaseolus-Vigna* complex is represented globally, weighted variables having been used. *Phaseolus* is isolated, whereas the genus *Vigna* is made up of a series of clusters more or less close together and which correspond remarkably well to the large subdivisions as conceived by Verdcourt (1970). The link between the two groups appears to be the group Sigmoidotropis, the subgenus *Sigmoidotropis,* as conceived by Verdcourt, hereby finding confirmation (Maréchal *et al.* 1978a).

The large and apparently primitive subgenus *Sigmoidotropis* was probably initiated in the neotropics and includes most of the American *Vigna* species (Baudoin & Maréchal 1985). The subgenus *Lasiospron* is also confined to the neotropical regions and presents most of the *Vigna* generic characters. All these characters are present in the subgenus *Plectrotropis,* which seems to have originated in the Old World. Two evolutionary tendencies appeared, namely, a differentiation toward a specialized floral morphology resulting in the homogeneous subgenus *Ceratotropis* in Asia, and, a relative simplification of the floral morphology retaining the bilateral symmetry in the species-rich subgenus *Vigna* in Africa. Relatively closely related to this African group, the subgenus *Haydonia* seems to represent a recent evolutionary trend expressed by the loss of some typical *Vigna* characters and acquisition of some new ones. The remaining subgenus of *Vigna*, namely *Macrorhynca*, appears remote from the others but is retained in the genus for convenience (Baudoin & Maréchal 1985), thereby reflecting the suggestion by Maréchal *et al.* (1978a) that more information is required before raising its status to genus.

Using the Latinised form, Professor Cayetano Savi of Pisa (de la Sagra, 1845) named the genus *Vigna* in 1824 after Domenico Vigni, born in Florence in about 1577 and died in Pisa in 1647. Vigni had evidently become a doctor before moving to Pisa and became physician to various Pisan families of the day. Since 1609 he was professor of Botany at the University of Pisa and the nineth curator of the Pisa Botanic Garden since 1614 (Verdcourt 1989). He was also known to superintend the Natural History Museum and Chemical Laboratory. Vigni wrote a commentary on Theophrastus' "Peri phyton historiae" and "Peri phyton aition" (Westphal 1974).

The cultivated species of *Vigna* form an excellent source of vegetable protein for human consumption, and many others hold promise as potential foodcrops. Interest in the genus *Vigna* is therefore increasing worldwide, particularly due to the stimulation provided by organisations such as the Food and Agricultural Organisation of the United Nations in its quest for crops with a higher vegetable protein content. These crops must essentially be resistent to unfavourable conditions such as drought, lack of suitable pollinators and infertility of soil. "Food for the millions" has become the constant cry inspiring geneticists, chemists and other specialized food researchers, taxonomists, crop specialists and agriculturists to dedicated and profound research into pulses.

Most common of the cultivated Vignas, is *Vigna unguiculata* (L.) Walp. subsp. *unguiculata* with its four most important cultigens, called culti-groups by Westphal (1974), namely cv. gr. *unguiculata* (L.) Westphal (cowpea, African bean, black-eye bean, black-eye pea, southern pea, China pea, kaffir pea, marble pea [English], kafferboontjie [Afrikaans], haricot dolique and dolique de Chine [French] and many more local names), cv. gr. *biflora* (L.) Westphal (catjang, catjang cowpea and many local names), cv. gr. *sesquipedalis* (L.) Westphal (yard-long bean, asparagus bean, snake bean

[English], dolique asperge [French] and many local names) and cv. gr. *textilis* A. Cheval, which is the only one not cultivated for food but for the strong fibres in the extraordinarily long peduncles (northern Nigeria). *Vigna aconitifolia* (Jacq.) Maréchal, *V. angularis* (Willd.) Ohwi & Ohashi, *V. mungo* (L.) Hepper (black gram or urd), *V. radiata* (L.) Wilcz. (green gram, mung bean), *V. trilobata* (L.) Verdc. and *V. umbellata* (Thunb.) Ohwi & Ohashi represent the surface crops most commonly cultivated in Asia, especially in India. However, there are also subterranean crops in the genus *Vigna* which could alleviate hunger. *Vigna subterranea* (L.) Verdc., known as `the bambara ground nut', presents small 1—2 cm long underground legumes containing variously coloured seeds. It has a wild variety, var. *spontanea* (Harms) Hepper cultivated in Africa. A second groundnut in the genus *Vigna*, is *V. minima* (Roxb.) Owhi & Ohashi, a native of the Western Ghats in India (rice bean). In this case two types of legumes are borne, namely, aerial legumes with 8—11 seeds and subterranean ones with only one or two seeds. All these potential food-providing *Vigna* species will be discussed in greater detail in the Discussion (CHAPTER 6).

Since plant breeding, which requires a constant supply of genes, can be considered evolution at the will of man, and since the natural gene source is gradually diminishing because of human activity that changes or destroys the natural habitats of the wild species of *Vigna*, selected hybridization programs are essential. It often happens that characters that are required do not exist in any of the cultivated species, nor even in the wild ones that scientists want to improve. The cause is the presence of interspecific incompatibilities. These vary greatly and are the function of phyletic differences between species, anyway. There are new scientific methods to overcome this problem, but it is important that the parents are phyletically similar for successful hybridization. In depth studies of interspecific incompatibility barriers and analyses of meiotic pairing in hybrids are urgently required to provide positive direction (Maréchal *et al.* 1978a). To facilitate the quest for improved cultivars, small quantities of seed at the International Institute of Tropical Agriculture at Ibadan, Nigeria, are distributed to scientists throughout the world but regular feedbacks are vital. Since the commencement of our study, co-operation with geneticists from the Germplasm Institute at Bari, Italy, has led to regular consignments of fresh *Vigna* seed from the NBI, Pretoria, being sent to their Institute.

Since the breeding of new cultivars entail hybridizing the natural groups with the already known cultivars, interest is turned to the Flora of Southern Africa region where certain robust wild species grow prolifically, especially in Natal and the Transvaal (Mithen 1988a). In particular, programs entailing hybridization experiments between *V. unguiculata* (L.) Walp. cultigens and *V. unguiculata* subsp. *stenophylla* (Harv.) Maréchal *et al.*, subsp. *tenuis* (E. Mey.) Maréchal *et al.* and subsp. *protracta* (E. Mey.) Pienaar (see ADDENDUM 1) are to be implemented by the Board for Plant Genetic Resources, based at the University of Zimbabwe in Harare (Mithen 1988b). To date hybridization experiments between *V. unguiculata* cultigens and *V. nervosa* Markötter, the only other member of the subgenus *Catjang*, which occurs in the Natal midlands and Transvaal and the eastern highlands of Zimbabwe, have failed.

Taxonomic studies of *Vigna* Savi in southern Africa is therefore, not inopportune at this stage and the need for clarity regarding the status of all taxa within the confines of southern Africa, is essential. The latter is borne out by the confusion existing among specimens borrowed from the main southern African herbaria which include, amongst others, species of *Dolichos* L., *Otoptera* DC. and *Sphenostylis* E. Mey.

As will be seen in the contribution on the historical background of the *Phaseolus-Vigna* grouping (CHAPTER 2), certain clear-cut characters make it possible to recognize members of *Vigna* relatively easily, e.g. stipules produced beyond the point of attachment, the adaxially bearded style, the prolongation of the style extending more or less beyond the lateral stigma in the form of a variously shaped beak or protuberance, the exine of the pollen grains sculptured in a coarse honeycomb fashion and internally segmented legumes. Certain guide lines are therefore available from the offset.

The main purpose of the present study is to investigate the species and infraspecific taxa that grow naturally in southern Africa with regard to their taxonomic circumscription and diagnostic characters. Information which may be of value to geneticists and specialized food specialists involved in hybrization programs, could thus be provided. Southern African botanists who need to identify specimens and deal with other taxonomic matters regarding the genus *Vigna*, are provided with workable keys and descriptions to be able to identify and name collections correctly. The confusion evident from the loans from the chief herbaria in southern Africa, may therefore be unravelled and understood after referring to this work.

This thesis contains six chapters and three addenda. Following this introduction (CHAPTER 1), the second provides the historical review concerning the problem surrounding the *Phaseolus-Vigna* complex, firstly as seen by recent European workers, notably Verdcourt (1970, 1971), Maréchal *et al.* (1978a) and Jaaska & Jaaska (1988), and secondly, as investigated in South Africa by the English Botanist, Harvey (1862), Burtt Davy (1932), an Englishman long in the service of the South African Government, and the South African-born botanist now working in Australia, Ross (1972).

The materials and methods employed to this end, are dealt with in CHAPTER 3. The most important diagnostic characters are evaluated and applied to the species of *Vigna* in southern Africa in detail in CHAPTER 4. The taxonomy of the genus *Vigna* and its subgenera and varieties, including identification keys, is expounded in CHAPTER 5, the principal contribution of the present study. Finally, the discussion of results, accompanied by notes on reproductive biology and important conclusions, is contained in CHAPTER 6. *V. unguiculata, V. mudenia* (a new species) and *V. vexillata* are fully discussed in three Addenda, their having been published in, or submitted to, the South African Journal of Botany.

CHAPTER 2

HISTORICAL BACKGROUND

"The contemporary status of any facet of science is better comprehended and oriented by the student who has a knowledge of its beginnings and development. The history of plant classification is a fascinating subject because one learns not only of the men responsible for it and of their contributions, but also that from these contributions there is being evolved a classification of plants based on biological facts."

G.H.M. Lawrence (1951): 13.

2.1 Status and generic limits of *Vigna* Savi

From the earliest times, the circumscription of the genera *Phaseolus* and *Vigna* has been a matter of confusion and botanists have attempted to differentiate between them by means of various distinguishing characters. The most obvious of these is the degree to which the keel of the beak is incurved. Thus Verdcourt (1970) quotes J.B. Gillett's memorandum of 1964 in which he sums up the confusion, and begins by citing Bentham (1865):

Phaseolus:	carina spiralis.
Vigna:	omnia Phaseoli nisi carina erostris vel rostro obliquo valde incurvo sed spiram perfectum non efficiente.

Freely translated, this is, *Phaseolus* has a spiral keel, that of *Vigna*, unlike the keels of all Phaseoleae, is beaked or the beak is strongly incurved at an oblique angle, but not forming a perfect spiral.

The result was that certain Old World species were placed into *Phaseolus* L. (type species *P. vulgaris* L.), because of the spiral keel, whereas they were in fact closer to *Vigna*. This character is directly opposed to the bilateral symmetry of the straight keel of the type species of *Vigna*, which occurs in both America and Africa, namely *V. luteola* (Jacq.) Benth. A large group of Asian beans, the `mungo' type, section *Ceratotropis* (Piper 1926), is characterized by asymmetric flowers in which the keel is bent or strongly twisted through 180° and bears a prominent erect pocket or spur on its left flank. This group was maintained in *Phaseolus* for a long time in spite of similar characters being found in certain African species of *Vigna*, e.g. *V. vexillata* (L.) A. Rich., *V. nuda* N.E. Br. and *V. kirkii* (Bak.) Gillett. They have, since, been transferred to *Vigna* by Verdcourt (1970).

As it was realized that the curvature of the keel was not satisfactory for diagnostic purposes, new characters were employed, as did Wilczek (1954a). He demarcated the two genera by the following means:

Phaseolus: stipules not prolonged below the point of insertion; keel in a spiral of one to five turns; stigma elongated, internal or sometimes very short and terminal or subterminal; style without an apical appendage.

Vigna: stipules prolonged below the point of insertion; keel erect, incurved, rarely making almost a complete spiral turn; style ending beyond the stigma in a more or less distinct beak.

On this basis, Wilczek (1954a) transferred *P. radiatus* L. and *P. campestris* Mart. to *Vigna*. However, he retained *P. schimperi* Taub. in *Phaseolus*, although it had often been moved to *Vigna* by various botanists. The above criterion also applied to the section *Ceratotropis* (Piper 1926) and was transferred to *Vigna* by Verdcourt (1970). However, Wilczek was not consistent since he retained four species with truncate stipules in *Vigna*.

Hepper (1958) transferred *P. mungo* to *Vigna* remarking that "this possesses large medifixed stipules and narrow septate pods, both of which are characters of *Vigna* under the new concept of the genus adopted by Dr. Wilczek." He evidently followed Wilczek's concept of the genus *Vigna* although Wilczek had not mentioned the septate pods. In Flora of West Tropical Africa, Hepper (1958) used the following characters:

Phaseolus: stipules truncate at the base; keel spirally twisted; fruit not septate.

Vigna: stipules cordate or appendaged below the base; keel straight or spirally twisted; fruit septate.

Hepper had retained *P. calcaratus* Roxb. in *Phaseolus* in spite of its medifixed stipules and more or less septate fruit, but he wrote a note on his Kew Herbarium sheets to say that *P. calcaratus* is a *Vigna*. Kurz (1876, fide Verdcourt 1970) transferred the species to *Vigna*, but the epithet could not be retained if Ohwi's opinion that this species is conspecific with *Dolichos umbellatus* Thumb. was correct (fide Verdcourt 1970: 508). Consequently Verdcourt (1970) treated *V. calcarata* (Roxb.) Kurz as conspecific with *V. umbellata* (Thunb.) Ohwi & Ohashi; the species is often cultivated in East Africa.

Hepper (1958) renamed *P. schimperi* in *Vigna* as *V. macrorhynca* (Harms) Milne-Redhead since the name *V. schimperi* Bak. was already in existence. In contrast to Wilczek, he did this on account of the septate fruits, although it has truncate stipules. This was done as he did not find that the two genera are satisfactorily separable (Verdcourt 1970). Yet he did not give any reason for ignoring the style-tip which Wilczek found so significant. The style beak is highly curved, almost forming a circle. Verdcourt (1970) also included this taxon in *Vigna*, as *V. macrorhynca* (Harms) Milne-Redhead.

Tourneur (fide Verdcourt 1970: 508) introduced a new diagnostic character when considering Wilczek and Hepper's transfer of *P. radiatus* and *P. mungo* to *Vigna*, when he agreed with the move on the grounds that the first pair of leaves in seedlings, arising after the cotyledons, are sessile in *Vigna* as opposed to the petiolate ones in *Phaseolus*. However, his studies were not considered universally acceptable as he had studied too few species, only two of *Phaseolus* and three of *Vigna* (Verdcourt 1970). Verdcourt expressed the need for more complete studies of germination patterns in the two genera as it is known that both epigeal and hypogeal germination occur in *Phaseolus* s. str. and in *Vigna* subgenus *Ceratotropis*.

Recently Yeh *et al.* (1987) studied 37 agriculturally important members of the tribe Phaseoleae and in particular members of the *Phaseolus-Vigna* group. Using germination characters, they constructed a workable key in which such characters as primary leaf morphology (simple or three-foliolate), texture, shape, petiole length, stipule number and hypogeal or epigeal germination were employed. Both *Phaseolus* and *Vigna* have either hypogeal or epigeal cotyledons and have two stipules but the other characters differ from each other, thereby dividing the seedlings clearly into two genera.

Unfortunately much of the taxonomic work done on *Phaseolus* and *Vigna* has involved too few species at a time as did De Wildeman (1902) when working on African species that occur in Katanga only. He described the genus *Liebrechtsia*, separating it from *Vigna* on the basis that the style is prolonged beyond the stigma. *Liebrechtsia* has not been maintained since, except as a section in the subgenus *Vigna* by Verdcourt (1970). Here one of the demarcating characters which Verdcourt uses for the section, is `the style very prominently beaked beyond the stigma'. The only species in the section is *V. frutescens*, although there are three subgenera and two species in the one subgenus. Verdcourt (1970) questions the authenticity of *V. antunesii* Harms and has not encountered *V. debanensis* Martelli in the East African region, both species being reputed to have such a long style prolongation. *V. decipiens* Harv., a southern African species first recorded and named by Harvey (1862), has been found to be *V. frutescens* A. Rich. subsp. *frutescens* var. *frutescens* and has been moved there in this thesis. Several Old World species of *Phaseolus*, as it was demarcated in earliest times, were known for such style tips.

Piper (1926) recognized twelve genera in the American *Phaseolineae*. Of these, two were new and one other is *Strophostyles* Elliott (1822), which Bentham had reduced in rank to a section of *Phaseolus*. Piper (1926) includes all those species (largely Old World) that have stipules spurred below the point of insertion. He reinstated *Strophostyles* to generic rank and narrowed its limits once more to include two or three American species only .

Owhi, a Japanese botanist, demarcated five *Phaseolus* species including *P. angularis, P. calcaratus, P. radiatus* and *P. aureus* which would have been included in *Liebrechtsia*, all with style tips like *Liebrechtsia*, and created a new genus, *Azukia*, with type species *A. angularis* (Willd.) Ohwi, to accommodate them. The peltate stipules, keel, style and pollen characters are all different from those of *Phaseolus*, but later Owhi & Ohashi (1969) agreed that *Azukia* should be merged with *Vigna*.

Maekawa (1955) described a new genus, *Radua*, on the grounds of first foliage characters and style differences that separate it from the American *Phaseolus* and *Strophostyles* species, the African *Dolichos* and *Vigna* and from the Asian *Azukia*. However, Maekawa's studies were based on only a few species of each and are therefore, not acceptable.

At least one botanist, namely Gagnepain (1916), attempted to solve the problem of the demarcation of the genera *Dolichos, Phaseolus* and *Vigna* by uniting them in one genus and Richard (1847) suggested that the three genera mentioned might form three sections in one natural genus. The proposal was not accepted and Verdcourt (1970) rejected the idea by saying: "from a practical point of view of name changes, it would be a very arbitrary way of dealing with the problem at the expense of a large number of names." He argues that the differences between the type species, *P. vulgaris* L. and *V. luteola* (Jacq.) Benth., are so clear cut, that they cannot be considered to be congeneric; rather, the better solution would be to separate off the difficult marginal groups as genera and subgenera to be classified more correctly later. The result is that *Phaseolus* becomes a small, clear cut genus, whereas *Vigna* becomes almost unwieldy, containing a large number of `problem' species which can often fit into either of the genera.

An important contribution toward the demarcation of the genera, was made by Verdcourt (1970) when he found that all but a few African species of *Vigna*, reveal a remarkably open, coarse reticulation of the pollen exine sculpture. This is quite different from the finely reticulated sculpture of *Dolichos* or the sculpturing of *P. vulgaris* or its allies. A survey of pollen grain sculpture of all so-called *Phaseolus* material from the New World at Kew, indicated that many species, particularly those from the tropics, possess a wide, open reticulation and often have stipules produced beyond the point of attachment, i.e. they are clearly congeneric with *Vigna*. Later studies showed that five species of *Vigna* have a very finely reticulate, or almost smooth pollen exine sculpture, e.g. *V. juncea* Milne-Redhead and *V. schimperi* Bak.

Chromatographic methods to determine the amino-acid patterns of seeds were executed in 1953 by Dr. E.A. Bell of King's College (vide Verdcourt 1970: 510), but unfortunately the seeds were taken at face value and not positively correlated with herbarium material and some may, therefore, have been erroneously determined. Yet the results showed that typical *Phaseolus* and typical *Vigna* species have basically different patterns. The group of species separated by Ohwi as *Azukia*, came closer to *Vigna* in pattern. The importance of keeping voucher specimens of plants from which material for chemical analyses is taken, cannot be overstressed. To date, a number of researchers have done similar tests and have shown that chemical characters do not always tie in with pollen and style morphology. In several species e.g. *V. juncea* and *V. longifolia* (Benth.) Verdc., the one character points to *Vigna* and another to *Phaseolus* (Verdcourt 1970).

Germination patterns need to be more fully studied but it is known that in *Phaseolus* s. str. and in *Vigna* subgenus *Ceratotropis*, examples of both epigeal and hypogeal germination occur (Verdcourt 1970).

The magnitude of the generic problem is now evident and should be kept in mind when considering Verdcourt's first classification of *Vigna* (1971) for Tropical East Africa.

Maréchal *et al.* (1978a) used 167 characters in a numerical study of the *Phaseolus-Vigna* complex on a world scale, including other small related genera such as *Strophostyles* (Elliott) DC., *Physostigma* Balf. and *Macroptilium* Benth. All members of the Phaseolineae with styles bearded on the inner face, were considered. Live specimens, herbarium material and information on organographical, cytological and germination characters, palynological information regarding external morphology as well as the exine ultrastructure, were taken into account. A taxometric method was utilized to handle the tremendous amount of information collected regarding the numerous taxa, together with many different characters of ill-defined importance. The choice of characters was based on both botanical knowledge of the considered population and the statistical determination of its characters. An *a priori* weighting of characters was rejected to preserve the objectivity of the method. Once the individuals grouped, they were characterized by the variables of high taxonomic weight, determined by discriminate analysis and the results verified by the factorial analysis of the correspondence. From the weighted data, the hierarchization was able to be traced and could be expressed in terms of classical taxonomic categories. This, the researchers believed, meant that they were following the classical reasoning power for revisions while taking advantage of the mastery of objectivity of the computer. The results lead to the highest weighting obtained for inflorescence and floral characters and only slight weighting for seed and palynological characters, although it appears that the ultrastructural pattern of the exine is significant. After objective weighting, the subspecies grouping corresponded to a high degree to Verdcourt's 1971 classification (refer to Figures 1 & 2). This strengthened the idea of a restricted *Phaseolus* genus and a rather heterogeneous *Vigna* genus, the principles of which are also acceptable to me and are employed in this thesis as summarized in Table 1, overleaf.

Table 1. Synopsis of the classifications of Verdcourt (1971), Maréchal *et al.* (1978a) and the course adopted in this study, as applicable to the *FSA* region. Jaaska & Jaaska (1988) upgraded section *Catjang,* as used by Verdcourt (1970, 1971) and Maréchal *et al.* (1978a), to the status of subgenus and this has been employed in this study. All diagnostic characters have not been mentioned.

Verdcourt (1971)	Maréchal *et al.* (1978)	Present Study
Genus *Vigna* Subgen. *Vigna* Sect. *Vigna* Stipules bilobed; keel short; style beak short; muri reticulation wide. *V.luteola,* *V. marina,* *V. oblongifolia,* *V. comosa.*	Genus *Vigna* Subgen. *Vigna* Sect. *Vigna* Stipules bilobed; keel short; style beak short; muri reticulation wide, pollen triporate. *V. luteola,* *V. marina,* *V. oblongifolia.*	Genus *Vigna* Subgen. *Vigna* Sect. *Vigna* Stipules bilobed; keel short; style beak short; muri reticulation wide,pollen triporate. *V.luteola,* *V. marina,* *V. oblongifolia*
	Sect. *Comosae* Stipules truncate, filiform, on small pad; keel shortly twisted; style beak short,broad, flat; legumes distally broad. *V. comosa.*	Sect. *Comosae* Stipules truncate, filiform, on small pad; keel shortly twisted; style beak short, broad, flat; legumes distally broad. *V. comosa.*
Sect. *Macrodontae* Stipules bilobed; keel incurved, canoe-shaped; style beak short; muri raised, wide	Sect. *Macrodontae* Stipules lanceolate, bilobed; keel shortly twisted; style beak short; legumes narrow, erect, polyspermic,	Sect. *Macrodontae* Stipules bilobed, lanceolate; keel incurved, twisted; style beak short; muri raised, wide

reticulation; legumes narrow erect, polyspermic, up to 25 small seeds. *V. friesiorum.*	more than 12 small seeds. *V. friesiorum.*	reticulation; legumes linear, erect, many small seeds. *V. friesiorum.*
Sect. *Reticulatae* Stipules prolonged, cordate; keel shortly beaked, not incurved; style shortly beaked; muri raised, wide reticulation; tertiary veins transverse and subparallel, typical. *V.pygmaea.*	Sect. *Reticulatae* Stipules bilobed; keel blunt; style beak compressed, a lanceolate blade; reticulate venation parallel, typically recognizable. *V.pygmaea.*	Sect. *Reticulatae* Stipules produced, cordate; keel obtuse; style beak flattened, nervose blade; muri raised widely reticulate; tertiary veins close, subparallel to transverse ones. *V. pygmaea.*
Sect. *Liebrechtsia* Stipules bilobed; keel not incurved to 180°; style prominently beaked; wide reticulation of raised muri; flowers precocious. *V. frutescens.*	Sect. *Liebrechtsia* Stipules bilobed; keel blunt; style beak long, curved inward at rear; legumes erect, polyspermous; pyrophytic. *V.frutescens.*	Sect. *Liebrechtsia* Stipules bilobed; keel gently incurved; style prominently beaked; muri raised, wide reticulation; often pyrophytic. *V. frutescens.*
Sect. *Catjang* Stipules spurred; keel obtuse, short, incurved; style beak upturned; muri raised wide reticulation, *V. unguiculata*	Sect. *Catjang* Stipules peltate, spurred; flower almost symmetrical; style short, vestigial; pollen large poor aril. *V. unguiculata,*	Subgen. *Catjang* Sect. *Catjang* Stipules spurred; keel obtusely beaked, canoe-shaped; style a protuberance, hammer-shaped; muri raised, wide

subsp. *unguiculata,* subsp. *dekindtiana,* subsp. *sesquipedalis,* subsp. *cylindrica,* subsp. *mensensis,* *V.pubescens,* *V. tenuis,* *V. unguiculata* var. *protracta,* *V. nervosa,* *V. angustifoliolata* (1970).	subsp. *unguiculata,* cv. gr. *unguiculata,* cv. gr. *biflora,* cv. gr. *sesquipedalis,* cv. gr. *textilis,* subsp. *dekindtiana* var. *dekindtiana,* var. *mensensis,* var. *pubescens,* var. *protracta,* subsp. *tenuis,* subsp. *stenophylla,* *V. nervosa.*	reticulation. *V. unguiculata* subsp. *unguiculata* cv. gr. *unguiculata,* subsp. *protracta,* subsp. *dekindtiana* var. *dekindtiana,* var. *huillensis,* subsp. *mensensis,* subsp. *tenuis* var. *tenuis,* var. *ovata,* subsp. *stenophylla,* *V. nervosa.*
Subgen. *Haydonia* Stipules sublobed; keel short-beaked; stigma subterminal; short stamens often with pair of joined basal anther glands; no obvious pollen sculpture or smooth. *V. monophylla*	Subgen. *Haydonia* Stipules sublobed; keel short-rostrate; style beak short/ absent; glands basal to internal anther cycle; losing pollen sculpture; stems strongly alate. Sect. *Haydonia*, anther glands, no style prolongation, stipules truncate. *V. monophylla*. Sect. *Microspermae*, no stipule prolongation, small seeds, style shortly beaked. Sect. *Glossostylus*, pollen reticulations lost.	Subgen. *Haydonia* Stipules sublobed; keel short-beaked; style protuberance short/absent; inner whorl anther bases with pair/bunch/no glands; muri low/ absent; stems ribbed or alate. legumes thin, seeds small, aril absent. Sect.*Haydonia*, stems alate, anther glands, stigma obliquely terminal, no beak, stipules scarcely auriculate. *V. monophylla.* Sect. *Microspermae*, stipules reflexed, subauriculate,

		style with small protuberance, or reduced to swelling, muri reduced, wide reticulations, no anther glands, stems alate. *V. mudenia, V. sp. nov. A.*
Subg. *Plectrotropis* Stipules shortly appendaged, cordate; style apically lobed; keel with lateral pocket, rostrum twisted to 180°; reticulation of raised muri. Sect. *Plectrotropis*, flowers and leaves appear together. *V. vexillata* var. *vexillata,* var. *angustifolia,* var. *dolichonema,* *V. davyi.* Sect. *Pseudoliebrechtsia,* precocious, keel twist less. *V. lobatifolia.*	Subg. *Plectrotropis* Stipules bilobed, sometimes slightly peltate; style not noted; keel with lateral pocket, rostrum incurved, twisted to 180°. Sect. *Plectrotropis*, flower not precocious. *V. vexillata* var. *vexillata,* var. *angustifolia,* var. *dolichonema,* *V. davyi.* Sect. *Pseudoliebrechtsia*, pyrophytic, precocious. *V. lobatifolia.*	Subg. *Plectrotropis* Stipules bilobed, shortly appendaged; style prolongation bonnet-shaped; keel with lateral pocket, rostrum twisted to 180°; muri raised, wide reticulations. Sect. *Plectrotropis*, not precocious. *V .vexillata* var. *vexillata,* var. *angustifolia,* var.*ovata,* var. *davyi.* Sect. *Pseudoliebrechtsia*, keel slightly rostrate, curved; style prolongation bonnet-shaped. *V. lobatifolia*.

2.2 *Vigna* in southern Africa

The concept of *Vigna* in southern Africa began with Harvey in Harvey & Sonder (1862). Harvey employed characters regarding the number of flowers, leaf texture and shape, calyx and stipules to construct an infraspecific key. Since, Verdcourt (1970, 1971) has pointed out how precarious leaf shape and calyx characters are in treatments of *Vigna*. Harvey recognized eight species, the types of which are chiefly housed in Trinity College in Dublin (isotypes at Kew). Of these eight species, three do not belong to the genus, namely, *Otoptera burchellii* DC., *Sphenostylis angustifolia* Sond. and *Sphenostylis marginata* E. Mey.

J. Medley Wood (1908) published a checklist for Natal in which he listed nine *Vigna* species. However, *Otoptera burchellii* and *Sphenostylis angustifolia* were included.

Burtt Davy & Pott Leendertz published a checklist for the Transvaal and Swaziland in 1912 and, again, included the latter two species.

Burtt Davy (1932) described 16 species of *Vigna* for the Transvaal and Swaziland, also including *Otoptera burchellii* as *V. burchellii* (Harv.) Burtt Davy.

Phillips published his Genera of South African Flowering Plants in 1955, providing a genus description of *Vigna* and its distribution in the country.

Ross (1972) listed eight species for the Flora of Natal.

A summary of the taxa recognized by the last mentioned authors and the present study is provided in Table 2, overleaf.

Dyer (1975) gave a general description of the genus *Vigna*, saying that there are *ca*. 20 species in southern Africa, widespread from the eastern Cape but absent from the western Cape.

Taking into account the historical background of the generic confusion regarding the *Phaseolus-Vigna* complex here in southern Africa and in the rest of Africa, the treatment of the genus *Vigna* for the *FSA* Region may be regarded as timeous. To this end, the guidelines provided *by workers such as Verdcourt (1970, 1971) and Maréchal* et al. *(1978a),proved to be indispensable.*

Table 2. Summary of the species and infraspecific taxa of the genus Vigna *recognized in southern Africa by Harvey (1862), Burtt Davy (1932), Ross (1972) and in the present study.*

Harvey (1862)	*Burtt Davy (1932)*	*Ross (1972)*	*Present Study*
V. luteola *Benth.*	V. luteola *(Jacq.) Benth.*	V.luteola *(Jacq.) Benth.*	V. luteola *(Jacq.) Benth.*
V. retusa *Walp.*		V. retusa *(E. Mey.) Walp.*	V. marina *(Burm.)Merrill*
	V wilmsii *Burtt Davy*		V. oblongifolia *A. Rich.* *var.* oblongifolia, *var.* parviflora *(Bak.) Verdc.*
V. decipiens *Harv.*	V. decipiens *Harv.* V. longiloba *Burtt Davy* V. pongolensis *Burtt Davy*	V. decipiens *Harv.*	V. frutescens *A. Rich.* *subsp.* frutescens *var.* frutescens
	V. sinensis *(L.) Endl.* *pro parte*		V. unguiculata *subsp.* unguiculata *cv. gr.* unguiculata
V. triloba *Walp.* V. hispida *(E. Mey.) Harv.*	V. triloba *(Thunb.)* *Walp.* V. rhomboidea *Burtt Davy*	V. unguiculata *(L.) Walp.* *var.* protracta *(E. Mey.) Verdc.*	V. unguiculata *(L.) Walp.* *subsp.* protracta *(E. Mey.) Pienaar.*
	V. scabrida *Burtt Davy* *pro parte* V. sinensis *(L.) Endl.* pro parte		V. unguiculata *(L.) Walp.* *subsp.* dekindtiana *(Harms) Verdc.* *var.* dekindtiana *var.* huillensis
V. tenuis *E. Mey.* *var. α* ovata *var. ß* oblonga	V. scabrida *Burtt Davy* pro parte	V. tenuis *(E. Mey.)* *Dietr.*	V. unguiculata *(L.) Walp.* *subsp.* tenuis *(E. Mey.)* *Maréchel* et al. *var. tenuis* *var.* ovata *(E. Mey.) Pienaar*
V. triloba *var. ß* stenophylla	V. stenophylla *Burtt Davy*		V. unguiculata *(L.) Walp.* *subsp.* stenophylla *(Harv.) Maréchal* et al.
	V. galpinii *Burtt Davy*	V. nervosa *Markötter*	V. nervosa *Markötter*
V. vexillata *Benth.* *pro parte*	V. vexillata *(L.) A. Rich.*	V. vexillata *(L.) A. Rich.* *pro parte*	V.vexillata *(L.) A. Rich.* *var.* vexillata
V. vexillata *Benth.* *pro parte* V. angustifolia *Benth.*	V. hirta *Hook.*	V. vexillata *(L.) A. Rich.* *pro parte*	V. vexillata (L.) *A. Rich.* *var.* angustifolia *(Schumach. & Thonn.) Bak.*
V. vexillata *Benth.* *pro parte*	V. capensis *(Thunb.)* *Burtt Davy*	V. vexillata *pro parte*	V. vexillata *(L.) A. Rich.* *var.* ovata *(E. Mey.) Pienaar*
	V. davyi *Bol.*	V. davyi *Bol.*	V. vexillata *(L.) A. Rich.* *var.* davyi *(Bol.) Pienaar*
			V. mudenia *Pienaar* V. sp. nov. A

CHAPTER 3

MATERIALS AND METHODS

"Biology can answer many complex questions about nature, but the simple questions often confound the scientific machine....man by nature has always seemed to derive more pleasure and challenge from the process of discovery itself than from the process of synthesizing the results of previous discovery....the `machine' already has pervaded our daily lives and begun to make an impact on scientific research...."

S.S. Shetler (1947): 791.

"Is it objectivity, or lack of courage to evaluate?"

B.L. Burtt (1964): 14.

The notable taxonomic treatments by Verdcourt (1970, 1971) were studied to learn which species of the genus *Vigna* are found in Tropical East Africa and might be expected in southern Africa. The phenetic approach by Maréchal *et al.* (1978a), which is world-wide in approach, provided a second sound base for the treatment. Harvey (1862), Burtt Davy (1932) and Ross (1972) were the only authoritative texts on *Vigna* in southern Africa, but reference lists in all available literature amplified the sources at my disposal. Literature not available in our country, was kindly provided from the Resources Centre of the Royal Botanic Gardens, Kew, by the South African National Botanical Institute Liaison Officers, Messrs Ashley Nicholas and Craig Hilton-Taylor, based there.

Herbarium material was loaned from European and southern African Herbaria including BR, BM, BOL, DWU (i.e. Durban Westville University) FI, J, K, LISC, LISU, NH, P, PRE, PRU, SAM, SRGH and WIND. Two weeks were spent at the Kew Herbarium to acquaint myself with those southern African and some East African specimens in their collections. Cibachrome prints of Types were also made available by the Media Resources Centre, Royal Botanic Gardens, Kew, and are now housed at PRE. The NBI, Pretoria, photographer has provided black and white photographs of important specimens loaned from other herbaria.

Extensive fieldwork made it possible to study the live plants in their habitats, to supplement the PRE herbarium collections, to collect spirit material and to bring live material to the NBI, Pretoria, nursery for detailed comparative study. Cultivated plants were also studied to establish the periods of anthesis of the various species.

Distribution maps were constructed from locality plotting of collections according to the grid reference system of Edwards & Leistner (1971).

Explanatory tables were drawn up wherever possible to illustrate results of observations. Illustrative graphs were constructed to ensure that dependable diagnostic characters were chosen when distinguishing among the species and varieties. These latter graphs have not been included in the thesis as such, because of their bulk and the length of the thesis already attained. They indicated which particular characters are either obviously not of diagnostic value, or strongly so. They have a direct bearing upon the distinguishing characters chosen and discussed in CHAPTER 4.

Scanning electron microscopy (SEM) was employed in the search for diagnostic characters. For SEM studies, air dried herbarium material is mounted on aluminium stubs with double sided tape and glow-discharge coated with a thin (*ca*. 400 Å) layer of metallic gold in an `Eiko model IB-2' sputter coater. The stubs are then stored in a dessicator with silica gel or observed directly with an ISI SX-25 Scanning Electron Microscope, operated at 25 kv. SEM micrographs are taken with a Mamiya 6 X 7 cm camera on black and white Ilford FP4 120 roll film. Samples of fresh material are fixed in FAA (or spirit material may be used directly), then dehydrated on Dimethoxypropane (Merck) for two hours, washed for five minutes in acetone and critical point dried with CO^2 in a Baizers Union critical point drier at a pressure of 85 atmospheres and at temperature 40° C. Samples are mounted for viewing as above (Newman *et al*. 1982).

Pollen grains were removed from fresh or preserved specimens for each species and treated as described above for SEM investigation. Maréchal *et al*. (1978a) have stressed the importance of examining the structure of the exine, i.e. in section, in species of *Vigna* as it is of diagnostic importance. However, this could not be done in the context of the present study.

Electrophoresis profiles of seeds of all southern African species of *Vigna* were done with the kind co-operation of Dr. P. Perrino and Dr. G. Laghetti of the Germplasm Institute at Bari, Italy, using the method described by Laemmli (1970), an improved method of disc-electrophoresis in sodium dodecylsulphate (SDS).

Main conclusions of the entire study are discussed in CHAPTER 6. A summary of the resulting classification may be obtained from me on request, rather than my adding another chapter to the already lengthy thesis. I am of the opinion that the summary of the diagnostic characters of all combinations (in alphabetical order), at the end of CHAPTER 4, already serves the purpose of a final summarizing chapter.

CHAPTER 4

THE EVALUATION OF CHARACTERS

"One will always find characters for separation if one tries hard enough---and, one may add, find that characters used for separation do not hold when more material is examined!"
Davis & Heywood (1963):114.

1. Introduction

A variable and mind-boggling list of definitions for **character** is available in the literature, the simplest of which is probably that of Mayr (1969: 121): "any attribute of a member of a taxon by which it differs or may differ from a member of a different taxon". The definition changes with the approach of the classifier. Thus, Maréchal *et al.* (1978) who are biassed toward the use of the computer, define a `characteristic' as "the result of a natural or apparatus-aided observation susceptible to variation over the whole range of individuals studied." Furthermore, a variety of synonyms for character appear in literature, e.g. feature, quality, attribute, essence (essentialia), characteristic (descriptive term), property, difference and accident. However, Stuessy (1990: 30) summarizes the confusion in the following words: "difference, property, accident and essentialia have precise logical definitions; feature, quality and attribute all refer generally to some aspect of an organism (whether taxonomically useful or not); and characteristic and descriptive terms refer to aspects that are regarded as taxonomically significant".

The definition of a **taxonomic character**, as used by Stuessy (1990: 27) is most apt: "a feature of an organism that is divisible into at least two conditions (or states) and that is used for constructing classifications and associated activities (principally identification)." Davis & Heywood (1963: 114) add the final word by saying, "In identification and characterization the taxonomist seeks to employ **diagnostic** or **key** characters i.e. those of limited occurrence selected so that their use alone is sufficient for reaching a correct diagnosis."

As will be discussed in CHAPTER 6, the genus *Vigna* may commonly be confused with *Sphenostylis*, *Dolichos* or *Phaseolus* but they are easily distinguished by the use of diagnostic characters in the key provided in CHAPTER 5. All species of *Vigna* indigenous to southern Africa may be superficially recognized by their long, varyingly pubescent, prostrate or twining stems, with trifoliolate leaves, long peduncles that bear the yellowish or purple papilionate flowers well above the leaves and, thereafter, erect, relatively hairy, brown or black legumes in small reflexed bunches or, more typically, in erect, divergent pairs, at the apex of the peduncles. Careful attention must be given to the stipules, and whether all leaflets on the plant have a common shape. Generally the leaflet shape is too variable a character to determine the correct species unquestionably and it is important that both the primary leaflets and the underground system are collected if possible, **as well as** the leaves on younger stems bearing flowers and/or fruit. However, the most important diagnostic characters cannot be recognized in the field without the use of at least a good hand lens, and certainly not without flowers and, if possible, the legumes. The task of the taxonomist is facilitated by suitable, complete descriptions of obvious characters on the collector's labels, truly, of far too rare incidence! More often, the locality and the habit alone are supplied.

It has already been noted how indispensable earlier workers found correct descriptions of characters to differentiate between the various members of the *Phaseolineae*. Bentham (1865) distinguished between *Phaseolus* with its spiral keel and *Vigna* with its incurved beak, sometimes twisted but never forming a complete spiral. Hepper (1958) was able to transfer *P. mungo* to *Vigna* on the observation of medifixed stipules and narrow, septate legumes. De Wildeman's observation (1902) of the extraordinarily long style prolongation, led to the demarcating character used for *V. frutescens* A. Rich. by Verdcourt (1970). The importance of providing descriptive information on labels by collectors cannot be overstressed, as researchers may thereby be led to new demarcations of taxa. The object of collections in the field should be to provide the researcher in the herbarium with information which he cannot observe himself. Certain characters are obscured through the drying process and need to be brought to the worker's notice through an efficient labelling system.

4.2 Discussion of characters in *Vigna*

Cognizance should be taken throughout this discussion of illustrations provided of species in CHAPTER 5. References will be provided at appropriate places in the text.

4.2.1 Root

With regard to the root system, both shallow adventitious and perpendicular, dauciformis or carrot-shaped tap root systems are found. It is however, the spindle-shaped root tubers, developed in moniliform fashion, that are diagnostic of *V. lobatifolia* Bak. (Figure 17 A, j).

4.2.2 Stem

Stems are normally cylindrical or grooved, alate ones point toward the subgenus *Haydonia*, but additional diagnostic characters must then be investigated.

As regards the indumentum of stems, all hairs are broad-based (Figure 3 A, B & C). The occurrence of ferruginous hairs, whether aculeate or patent, is typical of *V. vexillata* and its varieties; var. *angustifolia* tends toward scabrid, aculeate stems, var. *vexillata* usually has patent hairs, var. *ovata* has short, strigose to almost velvety hairs and var. *davyi* has typical hard, setose bristles, which sometimes tend toward a yellowish colour. *Vigna lobatifolia* may have soft, bristle-like, ferruginous or colourless hairs, but when these two are mixed on the stems, it indicates *V. pygmaea*. Totally glabrous stems are rare, only occurring sometimes in *V. unguiculata* subsp. *dekindtiana* var. *dekindtiana* or *V. unguiculata* subsp. *tenuis*, when they often are red at the base. It should be noted that the concentration of hairs varies within species and even on single specimens and that young stems should be examined at all times.

There are cases where the stems never tend to twine but remain prostrate or scramble only, namely, *V. unguiculata* subsp. *protracta*, or often remain erect as in *V. friesiorum* var. *friesiorum*, *V. pygmaea* and *V. monophylla* of which the latter three taxa are reported to be pyrophytic. It would, therefore, appear to be of environmental consequence.

4.2.3 Stipule

Stipules have important diagnostic value and in the case of *Vigna* are elongated at the point of attachment in one way or another. In many cases they are cordate in shape, the elongation occurring laterally in the form of auricles, the more conspicuous elongation being a spur. In all these cases the elongation takes the form of loose appendages. In the case of the genera with which *Vigna* may be confused as mentioned above, the stipules are joined directly to the stem tissue and the basal tissue of the stipule appears to grow continuously with that of the stem.

The cordate stipules in *Vigna* are generally small, widest at the base and variously produced upward to an acute, acuminate or obtuse apex. The taxa in which they occur include subgenera *Vigna* (with sections *Vigna, Macrodontae, and Liebrechtsia*), *Plectrotropis* and *Haydonia* to a lesser degree (Figure 16 A, a).

The stipules of the section *Comosae* are scarcely prolonged but the base is attached to the stem by a peculiar pad-like structure (Figure 9 A, b i & b ii) interpreted to be the welding with the insertion of the two auricles at the base (Maréchal *et al.* 1978). Otherwise, the stipules are filiform and uninerved.

Stipules in the subgenus *Catjang* have accentuated spurs (Figure 3 a—g, ADDENDUM 1) which vary in shape from short, broad spurs, straight or oblique and often split, to slender, narrow ones, the point of attachment not always being noticeably constricted. At the seedling stage, however, stipules of the first leaflets appear shortly truncated, as do also those of *V. mudenia* (Figure 2 b in ADDENDUM 2) belonging to the subgenus *Haydonia*. In subgenus *Catjang*, the second pair of stipules appear auriculate and only thereafter the spurs develop fully. The stipules vary from three- to five- or multi-nerved in the *Catjang* and other groups.

The colour of the spurs in the fresh or dry state, vary from dark green in *V. unguiculata* subsp. *protracta*, to paler green in *V. unguiculata* subsp. *dekindtiana* var. *dekindtiana*, sometimes in var. *huillensis* and subsp. *mensensis*, subsp. *tenuis* and in *V. nervosa*; or brown in *V. unguiculata* subsp. *dekindtiana* var. *huillensis* and subsp. *mensensis* and subsp. *stenophylla*. They tend to be particularly large, broadly ovate and striking in *V. unguiculata* subsp. *protracta*.

Hairiness of the stipules is variable, from abundant hairs or relatively few over the whole surface to hairs on the nerves only to glabrous in *V. unguiculata* subsp. *protracta* and glabrous in some others. Hairy to glabrescent surfaces of stipules occur in *V. oblongifolia, V. friesiorum* var. *friesiorum, V. pygmaea, V. frutescens* subsp. *frutescens* var. *frutescens, V. nervosa, V. vexillata* and *V. lobatifolia*. The margin is coarsely ciliate throughout in *V. unguiculata* subsp. *protracta* and at the extremities only in most others.

4.2.4 Leaflets

As stated above, leaflet shape is a precarious character on which to base a diagnosis, yet it does give some indication of the group to which the specimen belongs. Stipules must be inspected in conjunction with it.

In almost all cases the lower two leaflets of the leaf are asymmetrical, whatever the general shape of the leaflets. Whether the shape of the basal leaflets on the stem is similar to the younger ones in the upper regions, is important. Leaflet shape may be divided roughly into three groups, namely, ovate and its related forms, rhomboid and ovate-lobulate. The ovate and related shapes, i.e. narrowly or broadly ovate with apices acute, obtuse or emarginate and bases cuneate or obtuse, to circular or lanceolate, are the most common in *Vigna*, e.g. *V. luteola*, *V. marina*, *V. oblongifolia*, *V. comosa*, *V. friesiorum* var. *friesiorum, V. unguiculata* subsp. *tenuis* and *stenophylla*, *V. nervosa*, *V. mudenia*, *V. vexillata*, *V. pygmaea*, *V. monophylla* and *V.* sp. A. (Figures 5—11 A, a). The latter, but one, is unifoliolate, and sometimes *V. vexillata* var. *davyi* too (Figures 15 A, a & 16 F). The latter has unifoliolate, bifoliolate and trifoliolate leaves on the same stem, a character which is possibly edaphic. This is suggested by *V. angivensis* Bak. (not seen), endemic to Madagascar and which also presents uni-, bi- and trifoliolate leaves on the same stems and which seems to be an expression of the granitic rocks amongst which it grows (Maréchal *et al.* 1978).

Rhomboid leaflets may be associated with the ovate ones and occur commonly in *V. unguiculata* subsp. *dekindtiana* var. *dekindtiana*, *V. vexillata* var. *davyi* and *V.* sp. A (Figures 3 f in ADDENDUM 1, 1 e in ADDENDUM 3 & 18 A a).

Lobed leaflets are most common in the *V. unguiculata* group of plants, *V. frutescens* subsp. *frutescens* var. *frutescens* and *V. lobatifolia* (Figures 3 b—g in ADDENDUM 1, 12 A, a & 17 A, a).

Confusion may occur between *V. frutescens* subsp. *frutescens* var. *frutescens* and *V. unguiculata* subsp. *dekindtiana* var. *huillensis*. Both species have regularly shaped hastate (narrowly ovate, basally lobed) leaflets with apices rounded. However the former are papyraceous and very strigose and the latter are coriaceous and more or less glabrous with strigose hairs on the nerves only. Here more microscopic characters come into play, which matter will be discussed later. *Vigna lobatifolia* may be mistaken for a member of the *V. unguiculata* group but is betrayed by its coriaceous texture and microscopic characters.

4.2.5 **Inflorescence**

All inflorescences, bar one, i.e. *V. nervosa* (Figure 14 F), are racemes with long peduncles carrying the flowers and legumes above the level of the leaves. Some species, e.g. *V. luteola*, *V. marina*, *V. oblongifolia* and *V. unguiculata* subsp. *protracta*, have 7—15(—20) flowers or legumes at the apex of the peduncle, the latter being reflexed in the former three species (Figures 5—8 A, h). The majority of species have more or less contracted racemes with only two or three flowers. The positioning of the extra-floral nectaries (Figures 3 E—G) is characteristic of the species and are persistent. They are noticeably alternate in the long-noded, multi-flowered racemes but appear to occur between flowers on contracted inflorescences.

4.2.6 **Flower**

The floral structure provides a number of diagnostic characters. The colour and size of the flower immediately divides the species into two groups, the first being the relatively smaller yellow to greenish ones of *V. luteola*, *V. oblongifolia*, *V. comosa*, *V. mudenia* and *V.* sp.A. All remaining species have relatively large flowers, excluding *V. nervosa* only, and range from pink, magenta, mauve to purple and blue.

Callosities on the inner face of the standard petal are taxonomically diagnostic at infraspecific level (Maréchal *et al.* 1978a). Fundamentally, they consist of two symmetrical calluses formed by fleshy folds of the upper limb for the one part, and on the other, by the median vein (Figures 5—11 A, d). They may consist of one pair only attached to the limb (Figures 12 & 17 A, d), or a second upper pair may occur in the centre of the standard, varying from a vestigial, thick ridge to relatively broad, flat appendages, either lying parallel to each other or divergent to the base or to the apex. The absolute length of the standard is also important. It is usually a relatively bright tint of the dominant colour of the flower, with one or two contrasting spots or nectar guides at the base. The outer surface, which shows once the flower has closed, may be greenish or fawn-yellow.

Regarding the wings, a relatively common oval shape is shared by all and their colour is the clearest and purest of all floral parts. The lateral spur or auricle (termed tooth by Maréchal *et al.* 1978a) varies in shape and texture, ranging from a smooth, rounded bulge in the *V. unguiculata* group (Figure 4 A) to long, narrow, papillate appendages in the *V. luteola* group (Figure 4 D) , and rugose, falcate spurs with folds in the tissue in the *V. vexillata* group (Figure 4 B).

The shape of the *keel* is important to observe and represents the inner whorl of the corolla. It is always a paler, washed-out colour or white. The occurrence of a hollow, inverted spur (the pocket) on the left side (Figure 16 A, e), causes a deflection of the rostrum, which in this case is elongated and twisted through 180°. This character is always associated with a bonnet-shaped style elongation (Figures 6—8 in ADDENDUM 3) to be discussed later. It occurs in subg. *Plectrotropis*, i.e. the *V. vexillata* group and in *V. lobatifolia* to a lesser degree. The result is an irregular flower whereas the remaining groups have bilaterally regular ones. The rostrum in the remaining species varies from obtuse to slightly incurved.

4.2.6 Calyx

Few diagnostic characters deserve mention regarding the calyx. All upper pairs of lobes are adnate to varying degrees. Pubescence is variable. Excessively long calyx lobes are typical of *V. vexillata* var. *davyi* and var. *dolichonema* (Figure 4 E), and *V. unguiculata* subsp. *mensensis*. *V. unguiculata* subsp. *dekindtiana* is recognized by its horizontally rugose calyx tube at maturity, the length of the lobes varying from shorter than, to the same length as the tube.

4.2.7 Style prolongation

Probably the most important diagnostic character in the flower of *genus Vigna*, is the form taken on by the prolongation of the style beyond the lateral stigma. Incorrect identifications may result when this character is ignored. A hand lens is therefore essential if correct identifications need to be made in the field, but microscopic investigation is recommended. Three main morphological categories are distinguished:

A) Prolongations often referred to as beaks, but such beaks are themselves of three types, namely, (a) mere thin, obtuse and even nerved, flaps of tissue as in *V. pygmaea* (Figure 11 A, g); (b) thick obtuse tissue, tongue-shaped, as in *V. luteola* (Figure 5 A, g) and *V. marina*, or (c) accentuated thick, subulate tissue, spathe-like, e.g. *V. oblongifolia* and *V. frutescens* subsp.*frutescens* var. *frutescens* (Figure 12 A, g), the latter being particularly long and visible to the naked eye.

B) The second form of style prolongation takes the shape of a rugose flap of tissue, bent over the lateral stigmatic papillae to form a bonnet (Figures 6—8 in ADDENDUM 3). This is typical of the subg. *Plectrotropis*, i.e. *Vigna vexillata* and *V. lobatifolia* (Figure 17 C). To the naked eye it simply appears lobular (Verdcourt 1971).

C) The third form is a protuberance developing from the style tissue to form various shapes. (a) *V. unguiculata* and all its subspecies and varieties (Figure 2 a & b in ADDENDUM 1) as well as *V. nervosa* (Figure 14 D), are immediately recognizable by the horizontal or oblique protuberance produced opposite to the stigmatic papillae thereby causing the whole to appear hammer-shaped. It must however, be noted that this structure ends in a definite dividing ridge which forms a point at the apex of the whole structure, almost like a cap. The protuberance varies in length from a mere 0.2—0.3 mm in a typical specimen of *V. unguiculata* subsp. *stenophylla*, to as much as 1 mm in subsp. *protracta*, whereas it is extremely small, probably a rudimentary remnant only, of the protuberance, in subsp. *mensensis* (Figure 13 B). The actual length of the protuberance does vary somewhat within the bounds of the subspecies and varieties as stipulated in the script, in the key in CHAPTER 5. (b) A second form of protuberance is that of *V. mudenia* which appears like an erect or oblique thimble at the apex of the style (Figure 3 in ADDENDUM 2) . In the latter case, hairs appear to separate the protuberance from the lower style tissue and the stigmatic papillae. In *V.* sp. nov. A, there is no true protuberance but only an obvious, rounded bend or swelling of the style tissue at *ca*. 90° (Figure 18 C). This may be the rudimentary remains only of the protuberance i.e. an evolutionary advance.

In the subgenus *Haydonia*, where a number of evolutionary advances are believed to have taken place (Maréchal *et al*. 1978a), the ultimate stage has no stylar beak, but a horizontal, obliquely terminal stigma, as in in *V.*

monophylla (Figure 15 C). Another indication of this evolutionary development is the presence of small clusters (Figure 15 E) or pairs of glands at the base of the inferior anthers, the latter occurring in *V. monophylla*.

4.2.8 Pollen

The genus *Vigna* has, according to Maréchal *et al.* (1978a), particularly large triporate pollen grains. Sometimes coarse granules cover the pores as in *V.frutescens* subsp. *frutescens* var. *frutescens* (Figure 12 D). The exine sculpturing of the pollen grains in *Vigna* consists generally of definite wide reticulations with relatively high muri. In *V. unguiculata* the muri are particularly high (Figure 13 D), in *V. luteola*, *V. marina*, *V. mudenia* and *V.* sp. A these muri are lower (Figures 5 C, 6 C, 5 b in ADDENDUM 2 & 18E) almost as though flattened and rounded, and in *V. monophylla* (Figure 15 E) the muri have completely disappeared, the completion of an evolutionary trend towards psilate grains. (Maréchal *et al.* 1978a).

4.2.9 Summary of diagnostic characters in southern African taxa of *Vigna*.

Species are arranged in alphabetical order. Further reference to Figures is made in CHAPTER 5:

4.2.9.1 *V. comosa* Bak. subsp. *comosa* var. *comosa* (Figure 9 A, B)

Habitat: disturbed places (possibly imported with seed).
Stem: slender, profusely branched, with greyish hairs.
Stipule: filiform, attached by pad-like structure; base more or less truncate; uninerved.
Leaflets: ovate.
Infloresc.: peduncle angular; raceme elongate.
Flower: yellow, mauve-tinged; standard 1 cm; superior callosities vertical, lower ones horizontal; keel rostrum shortly twisted.
Style Prolong.: shortly beaked, broad, flat.
Legume: reflexed, broadened toward tip.
Seed: 1—4, aril somewhat rugose.
Pollen: muri high, reticulation wide.

4.2.9.2 *V. friesiorum* Harms var. *friesiorum* (Figure 10 A—C)

Habitat: grassland.

Stem: erect or decumbent, often pyrophytic.

Stipule: cordate, oblong-lanceolate, glabrous.

Leaflets: oblong-hastate, with peculiar horizontal hairs at right angles to margin.

Infloresc: raceme contracted, pauciflorus.

Flower: creamy yellow to violet; callosities two pairs, parallel.

Style Prolong.: beak obtuse, disk-like.

Legume: erect, cylindrical, *ca*. 17-seeded or more, dark brown with yellowish hairs.

Seeds: small, *ca*. 2 X 1.5—2 mm, brown, mottled black, aril absent.

Pollen: muri raised, reticulation wide.

4.2.9.3 *V frutescens* A. Rich. subsp. *frutescens* var. *frutescens* (Figure 12 A—I)

Habitat: grassland, forest edges.

Stem: prostrate or twiner growing from extremely large, woody tuber up to 50 mm in diameter, often pyrophytic, heavily ferruginous to velvety.

Stipule: subcordate, oblong-lanceolate, glabrescent to pubescent.

Leaflets: broadly hastate with obtuse apices, papyraceous, adpressed velvety.

Infloresc.: raceme contracted.

Flower: large, lilac, standard oblate with margin thickened by short hairs or papillae, callosities one pair only, calyx glabrous.

Style Prolong.: prominently spathe-like, subulate, recurved, up to 2 mm long.

Legume: erect, brown, with shortly adpressed ferruginous hairs or glabrous, shortly beaked, 12—14-seeded.

Seed: red-brown, mottled black, *ca*. 3—6 X 2.5—3.5 mm, aril absent.

Pollen: muri raised, reticulation wide.

4.2.9.4 *V. lobatifolia* Bak. (Figure 17 A—E)

Habitat: sandy grassland of Namibia, typified by root system with moniliform tubers.
Stem: prostrate or twining; velvety with ferruginous or white hairs.
Stipule: subcordate to auriculate, acuminate, pubescent.
Leaflets: roundly lobulate, coriaceous, velvety strigose.
Infloresc.: raceme contracted, 2—4-flowered.
Flower: standard unequally oblate, 24 X 20 mm., keel twisted through less than 180°.
Style Prolong.: flap forming bonnet-shaped structure.
Legume: erect, compressed-cylindric, ferruginous silky to glabrescent, up to 130 mm long, 16-seeded.
Seed: mottled grey to black, aril vestigial.
Pollen: muri raised, reticulation wide.

4.2.9.5 *V. luteola* (Jacq.) Benth. (Figure 5 A—F, 4 D)

Habitat: estuaries and sea shores (salt-enduring).
Stem: strong twiners.
Stipule: cordate.
Leaflets: ovate, apex obtuse, often emarginate.
Infloresc.: raceme elongate, 15—20 flowers per raceme.
Flower: yellow, callosities lobular, upper pair divergent, lower ones less so.
Style Prolong.: short, thick, tongue-shaped.
Legume: slightly compressed, reflexed, brown, pubescent.
Seed: reddish to grey-brown, mottled black; aril scarcely formed.
Pollen: muri low, reticulation wide.

4.2.9.6 *V. marina* (Burm.) Merrill. (apparently extinct in southern Africa —— Figure 6 A—E)

Habitat: seashore dunes.
Stem: thicker than *V. luteola*, succulent (halophytic adaptation), prostrate or twiner..
Stipule: cordate.
Leaflets: broadly oblate, apex rounded.

Flower: as for *V. luteola*.

Style Prolong.: thick, short, tongue-shaped.

Legume: falcate, glabrous, broader than *V. luteola*.

Seed: red-brown, *ca*. 5—6 X 4.5—5 mm; aril absent.

Pollen: muri low, reticulation wide.

4.2.9.7 *V. monophylla* Taub. (Figure 15 A—F)

Habitat: grassland.

Stem: erect or twining, angled, scarcely hairy.

Stipule: lanceolate, auriculate, recurved, glabrous.

Leaflets: simple, elliptic to ovate-lanceolate, glabrous or hairy on nerves.

Infloresc.: raceme contracted, peduncle alate with stiff blackish hairs.

Flower: greenish-mauve, calyx lobes longer than tube, short stamens (alternate) with a pair of small glands at base of anthers.

Style Prolong.: obliquely terminal.

Legume: erect, up to 50 mm long, densely ferruginous, *ca*. 16-seeded.

Seed: reddish brown, mottled black, *ca*. 2—2.5 X 2—2.5 mm., aril absent.

Pollen: smooth.

4.2.9.8 *V. mudenia* Pienaar (Figures in ADDENDUM 2)

Habitat: rocky grassland.

Stem: straggler to twiner, patent with whitish hairs.

Stipule: slightly truncately elongated with primary leaves, later auriculate, recurved, patent.

Leaflets: elliptic, patent.

Infloresc.: raceme contracted.

Flower: two, cream, standard *ca*. 10 mm, superior callosities narrow, divergent.

Style Prolong.: oblique thimble-shaped protuberance.

Legume: erect, slightly compressed, black with whitish hairs, *ca*. 60 mm long, 12—14-seeded.

Seed: grey mottled with black, 3 X 2 mm, aril rudimentary.

Pollen: muri low, appearing rounded, reticulation wide.

4.2.9.9 *V. nervosa* Markötter (Figure 14 A—G)

Habitat: rocky grassland, elevations of 1500–1650 m.

Stem: delicate, twiner.

Stipule: spurred, extremities often obtuse, slight or no constriction, pilose to glabrous.

Leaflets: ovate to oblong, apex and base usually obtuse, pilose to glabrous, papyraceous.

Infloresc.: solitary.

Flower: pink to purple, standard *ca*. 10 mm long, lower callosities only.

Style Prolong.: lateral protuberance, *ca*. 0.4 mm long, hammer-shaped.

Legume: erect, glabrous, *ca*. 40 mm long.

Seed: reddish brown, *ca*. 0.3 X 0.35 mm, aril extended almost to lower end of seed.

Pollen: muri high, reticulation wide.

4.2.9.10 *V. oblongifolia* A. Rich. var. *oblongifolia* (Figure 7 A—E)

Habitat: fresh watercourses or irrigated farm-lands.

Stem: with whitish pubescence, setaceous, arising from shallow, adventitious roots.

Stipule: cordate, setaceous.

Leaflets: ovate-lanceolate, 80—122 mm long.

Infloresc.: raceme elongate.

Flower: whitish yellow, standard 10—12 mm long, two pairs callosities.

Style Prolong.: shortly spathe-like, reflexed, *ca*. 0.6 mm long.

Legume: reflexed, dark brown, pubescent, 40—60 mm long.

Seed: yellowish to brown-grey, mottled black, *ca*. 2—3 X 1.5 mm, aril appearing double-layered in lower half.

Pollen: muri low, reticulation wide.

4.2.9.11 *V. oblongifolia* A. Rich. var. *parviflora* (Bak.) Verdc. (Figure 8 A—E, 3 D)

Habitat: disturbed areas, grassland.

Stem: delicate twiner, ramified, shallow adventitious root system, many nodules.

Stipule: cordate, setaceous.

Leaflets: narrow-lanceolate or obtusely oblong, up to 80 mm long.

Infloresc.: raceme elongated.

Flower: whitish, flushed violet, standard 6—8 mm long, two pairs callosities.

Style Prolong.: short spathe-like, 0.2—0.4 mm long.

Legume: reflexed, dark brown pubescent, less than 60 mm long.

Seed: as for var. *oblongifolia*.

Pollen: muri low, reticulation wide.

4.2.9.12 *V. pygmaea* R.E. Fries (Figure 11 A—I)

Habitat: grassland.

Stem: erect, pyrophytic, several arising from one or more fusiform tubers, pubescence of ferruginous and white hairs mixed.

Stipule: truncate, lanceolate, reflexed, ribbed, strigose.

Leaflets: oval to narrowly ovate, ferruginous and white hairs admixed on both surfaces.

Infloresc.: raceme subcontracted.

Flower: one to several, mauve to violet, standard 8—12 X 8—14 mm, two pairs *ca*. parallel callosities; vexillary stamen not thickened at base.

Style Prolong.: oblique, thin flap.

Legume: erect with short, adnate bristles, white and ferruginous mixed.

Seed: pale reddish brown, mottled black , *ca*. 2.8 X 2 mm., aril absent.

Pollen: muri high, reticulation wide.

4.2.9.13 *V. unguiculata* (L.) Walp. subsp. *dekindtiana* (Harms) Verdc. var. *dekindtiana* (Figures in ADDENDUM 1, 3 F & 13 A—E)

Habitat: sandy grassland.

Stem: branched from soil level, glabrate, often reddish at base, growing from tubers or more often, shallow, adventitious roots.

Stipule: spurred, spurs slender or short, glabrous, ciliate at extremities.

Leaflets: ovate-rhomboid, papyraceous, often flushed scarlet, basically green, marked lighter green, younger leaflets often hastate, i.e. heterophyllous, papyraceous.

Infloresc.: raceme contracted.

Flower: large, purple, standard 13—22 X 15—25 mm, outer surface buff-yellow, superior callosities narrow, parallel to divergent, with calyx tube horizontally rugose-plicate, lobes shorter than tube.

Style Prolong.: horizontal protuberance, 0.2—0.4 mm long, hammer-shaped.

Legume: erect, usually two, black, scabrid, beaked, up to 100 mm long, *ca*. 16-seeded.

Seed: dark red-brown, mottled black, *ca*. 3—4 X 2.5—3.5 mm, aril rim thick.

Pollen.: muri markedly high, reticulation wide.

4.2.9.14 *V. unguiculata* (L.) Walp. subsp. *dekindtiana* (Harms) Verdc. var. *huillensis* Welw. ex Bak. (Figures in ADDENDUM 1, 13 H)

Habitat: warm dry sandy grassland of eastern Namibia and Botswana.

Stem: long, prostrate, grooved, herbaceous, branched at intervals along the vine, arising from edible tubers.

Stipule: glabrous, mostly slender, narrowly ovate, ciliate at extremities, green or brown.

Leaflets: narrowly hastate, coriaceous, blue-green with grey-green markings, margins thickened.

Infloresc.: raceme contracted.

Flower: purple, as for var. *dekindtiana*, with calyx lobes shorter than papillose tube.

Style Prolong.: as for var. *dekindtiana*.

Legume: erect, glabrous to scabrid, up to 100 mm long, *ca.*16-seeded.
Seed: as for var. *dekindtiana*.
Pollen: as for var. *dekindtiana*.

4.2.9.15 *V. unguiculata* (L.) Walp. subsp. *protracta* (E. Mey.) Pienaar (Figures in ADDENDUM 1 & 13 F, G)

Habitat: subtropical, rain-drenched coasts and lower midland grassland.
Stem: robust ramblers, patent to velvety.
Stipule: prominently ovate, spurred, spurs broad, oblique or split, strigose over whole surface, or partly, or on ribs only or glabrous; margin coarsely ciliate.
Leaflets: large, roundly lobular, ovate to lanceolate-rhomboid to narrowly hastate, papyraceous, strigose.
Infloresc.: raceme 4—7-flowered.
Flower: blue to purple, standard 13—22 X 15—25 mm, superior callosities narrow, divergent, with calyx lobes longer than tube.
Style Prolong.: lateral to oblique protuberance, up to 1 mm long, hammer-shaped.
Legume: erect, linear-cylindrical, black, pubescent with longish hairs.
Seed: dark red-brown, mottled black, 3—4 X 2.5—3.5 mm., aril rim slightly developed.
Pollen: muri prominent, reticulation wide.

4.2.9.16 *V. unguiculata* (L.) Walp. subsp. *stenophylla* (Harv.) Maréchal *et al.* (Figures in ADDENDUM 1 & 13 C, D & E)

Habitat: moist grassland of eastern mountains and interior savannas.
Stem: angular, patent to scabrid.
Stipule: spurred, slender, brown, somewhat recurved or green with spurs short.
Leaflets: much longer than broad, rarely subhastate, often coriaceous, strigose to glabrescent, acuminate.
Infloresc.: raceme contracted.
Flower: pinkish to mauve, smaller than other subspecies, standard *ca.* 13 X 15 mm.
Style Prolong.: short lateral protuberance, *ca.* 0.3 mm long, hammer-shaped.

Legume: erect, brown, grey to black, up to 100 mm long, pubescent to scabrid.

Seed: reddish brown, brown, mottled black, aril slightly developed, 3—6 X 2—4 mm.

Pollen: muri prominent, reticulation wide.

4.2.9.17 *V. unguiculata* (L.) Walp. subsp. *tenuis* (E.Mey.) Maréchal *et al.* (Figures in ADDENDUM 1, 4 A & 13 I)

Habitat: coastal grassland of Transkei and Natal.

Stem: vigorous twiner, stem *ca*. glabrous and reddish at base.

Leaflets: two types, therefore two varieties, namely, (a) oblong ones with truncate base, sublobed, dark green, papyraceous, (var. *tenuis*); (b) ovate ones, base obtuse or cuneate, green to grey-green, often coriaceous [var. *ovata* (E. Mey.) Pienaar] .

Infloresc.: raceme contracted.

Flower: blue, large, standard 13—22 X 15—25 mm.

Style Prolong.: horizontal protuberance, *ca*. 0.4 mm long, hammer-shaped.

Legume: erect, black, glabrous, up to 60 mm long, 10-seeded.

Seed: brown, mottled black, aril slight, 2.5—3 X 2.5 mm.

4.2.9.18 *V. vexillata* (L.) A. Rich. var. *angustifolia* (Schumach. & Thonn.) Verdc. (Figures in ADDENDUM 3, 3 B & 16 A—F)

Habitat: savanna grassland.

Stem: stragglers or strong twiners, ferruginous, aculeate to glabrescent, growing from woody tubers.

Leaflets: ovate-lanceolate or rhombic, longer than broad, apex acuminate, base truncate or sometimes obtuse, papyraceous, strigose.

Infloresc.: raceme contracted, 2—4-flowered.

Flower: mauve to purple, standard oblate, repand, 30 X 40 mm, keel with lateral pocket causing twist to 180° (Figure 16 A), calyx lobes longer than tube.

Style Prolong.: rugose flap of tissue stretched over top to form bonnet-shaped organ.

Legume: erect, divergent, black, ferruginous, up to 100 mm long, up to 18-seeded.

Seed: light yellowish brown to black or reddish, mottled, 2.5—4.5 X 2—2.5 mm., aril narrow to absent.

Pollen: muri prominent, reticulation wide.

4.2.9.19 *V. vexillata* (L.) A. Rich. var. *davyi* (Bol.) Pienaar

(Figures in ADDENDUM 3 & 16 A, H, I)

Habitat: high altitude grassland associated with granite outcrops.

Stem: robust scrambler, sometimes erect, ferruginous, tending toward yellowish, setaceous.

Stipules: short, cordate, setaceous.

Leaflets: unifoliolate, bifoliolate or trifoliolate on same stem, broadly ovate to rhombic, papyraceous, setaceous-strigose.

Infloresc.: raceme contracted, 2—4-flowered.

Flower: bright magenta, standard 30 X 40 mm, more repand than other varieties, calyx lobes much longer than tube, setaceous.

Legume: erect, thickly setaceous, ferruginous, 100 mm long, 18-seeded.

Seed: as for var. *angustifolia*.

Pollen: as for var. *angustifolia*.

4.2.9.20 *V. vexillata* (L.) A. Rich. var. *ovata* (E.Mey.) Pienaar

(Figures in ADDENDUM 3, 3 E, F, 4 B & 16 A)

Habitat: coastal grassland of eastern Cape, Transkei and Natal.

Stem: delicate, creeping close to soil surface, vigorous twiners.

Stipule: small, cordate, ferruginous.

Leaflets: smaller than other varieties, circular to broadly ovate to oblong-ovate, velvety strigose, ferruginous.

Infloresc.: raceme contracted, thick, long peduncles, to 3 mm thick, swollen joint, woody at maturity (Figure 16 G).

Flower: normal *V. vexillata* size and structure, mauve to purple.

Style Prolong.: bonnet-shaped.

Legume: erect, black, up to 55 mm long, 10-seeded.

Seed: as for var. *angustifolia*.

Pollen: as for var. *angustifolia*.

4.2.9.21 *V. vexillata* (L.) A. Rich. var. *vexillata* (Figures in ADDENDUM 3, 3 A, C, H, 4 B & 16 A—E)

Habitat: cosmopolitan, grassland.

Stem: straggler or strong twiner, patently ferruginous, growing from a woody tuber.

Stipule: cordate-auriculate, densely ferruginous.

Leaflets: essentially ovate, apex acute, base cuneate, ferruginous, strigose.

Infloresc.: raceme contracted, 2—4-flowered, mauve to purple, standard oblate, 30 X 40 mm, upright lateral pocket causing deflection of keel to 180°, calyx lobes longer than tube, ferruginous.

Style Prolong.: bonnet-shaped.

Legume: erect, black, ferruginous, 100 mm long, 18-seeded.

Seed: as for var. *angustifolia*.

Pollen: as for var. *angustifolia*.

4.2.91.22 *V.* sp.A. (possibly undescribed species —— Figure 18 A—E)

Habitat: dry woodland in Transvaal and north-central and east Namibia.

Stem: erect in youth, twining at length, ridged to alate, glabrescent.

Stipule: base cordate, later auriculate, lanceolate, acuminate, reflexed, margins ciliate, in youth shortly truncate (cf. *V. mudenia*).

Leaflets: oblong with apex and base rounded in youth, 25—58 X 0.8—30 mm, sublobular with rounded lobes and base cuneate in maturity, *ca*. 58 X 25—30 mm at broadest point, papyraceous, glabrous to strigose.

Infloresc.: raceme contracted.

Flower: one pair yellowish green flowers flushed violet, standard ovate to oblate, *ca*. 10—14 mm, superior callosities divergent, vestigial, wing auricle scarcely papillate, keel obtuse, no anther glands.

Style Prolong.: almost non-existent, scarcely projecting at bend of style toward stigmatic papillae.

Legume: beaked, *ca*. 68 mm long, brown-black, scabrid, 18-seeded.

Seed: 3—4 mm long, yellowish to dark brown, mottled black, aril rudimentary.

Pollen: reticulation very low, sub-smooth.

CHAPTER 5

A CLASSIFICATION OF *VIGNA* SAVI FOR SOUTHERN AFRICA

"And because identification is a necessary step in both storing and retrieving information, a classification that facilitates identification is essential to all organismic-evolutionary biologists."

Darlington (1971): 343.

5.1 Introduction

Much confusion surrounded the tribe Phaseoleae in the Papilionoideae from the earliest times, until Verdcourt (1970, 1971) restructured it. He chose to create a small, clear cut genus, *Phaseolus*, and a large, rather unwieldy genus, *Vigna*, which contains a large number of problem species that could fit in either genus. One such species is *Vigna juncea* Milne-Redh., in which the pollen sculpture, unlike the typical open reticulation of *Vigna*, is smooth like that of *Phaseolus*. Groups of glands occur at the base of the internal whorl of anthers, a character foreign to the latter genus (Figure 15 E). However, the distribution of amino acids in the seed of *V. juncea* is similar to the pattern of a typical *Vigna*, which latter character discards it from *Phaseolus*. Verdcourt's classification of *Vigna* for the Flora of Tropical East Africa (1970) was succeeded by a classification by Maréchal *et al.* (1978a) in which they employed computerized numerical analyses.

For southern Africa, Harvey (1862) described ten *Vigna* species, two of which were unknown to him. However, three of these are no longer considered members of *Vigna*, namely, the taxa currently named *Otoptera burchellii*, *Sphenostylis angustifolia* and *S. marginata*. Burtt Davy (1932) described seven new species of *Vigna* and made one new combination thereby, besides including five species described by Harvey, recognizing 16 species in all. Of these, *V. burchellii* Harv. is a synonym for *Otoptera burchellii* and *V. junodii* Harms for *Dolichos junodii* (Harms) Verdc. Wood (1908) listed nine species of *Vigna* in his checklist for Natal, once more including *Otoptera burchellii* and *Sphenostylis angustifolia*. Burtt Davy & Pott-Leendertz's (1912) checklist for the Transvaal and Swaziland also included these latter two species. Compton's (1966) annotated checklist for Swaziland omitted them, as did Ross (1972).

5.2 *Vigna* and its related genera

According to information gleaned from specimens of *Vigna* in southern African herbaria, the common problem apparently confronting the botanist is how to distinguish among the genera *Sphenostylis*, *Phaseolus*, *Dolichos* and *Vigna*. These taxa have characters in common, such as twining or creeping stems and trifoliolate leaves, but the chief distinguishing characters concern the morphology of the stipules, style and stigma, the legumes and pollen sculpture. A key best solves this problem:

KEY TO *VIGNA* AND RELATED GENERA IN SOUTHERN AFRICA:

1a. Style swollen and thickened, usually curved, sometimes twisted at the base; mostly glabrous save for the terminal, invariably penicillate stigma; legumes compressed, not septate .... *Dolichos*

1b. Style partially swollen, barbate or glabrous but not penicillate at the apex only; legumes compressed or cylindrical 2

2a. Style twisted, thickened basally, thinning near the middle before enlarging into a flattened, spathulate apex, pubescent within and along the margins; stigma terminal; legumes linear, compressed .... *Sphenostylis*

2b. Style apically twisted, tenuous basally, glabrous or hairy toward the tip; stigma lateral, terminal or subterminal; legumes compressed or cylindrical 3

3a. Upper thickened part of style glabrous or hairy on the inner surface toward the tip; twisted through at least 360° but this is never accompanied by an erect, conical pocket in the keel; stigma oblique, lateral, terminal or subterminal; legumes compressed, filled between the seeds; stipules never prolonged beyond the point of insertion; pollen sculpture smooth or finely reticulate .... *Phaseolus*

3b. Upper thickened part of style always barbate on the inner surface of the upper half; sometimes twisted through up to 360° and then always accompanied by an erect, conical pocket on left side of keel; style ± prolonged beyond the lateral stigma; legumes cylindrical, septate; pollen sculpture coarsely reticulate, rarely ± smooth (subg. *Haydonia* sect. *Haydonia*) .... *Vigna*

5.3 Taxonomy

VIGNA

Vigna *Savi* in Pisa nuov. giorn. lett. 8: 113 (1824); Walp.: 778 (1842); De la Sagra: 191 (1845); A. Rich.: 217 (1847); Mart.: 194 (1859); Harv.: 238 (1862); Bak.: 194 (1871); Harms: 685 (1915); Bak.: 391 (1929); Phill: 426 (1951); Wilcz.: 343 (1954); Verdc.: 617 (1971); Dyer: 273 (1975); Maréchal *et al.*: 164 (1978a). Iconotype of species: *V. luteola*, illustration in Jacq., Hort. Bot. Vindob. vol. 1:39, t. 90, drawn from plant grown in Vienna from Tropical American seed (PRE!, facsimile. According to Fawcett & Rendle [1920], the specimen used by Jacquin for his illustration is preserved in BM!, holo., and another with a ticket in Jacquin's handwriting, in LINN, the number being 900.4, [Verdcourt, 1971]).

Haydonia Wilcz. in Bull. Jard. Bot. Nat. Belg. 24: 405 (1954); Maréchal: 461 (1967). Type: Africa, Tanganyika/Uganda, Kavinji and Kirere in Mpororo, 1240—1400 m above the alluvial valley, *Stuhlman 2001, 2108* (B, syn., destroyed; Uganda, Busogo, *Dawe 95* (K!, neo.).

Annual or perennial herbs usually dying down in winter, rejuvenating in spring; sometimes erect, usually twining or creeping. **Root systems** shallow, adventitious, or swollen tap root systems becoming woody with age, perpendicular, dauciformis, fusiform, turbinate or bearing fusiform-moniliform tubers on the roots, always bearing nodules especially in youth. **Stems** cylindrical to ridged or deeply grooved and winged; thick and almost woody to thin, soft or wiry; indumentum of broad-based scabrid, retrorsely aculeate or short erect velvety hairs, to patent, long, slightly curled hairs (Figure 3 A—C), ferruginous or white/colourless or mixed. **Leaves** usually trifoliolate, sometimes simple or mixed on the same plant, always petiolate, stipellate; leaflets more or less appressed strigose, trinerved from the base with lateral nerves variously reticulate, subparallel in Sect. *Reticulatae* (Figure 11 F—I), apiculate (Figure 3 D) or mucronate; shape seldom consistent per species, more often variable, often with lighter circular markings toward base of lamina, texture varying from softly herbaceous or papyraceous to coriaceous and brittle; **petioles** glabrescent to variously pubescent, **petiolules** patently pubescent to setose (Figure 16 B); **stipels** varying from ovate and obtuse to linear and acute, several to one-nerved, ciliate and usually pubescent. **Stipules** typical of the species, varying from ovate to lanceolate or almost linear to filiform, apex obtuse to acuminate, base varying from spurred below the point of attachment to cordate and median attachment with free lateral auricles but always extended beyond point of attachment, one to multinerved, margin ciliate at least at apex, surface glabrous to pubescent to hairy on nerves only, size variable from very small to large and prominent. **Inflorescence** a raceme or solitary, axillary, peduncles erect, carrying flowers well above the level of leaves, retrorsely aculeate to strigose, thickest at apex; sometimes raceme contracted with two flowers only, more commonly 2—4-flowered of which all buds do not mature, or an elongated raceme with up to 15 flowers; **extrafloral nectaries** representing abortive flower buds replaced by glands containing vertical rows of orifices (Figure 3 E—G), always present, the whole being variously arranged on the inflorescence rhachis, between two pedicels or alternately. **Flowers** papilionate, either shading from white flushed with mauve to cream flushed with green or yellow; or shading from blue, lilac, mauve, purple to magenta or even apricot; **pedicels** variously short, never exceeding length of the calyx, **bracts** and **bracteoles** usually caducous, linear, uninerved, apex obtuse, base truncate or obtuse, appearing spurred, ciliate. **Calyx** campanulate, 5, free lobes varying from triangular to acuminate and subulate, shorter than or equal to or longer than tube, upper pair variously connate, lower lobe longer than others, rugose to strigose or setose. **Standard** initially erect, reflexed, often closing over inner floral parts after a few hours (after tripping), causing confusion in flower colour due to buff to yellow external colouring; varying from reniform to oblate, usually emarginate, varying in size per species, sometimes repand; spur curved or straight, sometimes alate, always bearing one pair divergent callosites at apex, second pair of subparallel or divergent callosities above them on the standard blade, sometimes vestigial or absent; nerves radiating from spur, sometimes markedly darker in colour. **Wings** narrowly ovate to ovate, apex obtuse, spur varying from long and narrow to alate, auricle ('tooth' according to Maréchal *et al.* 1978a) varying from a scarcely rounded bulge to a narrow appendage, surface smooth to papillate; outer wing wraps round keel, inner wing shorter, assisting pump action at pollination, attached by auricles to lower callosities of the standard and by lateral depressions to the keel, usually paler than standard. **Keel** straight, curved or twisted up to 180° with erect conical pocket on left, apex obtuse or acute, straight or upturned, free only at base and at apex where pistil extrudes at pollination, usually palest part of corolla. **Androecium** diadelphous with nine **filaments** forming an open tube, anterior free filament usually incrassate and geniculate, nine free filaments of two alternate lengths, alate, sometimes markedly broader immediately below anther, wrapped around pistil before pollination so that pollen lies in close proximity to the unripe stigma which is shielded by the style brush; **anthers** oblong to oblate with or without basal glands. **Gynoecium** superior, pubescent, unilocular, **ovules** marginal. **Style** initially tenuous, variously thickened or broadened and compressed, curving upward only or twisted up to 180°, barbate on adaxial face (i.e. style brush), twisted to the right from below stigma at maturity, variously extended beyond stigma into shapes and lengths typical of species. **Stigma** lateral or oblique to almost terminal, usually globular when unripe, fringed basally by short hairs protecting stigma from selfing, or receptive papillae on a flat flap of tissue beyond a space in the bearded style, or as receding papillae within bonnet of the style. **Fruit** a legume, cylindric to compressed, dehiscing spirally in wild species, not so in cultivated species; variously grading from reddish and yellowish brown to grey or black, scabrid or glabrescent to pubescent, in single, erect, divergent pairs to bunches, often reflexed, at the apex of peduncle, variously beaked. **Seeds** cylindric to somewhat compressed to rectangular, variously mottled to unicoloured, testa pitted-reticulate (Figure 16 D); hilum eccentric to almost central, covered by soft, spongy, white tissue (Figure 14 E), aril broad to vestigial or absent.

About 160 species of *Vigna* are distributed throughout both tropical hemispheres (Steele & Mehra 1978) and of these more than 50 species occur in tropical Africa. Of these about 14 grow in southern Africa of which at least three taxa are more or less endemic.

The following characters are distinctive (Maréchal *et al.* 1978a) but are also shared by other small, subsidiary genera: uncinated hair absent, floral bracts caducous, secondary axes of the inflorescence reduced to glandular excrescences, flowers never more than two per node, pedicels thick and shorter than, or at most, as long as the calyx, petals of subequal length, style caducous and legumes linear, subseptate.

The peculiarity of the genus *Vigna*, lies in the following combination of characters: stipules prolonged below the point of insertion i.e. auriculate-cordate or spurred at the base, inflorescence with rhachis contracted in all sections excepting Sect. *Vigna* and Sect. *Comosae*, style prolonged beyond the stigma as a beak of varying lengths or protuberance of varying shapes, and pollen triporate, sculpture an open reticulum and muri of varying height.

The taxonomic treatment of the genus *Vigna* is presented within the southern African context. For an East African treatment, consult Verdcourt (1970, 1971) and for an universal treatment, consult Maréchal *et al.* (1978a).

KEY TO THE SUBGENERA AND SECTIONS OF *VIGNA* IN SOUTHERN AFRICA:

The infrageneric demarcation of *Vigna* in southern Africa is based mainly on the contributions of Verdcourt (1971), Maréchal *et al.* (1978a) and Jaaska & Jaaska (1988).

1a. Vexillary and short stamens with either a pair, or a bunch of small glands at the base of anthers, sometimes without; pollen scarcely sculptured or smooth ....3 subgenus *Haydonia*..2

1b. Vexillary and short stamens always without anther glands; pollen always sculptured 3

2a. Anther glands present; exine of pollen grains smooth, without reticulations; prolongation of the style absent ....3 subg. *Haydonia* 1 sect. *Haydonia*

2b. Anther glands absent; exine of pollen grains scarcely reticulate; prolongation of style a short beak or protuberance ....3 subg. *Haydonia* 2 sect. *Microspermae*

3a. Pollen grains with broad reticulate, prominently-walled sculpture; flowers often appear before the leaflets; style prolongation prominently beaked, subulate .... 1 subg. *Vigna* 5 sect. *Liebrechtsia*

3b. Pollen grains sometimes with less prominently-walled sculpture; flowers and leaflets appear at the same time; style prolongation shorter, subulate or obsolete 4

4a. Tertiary veins of leaflets characteristically close, transversely parallel; style prolongation a thin flap of tissue, rudimentary; leaflets with hairs admixed ferruginous and white ....
....1 subg. *Vigna* 4 sect. *Reticulatae*

4b. Tertiary veins not as above; style prolongation rudimentary or beaked, subulate or obtuse; leaflet hairs white, silky when young, strigose or glabrous 5

5a. Style prolongation rudimentary; leaflets silky when young, with typical marginal hairs at right angles to the margin; legumes long, narrowly cylindrical, up to 25-seeded ....1 subg. *Vigna* 3 sect. *Macrodontae*

5b. Style prolongation beaked; leaflets strigose or glabrous; legumes variously broader, compressed, up to 20-seeded 6

6a. Style prolongation variously beaked, subulate or obtuse; leaflets often glabrous, adnately strigose or silky; legumes in bunches (up to 15) at apex of peduncle, reflexed; stipules cordate, strigose ....1 subg. *Vigna* 1 sect. *Vigna*

6b. Style prolongation beaked or a protuberance; leaflets variously strigose; legumes 2–7 (not always bunched) at apex of peduncle, erect; stipules not cordate 7

7a. Style prolongation a short, broad, obtuse beak; stipules filiform, mounted on a pad-like cushion, peltate; leaflets ovate to lanceolate, obsoletely hastate, pubescent or glabrescent ....1 *Vigna* 2 sect. *Comosae*

7b. Style prolongation a protuberance, the structure hammer-shaped as a whole, or a flap of tissue, bonnet-shaped as a whole; stipules spurred or auriculately cordate; leaflets ovate, narrowly ovate to lanceolate, lobed or unlobed, ferruginous or colourless strigose 8

8a. Style prolongation a protuberance opposite stigma, a hammer-shaped structure as a whole; stipules spurred below point of attachment; pubescence variously strigose, colourless; leaflets seldom unlobed, usually sublobed to strongly lobed; keel beak short, canoe-shaped ....2 subg. *Catjang* 1 sect. *Catjang*

8b. Style prolongation a flap of tissue covering the stigma papillae, bonnet-shaped as a whole; stipules auriculate-cordate, sometimes elongated at base but rounded; pubescence setaceous to glabrescent, ferruginous, pale ferruginous or colourless; leaflets variously shaped but not lobed; keel beak short or twisted through 180° ....4 subg. *Plectrotropis*...9

9a. Stipules all auriculate-cordate; leaflets papyraceous, ovate, narrowly ovate or lanceolate and sometimes obsoletely lobed, unmarked; setaceous to aculeate-glabrescent; hairs ferruginous, seldom colourless; calyx lobes shorter than tube, as long or very much longer, triangular to acuminate; keel beak twisted through 180°; fusiform tuber at base of stem; widely distributed ....4 subg. *Plectrotropis* 1 sect. *Plectrotropis*

9b. Stipules towards apex of stem often elongated at base but rounded, later cordate; leaflets subcoriaceous, lobed, similar to *V. frutescens*, marked near base of lamina; glabrescent; hairs either ferruginous or colourless; calyx lobes much longer than tube, acuminate; keel beak only slightly twisted; fusiform tuber at base of stem and noted for moniliform tubers on roots; only recorded from Namibia ....4 subg. *Plectrotropis* 2 sect. *Pseudoliebrechtsia*

KEY TO NATURAL SPECIES AND INFRASPECIFIC TAXA OF *VIGNA* IN SOUTHERN AFRICA:

1a. Flowers essentially yellow, cream or white 2

1b. Flowers essentially magenta, mauve or purple, even when standard is yellow on outer surface 8

2a. Inflorescence an elongated raceme with 3—15 flowers, legumes bunched at the apex of the peduncle, deflexed or spreading. Leaflets ovate, oblong or lanceolate. Stipules adnate to stem. Style prolongation variously beaked 3

2b. Inflorescence a contracted raceme with *ca.* 2 flowers, legumes 1 or 2, erect at the apex of the peduncle. Leaflets ovate to oblong. Stipules typically reflexed from stem. Style prolongation a protuberance 7

3a. Stems pubescent to glabrescent, hairs soft, silky. Leaflets narrowly ovate to broadly obovate with apex obtuse or emarginate, base cuneate. Flowers yellow, standard broadly reniform, emarginate; style prolongation thick, obtuse, tongue-shaped. Legumes partially compressed, slightly constricted between seeds, pubescent to glabrescent with long adpressed, soft hairs ....1 *Vigna luteola*

3b. Stems patent to glabrous or bristly. Leaflets broadly oblate or narrowly ovate to lanceolate, apex rounded, emarginate to acute, base cuneate or obtuse. Flowers yellow or greenish white, sometimes flushed with violet; standard broadly reniform or narrower and broadly conical with base cuneate, emarginate. Style prolongation thick and obtuse or thin and acute. Legumes compressed or moniliform, more or less thickly pubescent with long, soft or stiff, adpressed hairs 4

4a. Stems patent to glabrous. Leaflets glabrous, broadly oblate or narrowly ovate (in tropics), apex emarginate, base cuneate. Flowers yellow; standard broadly reniform, emarginate. Style prolongation thick, obtuse. Legume thick and coriaceous, moniliform, *ca*. 60 x 6 mm, *ca*. 6—7-seeded. Seeds red-brown ....2 *Vigna marina*

4b. Stems setaceous with yellow-brown or white hairs. Leaflets strigose, narrowly ovate to lanceolate or subhastate, apex acute or subacute, base obtuse or cuneate. Flowers greenish-white or yellowish, standard narrow but broadly conical with base cuneate and scarcely emarginate or oblate and emarginate. Style prolongation narrowly beaked or short and flat. Legumes compressed or inflated, thickly or sparsely pubescent with long, stiff, silky white hairs, size variable, 1—9-seeded; seeds reddish brown or yellowish to brown-grey, mottled 5

5a. Leaflets ovate to lanceolate or subhastate, apex obtuse to subacute, base obtuse or cuneate, 30—36 X 2—3 mm. Standard oblate, emarginate with superior callosities divergently vertical, inferior ones horizontal. Style prolongation short, flat. Legumes cylindrical or distally broadened, usually falcate. Seeds reddish brown ....4 *V. comosa* subsp. *comosa* var. *comosa*

5b. Leaflets ovate to lanceolate, apex acute, base obtuse, length variable from 15—120 mm. Standard narrow, scarcely emarginate, the whole cuneiform, both pairs callosities vertical, spur long. Style prolongation a long beak. Legumes compressed. Seeds yellowish to brown-grey 6

6a. Leaflets up to 120 x 22 mm. Standard 10—12 mm long; style beak *ca*. 0.7—0.8 mm long. Legumes 40—65 mm long ....3a *Vigna oblongifolia* var. *oblongifolia*

6b. Leaflets 15—80 x 2—25 mm. Standard 6—8 mm long; style beak *ca*. 0.3—0.4 mm long. Legumes 30—40 mm long ....3b *Vigna oblongifolia* var. *parviflora*

7a. Leaflets ovate, apex acute, base cuneate at all stages. Style prolongation oblique thimble-shaped protuberance ....11 *Vigna mudenia*

7b. Leaflets oblong, apex and base rounded in youth, rhombic or sublobed at maturity. Style prolongation a slight protuberance in bend of style, opposite to stigma .... 12 *Vigna* sp. nov. A

8a. Stipules elongated laterally beyond point of attachment, base cordate. Inflorescence a contracted raceme. Standard more or less rotund, repand. Keel sometimes twisted, having a conical pocket on left side. Style prolongation appearing obtuse or extended beyond stigma as beak or bonnet-shaped organ 9

8b. Stipules extended with a spur beyond point of attachment. Inflorescence robust, elongate or contracted raceme. Standard subrotund, scarcely repand; keel straight, without pocket. Style extended horizontally or obliquely upward by a protuberance so that stigma appears hammer-shaped 17

9a. Plants pyrophytic, flowers precocious after grass fires. Style beaked 10

9b. Plants with flowers and leaves appearing together. Style prolongation somewhat flattened, oblique 11

10a. Plant with ferruginous and white hairs mixed on stems, leaflets, calyx; adpressed or patent. Leaflets with characteristic raised venation, tertiary veins close, transverse and subparallel. Standard less than 20 mm long and broad, pale to deep mauve or violet. Style with short rounded beak *ca*. 0.5 mm long ....6 *Vigna pygmaea*

10b. Plant with velvety, light coloured hairs, rarely glabrous. Leaflet venation typical of genus i.e. trinerved from base, then reticulate. Standard large, oblate, up to 30 mm long and broad, lilac to almost white. Style with long, spathe-like beak, up to 2 mm long ....7 *Vigna frutescens* subsp. *frutescens* var. *frutescens*

11a. Venation raised and reticulate on both leaf surfaces. Keel slightly incurved like a canoe, otherwise straight; style prolongation oblique, shortly prolonged, somewhat flattened 12

11b. Venation typical of the genus not particularly raised. Keel twisted through 180°, accompanied by an erect, conical pocket on left side. Style prolongation apparently obtuse, stigma covered by bonnet-shaped flap of tissue 13

12a. Leaves unifoliolate, ovate to oblong-lanceolate or elliptic, unlobed; glabrous or few hairs on dorsal nerves. Calyx glabrous or with short, adpressed black hairs. Inner whorl of anthers with a pair of glands at base ....*Vigna monophylla*

12b. Leaves trifoliolate, oblong, elliptic to linear-lanceolate, slightly lobed at base; glabrous to pubescent or pilose on both surfaces with characteristic short, marginal hairs lying at right angles to margin. Calyx glabrous or hairy with yellowish or white hairs. No anther glands ....5 *Vigna friesiorum* var. *friesiorum*

13a. Leaflets more or less obtusely trilobed, bright green, sometimes marked with lighter green, obvious when dried; hairs light ferruginous or white. Flowers lilac with extrafloral glands apical on inflorescence rhachis. Tubers fusiform, moniliform on roots ....14 *Vigna lobatifolia*

13b. Leaflets variable from almost round, ovate to linear, dark green to reddish, unmarked; ferruginous hairs on all vegetative parts. Flowers from pinkish-mauve to magenta, profusely dark-veined, extrafloral glands in vertical rows between pairs of flowers on inflorescence rhachis. Rootstock woody, thin, perpendicular 14

14a. Leaflets large, ovate or elliptic; apex acute, base cuneate. Ferruginous hairs puberulous to pubescent, patent. Calyx lobes longer than tube. Legumes ferruginously pubescent, up to 100 mm long, *ca*. 18-seeded ....13a *Vigna vexillata* var. *vexillata*

14b. Leaflet size variable, ovate to subrotund or lanceolate to linear; apex rounded, acute or acuminate, base variable. Ferruginous hairs setaceous to patent, adnate strigose to glabrescent. Calyx lobes longer or shorter than tube. Legumes ferruginous or scabrid, *ca*. 55—100 mm long, 10—18-seeded 15

15a. Robust twiners, sometimes prostrate. Leaflets lanceolate to linear, *ca*. 40—150 x 4—25 mm, apex acuminate, base truncate or obtuse. Ferruginous hairs adnate strigose to aculeate-glabrescent. Calyx lobes as long as, or shorter than tube. Standard oblate, repand. Legumes scabrid, *ca*. 100 mm long, 18-seeded ....13b *Vigna vexillata* var. *angustifolia*

15b. Stems robust or delicate, prostrate. Leaflets rotund to ovate to linear, *ca*. 25—80 x 25—100 mm, apex obtuse or acute, base cuneate or obtuse. Ferruginous hairs shortly strigose to lightly patent to setaceous. Calyx lobes usually longer than tube. Standard varyingly oblate, repand. Legumes strigose to thickly setaceous, *ca*. 55—100 mm long, 10—18-seeded 16

16a. Stems robust trailers or erect plants, ferruginous, setaceous. Leaves one-, two- or three-foliolate, large, broadly ovate, broadly linear or elongate-rhomboid, always longer than broad, hairs ferruginous, sometimes yellow, setaceous, crisply papyraceous. Calyx lobes very long, subulate, setaceous. Standard broadly oblate, very repand, bright magenta. Peduncles as in other varieties .... 13d *Vigna vexillata* var. *davyi*

16b. Stems delicate, creeping close to the ground, ferruginous, patent. Leaflets trifoliolate, small, ovate to rotund, ovate to linear, finely adpressed hairy or glabrescent, papyraceous. Calyx lobes longer or shorter than tube, strigose. Standard oblate, repand, mauve. Peduncles up to 250 mm long to carry blooms well above the grasses, base swollen up to 3 mm thick, woody at maturity ....13c *Vigna vexillata* var. *ovata*

17a. Stems delicate, creeping among rocks or twining in grassland at *ca.* 1630 m altitude. Stipules ribbed, not always prominent, both ends often rounded. Flowers small, solitary, pink or purple. Style prolongation horizontal, up to 0.4 mm long, hammer-shaped as a whole ....9 *Vigna nervosa*

17b. Stems usually robust, twining or prostrate, from sea level to highveld altitudes. Stipules prominently ribbed, ends obtuse to acute. Flowers in racemes, robust or contracted, purple, mauve to blue. Style prolongation horizontal or upturned by *ca.* 45°, hammer-shaped as a whole ....*Vigna unguiculata*...18

18a. Stems patently hairy or velvety. Stipules patently hairy, varying from abundant hairs to few, on nerves only or none, margins coarsely ciliate, striking, large, broadly ovate, usually dark green; spur short and broad, often oblique and/or split, adnate. Calyx lobes longer than tube. Flowers 4—7 in racemes, all buds not maturing, robust, purple, mauve or blue. Style prolongation horizontal or turned upward to *ca.* 45°, up to 1 mm long, hammer-shaped as a whole ....8a *Vigna unguiculata* subsp. *protracta*

18b. Stems puberulous to sparingly patent. Stipules glabrous, margins with apical cilia only, ovate to narrowly ovate to lanceolate, brownish; spur usually lanceolate, acuminate, often reflexed from stem. Calyx lobes shorter than or equalling tube. Flowers 2—4, contracted rhachis, purple shades. Style prolongation horizontal, *ca.* 0.1—0.4 mm long, hammer-shaped as a whole 19

19a. Style protuberance horizontal, *ca*. 0.3—0.4 mm long, hammer-shaped as a whole or greatly reduced. Leaflets more or less uniform in size and shape, texture papyraceous, soft to slightly coriaceous. Stipules ovate or slender, small 20

19b. Style protuberance horizontal, 0.1—0.3 mm long, hammer-shaped as a whole. Leaflets lanceolate to linear in outline, rarely basally lobed, texture usually leathery. Stipules lanceolate 23

20a. Stems herbaceous. Leaflets large, thin, uniformly rhombic-triangular or upper leaflets hastate i.e. heterophyllous. Calyx lobes shorter than tube. Style protuberance *ca*. 0.4 mm long.................................... ....8b i *Vigna unguiculata* subsp *dekindtiana* var. *dekindtiana*

20b. Stems herbaceous to woody. Leaflets large or small, papyraceous or subcoriaceous, either uniformly rhombic-triangular or hastate. Calyx lobes longer or shorter than tube. Style protuberance reduced or up to 0.4 mm long... 21

21a. Stems woody. Leaflets uniformly large, papyraceous, more or less uniformly rhombic-triangular. Calyx lobes much longer than tube. Legumes 100 mm long. Style protuberance almost absent............... ....8b iii *Vigna unguiculata* subsp. *mensensis*

21b. Stems thin, often reddish with long internodes toward base of plant. Leaflets uniformly small, thinly coriaceous or papyraceous, uniformly rhombic-triangular or oblong with base truncate, obsoletely lobed. Calyx lobes more or less as long as tube. Legumes 40 mm long. Style protuberance *ca*. 0.4 mm....................................... ....8c *Vigna unguiculata* subsp. *tenuis*..22

22a. Leaflets oblong, apex obtuse, base bilobed, truncate, lateral leaflets one-lobed, asymmetric, bright green, soft papyraceous ....8c i *Vigna unguiculata* subsp. *tenuis* var. *tenuis*

22b. Leaflets rhombic-triangular or essentially ovate, apex acute, base cuneate or obtuse, lateral leaflets roundly asymmetric, greyish or green, thinly coriaceous or papyraceous ....8c ii *Vigna unguiculata* subsp. *tenuis* var. *ovata*

23a. Stems aculeate or puberulous to scarcely patent. Leaflets linear, very much longer than narrow, apex acuminate, unlobed or scarcely lobed, unmarked, texture coriaceous. Calyx lobes as long as or shorter than tube ....8d *Vigna unguiculata* subsp. *stenophylla*

23b. Stems scarcely patent to glabrous. Leaflets narrowly hastate, apex subacute, base obtuse, marked silvery grey at base, coriaceous. Calyx lobes shorter than tube, horizontally rugose-plicate ....8b ii *Vigna unguiculata* subsp. *dekindtiana* var. *huillensis*

Vigna Savi in *Pisa nuova giornale lettura* 8: 113 (1824):
[For full taxonomic references, see 5.4, p. 42].

Subgenus 1. *Vigna*

Stipules bilobed. **Flower** bilaterally symmetrical. **Keel** not or slightly incurved (rarely distinctly incurved), without pocket on the left hand side. **Style** with thickened part straight or slightly curved, beaked. **Pollen** grains triporate with a conspicuous and coarse reticulation, muri height variable.

Section 1. *Vigna*

Scytalis E. Mey. sect. *Helicopus* E. Mey. (1836).
Vigna Savi sect. *Microdontae* Harms (1915).

Type of section and genus: *Vigna luteola* (Jacq.) Benth.: vol.1: 39, t. 90. (1859).

Keel obtuse. **Style** with thickened part gently curved, shortly beaked. **Keel** pockets absent. **Pollen** grains with wide reticulation of low, raised muri.

1. **Vigna luteola** (*Jacq.) Benth.* in Mart., Flora brasiliensis 15,1: 194, t. 50 (1859); Harv: 241 (1862); Bak.: 205 (1871); Bak. f.: 401 (1929); Burtt Davy: 421 (1932); Wilczek: 363 (1954a); Hepper: 569 (1958); Verdc.: 625—626 (1971); Maréchal et al.: 165 & 166 (1978a). Iconotype:

illustration in *Jacquin* (1770), Hortus botanicus vindobonensis t. 90, drawn from plant grown in Vienna from tropical American seed. (PRE! Facsimile).

Dolichos repens L.: 1163 (1759). Type: St. George, Jamaica, *P. Browne*, not found; UPS—THUNBERG may be an isotype (Verdc. 1971).

D. luteolus Jacq.: 39 (1770). Iconotype: as above.

Phaseolus luteolus (Jacq.) Gagnepain: 229 (1916). Iconotype: as above.

D. niloticus Delile: 253, t. 38 (1814); Guillemin, Perrotet & Richard: 218 (1831). Type: Egypt, borders of the River Nile, *Delile* (P!, holo.).

Vigna nilotica (Del.) Hook. f.: 311 (1849); Bak.: 204 (1871); Bak. f.: 404 (1929). Type: as above.

Dolichos gangeticus Roxb.: 310 (1832). Type: India, Bengal, *Bun Burbutee* (herb. unknown).

Scytalis helicopus E. Mey.: 146 (1836). Types: var. a. *major*, South Africa, inter Omsamculo et Omcomas, in fruticeto ad ostia fluvii cujusdam minoris, *Drège V, c,* (P! holo.); var. ß. *minor* inter Omtendo et Omsamculo in fruticetis humidis, infra 200 ped. alt., *Drège V, c,* (P! holo.). (Figure 5D)

Vigna helicopus (E. Mey.) Walp.: 779 (1842). Types: as above.

V. brachystachyus Benth.: 86 (1844). Type: Guayaquil, *Bentham s.n.* (K!, holo.).

V. bukobensis Harms: 92 (1901). Types: Africa, Tanganyika, Bukoba, *Stuhlmann 3931* & Congo, north-west shore of Lake Edward, *Stuhlmann 3039* (B, syn. destroyed).

Vigna nigerica A. Chev. 24: 134, 135 (1944). Type: Casamance: Marsasoun, on river banks, *Chevalier 3407*. (P, holo., K!, iso.).

Perennial climber, growing in damp to marshy seepage grassland on banks of dams or rivers, or at river mouths. **Stems** pubescent to glabrescent, with soft, silky hairs. **Stipules** cordate at base, narrowing abruptly or gradually to the acute apex, *ca*. 5 X 2 mm, pubescent. **Leaflets** vary from narrowly ovate or almost lanceolate, and ovate to almost rotund with cuneate base; apex mostly *ca*. obtuse or emarginate, occasionally acute, apiculate, 30—105 X 15—45 mm; sparingly sericeous on both surfaces, especially along dorsal nerves, to glabrous and almost succulent; **rhachis** usually less than 1.0 mm long; **petiole** up to 50 mm long. **Inflorescence** an elongate raceme with 3—15(—20) yellow to yellow-green flowers on the upper 20—30 mm of the peduncle that carries them well above the leaves, rhachis with alternate interfloral glands, twisted. **Calyx** pubescent or glabrescent; tube 3—4 mm long, lobes shorter than tube, 2—4 mm, deltoid, upper two at least 2/3 connate often appearing as one with two apices, lower lobe subulate, longer than other lobes. **Standard** *ca.* oblate, emarginate, 13—25 X 12—26 mm, callosities 2 pairs, the superior pair broad, lobular, 0.5 mm broad, 1.5 mm long, both pairs divergent; **wing** auricle long, *ca*. 1—1.5 X 0.2 mm, papillate; **keel** beak short, obtuse. **Stigma** lateral with shortly beaked style (obtuse, tongue-shaped), 0.5—0.7 mm long. **Legumes** in bunches, deflexed, somewhat moniliform, pubescent to glabrescent, *ca*. 40—70 X 4.5—6.5 mm, varying from grey-black to brown, 6—9 seeded, compressed. **Seeds** reddish to grey-brown mottled with black, *ca.* 4—7 X 3—6 mm, hilum oblong, aril not or scarcely developed. (Figure 5)

Twining over species of *Pycreus* Beauv., *Phragmites* Trin., etc. from Botswana (Moanachira, Linyandi and Boro Rivers), to eastern Transvaal (Sabie and Komati Rivers), abundant along the entire Natal coast (estuaries of the Kosi System and Lake St. Lucia, the Umgeni Mouth to Beach Terminus at Port Shepstone) and into Transkei and eastern Cape (rivers emptying at Port St. Johns, Port Alfred to the Goukama at Knysna). It tolerates salt water.

Verdcourt (1971) separates the "more or less glabrous" plants into var. *luteola*. However, the floral characters are stable and Maréchal *et al.* (1978) do not find the division necessary. In southern Africa the shiny, more glabrous members with obtuse and emarginate leaflets are the most common. Specimens from parts of tropical Africa commonly have patently pubescent stems and the leaflets are dull due to the pubescence. As a result, O. Kuntze (1891) divided his *V. repens* into three divisions, namely, *α, luteola* O. Kuntze with ovate, acute leaflets, var. *villosa* O. Kuntze with `normal' pilosity, from Caracas; ß, *lutea* (Sw.) O. Kuntze with broad, obtuse leaflets, var. *glabra* (Savi) O. Kuntze, with a powdery surface, from Porto Rico, Guyama; γ , *angustifolia* O. Kuntze with ovate-lanceolate leaflets, var. *glabra* (Savi) O. Kuntze with the width of the leaflets and the state of the pubescence totally `independent' of each other. Furthermore, O. Kuntze had placed *V. repens* under *V. catjang* (Endl.), a wrong subgenus which is fully discussed later in this chapter and for which reason O Kuntze's combination is regarded as illegal.

V. luteola may be confused with *V. oblongifolia* A. Rich. var. *oblongifolia* when leaflets are narrowly ovate, but the latter commonly grows in disturbed areas (e.g. ploughed maize fields) as well as along freshwater courses; its hairs are stiff and more bristly, the inflorescence dense and pale and the flowers small, 11 mm or less.

The plant is known to be cultivated for cattle feed in parts of Africa.

Specimens examined

--1724 (Katima Mulilo): Liambezi Lake (-CD), *Gibbs Russell 2453* (K, SRGH); bank of Linyandi River, west of Kasane (-CD), *Moss 15073* (J).

--1725 (Livingstone): Chobe River, Kasane (-CC), *Gibbs Russell & Biegel 3905* (PRE).

--1824 (Kachikau): Linyandi River at Shaile (-AA), *Gibbs Russell 2414* (PRE).

--1923 (Maun): Okavango Swamps, island on Moanachira River (-AA), *Biegel & Gibbs Russell 3904* (PRE); Moanachira River, near Godikwa Lagoon (-AA), *Ellery 102* (PRE); between Godikwa Lagoon and Godikwa Island (-AA), *Ellery 236* (PRE); between Godikwa and Gobega Lagoons (-AA), *Ellery 345* (J, PRE); Moanachira River banks (-AA), *Smith 211* (NBG, PRE); Boro River (-CA), *Biggs M77* (PRE).

--2023 (Kwebe Hills): Botchi River, 24 km east of Maun (-AA), *Mithen 599* (PRE).

--2331 (Phalaborwa): Letaba, Kruger National Park (-DC), *Van der Schyff 3188* (K, PRE).

--2431 (Acornhoek): PWB-works area, storage dam embankment (-AA), *Retief 263* (PRE).

--2531 (Komatipoort): near Lower Sabie Camp, Kruger National Park (-BB), *Codd 6131* (K, PRE); Komatipoort (-BD), *Rogers 10929* (K), *20278* (PRE).

--2632 (Bela Vista): margin of reed bed, Ndumo Game Reserve (-CC), *M. Ward 2530* (Photocopy, PRE); Banzi pan, Ndumo Game Reserve (-CD), *Pooley 358* (NH); hygrophyllous grassland, Hlange Lake, Kosi Bay (-DD), *Balsinhas 3106* (PRE), *Tinley 354* (PRE), *Ward 8063* (DWU), *Ward 8820* (K, NH, PRE, DWU), *M. Ward s.n.* (Photocopy, PRE); Kosi Bay Nature Reserve (-DD), *Ward 865* (NH).

--2732 (Ubombo): 1 mile north-east of Kwa Zibi (-BB), *Ross & Moll 5070* (K, NH, PRE); Mandozi, near Lake Sibaya (-BC), *Ngwenya 295* (PRE); Lake Sibayi (-BC), *Ward 222* (NH), *M. Ward s.n.* (Photocopy, PRE); 1 km upstream of Mkuze mouth, St. Lucia (-CD), *Mc Lean s.n.* (PRE).

--2829 (Harrismith): Winterton (-DC), *King 347* (NH).

--2830 (Dundee): Weenen (-CC), *Wood 10794* (NH).

--2831 (Nkandla): Eshowe (-CD), *Lawn 1485* (NH); Mtunzini Nature Reserve (-DD), *Kok & Pienaar* 1270 (PRE, PRU), *Lawn 1625* (NH); Hameworth, Mtunzini dist. (-DD), *Mogg 4437, 5988* (PRE).
--2832 (Mtubatuba): Hluhluwe Game Reserve (-AA), *Deane 10* (PRE); alongside lagoon, St. Lucia Estuary (-AD), *Clarke 525* (PRE), *Moll & Strey 3860* (K, PRE); Richards Bay (-CC), *Venter 5609* (PRE).
--2930 (Pietermaritzburg): Merebank, south-west (-DD), *Baijnath 196* (DWU, PRE); Isipingo-North (-DD), *Ward 383* (NH).
--2931 (Stanger): Hawaan Forest, south bank of Umhlanga River (-CA), *Ross & Moll 2179* (NH); swamp near Umgeni River mouth (-CC), *Evans 186* (NH), *Forbes & Obermeyer 79* (NH, PRE), *Strey 7329* (DWU, K, PRE); Blue Lagoon (-CC), *Forbes 1071* (NH), *Johnson 1354* (K, NH, PRE), *Mc Lean NH 22334* (NH); Port Natal (CC), *Krauss 233* (TCD); banks of Umhlatuzana and Umgeni Rivers (-CC), *Krauss 233* (BM, SAM); swamp at head of bay (-CC), *Wood 865* (BM, NH), *Wood 4123* (K, NH); near Durban (-CC), *Wood 6097* (BOL), *Wood 9438* (SAM); sea beach near Umgeni River (-CC), *Wood 7289, 7959* (NH).
--3030 (Port Shepstone): Umbogintwini (-BB), *Moses NH 20919* (NH); Umkomaas ski-boat club (-BB), *Pienaar 1371* (PRE); Doonside (-BB), *Wylie NH 23291* (NH); Beach Terminus (-CD), *Forssman PRE 56123* (PRE); Palm Beach (-CD), *Jacques 5582* (NBG); St. Michaels on Sea (-CD), *Nicholson 890* (NH, PRE); Uvongo (-CD), *Nicholson 1310* (PRE).
--3129 (Port St. Johns): river bank, Port St. Johns (-DA), *Moss 3189* (J); bush bordering Port St. Johns (-DA), *Pegler 1544* (BOL, K, PRE).
--3227 (Stutterheim): Beacon Bay, East London (-DD), *Van Wyk 3229* (PRE).
--3228 (Butterworth): Mazeppa Bay (-BC), *Theron 1202* (K, PRE); between Kei River Mouth and Rooiwal (-CB), *Flanagan 833* (BOL, NH, PRE, SAM).
--3322 (Beaufort West): wetland fringe (-DD), *Verboom s.n.* (PRE).
--3324 (Steytlerville): Humansdorp, Mondplaas, banks of Gamtoos River (-DD), *Deacon s.n.* (PRE).
--3325 (Port Elizabeth): Uitenhage (-CD), *Zeyher 25* (BM); Zwartkops River (-DC), *Zeyher 2412* (SAM).
--3326 (Grahamstown): Riet River, Albany (-BD), *Atherstone s.n.* (K); Port Alfred (-DB), *Salisbury PRE 56128* (PRE), *Tyson PRE 56100, PRE 56128* (PRE).
--3327 (Peddie): Peddie, swamp near Begha [Bira?] River (-AD), *Mullins s.n.* (PRE).
--3422 (Mossel Bay): Banks of Goukama River (-BB), *Duthie 846* (BOL); Sedgefield, Swartvlei (-BB), *Mullins s.n.* (PRE).

Precise locality unknown

Flanagan 3905 (PRE); Umhlatuzana Hills, *Venter 2026* (PRE).

Other African localities

Mocambique: *Balsinhas 1162*; Hlangani, *Borle 441* (PRE); *Hornby 2630* (PRE); Gaza, Magula River, *Pedro 213* (PRE); Inharrime, *Pedro 267* (PRE).
Zimbabwe: Teviotdale Road, Harare, *Bayliss 10666* (PRE); Kariba, *Boughey 10687* (SRGH); Victoria Falls, *Flanagan 3086* (BOL); *Wild 26309* (PRE); Sengwa River Estuary, Lake Kariba *Gibbs Russell 2601* (PRE).
Zambia: Barotseland, 5 miles north of Senanga, *Codd 7256* (PRE); Kasamba River, 30 km. south-west of Mpungwe, *Mithen 249* (PRE); Livingstone, *Rogers 7279, 7453* (BOL).
Angola: Mashi River near Shangombo, *Codd 7570* (PRE).
Burundi: Bujumbura, *Reekmans 5777, 9536* (PRE).
Uganda: Kiagwe, *Eggeling 664* (K); Lake Mutanda, *Purseglove 2458* (K); Kyagwe, *Rwaburindore 2543, 2281* (PRE).
Kenya: Kiambu, Kamiti River, *Kirrika 230* (K); Karara Dam, *Symes 338* (K); Kigomo, *Verdcourt 2799* (PRE); Nanyuki, Mawingo Hotel, *Paulo 504* (PRE); Mambre Kamiti River, *Kirrika 230* (PRE).
Malawi: Lake Malawi, Benga, *Brass 17484* (PRE); Nkhotakota Lake shore, *Brummitt 11427* (PRE); Lake Chilwa, Kachulu Jetty, *Mithen 367* (PRE); Lake Chilwa, eastern shore of Chisi

Island, *Mithen 370* (PRE); Mpatananga Bridge, 38 km. west of Chileka Airport, *Mithen 473* (PRE).
Tanzania: Ngoitokitok Springs, eastern Ngorogoro Crater flow, *Greenway & Kanuri 12612* (PRE); Kiringi, on shores of Lake Tanganyika, *Reekmans 11097* (PRE); Lake Tanganyika, Kasanga, *Richards 10106* (K), 20673 (SRGH); Mwanza, *Rounce 189* (K); near Kigoma Prison, *Verdcourt 2799* (K); Mbulu, north-east of Lake Manyara, *Greenway & Kenuri 11839* (PRE).
Ethiopia: Northwest shore of Lake Chamo, *De Wilde 5645* (PRE).
Zaïre: Mayaga, *Liben 1534* (PRE); Yangambi, *Louis 6916* (PRE); Butetsi, *Michel 2304* (PRE); Stanley Pool, *Schlechter 12576* (PRE); shore of Lake Edward, *Smuts 2234* (PRE).
Senegal: Sedhiou, *Adam 13530* (PRE).

Precise locality unknown

Bouga, *Schlechter 12657* (PRE); Central Africa, *Schweinfurth 1124* (NH, PRE).

2. **Vigna marina** *(Burm.) Merrill* in Interpret. Rumph. herb. Amboina: 285 (1917); Hepper: 569 (1958); Verdc.: 526 (1970), : 626 (1971); Maréchal *et al.*: 166 (1978a). Iconotype: Molucca Islands, Amboina, based on *Rumphius*, Herb. Amboin. 5: 391, t. 141/2 (1750), (K! [resouces Centre], holo.).

Phaseolus marinus Burm.: 161 (1768). Type: as above.

Dolichos luteus (Sw.) DC.: 398 (1825). Type: Jamaica, *Swartz s.n.* (Herb. unknown).

Vigna lutea (Sw.) A. Gray: 452 (1854); Bak.: 206 (1871); Bak. f.: 401 (1929). Type: as above.

Scytalis retusa E. Mey.: 147 (1836). Type: South Africa, in collibus arenosis litoralibus inter Omtendo et Omcomas, *Drège V, c* (P!, holo., K!, iso.). (Figure 6 D)

Vigna retusa (E. Mey.) Walp.: 778 (1842); Dietrich: 1177 (1847); Harv.: 242 (1862). Type: as above.

Stems prostrate, pubescent to glabrescent with long, silky white hairs. **Leaflets** almost rotund, *ca.* 40—55 X 35—40 mm, with base cuneate and apex rounded, obtuse to emarginate. **Floral characters** are similar to *V. luteola*, including stigma and style elongation of *ca.* 0.7 mm long.
Standard somewhat smaller than *V. luteola*, *ca.* 50 X 9 mm. **Wing** auricle narrow, 1—1.2 mm long and papillate. **Legumes** coriaceous, shorter and broader than *V. luteola*, 50 mm long, 9 mm broad. **Seeds** larger than *V. luteola*, 6—7 X 5—6 mm, and red-brown. (Figure 6)

Three local collections of the species exist, namely, *Wood 4006* (BOL, K) and *Wood 10445* (PRE), the latter from "sandy hills at the Umgeni mouth" and *Gueinzius s.n.* (TCD) from Port Natal (Durban). Many *V. luteola* collections come from of the Umgeni Mouth and Durban Bay swamps; no *V. marina* collections occur. Intermediate leaflet forms between *V. marina* and the ovate to elliptic leaflets of *V. luteola* occur from the marshy Durban harbour area viz. *Wood 4123*, cited by Ross (1972) as *V. luteola*, and *Baijnath 196* from Merebank, south of Durban. The Durban harbour swamps have been drained for industrial purposes, hence destroying the habitat for *V. marina*. It is known from neighbouring Mozambique, but collections have not been reported from the wetland coasts between Durban and Mozambique. The possibility exists that *V. marina* due to the destruction of its habitat, has become extinct in southern Africa. However, some specimens of *V. luteola* resembling *V. marina*, may point to previous interspecific exchange of genes between the two taxa.

Vigna marina is very similar to *V.luteola* in floral structure. The main differences lie in the vegetative characters, namely, the stems and leaflets are succulent, the latter markedly obovate, [fan-shaped], with apex rotund and often emarginate i.e. retuse, and the base cuneate. The legumes are broader, more glabrous, almost leathery in appearance, torulose, slightly falcate and reddish in colour. The seeds are oval, reddish-brown in colour and larger than those of *V. luteola*.

Specimens of *V. marina* from West Africa housed at PRE, have markedly narrower leaflets which raises the question whether they should not be named *V. luteola*? Verdcourt (1971) purposely omitted West African specimens (*V. oblonga* Benth. 1844) for two reasons, namely, because the retuse leaflets have raised, reticulate venation and since the legumes are less inflated, with close, rather sparse adpressed hairs and smaller seeds. The collections at PRE do not even have the obvious retuse leaflets. Fawcett & Rendle (1920) unite *V. lutea* and *V. luteola*, using the name *V. repens* (L.) Kuntze, an arrangement with which Verdcourt disagrees. Maréchal *et al.* (1978a) regard *V. marina* as the completed edaphic adaptation to halophytic conditions as its stems and leaflets are inclined toward succulence and its legumes are thick and watertight, with large seeds. The specimens from West Africa present the narrow, pilose leaflets with acute apices and have the thin, pilose legumes, not necessarily water resistant, of *V. luteola*.

Specimens examined

--2931 (Stanger): sand hills near mouth of Umgeni River (-CC), *Wood 4006* (BOL, K); Umgeni (-CC), *Wood 10445* (NH, PRE); Port Natal (-CC),*Guienzius s.n.* (TCD).

Other localities in Africa

Mozambique: Santa Carolina Island, near Farelim Beach, *Mogg 28596* (PRE).
Tanzania: *Batty 10* (K); Zanzibar, *Faulkner 2883, 2818* (K).
Cameroun: 1 km east of Lobe River Mouth, sandy beach, *Bos 3143* (PRE); Lobé River Mouth, south of Kribi, flat sandy beach, *Bos 4173* (PRE).

3. **Vigna oblongifolia***A. Rich.*, Tentamen florae abyssinicae 1: 220 (1847); Bak.: 196 (187); Bak. f.: 410 (1929); Wilczek: 360 (1954a); Verdc.: 527 (1970); Verdc.:629 (1971); Maréchal *et al.*: 167 (1978a). Type: Ethiopia, Tigre, *Quartin Dillon* (P, holo, K!, MPU., iso).

Annual prostrate or twining herb. **Root system** shallow, growing in damp to marshy grassland and as a weed of cultivation, a woody rootstock sometimes developing. **Stems** slender, strigose to patent, hairs yellow-brown to white. **Stipules** small, cordate, strigose. **Leaflets** narrowly ovate to lanceolate, *ca.* 21—122 X 3—25 mm at the broadest point, more or less subulate, apiculate, sparingly strigose on both surfaces, thicker along nerves; **rhachis** usually less than 20 mm, **petioles** up to *ca.* 65 mm long. **Inflorescence** a short, dense raceme of up to 10 almost oppositely arranged small flowers, at the apex of the long peduncle up to 260 mm long, the extrafloral nectaries (glands) present at the base of the pedicels. **Calyx** pubescent, lobes longer than tube, upper lobes connate to form an apiculate tip, lower lobe narrow, subulate, longer than others.

Standard pale yellow, yellow-green, sometimes flushed purple, 10—12 mm long, obovate with cuneate base and long narrow spur; **wings** pale yellow; **keel** short, straight, *ca*. 10 mm long, pale yellow to greenish, rostrum green. **Style** elongation beaked, recurved, obtuse to acute, 0.3—0.6 mm long. **Legumes** in groups, deflexed, greenish to brownish grey, pubescent, 40—65 X 4—5 mm, shortly beaked, 2—9-seeded, slightly constricted between seeds, compressed. **Seeds** yellowish to brownish grey, black-mottled, *ca*. 2—3 X 1.5 X 2 mm, hilum eccentric, aril well-developed, appearing double-layered in the lower half.

Key to varieties:

1a. Leaflets up to *ca*. 122 mm X 25 mm; standard *ca*. 10—12 mm long; legumes *ca*. 40—65 X 5 mm; style beaked, reflexed, up to 0.6 mm long ....3 (a) var. *oblongifolia*

1b. Leaflets narrowly ovate to lanceolate or linear, subulate or strap-shaped, *ca*. 15—80 X 3—5 mm; standard *ca*. 6—8 mm long; legumes *ca*. 23—40 mm; style beaked, reflexed 0.2—0.4 mm long ....3 (b) var. *parviflora*

3a. *Vigna oblongifolia* var. *oblongifolia*

Vigna lancifolia A. Rich.: 221 (1847); Bak.:196 (1871); Bak. f.: 398 (1929); Hepper: 568 (1958). Type: Chiré, Belesse, *Quartin Dillon s.n.* (P, holo., K!, iso.).

V. wilmsii Burtt Davy: 419, 421 (1932). Type: Transvaal, "Lydenburg dorp", *Wilms 407a* (K!, holo.).

These plants are recognized by their larger dimensions as opposed to var. *parviflora*. (Figure 7).

Moist grassland or irrigated grain fields in Natal, Highveld of the Transvaal and the Orange Free State and Namibia. (Figure 7 B).

Specimens examined

--1719 (Runtu): Banks of Okavango River (-DD), *De Winter & Marais 4908* (PRE).
--1914 (Kamanjab): Arendsnes (-DB), *Le Roux 1409* (WIND).
--1915 (Okaukuejo): Etosha National Park, 84 km west of Okaukuejo (-AA), *Volk & Le Roux 790* (PRE, WIND).
--1917 (Tsumeb): Farm Kumkauas, Omuramba Camp (-CA), *Merxmüller & Giess 30164* (PRE, WIND).
--2430 (Pilgrim's Rest): on road to Bourke's Luck (-DD), *Germishuizen 154* (PRE).
--2526 (Zeerust): Swartruggens, Brakfontein Farm (-DA), *Van Hoepen 1719* (PRE).
--2528 (Pretoria): Prinshof Experimental Station (-CA), *Prinshof 1839* (PRE); Onderstepoort (-CA), *Theiler s.n.* (PRE); T.U.C. (Pretoria University) Farm (-CB), *Verdoorn PRE 10066* (PRE).
--2530 (Lydenburg): Lydenburg (-AB), *Wilms 407a* (K, holo, PRE, photo, type for *V. wilmsii*).
--2531 (Komatipoort): Fayi Spruit, Kruger National Park (-AB), *Van der Schyff 2015* (PRE); Sigase River, Kruger National Park, (-AD), *Codd 5250* (K, PRE); Mhlambane Dam, Malelane, Kruger National Park (-DA), *Brynard & J.Pienaar 4458* (PRE).

--2627 (Potchefstroom): Frankenwald (-BB), *Morwood J 26553* (J); maize field, Potchefstroom (-CA), *Sellschop s.n.* (PRE).
--2630 (Carolina): 20 miles from Lochiel (-BA), *Germishuizen 3859b* (PRE).
--2726 (Odendaalsrus): Leeudoorns, Wolmaransstad (-AD), *Pilkington 115679* (K).
--2727 (Kroonstad): Weed in maize fields (-CA), *Gerber s.n.* (PRE), weed in wheat fields (-CA), *Hugo s.n.* (PRE).
--2729 (Volksrust): Agronomic weed, Amersfoort (-BB), *Van Gass s.n.* (PRE).
--2730 (Vryheid): Fairbreeze Farm, Dannhauser district (-CC), *Ngwenya 576* (PRE).
--2830 (Dundee): Weenen (-CC), *Wood 10794* (K, NH, PRE).
--2927 (Maseru): Weed in maize fields, Ladybrand (-AB), *Mc Farlane s.n.* (PRE).
--2930 (Pietermaritzburg): Umvoti Bridge on Greytown to Pietermaritzburg road (-BA), *Edwards 3075* (PRE); roadside, Greytown-Pietermaritzburg road (-BC), *Pienaar 1384* (PRE); waterfall near Richmond (-CD), *Thode A1207* (K, NH, PRE).
--2931 (Stanger): Port Natal (-CC), *Gerrard & Mc Ken 1108* (TCD).

Precise locality unknown

Kunene River, *Barnard 527* (SAM).

Other localities in Africa

Zimbabwe: Inyanga-Rhodes road, Inyanga, *Corby 1093* (PRE);
Zimbabwe Hotel, Victoria, *Corby 2177* (PRE); Insiza, *Eyles 3284* (BOL); Salisbury, *Eyles 567* (SAM); Salisbury, *Lenton s.n.* (PRE); Bulawayo, *Miller 2714* (PRE); Gokwe, *Jacobsen 4082* (PRE); Mongu, *Drummond & Cockson 6583* (PRE); Chiturupazi Store, Beitbridge, *Staples CP 152866* (PRE).
Zambia: Luwinga, *Robinson 5057* (PRE); Mt. Mahulu, *Verboom L105* (PRE).
Malawi: Bunda College of Agriculture, *Staples CP 152864* (PRE); Chimwavi Dambo, near Kasungu, *Staples CP 152329* (PRE).
Tanzania: Great North Road, 3 miles north of Dodoma, *Polhill & Paulo 2105* (K, PRE); Meserani Dam, 16 km. south of Monduli, *Greenway 7798* (K, PRE), *10567* (PRE).
Ethiopia: *Schimper 463, 1544, 3393* (PRE).
Kenya: Nakuru, Soysambu estate, *Bogdon 1009, 3091* (K); *Maher 2061* (K); Nairobi, *Napier 234* (K); Samburu, *Newbould 3336* (K).
Uganda: Serere, *Chandler 855* (K); Entebbe, *Norman 10* (K); Pian, *Wilson 593* (K).

3b. *Vigna oblongifolia* var. *parviflora* (Bak.) Verdc. in *Kew Bull.* 24: 528 (1970); Maréchal *et al.*: 168 (1978a). Type: Angola, Mossamedes, River Bero, *Welwitsch 226* (LISU, holo, BM!, iso.).

Vigna parviflora Bak. (Welw. mss.): 201 (1871); Bak. f.: 399 (1929); Wilcz.: 353 (1954); Torre: 265 (1966). Type: as above.

Vigna hygrophylla Harms: 449 (1913). Type: South West Africa, Okahanja, 1200 m, marshy *Cyperus* grassveld, April 1907, *Dinter 495* (SAM!, iso.).

Both varieties occur in areas of damp grassland near dams, rivers and lakes in Namibia (Caprivi), Okavango Swamps, Botswana, eastern Transvaal, Natal midlands, or in disturbed areas like ploughed maize or wheat fields where irrigation is practised in the drier interior of the Orange Free State and Transvaal. They seem to prefer disturbed soil more specifically. (Figure 8 B). The leaflets do vary in length sometimes, but the more delicate form of *V. oblongifolia* i.e. var. *parviflora*, usually conforms with the measurements in the key. Soil conditions may affect the growth of the leaflets. Small flowers are constant and the plant in general is thin and slender. (Figure 8)

According to Maréchal *et al.* (1978), the nanism of var. *parviflora* is not due to ploidy as both varieties have the same chromosome number (2n = 22). The erect habit of many *V. oblongifolia* plants is probably the result of very poor edaphic conditions.

Specimens examined

--1719 (Runtu): Road to Mupini (-DD), *De Winter & Marais 4928* (K, PRE).
--1724 (Katima Mulilo): Katima Mulilo, near Hippo Lodge, where electric pylons join the main road (-AD), *Pienaar 1390* (PRE).
--1821 (Andara): Bagani Clinic (-BA), *Pienaar 1385* (PRE).
--1915 (Okaukuejo): Etosha National Park, 84 km west of Okaukuejo (-AB), *Volk & Le Roux 790* (WIND).
--1918 (Grootfontein): Grootfontein north, Omuramba Marshes (-DB), *Merxmüller & Giess 2086* (PRE, WIND).
--1923 (Maun): Moremi Game Reserve, 117 miles north of Maun (-BA), *Mithen 614* (PRE).
--1924 (Joverega): Segxebe pan (-DA), *Smith 2435* (K).
--2016 (Otjiwarongo): Farm Otjihaenemaparero (-CD), *Giess 15242* (PRE, WIND).
--2017 (Waterberg): Quickborn, Waterberg (-CA), *Bradfield 159* (PRE).
--2023 (Kwebe Hills): Boteti River, 24 km east of Maun (-BA), *Mithen 601* (PRE).
--2115 (Karibib): Farm Amieb (KAR 60) (-DC), *Merxmüller & Giess 30711* (WIND).
--2116 (Okahandja): Okahandja (-AA), *Dinter 495* (BR, K, SAM,
isotype & syntype); Okahandja-Otjisazu road (-DD), *Dinter 2545* (SAM).
--2127 (Francistown): Francistown (-BA), *Morwe 127* (SRGH).
--2428 (Nylstroom): 4 miles east of Naboomspruit, Mosdene Farm (-DB), *Germishuizen 1241* (PRE).
--2528 (Pretoria): Kloppersdam, road to Rust de Winter (-BB), *Germishuizen 3714* (PRE); Sandfontein (-CA), *Schlechter 4237* (BR, PRE).
--2627 (Potchefstroom): Potchefstroom (-CA), *Van der Westhuizen s.n.* (PRE).
--2629 (Bethal): Weed in maize fields, Bethal (-AD), *Potgieter s.n.* (PRE).

Precise locality unknown

Eyles 567 (SAM); Sandfontein, *Schlechter 1894* (TCD).

Other localities in Africa

Zimbabwe: Luanginga River, 4 miles northwest of Sandaula Pontoon, *Drummond & Cookson 6583* (PRE); Sengwa Research Station, *Jacobson 4082* (PRE); Bulawayo, *Miller 2714* (PRE).
Tanzania: Seronera, Serengeti, *Greenway 10567* (K, PRE); Moru Kopjes, Musoma, *Greenway, Turner & Van Rensburg 10590* (PRE); Mbeya, Igawa, *Polhill & Paulo 1968* (K, PRE); *Richards* (K).
Malawi: 13 km. southeast of Lilongwe on road to Dedza, *Mithen 337* (PRE).
Zaire: Bugesera, *Liben 1036* (PRE); *Germain 5924, 6172*

Section 2. *Comosae*

Section *Comosae* Maréchal *et al.* in *Taxon* 27: 200 (1978b).
Type of section: *V. comosa* Bak. in Flora of Tropical Africa: 406 (1929).

Stipules filiform, uninerved, not prolonged beyond the point of insertion but attached on a small pad. **Peduncle** angular. **Keel** subsymmetrical with short rostrum twisted at the top. **Style** beak very short, broad and flattened. **Pollen** grains reticulate with raised muri.

4. **Vigna comosa** *Bak*. in Oliver, Flora of Tropical Africa 2: 202 (1871). Verdc.: 528 (1970), 630 (1971); Maréchal *et al*.: 179 (1978a). Type: Angola, Cuanza Norte, Pungo Andongo, near Condo, *Welwitsch 2257* (LISU, holo., BM!, K!, iso.).

Vigna micrantha Harms: 311 (1899); Bak. f.: 406 (1929); Wilczek: 353 (1954); Hepper: 568 (1958). Types: Zaïre, Kasai, near Mukenge, *Pogge 811, 834* & Tanzania, Bukoba, *Stuhlmann 1141* (all B, destroyed).

Perennial prostrate or climbing herb. **Stems** delicate, sometimes becoming robust with dense, short white pubescence or patent greyish hairs. **Leaflets** ovate to lanceolate, 8—35(—60) X 4—20(—38) mm, often hastately lobed, apex rounded to subacute, base cuneate to obtuse, pubescent or glabrescent; **petioles** 6—25 mm long, **rhachis** *ca*. 2—10 mm. **Stipules** appear to be joined to the stem by a cushion-like structure but they are not truly spurred, filiform, 2—3 mm long, base more or less truncate. **Inflorescence** a raceme of small or large flowers resembling *V. oblongifolia*, peduncle 40—65 mm long with rhachis slightly zigzag, glands at the base of the alternate flowers. **Calyx** sparsely pubescent, tube 1.5—2 mm long, lobes shorter than the tube, 0.6—1.5 mm long, triangular, the upper lobes being adnate to form an emarginate or bidentate lip. **Standard** oblate, emarginate, with callosities peculiar to the group, namely, the superior pair vertical and the inferior pair horizontal; yellow or yellow flushed purple, red-brown or green, (0.5—)0.8—10 X 95—140 mm; **keel** with short, slightly incurved beak due to slight twist. **Style** prolongation a short, broad beak. **Legumes** pendant, oblong-falcate, broadened distally, sparsely pubescent, 1—4-seeded. **Seeds** reddish-brown, 3—5 X 2—3 mm, hilum eccentric, aril somewhat rugose.

Key to subspecies and varieties according to Verdcourt (1970) and Maréchal *et al*. (1978a):

1a. Habitat open woodland with grass, savannah or pure grassland; leaflets ovate to lanceolate or subhastate; inflorescence in close racemes, flowers large or small ....4 (a) subsp. *comosa*..2

1b. Habitat woodland or dense bush or grass; leaflets never lobulate; inflorescence less dense but flowers large, robust ....4 (b) subsp. *abercornensis* (Zambia)

2a. Stems graceful; leaflets up to 35 mm long, 20 mm wide; standard *ca.* 10mm ....
....4 (a) subsp. *comosa* (i) var. *comosa* (practically throughout tropical Africa)

2b. Stems robust; leaflets entire or hastate, 35—60 mm long, 10—38 mm wide; standard large .... 4 (a) subsp. *comosa* (ii) var. *lebrunii* (Zaïre)

4a i. *V. comosa* **subsp.** *comosa* **var.** *comosa*

Annual herb, twiner. **Stems** slender, very ramified and patent with greyish hairs. **Stipules** linear, uninerved, not truly extended beyond the point of attachment but resting on cushion tissue, minute. **Leaflets** ovate, 30—36 X 2—3 mm, apex acute, base rounded, papyraceous, lightly pilose on both surfaces, **rhachis** *ca.* 10 mm long, **petiole** *ca.* 6—8 mm long, lateral leaflets asymmetric. **Inflorescence** a close raceme 24—30 mm long at apex of peduncle up to 20 mm long, patent. **Calyx** campanulate, lobes *ca.* as long as tube, subglabrous. **Standard** 8—10 mm long, blue or whitish, superior callosities parallel and inferior ones horizontal. **Legume** *ca.* 6 X 2 mm, straight but broadened toward base, glabrous. (Figure 9)

Found throughout tropical Africa. Only one herbarium specimen of *V. comosa* has been collected in southern Africa; in 1990, it was found as a weed of cultivation in maize fields. (Figure 9 B) The likelihood exists that it was imported with seed from foreign sources.

Specimen examined

--2627 (Potchefstroom): Sasolburg district, maize fields (-DD), *Buys s.n.* (PRE).

Other tropical localities

Kenya: Muramvua, *Reekmans 372, 10169* (PRE).
Malawi: Mt. Mlanje, *Mithen 378* (PRE); Lichenya plateau, Mt. Mlanje, *Mithen 395* (PRE).
Uganda: Nyambushozi, Ankole, 28 miles on Mbarara-Masaka road, *Rwaburindore 643*; Karambi, Rugongo, *Rwaburindore 2418* (PRE); Kiyaka K. plateau, Kwango, *Devied 1619* (PRE).
Urundi: Rusengo, *Michel 4271* (PRE).
Zaïre: Brazzaville, *Lebrun s.n.* (*V. micrantha*, PRE); East Congo, Mahagi, Gabu Golu Road at Shari River, *Taton s.n.* (PRE); Equatorial region Coquilhatville, *Schlechter 12592* (PRE); Ealaca, *ca.* 1 km from Ruhi River, *Jean-Louis 1897* (PRE).
Guinea: Macenta, Bogbazau, *Adam 6746* (PRE).

Section 3. *Macrodontae*

Section *Macrodontae* Harms *in Engler,* Pflanzenwelt Afrikas 3: 688 (1915), emend. Verdcourt, *Kew Bull.* 24: 534 (1970).

Lectotype of section: *Vigna membranacea* A. Rich., Tent. Fl. Abyss. 1: 219 (1847). Type: Abyssinia, in the moist province Chiré, flowering and fruiting in October, *Quartin Dillon s.n.* and the foothills of the Selleuda Mountains, flowering and fruiting in October, *Schimper s.n.* (herb unknown).

Stipules bilobed at base. **Keel** beak slightly incurved and twisted, canoe-shaped, containing no pockets. **Style** with thickened part only bent slightly at the base, projecting as a short beak beyond the stigma. **Pollen** grains with a wide reticulation of raised muri. **Legumes** linear, erect, many-seeded with more than 12 seeds, aril undeveloped.

5. Vigna friesiorum *Harms, Notizblatt Botanischen Gartens und Museums su Berlin-Dahlem* 10: 89 (1930); Bak. f.: 400 (1929); Verdc.: 641 (1971); Maréchal *et al.*: 183 (1978a). Type: Kenia, inter Jaracuma et Meru, loco aperto graminoso decumbens, 15:2:1922, *R.E. et Th.C.E. Fries n. 1591* (UPS, holo., K!, iso.).

Perennial herb with somewhat thickened, dauciformis tuber. **Stems** erect or procumbent, not twining, thin, shortly hirsute or patently pilose. **Leaflets** small, entire, varying from oblong to broadly elliptic or round to scarcely hastate, base and apex obtuse, *ca.* 15—30 X 2—8 mm, surfaces adpressed pilose or glabrescent, often characteristically margined with short hairs at right angles to the lamina margin, **rhachis** *ca.* 5 mm long, **petiole** 15—30 mm long, sometimes longer. **Stipules** cordate, lanceolate or ovate-lanceolate, acuminate. **Inflorescence** a contracted raceme, few-flowered, with peduncles short or often elongated to carry flowers above the leaflets, *ca.* 25—70 mm long. **Calyx** more or less pilose with yellowish hairs, *ca.* 5—6 mm long with lobes 3—3.5 mm long, lanceolate, apices acute. **Standard** 12—15 mm long, violet. **Legumes** erect, linear-cylindrical, 40—50 X 2—3.5 mm, minutely puberulous to yellowish-pubescent or covered with minute scale-like hairs, polyspermic with 17—20 seeds. **Seeds** brown, sometimes faintly mottled with black, subcylindrical or rectangular, *ca.* 1.8—2.5 X 1.5—2 mm, hilum minute, central or eccentric; aril absent.

Key to the varieties in Africa according to Verdcourt (1971):

1a. Leaflets linear-lanceolate, up to 70 mm long; stems erect or procumbent ....5 (a) var. *angustifolia*

1b. Leaflets rounded to oblong 2

2a. Stems procumbent; leaflets round to oblong, sometimes minutely hastate, *ca*. 25 mm long; legumes minutely puberulous to yellowish pubescent ....5 (b) var. *friesiorum*

2b. Stems mostly erect; leaflets round to elliptic-oblong, 10—40 mm long; legumes minutely puberulous ....5 (c) var. *ulugurensis*

The three varieties are distributed throughout tropical East and central Africa (Ethiopia, Uganda, Kenya, Tanzania, Zaïre, Sudan). Verdcourt (1971) and Maréchal *et al.* (1978a) maintain that the three varieties often grade into each other and cannot always be kept distinct.

5b. *Vigna friesiorum* **var.** *friesiorum*

Erect or decumbent pyrophytic herb with a thickened, softly woody dauciformis tap root. *Stems* procumbent, sparingly patent. *Stipules* oblong-lanceolate, *ca*. twice as long as broad, cordate-based, glabrescent. *Leaflets* oblong to broadly elliptic or round, the specimen from Komati having scarcely hastate leaflets, apex and base obtuse, sparingly hirsute and margins lined with oblique, outward-pointing hairs. *Inflorescence* a few-flowered raceme with two to several flowers at the extreme tip of peduncle up to 80 mm long, creamy yellow, greenish with violet basal stripes or entirely mauve. *Standard ca*. 10—14 mm long with superior and inferior callosities *ca*. parallel. *Keel* pale, yellow or green, canoe-shaped. *Style* an obtuse disc-like elongation, up to 0.3 mm long. *Legume* erect, darkish brown with yellowish hairs, linear-cylindrical, 65 X 0.4 mm, *ca*. 17-seeded. *Seed* brown faintly mottled with black, *ca*. 2 X 1.5—2 mm, hilum minute, central or eccentric, aril absent. (Figure 10)

Of the three varieties only two collections were made in southern Africa by H. Bolus in 1934 at the "drifts" of the Komati and Crocodile Rivers, and one by Warrington at Koloburg [unknown locality]. (Figure 10 B) This is a diminutive plant belonging to var. *friesiorum*. Intensive searching in the Komati area has as yet yielded no more collections.

Grows in grassland in hilly or mountainous country in tropical East and Central Africa and southern Africa or a weed of cultivation in wheat fields; at 1200—2400 m. elevation (Verdcourt 1971).

Specimens examined

--2531 (Komatipoort): Komatipoort, drifts of Crocodile and Komati Rivers (-BD), *H. Bolus 7736* (BOL, K). [Koloburg, Cape of Good Hope, unknown locality, *Warrington s.n.* (TCD).]

Other localities in Africa

Kenya: Between Jaracuma and Meru, *Rob & Fries 1591* (K! iso-type, PRE, photograph.); Uasin Gishu, *Harvey 64* (K); north of Mt. Kenya, *Ward 3259* (K).
Tanzania: Engare Olmontoni, *Peter 49943* (K); Ngara Nairobi, *Haarer 623* (K).
Uganda: western slopes of Kilimanjaro, *Greenway 6906* (K); *Richards 25454* (K).
Zaïre: Kibugabuga (Bugasera), *Liben 901* (PRE, var. *ulugurensis* [Harms] Verdc.).

Section 4. *Reticulatae*

Section *Reticulatae* Verdcourt in *Kew Bulletin* 24: 550 (1970).
Type of section: *V. reticulata* Hook. f.: 310 (1849). Type: Accra, *Vogel* (K! holo.).

V. linearifolia Hook. f.: 310 (1849).
V. andogensis Bak.: 197 (1871).

Stipules produced at base, cordate or subcordate. **Keel** obtuse, not incurved. **Style** thickened and curved at the base, upper part straight, the beak often a flattened nervose blade. **Pollen** grain with large reticulations. Tertiary **veins** of leaflets characteristically close, subparallel to the transverse ones.

6. **Vigna pygmaea** *R.E. Fries*, Wissenschaftliche Ergebnisse der Schwedischen Rhodesi-Kongo-Expedition 1911—1912: 103 (1914); Bak. f.: 414 (1929); Wilczęk: 374 (1954a); Verdc.: 551 (1970), 651 (1971); Maréchal *et al.*: 187 (1978a). Type: Zambia, Broken Hill, *Fries 230* (UPS, holo.).

Short, erect, pyrophytic herb, 30—300 mm tall. **Stems** several, rising from one or more woody fusiform or dauciformis tubers, the latter occurring at the base of the shoot or amongst the roots; stems with adpressed or somewhat bristly white or ferruginous hairs, the two colours appearing on the same organ. **Leaflets** petiolate, white and brown strigose hairs admixed on both surfaces, thickest on nerves, oval to narrowly ovate, *ca.* 20 X 13 mm, lateral ones scarcely asymmetric, apex obtuse to subacute, apiculate, base obtuse, almost sessile (petiolules *ca.* 1 mm long); reticulate venation typical of species namely, basally 3-palmate, smaller veins forming a network almost parallel to one another, all nerves raised above the surfaces (Figure 11 F—I); texture coriaceous, dark green (drying yellow- or grey-green). **Stipules** truncate, lanceolate, acuminate, *ca.* 8 mm long, deflexed from stem, ribbed, strigose. **Inflorescence** 1—several-flowered, the rhachis being short with the usual glandular nodes. **Flowers** mauve to violet. **Calyx** glabrescent to densely covered with dense, bristly white and ferruginous hairs, tube strongly ribbed, 2—3 mm long, lobes triangular, as long as, or shorter than tube, attenuate. **Standard** *ca.* 8—12 X 8—14 mm, emarginate with 2 pairs *ca.* parallel callosities, superior pair thick, parallel. **Wings** often darker than standard, so also **keel** tip, beak obtuse. **Vexillary stamen** not thickened at base. **Ovary** with short pubescence and longer hairs along the upper margin. **Style** broadened abruptly above ovary, elongation beyond stigma an oblique, apical flap or blade of tissue. **Legumes** erect, linear-cylindrical, with short adpressed bristle-like pubescence, white and brown admixed, *ca.* 7-seeded. **Seeds** pale reddish-brown, mottled with black, compressed, *ca.* 2.8 X 2 mm, slightly pointed at proximal end, hilum very small, aril absent. (Figure 11).

Woodland with scattered grasses, in Namibia, often on firebreaks (Figure 11 B).

Verdcourt (1971) divides *V. pygmaea* into two varieties, only var. *pygmaea* being recorded in the *FSA* region, in Namibia. Brummitt (1976) raised the second variety, *V. pygmaea* var. *grandiflora* Verdc. to specific rank as *V. phoenix* Brummitt: 168 (1976). It is not considered here.

Maréchal *et al.* (1978a) question the typical parallelism of the tertiary veins in *V. pygmaea* although unquestionable in the other species of the section. Since the flowering shoots of *V. pygmaea* are aphyllous and the leaf-bearing stems are sterile, their observations are impaired. The nature of the bracts and bracteoles differ from the other members of the section. Verdcourt (1970) requires more material to elucidate the true nature of the taxon. He regards the nature of the indumentum as important in separating the two varieties which he recognizes. The collections housed at PRE are too few for profound judgement to be passed. The venation is raised and reasonably indicative of tertiary parallelism (Figures 11 F—I), but no comparison can be made with the other representatives of the section.

Specimens examined

--1724 (Katima Mulilo): 8 miles south of the northern border on firebreak, 18 miles west of Katima Mulilo, perennial (-CA), *De Winter 9134* (PRE).

Other African localities

Zimbabwe: Odzani River valley, Umtali, *Teague 596* (BOL); Marandellas, *Corby 1648* (PRE); Trelawney, north-west of Salisbury, *Jack 227*(PRE); Salisbury, *Wild 4428* (PRE); Mangula, *Lacobsen 3990* (PRE); Hartmann's Hill, Salisbury, *Fairall 3944* (PRE).
Malawi: Golomoti, *Mithen 465* (PRE); Niyika Plateau, *Pawek 10269* (PRE); *Jackson 206* (K).
Tanzania: *Archbold 2540* (K); *Gillett 17801* (K); *Newbould 1978* (K); *Batty 762* (K); *Stefanesea 450* (K).

Zambia: Mazabuka Siding, *Rogers 8331* (SAM); Chambezi River, *Pole-Evans 2929* (PRE); Muntshiwemba, *Stöhr 93* (BOL).

Section 5. *Liebrechtsia*

Section *Liebrechtsia* (De Wild.) Bak. f. in Leg. Trop. Afr.: 397 (1929). Type of the section: *Vigna frutescens* A. Rich., Tent. Fl. Abyss. 1: 218 (1847).

Liebrechtsia De Wild.: 70 (1902).

Stipules bilobed at base. **Keel** not curved through more than 180°, pocket absent. **Style** with thickened part gently curved, very prominently beaked beyond stigma. **Pollen** grains with wide reticulation of raised muri. Pyrophytic herbs with leaves mostly appearing well after flowering has commenced [not southern Africa] (Verdcourt 1970).

7. V. frutescens *A. Rich.* in Tent. fl. Abyss.1 : 218 (1847); Bak.: 196 (1871); Bak. f: 406 (1929); Verdc.: 547 (1970), 647 (1971); Maréchal *et al.*: 189 (1978a). Type: Ethiopia, Shoa (Choa), *Quartin Dillon s.n.* (P, holo.).

Vigna decipiens Harv.: 241 (1862). Type: South Africa, grassy places by the Vaal River, January, *Burke & Zeyher s.n.* (K!, co-type, ?holo). (Figure 12 F).

Liebrechtsia esculenta De Wild.: 74, t. 25/1—10 (1902). Type: Katanga, Lukafu, October 1899, *Verdick 109 & 110* (BR!, holo.).

V. esculenta (De Wild.) De Wild.: 151 (1909); Bak. f.: 415 (1929); Wilczek: 373 (1954). Type: as above.

V. fragrans Bak, E.G.: 146 (1904—1906); Bak. f.: 406 (1929). Type: as for section.

V. pseudotriloba Harms in Notizbl. Bot. Gart. Berlin 5: 208 (1913). Type: South West Africa, Okahandja, *Dinter 369* (BM!, syn., K!, SAM!, isosyn.). (Figure 12 G).

V. longiloba Burtt Davy: 421 (1932). Type: South Africa, Komatipoort, *Kirk 77* (K! holo.). (Figure 12 H).

V. pongolensis Burtt Davy : 421 (1932). Type: South Africa, Pongola River Basin, *Burtt Davy 18313* (K!, holo.). (Figure 12 I).

Perennial prostrate or twining often pyrophytic herb or erect when appearing after grass burning (Verdcourt 1971). **Rootstock** a woody tuber as much as 50 mm in diameter in parts of Africa. **Stems** densely ferruginous-pubescent, more often velvety with soft hairs or glabrescent. **Leaflets** large or relatively small, trilobal (broadly hastate) with obtuse apices and bases in southern Africa, *ca.* 60 X 48 mm at the broadest point, reportedly ovate, oblong-ovate or rhomboid in other parts of Africa, velvety with adpressed tubercular-based hairs, texture soft to coriaceous. **Petiole** 9—48 mm long. **Rhachis** 8—20 mm. **Stipules** oblong-lanceolate, *ca.* 4.5—8 mm long, slightly prolonged and cordate at base, apex obtuse to subacute, glabrescent to puberulous. **Inflorescence** a contracted raceme appearing subumbellate, with several large lilac flowers. **Calyx** almost glabrous to pubescent with shiny, soft hairs, lobes sometimes shorter, usually longer than tube, the upper pair of lobes connate for *ca.* half their length. **Standard** oblate with margin thickened by short hairs or papillae, *ca.* 25 X 27 mm., one pair of arched lamellar callosities. **Wing** paler. **Keel** very pale to white, gently incurved, obtuse. **Style** beak typically long, spathe-like, subulate, acute, recurved. **Ovary** silky-pubescent. **Legume** erect, 60—90 mm long, shortly beaked, brown with shortly adpressed hairs or glabrous, 12—16-seeded. **Seeds** red-brown, black-mottled, *ca.* 3—6 X 2.5—3.5 mm, hilum more or less central, aril absent.

According to several labels at Kew, the flowers tend to be fragrant, which suggests that the plants are outbreeding.

Harvey (1862) cited *Burke 4117* as `co-type' of *V. decipiens*, but according to a note on the specimen (K!) by N.E. Brown, this is a specimen of *Dolichos decipiens* Burke mss. ex Harvey. It cannot be the specimen from which Harvey described *V. decipiens* as Harvey never saw Burke's specimens. Actually *Burke & Zeyher s.n.* (Harvey 1862) is an authentic specimen of *V. frutescens* A. Rich., but cannot be regarded as the type.

This species has never been correctly named in southern Africa before but has either been named *V. decipiens* Harv. or been mistaken for *V. unguiculata* subsp. *dekindtiana* (Harms) Verdc. because of the shape of its leaflets and because the characteristic beak of the stigma has not been noticed.

Key to infraspecific taxa of *V. frutescens* (Verdcourt 1971):

1a. Standard velvety outside ....7 (a) subsp. *kotschyi*

1b. Standard glabrous outside or with only traces of fine pubescence towards the margins 2

2a. Calyx lobes equalling tube, 2—5.5 mm long ....7 (b) subsp. *frutescens*..3

2b. Calyx lobes much longer than tube, 5—10 mm ....7 (c) subsp. *incana*

3a. Calyx, stems and pods pubescent to densely velvety ....7b (i) var. *frutescens*

3b. Calyx, stems and pods almost glabrous ....7b (ii) var. *buchneri*

Only *V. frutescens* subsp. *frutescens* var. *frutescens* is represented in the *FSA* region.

7b subsp.*frutescens* (i) var. *frutescens:*
Synonomy appears under the species.

Perennial prostrate or climbing herb, erect to *ca*. 200 mm when appearing after burning of grassland, blooming before mature leaflets are evident; where no burning has occurred, it blooms profusely while producing leaflets. **Rootstock** woody. **Stems** somewhat pubescent with longish soft hairs or woolly (densely velvety), though often glabrous and woody at maturity. **Leaflets** petiolate, usually trilobed, sometimes elongate, unlobed or ovate in other parts of Africa, scarcely strigose, *ca*. 60 mm X 48 mm (at broadest point) at maturity, apex obtuse or acute, apiculate, base *ca*. obtusely cuneate, midrib raised above dorsal lamina, texture soft to leathery, bright green marked with yellow-green (especially evident when dried); petiole 9—48 mm, rhachis 8—20 mm and petiolules 1—2 mm long. **Stipules** reflexed, oblong-lanceolate, slightly laterally elongated at point of attachment (ie. sub-cordate), *ca*. 3—5 mm long, apex obtuse to subacute, glabrescent to pubescent. **Inflorescence** a contracted raceme with up to 4 large lilac flowers. **Calyx** almost glabrous to pubescent with shiny, soft hairs, lobes triangular, sometimes shorter than, usually longer than tube, upper pair connate for half their length. **Standard** oblate with margin thickened by short hairs or papillae, *ca*. 25 X 27 mm. **Wings** paler, oblong to ovate with narrow spur, *ca*. 2 X 0.8 mm. **Keel** very pale to white, gently incurved, obtuse. **Style** elongation typically spathe-like, subulate, up to 2 mm long, recurved and stigma globular (young). **Ovary** silky-pubescent and legumes erect at maturity, 60—70 X 4—5 mm, brownish with shortly adpressed ferruginous hairs or glabrous, shortly beaked, 12—16-seeded. **Seeds** red-brown, black-mottled, *ca*. 3—6 X 2.5—3.5 mm; hilum more or less central, aril absent. (Figure 12)

Open woodland in the savannah areas of Natal, Transvaal (west, central and east to north-east), west Botswana and central Namibia. (Figure 12 B)

The precocious blooming recorded for the species cannot be used as a taxonomic character of value. As is commonly seen in southern Africa or when grown under glass (Maréchal *et al*. 1978a), leaflets and flowers may appear together. It is therefore only an expression of the environment.

Specimens examined

--1917 (Tsumeb): 13.4 miles south of Tsumeb on road to Grootfontein (-BD), *De Winter 3680* (K); Farm Kumkauas (-CA), *Giess 12465* (WIND).

--2016 (Otjiwarongo): Otjiwarongo (-BC), *Dinter SAM 73398* (SAM); Otjiwarongo Rock (-BC), *Craven 390* (WIND); Kalkfelf (-CC), *A. Engler 6447* (K); Ozondjacheberg (-DB), *Dinter 1683* (SAM).

--2017 (Waterberg): Waterberg (-AC), *Boss TM 36387* (PRE).

--2116 (Okahandja): Omataku-Sicht, district Okahandja (-BA), *Dinter 369* (Isotype, BM, BR, K, SAM).

--2216 (Otjimbingwe): Farm Haris, *ca.* 20 miles south-west of Windhoek (-DC), *De Winter 2563* (K); between Hoffnungsfeld and Haris (-DD), *H. Bolus 7736* (K); Lichtenstein (-CC), *Dinter 42980* (SAM); between Haris and Auas Mountains (-DD), *Pearson 9683* (BOL, K, SAM); Haris Kuiseb Riverbed (-DD), *Pearson 9554* (BOL).

--2217 (Windhoek): Windhoek municipality (-CA), *Giess 15299* (WIND); Schweieltfezer 2/253 (S.W.A.), Auasberge (-CA), *Meyer 855* (WIND); Auas Mountains, 12 km south-east of Windhoek (-CA), *Pearson 9605* (K); 19 km from Safari Motel, Windhoek on road to Rehoboth, roadside (-CA), *Pienaar 1367* (PRE); 14 km from Safari Motel, Windhoek, on Rehoboth road, below rail crossing (-CA), *Pienaar 1368* (PRE); Krumhuk, Windhoek (-CA), *Strey 2438* (K); Windhoek-Immental (-CA), *Van Koesert 564* (WIND); Farm Schöngelegen (-CA), *Seydel 2592* (K); Lithopsberg, Finkenstein (-CA), *Seydel 4184* (K, SRGH); 13.9 km from "Klein Windhoek" on road to airport (-CB), *Pienaar 1369* (PRE).

--2227 (Palapye): Selibe-Pikwe North (-BB), *Kerfoot & Falconer 77* (J).

--2228 (Maasstroom): Kremetartfontein (-DB), *Verdoorn 2073* (PRE).

--2229 (Waterpoort): Drumsheugh, near southern border (-AD), *O'Connor 1028* (J); near Dongola, Limpopo Valley (-BC), *Hutchinson 2135* (K); Dongola Wild Life Sanctuary (-BC), *Pole-Evans 4511* (PRE); between Mogawe and Vivo (-DA), *Schlieben & Hartmann 12035* (PRE); Waterberg-Alldays-Messina road (-DC), *Hardy & De Villiers 5139* (PRE); Wylie's Poort (-DD), *Mogg 37741* (PRE).

--2230 (Messina): Messina (-AC), *Acocks & Hafström 587* (PRE), *Ross & Rogers 060200* (J), *Rogers 19410* (PRE); Botanical Reserve, Messina (-AC), *Pole-Evans 3* (K), *1781A, 1781B* (PRE); Kupwe (-BD), *Van Rooyen 3187* (PRE).

--2231 (Pafuri): Klopperfontein, Kruger National Park (-CA), *Van der Schijff 3327* (K, PRE); Punda Maria Camp, Kruger National Park (-CA), *Codd & Dyer 4608* (PRE), *Van der Schijff 3613* (K, PRE); Kruger National Park (-CA), *Lang TM 32237* (K, PRE); Dzundweni Hill (-CC), *Codd & Dyer 4600* (PRE).

--2326 (Mahalapye): St. Patrick's Mission Church, Mahalapye (-BB), *Camerik 89* (PRE); Morde Research Station, Mahalapye (-BB), *De Beer D64* (K, PRE).

--2327 (Ellisras): north-west of town (-DA), *Bayliss 1810* (NBG).

--2328 (Baltimore): Withoogte near Leliefontein (-DD), *Stirton 5791* (K, PRE).

--2329 Pietersburg): Ben Lavin Nature Reserve, Louis Trichardt (-AA), *Ben Lavin Group A12* (PRE); road from Pietersburg to Louis Trichardt (-BB), *Clarke 1386* (PRE); north of Louis Trichardt (-BB), *Van Vuuren 1624* (PRE); Bandolierskop (-BD), *Hardy 416* (PRE), *Pole-Evans PRE 17116, PRE 18857* (PRE).

--2330 (Tzaneen): Mapayeni Village, Giyane (-BC), *Liengme 488* (K, PRE); Tzaneen (-CC), *Rogers 12532* (BOL).

--2428 (Nylstroom): Geelhoutkop, Waterberg (-AD), *Breyer 18123* (PRE), *Germishuizen 910* (K, PRE); Potgietersrust district (-BB), *Story 1589* (PRE); north-east of Nylstroom (-CB), *Codd 2262* (PRE); Klipplaat, Springbok Flats (-DB), *Galpin M729* (J, K, PRE).

--2429 (Zebediela): Percy Fife Reserve (-AA), *Huntley 1131* (PRE); Potgietersrust (-AA), *Thode A1688* (PRE); Zebediela (-AD), *Huntley 1107* (PRE); Ganspoort (-BB), *Codd & Dyer 7746* (PRE).

--2430 (Pilgrim's Rest): The Downs (-AA), *Smuts 1557* (K, PRE); Lekgalameetse Nature Reserve (-AB), *Stalmans 1250* (PRE); Penge (-AC), *Nel 200* (NBG, PRE), *Vorster & Coetzer 2116* (PRE); Erasmus Pass (-BC), *Strey 3653* (PRE); road from Ohrigstad to Burgersfort (-CB), *Coetzer 168* PRE); Branddraai (-DA), *Codd & De Winter 3257* (PRE); Klipbank Spruit (-DA), *Fourie 2845* (PRE); Echo Caves, Ohrigstad (-DA), *Hardy 6139* (PRE); north of Ohrigstad (-DA), *Young A721* (PRE); road to Blyderivier , Mariepskop (-DB), *Van der Schyff 5516* (PRE); Driehoek Farm, Swadini (-DB), *Venter 8709* (PRE).

--2526 (Zeerust): Lindley's Poort Dam (-DA), *Phillips 441* (PRE); Zwartruggens (-DA), *Sutton 775* (PRE); railway east of Koster (-DD), *Clarke 252* (K, PRE).

--2527 (Rustenburg): Buffelskloof (-AB), *Germishuizen 572* (PRE); near Crocodile Poort, Brits (-DB), *Dyer & Verdoorn 3433* (PRE).
--2528 (Pretoria): Middelkop (-AB), *Smith 2213* (PRE); Rust de Winter (-BA), *Van Rensburg P118N* (PRE); Prinshof, Pretoria (-CA), *Phillips 458, PRE 56087* (PRE); Fountains Valley, Pretoria (-CC), *Repton 458* (K, PRE).
--2529 (Witbank): Loskop Dam Reserve (-AD), *Theron 1610* (PRE); Tautesberg, Middelburg (-BD), *Young A221* (K, PRE).
--2531 (Komatipoort): between Komati River and Crocodile River drift (-BD), *Galpin 729* (K); Komatipoort (-BD), *Kirk 77* (K); Kaap River, Barberton (-CC), *Thorncroft 1015* (PRE).
--2626 (Klerksdorp): Goedgedacht, Coligny (-CB), *Sutton 510* (BR, PRE).
--2628 (Johannesburg): Hillary, Alexandra (-AA), *Burtt-Davy PRE 14144* (PRE).
--2631 (Mbabane): Big Bend, Hlatikulu (-DD), *Compton 30915* (NBG, PRE).
--2731 (Louwsburg): Phongola River Basin (-AC), *Burtt Davy 18313* (K); Pongola, bushveld farm (-BC), *Nel 228* (PRE); Itala Nature Reserve, Craigadam Farm (-CA), *Mc Donald 181* (PRE).
--2732 (Ubombo): Mkuze Game Reserve (-CA), *Galpin 13492* (PRE), *Ward 3586* (PRE).
--2830 (Dundee): 3 miles to Muden, Mooi River Valley, Weenen (-CC), *Edwards 2786* (K, PRE); road between Greytown and Muden (-CD), *Pienaar 406* (PRE).
--2831 (Nkandla): Umfolozi Game Reserve (-BD), *Downing 605* (PRE), *Venter 5208* (PRE).
--2930 (Pietermaritzburg): in thorns, Mooi River (-AC), *Wood 4486* (K).
--3029 (Kokstad): 9 miles from Mt. Frere, on road to Mt. Ayliffe (-CC), *Story 561* (PRE); Kenegha Valley below Nyeweni(-CD), *Acocks 12213* (PRE).
--3030 (Port Shepstone): Umpambinyoni (-AB), *Rudatis 1990* (NH); Umkomaas (-BB), *Sidey 3445* (PRE); Oribi, Gibraltar Rock (-CB), *Abbott 2666* (NH), *Germishuizen 1623* (PRE); Oribi Nature Reserve, along roadside into gorge (-CB), *Coertzer 80* (PRE); Mzimkulu River, Gibraltar Rock (-CB), *Nicholson 1592* (PRE).

Precise locality unknown

Botswana, (Derdepoort), *Codd 8894* (PRE).
Dinter 4298 (BM).
G. N. 6034 (PRE).
Natal & Zululand, *Gerrard 1742* (K).
Mathebe valley, Transvaal, *Holub* (K).
Lindley, Transvaal, *Phillips 441* (PRE).
Zeyher 523 (BM).

Other African localities

Uganda: Acholi district, *Purseglove 1397* (K); Karamoja district, *Eggerling 2594* (K); Masaka district, *Purseglove 1840* (K).
Kenya: Samburu, *Newbould 2983* (K); Kitale, *Bogdan 3682* (K); Fort Ternan Escarpment, Nairobi road, *Verdcourt 1626* (K); Broderick Falls, *Tweedie 3437* (K); north-east of Mt. Elgon, *Tweedie 846* (K); Voi Headquarters, Soho Road, Tsavo National Park, *Greenway & Kanuri 12942* (PRE); Narok, *Glover, Gwynne & Samuel 25, 347, 530* (PRE); Engare, Nairobi, *Greenway 6826, 7526, 7825* (PRE); 3 miles east of Lake Manyara, *Lamprey 504* (PRE); Lugard Falls Road, Tsavo National Park, *Greenway & Kanuri 12834* (PRE); Mangangwe, *Greenway & Kanuri 14741* (PRE).
Tanzania: Bukoba district, *Haarer 2259* (K); Moshi, *Greenway 4508* (PRE), *Greenway 7526* (K); Kungwe-Mahali Peninsular, *Harley 9292* (K); Ruaha Park, Kinyantupa Escarpment, *Richards 21248* (K); Pwapwa, *Hornby 264* (K); 37 km west of Halali Road crossing, *Gillett 17398* (PRE); Musoma district, Mara River Guard Post, *Greenway 10236* (PRE).
Zambia: Broken Hill, *Gillett 17460* (SRGH); Chilongowelo, *Richards 5818* (K); Chilanga, *Rogers 8490* (BOL, SAM); Maviri Hills, *Graham s.n.* (BOL); Greystone Park, 20 km east of Kitwe, *Mithen 195* (PRE); Protea Hill Farm, 15 km east of Lusaka, *Mithen 170* (PRE); Mount Muhulu, *Verboom L106* (PRE).
Zimbabwe: Gwelo, *Biegel 1319* (SRGH); Bulawayo, *Kolbe s.n.* (BOL); Mazoe, *Leach & Muller 11724* (SRGH); Salisbury, *Biegel 2670* (SRGH); Nuanetsi Experimental Station, *Kelly*

551 (PRE); Fort Victoria, *Jacques 1077* (PRE); Lomagundu Mangula, *Jacobsen 1793, 1872, 3263* (PRE); Nuanetsi, 10 miles from Rutenga Station on Victoria-Beitbridge road, *Leach 11321* (PRE); Umvukwe Hills, *Plowes 2137* (PRE); Marandellas, Makulu Research Station, *Corby 1619* (PRE); Lomagundi Road near Gilbert's Gin Factory, *Corby 1381* (PRE); Mazoe, great dyke on eastern slope of Vanad Pass, *Goldsmith 17/74* (PRE); Lomagundi district, Farm Ditchwe, *Jacobsen 3454* (PRE); Farm Geduld, *Jacobsen 2129* (PRE).
Mozambique: M'gulumi Mission, *Faulkner K5* (K).
Angola: A (Ci) Velei, *Pocock 702* (BOL); Malange, Capunda, *Hendriques 709* (PRE).

Subgenus 2. *Catjang*

Subgenus *Catjang* (DC.) Jaaska & Jaaska in Pl. Syst. Evol. 159: 145 (1988).

Stipules very distinctly spurred at the base or distinctly peltate. **Keel** obtusely beaked, slightly incurved, canoe-shaped and without pockets. **Style** with thickened part slightly curved and with a short upturned or horizontal protuberance, rather than a beak, beyond the stigma, the whole being distinctly hammer-shaped. **Pollen** grains with a wide reticulation of raised muri.

Section 1. *Catjang*

Section *Catjang* (DC.) Verdcourt, Kew Bull. 24: 542 (1970). Lectotype of subgenus and section: *V. unguiculata* subsp. *cylindrica* (L.) Verdcourt (1977). *Dolichos catjang* Burm. f. [= *Phaseolus minor* Rumph. (1747)].

Dolichos L. sect. *Catjang* DC., Prodr. 2: 398 (1825).

Dolichos L. sect. *Unguicularia* DC., *op. cit.*: 400 (1825).

Scytalis E. Mey. sect. *Catjang* (DC.) E. Mey., Comm. Pl. Afr. austr.: 145 (1836).

Vigna Savi sect. *Appendiculatae* Harms in Engl., Pflanzenw. Afr. 3: 686 (1915).

Diagnosis as for subgenus *Catjang*.

8. *Vigna unguiculata* (L.) Walp., Rep. 1: 779 (1842); Wilczek: 387 (1954a); Hepper: 569 (1958); Torre: 269 (1966); Verdc.: 542 (1970), 642 (1971); Maréchal *et al.*: 190 (1978a). Neotype: Wageningen, grown from seed collected in Ethiopia, *Westphal 8682* (WAG, holo., K, P, iso.).

FOR A COMPREHENSIVE TREATMENT OF *VIGNA UNGUICULATA* (L.) WALP., SEE ADDENDUM 2. (See Figure 1 for pollen sculpture; Figure 2a & b for extreme forms of style prolongations; Figure 3 for all leaflet shapes and stipules; Figure 4 for standard and wing; Figures 5—10 for known distribution of all subspecies and varieties).

In the *FSA* region, *Vigna unguiculata* (L.) Walp. is divided into the following infraspecific taxa:

a) subsp. *unguiculata* (L.) Verdc. (1970) cv. gr. *unguiculata* (L.) Westphal (1974). (Figure 13 E)

b) subsp. *protracta* (E. Mey.) Pienaar, comb. et stat. nov. (Figure 13 F, G)

c) subsp. *dekindtiana* (Harms) Verdc. (1970) var. *dekindtiana*, (Figure 13 A), var. *huillensis* (Welw. ex Bak.) Pienaar, comb. nov. (Figure 13 H).

d) subsp. *mensensis* (Schweinf.) Verdc. (1970). (Figure 13 B)

e) subsp. *tenuis* (E. Mey.) Maréchal *et al.* var. *tenuis* and var. *ovata* (E. Mey.) Pienaar, comb. nov.. (Figure 13 I)

f) subsp. *stenophylla* (Harv.) Maréchal *et al.* (1978a). (Figures 13 C, D & J)

8b *V. unguiculata* subsp. *protracta*

Specimens examined

--2229 (Waterpoort): Zoutpansberg (-CD), *Codd 6836* (K).

--2326 (Mahalapye): road verge, 24 km north of Artesia on main Francistown-Gaberone Road (-CD), *Mithen 499* PRE).

--2330 (Tzaneen): Modjadji (-CB), *Rogers 18017* (BM, PRE); Tzaneen Estates (-CC), *Burtt Davy 2559* (K, paratype, PRE).

--2425 (Gaberone): 17 km north of Gaberone, Gaberone North Farms (-BD), *Mithen 520* (PRE).

--2428 (Nylstroom): Mosdene Farm near Naboomspruit (-DB), *De Winter 721* (K, PRE), *Galpin M32* (PRE).

--2429 (Zebediela): Rooikop (-AB), *Smuts 1655* (PRE).

--2430 (Pilgrim's Rest): Bourke's Luck Mine, hillsides (-DB), *Galpin 14278* (BOL, PRE); Krantzkloof (-DC), *Rogers 24720* (K); Pilgrim's Rest distr. (-DD), *Codd & De Winter 3124* (PRE); hillside above Lisbon Mine (-DD), *Galpin 14596* (BOL, PRE).

--2526 (Zeerust): *ca.* 15 km south of Zeerust at Buffelfontein (-CA), *Van der Meulen 592* (PRE).

--2528 (Pretoria): *ca.* 27 km south-west of Warmbaths along road to Volstruispan (-AA), *Van der Meulen 1044* (PRE); Meintjies Kop near Pretoria (-CA), *H. Bolus 11835* (BOL); main road from Pienaar's River to Pretoria (-CA), *Pole-Evans 3938* (K, PRE), *3944* (PRE).

--2529 (Witbank): Near Witbank Station (-CC), *Gilfillan 295* (BOL, PRE); Witbank, dist. Middelburg (-CD), *Gilfillan 380* (PRE).

--2530 (Lydenburg): Lydenburg (-AB), *Wilms TM 5834* (PRE); western end of Schoemanskloof (-AD), *Young A341* (PRE); Wonderkloof Nature Reserve, Nelspruit dist. (-BC), *Elan-Puttick 173* (PRE); slopes above Rivulets Station (-BD), *Liebenberg 3315* (PRE); mountain grassveld near Rosehough (-BD), *Onderstall 1256* (PRE); Moodie's Estates near Mt. Morgan Mine south-west of Barberton (-DD), *Hayden 1161* (PRE).

--2531 (Komatipoort): Maid of the Mist Mountain (-CC), *Hutchinson 2466* (K).

--2624 (Vryburg): Zoet Vley Farm, Vryburg (-AA), *Speedy 304* (PRE).

--2628 (Johannesburg): Brakpan (-AB), *Moss 13247* (BM, J); Kaalfontein (-AB), *Pole-Evans H13537* (PRE).

--2629 (Bethal): 25 km from Witbank on road to Hendrina, near Komati Power Station (-BA), *Du Toit 11* (PRE); near Breyton (-BD), *Rogers 14050* (K); Ermelo Experimental Farm (-DB), *Burtt Davy 9360* (PRE); Ermelo dist. (-DB), *Scholars s.n.* (PRE).

--2630 (Carolina): Carolina (-AA), *Burtt Davy 7391* (PRE), *Galpin 12519* (PRE), *Galpin BOL 45144* (BOL), *Moss & Rogers 1135* (BM), *Rademacher 7502* (PRE), *Rogers 19585* (K, PRE);

Maviristad (-CA), *Pott-Leendertz 5075* (PRE); Nooitgedacht Farm, Ermelo (-CC), *Henrici 1101* (PRE); Athole Pasture Research Station (-DA), *Preller 125, 131* (PRE).

--2631 (Mbabane): 4.5 km north-east of Motjane (-AA), *Kemp 1011* (PRE); Malolotja Nature Reserve, near camp site (-AC), *Braun 618* (PRE), *Müller-Doblies 86003e* (PRE); Forbe's Reef Road, Mbabane district (-AC), *Compton 28535* (NBG); Kirkhill, Mbabane (-AC), *Compton 26078* (PRE); Black Mbuluzi Falls (-AC), *Compton 28181* (NBG, PRE); 3 miles from Siteki on road to Manzini (-BD), *Clarke 281* (PRE); Siteki, Swaziland (-BD), *Girdwood s.n.* (J); Ntondozi, Mankayane (-CA), *Karsten s.n.* (PRE); Kabutsa, Hlatikulu (-CD), *Compton 29226* (PRE).

--2632 (Bela Vista): Mlawula Nature Reserve (-AA), *Alward 320* (PRE); top of Lebombo Mountains, Blue Jay Farm (-AA), *Culverwell 0217, 1177* (PRE); Maputaland (-DD), *Maputa Expedition from Transvaal Museum 14400* (PRE).

--2730 (Vryheid): Piet Retief (-BB), *Collins TM 13238* (PRE), *Sidey 1957* (PRE); Paulpietersburg, *ca.* 1 km before town from Natal Spa (-BD), *Schrire 1317* (NH).

--2731 (Louwsburg): Itala Nature Reserve, *ca.* 2 miles from Bivane-Phongolo Rivers junction on track to warden's house (-AC), *Brown & Shapiro 341* (K, PRE); Itala Nature Reserve, Craigadam Section (-AD), *Porter & Ward 214* (NH); *ca.* 15 km from Ngome Forest Station on road to Vryheid (-CD), *Germishuizen 2127* (PRE).

-2732 (Ubombo): Lebombo Mountains, 18 km from Jozini on road to Ingwavuma (-AC), *Germishuizen 1010, 1024* (PRE); 12.6 km from turnoff on road to Mkuze (-CA), *Retief 232* (PRE); 36 km from Mkuze to Mtubatuba (-CC), *Stirton 8843* (NH, PRE).

--2830 (Dundee): Weenen, near Estcourt (-CC), *Acocks 10757* (NH, PRE).

--2831 (Nkandla): Mtonjaneni (-AD), *Codd 1837* (PRE); Zondela, Mahlabatini (-AD), *Gerstner 4274* (NH); Melmoth (-CB), *Lawn 1829*; Entumeni [Entunyeni] (-CB), *Wood 3984* (NH); Eshowe (-CD), *Gerstner 2399* (NH, PRE), *Lawn 79* (NH); *ca.* 5 km north of Nkwalini (-DC), *Acocks 12953* (PRE); 4.5 miles west of Ntambanana (-DA), *Codd 1893* (PRE); Mtunzini Game Park, near entrance (-DD), *Kok & Pienaar 1268* (PRE, PRU).

--2832 (Mtubatuba): Hluhluwe (-AA), *Cawood GH 51* (PRE); 10 miles south of Hluhluwe (-AB), *Grobbelaar 504* (PRE); Monzi, Mtubatuba dist. (-AD), *Jacobsen PRE 57988* (PRE); St. Lucia Estuary Game Park (-AD), *Pooley 1888* (K); Mfolozi River banks (-BC), *Pienaar 1364* (PRE); Nsezi River Bridge north-west of Richards Bay (-CC), *Pienaar & Archer 1344* (PRE).

--2929 (Underberg): Foothills of Drakensberg, Cathkin Peak area (-AB), *Hardy 44* (PRE).

--2930 (Pietermaritzburg): Howick (-AC), *Huntley 123* (-NH), *Rycroft 2027* (NBG); Dargle Road (-AC), *Mogg 5736* (PRE); Tweedie (-AC), *Mogg 6835* (PRE); 9 km from Greytown at Rietvlei turnoff on road to New Hanover (-BA), *Pienaar 394* (PRE); Greytown commonage west of town (-BA), *Pienaar 402* (PRE); 12 km from Greytown to Muden (-BA), *Pienaar 403* (K, PRE); Greytown dist. (-BA), *Wylie 22346* (PRE); Cedara State Forest (-CB), *Mac Devette 1454* (NH); open grassveld opposite Lincoln Mead, Pietermaritzburg (-CB), *Pienaar 391* (PRE); near Hay Paddock, Pietermaritzburg (-CB), *Allsopp 933* (NH, PRE); Pietermaritzburg (-CB), *Wilms 1941* (BM, K); road to Richmond, Pietermaritzburg (-CB), *Barker 5148* (NBG); Pietermaritzburg, World's View (-CB), *Edwards & Browning 204* (PRE); 2.2 km before Mkomazi River on road to Ixopo (-CC), *Pienaar 1066* (PRE); Drummond (-DA), *Stirton 5152* (K, PRE); 0.24 km beyond Inchanga Abattoir turnoff, old Durban Road (-DA), *Pienaar & Archer 1330* (PRE, PRU); Inchanga (-DA), *Stohr 66* (BM); Bridal Veil Road, Waterfall Public Health area (-DA), *Stirton 5122* (PRE); Matabetula Plateau, Inanda (-DB), *Ngwenya 427* (NH); 1 km to Inanda, from Drummond turnoff (-DB), *Pienaar 388* (PRE); 3 miles south of Ntsongweni Dam (-DC), *Moll 1899* (PRE); 1 km from Inanda turnoff at Botha's Hill (-DC), *Pienaar 3780* (PRE); Silverglen Nature Reserve (-DD), *Buthelezi 567* (NH, PRE), *616* (NH, PRE); Umlaas [Umlazi] (-DD), *Evans 340* (NH); Krantzkloof (-DD), *Haygarth 24720* (PRE); Springfield, near Durban (-CC), *Indian Collector NH 17815* (NH); University of Westville Campus (-DD), *Kajee 3* (DWU), *Mulla 13* (DWU), *Ward 6410* (K, DWU); Isipingo (-DD), *Vawda 27* (DWU).

--2931 (Stanger): Sans Souci (-AB), *Gerstner 6933* (PRE); north bank of Tugela River Mouth (-AB), *Stirton 5360* (PRE); Inanda, near Verulam (-CA), *Wood 1083* (BM, K, PRE); Port Natal [Durban] (-CC), *Guienzius 5* (SAM).

--3029 (Kokstad): Clydesdale (-BD), *Tyson 2091* (BOL, SAM); Zuurberg, & Clydesdale (-BD), *Tyson 1697* (SAM).

--3030 (Port Shepstone): Forest near Ixopo (-AA), *Clarke 57* (BM); Oribi Gorge (-CB), *Barker 9996* (NBG); 19 km from turnoff to Oribi Gorge Hotel on road to Paddock (-CB), *Germishuizen 1682* (PRE); Port Shepstone (-CB), *Mogg 13164* (PRE); Horseshoe Dam, iZingolweni (-CC), *Nicholson 1643* (PRE), *Strey 6172* (PRE), *Glen 112* (J); Uvongo Beach (-CD), *Liebenberg 7981* (K, PRE), *Stirton 8061* (PRE); St. Michaels on Sea, open hills *ca.* 2 km from sea (-CD), *Nicholson 1787* (PRE); Skyline Arboretum, St. Michaels on Sea (-CD), *Nicholson 2471* (NH), *Pienaar 585* (PRE); Ramsgate (-CD), *Strey 7704* (K, NH, PRE, DWU).
--3127 (Lady Frere): Engwali [Mgwali] River, near Engcoba (-DB), *Flanagan 2800* (PRE), *H. Bolus 8889* (BOL).
--3128 (Umtata): Bashee [Mbashe] River (-CA), *Schlechter 1873* (PRE); Kaffraria, Baziya (-CB), *Bauer 88* (BOL, K); near Omtata [Umtata], 1500ft. (-DB), *Drège V, b [Scytalis hispida, E. Mey. 5489*] (photo K, P).
--3227 (Stutterheim): Cove Rock, East London (-BB), *Mac Owen 23* (TCD); grassy hills near Komgha (-DB), *Flanagan 1132* (BOL, NBG, PRE, SAM); Nahoon, East London North (-DD), *Barker 2917* (NBG).
--3228 (Butterworth): Kentani dist. (-AD), *Pegler 1331* (PRE); at Kentani (-CB), *Pegler TM 4607* (PRE), *Pegler 667* (BOL).
--3325 (Port Elizabeth): near Galgebosch, alt. 800ft. (-CC), *Drège IV, C, c* (P), *Drège 1837* (K).
--3326 (Grahamstown): Kowie sand hills (-BC), *Mac Owen 435* (TCD); Alexandria Forest (-CB), *Jacot Guillarmod & Brink 21* (PRE); Alexandria (-CB), *Johnson 837* (PRE); 5 miles from Alexandria Forest (-CB), *Wells 4228* (K, PRE); 1 km outside Kenton-on-Sea on road to Port Alfred (-DA), *Germishuizen 1536* (K, PRE); Bathurst (-DB), *Britten 540, 5017, 5452* (PRE), *Hutchinson 1567* (BOL, K); between Rietfontein and seashore, near Barville Park (-DB), *Burchell 4117* (K); Port Alfred (-DB), *Rogers TM 2942* (PRE).
--3327 (Peddie): near Fish River mouth (-AC), *Phillipson 450* (PRE); grassy flats, East London (-BB), *Batten 1* (NBG), *Johns s.n.* (NBG), *Kuntze 5/394* (K), *Thode 6672* (PRE); near Bats' Cave, East London (-BB), *Schönberg 2804* (PRE); below cemetary at East London (-BB), *Smith 3794* (PRE).
--3423 (Knysna): at Knysna (-AA) and Plettenberg Bay (-AB), *Burke s.n.* (BM).

Precise locality unknown

Zululand, Egoa Farm, *Curson PRE 56130* (PRE); *Flanagan 3905* (PRE); Kaffraria, *Guienzius SAM 15594* (SAM); C. Spei, *Fr. Mafron*, (BM); C.B.S., Panmure, coast of British Kafraria, *Ms Hutton* (K); Swaziland, *Stewart TM 8891* (PRE); Tugela, *Gerrard & McKen 1743, 1745* (TCD).

8c i *V.unguiculata* subsp *dekindtiana* var. *dekindtiana*

Specimens examined

--1719 (Rundu): entrance to Rundu Rest Camp (-DD), *Pienaar 1371* (PRE, WIND); flood plain, Sarasunga River, Sarasunga Lodge, Rundu (-DD), *Pienaar 1372* (PRE, WIND); Rundu, south of Sarasunga Lodge Ruins (-DD), *Pienaar 1373* (PRE, WIND); east of Rundu, Ngone Village (-DD), *Pienaar 1374* (PRE); Waldensel, Rundu (-DD), *Volk 1963* (PRE).
--1720 (Sambio): Mashari Experimental Station, Sambio (-CC), *De Winter & Marais 4576* (K, PRE, SRGH); Mashari, 3 km before village, river bank (-CC), *Pienaar 1375* (PRE, WIND); 1 km east, beyond Mashari Agricultural College, turnoff for tarmac road to Rundu (-CC), *Pienaar 1376* (PRE, WIND).
--1724 (Katima Mulilo): *ca.* 500 m from Hippo Lodge, Katima Mulilo in open woodland and grass (-AD), *Pienaar 1389* (PRE, WIND), *Pienaar 1391* (PRE, WIND); *ca.* 3 km from Hippo Lodge turnoff, toward Katima Mulilo (-AD), *Pienaar 1392* (PRE, WIND); *ca.* 10 miles west of Katima Mulilo (-CA), *De Winter 9183* (PRE); roadside opposite Highway Cash Motors, at turnoff to Katimo Mulilo (-CA), *Pienaar 1395* (PRE, WIND); *ca.* 2.5 km from Hippo Lodge turnoff, southward (-CB), *Pienaar 1393* (PRE, WIND); 6 km west of Hippo Lodge turnoff, main road from Katimo Mulilo (-CB), *Pienaar 1394* (PRE, WIND).
--1816 (Namutoni): Etosha National Park, north-east Sandveld, Stand 3/72 (-BB), *Le Roux 765* (WIND).

--1819 (Karakuwisa): 28 miles north of Karakuwisa on Omuramba Omatako River (-DC), *Giess 10121* (PRE, WIND); Cigarette, north-east of Karakuwisa (-DB), *Maguire 2301, 2464* (NBG).

--1820 (Tarikora): Nyangana Village on road to Andara (-BA), *Pienaar 1377* (PRE, WIND); Linus Shashipapu Village, on road to Andara (-BB), *Pienaar 1379* (PRE, WIND); Shinyungwa Village, on road to Andara (-BB), *Pienaar 1378* (PRE, WIND).

--1821 (Andara): Andara, 2.5 km west of Frans Handari Youth Camp (-AB), *Pienaar 1380* (PRE, WIND); Bagani Clinic (-BA), *Pienaar 1386* (PRE, WIND); Popa Falls Rest Camp, along path to rapids (-BA), *Pienaar 1387* (PRE, WIND); *ca.* 7 km from Bagani station, West Caprivi Game Reserve (-BA) *Pienaar 1388* (PRE, WIND); Manaedinka, 7 km west of Bagani (-BA), *Pienaar 1396* (PRE, WIND); *ca.* 5 km east of Mohango Game Reserve entrance gate, toward Bagani (-BB), *Pienaar 1384* (PRE, WIND); look-out point at Kavango, *ca.* 2 km from gate of Mohango Game Reserve, second turnoff (-BB), *Pienaar 1381* (PRE, WIND); Mohango Game Reserve, *ca.* 300 m from Botswana border gate (-BB), *Pienaar 1382* (PRE, WIND); Mohango Game Reserve, *ca.* 100 m from entrance gate (-BB), *Pienaar 1383* (PRE, WIND); Okavango River, Muhembo (-BD), *Astle 7484* (SRGH).

--1822 (Kangara): road to Santsar-Seronga, 4,2 miles east of Masoko Pan [probably seasonal] (-CB), *Smith 457* (SRGH).

--1920 (Tsumkwe): bank of Omaramba at Tsotsana (-BA), *Giess 9960* (PRE, WIND); Aha Mountains, 10 miles south on road to Tsumkwe near the Botswana Border [mixed collection] (-DD), *Giess 9864* (PRE, WIND).

--1922 (Nokoneng): flood plain of Boro River, Okavango River Delta (-BA), *Dye s.n.* (J).

--1923 (Maun): 63 km north of Maun on Moremi road (-DB), *Mithen 612* (PRE).

--2021 (Koanaka Hills): foot of Xwihaba Hills (-AB), *Smith 3368* (PRE).

--2023 (Kgwebe Hills): Maun, 300 yards from river on road to Toteng (-AB), *Lampbrecht 33* (SRGH); Roulsich, road to Toteng-Maun, 114 km south-west of Maun (-AC), *Mithen 606* (PRE).

--2024 (Kang): Central Kalahari Game Reserve, 114 km east from Lone Tree Pan (-BD), *Verhagen & Barnard* (PRE).

--2122 (Kobe): 0.5 miles north-east of Kuke Camp, roadside (-AB), *Brown 8714* (PRE).

--2125 (Lothlekane): Central Botswana, Orapa, Boabab Drive (-DA), *Allen 45* (J).

--2218 (Gobabis): Breytenbach Farm, Gobabis (-DC), *Seydel 2515* (BR).

--2222 (Damara Pan): 121 km from Ghanzi to Xade Pan (-BD), *Chadwick 222* (PRE).

--2224 (Kukumane): Central Kalahari Game Reserve, Metseamonong, Ghanzi dist. (-CA), *Barnard 275* (PRE).

--2226 (Serowe): 5 km north of Serowe in river valley (-BC), *Mithen 623* (PRE); sandstone rocks 15 km east of Serowe (-DB), *Mithen 621* (PRE).

--2229 (Waterpoort): Messina, *ca.* 56 miles north-west on Greefswaldt Farm (-AB), *J. Pienaar 430* (PRE), *Theron 2962* (PRE); Dongola Reserve, Haakthorne Farm 608 (-BC), *Codd 4136* (K, PRE), *Pole-Evans 4585* (PRE); Langjan Nature Reserve (-CC), *Zwanziger 676* (PRE); Wylie's Poort (-DD), *Rogers 21667* (PRE).

--2230 (Messina): Messina (-AC), *Rogers 20811* (PRE), *20985* (J, PRE); Thathe Vondo, Venda (-CD), *Mugwedi s.n.* (PRE); Thengwe, Venda, on road to Tshikundu-Malema (-DA), *Van Wyk 3989* (PRE); Punda Maria, 3 km from Game Park gate (-DB), *Grobbelaar 2335* (PRE); Venda, Tshianzwani, Makonde Mission, 15 miles north-east of Sibasa (-DC), *Codd 6836* (K, PRE).

--2231 (Pafuri): Klopperfontein, Kruger National Park (-CA), *Van Der Schijf 3591* (K, PRE).

--2324 (Kuchwe Pan): 5 km south-east of Kutse Gate, Kalahari (-BC), *Chadwick 183* (PRE).

--2326 (Mahalapye): ruderal part at St. Patrick's Mission Church, Mahalapye (-BB), *Camerik 89* (PRE); Experimental Station, Mahalapye (-BB), *Talala 339* (PRE).

--2329 (Pietersburg): river forest, Blaaubergkloof (-AA), *Strey & Schlieben 8588* (PRE); Turfloop (-DD), *Sehume 29* (PRE).

--2330 (Tzaneen): Westfalia Estate, Duiwelskloof (-CA), *Scheepers 143* (PRE); Modjadji's Reserve near Duiwelskloof (-CB), *Krige 172* (PRE); wasteland, Tzaneen (-CC), *Stirton 5758* (PRE).

--2421 (Tshane): Nami Pan (-AA), *Story 5257* (K, NBG, PRE).

--2425 (Gaberone): 19.4 km west of Malepolole (-CB), *Mithen 509* (PRE); 10 km north of Gaberone near Sebele Agricultural Research Station (-DB), *Mithen 502* (PRE); 17 km north of Gaberone (-DB), *Mithen 520* (PRE).
--2426 (Mochudi): Mochudi (-AC), *Rogers 6400* (PRE), *6737* (J).
--2427 (Thabazimbi): Olieboomspoort, *ca.* 20 miles south of Ellisras (-CD), *Codd 1006* (PRE); Geelhoutbos Farm, Waterberg dist. (-BC), *Germishuizen 360* (K, PRE).
--2428 (Nylstroom): Potgietersrust (-AA), *Leendertz 7375* (PRE); 39 km north of Nylstroom (-CB), *Codd 2262* (PRE); 8 miles on Sandpoort Road, edge of Tarentaalvlei (-AD), *Smuts & Gillett 3405* (PRE); Mosdene Farm near Naboomspruit (-DB), *Germishuizen 3669, 3688* (PRE).
--2430 (Pilgrim's Rest): Lekhalameetse Nature Reserve (-AB), *Stalmans 523* (PRE); Mariepskop, Blyderivier (-DB), *Van Son PRE 56129* (PRE); 1 km from Pilgrim's Rest on road to Bourke's Luck (-DD), *Germishuizen 155, 163* (PRE).
--2431 (Acornhoek): Phalaborwa Water Board, 14 km south of Phalaborwa (-AA), *Retief 387, 574* (PRE); Ross Farm, 55 KU, Dover Farm, 33 KU, Klaserie Private Nature Reserve (-AA), *Zimbatis 1643* (PRE), *1112* (PRE).
--2525 (Mafikeng): Gopane, 25 miles west of Zeerust (-BD), *Snyman 87* (PRE).
--2526 (Zeerust): at Rietfontein, Zeerust (-BD), *Schoeman TM 4975* (PRE).
--2528 (Pretoria): Rust de Winter, Pretoria dist. (-BA), *Smuts & Gillett 2135* (PRE); Kwandebele, Boekenhoutfontein Farm (-BB), *Van Hoepen 1655* (PRE); southern slopes of Magaliesberg (-CA), *Nel PRE 56151* (PRE); near zoo grounds, climbing on *Clutea sp.* (-CA), *Smith 31* (PRE); National Botanic Gardens, northern ridge on west side of building (-CB), *Pienaar 902* (PRE).
--2529 (Witbank): 1 km from Kloof Motel on road to Loskop Dam (-AD), *Germishuizen 3723* (PRE).
--2530 (Lydenburg): 1 km from Plaston turnoff, *ca.* 14 km from Nelspruit (-BD), *Pienaar 1365* (PRE); entrance to Rand Mines, Lotzaba Forests, Glenthorpe, *ca.* 28 km from Nelshoogte (-DD), *Pienaar 1357* (PRE).
--2531 (Komatipoort): Nelspruit dist., Karino Station, 13 km from Nelspruit on road to Kaapmuiden (-AC), *Germishuizen 100* (PRE); 14 km from Nelspruit on road to Kaapmuiden (-AC), *Germishuizen 102, 104* (PRE); 6 km from White River on road to Hazy View (-AC), *Germishuizen 143, 189* (K, PRE); 12 km from Malelane on road to Hectorspruit (-BC), *Germishuizen 5137* (PRE); at Lebombo, Komati river (-BD), *Germishuizen 5145* (PRE); at confluence of Crocodile & Komati Rivers (-BD), *Kok & Pienaar 1298* (PRE).
--2723 (Kuruman): Kuruman (-AD), *Pole-Evans 2080* (PRE).
--2732 (Ubombo): *ca.* 2 km from Phelandaba turnoff on road to Mbazwane, Muzi Swamp (-BA), *Germishuizen 3112* (PRE); forestry firebreak road to eastern tip of Lake Sibayi (-BC), *Pooley 252* (PRE).
--2831 (Nkandla): Mtunzini, Siyay Nature Reserve (-DC), *Arnold 1425b* (PRE); Mtunzini, Umlalazi Nature Reserve near Nkwazi camping site (-DC), *Buthelezi 640* (PRE), near entrance, *Pienaar 1365* (PRE).
--2832 (Mtubatuba): St. Lucia Lake (-AD), *Gerstner 3167* (NH).

Precise locality unknown

Junod 3126 (PRE).

Other African localities

Angola: Rocadas, Cunene, *Da Silva 3083* (PRE).
Tanzania: Mbeya, *Polhill & Paulo 1960* (PRE); Ukerewe Island, *Conrads 5232* (PRE); Eastern Usemberas, *Greenway 2786* (PRE).
Zaïre: Ruzizi Plain, *Germain 5659* (PRE).
Zambia: Kalomo, *Verboom L 69B* (PRE).
Mozambique: Polane Farm, *Hornby L 1611* (PRE); Nhacoongo, *Cedro 350, 195, 339* (PRE); Belo Taverne, 25 km from Lorenco Marques, *H. Bolus 7738* (BOL); Sol du Sare, Inhaca Island, *Schelpe 4478* (BOL).
Cameroun: Melen, North-west Yaounde, *Leeuwenberg 7022* (PRE).

Zimbabwe: Gokwe, Sengwa Research Station, *Jacobsen 4184* (PRE); Lawrenceville Road verge, *Mithen 53* (PRE).

8c ii *V. unguiculata* subsp. *dekindtiana* var. ***huillensis***

Specimens examined

--1723 (Singalamwe): Caprivi zipfel (-CC), *Killick & Leistner 3158* (PRE).
--1724 (Katimo Mulilo): Caprivi Strip, *ca.* 10 miles west of Katimo Mulilo, *De Winter 9183*).
--1816 (Namutomi): 18 km from Tsumeb on the road to Otavi, in woodland kloof (-DB), *Grobbelaar 1889* (PRE).
--1819 (Karakuwisa): Cigarette, north-east of Karakuwisa (-DB), *Maguire 2242, 2283, 2290, 2336, 2379, 2435* (NBG, PRE).
--1820 (Tarikora): Omuramba Khaudum, east of Tamsu (-DA), *De Winter & Marais 4657* (PRE).
--1914 (Kamanjab): Katemba, 750 ft. (-DA), *Schlechter 11608* (BOL).
--1916 (Gobaub): Gladstone Farm, 28 miles west of Otavi (-DB), *De Winter 3007* (PRE).
--1917 (Tsumeb): Tsumeb (-BA), *Dinter 3022* (SAM); 18 km from Tsumeb to Otavi, in bushveld kloof (-BC), *Grobbelaar 1889* (PRE); 16 km from Tsumeb on Tsumeb—Grootfontein Road (-BD), *Wanntorp 552* (PRE); Okombangora Farm (Wynand Peypers), *ca.* 76 km from Otavi coming from Grootfontein (-DB), *Pienaar & Archer 1342* (PRE).
--1918 (Grootfontein): Abendruhe, Farm no. 913, Maroelaboom, Grootfontein district (-BB), *Pienaar 1370* (PRE, WIND); Grootfontein-North (-CA), *Giess 1866* (PRE); Oliewenhof Farm : GR 215, Grootfontein (-CA), *Giess, Volk & Bleissner 6518* (PRE, WIND); Grootfontein North, mouth of Omuramba Omotako (-DB),*Merxmuller & Giess 1920* (PRE).
--1920 (Tsumkwe): Kaukauveld, banks of the Omuramba at Tsotsana (-BA), *Giess 9960* (PRE); Aha Mountains, 10 miles south on Tsumkwe Road, near the Botswana Border [mixed collection] (-DB), *Giess 9864* (PRE).
--2013 (Unjab Mouth): Rooiplaat (-BB), *Leendertz 8405* (PRE).
--2017 (Waterberg): Waterberg-Platopark, dist. Otjiwarongo (-AC), *Jankowitz 1205* (WIND).
--2023 (Kwebe Hills): alongside the Xanakuna-Moshu Road (-DC), *Smith 1218* (PRE).
--2024 (Bushman Pits): old Maun Road near Kudiakam Pan (-BA), *Mithen 618* (PRE).
--2026 (Nata): [Central Kalahari Game Reserve], 114 km east of Lone Tree Pan (-AC), *Verhagen & Barnard 40* (PRE).
--2120 (Rietfontein): Hereroland, Rietfontein Block, Helena Wilskrag Area (-DC), *Adank & Visser s.n.* (WIND).
--2217 (Windhoek): 32 km north of Windhoek (Continental Hotel) on Okahanja Road, 9 km south of Otjehavera River (-AC), *Pienaar & Archer 1320* (PRE); Ondekaremba (-AD), *Dinter 2797* (SAM).
--2220 (Kalkfontein): 21 km south of Charles Hill (-CA), *Mithen 564* (PRE); 138 km south-west of Ghanzi (-DA), *Mithen 562* (PRE).
--2221 (Okwa): 7 km north of Bere (-DD), *Mithen 557* (PRE).
--2227 (Palapye): 101 km south of Francistown toward Gaberone (-AB), *Mithen 498* (PRE); Phikwe, eastern Botswana (-AC), *Kerfoot & Falconer 209* (J).
--2322 (Kang): 24 km from Maitlo-a-Phuduhudu Pan in an easterly direction (-AA), *Mithen 546* (PRE); Lokalane, Western Kalahari (-AB), *Vahrmeier & Steele 3098* (PRE).
--2323 (Luthle): 54.7 km west of Dutlwe (-AB), *Mithen 528* (PRE).
--2325 (Lephepe): Dinonyane, Kweneng dist., Central Kalahari (-CD), *Barnard 230* (PRE).
--2419 (Aranos): 20 miles north of Genesa (-DB), *Rogers 12567* (BOL).
--2420 (Union's End): Kalahari Park, east of Swartpan (-BA), *Van der Walt 5795* (PRE).
--2425 (Gaberone): Tsolafelo sewage ponds, Gaberone (-DB), *Barnes 509* (PRE).
--2523 (Pomfrey): 8 km north-east of Werda, Botswana (-AB), *Mithen 596* (PRE).
--2624 (Vryburg): Vryburg dist. (-DB), *Mogg 8370* (PRE).

Precise locality unknown

Ngamiland, *Curson 154* (PRE); alongside Xanekoba-Mosu road (-DC), *Smith 1218* (PRE); Central Kalahari Gemsbok Reserve, *Tanaka 32* (PRE).

Other African localities

Angola: Huilla, *De Kindt 468* (isotype), *De Kindt s.n.* (LISU); Caconda, Colonato, *Texeira & Figueira 4.882* (PRE).
Zambia: Mwinilunga district, *Milne-Redhead 2647* (PRE).
Malawi: 75 km north of Kasungu'Lake, *Mithen 414* (PRE).

8d i *V. unguiculata* subsp. *tenuis* var. *tenuis*

Specimens examined

--2230 (Messina): Thathe Vondo, Messina (-CD), *Hemm 1123* (J).
--2632 (Bela Vista): Kosi Estuary (-DD), *Vahrmeyer 1226* (PRE).
--2732 (Ubombo): Makanis Pont, Mengu, sand forest (-BA), *Venter 5170* (PRE); North of Lake Sibayi, grassveld (-BC), *Verdoorn PRE 56088* (PRE); Bhangazi Lake, grassland, dune (-DA), *Strey 4989* [mixed collection] (NH).
--2832 (Matubatuba): Richards Bay, southern sector, open dune grassland (-CC), *Ward 8664* (PRE, DWU).
--2930 (Pietermaritzburg): 0.25 km from Inchanga Abattoir turnoff on old Durban Road (-DA), *Pienaar & Archer 1331* (PRE).
--2931 (Stanger): Umdloti Beach, regularly cut bank (-CA), *Pienaar 600, 602, 603, 604* (PRE); Hawaan Forest, south bank of Umhlanga River (-CA), *Ross & Moll 2255* (PRE); Brighton Beach, Durban, playing fields between Marine Drive & Grosvenor, exposed sand (-CC), *Kok & Pienaar 1255* (PRE); Berea, Durban (-CC), *Wood 8860* (NH).
--3030 (Port Shepstone): St Michaels on Sea, open grassland (-CD), *Nicholson 2110* (PRE); Uvongo, grassland (-CD), *Nicholson 1508* (PRE); Selsdon Park (Boy & Anne Brand), opposite D203 road, 0.5 km from Mpenjati River, dappled shade of Eucalypts (-CD), *Pienaar 1376* (PRE).
--3130 (Port Edward): Mzamba River Mouth, deep, sandy, burnt grassland (-AA), *Stirton 5630* (PRE).

Other African localities

Mozambique: Inhaca Island, *Mogg 27660, Mogg 27252* (PRE); Gaza-Vila de Joao, *Pedro 198* (PRE).

8d ii *V. unguiculata* subsp. *tenuis* var. *ovata*

Specimens examined

--2732 (Ubombo): Muzi Flats (-CB), *Venter 4459* (PRE); Bhangazi Lake, grassland on dune [mixed collection] (-DA), *Strey 4989* (NH, PRE).
--2832 (Mtubatuba): Eastern Shores State Forest, southern Bokkie Valley (-AD), *Mac Devette 9* (NH); St. Lucia Game Park, (-AD), *Pienaar 887* (PRE).
--2930 (Pietermaritzburg): 0.25 km from Inchanga Abattoir turnoff on old Durban Road (-DA), *Pienaar & Archer 1331a* (PRE); Inanda (-DB), *Watmough 485* (PRE); Reservoir Hills, Durban dist. (-DD), *Abraham 18* (DWU); Pinetown, roadside (-DD), *Pienaar 1378* (PRE); Isipingo (-DD), *Ward 3780* (PRE).
--2931 (Stanger): Tinley Manor Beach (-AD), *Grobbelaar 1644* (PRE), *Pienaar 837, 1368* (PRE), *Ngwenya 267* (PRE); Melville (-AD), *Strey 9608* (NH, PRE); Tugela (-BA), *Gerrard & Mc Ken 1744* (TCD); Lower Tugela (-BA), *Moll 2586* (PRE); Umdloti Beach, 6, First Ave., grass bank (-CA), *Pienaar 598, 601* (PRE); crossroads, Durban North to Umhlanga Rocks and Mt. Edgecombe to Durban (-CA), *Pienaar 472, 474, 605* (PRE); carriageway to Umdloti

Beach, 1 km from Umhlanga Rocks (-CA), *Pienaar 477* (PRE); Hawaan Forest, south bank of Umhlanga River (-CA), *Ross & Moll 2257* (PRE); Salisbury Island, Durban (-CC), *Hennessy 83* (DWU); near Durban (-CC), *Gerrard 387*(TCD); Umgeni River bank, Riverside Road, Durban, opposite Incledon's Building (-CC), *Pienaar 607, 608* (PRE); south bank, Umgeni River, Blue Lagoon, Durban (-CC), *Pienaar 609* (PRE); on Northway Embankment, Blue Lagoon, Durban (-CC), *Kok & Pienaar 1256, Pienaar 1369* (PRE); Treasure Beach Nature Reserve (-CC), *Pienaar 610* (PRE), *Pienaar & Archer 1341* (PRE); between Brighton Beach and Grosvenor, Durban (-CC), *Pienaar & Kok 1254, Pienaar 1370* (PRE); Durban (-CC), *Wood 8029*, (NH), *Wood 8443* (BOL, NH, PRE).

--3030 (Port Shepstone): Warner Beach (-BB), *Stirton 8039* (PRE); Umkomaas, Rolands Harris Drive, immediately north of railway station (-BB), *Pienaar 1372* (PRE); Ifafa Beach, grassy bank facing beach (-BC), *Pienaar 1373* (PRE); Shelley Beach, Cowrey Cottage (-CD), *Du Toit 119* (PRE); Nicholson's property, Skyline, St. Michaels on Sea (-CD), *Pienaar 585, 589* (PRE); beyond Uvongo Village, vacant plot bounded by river (-CD), *Pienaar 597* (PRE); Hibberdene, grassland behind littoral scrub (-DA), *Mogg 36968* (PRE), *Strey 9694* (NH, PRE).

--3129 (Port St. Johns): dune grassland, Port St. Johns (-DA), *Moss 3191* (J), *Wager TM 24099* (PRE).

--3130 (Port Edward): 3 km to Umtamvuna Bridge (-AA), *Pienaar 789* (PRE); roadside through coastal grassland (-AA), *Stirton 8072* (PRE); Port Edward (-CB), *Taylor 5393*(NBG).

8e *V. unguiculata* subsp. *stenophylla*

Specimens examined

--1821 (Andara): between Bagani Camp & Mahango, grassland (-BA), *De Winter 4391* (PRE).

--2231 (Pafuri): Klopperfontein (-CA), *Van der Schijff 2959* (PRE).

--2330 (Tzaneen): Letaba Estates (-CD), *Grobbelaar 322* (PRE).

--2427 (Thabazimbi): Elandshoek (-BD), *Rogers 2996* (PRE).

--2428 (Nylstroom): Twenty-four Rivers, 13 miles north-east of Vaalwater (-AD), *Codd 960* (PRE); Potgietersrust dist., 50 km from Nylstroom on road to Melkrivier at Tarentaalstraat (-AD), *Germishuizen 772* (PRE).

--2429 (Zebediela): Rietvallei Farm, Pilgrim's Rest dist. (-CD), *Holy 6* (PRE).

--2430 (Pilgrim's Rest): Shabene area, Kruger National Park (-BB), *Van der Schijff 3199* (PRE).

--2431 (Acornhoek): Pilgrim's Rest dist., Manjeleti Game Reserve (-AD), *Bredenkamp 1553* (PRE); Albatross, Manjeleti Game Reserve (-AD), *Bredenkamp 1864* (PRE); Rabelais Dam, Kruger National Park (-AD), *Van der Schijff 2350* (PRE).

--2526 (Zeerust): 10 km east from road Zeerust-Blairbeth, south of Witpoortjie (-AC), *Van der Meulen 317* (PRE); Grasfontein, Lichtenburg (-CC), *Sutton 345* (PRE).

--2527 (Rustenburg): Vlakfontein, 10 miles east of Koster (-AB), *Liebenberg 160* (PRE); Buffelskloof Farm, mountainside (-BA), *Germishuizen & Retief 546* (PRE); Klipvoordam, grassland (-BB), *Peeters, Gericke & Burelli 669* (J, PRE); Beestekraal (-BC), *Jenkins 6975* (PRE); south-west of Rustenburg Town (-CA), *Nation 189* (BOL, K, PRE); Uitkomst 499 JQ., Pelindaba (-DD), *Coetzee 106* (PRE).

--2528 (Pretoria): Rietvallei 221, northern portion, sourveld (-CA), *Acocks 11327* (PRE); Pretoria University Farm, ridge behind Silverton (-CB), *Codd 869* (PRE); Cullinan dist., 24 km from BRI on road to Cullinan (-CB), *Herman, Retief & Schrire 3* (PRE); Premia Mine (-CB), *Rogers TM 20705* (PRE); Roodeplaat Dam Nature Reserve (-CB), *Van Rooyen 2556* (PRE); Swartkops Nature Reserve, Pretoria (-CC), *Defence Dpt. SK 64* (PRE); near Irene on the Lyttleton side (-CC), *Smith 1123* (PRE); C.S.I.R. Reserve, Pretoria (-CD), *Liebenberg 8692* (PRE); Rayton (-DA), *Rogers 20925* (PRE); *ca.* 30 km from Pretoria on Witbank road (-DC), *Pienaar 1366* (PRE).

--2529 (Witbank): near Witbank Station (-CC), *Gilfillan 7180* (BOL, PRE).

--2530 (Lydenburg): Zwagershoek Farm, Lydenburg dist. (-AD), *Obermeyer 194* (PRE); Nelspruit (-BD), *Breyer T.M. 17861* (PRE); *ca.* 15 km outside Nelspruit on road to White River, under first signpost to Karino (-BD), *Pienaar 1353* (PRE).

--2531 (Komatipoort): 11 miles east north-east of Pretoriuskop, Kruger National Park (-AB), *Acocks 16650* (K, PRE); 1 mile north of Pretoriuskop, Kruger National Park (-AB), *Codd & de Winter 4949* (PRE); 9 km from Pretoriuskop on road to Malelane, Kruger National Park (-AB), *Herman 804* (PRE), *Van der Schijff 1395* (PRE); 14 km from Nelspruit on road to Kaapmuiden (-AC), *Germishuizen 101* (PRE); 3 km from Karino turnoff on Komati Road (-AC), *Pienaar 1354* (PRE).
--2626 (Klerksdorp): Houthaalbomen (-AA), *Morris & Engelbrecht 1204* (PRE); 160 km to Lichtenburg from Ventersdorp (-AA), *Pienaar 1352* (PRE); 8 miles north-west of Ventersdorp (-BB), *Acocks 12403* (K, PRE), *Story 778* (PRE); P. O. Westerdam, 12 miles south-west of Ventersdorp (-BC), *Codd 2650* (PRE).
--2627 (Potchefstroom): Carletonville, A. Bailey Reserve (-AD), *Van Wyk 305* (PRE); Isaac Stegman Nature Reserve, Krugersdorp, Sterkfontein Caves and Zwartkrans 67 (-BA), *Mogg 35304* (J, PRE), *35676* (K, PRE); Grassveld, Midway, W.W.R. (-BD), *Moss 14105* (J); 7 miles from Parys on Vredefort road (-CD), *Grobbelaar 1424* (PRE); 6 miles from Kromdraai Drift, Vredefort dist. (-DD), *Acocks 24184* (PRE).
--2628 (Johannesburg): Benoni, Geduld Golf Course, now President Pleasure Resort (-AB), *Isaacs 51* (PRE); Modderbee, Witwatersrand (-AB), *Moss 14092* (J).
--2630 (Carolina): Sonnestraal Farm, *ca.* 9 km from turnoff on Waverley road (-BB), *Germishuizen 2939* (PRE).
--2632 (Bela Vista): Tongaland, Kosi Estuary (-DD), *Abbott 467* (NH).
--2726 (Odendaalsrus): Bothaville, Kroonstad dist. (-BC), *Goosens 1162* (PRE).
--2731 (Louwsburg): Itala Nature Reserve, Craigadam Farm (-CA), *Mc Donald 146* (PRE).
--2732 (Ubombo): Kwa Zulu, Maputoland plain, Sihangwana (-AB), *Liengme 596* (PRE); 5 miles from Sihangwane Store on road to Maputo (-DC), *Ross & Moll 1828* (NH); Muzi Marsh area *ca.* 2 km from Phelendaba turnoff to Mbazwana (-BA), *Germishuizen 3110, 3112* (PRE); 10 miles from Manzengwenya to Maputa on Ingwavuma road (-BA), *Moll 4905* (NH, PRE); near Manzengwenya Inspection Quarters (-BB), *Moll 4843* (NH, PRE); Kosi Bay, Natal Parks Board Camp (-BB), *Moll 4528* (PRE); coconut plantation, Kosi Bay (-BB), *Rousseau 107* (PRE); Mbazwana, grassland (-DA), *Balsinhas 3268* (PRE); Sordwana Bay (-DA), *Vahrmeijer & Tölken 839* (PRE).
--2825 (Boshoff): Bultfontein, Oppermansdrif Dam (-AB), *O'Connor 65* (PRE).
--2832 (Mtubatuba): Game Park, St. Lucia (-AD), *Pienaar 886* (PRE), *Pienaar 1363* (PRE); grassland beyond airstrip, St. Lucia (-AD), *Pienaar 891* (PRE).

Precise locality unknown

Kruger National Park, *Engelbrecht 6168*; Warmlaagte, north-eastern Kopje, *Maguire J 32402* (J); in grass at Wonderfontein, Mooierivier, *Zeyher 522* (SAM), *Zeyher 529* (SAM); grass, Natal, *Zeyher s.n.* (SAM).

9. *Vigna nervosa* Markötter in Ann. Univ. Stellenbosch 8, Sect. A, 1: 26 (1930); Verdc.: 546 (1970); Ross: 208 (1972); Maréchal *et al.*: 196 (1978a). Type: South Africa, Oliviershoek Pass, *Thode 5726* (Stellenbosch University Herbarium! holo., K!, photo, PRE!, photo).

Dolichos reticulata Schltr.: 219 (1897), nom. illeg. Type: In saxosis montium Drakensbergen prope Polela (Nataliae), alt. 6000—7000 ped., Feb. 1876, *Evans 630* (K!, holo.).

Vigna galpinii Burtt Davy: 421 (1932). Type: South Africa, Barberton, Umlomati Valley, *Galpin 1327* (K!, holo., BOL!, PRE!, SAM!, iso.).

Perennial herb, delicate twiner or procumbent, on uplands. **Root** tuberous with abundant nodules. **Stem** glabrous, scabrid to minutely pilose or patent, slender with long internodes, cylindric or striate. **Leaflets** petiolate, variable shape from narrowly ovate to ovate or linear-oblong, *ca*. 15—35 X 3—15 mm, apex rounded to obtuse or subacute, base obtuse, *ca*. pilose to glabrescent with prominent venation, papyraceous to *ca*. coriaceous, bright green; **petioles** *ca*. 25—30 mm, **rhachis** 4—6 mm long. **Stipules** elliptic to oval, depressed, often not constricted at point of attachment, spur and blade *ca*. equally long, margin long-ciliate, often prominently nerved, pilose to glabrous. *Inflorescence* a solitary, axillary flower, varying from coral pink to mauve or purple. *Calyx* 4—5 mm long, lobes as long as tube or shorter, triangular, subulate, upper pair connate for *ca*. 1/3 the length, glabrous or varyingly pilose. *Standard* rotund to reniform, emarginate, 6—9 X 10 mm, with a broad claw, callosities basal only, inflexed. *Wings* oblong with rounded spur. *Keel* broadly obtuse, saccate on both sides of claw. *Style* elongation above the lateral stigma typically hammer-shaped as in *V. unguiculata*, the protuberance being horizontal, rounded, 0.1—0.2 mm long. *Legume* glabrous at maturity, 35—40 mm long, prominently beaked, 6—8-seeded. *Seeds* reddish brown *ca*. 0.35 mm long, hilum almost central, aril extended almost to lower end of seed. (Figure 14)

In rocky grasslands at altitudes *ca*. 1550—1650 m above sea level in Natal and the Transvaal.

Closely allied to *V. unguiculata*. Spurred stipules often oval as a whole without a marked constriction at the point of attachment.

Hook. f. (: 310, 1849) named *V. reticulata* and its synonym, *V. linearfolia* from Tropical West Africa in Flora Niger. This makes *V. reticulata* Schltr. a later homonym. Subsequently, *V. reticulata* has been collected throughout tropical Africa and is inclined to be extremely polymorphic (Maréchal *et al*. 1978a). As its name suggests, *V. reticulata* Hook. f. belongs to the Section *Reticulatae* in the subgenus *Vigna*.

Specimens examined

--2330 (Tsaneen): Wolkberg (-CC), *Meeuse 9857* (PRE).
--2430 (Pilgrim's Rest): Buffelskloof Nature Reserve (-CD), *Germishuizen 5199* (PRE); Hebron Mountain (-DB), *Coetzer 147* (K, PRE); Graskop Peak (-DD), *Galpin 14355* (PRE); Graskop (-DD), *Kluge 1809* (PRE); Pilgrim's Rest, road to Bourke's Luck (-DD), *Germishuizen 157* (PRE); Pilgrim's Rest, road to Bosbokrand (-DD), *Germishuizen 172* (K, PRE).
--2530 (Lydenburg): Witklip (-BD), *Kluge 709* (PRE); Kaapsche Hoop (-CB), *Rogers 21069* (K).
--2531 (Komatipoort): Barberton, Mlumati Valley (-CC), *Galpin 1327* (BOL, K, PRE, SAM [syntype, *V. galpinii* Burtt-Davy]).
--2629 (Bethal): Ermelo (-DB), *Henrici 475* (PRE), *Leendertz TM 7824* (PRE).
--2630 (Carolina): 17 km from Lake Chrissie on road to Oshoek (-AB), *Germishuizen 5061* (PRE); Lake Chrissie (-AC), *Moss 16147* (J); 5 km from Jessievale on road to Oshoek (-BA), *Germishuizen 5068* (PRE); 43 km from Chrissiesmeer on Lothair road, 3 km from Jessievale Forest, 7 km from Amsterdam turnoff (-CA), *Pienaar 1360* (PRE); Panbult (-CC), *Germishuizen 3931*, *3940* (PRE); Athole Pasture Research Station (-DA), *Preller 146* (PRE).
--2631 (Mbabane): Forbe's Reef Road (-AC), *Compton 27581* (NBG, PRE).
--2729 (Volksrust): Botha's Pass (-DA), *Germishuizen 4370* (PRE).
--2730 (Vryheid): Tweekloof, Altemooi, Utrecht (-AD), *Thode A184* (NH, PRE).

--2828 (Bethlehem): Bethlehem (-AB), *Marais 1270* (PRE); Natal National Park (-DB), *Hardy 7* (PRE).
--2829 (Harrismith): Nolens Volens, Van Reenen (-AD), *Jacobsz 1592* NBG, PRE), *Jacobsz 1629* (PRE); Van Reenen (-AD), *Schlechter 6984* (BOL).
--2830 (Dundee): Babanango (-AC), *King 238* (PRE); road from Muden to Colenso (-CD), *Pienaar 426* (PRE); *ca.* 20 km from Muden on road to Weenen (-CD), *Pienaar & Archer 1314* (PRE, PRU); 1.8 km on district road D568 off Muden-Weenen road (-DC), *Pienaar & Archer 1322* (PRE, PRU).
--2831 (Nkandla): Nkandla Forest (-CA), *Hilliard 2637* (DWU), *Venter 3426* (PRE).
--2929 (Underberg): Hidcote (-BB), *Green 408* (NH); Estcourt (-BB), *Green 202* (NH); Mooi River (-BB), *Burtt Davy 10181* (PRE), *Mogg 26, 95, 7257* (PRE); Estcourt (-BB), *Sidey 130* (PRE); Nottingham Road (-BD), *Mc Clean 843* (NH, PRE); Fort Nottingham road (-BD), *Pienaar 513* (PRE); Drakensberg Mountains, near Pholela River (-DC), *Evans 630* (K); Tabamhlope, Underberg (-DC), *Miller 315* (PRE); Nkonzo State Forest (-DC), *Nicholas & Van den Berg 1849* (K, PRE).
--2930 (Pietermaritzburg): Tweedie (-AC), *Mogg 6760, 6828, 6950, PRE 56132* (PRE), *Pienaar 494* (PRE); koppie west of polo grounds, Greytown (-BA), *Kok & Pienaar 1222* (PRE, PRU); Netherby (-CA), *Pienaar 543* (PRE); road from Boston to Bulwer (-CA), *Pienaar 556* (PRE); Hilton (-CB), *Acocks 12552* (PRE), *Ford NH 20453* (NH); Cedara (-CB), *Pienaar 483* (PRE).
--3029 (Kokstad): Mount Currie (-AD), *Acocks 21995* (PRE); Clydesdale (-BD), *Tyson 1444* (BOL, SAM), *Tyson 2786* (NBG, K, PRE); Malowe (-BD), *Tyson 2128, 2885* (BOL, SAM); Kokstad (-CB), *Johnson 7* (NBG), *Tyson 1336* (PRE), *Tyson 1343* (NBG, PRE); Ntsizwa Mountain (-CD), *Schlechter 6444* (BOL); Bizana (-DD), *Acocks 13364* (PRE).
--3030 (Port Shepstone): Ixopo (-AC), *Acocks 13302* (PRE).
--3128 (Umtata): summit of Baziya Mountain, Transkei (-CB), *Strever 875* (PRE).
--3129 (Port St Johns): 9 miles east-south-east of Lusikisiki (-BC), *Acocks 13429* (PRE); road from Lusikisiki to Port Edward (-BC), *Grobbelaar 2319* (PRE).
--3130 (Port Edward): Umtamvuna Nature Reserve (-AA), *Abbott 960* (NH).

Other African localities

Zimbabwe: Mount Inyangani, *Bayliss 10632* (PRE); Inyanga district, *Wild 4930* (PRE); Fort Inyanga, *Fisher 1452* (PRE).

Subgenus 3. *Haydonia*

Subgenus *Haydonia* (Wilczek) Verdc. in Kew Bull. 24: 565 (1970).

Haydonia Wilcz.: 405 (1954b); Maréchal: 461 (1967). Type: *Haydonia monophylla* (Taub.) Wilcz.

Vigna ostinii Chiov.: 60 (1911). Type: Ethiopia, Dembia, Gondar, *Chiovenda 1704* (FI, holo.).

Dolichos gardneri Bak. f.: 450 (1929). Type: Rhodesia (Zimbabwe), Gwelo, *T. Gardner 38* (K, holo.).

Type of subgenus: *Vigna monophylla* Taub.

Stipules not or slightly bi-lobed at base. **Keel** beaked or slightly curved, without pockets. Thickened part of **style** slightly curved, not or scarcely beaked beyond the oblique or almost terminal stigma. **Pollen** grains not coarsely reticulate, muri low or smoothed. **Vexillar stamen** and four short ones often furnished with a pair of glands or a bunch of small glands at the base of alternate anthers (Figure 15 E).

Verdcourt (1970) first recognized the subgenus after Wilczek (1954a) had noticed the peculiar glands at the base of alternate anthers in two species of *Vigna* and had separated them into a new genus, *Haydonia* (Wilcz. 1954a). Maréchal (1967) moved *V. juncea* Milne-Redhead to the new genus *Haydonia* after noting the presence of anther glands. He regarded the characters of the bracteoles, the calyx lobes, standard appendages, wing shape, the shortly beaked keel, curved style with terminal stigma, linear legumes and very small seeds, as further reason for the decision. Occurrence of anther glands in specimens from Zambia and Zimbabwe, led Verdcourt (1970) to recognize the subgenus, *Haydonia* in the genus *Vigna* because the plants present the normal facies of *Vigna*. The pollen grains are not like those of *Vigna*, rather more like *Phaseolus*, as is the case in other species of *Vigna* e.g. *V. luteola*. However, Verdcourt (1970) found the shape of the keel, the thickened part of the style and the biochemistry of the seeds to provide sufficient support for maintaining the subgenus *Haydonia* as a satellite group of *Vigna* and included *V. monophylla* Taub., *V. triphylla* (Wilcz.) Verdc., *V. juncea* Milne-Redhead and *V. richardsiae* Verdc.

The glands are not always clearly visible as in *V. richardsiae* Verdc. and *V. mudenia* Pienaar, but careful examination of the floral structure and vegetative characters prove affinity with other members of the subgenus *Haydonia*.

Maréchal *et al*. (1978a) agreed with Verdcourt (1970), finding support in their numerical analysis. They regard the subgenus *Haydonia* as a group derived from the subgenus *Vigna* and in the full course of evolution. This entails the loss of not only the exine sculpture but also of two typical characteristics of the Old World *Vigna* species, namely, the prolongation of the stipules below their insertion and the style prolongation beyond the stigma. This evolution is also manifested by the acquisition of other characteristics, namely, glands below the anthers of the internal whorl, stems more or less strongly ribbed and seeds very small.

Section 1. *Haydonia*

Section *Haydonia*

Type of section: *Vigna monophylla* Taubert: 223 (1895). Type: Tanganyika/Uganda, Mpororo, Kavingi & Kirere, *Stuhlman 2001 & 2108* ; (B, syn., destroyed); Uganda, Busoga, *Dawe 95* (K!, neo.).

Stipules rounded at base, not prolonged, or scarcely. **Stems** distinctly ribbed or winged. **Keel** with short rostrum. **Stigma** obliquely terminal. **Stamens** of internal cycle with a bunch of small glands or a large gland at base of anthers. **Pollen** grains smooth, without large reticulations. **Legumes** fine with very small seeds, without arils.

10. V. monophylla *Taub.* in Engl. Die Pflanzenwelt Ost-Afrikas und der Nachbargebiete: 223 (1895); Bak.f.: 414 (1929); Verdc.: 661 (1971); Maréchal *et al*.: 197 (1978a). Types: Tanganyika/Uganda, Mpororo, Kavingi & Kirere, *Stuhlman 2001 & 2108* (B, syntype, destroyed); Uganda, Busoga, *Dawe 95* (K!, neo.). (Figure 15 C)

Vigna ostinii Chiov.: (1911). Type: Ethiopia, Dembia, Gondor, *Chiovenda 1704* (FI, holo.).

Dolichos gardneri Bak.f.: 450 (1929). Type: Rhodesia (Zimbabwe), Gwelo, *T. Gardner 38* (K, holo).

Haydonia monophylla (Taub.) Wilczek: 406 (1954). Type: as above.

Erect, twining or trailing herb growing from a slender fusiform rootstock. **Stems** erect, angled, glabrous or scarcely hairy. **Leaves** simple, petiolate, petiole reduced to a pulvinus and without stipels, ovate to oblong-lanceolate or more or less elliptic, *ca.* 20—115 X 5—30 mm, apex acute or rounded, apiculate, base obtuse or slightly cordate, glabrous or slightly hairy along nerves, margins sometimes ciliate, 3-veined from base as is typical of the genus, veins raised and reticulate; **petiole** *ca.* 15 mm long. **Stipules** lanceolate, apex pronouncedly acuminate, base scarcely auriculate, *ca.* 3—4 mm long, often recurved, glabrous, ciliate at apex. **Inflorescence** few-flowered, a contracted raceme at apex of winged peduncle, 70—350 mm long with stiff blackish hairs at apex. **Calyx** glabrous or with appressed blackish hairs, lobes as long as, or slightly longer, than tube, *ca.* 1.5—2.5 mm long, upper pair of lobes adnate for *ca.* 80% of their length. **Standard** variously coloured from green, through apricot-pink to mauve or white or purple with outer surface green. **Wing** 10—12 mm long, purplish or green, with a long narrow, outward pointing auricle. **Keel** somewhat incurved, apex obtuse. Alternate **anthers** bearing a pair of glands basally, typical of the section *Haydonia*. **Ovary** thickly pubescent. **Style** prolonged as an oblique knob of tissue beyond the lateral, globular stigma. (Figure 15 C). **Legume** erect, cylindrical, up to 50 mm long, 3—4 mm wide, tomentellous to densely ferruginous, *ca.* 16-seeded. **Seeds** reddish brown, often mottled black, *ca.* 2—2.5 mm X 2—2.5 mm, aril absent. (Figure 15).

Only one collection exists for southern Africa, from the grassland of Namibia. (Figure 15 B).

Specimens examined

--1815 (Okahakana): Sibuyu River, (-DA), *P.A. Smith 4272* (PRE).

Other African localities

Tanzania: Ufipa-Mpanda, *Bullock 2263* (K); Buroba Province, *Chambers K23* (K); Mbeya Road, *Fuller 96* (K); near Mabira, Karangwe, *Haarer 2245* (K); half mile south-east of Ilomba local court, *Harwood 9* (K); Songea District, *Milne-Redhead & Taylor 8443* and Mbeya Airfield, *10164* (K); Irundi, *Paget-Wilkes 741* (K); Nyansi, *Peter 34056* and West Tabora district, *46014* (K); Mbeya, *Pollock 38* (K); near Mbarana, *Purseglove 501* (K); Sumbawanga district, *Richards 8484*, and Ufipa district, *15826* (K); 2 miles north of Kasungu, *Robson & Jackson 1168* (PRE).

Kenya: Kapenguria, *Bally 4047* (K); Kitali, *Bogden 1800, 4067* (K); Kipkarren, *Broadhurst Hill 98, 337* (K); Kitala, *Napier 1986* (K); Kaimosi, *Rogers 275* (K); South-west slopes of Mt. Elgon, *Tweedie 176* (K); Kitale, *Wiltshire 46A* (K).

Uganda: Maruka, *Maitland 894A* (K).

Zimbabwe: Salisbury University Campus, *Mavi 778* (PRE).

Section 2. *Microspermae*

Section *Microspermae* Maréchal *et al.* in Taxon 27: 200 (1978b).
Type of section: *Vigna microsperma* Viguier: 178 (1952).

Stipules rounded or bilobate-auriculate at base. **Keel** with short rostrum. **Style** prolonged beyond the stigma by a short protuberance. **Stamens** without glands beneath anthers. **Seeds** with aril absent. **Pollen** grains with exine lacking broad, prominent reticulations.

11. **Vigna mudenia** *Pienaar* in South African Journal of Botany 57,6: 314—318 (1991). Type: South Africa, Natal, Muden district, 1.4 km on district road D568 off tarmac road (R74) from Muden to Weenen, 1989:01:26, *Pienaar & Archer 1325* (PRE!, holo., K!, MO!, PRU!, iso.)

FOR A COMPREHENSIVE TREATMENT OF *V. MUDENIA* PIENAAR, SEE ADDENDUM 2. (Figures 1—5 and Figure 18 in the thesis)

South-facing hillslopes in the Natal midlands thornveld (*Acacia robusta* in grassland), northwest of Muden village. Two other records exist, *Pott 5309* (PRE) from Barberton and *Lawn 1485* (NH) from Eshowe but to date no recent collections have been made in these localities.

Specimens examined

--2531 (Komatipoort): Barberton (-CC), *Pott 5309* (PRE).
--2830 (Dundee): 7 km from Muden on road to Colenso (-CD), *Pienaar 416* (PRE); 1.8 km on district road D568, turning off Muden—Colenso road (-CD), *Pienaar & Archer 1324* (PRE, PRU); 1.4 km on district road D568 (-CD), *Pienaar & Archer 1325* (PRE, PRU); 0.2 km from district road D568 back on road to Muden (-CD), *Pienaar & Archer 1326* (PRE, PRU).
--2831 (Nkandla): Eshowe (-CD), *Lawn 1485* (NH).

Subgenus 4. *Plectrotropis*

Subgenus *Plectrotropis* (Schumacher) Bak. in Hook., Fl. Brit. India 2: 206 (1876). Lectotype for subgenus and section designated by Verdc. (1970): *Plectrotropis angustifolia* Schumach. & Thonn. [= *Vigna vexillata* (L.) A. Rich. var. *angustifolia* (Schumach. & Thonn.) Bak.].

Plectrotropis Schumach. in Schumach. & Thonn., Beskriv. Guin. Pl..: 338 (1827); Piper in Contrib. U. S. Nat. Herb. 22: 663,664 (1926).
[*Strophostyles* sensu E. Mey.: 147 (1836), *non* Elliott.]
Vigna sect. *Vexillatae* Harms: 689 (1915).

Stipules shortly appendaged or distinctly to scarcely bilobed at base, but not peltate. **Style** with thickened part curved, thickened at the apex into a bonnet-like shape and lateral stigma. **Pollen** grains with wide reticulations of raised muri.

The subgenus occupies an intermediate position between the subgenera *Vigna* and *Ceratotropis* (Maréchal *et al.* 1978a). A similarity in the floral morphology to the latter is probably connected with specialization toward entogamous (i.e. selfing) fertilization (Maréchal *et al.* 1978a). It does not seem to be the result of simple convergence but to have an important phylogenetic significance.

Section 1. *Plectrotropis*

Lectotype: as for subgenus.

Ferruginous herbs, perennial, twining, flowers appearing with the leaves.

12. *Vigna vexillata* (L.) A. Rich. In De La Sagra, R., Hist. Fis. polit. nat. i. Cuba (Spanish ed.) 11: 191 (1845); A. Rich.: 440 (1846); Benth.: 194, t. 50/1 (excluding nos. 5—9, 17 & 29) (1859); Bak.: 199 (1871); Harv.: 240 (1862); Bak. f.: 413 (1929); Burtt Davy: 420 (1932); Wilcz.: 379, t. 29, text fig. 18/C (1954a); Hepper: 567 (1958); Verdc.: 553 (1970), 652 (1971); Maréchal *et al.*: 202 (1978a). Type: Cuba, Havana, *Phaseolus flore odorato vexillo amplo patulo* of *Dillenius*, Hortus elthamensis 2: 313, t. 234 f. 302 (1732). [Iconolecto: MO, NY, U, facsimile at PRE!, designated by Verdcourt (1971)].

FOR A COMPREHENSIVE TREATMENT OF *V. VEXILLATA* (L.) A. RICH. SEE ADDENDUM 3. (Figure 1a—e for leaflet shapes and stipules; Figures 2—5 for the known distribution of the varieties, and Figures 6—8 for the style prolongations).

The species (Figure 16 A) is divided into the following infraspecific taxa in southern Africa:
a) var. *vexillata*; (Figure 16 B—E).
b) var. *angustifolia* (Schumach. & Thonn.) Bak.; (Figure 16 F).
c) var. *ovata* (E. Mey.) Pienaar comb. nov.; (Figure 16 G).
d) var. *davyi* (Bol.) Pienaar, comb. et. stat. nov.; (Figure 16 H & I).

12a *V. vexillata* var. *vexillata*

Specimens examined

--2230 (Messina): Entabeni, Soutpansberg (-CC), *Obermeyer 1207* (PRE); Messina (-AC), *Rogers 20787* (K), *19926* (K).
--2328 (Baltimore): Leliefontein, Pietersburg (-AC), *Stirton 5772* (PRE).
--2329 (Pietersburg): Hangklip, Louis Trichardt, Soutpansberg (-BB), *Bremekamp & Schweickerdt 440* (PRE); Losmekaar, Soutpansberg (-BD), *Rogers 18203* (BOL, J, PRE); Soekmekaar, Soutpansberg (-BD), *Rogers 18203* (K, PRE); Pietersburg (-CD), *H.Bolus BOL 45193* (BOL), *Bredenkamp & van Vuuren 68, 93* (PRE); near Dap Naude Dam, Pietersburg (-CD), *Stirton 5745* (PRE); Haenertsburg (-DD), *Acocks & Hafström 595* (PRE), *Crawford*

301 (PRE), *356* (K, PRE), *Rogers 19016a* (J), *Stirton 5781* (K, PRE); Houtbosch, Pietersburg (-DD), *H.Bolus 10946* (BOL, PRE), *Brenan 14122* (K), *Hutchinson 2210* (K), *Mogg 14652* (K, PRE), *Mogg PRE 56111* (PRE), *Moss 15492* (J), *Swierstra 3764* (PRE), *Rehman 6253* (K).

--2330 (Tzaneen): Elim, Soutpansberg (-AA), *Obermeyer 849, 850* (PRE); Westphalia Estate, near Duiwelskloof (-CA), *Bos 1178* (PRE); 14 km from turnoff on road to Woodbush from Magoebaskloof (-CC), *Germishuizen 188* (K, PRE); Magoebaskloof (-CC), *Grobbelaar 416* (PRE).

--2331 (Phalaborwa): Letaba (-DC), *Scheepers 75,* (K), *158* (PRE).

--2428 (Nylstroom): Sterkrivier Dam Nature Reserve (-BC), *Jacobson 2051* (PRE); Geelhoutkop (-AD), *Breyer 18121* (PRE); Warmbaths (-CD), *Leendertz 5980* (PRE).

--2429 (Zebediela): 28.5 miles north-east of Groblersdal (-CD), *Acocks 20892* (PRE).

--2430 (Pilgrim's Rest): The Downs (-AA), *Junod 4379* (PRE); Pilgrim's Rest town (-DD) *Germishuizen 152* (K, PRE).

--2431(Acornhoek): 1 km from turnoff to Graskop from Bosbokrand road (-CC), *Germishuizen 151* (PRE).

--2526 (Zeerust): Swartruggens (-DA), *Sutton 976* (K, PRE), *Fouche 1* (PRE), *Sutton 977* PRE); 16 km from Zeerust on road to Mafikeng (-DA), *Grobbelaar 1849* (PRE).

--2527 (Rustenburg): Pelindaba, Uitkomst 499 JQ (-DD), *Coetzee 114* (PRE); Hartebeespoort (-DD), *Muller 177* (PRE).

--2528 (Pretoria) Hoornsnek, Pretoria dist. (-CA), *Codd 880* (PRE); near Pretoria zoo extension (-CA), *Codd 897* (PRE); Erf 33, Les Marais, Pretoria (-CA), *Hanekom 1910* (K, PRE); Pretoria (-CA), *Leendertz 8406* (PRE), *Moss 3190* (J); Ashbury station, Pretoria (-CA), *C.A.Smith 1354* (PRE); Onderstepoort, Pretoria (-CA), *Theiler 9309* (K, PRE); 14 miles south-east of Pretoria (-CB), *Codd 2207* (PRE); Franspoort Farm, 3 km north-east of Mamelodi (-CB), *Retief 1166* (PRE); Wonderboom Reserve, Pretoria (-CB), *Repton 2757* (K, PRE); Fountains valley, Pretoria (-CC), *Repton 107* (PRE); Waterkloof, Pretoria (-CC), *Verdoorn 134* (K, PRE); Smuts farm, Irene (-CC) *Germishuizen 73* (PRE); Irene (-CC), *C.A.Smith 3515* (PRE); Doornkloof, approx. 10 miles south of Pretoria (-CC), *van Niekerk 3309* (PRE); 13 miles from Pretoria on Delmas road (-CD), *Story 1466* (K, PRE); Bronkhorstspruit (-DC), *Merxmuller 410* (BM, K).

--2529 (Witbank): near Witbank station (-CC), *Gilfillan 7179* (PRE); Middelburg (-CC), *Jenkins 9142* (PRE).

--2530 (Lydenburg): Draaikraal, Lydenburg dist. (-AA), *Strey 3025* (K, PRE); 46 km from Burgersfort on road to Lydenburg (-AB), *Germishuizen 428* (PRE); Vermont station, Lydenburg dist. (-AD), *Burgoyne 912* (PRE); Witklip (-BB), *Kluge 397* (PRE); forest road turnoff, 43 km from Lydenburg (-BD), *Germishuizen 93* (K, PRE); Waterval-Boven (-CB), *Mason 28, 32* (K); 21 km from Machadodorp on road to Badplaas (-CC), *Germishuizen 5021* (PRE); entrance to Jambila forest, 29 km from Barberton on Badplaas road (-DD), *Kok & Pienaar 1297* (PRE).

--2531 (Komatipoort): 6 km from White River on road to Hazyview (-AC), *Germishuizen 142* (PRE); 14 km from Nelspruit on Kaapmuiden road (-AC), *Rogers 22083*; Komatipoort (-BD), *Rogers 22164* (K), *Germishuizen 105* (K, PRE); Sithungwane (-BD), *van der Schyff 1933* (PRE); 28 Renosterkop, dist. Nelspruit (-CA), *Onderstal 1185* (PRE); Eerste Geluk no. 16, Uitkyk (-CA), *Stirton 1728* (PRE); River's Creek, Barberton (-CC), *Galpin 795* (K, PRE); Berea Ridge, Barberton (-CC), *Galpin 1300* (PRE); 1 km from Ameida Forestry Station, Barberton (-CC), *Pienaar 905* (PRE); Saddleback Ridge, 14 km from north-east of Barberton (-CC), *Pienaar 919* (PRE); Barberton (-CC), *Rogers* 18502 (J), *Thorncroft 69* (PRE); Pigg's Peak, Swaziland (-CC), *Compton 30612* (NBG).

--2627 (Potchefstroom): Sterkfontein Caves, Isaac Stegman Nature Reserve, dist. Krugersdorp (-BA), *Mogg 33072, 34706, 35624, 36005* (J); Waterval, 2 miles west-north-west of Krugersdorp (-BA), *Mogg 23242* (J, PRE); Great Olifants River (-BA), *van Niekerk 7559* (PRE); Transvaal Botanic Garden, Roodepoort (-BB), *Behr 274* (NBG); New Canada Junction, Johannesburg (-BB), *Weeks J 060186* (J); Potchefstroom dist. (-CA), *Louw 1652* (PRE); Klipdrif, east of Potchefstroom (-CA), *Theron 1150* (PRE); Highveld Gardens, Sasolburg (-DD), *Kroon 108* (PRE).

--2628 (Johannesburg): Frankenwald North (-AA), *Collins J 32006* (J); Melville Koppies (-AA), *Gugwini J 39364* (J), *Lucas 92, 212* (J), *Macrae J 32790* (J); Johannesburg Bot.

Gdn. 2415 (-AA), *Lambert 22983* (PRE); Fourways Golf Course (-AA), *Laminski 10* (J); Johannesburg (-AA), *Leendertz 6092* (PRE); Lyme Park, Johannesburg (-AA), *Munday 632* (J); Frankenwald, Zoo Koppies, Johannesburg (-AA), *Moss 8367, 9365* (J), *Raal 55*, (J); Johannesburg (-AA), *Rand 841* (BM); Rooikop, Johannesburg (-CA), *Smuts & Gillett 2090* (PRE); Suikerbosrand Nature Reserve, Heidelberg dist. (-AC), *Wolff 3* (PRE), *Acocks 20852* (PRE); neck at Sedaven Dam (-CA), *Bredenkamp 330* (PRE).

--2629 (Bethal): Standerton (-CD), *Jenkins 9937* (PRE).

--2630 (Carolina): 17 km from Lake Chrissie on road to Oshoek (-AB), *Germishuizen 5062a* (PRE); Lake Chrissie outskirts on road to Lochiel (-AC), *Germishuizen 3902* (PRE); 4 km from Lake Chrissie on road to Oshoek (-AC), *Germishuizen 5056* (PRE).

--2631 (Mbabane): Mbabane, Swaziland (-AC), *Compton 22407a, 23275* (NBG), *25312b* (PRE).

--2727 (Kroonstad): Near convent, Kroonstad (-CA), *Pont 449* (PRE).

--2730 (Vryheid): 5 miles from Utrecht on Wakkerstroom road (-CB), *Hilliard 2187* (DWU).

--2731 (Louwsburg): Itala Nature reserve, west of fence, 3-4 miles south of Ithalu River (-CA), *Brown & Shapiro 488, 490* (PRE); 5.5 miles down Hlohlomo road, Ngotshe dist. (-CB), *Acocks 13043* (PRE); 21 km from Louwsburg on road to Ngome Forest (-CB), *Germishuizen 2162* (PRE); near Ngome Police Station (-CD), *Acocks 13948* (PRE).

--2732 (Ubombo): Tembe Elephant Park (-AB), *Ward 1932* (NH); IDC. rice project site, *ca.* 2 km from turnoff to Phelendaba on Mbazwana road (-BA), *Germishuizen 3614* (PRE); eucalyptus plantation, Mbazwane (-BC), *Vahrmeyer & Toelken* (K, PRE); Muzi Swamp area, approx. 5 km from rice project office (-CA), *Germishuizen 3138* (PRE).

--2824 (Kimberley): Warrenton, Kimberley dist. (-BB), *Wilman s.n.* (BOL).

--2829 (Harrismith): Drakensberg Bot. Gdn. (-AC), *van der Zeyde 177/71* (NBG); Pitcher's Rest, 12 km north-east of Van Reenen (-AD), *Jacobz 1707* (NBG, PRE); Kerkenberg (-CA), *Jacobz 1314* (PRE); Oliviershoek (-CA), *Strey 9504* (NH, PRE).

--2830 (Dundee): Babanango grassveld (-AC), *King 222* (PRE); New Beacon Hill Station, Weenen (-CC), *Acocks 10246a* (NH); 12 km from Muden on south-east slope (-CD), *Pienaar 420, 421, 422* (PRE); 24 km from Kranskop on road to Vryheid (-DD), *Arnold 1392* (PRE).

--2831 (Nkandla): Hluhluwe Game Reserve (-AA), *Ward 2418* (NH); 2 km from Mtonjaneni (-AD), *Acocks 13972* (PRE); Zondela, Mahlabatini (-AD), *Gerstner 4274* (PRE); stream valley, Hlabisa dist. (-BB), *Ward 2418* (PRE); Eshowe (-CD), *Gerstner 2399a* (PRE); 15 km north of Empangeni, north of Nkwalini heights on road to Melmoth (-DA), *Pienaar 1279* (PRE); 1 km from Mlalazi bridge on road to Mtunzini from Empangeni (-DD), *Pienaar 830* PRE).

--2832 (Mtubatuba): stream valley, Hlabisa district (-AA), *Ward 2418* (PRE).

--2929 (Underberg): near Dalton Bridge, Estcourt (-BB), *Sidey 131* (PRE); 4.3 km from Boston on road to Bulwer (-DB), *Pienaar 554* (PRE).

--2930 (Pietermaritzburg): Toward Muden on Middelrus Road, 2 km beyond Boshoff's farm, Vorentoe (-AA), *Kok & Pienaar 1201a* (PRE); Stonetrees Farm, Lion's River (-AC), *Hesom NH 27425* (NH); Lidgeton (-AC), *Mogg 1416* (PRE); Lion's River (-AC), *Mogg 5645* (PRE), *Rycroft 2376* (NBG); hay field, Single Tree, Lion's River (-AC), *Moll 621* (PRE); 3 km to Tweedie, from Howick, on farm road to O'Flahrty's smallholding (-AC), *Pienaar 492* (PRE); Dalton (-CA), *Mogg 59* (PRE); Mgeni river above Midmar Dam, Lion's River (-CA), *Moll 1244* (PRE); 11 km from Pietermaritzburg on road to Greytown (-CB), *Kok & Pienaar 1244* [forma alba] (PRE); road to Richmond, Pietermaritzburg (-CB), *Barker 5146* (NBG); Claversay, Pietermaritzburg dist. (-CB), *Barker 10600* (NBG); Pietermaritzburg (-CB), *Lowes PRE 56152* (PRE); 3 km from Cedara on old road to Pietermaritzburg (-CB), *Pienaar 482* (PRE); Bishopstowe (-CB), *Stirton 5522* (K, PRE); Byrne, Richmond (-CC), *Galpin 11973* (PRE); Westville University Campus (-CD), *Akoob 8* (DWU); 11 km from Thornville Junction on road to Eston (-CD), *Stirton 5440* (K, PRE); Umlaas Road (-DA), *Evans 341* (NH); 1 km from Inanda Village on Drummond-Inanda turnoff (-DA), *Pienaar 389* (PRE); 32 km to Umbumbulu on road to Eston (-DA), *Stirton 1102* (PRE); near Eston (-DA), *Schrire 466* (NH); Umlaas Road, Durban (-DA), *Stirton 517* (K, PRE); 7 km from Thornville to Eston (-DB), *Stirton 5434* (K, PRE); Inanda (-DB), *Wood 675* (NH), *1128* (BM, BOL, K); 8 km from Mid-Illovo to Eston (-DC), *Stirton 1121* (PRE); Dawn Crescent, Westville (-DD), *Adams 7* (PRE); Pinetown dist., Gillets, Chelmsford Park (-DD), *Hilliard 1822* (DWU); Durban dist. (-DD), *Jenkins 7088* (PRE); Silverglen Nature Reserve, north-east of Umlazi

Nursery (-DD), *Ngwenya 179* (NH); New Germany, Durban (-DD), *Strey 9296* (K, PRE); Merebank East, Durban (-DD), *Ward 5396* (PRE, DWU).
--2931 (Stanger): Hawaan Forest, Umhlanga (-CA), *Pienaar 846* (PRE); Lower Tugela, main road near Compensation Beach (-CA), *Stirton 1161* (PRE).
--3029 (Kokstad): Clydesdale (-BD), *Tyson 2535* (SAM); Kokstad (-CB), *Tyson 1344* (SAM); 20 km from iZingolweni to Harding (-AC), *Stirton 10377* (NH); Weza Forest (-DA), *Taylor 5261* (NBG); Rooi Vaal, Harding (-DB), *Taylor 5270* (NBG); near Harding, dist. Alfred (-DB), *Kelly 55* (NBG).
--3030 (Port Shepstone): Ixopo (-AA), *Nass NBG 16969* (NBG); Rock Fountain, Ixopo (-AA), *Clarke 91* (BM); St. James Anglican Church near Highflats (-AC), *Schrire 829* (PRE); Eucalyptus plantation, Fairfield (-AD), *Bayer 1403* (NH); 2 km from Umzinto to Highflats (-BC), *Stirton 5577* (K, PRE).
--3128 (Umtata): 1 mile south-east of Tsolo on road to Umtata (-BD), *Story 424* (K, PRE).
--3129 (Port St Johns): Between Port St Johns and Lusikisiki (-DA), *Hutchinson 1772* (K).
--3225 (Somerset East): Wilsdeli, Stockenstroom (-DD), *Scully 153* (PRE).
--3226 (Fort Beaufort): Kaffraria, Engotini, Shiloh Mission (-BB), *Rev. Bauer* (K); Katberg (-DA), *Sole 411* (PRE).

Precise localities unknown

Arnold s.n. (PRE); Bauer, *Marloth 8712* (PRE); *Breyer TM 23902* (K); *Flanagan s.n.* (PRE); Wattles, WWR, *Moss 13630* (J); *Moss 3190* (J); Natal, *Sanderson 340* (TCD); Latitude 30, Natal, *Sutherland* (K); Eastern Transvaal, *Taylor 1979* (PRE); *Tyson SAM 5840* (SAM); Transvaal, *van Niekerk 330* (BOL).

Other African localities

Mozambique: Inhaca Island, *Mogg 32137* (PRE).
Malawi: Malawi, (var. *dolichonema*), *Du Plessis* (PRE).
Cameroun: Manegouba Mountains, near Nkongasamba, (var. *dolichonema*), *Leeuenberg 8671* (PRE).

12b *V. vexillata* var. *angustifolia*.

Specimens examined

--2327 (Ellisras): Matlabas River (-CC), *Krantz TM 6849* (PRE).
--2328 (Baltimore): Magoeboeskloof (-DA), *Grobbelaar 457* (PRE).
--2329 (Zebediela): mountain home, Haenertsburg (-DD), *Murray W1* (PRE), *Pott TM 13442* (PRE).
--2330 (Tzaneen): Westfalia Estate, near Duiwelskloof (-CA), *Bos 1178a* (PRE), *Scheepers 1194* (PRE); Magoebaskloof (-CC), *Mogg 10661* (PRE); 2 miles from Tzaneen to Duiwelskloof (-CC), *Stirton 8035* (PRE).
--2428 (Nylstroom): Naboomspruit (-DA), *Galpin M91* (PRE).
--2430 (Pilgrim's Rest): Pilgrim's Rest (-DD), *Rogers 14505* (K).
--2431 (Acornhoek): Manyeleti Game Reserve (-CB), *Bredenkamp 1771* (PRE).
--2526 (Zeerust): Zeerust (-CA), *Jenkins TM 11678* (PRE), *Leendertz TM 11516* (PRE); Zwartruggens (-DA), *Sutton 953, 978* (PRE); Zwartruggens, Brakfontein Farm (-DA), *Van Hoepen 1749* (PRE).
--2527 (Rustenburg): Houwater 54 JQ, farm near dam (-AC), *Germishuizen 637* (PRE); Beestkraal (-AD), *Jenkins TM 6951* (PRE); Rustenburg (-CD), *Nation 79* (BOL); Hartebeestpoort Experimental Station, Brits (-DB), *Codd 260* (PRE); Hartebeestpoort (-DB), *Moss 13268* (J).
--2528 (Pretoria): Elands River Bridge, *ca.* 16 km from Cullinan to Groblersdal (-BC), *Germishuizen 1370* (PRE); Arcadia, Pretoria (-CA), *Burtt Davy 3930* (K, PRE); banks of Apies River (-CA), *Codd 669* (PRE); Pretoria (-CA), *Leendertz 421a* (PRE); Ashbury Dolomites, Pretoria (-CA), *Mogg 16187* (PRE); Apies River bank, Prinshof, Pretoria (-CA), *C.A. Smith 1453* (K, PRE), *Verdoorn 1481* (K); Magaliesberg, Hornsnek, Pretoria (-CA),

Schlieben 7835 (K); University Pretoria Experimental Farm (-CB), *Codd 585* (PRE), *Verdoorn PRE 10065* (PRE); S. A. Agricultural Research Institute near Koedoespoort, Pretoria (-CB), *Mogg 17558* (PRE), *Wager TM 27101* (PRE); Erasmus drift, Pretoria, (-CB), *Mogg PRE 11676* (PRE); 20—30 miles north-east of Pretoria (-CA), *Werdermann & Oberdiek 1234* (K, PRE); Botanical Reserve, Brummeria (-CB), *Letty 1959* (K, PRE); National Botanic Garden (-CB), *Dryfhout 926* (PRE); Waterkloof Glen Extension 2, Pretoria (-CC), *Joffe s.n.* (PRE); Fountains valley, Pretoria (-CC), *Verdoorn 706* (PRE); 18 miles south of Pretoria on road to Welbekend (-CD), *Clarke 145* (PRE); field off Rodericks Road, Lynnwood, Pretoria (-CD), *Clarke 1073* (PRE); Ravenal Stream, Wolwekloof, Garsfontein, Pretoria (-CD), *Mogg 15958* (PRE); Van Riebeeck Nature Reserve (-CD), *Kok 232* (PRE); Faerie Glen, Pretoria (-CD), *SAGP/SAAB 3/130* (PRE); Pienaar's River, Silverton (-CD), *Merxmüller 168* (BM, K, SRGH); 14 miles east of Pretoria (-DC), *Collins J32004* (J); 26 km from Pretoria on road to Bronkhorstspruit (-DC), *Germishuizen 458* (K, PRE).

--2530 (Lydenburg): Lydenburg (-AB), *Wilms TM 5842* (PRE); Nelspruit to Sabie, 20 km south of Sabie (-BB), *Onderstal 1037* (PRE); Sabie (-BB), *Rogers PRE 56236* (PRE); Crocodile River (-BC), *Burke 11843* (BM); Waterval-Boven (-CB), *Rogers 14414* (K); Belfast dist., Kaalbooi Farm 368 IT, 7 km from Waterval-Boven (-CB), *Jacobsen 4852* (PRE); Waterval-Onder (-CB), *Jenkins TM 6728* (PRE); Machadodorp (-CB), *Rogers 18189* (BOL); 24 km from Nelspruit on road to Barberton (-DB), *Germishuizen 125a* (K, PRE).

--2531 (Komatipoort): 6 km from White River on road to Hazyview (-AC), *Germishuizen 190* (K, PRE), *192* (PRE); Beersrust L 53 JV (-AC), *Jacobsen 5474* (PRE); 20 km from Kaapmuiden on road to Komatipoort (-BC), *Germishuizen 110* (K, PRE); 8 km from Hectorspruit on road to Komatipoort (-BC), *Germishuizen 112* (K, PRE); Eerstegeluk, 15.8 km from Nelspruit (-CA), *Retief 1241* (K, PRE); Eerstegeluk 16 (-CA), *Stirton 1741* (PRE); 9 km from Barberton on road to Havelock (-CC), *Germishuizen 136* (PRE); Barberton, 1 km from Ameida Forestry Station (-CC), *Pienaar 905* (PRE); near Matibiskom between Lourenzo Marques and Komatipoort (-DB), *H. Bolus 7735* (BOL).

--2627 (Potchefstroom): Ventersdorp/Krugersdorp road, 1 km from turnoff to Klerkskraal Dam (-BD), *Bezuidenhout 117* (PRE); Bailey Nature Reserve, Carltonville (-AD), *Van Wyk 165* (PRE); Sterkfontein Caves, Krugersdorp, Isaac Stegmann Nature Reserve (-BA), *Mogg 35266* (K, PRE, SRGH), *35566, 35567* (K); Krugersdorp (-BB), *Jenkins TM 9250* (PRE); empty erven at corner Monkor & Jukskei Roads, Johannesburg (-BB), *Liebenberg 8392* (K, PRE); Witpoortjie station, West Rand (-BB), *Strange 27548* (J); Potchefstroom (-CA), *Leendertz TM 9478* (PRE); Banks Station, Potchefstroom district (-CA), *Louw 1652* (K); Oudedorp, Potchefstroom (-CC), *Botha & Ubbink 1763* (PRE).

--2628 (Johannesburg): Frankenwald (-AA), *Lucas J33078* (J); Modderfontein (-AA), *Macnae J31997* (J), *Nation 1904* (K); Zoo Koppies, Johannesburg (-AA), *Moss 13631* (J); Lyme Park, Johannesburg (-AA), *Munday 684* (J); Steyn's Farm, Johannesburg (-AA), *Ommanney 102* (BM); Kensington, Johannesburg (-AA), *Peters 27577* (J); Bosch Koppies, Johannesburg (-AA), *Young J60192)* (J); Heidelberg (-CB), *Acocks 20852* (K).

--2630 (Carolina): 10 km from Badplaas on road to Lake Chrissie (-BA), *Germishuizen 5041* (PRE); 20 km from Lochiel on road to Badplaas (-BA), *Germishuizen 3859a* (PRE); 43 km from Lake Chrissie on road to Lothair, 3 km from Jessievale Forest, 7 km from Amsterdam turnoff (-CA), *Pienaar 1361* (PRE).

--2631 (Mbabane): Mbabane, above Waterford School (-AC), *Brenan & Vahrmeyer 14286* (K, PRE); Tshaneni (-DC), *Barrett 43* (PRE).

--2632 (Bela Vista): Phongolo flood-plain, Ndumu (-CD), *Pooley 173* (PRE); Kosi Bay Nature Reserve (-DD), *Ward 852* (NH).

--2725 (Bloemhof): Boskuil, Wolmaranstad (-BD), *Sutton 683* (PRE); Bloemhof Dam Nature Reserve, Bultfontein (-CB), *O'Connor 155* (K, PRE).

--2726 (Odendaalsrus): Viljoenskroon (-BB), *Sellschop s.n.* (PRE).

--2728 (Frankfort): Rietfontein Farm, 23 km south of Frankfort (-BC), *Retief 1046, 1046b* (PRE).

--2731 (Louwsburg): Golele, Pongolapoort Nature Reserve (-BD), *Kluge 2727* (PRE); 20 miles to Ndumu/Ingwavuma Foothills of the Lebombo Mountains (-DA), *Moll 4345* (PRE); Vryheid (-DD), *Galpin 9699* (PRE).

--2829 (Harrismith): Sandspruit area, Foot of Van Reenen's Pass (-DA), *Jacobsz 758* (K, PRE); Oliviershoek (-CA), *Strey 9504* (K); Spioenkop Nature Reserve near Winterton (-DA), *Schrire 2153* (NH).
--2830 (Dundee): near New Beacon Hill Station, Weenen (-CC), *Acocks 10426* (NH, PRE).
--2831 (Nkandla): Babanango grasslands (-AC), *King 224* (PRE); Hlabisa (-BB), *Ward 2417* (PRE); Melmoth (-CB), *Mogg 6187* (PRE); 3 km from Perry Ford Garage, Mtunzini (-DC), *Pienaar 831* (PRE).
--2832 (Mtubatuba): Hluhluwe Game Reserve (-AA), *Ward 2417* (NH).
--2930 (Pietermaritzburg): 2 km beyond Boshoff's Farm, Vorentoe, toward Muden on road to Middelrus (-AA), *Kok & Pienaar 1201* (PRE, PRU); St. Ives, road to Dargle (-AC), *Mogg 5644* (PRE); Tweedie (-AC), *Mogg 6756* (PRE); Lidgetton (-AC), *Mogg 8093* (PRE); 3 km to Tweedie from Howick, farm road on O'Flahrty's smallholding (-AC), *Pienaar 493, 493a* (PRE); 5 km from Lion's River Bridge, old road from Howick (-AC), *Pienaar 497*; 9 km on road from Pietermaritzburg to New Hanover (-AD), *Pienaar 392a* (PRE); Cooper Street Extension, Greytown (-BA), *Buthelezi 341* (NH), *Ngwenya 48* (NH); mountain-side, Greytown (-BA), *Galpin 14671, 14819* (PRE), *s.n.* (BOL); polocross grounds north of Greytown (-BA), *Kok & Pienaar 1217* (PRE, PRU); Ahrens, Mowbray, Greytown (-BB), *Fisher 915* (PRE); 11 km from New Hanover, coming from Greytown (-BC), *Pienaar & Kok 1239* (PRE, PRU); 16.4 km to Elandskop turnoff, on road to Merrivale from Boston (-CA), *Pienaar 538* (PRE); 3 km from Cedara on old road from Pietermaritzburg (-CB), *Pienaar 481* (K, PRE); Hay Paddock, Pietermaritzburg (-CD), *Pienaar 1060* (PRE); 1 km from Valley of a Thousand Hills on old main road to Durban (-DA), *Buthelezi 295* (NH); 0.25 km from Inchanga Abbattoir turnoff on old road to Durban (-DA), *Pienaar & Archer 1332* (PRE, PRU); 5 km from Eston turnoff on road to Natal South Coast (-DC), *Stirton 1101* (PRE); Inanda (-DB), *Moll 2007* (PRE), *Wood 675* (K), *1173* (K, NH); Key Ridge, Durban Highway (-DC), *Stirton 5079* (K, PRE); Reservoir Hills (-DD), *Matadin s.n.* (DWU); Isipingo Flats (-DD), *Ward 6526* (K, NH, PRE, DWU).
--2931 (Stanger): Groutville (-AD), *Moll 2549* (PRE).
--3028 (Matatiele): Avondale Farm (-BD), *Granger 3941* (PRE).
--3029 (Kokstad): Near Kokstad (-CB), *Tyson 1804* (BOL, SAM); Clydesdale (-BD), *Tyson 2536* (BOL, SAM).
--3030 (Port Shepstone): 6 km from Highflats on road to St. Faith's (-CA), *Pienaar 559* (PRE), *Acocks & Hafström 615* (PRE); Gibraltar Rock (-CB), *Germishuizen 1652* (PRE); Oribi Gorge, Port Shepstone district (-CB), *Hilliard 2778* (PRE).
--3126 (Queenstown): Bongolo Poort [Bonkolo Nek] (-DD), *Galpin 1975* (PRE).
--3128 (Umtata): 10 miles south of Qumbu (-BB), *Barker 9157* (NBG); Fort Gale, Umtata (-DD), *Germishuizen 2419, 3227* (PRE).
--3130 (Port Edward): 86.5 km from Lusikisiki on road to Port Edward (-DD), *Grobbelaar 2322* (PRE).
--3227 (Stutterheim): near Kei Road (-DA), *Ranger 259* (PRE); near Komgha (-DB), *Flanagan 128* (BOL, PRE, SAM).

Precise locality unknown

Springbok Flats (-AC), *Burtt Davy 873* (PRE); Rustenburg district, *Nation 79* (BOL); Kruger National Game Reserve (-DA), *Nel 5555* (PRE), *Van der Schyff 2079* (PRE); Crocodile River, *Zeyher SAM 32907*, pro parte, (SAM).

12c *Vigna vexillata* var. *ovata*

Specimens examined

--2329 (Pietersburg): near Pietersburg (-CD), *Bolus s.n.* (BOL).
--2531 (Komatipoort): near Barberton (-CC), *H.Bolus 7737* (BOL); Pigg's Peak (-CC), *Compton 30612* (PRE).
--2631 (Mbabane): Komati Pass, Mbabane (-AA), *Compton 31302* (NBG, PRE); Polwane Valley, Mbabane (-AC), *Compton 2536* (NBG, PRE); Little Usuta Valley, Mbabane (-AC), *Compton 25401* (NBG); Duiker Bush, Mbabane(-AC), *Compton 25538* (NBG, PRE); hill north-east of Mbabane (-AC), *Compton 25774* (PRE), *27547* [all 3 leaf shapes represented]

(NBG, PRE); Mukusini Hills, Mbabane (-AC), *Compton 31994* (NBG, PRE); road to Mooihoek, Hlatikulu (-CD), *Compton 27430* (NBG, PRE).
--2731 Louwsburg): 8 miles south of Hlatikulu (-CD), *Compton 30450* (NBG, PRE).
--2732 (Ubombo): Velabusha area (-BA), *Ward 251* (NH).
--2831 (Nkandla): 30 km to Eshowe, coming from Melmoth (-CB), *Pienaar 456* (PRE); Eshowe (-CD), *Lawn 1143* (NH); 4 km to Eshowe coming from Ginginhlovo (-CD), *Pienaar & Kok 1257* (PRE, PRU); Eshowe Game Park (-CD), *Pienaar & Kok 1266* (PRE, PRU).
--2930 (Pietermaritzburg): before Drummond on old main road, coming from Durban on side of Key Ridge (-DC), *Buthelezi 288* (NH); Gillitts, Durban (-DD), *Wood 11531* (PRE).
--3030 (Port Shepstone): 10 km on road from Highflats to Umzinto (-AD), *Schrire 840* (NH); Park Rynie (-BC), *Shepherd 42, 142* (NH); Scottburgh (-BC), *Schelpe 49* (BOL); 4 km after turnoff to Oribi Gorge on road from hotel to iZingolweni (-CA), *Schrire 468, 470* (NH); Gibraltar Rock, Port Shepstone (-CB), *Schrire 471* (NH, PRE); Port Shepstone (-CD), *Galpin 11009* (PRE); The Valleys Farm, Port Shepstone (-CD), *Mogg 13846* (PRE); Munster (-CD), *Gemmell BLF 6566* (PRE); Shelly Beach, Cowrie Cottage (-CD), *Du Toit 132* (PRE); Uvongo (-CD), *Grobbelaar 21513* (PRE), *Liebenberg 8071* (PRE), *Strey 6180* (PRE); Marina Beach, dist. Margate (-CD), *Jacobsen 2346* (PRE); Skyline Farm, Uvongo (-CD), *Mogg 38041, 38458* (PRE), *Pienaar 588* (PRE); 3 km south of Port Shepstone on Margate road (-CD), *Stirton 8046* (PRE); Margate (-CD), *Stirton 10355* (NH); 2 km from Hibberdene on road to Port Shepstone (-DA), *Germishuizen 1620* (PRE).
--3128 (Umtata): Baziya, Queenstown district (-CB), *Baur 89* (BOL); Baziya mountain, across Umtata River (-CB), *Baur 89* (SAM 32910); near Umtata, 20 miles south-west (-DC), *H. Bolus 8888* (BOL).
--3129 (Port St Johns): Lusikisiki (-BC), *Galpin 10963* (PRE); Mouth of Omsamcaba (Msikaba) river (-BD), *Drège v, c, 1* (P); Mkambati Nature Reserve (-BD), *Jordaan 934* (NH, PRE), *Nicholas & Smook* (PRE), *Sackleton 400* (PRE); between Mazizi Tea Estate and sea, Lusikisiki district, between Mtihlelo & Cutweni Rivers, in maize fields (-BD), *Van Wyk & Matthews 7791* (NH); 78.2 km from Umtata on road to Port St Johns (-CB), *Grobbelaar 2313* (PRE); near Cape Hermes Hotel, Port St Johns (-DA), *Germishuizen 695* (PRE); Port St Johns district (-DA), *Swinney & Baker TM 14132* (PRE).
--3130 (Port Edward): Umtamvuna Nature Reserve (-AA), *Abbott 939* (NH); Port Edward Beach (-AA), *Ngwenya 233* (PRE), *Pienaar 805* (PRE); 2 km from Umtamvuna Bridge on road to Port Edward (-AA), *Pienaar 779* (PRE); Port Edward roadside (-AA), *Stirton 8073* (PRE).
--3227 (Stutterheim): near Turpin Dam, Bedford (-AD), *Acocks 16258* (PRE); Dohne near 753, Stutterheim dist. (-CB), *Acocks 9477* (PRE); Dohne Hill (-CB), *Sim 20146* (PRE); Pirie Forests, *Kuntze 94* (K); Pirie, King William's Town (-CD), *Sim 4046* (PRE); 3 miles from Amabele, near spring (-DA), *De Vries 131* (PRE); near Kei Road (-DA), *Ranger 259* (K); Nahoon, East London (-DD), *Barker 2916* (NBG); Gonubie Springs, East London district (-DD), *Peacock SAM 66090* (SAM).
--3228 (Butterworth): Kẹntani (-CB), *Pegler 165* (PRE); between Gekau and Basche (Mbashe) (-BB), *Drège 1830* (BM, P, PRE); Mazeppa Bay (-BC), *Plowes 2413* (PRE), *Theron 1216* (K, PRE); 10 miles west of Kei Mouth (-CA), *Compton 17619* (NBG), *Flanagan 1131* (BOL, PRE, SAM); Haga Haga (-CD), *Clarke 461, 486* (PRE).
--3229 (Talemofu): Hole-in-the-wall, Transkei (-AA), *Germishuizen 1218, 1219, 1864* (PRE).
--3324 (Steytlerville): Zwartkops River (-DB), *Drège 146* (TCD), *5484 (iv, C, c, 19)* (P), *Ecklon & Zeyher SAM 32908* (K, SAM); *Zeyher 528* (K), *SAM 32907*, pro parte, (SAM).
--3325 (Port Elizabeth): Galgebosch (-CC), *Drège iv, C, c, 10* (P); Uitenhage (-CD), *Alexander 120* (K), *Drége 333, Zeyher 1181* (TCD); *Schlechter 2542* (PRE); Selborne, Addo, Port Elizabeth (-DA), *C.A.Smith 3703* (PRE).
--3326 (Grahamstown): Botha's Hill (-BA), *Mac Owen 224* (BM, BOL, K, TCD); Grahamstown (-BC), *Galpin 332* (PRE), *Zeyher* SAM 15590 (SAM); Round Hill, Lower Albany (-BD), *H. Bolus* (BOL); between Skietrug and Waaiheuwel turnoff on road from Salem to Alexandria (-CB), *Archibald 5349* (PRE); 11.75 miles from Alexandria (-CB), *Marais 192* (PRE); near golf course, Kowie, Bathurst (-DB), *Britten 5253, PRE 56150* (PRE); 5 km from Port Alfred on road to Kenton on Sea (-DB), *Germishuizen 1532* (PRE); 2 miles east of Port Alfred on road to East London (-DB), *Gibbs Russell s.n.* (PRE); Port Alfred (-DB), *Hutton 572* (BOL); coastal area, Bathurst (-DB), *Sidey 3143* (PRE).

--3327 (Peddie): Kidd's Beach, East London (-BA), *Taylor 5585* (NBG), *Vahrmeyer 2297* (PRE); slopes near sea, East London (-BB), *Galpin 1843* (PRE), *Potts 1808* (BOL); Downs, near Buffalo River Mouth (-BB), *Munsy 99* (SAM).
--3423 (Knysna): Knysna (-AA), *Duthie s.n.* (BOL); Plettenberg Bay (-AB), *Rogers 26670* (PRE); Wittedrif, Plettenberg Bay (-AB), *Zeyher SAM 15591* (SAM, TCD); Slang River, Humansdorp (-BA), *Fourcade 1847* (BOL); seashore at Eerste River, Humansdorp (-BA), *Fourcade 1968* (K).
Precise locality unknown

C.B.S. 1847, *Alexander* (BM); Kromme River, *H.Bolus 1404* (BOL); *Burchell 4531* (K); between Omtendo (Mtentu) and Omsamkulo (Mzimkulu) rivers, *Drège v,c; 3825* (P); Cap de Bonne Esperance [2 collected 1837] (P); *Flanagan* (PRE); *Ottley 2606b* (J); Promont. C. Spei, *Capt. Waldegrave* (BM); Natal, *Weeks 81* [159?] (J).

12.4 *Vigna vexillata* var. *davyi*

Specimens examined

--2530 (Lydenburg): Waterval-Boven (-CB), *Rogers 10926* (PRE), *11705* (BOL); Godwan River, Barberton (-DA), *Rogers 21636* (PRE); Kaapsche Hoop (-DB), *Rogers TM 18809* (PRE).
--2531 (Komatipoort): Barberton, Saddleback Mountain (-CC), *Galpin 439, 439a, 439B* (PRE), *567* (BOL, PRE); Barberton, (-CC), *Thorncroft TM 3110* (PRE), *Turnbull PRE 4070* (PRE); Pigg's Peak (-CC), *Compton 27056* (NBG, PRE).
--2630 (Carolina): 4 miles west of Oshoek (-AB), *Codd 4765* (PRE); 43 km from Lake Chrissie on road to Lothair, 3 km from Jessievale Forest, 7 km from Amsterdam turnoff (-CA), *Pienaar 1359* (PRE); Maviristad (-CA), *Pott TM 15088* (PRE); Athole Pasture Research Station, Ermelo (-DA), *Preller 136* (PRE).
--2631 (Mbabane): 4.5 km north-east of Motjane (-AA), *Kemp 1011A* (PRE); Mbabane (-AC), *Davy 2827* (BM, PRE); Forbe's Reef, Mbabane (-AC), *Compton 22407* (NBG); hill north-east of Mbabane (-AC), *Compton 25345* (PRE); Ukutula, Mbabane, (-AC), *Compton 24825* (NBG); Stroma, Mbabane (-AC), *Compton 25601* (NBG, PRE); Black Umbuluzi, Mbabane (-AC), *Dlamini s.n.* (PRE); Mbabane (-AC), *Rogers 11603* (BOL); eastern foot of Lebombo Mountains (-BD), *Burtt-Davy 10588* (BOL); 23 miles from Mbabane to Bhunya (-CA), *Clarke 299* (PRE); from Siteki to near Mankayana (-CA), *Compton 30990* (PRE).
--2730 (Vryheid): Mooihoek, Piet Retief (-BA), *Devenish 62* (PRE); Piet Retief (-BB), *Leipoldt PRE 56133* (PRE), *Sidey 1955, 1956* (PRE); Luneberg, Paulpietersburg (-BC), *Galpin 10905* (PRE); Paulpietersburg, (-BD), *Germishuizen 2372* (PRE); 34 km from Vryheid on road to Paulpietersburg at Bivane River (-DB), *Germishuizen 2345, 2359* (PRE); 0.4 km north of Natal Spa Hotel (-DB), *Pienaar 765* (PRE), *Kok & Pienaar 1276, 1285, 1286* (PRE, PRU); Natal Spa property, grassland sloping to Bivane River (-DB), *Schrire 1290* (NH).

Precise locality unknown

"High Veld", between Carolina and Dalriach, Mbabane, *Bolus 11836* (syntype, PRE); Swaziland, *Stewart TM 10087* (PRE).

Section 2. *Pseudoliebrechtsia*

Section *Pseudoliebrechtsia* Verdcourt, *Kew Bull.* 24: 555 (1970).
Type of section: *Vigna nuda* N.E. Br., *Kew. Bull.*: 121 (1902).

Liebrechtsia ringoetii (De Wild.) De Wild., in *Fedde Repert.* 13: 114 (1902). Type: *A. Schmitz 7287* (BR! holo.).

Stipules with base scarcely appendiculate or bilobed. **Keel** slightly rostrate and curved, provided with a pocket on the left side. **Style** with broadened part slightly curved, the prolongation appearing like a bonnet as in *V. vexillata*, **stigma** oblique. **Pollen** grains with large reticulations and high muri. A pyrophytic herb with precocious flowers.

13. Vigna lobatifolia *Bak.*: 199 (1871); Verdc.: 555 (1970); Schreiber: 150 (1970); Maréchal *et al.*: 207 (1978a). Type: South West Africa/Namibia, Otjitno, *Dinter 869* (SAM!, iso.).

Vigna dinteri Harms: 207 (1911), non *Phaseolus dinteri* Harms (1913); Schreiber: 60:123 (1970). Type: as above.

Stems prostrate or twining, rising from a root system with moniliform tuberous swellings up to 60 mm in diameter; covered in short velvety or moderately long soft bristles, pale ferruginous or white. **Leaflets** petiolate, apical ones basally lobed and apically narrow-drawn out, lobes and apex rounded, acuminate or acute, apiculate, base cuneate or obtuse, *ca.* 30—40 X 20—30 mm, lateral leaflets asymmetric, sometimes sublobate, *ca.* 55—85 X 40—55 mm, all leaflets sub-coriaceous, velvety strigose on both surfaces, petioles up to *ca.* 40 mm, rhachis up to *ca.* 20 mm, petiolules *ca.* 2 mm. **Stipules** ovate, apex drawn out, obtuse, base laterally auricled or auricles sometimes connate with stem, sub-cordate, *ca.* 3—4 mm long, pubescent. **Inflorescence** a contracted raceme of 3—4 flowers, peduncles up to *ca.* 120 mm long. **Calyx** lobes fimbriate from a broad base, *ca.* 7—11 mm long, tube *ca.* 5 mm, pubescent. **Standard** unequally oblate, *ca.* 24 X 20 mm, lilac to rose. **Keel** twisted through less than 180°, inferior callosities only. **Ovary** thickly pubescent, pale ferruginous. **Style** elongated beyond lateral, papillate stigma to form a bonnet-like flap (Figure 17 C). **Legumes** erect, compressed cylindric, ferruginous-silky at first, later subglabrous, up to 130 mm long and 5—7 mm broad, *ca.* 16-seeded. **Seeds** grey-mottled to black, *ca.* 6 X 4 mm, hilum eccentric, aril-rim vestigial to absent (Figure 17).

In the *FSA* region, it occurs only in the sandy grassland of Namibia (Figure 17 B).

In general facies, *V. lobatifolia* resembles *V. frutescence*, but the floral characters are those of the section, *Plectrotropis*.

Characterized by moniliform tuberous swellings on the roots (Bushmen reputed to roast these for food), stems with short or long bristles (pale ferruginous or white), leaflets ovate to roundly lobed, flowers with keels somewhat twisted and calyx with long acuminate lobes.

Specimens examined

--1713 (Swartbooisdrif): Oukango (-DD), *Dinter 3402* (SAM).
--1714 (Ruacana Falls): 56 km north of Abdreh nach Ohopoho, on the road from Kamanjab to Ruacana (-CB), *Giess & Van der Walt 12719* (WIND).
--1715 (Ondangua): 67 km east of Oshikango (-AD), *Rodin 9283* (PRE, WIND); Ongongo Agricultural College, Ondangwa (-DD), *Van Jaarsveld 3023* (NBG).
--1724 (Katima Mulilo): Caprivi Strip, *ca.* 10 miles west of Katima Mulilo (-CA), *De Winter 9182* (PRE).
--1816 (Namutoni): Tsumeb district, Etosha Game Reserve near southern boundary, opposite Nooitgedacht Farm (-CD), *Tinley 1306* (WIND).
--1817 (Tsintsabis): Omuramba Mpungu on road from Nkurenkuru to Tsintsabis (-AD), *De Winter 3874* (PRE).
--1819 (Karakuwisa): Okavango, sand dunes 28 miles north of Karakuwisa to Omuramba Omatako Road (-DA), *Giess 10120* (PRE); Cigarette, north of Karakuwisa, Grootfontein district (-DB), *Maguire 2274* (PRE), *2466* (NBG); North Kalahari near Karakuwisa (-DC), *Schoenfelder 3* (PRE).
--1820 (Tarikora): 15.8 miles south of Kapupahed on track to Tamsu (-BC), *De Winter & Marais 4636* (PRE).
--1913 (Sesfontein): Obimbo, Omugorua, Okuponde (-BB), *Grobbelaar 89* (PRE, WIND).
--1917 (Tsumeb): Farm Kumkauas: GR 552, Tsumeb (-CA), *Giess 14974* (WIND).
--1918 (Grootfontein): Farm Biesiespan: GR 971, Grootfontein district (-CA), *Giess, Volk & Bleissner 6550* (WIND).
--1920 (Tsumkwe): Kaukauveld, 55 miles south of road to Tsumkwe near Botswana boundary (-DC), *Giess 9875* (PRE, WIND); occasional on sandy parkland *ca.* 5 miles south of Nama Pan, district Grootfontein (-DC), *Story 6404, 5227* (PRE).
--2116 (Okahandja): Otjikoko (-AB), *Dinter 869* (isotype), *SAM 73705, 73706* (SAM).

Other African localities

Zimbabwe: Chishawasha, near Salisbury, *Kolbe* (BOL).

INSUFFICIENTLY KNOWN SPECIES

14. Vigna sp. A (sp. nov.) Type (provisional): South Africa, Transvaal, Schagen, woodland 0.8 km from Crocodile Hotel on road to Rosehough, *Pienaar 1364* (PRE).

Rootstock dauciformis, at length woody. **Stem** erect in youth, twining at length, somewhat ridged to alate, scarcely strigose to patent with light hairs. **Leaflets** oblong with apex and base rounded in juvenile stage, *ca.* 25—58 X 0.8—30 mm, surface smooth to touch, adnately strigose, thickest along dorsal nerves and lamina margin, rhomboid to sublobular with rounded lobes at maturity, *ca.* 80 X 60—70 mm at broadest point, apices abruptly

abruptly narrowed, obtuse, apiculate, base cuneate to obtuse, papyraceous, strigose. **Stipules** with cordate base, laterally auriculate at maturity, lanceolate, reflexed, *ca.* 6 X 1.5 mm, acuminate, margins ciliate; in youth base more or less elongated, truncate (cf. *V. mudenia* Pienaar 1991). **Inflorescence** contracted, peduncles alate, bearing at the apex, one pair of yellowish green flowers, flushed violet, with a vertical row of extrafloral nectary glands between them (Figure 18 D). **Calyx** campanulate, lobes acute with broad bases, *ca.* as long as tube or shorter, *ca.* 2 mm, tube up to 3.25 mm long, upper pair of lobes connate for 1/3 to 1/2 their length, strigose. **Standard** ovate to oblate, emarginate, *ca.* 10—14 mm long, spur straight with inferior callosities divergent, auricular, superior callosities divergent, narrow (vestigial). **Wings** narrowly ovate, *ca.* 10.0 X 5.5 mm, auricle slender with raised cell sculpturing (almost papillate). **Keel** *ca.* 11 mm long, obtuse, slightly upturned. **Filament tube** *ca.* 10 mm long, free filaments in two whorls, 3 or 4 mm long, anterior filament geniculate at base, *ca.* 13 mm long; anthers oblate, glands at base absent. **Ovary** pubescent, *ca.* 9—10 mm long, **style** broadened and flattened as it curves upward, pollen brush on anterior face, apically twisted at maturity, accentuated protuberance of style prolongation absent but stylar tissue swollen as it bends toward the stigmatic papillae at somewhat more than 90°. **Pollen** grains scarcely reticulate, muri low, rounded. **Legumes** beaked, *ca.* 68 mm long, scabrid with long, stiff hairs along margin, 18-seeded. **Seeds** 3.4 mm long, yellowish brown to dark brown, black mottled round hilum, hilum scarcely eccentric, aril scarcely developed or absent (Figure 18).

In dense undergrowth of dry woodland in the Transvaal and Caprivi of northern Namibia (Figure 18 B).

This is regarded as a new species near to *V. mudenia* Pienaar, its facies appearing much like it. The contracted inflorescence bears two yellow-green flowers like those of *V. mudenia* but the leaflets are oblong with rounded base and apex in youth, becoming sublobular at maturity. SEM micrographs of the style prolongation (Figure 18 C) and of the pollen grains (Figure 18 E), support the decision to keep it in the same section as *V. mudenia* but to accept it as a new species to be published later. Its distribution also differs from that of *V. mudenia*.

The stylar thickening at the bend toward the lateral stigma, rather than a true protuberance, may represent a stage further than other members of the section *Microspermae* in the evolutionary trend toward losing the stylar beak in the subgenus *Haydonia*. The reticulations of the pollen exine have almost disappeared, a further development toward the smoothness in the section *Haydonia*, species *V. monophylla* Taub.

Specimens examined

--1724 (Katima Mulilo): 20 km south-west of Katima Mulilo (-CA), *De Winter 9180* (PRE).
--1821 (Andara): Kaprivi side of river, near Andara Mission Station (-AB), *De Winter & Marais 4812* (PRE); Dico, Andara, (-AB), *Giess 15572* (WIND).
--2431 (Acornhoek): Nwanetzi, Kruger National Park (-AD), *Coetzee 6062* (PRE).
--2527 (Rustenburg): Mountainside, Saulspoort (-AA), *Germishuizen 514* (PRE).
--2530 (Lydenburg): Schagen, farm of J.J. Van Niekerk, Nelspruit district (-BD), *Liebenberg 3297* (PRE); 0.8 km from Crocodile Hotel on turnoff to Rosehough (-BD), *Kok & Pienaar 1297* (PRE, PRU); 0.8 km from Crocodile Hotel on turnoff to Rosehough (-BD), *Pienaar 1364* (PRE).

CHAPTER 6

DISCUSSION

"We as taxonomists celebrate diversity. We celebrate the wildness of the planet. We celebrate the numerous human attempts to understand this wildness, and we mourn its loss through human miscalculation. We sense the aesthetic of life and much of our efforts are aimed at reflecting this composition. Above all we celebrate the challenges of being alive and dealing with the living world. There is no greater responsibility, privilege, nor satisfaction."

Tod F. Stuessy (1990): 406.

6.1 Taxonomy of *Vigna* in southern Africa

With the assistance provided by Verdcourt's pioneer work (1970) in separating the genera *Phaseolus* as a small concise group, and the genus *Vigna* as a more clumsy, complicated group with aberrant satellite groups around it, the first steps could be taken in sorting out the species of *Vigna* in southern Africa. Maréchal *et al.* (1978a) strengthened suspicions that had already taken root regarding the classification and evolutionary trends, although my approach was not by computerized means but, rather by a reasoned, intuitive approach using personal field and microscopic observations; the intellectual challenge was both daunting and satisfying.

My taxonomic proposals contain minor changes from those of Maréchal *et al.* (1978a), chiefly because the latter did not have all species growing in the *FSA* region at their disposal. In that regard, a positive contribution has, hopefully, been made. The use of SEM micrographs, particularly of stylar prolongations and pollen grains, made, I believe, certain taxonomic decisions possible. However, the shortage of financial assistance to further collecting trips to uncovered ground in the Orange Free State and Namibia, was keenly felt, especially when one considers that the natural habitat of the genus *Vigna* is systematically being destroyed in settlement and development programs. Co-operation with the Germplasm Institute at Bari, Italy, has been particularly appreciated in this regard. The autoradiograms received, supported my delimitations of the genus. A complete article on the electrophoretic profiles of the genus *Vigna* with its various subgenera and varieties will be published at a later date.

The inclusion of *V. frutescens* subsp. *frutescens* var. *frutescens* may be regarded as particularly meaningful as the species had been regarded as a new one by Harvey (1863) and was named *V. decipiens* Harv. as it resembled the equally beautiful *V. vexillata* which was known to Harvey, the difference being the absence of the spiral rostrum. The presence of a species already known in Africa, *V. frutescens*, was not recognized probably because the unusual length of the stylar prolongation passed unnoticed.

In the subgenus *Catjang* (DC.) Jaaska & Jaaska, a nomenclatural contribution could be made regarding the original form of the name from Malaya and its accepted spelling. The correct usage of the section *Plectrotropis* as conceived by Schumach. & Thonn. (1827), rather than *Plectotropis*, was clarified in ADDENDUM 3. A third nomenclatural contribution is the recognition of the lectotypification of *V. unguiculata* (L.) Walp. subsp. *unguiculata* by Westphal (1974).

The subgenus *Catjang* posed a challenge as the difference among the subspecies and their varieties could only be practically experienced in their natural habitats. The characters are concealed when dried specimens only are inspected. The need for the resurrection of E. Meyer's epithet *protracta* as a subspecies, and the varieties *oblonga* (var. *tenuis*) and *ovata* in *V. tenuis* became self-evident in the field, both in leaf shape and texture. Some intergrading of subspecies became evident where prolification of the subspecies of *V. tenuis* and *V. stenophylla* along the entire Natal coast occurs, making the decision toward either subspecies difficult. However, the decision was taken to include all relatively leathery, longer-than-broad specimens in *V. stenophylla*, even though they appeared dwarfed along the extreme north coast of Natal. Similar problems presented themselves regarding differentiation between *V. unguiculata* subsp. *dekindtiana* var. *dekindtiana* and var. *huillensis*. Observing them in their natural habitats where the leaf texture, colour and the heterophylly of var. *dekindtiana* were obvious, determined my differentiating between them. The pyrophytic nature of var. *huillensis* in certain parts of Africa, as observed by Mithen (1988a), never entered my experience and did not influence me in splitting the two varieties. Measurement of the lengths of the style prolongation proved to be useful as a discerning character among the subspecies of *Catjang*, although a measure of intergrading does occur. SEM micrographs elucidate the concept of the hammer-shaped prolongation.

Regarding the section *Plectrotropis*, observations of *V. davyii* Bol. in the field, immediately drew the attention to the occurrence of unifoliolate, bifoliolate and trifoliolate leaflets on the same stem, in no set pattern (Figure

13 H). Most herbarium sheets contain only pieces of stems or small pieces of erect plants (Figure 13 I) on which this arrangement of leaflets is not obvious. Plants grown in the nursery continue this habit. This fact induced me to reduce the status to a variety of *V. vexillata*. At first the possibility of equal status in the hierarchy as a subspecies was considered, but when further observations, such as the probable effect of acid soil in the vicinity of granitic outcrops, were considered, the decision was taken to allocate variety status, equal to var. *vexillata* and var. *angustifolia*. According to Davis & Heywood (1963: 335, 405), "phenotypic variation...is the result of the plastic response of the individual to factors of the environment" and "a phenetic response of adaptive significance may be accompanied or followed by one which is genotypically controlled". Yet ecotypes may not be given species status.

The occurrence of a miniature variety of *V. vexillata* in the coastal regions of the eastern Cape and Natal, one that characteristically creeps close to the soil surface and produces exceptionally sturdy peduncles that can withstand pressure from prevailing winds, led to the resurrection of E. Meyer's var. *ovatus*. To prevent further splitting, the three varieties of E. Meyer, namely vars. *ovatus, lanceolata* and *longifolia*, were combined as it could be argued that all these shapes are variations of ovate.

The two new species included in this thesis, could only be positively identified and separated from each other by SEM micrographs of the stylar prolongations. Both species proved to possess style prolongations different from any other species hitherto examined in the *FSA* region. The sculpturing of the pollen grains suggested their affinity with the section *Microspermae* (Viguier) Maréchal *et al.* of the subgenus *Haydonia* (Wilcz.) Verdcourt. The presence of alate stems, greatly contracted inflorescences, small seeds and recurved stipules that appear slightly elongated and truncate in the juvenile stage, proved their affinity with each other. It was only when their stylar prolongations were viewed in SEM micrographs, that two different species could be distinguished.

The smoothed pollen muri and only a thickening of the stylar tissue in *V.* sp. nov. A points to a further stage in the evolution toward the section *Haydonia* of the genus *Vigna*.

The importance of microscopic investigation of the stylar prolongations in the genus *Vigna*, is illustrated by the case of *V. unguiculata*(L.) Walp. subsp. *mensensis* (Schweinf.) Verdcourt (1970). Only remnants of an isotype (a dissected flower) were procurable from BR. The variety has not been collected in the *FSA* region, but, recorded in Zinbabwe, it may yet be collected across the border in the neighbouring regions. When viewed under the light microscope, since no material was available for SEM inspection, the hammer-shaped style prolongation of *V. unguiculata* could scarcely be recognized. The prominent projection on the top of the whole structure as present in the other subspecies and varieties, could clearly be distinguished behind the ridge dividing the stigmatic tissue from the cap forming part of the style prolongation, and the protuberance itself is much reduced. This, besides the spurred stipules, proved its affinity with *V. unguiculata* beyond doubt, although in modified form.

During initial SEM investigation into characters which could be of diagnostic importance, it soon appeared that all trichomes are broad-based and do not differ in the various species, not even when they differ in texture, density or length on organs (e.g. stems, leaflets) [Figure 3 A—C]. There did not appear to be a difference in size or character of stomata present in stems or leaflets (Figure 3 H). The general shape and size of anthers appeared to be similar in all species, the only diagnostic character being the presence of basal glands in *V. monophylla* (Figure 15 E) Taub. The most important findings regarding SEM studies, proved to be the structure of the style prolongation that typifies the different *Vigna* species.

The question as to whether I may regard myself as a splitter or a lumper, is difficult to answer. Where meaningful differences between varieties are constantly present in the plants' habitat, notice must be taken of them with a view to genotypic investigation by the geneticists in their breeding projects. However, where definite affinity between species or varieties is evident and they may rather be classed as ecotypes, a combination of individual species must be made as in the case of *V. vexillata* var. *davyi*, previously known as *V. davyi* Bol. Where large colonies of *Vigna* grow, as in the moist subtropical regions of the Transkei and Natal and in the Caprivi of Namibia, variation is most evident and a measure of grading also occurs.

Provided the underground tubers can be removed unscathed and the plants can be potted *in loco*, the *Vigna* plants may be moved to the nursery where they produce a reasonable amount of seed, as long as they are under shade cover only and the pollinators can reach them. No experiments were performed in which their power of selfing was put to the test in confined glass houses. Collection of seed must be done regularly as the legumes spring open when the air is sufficiently dry. It was observed in the Caprivi that mature legumes resume their straight character while the wet weather lasts and the pods are drenched with rain, to spring open, exposing spirally twisted valves and scattering the seed as soon as the sun dries them sufficiently later. When *V. vexillata* forma *alba* with completely white flowers slightly streaked with mauve in the centre at the base of the corolla only, were brought to the nursery, the resulting hybrids produced completely streaked flowers as illustrated in the frontispiece. It was by bringing seeds of *V. mudenia* to the nursery where they were cultivated in glass houses, that the plant form, the protracted inflorescence with its pair of yellowish flowers and the peculiar stylar protuberance could be observed. A specimen of what then was known as *V. decipiens* Harv. was expected to grow from the few seeds gathered from the spent twiner in the field!

The keys produced in this thesis may appear clumsy and too detailed. However, the diagnostic characters are often best defined when detail is considered and, since southern African workers have long been deprived of a suitable taxonomic treatise applicable to the indigenous *Vigna* species, clarity is essential. Stress is laid on the necessity of at least hand lenses for correct identification even in the field, which elucidates the use of magnification (e.g. lengths of the style protuberance in *V. unguiculata* and the detailed shapes of the style prolongations) in the keys. This approach may invite criticism, but the absolute necessity can not be overstressed. Experience has proven the ease with which misidentification occurs when detail is neglected.

6.2 Economic potential

In ADDENDUM 1 in the discussion of the uses to which *V. unguiculata* subsp. *unguiculata* cv-gr. *unguiculata* [known as cowpea, southern pea or black-eyed pea, niébe, dolique de Chine (Steele & Mehra 1978)] is put, its use as a vegetable protein-rich pulse for human consumption as well as the problems round its consumption, have been stressed. This is the Africa-originated branch of the genus *Vigna*, which corresponds with the species of the taxonomic hierarchy and includes both the cultigens and wild forms which hybridize freely (Baudoin & Maréchal 1985). The secondary gene pool according to Harlan & De Wet (*fide* Baudoin & Maréchal 1985) comprises other species that are relatives of the crop and are suitable for interspecific hybridization. They are isolated from the species partly by barriers such as chromosomal and genic sterility. The tertiary gene pool involves still greater barriers to hybridization, embracing taxa that display either unviable or sterile hybrids with the cultivated plant and do not permit gene flow by normal introgression.

Wild forms and species of the genus *Vigna* in Africa have great potential for the improvement of cultigens of *V. unguiculata* subsp. *unguiculata*, the cowpea, and priority should be given to collections of wild species and hybridization possibilities. The primary gene pool for a species like cowpea encompasses a huge range of morphologic and agronomic attributes, exceeding the variability present in primary gene pools of many other food legumes, and so far, gene exchange has not proved successful between most wild and the cultivated forms. Although some geographical regions of genetic diversity have been well explored in search of useful characters, other areas, including south eastern and southern Africa have been neglected (Baudoin & Maréchal, 1985). The latter are convinced that the lack of serious collecting activities in these areas limits not only knowledge of the crop evolution, but also the possibilities of new and outstanding genetic improvement. They believe that greater attention should be devoted to collection efforts before investigation of crosses with other *Vigna* species is attempted. This has partially been rectified in South Africa, I believe, by concentrated collections for this study, especially since the Germplasm Institute in Bari have co-operated and given financial support as well as assistance in collection; the NBI have contributed seed collections to the above Institute, but large areas in Namibia still need to be explored.

Interspecific crosses with *V. unguiculata* subsp. *unguiculata* have not been successful to date, not even with *V. nervosa* from the same subgenus *Catjang* (Mithen 1988b), which should then have been included in the secondary gene pool. The only other section in the subgenus *Vigna*, namely , the section *Liebrechtsia* with *V. frutescens*, which shows a relatively high coefficient with *Catjang* (Maréchal *et al.* 1978a), possesses a different chromosome number which will, likely as not, restrict gene flow.

The presence of strong isolating barriers blocking exploitation of the tertiary gene pool, can no doubt be cancelled by sophisticated methods such as cell, tissue and embryo culture, protoplast fusion and chromosome manipulation. Other constraints may then emerge, such as hybrid sterility and expression of the transferred genes in novel genotypic backgrounds (Baudoin & Maréchal, 1985).

At the time of going to press of the paper on `Cowpea taxonomy, origin and germplasm' by Ng & Maréchal in Singh & Rachie (1985), it was reported that all four cultigens of *V. unguiculata* subsp. *unguiculata* and the varieties of the subspecies *dekindtiana* as formulated by Maréchal *et al.* (1978a), were interfertile, although hybridization between var. *protracta* and the cultivated species had not been attempted since "no living collection of this variety is available". This statement has now been reversed because large collections of subspecies *protracta*, as published in this thesis, have been made, especially along the coastal areas of Natal, since the beginning of this study and a quantity of seed despatched to Bari, whence, no doubt, some has been distributed to Ibadan (Perrino, pers. comm.). Duplicates of the collections concerned will be despatched in due course to European and American Herbaria such as K, MO.

The genus *Vigna* provides both underground and above-ground crop possibilities, although attention appears to be focused to a greater extent on the latter species. The bambara groundnut, *V. subterranea* (L.) Verdcourt (1978, 1980), formerly *Voandzeia subterranea* (L.) Thours., is an annual herb with short compact to long, loose, sparsely pubescent, densely leafy stems. The legumes are only 1—2 cm long and contain one or two variously coloured seeds, white, yellow, red, blackish or mottled. There are two varieties, namely, var. *subterranea* which is cultivated in many parts of Africa besides Ethiopia, as well as in the tropics outside Africa. The wild variety, var. *spontanea* (Harms) Hepper, has a more diffuse habit and smaller seeds and is known only from northern Nigeria, Cameroun and doubtfully from the Central African Republic (Verdcourt 1971).

The second groundnut species is *V. minima* (Roxb.) Ohwi & Ohashi, a plant native to the Western Ghats in India. This plant presents a polymorphic breeding system and mode of pollination. It is the wild progenitor of the rice bean. Studies by Gopinathan & Babu (1986), indicate that it reproduces chasmogomously (by open flowers), by aerial pseudocleistogamy (by closed flowers without pollinators), by subterranean pseudocleistogamy and obligate subterranean, true cleistogamy (within the closed flower). This results in the presentation of two fruit types, namely, aerial dehiscent legumes with 8—11 seeds, and subterranean, one to two-seeded, indehiscent legumes. The latter system apparently assists the plant to survive annual jungle fires and soil erosion accompanying heavy monsoon rains. The plant is therefore capable of sustaining itself by selfing as well as encouraging gene flow by outcrossing. The possibility of perfecting these plants as economically viable crops should be considered.

According to Baudoin & Maréchal (1985), *V. subterranea* is most closely related to *V. hosei* (Craib.) Backer of the section *Vigna*, of African origin. This wild species may belong to the secondary, if not the tertiary, gene pool of *V. subterranea*.

The examples mentioned of subterranean *Vigna* species, together with the well-known surface crops discussed under the subgenus *Catjang* Jaaska & Jaaska (1990) in ADDENDUM 1 of this thesis, hold untold possibilities for high-protein pulse foodcrops. The important uses to which the members of this subgenus are put are fully discussed in the conclusion of the addendum. They had, in fact, been known for centuries, Linnaeus (1753) giving the type locality as Barbados whence it was introduced into his Uppsala garden. However, it had probably been introduced from Ethiopia in tropical Africa to Barbados (Westphal 1974). *Vigna unguiculata* cv. gr. *unguiculata*, the cowpea, was also known in India before Christ, where it was given a Sanskrit name and it came to Europe early enough for the Greeks and Romans to grow. It reached the United States of America in the early 19th Century (Baudoin & Maréchal 1985).

The cultivated surface crops of *Vigna* grown in Asia belong to the subgenus *Ceratotropis* (Piper) Verdc. They include *V. aconitifolia* (Jacq.) Maréchal, *V. angularis* (Willd.) Ohwi & Ohashi, *V. mungo* (L.) Hepper, *V. radiata* (L.) Wilcz., *V. trilobata* (L.) Verdc. and *V. umbellata* (Thunb.) Ohwi & Ohashi. It would appear that *Phaseolus sublobata* Roxb. was the communal parent of two races, namely, race 1 with suberect, ascending legumes and a much raised hilum on the seeds like *V. mungo*, and race 2, with rather longer, less hairy legumes, horizontal or deflexed on the peduncle, and seeds with a thin, linear hilum protruding little above the testa, like *V. radiata*. These races were domesticated as *V. mungo* (the black gram or urd) and *V. radiata* (the green gram or mung bean). *Vigna radiata* is occasionally grown in southern Africa where Asian peoples live. The black gram is more commonly collected from wild colonies by the poorer people in India. *Vigna umbellata* is similar in morphological traits to *V. radiata*, and *V. angularis* also resembles it, so that the three species seem to form a taxonomic complex. *Vigna aconitifolia* and *V. trilobata* both differ markedly from *V. radiata* and have evolved into distinct and divergent elements (Jain & Mehra 1978). All clearly own the typical *Vigna* characters. *Vigna radiata* has been found to be a most successful female parent in crossing with *V. mungo*, but it is not a reciprocal state. The most successful crossings have been performed between *V. radiata* and *V. sublobata*. Extremely fertile F1 and F2 progenies have been raised indicating the close relationship between these species. The two grams have not always been kept apart as species by European Botanists, since they regarded them as varieties, but the Indian Botanists clearly distinguish between them as regards the stipules, flower colour, legumes and seeds. More recently chemical buffers have been discovered between them (Maréchal *et al.* 1978a).

The various *Vigna* species mentioned as food pulses in this thesis, have all been used as possible partners in hybridizing projects with *V. unguiculata* subsp. *unguiculata*. The latter is almost ideal for plant breeding and genetics research. It is a diploid with a relatively short life cycle. The large flowers and untwisted keels make it one of the easiest legumes to emasculate and pollinate. Although limited outcrossing has been reported, it exhibits self-pollination under most environmental conditions. Several researchers have counted chromosomes in *V. unguiculata* subsp. *unguiculata* and the overwhelming evidence indicates that $2n = 2x = 22$ (Faris 1964), and later research by Mukherjee (*fide* Fery 1985) indicates that the 11 bivalent complement consist of one short (19 µm), seven medium (26—36 µm) and three short (41—45 µm) chromosomes. He noted that the chromomeres are not distributed uniformly along the arms.

Interesting facts regarding hybridization blockers are mentioned in the following paragraph (Fery 1985). It was found that pollen sterility is the factor most limiting to the development of commercially useful tetraploid cultivars, four recessive genes causing genetic male sterility. The reproductive ontogeny of many cowpea cultivars is greatly influenced by photoperiod, the response to the photoperiod being conditioned by a pair of major genes. The short-day response is dominant over the photoperiod-insensitive response. Days to flowering or days to maturity of the cultivars indicates that late maturity is dominant over early maturity. This character is borne out in own collections throughout the southern African collecting area, namely, that the best period for collection is mid to late summer, particularly for the collection of seeds that are viable. Needless to say, all characters positively affecting competitive harvests of cowpea seeds, such as flower fertility, number and quality of seeds, period required to maturity and the resulting possibility of reaping more than one harvest (more plantings per season, adaptations to wet or dry climatic conditions), all are governed by specific genes.

In the field it was observed that the three leaflets constituting the leaves do not lie on the same plane. The upper leaflet appears to turn its margin to the sun's rays, probably in an attempt to conserve water. The two lower leaflets then face the sun with the upper surfaces, which in most cases, especially in the grasslands where shade is minimal, are protected by strigose hairs.

An interesting observation of live material in the NBI nursery, Pretoria, concerned the periods of flower opening of the various species. Under all weather conditions the flowers of all *V. unguiculata* subspecies were found to open very early in the mornings [at dawn (Lush 1979)] and closed with a bang at *ca*. nine o'clock in the morning. *V. vexillata* flowers, on the contrary, were known to remain open until late afternoon, or until tripped by the pollinators.

The explanation for the white form of *V. vexillata* collected in Natal and the resultant hybridizing with the purple forms in the NBI nursery (see frontispiece), is the presence of anthocyanin in purple flowers and its absence in the white forms. This is regulated by the free flow of genes governing the presence of either the colour factor or the complementary genes in the nursery conditions. The intensity of the colour is governed by the presence of the dominant factor C regulating the required pigment, the amount of anthocyanin, by the interaction between factors L (the pale colour) and D (the intensity of the colour which can only take effect in the presence of L) and another single dominant gene to govern the tinged colour. Dark flowers contain a high concentration of anthocyanin in all the flower parts, pale ones contain small amounts in the wings, tinged flowers have a faint narrow band of pigmentation along the outer edge of the standard and white flowers are completely devoid of anthocyanin (Fery 1985). The hybridized forms found in the NBI nursery have bands of purple colouring alternating with white bands.

In conclusion it should be said that all characters are governed by genes and that man's artificial manipulation of these genes, holds the important promise of *Vigna* cultivars being developed with the necessary resistance to disease, climatic problems or soil infertility and possessing the highest digestible protein content and the highest possible yield per season. This dream appears to be within relatively easy reach. Add to this that it is a known fact that *Vigna* plants add up to 240 kg of absorbable nitrogen per hectare by the legumes' unique nitrogen-fixing process, enough for its own growth requirements as well as depositing 60—70 kg in the soil for use by the next crop to be grown, be it tuber or cereal.

6.3 Reproductive biology

Turning to natural breeding methods in the genus *Vigna*, the extraordinary 'hugging' mechanism by which *V. vexillata* secures its pollination agent so that pollen is both foraged and deposited on the receptive surfaces of the stigma, has been fully described in ADDENDUM 3. Here the outward flow of genes is secured. The mechanisms employed by the *V. unguiculata* group of plants, being both self-pollination and cross-pollination, are efficient and are discussed in ADDENDUM 1. The two different systems employed by the ground-nut group of the genus *Vigna*, have already been described in this chapter, 6.2.

It is important, at this stage, to say something about the ingenious strategies of the flower structure to attract pollinators. Whether it is a trailer or twiner, the inflorescences are borne well above the leaves of the plant, by long or relatively short, peduncles. They are sturdy and stiff. Note particularly the peduncles produced by *V. vexillata* var. *ovata*, which grow up to 250 mm long and become woody and up to 3 mm thick (Figure 16 G). Most species of *Vigna* have flowers that are large and brightly coloured, such as *V. luteola* (bright yellow), *V. vexillata* (bright magenta in var. *davyi* or bright purple to mauve in var. *vexillata* and var. *angustifolia*), variously mauve, purple or blue in the wild subgenera of *V. unguiculata*, *V. lobatifolia* and *V. frutescens*. In cases where the flowers are small, but still strikingly coloured (white, only tinged with colour), as in *V. oblongifolia* and its varieties and *V. comosa*, the flowers are massed in racemes.

The erect standard petal provides attractive, obvious colouring in the first place, enhanced by a pronounced spot or two, the nectar guide, in a sharp contrasting colour well visible to the vectors, at its base. Once tripped, the standard droops and covers the sexual organs, and is an unattractive buff-yellow colour. Tests using 1% neutral red dissolved in distilled water, may be used to indicate the presence of osmophores or active sites of attractant odour production for, notably, the *Xylocopa* bee species to the large-flowered species and smaller flying insects to the small-flowered ones. Neutral red is a vital stain which is taken up by active secreting tissues. Freshly picked flowers are immersed in the neutral red solution for six to eight hours, care having been taken not to bruise the flowers as bruised tissues may also absorb the dye. After rinsing in ordinary water and drying the specimens, red spots indicate the odour secreting osmophores on the corolla parts at the base in the vicinity of the collar-shaped, lobed nectary. During SEM investigations an expanded cell at the edge of the wing tissue in the vicinity of the spur of *V. vexillata*, was found; it may well have been an osmophore.

The bees secure a firm foothold on the folds, or specialized pleated sculpturing, on the inner curve of the wing spur (Figure 4 B). It would appear that nectar is the main food reward provided for pollen vectors of the genus *Vigna*. The structure of the flower is such that the nectar is well concealed within the base of the filament tube and only bees with the expetise can obtain it. The pollen is as well concealed within the keel, within the upper filament tube and the stylar trichomes, to be pumped out in economic amounts during visits. Pollen is therefore not produced in large quantities for food.

The keel provides excellent support to the insect visitor but has its chief function in its involvement in the pumping mechanism by which pollen is forced out at the open apex of the keel during visits. The two keel petals have separate spurs by which they are attached to the receptacle, the slit between them being temporary before they are fused for a short distance. At the apex they separate once more to form an aperture through which the pistil can emerge when the keel is depressed by the pressure applied during the vector's visit. The wings are attached to the keel by small hollows, known as pockets, above the auricles. The pockets fit snugly into corresponding hollows in the keel.

The role played by the pollen brush (Lavin & Delgado 1990) now deserves attention. It forms an integral part of the pollination process. The style is thickened above the ovary to lend support to the emerging pistil. On the adaxial face of the style, fairly long, straight trichomes have developed with the sole function of enveloping the anthers at anthesis and trapping the pollen. When the visiting insect alights to forage nectar, the keel petals exert some leverage so as to lift the keel and the pressure of the bee's body causes the pumping process by which some of the ripe pollen is pushed out at the keel opening by the brush and deposited on the insect without the anthers emerging. This is a method by which pollen economy has evolved in the genus so that the next visitor may also be brushed with pollen and foreign pollen collected from him. The twist of the keel and style in the case of *V. vexillata* causes the pollen to be brushed on the one side of the vector's body.

The question of petal sculpturing and applicable terminology was first published by Stirton (1981). The structure of the wings in the subgenus *Vigna vexillata* is sculptured into small transverse epidermal folds to provide a landing stage for the pollinators in the curve of the lateral auricle of the wing. Consecutive folds may be easily observed under the SEM (Figure 4 B) and are termed the stairway, consisting of distinct troughs and ridges, each of which has a distinctive cell surface pattern. The cells comprising the ridges are smaller, more papillate and more densely covered with striae than the cells lining the troughs (Stirton 1981). The lower basal and the central region of the wing change from the basic pattern and is somewhat similar to the cells of the troughs. The lower basal cells of the subgenus *V. unguiculata* were observed as rather lunate with continuous, parallel lines at right angles, the latter probably being the nerves. The marginal cells of the auricle in *V. oblongifolia* and its relations are smooth and lack the parallel folding of the stairway described for *V. vexillata*. The epidermal epithelium is continuous throughout the surfaces of the petal. There is however, a marked difference between the adaxial and abaxial surfaces. Generally the outer surfaces are smoother with uniformly shaped cells. The lateral spur or auricle of the wing, which varies from a simple bulge in the outline of the wing in the subgenus *V. unguiculata* to a narrow appendage in the section *Vigna*, has evenly shaped cells in the former case and raised to papillate cells, visible to the naked eye or visible under minimal magnification (Figure 4 A—C) in the latter. The chief function of the auricle is to fix the wing to the standard. The papillae mentioned in *V. luteola* may have properties of scent.

Wing petal sculpturing forms a useful taxonomic characteristic and it is known that only about three quarters of the Phaseoleae present it. Stirton (1981) states that Tewari & Nair (1979) have described the wing sculpturing of nine Indian species of *Crotalaria* and are able to construct a workable key by using sculpturing and other features of the wings only..

All these adaptations toward more efficient pollination, is an essential component of a higher order functional-structural whole, reflecting something of the evolutionary development as a whole, of the papilionaceous flower (Stirton 1981). Outward-directed gene flow is ensured.

The occurrence of extrafloral nectaries arranged in a specific pattern, is a common character of the genus *Vigna*. In the species with an elongated raceme e.g. *V. luteola*, *V. oblongifolia* and *V. comosa*, they cause the zig-zag appearance of the spent raceme since they appear alternately below each flower. In the contracted racemes of the *V. vexillata* and *V. unguiculata* complexes, three such nectaries, appearing like pores, are arranged in a vertical row between each pair of flowers (Figure 3 E—G). The extrafloral nectaries are pores that are arranged on a raised cushion of tissue, the remnants of the basic unit of flower formation, the cushion unit or simple raceme (Westphal 1974). The persistent flower pair arises laterally to the cushion or tubercle, whereas the remaining flowers are borne on the cushion. Subsequently, the flowers on the cushion abort and drop, leaving gland-like scars on the cushion and the remaining pair of flowers develops to anthesis. There is probably no justification for these pores to be called nectaries, nor that they exude nectar. It is more likely to be a sugary product of autolysis of the peduncle and underlying tissues (Ojehomon 1968, *fide* Westphal 1974). This exudate attracts streams of ants of various sizes and species that travel up and down the peduncle i.e. *Vigna* species may be termed myrmecophilous plants.

Janzen (1977) hypothesized that floral nectar probably contains chemicals powerfully repugnant, indigestible, or toxic to ants. Feinsinger &

Swarm (1978) however performed experiments with *Erythrina poeppigiana* (Walp.) Cook and *Heliconia psittacorum* Sw. Obs., amongst others, in Trinidad. They found that when nectar was extracted and placed together with droplets of sucrose solution (*ca.* 100 μl of each) on an aluminium pan in vegetation through which ants foraged, so-called long visits of two to three seconds or more to the nectar, were far more numerous than visits to the sucrose. They found that no ants entered the flowers as there were structural deterrents, e.g. a slippery carina entrance or floral parts too close for entry.

Research by Guerrant & Fiedler (1981) to determine palatability to ants of nectar and of floral parts in wet and dry forests of Costa Rica, nectar, macerated floral parts and sucrose solutions were offered to foraging ants. Nectars and floral tissues were analysed chemically to ascertain potentially attractive and deterrent substances. They found that nectars are generally palatable to ants, whereas floral tissues showed highly variable palatability. Ants were found to forage inside only ten of the 25 flowers studied. Defence from nectar thieving by chewing insects seemed most often to involve varying degrees of chemical and morphological modification of floral parts, rather than by production of deterrent compounds in the nectar itself.

In the genus *Vigna* it appears to be the structure of an inaccessible flower that keeps ants out of the flower, whereas extrafloral nectaries provide them with protein-rich food as a symbiotic alternative (Schubart & Anderson 1978). The latter authors believe that ants have largely been excluded due to the efficiency of nectar-exploitation by winged pollinators, combined with morphological barriers in flowers which serve as anti-ant devices. Faegri & van der Pijl (1976) mention that ants, renowned as nectar thieves, have hard, smooth bodies that are not adapted for collecting and transporting pollen, which makes their entry redundant in any case. They are gregarious and bellicose and will keep all other insects away. It is well known in the tropics, that the carpenter bees (*Xylocopa*) have a strong tendency to rob blossoms of their nectar by puncturing, but the presence of ants between the blooms, foraging at the extrafloral nectaries, forces them to enter the flower by the legitimate way. It is also believed that a substance which renders pollen infertile, is exuded from some ants' bodies.

Black beatles with bright yellow stripes were often observed in the field in the hot, semitropical coastlands of Natal at Mochudu, destroying only the tender internal organs of *V. vexillata* flowers probably in a bid to reach the hidden pollen in the filament tube.

Faegri & Van der Pijl (1976) mention the fact that nectar-like substances were produced before pollination had evolved so that nectar production may be regarded as the utilization and further development of an already existing organization. The co-evolution of angiosperms and beetles followed the production of nectar. Ants probably had no association with flowers at the time (Schubart & Anderson 1978).

Summerfield *et al.* (1985) described how *V. unguiculata* subsp. *unguiculata* is characterized by a profligate loss of flower buds and open flowers or even immature fruits. This was observed in other *Vigna* species in southern Africa too. Mention has been made of buds that do not mature in the inflorescence (e.g. *V. unguiculata* subsp. *protracta*). In general, the first two flowers to open in any contracted raceme in the genus *Vigna* are likely to produce fruit, whereas the third pair, if they open, have little chance of doing so. From detailed observations by Ojehomon (*fide* Summerfield *et al.* 1985), calculations were made to illustrate that the respective contributions of racemes 1, 2 and 3 (in acropetal order in any inflorescence) to the total number of open flowers is in the ratio of 6 : 3 : 1. The environments (the factors, mainly day-length and night temperature as well as the reproductive demands on carbon metabolism and on symbiotic nitrogen fixation) conducive to either small, intermediate or large seed yields (43—92 g/plant), the likelihood of premature abscission of flowers from specific racemes, varies little; about 10, 34 and 52% failed to produce immature fruits at racemes 1, 2 and 3 respectively. If, in the absence of pests, the first pairs of flowers in cowpea inflorescences contribute at least 60% of the total that reach anthesis, and the chance of each of these flowers losing the fruits is only one in three, then the minority of later flowers that are the ones most likely to abscise, should not have a dramatic effect on yield potential; the number of inflorescences (reproductive nodes) is likely to be more important. In fact, the largest yielding plants opened 67 more flowers at raceme 1 than those that produced the smallest yields. The authors interpret the data to show that variations in phenologic potential (the number of reproductive nodes per plant) have large effects on seed yield, whereas only in specific situations will the premature abscission of potentially fruitful flowers become of major significance.

In studies by Wien & Roesingh (*fide* Summerfield *et al.*), they found that inherent differences in flower bud set between cultivars were related to resistance to the abscission-causing insect *Megalurothrips*. In thrips resistant cultivars, 76% of the flower buds on the lowermost main stem peduncles set fruits compared with an average of only 50% for the thrips-susceptible ones. These observations can again be applied to the natural species of *Vigna* in southern Africa. Two black, mature fruits per peduncle are the usual sight, excepting in *V. unguiculata tenuis* var. *tenuis* where three or sometimes four legumes are often seen. One could speculate that these species may contain the thrips-resistant genes. The robust specimens of *V. unguiculata* subsp. *protracta* on the Natal coast, were also often found to bear more than two fruits, the maximum only being three or four. Observations should now be made regarding the yield per peduncle in conjunction with its position on the stem.

In conclusion, the magnitude of the taxonomic and economic studies surrounding the genus *Vigna* should be obvious. A large number of relevant topics such as environment, edaphic factors, the significance of the style-stigma characters in the evolution of the genus, seed morphology and the importance of the exine structure, to name a few that come to hand, have either not been considered or scarcely touched upon.

LITERATURE REFERENCES

BAKER, J.G. 1871. 64. *Vigna* Savi. In:Flora of tropical Africa, ed. Oliver, D., vol. 2, pp. 194—207. Reeve & Co., London.

BAKER, J.G. 1876. Leguminosae. *Vigna* Savi. In: Hooker, J.D., Flora of British India 2, p. 205. L. Reeve & Co., 5 Henrietta Street, Covent Garden, London.

BAKER, E.G. 1905. *Vigna fragrans* sp. nov. *Jl. Linn. Soc.* 37: 146.

BAKER, E.G. 1929. LXXVII. *Vigna* Savi. The Leguminosae of Tropical Africa, pp. 391—450. Erasmus Press, Ghent.

BAUDOIN, J.P. & MARéCHAL, R. 1985. Genetic diversity in *Vigna*. In: *Cowpea Research, Production and Utilization*, ed. Singh, S.R. & Rachie, K.O., pp. 3—9. John Wiley & Sons, Chichester, New York, Brisbane, Toronto, Singapore.

BENTHAM, G. 1844. *Vigna brachystachyus* sp. nov., *Vigna carinalis* sp. nov. In: The Botany of the Voyage of H.M.S. Sulphur, p. 86. Smith, Elder & Co., London.

BENTHAM, G. 1859. *Vigna* Savi. In: Mart., C.F.P., Flora Braziliensis XV,I: 194, t. 50/1 (excluding nos. 5—9, 17 & 29).

BENTHAM, G. & Hooker, J.D. 1865. Genera Plantarum 1, part 2, p. 453. Lovell Reeve & Co., 5 Henrietta St., Covent Garden, London.

BROWN, N.E. 1901. 1. Diagnosis Africanae XIII. *V. nuda* n. sp. *Kew Bull.* 1901: 121.

BROWNE, P. 1789. *Dolichos.* In: The civil and natural history of Jamaica, ed. 2, pp. 293, 294. B. White & Son, London.

BRUMMITT, R.K. 1976. *Vigna phoenix* sp. nov. *Kew Bull.* 31: 168.

BURMANN, J. 1737. *Phaseolus marinus* Burm. In: Thesaurus Zeylonica, pp. 189, 190. Jansson-Waesberg & Schouten, Amsterdam.

BURMANN, N.L. 1768. Diadelpha Decandra. *Phaseolus marinus.* In: Flora Indica, p. 161. Cornelius Haek, Amsterdam.

BURTT, B.L. 1964. Angiosperm taxonomy in practice. In: *Phyletic and Phylogenetic Classification*, eds. Heywood, V.H & McNeill, J., pp. 5—16. Systematics Association, London.

BURTT DAVY, J. 1932. Papilionaceae (pea and bean family). *Vigna* Savi. In: Manual of flowering plants and ferns of Transvaalwith Swaziland, South Africa, Vol. 2, pp. 419—421. Longmans, Green & Co. Ltd., London.

BURTT DAVY, J. & POTT-LEENDERTZ, R. 1912. First check of flowering plants and ferns of Transvaal & Swaziland: 148. Reprint from *Ann. Transv. Mus.*, Pretoria, South Africa.

CHEVALIER, A. 1944. *V.* Espèces africaines affines de *V. sinensis*. *Revue de Botanique Appliquée et D'Agriculture Tropicale* 24, pp. 134—135. Muséum national d'Histoire naturelle, Laboratoire d'Agronomie Coloniale, Paris.

CHIOVENDA, E. 1911. *Vigna ostinii* n. sp. *Ann. Bot. Roma* 9: 60.

COMPTON, R.H. 1966. *Vigna* Savi. Annotated checklist of the Flora of Swaziland, p. 50. Mbabane, Swaziland.

DARLINGTON, P.J. 1971. Modern taxonomy, reality and usefulness. *Syst. Zoology* 20: 343.

DAVIS, P.H. & HEYWOOD, V.H. 1963. The concept of characters. Principles of Angiosperm Taxonomy, pp. 5, 114—335. Oliver & Boyd, Edinburgh & London.

DE CONDOLLE, A.P. 1825. CLXXV. *Dolichos* L. Sect. 1 *Eudolichos.,* 18. *D. luteus* (Sw.) DC. Prodromus systematis naturalis regni 2, pp. 398. Treuttel & Würtz, Paris.

DELILE, A. RAFFENEAU-. 1814. *Dolichos niloticus* n. sp. In: Flore l'Égypte, p. 253, t. 38. L'imprimerie Imperiale, Paris.

DE WILDEMAN, ÉM. 1902—1903. *Liebrechtsia esculenta. Ann. Mus. Congo, Bot.,* sér. 4: 74, t. 25/1—10.

DE WILDEMAN, ÉM. 1902. *Liebrechtsia ringoettii* De Wild. *Fedde. Rep.* 13: 114.

DE WILDEMAN, ÉM. 1909. *Vigna* Savi. In: Durand, T. & Durand, H, Sylloge Florae Congolanae, p. 151. Maison Albert de Boeck, Brussels.

DE WILDEMAN, ÉM. 1914. XXX. Decades Novarum Specierum Fl. Katang. XVIII. *Fedd. Rep.* 13: 103—117.

DIETRICH, D.N.F. 1847. *Vigna* Savi. *Synopsis Plantarum* 4, p. 1197. Bernhard Friedrich, Voigt, Weimar.

DILLENIUS, J.J. 1732. *Hortus elthamensis,* t. 234/302. Cornelius Haak, London.

DYER, R.A. 1975. *Vigna* Savi. The genera of South African flowering plants, Vol. 2, p. 273. Department of Agriculture and Technical Services, Botanical Research Institute, Pretoria.

EDWARDS, D. & LEISTNER, O.A. 1971. A degree reference system for citing biological records in southern Africa. *Mitt. Bot. Staatssamml. München* 10: 501—509.

ELLIOTT, S. 1822. *Strophostyles* Elliott. A Sketch of the Botany of South-Carolina (facsimile of 1816—1824) 2: 229. Hafner Pub. Co., New York.

FARIS, D.G. 1965. The origin and evolution of the cultivated forms of *Vigna sinensis. Ca. J. Genet. Cytol.*7: 433—452.

FAWCETT, W. & RENDLE, A.B. 1920. 21. *Vigna* Savi. In: Flora of Jamaica 4, pp. 66—69. Longmans, Green & Co., London.

FEINSINGER, P. & SWARM, L.A. 1978. How common are ant-repellent nectars? *Biotropica* 10,3: 238—239.

FERY, R.L. 1985. The genetics of cowpeas: a review of world literature. In: *Cowpea Research, Production and Utilization,* ed. Singh, S.R. & Rachie, K.O., pp. 25—62. John Wiley & Sons, London.

FRIES, R.E. 1914. *V. pygmaea* F.E. Fries n. sp. *Wiss. Erb. Schwed. Rhod.-Kongo-Exped.* 1911—1912, pp. 103—104.

GAGNEPAIN, F. 1916. *Phaseolus luteolus* Gagnep., nom.nov. In: Flore Génerale de l'Indo-Chine, ed. Lecomté, P.H., Vol. 2, p. 229.

GUERRANT, E.O. & FIEDLER, P.L. 1981. Flower defences against nectar-pilferage by ants. *Reproductive Botany*, Supp., *Biotropica* 13,2: 25—33.

GOPINATHAN, M.C. & BABU, C.R. 1986. The unique growth pattern associated with cleistogamy in a tropical legume, *Vigna minima* (Roxb.) Owhi & Ohashi (Leguminosae). *Bot. Jl. Linn. Soc.* 92: 263—268.

GUILLEMIN, PERROTET, & RICHARD. 1830—1833. *Dolichos niloticus* Delil., *D. unguiculatus, D.* L., *D. oleraceus* Schum. Florae Senegambiae Tentamen, p. 218. Treuttel & Würtz, Paris.

HARMS, H.A.T. 1899. Leguminosae africanae, II. *V. micrantha* n. sp. *Bot. Jb.* 25: 311.

HARMS, H.A.T. 1902. *Vigna* Savi. *Vigna bukobensis* Harms sp. nov. *Bot. Jb.* 30: 92.

HARMS, H.A.T. 1911. *Vigna dinteri* Harms sp. nov., *Vigna pseudotriloba* Harms sp. nov. *Notizbl. bot. Gart. Mus. Berl.* 5: 207, 210.

HARMS, H.A.T. 1913. Leguminosae africanae VI. *Vigna hygrophila* Harms n. sp. *Bot. Jb.* 49: 449.

HARMS, H.A.T. 1915. Rosales—Leguminosae. *Vigna* Savi. *Vegn. Erde*, Engler, A. & Drude, O., 9, *Phlanzenw. Afr.*, 3, 1: 685—690.

HARMS, H.A.T. 1930. *Vigna friesiorum* Harms n. sp. *Notiz. Bot. Gart. Mus.* 10: 89.

HARVEY, W.H. 1862. Leguminosae. LV. *Vigna* Savi. In *Flora Capensis*, eds., Harvey, W.H. & Sonder, O.W., Vol. 2, pp. 239—242. Hodges, Smith & Co., Dublin.

HEPPER, F.N. 1958. Papilionaceae. *Vigna* Savi. In *Flora of West Tropical Africa*, ed. Hutchinson, J.& Dalziel, J.M., sec. ed. revised, Keay, P.W.J., Vol. 1, Pt. 2, pp. 565—569. Crown Agents for Oversea Governments & Administrations, London.

HIERN, W.P. 1853—61. Leguminosae. *Vigna* Savi. *Cat. Afr. Pl., Dr. F. Welwitsch*, 1, pp. 256—260. Longmans & Co., London.

HOOKER, J.D. 1849. Flora Nigritiana, In: *Niger Flora*, ed. Hooker, W.J., pp. 308—312. Hippolyte Bailliere, London.

JAASKA, V. & JAASKA, V. 1988. Isoenzyme variation in the genera *Phaseolus* and *Vigna* (Fabaceae) in relation to their systematics: aspartate aminotransferase and superoxide dismutase. *Pl. Syst. Evol.* 159: 145—159.

JACQUIN, N.J. 1770. *Dolichos luteolus* Benth. *Hortus botanicus vindobonensis*, Vol. 1, p. 39, t. 90. Facsimile edition, Leopoldi Joahennis Kalivoda, Koeltz, Vienna.

JAIN, H.K. & MEHRA, K.L. 1978. Evolution, Adaptation, Relationships and uses of the species of *Vigna* cultivated in India. In: *Advances in Legume science*, ed. Summerfield, R. J. & Bunting, A.H., pp. 459—467. University of Reading, England, Royal Bot. Gdns., Kew, Richmond, Surrey TW9 3AE, England.

JANZEN, D.H. 1977. Why do ants visit flowers? *Biotropica* 9: 252.

KUNTZE, O. 1891. *Vigna Catjang* Endl. (L.) cult. Turong, Beutenzorg. *Revisio Generum Plantarum*, pars 1, p. 212. Arthur Felix, Leipzig.

KURZ, W.S. 1876. Contributions to the knowledge of Burmese Flora. In *Jl. Asiatic Soc. Bengal* 45: 131.

LAEMMLI, U.K. 1970. Cleavage of structural proteins during the assembly of the head of bacteriophage T4. *Nature* no. 5253, Vol. 227: 680—685.

LAVIN, M. & DELGADO, S. 1990. Pollen brush of Papilionoideae (Leguminosae): morphological variation and systematic utility. *Amer. J. Bot.* 77,10: 1294—1302.

LAWRENCE, G.H.M. 1951. History of classification. In *Taxonomy of Plants*, p. 13. Macmillan Publishing Co., Inc., New York.

LINNAEUS, C. 1753. *Species Plantarum*, Tomus 1, p. 725. H.A.M.S., Uppsala.

LINNAEUS, C. 1759. *Systema Naturae* 2, p. 1163. H.A.M.S., Uppsala.

LUSH, W.M. 1979. Floral morphology of wild and cultivated cowpeas. *Econ. Bot.*: 442—447.

MAEKAWA, F. 1955. Topo-morphological and taxonomical studies in Phaseoleae, Leguminosae. *Jl. Jap. Bot.* 15: 106—116.

MARéCHAL, R. 1967. Une troisième espèce du genre africain *Haydonia* Wilczek (Papilionaceae). *Bull. Jard. Bot. Nat. Belg. Bull. Nat. Plantentuin Belg.* 37: 461—464.

MARéCHAL, R., MASCHERPA, J-M. & STAINIER, F. 1978a. Etude taxonomique d'un groupe d'espèces des genres *Phaseolus* et *Vigna* (Papilionaceae) sur la base de données morphologiques et polliniques traitées par l'analyse informatique. *Boissiera* 28: 160—231.

MARÉCHAL, R., MASCHERPA, J-M. & STAINIER, F. 1978b. Combinaisons et noms nouveaux dans les genres *Phaseolus, Minkeldersia, Macroptilium, Ramirizella* et *Vigna*. *Taxon* 27: 200, 201.

MARKöTTER, E.I. 1930. Leguminosae. *Vigna nervosa* n. sp. In *Annale van die Universiteit Stellenbosch* 8: 26, 27.

MARTIUS, C.F.P., de. 1859. Leguminosae: *Phaseolus* — *Vigna*. XLVI. *Vigna*. *Flora Brasiliensis*, Vol. XV,I, pp. 194—195.

MAYR, E. 1969. In: Principles of Systematic Zoology, p. 121. McGraw Hill, New York.

MERRILL, 1917. *Dolichos marinus* Burm. Interp. Rumphius, G.E. Herb. Amb.: 285. Bureau of Printing, Manila.

MEYER, E. 1836. Papilionaceae. *Scytalis*, sect. 1 *Catjang*, sect. 2. *Helicopus, Strophostyles* Elliott. Comm. Pl. Afr. austr., pp. 144—148. Perthes & Besser, Hamburg.

MITHEN, R. 1988a. Herbarium survey, pp. 68—74. International Board for Plant Genetic Resources, Department for Biological Sciences, University of Zimbabwe, Mount Pleasant, Harare, Zimbabwe, unpublished.

MITHEN, R. 1988b. The African genepool of *Vigna*, 1. *V. nervosa* and *V. unguiculata* from Zimbabwe. *FAO/IBGR plant genetic resources newsletter* 70: 13—19.

NEWMANN, A.J., RUSHING, A.E. & MUELLER, D.M.J. 1982. A modified, short protocol for preparation of Bryophytes for Scanning Electron Microscopy. *The Bryologist* 85: 74.

NG, N.Q. & MARÉCHAL, R. 1985. Cowpea taxonomy, origin and germ germplasm. In: Cowpea Research, Production and Utilization, ed. Singh & Rachie, pp. 11—21. John Wiley & Sons, London.

PIENAAR, B.J. 1991. *V. mudenia* sp. nov. *S.Afr. J. Bot.* 57,6: 314—318.

PIENAAR, B.J. & KOK, P.D.F. 1991. The *Vigna vexillata* complex (Fabaceae) in southern Africa. *S. Afr. J.* 57.5: 236—245.

PIPER, C.V. 1926. *Studies in the American Phaseolineae.* Government Printing Office, Washington.

OHWI, J. & OHASHI, H. 1969. Title unknown. *Jl. Jap. Bot.* 44: 29.

PHILLIPS, E.P. 1951. 97. *Vigna* Savi. *Genera of South African Flowering Plants,* p. 426. Department of Agriculture, Pretoria, South Africa.

RICHARD, A. 1845. Title unknown. I. *Historia fisica, politica y natural de la Isla Cuba,* ed. De la Sagra, R., Vol. 11, p. 191. Bertrand, Paris.

RICHARD, A. 1846. Essai d'une flore l'île de Cuba, p. 440. Bertrand, Paris.

RICHARD, A. 1847. *Vigna* Savi. *Tentamen Florae Abyssinicae* 1, pp. 217—221. Libraire de la Sociétè de Geographie, Paris.

ROSS, J.H. 1972. 84. *Vigna* Savi. The Flora of Natal, p. 208. *Botanical Survey Memoir* no. 39, Botanical Research Institute, Department of Agricultural Technical Services. Government Printer, Pretoria, Republic of South Africa.

ROXBURGH, W. 1832. *Dolichos. Flora Indica,* ed. Carey, 3, p. 562. W. Thacker & Co., Calcutta.

SAGRA, R. DE LA. 1845. *Vigna. Historia fisica politica y natural de la Isla de Cuba* (Spanish ed.) 11, p. 191. Establecimiento tipographico de Don Francisco de P. Mellado, Madrid.

SAVI, G. 1824. Observazioni sopra i generi *Phaseolus* et *Dolichos. Pisa Nuova Giorn. Lett.* 8: 106—123.

SCHLECHTER, R. 1897. Decades Plantarum Novarum Austro-Africanarum, 23. *Dolichos reticulata* sp. n. *Jl. Bot.* 35: 219.

SCHREIBER, A. 1970. 60. Fabaceae. 38. *Vigna* Savi. *Prodromus einer flora von Südwestafrika,* von Merxmüller, pp. 60:121—60:124. J. Cramer, 3301 Lehre.

SCHUBART, H.O.R. & ANDERSON, A.B. 1978. Why don't ants visit flowers? *Biotropica* 10,4: 310—311.

SCHUMACHER, F.C. & THONNING, E. 1827. 204. *Plectrotropis.* 1. *P.angustifolius,* 2. *P. hirsuta. Beskrivelse af Guineeske planter som er funde af danske botanikere,* pp. 338, 339. Videnskabers Selskabs Skrifter, Copenhagen.

SCHUMACHER, F.C. & THONNING, E. 1829. 205. *Dolichos*. 1. *D. oleraceus*. *Kongelige Danske Videnskabers Selskabs Afhand.* XIV, vol. 4, pp. 114, 115. Videnskabers Selskabs Skrifter, Copenhagen.

SCHWEINFURTH, G.A. 1896. Appendix II. *Vigna mensensis* Schwf. n. sp. *Bull. Herb. Boiss.* 4: 261, 262.

SHETLER, S.G. 1947. Information systems and data banking. In Radford, A. E., Dickison, W.C., Massey, J.R. & Bell, C.R., *Vascular Plant Systematics*, p. 791. Harper & Row, New York.

STEELE, W.M. & MEHRA, K.L. 1978. Structure, evolution, and adaptation to farming systems and environments in *Vigna*. In: Advances in Legume Science, ed. Summerfield, R.J. & Bunting, A.H., Vol. 1, Proceedings of the International Legume Conference, Kew, 31 July — 4 August 1978, pp. 393—403. Royal Botanic Gardens, Kew, Richmond, Surrey TW9 3AE, England.

STIRTON, C.H. 1981. Petal sculpturing in Papilionoid Legumes. In: Advances in Legume systematics, part 2, ed. Polhill, R.M. & Raven, P.H., pp. 771—788. Royal Bot. Gdns., Kew, Richmond, Surrey, TW9 3AE, England.

STUESSY, T.F. 1990. Characters. Plant taxonomy. In: The systematic Evaluation of Comparative Data, pp. 3, 27, 30, 406. Columbia University Press, New York.

SUMMERFIELD, R.J., PATE, J.S., ROBERTS, E.H. & WIEN, H.C. 1985. The physiology of Cowpeas. In: Cowpea Research, Production and Utilization, ed. Singh, S.R. & Rachie, K.O., pp. 65—101. John Wiley & Sons, London.

TAUBERT, P.H.W. 1895. *Vigna* Savi. *V. monophylla* Taub. n. sp., ed. Engler, A., *Pflanzenw. Ost-Afr.*: 223.

TEWARI, R.B. & NAIR, P.K.K. 1978. Wing morphology of the flower of *Crotalaria* . *Phytomorphology* 28: 283—290.

TORRE, A.R. da 1962—1966. Phaseoleae *Vigna*. *Consp. Fl. Angol.* 3, pp. 261—274. Junta Invest. Ultra., Lisbon.

VERDCOURT, B. 1970. Studies in the Leguminosae-Papilionoidae for the *Flora of Tropical East Africa* 4. *Kew Bull.* 24: 379—569.

VERDCOURT, B. 1971. 65. *Vigna*. In: Flora of Tropical East Africa, eds. Milne-Redhead, E. & Polhill, R.M., Vol. 4, pp. 617—664. Crown Agents for Overseas Governments, London.

VERDCOURT, B. 1977. *Vigna unguiculata* (Leguminosae-Papilionoideae) — a correction. *Kew Bull.* 31,4: 836.

VERDCOURT, B. 1978. The demise of two Legume genera. *Taxon* 27, 2/3: 219, 220.

VERDCOURT, B. 1980. The correct name for the Bambara Groundnut. *Kew Bull.* 35,3: 474.

VERDCOURT, B. 1989. Note on Domenico Vigni and the origin of the generic name *Vigna* (Leguminosae-Phaseoleae). *Bull. Mus. Natn. Hist. Nat., Paris*, 4e sér., 11, 1989; sect. B, *Adansonia*, no. 4: 403—405.

VIGUIER, R. 1952. Leguminosae Madacascariensis Novae. *V. microsperma* Viguier. *Not. Syst. Mus. Nat.* 14,3: 178.

WALPERS, G.G. 1842. *Vigna* Savi. *Repertorium Botanices Systematicae*, Tomus 1, pp. 778—779. Hofmeister, S.F., Lipsiae.

WESTPHAL, E. 1974. Pulses in Ethiopia, their taxonomy and agricultural significance. *Agricultural Research Report 815*, pp. 213—232. Centre for Agricultural Publishing and Documentation, Wageningen.

WILCZEK, R. 1954a. 77. *Vigna* Savi. In: Flore du Congo Belge et du Ruanda-Urundi, Spermatophytes, Vol. 6, pp. 261—264; 343—392. L'Institut National pour L'étude Agronomique du Congo Belge, Bruxelles.

WILCZEK, R. 1954b. Groupes nouveaux des *Phaseoleae-Phaseolineae* du Congo Belge et du Ruanda-Urundi. *Haydonia* Wilczek. *Bull. Jard. bot. nat. Belg.* 24: 405—411.

WOOD, M. 1908. *Vigna* Savi. Revised list of Flora of Natal, p. 149. South African Philosophical Society, Cape Town, South Africa.

YEH, M-S., YUASA, H. & KYODA, K. 1987. Seedling Morphology of the Tribe Phaseoleae (Papilionoideae, Leguminosae) as an aid to their taxonomy. *Jl. Taiwan Mus.* 40,2: 19—28.

ZIMMERMAN, J.G. 1932. Über die extrafloralen nektarien der Angiospermen. *Beih. bot. centralb.* XLIX, Abt. I: 99—196.

SUMMARY

A TAXONOMICAL REVISION OF THE GENUS *VIGNA* SAVI (FABACEAE) IN SOUTHERN AFRICA

by

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MAGISTER SCIENTIAE

The principal objective of this study is to revise the genus *Vigna* for the *Flora of Southern Africa* (*FSA*) region. For this purpose it was necessary to evaluate the existing revisions of the genus for other parts of Africa, notably that proposed by Verdcourt for The Flora of Tropical East Africa (1970, 1971), as well as a phenetic study done by Maréchal *et al.* (1978) for all tropical areas where the genus occurs.

Fieldwork, living material grown at the National Botanical Institute, dried specimens from local and overseas herbaria, low-power and scanning electron microscopy, were the main tools employed.

Four subgenera are recognized, namely, *Vigna* Savi, *Catjang* DC. [a section upgraded in status by Jaaska & Jaaska (1988)], *Haydonia* (Wilcz.) Verdc. and *Plectrotropis* (Schumach. & Thonn.) Verdc.

The subgenus *Vigna* which has style prolongations beaked, comprises five sections. The section *Vigna* is represented by *V. luteola* (Jacq.) Benth., *V. marina* (Burm.) Merrill, (recorded in the Durban harbour area in 1907 but believed to be extinct), *V. oblongifolia* A. Rich. var. *oblongifolia* and its diminutive form, var. *parviflora* (Bak.) Verdc. The second section, *Comosae*, represented by *V. comosa Bak.* subsp. *comosa* var. *comosa*, was first collected in 1990, as a weed in maize fields. These species all have yellow to white flowers and flourish in moist conditions. All subgenera and sections hereafter have mauve, purple or magenta flowers. Section three, *Macrodontae* Harms, is also represented by a single collection of *V. friesiorum* Harms var. *friesiorum*, by Bolus in 1934 at the drifts of the Komati and Crocodile Rivers. The fourth section, *Recticulatae* Verdc., is represented by a single collection of *V. pygmaea* Fries, made by De Winter in 1969 on a firebreak west of Katima Mulilo. The section *Liebrechtsia* (De Wild.) Bak.f. is represented by *V. frutescens* A. Rich. subsp. *frutescens* var. *frutescens* and was, until now, known as *V. decipiens* Harv., or mistaken for *V. dekindtiana* Harms because of similar leaf shapes, but its exceptionally long beak is distinctive. It is common in open woodland of the savannas.

Subspecies *Catjang* has stipules spurred and the style prolongation is a hammer-shaped protuberance. It is common in the *FSA* region and comprises two species. *Vigna nervosa* Markötter prefers altitudes of 1550 to 1650 m and is the only member of the subspecies with small, solitary flowers.

The wild parent of the cultivated cowpea, *Vigna unguiculata* (L.) Walp., is represented by five subspecies:

a) subsp. *protracta* (E. Mey.) Pienaar. This is a new combination, common on the subtropical coasts of the eastern Cape and Natal, and treated as conspecific with subsp. *dekindtiana* var. *pubescens* (Wilcz.) Maréchal in other parts of Africa. It can be recognized by stipules large, and pubescence heavily strigose.

b) subsp. *dekindtiana* (Harms) Verdc. with two distinct varieties. Var. *dekindtiana* is common in the subtropical Caprivi region of Namibia, with root system shallow, leaflets heterophyllous, vegetative parts glabrous to aculeate and stipules variably shaped. Var. *huillensis* (Welw. ex Bak.) Pienaar has roots edible and tuberous, vegetative parts glabrous to strigose, leaflets coriaceous, hastate and stipules slender, reflexed. It prefers sandy, Kalahari conditions.

c) subsp. *tenuis* (E. Mey.) Maréchal *et al.* from the Natal coast, but also reported from Zimbabwe, has two distinct varieties. Var. *tenuis* has leaflets oblong, apex subrounded and base sublobed, truncate. Var. *ovata* (E. Mey.) Pienaar has leaflets ovate.

d) subsp. *stenophylla* (Harv.) Maréchal *et al.* has leaflets typically acuminate, much longer than broad and seldom sublobed. It prefers the dry grassland of the interior.

e) subsp. *mensensis* (Schweinf.) Verd. has not been collected but deserves mention.

Subgenus *Haydonia*, superficially recognized by stems alate and stipules reflexed and subcordate, is newly recognized in the *FSA* region. It comprises two sections. Section *Haydonia* (Wilcz.) Maréchal *et al.* has the style prolongation subterminal and pollen exine smooth. It is represented by a single collection of *V. monophylla* Taub. from the Caprivi area of Namibia. Section *Microspermae* Maréchal *et al.* is represented by two previously undescribed species:

a) *V. mudenia* Pienaar has the style prolongation an oblique thimble-shaped protuberance. The pollen muri appear rounded. It grows in dry woodland in the Natal midlands.

b) *V.* sp. nov. A has the style prolongation reduced to a swelling at the bend of the style toward the stigma. Its juvenile leaflets differ from the mature ones. It occurs in woodland in the Transvaal and the Caprivi, Namibia.

Subgenus *Plectrotropis* has a typical carina spirally twisted through 180° or less and accompanied by an erect, hollow spur on the left side. The style prolongation forms an horizontal flap of tissue that appears like a bonnet-shaped organ. It comprises two sections:

a) *Plectrotropis*, represented by the ferruginous *V. vexillata* (L.) A. Rich., has four varieties: i. var. *vexillata* with leaflets essentially ovate, apex acute, base cuneate, and pubescence patent.

ii. var. *angustifolia* (Schumach. & Thonn.) Bak. with its leaflets essentially linear to rhombic, apex acuminate, base truncate and pubescence aculeate.

iii. var. *ovata* (E. Mey.) Pienaar, endemic to the eastern Cape, southern Natal and Swaziland and with its leaflets essentially small, round, ovate to oblong-elongate. It has typical stems thin, creeping and peduncles thick, long and becoming woody.

iv. var. *davyi* (Bol.) Pienaar, previously having species status, typically has pubescens thickly setaceous on all vegetative parts, stems bearing uni-, bi- and trifoliolate leaflets and flower standards extremely repand.

b) *Pseudoliebrechtsia* (Harms) Verdc., represented by *V. lobatifolia* Bak., syn. *V. dinteri* Harms, with carina twisted less than 180°, hairs on all vegetative parts either ferruginous or white, and leaflets coriaceous, lobed. It occurs in Namibia only.

OPSOMMING

'N MORFOLOGIES-TAKSONOMIESE ONDERSOEK VAN DIE GENUS *VIGNA* IN SUIDER-AFRIKA

deur

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Die hoofrede vir hierdie ondersoek is om die genus *Vigna* vir die *Flora of southern Africa*-gebied taksonomies te hersien. Hiervoor was dit noodsaaklik om bestaande hersienings van die genus vir dele in Afrika, bv. Verdcourt (1970, 1971) se hersiening vir Tropiese Oos-Afrika, te evalueer. Die fenetiese ondersoek van Maréchal *et al.* (1978) wat alle tropiese gebiede waar *Vigna* groei, dek, is ook geraadpleeg.

Veldwerk, lewende materiaal wat by die Nasionale Botaniese Instituut gekweek is, gedroogde herbariumeksemplare by plaaslike en oorseese herbaria geleen, lig- en aftaselektronmikroskopie is die belangrikste metodes wat gebruik is.

Vier subgenera word erken, naamlik, *Vigna* Savi, *Catjang* DC. [die status wat deur Jaaska & Jaaska (1988) vanaf seksie opgradeer is], *Haydonia* (Wilcz.) Verdc. en *Plectrotropis* (Schumach. & Thonn.) Verdc.

Die subgenus *Vigna* het tuitvormige stylverlengings en bestaan uit vyf seksies. Die seksie *Vigna* word verteenwoordig deur *V. luteola* (Jacq.) Benth., *V. marina* (Burm.) Merrill wat in 1907 in die Durbanse hawegebied laas versamel is en moontlik uitgesterf het, *V. oblongifolia* A. Rich. var. *oblongifolia* en die verdwergde vorm, *var. parviflora* (Bak.) Verdc. Die tweede seksie, *Comosae*, wat deur *V. comosa* Bak. subsp. *comosa* var. *comosa* verteenwoordig word, is vir die eerste keer in die *FSA*-gebied in 1990, as onkruid in mielielande versamel. Die spesies tot hiertoe bespreek, het geel tot wit blomme en verkies baie klam toestande. Die hieropvolgende subspesies en seksies het ligpers, pers of rooipers blomme. Die derde seksie, *Macrodontae* Harms word ook deur `n enkele versameling verteenwoordig, naamlik, *V. friesiorum* Fries var. *friesiorum*. Dit is deur Bolus in 1934 in die drifgebied van die Komatie- en Krokodilriviere versamel. Seksie vier, *Reticulatae* Verdc., verteenwoordig deur *V. pygmaea* is eenkeer in `n voorbrand wes van Katimo Mulilo deur De Winter in 1969 versamel. Die seksie *Liebrechtsia* (De Wild.) Bak. f. word deur *V. frutescens* A. Rich. subsp. *frutescens* var. *frutescens* verteenwoordig en is aanvanklik as *V. decipiens* Harv. benaam, of met *V. dekindtiana* Harms verwar weens die blaarvorm. Dit groei in groot getalle in oop boomveld in grasveld.

Subsgenus *Catjang* DC. word uitgeken aan stipule wat prominent gespoord is (dws. verlengings aan die onderpunt) en stylverlengings hamervormig, uitgestulp. Dit kom algemeen in die *FSA*-gebied voor en bestaan uit twee spesies. *V. nervosa* Markötter verkies hoogtes bo seespieël van 1550 tot 1650 m en is die enigste lid van die subgenus wat klein, enkelblomme dra. *V. unguiculata* (L.) Walp., algemeen beskou as die wilde ouer van die gekweekte kafferboontjie, word deur vier subspesies verteenwoordig:

a) subsp. *protracta* (E. Mey.) Pienaar, 'n nuwe kombinasie, kom algemeen in die subtropiese kusstreke van Oos-Kaap en Natal voor en word as dieselfde as subsp. *dekindtiana* var. *pubescens* (Wilcz.) Maréchal *et al.* in ander dele van Afrika, beskou. Dit word maklik herken aan die groot stipule en stekelharige beharing aan al die vegetatiewe dele.

b) subsp. *dekindtiana* (Harms) Verdc. met sy twee eiesoortige variëteite. Eerstens, var. *dekindtiana*, wat algemeen in die subtropiese Caprivi-streek van Namibië voorkom. Die wortelstelsel is vlak, heterofilie kom voor, die vegetatiewe dele is glad tot stekelrig en die stipule breed of smal. Tweedens, var. *huillensis* (Welw. ex Bak.) Pienaar met sy wortelstelsel eetbaar en knolvormig, vegetatiewe dele glad tot styfharig, blaartjies leeragtig en spiesvormig en stipule slank en teruggebuig. Dit verkies die sanderige toestande van die Kalahari.

c) subsp. *tenuis* (E. Mey.) Maréchal *et al.* met sy twee eiesoortige variëteite, wat hoofsaaklik aan die Natalse kus aangetref word, maar ook in Zimbabwe bekend is; var. *tenuis* se blaartjies is langwerpig met punte gerond, skynlobbe en basisse afgeplat, en var. *ovata* (E. Mey.) Pienaar, met blaartjies tipies ovaalvormig.

d) subsp. *stenophylla* (Harv.) Maréchal *et al* met sy blaartjies langwerpig-skerp gepunt, veel langer as wat hul breed is en selde met skynlobbe. Hulle verkies die droë grasveld van die binneland.

e) subsp. *mensensis* (Schweinf.) Verdc. is nie versamel nie maar verdien vermelding.

Die subgenus *Haydonia,* met die stam gevleuel en die stipule teruggebuig en half-hartvormig, was nie voorheen in die FSA-gebied bekend nie en bestaan uit twee seksies. Eerstens, seksie *Haydonia* (Wilcz.) Maréchal *et al.* wat uit 'n enkele versameling van *V. monophylla* Taub, uit die Caprivi-gebied van Namibië bekend is. Die stylverlenging is skuins-terminaal en die stuifmeeleksien is glad. Tweedens, seksie *Microspermae* Maréchal *et al.* waarvan albei spesies voorheen onbeskryf is. *Vigna mudenia* Pienaar het 'n stylverlenging wat 'n skuinsregop, vingerhoedvormige uitstulping is en lae stuifmeelmuri wat gerond vertoon. Dit kom in die droë bosse van die Natalse middelande voor. *Vigna* sp. nov. A, met die stylverlenging gereduseer tot 'n swelsel in die buig van die styl in die rigting van die stempel, het jeugblaartjies wat verskil van die volwasse stadium. Dit groei in droë bosveld van die Transvaal en die Caprivi-gebied, Namibië.

Subgenus *Plectrotropis* word herken aan 'n kiel, spiraalvorming gedraai tot 180° en wat altyd van 'n regop, hol spoor aan die linkerkant van die kiel voorsien is. Die stylverlenging bestaan uit 'n klap weefsel omgebuig om 'n kappievormige orgaan te vorm. Daar kom twee seksies voor:

a) *Plectrotropis,* word verteenwoordig deur die rooibruinharige *V. vexillata* met sy vier variëteite:

i. var. *vexillata,* met blaartjies altyd ovaalvormig, punt skerp en basis wigvormig of stomp-gerond, en regop hare;

ii. var. *angustifolia* (Schumach. & Thonn.) Bak. met blaartjies beslis langwerpig, langer as wat hul breed is, punt langpuntig, basis afgeplat tot stomp-gerond;

iii. var. *ovata* (E. Mey.) Pienaar, endemies aan Oos-Kaap, Natal en Swaziland, met blaartjies rond of ovaalvormig tot langwerpig, stingels tipies dun, laagkruipend op die grond en met blomstele besonder lank, dik en later houterig.

iv. var. *davyi* (Bol.) Pienaar, voorheen *V. davyi* Bol., se vegetatiewe dele met dik, borselhare oortrek, die stam dra een, twee of drie blaartjies aan dieselfde stengel en die vlag is besonder gekartel.

b) *Pseudoliebrechtsia* (Harms) Verdc., word deur *V. lobatifolia* Bak. wat alleenlik in Namibië voorkom, verteenwoordig. Dit het 'n kielspiraal minder as 180° gedraai, vegetatiewe dele met rooibruin of wit hare en blaartjies leeragtig en gelob.

ACKNOWLEDGEMENTS

My sincere thanks are expressed toward all who have encouraged me in the face of adversity; Professors P.D.F. Kok and A.E. van Wyk who have guided me with tremendous patience and sympathy, and perhaps more precious, humour; the Director of the National Botanical Institute, both past and present, for understanding and giving permission to use their amenities, as did the University of Pretoria; staff members of the NBI who have willingly done many favours by providing information over the telephone (Mss Potgieter and Lategan in the Library), delivering manuscripts (Mss M. and E. van Wyk), writing letters to herbaria, etc. (Ms M. Welman), receiving or returning Herbarium material (Ms. M. Heyman), for the Latin translation (Dr H. Glen), patiently assisting with SEM studies (Ms. S. Perold), light microscopy (Mr J van Rooy and Dr H Anderson), often doing rushed jobs in the photography department (Ms A. Romanovsky), meticulously drawing Botanical illustrations (Ms G. Condy and A. Pienaar), reading manuscripts (Ms E. du Plessis and G. Day), accompanying me on essential collecting trips (Prof. P.D.F. Kok, Messrs G. Germishuizen, R Archer, P. Herman and J. Brand from the Dept. of Agriculture in Namibia), watching over precious live material in the NBI Nursery (Mr. D. Hardy, Ms C. Clark) and, last but by no means least, for providing otherwise improcurable literature, the NBI Liaison Officer at the Royal Botanic Gardens, Kew (Messrs A. Nicholas and later, C. Hilton-Taylor). The Italian geneticists from the Germplasm Institute at Bari, deserve special mention for financial assistance, accompanying me on collecting trips and valuable electrophoretic profiles. An impressive list! My grateful thanks.

CURRICULUM VITAE

Barendina Jacoba Pienaar (neé de Villiers), born in Somerset East, Eastern Cape on 26 September 1926, spent the greater part of her life in Natal. She matriculated at Pietermaritzburg Girls' High School. She studied at the Natal University College and was awarded a B.Sc. degree, with majors botany and geography, in 1946. She received a Higher Teacher's Diploma the following year, after which she took up a post at Newcastle High School until 1952. She married Dr Ben Pienaar, an educationist, and four children were born to the couple. She accepted intermittent teaching and lecturing posts until she joined the Botanical Research Unit in Durban in 1979. Her duties included checking the correct botanical names of plants cultivated in the Durban Botanical Gardens, as well as some identification of indigenous plants. After her husband passed away in 1981, she was transferred to the Botanical Research Institute in Pretoria, where she became the public relations officer. She enrolled for B.Sc. Hons. as a part-time student at the University of Pretoria in 1982, at the time assisting Mr. T. Arnold at the Institute in his research on the food crop, *Pennisetum*. On being awarded the degree, she was transferred to the Herbarium (Wing B) as technician, where her duties included the identification of certain indigenous genera in the herbarium. She enrolled for her M.Sc. degree, on the classification of the genus *Vigna* in southern Africa, at the University of Pretoria in 1988, again as a part-time student. Due to serious illness in 1989, her studies were postponed until June 1990.

LIST OF PUBLICATIONS

ANDERSON, L.A.P., JOUBERT, J.P.J., KELLERMAN, T.S., SCHULTZ, R.A. & PIENAAR, B.J. 1987. Experimental evidence that the active principle of the poisonous plant *Thesium liniatum* L.f. (Santalaceae) is a bufadienolide. *Onderstepoort Jl. of Vet. Research* 54: 645—650.

GIBBS RUSSELL, G.E., WELMAN, W.G., RETIEF, E., IMMELMAN, K.L., GERMISHUIZEN, G., PIENAAR, B.J., VAN WYK, M. & NICHOLAS, A. 1987. List of species of southern African plants, ed. 2, part 2: 15, 16, 17—25, 43—51, 53.

PIENAAR, B.J. & NICHOLAS, A. 1988. Notes on African plants. Brassicaceae. *Heliophylla cornellsbergia,* a new species from the Richtersveld. *Bothalia* 18,2: 183—188.

DE WET, B.C., GIBBS RUSSELL, G.E., GERMISHUIZEN, G., SCHRIRE, B.D., JORDAAN, M., PIENAAR, B.J., WELMAN, W.G., REID, C., VAN WYK, C.M., FISH, L., IMMELMAN, K.L., VAN ROOY, J., GLEN, H.F., & BARKER, N.P. 1989. New taxa, new records and name changes for southern African plants. *Bothalia* 19,2: 275—294.

DE WET, B.C., GERMISHUIZEN, G., SCHRIRE, B.D., JORDAAN, M., PIENAAR, B.J., WELMAN, W.G., REID, C., VAN WYK, C.M., FISH, L., IMMELMAN, K.L., VAN ROOY, J., PEROLD, S.M., TAUSSIG, J., BARKER, N.P. & GLEN, H.F. 1990. New taxa, new records and name changes for southern African plants. *Bothalia* 20,2: 249—266.

PIENAAR, B.J. & KOK, P.D.F. 1991. The *Vigna vexillata* complex (Fabaceae) in southern Africa. *S.Afr. J. Bot.* 57,5: 236—245.

PIENAAR, B.J. 1991. A new species of *Vigna* Savi (Fabaceae) from southern Africa. *S.Afr. J. Bot.* 57,6: 314—318.

PART 2

ILLUSTRATIONS, PLATES AND DISTRIBUTION MAPS,

ADDENDA 1, 2 & 3

INDEX TO ILLUSTRATIONS, PLATES AND DISTRIBUTION MAPS

3. Species illustrated

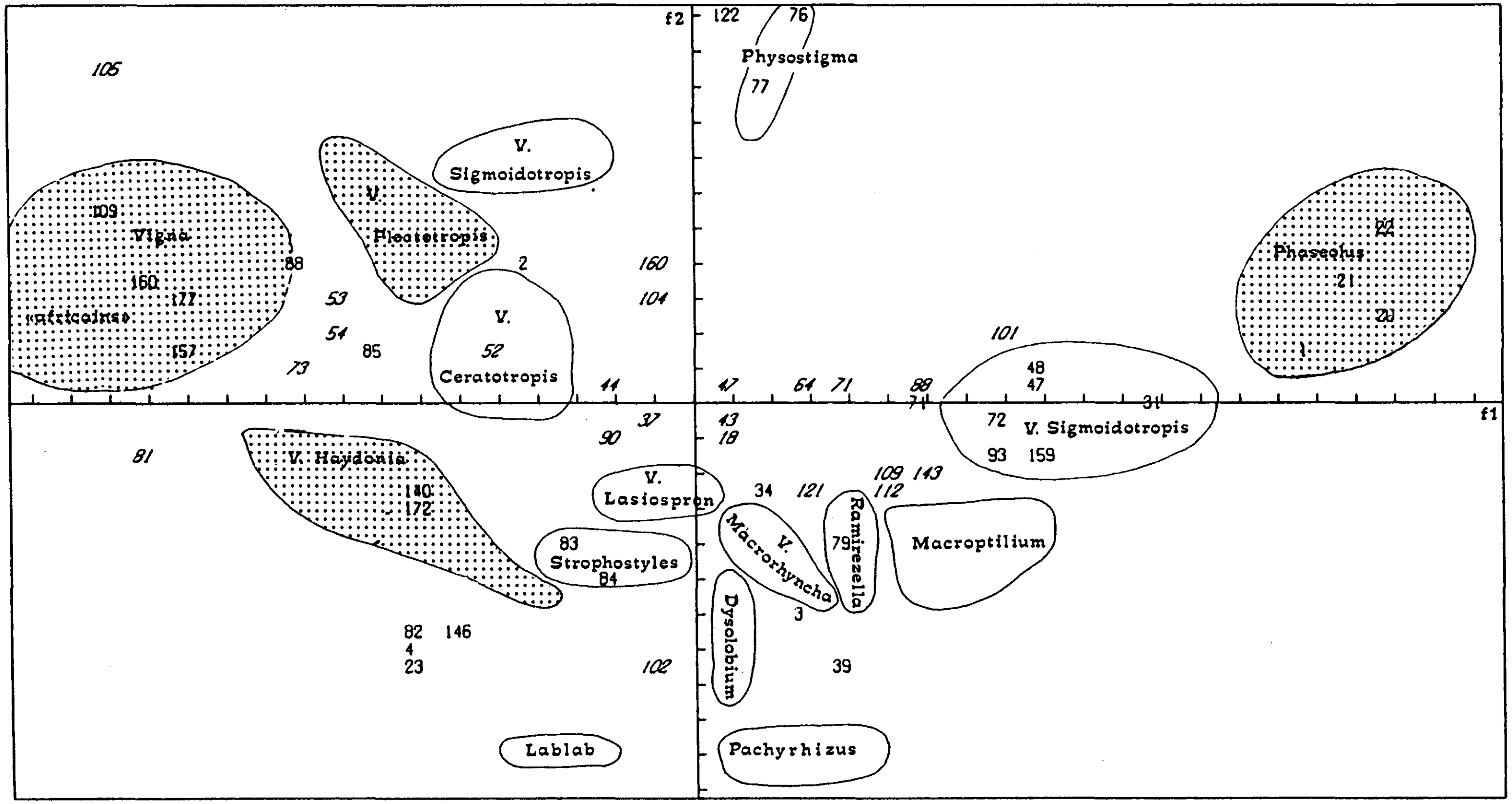


Figure 1. Correspondence analyses using Factors 1 & 2 (Maréchal *et al.* 1978a). Position of African *Vigna* group as opposed to *Phaseolus*, with the groups *V. plectrotropis* and *V. haydonia* nearest. The Asian *V. ceratotropis* group lies between the latter two, and the *V. sigmoidotropis* group forms the link between *Vigna* and *Phaseolus*. Southern African groups are shaded.

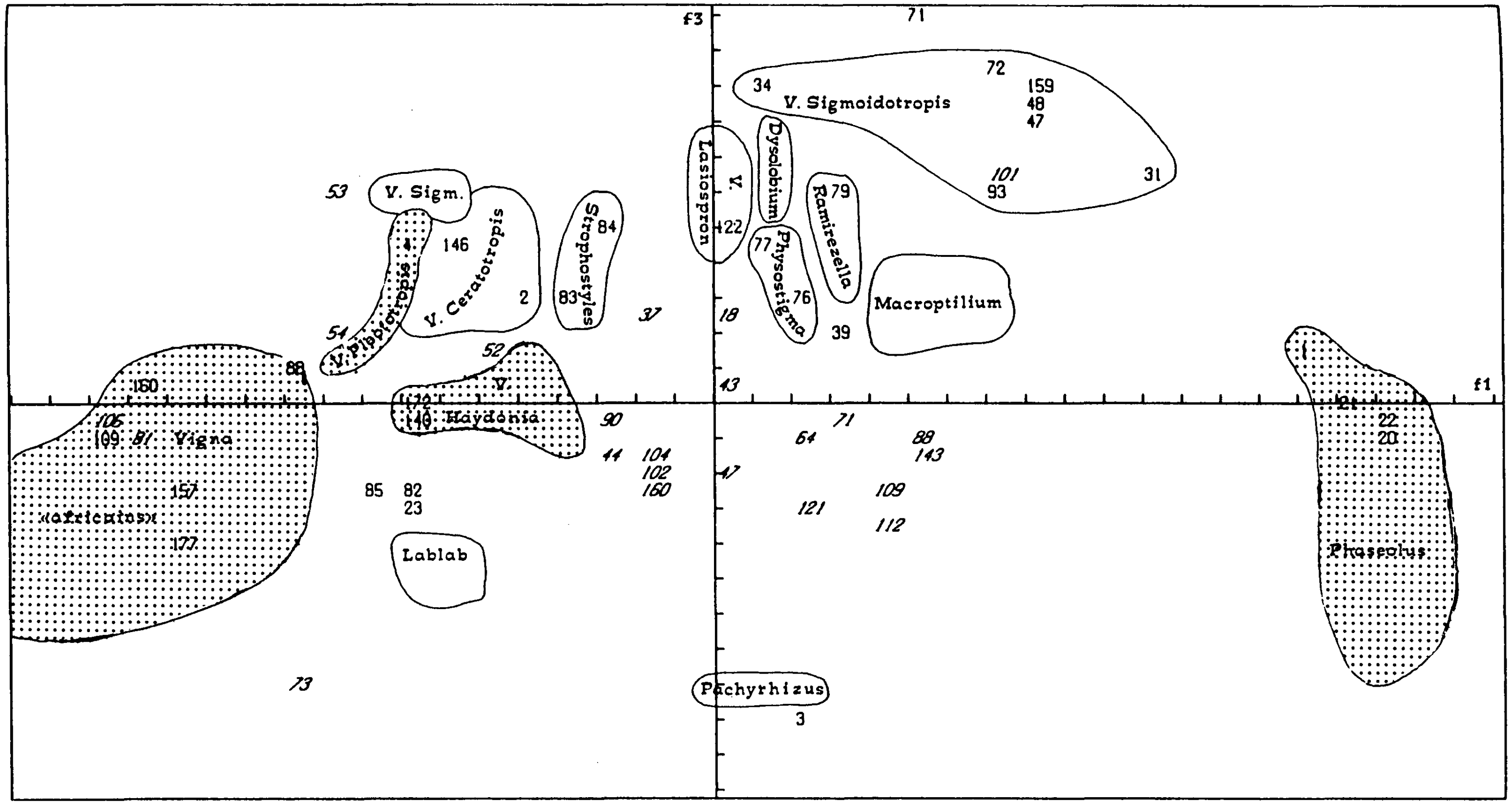


Figure 2. Correspondence analyses using Factors 1 & 3 (Maréchal *et al.* 1978a). Position of African *Vigna* group as opposed to *Phaseolus*, the groups *V. plectrotropis*, *V. haydonia* and the Asian group, *V. ceratotropis*, occupy similar positions to Figure 1. *V. sigmoidotropis* forms the link between the poles. Southern African species are shaded.

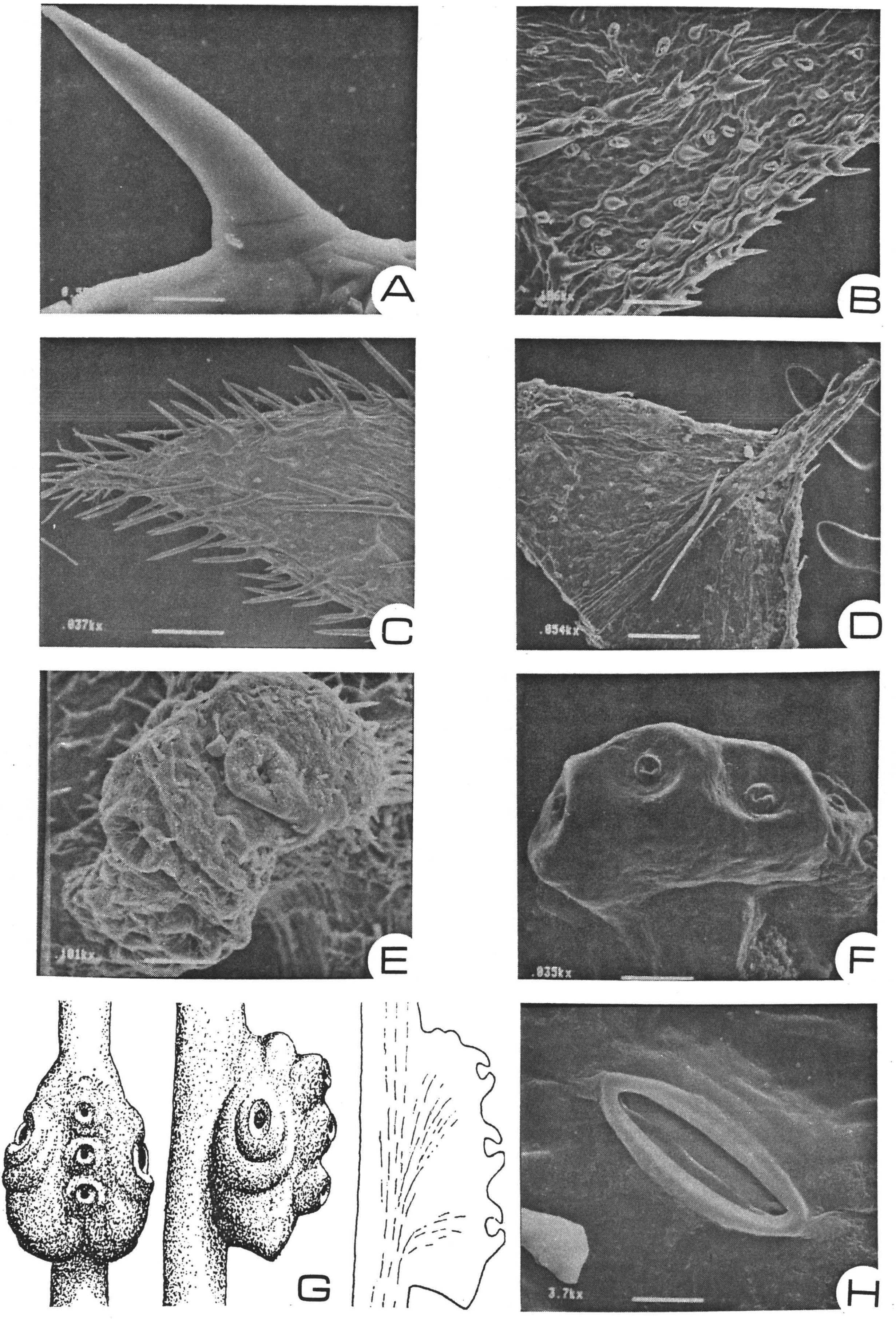


Figure 3. **A.** Typical broad-based trichome (X 228), *V. vexillata* var. *vexillata*, *Pienaar 420*, (PRE). **B.** Typical aculeate trichomes on dorsal leaf surface (X 63), *V. vexillata* var. *angustifolia*, *Pienaar 392a* (PRE). **C.** Strigose trichomes on ventral leaf surface (X 22), *V. vexillata* var. *vexillata*, *Pienaar 420* (PRE). **D.** Typical apiculate leaf with mucro, dorsal view (X 32), *V. oblongifolia* var. *parviflora*, *De Winter & Marais* (PRE). **E.** Extrafloral nectaries (X 60), *V. vexillata* var. *ovata*, *Plowes 2413* (PRE). **F.** Extrafloral nectaries (X 20), *V.unguiculata* subsp. *dekindtiana* var. *dekindtiana*, *Pienaar 1374* (PRE). **G.** Diagrammatic structure of extrafloral nectaries in *Vigna*, Zimmerman (1932). **H.** Stoma in leaf (X 222), *V. vexillata* var. *vexillata*, *Pienaar 420* (PRE).

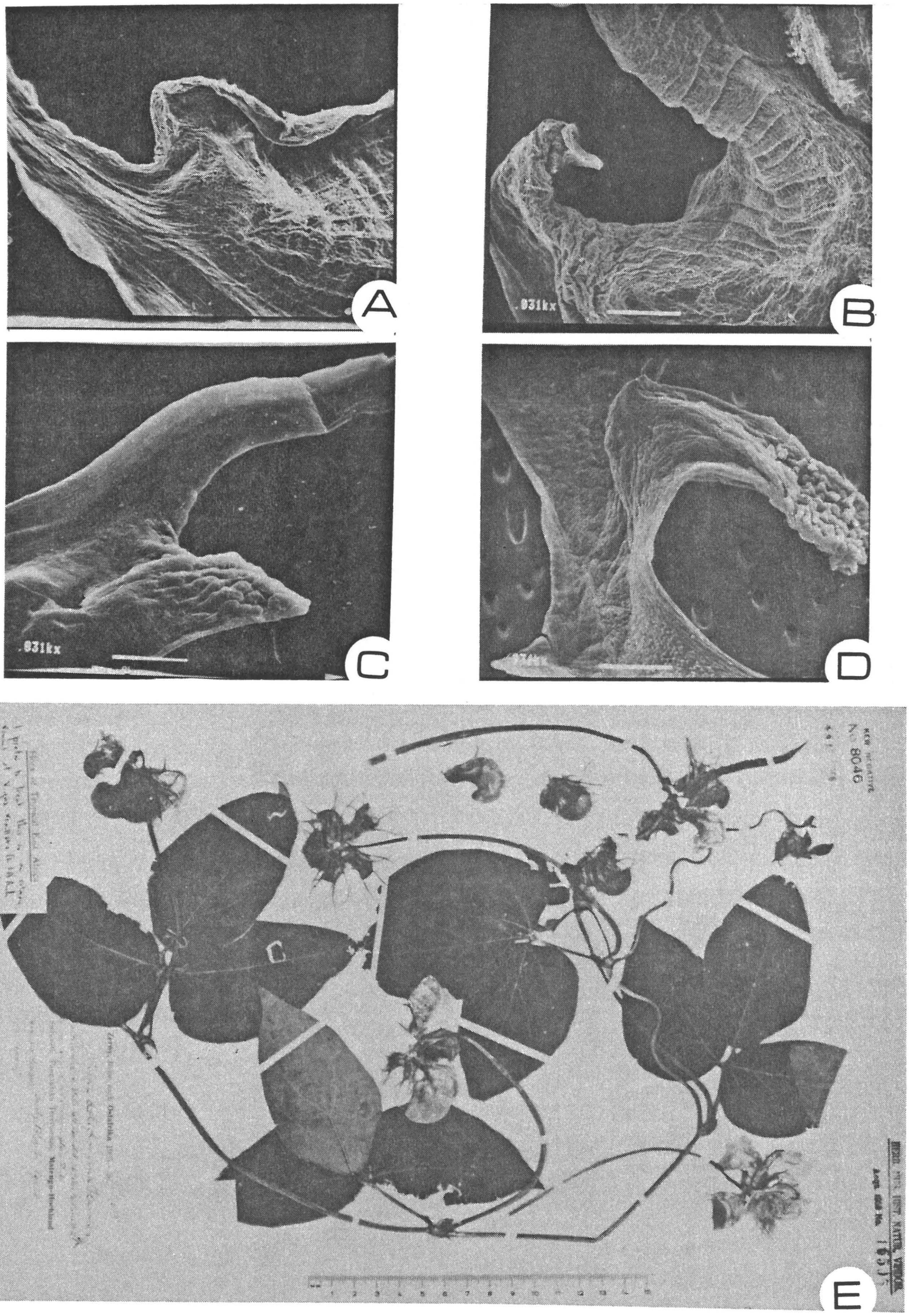


Figure 4. **A.** Round wing auricle (X 61,2), *V. unguiculata* subsp. *tenuis, Pienaar 597* (PRE). **B.** Falcate, ridged wing auricle (X 112), *V. vexillata* var. *vexillata, Pienaar 805* (PRE). **C.** Acute wing auricle with sculpturing (X 60), *V.* sp. A, *Pienaar 1364* (PRE). **D.** Elongate wing auricle, with papillae (X 22), *V. luteola, McLean s.n.* (PRE) **E.** Excessively long calyx lobes, *V. vexillata* var. *dolichonema, Zerny.* (K).

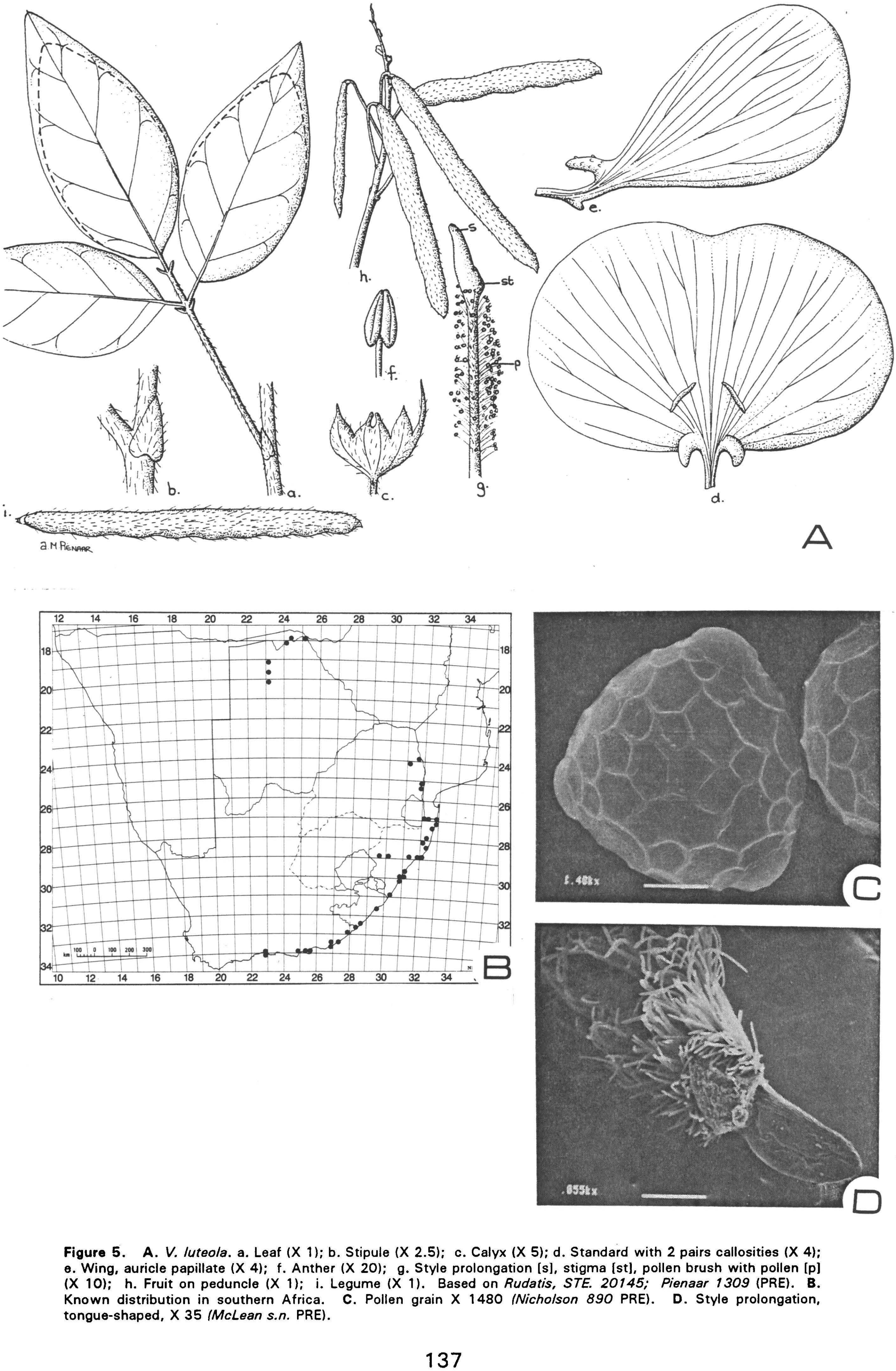


Figure 5. **A.** *V. luteola*. a. Leaf (X 1); b. Stipule (X 2.5); c. Calyx (X 5); d. Standard with 2 pairs callosities (X 4); e. Wing, auricle papillate (X 4); f. Anther (X 20); g. Style prolongation [s], stigma [st], pollen brush with pollen [p] (X 10); h. Fruit on peduncle (X 1); i. Legume (X 1). Based on *Rudatis, STE. 20145; Pienaar 1309* (PRE). **B.** Known distribution in southern Africa. **C.** Pollen grain X 1480 *(Nicholson 890* PRE). **D.** Style prolongation, tongue-shaped, X 35 *(McLean s.n.* PRE).

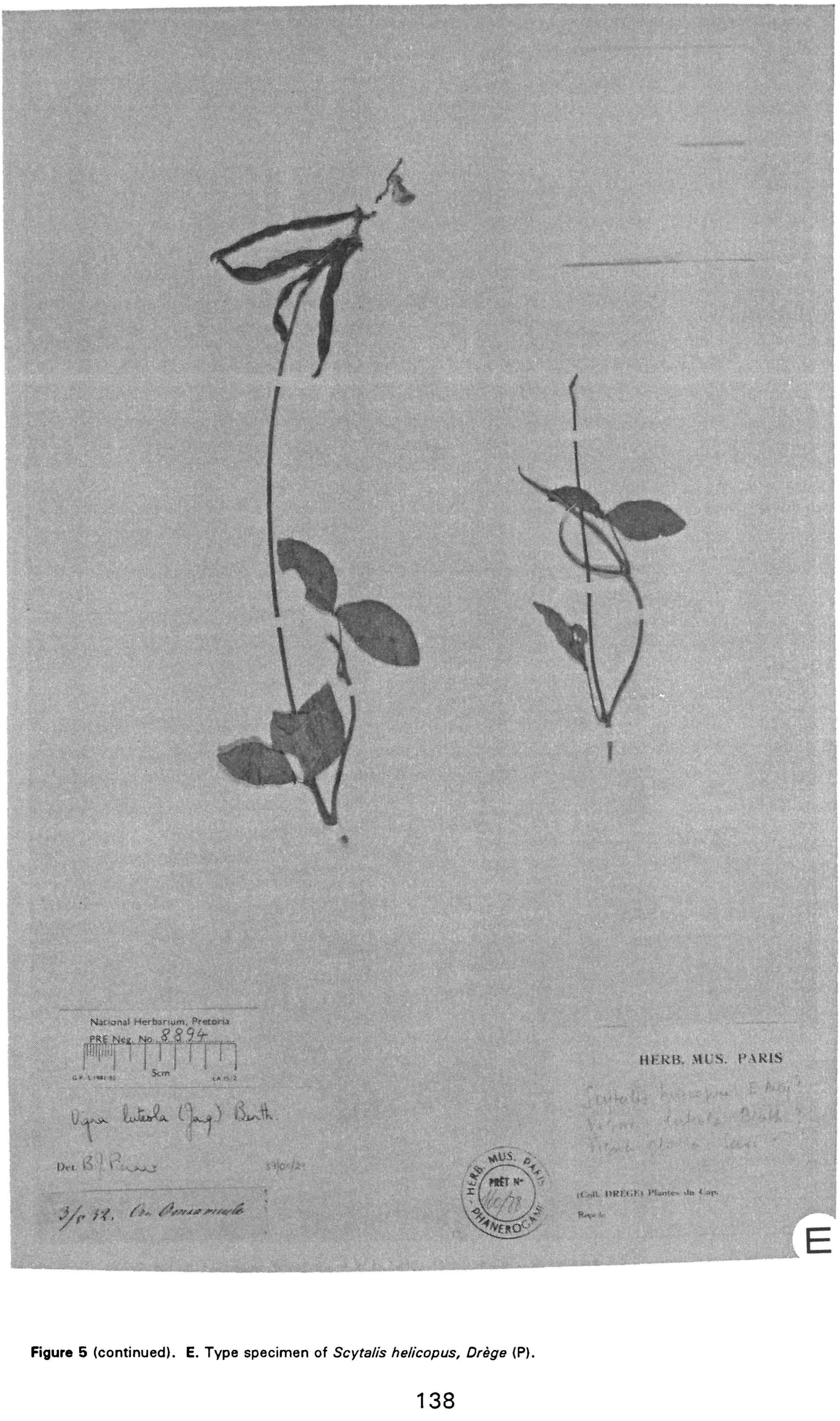


Figure 5 (continued). **E.** Type specimen of *Scytalis helicopus, Drège* (P).

Figure 5 (continued). **F.** Herbarium sheet of *Scytalis helicopus, Drège 1837* & *Krauss 1840* (K).

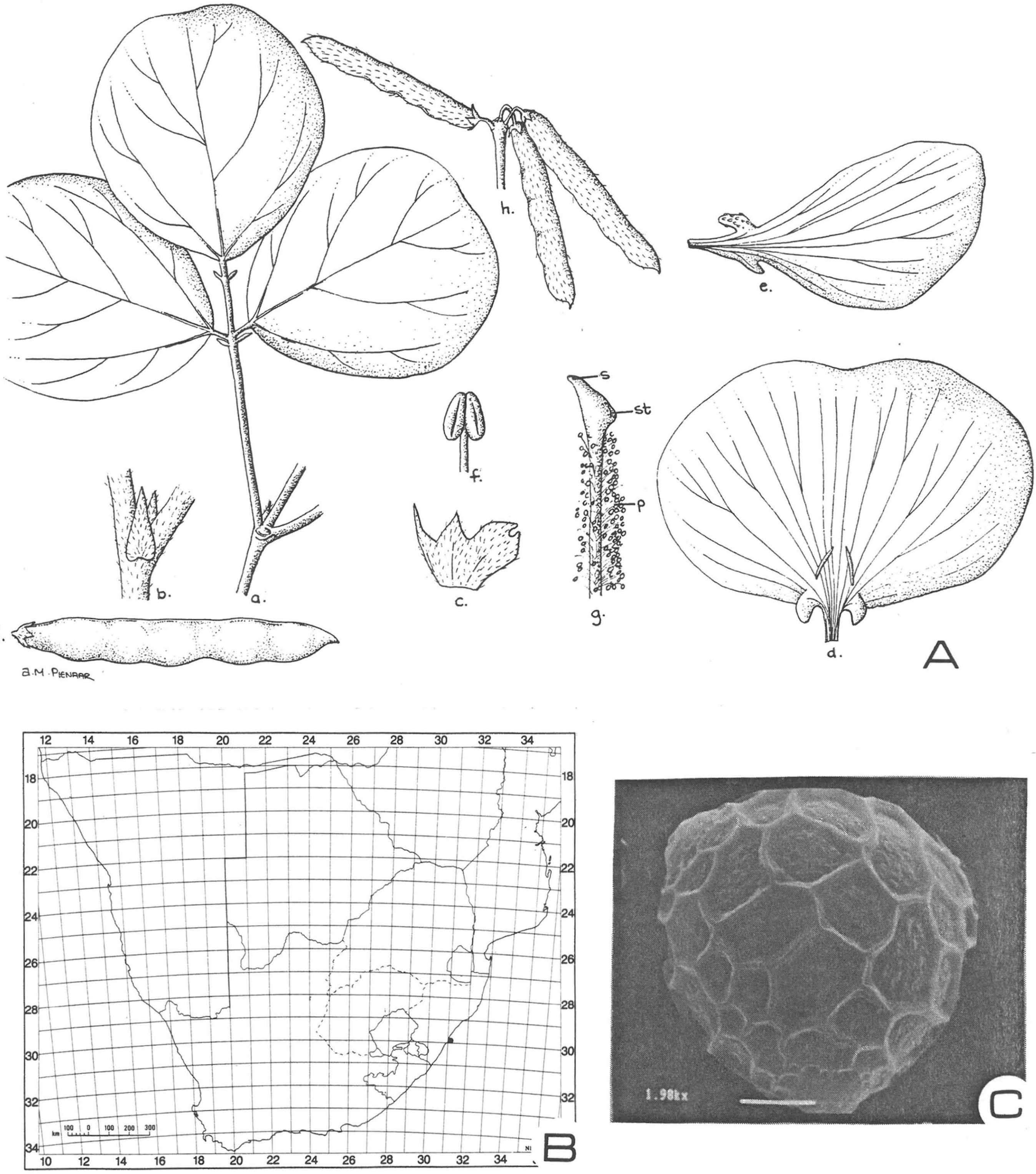


Figure 6. **A.** *V. marina*. a. Leaf (X 1); b. Stipule (X 2.5); c. Calyx (X5); d. Standard with 2 pairs callosities (X 5); e. Wing, auricle papillate (X 5); f. Anther (X20); g. Style prolongation [s], stigma [st], pollen brush with pollen [p] (X9); h. Fruit on peduncle (X 1); i. Legume (X 1). Based on *Wood 10445* (PRE). **B.** Known distribution in southern Africa. **C.** Pollen grain, X1980 (*Bos 3143*, PRE).

Figure 6 (continued). **D.** Type specimen of *Scytalis retusa, Drège 1837* (K).

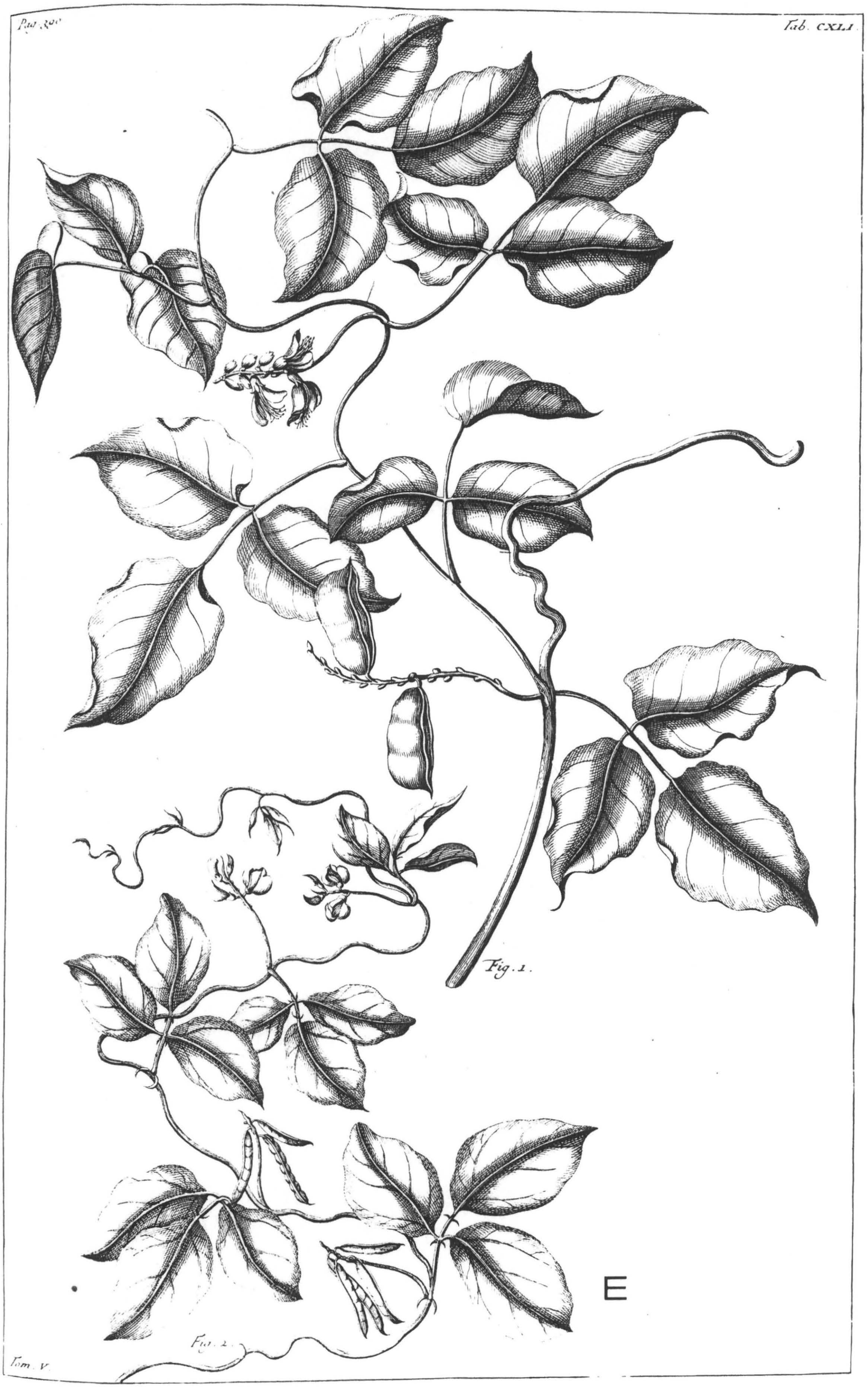
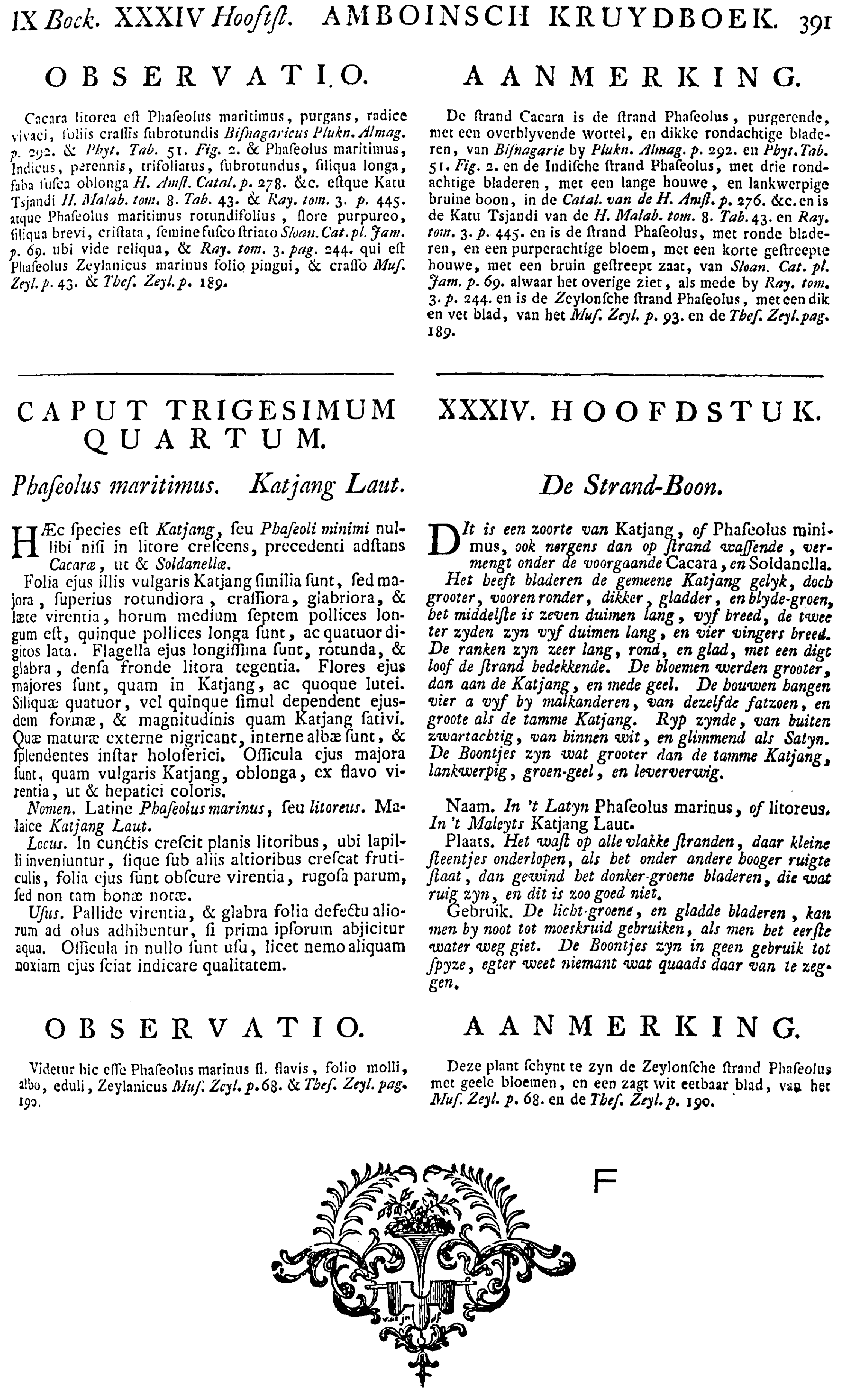


Figure 6 (continued). **E.** Authentic copy of Rumphius' illustrations of *Phaseolus marinus* or *Phaseolus litoreus* [currently *Vigna marina* (Burm.) Merrill] (Fig.1) and probably *Vigna luteola* (Jacq.) Benth.] (Fig. 2) from Rumphius' Amboinsch Kruydboek, p. 390 (1750), reproduced with permission of the Media Centre, Royal Botanic Gardens, Kew.



IX *Boek.* XXXIV *Hoofſt.* AMBOINSCH KRUYDBOEK. 391

OBSERVATIO.

Cacara litorea eſt Phaſeolus maritimus, purgans, radice vivaci, foliis craſſis ſubrotundis *Biſnagaricus Plukn. Almag. p.* 292. & *Phyt. Tab.* 51. *Fig.* 2. & Phaſeolus maritimus, Indicus, perennis, trifoliatus, ſubrotundus, ſiliqua longa, faba fuſca oblonga *H. Amſt. Catal. p.* 278. &c. eſtque Katu Tsjandi *H. Malab. tom.* 8. *Tab.* 43. & *Ray. tom.* 3. *p.* 445. atque Phaſeolus maritimus rotundifolius, flore purpureo, ſiliqua brevi, criſtata, ſemine fuſco ſtriato *Sloan. Cat. pl. Jam. p.* 69. ubi vide reliqua, & *Ray. tom.* 3. *pag.* 244. qui eſt Phaſeolus Zeylanicus marinus folio pingui, & craſſo *Muſ. Zeyl. p.* 43. & *Theſ. Zeyl. p.* 189.

AANMERKING.

De ſtrand Cacara is de ſtrand Phaſeolus, purgerende, met een overblyvende wortel, en dikke rondachtige bladeren, van *Biſnagarie* by *Plukn. Almag. p.* 292. en *Phyt. Tab.* 51. *Fig.* 2. en de Indiſche ſtrand Phaſeolus, met drie rondachtige bladeren, met een lange houwe, en lankwerpige bruine boon, in de *Catal. van de H. Amſt. p.* 276. &c. en is de Katu Tsjandi van de *H. Malab. tom.* 8. *Tab.* 43. en *Ray. tom.* 3. *p.* 445. en is de ſtrand Phaſeolus, met ronde bladeren, en een purperachtige bloem, met een korte geſtreepte houwe, met een bruin geſtreept zaat, van *Sloan. Cat. pl. Jam. p.* 69. alwaar het overige ziet, als mede by *Ray. tom.* 3. *p.* 244. en is de Zeylonſche ſtrand Phaſeolus, met een dik en vet blad, van het *Muſ. Zeyl. p.* 93. en de *Theſ. Zeyl. pag.* 189.

CAPUT TRIGESIMUM QUARTUM.

Phaſeolus maritimus. *Katjang Laut.*

HÆc ſpecies eſt *Katjang*, ſeu *Phaſeoli minimi* nullibi niſi in litore creſcens, precedenti adſtans *Cacaræ*, ut & *Soldanellæ*.

Folia ejus illis vulgaris Katjang ſimilia ſunt, ſed majora, ſuperius rotundiora, craſſiora, glabriora, & læte virentia, horum medium ſeptem pollices longum eſt, quinque pollices longa ſunt, ac quatuor digitos lata. Flagella ejus longiſſima ſunt, rotunda, & glabra, denſa fronde litora tegentia. Flores ejus majores ſunt, quam in Katjang, ac quoque lutei. Siliquæ quatuor, vel quinque ſimul dependent ejusdem formæ, & magnitudinis quam Katjang ſativi. Quæ maturæ externe nigricant, interne albæ ſunt, & ſplendentes inſtar holoſerici. Oſſicula ejus majora ſunt, quam vulgaris Katjang, oblonga, ex flavo virentia, ut & hepatici coloris.

Nomen. Latine *Phaſeolus marinus*, ſeu *litoreus.* Malaice *Katjang Laut.*

Locus. In cunctis creſcit planis litoribus, ubi lapilli inveniuntur, ſique ſub aliis altioribus creſcat fruticulis, folia ejus ſunt obſcure virentia, rugoſa parum, ſed non tam bonæ notæ.

Uſus. Pallide virentia, & glabra folia defectu aliorum ad olus adhibentur, ſi prima ipſorum abjicitur aqua. Oſſicula in nullo ſunt uſu, licet nemo aliquam noxiam ejus ſciat indicare qualitatem.

XXXIV. HOOFDSTUK.

De Strand-Boon.

D*It is een zoorte van* Katjang, *of* Phaſeolus minimus, *ook nergens dan op ſtrand waſſende, vermengt onder de voorgaande* Cacara, *en* Soldanella.

Het heeft bladeren de gemeene Katjang gelyk, doch grooter, vooren ronder, dikker, gladder, en blyde-groen, het middelſte is zeven duimen lang, vyf breed, de twee ter zyden zyn vyf duimen lang, en vier vingers breed. De ranken zyn zeer lang, rond, en glad, met een digt loof de ſtrand bedekkende. De bloemen werden grooter, dan aan de Katjang, en mede geel. De houwen hangen vier a vyf by malkanderen, van dezelfde fatzoen, en groote als de tamme Katjang. Ryp zynde, van buiten zwartachtig, van binnen wit, en glimmend als Satyn. De Boontjes zyn wat grooter dan de tamme Katjang, lankwerpig, groen-geel, en leververwig.

Naam. *In 't Latyn* Phaſeolus marinus, *of* litoreus. *In 't Maleyts* Katjang Laut.

Plaats. *Het waſt op alle vlakke ſtranden, daar kleine ſteentjes onderlopen, als het onder andere hooger ruigte ſtaat, dan gewind het donker-groene bladeren, die wat ruig zyn, en dit is zoo goed niet.*

Gebruik. *De licht-groene, en gladde bladeren, kan men by noot tot moeskruid gebruiken, als men het eerſte water weg giet. De Boontjes zyn in geen gebruik tot ſpyze, egter weet niemant wat quaads daar van te zeggen.*

OBSERVATIO.

Videtur hic eſſe Phaſeolus marinus fl. flavis, folio molli, albo, eduli, Zeylanicus *Muſ. Zeyl. p.* 68. & *Theſ. Zeyl. pag.* 190.

AANMERKING.

Deze plant ſchynt te zyn de Zeylonſche ſtrand Phaſeolus met geele bloemen, en een zagt wit eetbaar blad, van het *Muſ. Zeyl. p.* 68. en de *Theſ. Zeyl. p.* 190.

Figure 6 (continued). F. Authentic copy of Rumphius' Amboinsch Kruydboek, p. 391 (1750), description of *Phaseolus marinus*, reproduced with permission of the Media Centre, Royal Botanic Gardens, Kew.

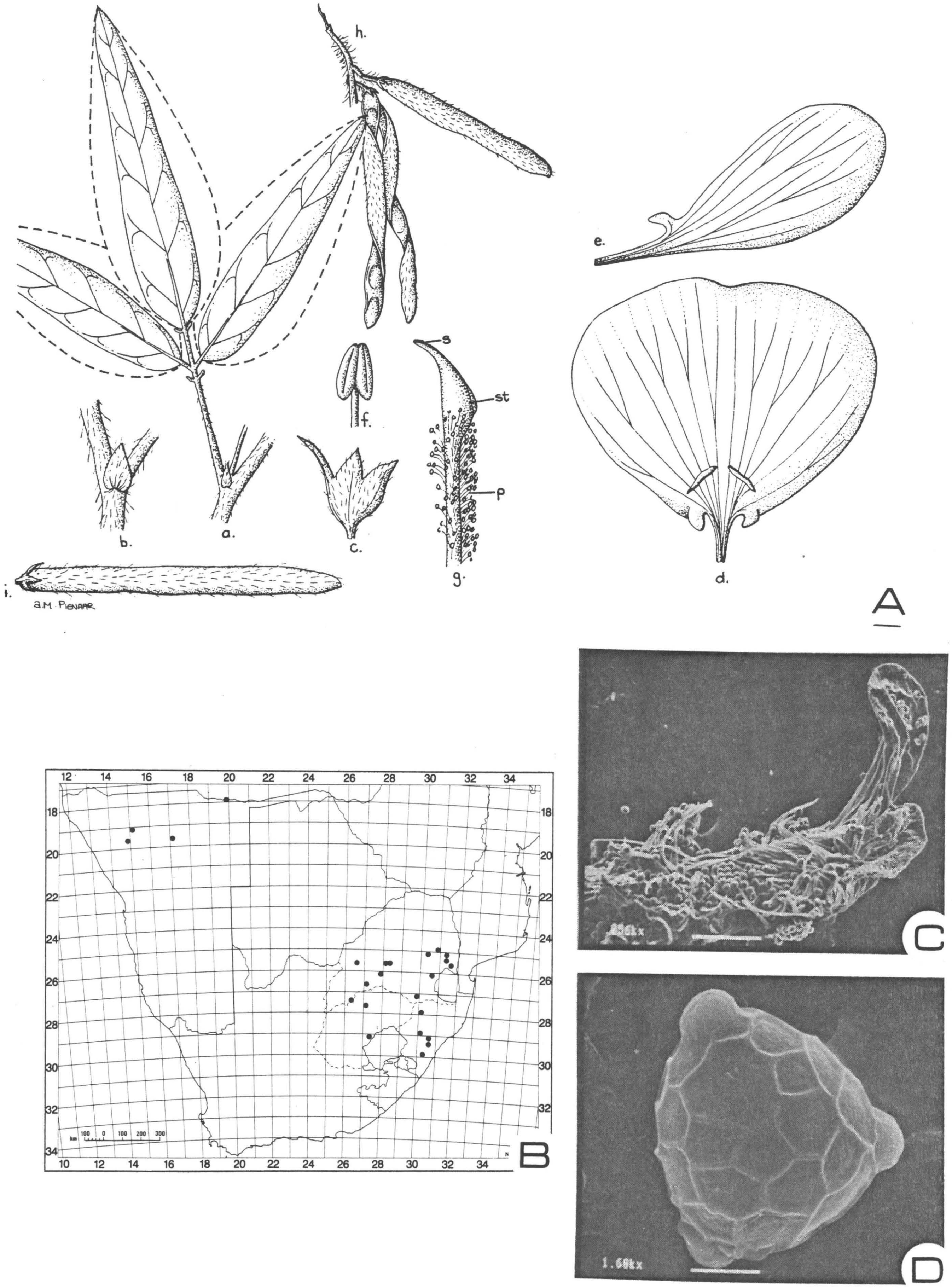
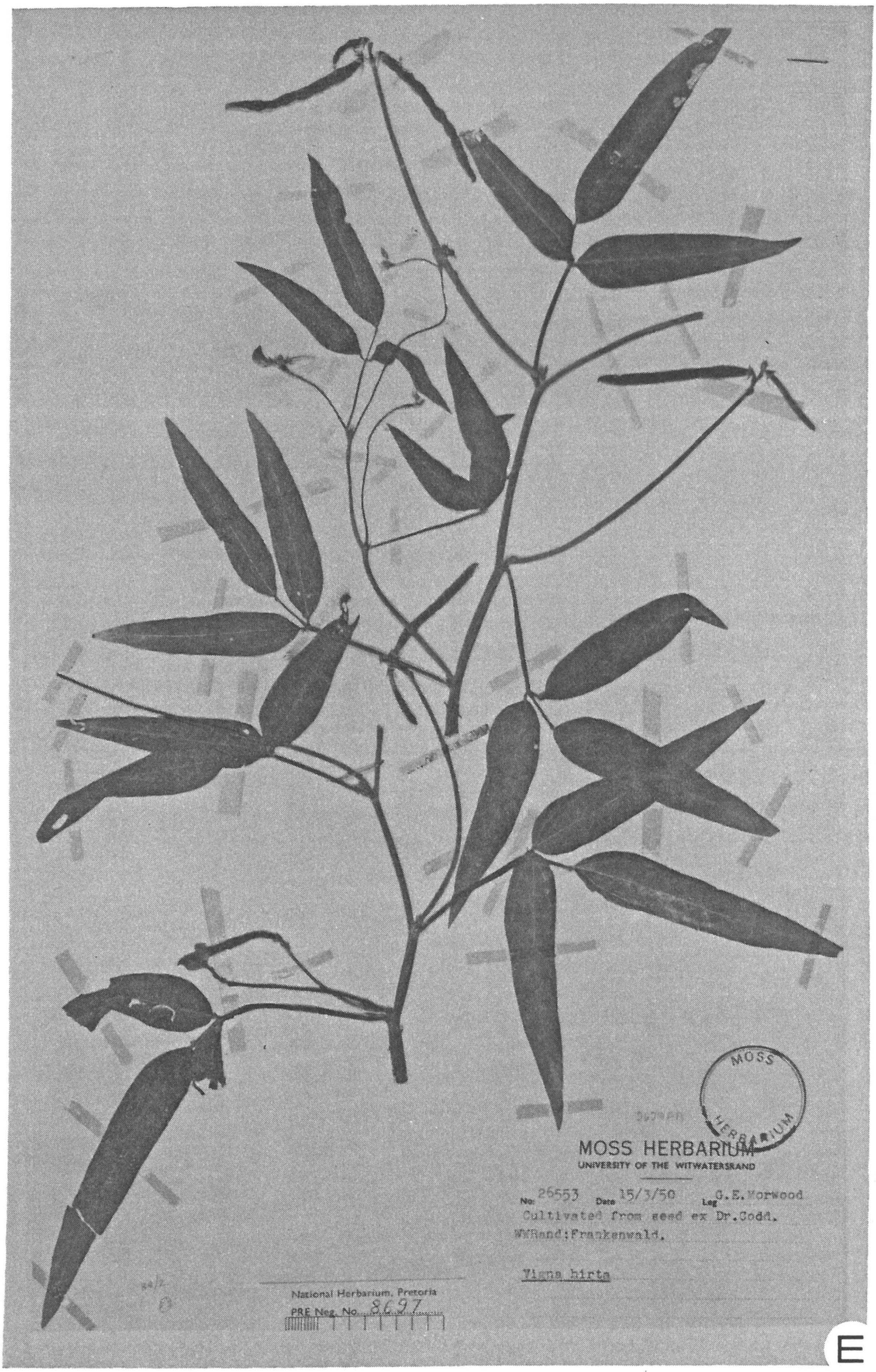


Figure 7. **A.** *V. oblongifolia* var. *oblongifolia*. a. Leaf (X 1); b. Stipule (X 2); c. Calyx (X 5); d. Standard with 2 pairs callosities (X 4); e. Wing (X 4); f. Anther (X 20); g. Style prolongation [s], stigma [st], pollen brush with pollen [p] (X 10); h. Legumes on peduncle (X 1); i. Legume (X 1). Based on *Van Hoepen 1719* (PRE). **B.** Known distribution in southern Africa. **C.** Style prolongation X 33 *(Germishuizen 3859b* PRE). **D.** Pollen grain X 1008 *(De Winter & Marais 4908* PRE).



MOSS HERBARIUM
UNIVERSITY OF THE WITWATERSRAND

No: 26553 Date 15/3/50 Leg G.E.Morwood
Cultivated from seed ex Dr.Codd.
WWRand:Frankenwald.

Vigna hirta

National Herbarium, Pretoria
PRE Neg. No. 8697

Figure 7 (continued). **E.** Herbarium specimen of *Vigna oblongifolia* var. *oblongifolia, Morwood J26553* (J).

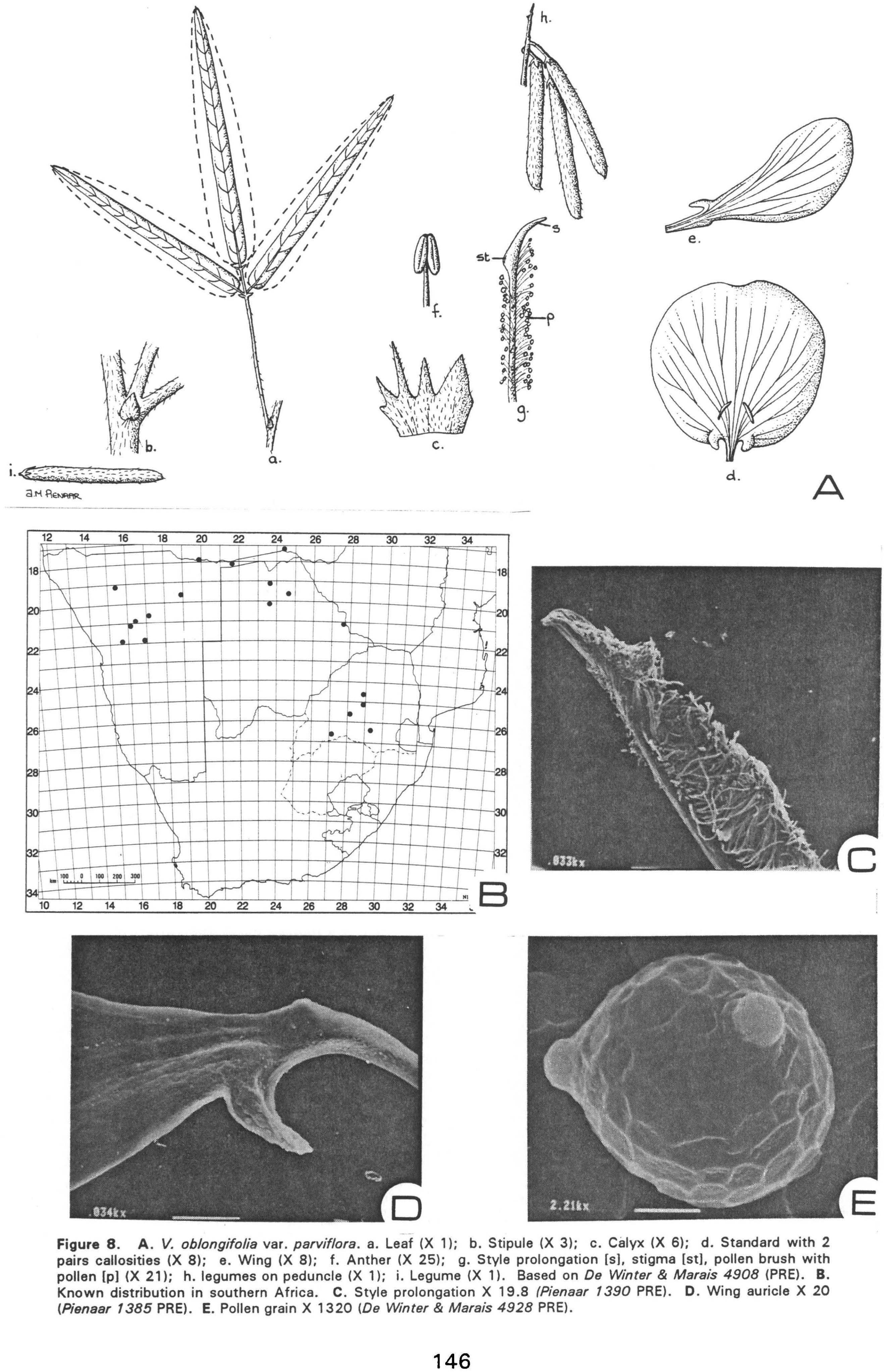


Figure 8. **A**. *V. oblongifolia* var. *parviflora*. a. Leaf (X 1); b. Stipule (X 3); c. Calyx (X 6); d. Standard with 2 pairs callosities (X 8); e. Wing (X 8); f. Anther (X 25); g. Style prolongation [s], stigma [st], pollen brush with pollen [p] (X 21); h. legumes on peduncle (X 1); i. Legume (X 1). Based on *De Winter & Marais 4908* (PRE). **B**. Known distribution in southern Africa. **C**. Style prolongation X 19.8 *(Pienaar 1390* PRE). **D**. Wing auricle X 20 (*Pienaar 1385* PRE). **E**. Pollen grain X 1320 (*De Winter & Marais 4928* PRE).

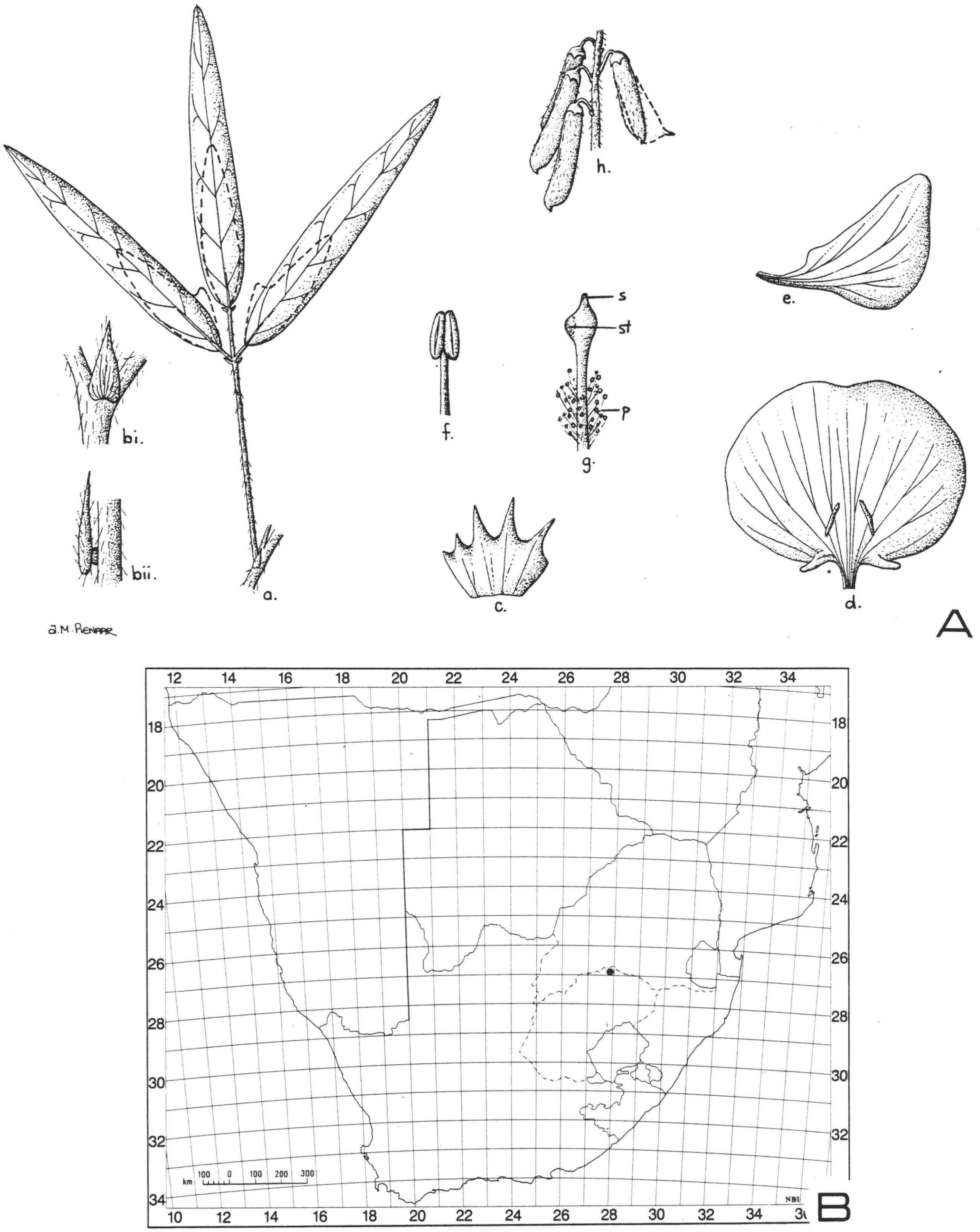


Figure 9. **A.** *V. comosa* subsp. *comosa* var. *comosa.* a. Leaf (X 1); bi. Stipule, frontal view; bii. Stipule, side view (X 4); c. Calyx (X 8); d. Standard with 2 pairs callosities (X 4); e. Wing (X 4); f. Anther (X 25); g. Style prolongation, side view [s], stigma [st], pollen brush with pollen [p] (X 20); h. Legumes on peduncle (X 1). Based on *Reekmans 10372* (Burundi, PRE). **B.** Known distribution in southern Africa.

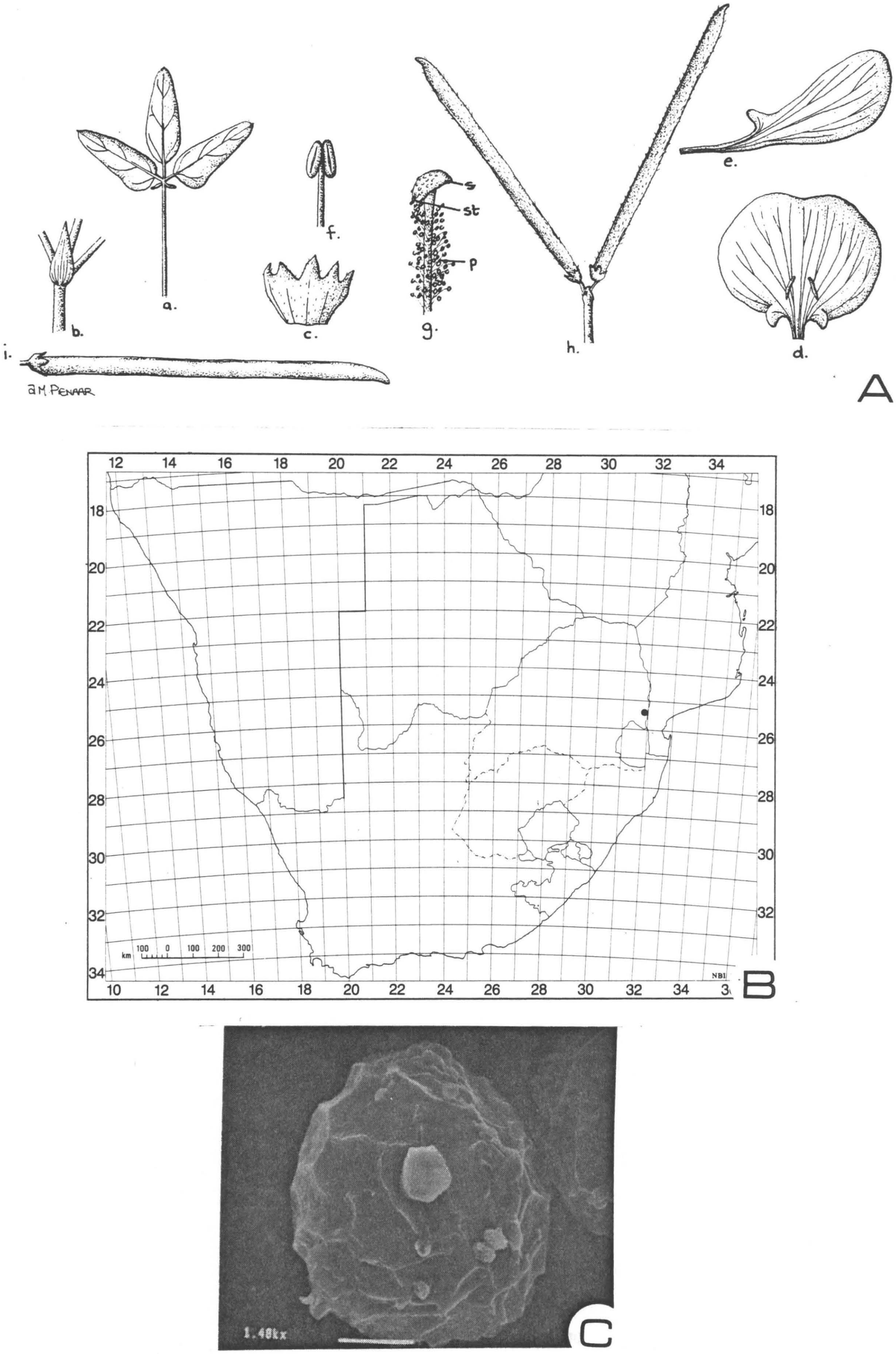


Figure 10. **A.** *V. friesiorum* var. *friesiorum*. a. Leaf (X 1); b. Stipule (X 6.5); c. Calyx (X 6); d. Standard with 2 pairs callosities (X 2.5); e. Wing (X 2.5); f. Anther (X 18); g. Style prolongation [s], stigma [st], pollen brush with pollen [p] (X 24); h. Legumes on peduncle (X 1); i. Legume (X 1). Based on *Bolus 7736* (BOL). **B.** Known distribution in southern Africa. **C.** Pollen grain X 1480 (*Bolus 7736* BOL).

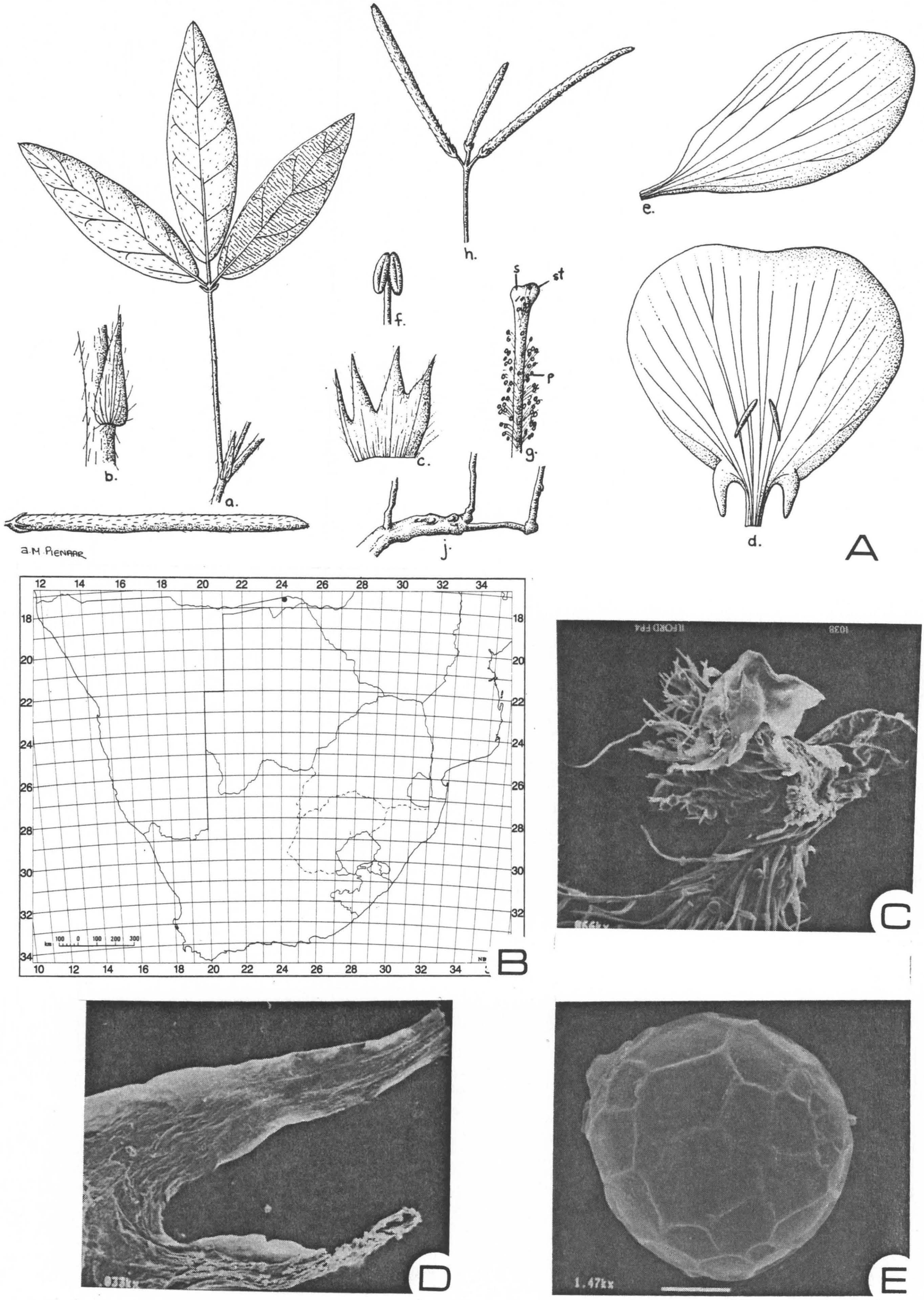


Figure 11. **A.** *V. pygmaea*. a. Leaf (X 1); b. Stipule (X 3); c. Calyx, incomplete (X 3.5); d. Standard with 2 pairs callosities (X 7); e. Wing (X 7); f. Anther (X 16); g. Style prolongation [s], stigma [st], pollen brush with pollen (X 10); h. Legumes on peduncle (X 1); i. Legume (X 1); j. underground system (X 0.33). Based on *De Winter 9134, Pocock 566* (Harare, PRE). **B.** Known distribution in southern Africa. **C.** Style prolongation with corolla remains X 396 (*Jack 227* Harare, PRE). **D.** Wing auricle X 19.8 (*Jack 227* PRE). **E.** Pollen grain X 1470 (*Pocock 566* Harare, (PRE).

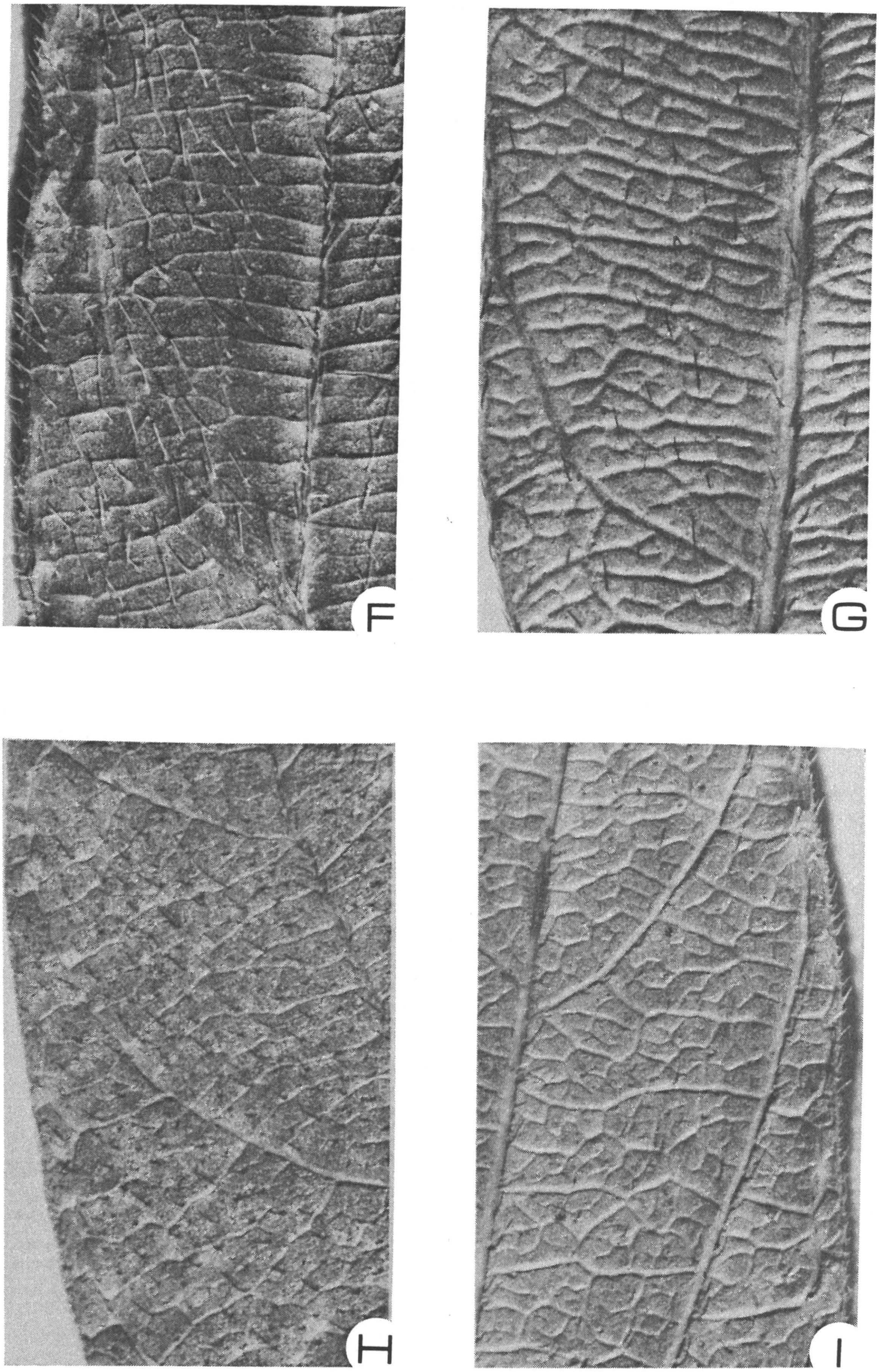


Figure 11 (continued). **F.** Ventral leaf surface, showing parallel tertiary venation and strigose hairs X10 (*Pocock 566* PRE). **G.** Dorsal leaf surface, showing parallel tertiary venation and strigose hairs X 10 (*Pocock 566* PRE). **H.** Ventral leaf surface X 10 (*V. vexillata* var. *vexillata*, *Pienaar 420* PRE). **I.** Dorsal leaf surface X 10 (*V. vexillata* var. *vexillata*, *Pienaar 420* PRE).

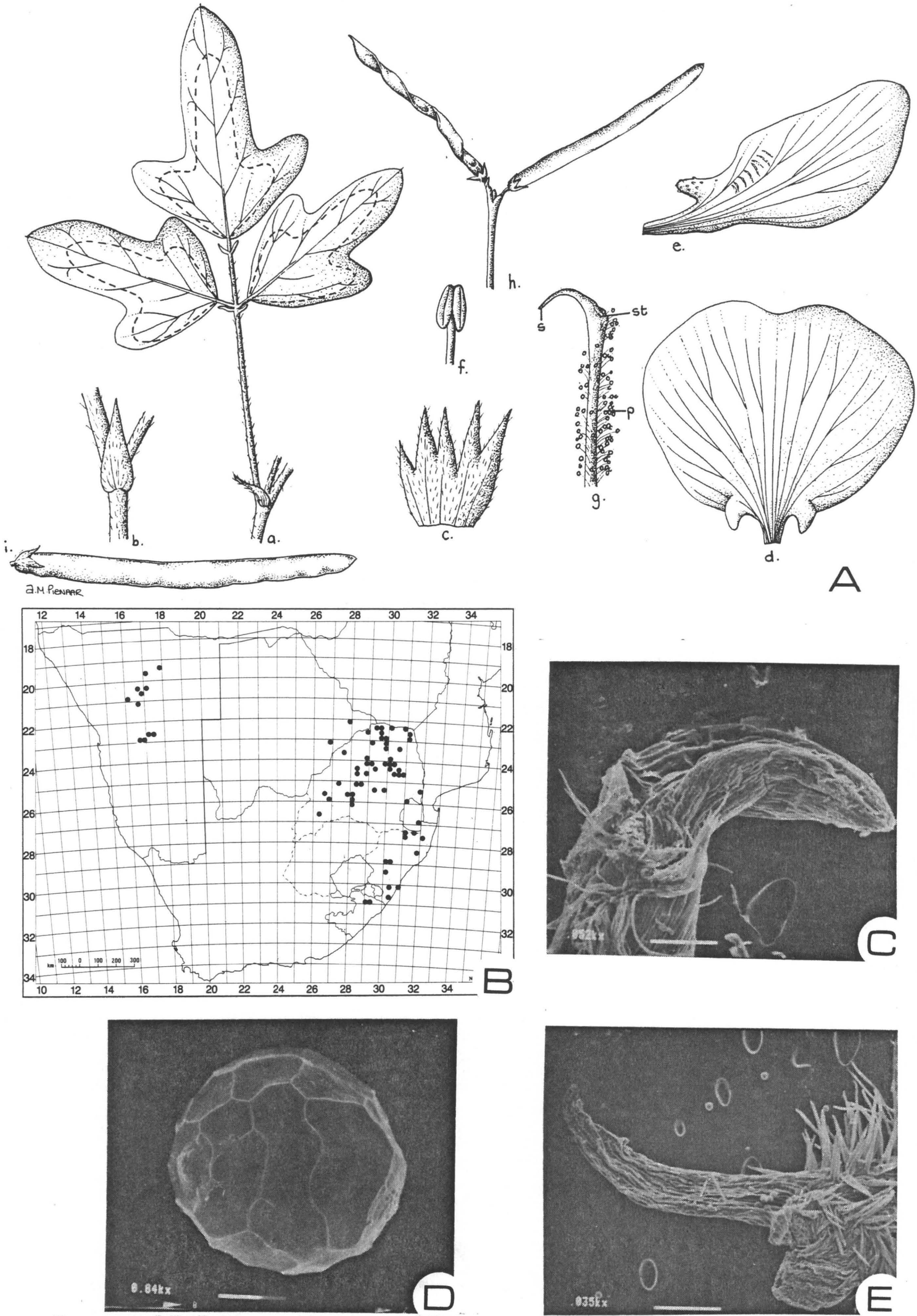


Figure 12. **A.** *V. frutescens* subsp. *frutescens* var. *frutescens*. a. Leaf (X 1); b. Stipule, often reflexed (X 3); c. Calyx (X 5); d. Standard with 1 pair callosities (X 4); e. Wing with papillae on auricle (X 4); f. Anther (X 9); g. Style prolongation [s], stigma [st], pollen brush with pollen (X 10); h. Legumes on peduncle (X 1); i. Legume (X 1). Based on *Pienaar 1309, Rudatis STE. 20145* (PRE). **B.** Known distribution in southern Africa. **C.** Style prolongation X 31 (*Pienaar 597* PRE). **D.** Pollen grain X 440 (*Pienaar 1367* PRE). **E.** Exceptionally long style prolongation X 24.2 (*Schleben & Hartman 120335* PRE).

Figure 12 (continued). F. Type specimen of *V. decipiens* Harv., *Burke* (K).

Vigna frutescens A. Rich. subsp. frutescens var. frutescens

DET B. J. Pienaar 1988

Station: Land. (Herero) ~~Damarabezirk~~ Nr. 6447

Wissensch. Name: Vigna pseudotriloba Harms

Einheim. Name: Name des Standorts: Kalkfeld

Beschaffenheit des Standorts: Lichtungen i. d. Akazienbusch

Höhe ü. d. M.:

Wuchs, Größe, Blütenfarbe etc.:

Gesammelt am [illegible] 1913 Sammler: A. Engler

Figure 12 (continued). **G.** Herbarium specimen of *V. pseudotriloba* Harms, *Engler 6447* (K).

Figure 12 (continued). **H.** Type specimen of *V. longiloba* Burtt Davy, *Kirk 77* (K).

Vigna frutescens A. Rich. subsp. frutescens var. frutescens
DET B. J. Pienaar 1988

FROM THE
IMPERIAL FORESTRY INSTITUTE.
HERBARIUM.
FLORA OF S. Africa No. 18313.
Vigna pongolensis Burtt Davy.
Waterberg Dist.
Dec., 1919.
COLLECTED BY Dr J Burtt Davy

Type Specimen. TT DAVYANUM
h Africa
No. 18313
Vigna pongolensis Burtt Davy
Drainage Basin of the Pongola River,
N.W. of 24-Rivers, Waterberg Dist.
Transvaal December 1919
Collected by JOSEPH BURTT-DAVY, F.L.S., F.R.G.S.

Vigna pongolensis Burtt Davy
Compared at Kew
by J. Burtt Davy

Figure 12 (continued). **l.** Type specimen of *V. pongolensis* Burtt Davy, *Burtt davy 18313* (K).

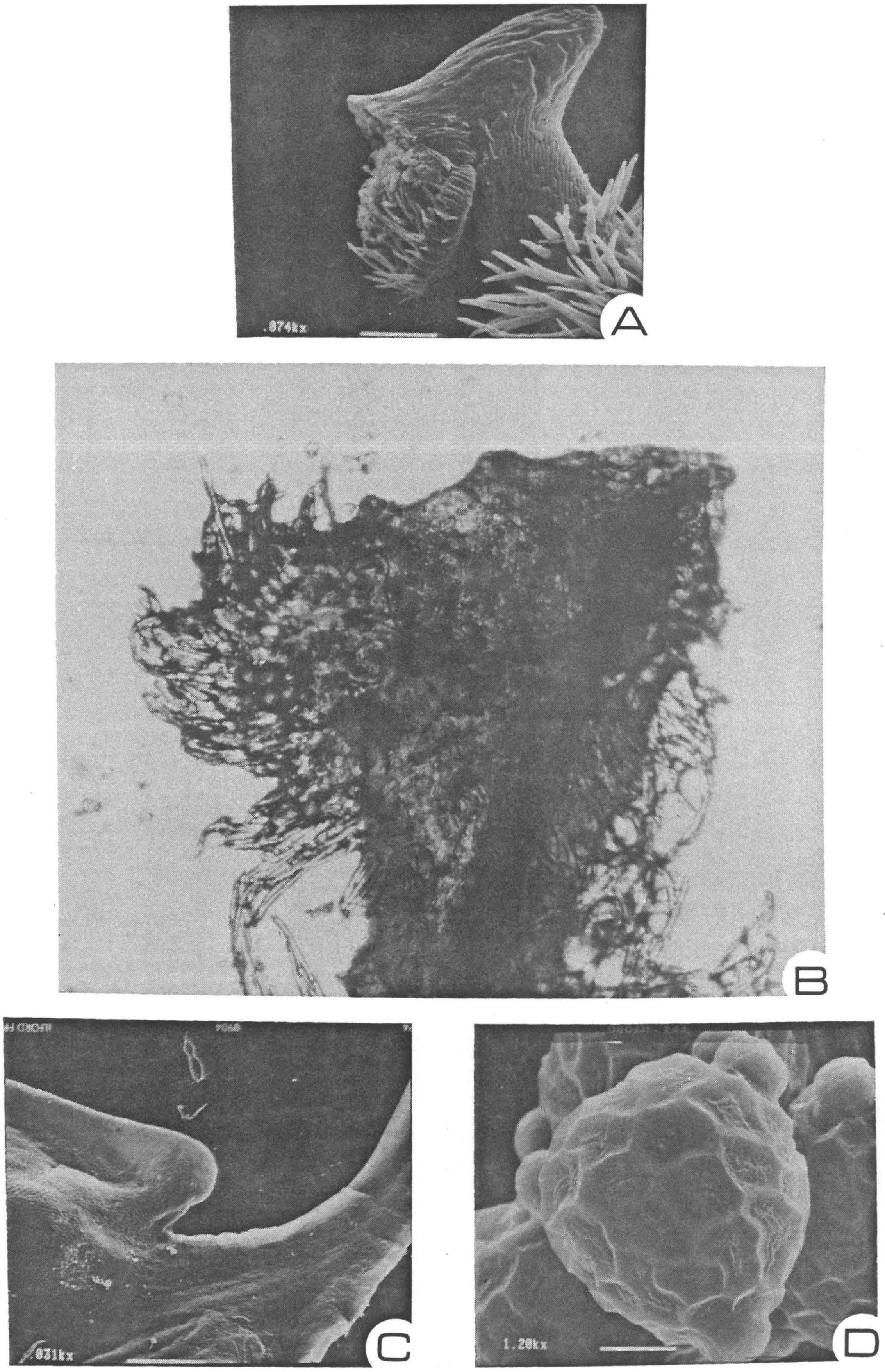
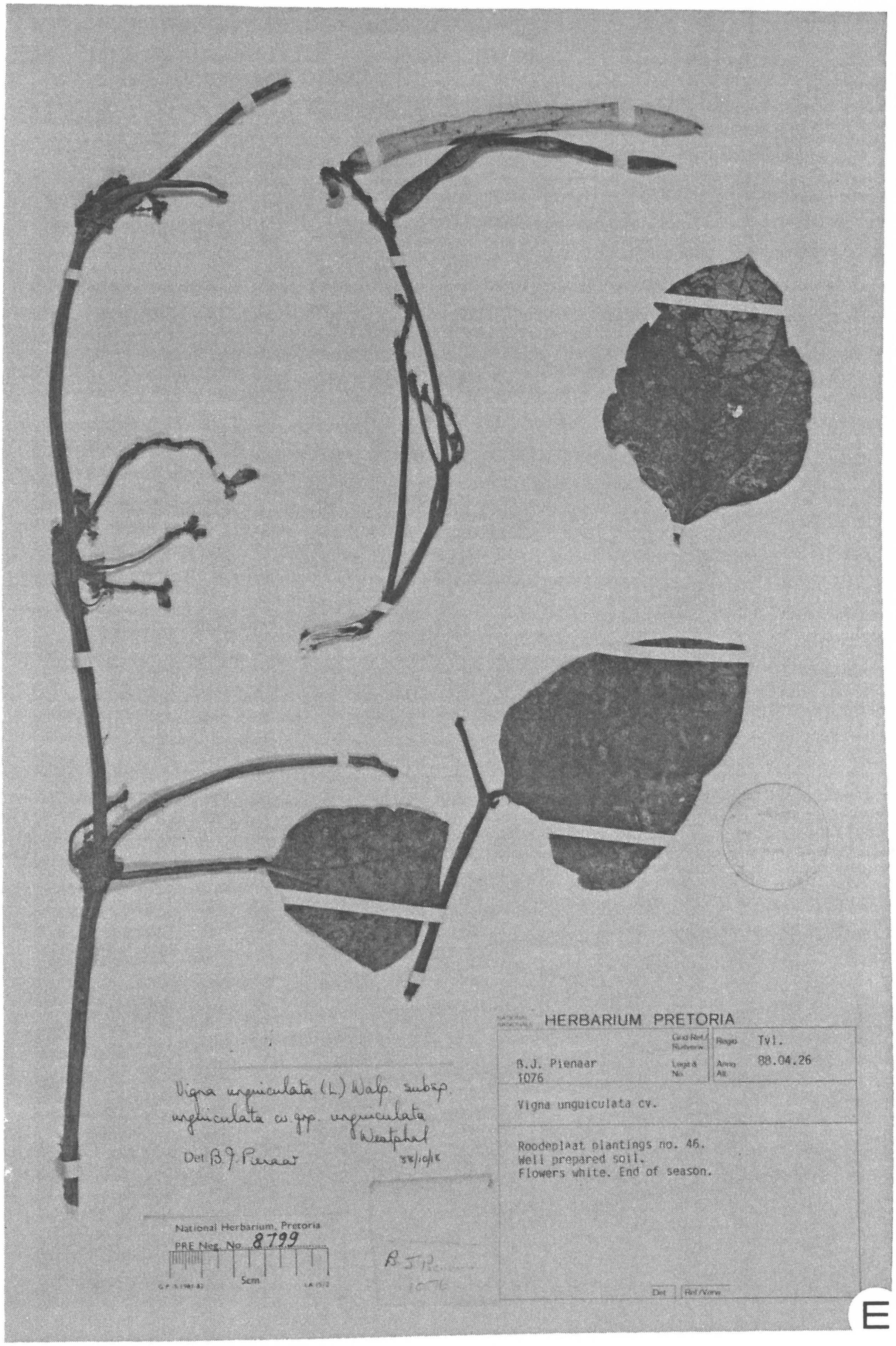


Figure 13. *V. unguiculata* and subspecies (see **ADDENDUM 1** for the following: **Figure 1**, pollen sculpture; **3**, for leaflets and stipules; **4**, for standard and wing shapes). **A.** Style prolongation X440 (subsp. *dekindtiana* var. *dekindtiana*, *Pienaar 1374* PRE). **B.** Vestige of style prolongation X 4 (subsp. *mensensis, Schweinfurth 1820*, isotype, B). **C.** Wing auricle X 22.2 (subsp. *stenophylla, Pienaar 1366* PRE). **D.** Pollen grain X 720 (subsp. *stenophylla, Sidey 1957* PRE).


HERBARIUM PRETORIA

B.J. Pienaar
1076

Tvl.
88.04.26

Vigna unguiculata cv.

Roodeplaat plantings no. 46.
Well prepared soil.
Flowers white. End of season.

Vigna unguiculata (L.) Walp. subsp. unguiculata cv gp. unguiculata Westphal
Det. B.J. Pienaar 88/10/18

National Herbarium, Pretoria
PRE Neg. No. 8799

B.J. P
1076

Figure 13 (continued). **E.** Herbarium specimen of *V. unguiculata* subsp. *unguiculata* cv. gr. *unguiculata, Pienaar 1076* (PRE).

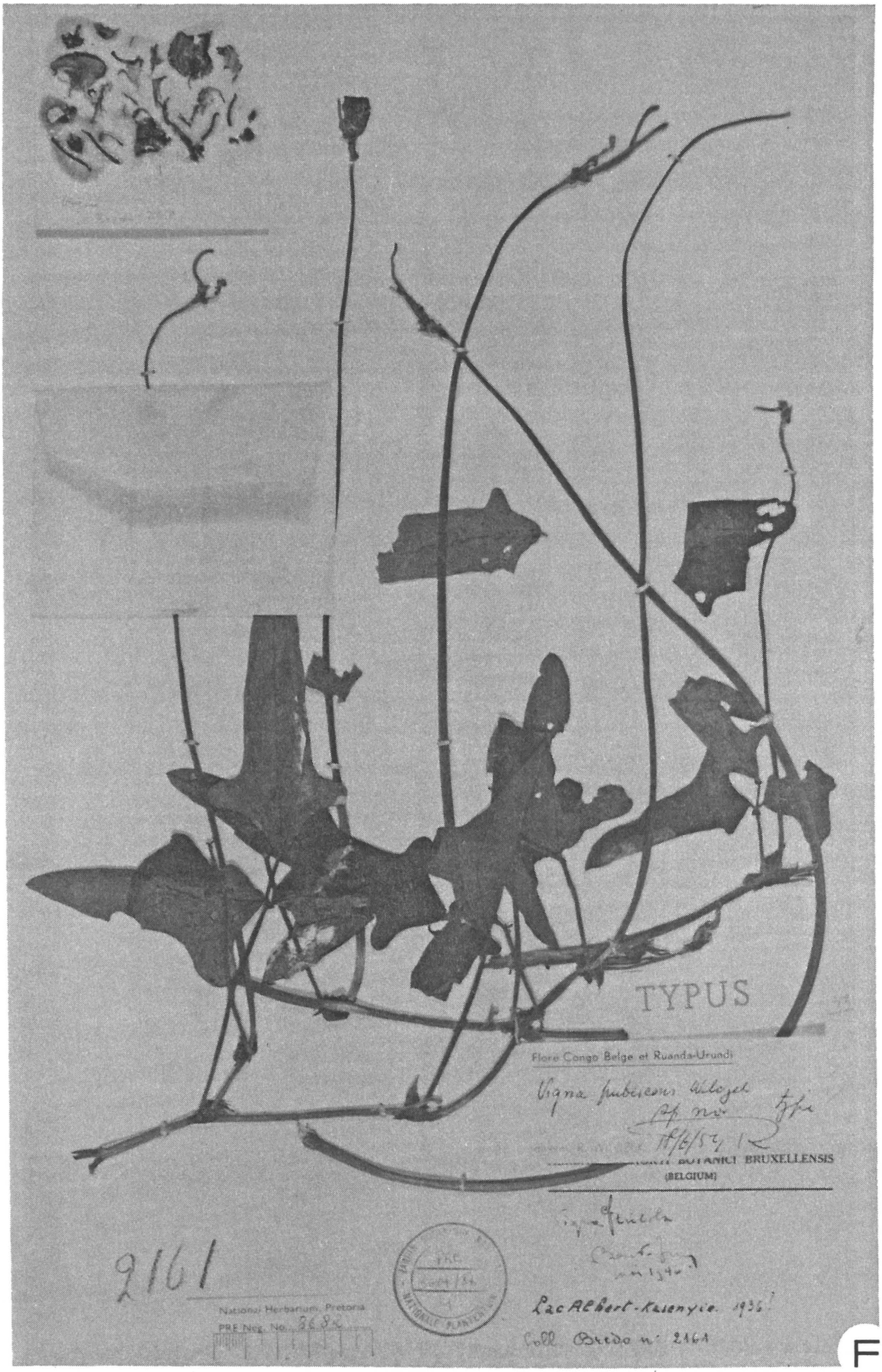


Figure 13 (continued). **F.** Type species of *V. pubescens* Wilcz., *Bredo 2164* (BR).

Figure 13 (continued). **G**. Type specimen of *Scytalis protracta*, *Drège 1837* (K).

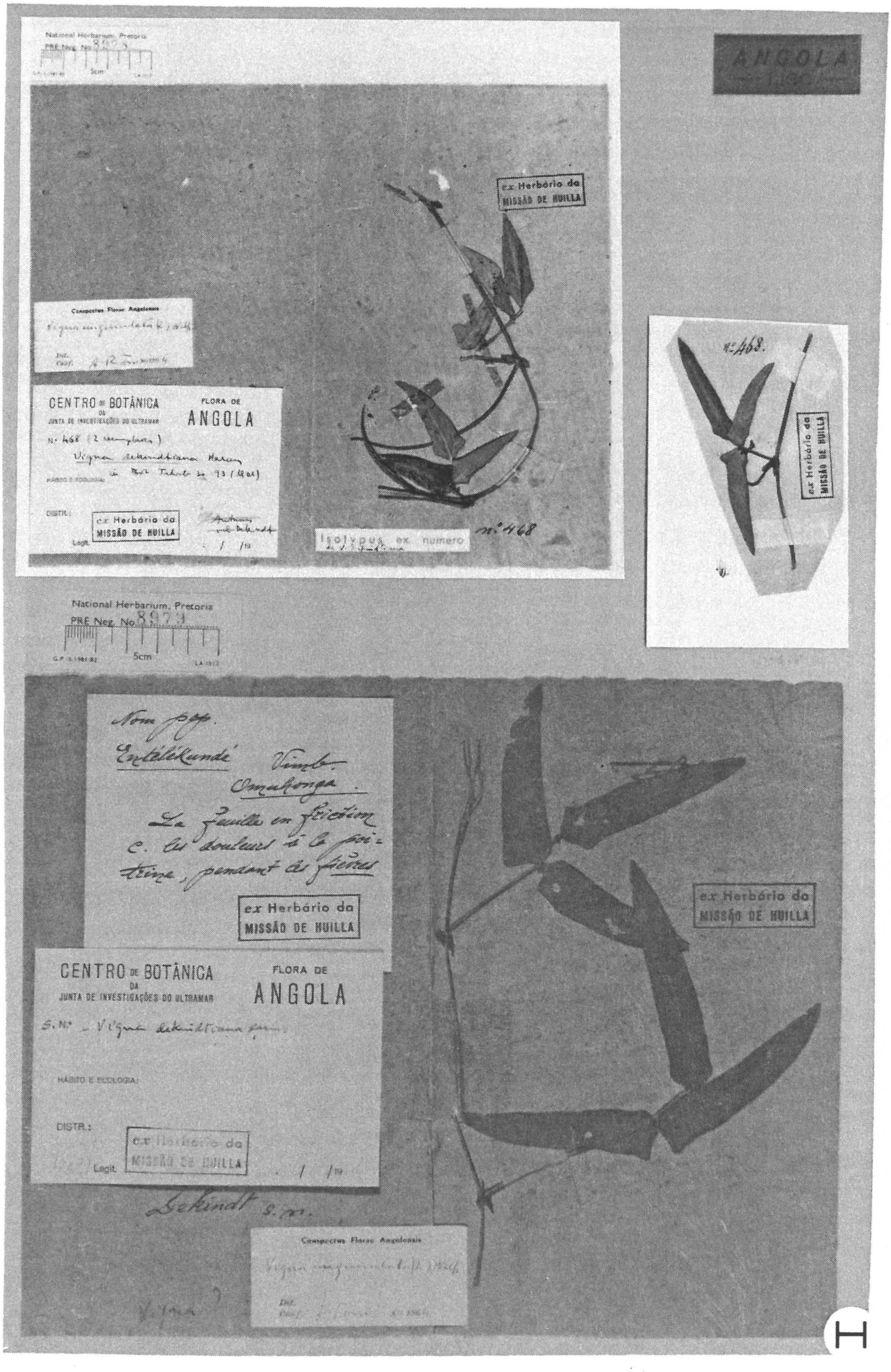


Figure 13 (continued). **H.** Herbarium specimens of *V. unguiculata* subsp. *dekindtiana* var. *huillensis*, *Dekindt 468* (isotype) and *Dekindt s.n.* (LISC).

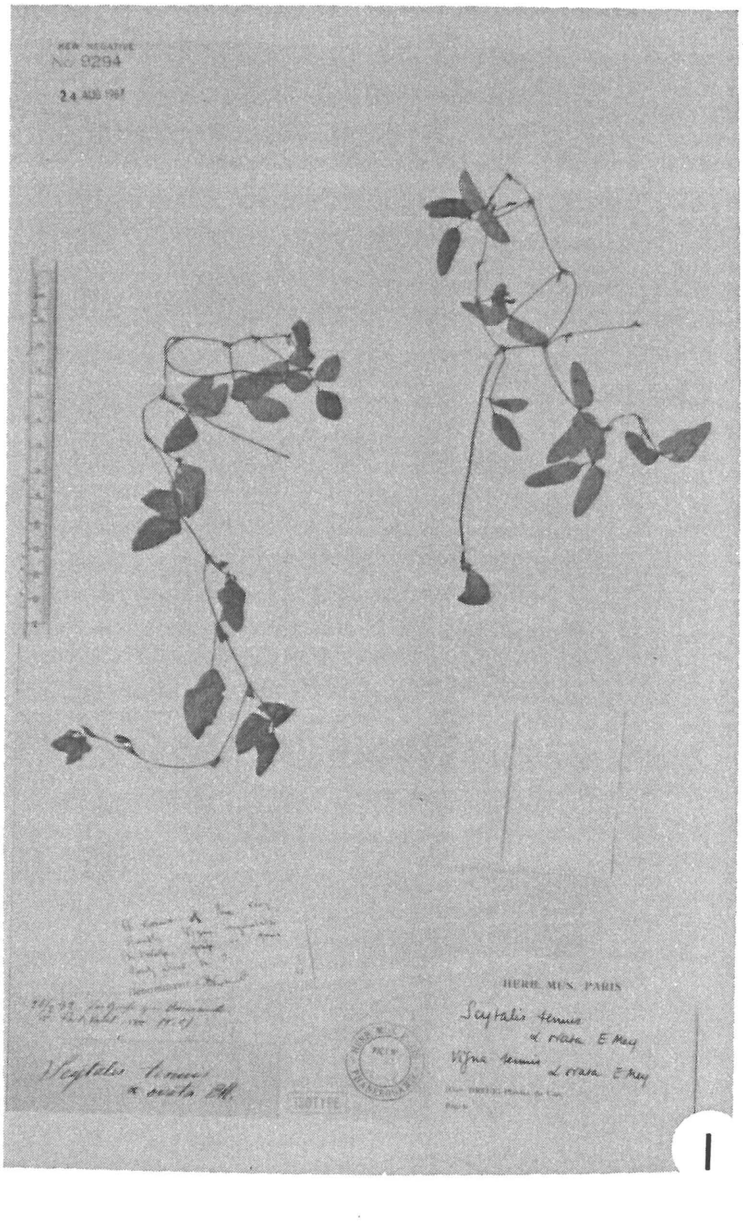


Figure 13 (continued). **I.** Type specimen of *Scytalis tenuis* var. *ovata* E. Mey., *Drège* (P).

Figure 13 (continued). J. Type specimen of *V. triloba* var. *stenophylla* Harv., *Burke 324* (K).

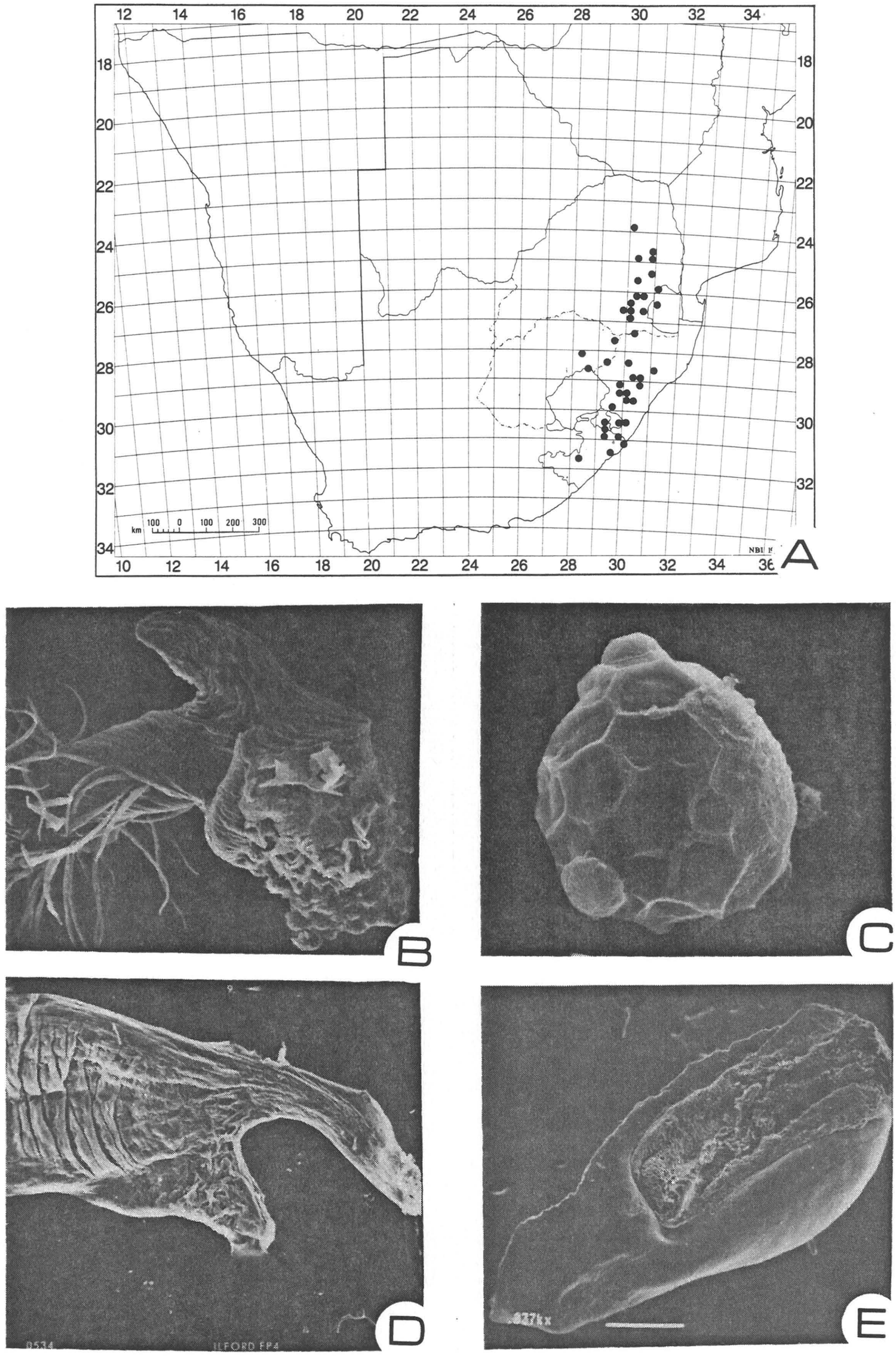


Figure 14. *V. nervosa.* **A.** Known distribution in southern Africa. **B.** Style prolongation X 53.4 (*Pienaar 513* PRE). **C.** Pollen grain X 744 (*Pienaar 513* PRE). **D.** Wing auricle X 19.2 (*Pienaar 513* PRE). **E.** Seed scar covered in spongy tissue X 26.6) (*Pienaar 513*).

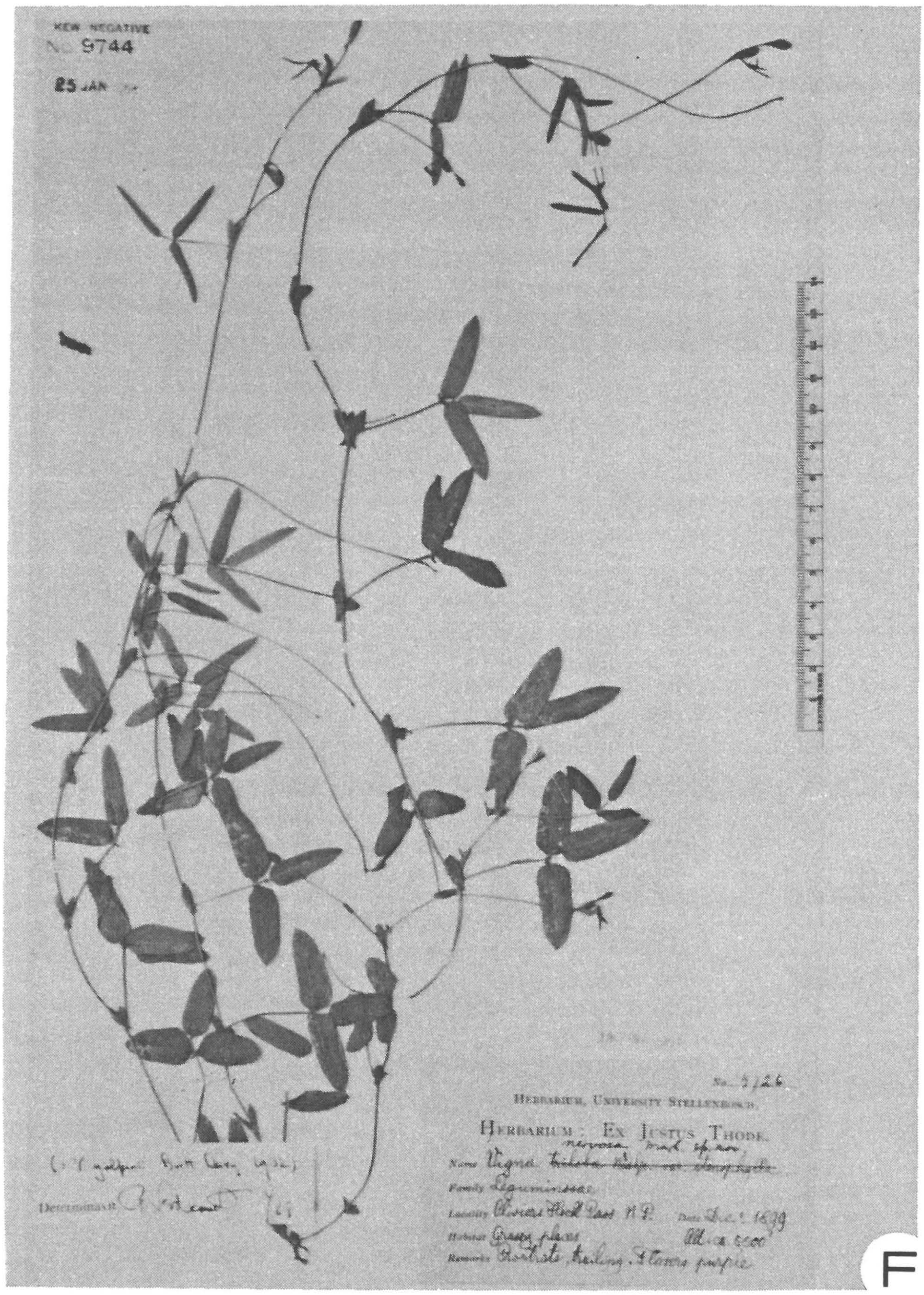


Figure 14 (continued). **F**. Type specimen of *V. nervosa, Thode STE 5726* (PRE).

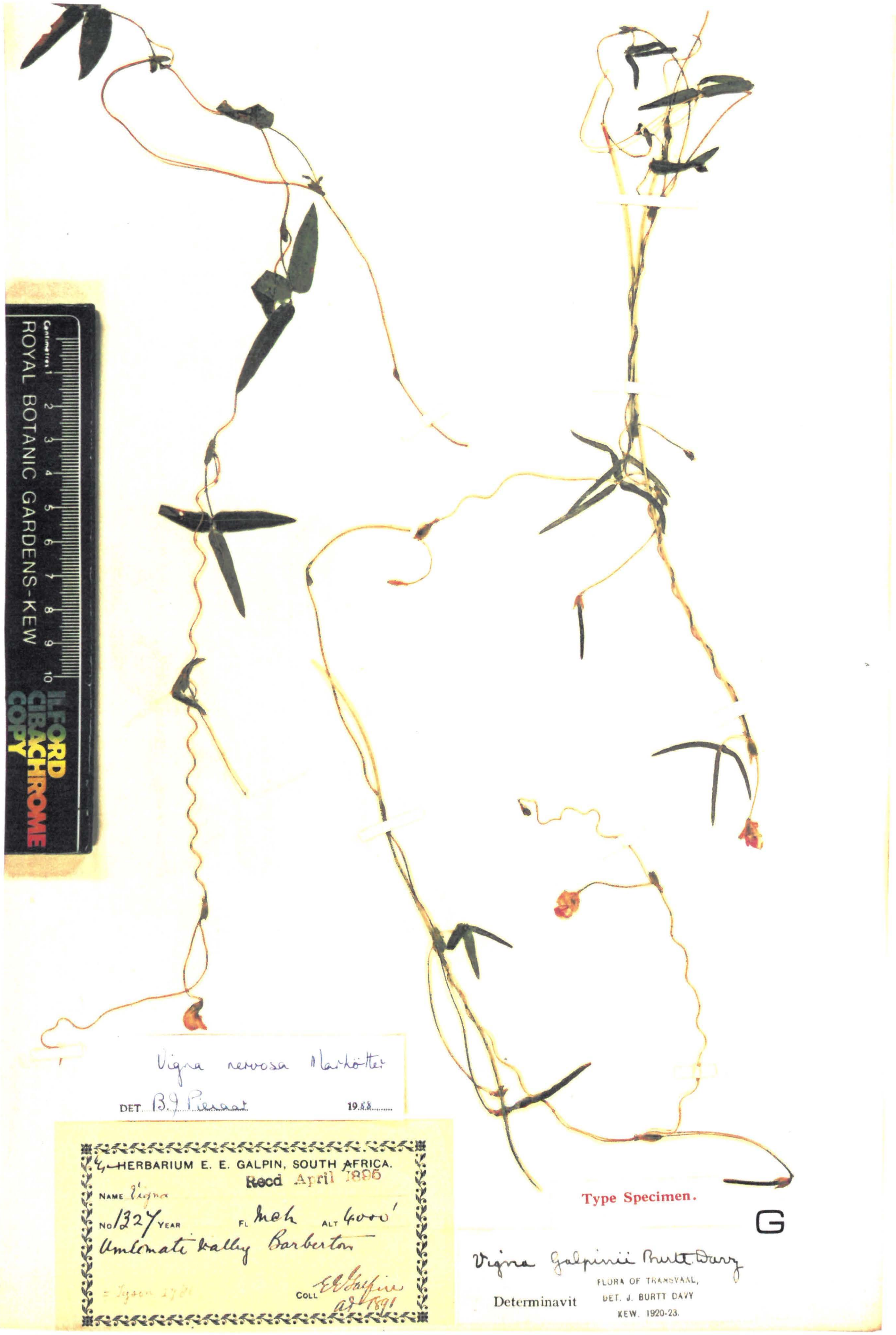


Figure 14 (continued). **G.** Type specimen of *V. galpinii, Galpin 1327* (K).

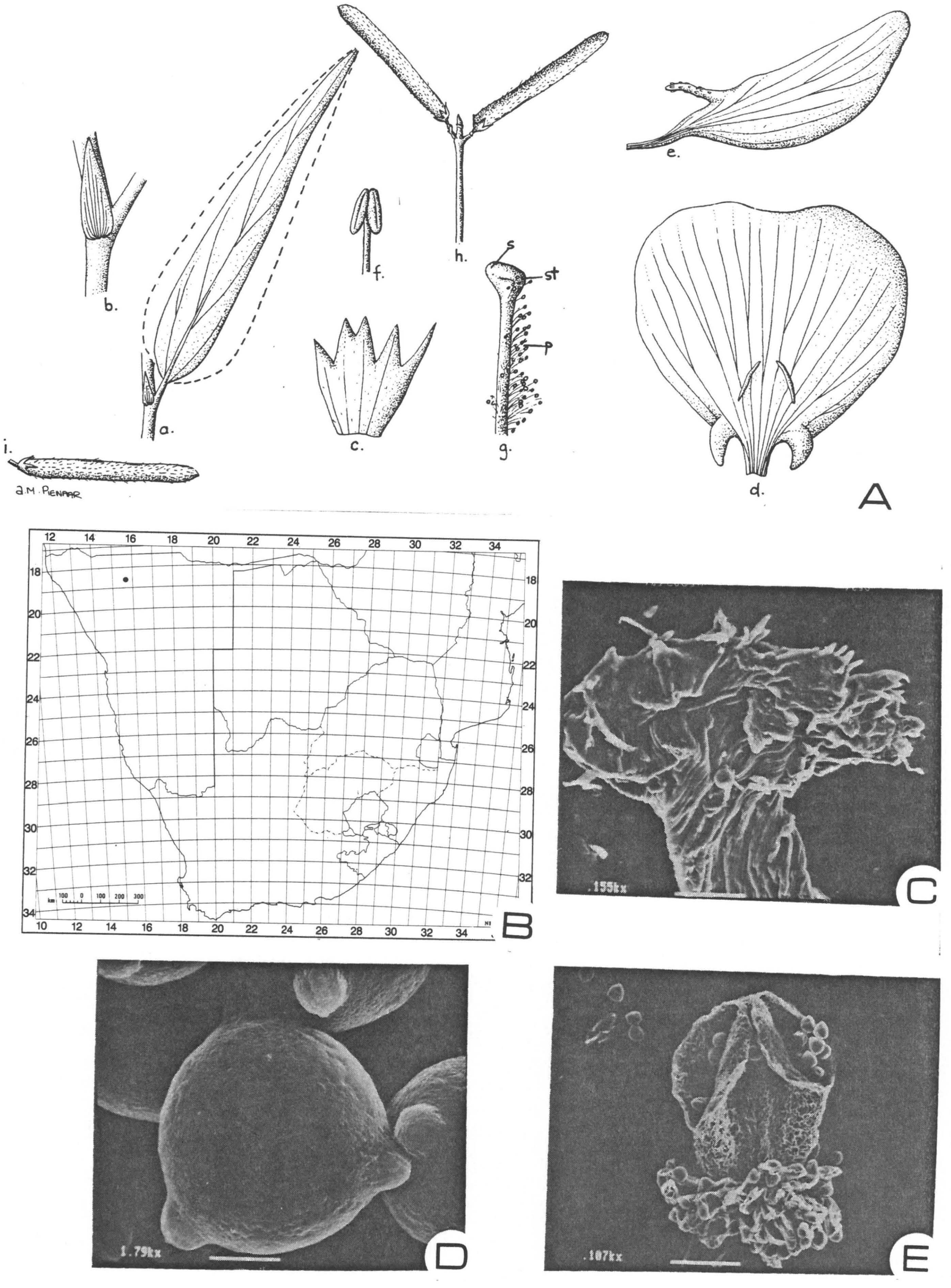


Figure 15. **A.** *V. monophylla* Taub.: a. Unifoliolate leaves (X 1); b. Stipule (X 6); c. Calyx (X 6); d. Standard with 2 pairs callosities (X 8); e. Wing (X 8); f. Anther (X 16); g. Style prolongation [s], stigma [st], pollen brush [p] (X 16); h. Legumes (erect) on peduncle (X 1); i. Legume (X 1). Based on *Bayliss 10658* (Harare, PRE). **B.** Known distribution of in southern Africa. **C.** Subterminal stigma, X 93 (*Bayliss 10658* Harare, PRE). **D.** Pollen grain, smooth, X 1074 (*Bayliss 10658* Harare, PRE). **E.** Glands at the base of anther, with pollen X 60.4, of *V. juncea* var. *major, Biegel 2689* (PRE).

Figure 15 (continued). F. Type specimen of *V. monophylla Dawe 95* (K).

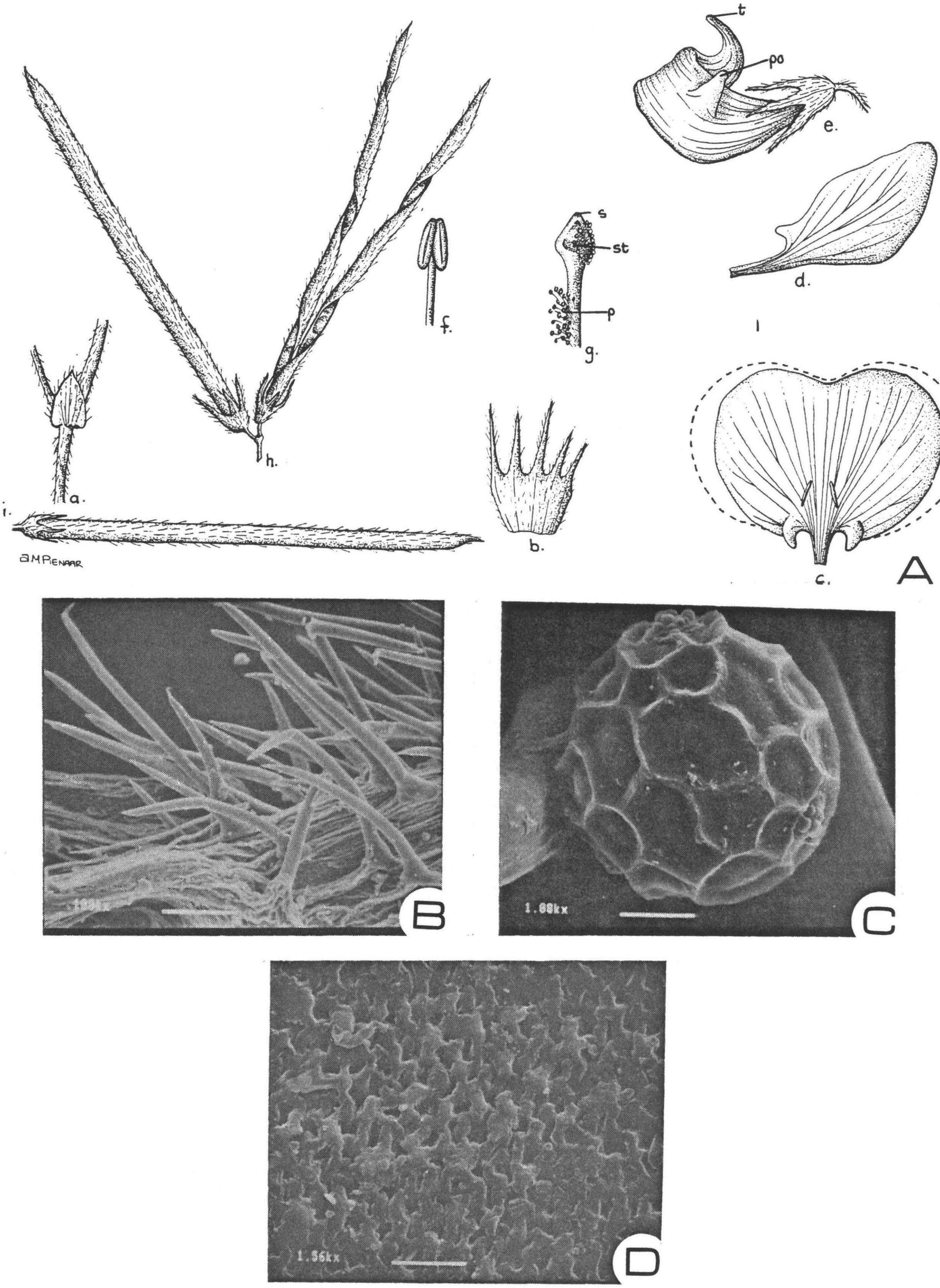


Figure 16. *V. vexillata* and varieties. (See **ADDENDUM 3** for the following, **Figure 1** for leaflet forms, **Figures 2, 3, 4, 5** for known distribution of the varieties in southern Africa, and **Figures 6, 7 & 8** for style prolongation). **A.** a. Stipule (X 1); b. Calyx (X 2.5); c. Standard, more often with unequal halves, (X 1.5); e. Wing (X 1.5): e. Keel, pocket [po], carina twist [t] (X 2); f. Anther (X 10); g. Style prolongation, frontal view, [s], stigma [st], pollen brush with pollen [p] (X 10); h. Legumes on peduncle (X 1); i. Legume, var. *ovata* excepted (X 1). Based on *Pienaar 420* (PRE). **B.** Typical patent indumentum of petiole, X 65 (var. *vexillata, Pienaar 420* PRE). **C.** Pollen grain, X 756 (var. *vexillata, Germishuizen 3902* PRE). **D.** Testa surface of seed, X 936 (*Pienaar 420*).

Figure 16 (continued). **E.** Typical herbarium specimen of var. *vexillata, Story 424* (PRE).

Figure 16 (continued). F. Typical herbarium specimen of var. *angustifolia*, *Zeyher 520* (K).

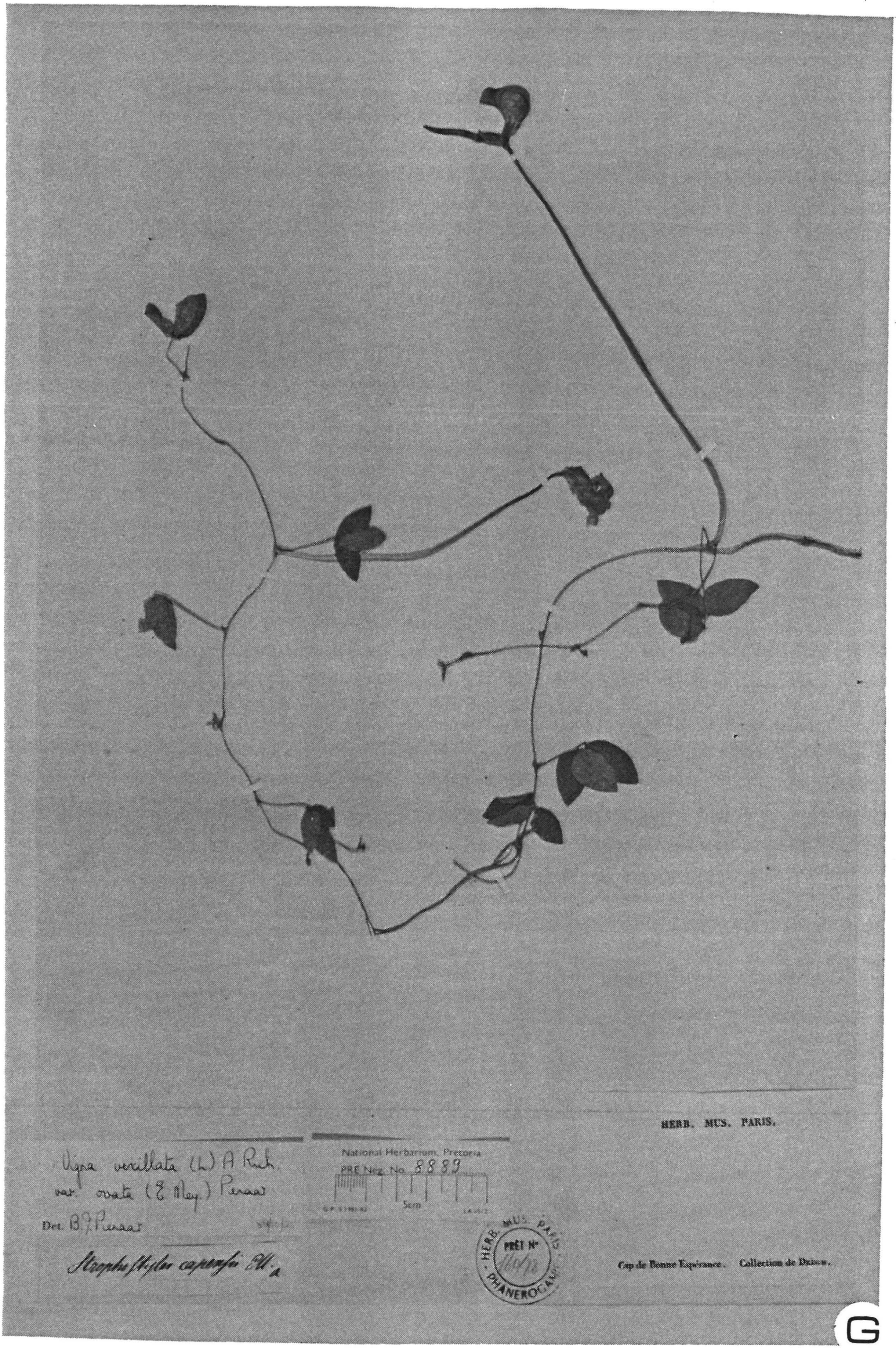
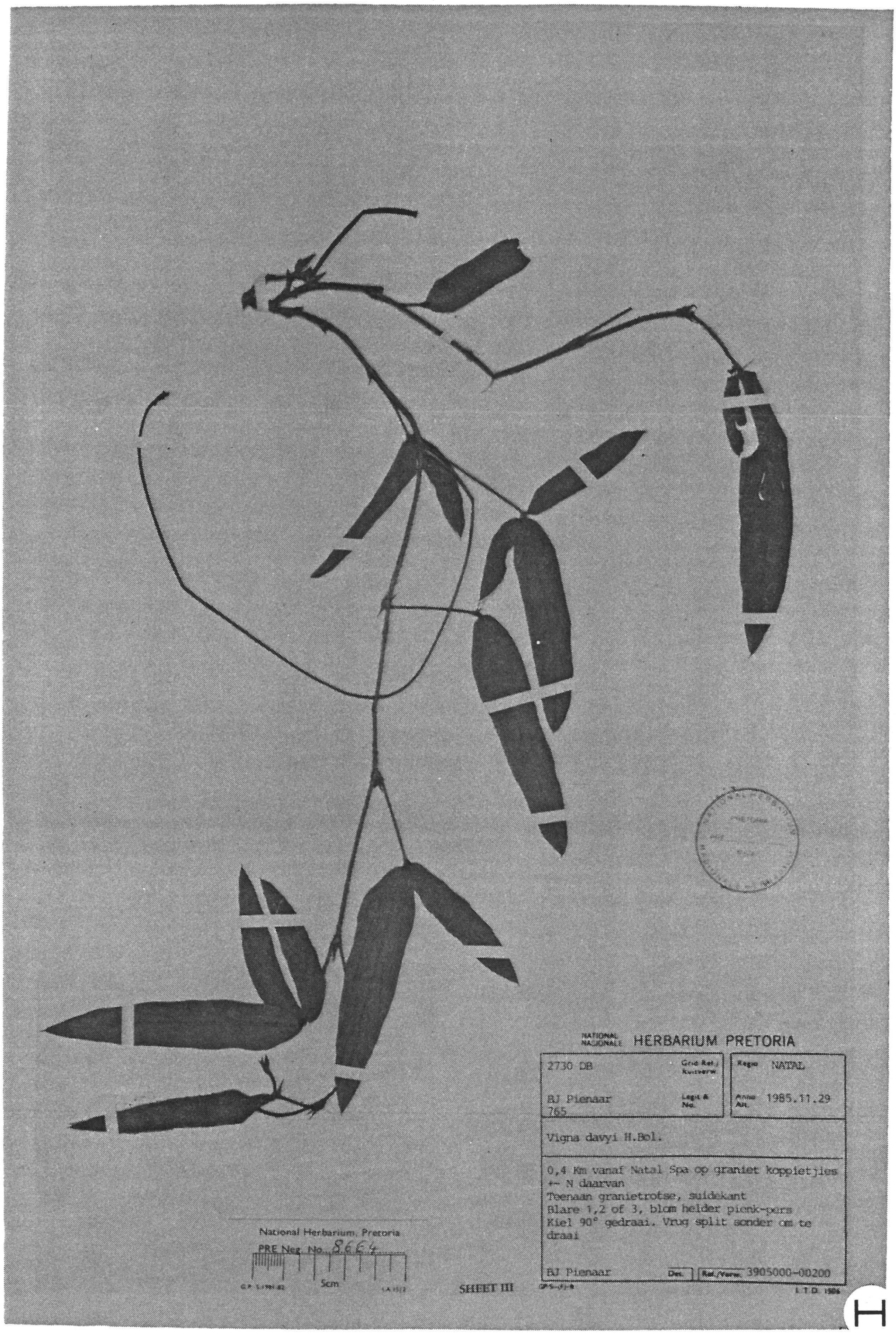


Figure 16 (continued). **G.** Type specimen of *Strophostyles capensis* E. Mey. var. *ovata, Drège* (P).



NATIONAL NASIONALE HERBARIUM PRETORIA

2730 DB Grid Ref./Kwierverw.
Regio NATAL

BJ Pienaar 765 Legit & No.
Anno Aht. 1985.11.29

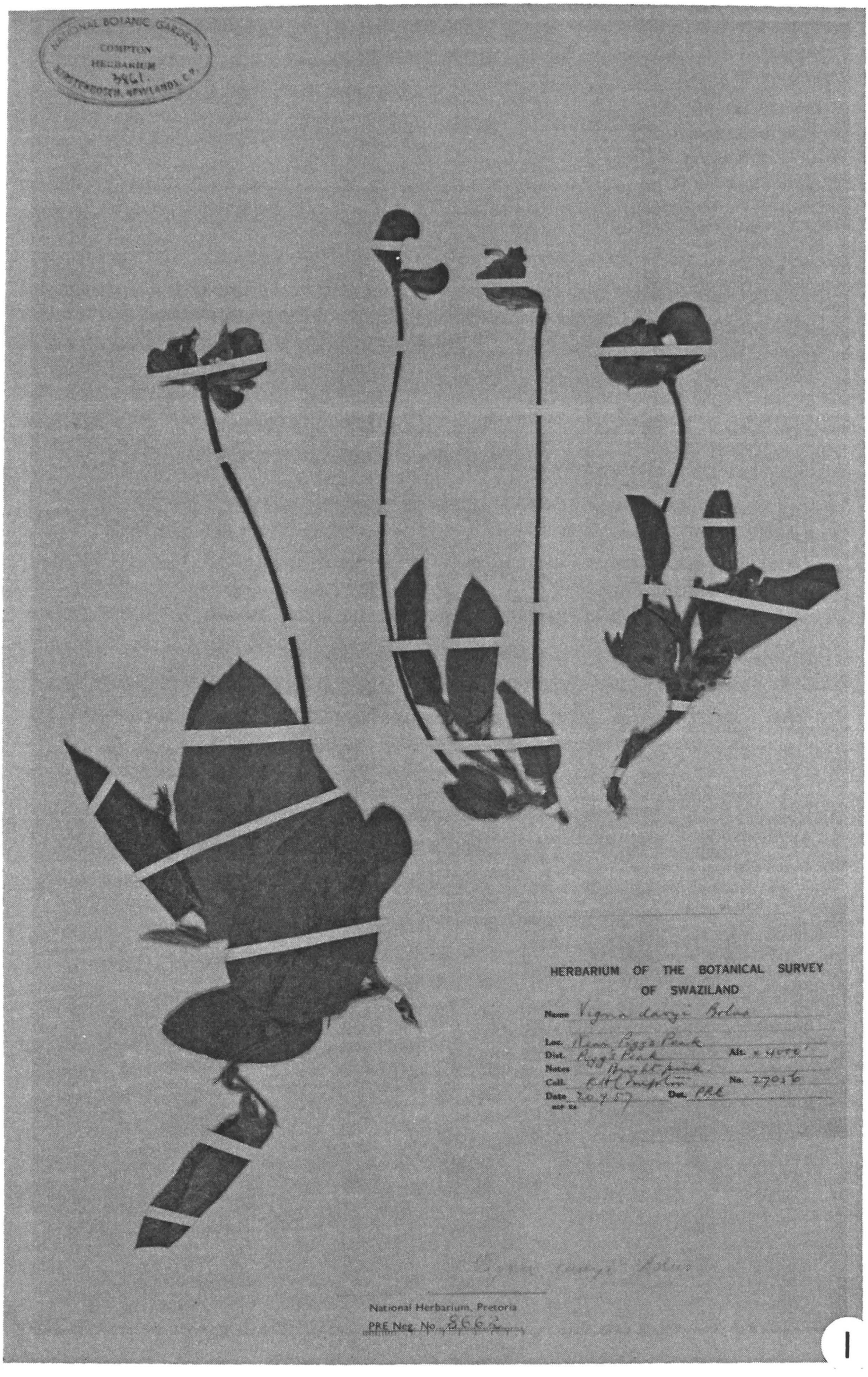
Vigna davyi H.Bol.

0,4 Km vanaf Natal Spa op graniet koppietjies +- N daarvan
Teenaan granietrotse, suidekant
Blare 1,2 of 3, blom helder pienk-pers
Kiel 90° gedraai. Vrug split sonder om te draai

BJ Pienaar Det. Ref./Verw. 3905000-00200

National Herbarium, Pretoria
PRE Neg. No. 8664

Figure 16 (continued). **H.** Typical branch of var. *davyi* with uni-, bi- and tri-foliolate leaflets on the same branch, *Pienaar 765*, (PRE).



HERBARIUM OF THE BOTANICAL SURVEY
OF SWAZILAND

Name Vigna davyi Bolus

Loc. Near Piggs Peak
Dist. Piggs Peak Alt. ± 4000'
Notes Bright pink
Coll. R.H. Compton No. 27056
Date 20.4.57 Det. PRE

Figure 16 (continued). **G.** Typical herbarium specimen of erect plants of var. *davyi*, *Compton 27056* (PRE).

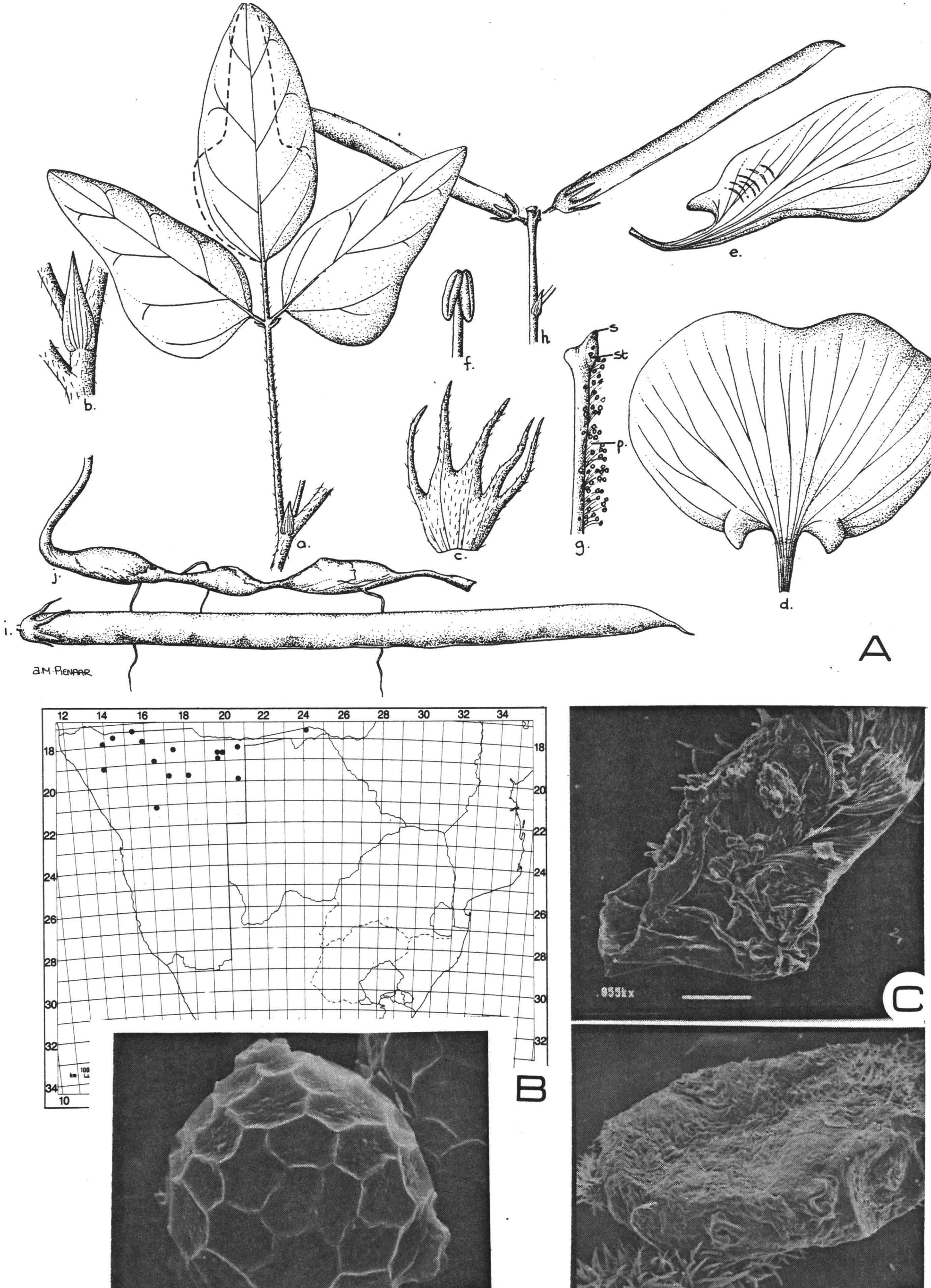


Figure 17. **A.** *V. lobatifolia*. a. Leaf (X 1); b. Stipule (X 6); c. Calyx (X 3); d. Standard with one pair callosities (X 3); e. Wing (X 3); f. Anther (X 10); g. Style prolongation [s], stigma [st], pollen brush with pollen [p]; h. Legume on peduncle (X 0.5); i. Legume (X 1); j. Underground system, moniliform (X .25). Based on *Giess 9794, Maguire 2466* (PRE). **B.** Known distribution in southern Africa. **C.** Style prolongation, bonnet-shaped, X 33 (*De Winter & Marais 4636* PRE). **D.** Pollen sculpture, X 774 (*De Winter & Marais 4636* PRE). **E.** Extrafloral nectaries, X 21 (*Story 6404* PRE).

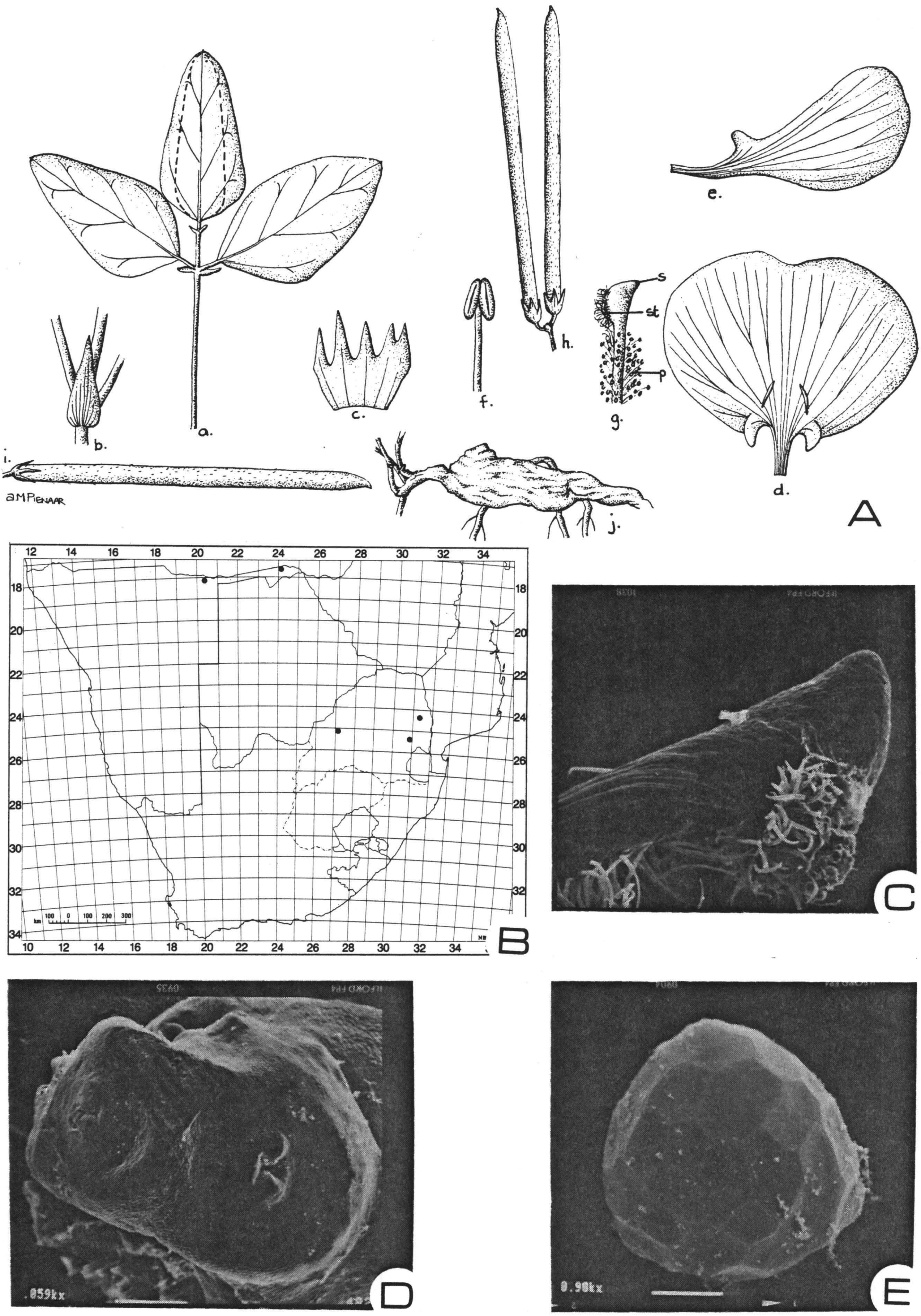


Figure 18. **A.** *V.* sp. A: a. Leaf (X 1); b. Stipule (X 3); c. Calyx (X 3); d. Standard with 2 pairs callosities (X 4); e. Wing (X 4); f. Anther (X 7); g. Style prolongation [s], stigma [st], pollen brush with pollen [p] (X 10); h. Legumes on peduncle (X 1); i. Legume (X 1); j. Underground tuber, vertical (X 0.25). Based on *Pienaar 1364* (PRE). **B.** Known distribution in southern Africa. **C.** Style prolongation, reduced to a swelling, X 38.4 (*Pienaar 1364* PRE). **D.** Extrafloral nectaries, X 35.4 (*Pienaar 1364* PRE). **E.** Pollen grain, X 540 (*Pienaar 1364* (PRE).

ADDENDUM 1

THE *VIGNA UNGUICULATA* COMPLEX (FABACEAE) IN SOUTHERN AFRICA

The *Vigna unguiculata* complex (Fabaceae) in southern Africa

B.J. Pienaar* and A.E. van Wyk

*National Botanical Institute, Private Bag X101, Pretoria, 0001 Republic of South Africa and H.G.W.J. Schweickerdt Herbarium, Department of Botany, University of Pretoria, Pretoria, 0002 Republic of South Africa

Proposals are made toward the infraspecific delimitation of taxa in the *Vigna unguiculata* complex. Only the forms occurring naturally in Africa are considered. A study of herbarium collections and extensive field work in southern Africa have led to a reassessment of the complex, resulting in the recognition of seven infraspecific taxa, namely *V. unguiculata* subsp. *protracta* (E. Mey.) B.J. Pienaar, subsp. *dekindtiana* (Harms) Verdc. with two varieties, var. *dekindtiana* and var. *huillensis* (Welw. ex Bak.) B.J. Pienaar, subsp. *mensensis* (Schweinf.) Verdc., subsp. *tenuis* (E. Mey.) Maréchal *et al.* with two varieties, var. *tenuis* and var. *ovata* (E. Mey.) B.J. Pienaar, and subsp. *stenophylla* (Harv.) Maréchal *et al.* The paper provides a key to the subspecies and varieties in Africa, the typification of the names and synonymy.

Infraspesifieke afbakening van taksons in die *Vigna unguiculata*-kompleks word voorgestel. Alleenlik die vorms wat natuurlik in Afrika voorkom, word behandel. 'n Ondersoek van herbariumeksemplare en uitgebreide veldwerk in Suider-Afrika het daartoe gelei dat sewe infraspesifieke taksons erken word, naamlik *V. unguiculata* subsp. *protracta* (E. Mey.) B.J. Pienaar, subsp. *dekindtiana* (Harms) Verdc. met twee variëteite, var. *dekindtiana* en var. *huillensis* (Welw. ex Bak.) B.J. Pienaar, subsp. *mensensis* (Schweinf.) Verdc., subsp. *tenuis* (E. Mey.) Maréchal *et al.* met twee variëteite, var. *tenuis* en var. *ovata* (E. Mey.) B.J. Pienaar, en subsp. *stenophylla* (Harv.) Maréchal *et al.* Hierdie ondersoek verskaf 'n sleutel tot die subspesies en variëteite in Afrika, die tipifisering van die name en hul sinonimie.

Keywords: Africa, Cowpea, Fabaceae, Phaseoleae, style, taxonomy, *Vigna*

*To whom correspondence should be addressed

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[1] Submitted for publication in *S.A. Journal of Botany*

Introduction

Taxonomic research on the wild forms of *Vigna unguiculata* (L.) Walp. is of particular interest because the cultivated form of this species is an important crop and source of protein in the tropics. Commonly known as the Cowpea or "Kafferboontjie", this species is the subject of intensive breeding studies in many parts of the world, and in particular at the International Institute for Tropical Agriculture at Ibadan, Nigeria. In this respect southern Africa is regarded as a largely unexploited genetic reservoir for the species. For example, the wild relative, *V. unguiculata* subsp. *dekindtiana* (Harms) Verdc. var. *protracta* (Maréchal *et al.* 1978) is considered to be "an effective parent for conferring pubescence to Cowpea, because the resistance to insects would best be served by developing genotypes with pubescent leaves" (communication from Dr. A.E. Hall, University of California, USA, in PRE, 1987-10-27).

Cowpea is used as hay, pasture, soil cover, green manure, a concentrate for farm animals, and as silage for which the best stage for cutting is when the first pods turn yellow and the plants contain 60% of their crude protein (Westphal 1974). Cowpea has a nutritional value as a protein food. African peoples are known to roast the tubers on hot coals, and also use the leaves like spinach or the green pods as a vegetable. As a pot-herb, it may be used in the fresh state or dried and stored for dry-season use. In tropical Africa, the plants do not mature in a definite period, but continue to produce new leaves if cut back regularly from an early stage (Purseglove, fide Westphal 1974). In India the leaves are used for a green dye when mixed with *Strobilanthus flaccidifolius* Nees and *Curcuma domestica* Val. (turmeric). In Nigeria fibres from the long peduncles of cv. gr. *textilis* are extracted for ropes.

The genus *Vigna* Savi belongs to the tribe *Phaseoleae* L. (subfamily Faboideae, family Fabaceae) and includes about 150 species distributed mainly throughout the tropics of both hemispheres. Five subgenera are recognized in the genus by Verdcourt (1971) and seven by Maréchal *et al.* (1978). Jaaska & Jaaska (1988) raised the status of section *Catjang* (DC.) Verdc. (1970) in the subgenus *Vigna* to that of subgenus. Four of these subgenera are represented in southern Africa, namely *Vigna*, *Plectrotropis* (Schumach.) Verdc., *Catjang* (DC.) Jaaska & Jaaska and *Haydonia* (Wilcz.) Verdc.

Subgenus *Catjang* includes *V. unguiculata* and all its infraspecific taxa, as well as *V. nervosa* Markötter. The name *Catjang,* frequently spelled *Catiang,* originated in the Orient as *Catjang* (Gove 1961), the Malayan and Sundanese name of a bean or the "pigeon" pea, and was accepted in that form into the Dutch vocabulary. Linnaeus (1771) cites *Burm. ind. 161* for his *Dolichos catiang,* which Burm. f. (1768) had actually named *Dolichos catjang* Burm. f., reverting to the original spelling. As to the correct spelling of the name *Catjang,* it would appear that the original form is *Catjang* (*Catjung,* fide Westphal p. 223, 1974) but that Linnaeus published *Dolichos catiang* in his *Mantissa* (1771) and that this version enjoys preference. However, Article 73.1 of the I.C.B.N. (Greuter *et al.* 1988) recommends that the original spelling should be retained and Article 73.5 recommends that, where the spelling is changed as a result of Latin usage (i.e. where `i' is used because of the absence of `j' in Latin), the original spelling be restored. We have therefore adopted *Catjang* as the spelling of the subgeneric name.

De Candolle (1825) first referred to *Catjang* as a section with "legumina cylindrica". No mention is made of the stipules with spurs below the point of attachment. The presence of these characteristic spurs was first recorded by Schumacher (1829) when describing *Dolichos oleraceus* Schumach. & Thonn., although no mention was made of *Catjang*. E. Meyer (1836) united sections *Catjang* DC. and *Unguicularia* DC. as section *Catjang* (DC.) E. Mey. of the genus *Scytalis,* the discerning character being the bearded style. Walpers (1839) published the new combination *Vigna catjang* (Burm. f.) Walp. [syn. *Scytalis catjang* (Burm. f.) E. Mey.].

Verdcourt (1970, 1971) reinstated *Catjang* ("*Catiang*") as a section of *Vigna,* characterized by stipules distinctly spurred at the base, or often distinctly peltate [hence Harm's (1915) sect. *Appendiculatae* Harms for the group]; keel obtusely beaked, slightly incurved, canoe-shaped and without pockets (as in section *Plectrotropis*); style with the thickened part slightly curved and a short upturned or horizontal beak beyond the stigma, and pollen sculpture of a wide reticulation of raised muri (compare Figure 1).

According to Maréchal *et al.* (1978) the pollen grains of subspecies *Catjang* are larger than in the other *Phaseoleae* members. They recognize only two species in their section *Catjang,* namely *V. unguiculata* (L.) Walp. which is most variable and complex, and *V. nervosa*. The wild forms of *V.*

unguiculata occupy almost the whole of tropical Africa, the greatest variability amongst them concentrated in southern Africa.

Westphal (1974) refers to the various cultivated forms of *V. unguiculata* as cultivar-groups. He recognizes four such groups, namely cv. gr. *unguiculata* (L.) Westphal, cv. gr. *biflora* (L.) Westphal, cv. gr. *sesquipedalis* (L.) Westphal and cv. gr. *textilis* (A. Cheval.) Westphal. Each taxon constitutes a group of cultivars distinguished from one another by a very small number of characters, and sometimes by different agricultural practices only or by their uses. They interbreed freely to form fully fertile hybrids and show Mendelian inheritance (Sen & Bhowal 1960). Verdcourt (1970, 1971) recognizes five subspecies in *Vigna unguiculata*, namely subsp. *unguiculata*, subsp. *sesquipedalis* (L.) Verdc. and subsp. *cylindrica* (L.) Verdc., all of which are cultivated, and subsp. *mensensis* (Schweinf.) Verdc. and subsp. *dekindtiana* (Harms) Verdc., both wild.

Maréchal *et al.* (1978) include all cultivated forms under subsp. *unguiculata*. This use of cultivar groups as proposed by Westphal (1974) was accepted by Maréchal *et al.* (1978) as a very logical solution to define the genetic entities forming the basis of all existing cultivars. Ohashi (1975), however, prefers the status of variety for the cultivar groups since he approaches the problem from the floristic point of view. We incorporate all cultivated forms under subsp. *unguiculata*, with informal cultivar groups reflecting the various genetic entities.

In southern Africa the genus *Vigna* as a whole has not been revised since Harvey in Harvey & Sonder (1862). Although the epithet *unguiculata* did not figure at all in that revision, Harvey did recognize *Vigna tenuis* (E. Mey.) Dietr. and *V. triloba* Walp. nom. illeg. (Verdc. 1968) [= *Dolichos trilobus* sensu Thunb. and *Scytalis protracta* E. Mey.]. He also proposed a new variety, namely var. *stenophylla* Harv., under *Vigna triloba*. Burtt Davy (1932) revised the genus *Vigna* for the Transvaal and Swaziland only, also not mentioning the epithet *unguiculata*. He introduced *V. stenophylla* Burtt Davy non Harms [= *V. triloba* var. *stenophylla*], *V. triloba* (= *Dolichos trilobus* sensu Thunb. and *Scytalis protracta*), *V. rhomboidea* Burtt Davy, *V. sinensis* (L.) Hassk. (= *Dolichos sinensis* L., *V. catiang*), *V. scabrida* Burtt Davy and *V. galpinii* Burtt Davy (= *V. nervosa* Markötter). These taxa will be dealt with further on.

According to Gibbs Russell *et al.* (1987), the group of *Vigna* species belonging to the *Vigna unguiculata* complex includes in alphabetical order, *V. angustifoliolata* Verdc., *V. huillensis* Welw. ex Bak., *V. nervosa*, *V. tenuis*, *V. unguiculata* subsp. *dekindtiana* (Harms) Verdc. and *V. unguiculata* subsp. *unguiculata*. De Wet *et al.* (1989) placed *V. huillensis* into synonymy with *V. unguiculata* subsp. *dekindtiana*. In 1990 De Wet *et al.* merely referred to the taxonomic treatment of *Vigna* by Verdcourt (1971), without making any recommendations as to the acceptability of taxa and names. Verdcourt (1970, 1971) as well as Maréchal *et al.* (1978), recognizes *V. nervosa* (= *V. galpinii*) as a species belonging to the *V. unguiculata* group of *Vigna* and therefore as a member of subgenus *Catjang* (Jaaska & Jaaska 1988).

The aim of the present study is to evaluate the classification proposals made by recent authors such as Verdcourt (1970, 1971) and Maréchal *et al.* (1978), and to determine whether they are applicable to southern African material and, where necessary, to make recommendations to accommodate those endemic taxa not fully covered by the latter workers. An attempt is made to consider the southern African taxa of subgenus *Catjang* in the light of existing taxonomic treatments, combined with personal work in the field and the herbarium. The principle motive is to avail workers of information and a workable key by which to identify the various taxonomic entities in southern Africa. Detailed descriptions are provided for all taxa native to the region.

Materials and Methods

Herbarium specimens from BR, BM, BOL, DWU, J, K, LISC, NBG, NH, P, PRE, PRU, SAM, and SRGH were studied.

Extensive fieldwork was done so that first-hand observations of live material could be made; seedlings and older plants were transplanted in the nursery of the National Botanical Institute, Pretoria, so that ample material was available for detailed comparative investigation. SEM studies were conducted, amongst others, of the style prolongation beyond the stigma and valuable deductions were made.

Distribution maps and explanatory tables were constructed to aid in the delimitation of taxa. Localities are plotted according to the grid reference system of Edwards & Leistner (1971). Citation of specimens is purely representative, i.e. one specimen per grid, a complete list being available on request.

Taxonomy

Vigna unguiculata *(L.) Walp.*, Repertorium botanices systematicae 1: 779 (1842); Wilczek: 387, t. 30 (1954); Hepper: 569 (1958); Verdc.: 542 (1970); Verdc.: 642 (1971); Maréchal *et al.*: 190 (1978); Baudoin & Maréchal: 6 (1985). Type: designated by Westphal (1974); plant cultivated from seed collected in Ethiopia, *Westphal 8682* (WAG, neo.; K, P, isoneo.). See discussion.

Dolichos unguiculatus L.: 725 (1753). Type from Barbados; presumably grown at UPSV from seed, but no specimen found (neotype designated by Westphal).

Herbaceous annual or perennial, erect, trailing or twining, cultivated or wild, chiefly in grassland, but also in open woodland and woodland edges. *Root system* shallow, adventitious or turbinate tubers, nodules common on all systems. *Stems* variable in thickness, patent, pubescent to aculeate, scabrid to glabrous, hairs colourless. *Leaflets* variously shaped, from obtusely trilobed to more or less triangular-rhomboid to elongate-hastate, texture variable from soft chartaceous to coriaceous, pubescence variable from strigose on both lamina surfaces to sparsely strigose on dorsal nerves only. *Stipules* typically spurred, i.e. appendaged below the point of attachment; variable from large, broadly ovate and most obvious, green, extremely strigose and ranging to hairy on ribs only or glabrous, to relatively small, lanceolate, brown and glabrous, all margins ciliate. *Inflorescence* axillary, a raceme varying from elongated with 4—7 flowers to contracted with 2 flowers, extrafloral nectaries alternating with flowers. *Flowers* blue, mauve, purple to pinkish mauve. *Calyx* campanulate, lobes longer or shorter than tube, variably strigose, the two upper lobes connate up to half their length, rugose and plicate with age. *Standard* known to snap closed from the time of anthesis to a few hours later, buff or yellowish on outer surface so that the closed flower appears to be yellow as reported by many collectors, oblate, upper pair of calluses narrow, perpendicular, more or less parallel or divergent. *Keel* straight, obtuse, slightly canoe-shaped, paler mauve to white, contains no pockets. *Stamens* 9, connate to form an open tube in the lower part, free filaments of two lengths, anthers entangled with dorsal style brush (Lavin & Delgado 1990) so that they distribute pollen when forced through the rigid keel opening as it is suppressed by visiting insects, vexillary stamen free, geniculate at base. *Nectary* collar-shaped, lobed, surrounding base of ovary. *Ovary* pilose to pubescent or puberulous with long stiff hairs along the suture. *Style* elongation extended horizontally or up to an angle of *ca*. 45° beyond the stigma, flattened, rounded or truncate, 0.2—0.8(—1.0) mm long, the whole appearing hammer-shaped (Figure 2 a & b). *Legumes* erect or pendant, black to yellow, varyingly pubescent to glabrous, from *ca*. 200—300 mm in cultivated forms (900 mm in cv. gr. *sesquipedalis*) and *ca*. 60—100 mm long in the wild forms, beaked, twisted spirally for seed dispersal in wild forms, non-dehiscent in cultivated forms. *Seeds* variable in colour from white, red, light to dark brown or black, often mottled, size variable from 6—9 mm in cultivated forms, much smaller in wild forms, hilum eccentric, aril ring-like. Figures 3 & 4.

Key to species and infraspecific taxa of *Vigna* subgenus *Catjang* in Africa:

1a. Flowers solitary, small, standard reniform, *ca*. 8.0 x 9.5 mm, keel up to 8(—10) mm long, pink to purple .... *V. nervosa*

1b. Inflorescence racemose, robust and elongate, 4—7-flowered, or contracted with *ca.* 2 flowers only; flowers large with standard orbiculate-obovate, up to 22 x 25 mm, blue, purple or pinkish mauve 2

2a. Style elongation 0.5—0.8 (—1) mm, often inclined at 45°. Stems patently hairy or velvety. Stipules conspicuously large, up to 20 x 8 mm, broadly ovate, dark green, indumentum varying from abundantly strigose to sparingly hairy over the entire surface or on veins only or glabrous, margins always coarsely ciliate. Calyx lobes longer than tube .... *V. unguiculata* subsp. *protracta*

2b. Style elongation 0.1—0.4 mm long, always horizontal. Stems puberulous to sparingly patent. Stipules not conspicuously large, *ca*. 6—14 x 2—4 mm, ovate to narrowly ovate to lanceolate, brownish or green, glabrous, margins with apical cilia only. Calyx lobes shorter or longer than or equalling tube 3

3a. Leaflets usually 60—100 x 50—70 mm, rhombic-ovate, lateral leaflets asymmetric, more or less uniform in size and shape, or lower leaflets so and upper leaflets hastate, of varying size, or all leaflets hastate, or oblong, or lanceolate to linear, apex acute to shortly acute, chartaceous or coriaceous. Stems thinner than in var. *protracta* but not particularly so, cylindrical or grooved, glabrous to scarcely patent, variously branched 4

4a. Root system markedly shallow, much branched. Stems scarcely patent, scabrid or glabrous, angular, much branched horizontally at soil level, green to red. Leaflets papyraceous, uniformly elongate-triangular or lower leaflets elongate-triangular and upper leaflets hastate, glabrous, red-veined or flushed red on undersurface, apex acute. Stipules lanceolate or ovate, spurs long or short and adnate, often red. Calyx lobes shorter or equalling the tube .... *V. unguiculata* subsp. *dekindtiana* var. *dekindtiana*

4b. Root system a woody or fleshy tap root. Stems glabrous or subglabrous, grooved or cylindrical, herbaceous or woody. Leaflets coriaceous or papyraceous, hastate with basal lobes rounded or ovate-rhombic throughout or at the base of the plant only and hastate further along the vine, glabrous, blue-green with grey-green markings or bright green with paler markings, totally glabrous or lower veins strigose, apex acute or shortly acute. Stipules lanceolate or ovate, spurs reflexed or adnate to the stem. Calyx lobes shorter or markedly longer than the tube 5

5a. Root system woody. Stems cylindrical, usually subglabrous, woody, profusely branched from the base. Leaflets papyraceous, ovate-rhombic, sublobulate, or hastate toward the apex of the vine, bright green with paler markings, totally glabrous, apex acute. Stipule spurs often short and adnate. Calyx lobes markedly longer than the tube ....*V. unguiculata* subsp. *mensensis* (not yet recorded in southern Africa)

5b. Root system a swollen (dauciformis) tap root. Stems angular, glabrous, herbaceous, branched at intervals along the vine. Leaflets coriaceous, hastate with basal lobes rounded, blue-green with grey-green markings, strigose along the dorsal veins, apex shortly acute. Stipules lanceolate, spurs usually reflexed. Calyx lobes shorter than the tube ....*V. unguiculata* subsp. *dekindtiana* var. *huillensis*

3b. Leaflets usually 25—50 x 20—75 mm, uniformly triangular to rhombic or oblong, or *ca.* 20 x 2—120 x 10 mm, narrow-linear leaflets much longer than broad, papyraceous or coriaceous, apex acute to acuminate or obtuse. Stems thin, glabrous or glabrescent, or angular and sometimes patent but not particularly thin, normally branched from main stem 6

6a. Leaflets either uniformly triangular-rhombic or oblong, bases commonly lobed, apex acute to obtuse. Stems thin, glabrous, often red at the base where leaflets drop but stipules persist. Stipules ovate, small, with spurs broad. Inflorescence a 5 or 6-flowered raceme, with standard *ca.* 25 x 29 mm. Style elongation *ca.* 0.2—0.4 mm. Legumes *ca.* 60 mm long, black, scabrid with longer, stiff hairs along the suture 7

7a. Leaflets oblong, base gibbose, truncate, apex obtuse, lateral leaflets asymmetric, apiculate, thinly textured .... *V. unguiculata* subsp. *tenuis* var. *tenuis*

7b. Leaflets triangular to rhombic or essentially ovate, lateral leaflets asymmetric, apex acute or obtuse, apiculate, sometimes leathery ..... *V. unguiculata* subsp. *tenuis* var. *ovata*

6b. Leaflets lanceolate to linear, much longer than broad, seldom basally lobed, apex acuminate. Stems not particularly thin, commonly ridged, scabrid to sparsely patent, green to grey-green. Stipules lanceolate, usually slender-spurred. Inflorescence contracted, usually 2-flowered, with standard *ca.* 14 x 17 mm. Style elongation *ca.* 0.1—0.3 mm long. Legumes *ca.* 100 mm long, grey to black, pubescent .... *V. unguiculata* subsp. *stenophylla*

In southern Africa the subgenus *Catjang* is represented by *V. unguiculata* with five subspecies, and *V. nervosa.*

a. subsp. *unguiculata.* Verdc.: 543 (1970); Verdc.: 643 (1971); Maréchal *et al.*: 191 (1978).

Westphal (1974) recognized four cultivar groups to represent all the cultivated forms. For these he chose neotypes grown by himself and preserved at WAG., cv. gr. *biflora* alone was based on a description and specimen in Van Royen's herbarium. Only one, the Cowpea (cv. gr. *unguiculata*), occurs commonly under cultivation in southern Africa. This taxon will not further be dealt with here as we are concerned with the wild forms only.

b. subsp. *protracta* (E. Mey.) B.J. Pienaar, comb. et stat. nov.

Scytalis protracta E. Mey.: 146, n. 4. (1836). Type: South Africa, Cape, prope Galgebosch, alt. 800 ped., *Drège 1V, C, c* (P!, lecto., designated here, K! isolecto.); inter Gekau et Basche [Mbashe], alt. 1500 ped., *Drège V, b* (P!, K! lectopara.).

S. hispida E. Mey.: 146, n. 3. (1836). Drège: 148, n. 44 (1843). *Vigna hispida* (E.Mey.) Walp.: 534 (1839). Type: South Africa, Cape, in collibus graminosis prope Omtata, alt. 1500 ped., *Drège V, b* (P!, holo., K! iso.).

Vigna triloba (Thunb.) Walp.: (1839) nom. illeg.

V. rhomboidea Burtt Davy: 421 (1932). Type: Transvaal, Berea Ridge, Barberton, *Burtt Davy 2559* (K!, holo., PRE! iso.).

V. pubescens Wilczek: 442 (1954). Type: Africa, Lake Albert, Kasenyie, *Bredo 2161* (BR!, holo.).

Robust perennial. *Stems* thick, hairs patent, tough, retrorse or short, velvety [as in *V. pubescens* type, *Bredo 2161* (BR)], roots at nodes. *Leaflets* (Figure 3 g) strigose, large, 22—80 x 20—60 mm, with 3 rounded, obtuse lobes as in type *Drège IV, C, c*, or ovate to lanceolate-rhomboid, broadly triangular to narrowly hastate (*Bredo 2161*), apex rounded to subacute, apiculate, base obtuse or cuneate. *Stipules* obvious, large, (2.8—)4.0—7.7 x 3—9(—10) mm, dark green, ovate, spur broad at point of attachment, scarcely constricted, adnate to stem, short, oblique or split, strongly ribbed, surface varying from strigose to hairy on ribs only to glabrous, always coarsely ciliate along most of margin. *Raceme* somewhat elongated, 4—7-flowered (buds often not all maturing). *Flowers* large, blue to purple. *Calyx* lobes usually longer than tube, narrowly triangular to linear-acicular, strigose-pubescent. *Standard* 13—22 x 15—25 mm. *Ovary* pilose. *Style* extension oblique, up to 45°, at least 0.5—0.8(—1) mm long, obtuse or truncate. *Legume* black, erect, linear-cylindrical, pubescent with longish white hairs, 70—90 x 5 mm, up to 18-seeded. *Seeds* dark red-brown with black speckles, 3.0—4.0 x 2.5—3.5 mm.

Most common along the subtropical Natal and Transkeian coast and in the warm grasslands of the Natal midlands, following the coast northward into Zululand, Swaziland, the eastern Transvaal and the southern Transvaal highveld, the latter three areas supporting plants with the usually smaller dimensions and unlobed leaflets (Figure 5). Original collections with typical broad trilobed leaflets came from the eastern Cape, collected by Drège (*Drège 1843*).

Selected specimens examined:

—**2229** (Waterpoort): Zoutpansberg (-CD), *Codd 6836* (K).
—**2326** (Mahalapye): road verge, 24 km north of Artesia on main Francistown-Gaberone road (-CD), *Mithen 499* (PRE).
—**2330** (Tzaneen): Tzaneen Estates (-CC), *Burtt Davy 2559* (PRE).
—**2425** (Gaberone): 17 km north of Gaberone, Gaberone North Farms (-DB), *Mithen 520* (PRE).
—**2428** (Nylstroom): farm Mosdene near Naboomspruit (-DB), *De Winter 721* (K, PRE).
—**2430** (Pilgrim's Rest): Bourke's Luck mine, hillsides (-DB), *Galpin 14278* (BOL, PRE).
—**2526** (Zeerust): *ca.* 15 km south of Zeerust at Buffelfontein (-CA), *Van der Meulen 592* (PRE).
—**2528** (Pretoria): main road from Pienaar's River to Pretoria (-CA), *Pole-Evans 3938* (K, PRE).
—**2529** (Witbank): near Witbank station (-CC), *Gilfillan 295* (BOL, PRE).
—**2530** (Lydenburg): Lydenburg (-AB), *Wilms TM 5834* (PRE).
—**2531** (Komatipoort): Maid of the Mist Mountain (-CC), *Hutchinson 2466* (K).
—**2624** (Vryburg): farm Zoetvley, Vryburg (-AA), *Speedy 304* (PRE).
—**2628** (Johannesburg): Brakpan (-AB), *Moss 13247* (BM, J).
—**2629** (Bethal): 25 km from Witbank on road to Hendrina, near Komati Power Station (-BA), *Du Toit 11* (PRE).
—**2630** (Carolina): Carolina (-AA), *Burtt Davy 7391* (PRE).
—**2631** (Mbabane): 4.5 km NE of Motjane (-AA), *Kemp 1011* (PRE).
—**2632** (Bela Vista): top of Lebombo Mountains, farm Blue Jay (-AA), *Culverwell 1177* (PRE).
—**2730** (Vryheid): Piet Retief (-BB), *Sidey 1957* (PRE).
—**2731** (Louwsburg): *ca.* 15 km from Ngome Forest station, on road to Vryheid (-CD), *Germishuizen 2127* (PRE).
—**2732** (Ubombo): 12.6 km from turnoff on road to Mkuze (-CA), *Retief 232* (PRE).
—**2830** (Dundee): Weenen, near Estcourt (-CC), *Acocks 10757* (NH, PRE).
—**2831** (Nkandla): Zondela, Mahlabatini (-AD), *Gerstner 4274* (NH).
—**2832** (Mtubatuba): Hluhluwe (-AA), *Cawood GH 51* (PRE).
—**2929** (Underberg): foothills of Drakensberg, Cathkin area (-AB), *Hardy 44* (PRE).
—**2930** (Pietermaritzburg): 12 km from Greytown to Muden (-BA), *Pienaar 403* (K, PRE).
—**2931** (Stanger): Inanda, near Verulam (-CA), *Wood 1083* (BM, K, PRE).
—**3029** (Kokstad): Zuurberg and Clydesdale Mountains (-BD), *Tyson 1697* (SAM).
—**3030** (Port Shepstone): St. Michaels on Sea, open hills 2 km from sea (-CD), *Nicholson 1787* (PRE).
—**3127** (Lady Frere): Engwali [Mgwali] River, near Engcobo (-DB), *Flanagan 2800* (PRE).
—**3128** (Umtata): Bashee [Mbashe] River (-CA), *Schlechter 1873* (PRE).
—**3227** (Stutterheim): grassy hills near Komgha (-DB), *Flanagan 1132* (BOL, NBG, PRE, SAM).
—**3228** (Butterworth): at Kentani (-CB), *Pegler TM 4607* (PRE).

—**3325** (Port Elizabeth): near Galgebosch, alt. 800 ft. (-CC), *Drège IV, C, c* (P, K).
—**3326** (Grahamstown): 5 miles from Alexandria Forest (-CB), *Wells 4228* (K, PRE).
—**3327** (Peddie): near Bats' Cave, East London (-BB), *Schönberg 2804* (PRE).
—**3423** (Knysna): at Knysna (-AA), and Plettenberg Bay (-AB), *Burke s. n.* (BM).
Precise locality unknown

Zululand, Farm Egoa, *Curson PRE 56130*; *Flanagan 3905* (PRE); Kaffraria, *Guienzius SAM 15594* (SAM); C. Spei, *Fr. Mafron* (BM); C.B.S., Panmure, coast of British Kafraria, *Ms. Hutton* (K); Swaziland, *Stewart TM 8891* (PRE).

c. subsp. *dekindtiana* (Harms) Verdc. in Studies in Leguminosae-Papilionoideae for Flora of Tropical East Africa 4, Kew Bulletin 24,3: 544 (1970); Verdc.: 643, 644 (1971); Maréchal *et al.*: 193 (1978). Type: Angola, Huila, *Dekindt 468* (B+, holo.)

Vigna dekindtiana Harms: 93 (1902); Bak. f.: 407 (1929); Brenan: 410 (1954).

V. unguiculata (L.) Walp. sensu Wilcz.: 387 (1957).
V. coerulea Bak.: 203 (1871); Bak. f.: 409 (1929). Type: Mozambique, mouth of Zambezi River, Luabo, *Kirk* (K!, holo.).

Annual or perennial. *Rootstock* a swollen taproot (dauciformis) becoming woody with age or markedly shallow, very much branched. *Stems* branched only from the main vine or profusely branched from the primary stem at soil level, green to brown or flushed scarlet, scabrous to glabrous. *Stipules* brown or green flushed scarlet, ovate or narrowly ovate to lanceolate, acuminate, spurs slender, as long as the lobe, or shorter than lobe and broad, acuminate, reflexed from stem or adnate, glabrous except for apical cilia, strongly ribbed, point of attachment mostly constricted. *Leaflets* (Figure 3 f) scarcely strigose to glabrous, hairs thickest along dorsal nerves, coriaceous or papyraceous, varying from lanceolate-hastate to ovate-rhombic, all three leaflets basally lobed, the lobes typically round, or apical leaflet sublobular, base cuneate or obtuse, lateral leaflets asymmetric, blue-green with grey-green markings, or bright green with paler markings, apex acute or obtuse, apiculate. *Raceme* contracted, usually 2(—4)-flowered, mauve to violet, with standard 15—20 x 17—22 mm, peduncle often winged. *Calyx* rugose-plicate, lobes as long as tube or shorter. *Ovary* with short pubescence, longer along suture. *Style* elongation horizontal, rounded, usually 0.2—0.4 mm. *Legume* black, cylindrical, scabrid to aculeate, beaked, up to 100 mm long, up to 16-seeded, dehiscing spirally or apparently not. *Seeds ca.* 4.0 x 2.5 mm, mottled greyish brown, aril rim thick.

Two varieties are recognized in Africa:

i. var. *dekindtiana*

Clitoria alba G. Don.: 215 (1832). *Vigna alba* (G. Don) Bak. f.: 407 (1929); Brenan: 410 (1954). Type: S. Tome, *Don* (BM!, holo.).

V. baoulensis A. Chev.: 163 (1912); Bak. f.: 408 (1929); Hepper: 569 (1958). Types: Ivory Coast, Baoule, Kodiokoffi, *Chevalier 22356* & Dyolas, between Danene and Mt. Goula, *Chevalier 21230* & environs of N. Baoule, between Marabadiassa and Gottoru, *Chevalier 22032* (all P, syn., K!, fragments, isosyn.).

Liebrechtsia scabra De Wild.: 75 (1902). *Vigna scabra* (De Wild.) Th. & H. Durand: 152 (1909). Type: Lukafu, July 1900, *Verdick 602* (BR, holo.).

Characterized by a shallow root system, stems markedly branched at soil level, leaflets ovate-rhombic, papyraceous or with apical leaflets hastate, lateral ones asymmetric (Figure 3 f). In the Caprivi and in the north-west of Namibia the leaflets, as well as stems, stipules and veins, may be flushed scarlet. In rainy weather the ripe legumes remain straight and closed, apparently waiting for dry weather before dehiscing spirally. Most like the cultivated forms in appearance.

Common through the dry grasslands of the Transvaal, the open woodland grasslands of northern Transvaal, Botswana, central and northern Namibia and apparently ranging into Angola, Zimbabwe, Zambia and further north, i.e. the savannah areas of Africa (Figure 6).

Selected specimens examined:

—**1719** (Rundu): Waldensel, Rundu (-DD), *Volk 1963* (PRE).
—**1720** (Sambio): Mashari Experimental Station, Sambio (-CC), *De Winter & Marais 4576* (K, PRE, SRGH).
—**1724** (Katima Mulilo): *ca.* 500 m from Hippo Lodge, Katima Mulilo, open woodland, grass (-AD), *Pienaar 1389* (PRE, WIND).
—**1816** (Namutoni): Etosha National Park, north-east Sandveld, stand 3/72 (-BB), *Le Roux 765* (WIND).
—**1819** (Karakuwisa): 28 miles north of Karakuwisa on Omaramba Omatako River (-DC), *Giess 10121* (PRE, WIND).
—**1820** (Tarikora): Shinyungwa village, on road to Andara (-BB), *Pienaar 1378* (PRE, WIND).
—**1821** (Andara): 2.5 km west of Frans Handari Youth Camp on road to Andara (-AB), *Pienaar 1380* (PRE, WIND).
—**1822** (Kangara): Santsar-Seronga road, 4.2 miles east of Masoko Pan (-CB), *Smith 457* (SRGH).
—**1920** (Tsumkwe): Aha Mountains, 10 miles south on Tsumkwe road near the Botswana border (-DB), *Giess 9864* (PRE, WIND).
—**1923** (Maun): 64 km north of Maun on Moremi road (-DB), *Mithen 612* (PRE).
—**2021** (Koanaka Hills): foot of Xwihaba Hills (-AB), *Smith 3368* (PRE).
—**2023** (Kgwebe Hills): Maun, 300 yards from the river on road to Toteng (-AB), *Lampbrecht 33* (SRGH).
—**2122** (Kobe): 0.5 miles north-east of Kuke Camp, roadside (-AB), *Brown 8714* (PRE).
—**2125** (Lothlekane): central Botswana, Orapa, Baobab Drive (-DA), *Allen 45* (J).
—**2218** (Gobabis): Breytenbach farm, Gobabis (-DC), *Seydel 2515* (BR).

—**2222** (Damara Pan): 121 km from Ghanzi to Kade [Xade] Pan (-BD), *Chadwick 222* (PRE).
—**2224** (Kukumane): Central Kalahari Game Reserve, Metsiamonong, Ghanzi dist. (-CA), *Barnard 275* (PRE).
—**2226** (Serowe): 5 km north of Serowe in river valley (-BC), *Mithen 623* (PRE).
—**2229** (Waterpoort): Dongola Reserve, farm Haakthorne 608 (-BC), *Codd 4136* (K, PRE).
—**2230** (Messina): Venda, Tshianzwane, Makonde Mission, 15 miles north-east of Sibasa (-DC), *Codd 6836* (K, PRE).
—**2231** (Pafuri): Punda Milia [Maria], 3 km from Game Park gate, Kruger National Park (-CA), *Grobbelaar 2335* (PRE).
—**2324** (Kuchwe Pan): 5 km south of Khutse [Kutsi] Gate, Kalahari (-BC), *Chadwick 183* (PRE).
—**2326** (Mahalapye): Experimental Station, Mahalapye (-BB), *Talala 339* (PRE).
—**2329** (Pietersburg): river forest, Blaubergkloof (-AA), *Strey & Schlieben 8588* (PRE).
—**2330** (Tzaneen): Modjaji's Reserve near Duiwelskloof (-CB), *Krige 172* (PRE).
—**2425** (Gaberone): 10 km north of Gaberone, near Sebele Agricultural Research Station (-DB), *Mithen 502* (PRE).
—**2426** (Mochudi): Mochudi (-AC), *Rogers 6400* (PRE).
—**2427** (Thabazimbi): Geelhoutbos farm, Waterberg dist. (-BC), *Germishuizen 360* (K, PRE).
—**2428** (Nylstroom): 39 km north of Nylstroom (-CB), *Codd 2262* (PRE).
—**2430** (Pilgrim's Rest): 1 km from Pilgrim's Rest on road to Bourke's Luck (-DD), *Germishuizen 155* (K, PRE).
—**2431** (Acornhoek): Phalaborwa Water Board, 14 km south of Phalaborwa (-AA), *Retief 387* (PRE).
—**2525** (Mafikeng): Gopane, 25 miles west of Zeerust (-BD), *Snyman 87* (PRE).
—**2526** (Zeerust): at Rietfontein, Zeerust (-BD), *Schoeman TM 4975* (PRE).
—**2528** (Pretoria): Rust de Winter, Pretoria Dist. (-BA), *Smuts & Gillett 2135* (PRE).
—**2529** (Witbank): 1 km from Kloof Motel on road to Loskop Dam (-AD), *Germishuizen 3723* (PRE).
—**2530** (Lydenburg): entrance to Rand Mines, Lotzaba Forests, Glenthorpe, *ca*. 28 km from Nelshoogte, in direction of Barberton (-DD), *Pienaar 1357* (PRE).
—**2531** (Komatipoort): 6 km from White River on road to Hazy View (-AC), *Germishuizen 143* (K, PRE).
—**2723** (Kuruman): Kuruman (-AD), *Pole Evans 2080* (PRE).
—**2732** (Ubombo): forestry firebreak road to eastern tip of Lake Sibaya (-BC), *Pooley 252* (PRE).
—**2831** (Nkandla): near entrance to Umlalazi Nature Reserve (-DD), *Pienaar 1365* (PRE).
—**2832** (Mtubatuba): St. Lucia (-AD), *Gerstner 3167* (NH).

Precise locality unknown: *Junod 3126* (PRE).

ii. var. *huillensis* (Welw. ex Bak.) Pienaar in Flora of Tropical Africa: 204 (1871); Torre: 263 (1962—1966). Type: Angola, Huila, Humpata-Lopolo, *Welwitsch 2264* (LISU, holo., BM, iso.).

Plants characterized by swollen rootstocks (dauciformis), long, grooved, herbaceous, prostrate or twining stems, branched at intervals along the vine; leaflets (Figure 3 d) markedly hastate, the basal lobes rounded (the apical leaflets symmetrical and the lateral ones asymmetrical), base cuneate or obtuse, coriaceous with thickened margins, blue-green marked with grey-green; calyx teeth rather shorter than the "papilose" tube (*fide* Hiern), deltoid; legumes glabrous, dehiscing into spirally twisted valves.

Variety *huillensis* is concentrated in the central and western parts of Namibia (Figure 7) where the roasted swollen rootstocks are relished by the Bushmen (San) and other tribes, the dry desert grasslands of the Kalahari (Namibia, Botswana) and the "bushy pastures" highland areas between 4 000 and 5 000 feet (Hiern 1896). It may occur that only the apical parts of stems are collected so that the lower parts with rhomboid leaflets are not obvious, but if the leaflets tend to be coriaceous with thickened margins, the diagnosis should be correct.

Selected specimens examined:

—**1723** (Singalamwe): Caprivi Zipfel (-CC), *Killick & Leistner 3158* (PRE).
—**1819** (Karakuwisa): Cigarette, north-east of Karakuwisa (-DC), *Maguire 2283* (PRE).
—**1820** (Tarikora): Omaramba Khaudum east of Tamsu (-DA), *De Winter & Marais 4657* (PRE).
—**1914** (Kamanjab): Katembe, 750 ft. (-DA), *Schlechter 11608* (BOL).
—**1916** (Kanoulei): Farm Gladstone, 28 miles west of Otavi (-DB), *De Winter 3007* (PRE).
—**1917** (Tsumeb): farm Okombangora (Peypers), *ca.* 76 km from Otavi, on road from Grootfontein (-DA), *Pienaar & Archer 1342* (PRE, PRU).
—**1918** (Grootfontein): farm Oliewenhof: GR 215, Grootfontein (-CA), *Giess, Volk & Bleissner 6518* (PRE, WIND).
—**1920** (Tsumkwe): bank of Omaramba at Tsotsana (-BA), *Giess 9960* (PRE, WIND).
—**2013** (Unjab Mouth): Rooiplaat (-BB), *Leendertz 8405* (PRE).
—**2017** (Waterberg): Waterberg-Platoberg, dist. Otjiwarongo (-AC), *Jankowitz 1205* (WIND).
—**2023** (Kwebe Hills): alongside Xanakuna-Mosu road (-DC), *Smith 1218* (PRE).
—**2024** (Bushman Pits): Central Kalahari Game Reserve, western part, 114 km east of Lone Tree Pan (-BD), *Verhagen & Barnard 40* (PRE).
—**2120** (Rietfontein): Hereroland, Rietfontein Block, Helena Wilskrag area (-DC), *Adank & Visser s.n.* (WIND).
—**2217** (Windhoek): 32 km north of Windhoek (Continental Hotel) on Okahandja road, 9 km south of Otjehavera River (-AC),`*Pienaar & Archer 1320* (PRE).
—**2220** (Kalkfontein): 138 km south-west of Ghanzi (-BA), *Mithen 562* (PRE).
—**2221** (Okwa): 7 km north of Bere (-DD), *Mithen 557* (PRE, SRGH).
—**2222** (Damara Pan): 21 km south of Charles' Hill (-AC), *Mithen 564* (PRE, SRGH).
—**2227** (Palapye): 101 km south of Francistown toward Gaberone (-AB), *Mithen 498* (PRE, SRGH).
—**2322** (Kang): Lokalani, western Kalahari (-AB), *Vahrmeijer & Steele 3098* (PRE).
—**2323** (Lithle): 54.7 km west of Dutlwe (-AD), *Mithen 528* (PRE).
—**2325** (Lephepe): Central Kalahari, Kweneng Dist., Dinojane (-BC), *Barnard 230* (PRE).
—**2419** (Aranos): 20 miles north of Genesa (-DB), *Rogers 12567* (BOL).
—**2420** (Union's End): Kalahari Park, east of Swartpan (-BA), *Van der Walt 5795* (PRE).
—**2425** (Gaberone): Tsolafelo sewage ponds, Gaberone (-DB), *Barnes 095* (PRE).
—**2523** ((Pomfrey): 8 km north-east of Werda, Botswana (-AD), *Mithen 596* (PRE).
—**2624** (Vryburg): Vryburg Dist.(-DB), *Mogg 8370* (PRE).

Precise locality unknown

Ngamiland, *Curson 154* (PRE); Central Kalahari Gemsbok Park Reserve, *Tanaka 32* (PRE).

Other localities in Africa
Angola, Huilla, *Dekindt 468* (isotype) and *Dekindt s.n.* (LISC).

d. subsp. *mensensis* (Schweinf.) Verdcourt in Kew Bulletin 24,3: 545 (1970). Type: Ethiopia, Eritrea, at the Amba Rivulet near Geleb in Mensa (2 000 m), *Schweinfurth 1820*, (B+, holo., BR!, iso, [fragments]).

Vigna mensensis Schweinf.: 261 (1896). *V. mensensis* Schweinf. var. *hastata* sensu Robyns: 362 (1948), no types mentioned, cited *Lebrun 8170, De Witte 2199*.

V. mensensis Wilcz.: 390 (1954), non Chiov. Type as above.

V. unguiculata (L.) Walp. subsp. *dekindtiana* (Harms) Verdc. var. *mensensis* (Schweinf.) Maréchal *et al.*: 190 (1978).

Root system woody. *Stems* branched from the base, sometimes hairy. *Leaflets* (Figure 3 f) wavy-lobulate to ovate-rhomboid, acute to acuminate, base usually cuneate, lateral ones asymmetric. *Flowers* two per inflorescence (contracted), appear to be larger than in the other two varieties with vexillum 18 x 18—30 x 40 mm, but its discerning character is the markedly longer *calyx* lobes, 5.0—14.0 mm long as opposed to the tube, 3.0—5.5 mm long (Verdcourt 1971).

Subsp. *mensensis* grows in African savannah (not yet collected in southern Africa) in swampy grasslands and open forests and interbreeds freely with var. *dekindtiana*. Mithen (1988) reports the subspecies from Zaïre, Burundi, Zimbabwe and Mozambique and it seems likely that it should spread across the borders, but none has been collected in southern Africa. We regard it important to draw collector's attention to the possibility of its occurrence.

Evidence (fragments, *Schweinfurth 1820*, BR) indicates that the style prolongation is minimal. No leaflets or stipules were available, but it is clear that the subspecies should be maintained in a category in the *V. unguiculata* group.

Specimens examined:

Schweinfurth 1828 (BR).
Chandler 1019, Geilinger s. n., Loveridge 39, Napier 1135, 2994, Newbold 3565, Polhill 123, Semsei 3924, Tweedie 3721, all from tropical East Africa (K).

e. subsp. *tenuis* (E. Mey.) Maréchal et al. in Taxon 27: 200 (1978). Type: var. ß. *oblonga* South Africa, in graminosis inter Omtendo et Omsamculo [Umzimkulu], alt. 300 ped., *Drège V, c* (P!, lecto., designated here, K!, photo.).

Scytalis tenuis E. Mey.: 145, 146 (1836). *Vigna tenuis* (E. Mey.) Dietrich: 1197 (1847); Harv.: 242 (1862); Verdc.: 546 (1970). Type as above.

Characterized by small, bright green, ovate or oblong, thinly textured obtuse *leaflets* of two main shapes, of uniform size on each plant, apices rounded or obtuse but apiculate, bases obtuse to cuneate in ovate leaflets, obtuse to deltoid or truncate and gibbose in oblong leaflets, lateral leaflets asymmetrical; two varieties often found growing intermingled with each other. *Stems* prostrate, seldom twining, typically glabrous or scabrous, thin, often reddish at base, leaflets dropping but stipules persistent (especially those occurring along the Natal south coast). *Stipules* small, ovate, almost wholly glabrous with short broad spurs, not deeply constricted. *Flowers* usually 2, more abortive buds present, with standard 22 x 25 mm, commonly blue. *Style* elongation horizontal, usually acute, *ca.* 0,4 mm long. *Legume* black, shorter than other subspecies, *ca.* 60 mm, scabrid with longer strigose hairs along margin [described as subserrate by Meyer (1836)].

Two varieties [as described by Meyer (1836)] are recognized:

i) var. *tenuis*

Scytalis tenuis E. Mey. var. *oblonga* E. Mey.: 146 (1836). Type as above.

Leaflets (Figure 3 b) oblong to lanceolate, somewhat longer than the type but common along the Natal coast dune grasslands (Figure 8), leaflet bases almost square and two-lobed (gibbose) or the lateral ones unilobed, apices never acuminate.

Selected specimens examined:

—**2230** (Messina): Thathe Vondo, Messina (-CD), *Hemm 1123* (J).
—**2632** (Bela Vista): Tongaland, Kosi Estuary (-DD), *Vahrmeyer 1226* (NH).
—**2732** (Ubombo): north of Lake Sibaya, grassland (-BC), *Verdoorn PRE 56088* (PRE).
—**2832** (Matubatuba): Richards Bay, southern sector, open dune grassland (-CC), *Ward 8664* (PRE, WU).
—**2930** (Pietermaritzburg): 0.25 km from Inchanga abattoir turnoff on old Durban road (-DA), *Pienaar & Archer 1331* (PRE).
—**2931** (Stanger): Umdloti Beach, regularly cut grassy bank (-CA), *Pienaar 603* (PRE).
—**3030** (Port Shepstone): Selsdon Park (Boy & Anne Brand), opposite road D203, 0.5 km from Mpenjati River, dappled shade of Eucalypts (-CD), *Pienaar 1376* (PRE).
—**3130** (Port Edward): Mzamba River Mouth, deep sandy burnt grassland (-AA), *Stirton 5630* (PRE).

ii) var. *ovata* (E. Mey.) Pienaar comb. nov. Type: var. *α. ovata* South Africa, in graminosis inter Omsamkulu [Umzimkulu] et Port Natal [Durban], alt. 500 ped., *Drège V, c* (P!, holo., K!, photo.).

Scytalis tenuis E. Mey. var. *ovata* E. Mey.: 146 (1836). Type as for var. *α* above.

With leaflets typically ovate (Figure 3 c). Common in coastal grassland along the east coast (Figure 9).

Selected specimens examined:

—**2732** (Ubombo): Muzi Flats (-CB), *Venter 4459* (PRE).
—**2832** (Mtubatuba): Game park, St. Lucia (-AD), *Pienaar 887* (PRE).
—**2930** (Pietermaritzburg): Reservoir Hills, Durban Dist. (-DD), *Abraham 18* (DWU).
—**2931** (Stanger): Durban (-CC), *Wood 8443* (BOL, K, NH, PRE).
—**3030** (Port Shepstone): Nicholson's property, Skyline, St. Michael's on Sea (-CD), *Pienaar 585* (PRE).
—**3129** (Port St. Johns): dune grassland, Port St. Johns (-DA), *Moss 3191* (BM, J).
—**3131** (Port Edward): 3 km to Umtamvuna Bridge (-AA), *Pienaar 789* (PRE).

f. subsp. *stenophylla* (Harv.) Maréchal *et al.* in Taxon 27: 200 (1978). Syntypes: South Africa, Schoen Stroom & Vaal River, *Burke & Zeyher s.n.* & South Africa, Waterfontein, Mooierivier, Transvaal, *Zeyher 529* (BM!, K!).

Vigna triloba Walp. var. *stenophylla* Harv.: 241 (1862). *V. stenophylla* (Harv.) Burtt Davy: 421 (1932), non Harms (1911). Types as above.

V. angustifoliolata Verdc.: 547 (1970). Types as above.

Characterized by leathery, narrow-linear leaflets (Figure 3 a), much longer than wide, ca. 20 x 2—120 x 10 mm, attenuate, obsoletely hastate, base obtuse or cuneate to sub-lobed, midrib raised above lower surface. *Stems* glabrous, scabrid to patent (in forms from the eastern Transvaal mountains), angular. *Stipules* green or brown, ovate to lanceolate, acuminate with short, oblique to slender straight spurs, glabrous with terminal cilia or scarcely ciliate in mountain forms, often recurved. *Raceme* contracted, 2-flowered, flowers somewhat smaller than in other subspecies with standard *ca.* 13 x 15 mm, pinkish violet or mauve. *Style* elongation rounded, 0.2—0.3 mm. *Legumes* black, brown to grey, 60—100 mm long, scabrid to strigose.

Commonly found in grasslands of the interior of the Transvaal and Botswana; smaller forms along coastal dune grasslands of northern Natal (Figure 10).

Selected specimens examined:

—**1821** (Andara): between Bagani camp & Mahango, grassland (-BA), *De Winter 4391* (K, PRE).
—**2231** (Pafuri): Klopperfontein (-CA), *Van der Schijff 2959* (PRE).
—**2330** (Tzaneen): Letaba Estates (-CD), *Grobbelaar 322* (PRE).
—**2427** (Thabazimbi): Elandshoek (-BD), *Rogers 2996* (PRE).
—**2428** (Nylstroom): Twenty-four Rivers, 13 miles north-east of Vaalwater (-AD), *Codd 960* (PRE).
—**2429** (Zebediela): Pilgrim's Rest, Riet Valley Farm (-CD), *Holy 6* (PRE).
—**2430** (Pilgrim's Rest): Shabene area (-BB), *Van der Schijff 3199* (PRE).
—**2431** (Acornhoek): Rabelais Dam, Kruger National Park (-AD), *Van der Schijff 2350* (PRE).

—**2526** (Zeerust): 10 km east of the road Zeerust-Blairbeth, south of Witpoortjie (-AC), *Van der Meulen 317* (PRE).
—**2527** (Rustenburg): south-west of Rustenburg town (-CA), *Nation 189* (BOL, K, PRE)..
—**2528** (Pretoria): University of Pretoria farm, ridge behind Silverton (-CB), *Codd 869* (PRE).
—**2529** (Witbank): *ca.* 30 km from Pretoria on Witbank road (-DC), *Pienaar 1366* (PRE).
—**2530** (Lydenburg): Nelspruit (-BB), *Breyer TM 17861* (PRE).
—**2531** (Komatipoort): 1 mile north of Pretoriuskop, Kruger National Park (-AB), *Codd & De Winter 4949* (PRE).
—**2626** (Klerksdorp): 8 miles north-west of Ventersdorp (-BD), *Acocks 12403* (K, PRE).
—**2627** (Potchefstroom): Sterkfontein Caves, Krugersdorp (-BA), *Mogg 35676* (J, K, PRE).
—**2628** (Johannesburg): Benoni, Geduld Golf Course, now President Pleasure Resort (-AB), *Isaacs 51* (PRE).
—**2630** (Carolina): Sonnestraal Farm, *ca.* 9 km from turnoff on Waverley road (-BB), *Germishuizen 2939* (PRE).
—**2726** (Odendaalsrus): Bothaville, Kroonstad District (-BC), *Goosens 1162* (PRE).
—**2731** (Louwsburg): Itala Nature Reserve, Craigadam Farm (-CA), *Mc Donald 146* (PRE).
—**2732** (Ubombo): Kwa Zulu, Maputoland Plain, Sihangwana (-AB), *Liengme 596* (PRE).
—**2825** (Boshoff): Bultfontein, Oppermansdrif Dam (-AB), *O'Connor 65* (PRE).

Precise locality unknown:

Kruger National Park, *Engelbrecht 6168*; Warmlaagte, north-eastern kopje, *Maquire J 32402* (J); in grass at Wonderfontein, Mooie rivier, *Zeyher 522* (SAM); in grass at Wonderfontein, Bechuana Country, *Zeyher 529* (SAM); grass, Natal, *Zeyher s. n., SAM 15593* (SAM).

Discussion

The type of the genus *Vigna* is *V. luteola* (Jacq.) Benth. Verdcourt (1970) noted that no herbarium specimen representing Linnaeus's type cultivated from seeds from Barbados is preserved in his Uppsala herbarium, nor in the Linnean herbarium in London. Article 37.1 of the ICBN (Greuter *et al.* 1988) states that `the publication on or after 1 Jan. 1958 of the name of a new taxon of the rank of genus, or below, is valid only when the holotype of the name is indicated'. In an earlier issue of the ICBN (Lanjouw *et al.* 1966), the publication directly affecting Verdcourt's decision regarding the typification of the cultivated *Vigna* species , declares it possible to accept `a description or figure' as type for a name. However, Verdcourt (1970, 1971) did not do this, only proposing (Verdcourt 1970, p. 543) that it should irrevocably be accepted that Linnaeus' (1753) specimen was a cultivated Cowpea from Barbados for which no specimen could be traced.

Article 9.1 of the 1988 Code states that the `holo-, lecto- or neotype of a specific or infraspecific taxon is a single specimen or illustration', a description being apparently no longer acceptable. For the latter, Jacquin's (1770) description and illustration appear to be appropriate. However, the origin of the plant is not mentioned and the erect pods indicate the *Catjang* Cowpea i.e. the cv. gr. *biflorus* (L.) Westphal (1974).

After much consideration regarding the origin of *Vigna unguiculata*, it could not be denied that Linnaeus's specimen came from the Barbados where too, it must have been introduced `from anywhere in the tropics' (Westphal 1974). According to Faris (1965), the most commonly cultivated Cowpea and the wild ones belong to the group of *Vigna* species that fall into the *V. sinensis* (L.) Savi group. The seed of the cultivated forms vary from pink to white with a black hilum to the mottled ones of the wild Cowpeas whereas the wild forms always have relatively mottled seed. The character that separates wild from cultivated forms of *V. sinensis*, i.e, the explosive action of the legume of the wild forms, is controlled by at least one dominant gene (Faris 1965). The area from which the forms of *Vigna unguiculata* originated, is West or Central Africa. Consequently Westphal's neotype, grown and preserved at Wageningen, with isoneotypes deposited at Kew and Paris, and grown from seeds collected in Ethiopia where this pulse has been cultivated `from times immemorial', is acceptable. For Westphal's complete argumentation, see Westphal (1974: 222—224).

A second problem facing Verdcourt (1970) was whether he should include in his classification all members of section *Catjang* in the same subgenus as *V. unguiculata*, or separate the genetically improved, cultivated forms. The main differences appear to be the more erect, glabrous, pale-flowered and generally larger cultivated plants bearing large, indehiscent, pale yellow fruits with brightly coloured seeds as opposed to the wild forms which are generally vigorous twiners with obvious pubescence, brightly coloured blue, mauve or purple flowers and small, erect, black, variously pubescent and dehiscent fruits with small, grey, brown or mottled seeds.

Only since 1970 has the name *V. unguiculata* (L.) Walp. in the section *Catjang* (DC.) Verdc. been applied to all species of *Vigna* bearing stipules extended by means of a spur beyond the point of attachment. Maréchal *et al.* (1978) refer to the work done by Westphal (1974) at Wageningen in which he recognized so-called cultivar groups for the cultivated forms as opposed to the natural forms, and proposed that they should be grouped under *V. unguiculata* subsp. *unguiculata*. For the cultivar group bearing the latter name, a neotype was proposed. Verdcourt

(1970) divided the wild species into three subspecies and three varieties.

Vigna pubescens Wilcz. (1954) has been recognized as a separate species until 1978, its excessive hairiness over all plant parts being the chief discerning character. Verdcourt (1970) commented that "further work may show that it is only a well-marked variety of *V. unguiculata*". Our work supports this suspicion, hence our reduction of *V. pubescence* to the synonymy of *V. unguiculata* subsp. *protracta*.

In southern Africa subspecies *protracta* prefers the warm, rain-drenched coastal grasslands. An outstanding feature of the plants is the variableness of the shape of the lush, dark green leaflets —— most common are the large trilobed, roughly strigose leaflets [typical of Meyer's (1936) *Scytalis protracta* and *Scytalis hirta* (1836)] in the eastern Cape and southern Natal. The leaflets vary, however, to triangular and even elongate-hastate as in the type, *Bredo 2161* (BR), and these unlobed forms extend northward into eastern Transvaal. In Botswana specimens collected by Mithen (e.g. *Mithen 499*), the leaflets even look much like those of *V. dekindtiana*, but the apices of the stipules are hairy on the upper surface and we prefer to include them in subspecies *protracta*.

The specimens of *V. unguiculata* subsp. *protracta* (the so-called *V. pubescens*) with typical trilobed leaflets have thick, rough, patently hairy stems which become velvety toward tropical East Africa as in *Bredo 2161*. The large and conspicuous stipules, broadly oval, represent the full scope of hairiness, namely from totally covered in long hairs as in *Bredo 2161* and some Swaziland specimens, to a few hairs only spread across the entire surface, to hairs on the ridges only, to scabrid surfaces only. They are always accompanied by long, coarse cilia along the entire margin. The specimens in the Transvaal with smaller hastate leaflets appear to have smaller stipules, but they are still relatively large and conspicuous, ovate, with almost no constriction at the point of attachment and with short, broad, often oblique spurs. The hammer-shaped appearance of the stigma in these hairy plants, with their accentuated oblique style elongation up to 1 mm long, is furthermore typical of all these plants, more correctly named *V. unguiculata* subsp. *protracta* after the basionym *Scytalis protracta* E. Mey. Since the full scope of the described characters (shapes of leaflets, hairiness, especially of the stipules) appears in *V. pubescens* Wilcz. and in all similar specimens collected in southern Africa, *V. pubescens* is regarded as conspecific with *V. unguiculata* (L.) Walp. subsp. *protracta* (E. Mey.) Pienaar.

all similar specimens collected in southern Africa, *V. pubescens* is regarded as conspecific with *V. unguiculata* (L.) Walp. subsp. *protracta* (E. Mey.) Pienaar.

A specimen in the Linnean Society Herbarium, London, numbered 900.22 and bearing only the information CAP (Cape), appears similar to *Drège 1837* from Galgebosch (K!) and, in our opinion, may represent a Cape specimen of *V. unguiculata* subsp. *protracta*.

Maréchal *et al.* (1978) found the similarity coefficient for *V. pubescens* to be 93% with *V. unguiculata* subsp. *dekindtiana* and therefore preferred to reduce it to a variety of subsp. *dekindtiana*, also recognizing var. *protracta* (proposed by Verdcourt 1970). Thorough examination of a large number of these plants in southern Africa, led us to include, in addition to *V. pubescens* Wilcz. (1954), also *V. unguiculata* (L.) Walp. var. *protracta* (E. Mey.) Verdc. (1970) and *V. unguiculata* (L.) Walp. subsp. *dekindtiana* (Harms) Verdc. var. *protracta* (E. Mey.) Verdc. as proposed by Marèchal *et al.* (1978) in the synonymy of subsp. *protracta* (E. Mey.) Pienaar.

With regard to *V. unguiculata* subsp. *dekindtiana* (Harms) Verdc. (1970, 1971), the concept of the taxon in southern Africa points to the exclusion of a previously recognized species, *V. mensensis* Schweinf. as a variety of *V. dekindtiana* as recognized by Maréchal *et al.* (1978). Verdcourt (1970) mentioned that it differed from the latter only in the length of the calyx lobes but the style prolongation disproves this. The character of the calyx lobes was questioned by Verdcourt in any case for its diagnostic importance (1970 p. 543). He reduced it to a subspecies of *V. unguiculata*. Maréchal *et al.* (1978) reduced it further to a variety under *V. unguiculata* subsp. *dekindtiana*, again stressing the length of the calyx lobes. We cannot uphold the latter decision, when considering the morphological importance of the style prolongation, although no collections with excessively long calyx lobes nor vestigial remains of the hammer-shaped style prolongation, have been made in southern Africa. Mithen (1988) cites Zaïre, Burundi, Zimbabwe and Mozambique as localities and one would expect the subspecies to penetrate the Republic of South Africa along these borders. Considering the habitat of subsp. *mensensis* in semi-shade along forest edges or in open forest and marshes (Schweinfurth 1896), reason for the soft texture of the leaflets, similar to those of *V. dekindtiana* var. *dekindtiana*, becomes evident. The leaflet shape of these open forest varieties of subsp. *dekindtiana* and *mensensis* most closely approaches that of the cultivated forms. Sometimes both ovate-triangular and hastate forms of leaflet shape appear on the same plant (Schweinf. 1896, Wilcz. 1954). Other characters shared between *V. unguiculata* subsp. *dekindtiana* var. *dekindtiana* and subsp. *mensensis* include lanceolate stipules tending to be brown, glabrous except for apical cilia and with slender spurs that tend to recurve, varying pubescence from an almost glabrous aculeate condition to scarcely patent, and a pauciflorous contracted inflorescence with large, blue to purple flowers. The horizontal extension of the style is significantly reduced in *Schweinfurth 1820*, placing it in a category of its own. The calyx tube is varyingly scabrid and horizontally wrinkled at maturity, and the black erect fruits varyingly scabrid but with longer hairs along the suture.

A marked difference was observed between the dry grassland forms of *V. unguiculata* var. *dekindtiana* in central Namibia and those collected in the Caprivi region of north-east Namibia. The former ones have deep turbinate rootstocks reputed to be roasted and eaten by the local inhabitants, whereas shallow adventitious root systems occur in the latter collections, the stems tending to root when covered by soil. The stems, stipules and even the undersurfaces and veins of some leaflets of the Caprivi forms are often flushed bright red. Stipules tend to be more commonly ovate with short, broad, oblique spurs as opposed to the slender, reflexed ones of their dry grassland counterparts. Considering these obviously distinguishing characters (facts rarely mentioned on collectors' labels), we have decided to recognize these wild forms as two varieties, namely var. *dekindtiana* and var. *huillensis*, again to stress the importance of visible phenotypical (and perhaps genetic) characters for breeding purposes. Both var. *dekindtiana* and subsp. *mensensis* have the papyraceous leaflet forms that vary from ovate-rhombic to hastate on the same plant. Variety *huillensis*, on the other hand, has the coriaceous, narrow-hastate form of leaflets that is constant throughout, and blue-green colouring. Therefore, we have chosen to reinstate var. *huillensis* for the dry grassland forms of central Namibia and Botswana. Mithen (1988) had suggested the reinstatement of var. *huillensis* for a different reason, namely for central African collections that are pyrophytic and therefore precocious after veld burning. A few such specimens, namely *Teixeira & M.M. 30/8* from Angola and *Milne-Redhead 1123* from Zambia were present in the PRE collections. Although the woody tubers of the variety make it possible to survive veld fires in any case, it has not been observed in southern African collections that they then bloom without producing leaves. It should be stressed that edaphic factors appear to have the greatest influence on variety evolution in *Vigna*.

Lush (1979) maintains that the difference between subsp. *mensensis* and var. *dekindtiana* lies in the size, aroma and prolonged opening of flowers, together with the high rate of flower abcission when subsp. *mensensis* is grown in screenhouses and that Rawal (*fide* Lush 1979) had concluded that this is due to different breeding systems. Subspecies *mensensis* is an obligate outcrosser and var. *dekindtiana*, the only truly wild form, is inbreeding (Lush 1979). It was observed in the nursery of the National Botanical Institute, Pretoria, as in other parts of Africa and Canberra, that flowers of all lines of Cowpeas grown, opened only once (before dawn), and shut by midmorning. In Pretoria they are known to close with a "bang" by 9 o'clock. Accessions of subsp. *mensensis* from southern Nigeria remained open all day (Lush 1979), were more fragrant and larger, the size of var. *dekindtiana* flowers sometimes found to intergrade with that of cultivated forms. In Rawal's experiments (Lush 1979) virtually all flowers of var. *dekindtiana* and of cultivated forms, set pods regardless of whether they were hand-pollinated, whereas hand-pollination did not increase pod-setting markedly in subsp. *mensensis*. This may be due to the flower structure. Subspecies *mensensis* has long styles so that the stigma reaches beyond the ring of anthers, whereas var. *dekindtiana* also has a long style but some of the anthers are able to reach the stigma. In cultivated lines the style is short and the stigma is surrounded by the anthers. The styles of subsp. *mensensis* bear many long hairs, known as a brush (Lavin & Delgado 1990), which trap the pollen released from the anthers of the same flower, whereas those of var. *dekindtiana* are less hairy. In lines of subsp. *mensensis* from Nigeria, the receptive surface of the stigma is directed upward and surrounded by the style hairs which block off the upward movement of pollen. In other lines from Tanzania, the receptive surface is directed downward so that this condition is not constant. Lush (1979) maintains that the facts above support Verdcourt's (1970) decision to separate the two subspecies. In southern Africa, however, the difference in flower structure, and consequently pollination, was not observed in spite of studies with various flowers of subsp. *dekindtiana* chosen at random.

The recognition of *V. unguiculata* subsp. *tenuis* (E. Mey.) Maréchal *et al.* seems to be generally accepted, although Verdcourt (1970) still quotes it as an independent species. Maréchal *et al.* (1978) recognize the group as a subspecies of *V. unguiculata*. Collections along the eastern Cape and Natal coasts often presented these typically creeping to scrambling plants with leaflets varying somewhat in size, but the size in one plant is always more or less constant. Plants from the north coast of Natal often presented a strangely oblong, gibbose leaflet with its typical square or truncate base, the lateral leaflets being asymmetrically unilobed. These oblong leaflets are inclined to be bright green and of a tender, soft texture. For this reason E. Meyer's (1836) varieties *ovata* and *oblonga* (the latter as var. *tenuis*) have been reinstated. Sometimes the two varieties are found growing in separate colonies, sometimes intermingled. The showy blue flowers (usually only two or occasionally three in each inflorescence) are impressive and large. Although the inflorescence appears as pronounced as in subsp. *protracta*, the buds probably abort when about three flowers have been fertilized, the number of legumes never exceeding two or three per peduncle. The extension of the style is horizontal, often subulate and *ca.* 4 mm long. Legumes are black, erect, beaked and markedly shorter than in the other subspecies, *ca.* 60 mm long.

Verdcourt (1970) and Maréchal *et al.* (1978) cited *Dolichos reticulata* Schltr. (1897) as a synonym of *V. tenuis*. However, we suspected that the specimen belongs to *V. nervosa* Markötter as Schlechter's description aptly fits it, namely the single, small, pink flower, the beaked fruit and the elevation at which it was collected. The type specimen (*Evans 630*, K!) proved this suspicion to be correct. *V. unguiculata* subsp. *tenuis* is a coastal species found in Natal and the eastern Cape as opposed to the inland habitat of *V. nervosa*, in grasslands at an elevation of between 1 500 and 1 650 m. Other specimens of *V. nervosa* from the Drakensberg area in South African herbaria include *Green 408* (NH), *Sidey 130* (PRE) and *Van den Berg 1849* (PRE).

Verdcourt (1970) recognized the fact that *V. stenophylla* (Harv.) Burtt Davy is a later homonym and proposed the name *V. angustifoliolata* in its place to house those members of the section *Catjang* with the extremely long, narrow leaflets. Maréchal *et al.* (1978) reinstated the former epithet as the subspecies *stenophylla* (Harv.) Maréchal *et al.* under *V. unguiculata* because of its close affinity to this species. We agree with the latter decision as the style extension beyond the stigma, generally rounded and very short (often only 1 mm long), places them undoubtedly in this group. Their stipules tend to be slender, glabrous, brown and acuminate, but with spurs that are often oblique and short, akin to subsp. *protracta*. The inflorescence is a contracted raceme bearing only two to three flowers that are smaller than those of the other subspecies and inclined to be pinkish mauve. Fruits are long, 60—100 mm, variably strigose and often paler (brown) than the other subspecies. The leaflets, as mentioned, are characteristically up to ten times longer than broad and are inclined to be leathery, a possible adaptation to their habitat, the open grassveld of western Transvaal and Botswana. Along the dune grasslands of the extreme north coast of Natal, glabrous plants with more diminutive leaflets and legumes occur. This probably suggests interbreeding with subsp. *tenuis*, e.g. *Pienaar 1363* (PRE) from the game park, St. Lucia].

A summary of the treatment of infraspecific taxa in *V. unguiculata* as proposed by Verdcourt (1970), Maréchal *et al.* (1978) and in the present paper, is supplied in Table 1.

INSERT TABLE 1

In West Africa, notably Nigeria, a great diversity of "weedy types" of *V. unguiculata* is found. It is currently believed that they have originated from escaped cultivars or wild plants more or less crossed with cultivars, the wild parents being subsp. *mensensis* Verdc. and var. *dekindtiana* Verdc. (1970). It is therefore possible that this region is the centre of primary domestication of the Cowpea by the local inhabitants. However, the most derived and superior cultivated forms seem to have originated and been perfected in South-east Asia or the Far East, e.g. the very long, succulent pendant pods of cv. gr. *sesquipedalis* which are eaten as a green vegetable. The African cultivars derived from the wild forms normally have thin, erect pods.

Regarding the nutritional value of the Cowpea, valuable work has been done by Bressani (1985). The chemical composition of Cowpeas is found to be similar to that of most legumes or pulses. It contains about

23—30% protein, 62% soluble carbohydrates and small amounts of other nutrients. The protein content is influenced by genotype as well as environmental factors. Constant selection of cultivars for hybridization is employed to raise the protein content. Cowpea protein is, however, deficient in sulphur-containing amino acids, these being important where diets are based on rootcrops or other starchy foods. Addition of methionine to Cowpea protein increases the protein quality significantly. When the seedcoat is removed, the digestibility of Cowpea protein is improved. The greatest value of Cowpea in the diet lies in its use as a complement to cereal grains, e.g. sorghum. It is clear that the two factors that must be stressed in selection programmes, are the sulphur amino acid content and the protein digestibility (Bressani 1985). The Cowpea is eaten dried and boiled or ground to flour.

References

BAKER, E.G. 1929. *Vigna* Savi. In: The Leguminosae of tropical Africa, pp. 407—409. Erasmus Press, Ghent.

BAKER, J.G. 1871. *Vigna* Savi. In: Flora of tropical Africa, ed. Oliver, D., Vol. 2, pp. 203—205. Reeve & Co., London.

BAUDOIN, J.P. & MARÉCHAL, R. 1985. Genetic diversity in *Vigna*. In: Cowpea research, production & utilization, ed. Singh, S.R. & Rachie, K.O., pp. 6—9. John Wiley & Sons, Chichester.

BRENAN, J.P.M. 1954. Plants collected by the Vernay Nyasaland Expedition of 1946. *Vigna dekindtiana*. *Mem. New York Bot. Gard.* 8(5): 410.

BRESSANI, R. 1985. Nutritive value of cowpea. In: Cowpea research, production & utilization, ed. Singh, S.R. & Rachie, K.O., pp. 353—359. John Wiley & Sons, Chichester.

BURMAN, N.L. 1768. Diadelpha Decandra. Flora Indica: 161. Cornelius Haak, Amsterdam.

BURTT DAVY, J. 1932. Papilionaceae (pea and bean family). *Vigna* Savi. Manual of flowering plants and ferns of Transvaal with Swaziland, South Africa, Vol. 2, pp. 419—421. Longmans, Green & Co. Ltd., London.

CHEVALIER, A.J.B. 1912 (Publ. 1920). Exploration botanique de L'Afrique. *Mém. Soc. Bot. Fr.* 8: 163.

DE CONDOLLE, A.P. 1825. Sect. ii. *Catiang*. Prodromus Systematis Naturalis 2: 398. Treutel et Würtz, Argentorati et London.

DE WET, B.C., GIBBS RUSSELL, G.E., GERMISHUIZEN, G., SCHRIRE, B.D., JORDAAN, M., PIENAAR, B.J., WELMAN, W.G., REID, C., VAN WYK, C.M., FISH, L., IMMELMAN, K.L., VAN ROOY, J., GLEN, H.F. & BARKER, N.P. 1989. New taxa, new records and name changes for southern African plants. *Bothalia* 19: 275—294.

DE WET, B.C., GERMISHUIZEN, C., SCHRIRE, B.D., JORDAAN, M., PIENAAR, B.J., WELMAN, W.G., REID, C., VAN WYK, C.M., FISH, L., IMMELMAN, K.L., VAN ROOY, J., PEROLD, S.M., TAUSSIG, J., BARKER, N.P. & GLEN, H.F. 1990. New taxa, new records and name changes for southern African plants. *Bothalia* 20: 249—266.

DE WILDEMAN, É. 1902—1903. *Liebrechtsia scabra* nov. sp. Annales du Musée du Congo, série 4, Études sur la Flore du Katanga: 75. Conservateur au Jardin Botanique de L'État a Bruxelles, Brussels.

DIETRICH, D.N.F. 1847. *Vigna* Savi. 3, *Vigna tenuis*. Synopsis Plantarum 4: 1197. Bernhard Friedrich, Voigt, Weimar.

DON, G. 1832. *Clitoria alba*. A general history of Dichlamydonous plants. General Systema 2: 215. F. Rivington, London.

DRèGE, J.F. 1843. Zwei Pflanzengeographische Documente nebst einer Eintleitung von E. Meyer: 127, 145, 148. Publisher unknown, Leipzig.

DURAND, TH. & H. 1909. Sylloge Floré Congolange (Phanerogamae): 152. Maison Albert de Boeck, Bruxelle.

EDWARDS, D. & LEISTNER, O.A. 1971. A degree reference system for citing biological records in southern Africa. *Mitt. Bot. Staatssamml. München* 10: 501—509.

FARIS, D.G. 1965. The origin and evolution of the cultivated forms of *Vigna sinensis*. *Can. J. Genet. Cytol.* 7: 433—452.

GIBBS RUSSELL, G.E., WELMAN, W.G., RETIEF, E., IMMELMAN, K.L., GERMISHUIZEN, G., PIENAAR, B.J., VAN WYK, C.M. & NICHOLAS, A. 1987. List of species of South African plants, ed. 2, pt. 2: 95. Department of Agriculture and Water Supply, Pretoria.

GOVE, P.B. 1961. In: Webster's Third New International Dictionary of the English Language, unabridged: 354. Bell, G. & Sons Ltd., London. Merriam, G.& C. Co., Springfield, Massachusets.

GREUTER, W., BURDET, H.M., CHALONER, W.D., DEMOULIN, V., GROLLE, R., HAWKSWORTH, D.L., NICHOLSON, D.H., SILVA, P.C., STAFLEU, F.A., VOSS, E.G. & MC NEILL, J., 1988. International Code of Botanical Nomenclature. Koeltz Scientific Books, Königstein.

HARMS, H. 1902. Leguminosae Africanae 11. *Bot. Jb.* 30: 92—94.

HARVEY, W.H. 1862. Leguminosae. *Vigna* Savi. In: Flora Capensis, eds. Harvey, W.H. & Sonder, W.O., vol. 2, pp. 240—242. Hodges, Smith & Co., Dublin.

HEPPER, F.N. 1958. Papilionaceae. *Vigna* Savi. In: Flora of West Tropical Africa, ed. Hutchinson, J., Dalziel, J.M., 2nd. ed. revised by Keay, P.W.J., Vol. 1, Pt. 2, pp. 567, 569. Crown Agents for Oversea Governments & Administrations, London.

HIERN, W.P. 1896. Catalogue of African Plants collected by Dr. Friedrich Welwitsch, 1853—1861, 1: 259. Longmans, London.

JAASKA, V. & JAASKA, V. 1988. Isoenzyme variation in the genera *Phaseolus* and *Vigna* (Fabaceae) in relation to their systematics: aspartate aminotransferase and superoxide dismutase. *Pl. Syst. & Evol.* 159: 145—159.

JACQUIN, N.J. 1772. *Dolichos unguiculatus* L. syst. p. 482. Hortus Botanicus Vindobonensis 1: 8, 9, t. 23. Facsimile edition, Koeltz, Vienna.

LANJOUW, J., MAMAY, S.H., McVAUGH, R., ROBYNS, W., ROLLINS, R.C., ROSS, R., ROUSSEAU, J., SCHULZE, G.M., DE VILMORIN, R. & STAFLEU, F.A. 1966. International Code of Botanical Nomenclature. International Bureau for Plant Taxonomy and Nomenclature of the International Association for Plant Taxonomy, Utrecht, Netherlands.

LINNAEUS, C. 1753. *Phaseolus*. Species Plantarum, Tomus 1, p. 725. H.A.M.S., Uppsala.

LINNAEUS, C. 1771. Mantissa Plantes. Diadelphia Decandra. *Catiang*, *Dolichos*: 8. Cramer, J. & Weinheim, 1961 Facsimile, Wheldon & Wesley Ltd., Hafner Pub. Co., New York.

LUSH, W.M. 1979. Floral morphology of wild and cultivated cowpeas. *Econ. Bot.*: 442—447.

MARÉCHAL, R., MASCHERPA, J-M. & STAINIER, F. 1978. Etude Taxonomique d'une Groupe D'espèces des Genres *Phaseolus* et *Vigna* (Papilionaceae) sur la Base de Données Morphologiques et Polliniques Traitées par l'analyse Informatique. *Boissiera* 28: 190—196.

MARÉCHAL, R., MASCHERPA, J-M. & STAINIER, F. 1981. A Taxonometric Study of the *Phaseolus-Vigna* Complex and Related Genera. Adv. in Leg. Syst., ed. Polhill, R.M. & Raven, P.H.

MARKöTTER, E.I. 1930. Leguminosae. *V. nervosa* n. sp. In *Annale van die Universiteit Stellenbosch* 8: 26, 27.

MEYER, E. 1836. Papilionaceae. *Scytalis*. Commentariorum de plantis Africae australioris, pp. 145—146. Perthes & Besser, Hamburg.

MITHEN, R. 1988. (unpublished report). Herbarium survey, pp. 68—74. International Board for Plant Genetic Resources, Department for Biological Sciences, University of Zimbabwe, Mount Pleasant, Harare, Zimbabwe.

NEWMAN, A.J., RUSHING, A.E. & MUELLER, D.M. 1982. A Modified Short Protocol for the Preparation of Bryophytes for Scanning Electron Microscopy.

OHASHI, H. 1975. Flora of eastern Himalaya. Third report. *Bull. Tokyo Sci. Mus.* 8: 13—88.

SCHLECHTER, R. 1897. Decades Plantarum Novarum Austro-Africanarum, 23. *Dolichos reticulata* sp. n. *Jl. Bot.* 35: 219.

SEN, N.K. & BHOWAL, J.G. 1960. Cytotaxonomic studies on *Vigna*. *Cytologia* 25: 205—207.

SCHUMACHER, F.C. & THONNING, E. 1827. 205. *Dolichos*. 1. *D. oleraceus*. Beskrivelse af Gineeske Planter: 339. Videnskabers Selskabs Skrifter, Copenhagen.

SCHWEINFURTH, G.A. 1896. *Vigna mensensis* Schweinf. n. sp. *Bull. L'Herb. Boiss.* 4: 261.

TORRE, A.R. 1962—1966. Phaseoleae: *Vigna*. In: Consp. Fl. Angolensis 3: 263, 268. Junta Invest. Ultra., Lisbon.

THUNBERG, C.P. 1800. *Dolichos*. In: Prodromus Plantarum Capensium. Edman, Reg. Acad. Typogr., Uppsala.

VERDCOURT, B. 1968. The identities of *Dolichos trilobus* L. and *Dolichos trilobatus* L. *Taxon* 17: 170—173.

VERDCOURT, B. 1970. Studies in the Leguminosae—Papilionoidae for the 'Flora of Tropical East Africa' 4. *Kew Bull.* 24: 542—545.

VERDCOURT, B. 1971. *Vigna*. In: Flora of Tropical East Africa, eds. Milne-Redhead, E. & Polhill, R.M., Vol. 4 pp. 642—647. Crown Agents for Overseas Governments, London.

WALPERS, G.G. 1839. *Vigna* Savi. *Linnaea* XII: 533, 544.

WALPERS, G.G. 1842. Repertorium Botanices Systemticae 1: 778, 779. Hofmeister, Leipzig.

WESTPHAL, E. 1957. Pulses in Ethiopia, their taxonomy and agricultural significance. Agricultural Research Report: 213—232. Centre for Agricultural Publishing and Documentation, Wageningen.

WILCZECK, R. 1954. *Vigna* Savi. In: Flore du Congo Belge et du Ruanda-Urundi, Spermatophytes, Vol. VI: 387—391. L'Instituut National pour L'Étude Agronomique du Congo, Belge, Bruxelles.

CAPTIONS FOR FIGURES

Figure 1 Pollen grain sculpure in *Vigna unguiculata* subsp. *stenophylla*. Note the wide reticulation of raised muri —— characteristic for members of *Vigna* section *Catjang*.

Figure 2 Representative examples of stigma and pollen brush morphology in subspecies of *Vigna unguiculata*. Note stigma, hammer-shaped, style elongation horizontal. **a.** *V. unguiculata* subsp. *dekindtiana* var. *dekindtiana*, x20 (*Pienaar 1389*). **b.** *V. unguiculata* subsp. *stenophylla*, x40 (*Pienaar 1366*).

Figure 3 Representative leaves (x1) and stipules (x2) of the different subspecies and their varieties in the wild forms of *Vigna unguiculata*, and of *V. nervosa*. **a.** *V. unguiculata* subsp. *stenophylla*. **b.** *V. unguiculata* subsp. *tenuis* var. *tenuis*. **c.** *V. unguiculata* subsp. *tenuis* var. *ovata*. **d.** *V. unguiculata* subsp. *dekindtiana* var. *huillensis*. **e.** *V. nervosa*. **f.** *V. unguiculata* subsp. *dekindtiana* var. *dekindtiana* (also subsp. *mensensis*), note two types of leaves often present on the same plant. **g.** *V. unguiculata* subsp. *protracta*.

Figure 4 Standard and wing of *Vigna unguiculata* (subsp. *protracta*) —— illustrating the prevailing shape for the species, x4 (*Pienaar 403*).

Figure 5 The known geographical distribution of *Vigna unguiculata* subsp. *protracta* in southern Africa.

Figure 6 The known geographical distribution of *Vigna unguiculata* subsp. *dekindtiana* var. *dekindtiana* in southern Africa.

Figure 7 The known geographical distribution of *Vigna unguiculata* subsp. *dekindtiana* var. *huillensis* in southern Africa.

Figure 8 The known geographical distribution of *Vigna unguiculata* subsp. *tenuis* var. *tenuis* in southern Africa.

Figure 9 The known geographical distribution of *Vigna unguiculata* subsp. *tenuis* var. *ovata* in southern Africa.

Figure 10 The known geographical distribution of *Vigna unguiculata* subsp. *stenophylla* in southern Africa.

Table 1 Summary of the delimitation of the infraspecific taxa in *V. unguiculata* as proposed by Verdcourt (1970), Maréchall *et al.* (1978) and the present authors

Verdcourt (1970)	Maréchal *et al.* (1978)	Present study
V. unguiculata	*V. unguiculata*	*V. unguiculata*
subsp. *unguiculata*	subsp. *unguiculata*	subsp. *unguiculata*
	cv. gr. *unguiculata*	cv. gr. *unguiculata*
subsp. *cylindrica*	cv. gr. *biflora*	cv. gr. *biflora* (not southern Afr.)
subsp. *sesquipedalis*	cv. gr. *sesquipedalis*	cv. gr. *sesquipedalis* (not southern Afr.)
——	cv. gr. *textilis*	cv. gr. *textilis* (not southern Afr.)
subsp. *dekindtiana*	subsp. *dekindtiana*	subsp. *dekindtiana*
——	var. *dekindtiana*	var. *dekindtiana*
subsp. *mensensis*	var. *mensensis*	var. *huillensis*
——	——	subsp. *mensensis* (not southern Afr.)
var. *protracta*	var. *protracta*	subsp. *protracta*
V. pubescens	var. *pubescens*	subsp. *protracta*
V. tenuis	subsp. *tenuis*	subsp. *tenuis* var. *tenuis* & var. *ovata*
V. angustifoliolata	subsp. *stenophylla*	subsp. *stenophylla*

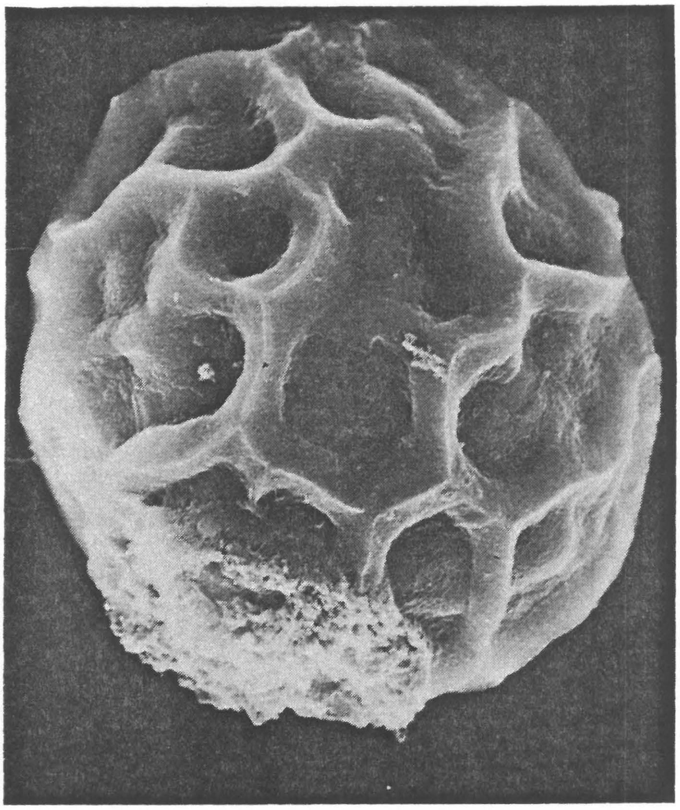

Figure 1 Pollen grain sculpure in *Vigna unguiculata* subsp. *stenophylla*. Note the wide reticulation of raised muri —— characteristic for members of *Vigna* section *Catjang*.

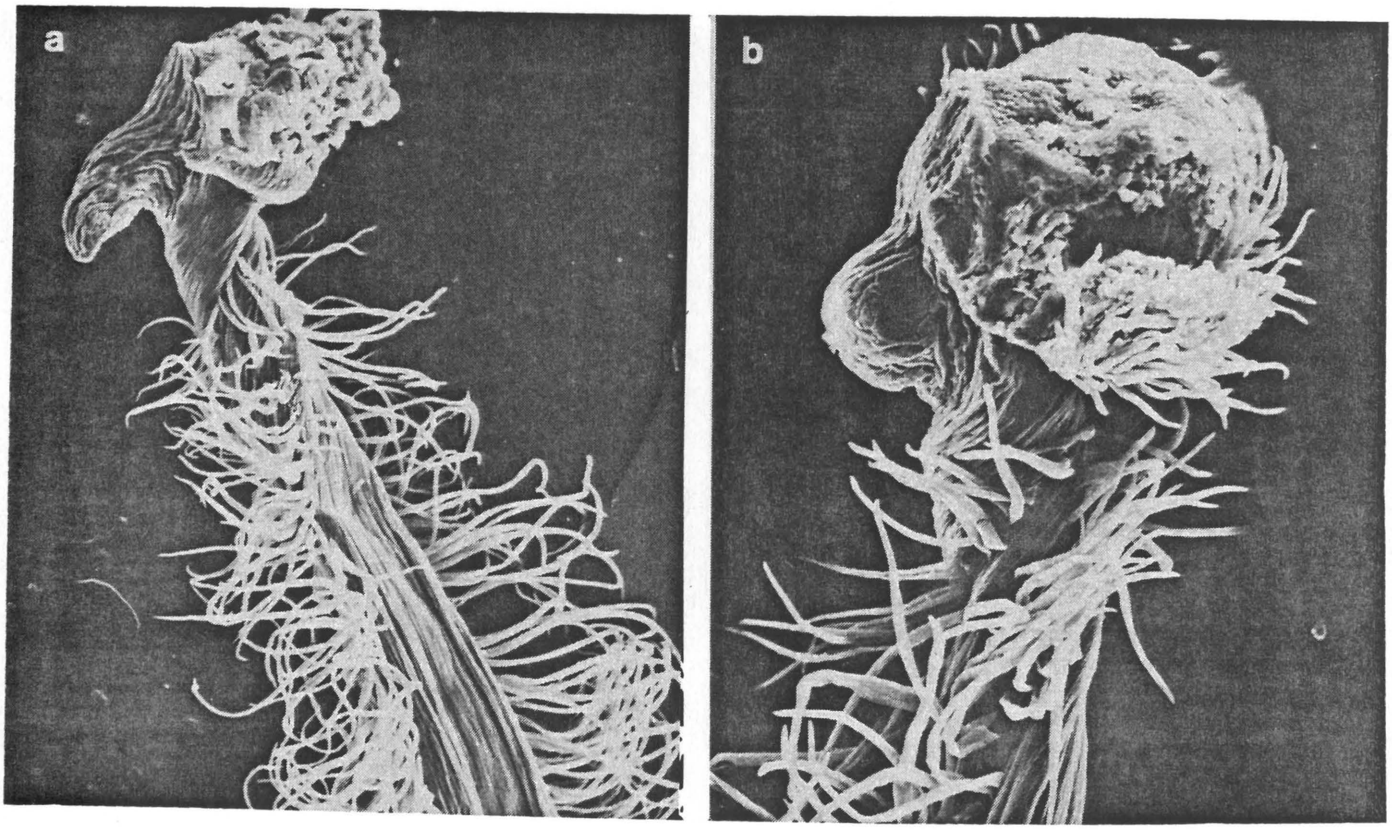

Figure 2 Representative examples of stigma and pollen brush morphology in subspecies of *Vigna unguiculata*. Note stigma, hammer-shaped, style elongation horizontal. **a.** *V. unguiculata* subsp. *dekindtiana* var. *dekindtiana*, x20 (*Pienaar 1389*). **b.** *V. unguiculata* subsp. *stenophylla*, x40 (*Pienaar 1366*).

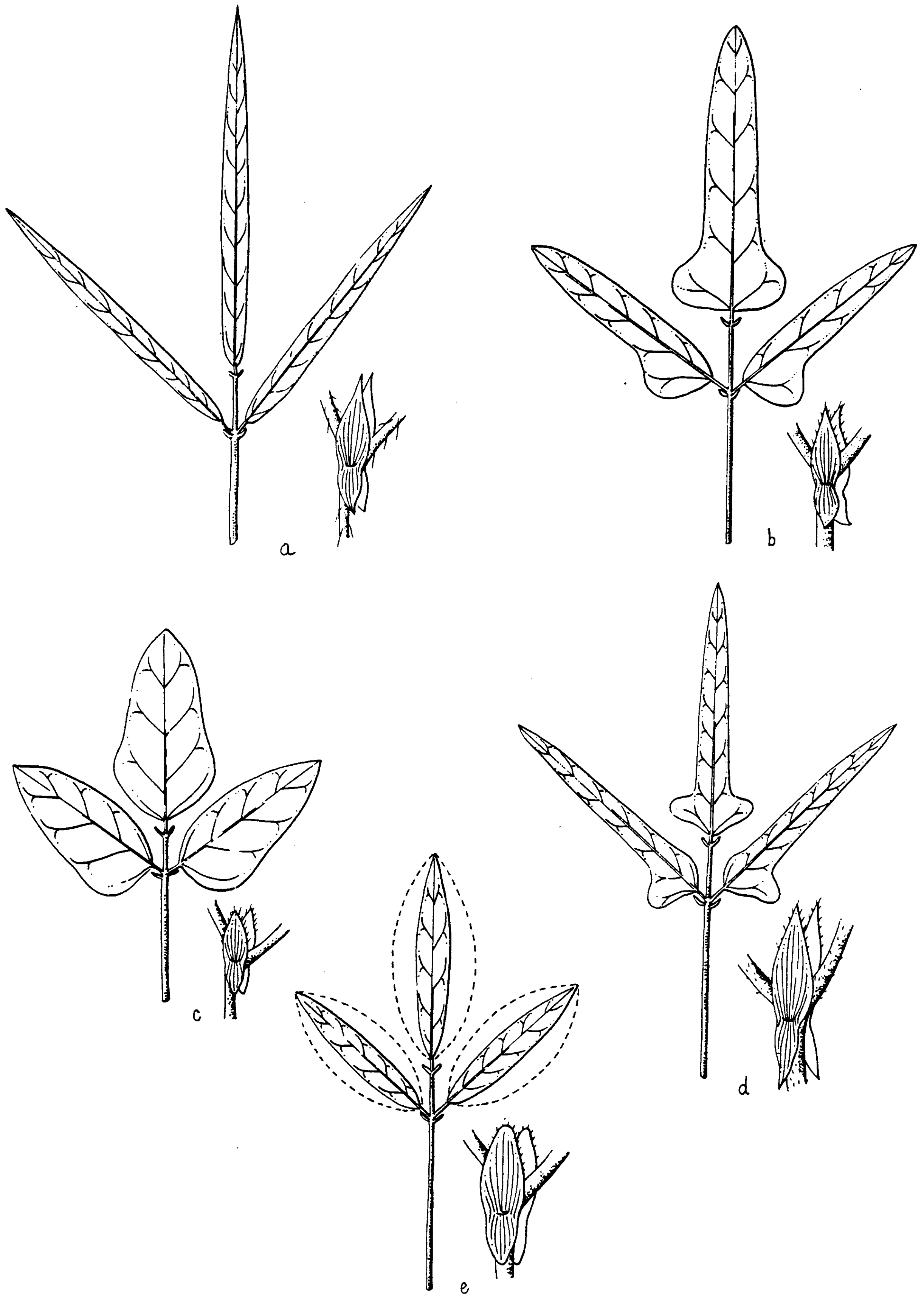

Figure 3 Representative leaves (x1) and stipules (x2) of the different subspecies and their varieties in the wild forms of *Vigna unguiculata*, and of *V. nervosa*. **a.** *V. unguiculata* subsp. *stenophylla*. **b.** *V. unguiculata* subsp. *tenuis* var. *tenuis*. **c.** *V. unguiculata* subsp. *tenuis* var. *ovata*. **d.** *V. unguiculata* subsp. *dekindtiana* var. *huillensis*. **e.** *V. nervosa*. **f.** *V. unguiculata* subsp. *dekindtiana* var. *dekindtiana* (also subsp. *mensensis*), note two types of leaves often present on the same plant. **g.** *V. unguiculata* subsp. *protracta*.

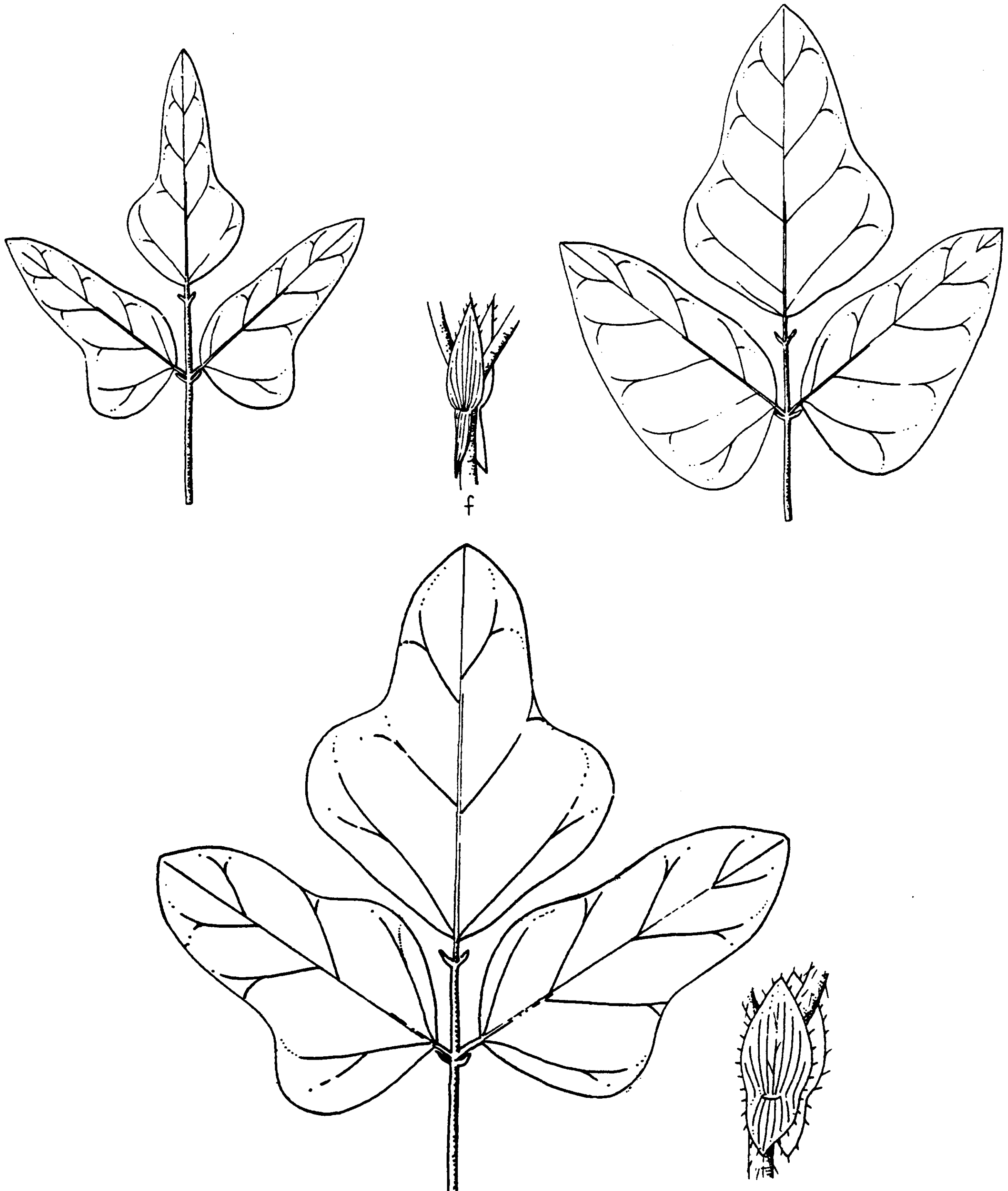

Figure 3 (continued)...

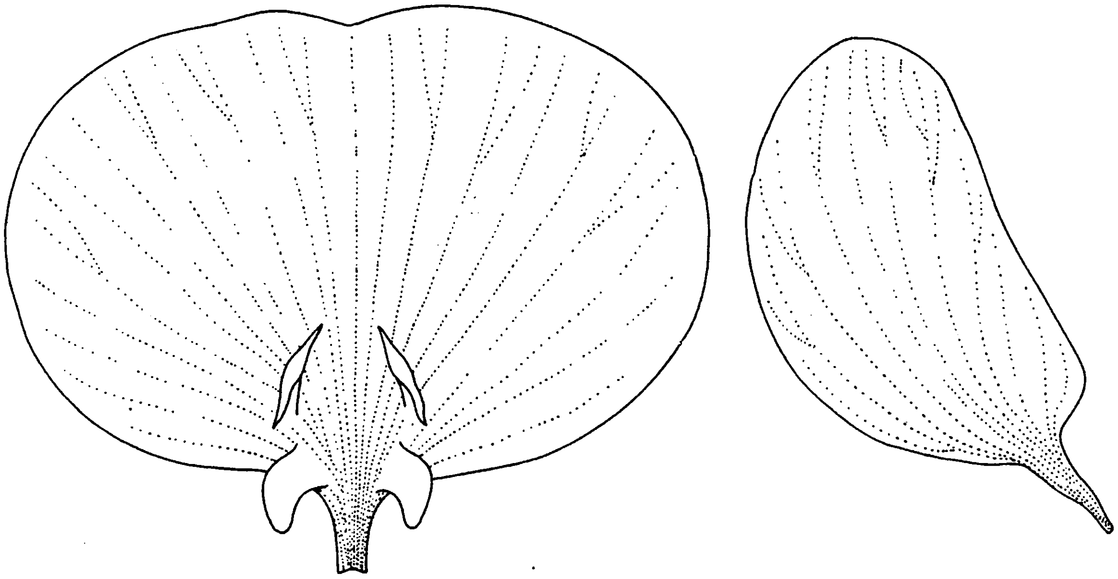

Figure 4 Standard and wing of *Vigna unguiculata* (subsp. *protracta*) —— illustrating the prevailing shape for the species, x4 (*Pienaar 403*).

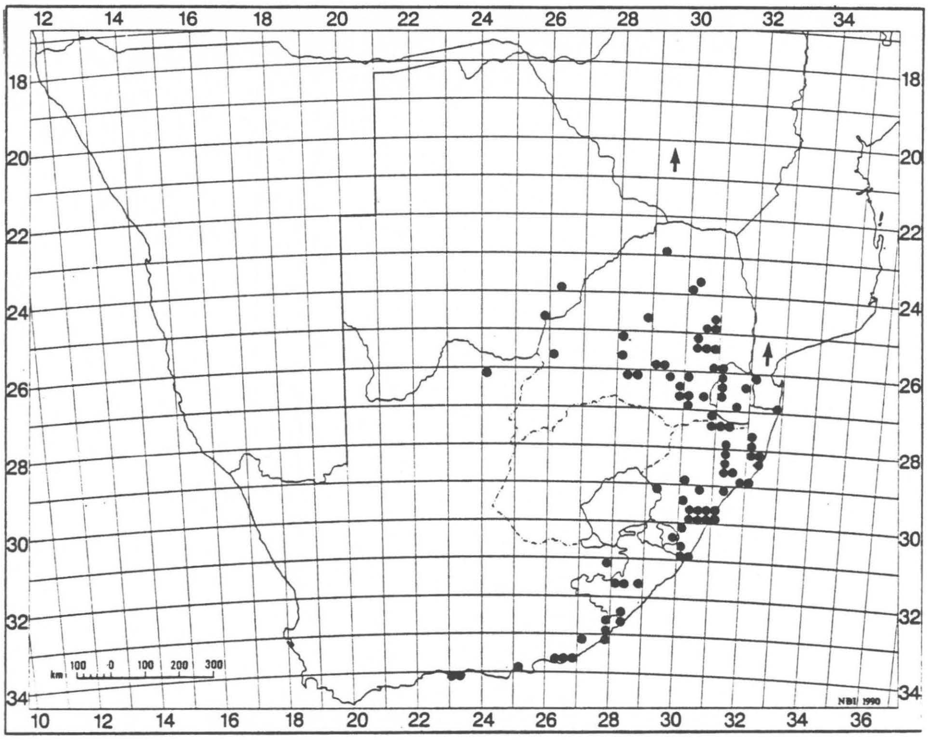

Figure 5 The known geographical distribution of *Vigna unguiculata* subsp. *protracta* in southern Africa.

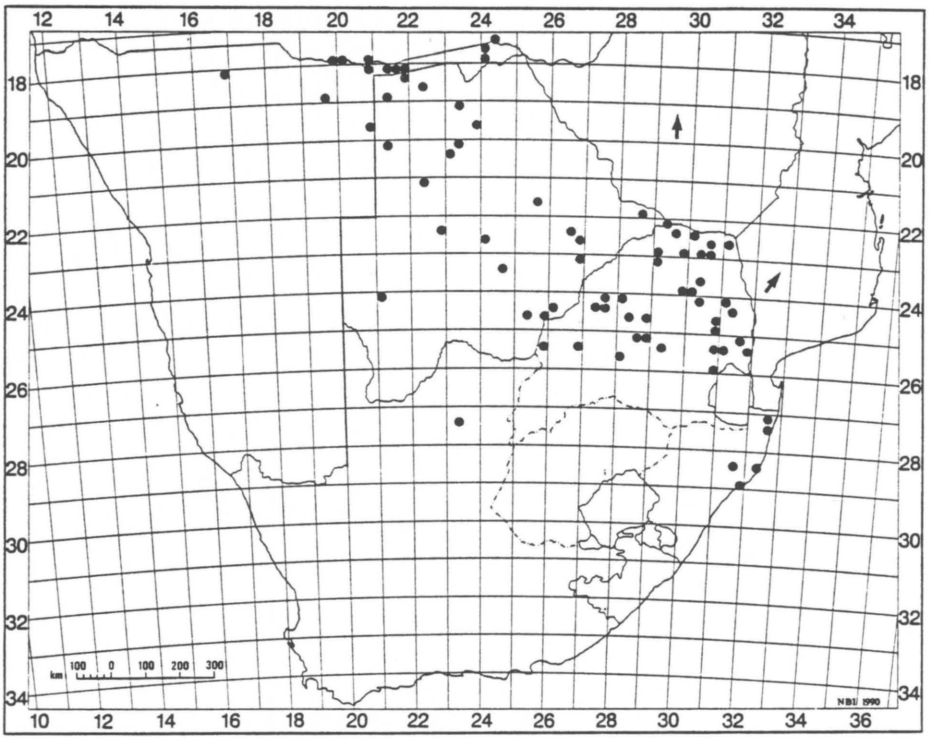

Figure 6 The known geographical distribution of *Vigna unguiculata* subsp. *dekindtiana* var. *dekindtiana* in southern Africa.

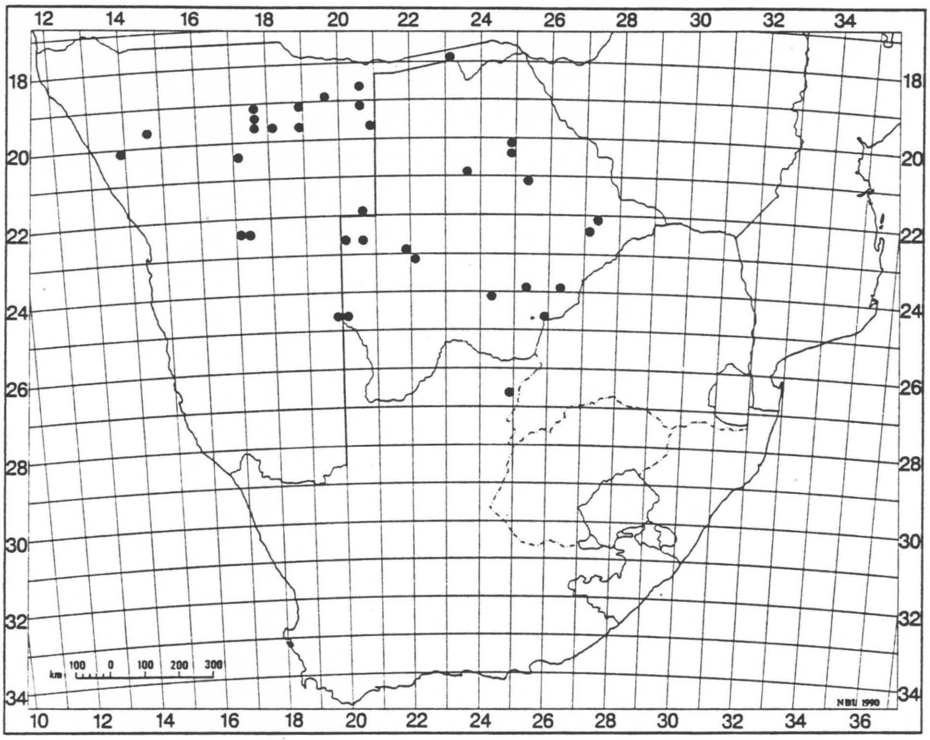

Figure 7 The known geographical distribution of *Vigna unguiculata* subsp. *dekindtiana* var. *huillensis* in southern Africa.

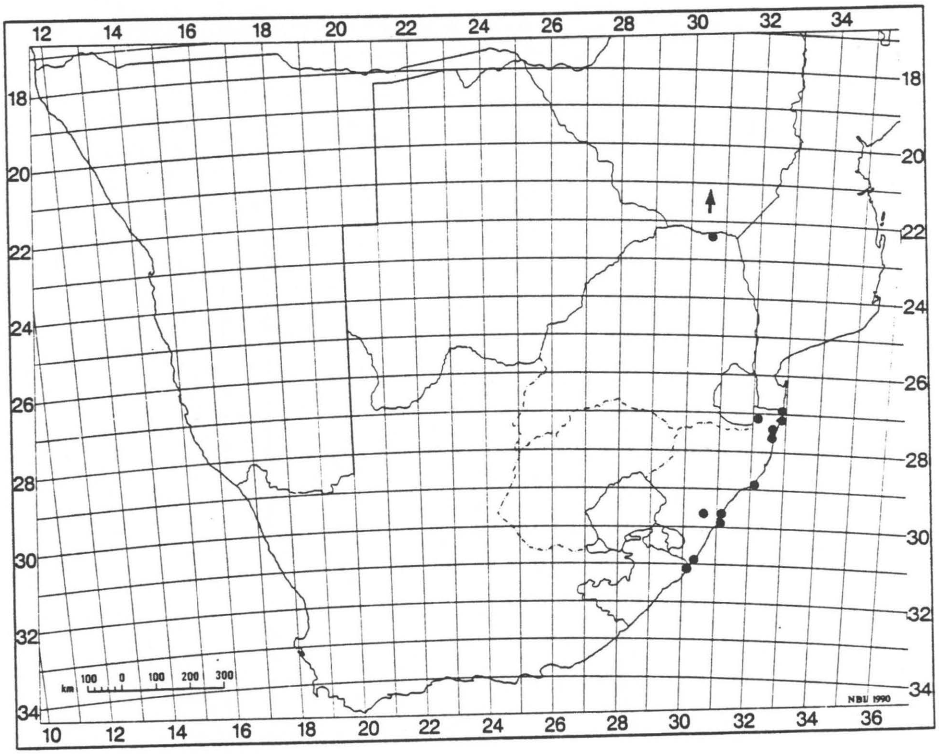

Figure 8 The known geographical distribution of *Vigna unguiculata* subsp. *tenuis* var. *tenuis* in southern Africa.

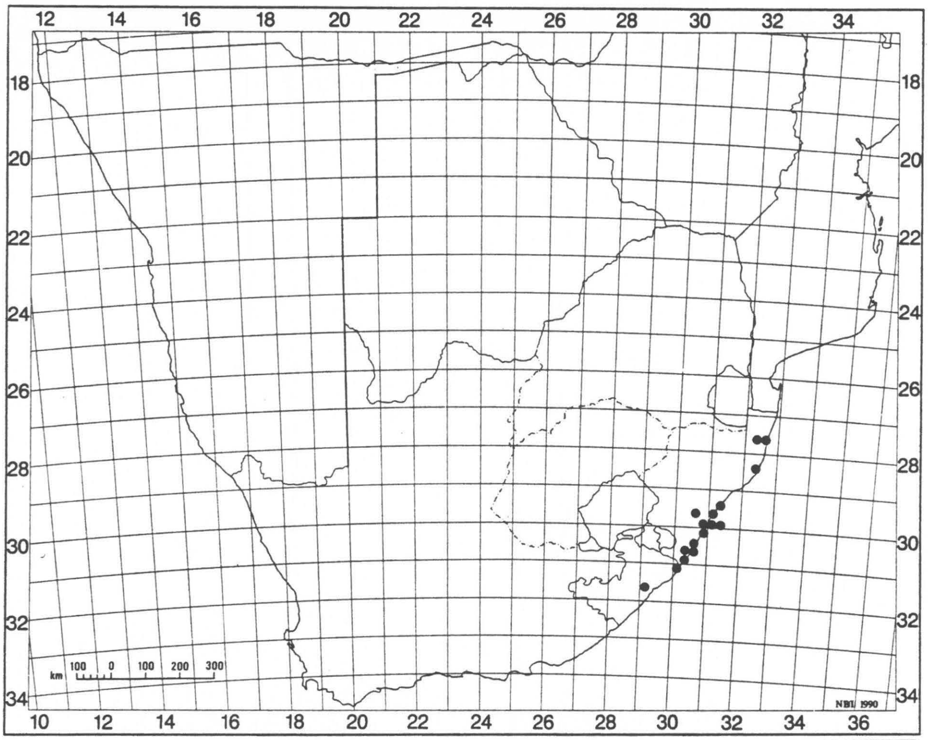

Figure 9 The known geographical distribution of *Vigna unguiculata* subsp. *tenuis* var. *ovata* in southern Africa.

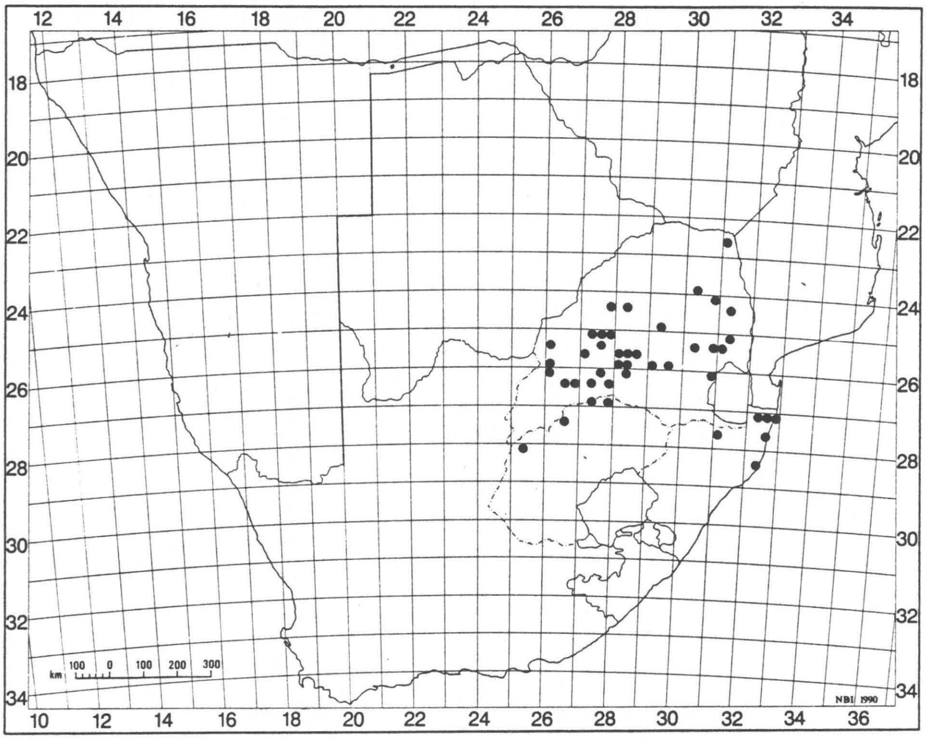

Figure 10 The known geographical distribution of *Vigna unguiculata* subsp. *stenophylla* in southern Africa.

ADDENDUM 2

A NEW SPECIES OF *VIGNA* SAVI (FABACEAE) FROM SOUTHERN AFRICA

FIGURES

S.Afr.J.Bot., 1991, 57(6): 314 – 318

A new species of *Vigna* Savi (Fabaceae) from southern Africa

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Vigna mudenia B.J. Pienaar, a new species with axillary peduncles up to 150 mm long and bearing a single pair of small, cream-coloured flowers at the apex of each peduncle, is described and illustrated. It grows in profusion on southern hillslopes in parts of the Natal midlands thornveld, particularly northwest of Muden village. Old collections of the species are also known from the Barberton and Eshowe areas, but recent efforts to find it in these localities were unsuccessful. *V. mudenia* belongs to the subgenus *Haydonia* (Wilcz.) Verdc. and may be recognized by the stems being subalate, with patent hairs; leaflets elliptic; stipules lanceolate with the base ovate, reflexed on mature stems; inflorescences contracted with a pair of cream-coloured (yellowish) flowers; and the style elongation shaped like an erect fingertip.

Vigna mudenia B.J. Pienaar, 'n nuwe *Vigna* spesie met 'n enkele paar klein, roomkleurige blomme aan die punt van asstandige blomstele wat tot 150 mm lank word, word beskryf en geïllustreer. Die nuwe spesie groei volop in die doringveld van dele van die Natalse middelland, veral suidelike heuwelhange noordwes van die dorpie Muden. Ou versamelings van die spesie is ook bekend vanaf Barberton en Eshowe, maar onlangse pogings om dit aldaar te vind, het misluk. *V. mudenia* behoort tot die subgenus *Haydonia* (Wilcz.) Verdc. en word herken aan die half-gevleuelde stamme met spreidende hare; eliptiese pinnas; lansetvormige skutblare met 'n hartvormige basis, wat teruggebuig is aan volwasse stamme; saamgetrekte bloeiwyses met een paar roomkleurige blomme aan die bopunt; en die stylverlenging wat soos 'n regop vingerpunt lyk.

Keywords: Fabaceae, new species, South Africa, subgenus *Haydonia*, *Vigna*.

Introduction

The most recent taxonomic revisions of *Vigna* Savi were done for Tropical East Africa by Verdcourt (1971) and worldwide by Maréchal *et al.* (1978a), using numerical taxonomy. These revisions make it possible to place the new species into its most suitable subgenus and section. In 1985 the author first encountered a plant of the new species, *V. mudenia*, about 7 km northwest of Muden, Natal, twining into an *Acacia robusta* tree and bearing only two ripe pods. These pods were taken to the nursery of the National Botanical Institute in Pretoria where the seeds germinated and the plants produced flowers and seed. More extensive collections were made in January 1989, when seedlings and mature plants were collected 7.5 km northwest of Muden, along a district road as well as along the main road. The specific epithet is derived from Muden where it grows prolifically. Despite thorough searches in the areas, the species has not yet been recollected from the localities recorded many years ago by Pott (Barberton) and Lawn (Eshowe). Unfortunately these collectors did not provide very exact localities, other than the nearest town.

Electrophoretic profiles of the proteins contained in southern African *Vigna* seeds, executed by Drs P. Perrino and G. Laghetti at the Germplasm Institute at Bari, Italy, according to the method employed by Laemmli (1970), are preserved at the National Botanical Institute, Pretoria, where they may be viewed. These results, as well as SEM studies of the stigma and the style, indicate that *V. mudenia* is different from all other named species of *Vigna* in southern Africa.

Description

Vigna mudenia B.J. Pienaar, sp. nov.

Herba perennis, caulibus volubilibus in silvis spinosis, humo petroso vel gramineto aperto recumbens, e radice dauciformi crescens. *Caulis* profunde sulcatus vel alatus, pilis patentibus longis albis vel incoloris obtectus. *Foliola* elliptica, circa 40 × 20 mm, apice acuta, apiculata, foliolis terminalis basi plus minusve cuneatis, foliola lateralia late cuneata asymmetrica, superficiebus foliolorum ambobus sparse strigosis, basin trinervatis, nervis elevatis, in superficie inferiori reticulatis, petiolis ad 48 mm, rhachide ad 8 mm, petiolulis 2 mm longis. Stipulae lanceolatae, circa 5 – 6 mm longae, reflexae, apice obtusae, basi auriculis lateralibus, plus minusve cordatae, marginis ciliatis. *Inflorescentia* axillaris, pedunculo aliquantum compresso et alato, subpatente, circa 100 mm longo, apice floribus duobus parvis, inter pedicellos serie verticali glandium. *Flores* cremei viridecentes et flava ad basin vexilli erecti. *Calyx* campanulatus, lobis acuminatis basibus latis triangularibus, tubo subaequilongo, circa 2 mm, pare superio connati per tertium vel dimidium longitudinis, pilis patentibus. *Vexillum* ovatum ad oblatum, emarginatum, circa 10 × 14 mm; calcar rectus apice auriculis vel callis divergentibus, calli superiores angusti; *alae* angustae ovatae, circa 10 × 5.5 mm, calcar gracilis, circa 3 mm, auriculo laterali circa 1 mm; *carina* circa 11 mm longa, obtusa, subsursum versus. *Filamentorum tubus* circa 10 mm longus, filamenta libera 3 et 4 mm longa, filamento antico geniculato, circa 13 mm longo; *antheris* oblatis, circa 1 mm. *Ovarium* pubescens, circa 9 mm longum; *stylo* apicem versus late facto et complanato, sursum curvens, antica superficie barbata, apice convoluto, supra stigma elongato sicut digito erecto, circa 0.2 – 0.3 (– 0.4) mm; stigma anteriore laterale, globulosum basin versus brevipilosum. *Legumina* erecta, subcompressa, pilis sublongis, circa 60 mm longa, obtuse rostrata, seminibus plus minusve 12 – 14. *Semina* grisea nigropunctata, rectangularia, 3 × 2 mm; hilo subcentrale, arillo subabsente.

TYPUS:— Natal, Muden district, 1.4 km on district road D568 off tarmac road (R74) from Muden to Weenen, 1989-01-26, *Pienaar & Archer 1325* (PRE, holo.!; K, MO, PRU, iso.).

Perennial herb, twiner in thornveld, in rocky soil, or recumbent in grass, growing from a dauciformis tap root. *Stems* deeply grooved to winged, with long white or colourless patent hairs. *Leaflets elliptic, ca.* 40 × 20 mm, apex acute, apiculate, base more or less cuneate in terminal leaflets, broadly cuneate and asymmetrical in lateral leaflets (Figures 1 & 2a), both surfaces sparsely strigose, trinerved at base, nerves raised, reticulate on undersurface; petioles up to 48 mm long, rhachis up to 8 mm long, petiolules 2 mm long. *Stipules* lanceolate, *ca.* 5 – 6 mm long, reflexed, apex obtuse, base with lateral auricles, more or less cordate, margins ciliate, more or less truncate-elongated below point of insertion in seedlings only (Figure 2b). *Inflorescences* axillary, pedicel somewhat compressed and winged, sparingly patent, *ca.* 100 mm long, bearing two small flowers at the apex, with a vertical row of glands between the pedicels. *Flowers* cream-flushed with green and a yellow spot at base of erect standard. *Calyx* campanulate, lobes acuminate with broad triangular bases, about as long as tube, *ca.* 2 mm, upper pair connate for $^1/_3$ to $^1/_2$ their length, patently pubescent. *Standard* ovate to oblate, emarginate, *ca.* 10 – 14 mm, spur straight with divergent auricles or calluses at the apex, upper calluses narrow (Figure 2c); wings narrowly ovate, *ca.* 10.0 x 5.5 mm, spur slender, *ca.* 3 mm long, lateral auricle *ca.* 1 mm long; keel *ca.* 11 mm long, obtuse, slightly upturned. *Filament tube ca.* 10 mm long, free filaments 3 and 4 mm long, anterior filament geniculate at base, *ca.* 13 mm long; anthers oblate, *ca.* 1 mm long. *Ovary* pubescent, *ca.* 9 mm long; style broadened and flattened as it curves upward, bearded on anterior face (Figure 2d), apically twisted at maturity, elongated beyond stigma like an erect fingertip, *ca.* 0.2 – 0.3 (– 0.4) mm long; stigma anteriorly lateral, globose before pellicle is broken, with short hairs at base (Figures 2e & 3). *Legumes* erect, slightly compressed, *ca.* 60 mm long, obtusely beaked, with longish white hairs, *ca.* 12 – 14-seeded. *Seeds* grey mottled with black, more or less rectangular, *ca.* 3 × 2 mm; hilum almost central, aril almost absent.

Figure 1 *Vigna mudenia*, herbarium specimen of plant grown in the nursery of the National Botanical Institute from seed collected in the Muden district (*Joffe 30*, seeds from *Pienaar 416*).

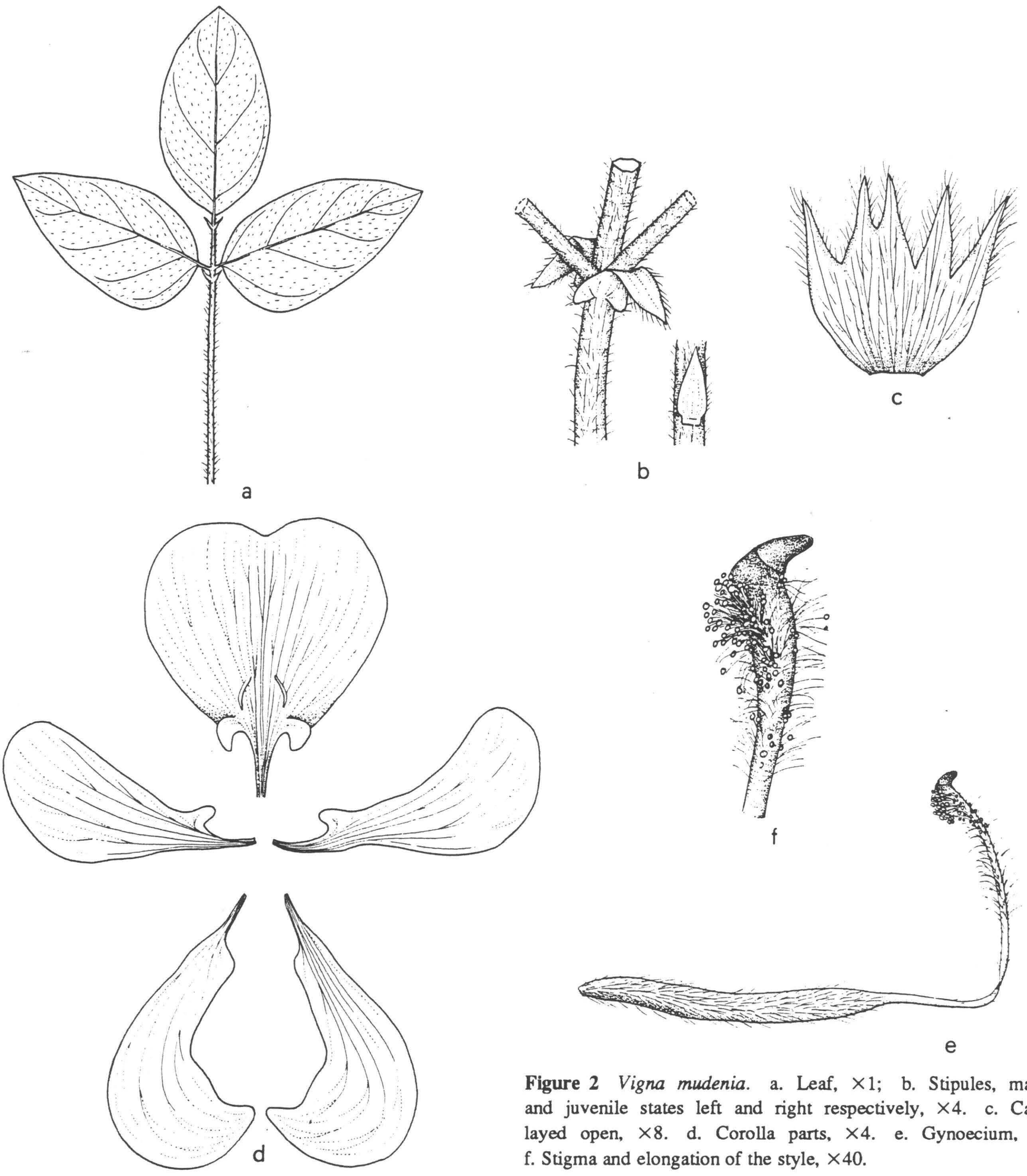

Figure 2 *Vigna mudenia*. a. Leaf, ×1; b. Stipules, mature and juvenile states left and right respectively, ×4. c. Calyx, layed open, ×8. d. Corolla parts, ×4. e. Gynoecium, ×4; f. Stigma and elongation of the style, ×40.

Diagnostic characters

Leaflets pale green, elliptic, apex acute, base cuneate. *Stipules* slightly prolonged truncate appendages in seedlings, soon reverting to auriculate lobes on both sides, and sharply reflexed as in *V. richardsiae* and *V. triphylla*; pulvinous action apparent in seedlings. *Stems* deeply grooved to winged. *Style* with beak present as a short semi-erect, rounded 'fingertip' or 'thimble'-like projection within the short-rostrate keel. *Legumes* erect, paired, up to 60 mm long, obtusely beaked, 14-seeded. *Seeds* small, almost spherical, 3 × 2 mm, with aril scarcely developed.

Distribution

Only plants that could be positively identified as *V. mudenia* are noted on the distribution map (Figure 4). Mention should

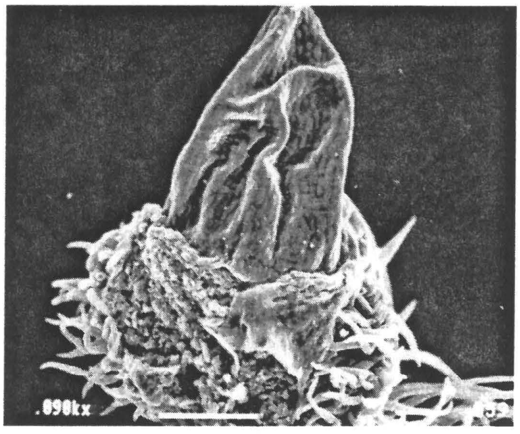

Figure 3 SEM micrograph of stigma of *Vigna mudenia* indicating 'thimble-like' elongation of the style. Scale bar = 100 μm.

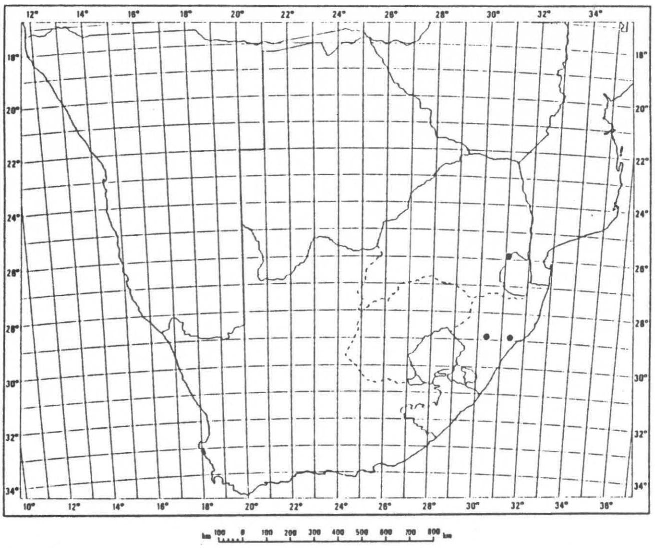

Figure 4 Known distribution of *Vigna mudenia*.

be made of plants from the Transvaal and Namibia that have similar vegetative characters but of which floral material is lacking and for which no positive identification can be made at this stage.

Specimens examined

—**2531** (Komatipoort): Barberton (–CC), *Pott 5309* (PRE).

—**2830** (Dundee): 7 km from Muden on road to Colenso (–CD), *Pienaar 416* (PRE); 1.8 km on district road D568, turning off Muden–Colenso road, *Pienaar & Archer 1324* (PRE, PRU); 1.4 km on district road D568, *Pienaar & Archer 1325* (K, MO, PRE, PRU); 0.2 km from district road D568 back on road to Muden, *Pienaar & Archer 1326* (PRE, PRU).

—**2831** (Nkandla): Eshowe (–CD), *Lawn 1485* (NH).

Cultivated: NBI nursery, Pretoria, from seed collected in the Muden District, *Joffe 30* (PRE).

Discussion

Superficially *V. mudenia* appears to belong to subgenus *Vigna* section *Vigna*, the pollen reticulations being less prominent like that of *V. luteola* (Jacq.) Benth. (*cf. V. richardsiae* Verdc.). However, detailed examination of flowers and vegetative parts reveals clear differences and rather points to subgenus *Haydonia* (Wilcz.) Verdc. (1970).

When Wilczek (1954) established the new genus *Haydonia* within the African Phaseolineae, he included only two species, viz. the type species, *H. monophylla* (Taub.) Wilcz., and *H. triphylla* Wilcz. Peculiar to this new genus were the glands at the base of the inferior anthers. Maréchal (1967) extended the genus to include *V. juncea* Milne-Redhead with two varieties, viz. var. *juncea* and var. *major* Milne-Redhead, a species in which the anther glands are less prominent. Verdcourt (1970) attributed four species, viz. *V. monophylla* Taub., *V. triphylla* (Wilcz.) Verdc., *V. juncea* Milne-Redh. and a new species, *V. richardsiae* Verdc., to this group, and returned the genus *Haydonia* to *Vigna* as a subgenus.

According to the numerical analysis by Maréchal *et al.* (1978a), the close relationship between the genus *Haydonia* Wilcz. (1954) and the African members of *Vigna* was confirmed and Verdcourt's (1970) judgement supported. The relationship between Verdcourt's section *Glossostylus*, under subgenus *Vigna*, and three other African species of *Vigna* whose pollen had lost the typical broad, raised reticulations typical of *Vigna*, was also supported, despite the light weighting of this character. All African representatives of the genus *Vigna* with symmetrical flowers and atypical pollen may therefore be assembled in one subgenus, *Haydonia*.

As conceived by Maréchal *et al.* (1978b), the subgenus *Haydonia* constitutes a group in the full course of evolution, derived from the subgenus *Vigna* and resulting in the loss of the coarse exine reticulations (Figures 5a & 5b), as well as two typical Old World *Vigna* characters, viz. the prolongation of stipules below their insertion and prolongation of the style beyond the stigma. Additional characters have also been acquired, viz. glands or groups of glands below the anthers of the inner cycle of stamens, stems that are more or less strongly ribbed and/or winged and very small seeds. Maréchal *et al.* (1978b) suggested that this evolutionary development took place in Africa. Consequently, Maréchal *et al.* (1978b) divided the subgenus *Haydonia* into three distinct sections, viz:

(a) Section *Haydonia*, with the type species *V. monophylla* Taub. and including *V. triphylla* (Wilcz.) Verdc., *V. juncea* Milne-Red. var. *juncea* and var. *major* Milne-Redh.

(b) Section *Microspermae* Maréchal *et al.* (1978b), with the type species *V. microsperma* Viguier (1952) and in-

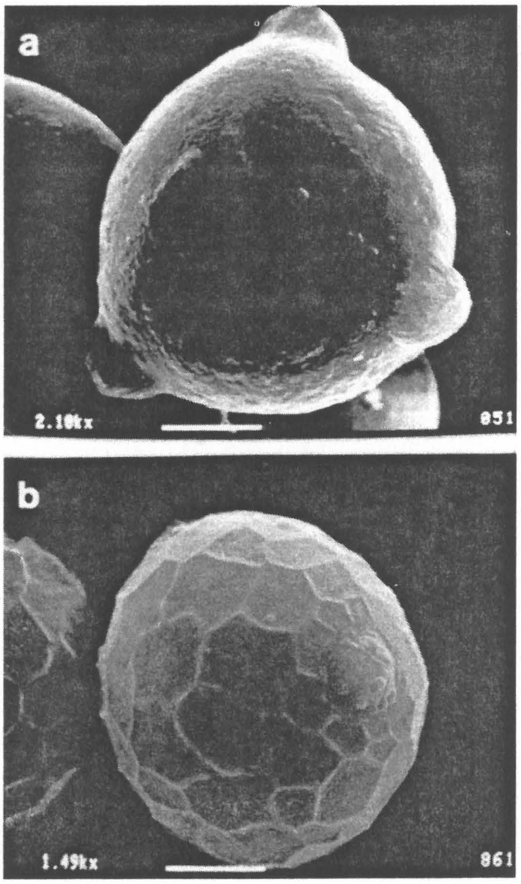

Figure 5 SEM micrographs of pollen grains showing exine sculpture. a. *Vigna monophylla* (*Bayliss 10658*); b. *Vigna mudenia* (*Pienaar 416*). Scale bar = 10 μm.

cluding *V. richardsiae* Verdc. and *V. schimperi* Bak.

(c) Section *Glossostylus* Verdc. (1970), with the type *V. nigritia* Hook. f.

Section *Microspermae* lies intermediate between section *Haydonia* in which the evolutionary trends have been completely effected and section *Glossostylus* in which they have only begun in the loss of the exine reticulations. It is in this middle group, the *Microspermae* Maréchal *et al.* that *V. mudenia* fits. *V. microsperma*, the type species, hails from Madagascar and it seems likely that *V. mudenia* may be related to this species across the Mozambique Channel, since Madagascar was once a part of the African continent.

Acknowledgements

I wish to thank Mrs S. Perold for SEM micrographs, Dr Hugh Glen for the Latin description, Mrs E. du Plessis for her critical reading of the manuscript, Drs P. Perrino and G. Laghetti for electrophoretic profiles of *Vigna* seed proteins, both the National Botanical Institute, Pretoria, and the University of Pretoria for the amenities at my disposal, and Profs. P.D.F. Kok and A.E. van Wyk for professional assistance.

References

LAEMMLI, U.K. 1970. Cleavage of structural proteins during the assembly of the head of bacteriophage T4. *Nature* 5253, 227: 680 – 685.

MARÉCHAL, R. 1967. Une troisième espèce du genre africain, *Haydonia* Wilcz. (Papilionaceae). *Bull. Jard. bot. Etat Brux.* 37: 463.

MARÉCHAL, R., MASCHERPA, J.-M. & STAINIER, F. 1978a. Etude taxonomique d'un groupe d'espèces des genres *Phaseolus* et *Vigna* (Papilionaceae) sur la base de données morphologiques et polliniques, traitées par l'analyse informatique. *Boissiera* 28: 196 – 201.

MARÉCHAL, H., MASCHERPA, J.-M. & STAINIER, F. 1978b. Combinaisons et noms nouveaux dans les genres *Phaseolus*, *Minkelersia*, *Macroptilium*, *Ramirezella* et *Vigna*. *Taxon* 27: 200.

MILNE-REDHEAD, E.W.B.H. 1934. *Vigna juncea* Milne-Redhead. *Kew Bull.* 1934: 301.

VERDCOURT, B. 1970. Studies in the Leguminosae – Papilionoideae for the 'Flora of Tropical East Africa': IV. *Kew Bull.* 24(3): 519 – 524; 551.

VERDCOURT, B. 1971. *Vigna* Savi. In: Flora of Tropical East Africa, Leguminosae, 4: 660 – 663. Crown Agents for Overseas Governments, London.

VIGUIER, R. 1952. *Vigna*. In: Leguminosae Madagascariensis novae. *Vigna microsperma* R. Vig. *Not. Syst.* 14(3): 178.

WILCZEK, R. 1954. Groupes nouveaux des Papilionaceae – Phaseolinae du Congo Belge et Ruanda Urundi. *Bull. Jard. bot. Etat Brux.* 24: 405.

ADDENDUM 3

THE *VIGNA VEXILLATA* COMPLEX (FABACEAE) IN SOUTHERN AFRICA

TABLES

FIGURES

The *Vigna vexillata* complex (Fabaceae) in southern Africa

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Proposals are made toward the infraspecific delimitation of taxa in the *Vigna vexillata* complex in southern Africa. Extensive fieldwork and an assessment of herbarium collections have led to the recognition of four varieties within the species. These are var. *ovata* [= E. Meyer's *Strophostyles capensis* (Thunb.) E. Mey. vars. *ovatus*, *lanceolata* and *longifolia* (1836)] and var. *davyi* (= *V. davyi* H. Bol.), both endemic to southern Africa, and vars. *vexillata* and *angustifolia* which also extend to other parts of Africa. The paper provides a key, the typification of the names and synonymy.

Infraspesifieke afbakening van taksons in die *Vigna vexillata* kompleks in suidelike Afrika word voorgestel. Uitgebreide veldwerk en 'n evaluering van herbariumeksemplare het daartoe gelei dat vier variëteite binne die spesie erken word. Hulle is var. *ovata* [= E. Meyer se *Strophostyles capensis* (Thunb.) E. Mey. var. *ovatus*, *lanceolata* en *longifolia* (1836)] en var. *davyi* (= *V. davyi* H. Bol.) wat albei endemies tot suidelike Afrika is, en var. *vexillata* en *angustifolia* wat ook in ander dele van Afrika voorkom. Hierdie ondersoek verskaf 'n sleutel, die tipering van die name en die sinonimie.

Keywords: Fabaceae, Phaseoleae, southern Africa, style, taxonomy, *Vigna vexillata*

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Introduction

The genus *Vigna* belongs to the tribe Phaseoleae (subfamily Papilionoideae – family Fabaceae) and includes about 150 species, distributed mainly throughout the tropics of both hemispheres. Five subgenera are recognized in the genus by Verdcourt (1971) and seven by Maréchal *et al.* (1978). Jaaska and Jaaska (1988) raised the status of section *Catjang* (DC.) Verdc. to that of subgenus. Four subgenera are represented in southern Africa, namely *Vigna*, *Plectrotropis* (Schumach.) Bak., *Haydonia* (Wilcz.) Verdc. and *Catjang* (DC.) Jaaska & Jaaska. According to Schumacher and Thonning (1827), the genus *Plectrotropis*, derived from the Greek *plectro* meaning 'spur' and *tropis* meaning 'keel of a ship', refers to the inverted hollow spur on the left side of the keel which causes the deflection of its falcate apex — '*carina hinc deflexa inde calcarata*'. Note also Articles 62.2, 73.1 and 73.2 in the International Code of Botanical Nomenclature (Greuter *et al.* 1988) in support of our decision to retain *Plectrotropis* rather than *Plectotropis* as used by Maréchal *et al.* (1978), Jaaska and Jaaska (1988) and others.

Three species of the subgenus *Plectrotropis* (Schumach.) Bak. are currently represented in southern Africa, namely *Vigna vexillata* (L.) A. Rich., *V. davyi* Bol. and *Vigna lobatifolia* Bak., the former two in section *Plectrotropis* and the latter in section *Pseudoliebrechtsia* Verdc. The main differences among these three species include the fusiform rootstock of *V. vexillata* and *V. davyi* as opposed to the moniliform tuberous swellings on the roots of *V. lobatifolia*; the essentially ferruginous hairs of varying lengths in *V. vexillata*, setaceous in *V. davyi*, as opposed to the more velvety, soft bristles which are pale ferruginous or white in *V. lobatifolia*; the more softly textured, chiefly unlobed leaflets of *V. vexillata* and *V. davyi* as opposed to the more leathery or sub-coreaceous, normally basally lobed lamina with the apex narrowly drawn out in *V. lobatifolia*; and the cylindrical legumes of *V. vexillata* and *V. davyi* as opposed to the compressed ones of *V. lobatifolia*.

Subgenus *Plectrotropis* occupies a position intermediate between the subgenera *Vigna* and *Ceratotropis* [fide Maréchal *et al.* p. 201 (1978)]. It is characterized by stipules that are shortly elongated but not truly appendaged, rather bilobed, with base cordate and edges completely free; keel with erect, inverted pocket on left side, beak incurved, distinctly twisted through 180°; style with thickened part curved and upper part equally twisted through 180°, stigma papillae lateral, withdrawn within covering flap of style elongation, a vestigial condition, like a 'bonnet'; pollen sculpture a wide reticulation of raised walls.

Vigna vexillata has a pantropical distribution. The lectotype designated by Verdcourt (1971) is an illustration by Dillenius of a plant from Havana, Cuba, as indicated by Linnaeus (1753). Due to its worldwide distribution, the species is characterized by enormous variation mainly with regard to leaflet shape and hairiness, resulting in the application of different names to the same species, the recognition of various infraspecific taxa and frequent changes to the taxonomic status of some of these.

Verdcourt (1970, 1971) not only unravelled the complicated conglomeration of *Phaseolus* L., *Dolichos* L., *Sphenostylis* E. Mey. and *Vigna* Savi, but also took the drastic step of reducing a large number of names in use into synonymy under *V. vexillata* [for a complete list refer to Verdcourt (1970)]. He recognized three varieties for tropical East Africa, namely vars. *vexillata*, *angustifolia* (Schumach. & Thonn.) Bak., and *dolichonema* (Harms) Verdc.

In a phenetic treatment of the genera *Phaseolus* and *Vigna*, Maréchal *et al.* (1978) added var. *macrosperma* Maréchal *et al.* for Australia, Costa Rica, Laos, Vietnam and Yunnan, var. *yunnanensis* Franchet for Yunnan and var.

pluriflora Franchet for China to this already cosmopolitan species.

In an unpublished herbarium survey by Mithen (1988) who worked in the Flora Zambesiaca region, a variety, *V. vexillata* var. *hirta* (Hook.) Bak., is proposed to accommodate the material in southern Africa which strictly cannot be classified in *V. vexillata* var. *vexillata* or var. *angustifolia*.

The genus as a whole has not been revised for southern Africa since Harvey (1862) and Burtt Davy (1932) for the Transvaal only. As regards *Vigna vexillata* in southern Africa, neither Gibbs Russell *et al.* (1987) nor De Wet *et al.* (1990) recognize any infraspecific taxa. Reference is, however, made in the latter two publications to Verdcourt (1970, 1971) in which various infraspecific taxa are proposed.

The aim of the present study is to evaluate the classification proposals of authors such as Verdcourt (1970, 1971) and Maréchal *et al.* (1978) to determine whether the proposals are applicable to material in southern Africa and where necessary, to make recommendations as to the treatment of the endemic taxa. An attempt is made to consider the southern African taxa of subgenus *Plectrotropis* in the light of the information available to us as well as personal experience in the field. However, the purpose of the study is specifically to provide southern African workers with a workable key to the various taxa in the region, as well as their correct names and synonymy. Detailed descriptions are provided for all the taxa native to southern Africa. The synonymy is selective since complete synonymy would be too lengthy and irrelevant to southern Africa.

Material and Methods

Herbarium material from BR, BM, BOL, J, K, NBG, NH, P, PRE, PRU, SAM, SRGH and WU was studied.

Extensive fieldwork was done, resulting in first-hand observations of live material. Seedlings and older plants were transplanted in the nursery of the National Botanical Institute (NBI), Pretoria, to enable more detailed observations. SEM studies were conducted of, amongst others, the apical part of the style and pollen. Distribution graphs and explanatory tables were constructed to aid in the delimitation of varieties. Localities were plotted according to the grid reference system of Leistner and Morris (1976).

Citation of specimens is purely representative, a complete list of the material investigated being available on request.

Taxonomy

Vigna vexillata (L.) A. Rich. In: De la Sagra, R., Historia fisica, politica y natural de la Isla du Cuba (Spanish ed.) 11: 191 (1845); A. Rich.: 440 (1846); Benth.: 194 t. 50/1 (excluding Nos. 5 – 9, 17 & 29) (1859); Bak.: 199 (1871); Harv.: 240 (1894); Bak. f.: 413 (1929); Burtt Davy: 420 (1932); Wilczek: 379 t. 29, text fig. 18/C (1954); Hepper: 566 (1958); Verdc.: 652 (1971); Maréchal *et al.*: 202 (1978). Type: Cuba, Havana, *Phaseolus flore odorato vexillo amplo patulo* of *Dillenius*, Hortus elthamensis 2: 313 t. 234 f. 302 (1732) (iconolecto.; designated by Verdcourt (1971) MO, NY, U, facsimile at PRE!).

Pantropical perennial. *Stem* herbaceous, climbing or trailing, from narrowly fusiform rootstock; whole plant dense to sparsely covered in retrorse, ferruginous or yellowish hairs, setaceous to aculeate. *Leaflets* mono-, bi- or trifoliolate, shape variable. *Stipules* lanceolate-cordate, lateral edges free at base. *Inflorescence* a contracted 2 – 4-flowered raceme, axillary; *extrafloral nectaries* arranged in a vertical row, normally three, the pedicels arising alternately from the base of a nectary (punctate gland); *flowers* magenta pink to purple, rarely white, on peduncles 50 – 350 mm long, axillary, with retrorse, ferruginous prickles densest at the apex; *calyx* lobes as long as or longer than tube; standard bilaterally asymmetric, oblate, repand, 20 – 30 mm × 20 – 40 mm, outer surface yellow to buff, standard enveloping rest of flower after pollination so collectors often describe flower as yellow; *keel* white or lilac, twisted to one side through 180°, inverted conical pocket on left side; *stigma* lateral, recessed papillae within 'bonnet-shaped' style elongation. *Legumes* erect, divergent, cylindric, 45 – 100 mm × 24 – 40 mm, black, densely ferruginous, hirsute, 10 – 18-seeded; *seeds* vary from light yellowish-brown to black or reddish, often speckled, approx. 2.5 – 4.5 mm × 2 – 2.5 mm, hilum eccentric, aril narrow to absent.

Four varieties are recognized in southern Africa.

Key to varieties in southern Africa

1a Leaflets always trifoliolate, shape varying, almost round to ovate, base essentially cuneate to more or less obtuse, or more or less lanceolate (much longer than broad), base essentially truncate to obtuse; stems ferruginous, villous to subglabrous; calyx lobes longer or shorter than tube 2

2a Terminal leaflets essentially ovate, base cuneate to obtuse; apex obtuse or acute; size variable; stems densely ferruginously villous to puberulent; calyx lobes usually longer than tube 3

3a Plant usually densely ferruginous; terminal leaflets broadly or narrowly ovate to elliptic or rhombic-ovate, base essentially cuneate to more or less obtuse, up to 120 × 55 mm, strigose; peduncles usually as thick as or thinner than straggling or twining stems; calyx lobes longer than tube; legumes up to approx. 100 mm long .... **var. *vexillata***

3b Plant often appearing less pubescent owing to more diminutive size, ferruginous; terminal leaflets rotund, elliptic, ovate to narrowly ovate or more or less lanceolate to linear, base usually obtuse, seldom longer than 25 mm when rotund, up to 40 mm when lanceolate, almost velvety to strigose to glabrescent; stems low-creeping, thin, delicate in contrast to tall thickened peduncles, up to 250 mm long and up to 3 mm thick; calyx lobes usually longer than tube, legumes approx. 55 mm long .... **var. *ovata***

2b Terminal leaflets essentially lanceolate to linear, base truncate to more or less obtuse, apex acuminate, up to approx. 100 – 150 × 8 – 18 mm; stems often glabrescent or aculeate; calyx lobes often shorter than tube .... **var. *angustifolia***

1b Leaflets sometimes all unifoliate, or one-, two- or three-foliolate on the same stem; shape more or less rhombic to broadly ovate with base cuneate; stems densely ferruginous, setaceous, hairs sometimes light-coloured; calyx lobes much longer than tube .... **var. *davyi***

(i) var. *vexillata*

Phaseolus vexillatus L.: 724 (1753). Type: as for the species.

Plectrotropis hirsuta Schumach. & Thonn.: 339 (1827). *Vigna thonningii* Hook. f.: 311 (1849). Type: Cape coast, *Vogel 52, 64* (K!, syn.) and Fernando Po, *Vogel 222* (K!, syn.).

V. scabra Sond.: 32 (1850). Type: Port Natal, *Gueinzius 206* (not traced).

See Verdcourt (1970) for a comprehensive list of synonyms and comments.

Diagnostic characters

Plants ferruginous; *stems* creeping or twining; *leaflets* trifoliolate, usually ovate–elliptic, base cuneate, apex usually acute (Figure 1a), lateral leaflets oblique; *peduncles* as thick as, or thinner than stems; *calyx* lobes usually longer than tube, approx. 9 mm, tube approx. 4 – 5 mm; *standard* 20 – 27 × 20 – 35 mm; *legumes* up to 100 mm long, approx. 18-seeded; seeds dark red-brown to black, 4 mm × 2 – 2.5 mm, aril narrow.

A white-flowered form slightly streaked with mauve, was collected 11 km from Pietermaritzburg on the Greytown road, alongside a dam (*Pienaar 1244* PRE).

Distributed chiefly throughout Natal, Swaziland and Transvaal (Figure 2).

Representative specimens

—**2230** (Messina): Entabeni, Soutpansberg (–CC), *Obermeyer 1207* (PRE).

—**2329** (Pietersburg): Losmekaar, Soutpansberg (–BD), *Rogers 18203* (BOL, J, PRE).

—**2330** (Tzaneen): 14 km from turn-off on road to Woodbush from Magoebaskloof (–CC), *Germishuizen 188* (K, PRE).

—**2331** (Phalaborwa): Letaba (–DC), *Scheepers 75* (K).

—**2428** (Nylstroom): Sterkrivier Dam Nature Reserve (–BC), *Jacobson 2051* (PRE).

—**2429** (Zebediela): Maribaskloof, Potgietersrust (–AA), *Van Dam s.n.* (PRE).

—**2430** (Pilgrim's Rest): Pilgrim's Rest town (–DD), *Germishuizen 152* (K, PRE).

—**2431** (Acornhoek): 1 km from turn-off to Graskop from Bosbokrand road (–CC), *Germishuizen 151* (PRE).

—**2526** (Zeerust): 16 km from Zeerust on road to Mafikeng, *Grobbelaar 1849* (PRE).

—**2527** (Rustenburg): Pelindaba, Uitkomst 499 JQ (–DD), *Coetzee 114* (PRE).

—**2528** (Pretoria): 13 miles from Pretoria on Delmas road (–CA), *Story 1466* (K, PRE).

—**2529** (Witbank): 28.5 miles north-east of Groblersdal (–AB), *Acocks 20892* (PRE).

—**2530** (Lydenburg): Draaikraal, Belfast dist. (–CA), *Strey 3025* (K, PRE).

—**2531** (Komatipoort): Stonwane (–AB), *Van der Schijff 1933* (PRE).

—**2627** (Potchefstroom): Transvaal Botanic Garden, Roodepoort (–BB), *Behr 274* (NBG).

—**2628** (Johannesburg): Suikerbosrand, neck at Sedaven Dam (–CA), *Bredenkamp 330* (PRE).

—**2629** (Bethal): Standerton (–CD), *Jenkins 9937* (PRE).

—**2630** (Carolina): 17 km from Lake Chrissie on road to Oshoek (–AB), *Germishuizen 5062a* (PRE).

—**2631** (Mbabane): Mbabane, Swaziland (–AC), *Compton 22407a* (NBG).

—**2727** (Kroonstad): Near convent, Kroonstad (–CA), *Pont 449* (PRE).

—**2730** (Vryheid): 5 miles from Utrecht on Wakkerstroom road (–CB), *Hilliard 2187* (WU).

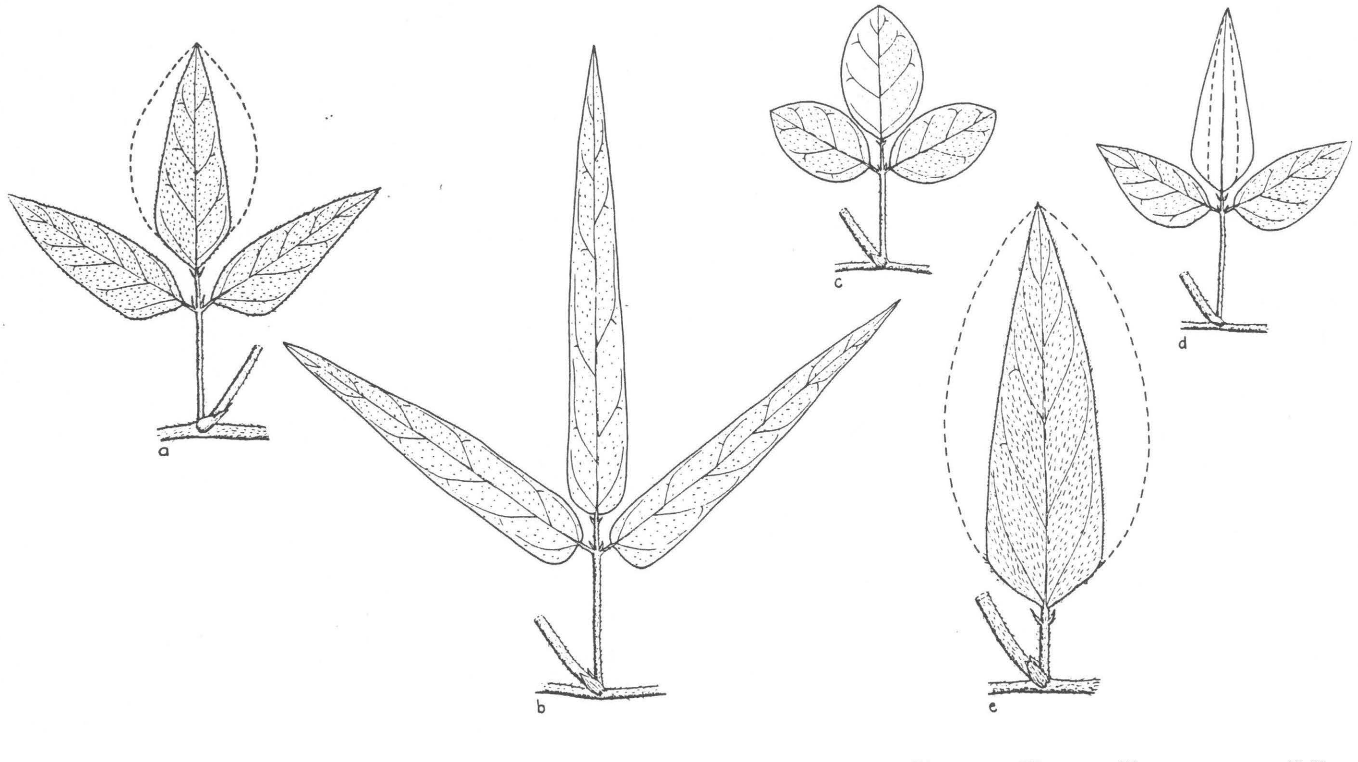


Figure 1 Leaves of the different varieties of *Vigna vexillata*. a: *Vigna vexillata* var. *vexillata*. b: *Vigna vexillata* var. *angustifolia*. c & d: *Vigna vexillata* var. *ovata*. e: *Vigna vexillata* var. *davyi*.

—**2731** (Louwsburg): Itala Nature Reserve, west of fence, 3 – 4 miles south of Itala River (–AC), *Brown & Shapiro 488* (PRE).
—**2732** (Ubombo): Tembe Elephant Park (–AB), *Ward 1932* (NH).
—**2824** (Kimberley): Warrenton, Kimberley dist. (–BB), *Wilman s.n.* (BOL).
—**2829** (Harrismith): Oliviershoek (–AC), *Strey 9504* (NH, PRE).
—**2830** (Dundee): 12 km from Muden on south-east slope (–CD), *Pienaar 420* (PRE).
—**2831** (Nkandla): 1 km from Umlalazi bridge on road to Mtunzini from Empangeni (–DD), *Pienaar 830* (PRE).
—**2832** (Mtubatuba): Stream valley, Hlabisa dist. (–AA), *Ward 2418* (PRE).
—**2929** (Underberg): 4.3 km from Boston on Bulwer road (–DB), *Pienaar 554* (PRE).
—**2930** (Pietermaritzburg): 11 km from Thornville Junction on road to Eston, *Stirton 5440* (K, PRE).
—**2931** (Stanger): Hawaan Forest, Umhlanga (–CA), *Pienaar 846* (PRE).
—**3024** (De Aar): Katberg (–CC), *Sole 411* (PRE).
—**3028** (Matatiele): Willeary Farm, west of Matatiele (–BC), *Granger 3758* (PRE).
—**3029** (Kokstad): Clydesdale (–BD), *Tyson 2535* (SAM).
—**3030** (Port Shepstone): St. James Anglican Church near Highflats (–AC), *Schrire 829* (PRE).
—**3128** (Umtata): 1 mile south-east of Tsolo on road to Umtata (–BC), *Story 424* (K, PRE).
—**3129** (Port St Johns): between Port St Johns and Lusikisiki (–DA), *Hutchinson 1772* (K).
—**3225** (Somerset East): Wilsdeli, Stockenstroom (–DD), *Scully 153* (PRE).
—**3226** (Fort Beaufort): Kaffraria, Enjotini, Shiloh Mission (–BB), *Bauer s.n.* (K).

(ii) var. *angustifolia* (Schumach. & Thonn.) Bak. In: Flora of tropical Africa, ed. Oliver, D., 2: 200 (1871); Wilczek: 382 (1954); Verdc.: 654 (1971); Maréchal *et al.*: 204 (1978). Type: Ghana, Quitta, *Thonning s.n.* (C, holo.).

Plectrotropis angustifolia Schumach. & Thonn.: 338 (1827).

Vigna angustifolia (Schumach. & Thonn.) Hook. f.: 311 (1849).

V. hirta Hook.: t. 637 (1844). Type: South Africa, *Burke* ex hort. (K!, holo.).

Diagnostic characters

Leaflets narrow, lanceolate, base essentially truncate to obtuse, apex acuminate (Figure 1b), strigose to glabrescent; *stems* often puberulous to aculeate, ferruginous; floral characters similar to var. *vexillata*; *calyx* lobes usually shorter than tube, 2 – 3 mm long, tube 3 – 4 mm.

Distribution throughout Natal, Swaziland and Transvaal, similar to that of *V. vexillata* var. *vexillata* (Figure 3).

Representative specimens

—**2327** (Ellisras): Matlabas River (–CC), *Krantz TM 6849* (PRE).
—**2328** (Baltimore): Magoebaskloof (–DA), *Grobbelaar 457* (PRE).
—**2329** (Zebediela): Mountain home, Haenertsburg (–DD), *Murray W1* (PRE).
—**2330** (Tzaneen): Top house, Westfalia Estate (–CA), *Scheepers 1194* (PRE).
—**2428** (Nylstroom): Naboomspruit (–DA), *Galpin M91* (PRE).
—**2430** (Pilgrim's Rest): Pilgrim's Rest (–DD), *Rogers 14505 (K).*
—**2431** (Acornhoek): Manyeleti Game Reserve (–CB), *Bredenkamp 1771* (PRE).
—**2526** (Zeerust): Springbok Flats (–AC), *Burtt Davy 873* (PRE).
—**2527** (Rustenburg): Houwater 54 JQ, farm near dam (–AC), *Germishuizen 637* (PRE).
—**2528** (Pretoria): Elands River bridge, approx. 16 km from Cullinan to Groblersdal (–BC), *Germishuizen 1370* (PRE).
—**2530** (Lydenburg): Nelspruit to Sabie, 20 km south of Sabie (–DD), *Onderstall 1037* (PRE).
—**2531** (Komatipoort): 6 km from White River on Hazyview road (–AC), *Germishuizen 190* (K, PRE).
—**2626** (Klerksdorp): Ventersdorp/Krugersdorp road, 1 km from turn-off to Klerkskraal Dam (–BD), *Bezuidenhout 117* (PRE).
—**2627** (Potchefstroom): Bailey Nature Reserve, Carltonville (–AD), *Van Wyk 165* (PRE).
—**2628** (Johannesburg): Frankenwald (–AA), *Lucas J33078* (J).

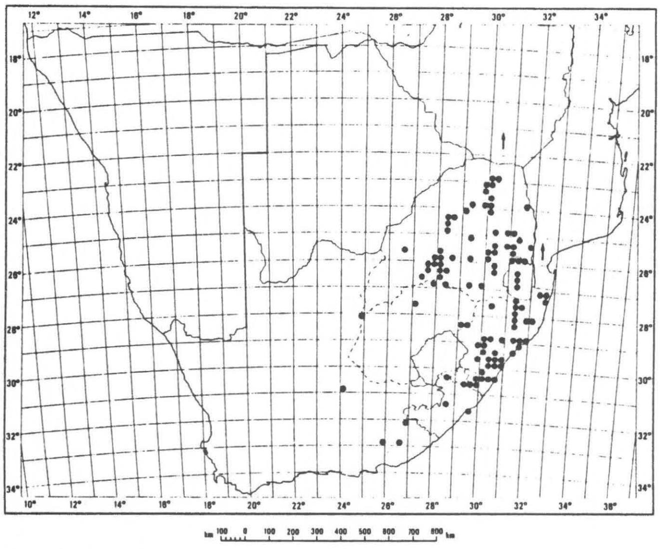


Figure 2 The known geographical distribution of *Vigna vexillata* var. *vexillata* in southern Africa.

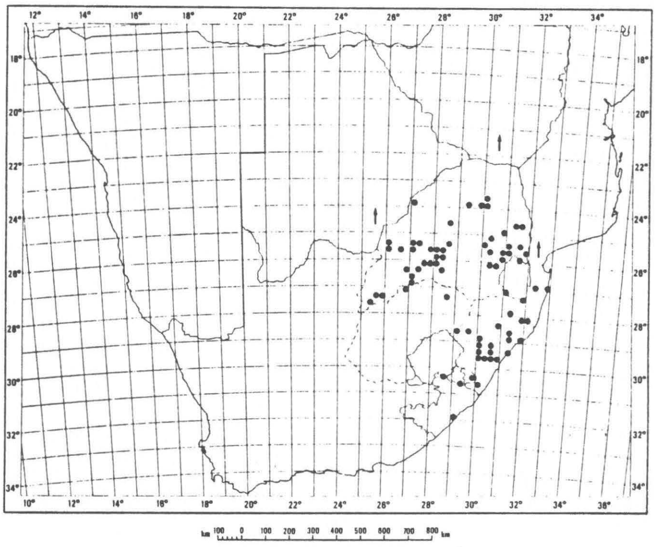


Figure 3 The known geographical distribution of *Vigna vexillata* var. *angustifolia* in southern Africa.

—**2630** (Carolina): 10 km from Badplaas to Lake Chrissie (–AB), *Germishuizen 5041* (PRE).

—**2632** (Bela Vista): Pongola floodplain, Ndumu (–CD), *Pooley 173* (PRE).

—**2725** (Bloemhof): Boskuil, Wolmaranstad (–BD), *Sutton 683* (PRE).

—**2726** (Odendaalsrus): Viljoenskroon (–BB), *Sellschop s.n.* (PRE).

—**2728** (Frankfort): Farm Rietfontein, 23 km south of Frankfort (–BC), *Retief 1046* (PRE).

—**2731** (Louwsburg): Golele, Pongolapoort Nature Reserve (–BD), Kluge 2727 (PRE).

—**2829** (Harrismith): Oliviershoek (–CA), *Strey 9504 (K).*

—**2830** (Dundee): Near New Beacon Hill Station, Weenen (–CC), *Acocks 10426* (NH, PRE).

—**2831** (Nkandla): 3 km from Perry Ford Garage, Mtunzini (–DD), *Pienaar 831* (PRE).

—**2832** (Mtubatuba): Hlabisa (–AA), *Ward 2417* (PRE).

—**2930** (Pietermaritzburg): 2 km beyond Boshoff's farm, Vorentoe, toward Muden on Middlerest road (–AA), *Kok & Pienaar* (PRE, PRU).

—**2931** (Stanger): Groutville (–AD), *Moll 2549* (PRE).

—**3028** (Matatiele): Sigoga distr., Willeary farm, 25 km west of Matatiele (–BC), *Granger 3758* (PRE).

—**3029** (Kokstad): Kokstad (–CB), *Tyson 1804* (BOL, SAM).

—**3030** (Port Shepstone): Gibraltar Rock (–CA), *Germishuizen 1652* (PRE).

(iii) var. *ovata* (E. Mey.) Pienaar, comb. nov.

Phaseolus capensis Thunb.: 130 (1800) non Burm. f.; Thunb.: 589 (1823). Type: South Africa, Thunberg specimens from Gamtoos and Swartkops Rivers, flowering Nov., Dec., Jan., specimens not seen.

Strophostyles capensis (Thunb.) E. Mey.: 147 (1836), non *Phaseolus capensis* Thunb. sensu stricto. Type:

(a) var. *ovatus* E. Mey., South Africa, Galgebosch, 800 ft., *Drège iv, C, c,* [Drège: 127 (1843)] (P!, lecto. designated here); between Gekau and Basche, 1500 – 2000 ft., *Drège v, b, 22* [Drège: 145 (1843)] (P!, lectopara.); mouth of Omsamcaba River, *Drège v, c, 1* [Drège: 153 (1843)] (P!, lectopara.).

(b) var. *lanceolata* E. Mey., South Africa, inter Omtendo and Omsamculo, *Drège v, c, 8'* [Drège 154 (1843)] (P!, holo, K! iso.).

(c) var. *longifolia* E. Mey., South Africa, Zwartkops River, 100 ft., *Drège iv, C, c, 19* [Drège: 129 (1843)] (P!, syn.); Ado, 1000 – 2000 ft., *Drège v, a, 2* [Drège: 131 (1843)] (P!, syn.); between Gekau and Basche, 1500 ft., *Drège v, b, 22* [Drège: 145 (1843)] (P!, syn).

Vigna capensis (Thunb.) Burtt Davy : 420 (1932) non *V. capensis* (L.) Walp., nom. illeg.

Diagnostic characters

Essentially a small-leaved variety, varying from green to reddish maroon-green, leaf shape varying from round to rotund or ovate to ovate-lanceolate to almost linear, apex rather obtuse, apiculate, base obtuse (Figures 1c & 1d); *stems* very thin and delicate, creeping close to the ground, in contrast to peduncles which are up to 250 mm long and up to 3 mm thick, becoming hard, swollen and glabrous in fruit; *flowers* as for var. *vexillata*, *standard* seldom smaller; *legumes* up to 55 mm × 4 mm, 10-seeded; *seeds* reddish brown to almost black, 2.2 × 3.3 mm, aril narrow.

Commonly occurring along the coast from the southern and eastern Cape to southern Natal (Figure 4).

Specimens with shorter, thinner peduncles and twining stems occur in Swaziland.

Representative specimens

—**2531** (Komatipoort): near Barberton (–CC), *H. Bolus 7737* (BOL).

—**2631** (Mbabane): Komati Pass, Mbabane (–AA), *Compton 31302* (NBG, PRE).

—**2732** (Ubombo): Velabusha area (–BA), *Ward 251* (NH).

—**2831** (Nkandla): 4 km to Eshowe coming from Ginginhlovo, *Pienaar & Kok 1257* (PRE, PRU).

—**2930** (Pietermaritzburg): Before Drummond on old main road coming from Durban on side of Key Ridge (–DC); *Buthelezi 288* (NH).

—**3028** (Matatiele): Avondale farm (–BC), *Granger 3941* (PRE).

—**3029** (Kokstad): Clydesdale (–BD), *Tyson 2536* (BOL, SAM).

—**3030** (Port Shepstone): 10 km from Highflats to Umzinto (–AD), *Schrire 840* (NH).

—**3126** (Queenstown): Bongolopoort, Queenstown (–DD), *Galpin 1974* (PRE).

—**3128** (Umtata): Baziya, Queenstown dist. (–CB), *Baur 89* (BOL).

—**3129** (Port St Johns): Mkambati Nature Reserve (–BD), *Jordaan 934* (NH, PRE).

—**3130** (Port Edward): Port Edward beach front (–AA), *Pienaar 805* (PRE).

—**3227** (Stutterheim): Gonubie Springs, East London dist. (–CD), *Peacock SAM 66090* (SAM).

—**3228** (Butterworth): Between Gekau and Basche [Mbashe) (–BB), *Drège 1830* (BM, P, PRE).

—**3229** (Talemofu): Hole-in-the-wall, Transkei (–AA), *Germishuizen 1218, 1219, 1864* (PRE).

—**3324** (Steytlerville): Zwartkops River (–DB), *Drège 5484, iv, C, c* (P), *Ecklon & Zeyher s.n. SAM 32908, Zeyher 528* (K, SAM).

—**3325** (Port Elizabeth): Uitenhage (–CD), *Alexander 120* (BM, K).

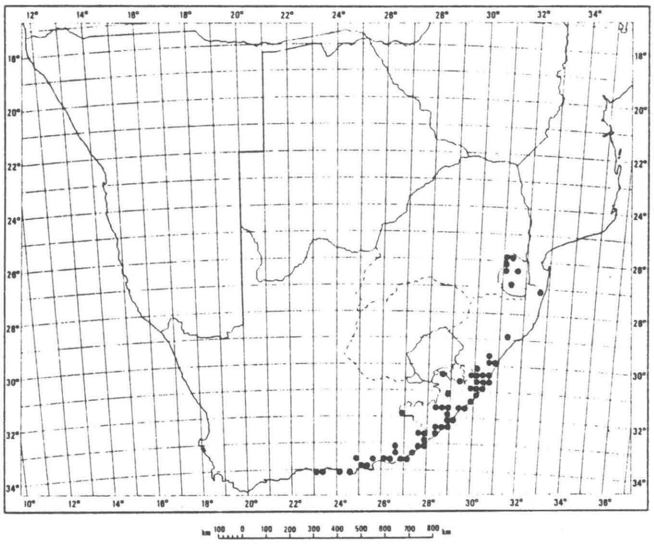


Figure 4 The known geographical distribution of *Vigna vexillata* var. *ovata* in southern Africa (endemic).

—3326 (Grahamstown): Botha's Hill (–BA), *Mac Owen 224* (BM, K, BOL).
—3327 (Peddie): Kidd's Beach, East London (–BA), *Taylor 5585* (NBG).
—3423 (Knysna): Plettenberg Bay (–AB), *Rogers 26670* (PRE).
—3424 (Humansdorp): Slang River, Humansdorp (–BA), *Fourcade 1847* (BOL).

(iv) var. *davyi* (H. Bol.) Pienaar, comb. et stat. nov.

Vigna davyi H. Bol. in Trans. S. Afr. Philos. Soc. 16: 382 (1907); Burtt Davy: 420 (1932); Verdc.: 553 (1970); Marèchal *et al.*: 205 (1978). Type: South Africa, 'High Veld' between Carolina and Dalriach, *Bolus 11836* (BOL!, holo.; K!, iso.).

Diagnostic characters

Plants heavily hirsute or setose, ferruginous or sometimes with hairs yellow. *Leaves* originally described as simple but this is not constant, stems often bearing leaves with one, two or three leaflets; when one or two leaflets occur, normal stipels remain, i.e. two per apical leaflet and one each per lateral leaflet. Leaflet shape variable between elongate-rhombic and broadly ovate, leaflet base usually broadly obtuse or cuneate (Figure 1e). *Stipules* shaped like those of *V. vexillata* var. *vexillata*, setose. *Flower* structure similar, though standard more repand, larger, 27 – 30 mm × 35 – 40 mm and usually brighter magenta pink; *stigma* lateral, recessed papillae covered by 'bonnet-shaped' flap extension of style; *calyx* lobes much longer than tube. *Legumes* up to 100 mm long × 4 – 5 mm, beaked, erect, setose, approx. 18-seeded; *seeds* black, 4 mm × 2.5 mm, aril almost absent.

Occurs in a relatively small area in northern Natal extending into south-eastern Transvaal, associated with granite outcrops, and into Swaziland in mountain grassland between 1010 and 1700 m above sea-level (Figure 5).

Representative specimens

—2529 (Witbank): near Witbank station (–CC), *Gilfillan 7179* (PRE).
—2530 (Lydenburg): Waterval-Boven (–CB), *Rogers 10926* (PRE).
—2531 (Komatipoort): Barberton, Saddleback Mountain (–CC), *Galpin 567* (BOL, PRE).
—2629 (Bethal): 4 miles west of Oshoek (–DA), *Codd 4765* (PRE).
—2630 (Carolina): 43 km from Lake Chrissie on Lothair road, 3 km from Jessievale Forest, 7 km from Amsterdam turn-off (–BA), *Pienaar 1359* (PRE).
—2631 (Mbabane): Forbes Reef, Mbabane (–AA), *Compton 22407* (NBG).
—2730 (Vryheid): Natal Spa Hotel (–DB), *Kok & Pienaar 1276, 1285, 1286* (PRE, PRU).

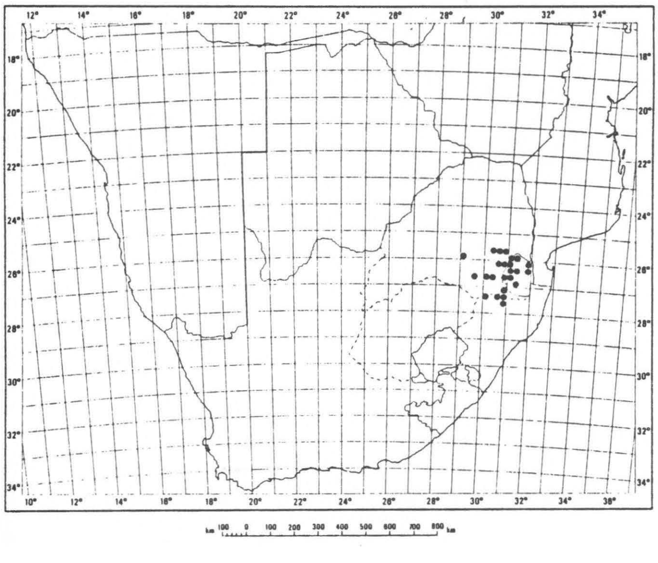


Figure 5 The known geographical distribution of *Vigna vexillata* var. *davyi* in southern Africa (endemic).

Discussion and Conclusions

Throughout the variation spectrum of *V. vexillata* the most constant specific character is the ferruginous hairs which vary from aculeate, predominantly in var. *angustifolia*, to tomentose-hirsute or hispid in var. *vexillata*, to a shorter velvety indumentum in var. *ovata*, to thick setaceous bristles in var. *davyi*. A small group of plants within the var. *davyi* group have yellowish hairs, but these remain setaceous. Some of these latter plants were named *V. hirta* Hook. in the past.

Leaf characters of *V. vexillata* vars. *vexillata* and *angustifolia* often merge into each other, probably owing to interbreeding. However, the base of the terminal leaflet is a reliable diagnostic character to distinguish between these two varieties. Wilczek (1954: plate 29) illustrates the leaflet base of var. *vexillata* as cuneate to rounded or obtuse and describes that of var. *angustifolia* as truncate; Burtt Davy (1932) describes *V. vexillata* as 'cuneate at base' and var. *angustifolia* (= *V. hirta* Hook.) as 'abruptly rounded to truncate ... at base'. This prompted us to place *Vigna hirta* Hook. (1844) and its so-called 'twin', *Zeyher 520* (K!) (Drège 1847; Harv. 1894) in the synonymy of *V. vexillata* var. *angustifolia*.

In a study of the leaflets of *V. vexillata* collected in southern Africa, 52 specimens of both vars. *vexillata* and *angustifolia* were sampled at random. The shape of the apex and base, the proportion of length to width of the apical leaflet lamina and hairiness of the petiole were studied. The results obtained are summarized in Table 1.

Variety *vexillata* is characterized by leaflets with an acute (seldom obtuse) apex, cuneate or obtuse base and a length : width ratio ranging from 1.06 – 3.9 : 1. Specimens of var. *angustifolia* have leaflets with acuminate (seldom obtuse) apices, truncate (seldom obtuse) bases and a length : width ratio ranging from 3.2 – 21.2 : 1. The hairiness of the

Table 1 Shape of the apex and base, the range of the length : width ratio and hairiness of petioles of apical leaflets in 52 specimens of *V. vexillata* var. *vexillata* and 52 of var. *angustifolia* in southern Africa

	Apex[a]			Base[a]			Ratio range	Petiole hairiness[a]	
	A	Ac	Ob	Cu	Ob	Tr	(length:width)	Lp	Sr
var. *vexillata*	42	—	10	21	31	—	1.06 – 3.9 : 1	29	23
var. *angustifolia*	—	37	15	—	2	50	3.2 – 21.2 : 1	31	21

[a] Abbreviations: A – acute; Ac – acuminate; Ob – obtuse; Cu – cuneate; Tr – truncate; Lp – long, patent; Sr – short, retrorse.

petioles does not prove to be a very dependable diagnostic character.

Mithen (1988) suggested the reinstatement of *V. hirta* Hook. to accommodate the intermediate specimens between the two varieties found in southern Africa. We do not regard this as necessary.

Vanderborght (1989), in germination studies on *V. vexillata* vars. *vexillata*, *angustifolia* and *macrosperma*, observed that most seedlings are characterized by oval-lanceolate primary leaves, only two out of nine specimens of var. *angustifolia* presenting narrow primary leaves and the remaining ones presenting primary leaves similar to their var. *vexillata* counterparts. He also observed that in a limited number of adult plants there was no positive correlation between the shape of the primary leaves and that of the trifoliolate ones. Moreover, a difference could also be observed between the shape of trifoliolate leaves taken at the top and from the base of the same plant. A possible example of this phenomenon in southern Africa occurs in *Acocks 10246* from Weenen, Natal, on which both broad and narrow leaflets appear, resulting in different names having been given to the duplicates, e.g. the NH specimen with its var. *vexillata* leaflet shape and cuneate base and the ones at PRE and NH which have the broad truncate leaflet base and shape of var. *angustifolia*. The question arises whether it was a mixed collection or an illustration of Vanderborght's observation. All these observations indicate that leaflet shape as a diagnostic character should be considered with great caution, as it is influenced both by a small number of genes and by the environment (Vanderborght 1989). It seems that plants with the narrow leaflet shape identified as var. *angustifolia* in their natural habitat did not always persist on plants grown in the uniform glasshouse conditions, as also observed in the NBI nursery. Furthermore, material of var. *angustifolia* seems to have been found under very different habitat conditions and the conception of an *angustifolia* variety based only on leaflet shape may be artificial in the sense that it does not correspond to a particular ecotype.

Other interesting facts emerging from Vanderborght's (1989) germination studies deserve discussion. Seed was obtained from the International Board of Plant Genetic Resources located at the National Botanic Garden of Belgium since 1988. He found that in vars. *vexillata* and *angustifolia* germination could be either epigeal or hypogeal, whereas var. *macrosperma* displayed only hypogeal cotyledons. In spite of uniform sowing depth, a relatively high variability was observed for the epigeal cotyledons with reference to soil level. However, all seed of vars. *vexillata* and *angustifolia* from America presented epigeal germination, those from Africa (barring Nigeria) and Australia hypogeal germination, and of the three from Asia, two presented hypogeal and one epigeal germination. This tallies with Gates's findings (Vanderborght 1989) regarding germination of the Fabaceae, that the Mimosoideae and Caesalpinioideae are apparently all epigeal, whereas the Papilionoideae, to which *Vigna* belongs, presents either form. The epigeal condition may represent a recent evolutionary trend among the New World taxa compared with the more primitive hypogeal state in the Old World, Africa, Australia and Asia.

Guided by the shape of the leaflets, Verdcourt (1970, 1971) and Maréchal *et al.* (1978) regarded the varieties described by Meyer (1836) under *Strophostyles* Elliot (namely *ovatus*, *lanceolata*, *longifolia*) as conspecific with either var. *vexillata* or var. *angustifolia*. However, Verdcourt (pers. comm.) also considers the possibility of a separate taxon to accommodate these specimens.

A study of the type specimens, followed by an investigation of the southern African material, has revealed a group of plants diminutive in size, with delicate stems creeping close to the ground, bearing pedicels and flowers comparable with those of the other *V. vexillata* varieties (tall pedicels up to 3 mm thick rising from the prostrate stems). It was therefore decided to reinstate var. *ovata* (E. Mey.) Pienaar to accommodate these plants.

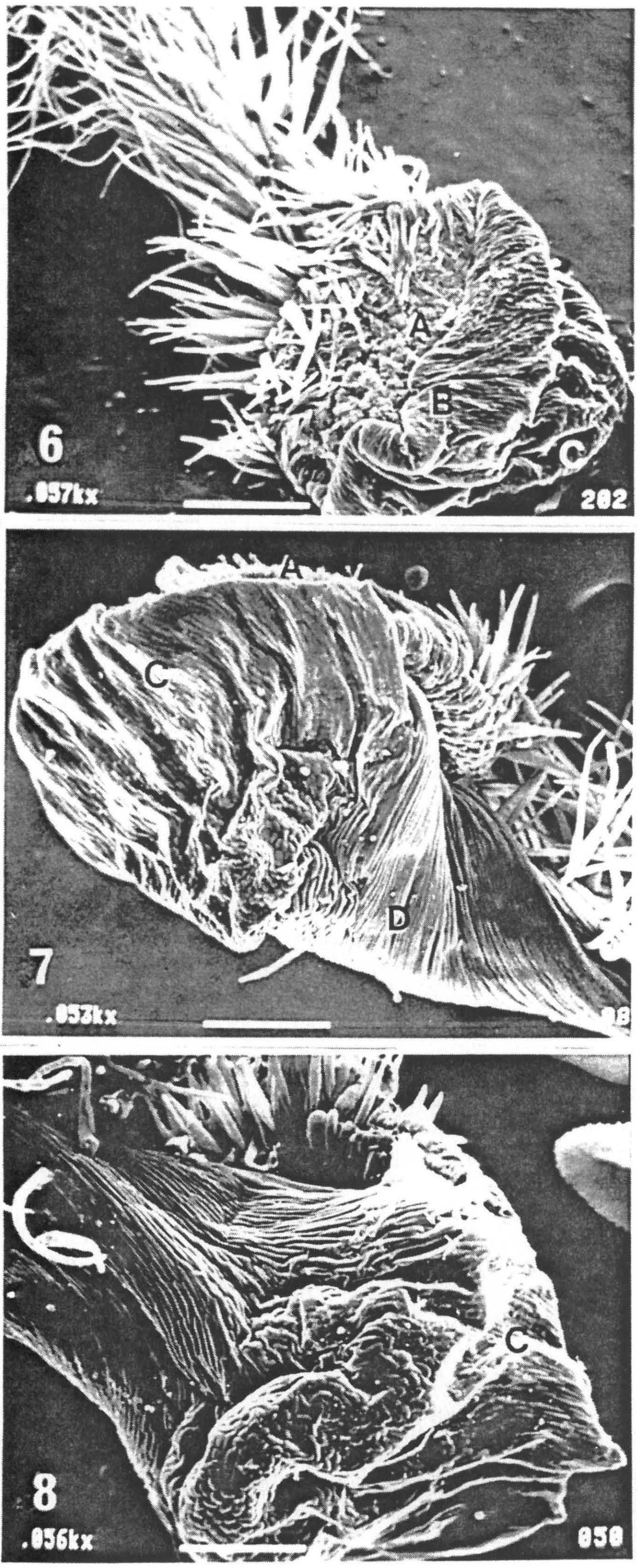
Meyer (1836) suggested that the plants with ovate to elliptic leaflets should be placed in his var. *ovatus* E. Mey. and those with the longer leaflets in var. *lanceolata* E. Mey. and/or *longifolia* E. Mey. However, as stated by Thunberg (1823), these plants often have elliptic juvenile leaflets followed by more lanceolate ones. Meyer (1836) noted that vars. *ovatus* and *longifolia* appear to be dissimilar but that they are 'coherent' through var. *lanceolata*. Since all these shapes are a variation of ovate, we regard the epithet *ovata* as suitable for the variety as a whole. Meyer's epithet *capensis* cannot be used as it was declared *nom. illeg.* by Verdcourt (1970a).

Plants of var. *ovata* with almost rotund, reddish green leaflets are found in profusion on the lower Natal coast. In Swaziland and occasionally in the Transvaal, plants have shorter, thinner peduncles than their Cape and Natal counterparts.

Over the greater part of its range, var. *ovata* does not appear to intergrade with other varieties of *V. vexillata*. Exceptions include specimens collected by *Tyson* (*1804* & *2536* BOL, SAM) at Kokstad and Clydesdale. These have thick stems and leaflets of which the shapes vary from typical var. *ovata* to var. *angustifolia*, i.e. oval and linear obtuse leaflets to very long and acuminate ones. However, these may be mixed collections as so many old ones are, or hybrids. *Ranger 259* from Kei Road and *Galpin 1975* from Queenstown bear legumes much longer than in the typical var. *ovata*. Specimens from Oribi Gorge also show apparent intermediates between vars. *angustifolia* and *ovata*.

Verdcourt (1970) and Maréchal *et al.* (1978) upheld *V. davyi* as a separate species but admitted a relationship with *V. vexillata*, the only difference between the two species being the unifoliate leaves of the former. This feature is characteristic of the holotype *Bolus 11836* (BOL). The flowers of *V. davyi* display the typical recessed lateral stigma papillae covered by the 'bonnet'-like rugose flap of elongated style tissue (Figure 6).

Extensive field work revealed that simple leaves are not constant in some colonies (e.g. Paulpietersburg, Natal), on the same plant nor even on the same branch. Less than a third of all specimens investigated have simple leaves only. The remainder bear a combination of simple, bi- or trifoliolate leaves, and in no set order. Table 2 illustrates this variation as observed in the field near Paulpietersburg where large stands of *V. davyi* grow in grassland among granite outcrops. A similar phenomenon was observed in colonies near Jessievale Forest, eastern Transvaal, and in potted



Figures 6 – 8. Stigma of *Vigna vexillata*. 6: *Vigna vexillata* var. *angustifolia* – ventral view. *Germishuizen 110* (PRE). 7: *Vigna vexillata* var. *vexillata* – dorsal view. *Germishuizen 3902* (PRE). 8: *Vigna vexillata* var. *davyi* – lateral view. *Pienaar 765* (PRE). [A: stigmatic papillae; B: 'bonnet' edge; C: style elongation; D: style twist at maturity (apical)]. Scale bar 170 μm.

specimens of *V. davyi* in the NBI nursery at Pretoria, grown from seedlings transplanted from the field.

Table 2 Leaflet number of consecutive leaves on different stems of two plants of *V. vexillata* var. *davyi*. Position of the leaves along the stem is recorded progressively, with the basal ones on the left and the apical ones on the right of the table

	Number of leaflets per leaf[a]																	
Stem[b]	Plant X								Plant Y									
A	3	2	3	2	3	3	3	3	1	1	1	1	3	1	1	2	2	1
B	3	3	1	3	3				1	1	1							
C	3	3	3	3	3	2			3	1	1	1	2					
D	1	2	3	1	3	3			1	1	3	1	3					
E	2	1	3	2	2	1			1	1	1	1	3	1	1	1	3	2
F	2	3	3	2					1	1	1	2	3	2	1	1	1	2
G	—								2	3	3	3	3	1	1	1	1	1
H	—								1	1	1	3	1	3	1			
I	—								1	1	1	3	3	1				

[a] 1: unifoliate; 2: bifoliolate; 3: trifoliolate.

[b] A – I: different stems on the same plant.

Specimens of *V. davyi* from the lowveld regions of the eastern Transvaal, e.g. *Galpin 567* (PRE) from the Saddleback Mountain, Barberton, and *Compton 27430* (PRE) from Swaziland and others from the same areas appear to have an erect habit, with narrowly ovate leaflets. They too bear a variation of simple, bi- or trifoliolate leaves. A note by E.P. Phillips, 18:7:33, on *Galpin 567* reads: 'although Burtt Davy (1932) states that *V. davyi* Bol. has only one leaflet, this sheet has been compared with the type and named by Burtt Davy as *V. davyi*'. These apparently erect specimens often have the anomalous thick, yellowish setaceous hairs (see var. *davyi*). The variation in leaflet number, the almost hoary ferruginous indumentum, the shape of the stipules, the floral structure and the style–stigma pattern support our decision to consider this species as conspecific with *V. vexillata*.

Electrophoretic profiles of seed proteins of all southern African species of *Vigna*, done in collaboration with Perrino and Laghetti at the Germplasm Institute, Bari, Italy (unpublished results), support our decision to include *V. davyi* as a variety of *V. vexillata*. Autoradiograms were constructed by these two scientists from the cleavage of structural proteins contained in seeds according to the process described by Laemmli (1970). Our full results will be published elsewhere.

The deflexed carina apex in *V. vexillata* can be linked to its extraordinary pollination strategy known as the 'hugging' mechanism. The following brief description of this mechanism is based on Hedström and Thulin's (1986) detailed studies on *V. vexillata* in Costa Rica. Large *Xylocopa gualanensis* bees alight having secured a foothold at the base of the wings, and set about foraging for nectar from the collar-shaped nectary at the base of the ovary. The wing and keel petals are depressed, causing pressure on the twisted part of the style. The barbate upper style and the upper free parts of the stamens slip out of the rigid keel beak, 'hugging' the bee over the dorsal part of its head and thorax. When the style slides over the body of the bee, pollen from the previously visited flower, if present, is received by the stigma. At the same time pollen is pumped or brushed out of the rigid keel beak. Such visits by bees last for as long as seven to eight seconds. Hedström and Thulin observed that flowers already visited were avoided by newly arriving bees, the reason probably being that these flowers have been 'marked' by an odour left behind by previous visitors. It is at this stage that the standard, coloured a yellowish buff externally, droops and covers the inner floral parts. We have observed similar behaviour by *Xylocopa* bees in southern Africa.

The usefulness of *V. vexillata* as a forage cover crop chiefly due to its aggressive growth, is reported from various African countries including Tanzania where the root is also fed to goats to increase the milk yield (Mithen 1988). The tubers are edible (Vanderborght 1989), being of high nutritive value and containing 15% protein, a value much higher than in root crops such as cassava (3%), potato (5%), sweet potato (5%) and yam (6%). Yet few attempts have been made to cultivate it as a root crop. It was reported (letter from Tatham, PRE) from Greytown, Natal, that *V. vexillata* invaded a *Paspalum* pasture, grew into a thick tangled mass covering as much as an acre, and is relished by horses and cattle, increasing the milk flow in the latter. The young pods and leaves, as well as the roasted turbinate rootstocks, are eaten by various African tribes. At the flowering stage, the herbage of *V. vexillata* var. *vexillata* has a crude protein content of 20.3% (Vanderborght 1989). In addition to its considerable potential, *V. vexillata* has also attracted attention because of the high content in its seeds of dipeptide para-aminophenylalaline, a compound reported to be a factor of resistance against bruchids (Vanderborght 1989).

From herbarium specimens, the extraordinary wide habitat tolerance range of *V. vexillata* is evident, although, like the other species of *Vigna*, it appears to prefer southerly slopes. The species is not only found in grassland habitats, but also commonly in disturbed areas such as ditches along roads, dams, along regularly trodden cattle paths and as a weed of cultivation. It establishes itself readily where the dense grass cover in the grasslands has been removed.

Ants were frequently seen to visit plants of *V. vexillata* and other species of the genus. They are regularly found travelling up and down the peduncle to forage around the extrafloral nectaries which show a typical arrangement in the various *Vigna* species. These nectaries were first mentioned by Dalzell (1850) under *Phaseolus sepiarius*, 'twin pedicels spring from the base of glands'. In *V. vexillata* they are arranged in a vertical row, normally three, the pedicels arising alternately from the base of a nectary. According to Maréchal *et al.* (1978), the inflorescence is actually a panicle of the type 'cluster of clusters' in which secondary axes are contracted and abort after the formation of two or more floral nodes. The lateral axis forms a large projection which, following the formation of two flowers, continues growth to produce more contracted internodes. At each node a floral bud cushion aborts rapidly and forms a scar which develops into a gland (a so-called extrafloral nectary or pedicellary gland). Each gland has a central pore (punctate gland) through which a sticky fluid is exuded. This apparently sugar-rich secretion is consumed by the ants.

The two varieties which we added to the species have certain distinctive facies which probably reflect edaphic or climatic adaptations. The low-creeping delicate stems, small leaflets and sturdy tall pedicels of var. *ovata* appear to be adaptations to the windy coastal conditions of the eastern Cape, southern Natal and the hills of Swaziland. Verdcourt (1971) mentions an 'ovate-round to ovate-leaved, short-petioled variety in Ruanda, Uganda and west Kenya' with a lemon-coloured flower, and it would be informative to study the relationship between this variety and var. *ovata* in more detail. *V. angivensis* Bojer from central Madagascar may have some affinity to var. *ovata* when considering its 'fine spreading brown hairs' and leaf and legume size from the original description (1882). However, if the description is correct and only one flower is produced, it may not even be a *Vigna*.

Regarding var. *davyi*, it would appear that the adaptation of this taxon to the acidity of the igneous, granitic outcrops of its habitat may have assisted in its differentiation from other varieties of the species. Verdcourt (1970) partly alluded to this when commenting that *V. davyi* is 'clearly recently derived' from *V. vexillata*. Recently, var. *davyi* was found intermixed with a rather isolated population of var. *vexillata* and *V. nervosa* Markötter, all confined to an area enclosed by granitic outcrops in the eastern Transvaal. No *Vigna* plants were found in the immediate grassland vicinity surrounding the area. Under these conditions one would expect the exchange of genes among the three taxa. This does not appear to be the case since no intergration was obvious. Some form of reproductive barrier appears to exist between vars. *vexillata* and *davyi*, and *V. nervosa*. Large *Xylocopa* bees are responsible for pollination in the varieties of *V. vexillata*, all of which do not have markedly different-sized flowers. *V. nervosa* has a very small flower probably pollinated by smaller flying insects and this may prevent interbreeding with the larger-flowered species.

The task of the taxonomist working within the restricted framework of a regional revision is a difficult one. A major problem is whether to evaluate the status of taxons for the genus as a whole, or for a restricted geographical region only. One is faced with the practicality of whether the decisions may be applied universally or whether the classification is of local significance only (perhaps even artificial). Taxonomic decisions in the present study are based on several field trips throughout the distributional range of *Vigna* in the RSA and Namibia, numerous herbarium collections from several major herbaria, as well as plants in cultivation. A wide range of taxonomic literature dealing with species of *Vigna* from all over the world has also been considered. We are therefore convinced that our taxa are natural entities based on a number of character correlations. There is the possibility that some of the taxa proposed for our area might be identical with ones in other parts of the range of *V. vexillata*. This, however, is unlikely since we have tried throughout to compare our material with existing taxonomic treatments of the group in other parts of the world. We have also studied herbarium specimens from various other parts of Africa.

References

BAKER, E.G. 1929. *Vigna* Savi. The Leguminosae of tropical Africa, pp. 412 – 413. Erasmus Press, Ghent.

BAKER, J.G. 1871. *Vigna* Savi. In: Flora of tropical Africa, ed. Oliver, D., Vol. 2, pp. 194 – 207. Reeve & Co., London.

BENTHAM, G. 1859. Leguminosae. *Phaseolus – Vigna*. In: Flora Braziliensis, ed. De Martius, C.F.P., Vol. 15, Pt. 1, pp. 194, t. 50/1. Karl W. Hierseman, Leipzig.

BOLUS, H. 1907. *Vigna davyi*, n. sp. (Leguminosae – Phaseoleae – Euphaseoleae). *Trans. S. Afr. Philos. Soc.* 16: 382.

BURTT DAVY, J. 1932. Papilionaceae (Pea and Bean Family). *Vigna* Savi. Manual of flowering plants and ferns of Transvaal with Swaziland, South Africa, Vol. 2, pp. 419 – 421. Longmans, Green & Co., London.

DE WET, B.C., GERMISHUIZEN, G., SCHRIRE, B.D., JORDAAN, M., PIENAAR, B.J., WELMAN, W.G., REID, C., VAN WYK, C.M., FISH, L., IMMELMAN, K.L., VAN ROOY, J., PEROLD, S.M., TAUSSIG, J., BARKER, N.P. & GLEN, H.F. 1990. New taxa, new records and name changes for southern African plants. *Bothalia* 20: 249 – 266.

DALZELL, N.A. 1850. Contributions to the botany of Western India; Leguminosae, *Phaseolus*. *Hooker's J. Bot. Kew Gdn Misc.* 2: 33.

DILLENIUS, J.J. 1732. Hortus elthamensis, t. 234/302. Cornelius Haak, London.

DRÈGE, J.F. 1843. Zwei pflanzengeographische Dokumente, pp. 44 – 160. Unknown, Leipzig.

DRÈGE, J.F. 1847. Vergleichungen der von Ecklon & Zeyher und von Drège gesammelten südafrikanischen Pflanzen. *Linnaea* 19: 646.

GIBBS RUSSELL G.E., WELMAN, W.G., RETIEF, E., IMMELMAN, K.L., GERMISHUIZEN, G., PIENAAR, B.J., VAN WYK, C.M. & NICHOLAS, A. 1987. List of species of South African plants, edn. 2, Pt. 2. *Mem. Bot. Surv. S. Afr.* 56: 95.

GREUTER, W., BURDET, H.M., CHALONER, W.G., DEMOULIN, V., GROLLE, R., HAWKSWORTH, D.L., NICHOLSON, D.H., SILVA, P.C., STAFLEU, F.A., VOSS, E.G. & MC NEILL, J. 1988. International Code of Botanical Nomenclature. Koeltz Scientific Books, Königstein.

HARVEY, W.H. 1862. Leguminosae. *Vigna* Savi. In: Flora Capensis, eds. Harvey, W.H. & Sonder, W.O., Vol. 2, pp. 239 – 242. Hodges, Smith & Co., Dublin.

HEDSTRÖM, I. & THULIN, M. 1986. Pollination by a hugging mechanism in *Vigna vexillata* (Leguminosae – Papillionoidae). *Pl. Syst. Evol.* 154: 275 – 283.

HEPPER, F.N. 1958. Papilionaceae. *Vigna* Savi. In: Flora of West Tropical Africa, eds. Hutchinson, J., Dalziel, J.M. & Keay, P.W.J., Vol. 2, Pt. 1, pp. 565 – 569. Crown Agents for Overseas Governments & Administrations, London.

HOOKER, W.J. 1844. Icones Plantarum, Vol. 3, t. 637. Hippolyte Bailliere, London.

HOOKER, D.J. 1849. In: Flora nigritiana, eds. Bentham, G. & Hooker, W.J., pp. 311. Hippolyte Baillliere, London.

JAASKA, V. & JAASKA, V. 1988. Isoenzyme variation in the genera *Phaseolus* and *Vigna* (Fabaceae) in relation to their systematics: asparte aminotransferase and superoxide dismutase. *Pl. Syst. Evol.* 159: 145 – 159.

LAEMMLI, U.K. 1970. Cleavage of structural proteins during the assembly of the head of bacteriophage T4. *Nature* No. 5253, Vol. 227: 680 – 685.

LEISTNER, O.A. & MORRIS, J.W. 1976. Southern African place names. *Ann. Cape Prov. Mus.*, Vol. 12.

LINNAEUS, C. 1753. *Phaseolus*. Species plantarum, Tomus 1, p. 724. H.A.M.S., Uppsala.

MARÉCHAL, R., MASCHERPA, J.-M. & STAINIER, F. 1978. Etude taxonomique d'une groupe d'espèces des genres *Phaseolus* et *Vigna* (Papilionaceae) sur la base de données morfologiques et polliniques traitées par l'analyse informatique. *Boissiera* 28: 10 – 231.

MEYER, E. 1836. Papilionaceae. *Strophostyles* Ell. Commentariorum de plantis Africas australioris, pp. 144 – 148. Perthes & Besser, Hamburg.

MITHEN, R. 1988 (unpublished). Herbarium survey, pp. 102 – 105. International Board for Plant Genetic Resources, Department for Biological Sciences, University of Zimbabwe, Mount Pleasant, Harare, Zimbabwe.

RICHARD, A. 1845. Title unknown. In: Historia fisica, politica y natural de la Isla du Cuba, ed. De la Sagra, R. Vol. 11: 191. Bertrand, Paris.

RICHARD, A. 1846. Essai d'une l'Ile de Cuba, pp. 440. Bertrand, Paris.

SCHUMACHER, C.F. & THONNING, P. 1827. Beskrivelse af Guineeske planter som er funde af danske botanikere, pp. 339. Videnskabers Selskabs Skrifter, Copenhagen.

SONDER, W.O. 1850. *Vigna scabra*. *Linnaea* 23: 32.

THUNBERG, C.P. 1800. *Phaseolus*. Prodromus plantarum Capensium. Pars posterior, pp. 130. Joh. Fr. Edman, Reg. Academie, Uppsala.

THUNBERG, C.P. 1823. *Phaseolus*. In: Flora Capensis sistens plantas Promontorii Bonae Spei Africes, ed. Schultes, I.A. Treutel & Wurtz, London & Paris.

VANDERBORGHT, T. 1989. Some observations on seedlings of *Vigna vexillata* (L.) A. Rich. (Fabaceae). *Bull. Jard. Bot. Nat. Belg.* 59: 179 – 187.

VERDCOURT, B. 1970a. *Dolichos* L. subgen. *Chloryllis* (E. Mey.) Verdc. for typification of *Dolichos capensis* L. In: *Kew Bull.* 24(3): 440 – 442.

VERDCOURT, B. 1970b. Studies in the Leguminosae – Papilionoidae for the 'Flora of Tropical East Africa': 4. In: *Kew Bull.* 24(3): 552 – 555.

VERDCOURT, B. 1971. Leguminosae. In: Flora of Tropical East Africa, eds. Milne-Redhead, E. & Polhill, R.M., Vol. 4, pp. 652 – 655. Crown Agency for Overseas Governments, London.

WILCZEK, R. 1954. *Vigna* Savi. In: Flore du Congo Belge et du Ruanda-Urundi, ed. unspecified, Vol. 6, pp. 343 – 349; 379 – 382. L'Institut national pour l'étude agronomique du Congo belge, Brussels.