DINTERIA NR. 12 — WINDHOEK, S.W.A. — MÄRZ 1976

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Euphorbia (Tetracanthae) in Angola and northern Kaokoland

(10 figures, 2 maps)

ABSTRACT

Euphorbia Sect. *Tetracanthae* Pax is considered to be morphologically and phylogenetically homogeneous. Its almost wholly tropical African distribution is divided into two disjunct portions, with the smaller western segment restricted to a relatively small area of south-western Angola and northern Kaokoland. The diagnostic characters of the group are discussed, eight new taxa are described and one new combination made. A key to the western taxa is provided as well as a map showing their distribution.

Pax's Section *Tetracanthae*, with its circumscription modified to include only those species with single horizontally arranged cymes and included ovaries, comprises a most homogeneous group of plants characterised by numerous "good" morphological characters, and it is considered that the species included under the above most apt epithet form a very natural group.

Its distribution is almost entirely tropical and is divided into two disjunct portions; that on the eastern side of Africa is by far the larger, both in number of species and its area of distribution, which extends south of the tropic to about 27° 30′ S. The western portion, with which this paper is concerned, is restricted, with relatively few species, to the south-west of Angola and northern Kaokoland, between 10° 30′ S and 18° 30′ S and lies ± 1 200 km to the west of the most westerly known representatives of the eastern segment of the distribution.

Although so widely separated geographically the two groups are obviously closely related and the similarities far too close and too numerous to be due to convergence. This close relationship is particularly evident between populations of *E. subsalsa s.l.* and those of robust plants of the *E. schinzii* affinity which occur along the Limpopo valley.

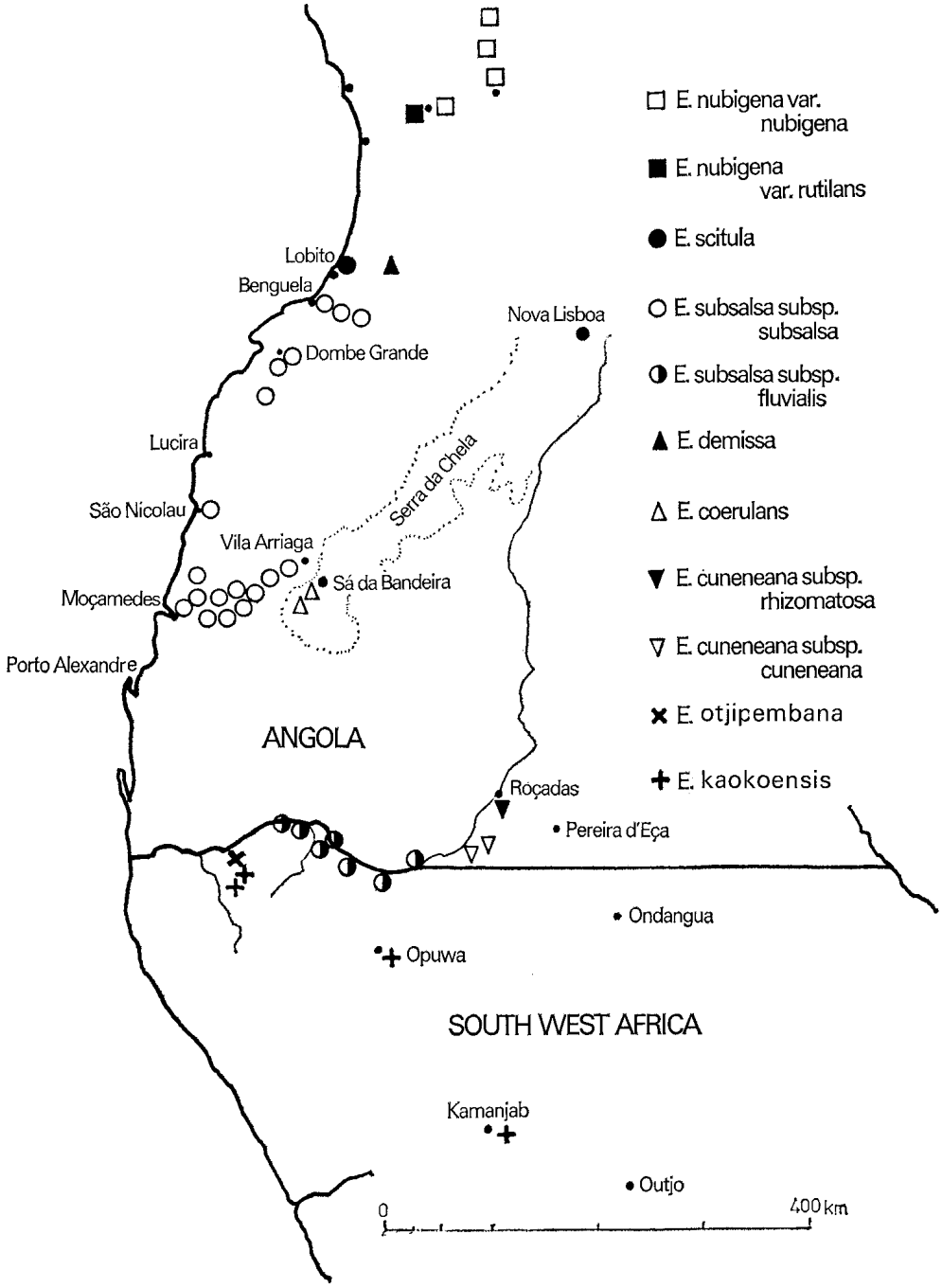
Plants belonging in this section are shrubby in habit, mostly of dwarf to medium height (usually less than 1 m), generally with 4-angled, more or less parallel-sided branches, with the characteristic 2 pairs of spines borne on more or less

Approximate distribution of *Euphorbia* Sect. *Tetracanthae*

narrowly cuneate, usually decurrent, seldom continuous, horny shields. The axillary inflorescence comprises a cyme of three horizontally arranged cyathia (exceptions are restricted to the addition of one or two axially disposed cyathia), with an included ovary, an obtusely 3-lobed scarcely exserted capsule and more or less ovoid or ellipsoid (seldom subglobose) verrucose seeds; epidermal characters include randomly orientated, scattered paracytic stomata and straight-sided, mostly pentagonal epidermal cells.

In the area under consideration eight species are now recognised. Of these *E. coerulans* and *E. subsalsa* were previously published, *E. subsalsa* var. *kaokoensis* is raised to specific rank and five new species and three infra-specific taxa are now described.

The majority of these have been in cultivation in the author's gardens over a number of years, and where possible have also been raised from seed gathered


E. nubigena var. nubigena
E. nubigena var. rutilans
E. scitula
E. subsalsa subsp. subsalsa
E. subsalsa subsp. fluvialis
E. demissa
E. coerulans
E. cuneneana subsp. rhizomatosa
E. cuneneana subsp. cuneneana
E. otjipembana
E. kaokoensis
Lobito
Benguela
Nova Lisboa
Dombe Grande
Lucira
Serra da Chela
São Nicolau
Vila Arriaga
Sá da Bandeira
Moçamedes
Porto Alexandre
ANGOLA
Roçadas
Pereira d'Eça
Ondangua
Opuwa
SOUTH WEST AFRICA
Kamanjab
Outjo
0
400 km

in the field. The criteria on which they are distinguished are those which have been retained in cultivation and which consequently appear to be genetically controlled.

Although a few species appear possibly to be morphologically more closely related to some of those of the eastern distribution, the following key is based on comparisons between taxa of the western group only, as this is considered not only to be more useful but probably more likely to reflect their phylogenetic relationship.

ZUSAMMENFASSUNG

Die Sektion *Tetracanthae* der Gattung *Euphorbia* wird als morphologisch und phylogenetisch einheitlich angesehen. Ihre fast ausschließlich tropische Verbreitung erstreckt sich auf zwei disjunkte Areale, wovon der kleinere westliche Teil auf ein relativ kleines Gebiet im südwestlichen Angola und dem nördlichen Kaokoland in Südwestafrika beschränkt ist. Die Erkennungsmerkmale der Gruppe werden besprochen, acht neue Arten beschrieben und eine neue Kombination ist aufgestellt. Für die westlichen Taxa wird ein Schlüssel gegeben, sowie eine ihre Verbreitung zeigende Karte.

Die von Pax beschriebene Sektion *Tetracanthae* mit ihrer abgeänderten Umgrenzung, um nur diejenigen Arten mit einzelnen, horizontal angeordneten Scheinblüten und mehr oder weniger sitzenden Fruchtknoten (Ovarien) zu umfassen, schließt eine äußerst einheitliche Gruppe Pflanzen ein, die durch zahlreiche gute morphologische Merkmale charakterisiert sind. Die unter diesem obengenannten äußerst passenden Epithet zusammengefaßten Arten werden als eine sehr natürliche Gruppe angesehen.

Ihre fast ausschließlich tropische Verbreitung ist in zwei disjunkte Areale geschieden, wobei das weit größere auf der östlichen Seite Afrikas liegt mit einer größeren Anzahl Arten und einem Verbreitungsareal, das sich südlich der Tropen bis etwa 27° 30′ S erstreckt. Der westliche Anteil, mit dem sich diese Arbeit befaßt, ist mit relativ wenigen Arten auf das südwestliche Angola und das nördliche Kaokoland zwischen 10° 30′ und 18° 30′ S beschränkt und liegt ± 1 200 km westlich des am weitesten westlich gelegenen Vertreters des östlichen Anteils der Verbreitung.

Wenn auch geographisch so weit voneinander geschieden, sind doch beide Gruppen unverkennbar eng verwandt. Ihre Gleichartigkeit ist zu eng, als daß sie nur auf Konvergenzen zurückgeführt werden könnte.

Die enge Verwandtschaft ist besonders augenscheinlich zwischen Populationen von *E. subsalsa* s.l. und denjenigen der kräftigen Pflanzen der *E. schinzii* Verwandtschaft, welche entlang des Limpopotales vorkommen.

Pflanzen dieser Sektion sind von strauchiger Wuchsform, meist von niederer bis mittlerer Höhe (meist weniger als 1 Meter), allgemein mit 4-kantigen ± parallelseitigen Ästen, mit den charakteristischen paarigen Dornen, auf ± schmalen, keilförmigen, gewöhnlich herablaufenden, selten ununterbrochen fortlaufenden Schildern. Die achselständigen Blütenstände sind in einer Trug-

dolde von drei horizontal angeordneten Scheinblüten zusammengesetzt (Ausnahmen sind auf die Vermehrung von zwei oder drei achselständig angeordneten Scheinblüten beschränkt), mit einem sitzenden Fruchtknoten (Ovarium), einer stumpflichen 3-lappigen, kaum herausragenden Kapsel und ± eiförmigen oder ellipsoiden (selten fast kugeligen) warzigen Samen; die epidermalen Charakter schließen unregelmäßig zerstreute parazytische Spaltöffnungen (Stomata) und asymmetrische, fast fünfeckige Epidermiszellen ein.

In dem Areal der Betrachtung werden jetzt 8 Arten angetroffen. Von diesen sind *E. coerulans* und *E. subsalsa* bereits früher beschrieben. *E. subsalsa* var. *kaokoensis* wird zu einer guten Art erhoben und 5 neue Arten und drei infraspezifische Taxa sind neu beschrieben.

Die Mehrzahl dieser Arten war über eine Anzahl von Jahren in dem Garten des Autors unter Kultur, und wo es möglich war, wurden diese aus durch im Veld gesammelte Samen angezogen.

Die Kriteria, unter denen sie unterschieden werden, sind solche, die sich auch unter Kultur erhalten haben und welche folglich genetisch kontrolliert erscheinen.

Obwohl einige Arten möglicherweise morphologisch mit einigen der östlichen Verbreitungsgruppe enger verwandt sind, werden dem Schlüssel nur Vergleiche der westlichen Gruppe zugrunde gelegt. Es wird angenommen, dass dies nicht nur verständlicher ist, sondern auch dadurch wahrscheinlich ihre phylogenetische Verwandschaft besser widergespiegelt wird.

SAMEVATTING

Euphorbia seksie *Tetracanthae* word as 'n morfologies en filogeneties homogene groep beskou. Sy feitlik tropies-Afrikaanse verspreiding word in twee onderskeidende groepe ingedeel, met die kleiner westelike segment wat beperk is tot 'n relatief klein gebied van suidwestelike Angola en noordelike Kaokoland. Die kenmerkende eienskappe van die groep word bespreek, agt nuwe taksons word beskryf en een nuwe kombinasie word voorgestel. 'n Sleutel met betrekking tot die westelike taksons word voorsien sowel as 'n kaart om hulle verspreiding aan te toon.

Pax se seksie *Tetracanthae,* waarvan die beskrywing verander is om slegs daardie spesies met 'n enkele horisontaal gerangskikte bloeiwyse met sittende vrugbeginsels in te sluit, omvat 'n uiters homogene groep plante wat gekenmerk word deur verskeie goeie morfologiese eienskappe. Alles in aanmerking geneem vorm die spesies onder die bogenoemde mees gepaste epiteton 'n baie natuurlike groep.

Sy verspreiding is feitlik heeltemal tropies en word verdeel in twee onderskeidende groepe; diè aan die oostelike kant van Afrika is by verre die grootste, in aantal spesies en die verspreidings area — wat suid van die trope tot ongeveer 27° 30′ S strek. Die westelike groep, waarop hierdie artikel gebaseer is besit relatief min spesies en is beperk tot die suidwestelike deel van Angola en Noordelike Kaokoland, tussen 10° 30′ en 18° 30′ S en is ongeveer 1 200 km

wes van die mees westelike verteenwoordigers van die oostelike verspreidingsgroep geleë.

Ten spyte daarvan dat die twee groepe geografies so ver van mekaar verwyder is, is hulle baie nou verwant en is die ooreenkomste te groot en te menigvuldig sodat ons dit aan konvergensie kan toeskryf. Hierdie noue verwantskap is veral duidelik tussen gemeenskappe van *E. subsalsa* s.l. en die sterkgroeiende plant wat verwantskap toon met *E. schinzii* wat in die Limpopovallei voorkom. Plante wat aan hierdie seksie behoort besit 'n struikagtige voorkoms; besit meestal 'n dwergagtige tot medium grootte (gewoonlik kleiner as 1 meter); meestal met vierhoekige, min of meer parallelsyige takke, met die kenmerkende twee paar (stekels) pendorings wat gedra word op 'n min of meer smal wigvormige, gewoonlik dalende, meestal ononderbroke horingagtige skilde. Die okselstandige trosvormige bloeiwyse is saamgestel uit drie horisontaal gerangskikte cyathiums (uitsonderings is beperk tot 'n bykomende een of twee okselstandige cyathiums) met 'n sittende vrugbeginsel, 'n afgestompte drielobbige, skaars gesteelde kapsels en ongeveer eiervormige of elipsvormige (selde halfbolrand) vratagtige sade. Epidermale kenmerke sluit in onreëlmatig verspreide parasitiese huidmondjies en asimmetriese meestal pentagonale epidermale selle.

In die area onder bespreking is agt spesies waargeneem. Hiervan is *E. coerulans* en *E. subsalsa* vantevore reeds gepubliseer; *E. subsalsa* var *kaokoensis* is verhef tot spesievlak terwyl vyf nuwe spesies en drie intraspesifieke taksons beskryf is.

Die meeste van die spesies is in die tuin van die outeur oor 'n aantal jare aangeplant, en waar moontlik gekweek van sade wat in die veld versamel is. Die kriteriums waarop hulle onderskei is, is diè wat verkry is onder aangeplante toestand en wat deurgaans geneties konstant vertoon het.

Hoewel dit blyk dat 'n paar spesies morfologies noue verwantskap toon met sommige spesies van die oostelike verspreidingsgroep, is die hieropvolgende sleutel slegs gebaseer op die vergelyking van taksons van die westelike groep. Dit is nie alleen taksonomies meer waardevol nie, maar hulle filogenetiese verwantskap word beter weerspieël.

A key to the western species of *Euphorbia* Sect. *Tetracanthae*

Spiny or spinulose erect shrubs or shrublets, up to ± 1,5 m high,
branches 3—7-angled or -ribbed, spines and/or spinules paired
Branches 4-angled, slender, less than 1,5 cm thick, ± parallel-sided,
not or only distantly constricted into segments
Spine-shields oblong-obtriangular or -obovate, often pointed at the
base, but not or only slightly decurrent, spine pairs often sub-equal;
plants less than 20 cm high
Angles prominently crenate, main spine pairs more than 7 mm
apart along the angles; root tuberous . . . . . (1) *E. coerulans*
Angles only lightly crenate, main spine pairs less than 7 mm
apart along the angles; with a woody tap-root . . . (2) *E. demissa*
Spine-shields decurrent

Spines less than 6 mm long, weak (needle-like)
Shields almost or quite reaching the flowering-eye below, often forming a subcontinuous horny margin . . (3) *E. nubigena*
Cyathia and fruits yellowish brown . . . . (3a) var. *nubigena*
Cyathia and fruits bright red . . . . . (3b) var. *rutilans*
Shields not reaching the flowering-eye below
Main spine pairs less than 10 mm apart along the angles, branches prominently whitish striped . . . . (4) *E. scitula*
Main spine pairs more than 12 mm apart along the angles, branches whitish striped when young . . . (5) *E. cuneneana*
Root tuberous, branches to 90 cm long . (5a) subsp. *cuneneana*
Root rhizomatous, branches up to 30 cm long . . . . . (5b) subsp. *rhizomatosa*
Spines more than 6 mm long, relatively strong . . . . (6) *E. subsalsa*
Branches pale striped, shrubs branched from base (6a) subsp. *subsalsa*
Branches unmarked, shrubs freely branched above (6b) subsp. *fluvialis*
Branches 3—7-angled or ribbed, stout, more than 1,5 cm thick
Shields decurrent ± to the flowering-eye below, usually forming a subcontinuous horny margin; spines less than 10 mm long (upper pair reduced to prickles; branches 3—6-angled, lightly constricted into segments . . . . . (7) *E. otjipembana*
Shields decurrent but seldom reaching the flowering-eye below, not forming a continuous margin; spines usually more than 10 mm long (up to 24 mm); branches 5—7-ribbed, not constricted into, segments . . . . . (8) *E. kaokoensis*

(1) Euphorbia coerulans Pax in Bull. Herb. Boiss. **6**: 739 (1898) et in Bot. Jahrb. **34**: 81 & 375 (1904). — N.E. Br. in Fl. Trop. Afr. **6** (1): 569 (1911). — Gossweiler & Mendonça, Carta Fitogeogr. Angol.: 165 (1939). — Jacobsen, Sukk. Lexikon: 184 (1970).

Type: Angola, Humpata, *Dekindt* 829 (B †; LISC, lectotype!).

Pax, in Bot. Jahrb. **34**: 375 (1904), suggested that *E. subsalsa* Hiern is most probably synonymous, but this is a very different, much larger shrub not to be confused with the dwarf *E. coerulans*.

Angola. Huila Distr., Humpata, *Dekindt* 829 (LISC); ibid. fl. 6.VIII.1905, *Fritzoehe* 218 (K, icon.); Tchivinguiro, fl. 15.V.1941, *Gossweiler* 12974 (LISC); Canhangole, 20 km de Huila, st. 6.II.1956, *Mendes* 1621 (LISC); Tchimpaca Leo, fl. 10.IV.1967, *Leach et al* 14018 (LISC; SRGH); ibid. cult. Greendale, fl. & fr. 26.IV.1973, 14018A (BM; LUAI), idem, fl. 29.IV.1974 (K).

E. coerulans appears to be restricted to the "Planalto da Humpata", and from the paucity of gatherings appears also to be rather rare, although this may be accounted for, at least in part, by its inconspicuous dwarf habit. The prominently humped tubercle teeth and the spinescence of *E. coerulans* seem perhaps to indicate a connection with *E. tetracanthoides* Pax and *E. nyassae* Pax, both from north-eastern Zambia and southern Tanzania. However, for the reasons discussed in the introduction, the following morphological comparisons are made with *E. subsalsa*. *E. subsalsa* is a very much larger shrub, sometimes up to 1,5 m tall, with branches with differently shaped, less prominent tubercle teeth and quite

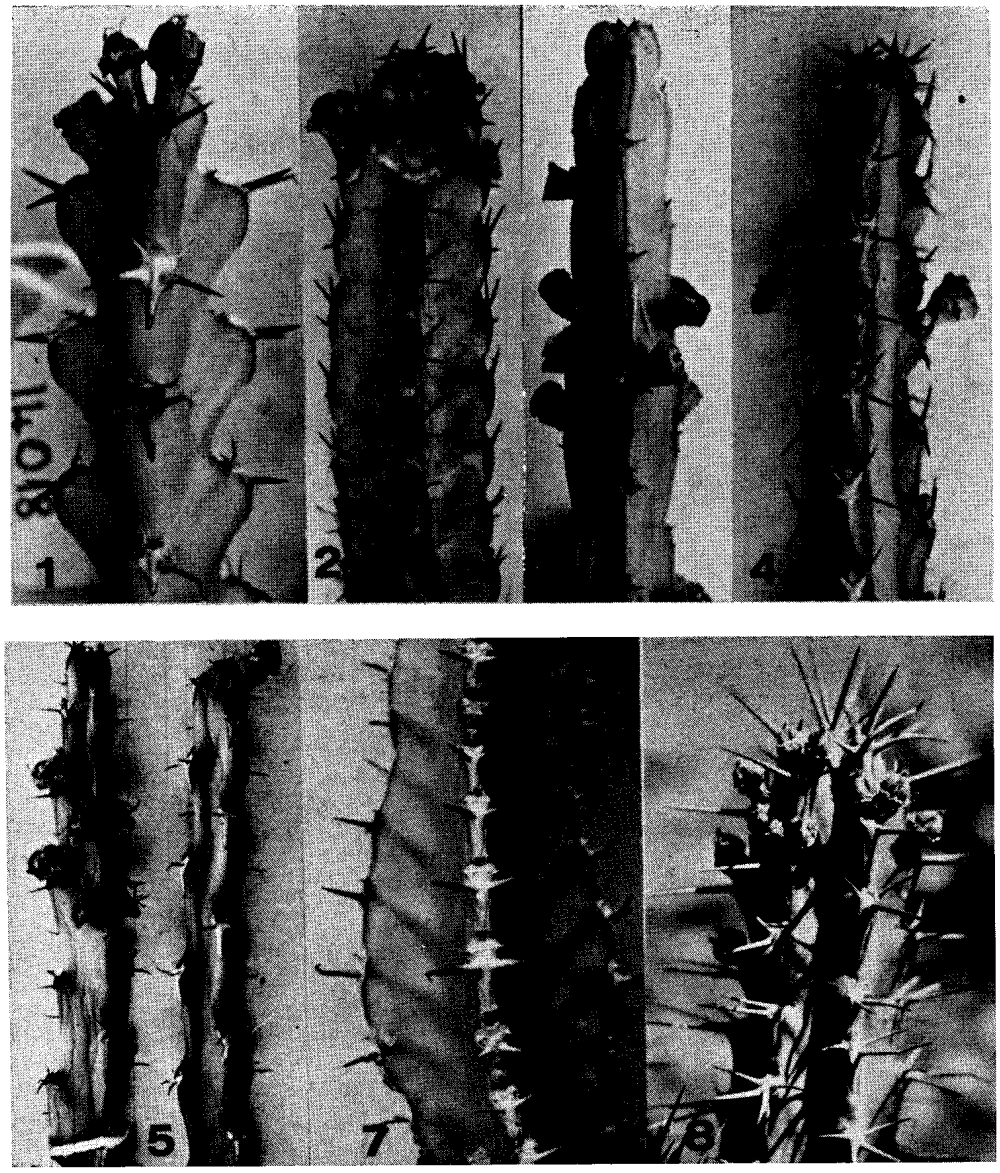
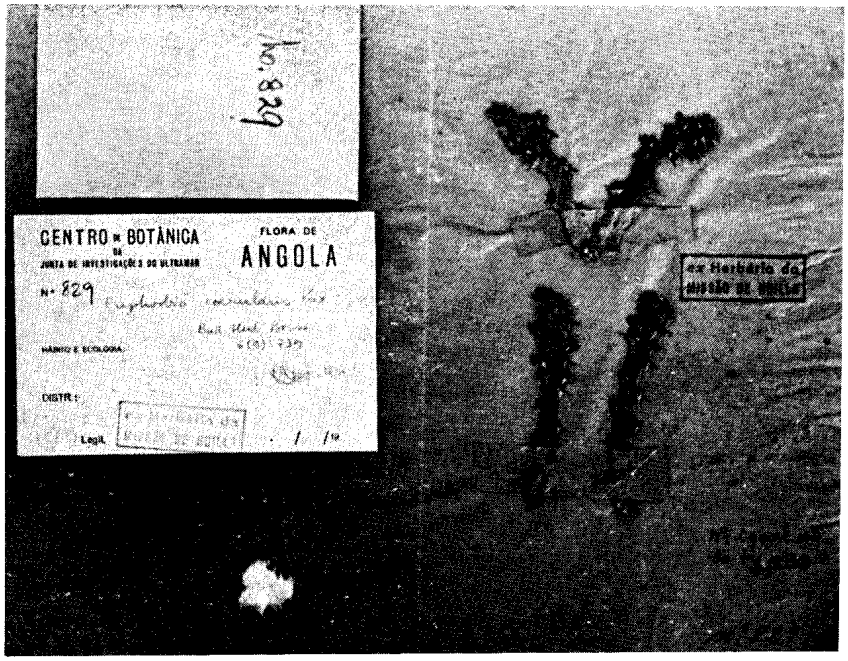


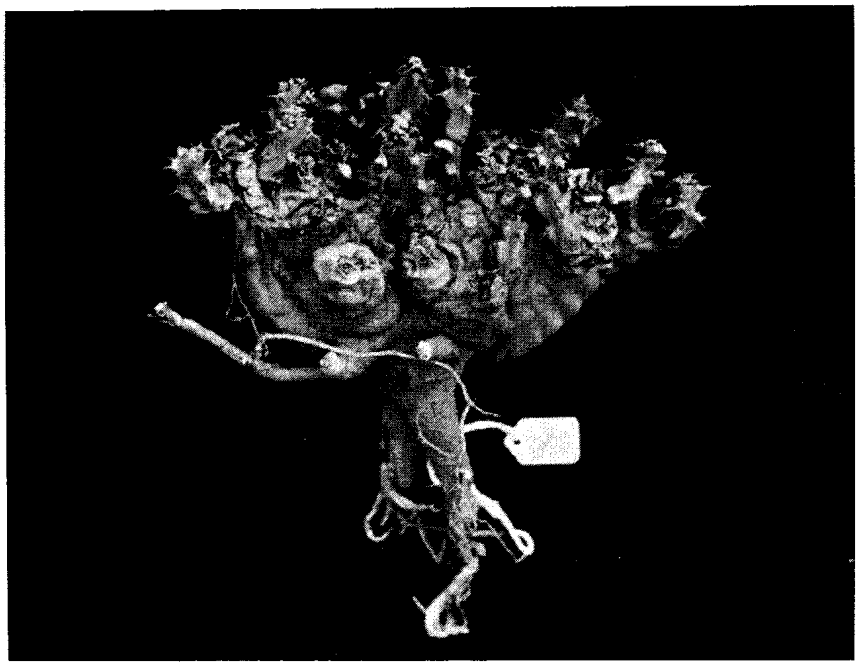
Fig. 1. (1) *E. coerulans* (2) *E. demissa* (3) *E. nubigena* (4) *E. scitula* (5) *E. cuneneana* (6) *E. subsalsa,* see Fig. 8a p. 28 (7) *E. otjipembana* (8) *E. kaokoensis*

different spinescence with the shields sometimes subcontinuous, and with a virtually sessile inflorescence of smaller cyathia; all very different from the tuberous rooted dwarf plants of *E. coerulans* with branches only a few cm long, widely spaced and widely divergent spine pairs on smaller, scarcely decurrent spine shields, a distinctly pedunculate inflorescence and longer, more slender, simple styles.

Fig. 2 **(1) Euphorbia coerulans** Pax



Lectotype: *Dekindt* 829 (LISC).



Plant from the Planalto da Humpata, *Leach & Cannell* 14018.

Plant: a perennial, spiny, dwarf succulent with numerous short branches arising from a relatively large irregularly shaped tuberous root. *Branches* mostly simple, 4-angled, prominently sinuately crenate along the angles, generally 6—7 cm long (exceptionally up to 15 cm), (8)12—20 mm diam. including the decussately arranged crenations which are up to 5 mm high, with their apices 10—15 mm apart along the angles. *Spine shields* at the apex of the crenations, dark brown very soon becoming grey, obtriangular or obovate to narrowly obtriangular, truncate at the apex, pointed at the base, sometimes decurrent to about half-way to the flowering-eye below. *Spines* 4, in widely divergent relatively widely spaced pairs, the lower pair 2,5—5 mm long, widely divergent, more or less horizontally spreading or sometimes somewhat deflexed; the upper pair, ± 2 mm above the lower, on each side of the transverse broadly elliptic leaf scar, variably divergent, usually suberect or pointing slightly inwards (seen from the side), very variable in length, 0,5—4,5 mm long, sometimes subequalling the lower pair. *Leaves* very fleshy, 1,5 mm wide, 0,75 mm long, acute, almost immediately caducous.

Inflorescence a single axillary pedunculate cyme of 3 cyathia, with the cyathia horizontally arranged; the initial central cyathium male, subpersistent and the laterals bisexual. *Peduncle* stout, up to 2,5 mm long; *bracts* subtending the lateral cyathia, oblong, obtuse, denticulate, ± 2,0 × 2,5 mm. *Involucral bracts* similar, up to 3 mm long, somewhat concave and fleshy towards the base, each subtending a well developed axillary bud. *Involucre* with a solid fleshy base merging with the cyme branch, the whole more or less obconical, ± 6 mm long, 5 mm diam. including the suberect glands; *glands* 5, transversely elliptic, ± 2,5 × 1,25 mm, contiguous, generally suberect, yellow, pitted rugulose on the upper surface with a narrow plain margin; *lobes* 5, more or less flabellate, fimbriate, ± 2 × 2 mm with fimbria up to 1 mm long. *Male flowers* ± 15, far exserted from the involucre, arranged in 5 fascicles, each fascicle with (2)3 flowers arranged in a single rank, closely enwrapped in a broad, laciniate bract, ± 3 mm long, with the lacinia narrowly cuneate, fimbriate; bracteoles filamentose or narrowly cuneate, fimbriate; *pedicels* ± 3 mm long; *filaments* ± 1,5 mm long. *Ovary* 3-lobed, trigonous, sessile, seated on a rudimentary perianth ± 0,5 mm long; ovule suspended under a rather fleshy, minutely fringed, somewhat 2-lobed obturator. *Styles* slender, united in a column ± 1 mm long at their base (becoming shorter in fruit), with the free portions spreading recurved, ± 2,5 mm long, scarcely grooved down the inner face, with enlarged, rugulose stigmas. *Capsule* obtusely 3-lobed, with the lobes somewhat compressed towards the apex (somewhat ovoid viewed from the end), ± 4,5 mm diam., 3,5 mm high, sessile, seated on a rudimentary pentagonal perianth ± 2,25 mm diam., 1,25—1,5 mm long. *Seed* brown, more or less ellipsoid, somewhat pointed at one end, more or less straight sided along the narrow dark brown suture and slightly laterally compressed, ± 2—2,25 mm long, 1,5 mm diam., irregularly verrucose, with the verrucae irregularly shaped, more or less flat-topped.

(2) Euphorbia demissa Leach, sp. nov.; *E. nubigenae* Leach apparenter arcte affinis sed radice palari lignosa; habitu demisso, ramis brevissimis plerumque subdecumbentibus; podariis obovatis latioribus vix decurrentibus, spinis superioribus suberectis; involucri bracteis oblongis, satis differens; podariis spinisque

probabiliter ad *E. coerulantem* Pax propius accedens sed pro parte maxima ab hac valde recedit.

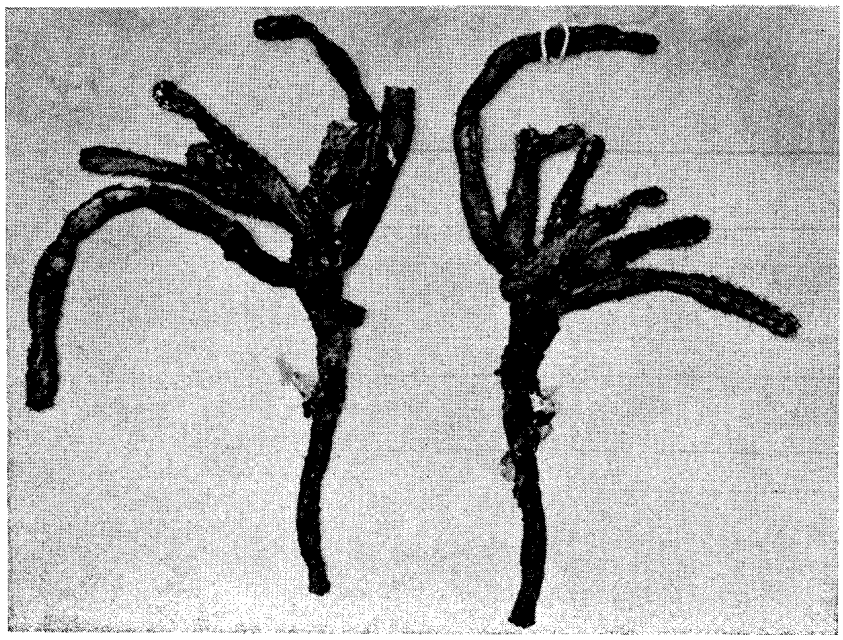
Fruticulus demissus, spinulosus, succulentus, ramis aliquam pronis, radice palari duro-lignosa. *Rami* valde patuli saepe decumbenti, plerumque simplices, in segmentis vix vel haud constricti, 4-angulati, lateribus plerumque profunde concavis, angulis saepe aliformibus, 8—10 mm crassi, usque ad 15 cm longi (plerumque c. 8 cm.), in angulis leniter sinuato-dentati, dentibus secus angulos 3,5—6,5 mm distantibus, 1—1,5 mm altis. *Podaria* plus minusve oblongo-obovata, basi breviter attenuata, 3—4,5 mm longa, c. 2 mm lata. *Spinae* binae, paribus relative late separatis (c. 1,5 mm), longitudine variantissima, interdum illis paris superioris quam illis paris inferioris longissimis, divergentibus, suberectis a latere visis, plerumque 2—3 mm longis, rarissime obsolescentibus; illis paris inferioris latissime divergentibus, horizontaliter patulis, plerumque c. 2—3 mm longis vel interdum obsolescentibus. *Folia* non visa, apparenter confestim caduca; cicatrix subcircularis vel transverse late elliptica. *Inflorescentia* cymosa, glabra, flava; cymae singulares, axillares, subsessiles, proxime super podarium insertae; cyathiis 3, horizontaliter dispositis; cyathium primum masculum deciduum; cyathia lateralia bisexualia, basi cymae in bractearum axillis inserta; *pedunculus* vestigialis, usque ad 1,5 mm longus, *bracteis* binis, carnosis, concavis, obtusis, denticulatis, c. 1,75 mm longis latisque, ut videtur persistentibus. *Involucrum* cyathiforme, c. 4 mm longum cymae ramo coalito incluso, 4,5—5,0 mm diam. glandulis inclusis; *bracteae* oblongae, obtusae vel subacutae, denticulatae, c. 2 mm longae, 1,0—1,25 mm latae, ut videtur persistentes; *glandulae* 5, contiguae, patulae, plus minusve transverse oblongae vel subreniformes, c. 1,0 x 2,5 mm, leviter concavae, hebetatae vel levissime pusticulatae margine exteriore angusto laevi; *lobi* 5,plus minusve flabelliformes, irregulariter fimbriati, c. 1,25 mm longi latique. *Flores masculi* bracteolis filiformibus paucis in fasciculis 5 dispositi; floribus 2—3 in quoque fasciculo uniseriatis, bractea interiore marsupium formanti subtentis; bractea c. 2 mm longa, profunde laciniata, lobis anguste cuneatis vel spathulatis, fimbriatis; *pedicelli* c. 2 mm longi; *filamenta* vix quam 0,5 mm longa. *Ovarium* obtuse 3-lobatum, perianthio rudimentali, c. 0,2 mm longo insidens; *ovulum* obturamento distincte bilobato suspensum; *styli* c. 2 mm longi, obtuse bilobati, libri fere ad basi, lobis brevissimis patulis. *Capsula* obtuse 3-lobata, c. 3,5 mm diam., 2,5 mm alta. *Semen* (forsan non perfecte evolutum), plus minusve oblongo-ellipsoideum, obscure verrucoso-rugulosum, c. 2 mm longum.

Typus: Angola, Benguela Distr., prope Sousa Lara, *Leach & Cannell* 14582 (LISC, holo.; SRGH).

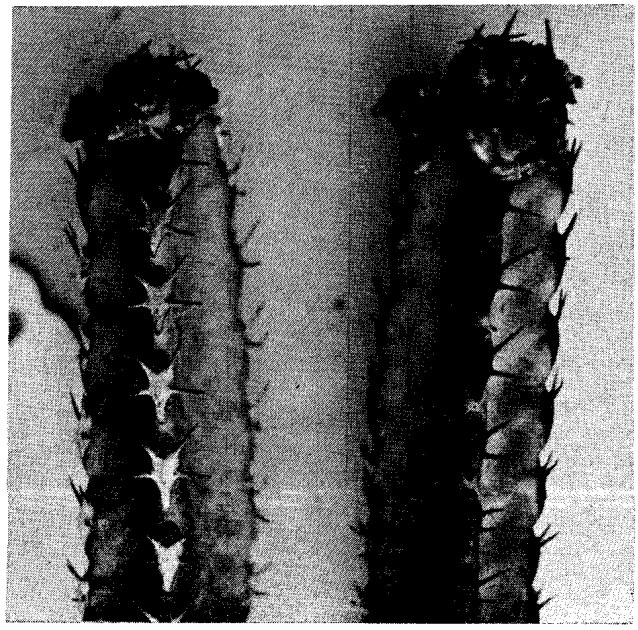
Angola. Benguela Distr., ± 14 km E of Sousa Lara; somewhat depressed dwarf plants, relatively plentiful on ridges of partially decomposed granite, in association with *Aloe andongensis* Bak. and *Huernia volkartii* Werderm. & Peitsch., fl. & fr. 6.X.1970, *Leach & Cannell* 14582 (LISC; SRGH).

E. demissa appears to be most closely related to *E. nubigena* but differs considerably in its lowly habit with crowded, much shorter, spreading branches arising from the apex of a hard woody tap-root, and is further distinguished by its wider, oblong-obovate, scarcely decurrent spine shields and suberect upper pair of spines, while finally the oblong involucral bracts are quite different from those

Fig. 3. **(2) Euphorbia demissa** Leach



Plant ± 12 cm high, with woody tap-root



Flowering branch apices showing spinescence

of its congener. In spinescence possibly closest to *E. coerulans*, the new species differs from this in most other characters. The species is at present known only from the type locality about 14 km to the east of Sousa Lara in the Benguela Distr. where plants are relatively plentiful on low ridges of partially decomposed granite, in association with *Aloe andongensis* Bak. and *Huernia volkartii* Werderm. & Peitsch. at approximately 1 000 m altitude.

A dwarf, spinulose, succulent *shrublet* with crowded, relatively short branches arising from the apex of a woody tap-root. *Branches* spreading, sometimes subdecumbent, usually simple, not or scarcely constricted into segments, 8—10 mm thick, usually ± 8 cm, up to 15 cm long, 4-angled, with the sides usually deeply concave and the angles often somewhat wing-like, shallowly sinuate-dentate, with the teeth 1—1,5 mm high, 3,5—6,5 mm apart along the angles. *Spine shields* more or less oblong-obovate, usually very shortly attenuate at the base, 3—4,5 mm long, ± 2 mm wide. *Spines* 4, arranged in relatively widely separated pairs ± 1,5 mm apart, those of the upper pair divergent, suberect when seen from the side, usually 2—3 mm long, very rarely obsolescent; those of the lower pair widely divergent, horizontally spreading, very variable in length, up to 3 mm long, frequently obsolescent and sometimes much shorter than those of the upper pair. *Leaves* not seen, apparently almost immediately caducous, leaving a subcircular or transversely broadly elliptic scar. *Inflorescence* cymose, glabrous, yellow; cymes solitary, axillary, inserted closely above the spine-shield, with 3 cyathia horizontally arranged; the initial central cyathium male, deciduous; lateral cyathia bisexual, inserted in the axils of the bracts at the base of the cymes; *peduncle* bibracteate, vestigial, rarely up to 1,5 mm long; *bracts* fleshy, concave, obtuse, denticulate, ± 1,75 mm long and broad, apparently persistent. *Involucre* cup-shaped, coalescent with the cyme branch, the whole ± 4 mm long, 4,5—5,0 mm diam.; *bracts* oblong, obtuse or subacute, denticulate, ± 2 mm long, 1,0—1,25 mm wide, apparently persistent; *glands* 5, contiguous, spreading, transversely oblong or subreniform, ± 1,0 x 2,5 mm, slightly concave, matt or very lightly rugulose, with a smooth, narrow, outer margin; *lobes* 5, more or less flabelliform, irregularly fimbriate, ± 1,25 mm long and wide. *Male flowers* with a few filiform bracteoles, arranged in 5 fascicles opposite the lobes, each with 2—3 flowers arranged in a single rank and subtended by an internal bract forming a pocket at its base; *bract* ± 2 mm long; deeply laciniate with the fimbriate lacinia narrowly cuneate or spathulate. *Ovary* obtusely 3-lobed, seated on a rudimentary perianth; *ovule* suspended beneath a distinctly 2-lobed obturator; *styles* ± 2 mm long, shortly united at their base into a somewhat 3-sulcate column ± 0,5 mm long, very shortly bifid at the apex with divergent, obtuse lobes. *Capsule* obtusely 3-lobed, ± 3,5 mm diam. x 2,5 mm high. *Seed*, perhaps not quite fully developed, more or less ellipsoid-oblong, shallowly verrucose-rugulose, ± 2 mm long.

(3) Euphorbia nubigena Leach, sp. nov.; inter species angolanas probabiliter ad *E. coerulantem* Pax arctissime affinis sed radice rhizomatosa, habitu altissimo, ramis gracilioribus debilioribusque marginibus levissime crenulatis, podariis longe decurrentibus spinisque debilioribus, cymis sessilibus subsessilibusve cyathiis minoribus stylisque dimidio brevioribus manifeste differens.

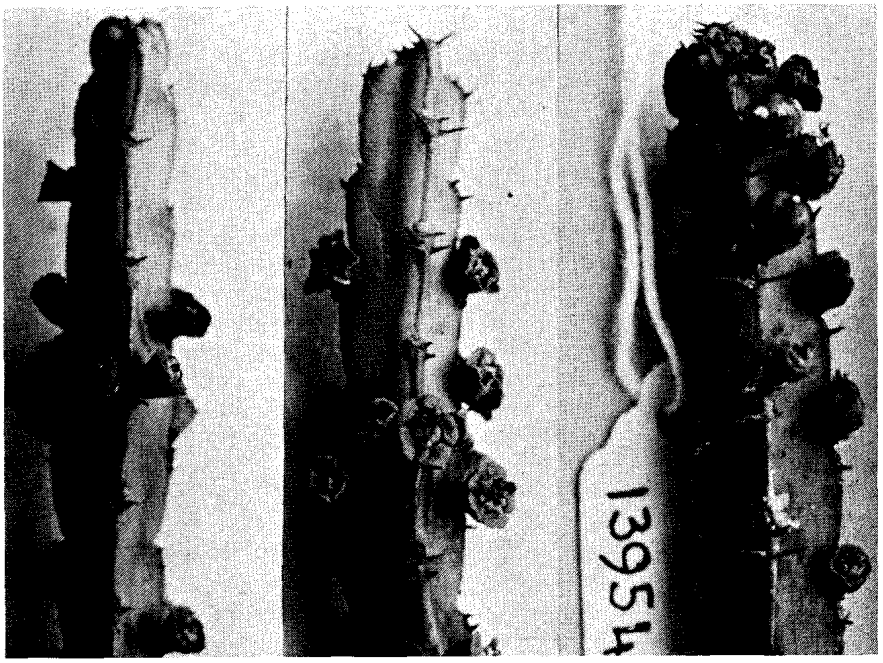
(3a) Var. **nubigena**. *Planta* aliquam infirme suberecta, succulenta, spinulosa, plerumque 20—40 cm alta (rarissime usque ad 90 cm), radice aliquanto rhizomatosa, in fissuris collium rupiumque graniticorum crescens. *Rami* saepissime simplices, flexibiles et facile fracti etsi demum sublignescentes, interdum plus minusve decumbentes, tum saepe arescentes mortuique; 4-angulati, angulis leviter crenulatis, inter angulos plus minusve plani, perrariter in segmentis constricti, brunneovirides, 5—8,5 (10) mm crassi. *Podaria* pallide brunnea mox cinerascentia, plus minusve angustissime triangularia, 6—8 mm longa, c. 1,5 mm ad apicem lata, fere ad gemmam inferam anguste decurrentia, interdum ramorum in partibus vetioribus contigua subcontinua. *Spinae* binae, 4, paris inferioris longitudine variantissima, obsolescentes vel usque ad 3 mm longae, infirme aciculares, divergentes, horizontaliter patulae; paris superioris 1,25—2,5 mm supra par inferius dispositae, late divergentes, 0,5—1,0 mm longae. *Folia* carnosa, deltata, acuta, c. 1,25 mm longa, caduca; *cicatrix* transverse late elliptica vel subcircularis. *Inflorescentia* cymosa, glabra, lutea; cymae singulares, axillares, sessiles vel subsessiles, arctissime supra podarium insertae, cyathiis 3, horizontaliter dispositis; cyathium primum masculum deciduum vel rariter bisexuale; cyathia lateralia bisexualia late divergentia, basi cymae in axillis bractearum inserta; *pedunculus* vestigialis; bracteis binis, subquadratis, obtusis, denticulatis, concavis, c. 1,5 x 1,5 mm. *Involucrum* plus minusve truncato-obconicum, 3—3,5 mm longum cymae ramo coalito incluso, 3,5—4,5 mm diam. glandulis inclusis; *bracteae* subcirculares c. 2 x 2 mm, denticulatae, basin versus carnosae, saepe dentibus 1 vel 2, longis patulis lateraliter prope basin instructae; *glandulae* 5, patulae, plus minusve transverse ellipticae vel reniformi-oblongae, c. 2,25 x 1,0 mm, arcte contiguae, rugulosae; *lobi* 5, subcirculares, denticulati vel irregulariter dentati (aliquanto laceri), c. 1,25 x 1,25 mm. *Flores masculi* 10, bracteolis angustissimis vel filiformibus in fasciculis 5 dispositi; quoque fasciculo bracteis 2—3 (? bractea una profunde laciniata) lobis oppositis subtento; *pedicelli* c. 2 mm longi; *filamenta* c. 0,75 mm longa. *Ovarium* sessile, perianthio irregulariter pentagono rudimentali insidens; *ovulum* aliquanto longe lacrimiforme, obturamento relative longo suspensum; *styli* c. 1,75 mm longi, basi breviter connati, partibus libris patulis reflexisque, apice emarginatis vel breviter bifidis, stigmatibus rugulosis patulis recurvis. *Capsula* obtuse 3-lobata, lobis apicem versus aliquanto angustatis, c. 3,5 mm diam., 3 mm alta, perianthio rudimentali carnoso, subpentagono, c. 1,5 mm diam., 0,5 mm longo, involucri reliquiis obritis arcte insidens. *Semen* (fere maturum) plus minusve ovoideum, apice aliquam acutum, c. 2,25 mm longum, c. 1,75 mm diam., aliquanto subtiliter verrucosum.

Typus: Angola, Cuanza Sul Distr., prope Gabela, *Leach & Cannell* 13954 (BM; K; LISC, holo.; PRE; SRGH).

Angola. Cuanza Sul Distr., Calulo, "Muinge arredores, c. 1 300 m alt." abundant in scanty soil in rock crevices, forming small colonies, 30—75 cm high, fl. 6.IV.1966, *G. Barbosa* 11150 (LISC; LUAI); granite hill ± 57 km N of Quibala, ± 1 200 m alt., in association with *Euphorbia atrocarmesina* Leach, *Sarcostemma* sp. etc., st. 12.X.1970, *Leach & Cannell* 14620 (LISC; LUA; M; SRGH); granite hill, ± 55 km N of Quibala, ± 1 200 m alt., in association with *E. atrocarmesina, Kalanchoe* sp. etc., fl. 24.VIII.1967, *Leach & Cannell* 13962 (BR; LUAI; MO); in fissures of granite slope ± 20 km E of Gabela, ± 1 300 m alt. in close association with *E. atrocarmesina* and *Xerophyta* sp., fl. & fr. 23.VIII.1967, *Leach & Cannell* 13954 (BM; K; LISC; PRE; SRGH).

Fig. 4. **(3a) Euphorbia nubigena** var. **nubigena**

Var. *nubigena* in rock crevice with slender *Xerophyta* sp.



Flowering and fruiting branches

Among Angolan species *E. nubigena* appears to be most closely related to *E. coerulans* Pax, but is a much taller plant with weaker, more slender branches and an entirely different habit with a somewhat rhizomatose root system; the differently shaped, only lightly crenulate tubercle teeth of the new species and its long, decurrent spine shields with much weaker spinescence, are quite different from those of its relative, and finally, the virtually sessile cymes of smaller cyathia, with styles only half the length of those of *E. coerulans*, are also quite distinctive. Although the relative significance of spinescence characters is not yet fully understood there seems possibly to be an affinity with several of the weakly spined species of the same Section, such as *E. isacantha* Pax, from the larger eastern segment of the distribution.

The new species appears to be particularly fire tender and in addition to its protected habitat is probably assisted to survive by means of its underground rhizomatose stems which run along fissures of the granite rocks in scanty soil and often give rise to colonies of connected plants. The branches, although eventually becoming more or less woody, are generally rather weak and easily broken, bent or distorted when young, and often when becoming to some extent decumbent, soon dry out from exposure of their length to the sun; plants, in consequence, are often surrounded by the dry fallen remains of dead branches.

The typical variety is, at all localities known to the author, closely associated with *E. atrocarmesina* and a small *Xerophyta* sp. Somewhat strangely no ferns, not even the almost ubiquitous *Selaginella* or *Cheilanthes* spp., were seen at these apparently eminently suitable localities; the specific epithet being prompted by our cloud-enveloped camp at the type locality.

Plants rather weakly suberect, somewhat straggly, succulent, spinulose shrublets, generally ± 20—40 cm high (exceptionally up to 90 cm), with a somewhat rhizomatose root system. *Branches* simple, soft and rather fragile, but the core eventually becoming rather woody, sometimes more or less decumbent, then usually drying out, 4-angled, with the sides more or less flat between the angles, becoming concave from shrinkage, not usually constricted into segments, brownish green, 5—8,5(10) mm thick; angles lightly crenulate with the crenulations rounded at the apex, sloping gradually down to the flowering eye below. *Spine shields* pale brown, soon becoming whitish grey, more or less very narrowly triangular, 6—8 mm long, ± 1,5 mm wide at the apex, narrowly decurrent almost to the flowering eye below, sometimes on older parts becoming contiguous subcontinuous. *Spines* 4, in pairs, the lower pair very variable in length, from the merest prickle to 3 mm, weakly needle-like, divergent, horizontally spreading; the upper pair spreading, widely divergent on each side of the leaf scar, 0,5—1,0 mm long, ± 1,25—2,5 mm above the lower pair. *Leaves* thick and fleshy, deltoid acute, ± 1,25 mm long, caducous, leaving a transversely broadly elliptic or subcircular scar. *Inflorescence* a glabrous, yellow, sessile or subsessile, axillary single cyme of 3 cyathia arranged at right-angles to the axis of the branch, inserted immediately above the spine shield, with the initial central cyathium usually male deciduous or rarely bisexual and the lateral bisexual cyathia widely diverging, inserted in the axils of the bracts at the base of the cyme; *peduncle* vestigial, bibracteate; *bracts* subquadrate obtuse, denticulate, concave, ± 1,5 × 1,5 mm when flattened. *Involucre* more or less truncate obconic, 3—3,5 mm long, 3,5—4,5 mm diam. including the glands,

with a solid fleshy base merging with the involucre and scarcely to be described as a cyme branch; *bracts* subcircular, denticulate, thick and fleshy towards the base, often with one or two long, spreading, lateral teeth near the base, ± 2 mm × 2 mm; *glands* 5, spreading, more or less transversely elliptic or somewhat reniform-oblong, ± 2,25 × 1 mm, closely contiguous, rugulose; *lobes* 5, subcircular, denticulate or irregularly dentate (torn), ± 1,25 × 1,25 mm. *Male flowers* 10, arranged in 5 fascicles, each fascicle subtended on the inside by 2 or 3 relatively broad, spathulate, finely fimbriate bracts (possibly a single, deeply laciniate or torn bract) and on the outside by a lobe; *bracteoles* narrow, some filiform, ± 1,5 mm long; *pedicels* ± 2 mm long; *filaments* ± 0,75 mm long. *Ovary* sessile, seated on a rudimentary, irregularly pentagonal perianth, ± 0,25 mm long, 1,0 mm diam.; *ovule* long tear-shaped, suspended under a relatively long hood-like obturator; *styles* ± 1,75 mm long, shortly united at the base, the free portions spreading recurved, with emarginate or shortly bifid, divergent recurved stigmas. *Capsule* obtusely 3-lobed, with the lobes somewhat ovoid (seen from the end), ± 3,5 mm diam., 3 mm high, closely seated on the crushed remains of the involucre, with a rudimentary, fleshy, somewhat pentagonal perianth ± 0,5 mm long, 1,5 mm diam. *Seed* (almost mature) more or less ovoid, somewhat pointed at the apex, ± 2,25 mm long, 1,75 mm diam., rather finely verrucose.

(3b) Var. **rutilans** Leach, var. nov.; a varietate typica facile distinguenda, cyathiis capsulisque rutilantibus; ramis laetius viridibus.

Typus: Angola, Cuanza Sul Distr., prope Quibala *Leach & Cannell* 13957 (BM; LISC, holo.; SRGH).

Angola. Cuanza Sul Distr., steep granite slope, ± 3 km W of Quibala, alt. ± 1 200 m, in association with *Aloe andongensis* Bak., *Kalanchoe* sp., *Crinum* sp. etc., fl. & fr. 24.VIII.1967, *Leach & Cannell* 13957 (BM; LISC; SRGH).

Variety *rutilans* is immediately distinguished from the rather drab typical variety by its bright red cyathia and fruits and by the bright green of its epidermis; specimens are also rather taller and more rigid, but these latter and possibly the brighter green of its branches are perhaps edaphically controlled, since plants in cultivation under identical conditions have, with the passage of time, come more closely to resemble each other.

(4) Euphorbia scitula Leach, sp. nov. *E. subsalsae* Hiern affinis sed planta minore, radice tuberosa relative grandi, ramis exilioribus debilioribus vivide virentibus, podariis minoribus brevioribus decurrentibus sed gemma non attingentibus, spinis paris superioris relative longis erecto-patentibus minus divergentibus, illis paris inferioris brevissimis latius divergentibus, involucri glandulis haud concavis, capsula pallide viridi usque ad dehiscentiam, semine cremeo subgloboso admodum differens.

Planta succulenta, spinosa, parce laticifera, ramis 1 vel aliquot radicis tuberosae sublignosae ex apice orientibus. *Rami* plerumque simplices, raro prope basin

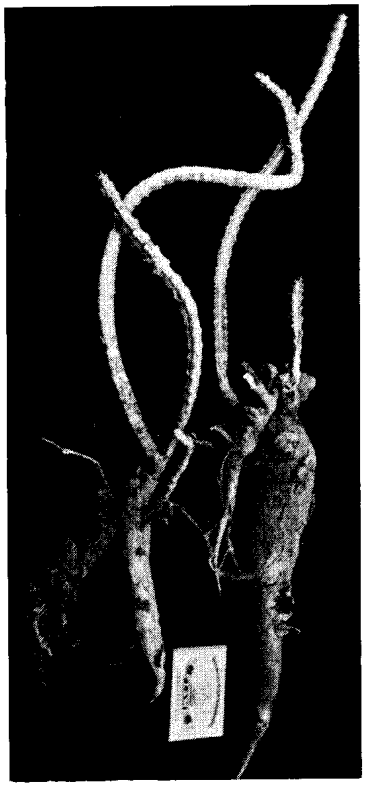
pauciramosi, erecti, plerumque plus minusve recti vel interdum flexi aliquando subprocumbentes, subacute 4-angulati, lateribus plus minusve parallelis vel apicem versus leviter contractis, faciebus plus minusve planis, 6,5—10 mm crassi, usque ad 50 cm longi, secus angulos sinuato-crenulati, apicibus crenarum 4—10 mm (plerumque c. 10 mm) distantibus, vivide virentes manifeste albido-vittati. *Podaria* plus minusve triangularia vel anguste triangularia, apice truncata vel retusa, c. 2 mm lata, 4—7 mm longa (plerumque c. 6,5 mm) decurrentia sed gemma non attingentia, interdum brevissima vix decurrentia, initio castanea vel pallide brunnea mox albescentia; *spinae* 4, binae; illis paris inferioris usque ad 4,5 mm longis, latissime divergentibus, horizontaliter patentibus vel saepe leviter deflexis; illis paris superioris usque ad 3 mm longis, aliquanto divergentibus, suberecto-patentibus, in quoque latere folii cicatricis dispositis. *Folia* carnosa, rudimentalia, plus minusve ovata, acuta, saepe apiculata, c. 1 mm × 1 mm, decidua vel interdum marcescentia. *Inflorescentia* cymosa, glabra; cymae singulares, axillares, subsessiles, arctissime supra podarium insertae; cyathiis 3, horizontaliter dispositis; cyathium primum masculum deciduum; cyathia lateralia bisexualia, basi cymae in axillis bractearum inserta; *pedunculus* bibracteatus, brevissimus, raro usque ad 1,5 mm longus; bracteae carnosae, concavae, semicirculares, c. 2 mm latae, 1,25 mm longae, irregulariter denticulatae, basi pedunculo coalescentes. *Involucrum* truncato-obconicum basi cymae ramo brevi crasso coalescens sine junctura manifesta, c. 2,5 mm longum (c. 4 mm cymae ramo incluso), 5—5,5 mm diam. glandulis inclusis; *bracteae* subquadratae, c. 2 mm × 2 mm, late obtusae denticulatae; *glandulae* 5, contiguae, patulae, planae vel parum convexae, demum levissime pusticulato-rugulosae, plus minusve transverse oblongae, c. 2,5 × 1 mm, initio virides, nectare copioso, demum brunnescentes margine sicco pallido; *lobi* 5, pallide lutei, rubello suffusi, plus minusve flabelliformes, fimbriati, c. 1,5 × 1,5 mm. *Flores masculi* 10, bracteolis filamentoso-laciniatis, in fasciculis 5 dispositi; quoque fasciculo floribus 2, uniseriatis, bractea interiore marsupium formanti subtento; bractea c. 2 mm longa, profunde bilaciniata, longe fimbriata; *pedicelli* c. 2 mm longi; *filamenta* c. 1 mm longa, perpallide viridia; *antherae* brunneolae, polline luteo. *Ovarium* obtuse 3-lobatum, perianthio rudimentali, irregulariter pentagono, c. 2 mm longo insidens; *ovulum* obturamento bilobato suspensum; *styli* cremei, c. 2 mm longi, in columnam c. 0,5 mm longam basi connati, partibus libris patulo-recurvis, apicibus breviter bilobatis, lobis late divergentibus recurvis rugulosis. *Capsula* obtuse 3-lobata, c. 3,25 mm diam., 2,5 mm alta, pallide viridis usque ad dehiscentiam; *perianthium* carnosum, subcirculare vel aliquam irregulariter obtuse pentagonum, c. 2 mm diam., late obconicum, c. 1 mm longum. *Semen* subglobosum vel aliquanto ovoideum c. 2 mm × 1,75 mm, leviter pusticulato-rugulosum, cremeum, sutura bubalina.

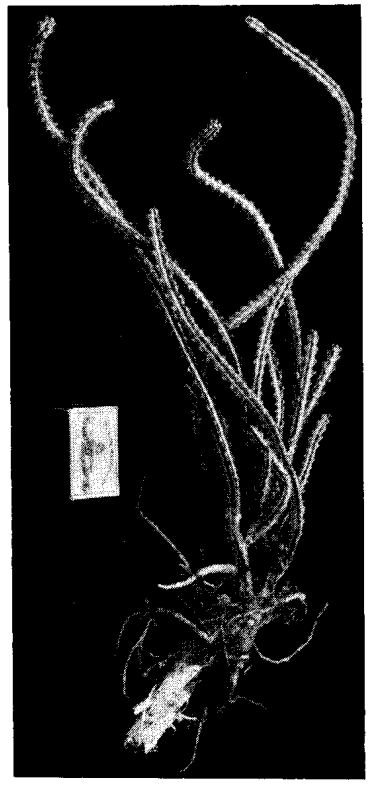
Typus: Angola, Benguela Distr., *Leach & Cannell* 13924 (BM; LISC, holo.; PRE; SRGH).

Angola. Benguela Distr., stony maritime hills ± 12 km N of Lobito, in association with scattered *E. carunculifera* Leach subsp. *subfastigiata* Leach, cult. Salisbury, Rhodesia, fl. Oct. 1973, *Leach & Cannell* 13924 (BM; LISC; PRE; SRGH).

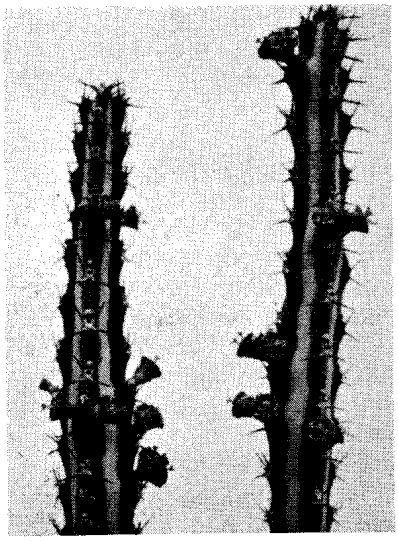
Euphorbia scitula appears to be most closely related to *E. subsalsa* but is a smaller plant with a very neat appearance and is easily distinguished by its

Fig. 5. **(4) Euphorbia scitula** Leach

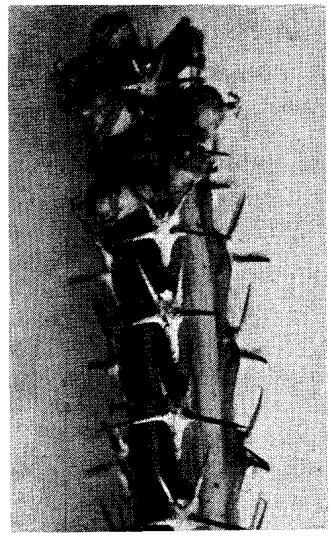




Plants from maritime hills near Lobito



Conspicuously striped branches;



apex with very obtuse fruits

relatively large tuberous root, its weaker more slender, white striped, bright green branches with shorter spine shields which do not reach the flowering eye below, and quite different weaker spinescence; the flat or slightly convex glands of the new species and its capsule which remains green up to dehiscence, as well as the more nearly globose, pusticulate cream coloured seed are all also quite distinctive. It may also be significant that although thriving under glass *E. scitula* is far from happy under cultivation in the open in Rhodesia, whereas *E. subsalsa* does extremely well under garden conditions, whether grown from seed or cuttings.

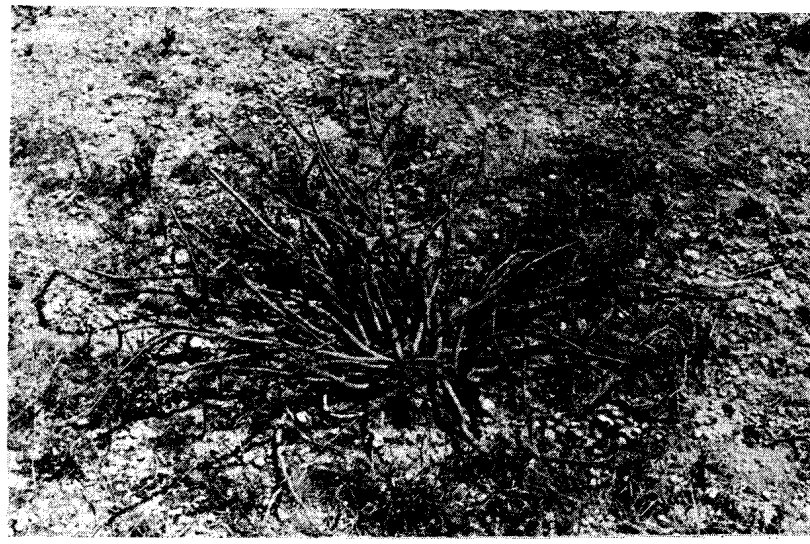
Plant: succulent, spiny, sparingly laticiferous, with one to several branches arising from the apex of a rather woody tuberous root. *Branches* usually simple, rarely few-branched from near the base, erect, usually more or less straight or sometimes becoming bent and occasionally subprocumbent, subacutely 4-angled, more or less parallel sided or slightly tapering towards the apex, with the sides flat or occasionally slightly convex, 6,5—10 mm thick, up to 50 cm long, sinuate-crenulate along the angles with the apices of the crenulations 4—10 mm (usually ± 10 mm) apart, bright green with a conspicuous, pale greenish cream (often almost white), somewhat flexuose, longitudinal stripe. *Spine shields* more or less triangular or narrowly triangular, truncate or retuse at the ± 2 mm wide apex, 4—7 mm (mostly ± 6,5 mm) long, decurrent but not reaching the flowering eye below, occasionally so short as scarcely to be described as decurrent, at first chestnut or pale brown, very soon becoming whitish; *spines* 4, in pairs, those of the lower pair up to 4,5 mm long, widely divergent (± 180 °), horizontally spreading, often somewhat deflexed, those of the upper pair up to 3 mm long, divergent but not very widely so, suberectly spreading on each side of the subcircular leaf-scar. *Leaves* fleshy, ovate acute, often apiculate, ± 1 mm long and broad, deciduous or sometimes marcescent. *Inflorescence* cymose, glabrous; cymes solitary, axillary, subsessile, inserted very closely above the spine shield; cyathia 3, horizontally arranged with the initial central cyathium male, deciduous and the laterals bisexual, inserted in the axils of the bracts at the base of the cyme; *peduncle* bibracteate, very short, rarely up to 1,5 mm long; bracts fleshy, concave, semicircular, ± 2 mm wide, 1,25 mm long, irregularly denticulate, not jointed at the base, merging into the peduncle. *Involucre* truncate obconic, merging at its base into the short stout cyme branch without any evident joint, ± 2,5 mm long (with the cyme branch ± 4 mm), 5—5,5 mm diam. including the glands, ± 2,5 mm diam. at its base, pale green, copiously white puncticulate; *bracts* more or less subquadrate, ± 2 mm × 2 mm broadly obtuse, denticulate; *glands* 5, contiguous, spreading, flat or slightly convex, becoming very slightly pusticulate rugulose, initially green with copious nectar, becoming brownish ochre with a pale, dry margin, more or less transversely oblong, ± 2,5 mm × 1,0 mm; *lobes* 5, pale yellow tinged pink, fringe toothed, more or less flabellate, ± 1,5 mm × 1,5 mm. *Male flowers* 10, arranged in 5 fascicles opposite the lobes, each with 2 flowers in a single rank and with the filamentously divided bracteoles subtended by a deeply bi-lobed, deeply fimbriate inner bract ± 2 mm long, attached at its sides near its base to the wall of the involucre and forming a pocket into which the flowers are inserted; *pedicels* ± 2 mm long; *filaments* ± 1 mm long, very pale green; *anthers* brownish with yellow pollen. *Ovary* obtusely 3-lobed, seated on a very rudimentary, irregularly pentagonal perianth ± 0,2 mm long; *ovule* suspended beneath a 2-lobed

obturator. *Styles* cream coloured ± 2 mm long, united at their base into a column ± 0,5 mm long; the free portions spreading recurved, slightly enlarged at the emarginate or shortly 2-lobed, widely divergent, recurved, rugulose apices. *Capsule* obtusely 3-lobed, ± 3,25 mm diam., 2,5 mm high, remaining green almost up to dehiscence; *perianth* fleshy, almost circular or somewhat irregularly obtusely pentagonal, broadly obconic, ± 1 mm long, 2 mm diam. *Seed* subglobose, or slightly ovoid, almost straight along the suture, cream coloured with a buff suture, lightly pustulate-rugulose, ± 2,0 mm × 1,75 mm.

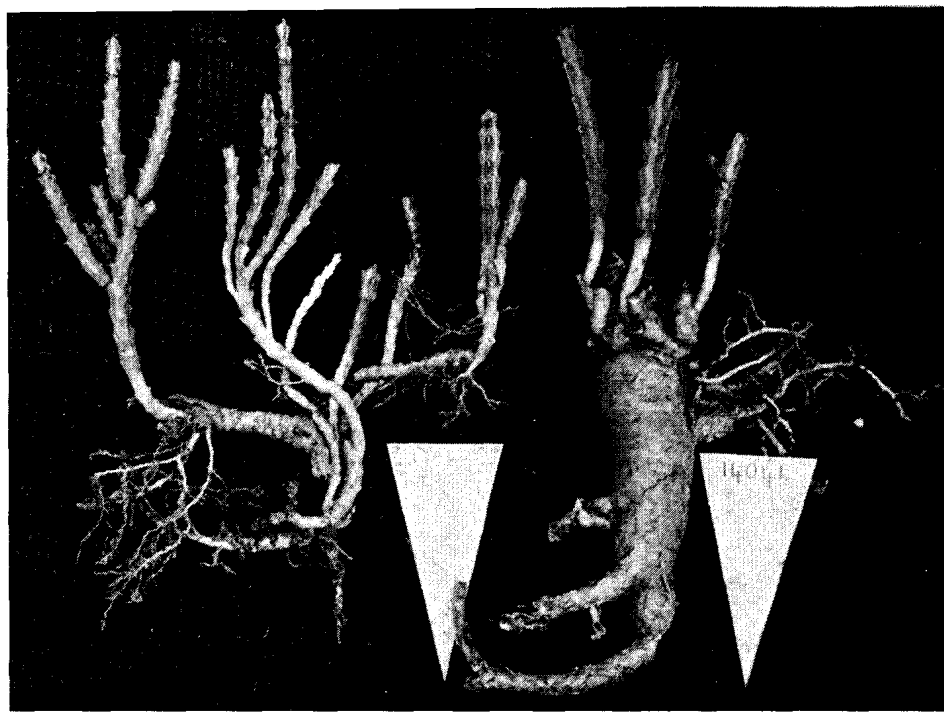
(5) Euphorbia cuneneana Leach, sp. nov. ad sectionem *Tetracanthas* pertinens sed aliis speciebus angolanis ejusdem sectionis ut videtur non arcte affinis; ab *E. subsalso* regionis mossamedensis radice tuberosa vel rhizomatosa; ramis debilioribus gracilioribus; podariis spinisque debilioribus et paribus dissitioribus; cymae cyathiis late divergentibus et involucro brevissimo latissimo facile distinguenda. Subspecies duae recognitae sunt.

(5a) Subsp. **cuneneana.** *Planta*: spinosa, succulenta, parce laticifera, ramis paucis vel multis, plerumque patulis saepe aliquanto effusis, radicis tuberosae relative amplae ab apice exorientes. *Rami* simplices vel temere divaricate pauci-ramosi, usque ad 90 cm longi, relative graciles, basin versus subteretes, c. 10(12,5) mm crassi, superne obtuse 4-angulati, 6—8 mm crassi, veneti, conspicue pallide flexuose vittati, angulis leviter longe sinuato-dentatis, dentibus secus angulos 12—22 mm distantibus. *Podaria* plus minusve obovata, truncata, anguste decurrentia, brunnea mox cinerascentia. *Spinae* 4, aciculares binatim dispositae, illis paris inferioris horizontaliter patulis, (3)4,5—6(10) mm longis non valde divergentibus; illis paris superioris latius divergentibus, a latere visis suberectis, 0,5—2,0 mm longis. *Folia* carnosa, caduca, sessilia, late ovata, apiculata, c. 1,0 mm longa, 1,5 mm lata. *Inflorescentia* cymosa; cymae singulares, axillares, subsessiles, cyathiis 3, horizontaliter dispositis; cyathium primum masculum deciduum (flore femineo abortivo); cyathia lateralia bisexualia, in ramis cymae crassis, usque ad 2 mm longis portata. *Bracteae* plus minusve semicirculares, c. 2,5 × 1,75 mm, apice denticulatae, dente longo patulo, basin versus a latere plerumque instructae, basi transverse brunneo-porcatae. *Involucrum* latissime obconicum, c. 2,5 mm longum, usque ad 6(7) mm diam. glandulis inclusis; *glandulae* 5, patulae, arcte contiguae, plus minusve transverse oblongo-ellipticae, 2,5—3,25 × 1,5 mm, leviter convexae, ruguloso-foveolatae, flavo-virentes; *lobi* 5, plus minusve transverse oblongi, c. 1,25 × 1,75 mm, saepe aliquanto bilobati, irregulariter fimbriato-dentati. *Flores masculi* valde exserti, bracteolis filiformibus c. 2 mm longis 5-fasciculati; flores 3 in quoque fasciculo unifariam dispositi, bractea lata laciniata fimbriata, c. 3 mm longa × 2,5 mm, lobis opposita subtenti; *pedicelli* 3—3,25 mm longi; *filamenta* c. 1,5 mm longa; *antherae* bubalinae, polline aureo. *Ovarium* plus minusve ovoideum, obtuse trilobatum, sessile, perianthio pentagono rudimentali insidens; *ovulum* obturamento aliquanto bilobato, minute denticulato suspensum. *Styli* c. 2,5 mm longi, in columnam c. 0,75 mm longam connati, partibus libris late patulis mox torsivis, apicibus capitatis rugulosis simplicibus vel interdum emarginatis, initio pallide virides mox brunnescens. *Capsula* obtuse trilobata, c. 4,5 mm diam., 3,5 mm alta, lobis

Fig. 6. **(5) Euphorbia cuneneana** Leach



Subsp. *cuneneana,* Naulila, ht. 60 cm



Young plants: 14042 Subsp. *rhizomatosa*
14041 Subsp. *cuneneana*

apicem versus aliquanto angustatis. *Perianthium* carnosum, obtuse trilobatum, c. 2,25 mm diam., 1 mm longum, basi perspicue pentagonum. *Semen* plus minusve ellipsoideum vel aliquanto ovoideum, apice interdum aliquanto acutum, c. 2 × 1,75 mm, obtuse verrucosum, brunneum, cera cremea plerumque obductum; *sutura* atrobrunnea.

Typus: Angola, Huila Distr., *Leach & Cannell* 14041 (BM; K; LISC, holo.; LUAI; MO; PRE; SRGH).

Angola. Huila Distr., "Mopane forest near Naulila, between Naulila and Cuamato", 1938, *M. Otzen & R. S. Cope* 2 sub PRE 30960—30961 (PRE), idem cult. PRE sub PRE 30962 (PRE), idem, Hort. Otzen., fl. March 1940 (BOL); gravelly, calcrete strewn slope near Naulila, fl. & fr. 17.IV.1967, *Leach & Cannell* 14041 (BM; K; LISC; LISC; LUAI; MO; PRE; SRGH; WIND), idem Hort. Leach., fl. 29.IV.1974, 14041A (M).

Plant: spiny, succulent, sparingly laticiferous, with few to many, usually spreading, often rather straggling branches, arising from the apex of a relatively large tuberous root. *Branches* simple, or randomly divaricately few branched, up to 90 cm long, relatively slender, subterete, ± 10(12,5) mm thick towards the base, becoming obtusely 4-angled, 6—8 mm thick above, bluish green with a "painted" appearance from the conspicuous (becoming inconspicuous with age), flexuose, pale longitudinal stripe and the darker, often purplish, lightly sinuately toothed angles. *Spine shields* at the apex of the widely spaced teeth, 12—22 mm apart, more or less obovate, truncate, narrowly decurrent to about half-way to the flowering eye below, brown soon becoming grey. *Spines* 4, needle-like, the lower pair more or less horizontally spreading, (3)4,5—6(10) mm long, slightly divergent; the upper pair, on each side of the variably shaped leaf scar, more widely divergent, suberect (seen from the side) 0,5—2,0 mm long. *Leaves* fleshy, caducous, sessile, broadly ovate, apiculate, ± 1,0 mm long, 1,5 mm wide. *Inflorescence* cymose; cymes axillary, touching or shortly above the spine shields; cyathia 3, horizontally disposed; the initial central cyathium male (with an aborted ♀ flower), deciduous, subsessile or borne on a short stout peduncle with a pair of bracts at its base; lateral cyathia bisexual, borne on stout cyme branches ± 2 mm long. *Bracts* subtending the cyme branches, more or less semicircular, ± 2,5 mm × 1,75 mm, denticulate, with a spreading tooth near the base on one or both sides and a thickened, brown, transverse ridge at the base. *Involucre* shallowly obconic, ± 2,5 mm long, up to 6(7) mm diam. including the glands; *glands* 5, bright yellow-green, with copious nectar, slightly convex, pitted-rugulose on the upper surface with a narrow, plain outer margin, more or less transversely oblong-elliptic, 2,5—3,25 × 1,5 mm, spreading, closely contiguous, rather thin, with a somewhat petaloid appearance from the slightly undulate outer margin. *Lobes* 5, more or less transversely oblong, somewhat 2-lobed, irregularly fringe toothed, ± 1,25 × 1,75 mm. *Male flowers* far exserted, arranged in 5 fascicles opposite the lobes, each fascicle with 3 flowers in a single rank, subtended by a broad, laciniate, fimbriate inner bract, ± 3 mm long × 2,5 mm, attached at its sides to the wall of the involucre and forming a pocket in which the ♂ flowers and bracteoles are inserted; *bracteoles* filiform, ± 2 mm long; *pedicels* 3—3,25 mm long; *filaments* ± 1,5 mm long; *anthers* buff coloured with bright yellow pollen. *Ovary* more or less ovoid, obtusely 3-lobed, sessile, seated on a rudimentary pentagonal perianth; *ovule* suspended

under a somewhat 2-lobed minutely denticulate obturator. *Styles* at first pale green, soon becoming buff coloured, ± 2,5 mm long, united at their base into a column ± 0,75 mm long with the free portions widely spreading, soon "corkscrewing" and becoming brown at the capitate, rugulose, simple, or occasionally emarginate apices. *Capsule* dark brown, ± 4,5 mm diam., 3,5 mm high, obtusely 3-lobed, with the lobes somewhat narrowed at the apex (seen from the end). *Perianth* fleshy, obtusely 3-lobed, ± 2,25 mm diam. ± 1 mm long, clearly pentagonal at the 2 mm diam. base. *Seed* obtusely verrucose, brown beneath the cream coloured waxy coating, with a dark brown suture, more or less ellipsoid or somewhat ovoid, sometimes rather pointed at one end, ± 2 × 1,75 mm.

(5b) Subsp. **rhizomatosa** Leach, subsp. nov.: a subspecie typica, radice rhizomatosa, ramis brevioribus plerumque simplicibus; involucri glandulis ante expansionem rubellis; floribus masculis paucioribus (saepe tantum quinque); stylis plerumque libris fere ad basim, satis differens.

Typus: Angola, Huila Distr., *Leach & Cannell* 14042 (LISC, holo.).

Angola. Huila Distr., "near Roçadas", st. VII. 1936, *G. Boss* s.n. sub Transv. Mus. 35960 (PRE); Roçadas, Peu-Peu, "solos arenosos compactos", fl. 10.VII.1970, Santos & Barroso 2724 (PRE; SRGH); "Roçadas, ao km 2 do trajecto para o Cuamato", st. 20.II.1969, *A. de Menezes* 3211 (LUAI; PRE; SRGH), idem Hort. Leach., fl. 12.IV.1971, sub *Leach* 14427 (BM; M); "vicinity of Roçadas, track to Naulila", fl. & fr. 18.IV.1967), *Leach & Cannell* 14042 (LISC), idem Hort. Leach., fl. 12.IV.1971, 14042A (BM; MO), fl. 10.IV.1973, 14042A (K; SRGH).

E. cuneneana belongs in Section *Tetracanthae* Pax but does not appear to be very closely related to other Angolan species of this section. Its distribution is limited, as far as is known, to a relatively small area in the vicinity of the Cunene River to the south of Roçadas, and is geographically nearest to that of *E. subsalsa*; it seems therefore to be most useful to make diagnostic comparisons with that species. Plants of *E. cuneneana* are of a rather untidy straggling habit and, although young stems and branches are very distinctively marked, are scarcely likely to attract horticultural attention. Distinguishing characters include the tuberous or rhizomatose root system, the weaker, more slender branches with weaker more widely spaced spinescence and the entirely different appearance of the inflorescence imparted by the widely divergent lateral cyathia and the short involucre with widely spreading glands.

The typical subspecies develops a large tuberous root, which can, it seems, attain a very large size. The plant sent to Pretoria under *Otzen* 2 is reported to have weighed more than 50 lbs.; however, such a size appears to be exceptional as no specimens even approaching this were seen in the Naulila area. The population at the type locality occurs on a calcrete strewn gravelly slope in association with scattered dwarf *Colophospermum mopane*, *Aloe esculenta* and a shrubby succulent *Senecio*.

Subspecies *rhizomatosa* appears to be far more plentiful than the typical subspecies and large numbers are to be found among innumerable dwarf "mopane" on the sandy alluvial soils in the vicinity of Roçadas. Due to their rhizomatose habit, plants which appear to be single individuals sometimes

occupy a relatively large area, somewhat after the manner of *Duvalia polita* N.E.Br., with which it is sometimes socially associated. Plants are readily distinguished from those of the typical subspecies by their rhizomatose habit, shorter (usually less than 30 cm), usually simple stems arising singly, and the reddish colour of their cyathia at early stages of their expansion (those of subspecies *cuneneana* are yellowish at all stages), while the smaller number of male flowers (often only 5) and styles which are usually free almost to their base, appear also to be constant characters. These differences appear to be genetically based as plants of both subspecies have retained their individual characteristics for more than seven years in cultivation under identical conditions.

(6) Euphorbia subsalsa Hiern, Cat. Afr. Pl. Welw. **1**: 948(1900). – N.E. Br. in Fl. Trop. Afr. **6**(1): 573(1911). – White, Dyer & Sloane, Succ. Euphorb. **2**: 789(1941), p.p. excl. var. *kaokoensis*. – Teixeira in Pecuaria Ann. Serviços Veterinaria, **1950**: 90(1950). – Jacobsen, Handb. Succ. Pl. **1**: 478, fig. 583 (1960), p.p. excl. var. *kaokoensis*. – Meyer in Merxmüller, Prodr. Flora Südwestafrika **67**: 34(1967), ? p.p. – Jacobsen, Sukk. Lexikon: 203, t. 80, fig. 5 (1970), p.p. excl. var. *kaokoensis*. – C. de Matos & B. de Sousa, Carta Veget. Res. Parc. Moçâmedes: 18(1970).

Type: Angola, Moçâmedes Distr., Pedra de Sal prope Riv. Maiomba, *Welwitsch* 642 (BM, holo., photo. PRE; K; LISU).

The precise locality of Pedra de Sal is not known but is believed to be 40–50 km inland, close to the Maiomba Riv. (a local name for the Giraul Riv.).

Euphorbia sp. cf. *E. subsalsa* Hiern sensu Barbosa, Carta Fitogeogr. Angol.: 247 (1970).

? *Euphorbia heteracantha* Pax in Bot. Jahrb. **34**: 83 & 375 (1904), excl. syn. *E. polyacantha* sensu Hiern.

Type: Angola, ? Huila Distr., *Antunes* 129.

N. E. Brown (Fl. Trop. Afr. **6**: 574; 1911) placed *E. heteracantha* in synonymy with *E. subsalsa* and *ex descr.* there seems no reason to doubt this identification.

However, considerable confusion appears to surround the identity of *Antunes* 129. Cited by Pax as the type of *E. heteracantha*, he later (*l.c.*: 375, 1904) considered it probably to be synonymous with *E. polyacantha* sensu Hiern. This latter is a synonym of *E. dekindtii* Pax so it is difficult to understand why Pax should have suggested equating the "ramis ... tetragonis ... leviter tantum lobulatis" of his *E. heteracantha* with this species, especially as he considered *E. dekindtii* possibly to equal *E. bellica* Hiern (= *E. virosa* Wills.).

E. subsalsa is the most widespread of the taxa under consideration and two subspecies may be recognised; the typical with its distribution extending southward from near Benguela to beyond Moçâmedes, and inland to the lower slopes of the Serra da Chela, mostly in desert or semi-desert conditions; and subsp. *fluvialis* which is restricted to the vicinity of the Cunene River.

(6a) Subsp. *subsalsa.*

Angola. Benguela Distr., "arredores de Benguela, regiao subdesertica", 29.IX.1964, *Barbosa, Wild & Santos* 10854a (SRGH); Cavaco Riv., ± 17 km E of Benguela, fl. 20.VIII.1967, *Leach & Cannell* 13921 (BM; LISC; PRE; SRGH), idem from seed, cult. SRGH, fl. 1971 (LISC; SRGH); Lengue, Benguela littoral, *Gossweiler* 9736 (BM; K; LISJC, excl. sheet no. 1); ± 32 km inland from Benguela, 15.VI.1905, *Gossweiler* s.n. (K); ± 45 km from Benguela, straggly plants among rocks, fl. 10.X.1970, *Leach & Cannell* 14606 (BM; LISC); straggly plants at thicket margin near Catengue, fl. 19.VIII.1967, *Leach & Cannell* 13918 (LUA; MO); Catengue, fl. 19.VIII.1967, *Leach & Cannell* 13915 (K; LISC; PRE; SRGH), ibid. fl. 10.X.1970, *Leach & Cannell* 14601 (BR; G; M; WIND; Z); between Embuluco & Kasimba, 7.VII.1905, *Gossweiler* 1723 (BM; LISJC); Rio Kaporolo, *Humbert* 16136 (BM); Dombe Grande, fl. 18.X.1970, *Leach & Cannell* 14639 (K; LUAI). Moçâmedes Distr., rocky maritime hills near mouth of Rio S. Nicolau, fl. 5.I.1956, *Mendes* 1215 (LISC); ± 20 km NE of Moçâmedes, Lucira road, fl. 31.X. 1970, *Leach & Cannell* 14689 (SRGH); Serra de Lua, Caracul, 15.VI.1967, *Menezes et al* 2889 (LISC; LUAI; PRE; SRGH), ibid. 13.VII.1967, *Menezes et al* 2980 (PRE); ± 24 km ENE of Moçâmedes, 1.IV.1964, *Menezes* 1052 (LISC; SRGH); Morro da Providência, Dois Irmãos, fl. & fr. 21.XII.1955 (LISC); Dois Irmãos, fl. 7.IX.1955, *Mendes* 21 (LISC); Perto de Moçâmedes, fl. & fr. 23.X.1967, *Teixeira et al* 12510 (LISC); Caraculo, fl. 19.I.1961, *Santos & Henriques* 414 (LUAI); Pedra de Sal, Oct. 1859, *Welwitsch* 642 (BM; K; LISU; PRE, photo.); ± 30 km E of Moçâmedes, fl. 26.X.1970, *Leach & Cannell* 14661 (LISC; SRGH); ± 11 km NE of Munhino, fl. 2.XI.1970, *Leach & Cannell* 14701 (BR; M; WIND); between Munhino and Vila Arriaga, mopane woodland, fl. 11.IX.1967, *Leach & Cannell* 14022 (K; PRE), idem, from seed, cult. SRGH, fl. 1971 (K; PRE); ± 27 km W of Vila Arriaga, on rock slopes, fl. 25.X.1970, *Leach & Cannell* 14657 (BM, M); "a 5 km NE do Pico do Azevedo", fl. 5.III.1969, *Teixeira et al* 12867 (LISC); Caracul, 12 km on Virei road, 14.VII.1967, *Menezes et al* 2995 (LISC; LUAI; SRGH).

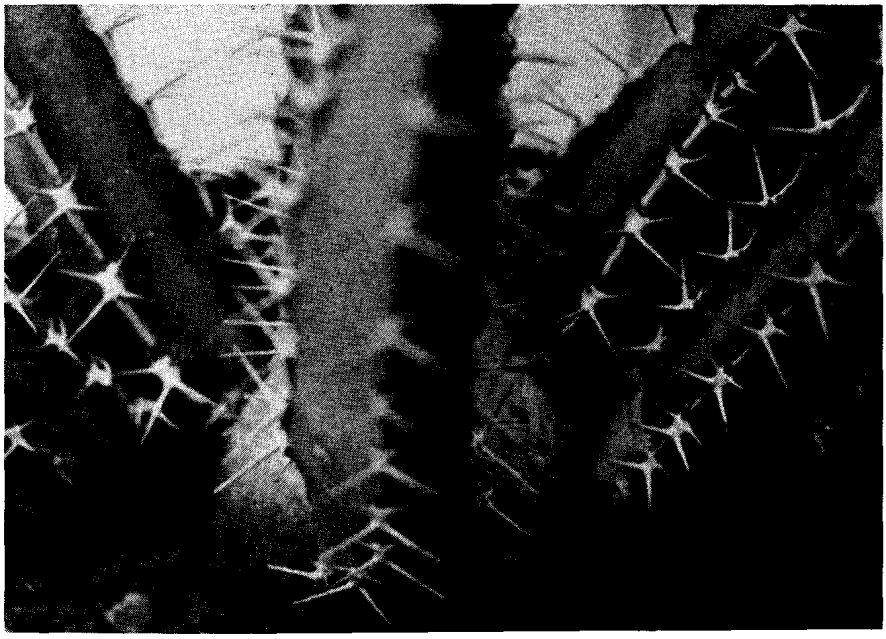
Plants of this subspecies vary considerably in stature and habit and although generally about 60 cm high occasionally attain a height of 1,5 metres. Shrubs are generally rather few branched from the base and sparingly rebranched above but lower bushier plants are found in the Cavaco River area (fig. 7a). However, these variations appear to be governed to a large extent by ecological factors since plants grown from seeds from Cavaco River (13921, bushy) and Munhino (14022, erect) were remarkably uniform in all respects. In all these cultivated specimens the initial stem developed a swollen base (fig. 8a) from which the secondary branches arose; a habit otherwise known only in some related species from Zambia and Tanzania and quite different from that of subsp. *fluvialis*, in which the secondary branches are developed randomly from the angles of the initial stem (fig. 7b). The 4-angled, strongly armed branches average about 1 cm in thickness and are almost always marked (sometimes rather obscurely) with a pale longitudinal stripe and the angles provided with narrow spine shields which are decurrent almost or quite to the flowering eye below and often form a sub-continuous horny margin. The strong spines are variable in length, with those of the lower pair generally about 10 mm long (6—16 mm) and those of the upper pair about 1/4 to 1/3rd the length of the complementary lower pair. Sessile or virtually so, the inflorescence is of the pattern characteristic of *Tetracanthae* with single axillary cymes of three horizontally arranged cyathia. Fig. 884 in White, Dyer & Sloane, Succ. Euphorb. (1941) shows the suberect, separate, concave involucral glands typical of the species; however, spreading, contiguous, more or less flat glands occasionally occur but not appearing to be correlated with distribution or any other factor do not seem to be taxonomically significant. Unfortunately it has not been possible to obtain evidence relating to their inheritability; however, all plants presently in cultivation bear cyathia with typically suberect, concave glands. Other cyathial characters appear to be relatively uni-

Fig. 7. **(6) Euphorbia subsalsa** Hiern

Subsp. *fluvialis*; Ruacana Falls, Cunene River

Subsp. *subsalsa*; low shrubby plants, Cavaco River area, E of Benguela

Fig. 8. **(6) Euphorbia subsalsa** Hiern



Above: Subsp. *subsalsa*, juvenile grown from seed from between Munhino and Vila Arriaga (14022) showing branching from the enlarged base.

Left: Subsp. *fluvialis*, cyathia of plant from Epupa Falls, showing distinct fascicles of ♂ flowers and reddish glands.

form, apart from the styles which vary in length from ± 1,25 mm to 2,5 mm, may be free to the base or shortly united and have entire, emarginate or shortly 2-lobed apices; the more or less flabellate, fringe toothed lobes are generally about 1,5 mm wide and rather less in length. The partially exserted capsules become brownish at an early stage (those of some plants of subsp. *fluvialis* and of *E. scitula* remain green almost up to dehiscence), and the brownish, 2 mm long seeds are heavily verrucose.

(6b) Subsp. **fluvialis** Leach, subsp. nov. A subspecie typica habitu ramosissimo robustiore, ramis haud vittatis, cymae ramis longioribus plane diversa.

Typus: Angola, Huila Distr., Ruacana Falls, *Leach & Cannell* 14509 (BM; K; LISC, holo.; LUAI; M; MO; PRE; SRGH).

Angola. Huila Distr., Cunene Riv., near the head of Montenegro rapids, fl. 18.I.1956, *Mendes* 1328 (LISC); Ruacana Falls, fl. & fr. 28.IX.1970, *Leach & Cannell* 14509 (BM; BR; K; LISC; M; MO; PRE; SRGH), ibid. fl. 17.IX.1970, *Menezes, Santos & Barroso* 3435 (BM; LISC; PRE), ibid. st. 28.XI.1939, *Otzen* 9 (PRE).

S.W. Africa. 1713 (Swartbooisdrif): Cunene River, Epupa Falls (-AB), cult. Salisbury, fl. & fr. IX.1971, *Giess* 9424 sub *Leach* 13305 (PRE; SRGH; WIND); fl. 19.VII.1973, *Leach & Cannell* 15036 (BR; LISC; PRE, SRGH; WIND); "Epupa", 12.VII.1969, *P. G. Meyer* s.n. (M, photo); Swartboois Drift (-BD), 20.XII,1951, *H. Hall* sub NBG 254/51 (NBG).

The S.W. African localities are recorded on the grid system adopted for the Flora of Southern Africa.

Subspecies *fluvialis* appears to be restricted to rocky sites on both banks of the Cunene River, especially in the vicinity of falls and rapids. Plants are distinguished from those of the typical subspecies by their densely branched and rebranched, more robust habit, with the stout central stem up to 5 cm thick and by their plain grey-green or greenish grey unstriped branches; the inflorescence of these riverine shrubs is also markedly more pedunculate, especially in the longer cyme branches on which the lateral cyathia are borne. Slightly smaller but more robust, rather greyish coloured shrubs are common on calcrete in sparse scrub mopane woodland on the southern bank, just to the east of Epupa Falls. The slightly larger cyathia of these plants are more orange in colour and the concave glands almost red, while the fascicles of male flowers are very distinctly separate. These differences do not appear to be affected by edaphic or climatic factors as they have been retained in cultivation under various conditions and over many years.

(7) Euphorbia otjipembana Leach, sp. nov. *E. subsalsae* Hiern et *E. kaokoensi* (White, Dyer & Sloane) Leach affinis sed ab illa habitu humili, ramis ramulisque 3—6-angulatis, ab hac spinis brevioribus quarum illae paris superioris brevissimae deorsum curvatae sunt et stylis brevioribus profundius bilobatis et ab ambabus ramis in segmentis constrictis, epidermide pisina, foliis brevibus proportione latioribus cicatrice angusta transversali bene distincta.

Fruticulus succulentus, spinosus, habitu crasso humili, saepissime minus quam 30 cm altus, e basi ramosus; rami simplices vel ramulis brevibus, plerumque ramorum apicem versus, ex axillis angulorum orientibus. *Rami* usque ad 30 cm (plerumque 15—20 cm) longi, 2—3 cm crassi, basi constricti, plerumque in

segmentis 2—5 cm longis leviter constricti, 4—6-angulati, angulis compressis, margine aequato vel perleviter sinuato, podariis corneis spinisque quatuor binatim munito; epidermide laete pisina; ramuli similes sed 3—5-angulati. *Podaria* decurrentia, initio separata demum saepe contigua vel interdum subcontinua; *spinae* binae, inferiores divaricatae, horizontaliter patulae, 4—9 mm longae, 7—10 mm distantes secus angulos plus minusve regulariter dispositae; superiores 0,75—1,5 mm longae, latissime divaricatae, plerumque deorsum curvatae. *Folia* decidua, semicircularia apiculata, c. 2-plo latiora quam longiora, plerumque minus quam 1 mm longa, cicatrice transverse anguste oblongo-elliptica, demum inconspicua. *Inflorescentia* cymosa, flava; cymae pedunculatae, cyathiis 3 horizontaliter dispositis, pedunculo brevi bibracteato, bracteis plus minusve semicircularibus, c. 2,5 mm latis, 1,5 mm longis, in axillis singulatim insertae; cyathium medium masculinum deciduum; cyathia lateralia bisexualia in cymarum ramis brevibus portata; bracteis subquadratis, obtusis, minute denticulatis, c. 2 mm × 2 mm. *Involucrum* plus minusve cyathiforme, c. 3 mm longum, 4,5 mm diam. glandulis inclusis; *glandulae* 5, carnosae, erectae vel suberectae, contiguae vel distantes, plus minusve transverse oblongae vel oblongo-ellipticae, 1,5—2,5 mm × 0,75—1,25 mm, concavae, flavae, superficie leviter foveolato-rugulosa, margine laevi; *lobi* 5, plus minusve obovati vel subquadrati, c. 1,5 mm × 1,5 mm, fimbriato-dentati, plerumque aliquando bilobati vel emarginati. *Flores masculi* 10 vel rarissime 15, 5-fasciculati, quoque fasciculum bracteolis filiformibus, bractea latissima fimbriata laciniata bilobata lobo opposita, laxe inclusum; *pedicelli* c. 3 mm longi; *filamenta* 1,25 mm longa. *Ovarium* profunde 3-lobatum, subsessile pedicello pentagono in cyathio inclusum; *ovulum* obturamento parvo suspensum. *Styli* c. 2,0—2,25 mm longi, in columnam breviter connati, partibus libris patulo-recurvis, ad apicem breviter bilobati, stigmatibus granuloso-rugulosis. *Capsula* 3-lobata, c. 3 mm diam., 3 mm alta; lobis obtusis, versus apicem aliquanto compressis; perianthio plus minusve 3-lobato, c. 2,25 mm diam., pedicello brevissimo obsolete pentagono, partim ex involucro exserta. *Semen* (fere maturum) anguste ovoideum, c. 2,0 mm longum, dense verrucoso-rugulosum.

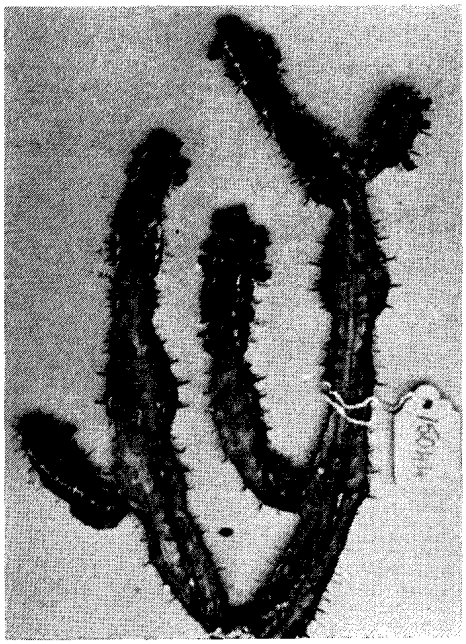
Typus: Southwest Africa, Kaokoland, *Leach & Cannell* 15044 (BM; K; LISC; M; MO; PRE, holo.; SRGH; WIND).

S.W. Africa. — 1712 (POSTO VELHO): "Bainesberge bei Otjipemba. Sprosse meist 5-kantig, lebhaft grün. Einzelnes Exemplar" (-BD), fl. July 1969, *P. G. Meyer* 1309 (M); stony eastern slopes of Baynes Mountains, north of Otjipemba (-BB), in dwarf mopane woodland, fl. & fr. 21.VII.1973, *Leach & Cannell* 15044 (BM; K; LISC; M; MO; PRE; SRGH; WIND).

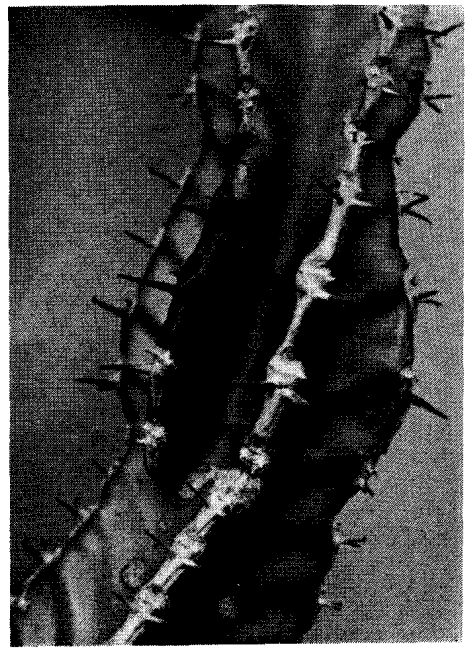
E. otjipembana appears to be most closely related to *E. subsalsa* subsp. *fluvialis* but may be immediately distinguished by its smaller stature, 3—6-angled, segmented branches and branchlets and the fresh green colour of its epidermis (described by P. G. Meyer on the collector's label as "lebhaft grün") which is quite different from that of any other member of the complex, as also is the narrow transverse scar left by the proportionally wider but much shorter leaf. There is also a connexion with *E. kaokoensis* but in addition to the foregoing the new species is separated therefrom by its quite different spinescence, particularly in the very much shorter down-curved upper pair, as well as by its shorter more deeply bifid styles.

Fig. 9. **(7) Euphorbia otjipembana** Leach

Plant ± 40 cm high, at foot of Baynes Mountains



Lightly segmented branch



Flowering branch

In common with other members of the complex there is considerable variation in the length of the peduncle and cyme branches; however, the inflorescence is never as nearly sessile as it is usually in typical *E. subsalsa*; the glands also are subject to some variation in shape and degree of erectness, but seem always to be concave on their upper surface.

E. otjipembana is known only from the eastern slopes of the Baynes Mountains, in the vicinity of and to the north of Otjipemba. Plants, scattered on stony slopes in dwarf mopane woodland in association with a succulent cissus, are by no means plentiful. It is perhaps noteworthy that plants of both subspecies of *E. subsalsa* as well as of *E. kaokoensis* are thriving in cultivation after a number of years and several transplantings, whereas a plant of *E. otjipembana* collapsed on the first onset of heavy rain, despite having appeared to have "taken".

Plant: a succulent spiny subshrub with a fresh green epidermis, usually less than 30 cm high, branched from the base, with relatively stout angular branches, with or without short branchlets arising from the axils of the tubercles along the angles, mostly towards the apex of the branches. *Branches* usually 15—20 (30) cm long, 2—3 cm thick, constricted at the base and usually slightly constricted into segments 2—5 cm long, 4—6-angled with the angles compressed, sometimes wing-like, with even or slightly sinuate margins furnished with horny spine shields and paired spines; branchlets similar to the branches but 3—5-angled. *Spine shields* decurrent, at first separate but often becoming contiguous and sometimes eventually forming a subcontinuous horny margin; *spines* paired, the lower pair diverging, horizontally spreading, 4—9 mm long and more or less regularly arranged 7—10 mm apart along the angles; the upper pair, only 0,75—1,5 mm long, are very widely divergent and usually down-curved. *Leaves* deciduous, more or less semicircular, shortly apiculate, usually less than 1 mm long; scar transverse, narrowly oblong-elliptic, soon becoming inconspicuous. *Inflorescence* cymose, yellow, with single, shortly pedunculate, axillary cymes, each comprising three horizontally arranged cyathia; *peduncle* bibracteate, up to 2,5 mm long; bracts more or less semicircular, ± 2,5 mm wide; the central cyathium male, deciduous and the bisexual laterals borne on short cyme branches up to 3 mm long; bracts subquadrate, obtuse, minutely toothed, ± 2 mm long. *Involucre* more or less cup-shaped, ± 3 mm long, 4,5 mm diam. including the glands; *glands* 5, fleshy, erect or suberect, contiguous or separate, more or less transversely oblong or oblong-elliptic, 1,5—2,5 mm × 0,75—1,25 mm, concave, yellow, with the upper surface lightly pitted, rugulose with a narrow smooth margin; *lobes* 5, more or less obovate or subquadrate, ± 1,5 mm × 1,5 mm, fimbriate toothed, usually somewhat bilobed or emarginate. *Male flowers* 10 or very rarely 15, arranged in 5 fascicles with filiform bracteoles, each fascicle subtended and loosely enwrapped by a broad, fimbriate-laciniate, bilobed bract opposite the lobes; *pedicels* ± 3 mm long; *filaments* 1,25 mm long. *Ovary* 3-lobed, trigonous, included in the involucre, subsessile on a very short pentagonal pedicel/perianth; *ovule* suspended under a small obturator. *Styles* 2—2,25 mm long, shortly connate at the base, with the free portions spreading recurved, shortly bifid at the apex with rugulose granulose stigmas. *Capsule* deeply 3-lobed, ± 3 mm diam. and high, with obtuse lobes which are somewhat compressed towards the apex, partially exserted from the involucre on a short, obsoletely pen-

tagonal pedicel; *perianth* more or less 3-lobed, ± 2,25 mm diam. *Seed* (not fully mature) narrowly ovoid, densely verrucose-rugulose.

(8) Euphorbia kaokoensis (White, Dyer & Sloane) Leach, stat. nov. *Euphorbia subsalsa* Hiern var. *kaokoensis* White, Dyer & Sloane, Succ. Euphorb. **2**: 965 (1941). – Jacobsen, Handb. Succ. Pl. **1**: 478 et fig. 584 (1960), et Sukk. Lexikon: 203 (1970).

Euphorbia subsalsa sensu White, Dyer & Sloane, tom. cit.: 788 (1941), p.p. quoad nom. prov. "var. *kaokoensis*". – Sensu P. G. Meyer in Merxmüller, Prodr. Fl. S.W. Afr. **67**: 34 (1967), p.p. quoad "? var. *kaokoensis*" et specim. *Otzen* 3.

Type: "Northern Kaokoveld" Kauas Okawe, *Otzen* 3 (PRE, holo.).

The precise locality of Kauas Okawe is uncertain; however, there is a farm "Cauas Okawa" a little to the east of Kamanjab in the southern Kaokoveld, in an area where *E. virosa* is known to occur. It seems very probable that Otzen's plant originated from here as despite extensive enquiries no other similar place name has been traced for anywhere in the Kaokoveld. It is unfortunate that *Story* 5754 is similarly vaguely located as "Northern Kaokoveld".

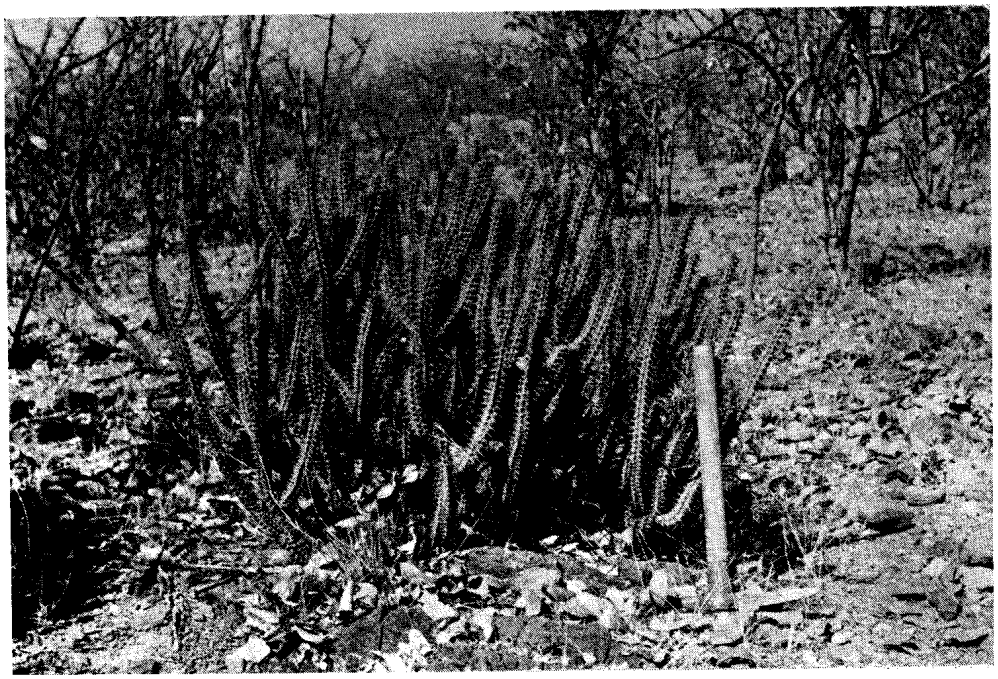
S.W. Africa. 1713 (Swartbooisdrif): ± 7 km N of the Epembe-Mariannefluss road, on the track to Otjipemba (-AC), in crevices on flat rock slabs in mopane woodland, fl. 24.VII.1973, *Leach & Cannell* 15053 (K; LISC; M; PRE; SRGH; WIND); *idem* cult. Salisbury, fr. 22.XI.1974 (LISC; SRGH); between Etengua and Otjijangasemo, st. July 1969, *P. G. Meyer* s.n. (M, photo). 1813 (Ohopoho), near Opuwa (Ohopoho), on limestone ridge, 15.II.1955, *J. G. Joubert* 3a (PRE), "said to be very poisonous and sap placed in water to poison wild animals".

? 1915 (Okaukuejo), Cauas Okawe (? a) (? Kauas Okawe) (-CA), "grows to huge bunches in rock clefts" *Otzen* 3 (PRE).

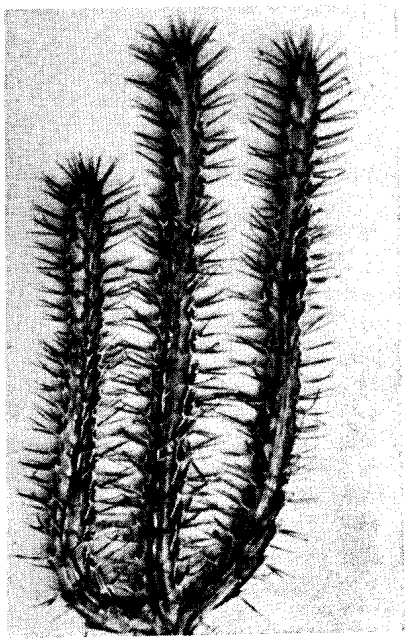
"Eastern portion of Kaokoveld" Dr. J. Watt per Dr. D. G. Steyn, "up to 30 cm tall with 6-angled branches" Dec. 1954 (PRE). "Northern Kaokoveld" cult. PRE, fl. 7.XII.1959, *Story* 5754 (PRE, 1 cyme & photo), *idem* cult. Nelspruit, fl. 31.X.1968, sub *Leach* 14128 (SRGH).

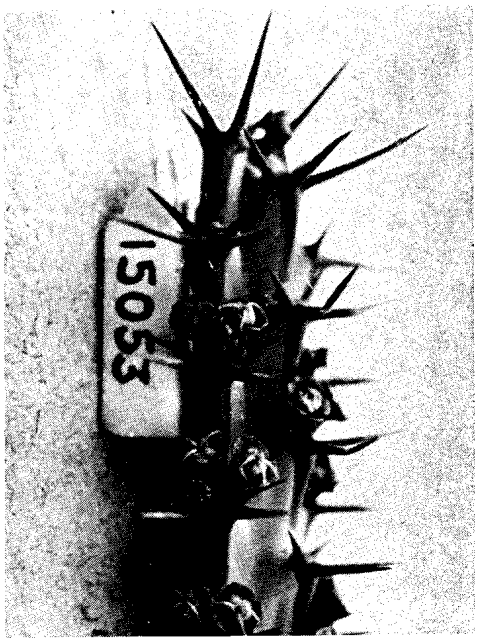
In vegetative characters the low stout shrubs of *E. kaokoensis* show marked discontinuities in relation to their geographically associated relatives, and in the complete absence of 4-angled branches this species does, in fact, differ from all other members of *Tetracanthae* known to me. It is probably most closely related to *E. subsalsa*, but in stout, ± 2 cm thick, 5–7 ribbed branches *E. kaokoensis* appears most nearly to approach the otherwise entirely different, 4–7 (9) ribbed *E. contorta* Leach from Northern Moçambique. Now that more complete material has become available it is apparent that several other, albeit less sharply defined, divergent characters serve further to distinguish *E. kaokoensis* and to illustrate that it is, in fact, more distinctly separated from *E. subsalsa* than are, for example: *E. complexa* R. A. Dyer, *E. lydenburgensis* Schweickerdt & Letty or *E. malevola* Leach, from the Transvaal and Rhodesia. In the Kaokoland plants the spine pairs are more closely set than those of *E. subsalsa* (often appearing to arise almost from a common point) while a third much shorter pair is not infrequently developed on or at the base of the upper pair. The apparently sub-persistent initial male cyathium is forced into an abaxial position by the closely set bisexual laterals (an arrangement quite unusual in the group) (fig. 10c). The

Fig. 10. **(8) Euphorbia kaokoensis** (White, Dyer & Sloane) Leach



Plant ± 50 cm high, N of Etengua





Branch and longitudinal segment with ± abaxial ♂ cyathium

longer (3 mm), more narrowly ovoid and somewhat pointed seed is also considered to be distinctive as are the slightly larger, often somewhat pointed, much darker coloured capsules.

It is in view of the foregoing and against the background of the general morphological homogeneity of *Tetracanthae* that it is considered that this taxon should be raised to specific status.

ACKNOWLEDGEMENTS

I am most grateful to all those who have assisted in so many ways towards the completion of this study, in particular to Mr. and Mrs. I. C. Cannell for their active co-operation and companionship in the field; to my colleagues of the Botanical Research Institute, Pretoria (PRE) and of the National Herbarium, Salisbury (SRGH), for many discussions and other assistance; to the Directors and Staffs of the Department of Botany, British Museum (BM), the Jardin Botanique National de Belgique (BR), the Royal Botanic Gardens, Kew (K), the Centro de Botânica, Lisboa (LISC), the Jardim e Museu Agricola do Ultramar, Lisboa (LISJC), the Instituto Botânico, Universidade de Lisboa (LISU), the Divisão de Botânica, I.I.A.A., Nova Lisboa (LUA), the Divisão de Botânica, I.I.C.A., Sá da Bandeira, Angola (LUAI), the Botanische Staatssammlung, München (M), the Botanical Research Institute, Pretoria (PRE) and the State Herbarium, Windhoek (WIND), for the facilities of their herbaria, for the loan of valuable material, for photographs and other assistance; and to Mr. W. Giess and Eng. A. de Menezes for living plants of *Euphorbia* Sect. *Tetracanthae*.

My thanks are also due to the Chief Commissioner, Dept. of Bantu Affairs, Windhoek, for permission to enter the Kaokoveld and the Director of Nature Conservation, Windhoek, for the necessary collecting permits; to Dr. B. de Winter and Mr. W. Giess for their assistance in this connection, and finally to the South African Council for Scientific and Industrial Research, for financial aid towards the expenses of the 1967 Angolan expedition.