DINTERIA NR. 10 — WINDHOEK, S.W.A. — JUNI 1974

Report on the plants noted in the course of a trip from Luderitz Bay to Spencer Bay, January 10—21, 1974

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During January, 1974, members of the staffs of the Desert Ecological Research Unit, Transvaal Museum, Windhoek Herbarium and Water Research Institute of the C.S.I.R. undertook a trip along the coast from Luderitz Bay to Spencer Bay. A collection of plants was made and general ecological data collected.

I. GENERAL OBSERVATIONS

(1) At the "Schadewald" and Agate Beach, near Luderitz Bay, *Salsola cf. nollothensis* forms dense dwarf shrub clumps on one/two metre hummocks. On sandy flats and between the hummocks *Stipagrostis subacaulis, S. hermannii* plants and *Mesembryanthemum hypertrophicum* occurred in large numbers.

(2) On the rocky ridges north of the "Schadewald" *Othonna furcata, Pelargonium* spp. and three species of *Salsola (Salsola aphylla, S. zeyheri* and *Salsola* sp.) were noted. At the time the collection was made the pelargoniums were in flower and *Othonna furcata* was in full foliage.

(3) *Stipagrostis sabulicola* formed tufts or low hummocks in the dune habitat, generally a few kilometres inland.

(4) At Anichab Pan — 40 kilometres from Luderitz Bay — the following species were noted or collected:

Acanthosicyos horrida	— only male plants being seen;
Capparis hereroensis	— with flowers and fruits;
Eragrostis cyperoides	— with seeds;
Salsola nollothensis	— moderately browsed;
Salsola spp.;	
Scirpus dioicus.	

(5) An extensive collection was made at Hottentot Bay, yielding seven species! On rock outcrops *Lycium decumbens* and a number of lichens were found, while the sandy talus slopes and shallow valleys were inhabited by species such as *Didelta carnosa* var. *tomentosa; Salsola nollothensis* — growing in exposed places, even to the first terrace above the beach; *Salsola* sp. which formed small, compact clumps where exposure to wind-blown sand was not as great; *Psilocaulon marlothii*; *Hypertelis angrae-pequenae* and *Drosanthemum luederitzii.*

(6) From Hottentot Bay to Saddle Hill collections were made only along the beach, thus only *Lycium decumbens, Salsola nollothensis, Stipagrostis sabulicola* and blue-green algae ("window algae"), under translucent rocks, were recorded.

(7) The commonest species at Saddle Hill were *Psilocaulon marlothii* and *Salsola* sp., but *Salsola nollothensis, Lycium decumbens, Othonna furcata* and *Hypertelis angrae-pequenae* were numerous in some localities.

(8) The Saddle Hill North area, which provides a number of different habitats (ridges, enclosed valleys, talus slopes and protected and exposed flat areas) was relatively rich floristically. *Salsola nollothensis* formed large hummocks and two pools of brackish water supported populations of *Ruppia maritima* (a submerged aquatic plant) and *Arthrocnemum dunense. Hypertelis angrae-pequenae* took advantage of the extra moisture which dripped from the roofs of buildings. In addition to these species, the following occured:

Asparagus capensis var. littoralis	— on the north-west side of the mountain; flowers and new growth;
Cotyledon schaeferana	— in sand-filled crevices;
Crotalaria schultzei	— in sandy patches; flowering;
Drosanthemum luederitzii	— on rocky talus slopes;
Eragrostis cyperoides	— some plants had been heavily grazed;
Eremothamnus marlothianus;	
Juttadinteria cf. deserticola;	
Mesembryanthemum hypertrophicum	— seedlings in washes;
Limonium membranaceum	— in sandy areas; seedlings present;
Lycium decumbens;	
Othonna furcata	— flowering;
Osteosperum crassifolium	— common on quartzite ridges;
Pelargonium cortusifolium;	
Tetragonia decumbens;	
Trianthema hereroensis	— from the dune area east of the camp; the most southerly locality for this species.

(9) Spencer Bay and Dolphin Head.
The latter is the type-locality of *Jensenobotrya lossowiana* and this succulent was very common in suitable localities. Most specimens were found on the lower, south-east slopes of the quartzite mountain. In addition to this species, the following were noted:

Cotyledon schaeferana	— common between rocks; flowering;
Drosanthemum luederitzii;	
Eragrostis cyperoides	— in sandy valleys;
Eremothamnus marlothianus;	
Hypertelis angrae-pequenae;	
Lebeckia multiflora var. parviflora	— sand washes to the south;
Lycium decumbens;	
Pelargonium cortusifolium;	
Psilocaulon marlothii;	
Salsola nollothensis;	
Salsola sp.;	
Tetragonia decumbens	— growing on the mountain above the *Otavi* wreck;
T. reduplicata;	
Zygophyllum cordifolium;	

three species of crustose lichens, two fruticose lichens and one foliose lichen.

(10) The most northerly point reached was Spencer Bay North Head (about 140 km from Luderitz Bay). The area had recently received rain (indicated by the presence of *Monsonia ignorata* and *Stipagrostis hermannii)* and many species, including *Jensenobotrya lossowiana, Lebeckia multiflora* and *Othonna furcata* were in full bloom. A watercourse leading to the small bay at the northern end of the Head supports a variety of plant communities, including a *Sporobolus virginicus* — *Arthrocnemum dunense* one.

In addition to the species mentioned above, the following were found:

Chrysanthemoides incana	— found on the eastern side of the rock outcrop forming the Head;
Crotalaria schultzei;	
Drosanthemum luederitzii;	
Ectadium virgatum var. latifolium;	
Eragrostis cyperoides;	
Helichrysum obtusum var. namibense;	
Limonium membranaceum;	
Lycium decumbens;	
Osteospermum crassifolium;	
Pteronia spinulosa;	
Psilocaulon marlothii;	
P. namibense;	
Salsola nollothensis;	
Tetragonia decumbens;	
Zygophyllum clavatum;	
and lichens.	

(11) Three species — namely *Drosanthemum luederitzii, Limonium membranaceum* and *Psilocaulon marlothii* were collected from Oyster Cliffs by Mr. Martin Jackson.

II. LIST OF PLANTS COLLECTED OR RECORDED

The system followed is that of MERXMÜLLER — Prodromus einer Flora von Südwestafrika, 1966-1972, J. Kramer, Lehre. In the cited collections G & R stands for Giess & Robinson. Species recorded but not collected are indicated by the note G & R obs. All species are housed in the S.W.A. Herbarium, Windhoek.

FAMILY MOLUGINACEAE
Hypertelis angrae-pequenae Friedr. — G & R 13176, 13194, 13208.

FAMILY AIZOACEAE
Drosanthemum luederitzii (Engler) Schwantes — G & R 13175, 13190, 13215.
Jensenobotrya lossowiana Herre — G & R 13168, 13207.
Mesembryanthemum hypertrophicum Dinter — G & R obs. (seedlings only found).
Psilocaulon marlothii (Pax) Friedr. — G & R 13164, 13182, 13213, 13223.
Psilocaulon namibense (Marl.) Friedr. — G & R 13186, 13209.
Trianthema hereroense Schinz — G & R 13202.

FAMILY TETRAGONIACEAE
Tetragonia decumbens Miller — G & R 13191, 13200.
Tetragonia reduplicata Welw. ex Oliver — G & R 13193.

FAMILY CHENOPODIACEAE
Arthrocnemum dunense Moss ex Adamson — G & R 13178, 13218.
Salsola aphylla L. fil. — G & R obs.
Salsola cf. *nollothensis* Aellen — G & R 13165, 13237.
Salsola zeyheri Moq. — G & R obs.
Salsola spp. — G & R 13174, 13180, 13181, 13189, 13221, 13228, 13229, 13230.

FAMILY CAPPARACEAE
Capparis hereroensis Schinz — G & R 13224, 13226.

FAMILY CRASSULACEAE
Cotyledon schaeferana Dinter — G & R 13204.

FAMILY FABACEAE
Crotalaria schultzei Harms — G & R 13199, 13201.
Lebeckia multiflora E. Meyer var. *parviflora* Schinz — G & R 13177.

FAMILY GERANIACEAE
Monsonia ignorata Merxm. & Schreiber — G & R 13187, 13203.
Pelargonium cortusifolium L'Hér. ex Aiton — G & R 13205.

FAMILY ZYGOPHYLLACEAE
Zygophyllum clavatum Schlechter & Diels — G & R 13184.
Zygophyllum cordifolium L. fil. — G & R 13206.

FAMILY PLUMBAGINACEAE
Limonium membranaceum R. A. Dyer — G & R 13171, 13179, 13214.

FAMILY PERIPLOCACEAE
Ectadium virgatum E. Meyer var. *latifolium* Schinz — G & R 13172.

FAMILY SOLANACEAE
Lycium decumbens Welw. ex Hiern — G & R 13166, 13211, 13220, 13222.

FAMILY ASTERACEAE
Chrysanthemoides incana (Burm. fil.) T. Norl. — G & R 13196.
Didelta carnosa (L. fil.) Aiton var. *tomentosa* (Less.) Roessler — G & R 13163.
Eremothamnus marlothianus O. Hoffm. — G & R 13195, 13210.
Helichrysum obtusum S. Moore var. *namibense* Merxm. & Schreiber — G & R 13198.
Osteospermum crassifolium (O. Hoffm.) T. Norl. — G & R 13183.
Othonna furcata (Lindley) Druce — G & R 13170.

Pteronia spinulosa Phillips — G & R 13192.

FAMILY POTAMOGETONACEAE
Ruppia maritima L. — G & R 13216, 13217.

FAMILY LILIACEAE
Asparagus capensis L. var. *litoralis* Suesseng. & Karl — G & R 13219.

FAMILY GRAMINEAE (POACEAE)
Eragrostis cyperoides (Thunb.) Beauv. — G & R 13167.
Sporobolus virginicus (L.) Kunth — G & R 13188.
Stipagrostis hermannii (Mez) de Winter — G & R 13169, 13185, 13197, 13212.
Stipagrostis sabulicola (Pilger) De Winter — G & R 13225.
Stipagrostis subacaulis (Nees) De Winter — G & R obs.

FAMILY CYPERACEAE
Scirpus dioicus (Kunth) Boeck. — G & R 13227.

ACKNOWLEDGEMENTS

We should like to thank Dr. M. K. Seely for permitting us to participate in the trip.

SUMMARY

In the course of a trip from Luderitz Bay to Spencer Bay during January, 1974 42 species of plants were collected or noted. The type locality of *Jensenobotrya lossowiana* was re-located and this species was also found at Spencer Bay North Head (a distance of 15 km north of the only previously known locality). Localities where species were encountered as well as general observations are given.

DINTERIA NR. 10 — WINDHOEK, S.W.A. — JUNI 1974

Anatomy of the leaves of the Velloziaceae in South Africa and South West Africa and a key based on leaf anatomy

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INTRODUCTION

According to the external morphology of the stem the Velloziaceae of South Africa and South West Africa can be divided into two groups, viz. the shrubs, which include *Xerophyta retinervis* Baker var. *retinervis, X. retinervis* Baker var. *equisetoides* (Baker) Coetzee, *X. retinervis* Baker var. *wentzeliana* (Harms) Coetzee, *X. clavata* Baker, *X. villosa* (Baker) Dur. & Schinz and *X. squarrosa* Baker, and the herbs, viz. *X. viscosa* Baker, *X. humilis* (Baker) Dur. & Schinz and *Talbotia elegans* Balfour.

The shrublike species have leaves borne in clusters near the stem apex and on small lateral branches among the leaf bases. The herbaceous species have terminal leaves (Coetzee, Van der Schijff and Steyn, 1973). In both groups the leaves occur along three orthostichies which, according to Weber (1954) alternate with three rhizostichies.

The leaves are linear, but *Xerophyta humilis, Talbotia elegans* and some representatives of *X. squarrosa* have linearlancetly-shaped leaves. A keel is formed abaxially of the median vein where the leaf folds towards the adaxial side. In *X. viscosa,* however, the leaf halves roll up abaxially.

All the species, except *T. elegans,* have leaves with longitudinal furrows. In *X. retinervis* var. *retinervis, X. villosa* and *X. clavata* furrows occur on both surfaces. The leaves of *X. squarrosa* may also be furrowed on both sides or the adaxial surface may be sinuated while the abaxial surface may have shallow furrows.

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* Extract from a dissertation accepted as part of the requirements for the M.Sc.-degree at the University of Pretoria.

MATERIAL

Fresh material was collected from several localities, fixed in formalin-acetic-acid-alcohol and dehydrated in an ethanol series. Paraffin wax with a melting point of 55°C was used for embedding. Transverse sections, varying in thickness between 8 μm and 10 μm, were made with a rotary microtome and stained with fast green, safranin and haematoxilin or toluidine blue. Herbarium material used for anatomical studies was soaked in water at 60°C for twelve hours, rinsed and boiled for three minutes before fixation.

INVESTIGATION AND RESULTS

Epidermis

The epidermal cells are brick-like, elongated longitudinally and thin-walled with thickened inner or outer tangential walls. In surface view longitudinal rows of regularly-shaped cells cover the ridges, but irregular cells with concentrated pitfields occur in the furrows. In *Talbotia elegans,* where furrows are lacking, the epidermal cells have wavy anticlinal walls in the vicinity of the stomata. These cells occur in longitudinal strips between adjacent vascular bundles and alternate with strips of regular cells opposite the vascular bundles where stomata are lacking.

The adaxial epidermal cells opposite the median vein are always larger than elsewhere (fig. 1) and appear papillate in transverse section. According to Diogo (1926) these cells have, together with the underlying water-containing cells, the same function as the motor cells in the leaves of the Gramineae and enable the leaf to fold towards the adaxial side during water loss. The cuticle of the cells is extremely thin and this may be connected with the absorption of water, which gathers here.

The epidermal cells in the furrows are thin-walled with a thick, spiny cuticle and appear papillate in transverse section (fig. 2). As the stomata are restricted to the furrows, they are protected when the latter become narrower so that stomatal transpiration is minimal. Diogo (1926) maintains that the papillate epidermal cells absorb water, but the thick cuticle of the investigated species would probably prevent this.

The guard-cells are large and kidney-shaped with their long axis parallel to the long axis of the leaf (fig. 3). The large lateral subsidiary cells have striated transverse walls and partly overlap the guard cells. Ayensu (1969) maintains that the transverse striations protect the guard cells against tension during contraction of the leaves. The striations may therefore play an important physiological role and were found in all the investigated species.

The cell walls of the guard cells are thickened on the sides bordering the

stomatal pore and outer and inner ledges, covered by cuticle, occur. The stomatal chambers are usually small, but may be large in some cases with the abaxial chambers as big as or bigger than the adaxial chambers.

The cuticle may be smooth or may have regular, longitudinal grooves. The cuticle of the leaf margin is always thicker than elsewhere. In *Xerophyta villosa* and *X. squarrosa* the thickness of the cuticle varies in plants of the same species but different localities. The cuticle of *Talbotia elegans* is usually thinner than that of the other species.

When a difference in cuticle thickness occurs between the two leaf surfaces, the adaxial cuticle is thinner (eg. *X. retinervis, X. humilis, X. villosa* and *X. squarrosa)* except in *X. viscosa* where some plants have a better developed adaxial cuticle. *Xerophyta viscosa* is the only species with sunken glands in the adaxial epidermis (fig. 4) and also the only species where the leaves roll up abaxially, so that the leaf margins lie alongside the median vein.

In the specimens of *X. squarrosa* without obvious furrows, the epidermis in the vicinity of the stomata has fine cuticular outgrowths. Similar protuberances were seen in the furrows of *X. viscosa.*

Multicellular structures of epidermal and hypodermal origin occur on the leaves of all the shrubs (fig. 2). Greves (1921) regard similar structures on the ovary wall as hairs of taxonomic importance. In *X. retinervis* var. *retinervis* and *X. clavata* these structures may either occur on the adaxial leaf surface or may be lacking. In *X. retinervis* var. *wentzeliana* they are found adaxially or on both surfaces and in *X. retinervis* var. *equisetoides* they are present on both surfaces, as is the case in *X. villosa* which has an extremely thick covering of hairs. The epidermal cells of the hairy protuberances are elongated whilst elongated hypodermal sclerenchymatous cells form the remaining part of the structure.

Sunken, cup-shaped glands of epidermal and hypodermal origin are present in the adaxial leaf surface of *X. viscosa.* The cells are big and regular with dark contents and probably excrete the sticky substances found on the leaves of this plant (fig. 4).

Assimilation tissue

The leaves are isobilateral, except in *Xerophyta squarrosa, X. humilis* and *X. viscosa.* In the shrubs with isobilateral leaves the mesophyll consists of six (in the furrows) to twenty layers of chlorenchyma cells with minute intercellular spaces (fig. 8) which according to Haberlandt (1914) suggest xerophytic characteristics. *X. retinervis* var. *retinervis* plants growing under more moderate conditions have bigger intercellular spaces than those collected in drier areas. *Talbotia elegans,* however, which grows in a very wet habitat, also has minute intercellular spaces. This probably corresponds to the fact that *T. elegans* is periodically subjected to desiccation. Water-containing cells were found in the mesophyll of the latter species.

The adaxial hypodermal cells opposite the median vein of the leaves of all the species (fig. 1) as well as the first two hypodermal layers in the adaxial and abaxial furrows of the shrubs (fig. 5) consist of large, colourless, thin-walled palisade-like or rounded cells. In *X. squarrosa* these cells are less obvious adaxially between adjacent vascular bundles (fig. 6). Warming (1893) describes similar cells in *Barbacenia* and maintains that they do not occur in the leaves of *Vellozia*. Goedhart (according to Lotsy, 1911) agrees with Warming. Esau (1965) and Warming and Graebner (1933) describe similar cells as water tissue, while Warming (1893) regards them as water-supplying cells. According to Diogo (1926) these cells cause the closing of the furrows during loss of water and subsequent decrease in volume.

In a transverse section of the leaf the elongated chlorenchyma cells in most cases radiate from the water cells, with their long axis parallel to the leaf surface (fig. 5). In some examples of *Xerophyta retinervis* var. *retinervis, X. villosa* and *X. clavata* (fig. 8) the water cells are isodiametric and the chlorenchyma cells are not arranged in this characteristic way.

In *X. viscosa* a single, colourless hypodermal cell layer is present on both sides of the leaf (fig. 13). The cells are smaller and more regular than the mesophyll cells with fewer, if any, chloroplasts. Diogo (1926) regards them as watery parenchyma cells which provide protection against light or heat extremes.

The parenchyma on the adaxial side of the vascular bundles corresponds in transverse sections of the leaves of *X. squarrosa* to that found in the furrows of the leaves of the other shrublike species. These cells, which interrupt the bundle sheath adaxially, are separated from the epidermis by one to three layers of small parenchyma cells or, in some cases, by one to four layers of sclerenchyma cells (fig. 8). Warming (1893) regards similar cells in the leaves of *Vellosia candida* and *V. variabilis* as water-supplying cells.

The leaves of *Xerophyta humilis, X. viscosa* and *X. squarrosa* are dorsiventral. In the latter the palisade tissue consists of three to five cell layers with small intercellular spaces, but large spaces were found in the leaves of some plants where the palisade tissue is arranged in strands. The latter type of leaf lacks deep furrows, but has an irregularly sinuated adaxial surface and shallow furrows in the abaxial epidermis (fig. 6). The spongy parenchyma of *X. squarrosa* consists of six to twelve cell layers with small intercellular spaces in the vicinity of the vascular bundles and larger spaces opposite the furrows.

In *X. humilis* a gradual transition occurs between the three to four layers of palisade cells and the underlying three to five layers of spongy parenchyma cells. The mesophyll tissue contains small intercellular spaces. Towards the leaf margin the palisade cells gradually change into spongy parenchyma, so that the leaf becomes isobilateral in this area.

In *X. viscosa* the palisade tissue varies between three to eight, while the spongy parenchyma consists of two to ten cell layers. The size of the intercellular spaces varies, being the smallest near the vascular bundles (fig. 12).

Hypodermal sclerenchyma

The distribution of hypodermal sclerenchyma is a constant characteristic of the species and this tissue is present in the leaves of all the shrubs. The sclerenchyma occurs in the ridges and on the margins of the furrows (figs. 2 and 7). The abaxial sclerenchymatous zones may contain fewer cell layers than the adaxial zones or may even be represented by a single layer or a number of isolated cell groups. In *X. villosa* two to five sub-epidermal sclerenchyma layers occur opposite the veins on the side where the girders associated with the vascular bundles are lacking (fig. 7).

Therefore, the presence of hypodermal sclerenchyma distinguishes the shrublike representatives of the genus from the herbaceous species.

On the abaxial side of the median vein hypodermal fibres may be present in *X. clavata* and *X. squarrosa* (fig. 8). These cells are probably responsible for the ribs or spines found on the keel of the leaf.

On the leaf margin of *X. clavata* and the varieties of *X. retinervis* a separate, local hypodermal sclerenchyma bundle occurs, separated from the sclerenchyma strand of the marginal vascular bundle by the bundle sheath (fig. 9). The epidermal cells overlying this sclerenchyma have a thick, grooved cuticle. A series of transverse sections shows that this structure originates as a small sclerenchyma group which enlarges to become the externally discernable spiny outgrowth of the leaf margin.

Vascular bundles

The lateral vascular bundles of the leaf are of approximately equal size and vary in number from leaf to leaf. They are collateral and are bordered ab- and adaxially by sclerenchyma girders (fig. 12).

The primary phloem consists of a continuous strand or two lateral strands separated by sclerenchyma (figs. 10 and 11). Ayensu (1969) maintains that this separation occurs by an intrusion of the abaxial sclerenchyma girder. This theory is not accepted in the present study since, in the investigated species, the sclerenchyma intrusion starts differentiating at the adaxial and median part of the phloem (fig. 10). Cheadle and Uhl (1948) maintain that such fibres should be regarded as part of the phloem. The lateral bundles nearer to the median vein usually have better developed sclerenchyma fibres than those nearer to the leaf margin.

The protoxylem lies on the adaxial side of the vascular bundle and is partly separated from the metaxylem by xylem parenchyma (fig. 10).

The metaxylem elements of the shrubs occur in the form of a V with the arms of the V facing the protoxylem (fig. 11). In the centre of the V a number of thickened metaxylem elements occur, with a single large element at the base.

The arms consist of relatively small elements (figs. 6, 7, 8 and 9). In the herbs, however, a number of large elements lies at the base of the metaxylem (fig. 10). According to Fahn (1954) the xylem of the leaves of *Talbotia elegans* contains tracheids only and Ayensu (1969) confirms this.

Among members of the Velloziaceae, the sclerenchyma associated with the lateral bundles varies in distribution. Ayensu (1967) regards this characteristic as being taxonomically so important that it justifies the grouping of the Velloziaceae species into members having a *Barbacenia,* a *Vellozia* and a *Xerophyta* type of vascular bundle.

During this study this grouping proved to be confusing. In the leaves of *X. viscosa,* for example, both the *Vellozia* type and *Barbacenia* type of vascular bundles occur, as well as transitions between the two types. Deviations from the basic *Vellozia* type were also found, eg. in *Talbotia elegans.* None of the plants examined exhibited a *Xerophyta* type of vascular bundle. Unless Ayensu's types are extended to include the South African and South West African species, this classification cannot be used taxonomically. It does, however, give a good idea of the main types of vascular bundles with associated parenchyma which occur in the Velloziaceae.

In the shrubs the abaxial sclerenchyma girder is Y-shaped (fig. 5), broadly U-shaped (fig. 6), or even semi-circular without a sclerenchyma extension to the epidermis (fig. 7). The adaxial girder is an inverted Y and prominent. In *X. squarrosa,* however, the adaxial girder is much smaller than the abaxial girder (fig. 6) while *X. villosa* has a small semi-circular girder (fig. 7). The arms of the abaxial and adaxial girders do not meet, but are separated by small, thin-walled (fig. 10) or thick-walled cells (fig. 11).

The girders are usually separated from the epidermis by the thin-walled bundle sheath only. In *X. squarrosa,* however, one to three layers of hypodermal parenchyma or sclerenchyma occur opposite the lateral vascular bundles (fig. 6).

The bundle sheath consists of thin-walled cells (fig. 11) with concentrated pit-fields or may contain a number of thick-walled cells lateral to the vascular tissue. In *X. clavata* these cells have pronounced thick walls. In *X. squarrosa* the bundle sheath is interrupted adaxially by one or more layers of palisade-shaped cells, regarded by Warming (1893) as water-supplying cells. The cells of the bundle sheath usually lack visible contents, but exceptions do occur (figs. 5 and 7).

In *X. humilis* the girders are rod-shaped and the phloem connects the adaxial girder with the abaxial laterally. The adaxial girder may form an inverted Y and border the protoxylem laterally. A single layer of parenchyma cells may be present between the bundle sheath and the epidermis.

In *X. viscosa* the vascular bundles of the lamina differ from those of the leaf base. The former have cup-shaped adaxial and abaxial girders and the bundle sheath is separated from both epidermal layers by three to four layers of mesophyll cells. The sub-epidermal layers consist of water tissue (fig. 12). In the leaf base the dorsal girder is Y-shaped while the ventral layer is either Y-shaped or V-shaped. The bundle sheath borders the epidermis ab- and adaxially.

In *T. elegans* the abaxial girder is cup-shaped and more extensive than the adaxial girder. The bundle sheath is generally separated from the epidermis by a parenchyma layer.

The sclerenchyma strand of the leaf margin is prominent in some cases (fig. 9) and is surrounded by the bundle sheath of the marginal vascular bundle. In *X. humilis* the strand, enclosed by a parenchyma layer, lies apart. The bundle sheath may be adjacent to the epidermis or separated from the latter by several parenchyma cells, eg. in *T. elegans, X. humilis* and *X. viscosa.* Where the bundle sheath encloses both the marginal vascular bundle and the sclerenchyma strand, the phloem consists of either one or two strands which partly surround the xylem. The bundle sheath cells adjacent to the vascular bundle may be thick-walled.

The median vascular bundle of the leaf is bordered abaxially by a large sclerenchyma strand (fig. 8), which partly surrounds the adjacent phloem. The latter may consist of a continuous semi-circular strand or two lateral strands. The primary xylem tissue consists of a few metaxylem elements arranged in a V and a small group of protoxylem elements. The vascular bundle and associated parenchyma are surrounded by a common thin-walled bundle sheath. In *X. squarrosa* this bundle sheath consists adaxially of elongated water cells (fig. 1). The cell walls of the bundle sheath may have reticulate thickenings.

DISCUSSION

Ayensu (1967) showed that the distribution of the sclerenchyma of the Velloziaceae leaf is of taxonomic importance. Hypodermal sclerenchyma is found only in the shrubs and this characteristic is clearly seen in transverse sections of the leaf.

Furrows in the leaf surface are lacking only in *Talbotia elegans,* while the depth of the furrows varies in the other species. Plants with sinuated leaf surfaces were also found.

Multicellular spines or hairy outgrowths are of little taxonomic importance, except in *Xerophyta villosa,* where the leaves have a thick covering of long, fine hairs. The differentiation of the mesophyll can be used successfully to distinguish between certain species. *X. squarrosa* is the only shrub-like species with palisade and spongy parenchyma. Differentiated mesophyll also occurs in the leaves of the herbs *X. viscosa* and *X. humilis.* In the latter, however, the difference between palisade and spongy parenchyma is not very obvious. The most distinctive characteristic of *X. viscosa,* however, is the presence of numerous sunken, cup-shaped glands in the adaxial epidermis, an anatomical feature not present in any other species.

The distribution of sclerenchyma associated with the vascular bundles, can also be of taxonomic importance, eg. in *T. elegans* and *X. humilis,* where the sclerenchyma is totally different from that of the other species. This character-

istic was, however, disregarded in the key, since other anatomically more obvious leaf characteristics were found in the species investigated. The presence of hypodermal water tissue in the leaves of *X. squarrosa* and *X. viscosa* and water cells in the mesophyll of *T. elegans* was also disregarded.

With regard to leaf anatomy, no distinction could be made between the leaves of *X. clavata* and the three varieties of *X. retinervis*.

The following key was compiled taking into account the above-mentioned taxonomically important characteristics.

1.	Hypodermal sclerenchyma present in ribs	4
	Hypodermal sclerenchyma not present in ribs	2
2.	Leaves without abaxial furrows	*Talbotia elegans*
	Leaves with abaxial furrows	3
3.	Leaves with sunken adaxial glands	*Xerophyta viscosa*
	Leaves without sunken adaxial glands	*Xerophyta humilis*
4.	Mesophyll differentiated into palisade and spongy parenchyma	*Xerophyta squarrosa*
	Mesophyll not differentiated into palisade and spongy parenchyma	5
5.	Leaves with numerous multi-cellular "hairs" on both surfaces	*Xerophyta villosa*
	Leaves without multi-cellular "hairs", except on margins of furrows where spines may occur	*Xerophyta retinervis* (3 varieties) and *Xerophyta clavata*

Abstract

The anatomy of the leaves of seven species and two varieties of the South African and South West African Velloziaceae was investigated.

The shrubs can easily be distinguished from the herbs by the presence of hypodermal sclerenchyma in the former. The sclerenchyma associated with the vascular tissue, however, varies within a species and this characteristic cannot be used to distinguish between the species of South Africa and South West Africa.

Hairy outgrowths of epidermal origin occur on the leaves of several species, but may also vary within the species.

Other anatomical characteristics regarded as taxonomically important, eg. glands,

water cells, hypodermal water tissue and longitudinal furrows on the leaf surface, were also investigated.

A key based on taxonomically important characteristics is given.

ACKNOWLEDGEMENTS

Thanks are due to the following bodies and persons for financial support and help during this investigation: The Research Committee of the University of Pretoria, the Council for Scientific and Industrial Research, the Rembrandt Tobacco Organisation, the National Parks Board, the National Herbarium, Mr. W. Giess of the South West African Herbarium and my supervisor and co-supervisor, Prof. dr. H. P. van der Schijff and Mrs. E. Steyn.

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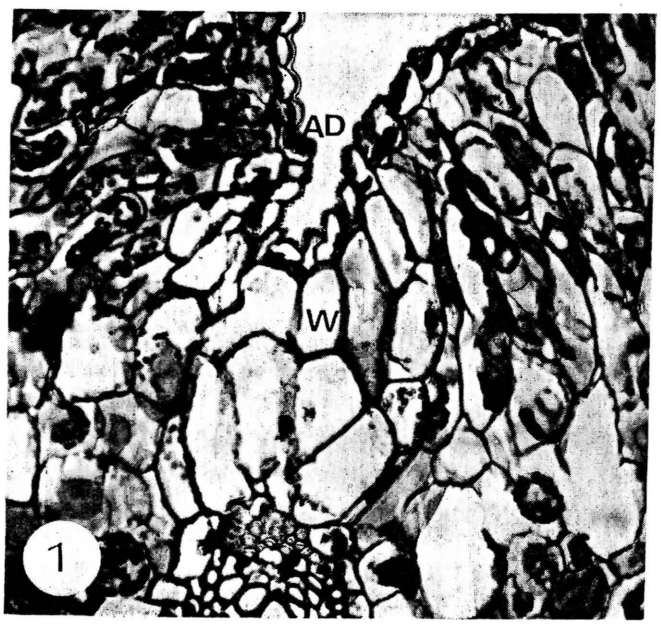


Fig. 1. Transection of a part of the leaf of *Xerophyta squarrosa* illustrating the tissues on the adaxial side of the median vascular bundle.
AD, adaxial epidermis; W, water-containing cells after loss of water.

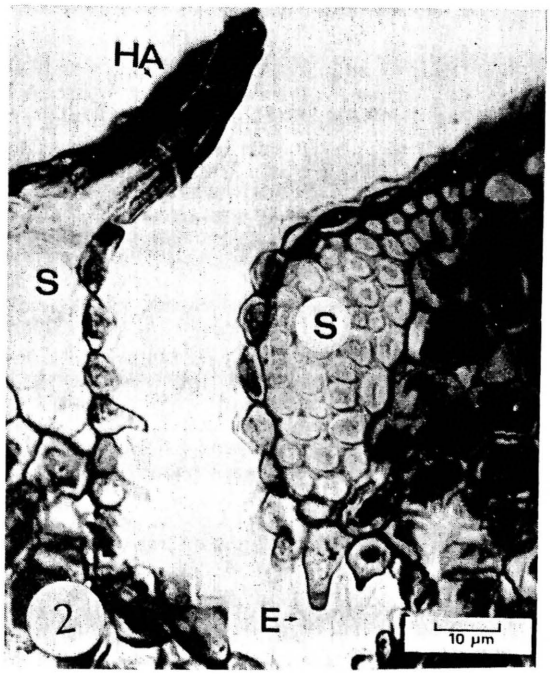


Fig. 2. Transection of a part of leaf of *Xerophyta retinervis* var. *retinervis* illustrating an adaxial furrow.
E, papillate epidermal cells with thickened cuticle; HA, multicellular hairy structure; S, hypodermal sclerenchyma of the ridge.

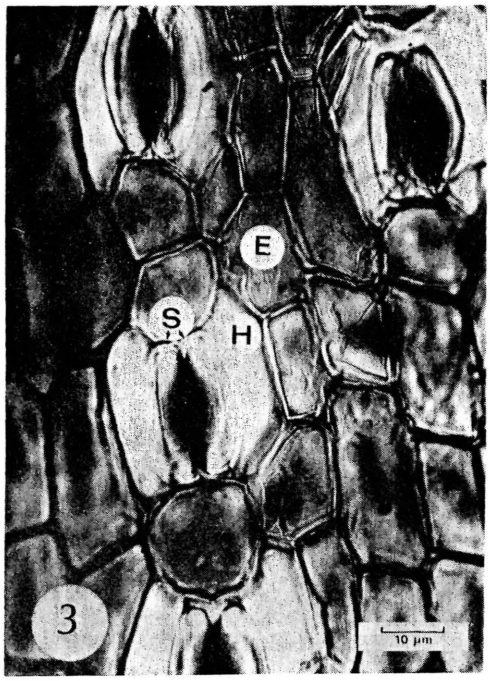


Fig. 3. Surface view of the epidermis of a part of the leaf of *Xerophyta retinervis* var. *wentzeliana*.
E, epidermal cell; H, subsidiary cell; S, guard cells.

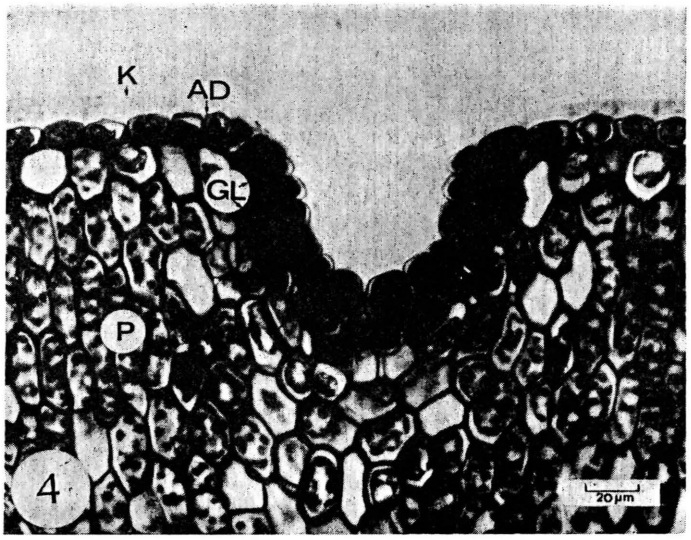


Fig. 4. Transection of a part of the leaf of *Xerophyta viscosa* illustrating a cup-shaped gland.
AD, adaxial epidermis; GL, glandular cells; K, thickened cuticle; P, palisade parenchyma.

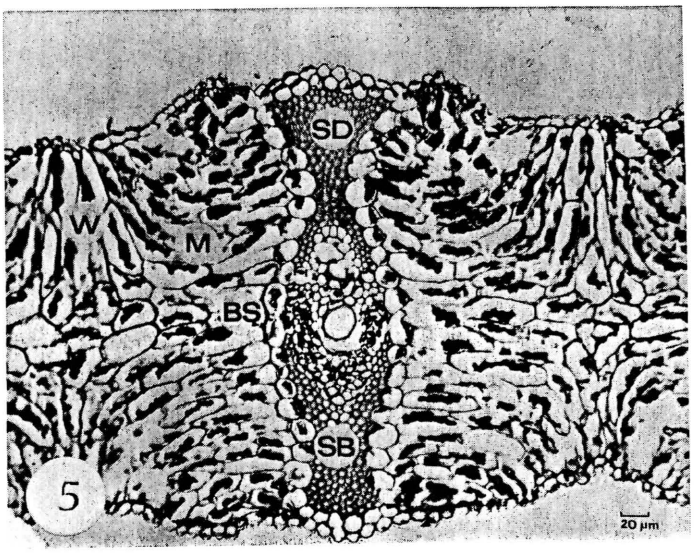


Fig. 5. Transection of a part of the leaf of *Xerophyta retinervis* var. *retinervis*.
BS, bundlesheath; M, horizontal chlorenchyma cells; SB, abaxial sclerenchyma girder; SD, adaxial sclerenchyma girder; W, water-containing cells.

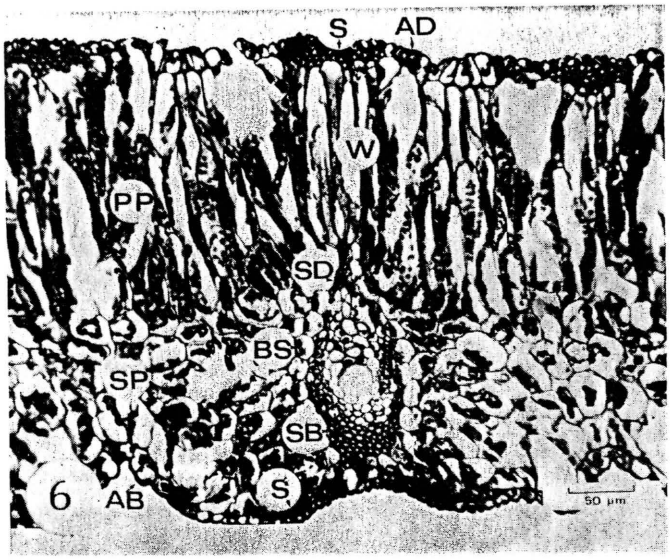


Fig. 6. Transection of a part of the leaf of *Xerophyta squarrosa* illustrating a lateral vascular bundle.
AB, abaxial epidermis; AD, adaxial epidermis, BS, bundle sheath; PP, palisade parenchyma; S, hypodermal sclerenchyma; SB, abaxial sclerenchyma girder; SD, adaxial sclerenchyma girder; SP, spongy parenchyma; W, water-containing cells.

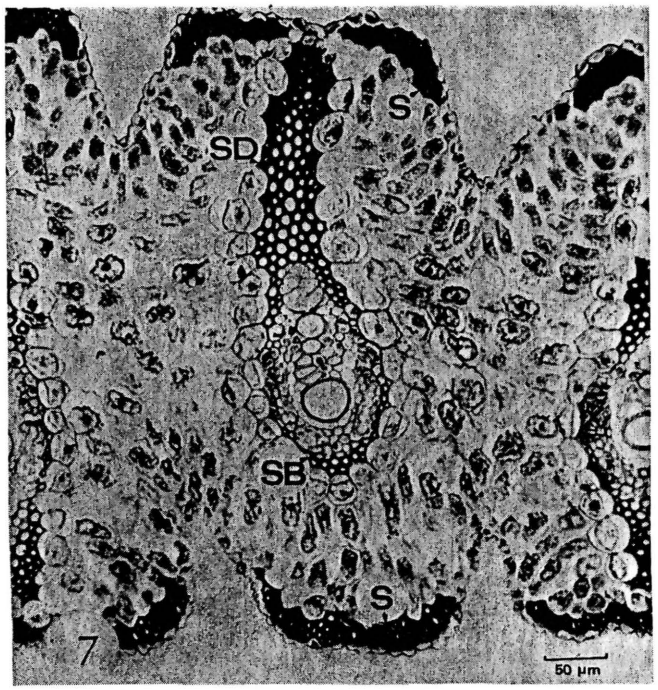


Fig. 7. Transection of a part of the leaf of *Xerophyta villosa*.
S, hypodermal sclerenchyma; SB, abaxial sclerenchyma girder; SD, adaxial sclerenchyma girder.

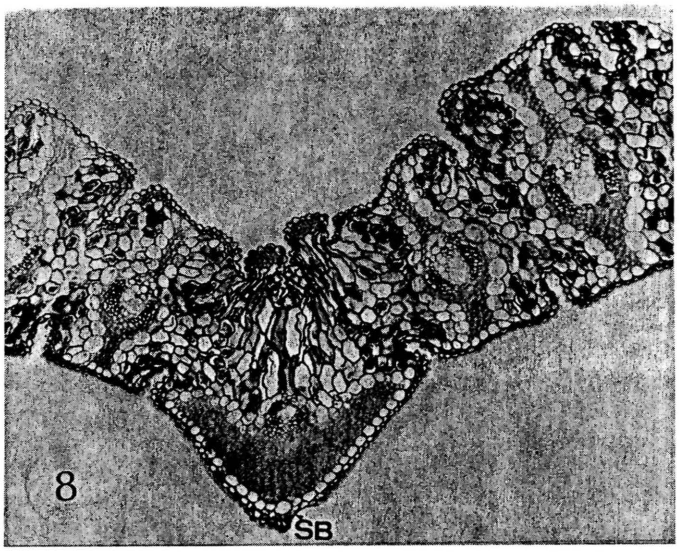


Fig. 8. Transection of a part of the leaf of *Xerophyta clavata*.
SB, hypodermal sclerenchyma on the abaxial side of the median vein.

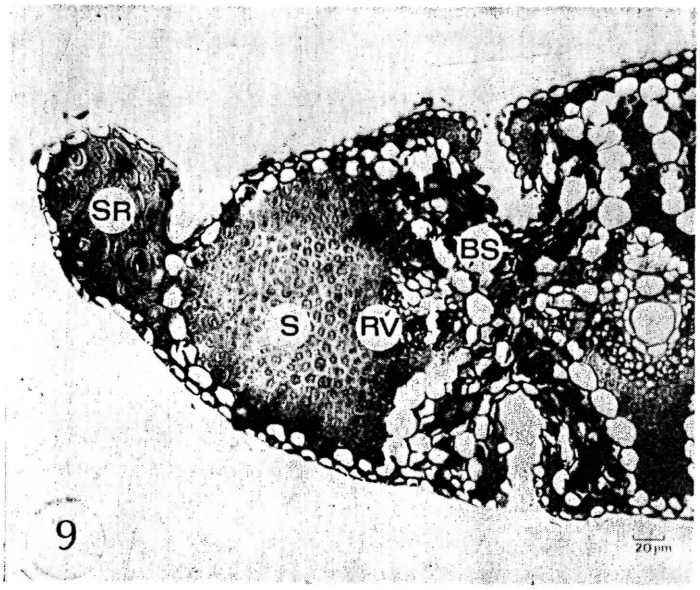


Fig. 9. Transection of the leaf margin of *Xerophyta clavata*.
BS, bundle sheath of marginal vascular bundle; RV, marginal vascular bundle; S, sclerenchyma strand of marginal vascular bundle; SR, hypodermal sclerenchyma of leaf margin.

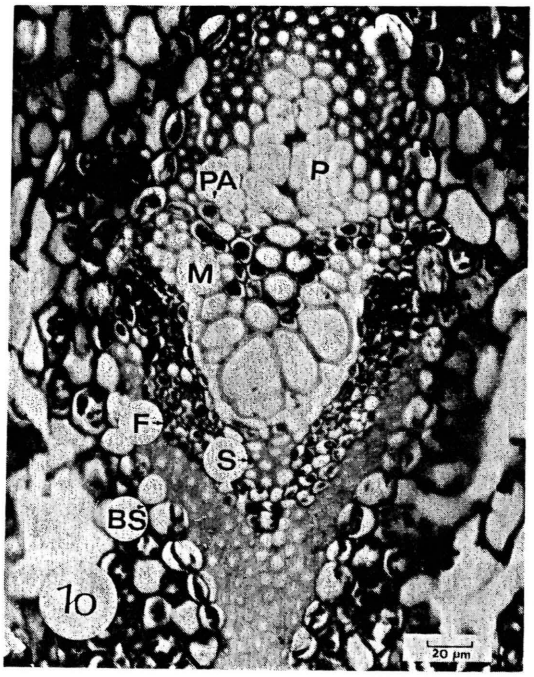


Fig. 10. Transection of a lateral vascular bundle of *Xerophyta viscosa*.
BS, bundle sheath; F, phloem; M, metaxylem; P, protoxylem; PA, xylem parenchyma; S, sclerenchyma separating the phloem.

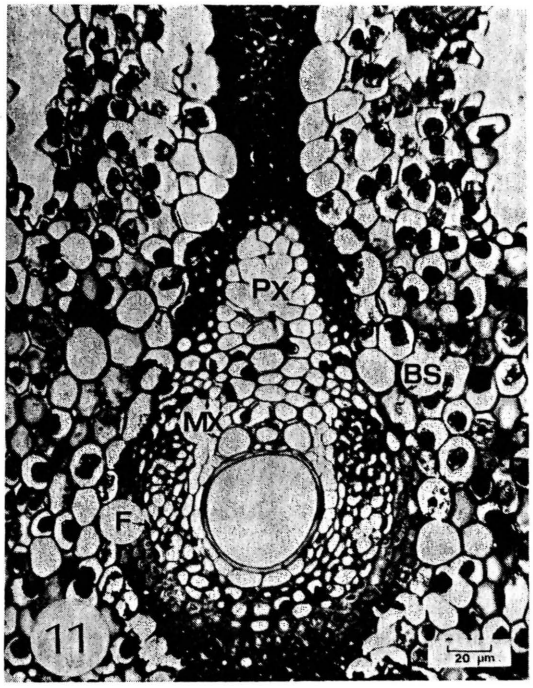


Fig. 11. Transection of a lateral vascular bundle of *Xerophyta retinervis* var. *retinervis*. BS, bundle sheath; F, phloem; MX, metaxylem; PX, protoxylem.

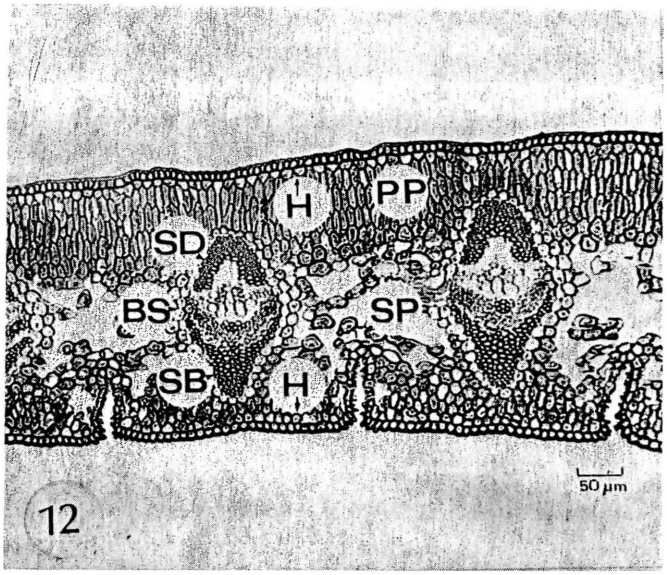


Fig. 12. Transection of a part of the leaf of *Xerophyta viscosa*.
BS, bundle sheath; H, hypodermal water tissue; PP, palisade parenchyma; SB, abaxial sclerenchyma girder; SD, adaxial sclerenchyma girder; SP spongy parenchyma.

DINTERIA NR. 10 — WINDHOEK, S.W.A. — JUNI 1974

BEOBACHTUNGEN ZUR SÜDWESTER FLORA

W. GIESS

Welche Pflanze ist das?

Herr H. Bachran, der Besitzer der Farm Palmenhorst am Swakop, berichtete mir von einer eigenartigen Hoodia, die er bei seinen Wanderungen im Felsgelände der Berge unweit des Swakops beobachtet hatte. Wir konnten mit ihm zusammen diese "Hoodia" besuchen, die sich im November 1971 noch in Blüte und fruchtend befand. Es handelte sich hierbei um eine Pflanze von der Wuchsform einer Hoodia. Jedoch die Blüten waren äusserst seltsam, leuchtend weinrot, sternförmig und mit einem Durchmesser von 5 cm. Etwa 25 Meter davon entfernt standen mehrere *Hoodia gordonii* in Blüte. Wie uns Herr Bachran später (1973) versicherte, konnte er keine andere dieser Pflanzen mit der eigenartigen Blütenform in dem ganzen Gebiet finden. Die Blütenform und -farbe erinnert sehr stark an die kleinen, kaum ein Zentimeter grossen Blütchen des *Trichocaulon pedicellatum*. Die Stämmchen waren, ebenso wie die der *Hoodia gordonii*, bis 60 cm hoch und hatten einen Durchmesser von 7 cm. Die Rippenzahl war etwas weniger, und zwar 19 bis 20, während letztere bis 22 Rippen hatte. Interessant war der Unterschied in der Bestachelung. Während unsere Pflanze feine, bräunliche Stacheln von 6 mm Länge mit einer kleinen, scharf abgesetzen Basis hatte, waren die Stacheln bei *H. gordonii* grösser, bis 1 cm lang, hell gefärbt und die Basis ging allmählich in den Stachel über. Die Nebenkronen waren bei beiden Blüten einander ähnlich. Die rosa-fleischfarbenen Blüten von *H. gordonii* hatten im Zentrum zerstreute dunkle Papillen, die teilweise kurze, kleine Haarspitzen trugen. Bei unserer Pflanzen waren wohl die Papillen im Zentrum vorhanden, jedoch alle ohne Haarspitzen.

Es kann sich bei unserer eigenartigen Pflanze m.E. nur um eine Kreuzung zwischen *Hoodia gordonii* (Masson) Sweet und *Trichocaulon pedicellatum* Schinz handeln. Wie mir Herr Bachran mitteilt, kommt *T. pedicellatum* in diesem Gebiet vor, obwohl wir sie selbst nicht gesehen haben.

Das mir bisher bekannte Verbreitungsareal von *Trichocaulon pedicellatum* erstreckt sich von den Zwartbankbergen am Kuiseb bis zum Kreuzkap. (Sammelnummer W. Giess 11630. Beleg im S.W.A. Herbarium, Windhoek.)

Abb. 1. Blüte der Kreuzung *Hoodia gordonii* (Masson) Sweet x *Trichocaulon pedicellatum* Schinz in natürlicher Grösse.

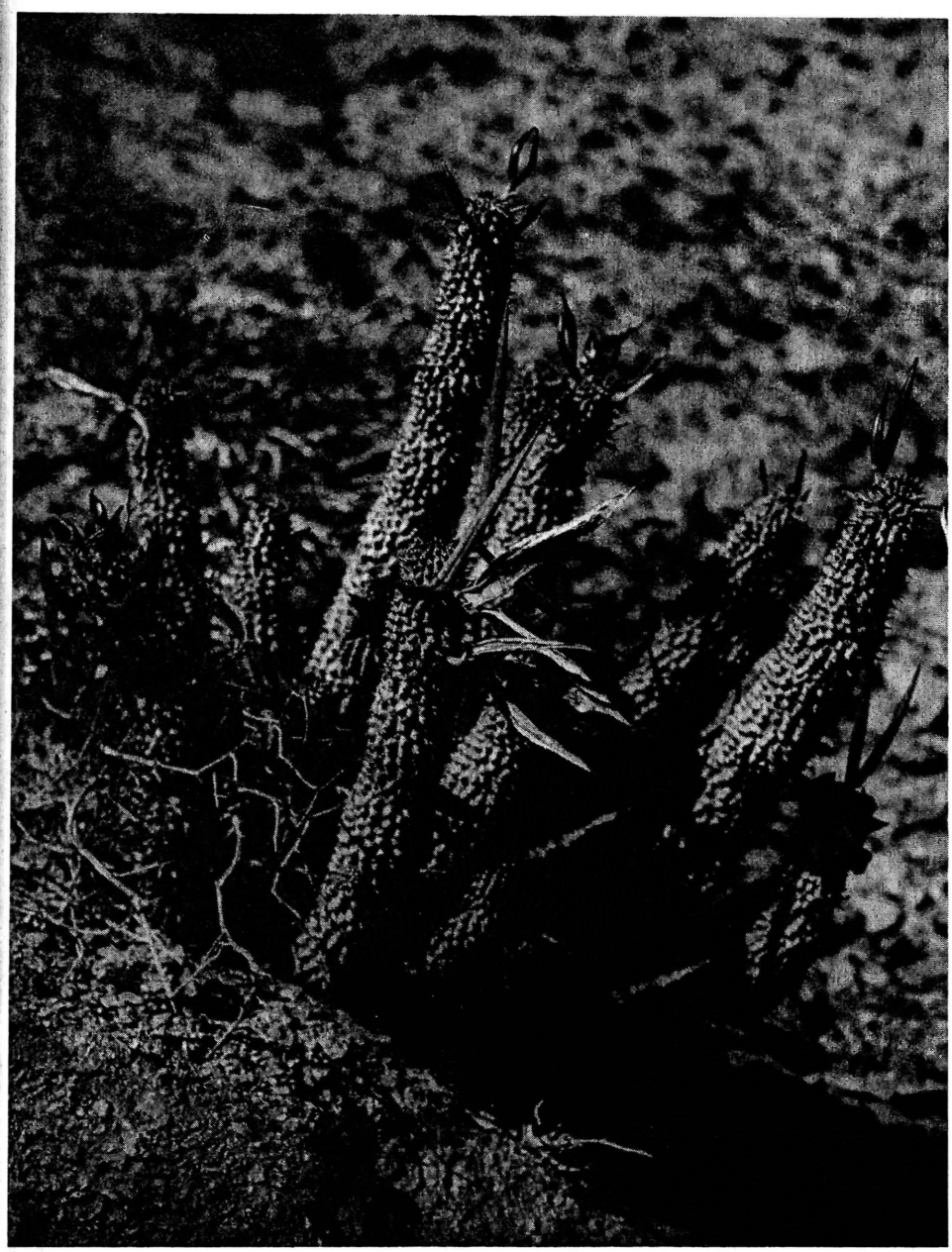


Abb. 2. *Hoodia gordonii* x *Trichocaulon pedicellatum* blühend und fruchtend im November 1971.

Abb. 3. Eine der Elternpflanzen, *Hoodia gordonii*, in Blüte, die unweit der Kreuzung stand.

nweit der Kreuzung

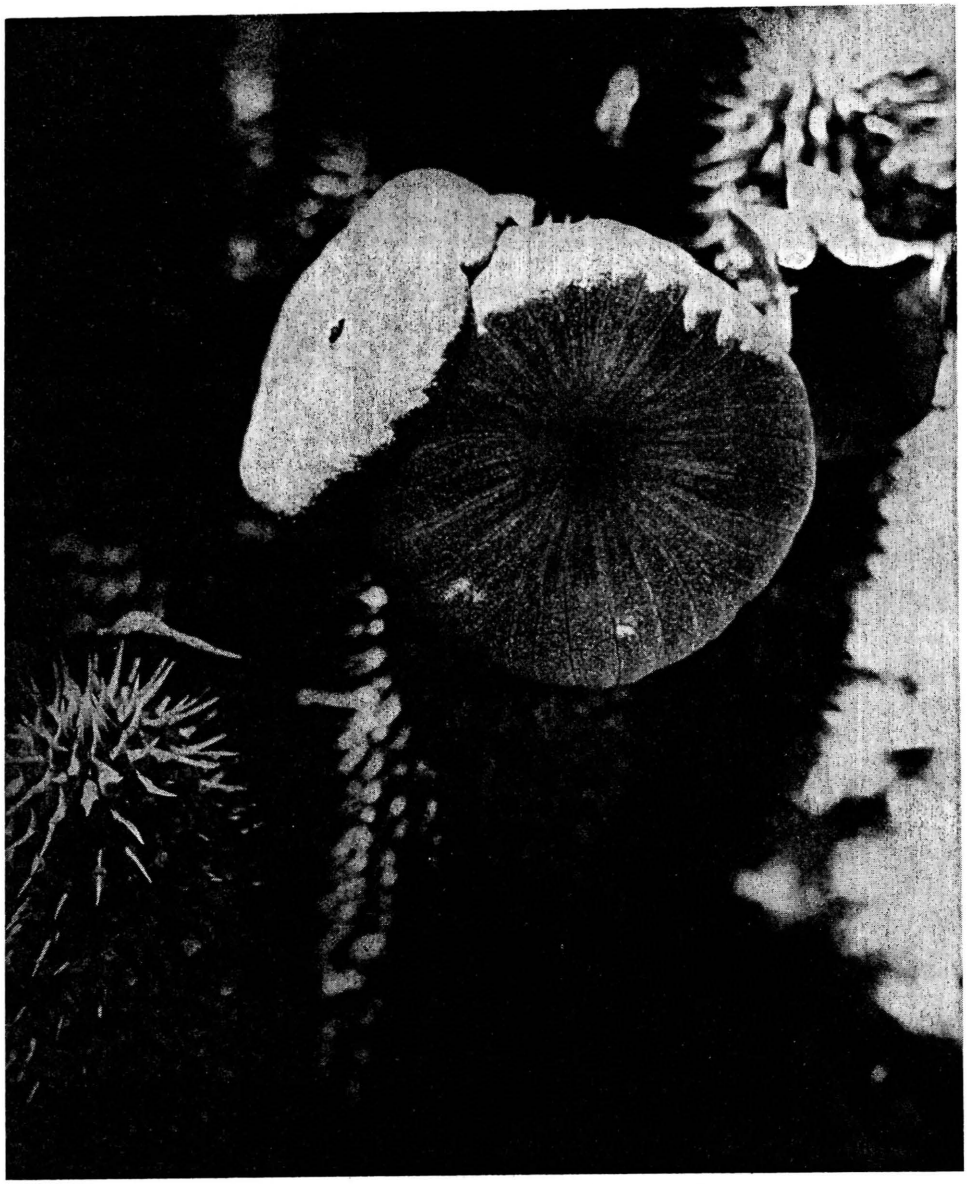
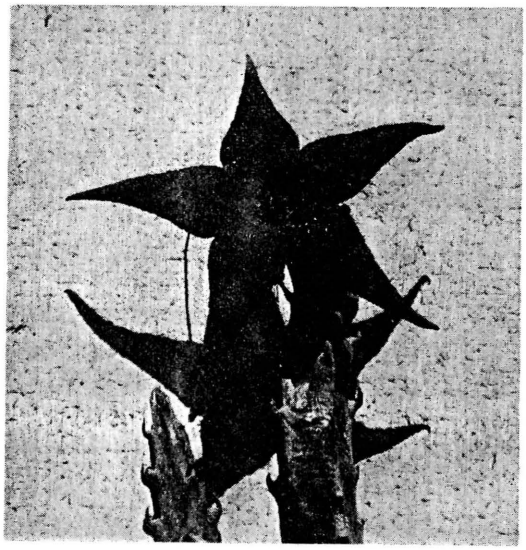


Abb. 4. Blüte von *Hoodia gordonii* (etwas verkleinert).

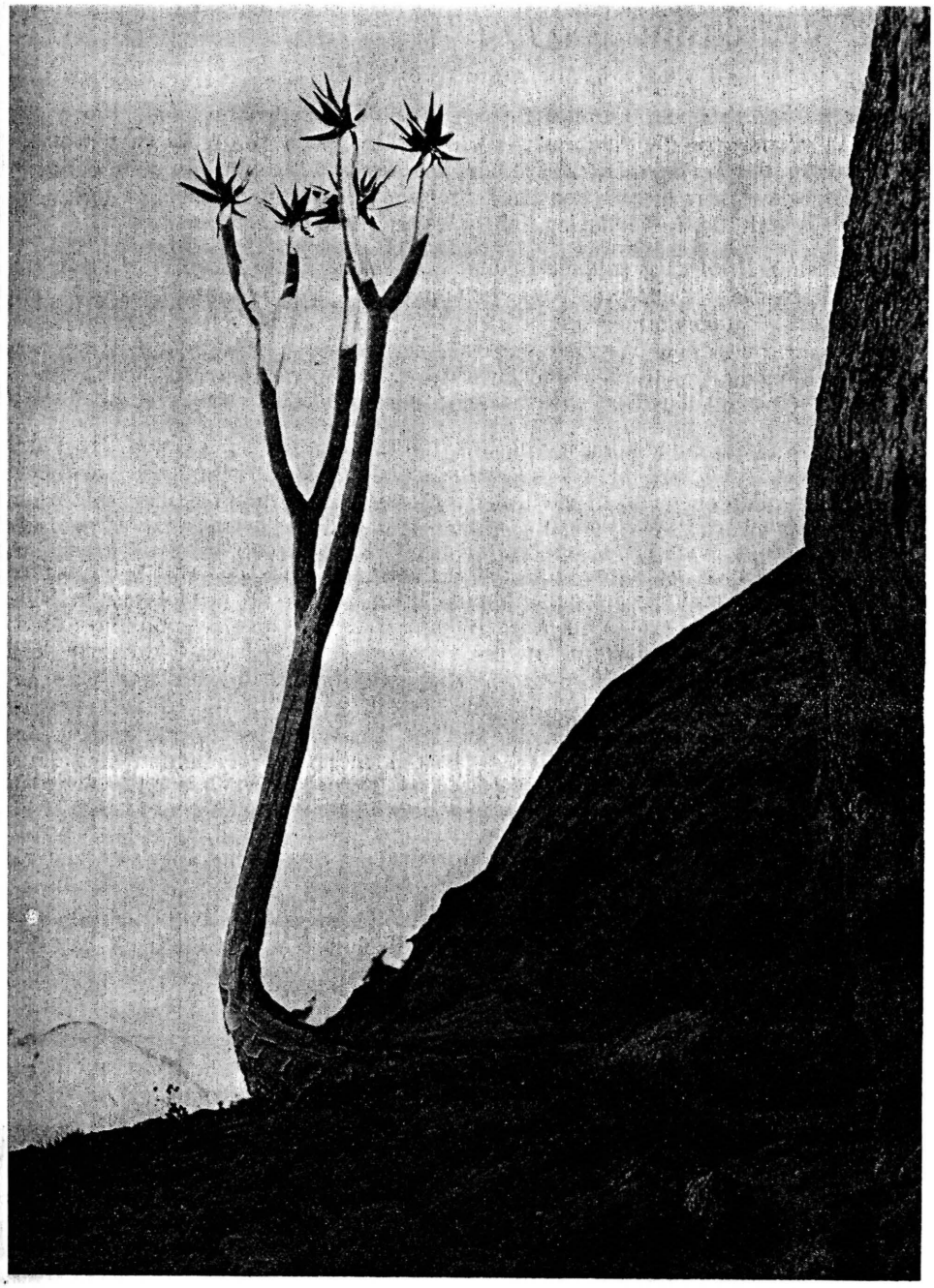
Stapelia schinzii Berger & Schlechter X *Stapelia kwebensis* N.E. Br.



Bei unserem Besuch mit Hans Herre im Jahre 1961 fanden wir in der näheren Umgebung des Otjikotosees bei Tsumeb sowohl *Stapelia schinzii* als auch *Stapelia kwebensis* in Blüte. Unter diesen fiel eine Pflanze vom Stämmchenhabitus der *Stapelia kwebensis* auf, die Blüten waren jedoch erheblich größer als die der *ST. kwebensis* und waren von der Farbe der *Stapelia schinzii*. Die Randwimpern der Blüten von letzterer fehlten jedoch völlig. Der Blütendurchmesser betrug etwa 5 cm. Da beide Eltern in der unmittelbaren Umgebung wuchsen, muss es sich bei unserer Pflanze um eine Kreuzung dieser beiden Stapelien Arten handeln. (Sammelnummer W. Giess 3362. Beleg in S.W.A. Herbarium.)

Beobachtungen zu Aloe *dichotoma Masson*

Auf den fast kahlen Granitfelsen bei Palmenhorst am Swakop befinden sich noch zahlreiche *Aloe dichotoma*-Pflanzen in Gesellschaft mit *Commiphora oblanceolata*-Sträuchern und anderen. Es ist erstaunlich, in welch kleinen Erdansammlungen diese grossen, baumartigen Aloen auf dem Granitfels wachsen. Bei den sporadisch auftretenden stärkeren Regenfällen wird ihnen im wahrsten Sinne des Wortes das wenige Erdreich unter den Füssen weggespült und die Pflanzen fallen um. Was geschieht dann? Wie wir an einigen Beispielen sehen konnten, sterben diese Pflanzen nicht alle ab. Befindet sich unter dem Stamm wieder genügend Erdreich, bilden sich an diesen Stellen neue Wurzeln und der Stamm richtet sich an diesen bewurzelten Stellen im scharfen rechten Winkel wieder auf und wächst weiter. Wie man an trockenen Blütenständen, die noch an den Stämmen vorhanden waren, ersehen konnte, blühen diese Pflanzen auch in den Jahren, in denen sie ausreichend Regen bekommen.



Eine der umgefallenen Aloe-Bäume, der sich nach der Bewurzelung wieder im rechten Winkel aufgerichtet hat, weiter wächst und blüht.

Zur Verbreitung von *Eragrostis sabinae* Launert

Mit der Bearbeitung der Familie Poaceae für den Prodromus einer Flora von Südwestafrika wurde die Neubeschreibung einer Anzahl von Gräsern nowendig. Diese wurden durch Herrn Dr. E. Launert vom British Museum, London, der auch die Familie der Gramineae (Poaceae) für den Prodromus bearbeitet hatte, im Anhang zur Familie, in Lieferung 160: 221-228 (1970) vorgenommen.

Darunter auch *Eragrostis sabinae* Launert, eine neue Eragrostis Art, die von mir irrtümlicherweise — aufgrund der behaarten Knoten — unter dem Namen *Eragrostis barbinodes,* einer Art aus der Verwandtschaft von *E. lehmanniana,* verteilt wurde. Die neue Art zeichnet sich besonders durch die Ausbildung von Ausläufern, behaarten Knoten und auch durch die in dichten, basalen Büscheln stehenden, pfriemlichen und gekräuselten Blätter aus.

Die erste Aufsammlung kommt von Johann H. Gaerdes no. 41 von der Farm Kalidona, OK 227 (2118 AC — Steinhausen) aus einer Brackpfanne bei Baken Südecke-Etembagrenze, 30.4.1953, die lange Zeit unbestimmbar im Herbarium lag, und sich als diese neue Art herausstellte.

Bei unserem Besuch des Etoscha National Parks im März 1963 wurde die neubeschriebene Aufsammlung gemacht. Sabine Bleissner no. 58 (Holotypus in München) und W. Giess, O. H. Volk & B. Bleissner no. 6099 (Topotyphus im S.W.A. Herbarium Windhoek, verteilt an die Herbarien in Pretoria, München und Würzburg), auf feuchtem, brackigen Kalkmergelboden unweit der Etoschapfanne bei Okondeka (1815 DD — Okaukuejo), 27.3.1963. — Bei diesen, wie auch der vorigen Aufsammlung waren die kleinen, ausdauernden Horste nur wenige Zentimeter hoch und die Blütenstände tragenden Halme erreichten eine Höhe von 15 cm.

K. L. Tinley, no. 1334, ebenfalls im Etoscha Park zwischen Wolfsnes und Okondeka (1915 BB — Okaukuejo) am 15.2.1966 gesammelt, machte dazu die folgende Anmerkung: „Perennial small tufted and rigorously stoloniferous grass. In Odyssea grass savanna. Locally common." — Auch diese Aufsammlung war von derselben Größe wie die beiden vorigen.

Bei einer weiteren Aufsammlung von D. P. J. Opperman no. 89 bei Omuhenge in Ovambo, 25.4.1968, beträgt die Höhe der sehr dichten, fast kugeligen Horste aus gekräuselten Blättern 15 cm und die Blütenstände erreichen eine Höhe von fast 35 cm. Wie Opperman mir mitteilte, kommt *Eragrostis sabinae* auf Grasflächen im südlichen Owambo stellenweise im Reinbestand vor.

Im Januar 1972 besuchten wir die Farm Excelsior, WIN 286 (2217 BC — Windhoek) und kamen bei der Farmbegehung zu einer Quelle auf einer grösseren Pfanne, deren Boden sehr brackig war. Die dort stehenden Springböcke ästen eine *Salsola* Art derart kurz, daß diese bis 70 cm große, dem Boden aufliegende Polster bildete. Eigenartigerweise und zum ersten Mal beobachtet, trieb diese *Salsola* erneut an den dem Boden aufliegenden Zweigen Wurzeln. Dazwischen wuchs ein kleines, zierliches, ausläuferbildendes Gräschen, das sich als *Eragrostis Sabinae* entpuppte (W. Giess 11627). Diese beiden Pflanzen bildeten zur Zeit

unseres Besuches die einzige Vegetation dieser Pfanne. Nur in der Nähe der Quelle, die in einer Senke an der tiefsten Stelle liegt, wuchs *Coronopus integrifolius* (DC.) Sprengel — (W. Giess 11626) zusammen mit *Atriplex suberecta* (W. Giess obs.)

Die Verbreitung von *Eragrostis sabinae* Launert ist somit für die Bezirke (nach der Karte in Prodr.Fl.SWA.) Owambo — Etoscha — Okahandja — Windhoek nachwiesen.

Ximenia caffra Sonder var. *natalensis* Sonder (Olacaceae) aus Owambo. Neu für Südwestafrika.

Im Februar 1973 brachte Herr Gabriel Taapopi vom Eingeborenen-Sprachbüro der Administration in Windhoek verschiedene Pflanzen aus Owambo von einem Urlaub in seinem Heimatland zum Herbarium. In den vergangenen Jahren hat Taapopi bereits viele interessante Hinweise zur Flora von Owambo gegeben. Er konnte uns auch über den Gebrauch vieler Pflanzen Auskunft geben, wie zum Beispiel über *Diospyros lycioides* subsp. *lycioides*, deren Zweige und Wurzeln zur Zahnpflege benutzt werden. Durch seine Kenntnis der Pflanzen von Owambo hat er auch bei der Herausgabe der Publikation von P. J. le Roux, *Algemene benaming en enkele gebruike van die meer bekende inheemse plante van Suidwes-Afrika,* Pamflet 47, Departement Bosbou, 1971, massgeblich für die Sprachen Ndonga und Kwanyama beigetragen.

Unter den mitgebrachten Pflanzen fiel mir eine *Ximenia* Art auf, die durch ihre kahlen Blätter und Triebe vollig aus dem Rahmen der bisher bekannten Arten und Varietäten herausfiel. Auch war der Name in Kwanyama von denen der anderen Arten verschieden. Nach Mitteilung von Taapopi werden die Früchte dieser *Ximenia* nicht von den Ovambo gegessen, sondern nur die fetthaltigen Kerne genutzt. Meine Bestimmung des Materials ergab, dass wir die var. *natalensis* von *Ximenia caffra* vorliegen hatten, die bisher für Südwestafrika noch nicht bekannt war. Dr. H. Roessler von der Botanischen Staatsammlung in München bestätigte meine Bestimmung.

In diesem Zusammenhang ist es interessant, die in Südwestafrika vorkommenden *Ximenia* Arten erneut aufzuzählen und die Namen, die im Volksmund gebraucht werden, zu nennen wie auch ihre Nutzung und Verbreitung.

1. *Ximenia americana* L. var. *microphylla* Welw. ex Oliver
D: Sauerpflaume — A: suurpruim — E: Sour plum, wild plum — Herero: omuninga (auch im Kaokofeld) — Ndonga: okakukulu (=Strauch), ombeke (=Frucht) — Kwanyama: Okakukulu (=Strauch), omheke (=Frucht) — Mbalantu und Nkolonkadhi: ompeke — Gciriko: kakukuru — Kwangali: kakukuru & sipeke — Mbukushu: mutenyahambia.

Als letztes Nama: ǂeros. Von diesem Namen ist die Benennung der Erosberge, des Erosstadtteils von Windhoek wie auch des Eros-Flughafens abgeleitet und nicht, wie oft angenommen wird, nach dem griechischen Gott der Liebe, Eros, genannt.

Die gelben Früchte von säuerlichem Geschmack sind essbar. Der Strauch hat eine weite Verbreitung im südlichen Afrika: Botswana, Transvaal, Natal, Mozambique und Südwestafrika, wo er in allen nördlichen Bezirken Kaokoland, Grootfontein, Outjo, Otjiwarongo, Okahandja, Karibib und Windhoek vorkommt.

2. *Ximenia caffra* Sonder var. *caffra*
D: unter den Farmern des Nordens wird meist der Hereroname omumbeke gebraucht — A: kaffersuurpruim — E: Kaffirplum — Herero: omumbeke — Ndonga: oshimbyupeke (=Strauch), ombyu (=Frucht) — Kwanyama: oshimbyupeke (=Strauch), oshipeke (=Frucht) — Mbalantu und Nkolonkhadi: ompeke — Kwangali: sipeke (=Pflanze), nompeke (=Frucht) — Mbukushu: hambya.

Die pflaumengroßen, jedoch beiderseits etwas abgerundeten, roten Früchte werden von allen Völkern gern gegessen. Sie sind am schmackhaftesten, wenn sie etwas überreif sind. Bei unseren Freunden von Alvensleben auf Kumkauas bei Otavi erhielten wir auch in diesem Jahr bei einem Besuch den roten Saft der omumbeke, der ein durststillendes und köstliches Getränk ergibt.

Die Verbreitung ist von Rhodesien über Botswana, Transvaal, Natal bis Mozambique und Südwestafrika. Hier kommte sie in den Bezirken: Kaokoland, Owambo, Grootfontein und Kavango vor. In den südlichen Teilen fehlt sie, da wir es mit einem tropischen Element zu tun haben.

3. *Ximenia caffra* Sonder var. *natalensis* Sonder.
Diese Varietät der *X.caffra* erhielten wir erstmals durch Gabriel Taapopi aus Owambo, wo dieser Strauch in der Umgebung von Ohangwena (etwa 16 km südlich von Oshikango, der Grenzstation nach Angola) häufig vorkommen soll. Im Gegensatz zu *Ximenia americana* var. *microphylla* und *X.caffra* var. *caffra* werden die Früchte nicht gegessen, sondern getrocknet, dann aufgeschlagen und die ölhaltigen Kerne gestampft. Zum Gerben der Felle wird die gestampfte Masse gleich auf die Felle aufgetragen. Das gewonnene Öl wird auch als Hautöl von den Frauen benutzt. Nach Taapopi stellen die Früchte einen wertvollen Handelsartikel in Owambo dar, da sie an Stämme verkauft werden, in deren Gegend die Pflanze nicht vorkommt. Auch wird das Öl verkauft und zur Seifenbereitung benutzt. Bisher sind mir nur die Kwanyama Namen für diese Pflanze bekannt: oshinenepeke (= Strauch) und omheke (= Frucht).

Eine leider sterile Aufsammlung von Owen-Smith aus dem Kaokoland stimmt mit der Aufsammlung von G. Taapopi völlig überein und dürfte ebenfalls dieser Varietät entsprechen. Der Hereroname für diese Aufsammlung ist omumbatu. Bei der Aufnahme von Hereronamen im Kaokoland auf einer gemeinsamen Fahrt mit Professor O. Köhler im September 1968 wurde mir ein steriler und blattloser *Ximenia* Strauch, leider unbestimmbar, mit dem Namen omuninga belegt, der aber dem ganzen Habitus nach keine *Ximenia americana* var. *microphylla* war. Auch hier wurde mir gesagt, dass die roten (und nicht gelben Früchte der *X.americana)* Früchte nicht gegessen, sondern nur die Kerne zur Ölbereitung benutzt werden. Es kann sich bei dieser Pflanze in den Baynesbergen bei Otjipemba unweit des Kunene auch um die obengenannte Varietät handeln.

In Südwestafrika wäre demnach bisher die Verbreitung auf Ovambo und Kaokoland beschränkt, während sie in Südafrika nach L. E. Codd eine südlichere Verbreitung als var. *caffra* hat, im östlichen Transvaal bis Natal und im Krüger National Park südlich des Sabierivieres anzutreffen ist.